OPTIMIZATION OF SHADE, NUTRIENTS AND GROWTH REGULATORS FOR CUT-FLOWER PRODUCTION IN ANTHURIUM

By

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THESIS

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DECLARATION

I hereby declare that the thesis entitled **"Optimization of shade, nutrients and growth regulators for cut-flower production in anthurium"** is a bonafide record of research work done by me during the course of research and that the thesis has not previously formed the basis for the award to me of any degree, diploma, fellowship, associateship or other similar title, of any other university or society.

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EXTERNAL EXAMINER

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ABBREVIATIONS

@	-	At the rate of
$AgNO_3$	-	Silver nitrate
BA	-	Benzyl adenine
$CoCl_2$	-	Cobalt chloride
EW	-	East-West
GA	-	Gibberellic acid
Gr	-	Growth rate
8-HQ	-	8-hydroxy quinoline
LAI	-	Leaf Area Index
mS	-	Milli Simen
MSL	-	Mean Sea Level
μg	-	microgram
NS	-	North-South
OD	-	Optical density
PLW	-	Physiological loss in weight
SLW	-	Specific leaf weight
SNG	-	Shade, Nutrient, Growth regulator

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Introduction

INTRODUCTION

Anthuriums are tropical ornamental plants cultivated for their colourful, long lasting flowers or for the attractive foliage. They have, of late, gained importance as major cut flowers of the modern world.

Anthurium is a native of Central and South America. The genus *Anthurium*, with over 700 species (Sheffer and Croat, 1983), is the largest in the family Araceae. The name anthurium is derived from the Greek *anthos*, flower, and *oura*, tail, referring to the spadix. The most popular and economically important flowering species of the genus are *A. andreanum* Lind and *A. scherzerianum* Schott; the former is called 'Painter's palette' and the latter, 'Flamingo flower'.

Anthurium andreanum Lind is the most popular with flower arrangers because of the bold effect and lasting qualities of the inflorescence. It is a native of Columbia and is a perennial, herbaceous, semiterrestrial plant, with somewhat creeping habit of growth, using aerial roots for anchorage. Plant is erect with long, lobed, heart shaped, green leaves. Anthurium flower is a combination of colourful modified leaf (spathe) and pencil like protrusion (spadix) born on leafless stalk or peduncle (Bhatt and Desai, 1989). Hundreds of small bisexual, sessile flowers are arranged on the spadix.

Anthuriums require warm greenhouse with shading from direct sunshine and a humid condition. Bright, but filtered, light is essential for abundant flowering. Bed as well as pot culture system is practiced using media which should be light, well drained and rich in organic matter. The plant produces blooms throughout the year, one bloom emerging from the axil of every leaf. Flowers are usually harvested once a week at three quarters maturity. Firmness of the peduncle and colour change of the spadix are used as maturity indices. Six to eight flowers are obtained per plant per year. Some of the Dutch varieties produce even upto 12 blooms per plant per year. Post harvest life varies from 7 to 44 days in unpacked flowers, held in deionised water (Paull *et al.*, 1992).

Today, hundreds of varieties are known in different colours. Bright red and bright orange are the colours for which greatest demand exists all over the world, followed by white and lastly, pink. Double coloured varieties are also gaining importance.

Anthurium cultivation is mainly concentrated in Hawaii, Holland and Mauritius. The major countries importing anthurium cut flowers are USA, Canada, Germany, Europe and Japan. The popularity of growing anthuriums as cut flowers has risen tremendously in the past few years and it has now become an important export oriented crop.

In India, anthurium industry is still in its infancy. There are only a few growers in Karnataka, Tamil Nadu and Kerala who send their flowers to big cities like Mumbai and Delhi. In Kerala, weather conditions are congenial for anthurium growing. Standardization of agrotechniques in anthurium for commercial cultivation in our State is a felt need of the present situation. The present research work is taken up with a view to find out the optimum shade level for growth, flowering and quality of flowers and to study the effects of foliar application of nutrients and growth regulators to enhance growth, to reduce the juvenile phase and to improve the yield and quality of flowers in this important cut flower crop. To find out the methods to prolong the post harvest life of flowers is also an objective of the present experiment.

Review of Literature

REVIEW OF LITERATURE

Anthurium andreanum Lind is a modern flower crop of immense value as an elegant cut flower. It is a tropical crop which thrives well under high humidity. The size and number of flowers produced in anthurium are influenced largely by shade and nutrient status. In recent years, plant growth regulators are being increasingly used to manipulate the production and post harvest life of cut flowers. Anthurium cultivation is gaining popularity in India, but the research work on the response of anthurium to varying environment and cultural management is relatively scanty. Literature pertaining to these aspects, mostly based on research conducted elsewhere, are reviewed in this chapter. Relevant aspects on other crops are also reviewed wherever literature on such aspects are lacking in anthurium.

2.1 Environment

Anthurium requires warm greenhouse with shading from direct sunshine and a humid condition. The optimum temperature for growth is 18-21 °C and the minimum temperature should not be less than 10 °C for a short period. The relative humidity, which also plays an important role in the growth and development of anthuriums, should be around 80 per cent (Ignasse, 1984; Otto, 1967 and Vonk Noordegraff, 1968 and 1969). Higher humidity has, however, marginal effect on the plants (Papenhagen, 1986). Bright, but filtered, light is essential for abundant flowering (Singh, 1987).

Maatsch and Bachthaler (1964) observed that plant vigour increased with increase in temperature. Leffering (1975) reported that the range of light intensity required for plant growth is between 2000-6000 lux. The unsuitable growing conditions stimulated the development of abnormal spathe and/or spadix and reduced the productivity of plant (Steen and Vijvosberg, 1973).

2.2 Growing medium

The medium for growing, whether in pot or bed, should be light, well drained and rich in organic matter with easy availability. Leaf growth and flower production of anthurium were better in gravel, in comparison to several growing media (Steiner and Van zon, 1957). Nakasone and Kamemoto (1962) found that the 1:1 mixture of wood shavings and soil or 5:1 mixture of wood shavings and cow manure and tree fern fibre produced best plant growth.

Nikolava and Zafirova (1980) reported that a medium containing peat + pine bark + perlite (2:2:1) gave 98.8 per cent top grade flowers and 18 per cent higher flower yield, as compared to other media used for growing anthurium. Voogt (1979) reported that the flower yield was inversely correlated with the salinity of the soil. Out of the salts present in soil, sodium chloride was most detrimental to growth and flowering. Similarly, wood products (Higaki and Imamura, 1985), broken aggregates (Welsh and Rober, 1995) and several other components, with mixture of above, have been suggested to be used for growing anthuriums.

2.3 Shade

2.3.1 Influence on morphological characters

In commercial practice, anthurium is grown under partial shade. The intensity of light affects the morphological characters, flower production and quality of flowers. Nakasone and Kamemoto (1962) pointed out that optimum plant growth was obtained with 63 to 75 per cent shading using a saran cloth house in preference to lath house.

Singh (1987) and Antoine (1994) observed that shade requirements of anthurium range from 60 to 80 per cent of full sunlight. Anthurium plants can be shaded with saran for uniform shade and these plants give more flowers per unit area. Some growers utilize the shade of coffee, citrus and other trees for growing anthuriums.

Henley and Robinson (1995) have studied the performance of 21 potted anthurium cultivars under shade after 38 weeks of growth. Vonk Noordegraff (1968) have pointed out that at low temperature ($< 20^{\circ}C$) associated with heavy shade, leaf growth was slow, the leaves were smaller in size, dark green in colour with thinner, longer stalks and the plants were more flacid. It is also necessary to protect the plants from excessive rains.

Three different systems of glass house shading were compared by Meij (1976). Flower yield, was better in a house with whitewash. Berg and Valentin (1977) suggested plastic film and cloth screening for saving energy. Croat (1980), Breedveld and Glass (1984) and Cherevchenko and Kushmir (1983) have also observed flowering behaviour, biology and production of *A. andreanum* in protected cultivation.

Bosse (1969), Cherevchenko and Kushmir (1983), Fericks (1984), Higaki and Imamura (1985), Han *et al.* (1986), Henny *et al.* (1988), Kuruppu and Yogaratnam (1989), Candura and Gusman (1991), Cruz (1993) and Bridley (1993) have emphasised the importance of the use of plastic shading for cut flower production of anthurium and some other flower crops.

Based on the study using 27, 43, 57 or 73 per cent shade. Poole and McConnel, 1971, opined that decrease in shade level, did not affect flower production, but reduced flower stem length. Leaves of plants kept under 27 per cent shade became chlorotic. In another experiment with 75, 50 or 25 per cent shade of full sunlight, the largest number of flowers were produced with the least shading, but flower quality was better under higher intensity of shade (Poole and McConnel, 1971).

Plants from cuttings without the apical bud showed less vegetative growth and did not show a marked response to light intensity (Boula *et al.*, 1973). Leffering (1975) reported that the growth rate increased and average flower production rose from 5 to 12 flowers per plant per year when plants received at least 45 per cent of the available light by means of an automatic system outside the green house. Overhead sprinklers were also used to prevent leaf scorch on sunny days. Reports of Steen and. Holsteyn (1975) advise to keep the shaded glass moist, in dry dull weather, to prevent leaf damage.

Hetman and Pudelska (1984) have reported the effect of rooting preparations and method of transpiration reduction on the rooting of cuttings of *A. andreanum* Lind. Schmidt and Lauterbach (1985) have presented data on plant height and diameter of 10 cultivars of anthurium under shade.

The response of anthurium 'Lady Jane' to different light and fertilizer levels was reported by Henny and Fooshee (1988). Klapwijk and Vander Spek (1988) observed that leaf plastochron duration was fairly constant from March until September, with an average of 72 days. Around 10th October, the duration was more than doubled. Subsequently, it decreased linearly to 72 days again, resulting in high leaf production around April. Leaf plastochron seems to be related to radiation. Daylength is probably not involved, as leaf emergence continued during winter. Klapwijk and Spek (1988) have also reported the influence of light intensity on development rate, flower growth and production of anthurium.

2.3.2 Influence on flowering

Light intensity associated with shade and temperature have profound influence on flower production in anthurium. Nakasone and Kamemoto (1962) have reported that increasing shade, increased stem and spathe size but reduced flower production.

Otto (1967) observed that, in *A. scherzerianum,* reduction in night temperature had little effect on flowering. Flower yield decreased, however, if the night temperature was reduced from 22°C to 13°C. The best flower yields were obtained by reducing night temperatures by 3°, 6° and 9°C during January, February and March, respectively. Optimum night temperature was 16°C. A simultaneous short day treatment delayed flowering by 10 days.

According to Vonk Noordegraff (1968), when *A. scherzerianum* plants were grown in shade, compared to full light, flowers were smaller and less in number. Light had the greatest effect on flower production, followed by temperature. He has also pointed out that while producing *A. scherzerianum* at a temperature above 18°C, the flower number and size are generally reduced to some extent.

Vonk Noordegraff (1973) was of the opinion that at temperature 18-21 °C, anthurium flowers were most abundant in spring time. Splitting of the leaves and flower initiation go together. From a certain stage of the plant, each leaf can produce a flower. Flower development is irregular, but could be promoted by lowering the temperature.

The time required for buds to develop into blooms ready for harvest, ranged from about 45 to 53 days from May to October and from about 65 to 75 days, from December to March (Klapwijk and Spek, 1984). In theory, one bloom could be produced for every leaf, but bud death could reduce the yield by upto 50 per cent. Some cultivars such as 'Hawaii' showed very slow bloom development but yielded heavily, while others such as Avo-Tineke produced a few, but rapidly maturing blooms. After September, as much light as possible in the glasshouse was essential for maximum leaf and bloom development. Schmidt and Lauterbach (1985) presented data on the number of inflorescences produced and diameter of spathe 10 cultivars.

Klapwijk and Vander Spek (1988) reported that in winter, the maximum period between emergence and harvest of flowers was around 21 in December. The flower production fluctuated strongly with a minimum in March and a maximum, in the second half of June. The year round flower bud abortion rate was approximately 50 per cent.

Different flowering responses of *A. scherzerianum* types have been reported by Schaper and Zimmer (1991). Dai and Paull (1991) have reported about the inter relationship of leaf development and flower growth in anthurium. Armitage and Son (1992) stated that plants grown under 67 per cent shade, had the longest stems and could be harvested three weeks earlier than field grown cut flower species.

2.3.3 Influence on nutrient uptake

In general, the mineral nutrient status of plants has been found to improve under shading as in the case of apple, cocoa, spinach and tea. Kraybill (1922) observed higher contents of moisture and nitrogen in shaded apple leaves.

Guers (1971) reported that cocoa leaves exposed to direct sunlight contained less moisture and nitrogen than shaded leaves. American Holly plant exhibited higher amounts of potassium and magnesium in leaf tissues when the plants were grown at 92 per cent shade (Fretz and Dunham, 1971). Cantiliffe (1972) observed in spinach, the concentration of potassium in the tissue increased with reduction in the light intensity. In *Dracaena sanderiana*, on the other hand, shade had little effect on the leaf nutrient content, except that high shade intensity increased potassium and magnesium, especially in young leaves (Rodriguez *et al.*, 1973).

Wahua and Miller (1978) reported that in soyabean total leaf and stem nitrogen contents were highly and negatively correlated with shade. According to Radha (1979) the uptake pattern of major nutrients in pineapple was not greately influenced by shading. In the case of coffee Oladokun (1980) observed that shade significantly affected the nitrogen, phosphorus and potassium contents in plants. According to Wong and Wilson (1980), nitrogen accumulation in all the plant components of green-panic was markedly improved by shading. But the nitrogen yield of siratro in pure sword declined with shading. Trang and Giddins (1980) were of the opinion that soyabean plants without shade had higher nitrogen content.

In cocoa, Gopinathan (1981) noticed higher percentage of N, P and K in plants grown under direct sunlight. Lalithabai (1981) also reported that due to shading N, P and K contents increased in all the components of colocasia, sweet potato, turmeric and ginger when grown as intercrops. The uptake of all the nutrients followed an identical pattern as that of dry matter accumulation in all the crops. On the other hand, Swapna (1996) reported that, in *Philodendron* Wendlandi, concentration of N, P and K in plants was not subjected to variations when different shade levels were provided.

2.3.4 Influence on pigment content

Spathe colour in anthurium is due to the presence of various anthocyanin pigments (Iwata *et al.*, 1979). Anthocyanin and chlorophyll contents of plants are, in turn, influenced by light intensity (Kunisaki, 1982).

Kamemato *et al.* (1988) had given a description of the genetics of the major spathe colours in anthuriums. The histological distribution of anthocyanins in anthurium spathes was studied by Wannakrairoj and Kamemoto (1990).

Most of the reported evidences show that the concentration of chlorophyll per unit weight of leaf increases with shading as reported in the case of plants like cocoa, tea, strawberry, bean, alfa-alfa etc. But the chloroplast content per unit leaf surface has been found to decrease with shading as in alfa-alfa and some other plants. In crops like cowpea, wheat etc., increasing shade intensities have been found to decrease the chlorophyll content per unit leaf weight.

Clark (1905) observed that in the case of strawberry, direct sunlight of high intensity resulted in the destruction of chlorophyll. Increase in chlorophyll content was noticed in the leaves of shaded cocoa plants (Evans and Murray, 1953 and Guers, 1971). Similar observations were made by Ramaswami (1960) and Venkataswami (1961) in the case of tea.

Chlorophyll content per unit weight of leaf was found to increase in the case of plants grown at lower light intensities, but the chlorophyll content per unit area of leaf surface was very often lower than the plants grown in the open (Bjorkman and Holmgreen, 1963). Similar observations were made by Cooper and Qualls (1967) in the case of alfa-alfa and Khossein (1970) in the case of bean plants.

Contrary to the earlier reports, in the case of cowpea, Higazy *et al.* (1975) observed that the concentration of total chlorophyll as well as its components 'a' and 'b' decreased by increasing shade intensity. In wheat, Moursi *et al.* (1976) observed that all the pigments decreased significantly with increasing shade intensities, viz., 100, 60, 40 or 20 per cent full sunlight; but the ratio of chlorophyll a:b remained constant at all the shade intensities. Radha (1979) observed that chlorophyll 'a', 'b' and 'total' content of leaves increased with the increased shade intensity in pineapple. The reason for the drop in chlorophyll concentration in plants subjected to low temperatures seems to be the photo oxidative damage to the membranes of the chloroplast thylakoides (Levitt, 1980).

2.1.2.5 Stomatal distribution and size

The size and distribution of stomata in plants are studied in relation to the response of plants to stress, light intensity, temperature, hormonal level and also as an indication of ploidy levels. In anthurium, Bindu (1992) have reported the stomatal size and distribution of five commercially important varieties of anthurium. Benhill *et al.* (1960) have reported about the guard cells of stomata, their functions and stomato sizes in green plant parts.

Stomatal frequency was considered as one of the indices of drought tolerance, as reported by Pant *et al.* (1989). He has reported that stomatal frequency in four varieties of sugarcane ranged from 175.40 to 212.82. Mansfield (1987) has suggested about the synergestic effect of several harmones on the fine control of stomatal movements as the basis of an integrated response to the abiotic stress. The change in stomatal apertures on cut flower stem of acasia in distilled water and citric acid for its diffusive resistance was reported by Willamson and Millburn (1995).

"Shade needles" from the middle and lower parts of the canopy open to smaller values of stomatal conductance, in response to photon flux density, than do the "sun needles" from the top of the canopy. Similar acclimatisation phenomenon has been induced by growing potted plants in different photon flux densities in controlled environments (Leverenz, 1978).

According to Jarvis (1980), more severe water stress in the first instance is avoided by stomatal closure. As in other parts, the stomata of conifers open and close in response to light. The relationship between stomatal conductance and light is hyperbolic, maximum opening being achieved at moderate photon flux densities with bilateral illumination. The stomata open and close in response to light in air with or without Co_2 present.

A distinct optimum temperature is required for maximum stomatal conductance and at low and high temperatures, the stomatal conductance is almost zero. Aclimatisation of stomatal conductance to temperature can be induced in controlled environments and without doubt, occurs in the field (Neilson and Jarvis, 1975).

Pardosi *et al.* (1992) and Save *et al.* (1995) have reported the water relations, ABA levels and spectral reflectance of stomatal aperture of *Gerbera jamesonii* Bolus.

Variations in stomatal size according to ploidy level have been reported. Chen *et al.* (1982) reported about stomata sizes of an aneuploid developed by somatic hybridization. Moyazaki *et al.* (1985) reported that the stomata on the third leaf from the top were shorter in diploid (26-32 μ) than in triploid varieties of taro (36-39 μ).

2.4 Nutrition

Anthuriums need adequate amount of fertilizers for their proper growth and flowering. The cultural systems with different doses of fertilizers have been reported earlier by several workers, viz., Kasasian (1961), Higaki (1974), Higaki and Imamura (1985), Schmidt (1986), Henny and Fooshee (1988), Bhatt and Desai (1989), Criley (1989), Higaki and Imamura (1989), Leonhardt *et al.* (1991), Paull *et al.* (1992), Rajeevan (1992), Sonneveld and Voogt (1993), Monje (1994), Nicado (1994), Broscht (1995), Ravindran and Shylaja (1995) and Prasad *et al.* (1996). Among the major elements, application of nitrogen, potassium and calcium markedly improve the yield and quality of flowers.

2.4.1 Influence on plant growth

George and Sherrington (1984) have recommended the application of unique combination of macronutrient salt solutions for tissue culture plants to get better growth, such as, Knop's solution and Hoagland solution with KNO_3, Ca $(NO_3)_2.4H_2O$, $MgSO_4.7H_2O$ and KH_2PO_4 in varying concentrations, either in half strength or in full strength, as sprays on the plants.

Higaki (1977) and Boertje (1978) have recommended the various proportions of fertilizers. In the Netherlands, ratios of N:K of 1.0:1.5 to 1.0:2.5 have been suggested, but in Hawaii, fertilizers with ratios of 1:2:2 and 1:1:1 are most widely used, with a targeted delivery of 450 kg N/ha/year.

Insufficient levels of nitrogen and potassium are associated with lower flower yield, reduced stem length and smaller flowers. Deficiency symptoms like leaf necrosis and dead root tips were observed with K deficiency (Bike and Straver, 1978; Imamura and Higaki, 1984).

Singh (1987) has recommended 16:16:16 complex fertilizer so as to supply 341 kg N/ha/year. Feischer and Meinken (1988) studied the effect of nitrogen source in soilless cultures with expanded clay using nutrient solution of ammonium sulphate and calcium nitrate on the development of *A. scherzerianum*. Fertilizer damage to plants, as indicated by decayed roots, burnt leaves and flowers, was reported by Mercy and Dale (1994).

Nikado (1994) has reported the effect of frequencies and rates of application of foliar fertilizers on the growth and flowering of anthurium var. Kaumana.

2.4.2 Influence on flowering

The size and number of flowers produced per year are influenced by the quantity of nutrients applied. Poole and Greaves (1969) and Bike (1976) have suggested the application of 126 mg N per 12.5 litre water per week, for *Anthurium andreanum*. An increase in K from 19 mg/12.5 l per week to 225 mg/12.5 l, improved both flower yield and quality. Adequate level of calcium is also necessary for obtaining optimum yield and to stabilize spathe colour. Deficiency of calcium resulted in colour break down, instability of the middle lamella and cell separation and collapse in proximal section of the lobe and spathe.

Boertje (1978) reviewed the nutrition of anthurium. About 10 flowers, smaller than 10 cm, were obtained from the plants which were not given any nitrogen. At higher nitrogen levels, flower production decreased, flowers were smaller and the flower stems shorter, thereby flowers being not sufficiently sturdy.

Higaki and Poole (1978) reported that the low fertilizer rate gave as good or better results in flower production as the high rates. Flower production decreased with age of the plant, but both stem length and flower size increased. The best results were obtained with an annual dressing of 29 g N + 30 g K_2O/m^2. They also recommended 14:14:12 complex fertilizer for *Anthurium andreanum* cv. 'Ozaki' so as to get 448 kg N/ha/year.

Higaki and Imamura (1985, 1988) have presented the effects of the method of application of fertilizers on flower production in anthurium. Henny *et al.* (1988) reported that N level affected the number of shoots, number of spathes and plant quality grade; the best plants being produced with 1500 lb N/acre.

Nikado (1994) has reported the effect of frequencies and rates of application of foliar fertilizers on the growth and flowering of anthurium var 'Kaumana'. He observed no significant difference among the treatments. First bloom appeared eight months after planting. Small flowers were obtained during the first few months. However, flower size increased as flowers appeared almost every two months.

2.4.3 Nutrient uptake

As per Higaki (1977) and Boertz (1978), at optimum levels of nutrients, mature leaves contained 2 per cent N and 3 per cent K. Adequate level of Ca is also necessary for obtaining optimum yield and to stabilize spathe colour. The problem of Ca deficiency is more serious at lower pH (3.0 to 4.0) of the substrate. The optimum Ca content in the lobe and leaf tissues have been found to be 0.16 and 0.54 per cent, respectively. Similar results were reported by Higaki *et al.* (1980a, 1980b) who remarked that colour break down in anthurium species was caused by Ca deficiency.

Imamura and Higaki (1984) studied the nutrient deficiency symptoms in anthurium. The deficiency symptoms assessed over 9-48 months suggested that N deficiency was first manifested in 9 months and sulphur deficiency, in 36 months, The occurrence, type and location of calcium oxalate crystals in the leaves of anthurium was reported by Genu and Hillson (1985).

Spek and Sonneveld (1985) and Voogt and Sonneveld (1988) have reported the adverse effects of salts on flower production.

The maximum flower yield in anthurium was obtained when leaf tissue level was 1.87 per cent for N; 0.17 per cent for P and 2.07 per cent for K. However, stem length and flower size were at their maximum with leaf N at 1.59 per cent and 1.67 per cent and K at 2.20 per cent and 1.86 per cent, respectively. No relationship was observed between the P content in leaves and flower size or stem length. A range of leaf tissue levels associated with optimum anthurium flower production was determined for Ca, Mg, B, Mn, Fe, Zn, Cu and Mo (Higaki *et al.*, 1992 and Holly *et al.*1994).

Sonneveld and Voogt (1993) studied the concentration of nutrients for growing *Anthurium andreanum*. The effect of nutrient concentration on the absorption of nutrients was examined by analysing young fully grown leaves. Bhargava (1993) has reported about the method of leaf analysis for nutrient diagnosis and fertilizer recommendation.

2.5 Growth regulators

Plant growth regulators are being increasingly used in anthurium and other flowering ornamentals for increasing growth, sucker production, reducing juvenile phase and for improving flower yield and quality.

2.5.1 Influence on morphological characters

Treatment of plants with PBA, BA or Ethephon are reported to induce adventitious buds. Maximum shoot formation was observed with BA at 100 mg/l (3.6 shoots per plant) followed by PBA 1500 mg/l (2.2 shoots per plant) and Ethphon at 1000 mg/l (1.8 shoots per plant). Control plants exhibited no adventitious shoot formation (Higaki and Rasmussen, 1979).

When the juvenile anthurium plants were treated by topping and or with foliar sprays of GA_3 and BA, with increasing concentrations (0 to 500 ppm) of GA_3, topped plants showed an increase in lateral shoots. With increasing concentrations (0 to 1000 ppm) of BA, the number of lateral shoots increased on both topped and intact plants. Topping alone increased lateral shoots (Imamura and Higaki, 1988).

Woltering (1991) has reported that treatment of the stems of Kniphofia (hybrid) with ethylene inhibited elongation growth, but had no appreciable effect on the response to gravity. Jardi *et al.* (1994) have discussed the effect of light and gibberellic acid on photosynthesis during leaf senescence of alstroemeria cut flowers.

2.5.2 Influence on flowering

In anthurium inflorescence is normally produced by dominant central stem initially and later by lateral stems. Cultivars with many lateral shoots, while desirable for pot culture, tend to flower later than those with strong apical dominance. Stimulating earlier flowering of lateral shoots could result in shorter flowering time and higher flower counts.

Light intensity and GA_3 concentration are important factors in regulating anthurium bloom count (Nakasone and Kamemoto, 1962 and Leffering, 1975).

Henny (1980, 1981, 1983 and 1989) reported that aroids could be induced to flower with a single foliar application of 250 mg/l gibberellic acid. Following GA_3 treatment, different species within a genus flowered simultaneously and produced significantly more inflorescences. Use of GA_3 treatments have proven invaluable as an aid to attempting interspecific crosses due to previously unpredictable bloom cycles between and within species. Hegazy *et al.* (1990) and Shedeed (1991) have also pointed out the positive influence of GA_3 sprays on flower production in gladiolus and aster, respectively.

Henny and Hamilton (1992) reported that 'Renate' at 280 μ m^2 S^{-1} light intensity before and after the treatment, resulted in higher bloom counts at all the GA_3 levels (0, 125, 250, 375 and 500 ppm). Plants treated with 375 or 500 mg GA_3/l produced more than three blooms per pot.

Dutta *et al.* (1993) reported early flowering in chrysanthemum with GA_3 sprays. According to Suma (1993), GA 50 and 100 ppm hastened flowering, increased the longevity of flowers in the field, increased the number of blooms and had significant positive influence on flower diameter and vase life of *Gerbera jamesonii*.

Kane *et al.* (1995) and Ballantyne (1995) have reported the positive influence of GA sprays in *Cryptocosyne* and hardy azaleas, respectively.

2.5.3 Influence on pigments

Lee and Kim (1994) reported effects of plant growth regulators on the change of petal colours in cut flowers of *Rosa hybrida* L. cv. Red Sandra.

2.6 Post harvest studies

Anthuriums are generally harvested when the spadix is fully developed. Pre harvest and post harvest factors influence the longevity of cut flowers. Senescence is associated with the plugging of stem vascular tissues accompanied by the loss in weight, visible changes including spathe glow loss, necrosis of spadix, blueing of spathe, stem collapse and abscission of the spathe and spadix from the stem (Akamine, 1976). Various floral preservatives and growth regulators are increasingly used in anthurium and other cut flowers to extend their vase life by means of pulsing and holding.

Fisher (1952) has studied the long term holding of cut flowers to extend their vase life. Kamemoto (1962) observed that the keeping quality of flowers increased as they developed and was maximum when 3/4th of the length of spadix had changed colour. Large and medium sized flowers kept better than small and miniature ones. The level of shade under which the plants were grown did not affect the keeping quality of flowers.

According to Kalkaman (1983), vase life is the longest in flowers which are cut when the spadix was almost completely white, the average vase life for flowers cut at this stage in winter and summer being 21.5 and 25.2 days, respectively. Cultivars also greatly differ in their post harvest life.

Treatment with benzyladenine is reported to reduce the respiration rate of flowers, to impart some tolerance to chilling and to extend the saleable period (Shirakawa *et al.*, 1964). Microorganism inhibition by 8-hydroxyquinoline citrate as related to cut flower senescence was reported by Larsen and Cromarty (1967). Positive effect of floral preservatives on bud opening and keeping quality of cut flowers also (Marouskey, 1972) and extension of vase life of cut flowers by the use of iso-ascorbate containing preservative solutions (Parups and Chan, 1973) were also reported.

Various commercial preservatives, chemicals and beverages (sodium benzoate, benzoic acid, glucose, sodium hypochlorite, hydrochloric acid, 7-up etc.), were used to prolong the shelf life of anthurium flowers (Akamine and Goo, 1975). A pre shipping dip of flower stems in solution of 2.25 per cent 7-up (a carbonated beverage), 500 ppm benzoic acid or 7.3 ppm of sodium hypochlorite remarkably extended the vase life of flowers (Akamine and Goo, 1975 and Akamine, 1976).

Akamine and Goo (1981) reported that cold storage at 13°C or storage in 2 per cent O_2 at 24-25°C was beneficial for extending the vase life of cut flowers of 'Ozaki' variety of anthurium. They have also reviewed the harvesting stage of anthurium inflorescences. The storage temperature and pulsing treatment for extending vase life of anthurium flowers are given by Prtichard *et al.* (1991).

Rating scales and their descriptions, based on spadix condition, spathe discoloration and gloss for inflorescence of anthurium are furnished by Paull (1982) and Antoine (1994), as vase life evaluation criteria. Dipping of the flower stems for 10-60 minutes in 4 mM silver nitrate solution (within 12 hours of harvest) also extended the vase life by 40-60 per cent (Paull and Goo, 1982). Paull (1983) suggested the use of wax for extending post harvest vase life of flowers. Out of eight products tested, FMC-819 carnaba based wax was most effective for imparting a high spathe gloss and for increasing the vase life to 36 days as compared to 18 days in the untreated control.

Paull *et al.* (1985) studied the physiological changes associated with senescence of cut anthurium flowers pulsing with silver nitrate to modify senescence process. It was revealed that spathe colour changes from red to blue, after 10 days from harvest, and the tissue pH, from 5.2 to 5.6. Pulsing with silver nitrate reduced stem plugging.

Paull (1987) stated that pulse treatment of 4 mM $AgNO_3$ (40 minutes), given immediately after harvest, increased post harvest life.

Paull and Goo (1985) studied the post harvest life of anthurium flower in relation to water balance. Rate of water uptake declined within 10 days to 20 per cent of that at the time of harvest. Silver nitrate pulsing reduced the decline in water uptake. They pointed out that spadix was the site of 50 to 60 per cent water loss, while 20 to 40 per cent of the loss occurred via the flower stem. Water loss can be reduced by waxing. They also stated that wound ethylene induced stem clogging was the major factor limiting the post harvest life, inducing water stress and senescence, rather than microbial clogging of vascular tissues. Mujaffar (1994) have also studied the water balance in cut anthurium flowers in storage and its effect on quality in the cultivar 'Trinidad Pink'. Hansen *et al.* (1991) have discussed the phytotoxic reaction of anthurium cut flowers to hydrogen cyanide fumigation with period of marketable days and shelf life.

Increase in the vase life of anthurium flowers with floral preservatives and carbohydrate soft drinks was reported by Surang (1988).

Paull *et al.* (1992) reported that pre harvest temperature and fertilization significantly (63 to 71%) influenced the post harvest life of anthurium.

Criley and Paull (1993) have reviewed the post harvest handling treatments of bold tropical cut flowers like *Anthurium, Alpinia purpureata, Heliconia and Sterltzia*. Hew *et al.* (1994) studied the circadian rhythm of CO_2

production by anthurium flowers after spathe and spadix removal, separately. Bhattacharjee (1994) has reviewed the causes for the senescence of cut flowers.

The effects of plant growth regulators (IAA, GA_3, BA and Ethephon) in the vase solution on the change of petal colour in cut flowers of *Rosa hybrida* were studied by Lee and Kim (1994). Use of ethylene inhibitor (1-MCP) to increase the life of ethylene sensitive cut flowers and potted plants (carnation, begonia and snapdragon) was suggested by Serek *et al.* (1994).

Sucrose improves the post harvest life of cut flowers of *Limonium* (Doi and Reid, 1995). Markharst and Harper (1995) have pointed out the deleterious effects of sucrose in preservative solutions on the leaves of cut roses.

Alvarez *et al.* (1995) in tuberose and Ravindran and Shylaja (1995) in anthurium, have suggested various post harvest treatments to increase the longevity of cut flowers.

Shaul *et al.* (1995) have reported the suppression of *Botrytis* blight in cut rose flowers with gibberellic acid. Hwang and Kim (1995) reported the post harvest pathology and the methods for prolonging the vase life of cut gladiolus. ANSOC (1996) have given some of the tips to increase the vase life of anthurium flowers.

2.7 Economics of cultivation

Cultivation of anthurium is reported to be highly remunerative by several workers. Singh (1987) has reported that on an average 61,750 plants can be grown per hectare. Each plant produces 5 spikes annually. This gives 3,08,750 spikes annually. If sold at Re.1/- per spike, the grower can fetch Rs.3,08,750/- annually.

Antoine (1994) has studied the production cost involved in the commercial production of anthurium in Mauritius, which is approximately Rs.15,00,000/- per hectare. Ananthakrishnan (1994) has discussed about the factors influencing the economics of anthurium cultivation in Kerala. Similarly, Ravindran and Shylaja (1995) have worked out the economics involved in anthurium cultivation. Menon (1996) described the present status of the anthurium cultivation under Kerala climate and the cost benefit involved therein.

Material and Methods

MATERIALS AND METHODS

The present investigations 'Optimization of shade, nutrients and growth regulators for cut-flower production in anthurium' were carried out at the Department of Pomology and Floriculture, College of Horticulture, Vellanikkara, Thrissur during 1995-1997. Experiments were conducted to find out the optimum shade level for growth, flowering and quality of flowers of *Anthurium andreanum* L. and to study the effects of foliar application of nutrients and growth regulators to enhance growth to reduce the juvenile phase and to improve the yield and quality of flowers. Experiments were also conducted with an intention to extend the vase life of cut flowers using various pulsing and holding solutions. The details of the experiments conducted and the methods followed for analysis of the data are presented in this chapter and also, an account of the general cultural practices adopted during the period of the experiment.

Vellanikkara is located at an altitude of 22.25 m above MSL and between $10^{\circ}32'$ N latitude and $76^{\circ}10'$ E longitude. The area enjoys a typical tropical humid climate. The meteorological data during the cropping period is presented in Appendices 1 and 2.

3.1 Planting material

A popular hybrid variety, 'Hawaiian Red' of *Anthurium andreanum* Lind having good demand for cut flowers was used for the study. Mericlones of 1½ months of age in net pots were procured and maintained in the nursery till they were ready for repotting at the age of four months.

3.2 General management in the nursery

Immediately after receiving the plants, drenching and spraying of Indofil M-45 (0.3%) were given. Plants were maintained under proper shade and sprays of fungicides and insecticides were given as and when required. Stray incidence of snails, leaf eating catterpillars, millipedes and diseases like rot and *Phytophthora* leaf spot were noticed. To boost up the growth, weekly sprays of Greencare (30:10:10 NPK with micronutrients) at 0.05 per cent concentration, alternated with a complex fertilizer (17:17:17 NPK), 0.5 per cent, were given. Mortality upto 1.1 per cent was noticed in establishment period. The plants were repotted to earthen pots of 9" size when they had attained a uniform growth at the age of 4 months.

3.3 Medium

A medium containing coarse sand, well rotten cowdung clumps, coconut husk, wood shavings, charcoal, earthen crocks and brick pieces (2:1:2:1:0.5:0.5:1 ratio) was used for potting plants.

3.4 Repotting

Four month-old plants were repotted in containers having the medium arranged in layers. A crock piece was placed on the hole of the pot at the bottom; above that 2" layer of coarse sand was spread followed by a 1" layer of sand plus cowdung mixture. Over this, pieces of bricks and charcoal were arranged in such a way that the plant, along with the root ball can be placed easily. Sides of the root ball were covered with pieces of coconut husk and a filler mixture of sand and cowdung was spread above it, so that the gaps within are filled up. A fine layer of wood shavings was spread on the top of the medium. Plants were placed firmly over the medium. The top 3" portion of the pot was left vacant for watering and manuring. Irrigation was followed immediately, and a drenching of Indofil M-45 0.3 per cent was given three days later. The plants were ready for the application of the treatments, a week after repotting (Plate1 and 2).

3.5 Experiment design

For preharvest studies a single replicated factorial experiment in completely randomised design (CRD) was laid. There were two factors (shade and nutrients), each at four levels and one factor (growth regulator) at 6 levels in addition to 4 control treatments. The highest order interaction in the experiment was taken as error in analysing and interpreting data (Kempthorne, 1969). There were 10 plants/plot. The levels of the different factors involved are detailed below.

3.6 Layout of the experiment

3.6.1 Pre-harvest studies

3.6.1.1 Shade levels : 4

S_1 80%
S_2 70%
S_3 60%
S_4 50%

Shade was provided with synthetic shade nets fabricated for the required shade levels. These shade nets were covered on permanent angular structures covered above with G.I. wire mesh. Shade house of size 15 m x 6 m was individually erected for each shade level, by keeping one metre space in between the two shades, so that the mutual shading was minimised to the extent possible. Top as well as sides of the shade houses were covered with the same type of net by keeping one metre space above the wall uncovered, to facilitate free air movement

Plate 1. Mericlones *A. andreanum* 'Hawaiian Red' ready for repotting

Plate 2. Plants (5 months old) at the time of imposing treatments

and to avoid direct entry of sun rays. An Aplab Lux meter was used for monitoring the shade level throughout the course of the experiment.

3.6.1.2 Nutrients : 4

N_1 17:17:17 Complex fertilizer (1% solution)

N_2 Hoagland solution (full strength)

N_3 Knop's solution (full strength)

N_4 Ohio solution (full strength)

Composition of the nutrient solutions are given in Appendix 3.

The nutrient solutions were applied as whole plant spray at weekly interval.

3.6.1.3 Growth regulators : 3 x 2 levels

G_1 GA 750 mg/l

G_2 GA 1500 mg/l

G_3 BA 750 mg/l

G_4 BA 1500 mg/l

G_5 Ethephon 750 mg/l

G_6 Ethephon 1500 mg/l

The growth regulators were sprayed on the plant at monthly interval.

Details of the treatment combinations are presented in Appendix 4.

3.6.2 Post-harvest studies

A separate experiment was conducted to test the post-harvest longevity of anthurium inflorescence. For this, uniform, normal size flowers were used. Inflorescences were harvested in the morning and were immediately brought to the laboratory. A fine slanting cut was given to the base of the stalk to expose more surface area and to facilitate easy absorption of the vase solution. Preliminary observations of the inflorescence, like, weight of inflorescence, stalk length, length of spathe and spadix, width of spathe etc. were noted before imposing treatments.

To standardise the stage of harvest, inflorescences at different stages of flower opening and various sizes of spathes were harvested and tested for their longevity; details of which are as follows:

3.6.2.1 Stage of harvest

M_1 Flowers on spadix unopened

M_2 Flowers on spadix 1/3 opened

M_3 Flowers on spadix 2/3 opened

M_4 Flowers on spadix 3/4 opened

M_5 Flowers on spadix fully opened

3.6.2.2 Size of spathe

M_6 Small

M_7 Medium

M_8 Large

The treatments were applied as detailed below:

3.6.2.3 Pulsing treatment

P_1 Silver nitrate 4 μm/l for 20 minutes

P_2 Silver nitrate 8 μm/l for 20 minutes

P_3 Silver nitrate 4 μm/l for 40 minutes

P_4 Silver nitrate 8 μm/l for 40 minutes

P_5 Silver nitrate 4 μm/l for 60 minutes

P_6 Silver nitrate 8 μm/l for 60 minutes

P_7 8-HQ 200 ppm for 6 hours

P_8 8-HQ 400 ppm for 6 hours

P_9 8-HQ 200 ppm for 12 hours

P_{10} 8-HQ 400 ppm for 12 hours

P_{11} BA 25 ppm for 6 hours

P_{12} BA 50 ppm for 6 hours

P_{13} BA 25 ppm for 12 hours

P_{14} BA 50 ppm for 12 hours

P_{15} Absolute control (no pulse treatment)

P_{16} Tap water control

T_{17} Distilled water control

After the pulsing treatment, inflorescences were held in distilled water (200 ml) for observing the vase life.

3.6.2.3 Holding solutions

H_1 Sucrose 5%

H_2 Bavistin 0.1%

H_3 Phosjet-40 0.2%

H_4 8-HQ 5 ppm

H_5 8-HQ 10 ppm

H_6 8-HQ 20 ppm

H_7 8-HQ 30 ppm

H_8 8-HQ 40 ppm

H_9 8-HQ 50 ppm

H_{10} BA 5 ppm

H_{11} BA 10 ppm

H_{12} BA 20 ppm

H_{13} BA 30 ppm

H_{14} BA 40 ppm

H_{15} BA 50 ppm

H_{16} Triadimefon 10 ppm

H_{17} Triadimefon 20 ppm

H_{18} Triadimefon 30 ppm

H_{19} Triadimefon 40 ppm

H_{20} Citric acid 500 ppm

H_{21} Benzoic acid 500 ppm

H_{22} Streptomycin 200 ppm

H_{23} Cobalt chloride 100 ppm

H_{24} $AgNO_3$ 10 ppm

H_{25} $AgNO_3$ 20 ppm

H_{26} Absolute control (no holding solution)

H_{27} Tap water control

H_{28} Distilled water control

3.6.2.4 Combination of pulsing and holding solutions

After studying the performance of inflorescences under different pulsing and holding treatments, the best treatment from both were selected for further studies with various combinations. Treatment details are as follows:

C_1 BA 50 ppm pulsing for 12 hours + sucrose 5% holding

C_2 BA 20 ppm + Sucrose 5% holding

C_3 BA 20 ppm + Bavistin 0.1% holding

C_4 8-HQ 400 ppm pulsing for 6 hours + sucrose 5% holding

C_5 8-HQ 40 ppm + Sucrose 5% holding

C_6 BA 20 ppm + 8-HQ 40 ppm + Sucrose 5% holding

C_7 Paraffin wax coating to spathe and spadix + distilled water holding

C_8 Paraffin wax coating to only spadix + distilled water holding.

Two hundred millilitres of holding solution was used uniformly to all the treated inflorescences, except in absolute control. Each treatment was replicated thrice. Every alternate day, a fresh fine cut was given to the base of the inflorescence stalk to remove blackened and dead tissues for easy absorption of the vase solution and for free respiration. Different parameters related to vase life were recorded during the experimental period as per the vase life evaluation criteria suggested by Paull (1982) and Antoine (1994), the details of which are given in Appendix 5.

3.7 Cultural management

All the plants received uniform cultural practices. Organic manuring was done by the application of cowdung clumps, neem cake, @ 20 g per plant and sheep manure mixed with dolomite @ 4 g per plant applied, once in a month. During the rainy season, the application of cowdung clumps was avoided to facilitate easy drainage. Sprays of neem cake supernatant solution were given at weekly interval. For this, neem cake was kept immersed in water for 4 days (1:10) and stirred well, daily once. Supernatant solution was filtered through musline cloth and sprayed on the plants.

Watering was done by overhead micro sprinklers provided in the shade houses twice daily during summer months for half an hour (morning and afternoon). During rainy season, plants were watered only on sunny days. Care was taken to provide good drainage.

Mulching with black polythene was done on the ground surface below the pots to check weed growth and the pots were always kept free of weeds.

3.8 Observations

The following observations were recorded.

3.8.1 Plant Characters

Observations on the following characters of all the plants under each treatment were recorded.

3.8.1.1 Plant height

The height of the plant was measured from the base to the top of the shoot at monthly interval and expressed in cetimetre. Per cent increase in height was also worked out.

3.8.1.2 Plant spread

The spread of the plant in East-West and North-South directions were measured and recorded in centimetre.

3.8.1.3 Leaf number

The total number of leaves present at the time of each observation was counted and recorded. Percentage increase in number of leaves over the previous month was also worked out.

3.8.1.4 Length, breadth and area of the leaf

The leaf length from the basal lobe to the leaf tip and width, at the centre of the leaf was measured in centimetre. The area for every newly emerged leaf was computed by using the following equation (Salvi *et al.*, 1995, unpublised).

Leaf area of the plant = 0.72 (Leaf length x Leaf breadth)

Per cent increase in leaf area monthly interval was also worked out and recorded.

3.8.1.5 Total leaf area

Total leaf area was estimated by summing up the individual leaf area of all the leaves on the plant over a given period of the experiment.

3.8.1.6 Petiole length

The length of petiole from the point of its emergence to the base of leaf lamina was measured and recorded in cm.

3.8.1.7 Number of branches per plant

The number of aerial shoots or branches emerging from the main stem was recorded. Per cent increase in the number branches at monthly interval was also worked out.

3.8.1.8 Number of suckers per plant

The number of new suckers with independent root system arising from the base of the plant was recorded. Per cent increase in sucker production over the previous month was worked out.

3.8.1.9 Growth rate analysis

Growth behaviour of anthurium plants was analysed by employing linear growth model and exponential growth model based on three important characters viz., plant height, number of leaves and leaf area. The linear and compound growth model rate for each treatment were calculated and the growth pattern under the best treatment in respect of each of these characters was presented graphically.

3.8.1.10 Fresh and dry weight of plant parts

Fresh and dry weights of leaves, petiole, root and whole plant were recorded. Similarly moisture percentage and dry matter percentage of each of these parts were recorded separately. Ratios of moisture and dry matter were worked out and recorded.

3.8.2 Leaf characters

3.8.2.1 Leaf area index

Leaf area index (LAI) was worked out following the gravimetric method (Ruck and Bolas, 1956). Destructive sampling was followed in which the leaves were separated from the representative samples. Five leaves were chosen at random and the leaf impressions were traced accurately on quality bond paper of known area per unit weight. The traced portions of paper were then cut out and weighed. From this, the area of the sample leaf was calculated from the weight to area relationship.

The leaves were then dried in a hot air oven at 72 to 80°C to constant weight and dry weight of the leaves were recorded separately. Total leaf area was estimated using weight to area relationship and total dry weight of leaves. Thus LAI was calculated using the equation,

$$\text{LAI} = \frac{\text{Total leaf area of five plants}}{\text{Land area occupied by the five plants}}$$

3.8.2.2 Specific leaf weight

SLW was worked out using the equation,

$$SLW = \frac{\text{Total leaf dry weight}}{\text{Total leaf area}}$$

3.8.2.3 Duration

Duration of leaf emergence to unfurling, unfurling to maturity and to senescence was noted and recorded.

3.8.2.4 Firmness

The firmness of the leaf blade was determined subjectively by hand and ranked as soft, hard and very hard following Dai and Paull (1990 and 1991).

3.8.2.5 Colour development

Leaf colour at the different stages of leaf development was noted as per the Colour Chart of the Royal Horticultural Society, London.

3.8.2.6 Senescence

The number of leaves drying due to senescence was noted and the mean value was counted per plant per month and recorded.

3.8.2.7 Stomatal number and size

For counting the number of stomata per unit area and measuring their size, peelings from abaxial sides of the leaves were taken from two leaves in each treatment. Peelings were examined under a magnification of 100 X. Size was measured using an occular micrometer.

3.8.3 Root characters

3.8.3.1 Aerial root number

The number of visible aerial roots present above the soil surface was counted and recorded.

3.8.3.2 Primary root number

The number of primary roots was counted and recorded.

3.8.3.3 Secondary root number

The number of secondary roots was counted and recorded.

3.8.3.4 Root length

Maximum root length was measured and expressed in cm.

3.8.3.5 Root spread

The maximum root spread was measured and reported.

3.8.4 Inflorescence characters

3.8.4.1 Time taken for first flower bud emergence

The number of days required from imposing treatments to the emergence of the first flower bud was recorded.

3.8.4.8 Spadix length

Length of spadix from the base to tip was measured in centimetres and recorded.

3.8.4.9 Flower stem length

Flower stem or peduncle length from its point of emergence to the point of attachment of the spathe was measured and recorded in centimetres.

3.8.4.10 Number of spikes per plant

The number of spikes produced during the experimental period under each treatment was noted and the mean values recorded. The number of stalkless inflorescences and normal inflorescences produced were noted and recorded separately.

3.8.5 Chemical analysis

3.8.5.1 Chlorophyll content of leaves

Chlorophyll content (a, b and total) of leaves from each of the treatments was estimated using a Spectronic-20 as described by Starnes and Hadley (1965). Fully matured second terminal green leaf was used for estimation. One gram of the representative sample collected from five plants chosen at random, under each treatment, was used for analysis. Standard procedure was followed for the preparation of sample. The OD (A) of an aliquot was measured at wavelength of 645 nm and 663 nm. The contents of chlorophyll 'a', 'b' and 'total' (mg g^{-1} fresh weight) were then estimated using the following relationships.

3.8.4.2 Time taken for flower bud emergence to spathe unfurling

Period between the inflorescence emergence and unfurling of the spathe was recorded.

3.8.4.3 Duration of inflorescence

The duration of inflorescence on the plant from its emergence to senescence, was recorded.

3.8.4.4 Flower opening on spadix

Number of days required for the completion of opening of true flowers on the spadix was recorded.

3.8.4.5 Inflorescence longevity on the plant

Number of days taken from spathe unfurling to senescence was recorded.

3.8.4.6 Interval of emergence of successive inflorescences

The number of days taken for the emergence of successive spikes was recorded.

3.8.4.7 Spathe length and breadth

The length of the spathe from the joint of the peduncle to the tip and breadth, at the centre were measured and recorded in centimetres.

3.8.4.8 Spadix length

Length of spadix from the base to tip was measured in centimetres and recorded.

3.8.4.9 Flower stem length

Flower stem or peduncle length from its point of emergence to the point of attachment of the spathe was measured and recorded in centimetres.

3.8.4.10 Number of spikes per plant

The number of spikes produced during the experimental period under each treatment was noted and the mean values recorded. The number of stalkless inflorescences and normal inflorescences produced were noted and recorded separately.

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Chlorophyll a = 12.72 A 663 - 2.58 A 645

Chlorophyll b = 22.87 A 645 - 4.67 A 663

Total chlorophyll (a+b) = 8.05 A 663 + 20.29 A 645

3.8.5.2 Pigment (anthocyanin) content of flowers

The estimation of anthocyanin pigment in the spathe was carried out by colorimetric method, as described by Sweon and Hills (1959).

Well matured spathes of anthurium were harvested and used for the anthocyanin estimation. Representative sample was crushed in mortar with ethnol and filtered through Whatman No.1 filter paper. One ml of the alcohol extract was pipetted out into a test tube and 3 ml of HCl in aqueous methanol, was added to it. One ml of peroxide reagent was added to the samples and 1 ml of methanol HCl, to the blank tubes. After 15 minutes in the dark, the OD (A) of the solutions was measured using colorimeter (spectronic-20 D) in a 1 cm cell at 525 nm against the blank. The anthocyanin present in the samples was calculated from a standard curve prepared with cyanin HCl or expressed the results as A 525 - Cyanin HCl 10 μg/ml in methanol HCl gives OD of 0.405 in a 1.0 cm cell at 525 nm.

3.8.5.3 Nutrient content of leaves

Samples of plant components collected for recording the dry weight were used for nutrient analysis. Representative samples were taken at the stage of flowering. Determination of nitrogen was done by the Microkjeldahl method; Phosphorus colorimetrically (Vandomolybdo - phosphoric yellow colour method)., Potassium, by Flame photometer and micronutrients (Ca, Mg, Mn, Zn, Cu, Fe), by

Atomic Absorption Spectrophotometer, as suggested by Jackson (1958), Sulphur was determined by the Turbidimetric method (Hesse, 1971).

3.8.5.4 Nutrient uptake

The total uptake of nutrients by the plant was calculated based on nutrient content and dry weight of plant component and expressed as g per plant.

3.8.6 Quality of irrigation water and leachate

At the final stage of the experiment, samples of irrigation water and leachate were analysed for pH, EC and nutrient contents (Jackson, 1958).

3.8.7 Post-harvest studies

3.8.7.1 Vase life

The vase life was taken as the number of days taken for fresh inflorescence to show signs of wilting. Spathe blueing initiation, spadix necrosis initiation, spathe gloss loss and inflorescence vase life till discarded were noted and reported.

3.8.7.2 Physiological loss in weight

Initial and final weight of inflorescence were noted at the beginning and at the end of the experiment, respectively, and by working out the difference between initial and final weights the PLW was arrived at.

3.8.7.3 Water uptake

The quantity of the vase solution remaining at the end of the experiment was measured and by finding the difference between initial and final volumes of the vase solution, total uptake was worked out.

3.8.7.4 pH

pH values of holding and pulsing solutions were read on a pH meter at initial and final stages of the experiment and the change in pH was worked out and recorded.

3.8.7.5 Electrolyte leakage

The EC reading of the vase solutions were noted with Electrical conductivity meter in mS/g/cm at the initial and final stages of the experiment and the difference between the two, was noted as electrolyte leakage. Eelectrical conductivity reading of distilled water was subtracted from the actual readings of all the vase solutions and was recorded as mS g^{-1} cm^{-1}.

3.9 Statistical analysis

The data recorded on the various experiments were subjected to statistical analysis following the method of Panse and Sukhatme (1985).

3.10 Economics of cultivation

The economics of cultivation based on the data obtained in the present experiment was worked out.

Results

RESULTS

The results of the experiments conducted to optimize the levels of shade, nutrients and growth regulators for cut flower production in *Anthurium andreanum* var. 'Hawaiian Red' are presented in this chapter.

4.1 Plant characters

The different morphological characters, viz., plant height, plant spread, number of leaves, petiole length, leaf length and breadth, leaf area, number of branches and suckers; and fresh and dry weight of different plant parts, as influenced by the treatments involving different levels of shade, nutrients, growth regulators and their interactions during the experimental period are presented separately.

4.1.1 Plant height

Data pertaining to mean height of the plant recorded at monthly interval and per cent increase in height over the previous month are presented in Tables 1 and 2 respectively (Fig.1).

Shade and growth regulators showed significant role in increasing the height of the plant. Effect of various shade levels on mean height of the plant was significantly different in all the months of the experiment. Shade levels of 80, 70 and 60 per cent were significantly superior over 50 per cent and were on par with each other. The maximum mean height of 5.68 cm per plant was recorded in 80 per cent shade level (S_1).

Table 1. Effect of shade, nutrients, growth regulators and their interactions on plant height (cm) of *A. andreanum* var. 'Hawaiian Red' at monthly interval

Treatments	Month													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Shade (S)														
S_1	1.67	2.23	3.05	3.48	3.74	3.88	4.01	4.03	4.27	4.27	4.61	4.88	5.31	5.68
S_2	1.50	2.05	2.90	3.37	3.71	3.81	4.01	4.06	4.34	4.40	4.60	4.78	4.95	5.65
S_3	1.08	1.94	2.73	3.05	3.40	3.60	3.79	4.00	4.21	4.20	4.35	4.59	4.77	5.42
S_4	1.44	2.04	2.68	2.93	3.10	3.30	3.33	3.45	3.48	3.54	3.72	3.91	4.16	4.86
CD(0.05)	0.15	0.18	0.18	0.21	0.24	0.21	0.19	0.20	0.19	0.22	0.25	0.34	0.38	0.49
Nutrient (N)														
N_1	1.45	2.24	3.00	3.35	3.65	3.80	3.94	4.01	4.21	4.18	4.28	4.54	4.78	5.46
N_2	1.39	2.04	2.80	3.15	3.46	3.56	3.71	3.83	4.00	4.04	4.30	4.55	4.90	5.36
N_3	1.42	2.05	2.91	3.24	3.47	3.73	3.82	3.89	4.10	4.14	4.33	4.50	4.73	5.41
N_4	1.44	1.92	2.65	3.09	3.36	3.51	3.67	3.81	4.00	4.05	4.37	4.57	4.80	5.38
CD(0.05)	-	0.18	0.18	-	-	0.21	0.19	-	-	-	-	-	-	-
Growth Regulator (G)														
G_1	1.50	2.13	3.02	3.28	3.39	3.56	3.67	3.70	3.82	3.83	3.94	4.01	4.23	4.71
G_2	1.45	2.08	2.86	3.20	3.49	3.57	3.72	3.77	3.89	3.92	4.01	4.22	4.42	4.84
G_3	1.38	2.03	2.96	3.42	3.64	3.77	3.91	4.05	4.29	4.34	4.59	4.80	5.12	6.11
G_4	1.37	2.03	2.79	3.17	3.56	3.69	3.88	4.02	4.32	4.37	4.68	4.96	5.23	5.85
G_5	1.46	2.04	2.66	3.03	3.39	3.63	3.77	3.89	4.06	4.04	4.37	4.53	4.82	5.37
G_6	1.38	2.08	2.76	3.16	3.45	3.67	3.76	3.87	4.09	4.11	4.34	4.74	4.99	5.54
CD(0.05)	-	-	0.22	-	-	-	-	-	0.24	0.27	0.30	0.42	0.47	0.61

Contd.

Table 1. Continued

Treatments	Month													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
<u>S x N interaction</u>														
S_1N_1	1.88	2.57	3.30	3.52	3.82	3.90	4.07	4.15	4.45	4.45	4.63	4.93	5.57	5.85
S_1N_2	1.70	2.40	3.03	3.42	3.68	3.75	3.85	3.85	4.05	4.05	4.45	4.90	5.38	5.83
S_1N_3	1.63	2.05	3.05	3.63	3.87	4.15	4.12	4.12	4.32	4.32	4.43	4.53	4.85	5.30
S_1N_4	1.47	1.88	2.82	3.35	3.60	3.73	4.00	4.00	4.27	4.27	4.93	5.17	5.45	5.75
S_2N_1	1.52	2.18	2.98	3.55	3.95	4.05	4.25	4.25	4.57	4.62	4.75	4.92	5.00	5.82
S_2N_2	1.45	1.97	2.72	3.08	3.55	3.63	3.83	3.83	4.17	4.20	4.33	4.42	4.72	5.07
S_2N_3	1.50	2.00	2.97	3.40	3.67	3.73	3.95	3.95	4.23	4.28	4.65	4.97	5.07	5.92
S_2N_4	1.55	2.07	2.95	3.43	3.68	3.82	4.00	4.20	4.40	4.48	4.67	4.83	5.03	5.82
S_3N_1	1.05	2.00	2.87	3.28	3.67	3.73	3.92	4.08	4.27	4.10	4.12	4.63	4.73	5.90
S_3N_2	1.00	1.75	2.77	3.08	3.42	3.52	3.82	4.07	4.20	4.25	4.55	4.73	5.03	5.43
S_3N_3	1.10	2.18	2.90	3.03	3.33	3.77	3.87	4.03	4.32	4.35	4.43	4.53	4.67	5.13
S_3N_4	1.18	1.82	2.38	2.80	3.17	3.38	3.55	3.80	4.07	4.12	4.30	4.47	4.65	5.20
S_4N_1	1.35	2.22	2.85	3.05	3.15	3.52	3.52	3.55	3.55	3.55	3.62	3.68	3.82	4.27
S_4N_2	1.40	2.03	2.67	3.02	3.20	3.33	3.35	3.57	3.57	3.67	3.88	4.17	4.45	5.10
S_4N_3	1.43	1.97	2.72	2.90	3.03	3.27	3.33	3.45	3.52	3.60	3.78	3.97	4.32	5.30
S_4N_4	1.57	1.93	2.47	2.77	3.00	3.10	3.13	3.25	3.28	3.33	3.58	3.82	4.07	4.77
CD(0.05)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>S x G interaction</u>														
S_1G_1	1.78	2.40	3.25	3.45	3.70	3.73	3.78	3.80	3.93	3.93	4.05	4.15	4.43	4.68
S_1G_2	1.78	2.27	3.13	3.50	3.75	3.88	4.03	4.07	4.20	4.20	4.30	4.73	4.75	4.93
S_1G_3	1.65	2.10	3.08	3.83	4.02	4.05	4.20	4.23	4.55	4.55	4.83	5.18	5.77	6.27
S_1G_4	1.53	2.20	2.95	3.28	3.58	3.75	4.02	4.05	4.45	4.45	4.88	5.30	5.98	6.50

Contd.

Table 1. Continued

Treatments	Month													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
S_1G_5	1.75	2.18	2.93	3.35	3.65	3.80	3.98	3.98	4.28	4.28	4.90	5.13	5.80	6.23
S_1G_6	1.55	2.20	2.98	3.48	3.75	4.10	4.05	4.05	4.23	4.23	4.73	4.83	5.15	5.50
S_2G_1	1.50	1.85	2.90	3.10	3.43	3.50	3.78	3.78	3.93	3.95	4.03	4.03	4.10	4.85
S_2G_2	1.53	2.15	2.95	3.38	3.45	3.63	3.88	3.90	4.18	4.18	4.25	4.43	4.65	5.10
S_2G_3	1.45	2.23	2.90	3.78	3.95	4.00	4.23	4.30	4.58	4.65	4.92	5.03	5.13	6.18
S_2G_4	1.57	2.03	2.88	3.50	4.03	4.10	4.23	4.27	4.65	4.75	4.95	5.10	5.25	5.83
S_2G_5	1.50	2.02	2.93	3.30	3.75	3.88	4.05	4.10	4.45	4.52	4.78	4.90	5.03	5.77
S_2G_6	1.48	2.05	2.87	3.15	3.68	3.75	3.90	4.00	4.27	4.33	4.68	5.23	5.58	6.20
S_3G_1	1.10	2.08	3.03	3.30	3.40	3.55	3.65	3.75	3.88	3.88	3.95	3.98	4.30	4.58
S_3G_2	1.05	1.93	2.58	2.93	3.32	3.40	3.55	3.63	3.77	3.82	3.93	4.08	4.15	4.48
S_3G_3	1.10	1.73	3.23	3.13	3.53	3.75	3.95	4.15	4.40	4.48	4.80	4.93	5.30	6.38
S_3G_4	1.08	2.00	2.63	3.10	3.52	3.78	4.05	4.45	4.67	4.70	4.90	5.15	5.28	5.98
S_3G_5	1.18	2.00	2.30	2.77	3.28	3.55	3.70	3.85	4.07	3.88	4.25	4.45	4.45	5.13
S_3G_6	1.00	1.90	2.63	3.07	3.32	3.58	3.83	4.15	4.48	4.48	4.28	4.98	5.15	5.98
S_4G_1	1.63	2.20	2.90	3.25	3.03	3.48	3.48	3.48	3.55	3.58	3.73	3.88	4.07	4.75
S_4G_2	1.45	1.98	2.78	3.00	3.45	3.40	3.43	3.48	3.40	3.48	3.58	3.65	4.15	4.85
S_4G_3	1.33	2.05	2.65	2.95	3.07	3.28	3.28	3.82	3.63	3.70	3.80	4.08	4.27	5.63
S_4G_4	1.30	1.90	2.70	2.80	3.10	3.15	3.23	3.30	3.50	3.58	3.98	4.30	4.40	5.10
S_4G_5	1.43	1.95	2.48	2.68	2.88	3.28	3.35	3.65	3.43	3.50	3.55	3.63	4.00	4.35
S_4G_6	1.50	2.15	2.55	2.93	3.05	3.25	3.25	3.30	3.38	3.40	3.68	3.93	4.07	4.48
CD(0.05)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
N x G interaction														
N_1G_1	1.68	2.38	3.13	3.23	3.40	3.50	3.68	3.70	3.80	3.80	3.83	3.88	3.90	4.33

Contd.

Table 1. Continued

Treatments	Month													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
N_1G_2	1.47	2.35	3.08	3.43	3.78	3.98	4.05	4.13	4.23	4.23	4.30	4.38	4.50	4.93
N_1G_3	1.43	2.18	3.15	3.55	3.85	3.98	4.10	4.23	4.45	4.45	4.53	4.63	5.28	6.33
N_1G_4	1.43	2.20	2.90	3.25	3.63	3.80	3.93	4.10	4.40	4.43	4.55	4.73	4.88	5.92
N_1G_5	1.45	2.08	2.92	3.30	3.63	3.82	3.93	3.93	4.15	3.93	4.40	4.65	4.78	5.20
N_1G_6	1.30	2.28	2.82	3.35	3.60	3.73	3.95	3.98	4.23	4.25	4.07	5.00	5.35	6.05
N_2G_1	1.40	2.03	3.00	3.30	3.48	3.55	3.68	3.68	3.85	3.88	4.07	4.17	4.50	4.88
N_2G_2	1.43	2.10	2.82	3.20	3.48	3.55	3.65	3.65	3.78	3.78	3.88	4.00	4.38	4.98
N_2G_3	1.28	2.25	2.93	3.40	3.68	3.73	3.88	4.00	4.28	4.35	4.83	5.18	5.48	6.28
N_2G_4	1.38	1.85	2.73	3.00	3.40	3.53	3.75	3.88	4.20	4.30	4.55	4.80	5.15	5.70
N_2G_5	1.45	2.00	2.55	2.98	3.50	3.63	3.82	4.07	3.98	4.03	4.20	4.45	4.73	5.00
N_2G_6	1.40	2.00	2.70	3.03	3.25	3.38	3.50	3.70	3.90	3.92	4.30	4.73	5.15	5.33
N_3G_1	1.50	2.25	3.18	3.45	3.58	3.73	3.80	3.82	3.90	3.90	4.00	4.10	4.27	4.73
N_3G_2	1.50	2.03	2.88	3.35	3.50	3.63	3.78	3.82	3.93	4.03	4.13	4.33	4.58	4.93
N_3G_3	1.40	1.83	3.08	3.33	3.53	3.73	3.88	4.00	4.23	4.30	4.58	4.75	4.93	6.63
N_3G_4	1.38	2.15	2.90	3.18	3.48	3.75	3.93	4.00	4.38	4.42	4.63	4.80	5.22	5.75
N_3G_5	1.33	2.05	2.60	2.95	3.25	3.63	3.75	3.85	4.13	4.15	4.45	4.65	4.83	5.50
N_3G_6	1.40	2.00	2.83	3.20	3.53	3.93	3.78	3.82	4.03	4.03	4.17	4.38	4.53	4.95
N_4G_1	1.48	1.88	2.77	3.13	3.10	3.48	3.52	3.60	3.73	3.75	3.85	3.88	4.23	4.93
N_4G_2	1.40	1.85	2.60	2.83	3.23	3.15	3.40	3.48	3.63	3.65	3.75	4.17	4.25	4.53
N_4G_3	1.43	1.85	2.70	3.40	3.53	3.65	3.80	3.98	4.20	4.28	4.42	4.65	4.80	5.23
N_4G_4	1.30	1.93	2.63	3.25	3.73	3.70	3.93	4.10	4.30	4.33	4.98	5.53	5.65	6.03
N_4G_5	1.63	2.03	2.55	2.88	3.18	3.43	3.58	3.73	3.98	4.07	4.43	4.35	4.95	5.78
N_4G_6	1.43	2.02	2.68	3.05	3.43	3.65	3.80	4.00	4.20	4.23	4.80	4.85	4.93	5.83
CD(0.05)	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 2. Effect of shade, nutrients, growth regulators and their interactions on per cent increase in plant height of *A. andreanum* var. `Hawaiian Red' at monthly interval

Treatments	Month												
	1	2	3	4	5	6	7	8	9	10	11	12	13
Shade (S)													
S_1	24.11	27.16	11.92	7.06	3.53	3.06	0.50	5.55	0.00	6.94	4.89	7.49	6.35
S_2	25.82	29.34	13.05	9.15	2.53	5.04	1.16	6.46	1.17	4.27	3.56	3.35	11.86
S_3	42.98	27.57	10.63	9.97	5.54	4.84	5.12	5.04	0.69	2.85	4.55	3.69	10.70
S_4	28.74	23.41	8.73	4.09	6.07	0.92	3.24	0.65	1.63	4.58	4.52	5.89	13.67
CD(0.05)	7.95	-	-	-	-	3.08	2.71	3.23	-	-	-	-	5.13
Nutrient (N)													
N_1	35.52	25.05	10.16	7.80	4.17	3.37	1.66	4.41	1.22	2.07	4.96	4.28	11.67
N_2	31.65	26.89	11.07	8.75	2.81	3.99	2.79	3.98	1.13	5.76	5.20	6.74	8.30
N_3	30.01	28.71	9.69	6.59	6.72	2.28	1.88	4.79	1.05	4.14	3.62	4.75	11.29
N_4	24.47	26.84	13.42	7.14	3.98	4.22	3.69	4.51	1.15	6.68	3.76	4.65	10.82
CD(0.05)	-	-	-	-	-	-	-	-	-	-	-	-	-
Growth regulators (G)													
G_1	28.96	24.15	7.79	2.04	5.08	2.82	0.83	3.06	0.31	2.69	1.57	4.98	10.10
G_2	30.06	28.63	10.50	8.11	1.95	3.80	1.36	2.86	0.86	2.33	4.42	4.67	8.39
G_3	31.07	22.70	12.05	6.12	3.46	3.47	3.59	5.36	1.35	4.88	4.32	5.69	15.74
G_4	32.20	29.33	11.56	10.49	3.52	4.75	3.25	6.84	1.20	6.52	5.56	4.76	10.33
G_5	27.52	20.00	12.18	10.40	6.83	3.81	3.01	3.47	1.01	7.02	3.22	4.68	10.05
G_6	32.68	15.66	12.44	8.25	5.67	2.15	2.99	4.94	0.46	4.53	7.20	4.86	9.26
CD(0.05)	-	-	-	-	-	-	-	-	-	-	-	-	-

Contd.

Table 2. Continued

Treatments	Month												
	1	2	3	4	5	6	7	8	9	10	11	12	13
S x N interaction													
S_1N_1	26.39	21.82	6.17	7.83	2.14	4.03	2.01	6.68	0.00	3.89	5.93	10.03	4.69
S_1N_2	28.70	20.85	11.09	7.27	1.76	2.61	0.00	4.92	0.00	8.75	8.87	8.89	7.27
S_1N_3	19.73	32.87	15.74	6.14	6.42	1.06	0.00	4.48	0.00	2.53	1.99	6.02	8.01
S_1N_4	21.62	33.11	14.68	6.98	3.81	6.66	0.00	6.10	0.00	12.60	2.78	5.00	5.43
S_2N_1	29.79	27.00	15.16	9.89	2.37	4.99	0.00	6.86	1.06	2.71	3.22	1.57	13.74
S_2N_2	25.25	27.64	11.15	13.15	2.37	5.11	0.00	7.76	0.71	2.99	1.62	5.85	7.34
S_2N_3	24.44	32.62	12.50	6.81	1.83	5.51	0.00	6.69	1.10	7.74	6.21	2.00	13.00
S_2N_4	23.81	30.11	13.39	6.78	3.57	4.57	4.65	4.51	1.83	3.64	3.18	3.97	13.37
S_3N_1	47.28	29.47	12.81	10.32	1.79	4.46	3.76	4.09	5.95	0.20	8.88	2.11	18.45
S_3N_2	42.28	35.47	10.63	9.11	2.89	7.71	6.12	3.15	1.10	5.87	3.86	5.94	6.73
S_3N_3	49.01	22.36	4.01	9.00	11.40	2.59	4.12	6.43	0.80	1.79	2.12	2.82	8.07
S_3N_4	33.34	23.00	15.09	11.46	6.08	4.58	6.49	6.48	1.29	3.93	3.35	3.91	9.55
S_4N_1	38.64	21.91	6.52	3.15	10.38	0.00	0.89	0.00	0.00	1.86	1.79	3.41	9.81
S_4N_2	30.36	23.62	11.40	5.49	4.20	0.54	5.05	0.07	2.73	5.42	6.43	6.29	11.84
S_4N_3	26.87	26.97	6.49	4.42	7.23	2.08	3.41	1.58	2.32	4.50	4.16	8.14	18.10
S_4N_4	19.10	21.14	10.52	3.32	2.48	1.08	3.60	9.05	1.49	6.55	5.72	5.70	14.92
CD(0.05)	-	-	-	-	-	-	-	-	-	-	-	-	-
S x G interaction													
S_1G_1	25.83	26.41	5.74	6.83	0.64	1.39	0.63	3.24	0.00	3.10	2.33	6.15	5.32
S_1G_2	22.12	27.06	10.42	6.51	3.54	3.80	1.14	3.00	0.00	2.33	8.09	0.81	3.56
S_1G_3	20.70	31.43	18.75	5.07	0.64	3.52	0.61	7.10	0.00	5.72	6.60	9.21	8.02

Contd.

Table 2. Continued

Treatments	Month												
	1	2	3	4	5	6	7	8	9	10	11	12	13
S_1G_4	30.79	25.66	9.58	8.34	4.68	6.81	0.64	8.94	0.00	8.06	7.29	11.71	7.83
S_1G_5	18.14	25.84	12.57	8.20	4.03	4.37	0.00	6.95	0.00	12.43	4.05	11.53	6.63
S_1G_6	27.07	26.58	14.46	7.38	7.67	1.52	0.00	4.04	0.00	10.02	0.99	5.52	6.71
S_2G_1	18.15	36.23	6.14	9.40	1.99	7.35	0.00	3.80	0.61	1.88	0.21	1.74	15.08
S_2G_2	28.24	27.27	11.94	2.05	4.82	6.33	0.66	6.67	0.00	1.66	3.84	4.94	8.84
S_2G_3	34.54	23.40	23.09	4.27	1.32	5.34	1.74	5.95	1.64	5.88	1.96	1.92	15.35
S_2G_4	21.48	29.57	17.55	13.08	1.80	2.92	1.06	8.14	2.13	3.95	2.88	2.90	9.43
S_2G_5	24.84	30.78	11.30	11.76	3.22	4.44	1.19	7.74	1.54	5.06	2.51	2.31	12.90
S_2G_6	27.69	28.81	8.30	14.35	2.03	3.90	2.33	6.44	1.11	7.49	10.36	6.29	9.56
S_3G_1	46.78	30.76	8.53	3.08	4.21	2.55	2.68	3.23	0.00	1.85	0.61	7.12	5.92
S_3G_2	43.73	24.98	12.38	11.49	2.33	4.25	2.16	4.06	1.36	2.56	3.73	1.81	6.87
S_3G_3	35.47	46.14	3.81	11.13	6.03	5.03	4.79	5.69	1.67	5.83	2.42	7.25	15.70
S_3G_4	44.85	23.35	15.50	11.98	6.49	6.91	8.98	4.77	0.53	4.07	4.60	2.31	10.63
S_3G_5	40.72	12.55	17.07	14.94	7.44	4.07	3.91	5.39	7.71	9.18	4.29	0.00	12.79
S_3G_6	46.31	27.67	14.14	7.22	6.84	6.21	8.19	7.09	0.00	6.40	11.67	3.68	12.30
S_4G_1	25.07	24.15	10.74	11.15	13.47	0.00	0.00	1.97	0.64	3.93	3.55	4.91	14.06
S_4G_2	26.14	28.63	7.24	12.40	2.80	0.83	1.50	2.27	2.08	2.77	2.01	11.11	14.30
S_4G_3	33.59	22.70	10.15	4.00	5.86	0.00	7.20	2.70	2.07	2.38	6.30	4.37	23.89
S_4G_4	31.66	29.33	3.60	8.56	1.11	2.37	2.32	5.50	2.15	9.99	7.48	2.11	13.41
S_4G_5	26.37	20.00	7.76	6.69	12.64	2.34	6.95	6.21	2.13	1.41	2.01	8.85	7.86
S_4G_6	29.63	15.66	12.88	4.06	6.14	0.00	1.45	2.21	0.74	7.01	5.79	3.96	8.48
CD(0.05)	-	-	-	-	-	-	-	-	-	-	-	-	-

Contd.

Table 2. Continued

Treatments	Month												
	1	2	3	4	5	6	7	8	9	10	11	12	13
N x G interaction													
N_1G_1	31.05	23.90	3.01	5.06	2.72	4.73	0.63	2.59	0.00	0.60	1.14	0.68	9.94
N_1G_2	38.95	23.50	10.11	8.91	5.38	1.67	1.83	2.23	0.00	1.66	1.62	3.07	8.54
N_1G_3	34.70	30.33	10.69	7.77	3.29	2.96	2.99	4.82	0.00	1.62	2.06	10.63	16.76
N_1G_4	35.50	23.89	10.84	9.78	4.73	3.24	3.97	6.49	0.51	2.90	3.74	2.79	16.70
N_1G_5	29.61	29.26	10.98	8.52	5.41	2.46	0.00	4.88	8.43	11.22	5.14	2.12	8.02
N_1G_6	43.32	19.42	15.35	6.75	3.49	5.17	0.56	5.46	0.58	5.60	16.03	6.41	10.06
N_2G_1	30.96	32.51	8.88	5.00	2.02	3.26	0.00	4.57	0.64	4.91	2.01	6.89	7.77
N_2G_2	31.98	26.90	9.93	7.71	2.19	2.70	0.00	3.27	0.00	2.55	3.02	8.36	11.67
N_2G_3	44.31	22.81	13.19	7.25	1.42	3.63	3.28	6.35	1.72	8.90	7.11	5.61	12.30
N_2G_4	26.13	32.34	9.09	10.98	3.89	5.85	2.78	7.80	2.45	5.60	5.17	6.32	9.17
N_2G_5	27.27	20.91	16.61	14.93	3.45	5.05	5.43	3.28	1.26	3.90	5.12	5.26	5.51
N_2G_6	29.22	25.91	10.70	6.66	3.82	3.46	5.26	5.15	0.74	8.68	8.75	8.03	3.36
N_3G_1	33.25	29.34	7.98	3.44	4.15	1.96	0.66	1.86	0.00	2.51	2.40	4.09	8.93
N_3G_2	25.45	28.62	13.64	4.28	3.59	3.94	1.35	1.97	2.71	2.45	4.51	5.28	6.81
N_3G_3	23.77	39.61	5.11	5.74	5.56	3.59	3.48	5.31	1.79	5.95	3.66	3.62	25.16
N_3G_4	34.52	25.74	8.41	8.11	7.09	4.58	1.84	8.80	1.09	4.41	3.60	7.87	8.75
N_3G_5	33.51	19.79	11.70	9.17	10.73	3.47	2.59	6.23	0.74	6.25	3.90	4.00	12.14
N_3G_6	29.58	29.14	11.29	8.80	9.19	3.86	1.36	4.59	0.00	3.27	3.64	3.61	8.97
N_4G_1	20.56	31.79	11.27	3.33	11.38	1.34	2.03	3.22	0.61	2.74	0.71	8.26	13.76
N_4G_2	23.84	28.93	8.30	11.56	3.35	6.90	2.27	3.98	0.74	2.66	8.52	1.96	6.55
N_4G_3	21.51	30.93	19.19	3.72	3.58	3.71	4.59	4.97	1.87	3.04	4.46	2.88	8.74
N_4G_4	32.63	25.94	17.91	13.09	1.63	5.33	4.41	4.26	0.76	13.16	9.73	2.05	6.68
N_4G_5	19.68	19.21	11.42	8.98	7.73	4.24	4.03	6.05	2.40	6.71	1.30	11.32	14.51
N_4G_6	28.58	24.25	12.44	10.80	6.19	3.81	4.78	4.58	0.53	11.77	0.41	1.40	14.60
CD(0.05)	-	-	-	-	-	-	-	-	-	-	-	-	-

The various nutrients tried did not influence the plant height, except in the 2nd, 3rd, 6th and 7th months. Plant height was significantly superior in treatments involving 1 per cent fertilizer complex (17:17:17) sprays, (N_1) which recorded maximum height of 5.46 cm.

Though the effect of growth regulators was not significant upto the 9th month, after that, the plant height was significantly increased. The maximum plant height of 6.11 cm was recorded in the treatment with BA 750 ppm (G_3). BA treatments were significantly superior to GA treatments and were on par with Ethephon treatments (Fig.2).

The interaction effects of shade and nutrient, shade and growth regulator and nutrient and growth regulator were not significant with respect to their influence on plant height. The maximum plant height (7.60 cm) was recorded in the treatment combination of 70 per cent shade + Knop's solution + 750 ppm BA ($S_2N_3G_3$) while 50 per cent shade + fertilizer complex + 1500 ppm Ethephon ($S_4N_1G_6$) recorded the minimum (3.6 cm), 14 months after imposing the treatments (Appendix 6).

Data presented in Table 2 show that the effect of shade levels on the rate of increase in mean height of the plant was significantly superior in 2nd, 7th, 8th and 9th months. The maximum percentage of increase in height was during the 2nd to 4th months and during the rest of the season, the increase in height was uniform under all the shade levels.

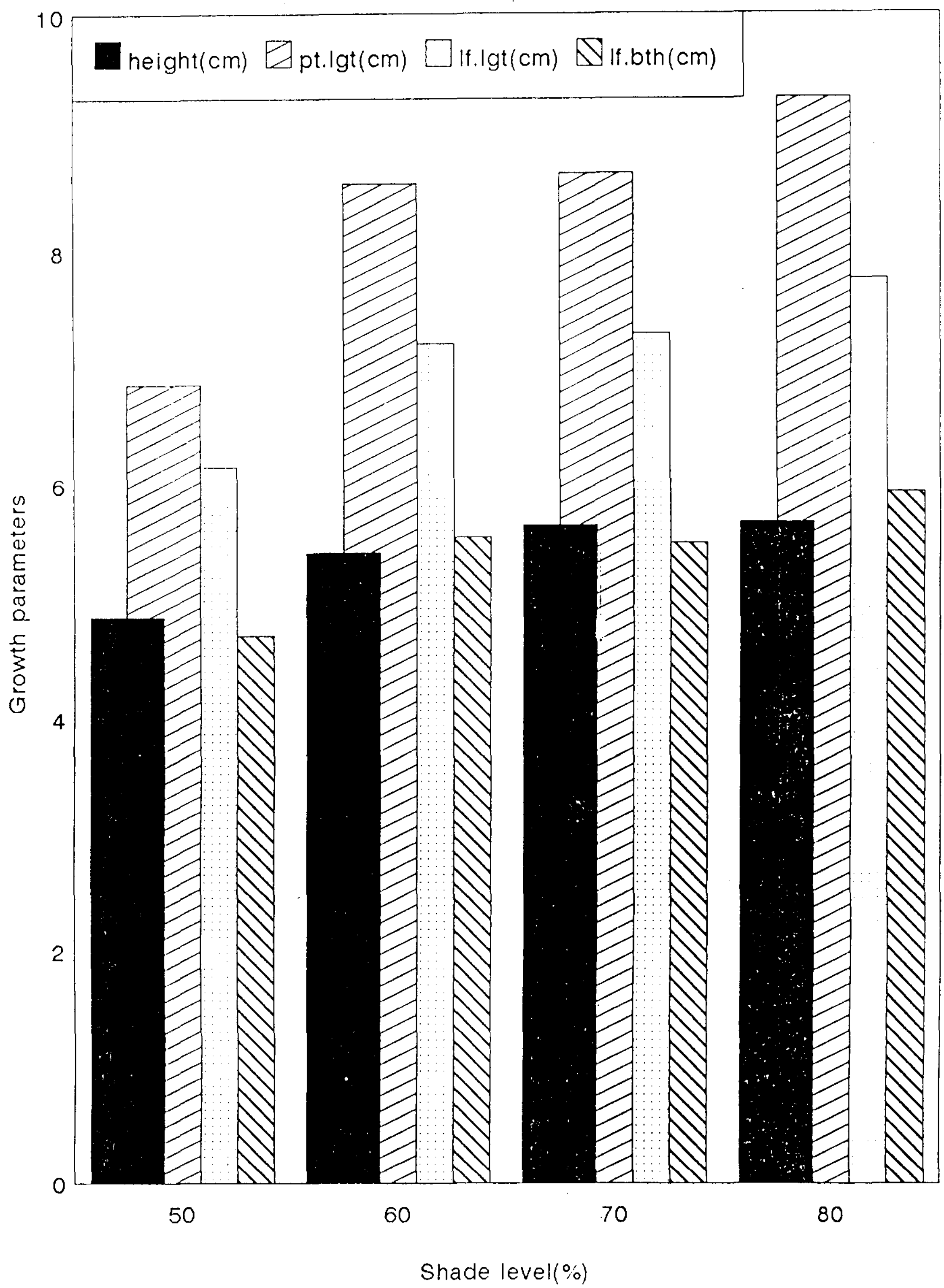


Fig. 1. Effect of shade on growth parameters of *A. andreanum* 'Hawaiin Red'

Under the influence of nutrients and growth regulators, the maximum percentage of increase in height of anthurium plants was recorded during the 2nd to 4th months of the experiment with the rest of the period showing slow growth. Neither nutrients nor growth regulators were significantly different with each other, with respect to per cent increase in height.

The interaction effect of shade and nutrient, shade and growth regulator and nutrient and growth regulator also had shown the similar trend of nutrients and growth regulators in the per cent increase in mean height of anthurium plants during the experimental period. No interaction had significantly influenced the per cent increase in height of the plants.

4.1.2 Plant spread

The effects of shade, nutrients and growth regulators on plant spread, EW and NS directions, are evident from in Tables 3 and 4, respectively (Plate 3).

Different shade levels had significant influence on plant spread in East-West direction, except in 2, 3, 6 and 12 month. As the shade level declined, the plant spread in EW direction also decreased. The highest intensity shade level (S_1, 80%) recorded the maximum plant spread, (20.13 cm) which was significantly superior to 60 per cent and 50 per cent, and on par with 70 per cent, at the final stage. Neither nutrients nor growth regulators had significant influence on plant spread.

The interaction effects (S x N, S x G and N x G) tried had no significant influence on plant spread. Maximum plant spread of 26.0 cm was recorded in the combination of 80 per cent shade + Ohio solution + 1500 ppm BA ($S_1N_4G_4$) while

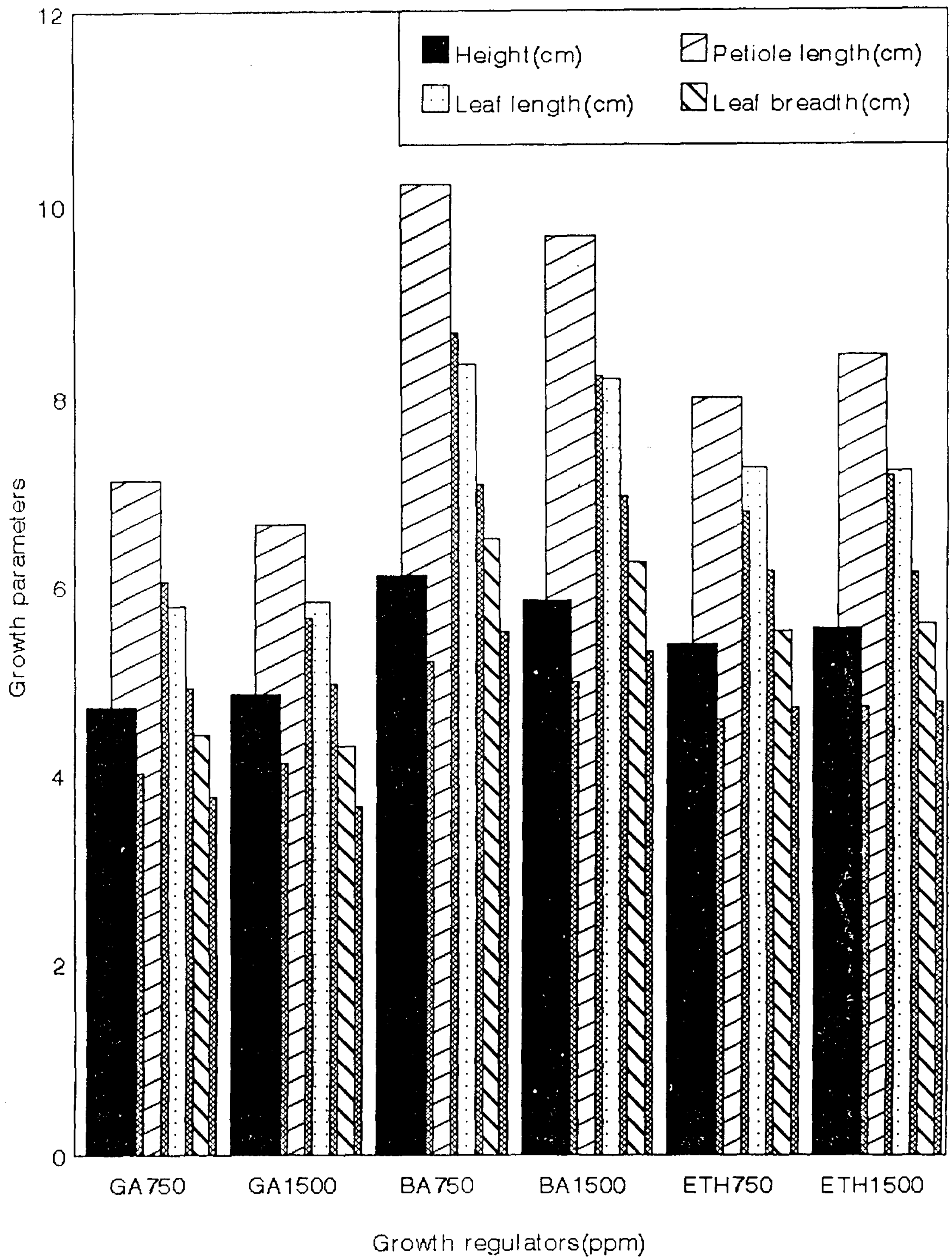


Fig.2. Effect of growth regulators on the growth parameters of *A. andreanum* 'Hawaiian Red'

Table 3. Effect of shade, nutrients, growth regulators and their interactions on plant spread - EW (cm) at monthly interval of *A. andreanum* var. 'Hawaiian Red'

Treatments	Month													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Shade (S)														
S_1	7.23	8.23	9.40	11.23	13.39	14.72	13.59	13.79	15.97	16.24	20.25	16.63	18.93	20.13
S_2	7.53	8.62	10.24	12.66	13.83	13.75	12.64	13.93	16.13	18.11	21.00	17.45	17.95	17.70
S_3	7.34	8.36	9.75	11.64	12.53	14.18	12.88	13.75	15.95	18.08	22.86	16.18	16.07	17.27
S_4	7.68	8.89	10.73	12.87	13.05	12.13	10.17	10.47	10.22	14.01	21.78	13.22	13.96	15.22
CD(0.05)	-	-	0.62	0.84	-	1.38	1.40	1.53	1.82	1.47	-	2.34	2.61	2.72
Nutrient (N)														
N_1	7.47	8.64	10.25	12.43	13.87	14.36	12.94	13.35	15.12	16.17	21.75	16.67	16.93	17.81
N_2	7.31	8.37	9.79	11.85	13.06	13.90	12.59	13.46	15.11	17.18	21.42	16.32	17.55	18.12
N_3	7.64	8.71	10.20	12.38	12.98	13.69	11.84	12.60	14.08	16.67	21.53	15.60	16.59	17.42
N_4	7.35	8.39	9.87	11.74	12.88	12.84	11.91	12.54	13.96	16.41	21.19	14.89	15.86	16.98
CD(0.05)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Growth regulator (G)														
G_1	7.63	8.77	10.32	12.56	13.43	14.61	13.03	13.38	15.32	16.14	21.42	16.78	17.22	17.83
G_2	7.33	8.41	10.06	12.41	14.10	14.59	12.84	13.73	15.88	17.63	22.64	16.14	17.63	19.46
G_3	7.43	8.54	10.03	11.74	12.54	13.67	11.98	13.15	14.71	17.41	21.88	16.39	17.95	18.72
G_4	7.30	8.33	9.84	11.76	12.66	12.42	11.28	12.05	13.42	16.08	21.03	15.96	15.84	16.58
G_5	7.55	8.69	10.03	12.06	12.83	13.53	11.96	12.95	14.14	16.26	20.75	14.78	15.76	16.33
G_6	7.42	8.41	9.90	12.06	13.64	13.35	12.83	12.66	13.94	16.15	21.08	15.18	15.98	16.56
CD(0.05)	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Contd.

Table 3. Continued

Treatments	Month													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
<u>S x N interaction</u>														
S_1N_1	7.13	8.28	9.60	11.12	14.65	15.72	15.55	15.40	16.92	14.62	20.85	18.95	18.77	20.28
S_1N_2	7.15	8.10	9.10	11.22	13.65	15.03	13.43	13.82	16.27	16.95	20.87	17.20	20.03	21.43
S_1N_3	7.10	8.15	9.30	11.03	12.80	14.38	12.32	13.15	15.45	16.83	20.28	15.43	19.95	20.27
S_1N_4	7.53	8.37	9.60	11.53	12.47	13.73	13.07	12.80	15.25	16.57	19.00	14.93	16.97	18.53
S_2N_1	7.50	8.58	10.52	13.07	13.83	13.48	13.30	14.33	16.78	19.00	21.30	18.15	19.83	18.67
S_2N_2	7.47	8.60	10.27	12.98	13.17	13.92	12.85	13.75	16.17	17.93	20.02	16.18	16.92	15.17
S_2N_3	7.85	8.87	10.25	12.48	13.65	13.58	11.98	12.85	15.18	17.58	20.68	17.85	17.75	18.95
S_2N_4	7.28	8.45	9.92	12.12	14.68	14.02	12.42	14.80	16.40	17.92	22.00	17.63	17.32	18.03
S_3N_1	7.27	8.40	10.00	12.75	14.45	16.00	14.28	15.12	18.47	18.80	23.48	18.07	18.67	20.43
S_3N_2	7.32	8.35	9.78	11.55	13.12	14.30	13.02	13.82	15.92	17.92	21.95	17.13	16.63	17.70
S_3N_3	7.58	8.65	10.20	12.03	11.37	14.28	12.43	13.73	15.43	17.97	22.80	15.40	14.22	14.82
S_3N_4	7.18	8.05	9.02	10.22	11.18	12.15	11.78	12.35	13.97	17.62	23.20	14.12	14.77	16.13
S_4N_1	7.98	9.28	10.90	12.77	12.57	12.23	8.62	8.53	8.32	12.27	21.37	11.50	10.43	11.85
S_4N_2	7.30	8.42	10.02	11.65	12.32	12.33	11.07	12.45	12.10	15.93	22.83	14.77	16.60	18.17
S_4N_3	8.02	9.17	11.07	13.97	14.10	12.50	10.62	10.67	10.23	14.30	22.37	13.73	14.43	15.65
S_4N_4	7.40	8.70	10.95	13.08	13.20	11.45	10.37	10.22	10.22	13.55	20.55	12.88	14.38	15.20
CD(0.05)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>S x G interaction</u>														
S_1G_1	7.35	8.50	9.55	11.33	13.45	16.28	15.83	15.08	18.98	16.63	21.83	19.55	22.45	23.08
S_1G_2	6.68	7.55	9.08	10.85	12.93	14.13	13.00	13.38	16.40	16.13	18.78	18.65	19.05	22.30
S_1G_3	6.90	7.95	9.02	10.45	12.75	13.93	12.05	12.58	15.05	15.63	20.15	15.83	18.03	19.57
S_1G_4	7.35	8.05	9.05	10.73	13.00	12.90	11.95	12.68	13.15	14.85	18.70	13.40	14.80	15.80

Contd.

Table 3. Continued

Treatments	Month													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
S_1G_5	7.83	9.10	10.00	12.20	14.05	15.00	14.15	13.98	15.15	16.00	19.75	14.73	17.78	16.93
S_1G_6	7.28	8.20	9.70	11.80	14.18	16.08	14.58	15.08	17.10	18.22	22.30	17.63	21.48	23.10
S_2G_1	7.60	8.75	11.00	13.33	14.55	15.93	14.13	15.98	18.80	19.67	24.18	20.72	21.58	20.63
S_2G_2	7.18	8.20	9.52	12.80	15.38	15.05	12.88	15.03	18.25	20.35	24.65	20.50	20.45	21.25
S_2G_3	7.93	9.05	10.38	12.05	13.28	13.25	11.35	13.13	15.85	18.45	20.25	18.15	19.63	18.05
S_2G_4	7.40	8.63	10.40	12.42	12.25	11.98	11.70	13.40	15.42	17.95	21.15	17.85	18.53	18.00
S_2G_5	7.63	8.77	10.18	12.35	12.33	12.88	11.40	13.38	15.00	17.10	18.63	14.50	14.30	16.15
S_2G_6	7.43	8.35	9.95	13.03	15.23	13.42	14.38	12.70	13.48	15.13	17.15	13.00	13.25	12.15
S_3G_1	7.58	8.68	9.92	12.23	13.15	13.90	12.28	12.28	14.03	15.95	20.28	14.30	12.45	13.75
S_3G_2	7.53	8.60	10.05	12.03	13.93	15.75	14.58	15.73	19.00	20.53	25.13	13.45	18.47	19.82
S_3G_3	7.18	8.17	9.83	11.70	11.55	15.60	14.28	16.13	17.75	20.17	24.47	19.35	19.67	20.88
S_3G_4	7.03	8.10	9.48	11.17	11.90	12.30	11.48	11.98	13.75	16.73	21.43	18.53	14.70	15.88
S_3G_5	7.03	7.93	9.38	11.03	11.93	13.90	12.23	13.60	15.98	17.80	23.20	15.67	15.95	17.73
S_3G_6	7.70	8.70	9.85	11.68	12.73	13.65	12.45	12.83	15.18	17.28	22.65	15.78	15.17	15.57
S_4G_1	7.98	9.18	10.80	13.35	12.55	12.35	9.90	10.20	9.48	12.30	19.55	12.55	12.40	13.88
S_4G_2	7.92	9.30	11.60	13.95	14.18	13.43	10.90	10.80	9.85	13.50	22.00	11.95	12.55	14.48
S_4G_3	7.73	9.00	10.90	12.78	12.60	11.90	10.22	10.78	10.20	15.38	22.65	12.25	14.48	16.38
S_4G_4	7.43	8.55	10.43	12.70	13.48	12.53	9.98	10.15	11.35	14.78	22.85	14.05	15.33	16.65
S_4G_5	7.73	8.95	10.58	12.67	13.03	12.33	10.08	10.85	10.43	14.15	21.43	14.23	15.00	14.53
S_4G_6	7.27	8.38	10.10	11.75	12.45	10.25	9.93	10.02	10.00	13.98	22.20	14.30	14.03	15.40
CD(0.05)	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Contd.

Table 3. Continued

Treatments	Month													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
N x G interaction														
N_1G_1	7.98	9.20	10.88	13.38	14.33	14.90	14.03	14.30	16.15	15.68	22.10	17.70	17.65	18.42
N_1G_2	7.05	8.40	10.20	13.17	15.40	16.65	15.63	15.63	18.58	18.32	24.55	17.20	19.20	20.75
N_1G_3	7.73	9.00	10.53	12.48	14.35	14.90	13.70	14.88	15.78	16.70	23.23	19.17	18.55	19.93
N_1G_4	7.30	8.27	9.75	11.65	13.18	12.60	10.90	12.05	13.35	15.75	20.95	16.10	15.53	16.33
N_1G_5	7.30	8.42	10.15	11.90	13.45	13.75	11.20	12.05	13.25	15.98	18.65	13.95	15.55	15.15
N_1G_6	7.48	8.52	10.03	11.98	12.55	13.35	12.17	11.18	13.63	14.60	21.03	15.88	15.08	16.28
N_2G_1	7.60	8.60	10.10	11.65	13.17	15.05	13.17	12.93	15.63	16.30	21.83	16.33	18.25	16.70
N_2G_2	6.85	7.85	9.58	11.50	13.65	14.68	12.28	14.00	15.90	18.60	22.93	15.48	19.20	20.82
N_2G_3	7.18	8.20	9.70	11.42	12.43	12.88	11.63	13.35	15.15	18.92	21.38	17.92	19.28	20.67
N_2G_4	7.33	8.38	9.88	11.90	12.20	12.18	11.73	11.98	12.88	15.65	20.08	16.58	14.70	15.80
N_2G_5	7.60	8.88	9.65	12.28	13.42	13.85	12.25	13.75	15.75	16.25	20.58	15.37	17.50	16.83
N_2G_6	7.30	8.30	9.85	12.35	13.50	14.75	14.50	14.75	15.38	17.38	21.72	16.25	16.35	17.88
N_3G_1	7.73	8.95	10.80	13.68	14.85	15.67	13.03	13.85	15.55	17.17	21.98	16.78	17.05	18.85
N_3G_2	7.48	8.55	10.13	12.68	14.68	14.10	11.58	13.18	15.35	16.72	22.63	16.58	17.25	18.67
N_3G_3	7.40	8.58	10.08	11.55	11.03	13.58	11.45	12.45	14.10	16.80	21.05	14.90	17.30	18.30
N_3G_4	7.63	8.58	9.73	11.65	12.43	16.63	11.50	11.45	13.63	16.83	21.05	15.65	15.42	15.60
N_3G_5	7.93	8.95	10.33	12.60	12.45	13.58	11.70	12.60	12.98	16.45	21.75	15.53	15.93	17.07
N_3G_6	7.68	8.65	10.18	12.13	12.45	12.58	11.78	12.08	12.85	16.05	20.75	14.20	16.57	16.03
N_4G_1	7.20	8.35	9.50	11.53	11.35	12.83	11.90	12.45	13.95	15.40	19.92	16.33	15.92	17.35
N_4G_2	7.92	8.85	10.35	12.28	12.68	12.92	11.88	12.13	13.68	16.85	20.45	15.30	14.88	17.60
N_4G_3	7.43	8.40	9.83	11.53	12.38	13.33	11.13	11.93	11.83	17.20	21.88	13.58	16.67	15.98
N_4G_4	6.95	8.10	10.00	11.83	12.83	12.30	10.98	12.73	13.83	16.08	22.05	15.50	17.70	18.60
N_4G_5	7.38	8.50	10.00	11.48	12.00	12.92	12.70	13.40	14.58	14.38	22.03	14.28	14.05	16.28
N_4G_6	7.23	8.15	9.55	11.80	16.07	12.73	12.88	12.63	13.90	16.58	20.80	14.38	15.93	16.05
CD(0.05)	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 4. Effect of shade, nutrients, growth regulators and their interactions on plant spread - NS (cm) at monthly interval of *A. andreanum* var. 'Hawaiian Red'

Treatments	Month													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
<u>Shade (S)</u>														
S_1	7.05	8.03	9.20	10.93	12.98	13.42	12.70	13.01	15.75	15.88	19.78	16.98	18.62	19.80
S_2	7.50	8.55	10.22	12.26	13.00	12.42	11.98	13.33	15.45	17.60	22.16	17.46	17.64	18.38
S_3	7.49	8.54	9.73	11.26	12.43	12.60	12.02	13.11	15.77	17.36	23.60	16.25	16.10	17.22
S_4	7.75	8.90	10.50	12.43	12.18	10.87	9.37	10.47	10.72	13.18	22.35	12.65	13.79	15.43
CD(0.05)	0.41	0.47	0.64	1.05	-	1.42	1.46	1.66	1.93	1.71	1.85	2.42	2.64	2.82
<u>Nutrient (N)</u>														
N_1	7.50	8.59	10.30	12.15	13.45	13.01	12.17	12.35	14.88	14.93	22.35	16.28	16.56	17.99
N_2	7.21	8.27	9.60	11.40	12.54	12.36	11.68	13.23	15.06	16.68	22.05	16.46	16.89	18.90
N_3	7.60	8.70	10.06	11.90	12.37	12.37	11.27	12.18	14.05	16.37	22.11	15.36	16.45	16.93
N_4	7.48	8.47	9.70	11.44	12.25	11.56	10.94	12.17	13.70	16.05	21.38	15.21	16.23	17.00
CD(0.05)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>Growth regulator (G)</u>														
G_1	7.49	8.64	10.17	12.08	13.62	12.53	12.19	12.89	14.94	16.13	21.81	16.64	17.22	18.16
G_2	7.38	8.44	9.78	11.68	13.11	13.23	11.99	13.58	16.05	17.36	23.15	17.30	18.15	19.77
G_3	7.51	8.66	10.08	11.71	12.39	12.29	11.35	12.89	14.85	16.43	21.92	16.91	17.71	18.51
G_4	7.40	8.36	9.71	11.19	11.86	11.23	10.25	11.49	13.37	15.10	21.78	15.06	15.41	16.54
G_5	7.53	8.56	9.99	12.21	12.22	12.28	11.41	12.18	13.67	15.66	21.75	14.49	15.45	16.46
G_6	7.37	8.39	9.76	11.46	12.71	12.42	11.91	11.85	13.66	15.35	21.42	14.57	15.27	16.79
CD(0.05)	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Contd.

Table 4. Continued

Treatments	Month													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
S x N interaction														
S_1N_1	7.05	8.13	9.60	11.00	13.52	14.32	14.52	14.15	16.98	13.58	20.53	18.98	19.13	19.87
S_1N_2	6.97	7.98	8.97	10.40	13.33	13.63	12.12	12.95	15.78	16.82	20.58	17.50	19.35	21.77
S_1N_3	6.88	7.95	9.05	11.25	12.38	13.22	12.32	12.38	15.40	16.67	19.65	15.43	18.81	19.72
S_1N_4	7.28	8.07	9.18	11.08	12.80	12.52	11.87	12.57	14.85	16.45	18.35	16.02	17.17	17.85
S_2N_1	7.37	8.40	10.45	12.28	13.45	12.07	12.30	12.75	16.13	18.02	22.42	18.00	17.88	19.60
S_2N_2	7.38	8.47	10.12	12.65	12.97	12.75	12.80	13.82	15.72	17.90	21.87	17.02	16.62	17.57
S_2N_3	7.82	8.82	10.38	12.33	12.23	12.08	10.90	12.65	14.30	16.97	21.53	17.23	17.82	17.82
S_2N_4	7.45	8.52	9.95	11.78	13.37	12.77	11.90	14.10	15.63	17.52	22.82	17.58	18.73	18.53
S_3N_1	7.90	9.02	10.52	12.75	14.00	14.12	13.55	14.13	17.75	17.53	23.75	18.35	18.57	20.13
S_3N_2	7.10	8.07	9.25	10.88	12.75	12.37	11.60	13.08	15.52	17.27	22.92	16.92	16.11	17.62
S_3N_3	7.60	8.73	9.83	11.10	11.88	12.82	12.22	13.00	15.68	17.82	23.87	15.09	15.05	14.90
S_3N_4	7.35	8.35	9.33	10.30	11.10	11.08	10.70	12.22	14.15	16.82	22.88	14.63	14.62	16.22
S_4N_1	7.70	8.80	10.65	12.55	12.82	11.55	8.32	8.35	8.65	10.57	22.70	9.77	10.62	12.37
S_4N_2	7.40	8.57	10.05	11.67	11.20	10.70	10.22	13.05	15.23	14.73	22.83	14.42	15.45	18.67
S_4N_3	8.08	9.32	10.97	12.90	12.98	11.37	9.67	10.67	10.82	14.02	23.40	13.70	14.63	15.30
S_4N_4	7.82	8.93	10.32	12.58	11.73	9.87	9.28	9.80	10.18	13.40	20.45	12.62	14.42	15.38
CD(0.05)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S x G interaction														
S_1G_1	7.15	8.15	9.30	10.90	13.93	14.60	14.63	14.60	18.88	17.10	19.30	20.92	22.65	22.83
S_1G_2	6.70	7.73	8.95	10.18	12.25	13.78	12.38	12.45	17.03	16.08	21.00	18.50	19.35	21.18
S_1G_3	6.70	7.80	9.05	10.23	12.08	12.28	11.75	12.00	13.70	15.67	18.05	16.32	17.95	19.13
S_1G_4	7.20	7.83	8.75	10.10	12.65	11.83	10.38	12.50	13.25	13.15	18.58	13.48	14.55	14.98

Contd.

Table 4. Continued

Treatments	Month													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
S_1G_5	7.45	8.70	9.90	13.33	13.58	13.70	12.95	12.40	14.55	15.50	19.40	14.13	16.82	17.75
S_1G_6	7.08	8.00	9.25	10.88	13.43	14.35	14.15	14.13	17.13	12.78	22.35	18.55	20.38	22.95
S_2G_1	7.63	8.93	10.92	13.45	14.75	14.30	13.38	15.32	18.05	20.90	25.05	21.58	21.05	23.20
S_2G_2	7.10	8.13	9.55	11.50	14.13	13.85	12.05	15.48	17.78	20.20	24.48	19.92	20.42	21.70
S_2G_3	7.75	8.93	10.10	11.95	12.38	11.38	10.80	13.40	15.00	16.75	22.38	18.00	20.10	18.88
S_2G_4	7.10	8.25	9.95	11.83	12.05	11.18	10.63	12.05	14.90	16.95	22.18	18.10	17.40	19.13
S_2G_5	7.88	8.67	10.40	12.40	11.83	11.75	11.53	13.13	13.50	16.48	21.25	14.57	14.70	14.85
S_2G_6	7.58	8.40	10.43	12.45	12.90	12.05	13.48	10.60	13.45	14.33	17.63	12.58	12.15	12.53
S_3G_1	7.40	8.65	9.88	11.50	12.88	11.70	11.92	11.63	13.80	14.90	21.58	13.28	10.58	12.98
S_3G_2	7.70	8.75	9.92	11.85	13.35	14.30	13.43	15.88	19.38	20.78	25.93	18.97	19.73	21.35
S_3G_3	7.48	8.65	10.38	11.78	12.98	14.08	13.45	15.20	18.22	19.65	25.30	19.13	18.55	20.45
S_3G_4	7.48	8.27	9.40	10.60	11.35	10.80	10.55	11.17	13.70	15.43	22.60	13.95	14.73	15.40
S_3G_5	7.38	8.27	9.25	10.90	11.83	12.90	11.85	12.62	15.58	17.45	23.58	16.75	16.50	17.70
S_3G_6	7.50	8.65	9.58	10.92	12.23	11.80	10.90	12.15	13.98	15.95	22.65	15.40	14.54	15.43
S_4G_1	7.80	8.83	10.60	12.45	12.93	9.50	8.83	10.00	9.05	11.60	21.33	10.80	12.60	13.65
S_4G_2	8.02	9.18	10.70	13.12	12.70	10.98	10.10	10.53	10.03	12.38	21.20	11.80	13.10	14.85
S_4G_3	8.10	9.27	10.78	12.88	12.15	11.43	9.40	10.95	12.48	13.65	21.95	14.20	14.25	15.58
S_4G_4	7.83	9.08	10.73	12.25	11.38	11.10	9.45	10.23	11.63	14.88	23.78	14.70	14.98	16.67
S_4G_5	7.43	8.58	10.40	12.23	11.65	10.75	9.33	10.58	11.05	13.23	22.78	12.50	13.78	15.55
S_4G_6	7.33	8.39	9.77	11.58	12.30	11.48	9.13	10.53	10.10	13.35	23.05	11.75	14.05	16.28
CD(0.05)	-	-	-	-	-	-	-	-	-	4.19	-	-	-	-

Contd.

Table 4. Continued

Treatments	Month													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
N x G interaction														
N_1G_1	8.13	9.30	11.18	13.58	14.68	14.38	13.48	13.05	15.15	16.05	22.63	17.42	18.25	18.65
N_1G_2	7.30	8.70	10.50	12.58	15.08	14.90	14.53	15.70	18.75	16.85	25.08	19.70	20.00	21.70
N_1G_3	7.90	9.05	10.50	12.48	13.40	14.03	13.23	13.45	15.93	15.58	22.95	17.30	17.08	19.48
N_1G_4	7.38	8.17	9.77	11.28	13.03	11.63	9.85	11.23	13.83	13.70	21.58	14.80	14.95	17.58
N_1G_5	7.15	8.13	9.65	11.80	12.65	11.78	10.43	10.40	12.55	13.50	21.00	14.45	14.68	14.88
N_1G_6	7.18	8.17	9.83	11.18	11.85	11.38	11.53	10.25	13.07	13.88	20.88	13.98	14.42	15.67
N_2G_1	7.20	8.18	9.60	10.98	13.95	11.05	11.58	13.17	15.50	15.98	22.83	16.55	18.03	19.00
N_2G_2	6.75	7.68	8.85	10.40	12.42	13.13	11.88	13.50	16.45	18.53	23.05	18.78	18.15	21.50
N_2G_3	7.08	8.30	9.60	11.18	11.68	11.65	11.63	14.43	15.73	17.50	21.83	18.83	18.48	20.35
N_2G_4	7.33	8.20	9.33	10.95	11.10	11.18	10.85	11.08	12.90	15.23	21.45	13.88	14.20	15.58
N_2G_5	7.35	8.43	9.90	12.55	12.53	12.73	11.40	13.78	14.83	16.08	21.00	14.88	16.40	18.53
N_2G_6	7.58	8.85	10.30	12.35	13.55	14.45	12.78	13.40	14.98	16.78	22.15	15.83	16.38	18.48
N_3G_1	7.78	9.05	10.83	13.03	13.68	13.45	12.80	13.48	15.80	16.63	22.90	16.55	16.82	17.10
N_3G_2	7.67	8.78	10.05	12.48	12.45	12.88	10.80	13.03	14.95	17.17	23.18	17.07	18.12	18.40
N_3G_3	7.50	8.75	10.00	11.58	12.63	12.28	10.65	12.55	14.65	16.35	21.95	16.38	16.88	17.58
N_3G_4	7.43	8.50	9.63	10.85	11.95	11.38	10.33	11.48	12.85	15.42	21.63	14.20	15.58	15.60
N_3G_5	7.90	9.02	10.38	12.85	11.80	12.78	12.28	11.20	13.13	16.78	21.83	13.30	15.70	16.15
N_3G_6	7.30	8.13	9.48	10.60	11.73	11.68	10.80	11.33	12.92	15.85	21.20	14.68	15.63	16.78
N_4G_1	6.88	8.02	9.10	10.73	12.18	11.23	10.90	11.85	13.32	15.85	18.90	16.05	15.78	17.90
N_4G_2	7.80	8.63	9.73	11.25	12.48	12.20	10.75	12.10	14.05	16.88	21.30	13.65	16.32	17.48
N_4G_3	7.55	8.55	9.80	11.60	11.88	11.20	9.90	11.13	13.10	16.30	20.95	15.10	18.42	16.63
N_4G_4	7.48	8.55	10.10	11.70	11.35	10.73	9.98	12.18	13.90	16.05	22.48	17.35	16.93	17.42
N_4G_5	7.73	8.65	10.02	11.65	11.90	11.83	11.55	13.35	14.17	16.20	23.18	15.33	15.23	16.30
N_4G_6	7.42	8.40	9.43	11.70	13.73	12.18	12.55	12.42	13.67	14.90	21.45	15.80	14.74	16.25
CD(0.05)	-	-	-	-	-	-	-	-	-	-	-	-	-	-

70 per cent shade + Hoagland solution + 1500 ppm GA ($S_2N_2G_2$) recorded the minimum (9.7 cm), as compared to all the other treatment combinations (Appendix 7).

The plant spread in North-South direction also showed similar trend to that of the spread in East-West direction. Shade levels showed significant influence on the NS spread throughout the experimental period, except in the 6th month. The maximum spread of 19.80 cm was recorded under 80 per cent shade level (S_1). The treatment combination of 80 per cent shade + fertilizer complex + 750 ppm BA ($S_1N_1G_3$) recorded the maximum of 28.7 cm plant spread in NS direction, while 50 per cent shade + Ohio solution + 1500 ppm GA ($S_4N_4G_2$) recorded the minimum (9.8 cm) (Appendix 8). It was found that higher shade intensity and both the concentrations of BA had significantly improved the plant spread in EW and NS directions.

4.1.3 Number of leaves

The number of leaves per plant and the per cent increase in number of leaves in comparison to the earlier month, under the influence of shade, nutrients and growth regulators are presented in Tables 5 and 6, respectively (Fig.3).

The number of leaves produced per plant during the experimental period was significantly influenced by shade. Plants under 80 per cent shade (S_1) had the maximum number of leaves per plant (14.03) which was superior to those under all the other shade levels. None of the nutrients significantly differed with respect to leaf production.

Table 5. Effect of shade, nutrients, growth regulators and their interactions on number of leaves of *A. andreanum* var. 'Hawaiian Red' at monthly interval

Treatments	Month													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
<u>Shade (S)</u>														
S_1	4.56	5.49	6.42	7.22	8.19	9.09	10.10	10.61	12.17	12.52	12.88	11.78	12.31	14.03
S_2	4.59	5.55	6.33	7.23	8.10	7.89	9.52	10.32	12.02	13.43	12.05	11.32	12.42	12.01
S_3	4.78	5.50	6.05	6.76	7.33	6.48	7.60	8.47	9.98	11.52	10.63	9.64	10.07	10.45
S_4	5.51	5.93	6.85	7.08	7.25	7.20	7.70	8.35	8.11	10.11	9.37	9.47	11.54	12.34
CD(0.05)	0.24	0.24	0.27	-	0.61	0.79	0.93	1.04	1.34	1.48	1.38	1.41	1.57	1.70
<u>Nutrient (N)</u>														
N_1	4.92	5.72	6.58	7.10	7.89	7.57	8.71	9.03	9.77	11.03	10.64	10.12	11.16	12.10
N_2	4.78	5.52	6.23	6.83	7.58	7.42	8.98	9.73	10.87	12.05	11.45	10.91	11.72	11.94
N_3	4.87	5.74	6.62	7.31	7.78	7.73	8.48	9.16	10.24	11.84	11.05	10.47	11.52	11.91
N_4	4.88	5.49	6.22	7.05	7.61	7.95	8.74	9.83	11.40	12.66	11.78	10.71	11.95	12.97
CD(0.05)	-	-	0.27	-	-	-	-	-	-	-	-	-	-	-
<u>Growth regulator (G)</u>														
G_1	4.88	5.69	6.39	7.09	7.58	7.44	7.99	9.24	10.46	12.01	11.61	10.91	12.34	12.82
G_2	4.92	5.64	5.53	7.23	7.42	7.29	7.93	8.83	10.01	11.00	10.68	10.01	10.67	11.41
G_3	4.76	5.51	6.41	7.26	7.97	8.15	9.87	10.29	12.07	12.81	12.65	12.09	13.00	14.02
G_4	4.93	5.66	6.33	7.13	8.13	8.68	9.98	10.66	12.21	13.78	12.74	12.08	13.01	13.37
G_5	4.84	5.60	6.31	6.73	7.38	7.20	8.17	8.51	9.36	10.46	9.41	8.87	9.91	10.11
G_6	4.83	5.62	6.50	6.99	7.82	7.23	8.44	9.10	9.33	11.32	10.29	9.36	10.58	11.67
CD(0.05)	-	-	-	-	-	0.97	1.14	1.27	1.65	1.81	1.69	1.72	3.15	2.08

Contd.

Table 5. Continued

Treatments	Month													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
<u>S x N Interaction</u>														
S_1N_1	4.63	5.53	6.48	7.17	8.08	8.68	9.27	9.62	10.27	9.68	10.15	9.38	9.93	10.73
S_1N_2	4.60	5.43	6.30	7.05	8.00	8.58	9.27	9.73	11.15	11.63	12.05	11.25	11.62	12.88
S_1N_3	4.57	5.47	6.50	7.08	7.88	9.10	10.08	10.35	11.95	12.88	13.57	11.98	12.58	14.47
S_1N_4	4.45	5.52	6.42	7.58	8.78	10.00	11.77	12.75	15.33	15.90	15.75	14.52	15.12	18.03
S_2N_1	4.67	5.72	6.72	7.48	8.30	7.95	10.30	10.97	12.55	13.53	13.47	12.63	14.33	14.92
S_2N_2	4.42	5.55	6.08	6.75	7.38	7.25	9.60	10.67	12.83	14.10	12.62	11.67	12.70	10.73
S_2N_3	4.65	5.57	6.45	7.55	8.65	8.37	9.27	9.82	11.42	13.30	10.75	10.53	11.07	11.18
S_2N_4	4.62	5.37	6.05	7.13	8.07	8.00	8.92	9.82	11.28	12.78	11.35	10.45	11.58	11.20
S_3N_1	4.73	5.53	6.25	6.82	7.78	6.42	7.65	8.18	9.37	11.22	10.20	9.55	9.87	10.38
S_3N_2	4.60	5.40	5.93	6.68	7.40	6.65	8.28	8.92	11.10	12.92	11.92	11.27	12.00	12.85
S_3N_3	4.65	5.63	6.28	7.07	7.58	6.60	7.10	7.90	9.12	9.83	10.12	8.98	9.15	9.07
S_3N_4	5.12	5.45	5.72	6.47	6.53	6.23	7.38	8.90	10.35	12.12	10.28	8.77	9.27	9.52
S_4N_1	5.63	6.08	6.88	6.93	7.40	7.23	7.63	7.37	6.92	9.68	8.75	8.90	10.50	12.38
S_4N_2	5.50	5.70	6.58	6.83	7.53	7.18	8.77	9.60	8.38	9.55	9.23	9.47	10.57	11.30
S_4N_3	5.60	6.30	7.25	7.55	7.00	6.83	7.48	8.57	8.48	11.35	9.75	10.40	13.27	12.93
S_4N_4	5.32	5.63	6.68	7.00	7.05	7.55	6.90	7.85	8.65	9.85	9.73	9.12	11.82	13.13
CD(0.05)	-	-	-	-	-	-	-	-	-	2.96	2.76	2.81	3.14	3.40
<u>S x G interaction</u>														
S_1G_1	4.85	5.67	6.50	7.33	7.90	8.52	8.70	9.85	10.80	11.33	11.93	10.30	10.75	11.90
S_1G_2	4.70	5.55	6.52	7.80	8.63	9.73	9.88	10.08	11.33	11.83	12.25	11.67	12.28	13.65
S_1G_3	4.50	5.13	6.38	7.13	8.05	10.13	11.90	12.53	15.95	14.90	16.30	15.85	16.15	18.85
S_1G_4	4.50	5.45	6.05	6.95	8.27	9.73	11.63	12.28	14.05	13.98	14.50	12.83	13.48	14.95

Contd.

Table 5. Continued

Treatments	Month													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
S_1G_5	4.30	5.48	6.40	6.85	8.08	8.35	8.83	8.88	9.90	10.00	10.18	9.50	9.70	11.13
S_1G_6	4.53	5.75	6.70	7.28	8.20	8.10	9.65	10.08	11.03	13.13	12.13	10.55	11.53	13.70
S_2G_1	4.40	5.63	6.28	6.95	7.75	7.33	8.28	9.65	11.50	13.65	12.05	11.65	13.73	12.90
S_2G_2	4.53	5.40	6.25	7.08	7.58	7.60	8.60	9.08	10.75	11.08	9.53	8.10	8.58	8.68
S_2G_3	4.55	5.72	6.60	7.48	8.55	8.85	11.53	11.98	14.13	14.83	13.88	13.33	14.10	14.25
S_2G_4	4.83	5.77	6.55	7.63	9.10	9.43	11.53	11.98	15.28	16.55	14.95	14.38	15.88	14.15
S_2G_5	4.65	5.45	6.25	7.00	7.45	6.95	8.52	8.97	10.08	11.60	10.61	10.25	10.80	10.38
S_2G_6	4.58	5.25	6.03	7.25	8.18	7.20	8.68	10.25	10.40	12.88	11.28	10.23	11.45	11.70
S_3G_1	4.70	5.65	6.08	6.85	7.33	6.40	7.55	8.63	10.70	14.15	12.40	11.13	11.70	12.93
S_3G_2	4.98	5.63	6.25	6.75	6.93	5.55	7.05	8.28	10.83	11.33	10.63	10.60	10.38	10.33
S_3G_3	4.50	5.43	5.93	7.08	8.05	7.58	8.30	9.02	9.98	11.60	11.33	9.98	10.73	10.67
S_3G_4	4.78	5.53	6.10	7.00	7.80	7.48	8.60	9.25	10.57	12.98	11.92	11.23	11.43	11.85
S_3G_5	4.95	5.33	5.75	6.27	6.48	5.47	7.10	7.73	9.08	9.45	8.52	6.67	7.52	7.63
S_3G_6	4.75	5.48	6.18	6.60	7.38	6.38	7.02	7.95	8.75	9.63	8.98	8.25	8.68	9.33
S_4G_1	5.58	5.83	6.73	7.25	7.35	7.50	7.45	8.83	8.83	8.93	10.05	10.58	13.20	13.55
S_4G_2	5.48	5.90	7.10	7.30	6.55	6.28	6.20	7.88	7.15	9.77	10.30	9.67	11.45	13.00
S_4G_3	5.50	5.75	6.75	7.35	7.23	6.05	7.75	7.65	8.23	9.90	9.10	9.23	11.03	12.30
S_4G_4	5.63	5.88	6.60	6.95	7.33	8.10	8.15	9.13	8.93	11.63	9.60	9.90	11.28	12.53
S_4G_5	5.45	6.23	6.83	6.77	7.50	8.03	8.23	8.48	8.40	10.78	8.35	9.05	11.63	11.30
S_4G_6	5.45	6.00	7.10	6.85	7.53	7.25	8.40	8.13	7.13	9.65	8.80	8.40	10.65	11.95
CD(0.05)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>N x G interaction</u>														
N_1G_1	5.28	5.65	6.33	6.88	7.50	7.35	8.05	8.83	9.85	10.60	10.40	10.17	11.00	11.15

Contd.

Table 5. Continued

Treatments	Month													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
N_1G_2	4.85	5.67	6.70	7.38	8.02	7.78	8.92	9.63	9.65	10.08	9.35	9.13	9.95	11.33
N_1G_3	4.63	5.45	6.75	7.48	8.40	8.15	10.58	10.25	11.70	12.23	11.93	11.83	12.98	13.88
N_1G_4	5.03	5.83	6.70	7.28.	8.18	8.25	9.58	10.25	11.13	13.53	13.08	12.00	13.58	14.23
N_1G_5	4.95	5.88	6.53	6.67	7.35	7.10	7.45	7.35	7.95	9.65	8.98	8.40	9.38	10.33
N_1G_6	4.77	5.85	6.50	6.93	7.90	6,80	7.70	7.90	8.38	10.10	10.13	9.17	10.08	11.73
N_2G_1	4.83	5.83	6.58	7.30	8.00	7.50	8.15	9.88	11.58	12.73	12.28	12.00	14.42	14.33
N_2G_2	4.77	5.65	6.33	6.48	6.35	6.52	7.63	8.68	10.35	10.98	10.85	10.02	10.63	11.40
N_2G_3	4.73	5.43	6.18	7.13	7.92	8.05	9.75	10.58	11.73	12.80	12.70	12.23	13.00	12.95
N_2G_4	4.73	5.43	6.05	6.85	8.10	8.27	10.33	10.63	11.92	13.53	12.50	12.48	12.17	12.90
N_2G_5	4.90	5.35	6.00	6.67	7.53	7.08	8.90	8.50	9.58	10.05	9.68	8.95	9.60	9.02
N_2G_6	4.73	5.45	6.23	6.55	7.58	7.08	9.13	10.13	10.05	12.23	10.73	9.80	10.50	11.05
N_3G_1	4.73	5.80	6.70	7.77	8.02	7.75	7.88	9.13	10.05	11.83	11.95	10.85	11.63	12.28
N_3G_2	5.00	5.55	6.65	7.55	7.93	7.63	7.10	8.02	9.33	10.85	10.27	10.05	9.88	10.23
N_3G_3	4.90	5.63	6.58	7.13	7.98	7.80	9.93	9.65	11.58	12.98	12.80	11.80	12.98	13.63
N_3G_4	4.98	5.88	6.50	7.27	8.28	8.88	9.90	10.50	12.00	13.75	12.30	11.93	12.95	13.17
N_3G_5	4.78	5.73	6.58	6.85	6.85	7.15	8.02	8.58	9.42	10.45	9.10	9.00	10.86	10.23
N_3G_6	4.83	5.88	6.73	7.30	7.63	7.15	8.08	9.08	9.08	11.20	9.85	9.23	10.88	11.95
N_4G_1	4.70	5.50	5.98	6.43	6.80	7.15	7.90	9.13	10.35	12.90	11.80	10.63	12.33	13.53
N_4G_2	5.05	5.68	6.45	7.53	7.38	7.23	8.08	8.98	10.73	12.10	12.23	10.85	12.23	12.70
N_4G_3	4.80	5.53	6.15	7.30	7.58	8.60	9.23	10.70	13.28	13.23	13.18	12.53	13.05	15.63
N_4G_4	5.00	5.50	6.05	7.13	7.95	9.33	10.10	11.25	13.78	14.33	13.10	11.92	13.35	13.18
N_4G_5	4.73	5.45	6.13	6.70	7.77	7.48	8.30	9.63	10.50	11.68	9.90	9.13	9.88	10.85
N_4G_6	4.98	5.30	6.55	7.20	8.18	7.90	8.85	9.30	9.80	11.75	10.48	9.23	10.85	11.95
CD(0.05)	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 6. Effect of shade, nutrients, growth regulators and their interactions on per cent increase in leaf production of *A. andreanum* var. 'Hawaiian Red' at the monthly interval

Treatments	Month												
	1	2	3	4	5	6	7	8	9	10	11	12	13
Shade (S)													
S_1	16.79	14.42	10.51	11.62	8.89	7.87	4.13	11.58	2.23	1.97	-9.76	4.03	11.39
S_2	17.09	12.06	12.10	10.22	-4.14	16.44	7.80	12.65	10.80	-13.10	-7.37	7.71	-4.41
S_3	12.86	8.77	10.19	6.55	-14.10	14.25	10.23	14.31	10.90	-7.97	-12.30	4.47	2.31
S_4	6.72	13.30	2.88	1.43	-2.14	4.48	6.95	-4.48	18.69	-8.88	0.59	17.39	6.86
CD(0.05)	5.40	3.59	4.73	6.08	8.85	-	-	7.34	8.88	9.50	7.50	6.84	7.81
Nutrient (N)													
N_1	14.04	12.92	7.04	9.60	-6.72	11.70	2.73	5.33	11.06	-4.30	-6.28	8.90	8.09
N_2	13.12	11.91	8.37	8.90	-3.60	16.73	7.35	7.57	8.78	-5.60	-5.92	6.57	0.17
N_3	15.15	13.20	9.32	4.95	-2.67	7.52	7.78	8.87	13.04	-9.14	-6.05	8.08	2.16
N_4	11.15	11.23	10.96	6.36	1.52	7.09	11.26	12.29	9.73	-8.95	-10.59	10.05	5.73
CD(0.05)	-	-	-	-	-	-	-	-	-	-	-	-	-
Growth regulator (G)													
G_1	14.11	10.73	9.51	5.95	-2.94	6.10	13.25	10.90	11.02	-3.54	-6.96	10.16	3.57
G_2	12.53	13.45	8.61	0.75	-4.80	8.96	10.77	8.34	9.40	-4.12	-7.55	5.42	5.58
G_3	13.37	13.87	11.47	8.12	-0.82	15.63	3.36	13.39	7.11	-2.75	-5.22	7.41	5.43
G_4	12.85	10.46	11.15	11.67	4.26	10.96	6.11	11.02	11.61	-9.63	-4.98	6.33	1.28
G_5	13.53	10.94	6.22	7.97	-4.19	11.38	3.63	8.14	9.10	-11.80	-8.28	9.89	0.67
G_6	13.81	13.39	6.58	10.28	-8.72	13.53	6.56	-0.69	15.69	-10.13	-10.28	11.19	7.70
CD(0.05)	-	-	-	-	-	-	-	-	-	-	-	-	-

Contd.

Table 6. Continued

Treatments	Month													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
S x N interaction														
S_1N_1	16.39	14.30	9.44	11.05	6.06	5.21	3.27	5.10	-5.86	2.99	-9.36	5.80	7.64	
S_1N_2	15.08	13.77	10.60	11.57	6.19	6.38	4.09	12.08	3.47	3.07	-7.43	2.43	9.81	
S_1N_3	16.42	15.73	8.18	10.01	13.01	5.52	2.87	12.64	7.27	5.27	-13.88	4.51	13.08	
S_1N_4	19.28	13.88	13.83	13.84	10.31	14.35	6.28	16.49	4.03	-3.45	-8.39	3.36	15.02	
S_2N_1	18.35	14.50	10.16	9.25	-5.51	21.69	6.28	11.21	7.79	-0.62	-7.30	10.92	4.20	
S_2N_2	19.91	8.78	9.46	8.26	3.86	24.34	10.02	16.87	8.94	-12.73	-9.72	5.50	-18.51	
S_2N_3	16.22	13.67	14.40	12.03	-4.70	9.56	5.50	12.40	14.19	-25.41	-2.52	4.55	1.02	
S_2N_4	13.89	11.31	14.39	11.34	-2.48	10.17	9.42	10.11	12.27	-13.66	-9.95	9.87	-4.36	
S_3N_1	14.20	11.42	8.09	12.20	-23.05	15.09	6.33	12.65	14.91	-9.21	-9.45	3.86	5.30	
S_3N_2	14.20	8.86	10.65	6.99	-11.70	19.72	7.40	19.18	11.67	-8.05	-8.10	6.87	4.10	
S_3N_3	16.96	10.36	11.01	6.35	-15.59	6.92	10.27	12.29	5.87	-1.77	-13.87	2.39	-2.56	
S_3N_4	6.08	4.42	11.02	0.66	-6.06	15.29	16.94	13.11	11.15	-16.31	-17.78	4.76	2.41	
S_4N_1	7.22	11.45	0.47	5.92	-4.39	4.79	-4.94	-7.63	27.42	-10.28	1.00	15.02	15.23	
S_4N_2	3.30	13.42	2.76	8.79	-5.05	16.50	7.89	-17.86	11.04	-4.69	1.57	11.47	5.29	
S_4N_3	11.02	13.05	3.67	-8.59	-3.40	8.06	12.48	-1.87	24.84	-18.17	6.05	20.87	-2.89	
S_4N_4	5.33	15.30	4.62	-0.40	4.30	-11.44	12.38	9.45	11.46	-2.30	-6.26	22.22	9.84	
CD(0.05)	-	-	-	-	-	-	-	-	-	-	-	-	-	
S x G interaction														
S_1G_1	14.48	12.48	11.15	7.13	6.86	0.36	11.78	8.89	3.31	4.00	-16.47	3.91	10.07	
S_1G_2	15.18	14.97	14.40	10.09	11.33	-2.58	2.44	9.27	3.18	2.75	-5.44	5.52	10.72	
S_1G_3	11.99	19.47	10.45	11.17	19.31	14.66	3.83	21.41	-6.96	8.17	-2.04	1.50	12.59	
S_1G_4	17.43	9.89	12.96	15.95	14.31	15.59	2.90	13.12	-1.56	3.30	-12.37	2.86	8.43	

Contd.

Table 6. Continued

Treatments	Month													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
S_1G_5	20.43	15.57	6.53	14.40	3.12	3.99	0.06	8.98	1.39	1.93	-6.78	1.81	11.89	
S_1G_6	21.23	14.13	7.58	10.97	-1.55	15.18	3.75	7.81	13.99	-8.32	-15.49	8.56	14.61	
S_2G_1	21.71	10.36	8.87	10.77	-5.89	11.53	14.11	15.88	16.01	-15.27	-3.30	12.40	-6.63	
S_2G_2	16.74	12.07	11.00	5.74	-2.25	11.68	5.16	13.38	3.50	-16.44	-17.78	5.30	0.50	
S_2G_3	20.55	13.11	11.37	12.37	3.03	22.51	3.66	14.65	5.01	-6.86	-4.63	4.30	-0.15	
S_2G_4	16.62	11.38	13.90	16.14	0.96	18.15	3.68	21.47	7.69	-11.71	-3.67	8.71	-15.43	
S_2G_5	14.39	12.75	10.68	5.75	-7.15	18.31	4.93	10.49	13.03	-10.38	-4.15	5.18	-5.51	
S_2G_6	12.54	12.72	16.79	11.16	-13.82	16.46	15.23	0.01	19.53	-17.96	-10.38	10.38	-0.76	
S_3G_1	16.03	6.83	11.05	5.59	-14.35	13.81	12.46	18.90	23.68	-13.91	-12.58	4.85	8.19	
S_3G_2	11.31	9.84	6.86	-0.60	-23.61	20.30	15.19	23.40	4.30	-6.55	-1.01	-3.55	1.10	
S_3G_3	16.74	8.28	16.10	10.77	-6.19	7.59	7.90	9.72	13.11	-3.08	-14.82	7.05	-0.87	
S_3G_4	13.48	9.42	12.79	10.12	-5.47	12.52	7.32	11.20	18.51	-9.98	-6.18	1.68	1.95	
S_3G_5	7.05	6.79	8.43	2.96	-18.91	22.59	7.02	14.32	2.07	-9.71	-28.93	11.33	-0.82	
S_3G_6	12.55	11.43	5.94	10.46	-16.09	8.75	11.52	8.31	3.73	-4.59	-10.28	5.43	6.50	
S_4G_1	4.21	13.24	6.96	0.92	1.60	-1.30	14.64	-0.08	1.08	11.02	4.50	19.49	2.64	
S_4G_2	6.88	16.91	2.18	-12.21	-4.97	-1.56	20.28	-12.72	26.61	3.76	-5.95	14.39	12.22	
S_4G_3	4.19	14.62	7.96	-1.84	-19.43	17.77	-1.97	7.80	17.26	-9.24	0.62	16.78	10.13	
S_4G_4	3.87	11.14	2.94	4.45	7.22	-2.45	10.56	-1.72	21.79	-20.12	2.59	12.08	10.16	
S_4G_5	12.26	8.63	-0.75	8.75	6.18	0.67	2.46	-1.24	19.89	-29.05	6.75	21.25	-2.89	
S_4G_6	8.91	15.29	-4.00	8.52	-3.72	13.74	-4.26	-18.90	25.50	-9.64	-4.97	20.37	8.93	
CD(0.05)	-	-	-	-	-	-	-	-	-	-	-	-	-	
N x G interaction														
N_1G_1	6.31	10.65	7.98	7.66	-3.19	7.27	8.82	9.47	6.34	-2.40	-3.43	7.71	1.93	

Contd.

Table 6. Continued

Treatments	Month													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
N_1G_2	14.69	15.18	8.78	7.63	-6.50	12.62	6.50	-3.27	4.50	-7.48	-2.32	8.59	12.18
N_1G_3	15.09	12.18	9.64	10.80	-5.20	22.31	-5.60	10.47	5.42	-2.58	-1.59	8.94	7.33
N_1G_4	14.07	18.79	8.01	10.29	-1.42	12.46	6.79	5.23	18.64	-5.72	-8.77	9.45	5.28
N_1G_5	15.67	9.96	2.06	8.91	-7.47	4.29	-1.59	7.32	14.18	-6.96	-10.24	10.01	9.30
N_1G_6	18.41	9.74	5.78	12.34	-16.56	11.21	1.49	2.76	17.30	-0.66	-11.21	9.16	12.52
N_2G_1	17.15	11.28	9.73	8.67	-7.98	7.06	17.37	13.30	5.93	-2.30	-2.79	14.98	-2.57
N_2G_2	14.95	10.50	2.16	-4.05	-0.45	14.08	12.54	12.08	6.45	-1.64	-9.75	5.31	4.20
N_2G_3	12.61	12.19	12.83	9.25	-1.41	16.77	7.92	8.68	8.87	-1.26	-4.22	6.33	-1.78
N_2G_4	12.72	10.31	11.33	15.42	1.90	19.43	1.99	9.87	9.94	-9.91	0.52	-3.07	5.30
N_2G_5	8.51	10.32	10.18	11.06	-6.59	20.48	-4.74	9.77	3.58	-4.68	-10.61	8.38	-8.12
N_2G_6	12.82	12.63	3.98	13.07	-7.10	22.59	9.03	-7.99	17.90	-13.80	-8.66	7.52	3.99
N_3G_1	18.52	13.23	13.78	2.98	-5.52	1.58	13.43	8.79	15.01	0.60	-10.69	4.13	6.11
N_3G_2	9.72	16.63	11.77	1.96	-6.30	-7.70	11.45	9.92	14.60	-5.59	-3.57	-3.00	3.61
N_3G_3	12.83	14.27	7.76	9.99	-3.34	20.52	-2.84	15.82	11.20	-3.05	-8.61	9.55	3.95
N_3G_4	15.36	9.68	10.62	11.25	4.12	10.25	6.32	11.63	13.10	-13.41	-2.77	8.33	0.38
N_3G_5	16.54	12.90	4.15	-0.47	2.52	10.01	7.06	8.58	8.55	-17.67	-3.36	14.84	7.42
N_3G_6	17.94	12.50	7.82	3.99	-7.51	10.44	11.24	-1.53	15.83	-15.70	-7.22	14.61	6.35
N_4G_1	14.46	7.76	6.54	4.49	4.91	8.49	13.36	12.02	16.80	-10.05	-10.84	13.83	8.79
N_4G_2	10.75	11.47	11.73	-2.52	-5.95	8.84	12.58	14.60	12.04	-1.77	-14.55	10.77	2.35
N_4G_3	12.95	9.84	15.65	2.43	6.67	2.93	13.94	18.90	2.92	-4.11	-6.43	5.25	12.20
N_4G_4	9.25	9.04	14.63	9.70	12.43	1.68	9.35	17.33	4.76	-9.47	-8.91	10.61	-5.85
N_4G_5	13.41	10.57	8.50	12.36	-5.21	10.73	13.82	6.88	10.08	-17.90	-8.90	6.39	8.91
N_4G_6	6.06	18.69	8.74	11.70	-3.73	9.90	4.49	3.99	11.76	-10.37	-13.93	13.46	7.94
CD(0.05)	-	-	-	-	-	-	-	-	-	-	-	-	-

Growth regulator treatments had shown significant differences after the first five months of the experiment. Plants sprayed with BA 750 ppm (G_3) had the maximum mean number of leaves per plant (14.02) at the final stage.

Among the three interactions (S x N, S x G and N x G), shade x nutrient interaction has shown significant influence on mean number of leaves produced per plant in the last five month-period of the experiment. The combination of 80 per cent shade with Ohio solution (S_1N_4) produced the maximum number of leaves per plant (18.03) which was significantly superior to all the other treatments. The treatment combination of 80 per cent shade + Ohio solution + 750 ppm BA ($S_1N_4G_3$) produced the maximum (26.20) and the controll under 50 per cent shade ($S_4N_0G_0$) recorded the minimum (5.4) mean number of leaves (Appendix 9).

The per cent increase in number of leaves over the previous month was significantly influenced throughout the experimental period by shade levels, with the exception of 7th and 8th months. The maximum per cent increase in leaf production was during the period from 3rd to 9th month. Nutrients, growth regulators and their interactions had no significant influence on per cent increase in leaf production.

4.1.4 Petiole length

Data on the mean petiole length as influenced by shade, nutrients, growth regulators and their interactions are presented in Table 7 and Fig.1.

The mean petiole length was significantly different under the four shade levels during the experimental period with the exception of 4th and 5th months. At the final stage of the experiment, the highest shade intensity (S_1, 80%) produced the maximum mean petiole length (9.29 cm) which was significantly superior to that

Table 7. Effect of shade, nutrients, growth regulators and their interactions on petiole length (cm) of *A. andreanum* var. 'Hawaiian Red' at monthly interval

Treatments	Month													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
<u>Shade (S)</u>														
S_1	4.54	5.09	4.59	5.08	5.45	5.51	6.17	6.42	7.32	8.42	8.67	8.20	8.94	9.29
S_2	4.86	5.58	4.79	4.93	5.30	5.19	5.64	6.27	6.90	8.58	9.14	8.41	8.46	8.65
S_3	4.98	5.67	5.47	5.27	5.43	5.42	5.84	6.30	6.95	8.13	8.81	8.07	7.97	8.57
S_4	5.36	6.04	5.83	5.05	5.50	4.72	4.41	4.70	4.70	6.62	7.10	5.76	6.10	6.85
CD(0.05)	0.46	0.42	0.39	-	-	0.44	0.56	0.68	0.64	0.72	0.82	0.84	0.91	0.93
<u>Nutrient (N)</u>														
N_1	5.10	5.68	5.37	5.51	5.71	5.36	5.55	5.81	6.62	5.10	8.23	7.54	7.82	8.33
N_2	4.95	5.59	4.92	5.00	5.20	5.10	5.67	6.02	6.78	7.65	8.64	7.82	8.14	8.60
N_3	5.02	5.72	5.54	5.25	5.69	5.30	5.48	5.99	6.36	6.68	8.36	7.48	7.72	8.06
N_4	4.67	5.39	4.85	4.66	5.08	5.08	5.35	5.87	6.11	7.03	8.50	7.60	7.78	8.41
CD(0.05)	-	-	0.39	0.45	-	-	-	-	-	-	-	-	-	-
<u>Growth regulator (G)</u>														
G_1	4.94	5.81	5.21	5.23	5.26	5.02	4.93	4.90	5.26	6.89	7.51	6.32	6.52	7.12
G_2	5.17	5.83	5.48	5.50	5.76	5.59	5.51	5.19	5.66	7.24	7.43	6.48	6.56	6.66
G_3	4.83	5.40	5.22	5.31	5.68	5.48	6.03	6.71	7.38	9.04	9.83	9.24	9.49	10.19
G_4	4.94	5.55	5.16	5.16	5.56	5.41	5.77	6.56	7.45	9.14	9.62	8.77	9.26	9.66
G_5	4.88	5.51	4.93	4.53	5.18	4.98	5.51	6.06	6.52	7.73	8.06	7.39	7.51	7.98
G_6	4.86	5.47	5.01	4.89	5.09	4.77	5.34	6.12	6.54	7.58	8.13	7.44	7.84	8.43
CD(0.05)	-	-	-	0.55	-	0.54	-	0.84	0.79	0.88	1.00	1.03	1.11	1.14

Contd.

Table 7. Continued

Treatments	Month													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
S x N interaction														
S_1N_1	4.83	5.48	5.38	6.03	6.28	6.38	7.27	6.93	8.65	9.20	8.92	8.48	9.00	9.05
S_1N_2	4.68	5.18	4.45	4.80	5.43	5.52	6.17	6.22	7.32	8.58	9.13	8.15	9.05	9.70
S_1N_3	4.20	4.77	4.47	5.18	5.15	5.00	5.77	6.07	6.53	7.58	7.98	7.75	8.35	8.63
S_1N_4	4.45	4.92	4.07	4.32	4.95	5.13	5.48	6.48	6.78	8.30	8.65	8.42	9.35	9.78
S_2N_1	5.05	5.60	4.77	5.27	5.40	5.13	5.70	6.18	7.13	8.78	9.65	8.47	8.98	9.58
S_2N_2	4.80	5.25	4.40	4.70	4.83	4.95	5.32	5.80	6.65	8.55	8.68	7.92	7.68	7.78
S_2N_3	5.12	5.82	5.23	4.78	5.90	5.48	5.78	6.70	7.23	8.82	8.82	8.90	8.67	8.67
S_2N_4	4.48	5.63	4.75	4.98	5.07	5.20	5.75	6.38	6.60	8.15	9.40	8.35	8.50	8.55
S_3N_1	5.32	5.82	5.83	5.95	5.82	5.90	5.85	6.43	7.02	8.45	8.88	8.63	8.63	9.47
S_3N_2	4.83	5.43	5.07	5.17	5.33	5.28	6.02	6.40	7.28	8.17	8.82	8.55	8.78	9.00
S_3N_3	5.37	6.32	6.13	5.57	5.77	5.55	6.07	6.47	6.98	7.77	9.22	7.27	7.30	7.63
S_3N_4	4.42	5.13	4.83	4.38	4.80	4.93	5.42	5.90	6.52	8.15	8.33	7.82	7.15	8.18
S_4N_1	5.22	5.82	5.48	4.78	5.35	4.03	3.38	3.70	3.68	5.10	5.47	4.57	4.65	5.22
S_4N_2	5.48	6.50	5.75	5.32	5.22	4.63	5.18	5.67	5.85	7.65	7.92	6.65	7.05	7.90
S_4N_3	5.40	5.98	6.33	5.45	5.93	5.15	4.32	4.72	4.70	6.68	7.42	6.02	6.57	7.18
S_4N_4	5.33	5.87	5.73	4.95	5.50	5.07	4.75	4.72	4.55	7.03	7.60	5.80	6.13	7.12
CD(0.05)	-	-	-	-	-	0.89	1.13	-	1.29	-	-	-	-	-
S x G interaction														
S_1G_1	4.43	5.03	4.65	5.25	5.10	5.08	5.52	5.08	5.63	7.08	7.58	6.15	6.45	7.03
S_1G_2	4.88	5.48	4.88	5.80	5.93	6.25	6.35	6.27	7.00	8.23	7.95	7.45	7.98	7.98
S_1G_3	4.40	4.90	4.60	5.25	5.85	5.68	6.55	6.85	8.33	9.85	10.28	10.27	10.88	11.80
S_1G_4	4.68	5.17	4.53	5.55	5.80	5.75	6.68	7.20	8.42	9.45	9.90	9.60	10.78	10.93

Contd.

Table 7. Continued

Treatments	Month													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
S_1G_5	4.55	5.13	4.30	4.20	5.20	5.52	6.43	6.83	7.63	8.47	8.63	8.38	9.35	9.27
S_1G_6	4.33	4.83	4.60	4.45	4.85	4.77	5.50	6.33	6.93	7.42	7.70	7.35	8.20	8.75
S_2G_1	3.88	5.25	4.58	5.05	5.00	5.00	5.05	5.13	5.50	7.58	7.83	6.80	7.05	7.28
S_2G_2	5.25	5.95	5.30	5.50	5.58	5.55	5.58	5.38	5.53	7.38	7.13	7.15	6.33	6.15
S_2G_3	5.05	5.50	4.88	5.40	5.70	5.75	6.53	7.63	8.43	10.08	11.05	10.75	10.83	10.88
S_2G_4	5.08	5.60	4.95	4.43	5.68	5.35	5.68	6.73	7.90	9.95	10.38	9.52	9.88	10.10
S_2G_5	4.70	5.45	4.65	4.30	5.15	4.93	5.75	6.68	7.08	8.35	9.28	8.25	7.98	8.58
S_2G_6	5.23	5.70	4.38	4.93	4.70	4.58	5.25	6.08	7.00	8.13	9.17	7.97	8.70	8.90
S_3G_1	5.45	6.22	5.60	5.68	5.68	5.58	5.25	5.33	5.98	6.85	7.88	6.75	7.03	7.77
S_3G_2	5.18	5.93	5.78	5.48	5.63	5.48	5.50	5.00	5.55	6.93	7.63	6.48	6.43	6.43
S_3G_3	4.85	5.50	5.78	5.40	5.80	5.95	6.55	7.48	8.10	9.45	10.60	10.08	10.00	11.08
S_3G_4	5.00	5.68	5.35	5.60	5.48	5.90	6.33	7.30	8.20	9.93	10.13	9.27	9.40	9.52
S_3G_5	4.63	5.25	5.93	4.30	4.73	4.45	5.25	5.60	6.58	7.25	7.78	7.35	6.88	7.53
S_3G_6	4.80	5.48	5.38	5.15	5.27	5.15	6.15	7.10	7.30	8.40	8.88	8.48	8.08	9.10
S_4G_1	6.03	6.75	6.63	4.95	5.28	4.43	3.90	4.07	3.95	6.08	6.77	5.58	5.58	6.40
S_4G_2	5.38	5.98	5.98	5.23	5.92	5.08	4.60	4.10	4.55	6.43	7.03	4.83	5.53	6.10
S_4G_3	5.03	5.70	5.62	5.18	5.35	4.55	4.48	4.88	4.68	6.78	7.40	5.88	6.28	7.00
S_4G_4	5.03	5.75	5.83	5.05	5.30	4.65	4.40	5.02	5.27	7.23	8.08	6.70	7.00	8.10
S_4G_5	5.63	6.20	5.83	5.30	5.65	5.03	4.60	5.15	4.80	6.83	6.55	5.60	5.84	6.55
S_4G_6	5.08	5.88	5.68	5.05	5.53	4.60	4.48	4.98	4.93	6.38	6.77	5.98	6.83	6.98
CD(0.05)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
N x G interaction														
N_1G_1	5.00	5.55	5.48	5.55	5.40	4.95	4.95	4.67	5.33	6.50	6.78	5.60	5.83	6.52

Contd.

Table 7. Continued

Treatments	Month													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
N_1G_2	5.25	5.85	5.80	5.95	6.33	5.68	5.70	5.80	6.10	7.55	7.50	6.88	6.55	6.95
N_1G_3	5.02	5.55	5.85	6.23	6.35	5.80	6.10	6.55	7.55	9.10	9.63	9.33	9.53	10.95
N_1G_4	5.25	5.88	5.40	5.70	5.90	5.63	5.15	5.90	7.23	8.75	9.27	8.63	9.25	9.50
N_1G_5	5.08	5.63	4.70	4.53	5.17	5.20	5.60	5.95	6.75	7.65	8.08	7.63	7.77	8.10
N_1G_6	5.03	5.63	4.98	5.10	5.13	4.93	5.80	6.00	6.78	7.75	8.13	7.17	7.98	7.95
N_2G_1	5.55	6.27	5.03	5.30	5.35	4.98	5.03	4.88	5.60	7.23	7.93	6.60	6.75	7.53
N_2G_2	5.23	5.90	5.25	5.05	5.33	5.45	5.48	5.08	5.73	7.45	7.23	6.53	6.60	7.02
N_2G_3	4.70	5.30	4.75	4.88	5.35	5.55	6.60	7.45	8.00	9.78	10.50	9.68	10.53	10.65
N_2G_4	4.88	5.58	4.90	4.93	5.33	5.35	6.15	6.73	7.53	9.50	9.48	8.95	9.38	9.93
N_2G_5	4.88	5.38	4.95	4.70	4.83	4.65	5.45	5.83	6.83	7.55	8.00	6.98	7.33	7.55
N_2G_6	4.48	5.13	4.63	5.13	5.05	4.60	5.33	6.18	6.98	7.92	8.70	8.10	8.27	8.90
N_3G_1	5.15	6.20	5.77	5.48	5.83	5.55	5.30	5.20	5.48	7.05	8.13	7.00	6.85	7.27
N_3G_2	5.33	5.90	6.00	6.23	6.02	5.88	5.77	5.00	5.68	6.85	7.48	6.43	6.58	6.27
N_3G_3	4.85	5.60	5.68	5.55	5.95	5.60	6.33	6.83	7.70	9.25	10.45	9.45	10.02	10.25
N_3G_4	4.75	5.27	5.35	5.08	5.70	5.28	5.55	6.97	7.45	8.63	9.25	8.38	8.68	8.98
N_3G_5	4.85	5.50	5.10	4.43	5.30	4.95	5.39	6.25	6.25	7.28	7.70	7.43	7.23	7.88
N_3G_6	5.20	5.85	5.35	4.73	5.33	4.52	4.58	5.68	5.63	7.23	7.15	6.23	6.98	7.53
N_4G_1	4.07	5.23	4.58	4.60	4.48	4.60	4.45	4.85	4.65	6.80	7.23	6.08	6.68	7.15
N_4G_2	4.88	5.68	4.88	4.78	5.38	5.35	5.08	4.88	5.13	7.10	7.53	6.88	6.53	6.40
N_4G_3	4.75	5.15	4.60	4.58	5.05	4.98	5.08	6.00	6.28	8.02	8.75	8.52	7.90	8.90
N_4G_4	4.90	5.48	5.00	4.93	5.33	5.40	6.23	6.65	7.60	9.68	10.48	9.15	9.75	10.25
N_4G_5	4.70	5.53	4.95	4.45	5.40	5.13	5.60	6.23	6.25	8.42	8.45	7.55	7.73	8.40
N_4G_6	4.73	5.27	5.07	4.63	4.85	5.05	5.68	6.63	6.77	7.43	8.55	8.20	8.13	9.35
CD(0.05)	-	-	-	-	-	-	-	-	-	-	-	-	-	-

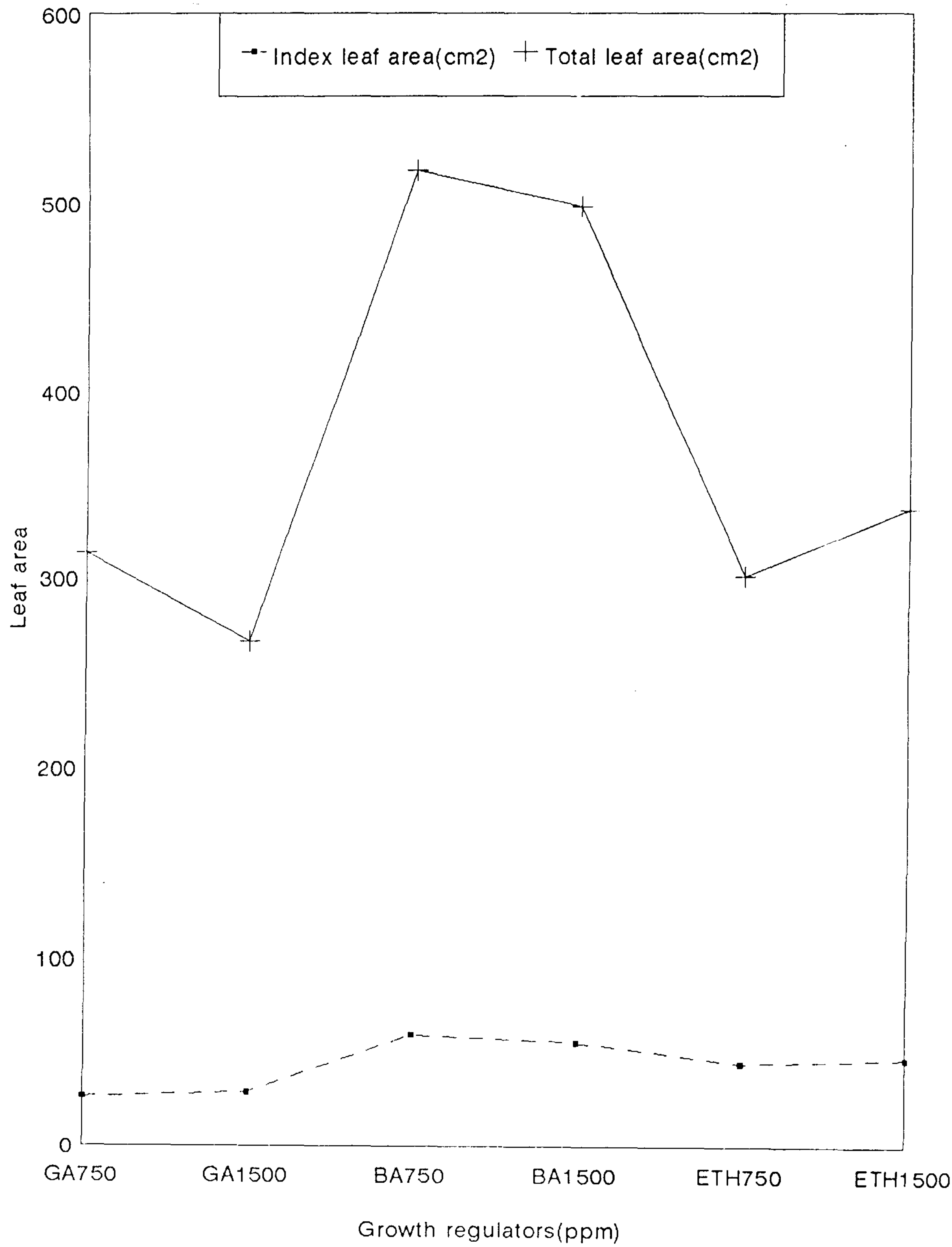


Fig.3. Effect of growth regulators on leaf area in *A. andreanum* 'Hawaiian Red'

under 50 per cent shade level, and was on par with those of 70 and 60 per cent shade levels.

There was no significant difference among the nutrients during the experiment period with the exception of 3rd and 4th months. Hoagland solution (N_2) was found to be the best with respect to petiole length (8.60 cm).

Growth regulators had significant influence on petiole length. BA 750 ppm (G_3) was significantly superior to all other treatments with the petiole length of 10.79 cm (Fig.2).

The interactions (S x G and N x G) had no significant effect at the final stage of the experiment, but, shade x nutrient (S x N) had significant influence in 7th, 8th and 10th months. The treatment combination of 80 per cent shade + Ohio solution + 1500 ppm BA ($S_1N_4G_4$) had the maximum influence (14.0cm) on mean petiole length while 50 per cent shade + fertilizer complex + 1500 ppm Ethephon ($S_4N_1G_6$) recorded the minimum (4.6 cm) (Appendix 10).

4.1.5 Leaf length and breadth

Data recorded on the effect of shade, nutrients and growth regulators on leaf length and breadth are presented in Tables 8 and 9, respectively (Fig.1 and 2).

Leaf length

Shade levels significantly influenced leaf length throughout the period of the experiment. With the decrease in shade intensity, the mean leaf length also decreased significantly. The maximum leaf length (7.76 cm) was recorded under 80 per cent shade (S_1) which was significantly superior to that under 50 per cent and

Table 8. Effect of shade, nutrients, growth regulators and their interactions on leaf length (cm) of *A. andreanum* var. 'Hawaiian Red' at monthly interval

Treatments	Month													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Shade (S)														
S_1	3.71	4.23	3.88	5.19	5.78	5.30	5.58	6.60	6.44	7.82	7.92	7.44	7.61	7.75
S_2	3.71	4.47	4.13	6.77	5.08	5.20	5.10	6.61	6.34	7.57	8.03	7.62	7.54	7.28
S_3	3.89	4.45	4.20	4.89	5.75	5.03	5.20	5.47	6.43	7.70	8.20	7.22	7.28	7.20
S_4	4.26	4.48	4.29	4.85	5.50	4.48	4.14	4.55	4.54	5.55	6.08	5.09	5.49	6.15
CD(0.05)	0.29	0.22	0.23	-	0.42	0.43	0.40	0.54	0.57	0.66	0.74	0.76	0.71	0.75
Nutrient (N)														
N_1	4.08	4.54	4.20	5.20	5.69	5.10	5.08	5.93	6.26	7.20	7.58	7.02	7.07	7.23
N_2	3.82	4.28	4.02	4.85	5.37	4.97	5.07	5.92	6.02	7.44	7.86	7.05	7.17	7.33
N_3	3.92	4.65	4.28	5.15	5.57	4.99	5.16	5.86	5.82	6.98	7.28	6.73	6.81	6.87
N_4	3.75	4.17	4.00	6.50	5.49	4.95	4.72	5.52	5.65	7.03	7.51	6.57	6.88	6.95
CD(0.05)	-	0.22	-	-	-	-	-	-	-	-	-	-	-	-
Growth regulator (G)														
G_1	3.87	4.38	4.08	4.81	5.41	4.58	4.54	4.97	5.03	5.88	6.48	5.70	5.69	5.78
G_2	3.84	4.50	4.21	5.12	5.26	4.89	4.72	5.19	5.29	6.23	6.41	5.65	5.79	5.84
G_3	3.78	4.53	4.21	6.50	6.01	5.51	5.56	6.51	6.68	8.31	8.83	8.24	8.23	8.33
G_4	3.98	4.39	4.19	6.41	5.74	5.37	5.37	6.36	6.71	8.14	8.58	7.86	8.14	8.18
G_5	3.95	4.28	4.05	4.89	5.41	4.91	4.92	6.01	6.04	7.09	7.71	6.86	6.89	7.24
G_6	3.93	4.38	4.00	4.89	5.34	4.76	4.92	5.81	5.89	7.33	7.37	6.74	7.15	7.22
CD(0.05)	-	-	-	-	0.84	0.53	0.49	0.66	0.69	0.81	0.91	0.93	0.86	0.92

Contd.

Table 8. Continued

Treatments	Month													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
<u>S x N interaction</u>														
S_1N_1	3.73	4.57	4.22	5.77	6.28	5.82	6.10	7.08	7.23	8.35	8.40	7.98	7.82	7.82
S_1N_2	3.52	4.12	3.80	4.75	5.70	5.22	5.52	6.58	6.43	8.13	7.98	7.70	7.77	8.17
S_1N_3	3.92	4.27	3.82	5.12	5.50	5.10	5.72	6.12	6.12	7.00	7.45	7.08	7.10	7.38
S_1N_4	3.67	3.95	3.67	5.13	5.65	5.07	5.00	6.62	5.98	7.80	7.87	7.00	7.77	7.65
S_2N_1	4.03	4.50	4.08	5.35	5.28	5.28	5.30	7.20	6.82	8.18	8.75	8.23	7.98	7.90
S_2N_2	3.67	4.33	3.87	4.88	4.37	5.10	4.92	6.37	6.00	7.23	7.92	7.07	6.93	6.57
S_2N_3	3.63	4.60	4.35	5.38	5.07	5.17	5.23	7.05	6.27	7.50	7.72	7.68	7.77	7.55
S_2N_4	3.50	4.45	4.20	11.47	5.58	5.17	4.97	5.83	6.28	7.35	7.75	7.48	7.53	7.10
S_3N_1	4.07	4.58	4.23	5.27	6.13	5.20	5.28	5.68	6.95	7.70	8.38	7.62	7.65	7.88
S_3N_2	3.80	4.38	4.18	4.90	5.63	5.15	5.33	5.40	6.45	7.90	8.37	7.60	7.72	7.57
S_3N_3	3.78	4.83	4.40	5.02	6.22	4.98	5.47	5.60	6.30	7.68	7.97	6.88	6.85	6.46
S_3N_4	3.92	4.02	3.98	4.38	5.03	4.80	4.70	5.18	6.03	7.52	8.08	6.78	6.90	6.97
S_4N_1	4.47	4.52	4.25	4.43	5.05	4.02	3.63	3.75	4.05	4.57	4.80	4.25	4.84	5.33
S_4N_2	4.28	4.28	4.22	4.85	5.78	4.42	4.50	5.33	5.20	6.48	7.18	5.85	6.25	7.03
S_4N_3	4.35	4.88	4.53	5.10	5.48	4.70	4.23	4.67	4.60	5.72	6.00	5.25	5.58	6.13
S_4N_4	3.93	4.25	4.17	5.03	5.70	4.77	4.20	4.43	4.32	5.45	6.35	5.00	5.32	6.08
CD(0.05)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>S x G interaction</u>														
S_1G_1	3.40	4.18	3.75	4.90	5.33	4.40	4.80	5.38	5.05	6.35	6.48	5.60	5.78	5.83
S_1G_2	3.73	4.45	3.98	5.23	5.77	5.43	5.43	6.23	6.13	7.00	7.15	6.58	6.75	6.58
S_1G_3	3.77	4.33	3.98	5.55	6.30	5.98	6.13	7.63	7.23	9.03	9.55	9.23	9.05	9.40
S_2G_4	3.93	4.23	3.87	5.25	6.03	5.83	6.08	7.20	7.43	8.70	9.20	8.43	9.02	8.83

Contd.

Table 8. Continued

Treatments	Month													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
S_1G_5	3.70	3.98	3.88	5.43	5.68	5.45	5.70	6.98	6.75	7.92	8.43	8.18	7.83	8.50
S_1G_6	3.73	4.20	3.80	4.80	5.60	4.73	5.38	6.20	6.08	7.93	6.75	6.65	7.25	7.40
S_2G_1	3.50	4.23	3.93	4.75	4.80	4.55	4.58	5.85	5.25	5.93	6.60	6.15	5.87	5.88
S_2G_2	3.53	4.55	4.00	5.55	4.88	5.10	4.45	5.75	5.35	6.58	6.38	5.83	5.88	5.28
S_2G_3	3.48	4.68	4.15	10.30	5.75	5.83	5.98	7.38	7.45	9.02	9.70	9.08	9.15	8.93
S_2G_4	4.00	4.75	4.43	10.15	5.17	5.65	5.45	7.15	7.13	8.75	8.95	8.88	8.50	8.33
S_2G_5	3.90	4.25	4.25	4.95	5.08	5.08	5.23	6.93	6.53	7.55	8.50	7.83	7.78	7.55
S_2G_6	3.85	4.38	4.00	4.93	4.78	5.03	4.95	6.63	6.35	7.58	8.08	7.95	8.08	7.73
S_3G_1	4.03	4.65	4.33	4.90	5.78	4.90	4.70	4.68	5.63	6.33	7.05	6.10	5.88	5.90
S_3G_2	3.98	4.53	4.28	4.63	5.22	4.53	4.63	4.35	5.23	6.08	6.48	5.75	5.65	5.52
S_3G_3	3.60	4.55	4.40	5.28	6.20	5.38	6.00	6.23	7.40	9.45	9.85	9.13	8.93	8.83
S_3G_4	3.73	4.35	4.27	5.30	6.13	5.52	5.88	6.23	7.35	8.98	9.48	8.23	8.92	8.65
S_3G_5	4.02	4.23	3.98	4.48	5.40	4.50	4.78	5.20	6.30	7.17	7.95	6.53	6.63	6.85
S_3G_6	4.00	4.42	3.95	4.78	5.80	5.18	5.20	6.13	6.70	8.20	8.40	7.60	7.68	7.48
S_4G_1	4.55	4.48	4.33	4.68	5.75	4.48	4.10	3.98	4.17	4.90	5.78	4.95	5.25	5.53
S_4G_2	4.15	4.48	4.58	5.08	5.18	4.53	4.38	4.43	4.48	5.28	5.63	4.45	4.87	5.97
S_4G_3	4.27	4.55	4.30	4.88	5.78	4.65	4.15	4.80	4.63	5.73	6.20	5.55	5.78	6.15
S_4G_4	4.25	4.23	4.20	4.95	5.65	4.48	4.07	4.85	4.95	6.13	6.68	5.90	6.13	6.90
S_4G_5	4.18	4.67	4.10	4.70	5.50	4.63	4.00	4.93	4.60	5.70	5.98	4.90	5.33	6.05
S_4G_6	4.15	4.50	4.25	4.85	5.18	4.10	4.15	4.30	4.43	5.60	6.25	4.77	5.60	6.28
CD(0.05)	-	-	-	-	-	-	-	-	-	-	-	-	-	
<u>N x G interaction</u>														
N_1G_1	4.07	4.58	4.20	4.93	5.38	4.43	4.60	4.98	5.15	5.53	5.98	5.30	5.38	5.73

Contd.

Table 8. Continued

Treatments	Month													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
N_1G_2	3.88	4.60	4.20	5.17	5.63	5.28	4.95	5.85	5.65	6.73	6.75	6.30	6.15	6.15
N_1G_3	4.10	4.65	4.33	5.73	6.40	5.60	5.63	6.58	6.85	8.08	8.80	8.55	8.27	8.58
N_1G_4	4.18	4.48	4.33	5.55	6.00	5.33	5.10	6.08	6.63	7.98	8.33	7.52	7.83	8.08
N_1G_5	4.13	4.42	4.02	4.98	5.35	4.98	5.20	6.15	6.85	7.45	8.03	7.33	7.28	7.52
N_1G_6	4.10	4.53	4.10	4.88	5.38	5.03	5.00	5.95	6.45	7.45	7.62	7.13	7.50	7.35
N_2G_1	3.98	4.23	4.03	4.80	5.70	4.63	4.75	4.73	5.10	6.15	7.05	5.83	5.85	5.93
N_2G_2	3.68	4.38	4.23	4.93	4.93	4.83	4.65	5.03	5.33	6.43	6.13	5.58	5.88	6.10
N_2G_3	3.50	4.40	4.07	5.10	5.93	5.93	6.00	7.03	7.30	9.30	9.97	9.20	9.18	9.00
N_2G_4	3.95	4.28	4.13	4.93	5.43	5.27	5.43	6.63	6.70	8.55	9.02	8.15	8.18	8.30
N_2G_5	3.82	4.13	3.98	4.70	5.00	4.60	4.68	5.93	5.58	6.77	7.60	6.55	6.45	6.95
N_2G_6	3.98	4.28	3.68	4.63	5.25	4.58	4.90	6.20	6.13	7.42	7.40	7.03	7.48	7.73
N_3G_1	3.90	4.70	4.38	5.05	5.70	5.10	4.70	5.48	5.38	6.23	6.55	6.33	5.83	5.92
N_3G_2	4.05	4.77	4.35	5.35	5.08	4.73	4.88	5.22	5.27	5.93	6.35	5.60	5.78	5.78
N_3G_3	3.70	4.80	4.53	5.35	6.00	5.50	5.75	6.88	6.80	8.88	8.90	8.35	8.17	8.58
N_3G_4	4.05	4.43	4.38	5.23	5.83	5.55	5.63	6.30	6.70	7.65	8.00	7.55	7.85	7.67
N_3G_5	4.02	4.55	4.02	5.15	5.60	4.78	5.08	5.95	5.83	6.70	7.42	6.83	6.88	7.00
N_3G_6	3.80	4.63	4.00	4.80	5.20	4.28	4.95	5.33	4.95	6.48	6.48	5.70	6.38	6.25
N_4G_1	3.53	4.02	3.73	4.45	4.88	4.18	4.13	4.70	4.48	5.60	6.33	5.35	5.73	5.55
N_4G_2	3.77	4.25	4.05	5.03	5.43	4.75	4.40	4.65	4.92	5.85	6.40	5.13	5.35	5.33
N_4G_3	3.83	4.25	3.90	9.83	5.70	5.00	4.88	5.85	5.75	6.98	7.63	6.88	7.27	7.15
N_4G_4	3.73	4.38	3.95	9.95	6.73	5.33	5.33	6.43	6.83	8.38	8.95	8.20	8.73	8.65
N_4G_5	3.82	4.03	4.18	4.73	5.70	5.30	4.75	6.00	5.93	7.43	7.80	6.73	6.95	7.48
N_4G_6	3.85	4.08	4.23	5.05	5.52	5.15	4.83	5.78	4.33	7.95	7.98	7.13	7.25	7.55
CD(0.05)	-	-	-	-	-	-	-	-	-	-	-	-	-	-

was on par with 70 per cent (S_2) and 60 per cent (S_3) shade levels. The four nutrient solutions tried were on par, while after the initial four month period all the growth regulators tried, differed significantly. BA 750 ppm (G_3) and 1500 ppm (G_4) were significantly superior to both the concentrations of GA and Ethephon. Plants sprayed with BA 750 ppm (G_3) had the maximum mean leaf length (8.33 cm).

The three interactions tried (S x N, S x G and N x G) had no significant influence on leaf length. The combination of 60 per cent shade + Hoagland solution + 750 ppm BA ($S_3N_2G_3$) recorded the maximum mean leaf length (10.50 cm), while 70 per cent shade + Ohio solution + 1500 ppm GA ($S_2N_4G_2$) recorded the minimum (4.2 cm) compared to all the other treatments (Appendix 11).

Leaf breadth

The shade levels differed significantly with respect to the mean leaf breadth during latter half of the period of the experiment (8th to 14th month). Plants under 80 per cent (S_1) shade had the maximum leaf breadth (5.93 cm) which was significantly superior to plants under 50 per cent (S_4) shade level (4.70 cm) and was on par with plants under 60 per cent (S_3) and 70 per cent (S_2) shade levels (5.55 cm and 5.50 cm, respectively). All the nutrients tried failed to show any significant difference throughout the experiment period and the various growth regulators tried showed significant differences like shade levels during latter half of the experiment. Plants under the treatment BA 750 ppm (G_3) recorded the maximum mean leaf breadth (6.49 cm) which was on par with the higher concentration of BA 1500 ppm (G_4) and was significantly superior to both the concentrations of GA and Ethephon.

Table 9 Effect of shade, nutrients, growth regulators and their interactions on leaf breadth (cm) of *A. andreanum* var. 'Hawaiian Red' at monthly interval

Treatments	Month													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
<u>Shade (S)</u>														
S_1	3.04	3.39	3.50	3.56	4.13	3.93	4.31	4.56	4.95	5.28	5.54	5.71	5.73	5.93
S_2	3.04	3.45	3.42	3.65	4.08	3.85	4.13	4.49	4.88	5.62	5.67	5.54	5.60	5.50
S_3	3.11	3.47	3.41	3.63	4.14	3.68	6.72	4.32	4.82	5.46	6.00	5.36	5.59	5.55
S_4	3.47	3.50	3.35	3.53	4.30	3.53	3.65	3.70	3.68	4.11	4.36	3.92	4.22	4.70
CD(0.05)	0.20	-	-	-	-	-	-	0.43	0.48	0.58	0.60	0.63	0.67	0.63
<u>Nutrient (N)</u>														
N_1	3.28	3.61	3.51	3.70	4.53	3.80	4.11	4.36	4.84	5.16	5.41	5.16	5.27	5.53
N_2	3.03	3.35	3.38	3.57	4.04	3.68	4.12	4.29	4.69	5.22	5.62	5.28	5.71	5.50
N_3	3.28	3.54	3.45	6.58	4.02	3.70	6.64	4.23	4.47	5.18	5.23	5.10	5.11	5.30
N_4	3.08	3.30	3.34	3.51	4.06	3.79	3.94	4.19	4.32	4.91	5.32	4.98	5.04	5.35
CD(0.05)	0.20	0.19	-	-	-	-	-	-	-	-	-	-	-	-
<u>Growth Regulator (G)</u>														
G_1	3.18	3.39	3.37	3.44	4.56	3.36	4.28	3.54	3.79	4.02	4.39	4.13	4.07	4.41
G_2	3.14	3.48	3.44	3.65	3.84	3.42	3.74	3.76	3.87	4.18	4.42	4.02	4.36	4.28
G_3	3.10	3.56	3.51	3.75	4.39	4.07	4.53	4.84	5.29	5.88	6.41	6.23	6.33	6.49
G_4	3.23	3.46	3.48	8.05	4.16	4.05	4.43	4.74	5.17	5.89	6.38	6.02	6.36	6.24
G_5	3.18	3.43	3.41	3.60	3.99	3.77	4.12	4.42	4.78	5.41	5.38	5.25	5.37	5.52
G_6	3.18	3.39	3.31	3.56	4.01	3.79	4.11	4.31	4.59	5.33	5.39	5.14	5.21	5.59
CD(0.05)	-	-	-	-	-	0.36	-	0.53	0.59	0.72	0.74	0.78	0.82	0.78

Contd.

Table 9. Continued

Treatments	Month 1	2	3	4	5	6	7	8	9	10	11	12	13	14
<u>S x N interaction</u>														
S_1N_1	3.08	3.73	3.87	3.82	4.40	4.28	4.90	5.07	5.77	6.00	6.20	5.88	5.85	5.93
S_1N_2	2.75	3.33	3.57	3.33	4.22	3.97	4.32	4.55	4.97	5.58	5.72	5.75	6.00	6.22
S_1N_3	3.28	3.27	3.27	3.62	3.75	3.57	4.10	4.27	4.40	4.85	5.02	5.63	5.23	5.63
S_1N_4	3.05	3.23	3.32	3.48	4.13	3.88	3.93	4.37	4.65	4.70	5.23	5.57	5.82	5.93
S_2N_1	3.22	3.63	3.47	3.83	5.22	3.77	4.27	4.85	5.17	5.72	5.87	5.90	5.92	5.87
S_2N_2	2.93	3.27	3.28	3.58	3.30	3.67	3.98	4.10	4.85	5.02	5.43	4.98	5.18	4.93
S_2N_3	3.10	3.53	3.40	3.75	3.62	3.93	4.20	4.50	4.85	6.42	5.57	5.65	5.68	5.70
S_2N_4	2.92	3.37	3.52	3.43	4.17	4.03	4.05	4.50	4.63	5.32	5.80	5.63	5.62	5.52
S_3N_1	3.22	3.48	3.47	3.90	4.52	3.92	4.22	4.38	5.10	5.57	5.98	5.67	5.70	6.00
S_3N_2	2.97	3.42	3.42	3.68	4.13	3.68	4.12	4.43	4.80	5.48	6.22	5.78	6.83	5.70
S_3N_3	3.13	3.73	3.47	3.65	4.27	3.50	14.45	4.45	4.83	5.52	5.93	5.12	5.18	5.10
S_3N_4	3.13	3.23	3.30	3.28	3.63	3.60	4.10	4.02	4.55	5.28	5.88	4.87	4.65	5.40
S_4N_1	3.62	3.60	3.25	3.27	3.97	3.25	3.07	3.13	3.33	3.37	3.58	3.20	3.62	4.33
S_4N_2	3.47	3.40	3.23	3.67	4.50	3.42	4.07	4.07	4.15	4.78	5.10	4.62	4.82	5.13
S_4N_3	3.62	3.62	3.68	15.32	4.43	3.82	3.80	3.72	3.78	3.95	4.40	4.00	4.35	4.78
S_4N_4	3.20	3.38	3.22	3.85	4.30	3.63	3.67	3.87	3.45	4.35	3.37	3.85	4.08	4.57
CD(0.05)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>S x G interaction</u>														
S_1G_1	3.00	3.30	3.30	3.15	3.75	3.35	3.58	3.53	4.25	4.10	4.17	4.45	4.30	4.20
S_1G_2	3.08	3.57	3.70	3.60	3.98	3.65	3.95	4.13	4.40	4.50	4.75	4.92	4.88	4.95
S_1G_3	2.98	3.50	3.68	3.77	4.50	4.38	4.83	5.15	5.75	6.15	6.83	6.95	6.80	7.28
S_1G_4	3.10	3.40	3.52	3.58	4.33	4.20	4.77	5.30	5.23	6.10	6.53	6.63	6.85	6.75

Contd.

Table 9. Continued

Treatments	Month													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
S_1G_5	3.03	3.35	3.50	3.73	4.15	4.00	4.60	4.88	5.33	5.75	5.95	6.23	6.25	6.55
S_1G_6	3.08	3.23	3.33	3.55	4.05	3.98	4.15	4.40	4.73	5.10	5.03	5.08	5.28	5.85
S_2G_1	2.93	3.23	3.20	3.55	5.70	3.28	3.60	3.60	3.88	4.03	4.43	4.15	4.10	4.23
S_2G_2	3.00	3.32	3.35	3.90	3.35	3.40	3.57	3.93	3.88	4.23	4.15	3.82	4.15	3.80
S_2G_3	2.90	3.88	3.52	3.95	4.28	4.45	4.78	5.28	3.85	6.55	7.08	6.93	7.02	6.85
S_2G_4	3.28	3.75	3.63	3.63	3.85	4.30	4.55	4.98	5.55	6.40	6.63	6.70	6.70	6.48
S_2G_5	3.13	3.43	3.45	3.55	3.68	3.87	4.20	4.63	5.28	6.33	5.92	5.90	5.78	5.78
S_2G_6	3.03	3.30	3.35	3.32	3.60	3.80	4.05	4.52	4.83	6.18	5.80	5.75	5.85	5.90
S_3G_1	3.25	3.58	3.53	3.58	3.88	3.43	18.58	3.68	4.07	4.40	4.90	4.25	3.95	4.43
S_3G_2	3.10	3.48	3.38	3.50	3.88	3.10	3.70	3.45	3.70	4.13	4.55	3.88	4.45	4.15
S_3G_3	2.95	3.52	3.48	3.80	4.75	3.95	4.88	5.15	5.75	6.55	7.30	6.85	7.30	7.05
S_3G_4	3.00	3.45	3.43	3.75	4.30	4.15	4.65	4.73	5.80	6.68	7.40	6.33	7.15	6.35
S_3G_5	3.20	3.33	3.35	3.43	3.85	3.50	3.90	4.20	4.53	5.13	5.52	5.10	5.23	5.25
S_3G_6	3.18	3.45	3.33	3.73	4.18	3.93	4.63	4.73	5.08	5.90	6.35	5.75	5.48	6.08
S_4G_1	3.53	3.45	3.45	3.50	4.90	3.40	3.35	3.38	2.98	3.55	4.05	3.68	3.93	4.80
S_4G_2	3.38	3.55	3.33	3.60	4.18	3.55	3.75	3.53	3.50	3.88	4.23	3.45	3.98	4.23
S_4G_3	3.58	3.53	3.38	3.48	4.05	3.52	3.65	3.78	3.80	4.28	4.43	4.18	4.20	4.78
S_4G_4	3.53	3.25	3.32	21.25	4.15	3.55	3.75	3.95	4.10	4.40	4.95	4.43	4.75	5.40
S_4G_5	3.38	3.63	3.35	3.70	4.30	3.70	3.78	3.98	3.98	4.43	4.13	3.78	4.23	4.50
S_4G_6	3.45	3.60	3.25	3.63	4.23	3.45	3.63	3.58	3.73	4.15	4.40	4.00	4.23	4.53
CD(0.05)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
N x G interaction														
N_1G_1	3.28	3.63	3.42	3.40	6.12	3.40	3.58	3.50	3.90	3.83	4.07	3.63	3.80	4.50

Conted.

Table 9. Continued

Treatments	Month													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
N_1G_2	3.13	3.60	3.45	3.68	4.13	3.63	3.88	4.03	4.28	4.40	4.42	4.35	4.38	4.60
N_1G_3	3.27	3.63	3.68	3.88	4.70	4.05	4.48	4.85	5.48	5.88	6.65	6.50	6.10	6.75
N_1G_4	3.48	3.60	3.70	3.80	4.27	3.90	4.23	4.73	5.23	5.73	6.10	5.65	6.08	6.08
N_1G_5	3.28	3.53	3.35	3.65	3.73	3.90	4.15	4.65	5.10	5.62	5.60	5.63	5.63	5.70
N_1G_6	3.28	3.70	3.48	3.82	4.20	3.95	4.38	4.40	5.08	5.53	5.60	5.23	5.65	5.58
N_2G_1	3.00	3.30	3.48	3.45	4.48	3.40	3.65	3.43	3.65	4.05	4.80	4.30	4.17	4.48
N_2G_2	2.98	3.50	3.68	3.53	3.80	3.27	3.50	3.45	3.83	4.30	4.33	3.88	4.83	4.15
N_2G_3	2.85	3.60	3.32	3.78	4.45	4.53	5.10	5.13	5.73	6.75	7.23	6.85	7.85	7.00
N_2G_4	3.18	3.30	3.28	3.60	4.07	3.98	4.60	4.93	5.05	6.10	6.60	6.38	6.88	6.45
N_2G_5	2.95	3.27	3.35	3.75	3.57	3.42	3.88	4.25	5.00	4.93	5.30	4.95	5.10	5.18
N_2G_6	3.23	3.15	3.10	3.30	3.85	3.50	4.00	4.55	4.90	5.17	5.45	5.35	5.43	5.73
N_3G_1	3.30	3.57	3.48	3.58	3.95	3.50	18.63	3.80	4.15	4.30	4.60	4.68	4.27	4.53
N_3G_2	3.38	3.55	3.38	3.90	3.82	3.33	3.80	3.75	4.00	4.08	4.48	4.05	4.15	4.23
N_3G_3	3.18	3.68	3.65	3.73	4.13	4.95	4.60	4.98	5.60	6.10	6.37	6.43	6.13	6.65
N_3G_4	3.35	3.55	3.52	21.18	4.13	4.10	4.50	4.68	4.85	5.63	6.05	5.88	6.08	5.95
N_3G_5	3.40	3.50	3.50	3.63	4.28	3.77	4.27	4.33	4.48	5.65	5.13	5.15	5.18	5.43
N_3G_6	3.10	3.38	3.20	3.50	3.80	3.58	4.00	3.87	3.73	5.35	4.75	4.43	4.88	5.05
N_4G_1	3.13	3.05	3.10	3.35	3.68	3.15	3.25	3.45	3.48	3.90	4.08	3.92	4.03	4.15
N_4G_2	3.07	3.27	3.25	3.50	3.63	3.48	3.80	3.80	3.38	3.95	4.45	3.80	4.10	4.15
N_4G_3	3.10	3.33	3.35	3.63	4.30	3.77	3.95	4.40	4.35	4.80	5.38	5.13	5.25	5.55
N_4G_4	2.93	3.40	3.40	3.63	4.15	4.23	4.40	4.63	5.55	6.13	6.75	6.18	6.42	6.50
N_4G_5	3.10	3.43	3.45	3.38	4.40	3.98	4.18	4.45	4.53	5.43	5.50	5.28	5.58	5.78
N_4G_6	3.13	3.35	3.48	3.60	4.20	4.13	4.05	4.40	4.65	5.28	5.77	5.58	4.88	6.00
CD(0.05)	-	-	-	-	-	-	-	-	-	-	-	-	-	-

None of the interactions (S x N, S x G and N x G) showed significant influence on this character.The maximum mean leaf breadth (8.0 cm) was recorded in the treatment combination of 60 per cent shade + 1 per cent fertilizer complex + 750 ppm BA ($S_3N_1G_3$), while 70 per cent shade + Hoagland solution + 1500 ppm GA ($S_2N_2G_2$) recorded the minimum (3.0 cm), compared to all the other treatments (Appendix 12).

4.1.6 Leaf area

Data on the mean leaf area of index leaf, per cent increase in index leaf area over earlier month and total leaf area at monthly interval are presented in Tables 10, 11 and 12, respectively (Plate 4).

The different shade levels had shown significant effect on mean leaf area of index leaf during the experimental period with the exception of the 2nd, 3rd and 4th months. At the final stage of the experiment, the maximum mean leaf area (50.75 cm^2) was recorded under 80 per cent shade (S_1) which was significantly superior to that under 50 per cent (S_4) shade level (32.57 cm^2) and was on par with those of 70 per cent (S_2) and 60 per cent (S_3) shade levels. As the shade intensity declined, the mean index leaf area also decreased. All the four nutrients tried had no significant effect on leaf area, while the various growth regulators tried had shown significant differences during the latter period of the experiment. BA 750 ppm (G_3) produced the maximum mean index leaf area (59.60 cm^2) which was significantly superior to both the concentrations of GA (G_1 and G_2) and Ethephon (G_5 and G_6) and was on par with BA 1500 ppm (G_4). BA had significantly dominated the other two growth regulators throughout the experimental period (Fig.3).

Table 10. Effect of shade, nutrients, growth regulators and their interactions on index leaf area (cm^2) of *A. andreanum* var. 'Hawaiian Red' at monthly interval

Treatments	Month													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Shade (S)														
S_1	11.65	14.61	13.68	19.00	25.27	22.69	26.00	33.65	36.09	44.90	48.86	48.13	48.09	50.75
S_2	11.91	15.98	14.43	18.90	19.90	21.18	22.84	32.52	34.02	45.74	50.65	47.29	47.85	46.19
S_3	13.02	15.67	14.86	18.31	24.72	20.27	24.15	28.06	32.58	46.66	55.47	43.26	43.50	45.25
S_4	15.36	16.16	14.85	18.36	24.76	16.53	16.40	16.70	19.30	25.88	30.83	22.87	25.99	32.57
CD(0.05)	1.71	-	-	-	3.68	3.25	3.89	5.57	6.11	8.25	9.97	9.47	8.78	9.52
Nutrient (N)														
N_1	13.92	16.48	14.73	19.71	24.80	21.06	23.37	29.16	32.93	42.75	47.45	41.54	42.47	44.64
N_2	12.51	14.76	13.92	17.69	23.14	19.88	22.68	26.81	30.52	43.29	48.86	42.63	43.29	45.53
N_3	13.47	16.58	15.34	19.42	23.08	19.49	22.35	27.69	29.56	37.62	42.23	38.45	38.91	41.11
N_4	12.04	14.61	13.83	17.75	23.62	20.24	21.00	27.27	28.98	39.52	47.27	38.94	40.77	43.49
CD(0.05)	-	1.70	-	-	-	-	-	-	-	-	-	-	-	-
Growth Regulator (G)														
G_1	13.08	15.26	14.28	16.59	22.20	16.53	17.33	19.46	21.25	25.81	30.41	24.71	25.11	26.85
G_2	12.57	15.93	14.68	18.37	21.91	17.84	18.78	21.58	22.76	28.15	33.08	28.12	26.36	29.25
G_3	12.51	16.53	15.21	21.04	27.58	24.34	27.55	24.31	39.18	55.87	62.61	56.08	56.02	59.60
G_4	13.48	15.42	14.93	19.95	25.27	23.45	25.93	33.59	39.43	52.84	60.64	53.05	57.12	55.50
G_5	13.27	15.53	14.13	18.14	22.94	19.31	21.89	29.56	29.35	40.48	46.16	41.37	41.29	44.31
G_6	13.01	14.98	13.51	17.77	22.07	19.53	22.61	27.89	31.02	41.63	45.82	39.01	42.26	46.64
CD(0.05)	-	-	-	2.46	-	3.99	4.76	6.82	7.48	10.11	12.21	11.61	10.76	11.66

Contd.

Table 10. Continued

Treatments	Month													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
<u>S x N interaction</u>														
S_1N_1	11.37	16.90	16.22	21.55	28.63	26.65	32.07	38.60	44.42	53.28	56.98	49.92	48.98	50.05
S_1N_2	10.18	13.85	13.02	16.03	25.22	22.67	25.38	32.97	33.60	49.57	49.35	49.40	50.73	55.42
S_1N_3	13.48	13.73	12.92	19.50	21.08	19.52	23.48	28.75	33.15	36.13	39.45	44.45	41.45	44.58
S_1N_4	11.58	13.97	12.58	18.93	26.13	21.93	23.08	34.30	33.18	40.60	49.67	48.77	51.20	52.97
S_2N_1	13.45	16.58	13.60	20.80	20.12	21.58	23.98	36.88	37.58	52.50	55.50	53.02	53.77	51.03
S_2N_2	11.73	14.48	13.47	17.67	15.42	19.92	21.87	29.43	34.98	40.90	47.37	41.55	40.65	38.72
S_2N_3	11.58	16.80	15.60	19.98	19.17	21.30	23.35	35.28	33.42	45.70	49.17	46.82	49.47	49.42
S_2N_4	10.88	16.03	15.03	17.17	24.88	21.92	22.17	28.48	33.08	43.85	50.58	47.77	47.52	45.60
S_3N_1	13.75	16.18	15.13	21.43	29.67	22.00	25.15	27.68	34.98	47.78	56.75	48.13	48.03	52.90
S_3N_2	12.82	15.47	14.95	18.67	24.22	21.32	24.00	31.43	31.75	48.68	57.78	48.43	48.88	46.33
S_3N_3	12.83	17.33	15.52	18.42	26.00	18.47	26.17	27.58	32.23	43.58	51.25	38.80	37.78	37.00
S_3N_4	12.67	13.72	13.83	14.72	19.00	19.28	21.27	25.53	31.35	46.60	56.10	37.68	39.28	44.78
S_4N_1	17.12	16.25	13.97	15.05	20.80	14.00	12.27	13.48	14.75	17.43	20.58	15.10	19.08	24.58
S_4N_2	15.32	15.23	14.25	18.40	27.70	15.63	19.45	13.40	24.75	34.02	40.95	31.12	32.88	41.65
S_4N_3	15.97	18.43	17.33	19.78	26.07	18.67	16.40	19.15	19.43	25.05	29.05	23.72	26.93	33.43
S_4N_4	13.03	14.73	13.85	20.20	24.47	17.82	17.47	20.77	18.28	27.03	32.73	21.55	25.07	30.60
CD(0.05)	-	-	-	4.02	7.37	-	-	-	-	-	-	-	-	-
<u>S x G interaction</u>														
S_1G_1	10.60	13.88	12.53	15.73	20.53	16.97	18.15	20.65	23.10	27.63	27.05	24.03	26.93	26.35
S_1G_2	11.90	15.38	14.50	20.55	25.25	22.55	23.93	30.38	31.03	31.20	40.08	44.65	37.78	38.18
S_1G_3	11.50	15.53	14.78	21.30	29.53	28.10	31.45	41.10	44.03	61.30	67.08	63.78	63.80	71.80
S_1G_4	12.93	14.50	13.93	18.48	27.75	25.68	30.47	41.80	47.57	57.78	66.10	60.58	66.63	64.08

Contd.

Table 10. Continued

Treatments	Month													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
S_1G_5	11.60	14.82	13.53	20.42	25.15	22.53	28.04	37.63	38.43	48.80	56.38	59.10	51.75	60.08
S_1G_6	11.40	13.58	12.85	17.55	23.40	20.33	23.63	30.38	32.38	42.68	36.50	36.68	41.68	44.05
S_2G_1	10.53	13.90	12.70	15.75	15.30	15.28	17.73	23.85	22.15	26.15	30.43	28.03	26.35	25.78
S_2G_2	10.95	15.62	13.50	16.90	17.58	17.15	16.90	21.75	23.00	30.25	29.05	25.80	26.27	22.88
S_2G_3	10.83	17.53	15.20	22.93	26.03	27.63	30.50	40.93	47.75	66.85	74.45	67.45	68.73	67.48
S_2G_4	13.28	18.23	16.43	22.10	21.13	26.13	26.70	39.93	42.08	60.70	63.48	61.30	62.33	60.63
S_2G_5	13.25	15.98	15.18	18.75	20.67	20.63	22.95	33.88	35.33	45.38	54.88	49.93	50.95	48.25
S_2G_6	12.65	14.60	13.55	17.00	18.67	20.28	22.28	34.80	33.80	45.10	51.65	51.23	52.48	52.15
S_3G_1	14.92	17.20	16.42	18.05	22.70	17.72	18.48	18.53	24.28	29.68	37.60	27.13	24.83	28.45
S_3G_2	12.85	16.38	15.33	16.95	20.78	14.72	16.50	16.48	17.92	26.60	34.55	24.18	21.40	25.53
S_3G_3	11.48	16.10	15.48	21.13	31.50	23.93	31.45	34.63	44.45	66.93	77.10	67.85	65.18	65.13
S_3G_4	11.98	14.55	15.05	20.33	27.70	26.25	29.88	34.00	45.30	63.98	76.10	57.60	63.98	57.73
S_3G_5	13.68	14.30	13.53	15.63	21.33	17.13	20.48	31.85	25.28	41.43	46.23	36.80	38.47	39.47
S_3G_6	13.20	15.53	13.35	17.78	24.33	21.85	28.10	32.88	38.25	51.38	61.25	46.03	47.13	55.23
S_4G_1	16.25	16.05	15.45	16.85	30.28	16.15	14.98	14.83	15.48	19.78	26.58	19.67	22.33	26.83
S_4G_2	14.58	16.33	15.38	19.08	24.03	16.92	17.78	17.73	19.10	24.55	28.65	17.85	19.98	30.43
S_4G_3	16.25	16.98	15.38	18.80	23.25	17.73	16.80	20.57	20.48	28.40	31.83	25.23	26.38	34.00
S_4G_4	15.75	14.40	14.33	18.90	24.50	15.73	16.65	18.65	22.75	28.90	36.90	32.73	35.55	39.58
S_4G_5	14.55	18.00	14.30	17.78	24.63	16.98	15.75	14.90	18.38	26.30	27.15	19.65	23.98	29.43
S_4G_6	14.78	16.23	14.28	18.75	21.88	15.67	16.42	13.53	19.65	27.38	33.88	22.10	27.75	35.15
CD(0.05)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>N x G interaction</u>														
N_1G_1	13.75	16.90	14.53	15.70	19.75	16.97	17.78	18.85	22.08	22.90	26.80	20.80	22.18	24.60

Contd.

Table 10. Continued

Treatments	Month													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
N_1G_2	12.53	11.50	13.65	18.58	23.83	19.65	19.95	25.30	25.75	32.05	35.53	30.12	26.83	31.30
N_1G_3	15.00	17.15	16.25	22.53	32.33	25.08	27.40	35.20	42.38	54.98	66.35	60.50	56.55	62.95
N_1G_4	14.45	16.32	16.35	21.40	26.63	22.06	23.70	32.33	37.38	50.18	56.65	47.43	52.60	53.00
N_1G_5	13.98	15.42	13.58	18.75	22.18	20.50	23.78	32.13	31.75	45.53	49.75	46.75	48.80	48.35
N_1G_6	13.83	16.58	14.03	21.30	24.13	22.10	27.60	31.18	38.27	50.88	49.65	43.65	47.85	47.65
N_2G_1	14.03	13.82	14.90	16.80	27.53	16.75	18.92	18.53	21.35	26.62	35.82	27.33	26.70	29.70
N_2G_2	11.35	15.15	14.68	16.70	19.90	15.65	16.85	18.63	19.15	29.68	28.63	26.85	24.50	29.68
N_2G_3	10.20	16.48	14.75	20.60	27.60	29.08	32.90	38.27	45.28	68.30	75.93	65.78	69.42	66.18
N_2G_4	13.33	14.95	14.17	19.40	24.40	23.90	26.93	31.60	36.90	56.43	64.53	59.83	59.48	59.63
N_2G_5	12.55	14.18	13.33	17.40	18.47	16.50	19.47	27.75	27.70	36.88	43.48	35.38	35.22	38.28
N_2G_6	13.63	13.98	11.70	15.25	20.92	17.42	20.98	26.08	32.75	41.85	44.80	40.60	44.40	49.73
N_3G_1	13.13	17.42	15.65	18.53	22.43	18.67	18.13	23.28	24.50	29.70	32.50	27.90	26.60	28.05
N_3G_2	14.35	17.58	16.45	19.20	22.03	16.28	19.00	21.00	22.63	24.05	30.78	29.08	25.85	27.55
N_3G_3	12.53	17.95	16.30	22.48	24.53	23.00	27.73	36.30	39.75	58.48	60.68	58.35	53.75	61.75
N_3G_4	14.38	14.63	15.67	20.53	24.88	27.78	26.65	32.97	40.70	48.08	53.58	46.85	54.45	52.73
N_3G_5	14.00	16.23	14.90	19.23	25.35	19.10	23.08	28.70	28.50	36.38	41.40	40.18	39.47	42.82
N_3G_6	12.43	15.65	13.08	16.58	19.28	16.10	19.53	23.90	21.28	29.03	34.45	28.33	33.33	33.75
N_4G_1	11.40	12.88	12.03	15.35	19.10	13.73	14.50	17.20	17.08	24.00	26.53	22.83	24.95	25.05
N_4G_2	12.05	14.48	13.92	19.00	21.88	19.78	19.30	21.40	23.53	26.83	37.40	26.43	28.25	28.47
N_4G_3	12.33	14.55	13.53	18.55	25.85	20.23	22.18	27.45	29.30	41.72	47.50	39.68	44.35	47.53
N_4G_4	11.78	15.78	13.53	18.48	25.18	24.05	26.43	37.48	42.73	56.68	67.83	58.10	61.95	56.65
N_4G_5	12.55	16.28	14.73	17.20	25.77	21.15	21.25	29.68	29.45	43.13	50.00	43.18	41.65	47.78
N_4G_6	12.15	13.73	15.23	17.95	23.95	22.50	22.33	30.43	31.77	44.78	54.38	43.45	43.45	55.45
CD(0.05)	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 11. Effect of shade, nutrients, growth regulators and their interactions on per cent increase in leaf area of *A. andreanum* var. 'Hawaiian Red' at monthly interval

Treatments	Month												
	1	2	3	4	5	6	7	8	9	10	11	12	13
<u>Shade (S)</u>													
S_1	18.85	-7.80	26.89	23.18	-13.78	11.19	20.83	5.40	17.22	5.58	-3.39	-0.13	3.74
S_2	24.11	-11.91	22.43	0.51	4.93	6.92	27.96	2.59	23.56	8.52	-9.86	0.45	-6.44
S_3	15.22	-6.12	16.92	24.49	-24.83	13.75	10.36	8.20	27.89	15.71	-32.44	-2.21	4.42
S_4	2.89	-10.20	17.81	22.50	-54.57	-6.43	-34.76	9.49	24.87	13.21	-44.40	13.56	19.15
CD(0.05)	13.28	-	-	10.46	17.96	11.84	36.48	-	-	-	22.94	11.04	10.32
<u>Nutrient (N)</u>													
N_1	14.12	-13.25	23.02	17.40	-21.84	4.28	15.64	8.29	20.10	8.96	-21.26	2.64	7.39
N_2	13.64	-7.29	20.57	16.54	-23.26	12.06	-25.84	11.26	26.68	10.88	-18.30	0.50	4.25
N_3	16.63	-8.24	20.31	13.59	-22.28	8.24	16.26	4.20	19.35	10.41	-14.61	1.93	4.91
N_4	16.67	-7.25	20.15	23.15	-20.87	0.85	18.33	1.93	27.41	12.77	-35.81	6.61	4.32
CD(0.05)	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>Growth regulator (G)</u>													
G_1	12.48	-5.62	13.24	18.61	-35.04	1.93	8.70	7.47	16.45	13.75	-25.96	2.32	5.12
G_2	20.95	-6.09	17.79	13.82	-25.29	4.75	7.70	4.74	19.52	11.93	-38.16	-4.83	6.96
G_3	22.54	-10.11	25.98	20.71	-18.26	6.93	19.15	8.64	29.88	8.12	-15.65	0.07	7.53
G_4	10.90	-2.11	24.94	18.55	-15.09	7.59	1.96	15.53	22.60	13.40	-17.41	7.93	-2.90
G_5	12.65	-21.44	21.37	18.45	-20.53	5.83	5.53	-6.17	26.46	10.84	-17.76	1.85	7.08
G_6	12.08	-15.81	22.75	15.87	-18.17	11.11	-6.47	8.31	25.40	6.49	-20.19	10.19	7.50
CD(0.05)	-	-	-	-	-	-	-	-	-	-	-	-	-

Contd.

Table 11. Continued

Treatments	Month												
	1	2	3	4	5	6	7	8	9	10	11	12	13
S x N interaction													
S_1N_1	32.55	-4.70	24.25	23.67	-7.68	15.86	15.30	11.74	15.14	3.79	-21.87	0.36	1.45
S_1N_2	26.70	-6.57	18.00	34.29	-12.46	10.41	20.45	1.99	28.91	0.01	0.17	0.81	7.71
S_1N_3	-0.12	-6.94	32.67	7.69	-12.57	14.94	15.53	12.98	5.97	8.86	7.17	-6.39	5.32
S_1N_4	16.47	-12.98	32.63	27.06	-22.41	3.55	32.03	-5.12	18.85	9.69	0.97	4.72	0.47
S_2N_1	18.68	-23.82	33.84	-4.70	6.81	9.69	34.03	-0.00	26.31	4.05	-4.95	-0.23	-4.87
S_2N_2	15.01	-7.97	23.53	-16.13	17.70	8.66	23.23	9.00	17.91	12.57	-20.22	-2.46	-8.73
S_2N_3	31.02	-7.63	20.37	-5.03	9.66	8.03	33.51	-10.20	25.90	5.80	-6.68	3.39	-2.74
S_2N_4	31.72	-8.23	11.98	27.91	-14.43	1.30	21.07	11.55	24.10	11.68	-7.57	1.12	-9.44
S_3N_1	14.20	-7.92	27.90	26.44	-33.84	9.41	8.41	11.29	23.99	14.93	-21.18	-9.38	13.19
S_3N_2	15.66	-4.98	29.27	20.98	-18.44	9.58	15.71	-11.22	33.30	15.07	-19.21	-0.45	-2.34
S_3N_3	23.44	-12.08	15.85	28.52	-43.11	28.10	4.72	13.88	22.44	15.58	-36.02	-3.33	-2.93
S_3N_4	7.57	-0.48	4.65	22.03	-3.93	7.93	12.61	18.85	31.84	17.25	-53.33	4.33	9.77
S_4N_1	-8.93	-16.55	6.08	24.20	-52.64	-17.84	4.82	10.13	14.97	13.07	-37.44	19.80	19.78
S_4N_2	-2.82	-9.66	21.46	27.02	-79.85	19.58	-162.74	45.25	26.61	15.88	-33.94	4.11	20.35
S_4N_3	12.17	-6.30	12.35	23.19	-43.10	-18.11	11.27	0.16	23.08	11.40	-22.90	14.04	19.99
S_4N_4	11.13	-8.27	31.34	15.59	-42.69	-9.36	7.59	-17.57	34.83	12.47	-83.31	16.28	16.47
CD(0.05)	-	-	-	20.93	-	-	72.96	33.10	-	-	-	-	-
S x G interaction													
S_1G_1	22.36	-11.87	20.69	22.33	-22.24	4.88	13.04	9.29	16.58	-3.87	-16.07	10.78	-2.20
S_1G_2	23.24	-6.69	27.22	19.20	-14.65	7.23	18.03	2.00	1.63	17.53	7.82	-20.03	1.28
S_1G_3	25.31	-5.02	30.12	24.19	-8.88	11.65	23.24	5.75	28.03	7.56	-6.24	0.15	10.75
S_1G_4	9.35	-6.93	24.65	32.17	-7.79	15.62	25.85	12.32	11.67	11.07	-10.69	10.51	-6.07

Contd.

Table 11. Continued

Treatments	Month												
	1	2	3	4	5	6	7	8	9	10	11	12	13
S_1G_5	19.72	-9.80	33.82	17.68	-12.21	18.62	24.99	0.14	20.04	13.33	4.62	-15.11	13.81
S_1G_6	13.12	-6.49	24.81	23.49	-16.91	9.13	19.84	2.88	25.35	-12.10	0.20	12.94	4.88
S_2G_1	24.26	-10.90	19.86	-5.57	-1.24	13.54	23.59	-6.53	13.79	14.03	-13.52	-5.00	-3.80
S_2G_2	30.19	-18.64	18.88	-0.90	-1.31	-1.92	19.24	5.57	23.22	-4.52	-16.79	1.82	-19.67
S_2G_3	37.10	-15.37	32.93	7.42	4.29	9.34	24.77	14.49	28.05	10.47	-10.76	1.76	-2.06
S_2G_4	27.28	-12.09	25.72	-6.91	18.95	2.06	32.62	4.44	29.82	4.00	-5.25	0.72	-3.91
S_2G_5	12.73	-5.91	19.09	5.25	0.38	9.91	31.66	3.76	21.16	16.69	-11.15	0.10	-5.17
S_2G_6	13.09	-8.56	18.10	3.77	8.53	8.58	35.88	-6.19	25.30	10.48	-1.67	3.32	-4.06
S_3G_1	9.06	-3.78	6.77	19.90	-26.72	3.03	-0.16	23.54	16.12	21.17	-40.63	8.74	11.64
S_3G_2	13.83	-8.38	7.96	18.37	-41.32	9.13	-1.53	6.13	32.01	20.60	-46.31	-13.99	13.09
S_3G_3	26.18	-4.09	24.41	31.68	-34.99	24.98	8.61	20.71	32.96	12.09	-15.79	-6.78	2.23
S_3G_4	17.44	2.55	25.12	26.09	-8.66	11.80	10.49	24.86	28.26	15.22	-32.53	10.19	-12.14
S_3G_5	4.79	-6.12	13.08	24.77	-24.18	13.33	29.83	-38.46	35.59	10.36	-26.08	3.32	2.21
S_3G_6	14.01	-16.92	24.18	26.15	-13.11	20.25	14.92	12.42	23.42	14.82	-33.34	2.75	9.51
S_4G_1	-5.77	-5.62	5.62	37.80	-89.98	-13.72	-1.65	3.57	19.33	23.69	-33.62	12.22	14.85
S_4G_2	10.52	-6.09	17.12	18.61	-43.88	4.54	-4.93	5.24	21.21	14.12	-97.38	12.89	33.15
S_4G_3	1.58	-10.11	16.45	19.54	-33.46	-18.25	19.98	-6.38	30.47	2.35	-29.84	-5.14	19.21
S_4G_4	-10.47	-2.11	24.27	22.87	-62.84	0.87	-61.11	20.48	20.65	23.33	-21.17	10.28	10.52
S_4G_5	13.36	-21.44	19.48	26.11	-46.08	-18.54	-64.37	9.89	29.06	2.98	-38.43	19.08	17.48
S_4G_6	8.09	-15.81	23.90	10.07	-51.18	6.50	-96.50	24.15	28.52	12.76	-45.95	21.79	16.67
CD(0.05)	-	-	-	-	-	-	-	-	-	-	-	-	-
N x G interaction													
N_1G_1	17.56	-17.68	6.89	19.42	-18.02	-0.32	5.43	13.95	1.72	16.08	-30.62	-6.41	9.13

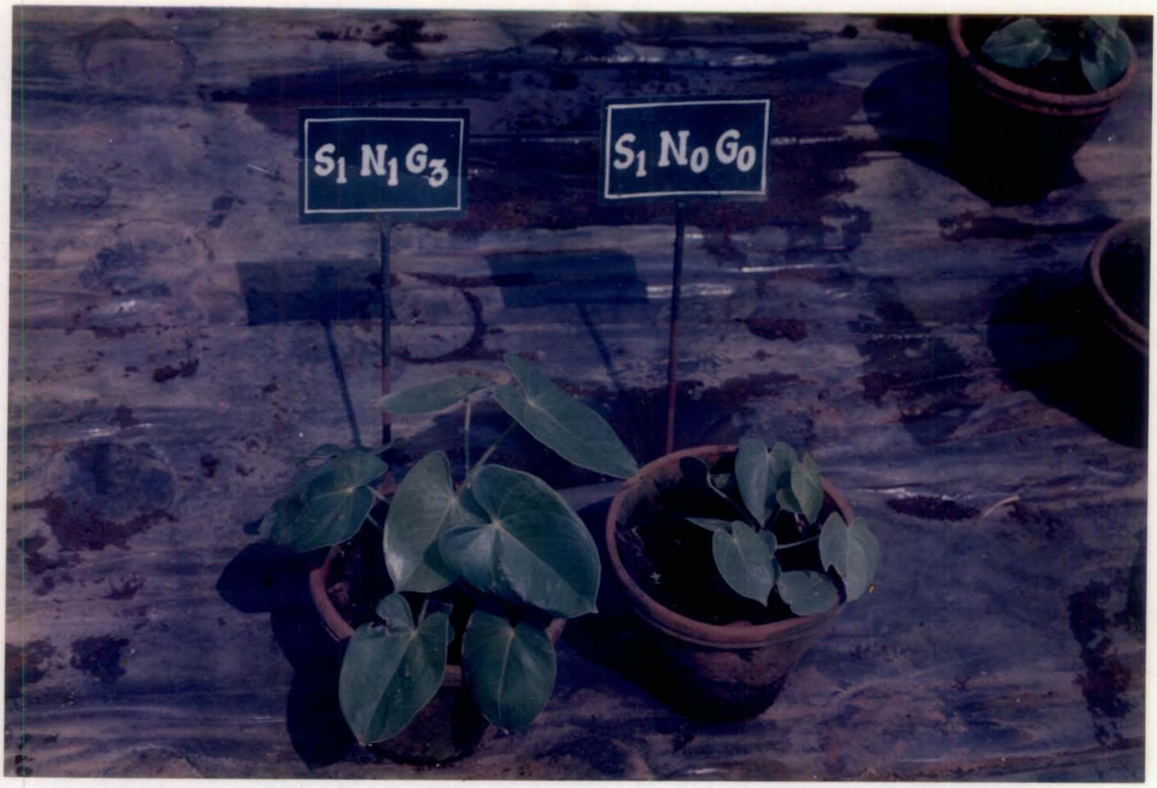
Contd.

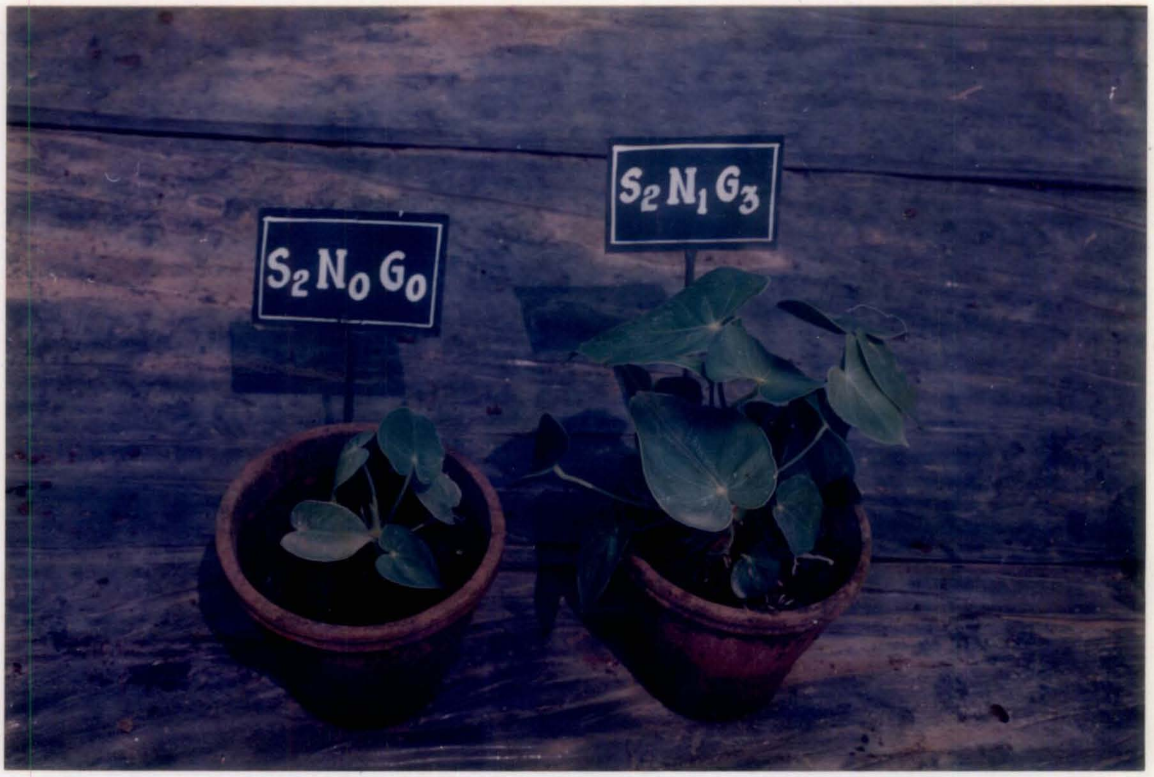
Table 11. Continued

Treatments	Month												
	1	2	3	4	5	6	7	8	9	10	11	12	13
N_1G_2	24.29	-23.80	24.73	21.55	-22.42	1.20	18.74	2.80	18.87	7.47	-20.13	-16.77	13.56
N_1G_3	10.16	-5.81	23.22	29.29	-32.16	6.04	21.32	13.17	23.03	13.96	-13.56	-7.63	15.79
N_1G_4	9.61	0.44	22.77	18.28	-23.69	-1.92	23.08	13.36	22.09	15.17	-30.71	13.45	3.26
N_1G_5	8.07	-14.23	26.69	14.19	-11.96	1.85	26.59	-13.07	30.44	2.54	-14.14	8.74	1.37
N_1G_6	15.05	-18.41	33.81	1.69	-22.79	18.83	-1.31	19.53	24.47	-1.46	-19.01	11.62	1.23
N_2G_1	-0.63	5.80	10.49	22.59	-64.09	10.84	-1.68	12.77	16.45	25.49	-34.47	-1.71	6.47
N_2G_2	25.16	-4.94	12.38	10.43	-26.92	6.20	8.71	-0.67	34.69	-4.39	-10.22	-9.15	7.00
N_2G_3	35.66	-11.47	28.25	19.19	1.68	11.45	13.56	14.22	32.08	10.68	-17.27	6.38	-2.96
N_2G_4	9.47	-7.21	26.87	15.10	-16.04	13.16	-61.55	22.10	32.44	13.45	-8.47	-1.42	-0.56
N_2G_5	8.72	-5.95	22.45	5.93	-12.55	14.35	-48.84	-6.45	22.60	15.45	-25.44	-0.14	6.49
N_2G_6	3.44	-19.98	22.97	26.00	-21.64	16.34	-65.20	25.56	21.84	4.61	-13.93	9.06	9.04
N_3G_1	21.50	-11.08	15.91	16.62	-20.83	-7.99	19.80	5.82	18.36	7.23	-17.78	-4.03	4.01
N_3G_2	17.96	-6.85	13.80	10.81	-36.66	13.25	8.57	4.08	6.60	19.93	-20.28	-5.48	6.09
N_3G_3	30.49	-9.32	26.16	7.72	-12.92	16.74	20.30	8.68	31.02	4.61	-6.16	-10.65	13.70
N_3G_4	-0.30	6.19	23.28	14.53	-6.10	8.94	17.15	17.86	11.23	9.76	-15.57	-13.95	-4.99
N_3G_5	11.76	-9.33	21.35	20.98	-26.19	6.77	17.29	1.51	20.99	12.90	-9.28	0.53	8.83
N_3G_6	18.36	-19.02	21.35	10.90	-20.92	11.92	14.44	-12.72	27.87	8.03	-18.60	17.24	1.85
N_4G_1	11.47	-9.20	19.65	15.83	-37.33	5.20	17.27	-2.67	29.28	6.22	-20.97	8.60	0.88
N_4G_2	16.38	-4.21	20.26	12.50	-15.16	-1.66	-5.20	12.72	17.90	24.71	-102.02	12.10	1.21
N_4G_3	13.85	-7.99	26.28	26.62	-29.50	-6.51	21.43	-1.49	33.39	3.23	-25.59	12.16	3.60
N_4G_4	24.82	-17.99	26.86	26.31	-14.51	10.17	29.17	8.78	24.65	15.24	-14.89	5.72	-9.31
N_4G_5	22.04	-13.75	14.97	32.72	-21.40	0.35	27.08	-6.67	31.82	12.46	-22.18	-1.75	11.65
N_4G_6	11.46	9.63	12.86	24.90	-7.31	-2.43	26.20	0.89	27.40	14.78	-29.22	2.82	17.88
CD(0.05)	-	-	-	-	-	-	-	-	-	-	-	-	-

Plate 3. Treatment having maximum plant spread, $S_1N_1G_3$ with control ($S_1N_0G_0$)

Plate 4. Treatment having maximum leaf area, $S_2N_1G_3$ with control


$S_1 N_1 G_3$
$S_1 N_0 G_0$


$S_2 N_0 G_0$
$S_2 N_1 G_3$

The interaction S x N had shown significant influence during the 4th and 5th months; all the other interaction effects were non-significant. The combination of 80 per cent shade + Hoagland solution + 1500 ppm BA ($S_1N_2G_4$) recorded the maximum mean index leaf area (90.9 cm^2) while 50 per cent shade + Ohio solution + 750 ppm BA ($S_4N_4G_3$) recorded the minimum (13.4 cm^2) compared to all the other treatments (Appendix 13).

There was significant difference among the different shade levels with respect to per cent increase in index leaf area with the exception of 3rd, 4th, 7th, 10th and 11th month. There was no marked difference in per cent increase in index leaf area under the influence of nutrients, growth regulators, S x G and N x G interactions. The interaction of shade x nutrient was significant during the 4th, 8th and 9th months.

The total leaf area was significantly influenced under the different shade levels throughout the experimental period with the exception of 4th, 5th and 6th months (rainy season). At the final stage of the experiment, maximum total leaf area (423.25 cm^2) was recorded under 70 per cent (S_2) which was significantly superior to that under 50 per cent (S_4) (308.63 cm^2) and was on par with those under 80 per cent (S_1) and 60 per cent (S_3) shade levels. The various nutrients tried had no significant influence on the total leaf area during the major part of the experimental period, with the exception of 2nd and 3rd months.

Different growth regulators had recorded significant influence on mean total leaf area during 1st, and 6th to 14th month-period continuously. BA had significantly dominated the other two growth regulators throughout the period of the experiment. BA 750 ppm (G_3) produced the maximum mean total leaf area

Table 12. Effect of shade nutrients, growth regulators and their interactions on total leaf area (cm^2) of *A. andreanum* var. `Hawaiian Red' at monthly interval

Treatment	Months													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
<u>Shade (S)</u>														
S_1	53.13	66.79	79.58	94.83	118.75	143.00	174.92	196.50	253.75	282.25	316.83	322.88	353.04	379.58
S_2	55.13	70.25	81.79	98.38	116.46	124.42	164.04	190.25	247.46	318.29	320.42	325.29	383.96	423.25
S_3	64.33	76.21	85.50	98.17	116.67	118.79	141.21	165.50	208.08	286.33	307.21	310.38	344.13	377.67
S_4	81.29	87.08	99.96	108.71	123.46	123.46	140.54	154.46	159.92	207.83	217.75	226.21	277.25	308.63
CD(0.05)	9.45	9.54	10.72	-	-	-	25.54	30.87	46.07	52.21	59.24	62.26	71.48	72.72
<u>Nutrient (N)</u>														
N_1	68.83	80.83	95.50	106.92	129.13	136.50	166.88	178.08	216.13	267.92	289.00	297.13	344.04	368.92
N_2	59.96	71.25	81.21	93.50	112.04	120.75	152.79	178.92	116.92	277.50	290.79	297.33	335.21	369.58
N_3	67.08	80.71	92.21	107.08	122.67	131.13	151.92	172.13	207.21	271.54	28658	292.38	334.33	373.04
N_4	58.00	67.54	77.92	92.58	111.50	121.29	149.13	177.58	228.96	277.75	295.83	297.92	343.79	377.58
CD(0.05)	-	9.54	10.72	-	-	-	-	-	-	-	-	-	-	-
<u>Growth regulator (G)</u>														
G_1	65.48	75.06	85.13	99.94	114.50	119.00	118.56	156.69	178.88	234.56	250.56	258.13	291.31	313.38
G_2	62.50	75.63	87.56	102.56	112.88	120.75	149.50	153.56	187.88	211.88	226.69	228.19	253.94	266.69
G_3	59.88	72.69	84.94	104.13	128.88	149.31	199.81	216.58	292.50	354.81	391.50	404.81	457.19	517.56
G_4	64.25	76.44	87.69	102.31	129.81	144.44	178.63	212.56	277.94	361.81	378.19	384.38	441.06	498.56
G_5	64.00	75.94	86.63	94.50	114.13	115.31	142.75	155.69	177.94	223.31	232.75	237.88	280.06	301.06
G_6	64.81	74.75	88.31	96.69	112.81	115.69	141.81	165.00	188.69	255.69	263.63	263.75	314.00	336.44
CD(0.05)	11.58	-	-	-	-	24.15	31.28	37.81	56.43	63.94	72.56	76.25	87.55	89.06

Contd.

Table 12. Continued

Treatment	Months													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
<u>S x N interaction</u>														
S_1N_1	52.00	67.00	82.67	97.33	123.83	146.83	167.00	181.33	214.50	228.67	278.83	294.50	322.17	340.00
S_1N_2	46.83	58.50	69.67	81.67	99.83	119.17	143.67	164.00	215.67	247.50	263.17	271.67	296.50	320.50
S_1N_3	62.33	74.33	87.50	98.50	121.17	146.83	180.50	193.50	249.67	288.67	311.83	311.83	340.67	368.67
S_1N_4	51.33	67.33	78.50	101.83	130.17	159.17	202.50	247.17	335.17	364.17	413.50	413.50	452.83	489.17
S_2N_1	65.50	83.17	96.83	111.83	129.83	136.33	193.33	215.50	281.17	345.83	354.33	354.33	463.83	502.00
S_2N_2	51.50	68.83	77.00	88.33	98.50	110.17	164.67	195.50	254.17	307.67	307.67	310.00	335.50	377.83
S_2N_3	53.33	68.83	82.67	103.67	124.17	131.17	156.50	181.33	226.83	334.17	334.17	344.00	378.33	427.83
S_2N_4	50.17	60.17	70.67	89.67	113.33	120.00	141.67	168.67	227.67	285.50	285.50	292.83	358.17	385.33
S_3N_1	70.00	81.67	95.00	107.17	136.67	136.67	165.50	180.00	214.50	313.67	335.83	345.33	364.83	386.67
S_3N_2	59.33	72.33	81.00	95.83	121.33	125.17	147.33	175.67	229.00	330.83	346.83	350.00	412.83	442.67
S_3N_3	63.33	79.00	90.17	102.50	117.17	118.33	130.00	154.17	189.17	230.00	263.67	263.67	294.50	332.33
S_3N_4	64.67	71.83	75.83	87.17	91.50	95.00	122.00	152.17	199.67	270.83	282.50	282.50	304.33	349.00
S_4N_1	87.83	91.50	107.50	111.33	126.17	126.17	141.67	135.50	154.33	183.50	187.00	194.33	225.33	247.00
S_4N_2	82.17	85.33	97.17	108.17	128.50	128.50	155.50	180.50	168.83	224.00	245.50	257.67	296.00	337.33
S_4N_3	89.33	100.67	108.50	123.67	128.17	128.17	134.67	159.50	163.17	233.33	236.67	250.00	323.83	363.33
S_4N_4	65.83	70.83	86.67	91.67	111.00	111.00	130.33	142.33	153.33	190.50	201.83	202.83	263.83	286.83
CD(0.05)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>S x G interaction</u>														
S_1G_1	50.75	61.75	72.00	84.00	101.25	115.75	128.25	149.25	169.00	196.75	210.50	219.00	233.75	242.50
S_1G_2	57.00	69.75	84.00	111.75	127.00	151.25	172.75	184.00	232.75	248.25	283.75	283.75	305.00	319.00
S_1G_3	51.50	61.25	80.25	95.75	128.50	183.50	236.75	264.50	406.75	427.50	506.75	531.50	559.25	628.75
S_1G_4	56.25	72.50	81.25	98.00	130.00	165.25	220.25	259.75	339.50	359.00	403.75	408.00	464.00	503.00

Contd.

Table 12. Continued

Treatment	Months													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
S_1G_5	50.75	66.75	79.75	89.00	122.50	132.25	153.25	164.00	200.25	216.00	246.50	245.25	266.00	281.50
S_1G_6	52.50	68.75	80.25	90.50	103.25	110.00	138.25	157.50	174.25	246.00	249.75	249.75	290.25	302.75
S_2G_1	46.25	63.50	71.50	82.75	95.00	95.50	111.00	144.75	182.25	237.25	241.75	244.50	288.50	321.75
S_2G_2	50.50	65.00	76.00	90.00	100.00	107.25	121.00	134.50	158.00	282.50	182.50	182.50	196.50	220.50
S_2G_3	47.75	66.25	80.25	99.50	126.25	150.75	224.25	244.75	346.75	423.00	423.00	431.25	504.75	571.00
S_2G_4	62.75	80.00	93.25	115.00	146.00	163.50	224.50	245.75	367.00	460.75	460.75	470.75	570.50	636.75
S_2G_5	64.50	78.00	90.25	103.75	114.50	109.50	150.50	164.50	199.50	268.50	268.50	276.75	330.00	350.25
S_2G_6	59.00	68.75	79.50	99.25	117.00	120.00	153.50	207.25	231.25	337.75	346.00	346.00	413.50	439.25
S_3G_1	68.00	86.75	94.50	109.25	122.50	125.50	119.50	167.25	216.25	322.75	335.00	338.50	354.00	375.75
S_3G_2	64.50	78.50	89.50	99.00	111.00	111.00	156.25	152.50	195.75	210.50	210.50	212.50	249.25	239.75
S_3G_3	59.25	74.75	85.25	107.50	146.00	148.25	184.75	203.25	242.50	360.50	428.00	441.50	504.00	559.25
S_3G_4	57.25	69.50	78.25	95.75	118.25	124.00	125.75	176.25	240.50	382.25	403.00	403.00	430.75	499.50
S_3G_5	64.75	70.25	76.75	85.00	89.75	89.75	129.75	138.50	168.75	196.50	203.75	203.75	236.50	266.50
S_3G_6	72.25	77.50	88.75	92.50	112.50	114.25	131.25	155.25	184.75	245.50	263.00	263.00	290.25	325.25
S_4G_1	96.50	88.25	102.50	123.75	139.25	139.25	115.50	165.50	148.00	181.50	215.00	230.50	289.00	313.50
S_4G_2	78.00	89.25	100.75	109.50	113.50	113.50	148.00	143.25	165.00	206.25	230.00	234.00	265.00	287.50
S_4G_3	81.00	88.50	94.00	113.75	114.75	114.75	153.50	153.75	174.00	208.25	208.25	215.00	260.75	311.25
S_4G_4	80.75	83.75	98.00	100.50	125.00	125.00	144.00	168.50	164.75	245.25	245.25	255.75	299.00	355.00
S_4G_5	76.00	88.75	99.75	100.25	129.75	129.75	138.00	155.75	143.25	212.25	212.25	225.75	287.75	306.00
S_4G_6	75.50	84.00	104.75	104.50	118.50	118.50	144.25	140.00	164.50	193.50	195.75	196.25	262.00	278.50
CD(0.05)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>N x G interaction</u>														
N_1G_1	78.25	73.00	92.00	103.75	116.25	123.25	139.50	153.75	175.75	210.00	217.50	224.00	243.75	260.25

Contd.

Table 12. Continued

Treatment	Months													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
N_1G_2	64.25	81.50	89.00	107.25	125.00	135.25	155.00	176.25	186.75	218.25	218.25	220.75	244.25	249.75
N_1G_3	69.00	86.25	104.25	124.25	157.00	169.00	224.75	233.50	307.50	367.00	419.50	457.75	517.25	557.25
N_1G_4	67.75	81.50	103.00	107.25	136.00	147.75	193.50	199.75	261.25	354.75	393.00	393.00	476.50	520.25
N_1G_5	72.50	86.75	89.00	101.50	119.50	122.25	130.75	145.25	143.25	206.50	224.25	225.75	281.00	302.25
N_1G_6	61.25	76.00	95.75	97.50	121.00	121.50	157.75	160.50	222.25	251.00	261.50	261.50	301.50	323.75
N_2G_1	67.25	81.00	80.75	104.50	125.25	128.50	100.00	179.00	194.50	264.25	286.50	303.75	352.50	367.75
N_2G_2	53.50	67.25	76.50	80.50	86.75	93.25	152.75	130.75	180.00	183.50	200.75	202.00	248.75	244.00
N_2G_3	48.50	61.50	74.00	92.25	117.25	147.75	187.25	227.25	270.00	370.50	386.75	392.00	459.25	523.00
N_2G_4	62.00	73.50	86.00	98.35	125.25	133.00	174.75	200.50	266.25	345.25	366.00	377.25	379.25	453.00
N_2G_5	61.25	68.00	82.25	89.00	109.75	110.50	148.75	146.25	181.25	203.75	207.00	211.25	238.50	266.50
N_2G_6	67.25	76.25	87.75	96.50	108.00	111.50	153.25	189.75	209.50	297.75	297.75	297.75	333.00	363.25
N_3G_1	63.75	84.00	95.00	117.25	129.75	134.50	132.75	172.75	203.25	253.50	276.75	280.50	306.50	340.25
N_3G_2	71.25	80.25	103.00	114.50	128.25	133.25	143.75	152.50	183.75	221.75	221.75	224.00	237.25	270.50
N_3G_3	61.75	74.50	82.75	104.00	129.75	146.00	198.00	203.75	282.50	369.50	409.50	409.50	466.50	541.25
N_3G_4	71.25	84.50	94.25	109.50	134.25	156.25	175.50	199.50	244.75	340.00	346.50	360.00	414.25	476.75
N_3G_5	64.75	80.00	93.25	98.75	109.50	109.50	152.50	157.75	175.00	221.50	238.25	253.00	305.75	317.75
N_3G_6	69.75	81.00	85.00	98.50	104.50	107.25	109.00	146.50	154.00	223.00	226.75	227.25	275.75	291.75
N_4G_1	52.25	62.25	72.25	74.25	86.75	89.75	102.00	121.25	142.00	210.50	221.50	224.25	262.50	285.25
N_4G_2	61.00	73.50	81.75	108.00	111.50	121.25	146.50	154.75	201.00	224.00	266.00	266.00	285.50	302.50
N_4G_3	60.25	68.50	78.75	96.00	111.50	134.50	189.25	201.75	310.00	312.25	350.25	360.00	385.75	448.75
N_4G_4	56.00	66.25	67.50	94.25	123.75	140.75	170.75	251.00	339.50	407.25	407.25	407.25	494.25	544.25
N_4G_5	57.50	69.00	82.00	88.75	117.75	119.00	139.00	173.50	212.25	261.50	261.50	261.50	295.00	317.75
N_4G_6	61.00	65.75	84.75	94.25	117.75	122.50	147.25	163.25	169.00	251.00	268.50	268.50	345.75	367.00
CD(0.05)	-	-	-	-	-	-	-	-	-	-	-	-	-	-

(517.56 cm²) which was significantly superior to both the concentrations of GA and Ethephon and was on par with BA 1500 ppm (G_4).

All the interactions (S x N, S x G and N x G) tried had no significant influence on total leaf area. The treatment combination of 70 per cent shade + 1 per cent fertilizer complex + 1500 ppm BA ($S_2N_1G_4$) recorded the maximum mean total leaf area (872.00 cm²) while 70 per cent shade + Hoagland solution + 1500 ppm GA ($S_2N_2G_2$) recorded the minimum (225.0 cm²) compared to all the other treatments (Appendix 14).

4.1.7 Number of branches

Data pertaining to the mean number of branches produced by the plant as influenced by shade levels, nutrients, growth regulators and interactions are presented in Table 13 and the per cent increase in the number of branches at monthly interval are presented in Table 14 and Plate 5.

In all the treatments, branching started 6 months after the commencement of the experiment. It was first started under 80 per cent (S_1) and 70 per cent (S_2) shade levels; plants under the other two shade levels 60 per cent (S_3) and 50 per cent (S_4) required additional one month time to produce branches. Branching was significantly different during 6th to 9th and 14th month. During 10th to 13th month, the difference was non significant. The maximum mean number of branches (2.29) was produced under 80 per cent (S_1) shade, which was on par with 70 per cent (S_2) shade and was significantly superior to 60 per cent (S_3) and 50 per cent (S_4) shade levels.

Table 13. Effect of shade, nutrients, growth, regulators and their interactions on number of branches produced by *A. andreanum* var. 'Hawaiian Red' at monthly interval

Treatment	Months								
	6	7	8	9	10	11	12	13	14
<u>Shade (S)</u>									
S_1	0.24	1.61	1.88	2.05	2.71	2.50	2.02	2.15	2.29
S_2	0.09	1.00	1.46	1.66	2.78	2.52	1.84	2.00	2.07
S_3	0.00	0.83	1.52	1.73	2.32	2.47	1.76	1.87	1.75
S_4	0.00	1.05	1.92	2.28	2.69	2.37	1.94	1.78	2.00
CD(0.05)	0.12	0.35	0.31	0.28	-	-	-	-	0.24
<u>Nutrient (N)</u>									
N_1	0.05	1.43	1.69	1.94	2.63	2.41	1.93	1.87	2.13
N_2	0.02	1.01	1.59	1.82	2.48	2.38	1.88	1.96	1.92
N_3	0.16	1.25	1.81	1.98	2.76	2.50	1.89	2.00	2.12
N_4	0.10	0.81	1.69	1.98	2.65	2.57	1.87	1.95	1.96
CD(0.05)	-	0.35	-	-	-	-	-	-	-
<u>Growth regulator (G)</u>									
G_1	0.14	1.52	1.96	2.15	2.98	2.83	2.25	2.23	2.38
G_2	0.15	1.43	1.94	1.23	2.88	2.71	2.14	2.34	2.23
G_3	0.02	1.32	1.80	2.07	2.81	2.59	1.92	1.89	2.05
G_4	0.11	1.24	1.73	1.95	2.83	2.52	1.79	1.81	1.98
G_5	0.04	0.56	1.41	1.67	2.14	2.00	1.65	1.70	1.76
G_6	0.04	0.69	1.33	1.51	2.13	2.14	1.59	1.71	1.80
CD(0.05)	-	0.43	0.38	0.35	0.44	0.39	0.33	0.40	0.30

Contd.

Table 13. Continued

Treatments	Month								
	6	7	8	9	10	11	12	13	14
<u>S x N interaction</u>									
S_1N_1	0.12	1.80	1.88	2.15	2.67	2.43	1.98	2.10	2.45
S_1N_2	0.07	1.33	1.47	1.63	2.28	2.23	1.80	1.95	2.03
S_1N_3	0.40	1.77	1.93	2.05	2.70	2.37	2.17	2.32	2.40
S_1N_4	0.37	1.53	2.23	2.37	3.18	2.97	2.15	2.22	2.28
S_2N_1	0.08	1.43	1.78	2.00	2.72	2.75	2.07	2.12	2.28
S_2N_2	0.00	0.90	1.28	1.53	2.73	2.55	1.70	2.10	2.02
S_2N_3	0.25	1.22	1.50	1.60	3.13	2.62	1.93	1.97	2.12
S_2N_4	0.03	0.47	1.27	1.50	2.55	2.17	1.67	1.80	1.87
S_3N_1	0.00	1.15	1.40	1.57	2.50	2.23	1.80	1.62	1.72
S_3N_2	0.00	0.80	1.58	1.82	2.32	2.50	1.93	2.05	1.62
S_3N_3	0.00	0.95	1.70	1.87	2.25	2.58	1.53	1.77	1.87
S_3N_4	0.00	0.43	1.38	1.67	2.22	2.55	1.78	2.03	1.82
S_4N_1	0.00	1.33	1.68	2.05	2.62	2.23	1.87	1.65	2.05
S_4N_2	0.00	1.00	2.03	2.28	2.57	2.23	2.07	1.73	2.02
S_4N_3	0.00	1.07	2.10	2.40	2.95	2.43	1.93	1.97	2.08
S_4N_4	0.00	0.80	1.87	2.38	2.63	2.58	1.88	1.77	1.87
CD(0.05)	-	-	-	-	-	-	-	-	-
<u>S x G interaction</u>									
S_1G_1	0.35	1.55	1.70	2.07	2.88	2.57	2.10	2.33	2.80
S_1G_2	0.48	2.23	2.33	2.50	3.27	3.15	2.53	2.63	2.83
S_1G_3	0.08	2.15	2.30	2.53	3.23	2.95	2.23	2.48	2.48
S_1G_4	0.23	1.80	2.15	2.20	2.95	2.40	1.90	1.93	1.98

Contd.

Table 13. Continued

Treatments	Month								
	6	7	8	9	10	11	12	13	14
S_1G_5	0.15	0.97	1.58	1.58	1.83	1.70	1.53	1.65	1.65
S_1G_6	0.15	0.95	1.23	1.43	2.10	2.23	1.87	1.87	2.03
S_2G_1	0.20	1.55	1.68	1.90	3.10	2.88	2.30	2.48	3.50
S_2G_2	0.13	1.35	1.65	1.90	2.77	2.55	2.03	2.08	2.15
S_2G_3	0.00	1.13	1.68	1.80	3.05	2.83	1.83	2.00	2.20
S_2G_4	0.23	1.35	1.65	1.80	3.40	2.78	1.80	1.93	2.15
S_2G_5	0.00	0.20	1.00	1.38	2.23	2.02	1.68	1.95	1.78
S_2G_6	0.00	0.45	1.10	1.27	2.15	2.08	1.43	1.55	1.65
S_3G_1	0.00	1.52	2.13	2.18	3.08	3.13	2.57	2.20	2.03
S_3G_2	0.00	0.98	2.05	2.33	2.67	2.70	1.83	2.88	2.00
S_3G_3	0.00	1.07	1.47	1.65	2.43	2.53	1.75	1.43	1.60
S_3G_4	0.00	0.87	1.23	1.50	3.35	2.63	1.70	1.78	1.88
S_3G_5	0.00	0.30	1.15	1.50	1.80	1.83	1.40	1.43	1.48
S_3G_6	0.00	0.25	1.08	1.23	1.60	2.00	1.32	1.50	1.55
S_4G_1	0.00	1.45	2.32	2.55	2.85	2.75	2.03	1.90	2.15
S_4G_2	0.00	1.15	1.75	2.18	2.78	2.43	2.20	1.77	1.93
S_4G_3	0.00	0.93	1.75	2.30	2.52	2.08	1.87	1.68	1.93
S_4G_4	0.00	0.93	1.90	2.30	2.63	2.27	1.78	1.63	1.93
S_4G_5	0.00	0.75	1.90	2.23	2.70	2.45	2.00	1.78	2.13
S_4G_6	0.00	1.10	1.90	2.13	2.68	2.25	1.75	1.93	1.98
CD(0.05)	-	-	-	-	-	-	-	-	-
<u>N x G interaction</u>									
N_1G_1	0.00	2.03	1.95	1.95	2.93	2.70	2.08	2.05	2.57

Contd.

Table 13. Continued

Treatments	Month								
	6	7	8	9	10	11	12	13	14
N_1G_2	0.13	2.00	2.18	2.40	2.78	2.88	2.18	2.23	2.50
N_1G_3	0.00	1.55	1.68	2.13	2.98	3.45	2.08	2.03	2.18
N_1G_4	0.18	1.70	1.98	2.13	3.03	2.68	1.93	1.90	2.05
N_1G_5	0.00	0.48	1.10	1.63	1.98	1.82	1.78	1.45	1.75
N_1G_6	0.00	0.83	1.25	1.43	2.08	1.95	1.55	1.58	1.70
N_2G_1	0.10	1.22	1.98	2.35	3.25	3.03	2.27	2.30	2.08
N_2G_2	0.00	1.55	2.00	2.20	2.90	2.70	2.53	2.63	2.20
N_2G_3	0.00	1.18	1.60	1.75	2.45	2.35	1.90	1.77	1.95
N_2G_4	0.00	1.08	1.55	1.75	2.68	2.35	1.58	1.65	1.93
N_2G_5	0.00	0.53	1.33	1.55	1.75	1.82	1.50	1.90	1.73
N_2G_6	0.00	0.50	1.10	1.30	1.83	2.03	1.48	1.50	1.65
N_3G_1	0.30	1.45	1.95	2.10	2.80	2.75	2.15	2.48	2.57
N_3G_2	0.23	1.10	1.95	1.97	2.83	2.68	1.88	2.02	2.20
N_3G_3	0.08	1.73	2.00	2.15	3.00	2.63	1.78	1.85	1.98
N_3G_4	0.23	1.50	1.90	2.13	3.02	258	1.93	1.82	1.98
N_3G_5	0.08	0.88	1.50	1.75	2.48	2.10	1.73	1.80	1.88
N_3G_6	0.08	0.85	1.55	1.78	2.43	2.27	1.90	2.05	2.10
N_4G_1	0.15	1.38	1.95	2.20	2.93	2.85	2.50	2.08	2.25
N_4G_2	0.25	1.05	1.65	2.32	3.00	2.57	2.00	2.48	2.00
N_4G_3	0.00	0.83	1.93	2.25	2.80	2.95	1.93	1.93	2.10
N_4G_4	0.05	0.68	1.50	1.80	2.60	2.48	1.75	1.88	1.97
N_4G_5	0.08	0.35	1.70	1.75	2.35	2.25	1.60	1.65	1.68
N_4G_6	0.08	0.58	1.40	1.55	2.20	2.30	1.45	1.72	1.75
CD(0.05)	-	-	-	-	-	-	-	-	-

Under the nutrients tried, the difference was significant only in the 7th month; 1 per cent fertilizer complex (17:17:17) (N_1) showed the supremacy over the other nutrients and continued to show the difference till the final stage of the experiment.

The different growth regulators tried, had shown significant difference from the 7th month onwards till the end of the experiment. Application of GA induced maximum branching compared to BA and Ethephon. GA at 750 ppm (G_1) was significantly superior, which recorded the maximum mean number of branches (2.37).

None of the interactions differed significantly. The treatment combination of 80 per cent shade + fertilizer complex + 1500 ppm GA ($S_1N_1G_2$) recorded the maximum mean number of branches (3.8) per plant while control under 70 per cent shade recorded the minimum (1.4) (Appendix 15).

The per cent increase in mean number of branches per plant was significantly influenced by shade, nutrients and growth regulators during 8th month. In addition, among the different shade levels, significant difference was observed during the 10th and 11th months. The shade x nutrient interaction had recorded significant difference only in the 10th month; rest of the interactions had not differed significantly. The maximum per cent increase in branching was recorded one month after the initiation of branching, and generally decreased during the succeeding months.

Table 14. Effect of shade, nutrients, growth regulators and their interactions on per cent increase in production of branches of *A. andreanum* var. `Hawaiian Red' at monthly interva;

Treatment	Months							
	7	8	9	10	11	12	13	14
Shade (S)								
S_1	83.44	15.81	8.71	23.67	-8.94	-24.35	5.58	5.29
S_2	89.91	36.76	12.65	38.85	10.95	-38.60	6.86	3.16
S_3	95.83	48.09	12.54	24.44	4.76	-48.29	0.43	-5.70
S_4	91.67	46.32	15.24	14.16	-15.07	-23.83	-11.62	10.93
CD(0.05)	-	15.91	-	8.94	11.78	-	-	-
Nutrient (N)								
N_1	97.45	20.92	14.18	24.44	-10.98	-24.55	-5.80	10.51
N_2	97.22	36.87	12.14	24.96	-4.12	-31.98	0.91	-2.43
N_3	86.42	32.94	8.57	26.87	-11.08	-37.83	4.99	5.37
N_4	79.75	56.25	14.25	24.85	-4.03	-40.71	1.16	0.22
CD(0.05)	-	15.97	-	-	-	-	-	-
Growth regulator (G)								
G_1	89.39	20.63	9.13	27.20	-5.95	-28.45	-2.71	3.50
G_2	85.42	27.47	11.31	21.78	7.48	-33.82	3.33	-7.01
G_3	99.28	27.91	11.81	25.52	-11.49	-37.67	-5.39	8.07
G_4	86.87	31.16	12.56	30.37	-13.91	-42.21	0.07	8.26
G_5	90.16	61.93	16.24	19.60	-6.91	-22.44	-0.37	2.59
G_6	90.16	51.37	12.66	27.19	0.41	-38.00	6.94	5.11
CD(0.05)	-	19.48	-	-	-	-	-	

Contd.

Table 14. Continued

Treatment	Months							
	7	8	9	10	11	12	13	14
<u>S x N interaction</u>								
S_1N_1	94.70	11.01	17.07	19.02	-11.77	-20.64	4.40	11.12
S_1N_2	88.89	11.51	8.77	26.58	-3.13	-23.85	7.67	4.20
S_1N_3	75.61	9.22	5.97	23.73	-13.63	-11.32	6.55	3.26
S_1N_4	74.56	31.52	3.03	25.34	-7.23	-41.60	3.72	2.58
S_2N_1	95.10	26.05	11.20	21.86	3.05	-32.93	2.43	6.81
S_2N_2	100.00	31.85	16.34	43.27	-6.89	-53.55	16.44	-4.15
S_2N_3	86.76	26.64	7.12	48.91	-21.64	-36.99	1.52	7.18
S_2N_4	77.78	62.50	15.94	41.36	-18.33	-30.91	7.05	2.78
S_3N_1	100.00	24.40	11.61	35.97	-13.20	-23.96	-11.87	5.46
S_3N_2	100.00	50.95	12.10	22.79	7.73	-41.57	-0.65	-23.68
S_3N_3	100.00	45.36	9.34	16.37	12.21	-76.51	13.44	5.36
S_3N_4	83.33	71.65	17.11	22.62	12.28	-51.12	0.81	-9.92
S_4N_1	100.00	22.21	16.83	20.90	-22.01	-20.69	-18.18	18.65
S_4N_2	100.00	53.17	11.35	7.18	-14.18	-8.93	-19.83	13.93
S_4N_3	83.33	50.55	11.84	18.48	-21.26	-26.49	-1.56	5.68
S_4N_4	83.33	59.33	20.93	10.07	-2.85	-39.21	-6.93	5.46
CD(0.05)	-	-	-	17.88	-	-	-	-
<u>S x G interaction</u>								
S_1G_1	68.69	12.27	19.41	27.59	-11.61	-26.34	10.34	15.65
S_1G_2	74.03	4.95	5.93	23.73	-3.54	-24.31	3.33	5.26
S_1G_3	97.12	6.52	8.17	21.33	-9.86	-34.38	10.05	0.00
S_1G_4	89.55	14.77	2.08	25.37	-24.28	-26.02	1.79	2.23

Contd.

Table 14. Continued

Treatment	Months							
	7	8	9	10	11	12	13	14
S_1G_5	85.63	34.34	1.81	11.12	-8.79	-13.10	7.98	0.00
S_1G_6	85.63	22.02	14.86	32.96	4.43	-21.96	0.00	8.60
S_2G_1	88.89	9.38	7.66	42.01	-8.22	-25.54	5.16	0.46
S_2G_2	92.65	19.09	12.73	28.48	-10.43	-25.02	2.17	2.88
S_2G_3	100.00	30.18	5.43	40.23	-8.71	-58.84	9.31	8.93
S_2G_4	82.92	21.21	9.66	47.48	-23.28	-54.92	6.51	9.65
S_2G_5	75.00	80.00	26.60	35.65	-10.20	-21.21	10.65	-8.75
S_2G_6	100.00	60.71	13.81	39.24	-4.87	-46.05	7.35	5.76
S_3G_1	100.00	23.95	1.67	29.36	0.92	-25.01	-16.66	-14.52
S_3G_2	100.00	54.24	10.85	12.80	-0.55	-74.96	31.88	-43.67
S_3G_3	100.00	28.88	9.62	32.02	-0.70	-45.57	-28.62	11.77
S_3G_4	100.00	30.05	19.05	35.48	8.47	-58.12	2.63	5.56
S_3G_5	100.00	73.47	21.84	15.39	1.94	-32.14	1.37	3.35
S_3G_6	75.00	77.95	12.21	21.57	18.44	-53.94	12.00	3.35
S_4G_1	100.00	36.90	7.78	9.85	-4.89	-36.93	-9.66	12.39
S_4G_2	75.00	31.61	15.71	22.10	-15.39	-11.00	-24.07	7.50
S_4G_3	100.00	46.07	24.03	8.60	-26.67	-11.90	-12.31	11.58
S_4G_4	75.00	58.60	19.44	23.15	-16.54	-29.79	-10.64	15.61
S_4G_5	100.00	59.91	14.71	16.24	-10.60	-23.31	-21.48	15.76
S_4G_6	100.00	44.81	9.77	15.00	-16.36	-30.04	8.41	2.72
CD(0.05)	-	-	-	-	-	-	-	-
N x G interaction								
N_1G_1	100.00	-4.82	0.00	31.39	-7.90	-30.43	-2.47	18.56

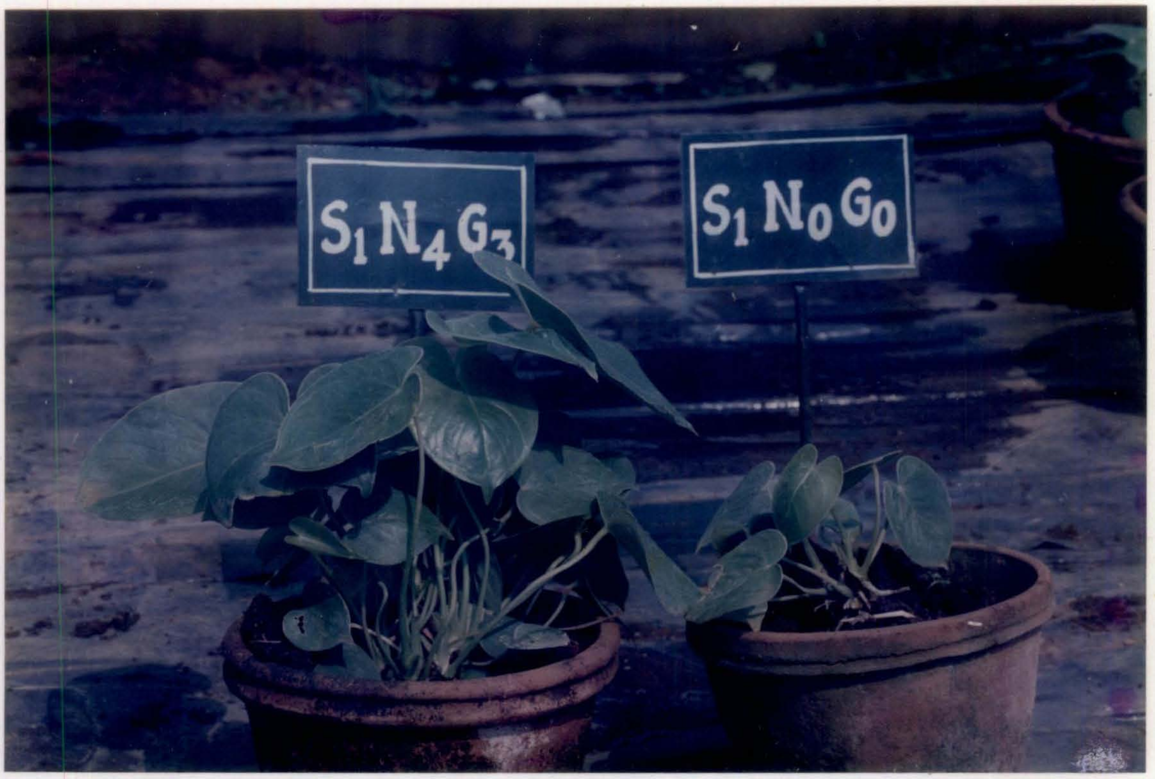
Contd.

Table 14. Continued

Treatment	Months							
	7	8	9	10	11	12	13	14
N_1G_2	92.65	8.88	9.46	13.12	1.97	-32.55	-0.38	9.03
N_1G_3	100.00	11.19	20.48	28.74	-30.16	-16.24	-3.13	6.82
N_1G_4	92.05	14.15	7.54	28.57	-13.62	-39.85	-2.30	7.15
N_1G_5	100.00	57.81	33.33	15.10	-9.67	-1.66	-28.50	14.29
N_1G_6	100.00	38.31	14.26	29.69	-6.52	-26.59	1.94	7.21
N_2G_1	83.33	34.67	18.53	28.47	-7.59	-36.48	-1.82	-15.82
N_2G_2	100.00	22.03	7.80	23.79	-8.63	-8.62	-1.64	-21.59
N_2G_3	100.00	27.74	6.00	29.02	-4.37	-29.85	-15.38	10.53
N_2G_4	100.00	23.70	13.07	33.56	-18.60	-51.76	2.64	12.77
N_2G_5	100.00	62.37	13.10	9.88	5.00	-26.10	19.97	-8.75
N_2G_6	100.00	50.71	7.33	25.02	-5.21	-39.03	1.67	8.30
N_3G_1	81.75	23.92	7.33	24.83	-5.21	-29.43	13.73	3.85
N_3G_2	60.95	41.67	1.32	28.38	-6.01	-64.55	9.38	8.15
N_3G_3	97.12	14.82	6.52	25.96	-14.22	-51.15	1.81	6.08
N_3G_4	88.75	22.86	9.38	28.35	-17.95	-36.72	-6.25	7.77
N_3G_5	95.00	45.21	15.98	26.88	-17.39	-22.08	4.31	3.26
N_3G_6	95.00	49.17	10.97	26.83	-5.70	-23.03	6.94	3.13
N_4G_1	92.50	28.73	10.65	24.11	-3.09	-17.47	-20.27	7.39
N_4G_2	88.10	37.31	26.65	21.81	-17.23	-29.57	5.96	-23.61
N_4G_3	100.00	57.90	14.26	18.38	2.81	-53.44	-4.87	8.85
N_4G_4	66.67	63.93	20.24	31.00	-5.45	-40.51	6.20	5.36
N_4G_5	65.63	82.33	2.56	26.54	-5.59	-39.91	2.75	1.56
N_4G_6	65.63	67.31	11.17	27.23	4.35	-63.34	17.21	1.79
CD(0.05)	-	-	-	-	-	-	-	-

Plate 5. Comparison of branching - the best treatment, $S_1N_1G_1$ (Right) with control (Left)

Plate 6. Treatment with maximum sucker production, $S_1N_4G_3$ and control



$S_1 N_4 G_3$
$S_1 N_0 G_0$

4.1.8 Number of suckers

The effect of shade levels, nutrients and growth regulators on the number of suckers produced per plant and per cent increase in mean number of suckers over the previous month are presented in Tables 15 and 16, respectively (Plate 6).

Different shade levels and nutrients had no significant influence on sucker production; but the growth regulators had significant influence, during the major part of the experimental period, with the exception of initial 2 to 3 months. Both the levels of BA had produced more number of suckers compared to GA and Ethephon levels throughout the experimental period. BA 750 ppm (G_3) produced the maximum mean number of suckers per plant (1.35), which was significantly superior to both the levels of Ethephon and was on par with the higher concentration of BA and both the levels of GA.

The shade x nutrient interaction differed significantly during initial two months and the last two month- period of the experiment. The combined effect of 80 per cent (S_1) shade and Ohio solution (N_4) had shown significant superiority with the highest mean number of suckers (1.73). The other two interactions had failed to show any significant influence.

The combination of 80 per cent shade + Ohio solution + 750 ppm BA ($S_1N_4G_3$) produced the maximum number of suckers per plant (2.5) compared to all other treatments (Appendix 16), and the minimum number (0.3), by the control under 70 per cent shade ($S_2N_0G_0$).

The different shade levels had differed significantly during 8th and 9th months, in per cent increase in sucker production. The effect of growth regulators

Table 15. Effect of shade, nutrients, growth regulators and their interactions on number of suckers produced by *A. andreanum* var. `Hawaiian Red' at monthly interval

Treatments	Month												
	2	3	4	5	6	7	8	9	10	11	12	13	14
Shade (S)													
S_1	0.01	0.01	0.04	0.14	0.31	0.36	0.37	0.47	0.51	0.69	0.72	0.90	1.25
S_2	0.00	0.00	0.04	0.09	0.30	0.33	0.33	0.51	0.56	0.71	0.83	1.03	1.15
S_3	0.00	0.00	0.01	0.04	0.29	0.28	0.31	0.46	0.52	0.63	0.69	0.88	0.98
S_4	0.00	0.00	0.01	0.16	0.42	0.46	0.46	0.46	0.49	0.61	0.65	0.87	1.09
CD(0.05)	-	-	-	-	-	-	-	-	-	-	-	-	-
Nutrient (N)													
N_1	0.00	0.00	0.02	0.12	0.38	0.44	0.44	0.50	0.55	0.70	0.75	0.90	1.05
N_2	0.00	0.00	0.00	0.10	0.31	0.32	0.32	0.48	0.53	0.68	0.73	0.92	1.07
N_3	0.01	0.01	0.02	0.08	0.31	0.33	0.35	0.44	0.45	0.62	0.70	0.91	1.15
N_4	0.00	0.00	0.06	0.13	0.31	0.35	0.37	0.48	0.55	0.65	0.71	0.92	1.20
CD(0.05)	-	-	-	0.009	0.15	-	-	-	-	-	-	-	-
Growth regulator (G)													
G_1	0.00	0.01	0.04	0.11	0.38	0.36	0.38	0.49	0.55	0.68	0.75	0.97	1.16
G_2	0.00	0.00	0.01	0.12	0.40	0.44	0.46	0.53	0.56	0.69	0.74	0.96	1.19
G_3	0.00	0.01	0.01	0.11	0.40	0.45	0.46	0.62	0.64	0.79	0.85	1.11	1.35
G_4	0.00	0.00	0.04	0.14	0.44	0.46	0.49	0.60	0.73	0.87	0.97	1.22	1.31
G_5	0.01	0.01	0.02	0.04	0.18	0.21	0.21	0.28	0.31	0.42	0.44	0.59	0.79
G_6	0.01	0.01	0.03	0.13	0.17	0.22	0.22	0.33	0.34	0.52	0.55	0.67	0.89
CD(0.05)	-	-	0.006	-	0.19	0.18	0.18	0.17	0.20	0.23	0.23	0.23	0.27

Contd.

Table 15. Continued

Treatments	Month												
	2	3	4	5	6	7	8	9	10	11	12	13	14
<u>S x N interaction</u>													
S_1N_1	0.00	0.00	0.00	0.08	0.23	0.35	0.37	0.40	0.40	0.68	0.68	0.73	0.75
S_1N_2	0.00	0.00	0.00	0.20	0.25	0.32	0.32	0.38	0.42	0.58	0.62	0.88	1.13
S_1N_3	0.03	0.02	0.03	0.08	0.33	0.33	0.33	0.53	0.57	0.70	0.70	0.82	1.37
S_1N_4	0.00	0.02	0.12	0.18	0.42	0.45	0.45	0.55	0.67	0.80	0.88	1.17	1.73
S_2N_1	0.00	0.00	0.03	0.10	0.33	0.38	0.38	0.55	0.73	0.87	1.00	1.17	1.33
S_2N_2	0.00	0.00	0.00	0.05	0.22	0.27	0.27	0.50	0.50	0.73	0.77	0.93	1.05
S_2N_3	0.00	0.02	0.03	0.10	0.40	0.42	0.42	0.53	0.53	0.60	0.73	0.92	1.08
S_2N_4	0.00	0.00	0.08	0.12	0.23	0.27	0.27	0.45	0.48	0.65	0.80	1.08	1.12
S_3N_1	0.00	0.00	0.00	0.05	0.48	0.50	0.50	0.52	0.52	0.63	0.67	0.95	0.98
S_3N_2	0.00	0.00	0.00	0.03	0.25	0.18	0.18	0.52	0.65	0.78	0.90	0.98	1.17
S_3N_3	0.00	0.00	0.00	0.03	0.20	0.20	0.27	0.32	0.35	0.52	0.58	0.73	0.87
S_3N_4	0.00	0.00	0.03	0.03	0.22	0.22	0.30	0.48	0.57	0.57	0.60	0.83	0.90
S_4N_1	0.00	0.00	0.03	0.23	0.47	0.52	0.54	0.52	0.55	0.63	0.63	0.85	1.12
S_4N_2	0.00	0.02	0.02	0.13	0.52	0.52	0.52	0.52	0.57	0.60	0.63	0.87	0.92
S_4N_3	0.00	0.00	0.00	0.10	0.30	0.37	0.37	0.37	0.37	0.65	0.78	1.17	1.28
S_4N_4	0.00	0.00	0.00	0.17	0.38	0.45	0.45	0.45	0.48	0.57	0.57	0.60	1.05
CD(0.05)	-	0.003	0.10	-	-	-	-	-	-	-	-	0.38	0.44
<u>S x G interaction</u>													
S_1G_1	0.00	0.03	0.15	0.05	0.30	0.33	0.33	0.38	0.43	0.55	0.58	0.70	0.95
S_1G_2	0.00	0.00	0.00	0.18	0.33	0.45	0.45	0.58	0.65	0.70	0.73	0.85	1.38
S_1G_3	0.00	0.00	0.00	0.20	0.53	0.55	0.58	0.70	0.73	0.92	0.92	1.23	1.68
S_1G_4	0.00	0.00	0.03	0.18	0.45	0.48	0.48	0.58	0.75	1.03	1.03	1.30	1.47

Contd.

Table 15. Continued

Treatments	Month												
	2	3	4	5	6	7	8	9	10	11	12	13	14
S_1G_5	0.03	0.00	0.03	0.05	0.08	0.18	0.18	0.23	0.23	0.38	0.45	0.58	0.85
S_1G_6	0.03	0.03	0.03	0.18	0.18	0.20	0.20	0.35	0.30	0.58	0.63	0.75	1.15
S_2G_1	0.00	0.00	0.00	0.08	0.30	0.30	0.30	0.55	0.55	0.65	0.75	1.08	1.18
S_2G_2	0.00	0.00	0.03	0.10	0.35	0.35	0 35	0.38	0.38	0.60	0.75	0.93	0.93
S_2G_3	0.00	0.00	0.03	0.05	0.33	0.33	0.33	0.72	0.80	0.97	1.08	1.28	1.55
S_2G_4	0.00	0.00	0.08	0.23	0.53	0.58	0.58	0.73	0.93	1.00	1.25	1.55	1.55
S_2G_5	0.00	0.00	0.03	0.03	0.15	0.18	0.18	0.33	0.35	0.50	0.55	0.67	0.90
S_2G_6	0.00	0.00	0.08	0.08	0.13	0.28	0.28	0.35	0.38	0.55	0.58	0.65	0.78
S_3G_1	0.00	0.00	0.00	0.10	0.48	0.35	0.40	0.55	0.75	0.95	1.08	1.28	1.40
S_3G_2	0.00	0.00	0.00	0.03	0.38	0.38	0.43	0.55	0.63	0.83	0.83	1.10	1.15
S_3G_3	0.00	0.00	0.03	0.03	0.38	0.38	0.40	0.50	0.50	0.63	0.70	0.95	1.05
S_3G_4	0.00	0.00	0.00	0.03	0.33	0.35	0.45	0.65	0.68	0.72	0.78	0.95	1.08
S_3G_5	0.00	0.00	0.03	0.03	0.15	0.15	0.15	0.23	0.25	0.28	0.35	0.45	0.60
S_3G_6	0.00	0.00	0.00	0.03	0.03	0.05	0.05	0.28	0.33	0.35	0.40	0.53	0.60
S_4G_1	0.00	0.00	0.03	0.20	0.43	0.48	0.48	0.48	0.48	0.55	0.60	0.83	1.10
S_4G_2	0.00	0.00	0.00	0.18	0.55	0.60	0.60	0.60	0.60	0.65	0.67	0.95	1.33
S_4G_3	0.00	0.03	0.00	0.15	0.38	0.55	0.55	0.55	0.55	0.63	0.70	0.98	1.13
S_4G_4	0.00	0.00	0.05	0.13	0.45	0.45	0.45	0.45	0.58	0.73	0.82	1.08	1.15
S_4G_5	0.00	0.00	0.00	0.05	0.35	0.35	0.35	0.35	0.40	0.53	0.53	0.65	0.80
S_4G_6	0.00	0.00	0.00	0.25	0.35	0.35	0.35	0.35	0.35	0.60	0.60	0.75	1.05
CD(0.05)	-	0.03	-	-	-	-	-	-	-	-	-	-	-
N x G interaction													
N_1G_1	0.00	0.00	0.03	0.05	0.30	0.33	0.33	0.43	0.43	0.60	0.63	0.90	0.95

Contd.

Table 15. Continued

Treatments	Month												
	2	3	4	5	6	7	8	9	10	11	12	13	14
N_1G_2	0.00	0.00	0.03	0.05	0.45	0.48	0.48	0.48	0.48	0.65	0.73	0.93	1.10
N_1G_3	0.00	0.00	0.03	0.20	0.58	0.65	0.67	0.83	0.90	1.10	1.13	1.20	1.40
N_1G_4	0.00	0.00	0.03	0.15	0.58	0.58	0.58	0.63	0.83	1.03	1.10	1.45	1.50
N_1G_5	0.00	0.00	0.00	0.08	0.23	0.33	0.33	0.33	0.35	0.40	0.45	0.50	0.73
N_1G_6	0.00	0.00	0.00	0.18	0.15	0.28	0.28	0.30	0.33	0.45	0.45	0.58	0.80
N_2G_1	0.00	0.00	0.00	0.13	0.63	0.50	0.50	0.63	0.78	0.92	1.07	1.20	1.37
N_2G_2	0.00	0.00	0.00	0.08	0.25	0.35	0.35	0.43	0.50	0.67	0.70	1.00	1.18
N_2G_3	0.00	0.03	0.00	0.13	0.25	0.25	0.25	0.53	0.53	0.65	0.68	1.05	1.30
N_2G_4	0.00	0.00	0.03	0.10	0.28	0.35	0.35	0.53	0.63	0.75	0.83	1.03	1.13
N_2G_5	0.00	0.00	0.00	0.00	0.20	0.23	0.23	0.38	0.38	0.53	0.53	0.58	0.65
N_2G_6	0.00	0.00	0.00	0.20	0.25	0.25	0.25	0.40	0.40	0.53	0.58	0.65	0.78
N_3G_1	0.00	0.00	0.00	0.15	0.25	0.25	0.28	0.40	0.43	0.58	0.63	0.88	1.07
N_3G_2	0.00	0.00	0.00	0.15	0.45	0.50	0.53	0.65	0.65	0.83	0.85	1.03	1.15
N_3G_3	0.00	0.00	0.00	0.03	0.35	0.40	0.40	0.48	0.50	0.63	0.80	1.08	1.47
N_3G_4	0.00	0.00	0.03	0.08	0.53	0.53	0.58	0.63	0.63	0.78	1.00	1.25	1.38
N_3G_5	0.03	0.03	0.03	0.00	0.13	0.13	0.13	0.20	0.20	0.40	0.40	0.55	0.85
N_3G_6	0.03	0.03	0.05	0.08	0.15	0.18	0.18	0.28	0.33	0.50	0.53	0.67	0.98
N_4G_1	0.00	0.03	0.15	0.10	0.33	0.38	0.40	0.50	0.58	0.60	0.67	0.90	1.25
N_4G_2	0.00	0.00	0.00	0.20	0.45	0.45	0.48	0.55	0.63	0.63	0.70	0.88	1.35
N_4G_3	0.00	0.00	0.03	0.08	0.43	0.50	0.53	0.65	0.65	0.78	0.80	1.10	1.43
N_4G_4	0.00	0.00	0.08	0.23	0.38	0.40	0.45	0.63	0.85	0.93	0.95	1.15	1.25
N_4G_5	0.00	0.00	0.05	0.08	0.18	0.18	0.18	0.23	0.30	0.35	0.50	0.73	0.93
N_4G_6	0.00	0.00	0.05	0.08	0.13	0.18	0.18	0.35	0.30	0.60	0.65	0.78	1.03
CD(0.05)	-	0.004	-	-	-	-	-	-	-	-	-	-	-

Table 16. Effect of shade, nutrients, growth regulators and their interactions on per cent increase in sucker production of *A. andreanum* var. 'Hawaiian Red' at monthly interval

Treatments	Month												
	2	3	4	5	6	7	8	9	10	11	12	13	14
Shade (S)													
S_1	8.33	4.17	11.81	31.25	40.96	15.28	0.83	25.44	-1.77	27.32	4.75	17.93	24.12
S_2	0.00	4.17	29.17	33.33	69.97	11.04	0.00	34.17	5.98	21.04	12.95	19.05	10.54
S_3	0.00	0.00	8.33	25.00	67.78	-1.04	10.14	29.70	10.65	16.73	9.80	20.92	11.23
S_4	0.00	4.17	12.50	68.75	60.87	9.72	0.00	0.00	5.75	18.47	4.63	22.67	18.52
CD(0.05)	-	-	-	-	-	-	5.26	18.49	-	-	-	-	-
Nutrient (N)													
N_1	0.00	0.00	16.67	50.00	60.27	16.32	0.83	7.92	6.24	24.67	5.56	18.32	11.64
N_2	0.00	4.17	4.17	50.00	61.33	4.79	0.00	34.31	6.39	20.75	5.62	19.51	12.24
N_3	8.33	4.17	12.50	41.67	63.17	7.64	4.10	21.77	5.46	22.98	9.79	22.77	19.93
N_4	0.00	4.17	28.47	16.67	54.80	6.25	6.04	25.31	2.53	15.16	11.17	19.97	20.60
CD(0.05)	-	-	-	-	-	-	-	-	-	-	-	-	-
Growth regulator (G)													
G_1	0.00	6.25	11.46	31.25	69.50	-3.65	3.65	20.70	7.05	19.05	7.16	22.95	15.42
G_2	0.00	0.00	6.25	56.25	70.16	9.58	2.81	14.10	5.54	17.28	7.42	20.93	15.89
G_3	0.00	6.25	12.50	46.88	61.31	10.94	4.38	27.02	2.46	17.45	8.24	22.39	15.25
G_4	0.00	0.00	31.25	46.87	70.37	7.19	5.63	16.84	13.07	14.94	9.00	20.05	7.16
G_5	6.25	6.25	18.75	18.75	67.71	8.13	0.00	23.54	7.81	28.68	10.95	17.13	23.95
G_6	6.25	0.00	12.50	37.50	20.31	20.31	0.00	31.77	-5.00	27.95	5.43	17.40	18.94
CD(0.05)	-	-	-	-	32.13	-	-	-	-	-	-	-	-

Contd.

Table 16. Continued

Treatments	Month												
	2	3	4	5	6	7	8	9	10	11	12	13	14
S x N interaction													
S_1N_1	0.00	0.00	0.00	33.33	50.00	38.89	3.33	6.67	0.00	35.52	0.00	3.85	2.78
S_1N_2	0.00	0.00	0.00	66.67	12.50	16.67	0.00	26.67	5.56	29.17	4.23	28.86	20.30
S_1N_3	33.33	0.00	16.67	50.00	67.13	0.00	0.00	44.72	5.16	17.22	0.00	15.41	40.02
S_1N_4	0.00	16.67	30.56	-25.00	34.20	5.56	0.00	23.70	-17.78	27.38	14.76	23.59	33.37
S_2N_1	0.00	0.00	33.33	41.67	78.47	12.50	0.00	19.44	20.20	16.83	11.12	13.45	17.29
S_2N_2	0.00	0.00	0.00	50.00	81.94	15.00	0.00	43.15	0.00	33.70	3.52	15.81	10.05
S_2N_3	0.00	16.67	33.33	33.33	57.78	8.33	0.00	32.64	0.00	12.69	14.77	21.90	11.48
S_2N_4	0.00	0.00	50.00	8.33	61.67	8.33	0.00	41.43	3.70	20.95	22.40	25.03	3.33
S_3N_1	0.00	0.00	0.00	50.00	60.95	8.33	0.00	5.56	0.00	30.62	11.11	28.52	4.62
S_3N_2	0.00	0.00	0.00	16.67	79.63	-12.50	0.00	67.42	12.85	16.20	11.71	8.89	14.33
S_3N_3	0.00	0.00	0.00	33.33	69.44	0.00	16.39	9.72	16.67	20.08	8.89	21.28	19.60
S_3N_4	0.00	0.00	33.33	0.00	61.11	0.00	24.17	36.11	13.10	0.00	7.50	25.01	6.37
S_4N_1	0.00	0.00	33.33	75.00	51.67	5.56	0.00	0.00	4.76	15.71	0.00	27.46	21.86
S_4N_2	0.00	16.67	16.67	66.67	71.25	0.00	0.00	0.00	7.14	3.94	3.03	24.47	4.29
S_4N_3	0.00	0.00	0.00	50.00	58.33	22.22	0.00	0.00	0.00	41.94	15.51	32.49	8.61
S_4N_4	0.00	0.00	0.00	83.33	62.22	11.11	0.00	0.00	11.11	12.30	0.00	6.25	39.32
CD(0.05)	-	-	-	-	-	-	10.52	-	-	-	-	-	23.64
S x G interaction													
S_1G_1	0.00	25.00	20.83	-100.00	85.42	8.33	0.00	10.00	10.42	17.50	2.78	14.96	20.63
S_1G_2	0.00	0.00	0.00	50.00	41.07	30.00	0.00	20.56	10.83	7.14	3.57	14.64	32.29
S_1G_3	0.00	0.00	0.00	100.00	41.48	2.08	5.00	23.33	3.57	17.21	0.00	24.55	23.34
S_1G_4	0.00	0.00	25.00	62.50	52.78	6.25	0.00	17.50	14.58	27.08	0.00	22.44	11.31

Contd.

Table 16. Continued

Treatments	Month												
	2	3	4	5	6	7	8	9	10	11	12	13	14
S_1G_5	25.00	0.00	25.00	50.00	25.00	20.00	0.00	37.50	0.00	43.75	15.00	17.71	26.30
S_1G_6	25.00	0.00	0.00	25.00	0.00	25.00	0.00	43.75	-50.00	51.25	7.14	13.26	30.83
S_2G_1	0.00	0.00	0.00	75.00	62.50	0.00	0.00	47.50	0.00	14.82	11.65	30.83	9.30
S_2G_2	0.00	0.00	25.00	50.00	79.17	0.00	0.00	12.50	0.00	34.52	23.33	19.38	0.00
S_2G_3	0.00	0.00	25.00	12.50	83.33	0.00	0.00	57.65	6.25	18.85	8.99	15.26	15.88
S_2G_4	0.00	0.00	50.00	62.50	57.29	0.00	0.00	20.68	16.27	7.32	20.36	19.17	0.00
S_2G_5	0.00	25.00	25.00	0.00	87.50	12.50	0.00	41.67	8.33	25.71	7.14	18.95	23.68
S_2G_6	0.00	0.00	50.00	0.00	50.00	43.75	0.00	25.00	5.00	25.00	6.25	10.71	14.38
S_3G_1	0.00	0.00	0.00	75.00	76.94	-31.25	14.58	25.30	17.79	23.61	9.69	16.86	8.55
S_3G_2	0.00	0.00	0.00	25.00	91.67	0.00	11.25	23.33	11.31	21.19	0.00	24.51	4.01
S_3G_3	0.00	0.00	25.00	0.00	75.00	0.00	12.50	27.08	0.00	18.75	14.58	26.48	8.33
S_3G_4	0.00	0.00	0.00	25.00	96.43	12.50	22.50	29.17	3.57	5.56	4.55	18.32	11.90
S_3G_5	0.00	0.00	25.00	0.00	66.67	0.00	0.00	15.00	6.25	25.00	21.67	15.63	27.78
S_3G_6	0.00	0.00	0.00	25.00	0.00	12.50	0.00	58.33	25.00	6.25	8.30	23.75	6.82
S_4G_1	0.00	0.00	25.00	75.00	53.13	8.33	0.00	0.00	0.00	20.28	4.55	29.17	23.21
S_4G_2	0.00	0.00	0.00	100.00	68.75	8.33	0.00	0.00	0.00	6.25	2.78	25.18	27.27
S_4G_3	0.00	25.00	0.00	75.00	45.42	41.67	0.00	0.00	0.00	15.00	9.38	23.25	13.45
S_4G_4	0.00	0.00	50.00	37.50	75.00	0.00	0.00	0.00	17.86	19.79	11.11	20.28	5.42
S_4G_5	0.00	0.00	0.00	25.00	91.67	0.00	0.00	0.00	16.67	20.24	0.00	16.25	18.06
S_4G_6	0.00	0.00	0.00	100.00	31.25	0.00	0.00	0.00	0.00	29.29	0.00	21.88	23.72
CD(0.05)	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>N x G interaction</u>													
N_1G_1	0.00	0.00	25.00	50.00	88.75	8.33	0.00	12.50	0.00	28.61	2.27	29.58	5.13

Contd.

Table 16. Continued

Treatments	Month												
	2	3	4	5	6	7	8	9	10	11	12	13	14
N_1G_2	0.00	0.00	25.00	25.00	91.67	5.00	0.00	0.00	0.00	27.38	8.33	19.17	12.64
N_1G_3	0.00	0.00	25.00	62.50	50.00	8.33	5.00	16.67	16.25	17.21	1.67	5.77	0.00
N_1G_4	0.00	0.00	25.00	65.50	77.05	0.00	0.00	10.00	17.86	20.00	4.41	25.39	3.33
N_1G_5	0.00	0.00	0.00	50.00	41.67	20.00	0.00	0.00	8.33	28.57	16.67	12.50	25.56
N_1G_6	0.00	0.00	0.00	50.00	12.50	56.25	0.00	8.33	5.00	26.25	0.00	17.50	23.16
N_2G_1	0.00	0.00	0.00	100.00	78.82	-31.25	0.00	19.05	11.54	18.85	12.01	12.05	12.30
N_2G_2	0.00	0.00	0.00	50.00	54.17	25.00	0.00	15.00	12.50	24.11	3.57	30.00	11.65
N_2G_3	0.00	25.00	0.00	50.00	60.00	0.00	0.00	51.61	0.00	15.63	2.78	32.77	19.35
N_2G_4	0.00	0.00	25.00	50.00	66.67	22.50	0.00	26.04	14.29	17.71	7.05	21.40	9.23
N_2G_5	0.00	0.00	0.00	0.00	75.00	12.50	0.00	52.50	0.00	29.46	0.00	8.33	9.13
N_2G_6	0.00	0.00	0.00	50.00	33.33	0.00	0.00	41.67	0.00	18.75	8.33	12.50	11.82
N_3G_1	0.00	0.00	0.00	75.00	37.50	0.00	8.33	32.92	4.17	23.75	5.00	29.36	17.34
N_3G_2	0.00	0.00	0.00	100.00	64.58	8.33	6.25	23.33	0.00	17.61	2.78	16.07	10.42
N_3G_3	0.00	0.00	0.00	25.00	68.75	25.00	0.00	11.46	3.57	24.03	22.25	25.17	22.29
N_3G_4	0.00	0.00	25.00	25.00	89.44	0.00	10.00	6.67	0.00	13.33	22.47	21.50	9.72
N_3G_5	25.00	25.00	25.00	0.00	100.00	0.00	0.00	29.17	0.00	39.17	0.00	17.14	39.03
N_3G_6	25.00	0.00	25.00	25.00	18.75	12.50	0.00	27.08	25.00	20.00	6.25	27.38	20.77
N_4G_1	0.00	25.00	20.83	-100.00	72.92	8.33	6.35	18.33	12.50	5.00	9.38	20.83	26.92
N_4G_2	0.00	0.00	0.00	50.00	70.24	0.00	5.00	18.06	9.64	0.00	15.00	18.47	28.87
N_4G_3	0.00	0.00	25.00	50.00	66.48	10.42	12.50	28.33	20.00	12.95	6.25	25.84	19.36
N_4G_4	0.00	0.00	50.00	50.00	48.33	6.25	12.50	24.64	20.14	8.71	2.08	11.90	6.35
N_4G_5	0.00	0.00	50.00	25.00	54.17	0.00	0.00	12.50	22.92	17.50	27.14	30.56	22.10
N_4G_6	0.00	0.00	25.00	25.00	16.67	12.50	0.00	50.00	-50.00	46.79	7.14	12.22	20.00
CD(0.05)	-	-	-	-	-	-	-	-	-	-	-	-	-

were significantly different only in the 6th month. The shade x nutrient interaction has shown significant difference during 8th and 14th months. The different nutrients, shade x growth regulator and nutrient x growth regulator interactions did not differ significantly. The maximum per cent increase in sucker production was restricted to 4th, 5th and 6th month period (rainy season).

4.1.9 Growth rate

Growth rate of anthurium plants under the influence of different levels of shade, nutrient and growth regulator combinations was studied by employing linear growth model and compound growth model. The R^2 values were worked out with compound growth model for five important characters, viz., plant height, number of leaves, leaf area, number of suckers and number of branches produced by plant and the data related to these are presented in Table 17. The observed and predicted values and regression equations of the best treatments with respect to height, number of leaves and leaf area are presented in Table 18 and depicted in Figure 4 (Plates 7 and 8).

4.1.9.1 Plant height

Significantly tall plants were produced by the treatment combination involving 60 per cent shade + Hoagland solution + 750 ppm BA (12.20%), while the growth rate was minimum (0.71%), under the treatment combination of 70 per cent shade + fertilizer complex + 1500 ppm GA. R^2 value was the maximum (0.97) in 70 per cent shade + Hoagland solution + 1500 ppm Ethephon ($S_2N_2G_6$) while, it was the minimum (0.57) in 60per cent shade + Hoagland solution + 750 BA ($S_3N_2G_3$).

Table 17. Growth behaviour of *A. andreanum* var. 'Hawaiian Red' as influenced by shade, nutrients and growth regulators

Treatment	Plant height			Number of leaves			Leaf area			Number of suckers			Number of branches		
	Linear growth rate (%)	Compound growth rate (%)	R2*	Linear growth rate (%)	Compound growth rate (%)	R2	Linear growth rate (%)	Compount growth rate (%)	R2	Linear growth rate (%)	Compund growth rate (%)	R2	Linear growth rate (%)	Compound growth rate (%)	R2
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
$S_1N_0G_0$	17.18	8.39	0.90	0.77	0.93	0.04	185.38	18.30	0.93	32.50	1.62	0.66	6.90	11.68	0.78
$S_2N_0G_0$	16.40	8.39	0.96	7.54	5.68	0.51	130.12	18.58	0.92	7.33	1.62	0.22	1.50	1.59	0.03
$S_3N_0G_0$	17.96	9.65	0.92	0.32	0.46	0.01	254.62	16.41	0.83	2.22	-0.46	0.01	15.43	11.17	0.67
$S_4N_0G_0$	15.00	8.39	0.94	3.74	3.03	0.50	17.22	8.39	0.71	2.80	-0.46	0.06	2.18	-3.84	0.11
$S_1N_1G_1$	5.72	4.47	0.83	3.41	3.03	0.28	6.38	4.95	0.47	4.54	-2.28	0.59	9.35	-0.00	0.00
$S_1N_1G_2$	5.89	4.47	0.78	7.06	5.44	0.60	9.16	6.66	0.59	4.28	-3.39	0.39	3.05	-9.22	0.29
$S_1N_1G_3$	17.19	8.39	0.86	18.71	9.14	0.96	93.50	14.29	0.92	6.02	-2.95	0.21	5.08	-5.59	0.40
$S_1N_1G_4$	15.13	7.89	0.93	16.20	8.39	0.85	67.13	14.29	0.86	5.23	-4.06	0.32	5.36	1.39	0.09
$S_1N_1G_5$	12.35	7.39	0.94	3.78	3.28	0.69	2.79	15.34	0.93	8.04	-0.92	0.05	1.68	10.66	0.78
$S_1N_1G_6$	15.54	8.14	0.94	2.52	2.33	0.36	36.64	12.98	0.77	2.76	-2.95	0.53	67.74	-5.16	0.28
$S_1N_2G_1$	8.48	5.92	0.84	14.45	7.65	0.94	18.36	9.14	0.87	3.22	-1.60	0.11	4.74	2.80	0.07
$S_1N_2G_2$	9.98	6.41	0.81	14.75	7.65	0.98	22.78	9.14	0.88	0.44	-0.23	0.02	67.25	10.66	0.46
$S_1N_2G_3$	12.06	6.90	0.92	30.62	10.92	0.94	200.26	16.68	0.90	2.90	2.09	0.04	3.03	-3.39	0.26
$S_1N_2G_4$	17.08	8.14	0.91	5.54	4.47	0.62	200.17	17.76	0.93	28.57	3.99	0.84	4.21	6.41	0.29
$S_1N_2G_5$	16.51	8.14	0.92	8.42	5.92	0.82	77.95	13.50	0.90	3.85	4.71	0.74	8.67	6.41	0.37
$S_1N_2G_6$	16.98	7.89	0.87	17.18	8.14	0.86	200.51	15.61	0.93	3.21	2.09	0.15	5.65	-2.72	0.25

*Coefficient of determination as obtained from the compound growth model

Contd.

Table 17. Continued

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
$S_1N_3G_1$	11.46	3.99	0.61	9.71	6.41	0.82	9.78	6.17	0.84	0.83	1.16	0.06	5.21	8.39	0.65
$S_1N_3G_2$	6.09	5.92	0.66	7.10	5.19	0.99	23.12	8.89	0.72	1.31	-0.46	0.00	2.11	-2.05	0.10
$S_1N_3G_3$	9.02	8.39	0.83	38.58	11.94	0.83	600.03	16.68	0.93	6.69	-2.73	0.08	89.54	0.46	0.01
$S_1N_3G_4$	15.84	9.14	0.91	24.89	10.41	0.22	29.11	10.66	0.85	4.32	-4.72	0.25	56.87	7.89	0.27
$S_1N_3G_5$	14.30	8.39	0.91	12.61	7.40	0.66	45.21	12.20	0.92	4.00	-1.60	0.08	2.76	-3.84	0.46
$S_1N_3G_6$	15.69	5.92	0.58	19.05	8.89	0.71	30.02	9.14	0.79	9.39	-3.39	0.25	6.14	-0.00	0.00
$S_1N_4G_1$	8.34	6.41	0.81	17.11	8.64	0.91	19.40	8.39	0.81	4.33	-1.82	0.15	1.36	7.40	0.55
$S_1N_4G_2$	9.03	8.64	0.94	24.76	10.66	0.95	43.48	12.46	0.91	2.87	-0.92	0.04	3.70	-3.17	0.53
$S_1N_4G_3$	14.97	9.14	0.84	55.68	13.50	0.91	200.78	14.81	0.91	6.93	0.23	0.10	1.67	3.04	0.10
$S_1N_4G_4$	16.09	11.17	0.95	43.99	12.98	0.88	255.82	18.85	0.90	7.00	0.23	0.01	2.88	4.71	0.13
$S_1N_4G_5$	28.52	9.39	0.93	10.86	7.15	0.76	448.97	15.88	0.89	72.31	0.69	0.00	3.41	-2.05	0.10
$S_1N_4G_6$	24.29	8.39	0.83	23.40	9.65	0.82	9.65	6.17	0.74	133.33	7.40	0.69	6.60	10.66	0.60
$S_2N_1G_1$	13.06	6.41	0.86	18.19	8.89	0.92	23.54	6.90	0.78	4.49	9.14	0.94	7.72	10.15	0.35
$S_2N_1G_2$	7.56	0.71	0.81	7.27	9.44	0.73	162.87	9.90	0.86	3.13	3.99	0.36	1.75	-1.59	0.13
$S_2N_1G_3$	9.15	6.66	0.79	23.07	10.15	0.88	14.91	15.08	0.84	3.94	1.86	0.07	28.30	10.41	0.40
$S_2N_1G_4$	10.29	7.39	0.88	27.10	11.43	0.95	767.16	13.76	0.85	4.31	-2.73	0.02	3.39	-7.96	0.35
$S_2N_1G_5$	13.83	9.39	0.90	11.96	6.91	0.93	83.04	16.41	0.92	6.20	-1.37	0.05	4.67	-1.59	0.04
$S_2N_1G_6$	19.03	9.90	0.88	25.38	9.65	0.96	8.82	15.08	0.87	4.04	-3.17	0.43	0.15	10.41	0.64
$S_2N_2G_1$	20.25	6.17	0.75	26.92	9.65	0.80	5.73	5.68	0.54	3.42	-2.95	0.22	1.29	-5.59	0.33
$S_2N_2G_2$	12.99	5.92	0.81	6.67	4.95	0.30	256.57	3.99	0.32	6.05	-2.50	0.19	4.89	1.16	0.03
$S_2N_2G_3$	8.55	9.14	0.87	13.23	7.89	0.72	34.54	17.49	0.88	2.82	4.06	0.31	2.02	10.15	0.42
$S_2N_2G_4$	12.97	8.89	0.87	23.66	10.41	0.84	34.96	11.43	0.82	6.47	-2.28	0.11	24.04	-5.59	0.47
$S_2N_2G_5$	16.98	7.65	0.87	12.97	7.40	0.72	147.99	11.17	0.79	4.13	1.37	0.05	3.84	4.23	0.13

Contd.

Table 17. Continued

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
$S_2N_2G_6$	13.31	8.39	0.97	12.76	7.65	0.74	16.86	14.29	0.94	62.86	0.92	0.02	222.85	-6.03	0.70
$S_2N_3G_1$	13.13	6.66	0.86	10.36	6.91	0.73	5.38	8.64	0.78	30.00	1.86	0.12	46.67	0.92	0.02
$S_2N_3G_2$	11.77	7.39	0.93	6.55	5.20	0.55	416.74	3.99	0.66	20.00	5.92	0.66	2.06	12.72	0.03
$S_2N_3G_3$	11.14	8.64	0.83	15.51	8.39	0.93	410.86	16.14	0.94	1.85	5.20	0.86	148.75	-4.28	0.27
$S_2N_3G_4$	15.49	9.39	0.92	14.68	8.39	0.80	58.13	15.88	0.92	1.54	4.95	0.33	249.00	2.56	0.07
$S_2N_3G_5$	18.08	9.39	0.90	8.48	5.68	0.80	40.77	12.98	0.92	2.86	2.33	0.18	67.45	8.14	0.30
$S_2N_3G_6$	17.47	5.44	0.90	5.14	4.23	0.43	27.87	12.46	0.83	2.58	0.00	0.00	10.39	-3.62	0.31
$S_2N_4G_1$	18.25	8.89	0.94	20.82	8.89	0.89	11.63	9.65	0.90	8.14	-2.28	0.07	3.15	11.43	0.74
$S_2N_4G_2$	15.37	8.39	0.88	2.94	2.56	0.44	28.63	7.15	0.61	5.56	-1.10	0.04	7.58	12.20	0.47
$S_2N_4G_3$	23.48	8.64	0.90	20.26	9.65	0.86	9.69	15.34	0.93	5.22	-3.00	0.19	6.02	-2.95	0.09
$S_2N_4G_4$	11.64	8.39	0.89	12.16	7.65	0.62	9.68	14.02	0.88	3.94	-	0.32	258.00	10.41	0.30
$S_2N_4G_5$	12.98	7.89	0.85	8.26	5.92	0.80	27.18	9.90	0.79	8.48	-2.50	0.28	3.33	-3.17	0.04
$S_2N_4G_6$	13.16	8.14	0.90	11.70	7.15	0.79	655.42	14.81	0.89	11.67	-2.28	0.28	21.80	0.23	0.01
$S_3N_1G_1$	15.85	5.19	0.86	9.93	6.17	0.82	4.96	3.51	0.52	24.54	-0.69	0.05	3.16	11.17	0.57
$S_3N_1G_2$	13.21	8.39	0.83	11.91	7.15	0.84	14.77	7.15	0.50	71.42	0.46	0.01	4.01	-5.38	0.49
$S_3N_1G_3$	9.36	10.15	0.85	15.23	8.39	0.85	258.58	15.88	0.89	135.38	4.95	0.28	8.55	1.39	0.06
$S_3N_1G_4$	17.09	10.41	0.84	9.98	6.17	0.79	58.16	12.46	0.86	97.56	6.41	0.82	8.29	10.92	0.41
$S_3N_1G_5$	24.85	7.65	0.84	2.68	2.33	0.35	38.89	11.17	0.75	2.73	2.33	0.61	6.91	-3.84	0.27
$S_3N_1G_6$	14.88	10.66	0.93	6.65	4.71	0.77	131.98	14.55	0.90	5.06	2.33	0.35	1.46	1.62	0.02
$S_3N_2G_1$	15.51	8.14	0.96	27.48	9.90	0.87	14.12	6.91	0.67	7.89	1.86	0.05	101.05	8.39	0.28
$S_3N_2G_2$	19.31	8.14	0.65	16.78	7.89	0.78	7.68	4.95	0.49	4.82	-0.00	0.00	1.90	-2.95	0.13
$S_3N_2G_3$	19.31	12.20	0.57	12.06	7.15	0.92	253.77	19.40	0.86	4.53	-1.14	0.01	2.17	8.89	0.33
$S_3N_2G_4$	13.05	10.92	0.78	25.04	10.15	0.63	239.38	16.95	0.84	6.74	-3.17	0.14	46.29	10.15	0.38

Contd.

Table 17. Continued

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
$S_3N_2G_5$	20.67	9.39	0.91	5.38	4.23	0.56	24.12	9.65	0.59	1.91	-2.50	0.42	3.01	9.14	0.36
$S_3N_2G_6$	31.50	10.41	0.71	22.54	9.65	0.80	30.82	10.41	0.85	7.56	-4.06	0.42	7.13	-4.06	0.71
$S_3N_3G_1$	22.01	6.90	0.60	12.12	6.91	0.75	5.86	4.71	0.34	80.00	-3.39	0.31	3.69	11.17	0.42
$S_3N_3G_2$	15.59	6.90	0.80	7.21	4.95	0.63	7.24	4.95	0.48	70.00	-2.95	0.28	9.18	10.41	0.27
$S_3N_3G_3$	10.80	9.39	0.85	11.68	9.65	0.85	105.17	14.02	0.77	26.66	-1.82	0.17	17.19	0.46	0.03
$S_3N_3G_4$	11.69	8.64	0.67	8.05	5.68	0.83	46.70	12.98	0.75	4.71	0.69	0.00	1.16	12.46	0.52
$S_3N_3G_5$	12.89	10.41	0.93	2.32	2.09	0.30	26.96	10.15	0.79	1.11	-0.46	0.05	3.97	-2.95	0.05
$S_3N_3G_6$	14.03	8.39	0.93	2.31	2.09	0.44	25.80	10.15	0.75	4.10	2.80	0.73	20.39	-0.46	0.00
$S_3N_4G_1$	20.79	8.14	0.92	21.61	9.14	0.72	13.09	6.90	0.55	3.85	5.19	0.94	10.96	9.14	0.47
$S_3N_4G_2$	17.41	8.39	0.79	10.19	6.17	0.69	3.42	2.56	0.22	8.95	-3.84	0.35	96.25	9.39	0.76
$S_3N_4G_3$	15.92	8.39	0.87	4.71	3.75	0.50	51.95	12.20	0.79	32.25	-3.17	0.07	3.42	0.23	0.00
$S_3N_4G_4$	15.14	11.43	0.66	13.27	7.40	0.71	227.36	17.49	0.85	5.34	-2.50	0.01	5.98	12.72	0.53
$S_3N_4G_5$	12.99	7.65	0.79	8.70	5.68	0.46	50.08	9.65	0.75	3.43	-1.37	0.08	5.50	6.46	0.61
$S_3N_4G_6$	21.48	14.81	0.85	1.94	1.86	0.35	264.13	16.14	0.76	1.71	1.16	0.17	4.24	2.56	0.06
$S_4N_1G_1$	20.28	4.23	0.91	10.54	5.68	0.72	1.75	1.39	0.08	750.00	-0.23	0.04	2.53	9.14	0.29
$S_4N_1G_2$	16.94	6.41	0.90	4.04	2.80	0.47	6.22	4.47	0.68	77.00	2.33	0.08	6.38	-3.84	0.44
$S_4N_1G_3$	11.75	7.15	0.93	4.65	3.51	0.54	3.60	2.33	0.20	62.50	4.71	0.03	1.59	10.15	0.44
$S_4N_1G_4$	8.76	6.41	0.67	9.79	4.23	0.87	7.69	4.23	0.31	11.54	1.86	0.22	3.84	10.15	0.49
$S_4N_1G_5$	6.81	5.19	0.89	9.03	5.44	0.71	0.39	-0.23	0.06	3.62	0.23	0.00	5.05	-2.05	0.07
$S_4N_1G_6$	8.62	4.71	0.89	8.91	5.20	0.63	5.38	-2.50	0.17	4.77	-2.28	0.07	8.69	7.89	0.12
$S_4N_2G_1$	7.48	7.15	0.76	10.21	6.17	0.91	18.09	4.71	0.15	4.58	-2.95	0.34	6.61	-6.67	0.17
$S_4N_2G_2$	5.45	6.41	0.68	12.11	6.41	0.85	35.39	7.89	0.64	4.85	-1.15	0.83	5.67	0.69	0.03
$S_4N_2G_3$	5.61	8.14	0.73	12.93	7.15	0.91	41.04	10.66	0.89	4.73	0.46	0.78	3.57	11.94	0.50

Contd.

Table 17. Continued

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
$S_4N_2G_4$	8.63	8.89	0.68*	13.11	7.40	0.83	14.75	9.90	0.63	6.46	1.39	0.35	4.00	0.46	0.04
$S_4N_2G_5$	11.24	5.95	0.75	2.95	2.33	0.38	34.07	6.17	0.34	6.21	-0.46	0.00	4.48	11.94	0.62
$S_4N_2G_6$	22.75	7.65	0.82	0.34	0.23	0.01	6.69	8.64	0.46	3.37	-2.05	0.31	11.22	-2.95	0.07
$S_4N_3G_1$	8.54	6.17	0.77	15.17	7.15	0.87	0.98	3.75	0.49	2.14	0.92	0.03	3.20	-0.00	0.00
$S_4N_3G_2$	9.43	7.89	0.58	10.98	8.17	0.71	11.49	0.69	0.19	37.73	-0.23	0.21	1.95	12.98	0.38
$S_4N_3G_3$	9.10	9.39	0.81	6.45	4.47	0.78	19.14	6.66	0.28	137.50	4.71	0.11	2.13	-5.81	0.30
$S_4N_3G_4$	9.10	7.80	0.83	10.26	5.93	0.84	2.87	8.89	0.84	38.89	5.19	0.14	9.14	2.33	0.29
$S_4N_3G_5$	3.14	7.65	0.89	11.14	6.17	0.70	2.05	2.33	0.31	51.67	3.51	0.27	3.16	9.65	0.10
$S_4N_3G_6$	18.95	4.79	0.70	14.87	7.15	0.83	1.22	2.33	0.10	60.00	1.86	0.33	14.19	6.17	0.27
$S_4N_4G_1$	22.37	5.44	0.90	13.37	6.66	0.84	0.78	1.39	0.12	100.00	-1.82	0.00	8.05	3.28	0.31
$S_4N_4G_2$	5.29	4.47	0.81	20.65	8.14	0.76	1.05	-0.23	0.04	56.25	-1.60	0.00	1.45	9.65	0.08
$S_4N_4G_3$	6.54	6.17	0.75	15.41	6.90	0.70	25.92	-1.14	0.02	4.90	-2.05	0.09	8.68	-3.39	0.04
$S_4N_4G_4$	6.81	8.39	0.94	6.15	4.47	0.68	12.25	9.39	0.84	1.78	-4.94	0.77	7.08	13.24	0.64
$S_4N_4G_5$	6.93	7.65	0.82	8.54	5.44	0.90	12.20	7.40	0.67	15.00	-1.66	0.75	67.79	11.69	0.03
$S_4N_4G_6$	9.72	7.15	0.93	7.49	5.20	0.78	36.69	11.17	0.79	38.89	3.75	0.35	1.05	-0.00	0.15

4.1.9.2 Leaf number

The rate of production of leaves per plant was the maximum (13.50%) in the treatment combination involving 80 per cent shade + Ohio solution + 750 ppm BA, while it was the minimum (0.23%) in the treatment combination of 50 per cent shade + Hoagland solution + 1500 ppm Ethephon. R^2 value was the maximum (0.99) in $S_1N_3G_2$ combination, while it was the minimum (0.01) in $S_3N_0G_0$ combination.

4.1.9.3 Leaf area

Leaf area was significantly superior (18.85%) in the treatment combination involving 80 per cent shade + Ohio solution + 1500 ppm BA, while it was the minimum in the treatment combination involving 50 per cent shade + fertilizer complex + 1500 ppm Ethephon (-2.50%). R^2 value was maximum in 70% shade + Hoagland solution + 1500 ppm Ethephon ($S_2N_2G_6$) (0.94), while it was the minimum (0.01) in $S_3N_0G_0$ (control treatment).

4.1.9.4 Number of suckers

The rate of sucker production per plant was significantly superior in the treatment combination involving 70 per cent shade + fertilizer complex + 750 ppm GA (9.14%), while it was the minimum under the treatment combination involving 50 per cent shade + Ohio solution + 1500 ppm BA (-4.94%). R^2 value was the maximum (0.94) in $S_2N_1G_1$ combination while it was the minimum (0.00) in the treatment combinations $S_1N_3G_2$, $S_2N_3G_6$, $S_3N_2G_2$, $S_3N_3G_4$, $S_4N_1G_5$, $S_4N_2G_5$, $S_4N_4G_1$ and $S_4N_4G_2$.

4.1.9.5 Number of branches

The rate of production of branches per plant was significantly superior (12.98%) in the treatment combination involving 50 per cent shade + Knop's solution + 1500 ppm GA, while it was the minimum (-7.96%) in the treatment combination involving 70 per cent shade + fertilizer complex + 1500 ppm BA. R^2 value was the maximum (0.78) in $S_1N_0G_0$ and $S_1N_1G_5$, while it was the minimum (0.00) in the treatment combinations $S_1N_1G_1$, $S_1N_3G_6$ and $S_2N_4G_1$.

4.1.9.6 Regression equation

Based on the maximum values recorded for the plant characters in the various treatmentment combinations, superior treatments with respect to plant height, number of leaves and leaf area were selected. The observed and predicted values for growth rate as well as their respective regression equations are presented in Table 18 and depicted in Fig.4.

4.1.10 Fresh weight, dry matter content and shoot:root ratio

The data on the effect of different shade levels, nutrients and growth regulators on fresh weight and dry matter content of plant parts, their percentages and shoot:root ratio are presented in Table 19 and 20, respectively.

4.1.10.1 Fresh weight of whole plant

Different shade levels, nutrients and interactions (S x N, S x G and N x G) did not differ significantly. Various growth regulators had influenced the fresh

Table 18. Regression equation - Compound growth model

Month	Plant height			Number of leaves			Leaf area		
	Best treatment $S_2N_3G_3$			Best treatment $S_1N_4G_3$			Best treatment $S_2N_1G_4$		
	Observed	Predicted	Equation	Observed	Predicted	Equation	Observed	Predicted	Equation
1	0.230	0.355	$H = 2.09(1.08)^t + e$	0.681	0.744	$L = 4.89(1.13)^t + e$	1.220	1.186	$LA = 13.49(1.14)^t + e$
2	0.301	0.391		0.732	0.799		1.303	1.243	
3	0.462	0.427		0.813	0.854		1.248	1.299	
4	0.556	0.463		0.881	0.909		1.362	1.355	
5	0.591	0.499		0.944	0.964		1.336	1.412	
6	0.591	0.535		1.114	1.019		1.386	1.468	
7	0.623	0.571		1.167	1.074		1.428	1.524	
8	0.623	0.607		1.228	1.129		1.646	1.581	
9	0.643	0.643		1.328	1.184		1.645	1.637	
10	0.653	0.679		1.238	1.239		1.877	1.693	
11	0.690	0.715		1.316	1.294		1.794	1.750	
12	0.699	0.751		1.274	1.350		1.845	1.806	
13	0.699	0.787		1.288	1.405		1.816	1.862	
14	0.881	0.823		1.418	1.460		1.827	1.919	

Plate 7. Comparison of growth in the best treatment ($S_1N_4G_3$) with control

Plate 8. The best treatment combination with control


$S_1 N_4 G_3$

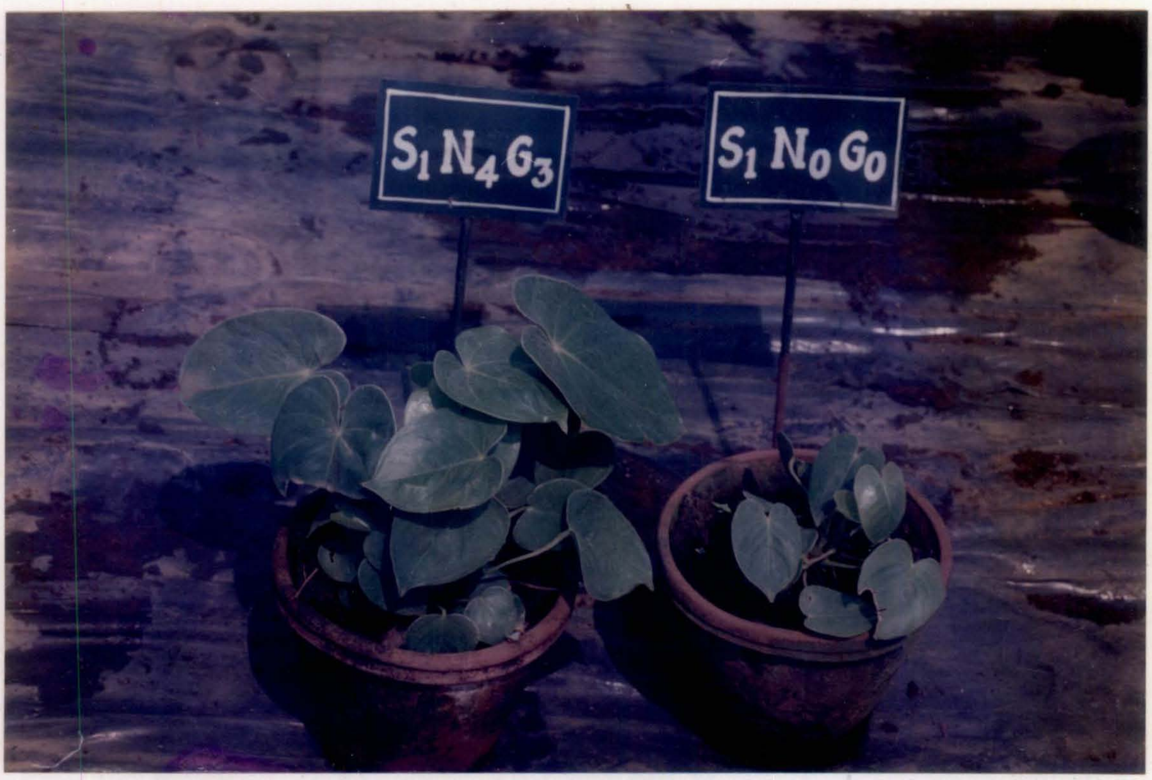
$S_1 N_0 G_0$

$S_1 N_4 G_3$
$S_1 N_0 G_0$

Plate 9. Comparison of nutrient treatments (best nutrient, N_4)

Plate 10. Comparison of growth regulator treatments (best growth regulator, G_3)


$S_1 N_0 G_0$
$S_1 N_1 G_3$
$S_1 N_2 G_3$
$S_1 N_3 G_3$
$S_1 N_4 G_3$

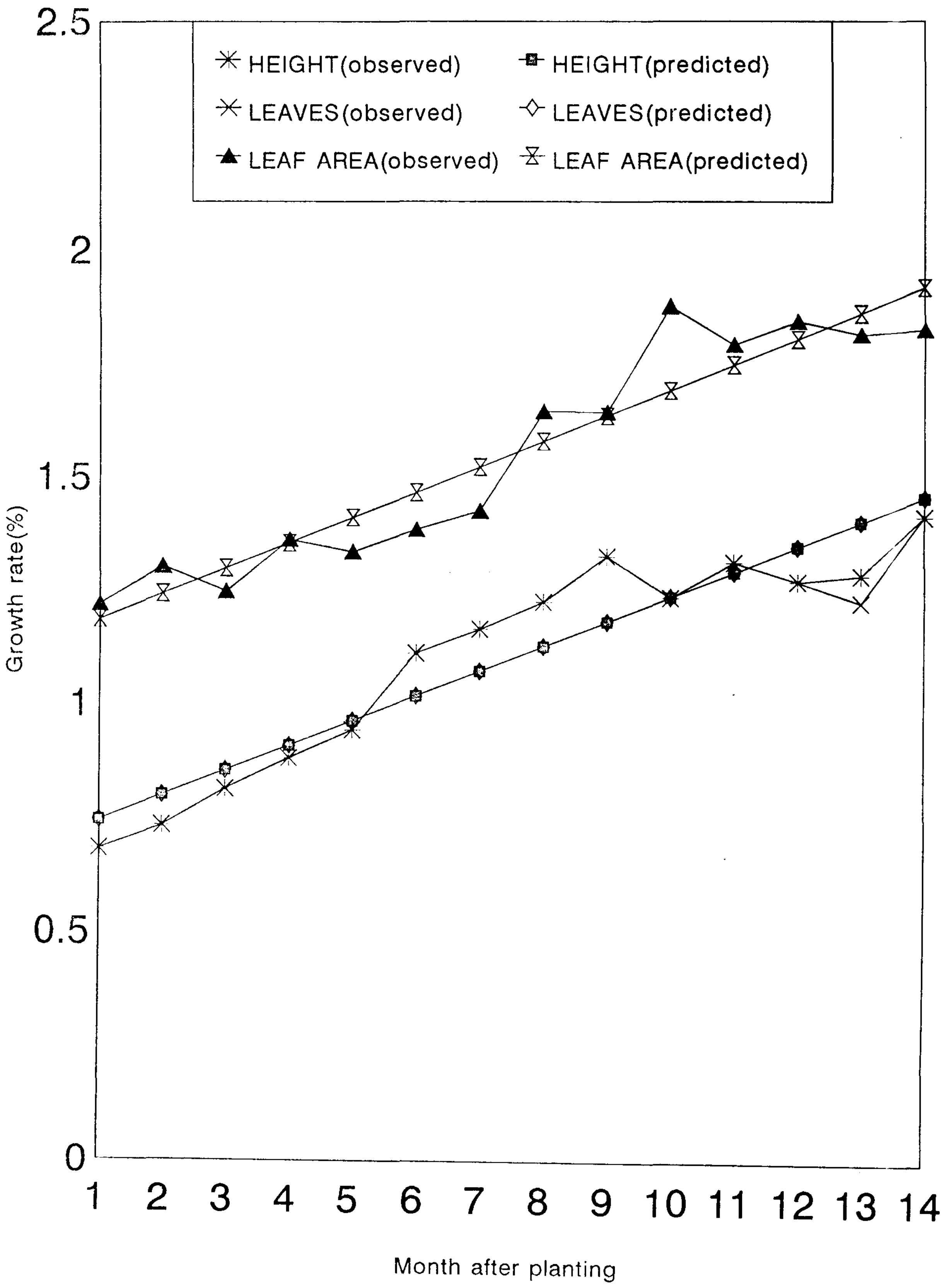


Fig.4.Growth rate(%) in *A.andreanum* `Hawaiian Red'

weight of whole plant significantly. BA 750 ppm (G_3) was significantly superior (27.52 g) to both the concentrations of GA and Ethephon and was on par with BA 1500 ppm (G_4). The treatment combination of 60 per cent shade + 1 per cent fertilizer complex + 750 ppm BA ($S_3N_1G_3$) recorded the maximum value for fresh weight (70.62 g), while 60 per cent shade + Hoagland solution + 750 ppm Ethephon ($S_3N_2G_5$) recorded the minimum (10.74 g) compared to all the other treatments (Appendix 17).

4.1.10.2 Dry weight of whole plant

Different shade levels, nutrients and growth regulators tried significantly influenced the dry weight of whole plant; but the interactions (S x N, S x G and N x G) failed to influence significantly. Sixty per cent shade level was significantly superior with respect to dry matter production of whole plant (4.21 g), compared to 80 per cent and 50 per cent shade, and was on par with 70 per cent shade.

Ohio solution (N_4) was significantly superior to Hoagland solution (N_2) in producing the maximum dry weight (4.26 g), but was on par with 1 per cent fertilizer complex (N_1) and Knop's solution (N_3). BA 750 ppm (G_3) was significantly superior (4.80 g) to both the concentrations of GA and Ethephon and was on par with BA 1500 ppm (G_4).

The treatment combination of 60 per cent shade + 1 per cent fertilizer complex + 750 ppm BA ($S_3N_1G_3$) recorded the maximum dry weight (10.56 g) while 80 per cent shade + Knop's soltuion + 750 pm GA recorded the minimum dry weight of whole plant (1.78 g), compared to all the other treatments (Appendix 17).

Table 19. Effect of shade, nutrients, growth regulators and their interactions on fresh and dry weight of plant parts of *A. andreanum* var. 'Hawaiian Red'

Treatment	Fresh weight of whole plant (g)	Dry weight of whole plant (g)	Fresh weight of leaves (g)	Dry weight of leaves (g)	Fresh weight of petiole (g)	Dry weight of petiole (g)	Fresh weight of roots (g)	Dry weight of roots (g)
1	2	3	4	5	6	7	8	9
<u>Shade (S)</u>								
S_1	20.54	3.05	7.26	1.26	2.11	0.20	11.17	1.55
S_2	19.30	3.71	7.29	1.26	1.86	0.23	9.44	2.26
S_3	21.92	4.21	7.67	1.34	2.37	0.31	12.76	2.48
S_4	16.17	3.03	6.22	1.25	1.66	0.20	8.80	1.57
CD(0.05)	-	0.89	-	-	-	0.11	-	0.65
<u>Nutrient (N)</u>								
N_1	21.79	3.38	7.64	1.37	2.33	0.31	12.56	1.65
N_2	18.53	2.73	7.00	1.13	1.94	0.20	9.72	1.32
N_3	17.84	3.65	7.41	1.32	1.87	0.25	8.56	2.14
N_4	19.78	4.26	7.09	1.29	1.85	0.20	10.83	2.75
CD(0.05)	-	0.89	-	-	-	0.11	-	0.65
<u>Growth regulator (G)</u>								
G_1	15.30	2.80	5.70	1.01	1.63	0.17	7.97	1.63
G_2	16.69	2.97	6.68	1.19	1.72	0.20	8.28	1.58
G_3	27.52	4.80	9.52	1.66	2.72	0.39	15.22	2.63
G_4	23.00	4.01	7.92	1.35	2.24	0.26	12.84	2.40
G_5	16.95	3.07	6.71	1.20	1.71	0.23	8.72	1.70
G_6	17.44	3.38	7.17	1.25	1.92	0.23	9.47	1.83
CD(0.05)	6.50	1.09	1.62	0.28	0.78	0.14	4.36	0.79

Contd.

Table 19. Continued

1	2	3	4	5	6	7	8	9
S x N interaction								
S_1N_1	24.65	3.70	7.35	1.35	2.62	0.26	14.67	1.98
S_1N_2	18.80	2.77	6.06	1.07	2.01	0.20	10.72	1.50
S_1N_3	18.72	2.80	7.51	1.31	2.14	0.22	9.07	1.32
S_1N_4	19.99	2.93	8.11	1.33	1.67	0.22	10.21	1.38
S_2N_1	18.87	2.71	8.43	1.34	1.69	0.24	8.75	1.12
S_2N_2	18.76	2.58	8.08	1.16	1.90	0.24	8.79	1.18
S_2N_3	18.75	4.14	8.40	1.36	1.74	0.24	8.60	2.72
S_2N_4	20.81	5.43	7.06	1.19	2.13	0.22	11.63	4.02
S_3N_1	25.91	4.42	8.36	1.51	3.35	0.51	17.21	2.41
S_3N_2	19.36	3.14	7.04	1.02	1.95	0.16	10.88	1.62
S_3N_3	19.00	4.11	7.40	1.34	2.03	0.30	9.57	2.50
S_3N_4	23.42	5.16	7.90	1.48	2.14	0.29	13.37	3.38
S_4N_1	17.73	2.61	6.44	1.28	1.67	0.24	9.61	1.10
S_4N_2	17.20	2.45	6.80	1.27	1.91	0.21	8.49	0.97
S_4N_3	14.89	3.53	6.33	1.28	1.57	0.24	7.00	2.01
S_4N_4	14.89	3.53	5.29	1.15	1.48	0.19	8.11	2.20
CD(0.05)	-	-	-	-	-	0.22	-	1.29
S x G interaction								
S_1G_1	15.73	2.34	5.53	0.91	1.67	0.17	8.54	1.31
S_1G_2	18.65	2.80	7.19	1.25	2.12	0.22	9.34	1.33
S_1G_3	29.28	4.10	9.11	1.62	2.91	0.28	17.26	2.20
S_1G_4	23.97	3.50	7.69	1.41	2.36	0.26	13.92	1.83
S_1G_5	19.63	3.05	7.56	1.33	1.93	0.25	10.14	1.48
S_1G_6	15.98	2.52	6.47	1.07	1.69	0.18	7.81	1.12

Contd.

Table 19. Continued

1	2	3	4	5	6	7	8	9
S_2G_1	15.09	3.14	6.28	1.01	1.47	0.16	7.34	1.96
S_2G_2	19.80	3.69	8.20	1.34	2.00	0.25	9.60	2.11
S_2G_3	22.88	4.29	10.47	1.44	2.07	0.32	10.34	2.53
S_2G_4	19.71	3.98	7.85	1.30	1.90	0.23	9.95	2.44
S_2G_5	19.27	3.59	7.38	1.22	1.98	0.22	9.92	2.40
S_2G_6	19.03	3.60	7.76	1.26	1.76	0.23	9.51	2.12
S_3G_1	16.47	2.83	6.18	1.00	1.80	0.18	8.50	1.65
S_3G_2	14.42	2.59	5.82	0.99	1.40	0.16	7.20	1.45
S_3G_3	40.03	7.75	11.30	2.30	4.42	0.77	24.32	4.23
S_3G_4	28.21	5.16	8.94	1.37	2.74	0.27	16.54	3.52
S_3G_5	14.05	2.66	5.59	0.96	1.44	0.19	7.77	1.50
S_3G_6	18.35	4.25	8.22	1.42	2.41	0.31	12.23	2.53
S_4G_1	13.92	2.92	4.83	1.12	1.57	0.18	7.52	1.62
S_4G_2	13.90	2.81	5.52	1.20	1.37	0.18	7.00	1.43
S_4G_3	17.87	3.05	7.18	1.26	1.74	0.21	8.95	1.58
S_4G_4	20.11	3.39	7.20	1.33	1.97	0.26	10.94	1.79
S_4G_5	14.86	2.97	6.33	1.31	1.49	0.25	7.07	1.41
S_4G_6	16.39	3.05	6.24	1.25	1.81	0.23	8.35	1.58
CD(0.05)	-	-	-	-	-	0.27	-	-
<u>N x G interaction</u>								
N_1G_1	18.25	2.65	6.35	1.07	2.06	0.20	9.85	1.39
N_1G_2	16.89	2.45	6.25	1.15	1.79	0.21	8.93	1.08
N_1G_3	35.49	5.17	10.94	2.02	3.79	0.63	20.77	2.52
N_1G_4	24.66	3.48	7.65	1.36	2.36	0.27	14.66	1.85
N_1G_5	19.35	3.06	7.07	1.31	1.94	0.25	10.34	1.51

Contd.

Table 19. Continued

1	2	3	4	5	6	7	8	9
N_1G_6	16.09	3.38	7.60	1.33	2.16	0.32	10.83	1.57
N_2G_1	14.22	2.29	5.35	0.98	1.59	0.18	7.29	1.14
N_2G_2	14.61	2.28	5.64	1.01	1.54	0.16	7.44	1.11
N_2G_3	28.12	3.97	10.48	1.23	2.71	0.24	14.94	2.00
N_2G_4	21.33	2.91	7.49	1.29	2.24	0.23	11.59	1.40
N_2G_5	16.07	2.43	6.23	1.11	1.74	0.20	8.85	1.12
N_2G_6	16.82	2.52	6.79	1.19	1.83	0.21	8.21	1.13
N_3G_1	13.43	3.10	5.76	1.05	1.45	0.16	6.21	1.94
N_3G_2	17.23	3.59	8.25	1.45	1.89	0.24	7.09	1.90
N_3G_3	23.61	4.52	8.64	1.64	2.46	0.35	12.50	2.59
N_3G_4	19.72	4.01	7.39	1.37	2.14	0.29	10.19	2.36
N_3G_5	16.34	3.22	7.20	1.23	1.59	0.25	7.57	1.99
N_3G_6	16.72	3.43	7.23	1.20	1.69	0.19	7.81	2.04
N_4G_1	15.30	3.17	5.35	0.95	1.41	0.16	8.54	2.07
N_4G_2	18.04	3.58	6.60	1.16	1.76	0.19	9.68	2.23
N_4G_3	22.85	5.53	8.02	1.74	2.18	0.36	12.66	3.43
N_4G_4	26.30	5.63	9.15	1.41	2.23	0.25	14.19	3.98
N_4G_5	16.06	3.57	6.36	1.18	1.56	0.21	8.14	2.18
N_4G_6	20.12	4.10	7.07	1.29	1.99	0.22	11.06	2.59
CD(0.05)	-	-	-	-	-	-	-	-

4.1.10.3 Fresh weight of leaves

Shade, nutrients and interactions (S x N, S x G and N x G) had not significantly influenced the fresh weight of leaves; while the effect of growth regulators was significant. Treatment with BA 750 ppm (G_3) recorded the maximum (9.52 g), which was on par with BA 1500 ppm and was significantly superior to both the concentrations of GA and Ethephon. Regarding the treatment combinations, the maximum value (16.71 g) was recorded under 60 per cent shade + 1 per cent fertilizer complex + 750 ppm BA ($S_3N_1G_3$), while 80 per cent shade + Hoagland solution + 1500 ppm GA ($S_1N_2G_2$) recorded the minimum (4.11 g), compared to all other treatments (Appendix 17).

4.1.10.4 Dry weight of leaves

Only growth regulators had significantly influenced the dry weight of leaves. Shade, nutrients and their interactions (S x N, S x G and N x G) did not differ significantly. BA 750 ppm (G_3) was significantly superior (1.66 g) compared to both the concentrations of GA and Ethephon and was on par with BA 1500 ppm (G_4). The treatment combination of 60 per cent shade + 1 per cent fertilizer complex + 750 ppm BA ($S_3N_1G_3$) produced the maximum dry weight of leaves (3.37 g), while 60 per cent shade + Hoagland solution + 1500 ppm BA ($S_3N_2G_2$), the minimum (0.71 g), compared to all the other treatments (Appendix 17).

4.1.10.5 Fresh weight of petiole

Only growth regulators had significantly influenced the fresh weight of petiole. Shade, nutrients and interactions (S x N, S x G and N x G) did not differ significantly. BA 750 ppm (G_4) was significantly superior (2.72 g) compared to both the concentrations of GA and Ethephon and was on par with BA 1500 ppm (G_4). The treatment combination of 60 per cent shade + 1 per cent fertilizer complex + 750 ppm BA ($S_3N_1G_3$) recorded the maximum value (9.06 g), while, 70 per cent shade + Knop's solution + 1500 ppm Ethephon ($S_2N_3G_6$) recorded the minimum (1.10 g), compared to all the other treatments (Appendix 17).

4.1.10.6 Dry weight of petiole

The shade levels, nutrients, growth regulators and shade x nutrient interaction had significant influence on dry weight of petiole. Sixty per cent shade level was significantly superior (0.31 g) to 80 per cent (S_1 and 50 per cent (S_4) and was on par with 70 per cent (S_2). Fertilizer complex (N_1) solution (1%) was significantly superior (0.31 g) to Hoagland (N_2) and Ohio (N_4) solutions and was on par with Knop's solution. BA 750 ppm (G_3) was significantly superior (0.39 g) to both the concentrations of GA and Ethephon, but was on par with BA 1500 ppm (G_4). Interaction S_3N_1 was significantly superior(0.51 g) to all the other interactions except S_3N_3 and S_3N_4 which were on par.

The combination of 60 per cent shade + 1 per cent fertilizer complex solution + 750 ppm BA ($S_3N_1G_3$) recorded the maximum value for petiole dry weight (1.68 g), while 80 per cent shade + Hoagland solution + 1500 ppm GA ($S_1N_2G_2$) recorded the minimum (0.12 g), compared to all the other treatments (Appendix17).

4.1.10.7 Fresh weight of roots

Different growth regulators had significant influence on fresh weight of roots, while the shade levels, nutrients and their interactions (S x N, S x G and N x G) did not differ significantly. BA 750 ppm (G_3) recorded the maximum value (15.22 g), which was significantly superior to both the concentrations of GA and Ethephon and was on par with BA 1500 ppm (G_4). The treatment combination of 60 per cent shade + 1 per cent fertilizer complex solution + 750 ppm BA ($S_3N_1G_3$) produced the maximum fresh weight of roots (44.85 g), while 70 per cent shade + 1 per cent fertilizer complex solution + 750 ppm GA, the minimum (5.13 g), compared to all the other treatments (Appendix 17).

4.1.10.8 Dry weight of roots

The shade levels, nutrients, growth regulators and shade x nutrient interaction had significant influence on dry weight of roots, but shade x growth regulator and nutrient x growth regulator interactions had not differed significantly. Sixty per cent shade level was significantly superior (2.48 g) compared to 80 per cent (S_1) and 50 per cent (S_4) and was on par with 70 per cent (S_2) shade. Among the nutrients, Ohio solution (N_4) was significantly superior (2.75 g) over fertilizer complex (N_1) and Hoagland solution (N_2) and was on par with Knop's solution (N_3). BA 750 ppm

(G_3)was significantly superior (2.63 g) than both the concentrations of GA and Ethephon and was on par with BA 1500 ppm (G_4).

The combination of 60 per cent shade + Ohio solution + 1500 ppm BA ($S_3N_4G_4$) recorded the maximum dry matter content of roots (8.49 g), while, 70 per cent shade + 1 per cent fertilizer complex + 750 ppm GA ($S_2N_1G_1$) recorded the minimum (0.64 g), compared to all other treatments (Appendix 17).

4.1.10.9 Dry matter per cent of whole plant

The different shade levels, nutrients and shade x nutrient interactions have influenced the dry matter per cent of whole plant significantly; but growth regulators and shade x growth regulator and nutrient x growth regulator interactions have not differed significantly. The value was the highest (19.25%) under 70 per cent (S_2) shade, which was significantly superior to that under 80 per cent (S_1) shade and was on par with those of 60 per cent and 50 per cent shade levels. Ohio solution (N_4) recorded the maximum value (21.41%) among the nutrients, which was significantly superior to fertilizer complex (N_1) and Hoagland solution (N_2) and was on par with Knop's solution (N_3). The interaction S_2N_4 (70% shade x Ohio solution) recorded the maximum value (26.38%). The maximum dry matter per cent (40.16%) was obtained under the treatment combination of 60 per cent shade + Ohio solution + 750 ppm BA ($S_3N_4G_3$), while, 70 per cent shade + fertilizer complex + 1500 ppm Ethephon ($S_2N_1G_6$) recorded the minimum (7.33%) compared to all the other treatments (Appendix 18) (Fig.5).

4.1.10.10 Dry matter per cent of leaf

Shade levels had significant influence on leaf dry matter per cent. The

Table 20. Effect of shade, nutrients, growth regulators and their interactions on per cent dry matter production of *A. andreanum* var. 'Hawaiian Red'

Treatment	Leaf		Petiole		Root		Whole plant		Shoot:root ratio	
	Dry matter	Moisture	Dry matter	Moisture	Dry matter	Moisture	Dry matter	Moisture	Fresh weight ratio	Dry matter ratio
1	2	3	4	5	6	7	8	9	10	11
<u>Shade (S)</u>										
S_1	17.46	82.53	11.36	88.64	14.06	85.94	15.09	84.99	0.88	1.03
S_2	16.26	83.74	12.84	87.16	22.97	77.03	19.25	80.78	1.05	0.80
S_3	17.13	82.79	12.05	87.95	20.69	79.23	18.79	81.26	0.86	0.76
S_4	20.53	79.47	13.55	86.47	20.14	79.53	18.97	81.03	0.94	0.99
CD(0.05)	1.59	1.65	-	-	2.97	3.01	2.21	2.23	-	0.12
<u>Nutrient (N)</u>										
N_1	17.99	82.01	13.03	86.97	13.26	86.66	14.74	85.34	0.86	1.10
N_2	16.93	83.07	11.12	88.88	13.68	86.07	15.12	84.87	0.94	1.10
N_3	18.02	81.99	13.75	86.25	25.72	74.28	20.82	79.26	1.11	0.79
N_4	18.45	81.47	11.90	88.11	25.20	74.71	21.41	78.60	0.85	0.64
CD(0.05)	-	-	-	-	2.97	3.01	2.21	2.23	0.19	0.12
<u>Growth regulator (G)</u>										
G_1	18.15	81.85	11.29	88.73	21.27	78.73	18.78	81.22	0.94	0.79
G_2	18.48	81.52	11.79	88.21	19.49	80.51	18.05	81.96	0.99	0.96
G_3	17.32	82.56	13.25	86.76	19.05	80.94	18.83	81.30	0.87	0.89
G_4	17.45	82.55	12.40	87.60	18.89	81.11	17.59	82.50	0.85	0.81
G_5	18.10	81.90	13.70	86.30	18.86	81.02	17.40	82.60	0.98	0.95
G_6	17.58	82.42	12.26	87.74	19.22	80.28	17.48	82.53	1.00	0.94
CD(0.05)	-	-	-	-	-	-	-	-	-	-

Table 20. Continued

1	2	3	4	5	6	7	8	9	10	11
S x N interaction										
S_1N_1	18.33	81.67	9.95	90.05	13.84	86.17	15.75	84.59	0.71	0.89
S_1N_2	17.69	82.32	9.97	90.03	14.20	85.80	14.80	85.20	0.78	0.86
S_1N_3	12.32	82.68	11.76	88.24	14.62	85.38	15.01	84.99	1.13	1.25
S_1N_4	16.52	83.48	13.75	86.24	13.58	86.42	14.80	85.20	0.97	1.15
S_2N_1	16.00	84.00	14.45	85.50	12.76	87.24	12.89	87.11	1.18	1.45
S_2N_2	15.02	84.98	12.71	87.29	13.49	86.49	15.29	84.66	1.12	1.19
S_2N_3	16.25	83.75	13.73	86.27	30.44	69.56	22.42	77.72	1.18	0.62
S_2N_4	17.76	82.24	10.48	89.52	35.17	64.83	26.38	73.65	0.78	0.34
S_3N_1	17.56	82.45	13.23	86.77	14.68	85.32	15.41	84.59	0.74	0.84
S_3N_2	15.49	84.51	10.27	89.73	14.97	85.04	15.56	84.44	0.86	0.94
S_3N_3	18.03	81.97	14.23	85.77	28.43	71.57	21.93	78.24	1.06	0.66
S_3N_4	17.43	82.24	10.46	89.54	24.67	74.99	22.25	77.76	0.82	0.64
S_4N_1	20.08	79.92	14.49	85.51	11.75	87.92	14.92	85.08	0.82	1.38
S_4N_2	19.53	80.47	11.52	88.48	12.05	86.95	14.82	85.18	1.04	1.54
S_4N_3	20.45	79.56	15.27	84.73	29.38	70.62	23.91	76.09	1.11	0.76
S_4N_4	22.08	77.92	12.92	87.13	27.39	72.61	22.22	77.77	0.83	0.61
CD(0.05)	-	-	-	-	5.94	6.02	4.42	4.47	-	0.22
S x G interaction										
S_1G_1	16.74	83.26	11.55	88.45	15.31	84.69	15.23	84.77	0.87	0.86
S_1G_2	17.61	82.39	10.20	89.78	14.17	85.83	14.91	85.09	0.99	1.09
S_1G_3	17.92	82.08	9.77	90.24	12.82	87.18	14.05	85.95	0.69	0.86
S_1G_4	18.36	81.64	11.85	88.15	13.36	86.64	15.04	85.46	0.77	0.96
S_1G_5	17.51	82.49	14.01	85.99	14.52	85.49	15.50	84.50	0.99	1.16
S_1G_6	16.65	83.35	10.76	89.24	14.18	85.82	15.82	84.20	1.05	1.26

Contd.

Table 20. Continued

1	2	3	4	5	6	7	8	9	10	11
S_2G_1	16.34	83.66	11.75	88.26	26.24	73.76	20.81	79.19	1.08	0.73
S_2G_2	17.72	82.28	12.05	87.95	21.50	78.50	19.00	81.04	1.02	0.86
S_2G_3	14.01	85.99	16.40	83.60	22.70	77.28	20.43	79.82	1.23	0.88
S_2G_4	16.65	83.35	12.26	87.74	23.86	76.14	19.78	80.11	0.98	0.75
S_2G_5	16.63	83.37	11.09	88.92	21.63	78.38	18.83	81.17	0.94	0.75
S_2G_6	16.20	83.81	13.53	86.47	21.88	78.13	16.62	83.38	1.07	0.82
S_3G_1	16.29	83.71	10.32	89.68	21.01	78.99	17.70	82.30	0.95	0.75
S_3G_2	16.90	83.10	11.40	88.60	20.84	79.17	17.87	82.13	0.99	0.84
S_3G_3	19.00	80.51	14.20	85.80	22.20	77.80	23.07	77.19	0.69	0.73
S_3G_4	16.22	83.79	11.25	88.76	19.10	80.90	17.61	82.39	0.78	0.62
S_3G_5	17.14	82.87	13.07	86.93	19.30	80.70	17.76	82.24	0.89	0.78
S_3G_6	17.22	82.78	12.05	87.95	21.68	77.83	18.70	81.30	0.92	0.74
S_4G_1	23.22	76.78	11.55	88.53	22.50	77.50	21.39	78.61	0.86	0.85
S_4G_2	21.71	78.29	13.51	86.49	21.47	78.54	20.43	79.56	0.97	1.06
S_4G_3	18.34	81.66	12.62	87.39	18.49	81.51	17.75	82.25	0.99	0.98
S_4G_4	18.55	81.45	14.26	85.74	19.25	80.75	17.95	82.05	0.87	0.92
S_4G_5	21.11	78.89	16.65	83.35	19.99	79.51	17.52	82.48	1.10	1.19
S_4G_6	26.56	79.74	12.71	87.30	19.15	79.36	18.78	81.23	0.96	1.01
CD(0.05)	-	-	-	-	-	-	-	-	-	-
<u>N x G interaction</u>										
N_1G_1	17.45	82.55	10.25	89.76	13.77	86.24	14.40	85.60	0.88	0.98
N_1G_2	18.60	81.40	12.59	87.41	11.99	88.01	14.58	85.43	0.89	1.27
N_1G_3	18.23	81.77	15.87	84.13	11.94	88.06	14.39	85.62	0.83	1.20
N_1G_4	17.79	82.21	11.36	88.64	12.99	87.01	14.74	85.76	0.71	0.91
N_1G_5	18.41	81.57	13.55	86.45	14.44	85.06	15.84	84.16	0.89	1.07

Contd.

Table 20. Continued

1	2	3	4	5	6	7	8	9	10	11
N_1G_6	17.45	82.55	14.56	85.44	14.42	85.59	14.51	85.49	0.98	1.26
N_2G_1	18.30	81.70	11.38	88.62	15.61	84.38	16.17	83.83	0.96	1.02
N_2G_2	17.98	82.02	10.88	89.12	14.84	85.16	15.66	84.34	0.94	1.04
N_2G_3	12.49	87.51	11.12	88.88	12.79	87.19	15.64	84.35	0.93	1.05
N_2G_4	17.17	82.83	10.23	89.77	12.30	87.70	13.74	86.16	0.86	1.10
N_2G_5	17.97	82.03	11.70	88.31	12.58	87.42	14.54	85.46	0.89	1.17
N_2G_6	17.69	82.31	11.41	88.59	13.94	84.56	14.94	85.07	1.05	1.25
N_3G_1	18.48	81.52	12.27	87.74	31.20	68.61	23.34	76.66	1.16	0.67
N_3G_2	18.13	81.87	12.90	87.10	27.88	72.12	21.47	78.53	1.40	0.95
N_3G_3	19.28	80.72	15.53	84.47	22.85	77.15	19.76	80.74	0.95	0.77
N_3G_4	18.50	81.51	13.97	86.03	23.75	76.25	20.27	79.69	0.95	0.71
N_3G_5	17.07	82.93	15.93	84.07	22.65	77.35	19.66	80.34	1.17	0.93
N_3G_6	16.64	83.37	11.88	88.12	25.98	74.02	20.40	79.60	1.15	0.74
N_4G_1	18.37	81.64	11.27	88.81	24.49	75.51	21.22	78.78	0.79	0.59
N_4G_2	19.23	80.77	10.78	89.20	23.26	76.74	20.51	79.54	0.83	0.67
N_4G_3	19.28	80.22	10.47	89.54	28.63	71.37	25.52	74.49	0.80	0.63
N_4G_4	16.32	83.68	14.06	85.94	26.53	73.47	21.60	78.40	0.87	0.58
N_4G_5	18.94	81.06	13.64	86.36	25.76	74.24	19.57	80.43	0.98	0.71
N_4G_6	18.55	81.45	11.20	88.80	22.54	76.96	20.06	79.95	0.84	0.67
CD(0.05)	-	-	-	-	-	-	-	-	-	-

nutrients, growth regulators, and various interactions (S x N, S x G and N x G) have not differed significantly. The maximum value was recorded by 50 per cent (S_4) shade, (20.53%), which was significantly superior to 60 (S_3), 70 (s_2) and 80 (S_1) per cent shade levels. The treatment combination of 50 per cent shade + Ohio solution + 750 ppm Ethephon ($S_4N_4G_5$) recorded the maximum (24.53%), while 70 per cent shade + Hoagland solution + 750 ppm BA ($S_2N_2G_3$), recorded minimum dry matter percentage of leaves compared to all other treatments (Appendix 18).

4.1.9.11 Dry matter per cent of petiole

None of the shade levels, nutrients, growth regulators and interactions had significant influence on dry matter per cent of petiole. The treatment combination of 70 per cent shade + 1 per cent fertilizer complex + 750 ppm BA ($S_2N_1G_3$) recorded the maximum (21.43%) value, while, 60 per cent shade + Ohio solution + 1500 ppm BA ($S_3N_4G_4$), recorded the minimum (6.44%) compared to all other treatments (Appendix 18).

4.1.10.12 Dry matter per cent of root

The different shade levels, nutrients and shade x nutrient interactions had significantly influenced the dry matter per dent of roots; but the growth regulators, shade x growth regulator and nutrient x growth regulator interactions failed to have significant influence. Dry matter percentage of root was the maximum (22.97%) under 70 per cent shade (S_2) which was significantly superior to 80 per cent (14.06%) and was on par with 60 per cent and 50 per cent shade levels. Among the nutrient solutions, Knop's solution (N_3) recorded the maximum value (25.72%), which was significantly superior to 1 per cent fertilizer complex (N_1) and Hoagland

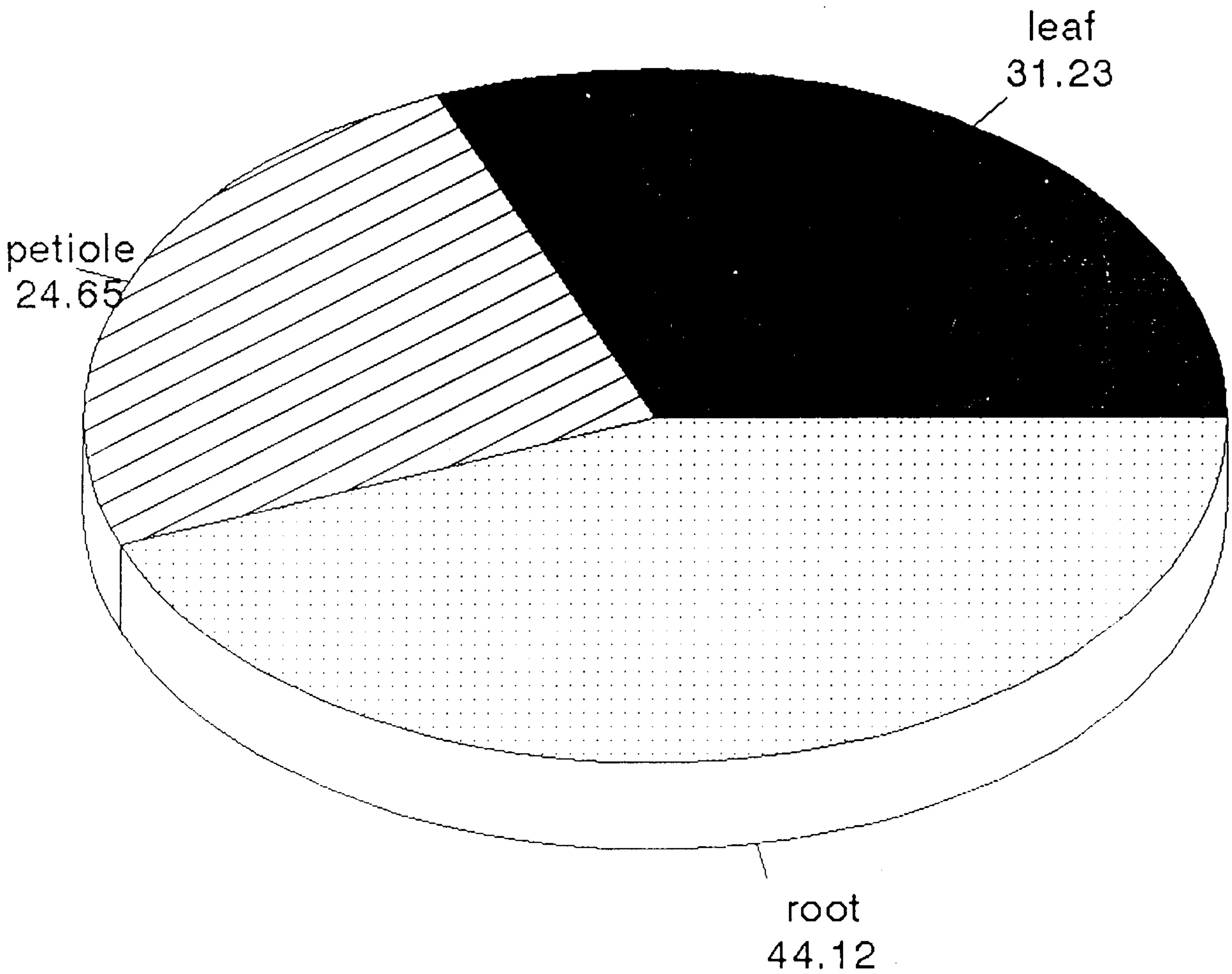


Fig.5. Dry matter content (%) in *A. andreanum* `Hawaiian Red'

solution (N_2), and was on par with Ohio solution N_4). The interaction, S_2N_4 recorded the maximum dry matter (35.17%) per cent of roots, which was significantly superior to all the other interactions except S_2N_3 and S_4N_3, which was on par with S_2N_4. The treatment combination of 70 per cent shade + Knop's solution + 1500 ppm BA ($S_2N_3G_2$) recorded the maximum value (39.97%), while 50 per cent shade + Hoagland solution + 1500 ppm BA ($S_4N_2G_4$) recorded the minimum (9.31%) among the treatments (Appendix 18).

4.1.10.13 Shoot : root ratio

Fresh weight ratio

The different nutrients have significantly influenced the shoot : root ratio (fresh weight basis) while, shade, growth regulators and interactions (S x N, S x G and N x G) have failed to influence. The maximum ratio for shoot and root (1.11) was recorded in the treatment with Knop's solution (N_3), which was significantly superior to fertilizer complex (N_1) and Ohio solution (N_4) and was on par with Hoagland solution (N_2). The treatment combination of 80 per cent shade + Knop's solution + 1500 ppm GA ($S_1N_3G_2$) recorded the maximum ratio (1.53), while 80 per cent shade + 1 per cent fertilizer complex + 1500 ppm BA ($S_1N_1G_4$), recorded the minimum (0.53) value compared to all the other treatments (Appendix 18).

Dry weight ratio

The different shade levels, nutrients and shade x nutrient interactions had significant influence; but growth regulators and shade x growth regulator and nutrient x growth regulator interactions failed to influence the shoot : root ratio (dry weight) significantly. The maximum value (1.03) was recorded under 80 per cent

(S_1) shade which was significantly superior to those under 70 per cent (S_2) and 60 per cent (S_3), but was on par with that under 50 per cent (S_4) shade. Both fertilizer complex (N_1) and Hoagland solution (N_2) recorded their significantly superior effect (1.10), compared to Knop's solution (N_3) and Ohio solution (N_4). The interaction S_4N_2 recorded significantly superior value (1.54) compared to all the other interactions, with the exceptions of S_2N_1 (1.45) and S_4N_1 (1.38) which were on par with S_4N_2. The treatment combination of 80 per cent shade + Knop's solution + 750 ppm Ethephon ($S_1N_3G_5$) recorded the maximum value (2.15), while 70 per cent shade + Ohio solution + 1500 ppm GA ($S_2N_4G_2$) recorded the minimum (0.27), among the treatments combinations (Appendix 18).

4.2 Leaf characters

The data on the effect of different shade levels, nutrients and growth regulators on leaf area index (LAI), specific leaf weight (SLW) and leaf duration; firmness and colour development; stomatal size and frequency; and leaf senescence are presented in Tables 21 to 24.

4.2.1 Leaf area index (LAI)

The different shade levels and growth regulators have significantly influenced the LAI but the nutrients and interactions (S x N, S x G and N x G) failed to show significant influence. Maximum LAI (0.43) was recorded under 70 per cent shade (S_2), which was significantly superior to 50 per cent (S_4) and was on par with 80 per cent (S_1) and 60 per cent (S_3) shade levels. Sprays with BA 750 ppm (G_3) produced the highest value (0.51), which was significantly superior to both the concentrations of GA and Ethephon and was on par with 1500 ppm BA

(G_4). The treatment combination of 70 per cent shade + 1 per cent fertilizer complex + 1500 ppm BA ($S_2N_1G_4$) recorded the maximum value (0.89) for leaf area index, while 70 per cent shade + Ohio solution + 1500 ppm GA ($S_2N_4G_2$) recorded the minimum (0.15), compared to all other treatments (Appendix 19).

4.2.2 Specific leaf weight (SLW)

Shade, nutrients and growth regulators as well as their various interactions had no significant influence on specific leaf weight.

4.2.3 Duration of leaf emergence to unfurling

The number of days taken for leaf emergence to unfurling was not significantly influenced by shade, nutrients and growth regulators as well as their various interactions.

4.2.4 Duration of leaf unfurling to maturity

Shade, nutrients and growth regulators as well as their various interactions did not influence the number of days taken from leaf unfurling to maturity significantly.

4.2.5 Duration of leaf maturity to senescence

Different shade levels, nutrients, growth regulators and shade x nutrient interaction had significantly influenced the period from leaf maturity to senescence, while, shade x growth regulator and nutrient x growth regulator interactions have failed to have significant influence. Sixty per cent shade level was significantly superior (124.42 days) to 80, 70 and 50 per cent shade levels. Among the nutrients,

Table 21. Influence of shade, nutrients, growth regulators and their interactions on leaf characters of *A. andreanum* var. 'Hawaiian Red'

Treatment	LAI	SLW	Leaf duration (days)			
			Emergence to unfurling	Unfurling to maturity	Maturity to senescence	Total leaf duration
1	2	3	4	5	6	7
<u>Shade (S)</u>						
S_1	0.39	0.05	14.00	11.21	119.33	144.67
S_2	0.43	0.04	14.42	10.83	119.88	145.13
S_3	0.38	0.04	14.29	10.42	124.42	149.13
S_4	0.31	0.05	14.50	11.08	120.63	146.21
CD(0.05)	0.07	-	-	-	3.18	-
<u>Nutrient (N)</u>						
N_1	0.38	0.05	14.42	11.25	118.63	144.29
N_2	0.37	0.04	15.58	10.71	118.00	144.42
N_3	0.37	0.05	13.58	11.21	122.17	146.96
N_4	0.39	0.04	13.63	10.38	125.46	149.46
CD(0.05)	-	-	1.46	-	3.18	3.38
<u>Growth regulator (G)</u>						
G_1	0.32	0.05	13.88	11.44	118.38	143.69
G_2	0.28	0.05	14.75	10.31	118.69	143.75
G_3	0.51	0.05	14.44	11.19	127.13	152.75
G_4	0.49	0.04	14.25	10.94	127.44	152.81
G_5	0.31	0.04	14.69	11.06	116.81	142.56
G_6	0.35	0.04	13.81	10.38	117.94	142.13
CD(0.05)	0.09	-	-	-	3.90	4.14
<u>S x N interaction</u>						
S_1N_1	0.36	0.04	14.83	11.83	120.83	147.50
S_1N_2	0.33	0.04	13.83	11.00	114.83	140.17
S_1N_3	0.38	0.05	13.67	11.33	118.00	143.00
S_1N_4	0.51	0.05	13.67	10.67	123.67	148.00
S_2N_1	0.53	0.05	14.17	11.00	115.17	140.33
S_2N_2	0.37	0.04	14.67	11.33	113.50	139.50
S_2N_3	0.42	0.04	14.17	11.00	126.00	151.17
S_2N_4	0.40	0.04	14.67	10.00	124.83	149.50

Contd.

Table 21. Continued

1	2	3	4	5	6	7
S_3N_1	0.41	0.04	13.00	11.33	123.33	147.67
S_3N_2	0.44	0.03	16.83	9.50	123.67	150.00
S_3N_3	0.33	0.04	14.00	11.67	120.33	146.00
S_3N_4	0.34	0.04	13.33	9.17	130.33	152.83
S_4N_1	0.25	0.06	15.67	10.83	115.17	141.67
S_4N_2	0.33	0.05	17.00	11.00	120.00	148.00
S_4N_3	0.36	0.05	12.50	10.83	124.33	147.67
S_4N_4	0.29	0.05	12.83	11.67	123.00	147.50
CD(0.05)	-	-	-	-	6.36	6.76
S x G interaction						
S_1G_1	0.26	0.05	13.25	12.75	116.75	142.75
S_1G_2	0.34	0.04	14.25	9.50	117.50	141.25
S_1G_3	0.62	0.05	14.00	12.00	126.75	152.75
S_1G_4	0.51	0.04	13.25	12.00	126.00	152.00
S_1G_5	0.30	0.06	14.75	10.50	114.75	140.00
S_1G_6	0.33	0.05	14.50	10.50	114.25	139.25
S_2G_1	0.32	0.05	14.50	11.00	113.75	139.25
S_2G_2	0.22	0.06	14.50	9.50	114.50	138.50
S_2G_3	0.56	0.04	15.00	10.25	128.75	164.00
S_2G_4	0.63	0.04	13.75	11.50	130.75	156.00
S_2G_5	0.37	0.04	14.75	11.50	114.25	140.50
S_2G_6	0.46	0.04	14.00	11.25	117.25	142.50
S_3G_1	0.39	0.04	13.75	10.75	122.25	146.75
S_3G_2	0.25	0.05	13.25	11.00	124.25	148.50
S_3G_3	0.56	0.05	15.00	10.25	127.50	152.75
S_3G_4	0.48	0.04	15.25	9.75	128.50	153.50
S_3G_5	0.26	0.03	15.25	11.00	121.25	147.50
S_3G_6	0.32	0.04	13.25	9.75	122.75	145.75
S_4G_1	0.32	0.05	14.00	11.25	120.75	146.00
S_4G_2	0.30	0.05	17.00	11.25	118.50	146.75
S_4G_3	0.29	0.05	13.75	12.25	125.50	151.50
S_4G_4	0.33	0.05	14.75	10.50	124.50	149.75
S_4G_5	0.32	0.05	14.00	11.25	117.00	142.25
S_4G_6	0.29	0.05	13.50	10.00	117.50	141.00
CD(0.05)	-	-	-	-	-	-
N x G interaction						
N_1G_1	0.27	0.05	13.00	11.00	114.50	138.50

Contd.

Table 21. Continued

1	2	3	4	5	6	7
N_1G_2	0.27	0.05	15.00	11.50	115.00	141.50
N_1G_3	0.57	0.05	15.00	10.50	128.00	153.50
N_1G_4	0.53	0.04	13.25	12.00	127.75	153.00
N_1G_5	0.31	0.05	16.25	11.50	112.25	140.00
N_1G_6	0.34	0.05	14.00	11.00	114.25	139.25
N_2G_1	0.39	0.04	16.25	11.00	114.25	141.50
N_2G_2	0.25	0.05	16.25	10.00	115.00	141.25
N_2G_3	0.51	0.04	14.25	11.75	124.75	150.75
N_2G_4	0.42	0.04	16.00	9.75	124.50	151.00
N_2G_5	0.26	0.05	15.75	10.50	114.50	140.75
N_2G_6	0.37	0.04	15.00	11.25	115.00	141.25
N_3G_1	0.34	0.05	14.00	12.25	119.50	145.75
N_3G_2	0.26	0.06	12.75	10.50	120.00	143.00
N_3G_3	0.52	0.04	14.00	12.50	127.25	153.75
N_3G_4	0.46	0.04	14.50	10.75	127.00	152.25
N_3G_5	0.34	0.05	13.75	11.25	118.75	143.75
N_3G_6	0.31	0.05	12.50	10.25	120.50	143.25
N_4G_1	0.29	0.05	12.25	11.50	125.25	149.00
N_4G_2	0.32	0.05	15.00	9.50	124.75	149.25
N_4G_3	0.44	0.05	14.50	10.00	128.50	153.00
N_4G_4	0.55	0.04	13.25	11.25	130.50	155.00
N_4G_5	0.33	0.04	13.00	11.00	121.75	145.75
N_4G_6	0.39	0.04	13.75	9.00	122.00	144.75
CD(0.05)	-	-	-	-	-	-

Ohio solution (N_4) was significantly superior (125.46 days) to fertilizer complex (N_1), Knop's (N_3) and Hoagland (N_2) solutions. BA 1500 ppm (G_4) produced the maximum total duration from maturity to senescence of leaves (127.44 days), which was significantly superior to both the concentrations of GA and Ethephon and was on par with BA 750 ppm (G_3). The interaction S_4N_3 recorded the maximum value (124.33 days), which was signifcantly superior to S_1N_2 (140.17 days), S_2N_1 (140.33 days), S_2N_2 (139.50 days) and S_4N_1 (141.67 days) interactions, and was on par with the other interactions.

The treatment combination of 70 per cent shade + 1 per cent fertilizer complex + 750 ppm BA ($S_2N_1G_3$) was the best with respect to the maximum duration of leaf from maturity to senescence (137 days), while 70 per cent shade + Ohio solution + 1500 ppm Ethephon ($S_1N_4G_6$) recorded the minimum value (104 days), compared to all the other treatments (Appendix 19).

4.2.6 Total leaf longevity (leaf emergence to senescence period)

The different nutrients, growth regulators and shade x nutrient interactions recorded significant influence on total leaf longevity, while shade levels and shade x growth regulator and nutrient x growth regulator interactions did not differ significantly. Ohio solution (N_4) recorded the maximum leaf longevity (149.46 days), which was significantly superior to fertilizer complex (N_1) and Hoagland solution (N_2) and was on par with Knop's solution (N_3). Among the growth regulators, BA 1500 ppm (G_4) was the best with respect to leaf longevity (152.81 days), and was significantly superior to both the concentrations of GA and Ethephon and was on par with BA 750 ppm (G_3). The interaction S_3N_4 recorded the maximum value for leaf longevity (152.83 days).

The treatment combination involving 70 per cent shade + fertilizer complex + 750 ppm BA ($S_2N_1G_3$) recorded the maximum total leaf longevity (161 days), while 80 per cent shade + Ohio solution + 1500 ppm Ethephon ($S_1N_4G_6$), the minimum (127 days), compared to all other treatments (Appendix 19).

4.2.7 Firmness

From the observations in Table 22, it is clear that initially the leaf appeared soft, tender and as the stage of growth advanced it became thicker, hard and brittle and ultimately at the onset of senescence, started drying.

4.2.8 Colour development

The observations in Table 22 show that, initially the leaf had light green colour, slowly turned glossy and dark green and finally started yellowing and necrosis set in as the senescence progressed.

4.2.9 Stomata (distribution, length and breadth)

Data presented in Table 23 clearly show that different shade levels, nutrients, growth regulators and their interactions did not differ significantly with respect to stomatal characters. The highest stomatal index was observed under treatment combination involving 80 per cent shade + 1 per cent fertilizer complex + 1500 ppm BA (18.35/mm²). The highest values of stomatal index was recorded under 70 per cent (S_2) shade (10.27/mm²), fertilizer complex (N_1) (10.45/mm²), 750 ppm Ethephon (G_5) (11.22/mm²) and interaction S_2G_5 (70% shade x 750 ppm

Table 22. Firmness and colour development of leaf of *A. andreanum* var. 'Hawaiian Red' at different stages of development

Sl. No.	Stage of leaf development	Leaf firmness	Colour
1	Sheath out	Soft, tender	Light green with purplish tinge
2	Leaf unfurling	Soft, tender	Light greenish yellow
3	Full opened leaf	Smooth, thick	Light green glossy
4	Mature leaf	Hard, thick, brittle	Dark green
5	Over mature/ senescing	Brittle, rough, drying	Yellow with greenish patches and necrotic leaf margin

Table 23. Influence of shade, nutrients, growth regulators and their interactions on stomatal characters of *A. andreanum* var. `Hawaiian Red'

Treatment	Stomatal index (Nos./mm²)	Stomata length (μ)	Stomata width (μ)
1	2	3	4
Shade (S)			
S_1	10.21	188.56	72.60
S_2	10.27	186.12	77.60
S_3	9.09	191.88	74.20
S_4	8.66	188.00	68.40
CD(0.05)	-	-	-
Nutrient (N)			
N_1	10.45	187.56	68.80
N_2	9.70	187.56	69.60
N_3	9.54	191.88	73.00
N_4	8.55	188.56	73.00
CD(0.05)	-	-	-
Growth regulator (G)			
G_1	8.69	186.84	72.80
G_2	8.23	191.16	71.60
G_3	9.34	186.84	72.80
G_4	9.61	191.16	72.87
G_5	11.22	186.84	72.80
G_6	10.23	188.00	69.00
CD(0.05)	-	-	-
S x N interaction			
S_1N_1	12.60	186.12	66.60
S_1N_2	9.36	186.12	70.00
S_1N_3	9.72	198.00	76.60
S_1N_4	9.19	180.00	76.60
S_2N_1	11.19	191.88	83.40
S_2N_2	11.42	186.12	73.40
S_2N_3	9.48	190.00	76.60
S_2N_4	9.01	173.88	76.60
S_3N_1	9.72	185.12	70.00
S_3N_2	9.42	186.12	70.00
S_3N_3	8.83	190.88	76.60

Contd.

Table 23. Continued

1	2	3	4
S_3N_4	8.36	204.12	80.00
S_4N_1	8.29	186.12	63.40
S_4N_2	8.59	191.88	73.40
S_4N_3	10.06	186.12	70.00
S_4N_4	7.65	191.88	66.60
CD(0.05)	-	-	-
<u>S x G interaction</u>			
S_1G_1	8.73	189.00	63.00
S_1G_2	9.79	171.00	63.00
S_1G_3	10.15	198.00	67.50
S_1G_4	11.47	189.00	67.50
S_1G_5	10.76	189.00	63.00
S_1G_6	10.32	189.00	67.50
S_2G_1	7.32	198.00	72.00
S_2G_2	7.59	189.00	72.00
S_2G_3	9.44	171.00	63.00
S_2G_4	9.88	189.00	72.00
S_2G_5	15.18	180.00	72.00
S_2G_6	12.18	189.00	67.50
S_3G_1	9.53	180.00	67.50
S_3G_2	8.65	198.00	63.00
S_3G_3	9.71	189.00	67.50
S_3G_4	8.29	198.00	72.00
S_3G_5	9.00	198.00	67.50
S_3G_6	9.35	189.00	63.00
S_4G_1	9.27	180.00	63.00
S_4G_2	6.97	207.00	63.00
S_4G_3	8.03	207.00	67.50
S_4G_4	8.74	189.00	63.00
S_4G_5	9.88	180.00	58.50
S_4G_6	9.00	189.00	56.00
CD(0.05)	-	-	-
<u>N x G interaction</u>			
N_1G_1	10.15	180.00	66.50
N_1G_2	7.50	189.00	66.50
N_1G_3	12.09	189.00	71.25
N_1G_4	10.85	189.00	71.25

Contd.

Table 23. Continued

1	2	3	4
N_1G_5	8.82	180.00	61.75
N_1G_6	13.24	198.00	66.50
N_2G_1	8.03	189.00	66.50
N_2G_2	8.74	189.00	66.50
N_2G_3	8.56	189.00	66.50
N_2G_4	9.26	189.00	76.00
N_2G_5	13.50	180.00	66.50
N_2G_6	10.06	189.00	66.50
N_3G_1	9.44	189.00	71.25
N_3G_2	8.47	198.00	71.25
N_3G_3	8.47	189.00	76.00
N_3G_4	10.15	189.00	71.25
N_3G_5	11.38	198.00	76.00
N_3G_6	9.26	189.00	61.75
N_4G_1	7.24	189.00	76.00
N_4G_2	8.29	189.00	71.25
N_4G_3	8.21	180.00	63.65
N_4G_4	8.12	198.00	71.25
N_4G_5	11.12	189.00	71.25
N_4G_6	8.29	180.00	71.25
CD(0.05)	-	-	-

Ethephon) (15.18/mm²). The length of stomata ranged between 171 μ to 207 μ while breadth ranged 61.75 μ to 77.60 μ.

4.2.10 Leaf senescence number

Data presented in Table 24 indicate that the mean number of leaves in senescence was significantly influenced by the shade levels, growth regulators and shade x nutrient interaction, during the different months of the experimental period, but was not influenced by nutrients, shade x growth regulator and nutrient x growth regulator interactions during any month of the experimental period.

Different shade levels have influenced significantly during the major part of the experimental period except in 2nd, 8th, 12th and 13th months. Growth regulators had influenced during 7th, 10th, 11th, 12th and 13th months of the experimental period. The shade x nutrient interaction had significant influence during two months (4th and 14th), while during the other months of the experimental period, the effect was not significant (Appendix 20).

4.3 Root characters

The data on the effect of different shade levels, nutrients and growth regulators and the interactions on the number of aerial roots, the number of primary roots, the number of secondary roots, length of roots and spread of roots are presented in Tables 25 and 26.

4.3.1 Number of aerial roots

The data presented in Table 25 clearly show that the different shade levels had significantly influenced the number of aerial roots produced during the

Table 24. Effect of shade, nutrients, growth regulators and their interactions on number of leaves senescenced of *A. andreanum* var. 'Hawaiin Red' at monthly interval

Treatment	Month													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Shade (S)														
S_1	1.96	0.06	1.10	0.37	0.33	1.83	2.67	2.30	1.87	1.78	2.20	2.03	1.41	1.01
S_2	1.90	0.12	1.45	0.67	0.28	1.66	2.49	2.17	1.64	1.75	2.41	2.05	1.30	1.33
S_3	1.88	0.12	1.13	0.26	0.30	2.38	2.28	2.41	1.45	2.17	1.99	1.99	1.45	1.37
S_4	1.39	0.15	1.20	0.81	0.88	2.18	2.65	2.08	1.38	1.98	1.87	1.73	1.25	1.11
CD(0.05)	0.20	-	0.14	0.20	0.21	0.21	0.24	-	0.21	0.23	0.25	-	-	0.24
Nutrient (N)														
N_1	1.82	0.09	1.16	0.65	0.55	2.01	2.46	2.39	1.63	1.87	2.20	1.96	1.23	1.25
N_2	1.88	0.15	1.21	0.55	0.34	1.83	2.46	2.20	1.60	1.83	2.11	2.07	1.36	1.23
N_3	1.76	0.07	1.32	0.40	0.48	2.10	2.55	2.12	1.64	1.99	2.21	1.97	1.35	1.22
N_4	1.66	0.13	1.19	0.50	0.42	2.11	2.62	2.26	1.48	1.98	1.96	1.81	1.47	1.13
CD(0.05)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Growth regulator (G)														
G_1	1.68	0.02	1.18	0.64	0.56	1.97	2.51	2.29	2.03	2.12	2.22	2.03	1.43	1.23
G_2	1.83	0.10	1.19	0.64	0.54	2.12	2.39	2.38	2.13	2.18	2.31	2.25	1.43	1.47
G_3	1.83	0.19	1.24	0.48	0.49	1.98	2.69	2.06	1.55	2.16	2.57	2.20	1.54	1.14
G_4	1.72	0.16	1.21	0.38	0.39	1.98	2.83	2.14	1.47	2.04	2.67	2.24	1.49	1.16
G_5	1.78	0.08	1.31	0.46	0.37	2.06	2.43	2.36	1.17	1.59	1.59	1.46	1.14	1.11
G_6	1.84	0.11	1.18	0.57	0.33	1.96	2.28	2.22	1.18	1.42	1.35	1.52	1.09	1.13
CD(0.05)	-	-	-	-	-	-	0.29	-	-	0.28	0.30	0.30	0.24	-

Contd.

Table 24. Continued

Treatment	Month													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
<u>S x N interaction</u>														
S_1N_1	1.52	0.05	1.05	0.22	0.42	1.90	2.53	2.35	1.85	1.68	2.23	2.48	1.27	1.30
S_1N_2	2.10	0.10	1.07	0.30	0.33	1.60	2.38	2.25	1.88	1.50	2.08	2.07	1.40	0.88
S_1N_3	2.12	0.03	1.13	0.62	0.42	1.92	2.83	2.10	2.03	1.85	2.30	1.95	1.47	0.77
S_1N_4	2.10	0.05	1.17	0.33	0.17	1.90	2.93	2.52	1.70	2.07	2.20	1.63	1.50	1.08
S_2N_1	2.15	0.12	1.45	0.77	0.38	1.57	2.47	2.27	1.58	1.82	2.38	1.87	1.28	1.03
S_2N_2	2.00	0.10	1.47	0.80	0.27	1.77	2.23	2.25	1.63	1.82	2.35	2.37	1.30	1.73
S_2N_3	1.73	0.10	1.43	0.40	0.25	1.78	2.57	1.97	1.82	1.60	2.47	1.98	1.23	1.32
S_2N_4	1.70	0.15	1.45	0.72	0.20	1.52	2.68	2.20	1.53	1.75	2.45	1.98	1.40	1.25
S_3N_1	2.17	0.13	1.02	0.32	0.23	2.30	2.13	2.62	1.40	2.07	2.17	2.02	1.40	1.42
S_3N_2	2.05	0.17	1.08	0.27	0.30	1.93	2.50	2.22	1.52	2.08	2.03	1.93	1.37	0.90
S_3N_3	1.88	0.02	1.40	0.10	0.32	2.53	2.25	2.25	1.62	2.45	2.18	2.07	1.48	1.70
S_3N_4	1.40	0.15	1.00	0.35	0.37	2.77	2.25	2.55	1.28	2.08	1.57	1.95	1.53	1.47
S_4N_1	1.43	0.07	1.13	1.32	1.18	2.27	2.72	2.32	1.67	1.90	2.02	1.48	0.97	1.23
S_4N_2	1.37	0.23	1.22	0.83	0.45	2.02	2.72	2.10	1.37	1.92	1.97	1.90	1.38	1.42
S_4N_3	1.30	0.12	1.30	0.50	0.92	2.17	2.55	2.15	1.10	2.07	1.90	1.87	1.22	1.08
S_4N_4	1.45	0.18	1.13	0.60	0.95	2.25	2.60	1.77	1.40	2.02	1.62	1.67	1.45	0.72
CD(0.05)	0.41	-	-	0.25	-	-	-	-	-	-	-	-	-	0.48
<u>S x G Interaction</u>														
S_1G_1	1.70	0.03	1.13	0.43	0.55	1.75	2.58	2.38	2.13	2.28	2.35	1.80	1.50	1.20
S_1G_2	2.15	0.10	1.05	0.35	0.45	1.85	2.78	2.45	2.30	2.15	2.32	2.28	1.53	1.28
S_1G_3	2.23	0.05	1.25	0.25	0.28	1.78	3.08	2.18	2.08	1.95	3.00	2.52	1.50	1.18
S_1G_4	1.80	1.05	1.15	0.38	0.23	1.78	2.83	2.28	2.05	1.82	2.63	2.28	1.43	0.85

Contd.

Table 24. Continued

Treatment	Month													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
S_1G_5	2.00	0.10	1.05	0.28	0.25	1.90	2.48	2.30	1.25	1.40	1.53	1.68	1.18	0.78
S_1G_6	1.88	0.03	1.00	0.53	0.25	1.93	2.30	2.25	1.40	1.05	1.40	1.65	1.33	0.78
S_2G_1	1.70	0.03	1.25	0.90	0.35	1.63	2.33	2.33	2.03	1.95	2.53	2.25	1.35	1.32
S_2G_2	1.90	0.13	1.33	0.70	0.33	1.83	2.43	2.48	2.50	2.40	2.70	2.75	1.35	1.80
S_2G_3	1.90	0.25	1.60	0.60	0.28	1.58	2.78	1.88	1.53	1.88	2.70	2.05	1.50	1.18
S_2G_4	2.05	0.15	1.33	0.48	0.25	1.63	2.85	1.82	1.38	1.78	2.90	2.28	1.53	1.35
S_2G_5	1.78	0.03	1.73	0.65	0.23	1.63	2.38	2.30	1.25	1.25	1.93	1.35	1.13	1.13
S_2G_6	2.05	0.13	1.47	0.70	0.23	1.68	2.18	2.23	1.18	1.22	1.72	1.63	0.98	1.22
S_3G_1	1.85	0.00	1.20	0.38	0.50	2.40	2.45	2.55	1.88	2.15	2.08	2.33	1.63	1.33
S_3G_2	1.88	0.03	1.18	0.45	0.40	2.65	2.13	2.63	1.80	2.18	2.38	2.38	1.20	1.60
S_3G_3	1.90	0.18	0.92	0.15	0.13	2.25	2.48	2.15	1.43	2.40	2.40	2.08	1.65	1.07
S_3G_4	1.72	0.15	1.07	0.00	0.20	2.40	2.63	2.25	1.30	2.28	2.65	2.23	1.57	1.35
S_3G_5	2.00	0.15	1.28	0.33	0.47	2.45	2.10	2.48	1.33	2.23	1.50	1.50	1.30	1.50
S_3G_6	1.90	0.20	1.10	0.25	0.13	2.15	1.93	2.40	1.00	1.80	0.93	1.45	1.32	1.38
S_4G_1	1.45	0.03	1.15	0.85	0.83	2.10	2.70	1.93	2.10	2.10	1.93	1.75	1.23	1.08
S_4G_2	1.38	0.15	1.20	1.05	1.00	2.15	2.23	1.98	1.90	1.97	1.83	1.60	1.65	1.20
S_4G_3	1.30	0.30	1.20	0.93	1.30	2.33	1.43	2.03	1.18	2.40	2.20	2.15	1.50	1.13
S_4G_4	1.30	0.28	1.28	0.68	0.88	2.13	3.03	2.23	1.15	2.27	2.53	2.20	1.45	1.08
S_4G_5	1.35	0.05	1.20	0.58	0.55	2.25	2.78	2.35	0.85	1.50	1.43	1.33	0.98	1.05
S_4G_6	1.55	0.10	1.15	0.80	0.70	2.10	2.73	2.00	1.13	1.60	1.35	1.35	0.72	1.15
CD(0.05)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>N x G interaction</u>														
N_1G_1	1.50	0.03	1.20	0.63	0.67	1.85	2.28	2.43	2.08	2.35	2.28	2.08	1.18	1.15

Contd.

Table 24. Continued

Treatment	Month													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
N_1G_2	1.78	0.13	1.20	0.60	0.55	2.02	2.40	2.40	2.08	2.05	2.45	2.33	1.55	1.73
N_1G_3	2.05	0.15	1.13	0.55	0.60	1.95	2.73	2.50	1.50	1.88	2.80	2.23	1.35	1.28
N_1G_4	1.90	0.13	1.25	0.50	0.63	2.13	2.80	2.35	1.63	1.86	2.78	2.23	1.28	1.33
N_1G_5	1.90	0.10	1.26	0.78	0.55	2.13	2.45	2.55	1.15	1.63	1.75	1.45	1.05	0.85
N_1G_6	1.78	0.03	1.00	0.88	0.33	1.98	2.13	2.10	1.32	1.43	1.15	1.47	0.97	1.15
N_2G_1	1.72	0.03	1.20	0.65	0.25	1.90	2.53	2.30	1.83	2.08	2.23	2.15	1.30	1.38
N_2G_2	1.82	0.08	1.18	0.98	0.70	2.13	2.13	2.43	2.25	2.07	2.32	2.48	1.35	1.30
N_2G_3	1.90	0.23	1.13	0.48	0.40	1.80	2.70	2.05	1.55	2.20	2.70	2.03	1.85	1.10
N_2G_4	1.93	0.33	1.13	0.40	0.15	1.65	2.73	2.05	1.55	1.95	2.50	2.23	1.55	1.10
N_2G_5	1.93	0.10	1.45	0.35	0.20	1.55	2.33	2.23	1.30	1.58	1.63	1.68	1.00	1.20
N_2G_6	1.97	0.15	1.18	0.45	0.33	1.95	2.35	2.18	1.13	1.10	1.28	1.85	1.13	1.33
N_3G_1	2.00	0.03	1.25	0.48	0.65	1.93	2.65	2.07	2.20	2.15	2.35	2.25	1.65	1.35
N_3G_2	1.97	0.08	1.25	0.18	0.30	2.10	2.40	2.45	2.15	2.27	2.40	2.33	1.38	1.45
N_3G_3	1.68	0.10	1.38	0.40	0.45	2.13	2.60	1.43	1.68	2.13	2.52	2.33	1.35	1.05
N_3G_4	1.53	0.05	1.28	0.35	0.35	2.00	2.90	1.88	1.55	2.13	2.85	2.33	1.43	1.18
N_3G_5	1.55	0.08	1.45	0.45	0.63	2.33	2.45	2.43	1.15	1.65	1.57	1.25	1.25	1.28
N_3G_6	1.83	0.08	1.30	0.58	0.48	2.13	2.30	2.45	1.12	1.63	1.58	1.33	1.05	1.00
N_4G_1	1.47	0.00	1.08	0.80	0.65	2.20	2.60	2.38	2.03	1.90	2.02	1.65	1.57	1.05
N_4G_2	1.73	0.13	1.13	0.80	0.63	2.23	2.63	2.25	2.02	2.30	2.05	1.88	1.45	1.40
N_4G_3	1.70	0.30	1.35	0.50	0.53	2.05	2.73	2.25	1.47	2.43	2.27	2.23	1.60	1.13
N_4G_4	1.53	0.13	1.18	0.28	0.43	2.15	2.90	2.30	1.15	2.20	2.58	2.20	1.73	1.03
N_4G_5	1.75	0.05	1.15	0.25	0.13	2.23	2.50	2.23	1.08	1.53	1.43	1.48	1.28	1.13
N_4G_6	1.80	0.20	1.25	0.38	0.18	1.80	2.35	2.15	1.13	1.53	1.40	1.43	1.20	1.05
CD	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 25. Effect of shade, nutrients, growth regulators and their interactions on number of aerial roots produced by *A. andreanum* var. 'Hawaiian Red' at monthly interval

Treatment	Month													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Shade (S)														
S_1	2.03	3.32	5.10	6.38	7.43	5.23	3.98	4.95	3.19	5.23	5.41	1.77	1.11	1.15
S_2	1.96	2.90	4.89	5.52	5.72	4.62	3.43	4.84	2.79	5.95	6.28	0.70	0.23	0.04
S_3	1.70	2.45	4.29	3.10	3.84	2.55	2.56	2.76	3.16	4.79	5.34	0.56	0.32	0.00
S_4	2.09	2.70	5.49	4.10	3.20	2.10	1.38	1.46	2.83	4.37	4.40	0.23	0.05	0.00
CD(0.05)	-	0.45	0.62	0.77	0.72	0.66	0.55	0.66	-	0.74	0.84	0.43	0.34	0.33
Nutrient (N)														
N_1	2.29	3.01	5.09	4.93	5.12	3.39	2.93	3.49	2.88	4.59	5.31	0.86	0.68	0.62
N_2	1.97	2.70	4.74	4.42	4.80	3.42	2.65	3.16	3.14	5.32	5.36	0.81	0.48	0.31
N_3	1.81	2.95	5.06	5.14	4.83	3.75	2.93	3.92	2.89	5.44	5.31	0.60	0.26	0.08
N_4	1.71	2.71	4.88	4.62	5.45	3.94	2.84	3.43	3.07	5.00	5.45	0.98	0.29	0.18
CD(0.05)	-	-	-	-	-	-	-	-	-	-	-	-	-	0.33
Growth regulator (G)														
G_1	1.94	3.09	5.16	4.97	5.27	3.58	2.87	3.31	2.60	4.69	5.00	0.66	0.34	0.31
G_2	1.99	2.94	4.88	5.20	5.06	3.33	2.64	2.88	2.56	4.73	4.83	0.72	0.30	0.24
G_3	1.99	2.73	5.22	4.89	4.84	3.43	3.19	3.92	3.28	5.52	6.31	0.83	0.48	0.34
G_4	1.59	2.68	4.75	4.31	4.74	3.26	2.42	3.51	3.36	5.59	5.89	0.83	0.41	0.31
G_5	2.24	2.78	4.94	4.41	4.89	3.93	2.84	3.46	3.02	4.78	4.89	0.99	0.58	0.24
G_6	1.91	2.86	4.70	4.86	5.49	4.22	3.06	3.94	3.16	5.22	5.22	0.86	0.47	0.34
CD(0.05)	-	-	-	-	-	-	-	-	-	-	1.03	-	-	-

Contd.

Table 25. Continued

Treatment	Month													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
<u>S x N interaction</u>														
S_1N_1	2.68	3.52	5.22	5.47	7.52	4.13	3.53	3.97	2.95	3.97	5.03	2.40	2.27	2.48
S_1N_2	1.55	3.15	4.43	5.38	7.33	4.58	3.78	4.13	2.73	5.40	5.33	1.93	1.32	1.23
S_1N_3	2.03	3.32	5.10	7.37	7.22	6.13	4.20	5.48	3.02	6.05	5.13	1.08	0.58	0.25
S_1N_4	1.85	3.30	5.65	7.32	7.67	6.08	4.40	6.20	4.07	5.52	6.13	1.65	0.28	0.62
S_2N_1	1.85	3.15	4.98	6.47	5.27	4.62	3.83	5.77	3.08	5.97	6.43	0.63	0.07	0.00
S_2N_2	2.70	2.48	4.65	5.30	4.85	4.40	3.12	4.93	2.52	5.97	6.08	0.43	0.20	0.00
S_2N_3	1.52	3.18	5.00	4.93	5.38	4.57	3.28	4.88	2.37	5.98	6.37	0.53	0.27	0.07
S_2N_4	1.77	2.80	4.92	5.38	7.38	4.88	3.48	3.77	3.20	5.90	6.25	1.18	0.38	0.10
S_3N_1	2.22	2.48	4.48	3.17	3.90	2.30	2.52	2.72	3.18	4.48	5.23	0.40	0.37	0.00
S_3N_2	1.53	2.23	4.25	3.27	4.15	2.67	2.45	2.35	3.13	5.13	4.75	0.42	0.23	0.00
S_3N_3	1.40	2.90	4.38	3.27	3.38	2.50	2.95	3.63	3.50	4.77	5.75	0.80	0.20	0.00
S_3N_4	1.65	2.18	4.03	2.68	3.92	2.72	2.32	2.33	2.83	4.78	5.62	0.62	0.47	0.00
S_4N_1	2.40	2.90	5.68	4.60	3.80	2.52	1.85	1.52	2.30	3.93	4.52	0.00	0.00	0.00
S_4N_2	2.10	2.95	5.62	3.72	2.85	2.03	1.23	1.23	4.17	4.77	5.27	0.47	0.15	0.00
S_4N_3	2.88	2.40	5.75	4.98	3.42	1.78	1.27	1.68	2.68	4.97	4.00	0.00	0.00	0.00
S_4N_4	1.57	2.57	4.90	3.08	2.83	2.07	1.15	1.40	2.18	3.80	3.80	0.45	0.03	0.00
CD(0.05)	-	-	-	1.54	-	-	-	1.32	1.05	-	-	-	0.68	0.66
<u>S x G interaction</u>														
S_1G_1	1.82	3.75	5.35	6.78	7.68	5.13	4.00	4.43	2.43	4.33	4.43	1.55	0.72	1.23
S_1G_2	2.25	3.77	5.23	6.80	7.67	5.23	4.15	4.40	2.90	4.63	5.13	1.90	0.70	0.85
S_1G_3	2.08	3.43	4.90	6.58	7.05	4.68	4.48	5.58	3.82	6.53	7.43	1.75	1.43	1.38
S_1G_4	1.20	2.60	5.20	6.50	6.92	4.73	3.53	4.98	3.55	5.37	5.85	1.05	0.90	1.25

Contd.

Table 25. Continued

Treatment	Month													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
S_1G_5	2.82	2.98	5.08	5.68	7.43	5.80	3.98	4.93	3.60	4.50	4.30	2.28	1.55	0.80
S_1G_6	2.00	3.43	4.85	5.98	7.85	5.85	3.75	5.38	2.85	6.05	5.33	2.08	1.38	1.38
S_2G_1	1.83	2.83	4.98	5.63	5.50	4.55	3.20	4.83	2.23	5.13	5.88	0.60	0.10	0.00
S_2G_2	2.35	3.32	5.18	6.15	6.30	4.90	3.63	4.25	2.53	5.70	5.85	0.80	0.10	0.10
S_2G_3	2.05	3.00	5.33	5.58	5.43	4.18	3.43	4.95	2.58	6.18	6.68	0.40	0.13	0.00
S_2G_4	1.47	3.15	5.03	5.15	6.00	4.00	2.70	4.68	2.98	6.38	7.00	0.90	0.30	0.00
S_2G_5	1.82	2.58	4.27	5.00	5.68	5.10	3.58	5.15	2.98	6.65	5.98	0.80	0.55	0.15
S_2G_6	2.23	2.55	4.55	5.63	5.42	4.98	4.05	5.17	3.48	6.10	6.33	0.67	0.20	0.00
S_3G_1	2.03	3.02	4.33	3.10	3.95	2.63	2.30	2.38	2.73	4.80	5.13	0.48	0.25	0.00
S_3G_2	1.40	2.08	4.00	2.90	3.50	1.50	1.85	1.88	2.58	4.70	4.53	0.18	0.40	0.00
S_3G_3	1.68	2.00	4.83	2.77	3.85	2.50	3.10	3.50	3.43	4.98	6.50	0.50	0.30	0.00
S_3G_4	1.58	2.60	3.98	2.75	3.48	2.63	2.27	2.95	3.88	5.65	5.90	0.95	0.43	0.00
S_3G_5	2.18	2.45	4.58	3.15	3.38	2.63	2.90	2.45	3.10	4.13	4.93	0.72	0.23	0.00
S_3G_6	1.35	2.55	4.03	3.90	4.88	3.40	2.93	3.40	3.28	4.50	5.05	0.53	0.30	0.00
S_4G_1	2.08	2.80	6.00	4.38	3.95	2.03	1.97	1.60	3.03	4.50	4.58	0.00	0.28	0.00
S_4G_2	1.98	2.57	5.10	4.95	2.75	1.68	0.93	0.97	2.23	3.90	3.80	0.00	0.00	0.00
S_4G_3	2.18	2.50	5.83	4.63	3.05	2.38	1.75	1.65	3.28	4.40	4.65	0.65	0.00	0.00
S_4G_4	2.10	2.35	4.80	2.85	2.55	1.68	1.18	1.43	3.02	4.95	4.83	0.40	0.00	0.00
S_4G_5	2.13	3.10	5.83	3.82	3.08	2.18	0.93	1.30	2.43	4.23	4.38	0.15	0.00	0.00
S_4G_6	2.08	2.90	5.38	3.95	3.82	2.68	1.50	1.80	3.02	4.23	4.18	0.18	0.00	0.00
CD(0.05)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
N x G interaction														
N_1G_1	2.05	3.12	6.13	4.28	5.13	3.07	3.13	2.88	2.10	3.53	3.73	0.70	0.63	0.95

Contd.

Table 25. Continued

Treatment	Month													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
N_1G_2	2.15	3.05	5.35	5.90	5.85	3.38	3.25	3.50	2.48	4.70	5.03	0.78	0.55	0.43
N_1G_3	2.55	2.43	5.08	5.05	4.75	2.83	3.20	3.58	2.78	4.73	5.95	0.48	0.45	0.73
N_1G_4	1.98	3.58	5.20	4.55	4.65	2.93	2.50	3.95	3.35	5.45	6.48	0.85	0.35	0.53
N_1G_5	2.25	2.90	4.50	4.53	4.63	3.70	2.58	3.25	3.03	4.53	4.95	1.25	1.10	0.29
N_1G_6	2.75	3.00	4.30	5.25	5.72	4.45	2.95	3.70	3.55	4.60	5.73	1.10	0.98	0.90
N_2G_1	2.03	3.12	4.73	4.50	5.10	3.50	2.48	2.93	2.60	5.30	5.05	0.40	0.23	0.00
N_2G_2	1.97	3.13	4.45	4.47	4.53	2.88	1.97	2.03	2.33	4.55	4.25	0.40	0.20	0.35
N_2G_3	1.90	3.10	4.68	4.65	4.83	3.52	3.20	3.45	3.55	5.40	6.30	1.05	0.70	0.65
N_2G_4	1.50	1.88	4.65	3.75	4.45	3.13	2.20	2.90	3.58	5.75	5.45	0.55	0.75	0.48
N_2G_5	2.65	2.45	4.98	4.80	5.25	4.15	2.82	3.83	3.68	5.35	5.18	1.45	0.50	0.00
N_2G_6	1.78	2.55	4.95	4.33	4.63	3.35	3.15	3.85	3.10	5.55	5.93	1.03	0.48	0.38
N_3G_1	1.78	3.38	5.70	6.15	5.75	4.25	3.20	3.98	3.08	4.70	5.85	0.58	0.15	0.15
N_3G_2	1.93	2.88	5.55	5.55	5.05	3.60	2.90	3.30	2.70	5.03	4.80	0.53	0.40	0.18
N_3G_3	2.13	2.82	5.40	4.75	4.20	3.28	2.83	4.23	2.98	6.83	5.90	0.78	0.43	0.00
N_3G_4	1.40	2.63	4.83	4.53	4.38	3.48	2.70	4.08	3.27	5.85	6.13	0.60	0.15	0.00
N_3G_5	2.23	2.98	4.85	4.50	4.58	3.45	2.80	3.05	2.53	4.58	4.65	0.90	0.30	0.15
N_3G_6	1.40	3.02	4.03	5.55	5.00	4.43	3.13	4.90	2.80	5.68	4.55	0.25	0.15	0.00
N_4G_1	1.90	2.75	4.10	4.95	5.10	3.50	2.68	3.45	2.63	5.23	5.38	0.95	0.35	0.13
N_4G_2	1.93	2.70	4.15	4.88	4.80	3.45	2.43	2.68	2.73	4.65	5.23	1.18	0.05	0.00
N_4G_3	1.40	2.57	5.73	5.10	5.60	4.10	3.53	4.43	3.80	5.13	7.10	1.00	0.28	0.00
N_4G_4	1.48	2.63	4.33	4.43	5.48	3.50	2.27	3.10	3.23	5.30	5.53	1.30	0.38	0.25
N_4G_5	1.82	2.78	5.43	3.82	5.10	4.40	3.13	3.60	2.88	4.65	4.80	0.35	0.43	0.60
N_4G_6	1.73	2.85	5.53	4.53	6.63	4.67	3.00	3.30	3.18	5.05	4.68	1.07	0.28	0.10
CD(0.05)	-	-	-	-	-	-	-	-	-	-	-	-	-	-

experiment period with the exception of 1st and 9th months. With the decrease in shade intensity, the aerial root number also decreased. Eighty per cent shade level recorded the maximum (6.38) and significantly superior number of aerial roots compared to the other shade levels during the major part of the experiment. Different nutrients had significant influence only during the 14th month of the experiment. Fertilizer complex was having significant superiority (0.62) over Knop's solution and Ohio solution but was on par with Hoagland solution. Growth regulators have shown significant influence only during the 11th month of the experiment. BA 750 ppm (G_3) recorded the maximum, number of aerial roots (6.31) which was significantly superior to both the concentrations of GA and Ethephon and was on par with the BA 1500 ppm (G_4). The shade x nutrient interaction has shown significant influence during 4th, 8th, 9th, 13th and 14th months of the experiment. Rest of the interactions i.e. shade x growth regulator and nutrient x growth regulator have not differed significantly. The wide range in aerial root production (0 to 10.2) under the influence of the different treatment combinations over the experimental period are presented in Appendix 21.

4.3.2 Number of primary roots

The number of primary roots produced by the plant was significantly influenced by the different shade levels, growth regulators and shade x nutrient interaction (Table 26). The nutrients, shade x growth regulator and nutrient x growth regulator have not differed significantly. Number of primary roots was maximum under 80 per cent (S_1) shade (11.13), which was significantly superior to 50 per cent and was on par with 70 per cent (S_2) and 60 per cent (S_3) shade levels. Among the growth regulators, BA 1500 ppm (G_4) recorded the maximum number of primary roots (12.69), which was significantly superior to both the concentrations of GA and Ethephon and was on par with BA 750 ppm (G_3). The S_1N_4 (80% shade x Ohio solution) interaction recorded the maximum (13.67), which was significantly superior to all the other interactions except S_3N_1 (60% shade x fertilizer complex) and S_3N_2 (60% shade x Hoagland solution) which were on par. The unique combination of 80 per cent shade + Ohio solution + 750 ppm BA recorded the maximum (18.00), while 50 per cent shade + fertilizer complex + Ethephon 750 ppm recorded the minimum (5.00) number of primary roots compared to all the other treatments (Appendix 22).

4.3.3 Number of secondary roots

The number of secondary roots produced was significantly influenced by the different shade levels, growth regulators and shade x nutrient interaction (Table 26). The different nutrients, shade x growth regulator and nutrient x growth regulator interactions had no significant influence. Eithy per cent shade produced significantly higher number of secondary roots (72.29) compared to 50per cent and was on par with 70per cent and 60per cent. Among the growth regulators, BA 1500 ppm (G_4) produced the maximum number of secondary roots (81.13), which was significantly superior to both the concentrations of GA and Ethophon and was on par with BA 750 ppm. The interaction S_1N_4 (80 per cent shade x Ohio solution) recorded the maximum number (98.50), which was significantly superior to all the other interactions except S_2N_1 and S_3N_1. The maximum number of secondary roots per plant (142.00) was produced under the treatment combination of 80 per cent shade + Ohio solution + 750 ppm BA ($S_1N_4G_3$) while, 50 per cent shade + fertilizer complex + 750 ppm GA ($S_4N_1G_1$) produced the minimum (21.00), compared to all the other treatments (Appendix 22).

4.3.4 Root length

The shade levels, growth regulators and shade x nutrient interaction have significantly influenced the length of roots. The nutrients, shade x growth regulator and nutrient x growth regulator interactions have not differed significantly (Table 26). Maximum root length (13.08 cm) was under 60 per cent (S_3) shade which was significantly superior to that under 50 per cent (S_4) and was on par with 70 per cent (S_2) and 80 per cent (S_1) shade levels. BA 1500 ppm (G_4) produced the longest roots (14.31 cm), which was significantly superior to both the concentrations of GA and Ethephon and was on par with the BA 750 ppm (G_3). Among the interactions, the S_3N_2 (60% shade x Hoagland solution) interaction recorded the maximum (15.33 cm) root length, which was on par with the S_1N_4, S_2N_1, S_2N_3 and S_3N_1 interactions and was significantly superior to the other interactions. The treatment combination of 60 per cent shade + Ohio solution + 1500 ppm BA ($S_3N_4G_4$) was found to be superior (19.00 cm) among the treatment combinations, while, 50 per cent shade + fertilizer complex + 750 ppm GA ($S_4N_1G_1$) recorded the minimum root length (7.00 cm) compared to all other treatment (Appendix 22).

4.3.5 Root spread

The different shade levels, growth regulators and shade x nutrient interaction have significantly influenced the root spread (Table 26). The nutrients, shade x growth regulator and nutrient x growth regulator interactions failed to influence this character significantly. Root spread was maximum (13.04 cm) under 80 per cent (S_1) shade, which was significantly superior to that under 50 per cent (S_4) and was on par with 70 per cent (S_2) and 60 per cent (S_3) shade levels. Among the

Table 26. Influence of shade, nutrients, growth regulators and their interactions on root characters of *A. andreanum* var. `Hawaiian Red'

Treatment	Primary roots (Nos.)	Secondary roots (Nos.)	Root length (cm)	Root spread (cm)
1	2	3	4	5
Shade (S)				
S_1	11.13	72.29	13.04	13.04
S_2	10.13	63.25	13.04	12.17
S_3	10.83	66.59	13.08	13.00
S_4	8.50	40.13	11.08	11.00
CD(0.05)	1.18	10.25	1.27	1.13
Nutrient (N)				
N_1	9.92	63.50	12.92	12.67
N_2	9.79	55.33	12.79	11.83
N_3	10.17	57.25	12.29	12.17
N_4	10.71	66.13	12.25	12.54
CD(0.05)	-	-	-	-
Growth regulator (G)				
G_1	8.38	46.63	11.25	11.63
G_2	8.63	47.50	11.00	11.19
G_3	12.25	80.63	13.88	13.50
G_4	12.69	81.13	14.31	14.00
G_5	9.31	52.94	12.44	11.31
G_6	9.63	54.50	12.50	12.19
CD(0.05)	1.44	12.55	1.56	1.39
S x N interaction				
S_1N_1	10.83	69.83	13.50	13.50
S_1N_2	10.00	57.50	11.50	12.00
S_1N_3	10.00	63.33	12.50	11.83
S_1N_4	13.67	98.50	14.67	14.83
S_2N_1	11.00	80.50	14.33	14.00
S_2N_2	9.17	51.33	11.67	10.17
S_2N_3	10.67	67.67	13.83	13.17
S_2N_4	9.67	53.50	10.33	11.33
S_3N_1	11.83	79.83	14.67	13.50
S_3N_2	11.67	73.67	15.33	13.67
S_3N_3	9.67	47.00	10.67	11.83

Contd.

Table 26. Continued

1	2	3	4	5
S_3N_4	10.17	65.67	11.67	10.13
S_4N_1	6.00	23.83	9.17	9.67
S_4N_2	8.33	38.83	12.67	11.50
S_4N_3	10.33	51.00	12.17	11.83
S_4N_4	9.33	46.83	10.33	11.00
CD(0.05)	2.36	20.50	2.54	2.26
S x G interaction				
S_1G_1	9.25	57.75	11.35	12.00
S_1G_2	9.25	56.00	11.00	11.50
S_1G_3	14.00	97.50	14.25	15.00
S_1G_4	14.00	97.25	14.50	15.00
S_1G_5	9.75	61.50	13.25	12.25
S_1G_6	10.50	63.75	14.00	12.50
S_2G_1	6.75	35.00	11.25	10.25
S_2G_2	7.00	36.75	10.75	10.25
S_2G_3	13.00	92.75	14.25	14.00
S_2G_4	13.25	94.75	14.75	14.25
S_2G_5	9.75	59.00	13.75	11.00
S_2G_6	11.00	61.25	13.50	13.25
S_3G_1	9.75	60.50	12.50	13.25
S_3G_2	10.50	62.00	11.50	12.25
S_3G_3	12.50	84.75	14.75	13.75
S_3G_4	13.25	85.75	15.75	15.25
S_3G_5	9.50	51.25	11.75	11.25
S_3G_6	9.50	55.00	12.25	12.25
S_4G_1	7.75	33.25	10.00	11.00
S_4G_2	7.75	35.25	10.75	10.75
S_4G_3	9.50	47.50	12.26	11.25
S_4G_4	10.25	46.75	12.25	11.50
S_4G_5	8.25	40.00	11.50	10.75
S_4G_6	7.50	38.00	10.25	10.75
CD(0.05)	-	-	-	-
N x G interaction				
N_1G_1	8.75	45.25	11.50	13.25
N_1G_2	8.00	42.75	10.25	11.50
N_1G_3	12.50	96.50	14.00	13.50
N_1G_4	12.25	90.25	14.75	14.00

Contd.

Table 26. Continued

1	2	3	4	5
N_1G_5	8.25	50.25	12.75	11.25
N_1G_6	9.75	56.00	14.25	12.50
N_2G_1	8.00	49.50	12.00	11.00
N_2G_2	9.00	47.50	11.75	10.75
N_2G_3	11.00	63.75	13.75	13.50
N_2G_4	12.25	63.75	12.75	13.75
N_2G_5	9.25	54.75	13.00	11.25
N_2G_6	9.25	52.75	12.50	11.75
N_3G_1	7.75	41.25	10.25	11.00
N_3G_2	8.50	44.25	10.50	11.75
N_3G_3	13.00	78.25	14.50	14.00
N_3G_4	13.00	82.00	14.00	14.50
N_3G_5	9.50	48.75	12.25	10.50
N_3G_6	9.25	49.00	12.25	13.25
N_4G_1	9.00	50.50	11.25	11.25
N_4G_2	9.00	55.50	11.25	11.45
N_4G_3	12.50	84.00	13.25	13.00
N_4G_4	13.25	88.50	14.75	14.75
N_4G_5	10.25	58.00	11.75	12.25
N_4G_6	10.25	60.25	11.00	12.25
CD(0.05)	-	-	-	-

growth regulators, BA 1500 ppm (G_4) was significantly superior (14.00 cm) to both the concentrations of GA and Ethephon and was on par with BA 750 ppm (G_3). The interaction S_1N_4 (80% shade x Ohio solution) recorded the maximum (14.83 cm) root spread, which was on par with S_1N_1, S_2N_1, S_2N_3, S_3N_1 and S_3N_2 and was significantly superior to the rest of the interactions. The treatment combination of 60 per cent shade + Ohio solution + 1500 ppm BA ($S_3N_4G_4$) recorded the maximum value for root spread (19.00 cm), while 70 per cent shade + Knop's solution + 750 ppm GA and 1500 ppm GA ($S_2N_3G_1$ and $S_2N_3G_2$) recorded the minimum (8.00 cm) root spread compared to all the other treatments (Appendix 22).

4.4 Flowering pattern and inflorescence characters

The data on the effect of different shade levels, nutrients and growth regulators on flowering pattern and characters of the inflorescence are presented in Table 27 and the inflorescence production at monthly interval, in Table 28.

4.4.1 Time taken for first flowering

None of the shade levels, nutrients, growth regulators and their interactions significantly influenced the time taken for first flowering.

4.4.2 Number of stalkless inflorescences

The shade level, nutrients, growth regulators and their interactions had no significant influence on the production of stalkless inflorescences.

4.4.3 Number of normal inflorescences

None of the shade levels, nutrients and growth regulator and their interactions had significant influence on the number of inflorescences produced during the experimental period.

4.4.4 Period between the production of Stalkless and Normal inflorescence

The shade level, nutrients and growth regulator and their interactions had no significant influence on this (Plate 11).

4.4.5 Period between the production of successive inflorescence

Only the different shade levels significantly influenced this character. Different nutrients, growth regulators, shade x nutrient, shade x growth regulator and nutrient x growth regulator interactions have failed to influence significantly. Among the shade levels, 70 per cent (S_2) shade has recorded the maximum influence (43.96 days), which was significantly superior to that of 60 per cent (S_3) and 50 per cent (S_4) and was on par with that of 80 per cent shade. Since plants under many of the treatments had not started flowering till the final stage of the experiment, this may not be comparable with all the treatments tried which is evident from the data presented in Appendix 23.

4.4.6 Period of inflorescence emergence to spathe unfurling

The different shade levels, nutrients and their interactions (S x N, S x G and N x G) did not influence significantly; but the growth regulators had significant influence in the time taken from inflorescence emergence to unfurting. BA 750 ppm (G_3) recorded the maximum (16.88 days) period which was significantly superior over both the levels of GA and was on par with both the levels of Ethephon and BA 1500 ppm (G_4). The data presented in Appendix 18 shows that the treatment combinations involving BA have recorded the maximum of 26 days while GA has recorded the minimum of 16 days from inflorescence emergence to spathe unfurling.

4.4.7 Duration of spathe unfurling to senescence

The different shade levels, nutrients and interactions (S x N, S x G and N x G) have not differed significantly with respect to the period from spathe unfurling to senescence of the inflorescence; only growth regulators had significant influence. BA 1500 ppm (G_4) recorded the maximum days (35.81), which was significantly superior to both the concentrations of GA and was on par with both the concentrations of Ethephon and 750 ppm BA (G_3). The treatment combination of 80 per cent shade + Hoagland solution + 1500 ppm BA ($S_1N_2G_4$) recorded the maximum period (53 days), while 50 per cent shade + fertilizer complex + 750 ppm BA ($S_4N_1G_3$) recorded the minimum period (31 days), among the treatments which started flowering (Appendix 23).

4.4.8 Inflorescence longevity on the plant

The different shade levels, nutrients and interactions (S x N, S x G and N x G) have not differed significantly with regard to the inflorescence longevity; but the growth regulators had significant influence. BA 1500 ppm (G_4) was significantly superior (59.44 days), to both the concentrations of GA and was on par with both the concentrations of Ethephon and BA 750 ppm (G_3). Among the treatment combinations, 80 per cent shade + Hoagland solution + 1500 ppm BA ($S_1N_2G_4$) was superior (86 days) while 60 per cent shade + Hoagland solution + 750 ppm

Table 27. Influence of shade, nutrients, growth regulators and their interactions on flowering pattern and inflorescence characters of *A. andreanum* var. 'Hawaiian Red'

Treatment	Time taken to first flowering (days)	Stalkless inflorescence (Nos)	Normal inflorescence (Nos)	Period between the production of stalkless and normal inflorescense (days)	Period of emergence of successive inflorescence (days)	Inflorescence emergence to unfurling period (days)	Inflorescence unfurting to senescence period (days)	Total duration of inflorescence (days)	Inflorescence stalk length (cm)	Spathe length (cm)	Spathe width (cm)	Spadix length (cm)
1	2	3	4	5	6	7	8	9	10	11	12	13
<u>Shade (S)</u>												
S_1	182.38	3.21	0.33	17.50	26.50	13.21	30.50	48.96	3.50	0.77	0.57	0.39
S_2	172.96	2.63	0.50	31.25	43.96	13.63	29.63	49.04	5.42	1.35	0.93	0.67
S_3	190.25	1.54	0.17	5.00	12.75	11.17	22.67	38.58	2.88	0.75	0.48	0.35
S_4	93.17	0.83	0.00	0.00	7.53	7.33	13.17	24.71	0.00	0.00	0.00	0.00
CD(0.05)	-	-	-	-	26.64	-	-	-	-	-	-	-
<u>Nutrient (N)</u>												
N_1	153.50	1.50	0.17	14.79	26.21	10.67	23.29	37.67	2.88	0.75	0.45	0.35
N_2	182.71	2.46	0.29	13.33	20.67	13.04	26.83	45.00	3.96	0.89	0.64	0.43
N_3	122.50	1.46	0.00	0.00	10.00	8.54	18.21	31.67	0.00	0.00	0.00	0.00
N_4	180.04	2.79	0.54	25.63	33.42	13.08	27.63	46.96	4.96	1.23	0.88	0.63
CD(0.05)	-	-	-	-	-	-	-	-	-	-	-	-
<u>Growth regulator (G)</u>												
G_1	79.88	0.75	0.00	0.00	16.63	6.00	11.81	21.44	0.00	0.00	0.00	0.00
G_2	89.50	1.75	0.44	9.39	25.50	6.25	13.06	21.94	3.00	0.75	0.49	0.41

Contd.

Table 27. Continued

1	2	3	4	5	6	7	8	9	10	11	12	13
G_3	215.50	2.63	0.44	26.88	29.81	16.88	34.44	58.81	4.50	1.09	0.74	0.52
G_4	214.38	3.50	0.13	15.00	26.25	16.38	35.81	59.44	3.19	0.78	0.54	0.35
G_5	179.00	2.13	0.25	15.00	18.75	11.31	24.69	40.31	2.75	0.61	0.54	0.34
G_6	179.88	1.56	0.25	14.38	18.50	11.19	24.13	40.00	4.25	1.00	0.66	0.51
CD(0.05)	-	-	-	-	-	8.08	16.57	28.01	-	-	-	-
<u>S x N interaction</u>												
S_1N_1	125.83	1.83	0.00	0.00	20.00	9.17	22.67	34.67	0.00	0.00	0.00	0.00
S_1N_2	231.50	2.50	0.17	20.00	35.00	17.83	40.00	63.83	4.67	1.07	0.75	0.43
S_1N_3	145.83	2.17	0.00	0.00	15.00	9.17	22.17	35.17	0.00	0.00	0.00	0.00
S_1N_4	226.33	6.33	1.17	50.00	35.00	16.67	37.17	62.17	9.33	2.00	1.52	1.13
S_2N_1	186.17	1.67	0.33	59.17	60.83	14.17	32.67	49.33	6.83	1.83	1.12	0.90
S_2N_2	167.00	3.67	0.83	33.33	20.00	14.83	30.17	50.67	8.17	1.67	1.28	0.90
S_2N_3	115.17	2.50	0.00	0.00	20.00	8.67	19.67	34.67	0.00	0.00	0.00	0.00
S_2N_4	223.50	2.67	0.83	32.50	75.00	16.83	36.00	61.50	6.67	1.90	1.32	0.90
S_3N_1	182.00	0.83	0.33	0.00	14.67	10.50	21.67	35.50	4.67	1.17	0.70	0.50
S_3N_2	284.33	3.33	0.17	0.00	22.67	16.33	31.33	54.67	3.00	0.83	0.53	0.40
S_3N_3	102.33	0.67	0.00	0.00	5.00	6.50	13.33	22.33	0.00	0.00	0.00	0.00
S_3N_4	192.33	1.33	0.17	20.00	8.67	11.33	24.33	41.83	3.83	1.00	0.68	0.50
S_4N_1	120.00	1.67	0.00	0.00	9.33	8.83	16.17	31.17	0.00	0.00	0.00	0.00
S_4N_2	48.00	0.33	0.00	0.00	5.00	3.17	5.83	10.83	0.00	0.00	0.00	0.00
S_4N_3	126.67	0.50	0.00	0.00	0.00	9.83	17.67	34.50	0.00	0.00	0.00	0.00
S_4N_4	78.00	0.83	0.00	0.00	15.00	7.50	13.00	22.33	0.00	0.00	0.00	0.00
CD(0.05)	-	-	-	-	-	-	-	-	-	-	-	-
<u>S x G interaction</u>												
S_1G_1	131.25	1.25	0.00	0.00	45.00	9.50	20.50	35.00	0.00	0.00	0.00	0.00
S_1G_2	57.00	5.00	1.50	37.50	7.50	5.75	10.75	19.50	7.50	1.75	1.15	1.05

Contd.

Table 27. Continued

1	2	3	4	5	6	7	8	9	10	11	12	13
S_1G_3	141.75	1.50	0.00	0.00	15.00	10.75	24.25	40.75	0.00	0.00	0.00	0.00
S_1G_4	270.00	6.00	0.25	30.00	30.00	22.00	51.30	79.75	7.00	1.60	1.13	0.65
S_1G_5	277.50	3.00	0.25	37.50	37.50	18.25	44.00	66.75	6.50	1.25	1.13	0.65
S_1G_6	216.75	2.50	0.00	0.00	22.50	13.00	32.00	52.00	0.00	0.00	0.00	0.00
S_2G_1	58.75	0.75	0.00	0.00	7.50	5.25	9.75	19.00	0.00	0.00	0.00	0.00
S_2G_2	118.00	1.25	0.00	0.00	75.00	8.75	21.50	34.25	0.00	0.00	0.00	0.00
S_2G_3	242.50	5.50	1.75	107.50	76.25	23.50	48.25	78.00	18.00	4.35	2.95	2.07
S_2G_4	240.00	3.75	0.00	0.00	45.00	19.00	43.25	72.75	0.00	0.00	0.00	0.00
S_2G_5	136.00	2.50	0.75	22.50	22.50	9.00	20.50	35.00	4.50	1.50	1.03	0.70
S_2G_6	242.00	2.00	0.50	57.50	37.50	16.25	34.50	55.25	10.00	2.25	1.60	1.28
S_3G_1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
S_3G_2	124.00	0.00	0.25	0.00	4.50	5.25	10.25	17.50	4.50	1.25	0.80	0.60
S_3G_3	305.75	2.50	0.00	0.00	20.50	17.75	38.25	65.00	0.00	0.00	0.00	0.00
S_3G_4	289.00	4.00	0.25	30.00	30.00	19.50	40.50	67.25	5.75	1.50	1.03	0.75
S_3G_5	162.50	1.00	0.00	0.00	7.50	9.00	17.00	29.00	0.00	0.00	0.00	0.00
S_3G_6	260.25	1.75	0.50	0.00	14.00	15.50	30.00	52.75	7.00	1.75	1.05	0.75
S_4G_1	129.50	1.00	0.00	0.00	14.00	9.25	17.00	31.75	0.00	0.00	0.00	0.00
S_4G_2	59.00	0.75	0.00	0.00	15.00	5.25	9.75	16.50	0.00	0.00	0.00	0.00
S_4G_3	172.00	1.00	0.00	0.00	7.50	15.50	27.00	51.50	0.00	0.00	0.00	0.00
S_4G_4	58.50	0.25	0.00	0.00	0.00	5.00	8.00	18.00	0.00	0.00	0.00	0.00
S_4G_5	140.00	2.00	0.00	0.00	7.50	9.00	17.25	30.50	0.00	0.00	0.00	0.00
S_4G_6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CD(0.05)	-	-	-	-	-	-	-	-	-	-	-	-
N x G interaction												
N_1G_1	57.50	0.50	0.00	0.00	6.50	4.50	8.25	15.50	0.00	0.00	0.00	0.00
N_1G_2	59.00	0.75	0.00	0.00	7.50	4.00	11.25	16.25	0.00	0.00	0.00	0.00
N_1G_3	204.25	1.25	0.25	53.75	61.25	16.00	31.50	52.75	5.50	1.50	0.80	0.70

Contd.

Table 27. Continued

1	2	3	4	5	6	7	8	9	10	11	12	13
N_1G_4	185.50	3.25	0.00	0.00	22.50	14.25	35.25	53.75	0.00	0.00	0.00	0.00
N_1G_5	124.25	2.25	0.00	0.00	22.50	9.00	18.50	30.75	0.00	0.00	0.00	0.00
N_1G_6	290.50	1.00	0.75	35.00	37.00	16.25	35.00	57.00	11.75	3.00	1.85	1.40
N_2G_1	196.25	2.00	0.00	0.00	37.50	15.50	30.00	55.50	0.00	0.00	0.00	0.00
N_2G_2	124.00	0.00	0.25	0.00	4.50	5.25	10.50	17.50	4.50	1.25	0.80	0.60
N_2G_3	201.25	3.75	1.00	27.50	22.50	16.50	34.75	56.75	7.00	1.50	1.13	0.73
N_2G_4	199.25	4.00	0.25	30.00	22.50	16.50	33.75	56.00	7.00	1.60	1.13	0.65
N_2G_5	155.75	1.25	0.00	0.00	15.00	9.00	20.00	30.25	0.00	0.00	0.00	0.00
N_2G_6	219.75	3.75	0.25	22.50	22.00	15.50	32.25	54.00	5.25	1.00	0.80	0.63
N_3G_1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
N_3G_2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
N_3G_3	193.75	12.00	0.00	0.00	7.50	14.25	29.25	52.75	0.00	0.00	0.00	0.00
N_3G_4	263.75	3.00	0.00	0.00	30.00	18.75	40.00	70.75	0.00	0.00	0.00	0.00
N_3G_5	205.00	3.00	0.00	0.00	15.00	13.75	29.25	49.25	0.00	0.00	0.00	0.00
N_3G_6	72.50	0.75	0.00	0.00	7.50	4.50	10.75	17.25	0.00	0.00	0.00	0.00
N_4G_1	65.75	0.50	0.00	0.00	22.50	4.00	9.00	14.75	0.00	0.00	0.00	0.00
N_4G_2	175.00	6.25	1.50	37.50	90.00	15.75	30.75	54.00	7.50	1.75	1.15	1.05
N_4G_3	262.75	3.50	0.50	26.25	28.00	20.75	42.25	73.00	5.50	1.35	0.95	0.65
N_4G_4	209.00	3.75	0.25	30.00	30.00	16.00	34.25	57.25	5.75	1.50	1.03	0.75
N_4G_5	231.00	2.00	1.00	60.00	22.50	13.50	31.00	51.00	11.00	2.75	2.15	1.35
N_4G_6	136.75	0.75	0.00	0.00	7.50	8.50	18.50	31.75	0.00	0.00	0.00	0.00
CD(0.05)	-	-	-	-	-	-	-	-	-	-	-	-

Ethephon ($S_3N_2G_5$) recorded the minimum days of inflorescence longevity (55 days) among the treatments which had started flowering (Appendix 23).

4.4.9 Inflorescence stalk length

None of the treatments influenced this character significantly.

4.4.10 Spathe length

Any of the treatments did not have significant influence on this character.

4.4.11 Spathe breadth

Spathe breadth was also not influenced by any of the treatments.

4.4.12 Spadix length

None of the treatments significantly influenced the spadix length.

4.4.13 Inflorescence production

The number of inflorescences produced in different months during the experimental period was not significantly different from each other under the influence of different shade levels, nutrients, growth regulators and their respective interactions (Table 28).

4.5 Pigment content

The data on the effect of shade, nutrient and growth regulator on chlorophyll and anthocyanin contents are presented in Table 29 (Fig.6).

Table 28. Effect of shade, nutrients, growth regulators and their interactions on inflorescence produced by *A. andreanum* var. 'Hawaiian Red' at monthly interval

Treatment	Month										
	4	5	6	7	8	9	10	11	12	13	14
<u>Shade (S)</u>											
S_1	0.03	0.03	0.07	0.10	0.06	0.02	0.01	0.01	0.01	0.01	0.00
S_2	0.03	0.05	0.04	0.07	0.02	0.02	0.02	0.01	0.01	0.03	0.00
S_3	0.00	0.00	0.03	0.05	0.03	0.02	0.02	0.00	0.00	0.02	0.00
S_4	0.03	0.01	0.03	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CD(0.05)	-	-	-	-	-	-	-	-	-	-	-
<u>Nutrient (N)</u>											
N_1	0.03	0.04	0.04	0.04	0.02	0.01	0.00	0.00	0.00	0.01	0.00
N_2	0.00	0.01	0.04	0.08	0.03	0.03	0.02	0.01	0.00	0.02	0.00
N_3	0.04	0.02	0.05	0.06	0.05	0.02	0.02	0.01	0.01	0.01	0.00
N_4	0.02	0.02	0.03	0.06	0.03	0.01	0.00	0.01	0.00	0.02	0.00
CD(0.05)	-	-	-	-	-	-	-	-	-	-	-
<u>Growth regulator (G)</u>											
G_1	0.04	0.04	0.06	0.11	0.04	0.01	0.01	0.02	0.01	0.03	0.01
G_2	0.03	0.03	0.06	0.08	0.03	0.02	0.01	0.00	0.00	0.01	0.00
G_3	0.03	0.01	0.04	0.09	0.05	0.03	0.01	0.01	0.01	0.01	0.01
G_4	0.01	0.03	0.01	0.02	0.03	0.02	0.02	0.00	0.00	0.01	0.00
G_5	0.03	0.03	0.05	0.04	0.03	0.02	0.02	0.02	0.02	0.03	0.01
G_6	0.02	0.01	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CD(0.05)	-	-	-	-	-	-	-	-	-	-	-

Contd.

Table 28. Continued

Treatment	Month										
	4	5	6	7	8	9	10	11	12	13	14
<u>S x N interaction</u>											
S_1N_1	0.03	0.05	0.07	0.07	0.03	0.02	0.00	0.00	0.00	0.00	0.00
S_1N_2	0.00	0.02	0.05	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00
S_1N_3	0.05	0.05	0.13	0.15	0.15	0.05	0.05	0.03	0.05	0.03	0.02
S_1N_4	0.03	0.02	0.05	0.07	0.07	0.02	0.00	0.00	0.00	0.02	0.00
S_2N_1	0.03	0.08	0.02	0.02	0.00	0.00	0.02	0.00	0.00	0.02	0.00
S_2N_2	0.02	0.03	0.07	0.12	0.02	0.05	0.02	0.02	0.02	0.05	0.02
S_2N_3	0.07	0.03	0.03	0.05	0.03	0.02	0.03	0.00	0.00	0.00	0.00
S_2N_4	0.02	0.03	0.03	0.10	0.03	0.02	0.00	0.03	0.02	0.03	0.00
S_3N_1	0.00	0.00	0.02	0.02	0.03	0.02	0.00	0.00	0.00	0.03	0.00
S_3N_2	0.00	0.00	0.03	0.08	0.08	0.05	0.07	0.02	0.00	0.02	0.00
S_3N_3	0.00	0.00	0.02	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00
S_3N_4	0.00	0.02	0.03	0.05	0.02	0.02	0.00	0.00	0.00	0.02	0.02
S_4N_1	0.05	0.02	0.05	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00
S_4N_2	0.00	0.00	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
S_4N_3	0.03	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
S_4N_4	0.03	0.02	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CD(0.05)	-	-	-	-	-	-	-	-	-	-	-
<u>S x G interaction</u>											
S_1G_1	0.03	0.05	0.13	0.25	0.13	0.03	0.00	0.03	0.00	0.00	0.00
S_1G_2	0.03	0.00	0.10	0.08	0.05	0.03	0.03	0.00	0.00	0.03	0.00
S_1G_3	0.00	0.00	0.08	0.10	0.05	0.03	0.00	0.00	0.00	0.00	0.00
S_1G_4	0.00	0.08	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00

Contd.

Table 28. Continued

Treatment	Month										
	4	5	6	7	8	9	10	11	12	13	14
S_1G_5	0.08	0.05	0.08	0.08	0.10	0.05	0.05	0.05	0.08	0.05	0.03
S_1G_6	0.05	0.03	0.08	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00
S_2G_1	0.08	0.10	0.01	0.18	0.03	0.03	0.03	0.05	0.03	0.10	0.03
S_2G_2	0.05	0.10	0.05	0.10	0.05	0.03	0.00	0.00	0.00	0.00	0.00
S_2G_3	0.03	0.03	0.03	0.10	0.03	0.03	0.03	0.03	0.03	0.03	0.00
S_2G_4	0.00	0.00	0.05	0.05	0.03	0.05	0.05	0.00	0.00	0.03	0.00
S_2G_5	0.03	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
S_2G_6	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
S_3G_1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00
S_3G_2	0.00	0.00	0.08	0.10	0.03	0.03	0.03	0.00	0.00	0.00	0.00
S_3G_3	0.00	0.00	0.05	0.15	0.13	0.05	0.03	0.00	0.00	0.03	0.03
S_3G_4	0.00	0.03	0.00	0.03	0.03	0.03	0.03	0.00	0.00	0.00	0.00
S_3G_5	0.00	0.00	0.03	0.03	0.03	0.03	0.03	0.03	0.00	0.05	0.00
S_3G_6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
S_4G_1	0.05	0.00	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00
S_4G_2	0.03	0.00	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00
S_4G_3	0.08	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
S_4G_4	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
S_4G_5	0.00	0.00	0.01	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00
S_4G_6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CD(0.05)	-	-	-	-	-	-	-	-	-	-	-
<u>N x G interaction</u>											
N_1G_1	0.08	0.05	0.03	0.05	0.00	0.00	0.00	0.00	0.00	0.03	0.00

Contd.

Table 28. Continued

Treatment	Month										
	4	5	6	7	8	9	10	11	12	13	14
N_1G_2	0.05	0.05	0.05	0.03	0.03	0.03	0.00	0.00	0.00	0.00	0.00
N_1G_3	0.03	0.00	0.05	0.05	0.05	0.03	0.00	0.00	0.00	0.00	0.00
N_1G_4	0.00	0.08	0.00	0.00	0.03	0.00	0.03	0.00	0.00	0.00	0.00
N_1G_5	0.03	0.05	0.08	0.08	0.00	0.00	0.00	0.00	0.00	0.05	0.00
N_1G_6	0.00	0.00	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00
N_2G_1	0.03	0.08	0.10	0.23	0.00	0.00	0.00	0.05	0.03	0.08	0.03
N_2G_2	0.00	0.00	0.08	0.08	0.00	0.03	0.03	0.00	0.00	0.00	0.00
N_2G_3	0.00	0.00	0.03	0.13	0.08	0.03	0.03	0.00	0.00	0.00	0.00
N_2G_4	0.00	0.00	0.03	0.03	0.05	0.08	0.05	0.00	0.00	0.03	0.00
N_2G_5	0.00	0.00	0.03	0.03	0.03	0.03	0.03	0.03	0.00	0.00	0.00
N_2G_6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
N_3G_1	0.03	0.00	0.05	0.08	0.05	0.03	0.03	0.00	0.00	0.00	0.00
N_3G_2	0.03	0.03	0.03	0.08	0.08	0.03	0.03	0.00	0.00	0.00	0.00
N_3G_3	0.05	0.03	0.08	0.10	0.03	0.00	0.03	0.00	0.00	0.00	0.00
N_3G_4	0.03	0.03	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00
N_3G_5	0.08	0.05	0.10	0.08	0.10	0.05	0.05	0.05	0.08	0.05	0.03
N_3G_6	0.03	0.00	0.05	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00
N_4G_1	0.03	0.03	0.08	0.10	0.10	0.03	0.00	0.03	0.00	0.03	0.00
N_4G_2	0.03	0.03	0.10	0.13	0.03	0.00	0.00	0.00	0.00	0.03	0.00
N_4G_3	0.03	0.03	0.00	0.08	0.05	0.05	0.00	0.03	0.03	0.05	0.03
N_4G_4	0.00	0.03	0.03	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00
N_4G_5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
N_4G_6	0.05	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CD(0.05)	-	-	-	-	-	-	-	-	-	-	-

Plate 11. Comparison of flowering in best treatments under 70 per cent shade with control


$S_2 N_0 G_0$
$S_2 N_2 G_3$
$S_2 N_2 G_6$

4.5.1 Chlorophyll 'a'

The different shade levels and growth regulators significantly influenced chlorophyll 'a' content in leaves, while the nutrients and interactions have failed to influence significantly. Among the shade levels, 80 per cent (S_1) shade recorded the maximum value (3.86 mg g^{-1} fresh weight) which was significantly superior to all the other shade levels. As the intensity of shade declined, the chlorophyll 'a' content also decreased significantly. Among the growth regulators, Ethephon 750 ppm (G_5) had the maximum influence (3.83 mg g^{-1} fresh weight), which was significantly superior to both the concentrations of GA and BA 750 ppm (G_1, G_2 and G_3) and was on par with BA 1500 ppm (G_4) and Ethephon (G_5 and G_6). The treatment combination of 70 per cent shade + Ohio solution + 750 ppm Ethephon ($S_2N_4G_5$) produced the maximum chlorophyll 'a' content (6.0 mg g^{-1} fresh weight), while 60 per cent shade + Knop's solution + 750 ppm BA ($S_3N_3G_3$), recorded the minimum (1.9 mg g^{-1} fresh weight), among the treatment combintations (Appendix 24).

4.5.2 Chlorophyll 'b'

The different shade levels and growth regulators had significant influence on chlorophyll 'b' content, while nutrients and interactions failed to record significant influence. Eighty per cent shade was superior among the four shade levels with the maximum (2.80 mg g^{-1} fresh weight) chlorophyll content, which was significantly superior to 50 per cent (S_4) and was on par with 70 per cent (S_2) and 60 per cent (S_3) shade levels. There was a clear trend of decrease in chlorophyll 'b' content with decrease in the intensity of shade. Ethephon 1500 ppm (G_6) was superior among the growth regulators with the maximum value (2.94 mg g^{-1} fresh weight), which was significantly superior to both the concentrations of GA and BA 750 ppm (G_1, G_2 and G_3) and was on par with BA 1500 ppm (G_4) and Ethephon 750 ppm (G_5). The treatment combination of 60 per cent shade + fertilizer complex + 750 ppm Ethephon ($S_3N_1G_5$) recorded the maximum chlorophyll 'b' content (3.7 mg g^{-1} fresh weight), while 70 per cent shade + Ohio solution + 750 ppm Ethephon recorded the minimum (1.2 mg g^{-1} f.w) (Appendix 24).

4.5.3. Total chlorophyll

The different shade levels and growth regulators showed significant influence, while the nutrients and interactions failed to influence significantly. Eighty per cent shade recorded the maximum (6.66 mg g^{-1} fresh weight), total chlorophyll content, which was significantly superior to 60 per cent (S_3) and 50 per cent (S_4) and was on par with 70 per cent (S_2) shade. There was a clear trend of decrease in 'total chlorophyll' content with decrease in shade intensity. Ethephon 1500 ppm (G_6) recorded the maximum (6.66 mg g^{-1} fresh weight) total chlorophyll, which was significantly superior to both the concentrations of GA and BA 750 ppm (G_3) and was on par with BA 1500 ppm (G_4) and Ethephon 750 ppm (G_5). The treatment combination of 60 per cent shade + Ohio solution + 750 ppm Ethephon ($S_3N_4G_5$) recorded the maximum (8.8 mg g^{-1} fresh weight), while, 60 per cent shade + Knop's solution + 750 ppm BA ($S_3N_3G_3$) recorded the minimum (3.5 mg g^{-1} fresh weight) compared to all the other treatments (Appendix 24).

4.5.4 Anthocyanin

The different shade levels, nutrients and growth regulators as well as their respective interactions did not influence the anthocyanin content significantly.

Table 29. Influence of shade, nutrients, growth regulators and their interactions on chlorophyll and anthocyanin content of *A. andreanum* var. 'Hawaiian Red'

Treatment	Chlorophyll 'a' (mg g^{-1})	Chlorophyll 'b' (mg g^{-1})	'Total' chlorophyll (mg g^{-1})	Anthocyanin ($\mu g\ ml^{-1}$ aliquot)
1	2	3	4	5
Shade (S)				
S_1	3.86	2.80	6.66	0.57
S_2	3.45	2.77	6.22	1.27
S_3	3.36	2.62	5.98	0.55
S_4	2.85	2.08	4.93	0.00
CD(0.05)	0.39	0.35	0.64	-
Nutrient (N)				
N_1	3.46	2.75	6.21	0.57
N_2	3.28	2.55	5.83	0.87
N_3	3.25	2.40	5.65	0.20
N_4	3.53	2.57	6.15	0.75
CD(0.05)	-	-	-	-
Growth regulator (G)				
G_1	3.01	2.27	5.29	0.00
G_2	3.06	2.35	5.41	0.29
G_3	3.13	2.39	5.52	1.62
G_4	3.54	2.65	6.19	0.62
G_5	3.83	2.80	6.63	0.29
G_6	3.72	2.94	6.66	0.76
CD(0.05)	0.48	0.43	0.78	-
S x N interaction				
S_1N_1	4.28	3.12	7.40	0.00
S_1N_2	3.30	2.45	5.75	0.87
S_1N_3	3.93	2.80	6.73	0.00
S_1N_4	3.92	2.82	6.74	1.40
S_2N_1	3.48	2.87	6.35	1.67
S_2N_2	3.45	2.82	6.27	1.80
S_2N_3	3.13	2.47	5.60	0.00
S_2N_4	3.75	2.35	6.10	1.62
S_3N_1	3.60	2.78	6.38	0.60

Contd.

Table 29. Continued

1	2	3	4	5
S_3N_2	3.37	2.82	6.18	0.80
S_3N_3	3.02	2.43	5.45	0.78
S_3N_4	3.47	3.03	6.67	0.00
S_4N_1	2.48	2.22	4.70	0.00
S_4N_2	3.00	2.13	5.13	0.00
S_4N_3	3.92	1.90	4.82	0.00
S_4N_4	3.00	2.08	5.08	0.00
CD(0.05)	-	-	-	-
<u>S x G interaction</u>				
S_1G_1	3.23	2.23	5.45	0.00
S_1G_2	3.55	2.60	6.15	1.18
S_1G_3	3.55	2.53	6.08	0.93
S_1G_4	4.45	3.23	7.68	1.30
S_1G_5	4.23	3.07	7.30	0.00
S_1G_6	4.15	3.13	7.28	0.00
S_2G_1	3.20	2.53	5.75	0.00
S_2G_2	3.03	2.43	5.45	0.00
S_2G_3	3.20	2.65	5.85	4.35
S_2G_4	3.30	2.55	5.85	0.00
S_2G_5	4.15	2.48	5.63	1.15
S_2G_6	3.85	3.13	6.98	2.13
S_3G_1	3.00	2.33	5.33	0.00
S_3G_2	3.00	2.45	5.45	0.00
S_3G_3	2.88	2.15	5.27	1.20
S_3G_4	3.48	2.93	6.40	1.18
S_3G_5	4.10	3.63	7.73	0.00
S_3G_6	3.73	3.13	6.85	0.90
S_4G_1	2.63	2.02	4.65	0.00
S_4G_2	2.65	1.93	4.58	0.00
S_4G_3	2.88	2.23	5.10	0.00
S_4G_4	2.95	1.90	4.85	0.00
S_4G_5	2.85	2.03	4.88	0.00
S_4G_6	3.15	2.40	5.55	0.00
CD(0.05)	-	-	-	-
<u>N x G interaction</u>				
N_1G_1	3.10	2.63	5.73	0.00
N_1G_2	3.63	3.05	6.68	0.00

Contd.

Table 29. Continued

1	2	3	4	5
N_1G_3	3.30	2.48	5.78	1.45
N_1G_4	3.30	2.43	5.73	0.00
N_1G_5	3.73	2.98	6.70	0.00
N_1G_6	3.73	2.93	6.65	1.95
N_2G_1	3.32	2.35	5.67	0.00
N_2G_2	2.70	2.13	4.83	0.00
N_2G_3	2.93	2.20	5.13	2.83
N_2G_4	3.50	2.68	6.18	1.30
N_2G_5	3.25	2.67	5.93	0.00
N_2G_6	3.98	3.30	2.27	1.08
N_3G_1	2.65	1.88	1.53	0.00
N_3G_2	2.98	2.15	5.13	0.00
N_3G_3	3.33	2.45	5.77	0.00
N_3G_4	3.38	2.58	5.95	1.18
N_3G_5	3.93	2.93	6.85	0.00
N_3G_6	3.25	2.43	5.67	0.00
N_4G_1	2.98	2.25	5.23	0.00
N_4G_2	2.93	2.08	5.00	1.18
N_4G_3	2.95	2.43	5.63	2.20
N_4G_4	4.00	2.93	6.93	0.00
N_4G_5	4.42	2.63	7.05	1.15
N_4G_6	3.93	3.12	7.05	0.00
CD(0.05)	-	-	-	-

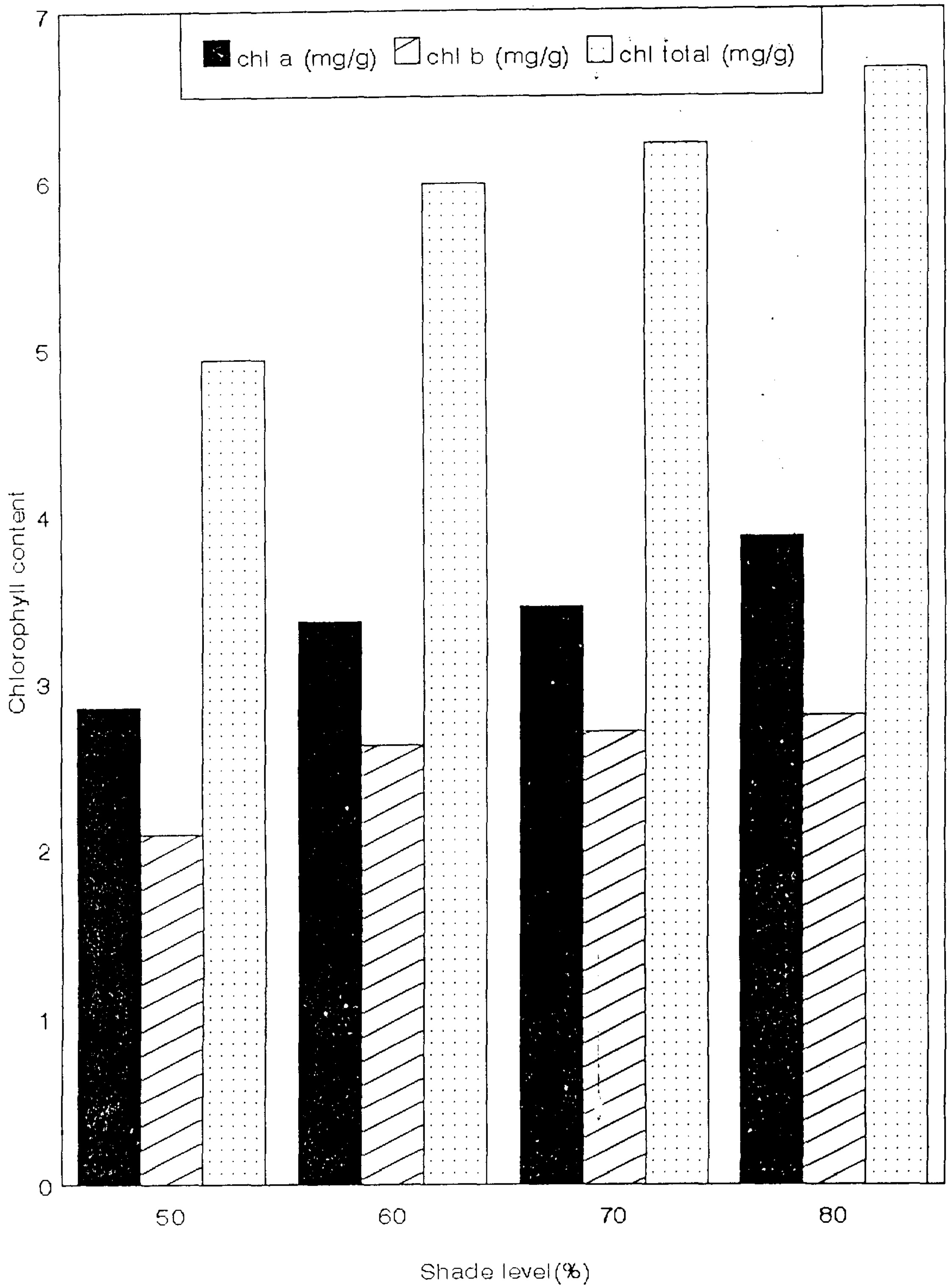


Fig.6. Effect of shade on chlorophyll content in *A. andreanum* `Hawaiian Red'

4.6 Leaf nutrient content

The nutrient content in leaves as influenced by shade, nutrients and growth regulators and their interactions are presented in Table 30 (Fig. 7 and 8).

4.6.1 Nitrogen (N)

The different shade levels and growth regulators had significantly influenced the nitrogen content. But nutrients applied and the interactions failed to have significant influence. Eighty per cent shade recorded the maximum value (1.62%), which was significantly superior to all the other shade levels. Among the growth regulators, BA 750 ppm (G_3) recorded the maximum (1.57%), which was significantly superior to both the concentrations of GA and Ethephon and was on par with BA 1500 ppm (G_4). The unique combination of 60 per cent shade + Hoagland solution + 750 ppm Ethephon ($S_3N_2G_5$) recorded the maximum (2.29%), while the control under 50 per cent shade ($S_4N_0G_0$) recorded the minimum (0.49%), compared to all the other treatments (Appendix 25).

4.6.2 Phosphorus (P)

The different shade levels, nutrients and growth regulators as well as their interactions did not influence the phosphorus content significantly. The treatment combination of 80 per cent shade + fertilizer complex + 1500 ppm Ethephon ($S_1N_1G_6$) produced the maximum P content (0.36%), while the minimum (0.19%) was under 50 per cent shade + Knop's solution + 750 ppm Ethephon ($S_4N_3G_5$), compared to all the other treatments.

4.6.3 Potassium (K)

The different shade levels and shade x nutrient interactions had significant influence on the K content, while, the nutrients, growth regulators, shade x growth regulator and nutrient x growth regulator did not have significant influence. The maximum value was recorded under 80 per cent (S_1) shade (1.96%), which was significantly superior to 50 per cent (S_4) and was on par with 70 per cent (S_2) and 60 per cent (S_3) shade levels. The interactions S_2N_4 and S_3N_1 recorded the maximum value for K content (2.09%), which was significantly superior to S_2N_1,S_3N_3, S_3N_4, S_4N_1, S_4N_2, S_4N_3 and S_4N_4 and was on par with the rest of the interactions. The treatment combination of 60 per cent shade + fertilizer complex + 1500 ppm GA ($S_3N_1G_2$) recorded the maximum (2.44%), while 50 per cent shade + fertilizer complex + 1500 ppm Ethephon ($S_4N_1G_6$) recorded the minimum (1.40%) value for K content compared to all the other treatments (Appendix 25).

4.6.4 Calcium (Ca)

The Ca content in leaf was significantly different only under different shade levels. The nutrients, growth regulators and their interactions (S x N, S x G and N x G) did not influence the Ca content significantly. Sixty per cent shade recorded the maximum value (1.49%), which was significantly superior to 80 per cent (S_1) and 50 per cent (S_4) and was on par with 70 per cent (S_2). The treatment combination of 60 per cent shade + Ohio solution + 1500 ppm Ethephon ($S_3N_4G_6$) retained the maximum Ca content in leaves (2.79%), while 80 per cent shade + fertilizer complex + 750 ppm GA ($S_1N_1G_1$) retained the minimum (0.76%), compared to all the other treatments (Appendix 25).

4.6.5 Magnesium (Mg)

The different shade levels, nutrients, growth regulators and their interactions did not influence the magnesium content significantly. The treatment combination of 70 per cent shade + Ohio solution + 750 ppm GA ($S_2N_4G_1$) retained the maximum (0.82%) Mg content in leaves, while 80 per cent shade + fertilizer complex + 750 ppm GA ($S_1N_1G_1$) retained the minimum (0.15%), compared to all the other treatments (Appendix 25).

4.6.6 Manganese (Mn)

The different shade levels significantly influenced the manganese content. The nutrients, growth regulators and their interactions did not differ significantly. The maximum Mn content (470.63 ppm) was recorded under 80 per cent (S_1) shade, which was significantly superior to 60 per cent (S_3) and 50 per cent (S_4) and was on par with 70 per cent (S_2) shade. The decline in shade intensity significantly decreased the manganese content. The treatment combination of 70 per cent shade + Hoagland solution + 750 ppm GA ($S_2N_2G_1$) showed the maximum value (819 ppm), for Mn content, while, the minimum (217 ppm) was in control under 50 per cent shade ($S_4N_0G_0$) (Appendix 25).

4.6.7 Zinc (Zn)

The different shade levels, nutrients and growth regulators as well as their interactions did not influence the Zn content significantly. The treatment combination of 70 per cent shade + Ohio solution + 750 ppm GA ($S_2N_4G_1$)

retained the maximum Zn content (403 ppm), while the control under 60 per cent shade ($S_3N_0G_0$) retained the minimum (129 ppm), compared to all the other treatments (Appendix 25).

4.6.8 Copper (Cu)

The different shade levels significantly influenced the Cu content. The different nutrients, growth regulators and their interactions did not differ significantly. Under 80 per cent (S_1) shade the leaves had the maximum (21.17 ppm) copper content. The treatment combination involving 80 per cent shade + Knop's solution + 750 ppm Ethephon ($S_1N_3G_5$) showed the maximum Cu content in leaf (137 ppm), while the minimum (7 ppm) was under the treatment combination involving 50 per cent shade + Ohio solution + 750 ppm Ethephon ($S_4N_4G_5$) (Appendix 25).

4.6.9 Iron (Fe)

The different shade levels and nutrients had significant influence on the Fe content. Growth regulators and their interactions (S x N, S x G and N x G) did not differ significantly with respect to Fe content in leaves. The maximum Fe content recorded (775.17 ppm) was under 80 per cent (S_1) shade, which was significantly superior to the values under all the other shade levels. With the decline in shade intensity, the content of Fe also decreased significantly. Hoagland solution recorded the maximum (585.38 ppm) Fe content, which was significantly superior to Ohio solution and was on par with fertilizer complex and Knop's solution. The treatment combination involving 80 per cent shade + Hoagland solution + 750 ppm GA ($S_1N_2G_1$) retained the maximum Fe content (1381 ppm), while the control

Table 30. Influence of shade, nutrients, growth regulators and their interactions on leaf nutrient content of *A. andreanum* var. 'Hawaiian Red'

Treatment	N (%)	P (%)	K (%)	Ca (%)	Mg (%)	Mn (ppm)	Zn (ppm)	Cu (ppm)	Fe (ppm)	S (ppm)
1	2	3	4	5	6	7	8	9	10	11
<u>Shade (S)</u>										
S_1	1.62	0.32	1.96	1.28	0.61	470.63	202.17	21.17	775.17	150.42
S_2	1.36	0.29	1.93	1.32	0.63	465.08	207.25	9.79	502.83	136.25
S_3	1.40	0.27	1.92	1.49	0.65	385.04	206.63	8.67	427.71	133.17
S_4	1.16	0.25	1.59	1.07	0.58	339.29	190.71	9.63	330.96	98.25
CD(0.05)	0.16	-	0.10	0.18	-	66.46	-	9.05	78.13	13.08
<u>Nutrient (N)</u>										
N_1	1.37	0.30	1.81	1.27	0.61	415.04	208.88	11.13	508.71	130.17
N_2	1.47	0.29	1.85	1.23	0.60	388.38	193.50	11.13	585.38	129.92
N_3	1.37	0.27	1.88	1.34	0.62	449.71	210.46	17.00	511.71	134.58
N_4	1.34	0.28	1.85	1.32	0.64	406.92	201.92	10.00	430.88	123.42
CD(0.05)	-	-	-	-	-	-	-	-	78.13	-
<u>Growth regulator (G)</u>										
G_1	1.24	0.30	1.82	1.33	0.61	368.25	214.75	12.06	562.31	129.13
G_2	1.33	0.29	1.94	1.30	0.63	419.63	197.94	10.38	530.56	135.63
G_3	1.57	0.28	1.84	1.17	0.62	456.00	198.94	10.38	471.63	130.63
G_4	1.51	0.29	1.87	1.26	0.61	411.63	190.63	12.25	511.94	125.75
G_5	1.34	0.27	1.80	1.33	0.61	433.00	206.99	18.19	481.50	129.13
G_6	1.28	0.28	1.83	1.36	0.62	401.56	200.94	10.63	497.06	126.88
CD(0.05)	0.20	-	-	-	-	-	-	-	-	-

Contd.

Table 30. Continued

1	2	3	4	5	6	7	8	9	10	11
<u>S x N interaction</u>										
S_1N_1	1.66	0.32	1.94	1.14	0.54	408.00	195.00	14.83	761.50	134.67
S_1N_2	1.67	0.30	1.96	1.26	0.62	388.50	201.33	16.00	1075.53	148.67
S_1N_3	1.56	0.34	2.01	1.46	0.65	604.17	223.67	39.50	698.67	169.33
S_1N_4	1.57	0.32	1.92	1.26	0.63	481.83	188.67	14.33	565.17	149.00
S_2N_1	1.31	0.31	1.70	1.34	0.64	508.00	215.50	10.67	518.83	157.33
S_2N_2	1.35	0.31	1.95	1.13	0.59	504.50	188.33	10.17	506.33	138.00
S_2N_3	1.51	0.27	1.98	1.43	0.63	398.50	204.33	9.17	489.83	117.67
S_2N_4	1.27	0.28	2.09	1.39	0.66	449.33	220.83	9.17	496.33	132.00
S_3N_1	1.32	0.30	2.09	1.57	0.66	388.00	200.00	8.50	410.00	127.33
S_3N_2	1.57	0.28	1.93	1.41	0.65	330.00	193.17	8.17	416.83	139.67
S_3N_3	1.29	0.26	1.88	1.39	0.62	443.50	220.33	10.33	465.33	147.67
S_3N_4	1.40	0.25	1.79	1.58	0.67	378.67	213.00	7.67	418.67	118.00
S_4N_1	1.17	0.27	1.53	1.02	0.60	356.17	193.00	10.50	344.50	101.33
S_4N_2	1.28	0.27	1.57	1.13	0.55	330.50	191.17	10.17	343.00	93.33
S_4N_3	1.11	0.22	1.66	1.06	0.59	352.67	193.50	9.00	393.00	103.67
S_4N_4	1.10	0.26	1.59	1.06	0.59	317.83	185.17	8.83	243.33	94.67
CD(0.05)	-	-	0.20	-	-	-	-	-	-	26.17
<u>S x G interation</u>										
S_1G_1	1.46	0.33	1.92	1.23	0.52	382.25	206.72	16.50	877.75	146.50
S_1G_2	1.52	0.33	2.09	1.26	0.62	449.50	199.00	13.75	767.75	162.50
S_1G_3	2.01	0.33	1.97	1.23	0.62	553.25	207.75	14.75	711.50	149.00
S_1G_4	1.89	0.30	1.99	1.30	0.63	491.50	193.00	22.75	804.00	148.00
S_1G_5	1.48	0.31	1.84	1.32	0.63	526.00	204.50	44.00	730.54	148.50
S_1G_6	1.33	0.34	1.92	1.35	0.64	421.25	202.00	15.25	759.50	148.00

Contd.

Table 30. Continued

1	2	3	4	5	6	7	8	9	10	11
S_2G_1	1.30	0.31	1.85	1.56	0.65	371.75	252.00	13.00	600.00	139.00
S_2G_2	1.25	0.29	2.05	1.24	0.62	491.00	198.50	9.25	528.25	155.50
S_2G_3	1.69	0.28	1.91	1.19	0.63	479.50	179.00	8.75	411.75	138.50
S_2G_4	1.60	0.28	1.93	1.31	0.63	459.25	187.00	8.75	473.25	121.00
S_2G_5	1.21	0.30	1.97	1.39	0.62	522.50	210.25	9.50	479.75	131.50
S_2G_6	1.12	0.29	1.88	1.26	0.63	466.50	216.75	9.50	524.00	132.00
S_3G_1	1.20	0.30	1.98	1.42	0.65	414.25	207.00	8.50	445.00	141.00
S_3G_2	1.38	0.28	2.06	1.51	0.66	405.25	205.25	9.00	475.75	136.50
S_3G_3	1.38	0.25	1.86	1.23	0.62	386.75	205.50	8.50	409.50	131.50
S_3G_4	1.37	0.29	1.84	1.27	0.62	316.25	188.00	8.25	453.50	126.50
S_3G_5	1.60	0.27	1.84	1.68	0.66	370.50	227.75	9.50	405.75	136.00
S_3G_6	1.46	0.27	1.95	1.81	0.69	417.25	206.25	8.25	376.75	127.50
S_4G_1	0.99	0.27	1.54	1.13	0.62	304.75	193.25	10.25	326.50	90.00
S_4G_2	1.18	0.28	1.54	1.20	0.62	332.75	189.00	9.50	350.50	88.00
S_4G_3	1.20	0.26	1.62	1.02	0.62	404.50	203.50	9.50	353.75	103.50
S_4G_4	1.17	0.28	1.72	1.14	0.58	379.50	194.50	9.25	317.00	107.50
S_4G_5	1.25	0.23	1.55	0.91	0.53	313.00	185.25	9.75	310.00	100.50
S_4G_6	1.20	0.21	1.55	1.00	0.53	301.25	178.75	9.50	328.00	100.00
CD(0.05)	-	-	-	-	-	-	-	-	-	-
<u>N x G interaction</u>										
N_1G_1	1.15	0.31	1.76	1.13	0.51	331.50	191.75	13.50	476.00	130.50
N_1G_2	1.42	0.32	2.05	1.23	0.63	483.50	205.75	10.75	515.75	129.00
N_1G_3	1.57	0.29	1.79	1.24	0.64	472.25	206.00	10.50	471.25	136.00
N_1G_4	1.59	0.31	1.78	1.20	0.61	336.50	186.50	11.00	546.25	124.00
N_1G_5	1.29	0.28	1.70	1.55	0.64	442.25	213.50	11.00	475.00	134.50

Contd.

Table 30. Continued

1	2	3	4	5	6	7	8	9	10	11
N_1G_6	1.19	0.30	1.79	1.27	0.63	424.25	201.75	10.00	568.00	127.00
N_2G_1	1.27	0.32	1.81	1.22	0.61	328.00	203.25	10.50	650.75	122.50
N_2G_2	1.26	0.29	1.88	1.31	0.62	346.50	184.00	10.50	581.25	135.50
N_2G_3	1.63	0.28	1.80	1.19	0.61	493.75	193.50	12.25	556.75	135.00
N_2G_4	1.40	0.30	1.89	1.20	0.58	441.50	189.50	10.25	533.00	125.00
N_2G_5	1.70	0.27	1.88	1.20	0.60	377.25	196.50	11.0	625.00	133.50
N_2G_6	1.55	0.29	1.88	1.27	0.60	343.25	194.25	12.25	565.50	128.00
N_3G_1	1.21	0.28	1.88	1.47	0.63	425.75	215.50	10.75	573.25	145.50
N_3G_2	1.32	0.27	1.91	1.42	0.64	474.25	222.50	10.25	574.00	144.00
N_3G_3	1.61	0.27	1.92	1.21	0.61	465.25	201.50	9.75	468.00	127.00
N_3G_4	1.52	0.28	1.92	1.34	0.62	483.00	201.75	19.25	506.50	131.00
N_3G_5	1.34	0.27	1.85	1.24	0.61	456.00	203.75	41.75	479.00	129.50
N_3G_6	1.20	0.26	1.81	1.33	0.63	394.00	217.75	10.25	469.50	130.50
N_4G_1	1.31	0.29	1.84	1.53	0.69	387.75	248.50	13.50	549.25	118.00
N_4G_2	1.32	0.30	1.91	1.24	0.63	374.25	179.50	10.00	451.25	134.00
N_4G_3	1.48	0.27	1.84	1.02	0.64	392.75	194.75	9.00	390.50	124.50
N_4G_4	1.52	0.27	1.89	1.28	0.64	385.50	184.75	8.50	462.00	123.00
N_4G_5	1.23	0.27	1.77	1.31	0.59	456.50	214.00	9.00	347.00	119.00
N_4G_6	1.16	0.26	1.83	1.55	0.64	444.75	190.00	10.00	385.25	122.00
CD(0.05)	-	-	-	-	-	-	-	-	-	-

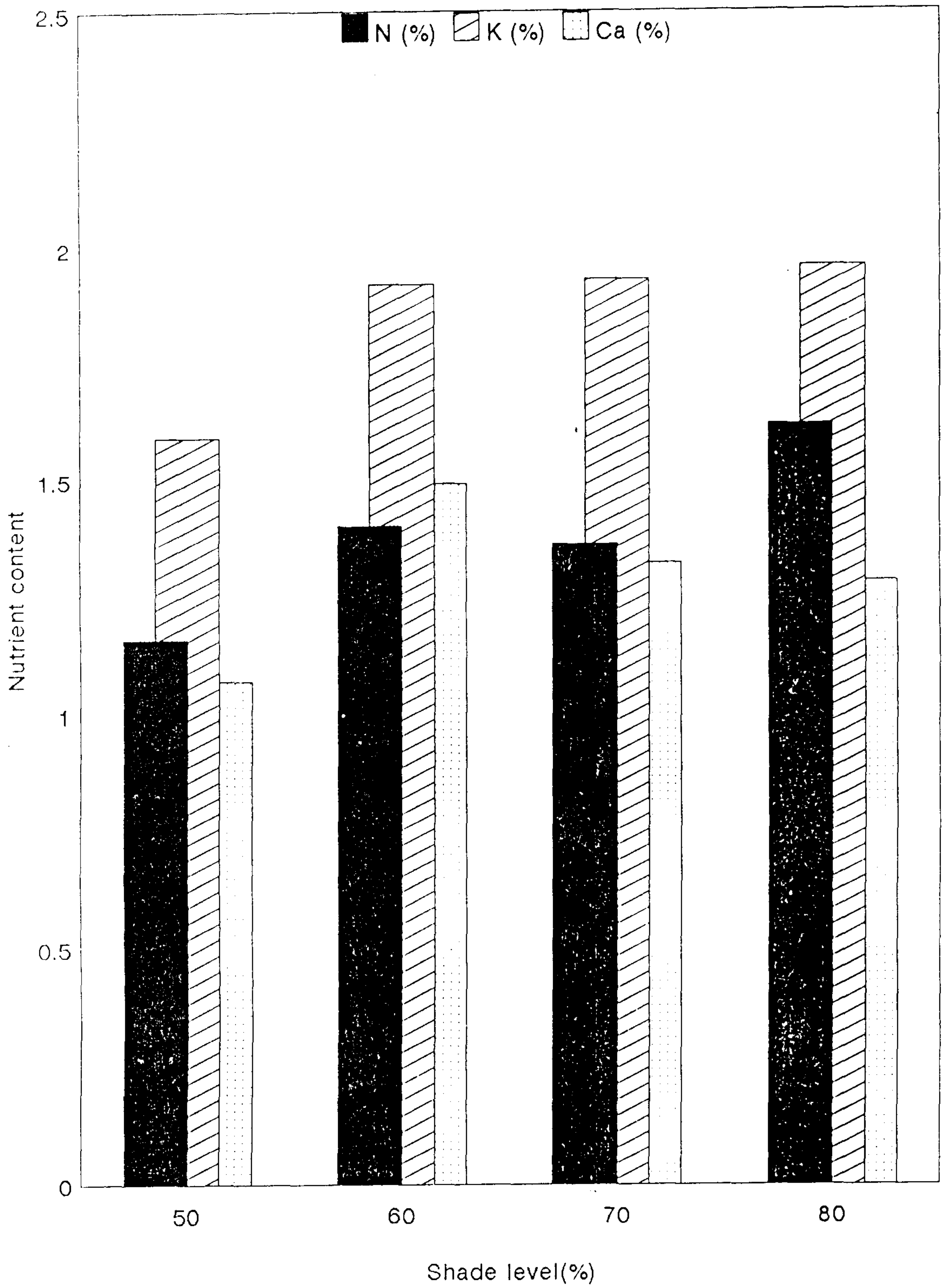


Fig.7. Effect of shade on leaf nutrient content in *A. andreanum* 'Hawaiian Red'

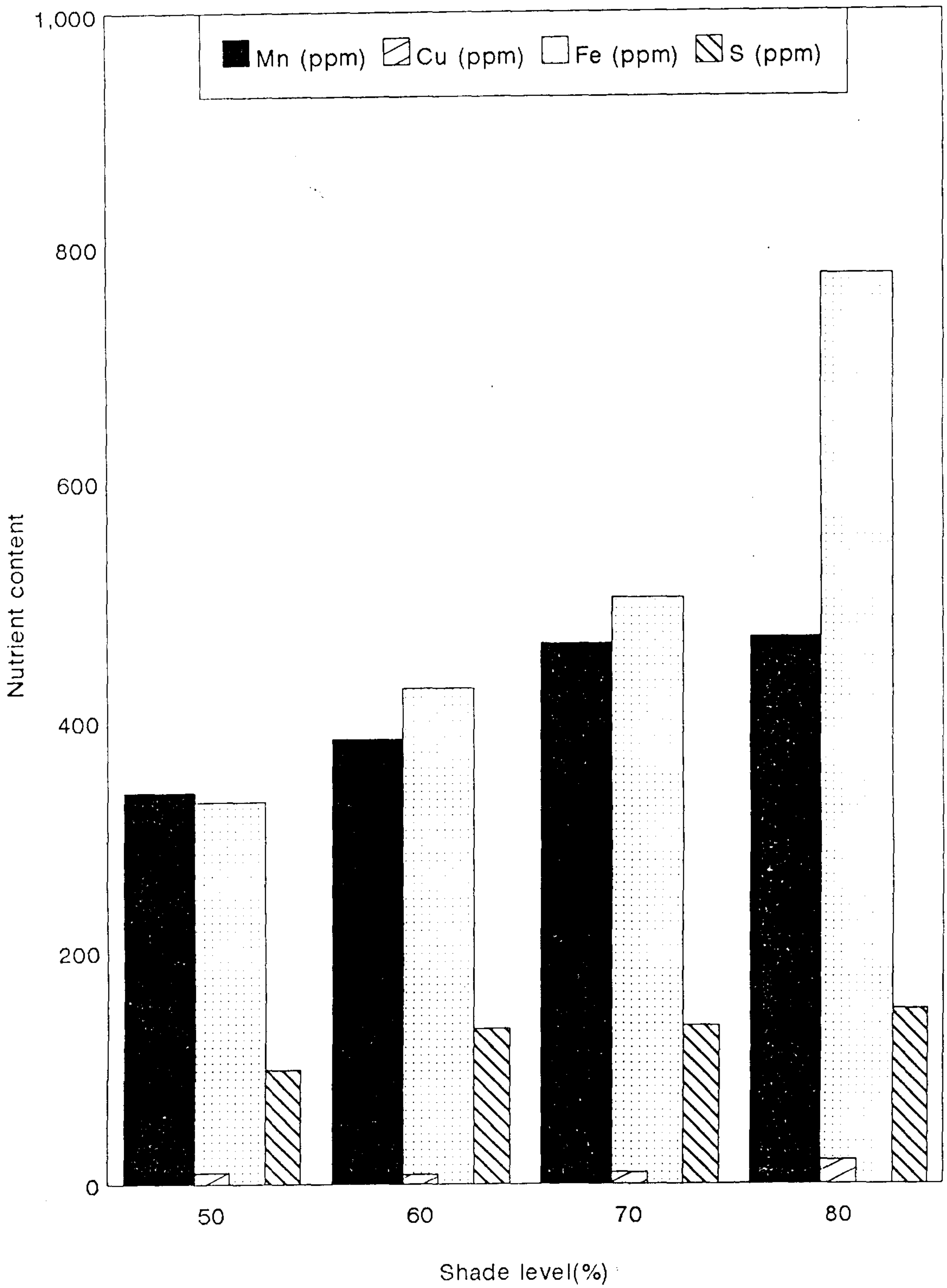


Fig.8. Effect of shade on leaf nutrient content in *A. andreanum* `Hawaiian Red'

under 50 per cent shade ($S_4N_0G_0$) retained the minimum (201 ppm), compared to all the other treatments (Appendix 25).

4.6.10 Sulphur (S)

The different shade levels and shade x nutrient interactions significantly influenced the sulphur content; but the nutrients, growth regulators, shade x growth regulator and nutrient x growth regulator interactions had no influence. Eighty per cent shade retained the maximum (150.42 ppm) sulphur content, which was significantly superior to 70 per cent (S_2), 60 per cent (S_3) and 50 per cent (S_4) shade levels. There was a decrease in sulphur content in leaf with decrease in the shade intensity. Among the interactions, the interaction S_1N_3 retained the maximum S content (169.33 ppm), which was on par with S_1N_2, S_2N_1 and S_3N_3 and was significantly supeior to the rest of the interactions. The treatment combination involving 80 per cent shade + Knop's solution + 750 ppm GA ($S_1N_3G_1$) retained the maximum sulphur content in leaves (198 ppm), while 50 per cent shade + fertilizer complex + 1500 ppm GA ($S_4N_1G_2$) retained the minimum (68 ppm), compared to all the other treatment combinations (Appendix 25).

4.7 Nutrient uptake

The nutrient uptake by the plants as influenced by the shade levels, nutrients and growth regulators and their interaction are presented in Table 31.

4.7.1 Nitrogen (N)

Shade and growth regulators significantly influenced the N uptake, though the different nutrient solutions and interactions (S x N, S x G and N x G) did not differ significantly. Eighty per cent shade was significantly superior (0.53 g) to 50 per cent (S_4) shade and was on par with 70 per cent (S_2) and 60 per cent (S_3) shade levels. There was a gradual decrease in N uptake as the shade intensity declined. Among the growth regulators, BA 1500 ppm (G_4) recorded the maximum N uptake (0.53 g), which was significantly superior to both the concentrations of Ethephon and was on par with both the concentrations of GA and BA 750 ppm (G_1 and G_3). The treatment combination of 80 per cent shade + Ohio solution + 1500 ppm BA ($S_1N_4G_4$) recorded the maximum N uptake (1.17 g), while the minimum uptake (0.07 g) was recorded by control under 70 per cent shade ($S_3N_0G_0$) compared to all the other treatment combinations (Appendix 26).

4.7.2 Phosphorus (P)

There was no significant difference in P uptake under the influence of different shade levels, nutrients, growth regulators and their interactions.

4.7.3 Potassium (K)

Shade and growth regulators significantly influenced 'K' uptake, though the different nutrients, growth regulators and their interactions did not differ significantly. Eighty per cent shade recorded the maximum K uptake (0.68 g), which was significantly superior to 60 per cent (S_3) and 50 per cent (S_4) shade levels and was on par with 70 per cent (S_2) shade. There was a gradual decrease in K uptake with decrease in the shade intensity. BA 750 ppm (G_3) recorded the maximum K uptake (0.65 g) which was significantly superior to both the concentrations of Ethephon and was on par with both the concentrations of GA and BA 1500 ppm (G_2 and G_4). The treatment combination of 80 per cent shade + Ohio solution +

Table 31. Influence of shade, nutrients, growth regulators and their interactions on nutrient uptake by plant (g) in *A. andreanum* var. 'Hawaiian Red'

Treatment	Nitrogen	Phosphorus	Potassium	Calcium	Magnesium
Shade (S)					
S_1	0.53	0.11	0.68	0.43	0.21
S_2	0.45	0.09	0.62	0.42	0.20
S_3	0.34	0.07	0.45	0.35	0.16
S_4	0.32	0.07	0.44	0.30	0.17
CD(0.05)	0.12	-	0.12	0.09	-
Nutrient (N)					
N_1	0.40	0.09	0.51	0.35	0.17
N_2	0.40	0.08	0.52	0.33	0.18
N_3	0.42	0.08	0.54	0.39	0.19
N_4	0.41	0.09	0.62	0.42	0.21
CD(0.05)	-	-	-	-	-
Growth regulator (G)					
G_1	0.40	0.10	0.55	0.40	0.20
G_2	0.42	0.10	0.62	0.39	0.20
G_3	0.52	0.10	0.65	0.41	0.22
G_4	0.53	0.10	0.64	0.43	0.22
G_5	0.29	0.06	0.38	0.27	0.13
G_6	0.30	0.07	0.44	0.31	0.15
CD(0.05)	0.15	-	0.15	0.11	-
S x N interaction					
S_1N_1	0.47	0.09	0.54	0.32	0.16
S_1N_2	0.52	0.09	0.60	0.34	0.19
S_1N_3	0.52	0.11	0.65	0.48	0.21
S_1N_4	0.60	0.15	0.91	0.58	0.30
S_2N_1	0.49	0.11	0.59	0.47	0.22
S_2N_2	0.43	0.10	0.60	0.35	0.18
S_2N_3	0.45	0.08	0.57	0.41	0.18
S_2N_4	0.45	0.10	0.71	0.47	0.22
S_3N_1	0.33	0.07	0.52	0.36	0.16
S_3N_2	0.39	0.08	0.50	0.37	017
S_3N_3	0.29	0.06	0.33	0.32	0.14
S_3N_4	0.35	0.06	0.44	0.36	0.16
S_4N_1	0.31	0.07	0.40	0.27	0.16
S_4N_2	0.29	0.07	0.37	0.28	0.18

Contd.

Table 31. Continued

Treatment	Nitrogen	Phosphorus	Potassium	Calcium	Magnesium
S_4N_3	0.40	0.08	0.60	0.38	0.21
S_4N_4	0.27	0.07	0.40	0.26	0.14
CD(0.05)	-	-	-	-	-
S x G interaction					
S_1G_1	0.44	0.10	0.59	0.38	0.17
S_1G_2	0.58	0.14	0.81	0.41	0.24
S_1G_3	0.74	0.16	0.98	0.60	0.31
S_1G_4	0.71	0.11	0.74	0.49	0.24
S_1G_5	0.33	0.07	0.43	0.31	0.15
S_1G_6	0.36	0.09	0.53	0.38	0.18
S_2G_1	0.40	0.10	0.58	0.49	0.20
S_2G_2	0.40	0.09	0.65	0.38	0.19
S_2G_3	0.68	0.12	0.76	0.49	0.26
S_2G_4	0.73	0.13	0.86	0.61	0.28
S_2G_5	0.25	0.06	0.41	0.29	0.13
S_2G_6	0.25	0.07	0.43	0.28	0.14
S_3G_1	0.43	0.12	0.54	0.50	0.23
S_3G_2	0.39	0.08	0.59	0.43	0.18
S_3G_3	0.34	0.06	0.45	0.29	0.15
S_3G_4	0.34	0.07	0.47	0.32	0.16
S_3G_5	0.25	0.04	0.28	0.25	0.10
S_3G_6	0.28	0.05	0.36	0.31	0.12
S_4G_1	0.31	0.09	0.49	0.36	0.20
S_4G_2	0.33	0.08	0.43	0.34	0.18
S_4G_3	0.31	0.07	0.41	0.26	0.16
S_4G_4	0.33	0.08	0.48	0.32	0.23
S_4G_5	0.30	0.06	0.40	0.23	0.14
S_4G_6	0.32	0.05	0.45	0.27	0.14
CD(0.05)	-	-	-	-	-
N x G interaction					
N_1G_1	0.24	0.07	0.39	0.24	0.11
N_1G_2	0.42	0.10	0.63	0.37	0.19
N_1G_3	0.62	0.11	0.66	0.48	0.24
N_1G_4	0.63	0.12	0.69	0.50	0.25
N_1G_5	0.24	0.05	0.33	0.27	0.12
N_1G_6	0.25	0.06	0.37	0.26	0.13
N_2G_1	0.58	0.13	0.68	0.46	0.23

Contd.

Table 31. Continued

Treatment	Nitrogen	Phosphorus	Potassium	Calcium	Magnesium
N_2G_2	0.41	0.10	0.60	0.34	0.20
N_2G_3	0.55	0.09	0.59	0.38	0.20
N_2G_4	0.36	0.08	0.50	0.32	0.21
N_2G_5	0.28	0.05	0.32	0.21	0.10
N_2G_6	0.35	0.07	0.42	0.29	0.13
N_3G_1	0.42	0.10	0.51	0.51	0.22
N_3G_2	0.36	0.08	0.52	0.39	0.17
N_3G_3	0.57	0.10	0.65	0.42	0.21
N_3G_4	0.51	0.09	0.62	0.43	0.20
N_3G_5	0.31	0.06	0.43	0.27	0.14
N_3G_6	0.33	0.07	0.50	0.35	0.17
N_4G_1	0.45	0.10	0.63	0.52	0.23
N_4G_2	0.51	0.12	0.74	0.47	0.24
N_4G_3	0.32	0.11	0.69	0.37	0.23
N_4G_4	0.62	0.10	0.73	0.49	0.24
N_4G_5	0.32	0.07	0.44	0.33	0.15
N_4G_6	0.28	0.07	0.47	0.33	0.15
CD(0.05)	-	-	-	-	-

750 ppm BA ($S_1N_4G_3$) was superior among the treatment combinations recording the maximum K uptake (1.31 g), while, 70 per cent shade + Knop's solution + 750 ppm GA recorded the minimum (0.07 g) (Appendix 26).

4.7.4 Calcium (Ca)

Shade and growth regulators significantly influenced the Ca uptake, though the different nutrients, growth regulators and their respective interactions did not differ significantly. Eighty per cent shade recorded the maximum (0.43 g) Ca uptake, which was significantly superior to 50 per cent (S_4) shade and was on par with 70 per cent (S_2) and 60 per cent (S_3) shade levels. There was a gradual decrease in Ca uptake with decrease in the shade intensity. BA 1500 ppm (G_4) recorded the maximum uptake (0.43 g), which was significantly superior to both the concentrations of Ethephon and was on par with BA 750 ppm. The treatment combination involving 70 per cent shade + fertilizer complex + 1500 ppm BA ($S_2N_1G_4$) recorded the maximum (0.87 g), while, 50 per cent shade + Hoagland solution + 750 ppm Ethephon ($S_4N_2G_5$) recorded the minimum (0.12 g) Ca uptake compared to all the other treatment combinations (Appendix 26).

4.7.5 Magnesium (Mg)

There was no significant difference in Mg uptake by the plants under the different shade levels, nutrients, growth, regulators and their respective interactions.

4.8 Chemical properties of irrigation water

The chemical properties of irrigation water and leachate water collected form the pots are presented in Appendix 27.

4.9 Post harvest studies

The results of the experiment conducted to study the effect of stage of harvest of inflorescence, pulsing solutions, holding solutions and combination of pulsing and holding solutions on vase life of anthurium flowers and the related parameters are presented in Tables 32 to 35.

4.9.1 Effect of stage of harvest of inflorescence

Data pertaining to the effect of stage of harvest and size of spathe on the vase life of anthurium flowers are presented in Table 32 (Fig.9).

4.9.1.1 Physiological loss in weight (PLW)

The minimum PLW (4.03 g) was in the inflorescence with flowers 2/3 opened on spadix, while, the maximum PLW (5.46 g) was in the inflorescence with flowers all opened on spadix which was on par with the other stages of harvest.

The minimum PLW (2.93 g) was in inflorescence with small spathe, which was significantly superior to medium and large size spathe. The maximum (6.76 g) PLW was recorded in inflorescence with large spathe.

4.9.1.2 Uptake of vase solution

Maximum uptake (19.00 ml) was recorded by inflorescence with 3/4 flowers opened on spadix which was significantly superior to the other stages of harvest. Minimum uptake (9.00 ml) was recorded by inflorescence with 1/3 flowers opened.

With respect to size of spathe, maximum uptake (18.00 ml) was recorded by inflorescence with small size spathe and as the size of spathe increased, the uptake decreased proportionately.

4.9.1.3 Change in pH of vase of solution

Maximum increase in pH (0.3) was noticed in inflorescence with 1/3 and all the flowers opened on spadix, which was significantly superior to the other stages of harvest. Minimum increase (0.1) in pH was noticed in inflorescences with 3/4 flowers opened on spadix.

Maximum increase in pH was noticed in inflorescence with small spathes (0.5) which was significantly superior to medium and large spathes. Inflorescence with medium size spathe recorded the minimum (0.1) increase in pH.

4.9.1.4 Change in EC of vase solution

The stage of harvest or size of spathe did not have any influence in the change in EC of the vase solution.

4.9.1.5 Days to spathe blueing initiation

Late spathe blueing (after 22.33 days) was seen in inflorescence with 1/3 flowers opened on spadix which was significantly superior to the other stages of harvest except in inflorescence with 2/3rd flowers opened on spadix. Early spathe blueing was noticed in inflorescences with unopened flowers.

Inflorescence with medium and large size spathes recorded late spathe blueing (after 22 days) which was significantly superior over small size spathe (after 19 days).

4.9.1.6 Days to initiation of spadix necrosis

Initiation of spadix necrosis was late in inflorescence with 3/4 flowers opened (after 19 days) which was significantly superior to the rest of the stages of harvest except in inflorescence with 1/3 flowers opened. Early spadix necrosis (after 8.67 days) was seen in inflorescence with unopened flowers on spadix.

Spadix necrosis was late in inflorescence with medium and large spathes (after 19 days) which was significantly superior to inflorescence with small spathe (after 15.67 days).

4.9.1.7 Days to gloss loss

Inflorescence with 1/3 and 2/3 flowers opened on spadix retained spathe gloss for longer period (20.00 days) which was significantly superior to other stages of harvest. Minimum period of gloss retention was in inflorescences with unopened flowers (7.67 days).

Inflorescence with medium and large spathes retained spathe gloss for a longer period (21 days). Minimum period of gloss retention was in inflorescence with small spathe (16.00 days).

4.9.1.8 Vase life

Inflorescence harvested at the stage of 1/3 flowers opened on spadix

Table 32. Effect of stage of harvest on vase life of anthurium

Treatment		Initial weight of inflo-rescence (g)	Final weight of inflo-rescence (g)	Physio-logical loss in weight (g)	Final volume of holding solution (ml)	Uptake of vase solution (ml)	Initial pH of vase solution	Final pH of vase solution	Change in pH of vase solution	Initial EC of vase solution (mS g^{-1})	Final EC of vase solution (mS g^{-1})	Change in EC of vase solution (mS g^{-1})	Days to spadix necrosis initiation	Days to spathe blueing initiation	Days to Gloss loss	Vase life of inflo-rescence (days)
M_1	Flowers unopened	6.60	2.13	4.46	185.00	15.00	6.6	6.8	0.2	0.03	0.08	0.05	8.67	11.33	7.67	12.33
M_2	Flowers 1/3 opened	7.06	2.30	4.76	191.00	9.00	6.6	6.9	0.3	0.03	0.10	0.07	18.00	22.33	20.00	23.33
M_3	Flowers 2/3 opened	6.90	2.86	4.03	190.00	10.00	6.6	6.8	0.2	0.03	0.10	0.07	17.67	21.33	20.00	22.33
M_4	Flowers 3/4 opened	8.46	3.30	5.16	181.00	19.00	6.6	6.7	0.1	0.03	0.09	0.06	19.00	18.00	16.00	19.00
M_5	Flowers all opened	7.43	1.96	5.46	187.33	12.67	6.6	6.9	0.3	0.03	0.08	0.05	16.00	16.33	15.33	17.33
M_6	Small size spathe	4.16	1.23	2.93	182.00	18.00	6.6	7.1	0.5	0.03	0.08	0.05	15.67	19.00	16.00	20.00
M_7	Medium size spathe	7.60	2.76	4.83	185.00	15.00	6.6	7.0	0.4	0.03	0.08	0.05	19.00	22.00	21.00	23.00
M_8	Large size spathe	10.93	4.16	6.76	188.66	11.33	6.6	6.9	0.3	0.03	0.09	0.06	19.00	22.00	21.00	23.00
CD(0.05)		2.29	1.04	2.37	4.10	3.90	-	0.09	0.05	-	-	-	1.10	1.10	0.67	1.15

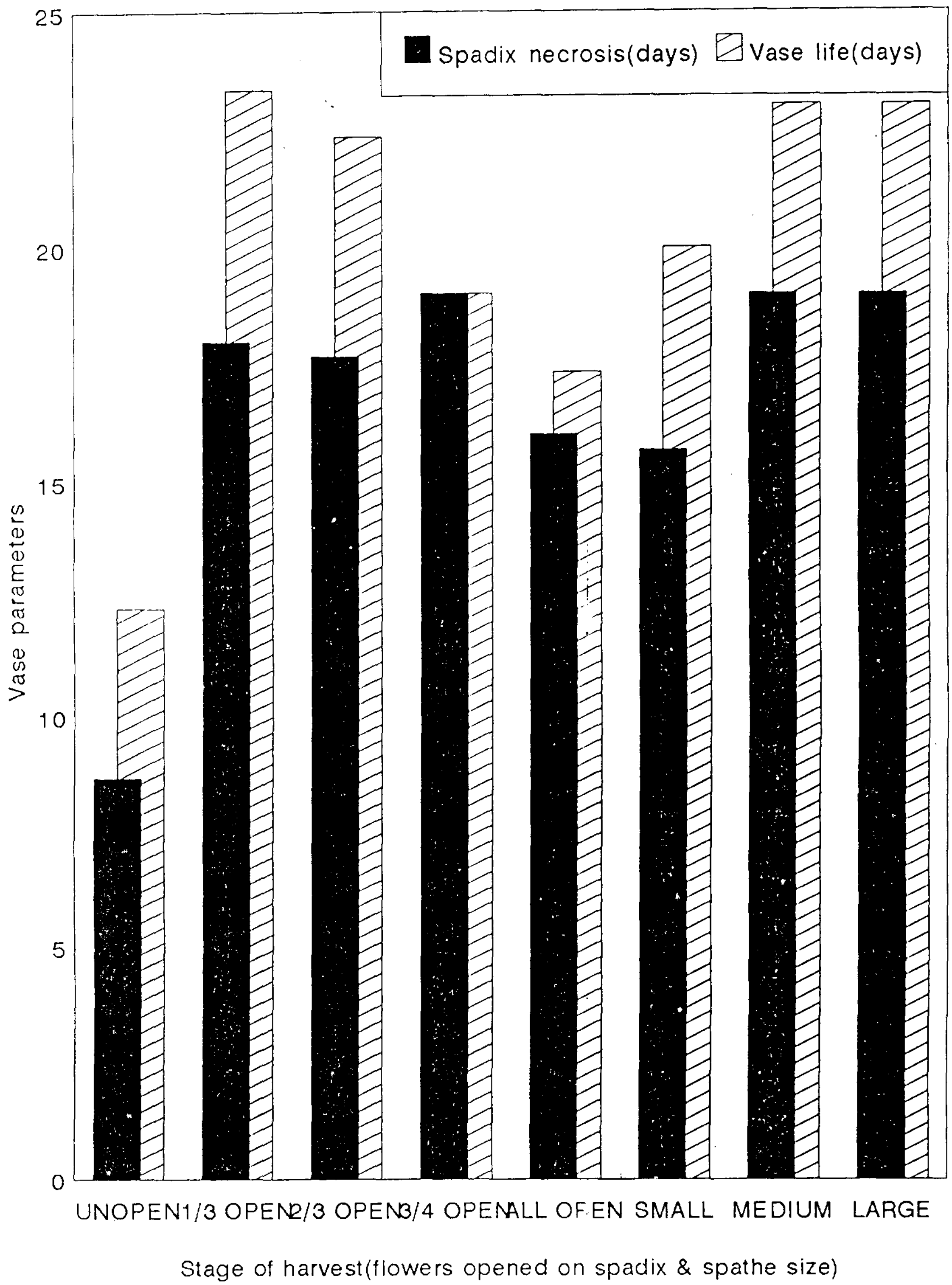


Fig.9. Effect of stage of harvest on vase life of anthurium

recorded significantly maximum (23.33 days) vase life which was on par with the inflorescence with 2/3 flowers opened. Minimum vase life was in inflorescence with unopened flowers (12.33 days).

Inflorescences with medium and large size spathes recorded maximum (23.00 days) vase life which was significantly superior to inflorescence with small size spathe (20.00 days).

4.9.2 Effect of pulsing treatments

Data pertaining to the effect of pulsing treatments on the vase life of anthurium flowers are given in Table 33 (Fig.10).

4.9.2.1 Physiological loss in weight (PLW)

The different pulsing treatments significantly influenced the physiological loss in weight. The minimum PLW was in the pulse treatment of BA 50 ppm for 12 hrs (1.13 g). The maximum PLW was in the pulse treatment with $AgNO_3$ 4 mM for 60 min (7.36 g) which was on par with P_1, P_2, P_3, P_{10}, P_{11} and P_{14} and was significantly higher over the rest of the treatments.

4.9.2.2 Uptake of vase solution

The uptake of vase solution was significantly influenced by the various pulsing treatments. Maximum uptake was in tap water control treatment (19.33 ml) which was significantly superior to all the other pulsing treatments, except 8-HQ 400 ppm for 6 hrs and distilled water control. The minimum uptake was in the treatment with 8-HQ 200 ppm for 6 hrs (4.67 ml).

4.9.2.3 Change in pH of vase solution

Change in pH was significantly influenced by the different pulse treatments. The maximum increase in pH was recorded in tap water control (0.3), followed by the $AgNO_3$ 8 mM for 40 minutes (0.2), while, in the rest of the treatments, pH decrease. . The maximum decreased in pH was recorded in pulse treatment with 8-HQ 200 ppm for 6 hrs (-0.6).

4.9.2.4 Change in EC of vase solution

There was no significant influence of various pulse treatments on change in EC of vase solution. The maximum increase in EC was recorded in (P_{16}) tap water control (0.09 mS g^{-1}), while decrease in EC was recorded in (P_{17}) distilled water control (-0.04 mS g^{-1}).

4.9.2.5 Days to initiate spathe blueing

Different pulsing treatments had significant influence on the time taken to initiate spathe blueing. The pulse treatment BA 50 ppm 12 hrs (P_{10}) recorded late spathe blueing (19 days). Early spathe blueing (10.33 days) was seen in absolute control (P_{15}).

4.9.2.6 Days to initiation of spadix necrosis

Different pulsing treatments had significant influence on initiation of spadix necrosis. Inflorescence pulse treated with BA 50 ppm for 12 hrs (P_{10}) recorded late spadix necrosis (after 19 days). Early spadix necrosis was noticed in absolute control (after 8.33 days).

Table 33. Effect of pulsing treatments on vase life of anthurium

Treatment	Initial weight of inflo-rescence (g)	Final weight of inflo-rescence (g)	Physio-logical loss in weight (g)	Final volume of holding solution (ml)	Uptake of vase solution (ml)	Initial pH of vase solution	Final pH of vase solution	Change in pH of vase solution	Initial EC of vase solution (mS g^{-1})	Final EC of vase solution (mS g^{-1})	Change in EC of vase solution (mS g^{-1})	Days to spadix necrosis initiation	Days to spathe blueing initiation	Days to Gloss loss	Vase life of inflo-rescence (days)
P_1 $AgNO_3$ 4 mM 20 min	6.60	2.63	3.96	188.33	11.66	6.6	6.5	-0.1	0.01	0.02	0.01	13.00	13.00	13.00	14.00
P_2 $AgNO_3$ 8 mM 20 min	7.27	2.53	4.73	186.66	13.33	6.6	6.5	-0.1	0.01	0.03	0.02	12.67	13.33	12.67	14.33
P_3 $AgNO_3$ 4 mM 40 min	8.80	4.16	4.63	191.33	8.66	6.6	6.2	-0.4	0.01	0.02	0.01	14.00	14.00	14.00	15.00
P_4 $AgNO_3$ 8 mM 40 min	9.43	3.33	6.10	192.66	7.33	6.6	6.8	0.2	0.01	0.09	0.08	12.67	14.33	13.00	15.33
P_5 $AgNO_3$ 4 mM 60 min	9.13	1.76	7.36	192.66	7.33	6.6	6.4	-0.2	0.01	0.02	0.01	12.00	13.67	12.00	14.67
P_6 $AgNO_3$ 8 mM 60 min	8.13	4.06	4.06	190.00	10.00	6.6	6.2	-0.4	0.01	0.02	0.01	13.67	14.33	13.33	15.33
P_7 BA 25 ppm 6 hrs	6.40	3.40	3.00	192.00	8.00	6.6	6.2	-0.4	0.01	0.02	0.01	15.67	16.67	15.33	17.67
P_8 BA 50 ppm 6 hrs	6.50	4.23	2.26	192.66	7.33	6.6	6.2	-0.4	0.01	0.06	0.05	15.67	17.00	15.00	18.00
P_9 BA 25 ppm 12 hrs	8.40	5.63	2.76	186.00	14.00	6.6	6.2	-0.4	0.01	0.02	0.01	15.33	17.00	15.00	18.00
P_{10} BA 50 ppm 12 hrs	7.96	6.68	1.13	185.33	14.67	6.6	6.3	-0.3	0.01	0.02	0.01	19.00	19.00	18.00	20.00
P_{11} 8-HQ 200 ppm 6 hrs	9.92	3.83	6.10	195.33	4.67	6.8	6.2	-0.6	0.02	0.05	0.03	17.00	15.67	13.67	16.67
P_{12} 8-HQ 400 ppm 6 hrs	8.43	3.90	4.53	182.67	17.33	6.8	6.4	-0.3	0.02	0.05	0.03	16.67	18.00	16.67	19.00
P_{13} 8-HQ 200 ppm 12 hrs	8.00	5.60	2.40	188.00	12.00	6.8	6.3	-0.5	0.02	0.03	0.01	15.67	17.33	13.67	18.33
P_{14} 8-HQ 400 ppm 12 hrs	7.96	4.50	3.46	191.33	8.67	6.8	6.5	-0.3	0.02	0.07	0.05	15.00	16.00	15.00	17.00
P_{15} Absolute control	7.20	1.83	5.36	-	-	-	-	-	-	-	-	8.33	10.33	8.33	11.33
P_{16} Tap water control	6.56	2.76	3.80	180.67	19.33	6.6	6.9	0.3	0.03	0.12	0.09	16.00	17.00	17.00	18.00
P_{17} Distilled water control	6.43	2.10	4.33	182.67	17.33	6.5	6.1	-0.5	0.07	0.03	-0.04	13.33	15.67	13.33	16.67
CD(0.05)	NS	2.74	2.91	NS	3.42	-	NS	0.34	NS	NS	NS	3.18	2.77	NS	3.07

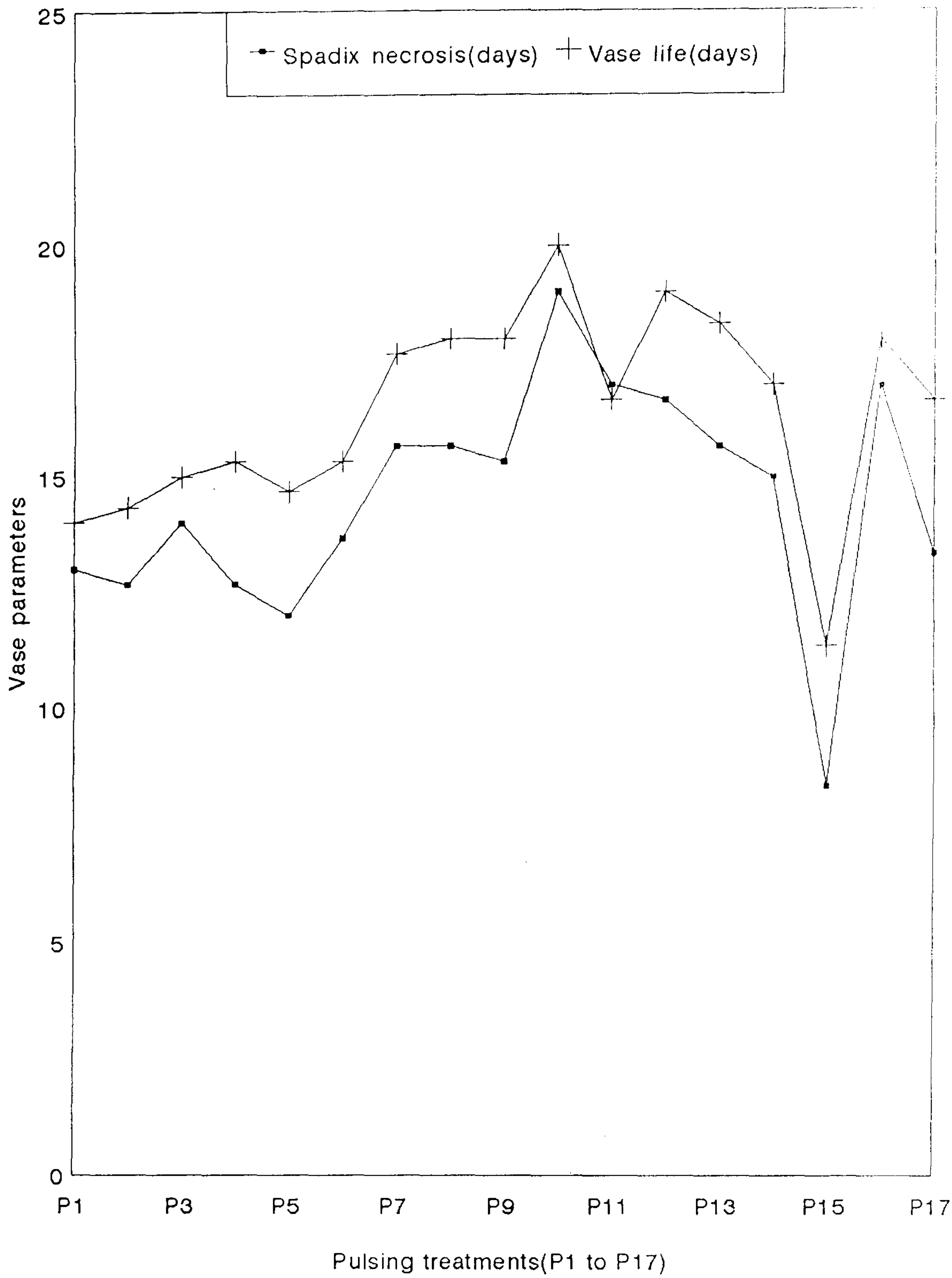


Fig.10. Effect of pulsing treatments on vase life of anthurium

4.9.2.7 Days to gloss loss

The gloss loss of inflorescence was not influenced significantly by the different pulse treatments. The gloss was retained for maximum period (18 days) by inflorescence pulse treated with BA 50 ppm for 12 hrs and it was the minimum (8.33 days), in absolute control.

4.9.2.8 Vase life of inflorescence

Different pulse treatments significantly influenced the vase life of inflorescence. The maximum vase life (20 days) was recorded by the pulse treatment with BA 50 ppm for 12 hrs. The minimum vase life (11.33 days) was recorded in absolute control (P_{15}).

4.9.3 Effect of holding solutions

Data pertaining to the effect of holding solutions on vase life of anthurium flowers are presented in Table 34 (Fig.11).

4.9.3.1 Physiological loss in weight (PLW)

There was no significant difference in physiological loss in weight of inflorescence as influenced by the different holding solutions. Minimum PLW was recorded in holding of 8-HQ 40 ppm (3.03 g), while, it was maximum in BA 50 ppm (6.16 g).

4.9.3.2 Uptake of vase solution

There was significant influence of the different holding solutions on the uptake of vase solution by the inflorescence. The maximum uptake was recorded by the treatment involving Benzoic acid 500 ppm (35.0 ml), which was significantly superior over all the other treatments except Triadimefon 10 and 30 ppm holding treatments, which were on par with it. The minimum (5.0 ml) uptake was recorded by BA 20 ppm.

4.9.3.3 Change in pH of vase solution

Different holding solutions had significant influence on change in pH of the holding solution. The maximum increase in pH (1.2) was recorded by the treatment involving Bavistin 0.2 per cent. The maximum decrease in pH (-1.5) was recorded by the treatment involving Triadimefon 10 ppm.

4.9.3.4 Change in EC of vase solution

Different holding solutions had significant influence on change in electrical conductivity of the holding solution. The maximum increase in EC (1.65 mS g^{-1}) was recorded by the treatment of Phosjet-40, 0.2 per cent, which was significantly superior to all the other treatments. The maximum decrease in EC (-0.18 mS g^{-1}) was recorded by the treatment with BA 50 ppm.

4.9.3.5 Days to spathe blueing initiation

Different holding solutions significantly influenced the period of initiation to spathe blueing. Spathe blueing occured late in the holding treatment of 8-HQ 30 ppm (after 26 days), which was on par with H_5, H_{17}, H_{23} and H_{24} (22.67 days) and was significantly superior to the rest of the treatments. Spathe blueing started first in absolute control (after 10.33 days).

Table 34. Effect of holding solutions on vase life of anthurium

Treatment		Initial weight of inflorescence (g)	Final weight of inflorescence (g)	Physiological loss in weight (g)	Final volume of holding solution (ml)	Uptake of vase solution (ml)	Initial pH of vase solution	Final pH of vase solution	Change in pH of vase solution	Initial EC of vase solution (mS g^{-1})	Final EC of vase solution (mS g^{-1})	Change in EC of vase solution (mS g^{-1})	Days to spadix necrosis initiation	Days to spathe blueing initiation	Days to gloss loss	Vase life of inflorescence (days)
H_1	$AgNO_3$ 10 ppm	7.86	4.06	3.80	181.00	19.00	7.2	5.9	-1.3	0.07	0.03	-0.04	12.33	14.33	11.00	14.67
H_2	$AgNO_3$ 20 ppm	8.36	3.90	4.46	183.00	17.00	7.6	8.0	0.4	0.08	0.03	-0.05	10.33	12.33	10.33	13.00
H_3	BA 5 ppm	7.43	3.23	4.20	192.00	8.00	6.2	6.5	0.3	0.09	0.09	0.00	16.67	21.33	19.00	22.33
H_4	BA 10 ppm	7.03	1.63	5.40	188.00	12.00	5.8	6.0	0.2	0.19	0.18	-0.01	17.00	17.67	17.67	18.67
H_5	BA 20 ppm	8.43	3.63	4.80	195.00	5.00	3.0	3.1	0.1	0.50	0.50	0.00	21.00	23.67	23.33	25.00
H_6	BA 30 ppm	9.03	2.96	6.06	184.00	16.00	2.9	3.2	0.3	0.91	0.90	-0.01	19.33	20.67	18.00	21.67
H_7	BA 40 ppm	10.00	3.20	6.80	188.67	11.33	2.6	2.7	0.1	1.43	1.40	-0.03	16.00	17.00	16.00	18.00
H_8	BA 50 ppm	8.70	2.53	6.16	192.00	8.00	2.3	2.3	0.0	1.72	1.54	-0.18	18.00	18.33	17.00	19.33
H_9	Bavistin 0.2%	11.46	6.00	5.46	183.33	12.67	4.0	5.2	1.2	0.14	0.12	-0.02	16.33	19.67	15.00	20.67
H_{10}	Benzoic acid 500 ppm	8.66	4.56	4.10	165.00	35.00	2.6	2.9	0.3	0.24	0.22	-0.02	15.00	17.00	14.67	18.00
H_{11}	Citric acid 500 ppm	8.43	2.73	5.70	185.00	15.00	2.6	2.8	0.2	0.38	0.32	-0.06	9.67	13.33	10.67	14.33
H_{12}	$CoCl_2$ 100 ppm	10.00	6.53	3.46	185.00	15.00	3.7	4.5	0.8	0.27	0.28	0.01	15.33	20.67	15.33	21.67
H_{13}	8-HQ 5 ppm	5.36	1.60	3.76	187.00	13.00	7.1	6.7	-0.4	0.04	0.08	0.04	16.00	17.00	14.33	18.00
H_{14}	8-HQ 10 ppm	6.53	2.00	4.53	186.67	13.33	7.3	7.2	-0.1	0.04	0.08	0.04	14.67	15.00	14.00	16.00
H_{15}	8-HQ 20 ppm	5.63	2.50	3.13	190.67	9.33	7.3	7.1	-0.2	0.04	0.08	0.04	15.33	19.00	17.00	20.00
H_{16}	8-HQ 30 ppm	8.56	4.80	3.76	193.33	6.67	7.4	6.8	-0.6	0.04	0.09	0.05	21.00	26.00	23.00	27.00
H_{17}	8-HQ 40 ppm	6.90	3.86	3.03	182.00	18.00	7.5	7.2	-0.3	0.05	0.09	0.04	21.00	22.67	21.67	24.00
H_{18}	8-HQ 50 ppm	8.36	2.96	5.40	171.67	28.33	7.6	7.2	-0.4	0.05	0.09	0.04	19.00	21.33	19.00	22.33
H_{19}	Phosjet-40 0.2%	9.90	4.63	5.26	194.00	6.00	6.8	4.8	-2.0	0.07	1.72	1.65	10.00	15.00	11.00	16.00
H_{20}	Streptomycin 200 ppm	8.26	3.56	4.70	187.00	13.00	4.3	3.8	-0.5	0.14	0.15	0.01	10.00	14.00	11.67	15.00
H_{21}	Sucrose 5%	6.33	8.53	3.80	182.00	18.00	4.9	4.6	-0.3	0.03	0.09	0.06	20.00	19.33	16.00	20.33
H_{22}	Triadimefon 10 ppm	9.70	5.43	4.27	167.67	32.33	5.8	4.3	-1.5	0.03	0.08	0.05	18.33	20.00	18.00	21.00
H_{23}	Triadimefon 20 ppm	8.96	2.83	6.13	188.00	12.00	6.0	6.2	0.2	0.03	0.08	0.05	18.00	22.00	16.00	23.00
H_{24}	Triadimefon 30 ppm	11.10	6.43	4.66	166.33	33.67	6.1	6.1	0.0	0.03	0.05	0.02	20.00	24.00	20.00	25.00
H_{25}	Triadimefon 40 ppm	8.10	3.97	4.13	188.00	12.00	6.2	6.2	0.0	0.03	0.06	0.03	15.33	17.00	16.00	18.00
H_{26}	Absolute control	7.20	1.83	5.36	-	-	-	-	-	-	-	-	8.33	10.33	8.33	11.33
H_{27}	Tap water control	6.56	2.76	3.80	180.67	19.33	6.6	6.9	0.3	0.03	0.12	0.09	16.00	17.00	17.00	18.00
H_{28}	Distilled water control	6.43	2.10	4.33	182.67	17.33	6.5	6.1	-0.4	0.07	0.03	-0.04	13.33	15.67	13.33	16.67
CD (0.05)		2.75	2.33	NS	NS	6.48	2.3	2.6	1.1	0.02	0.04	0.04	3.88	4.08	4.26	3.92

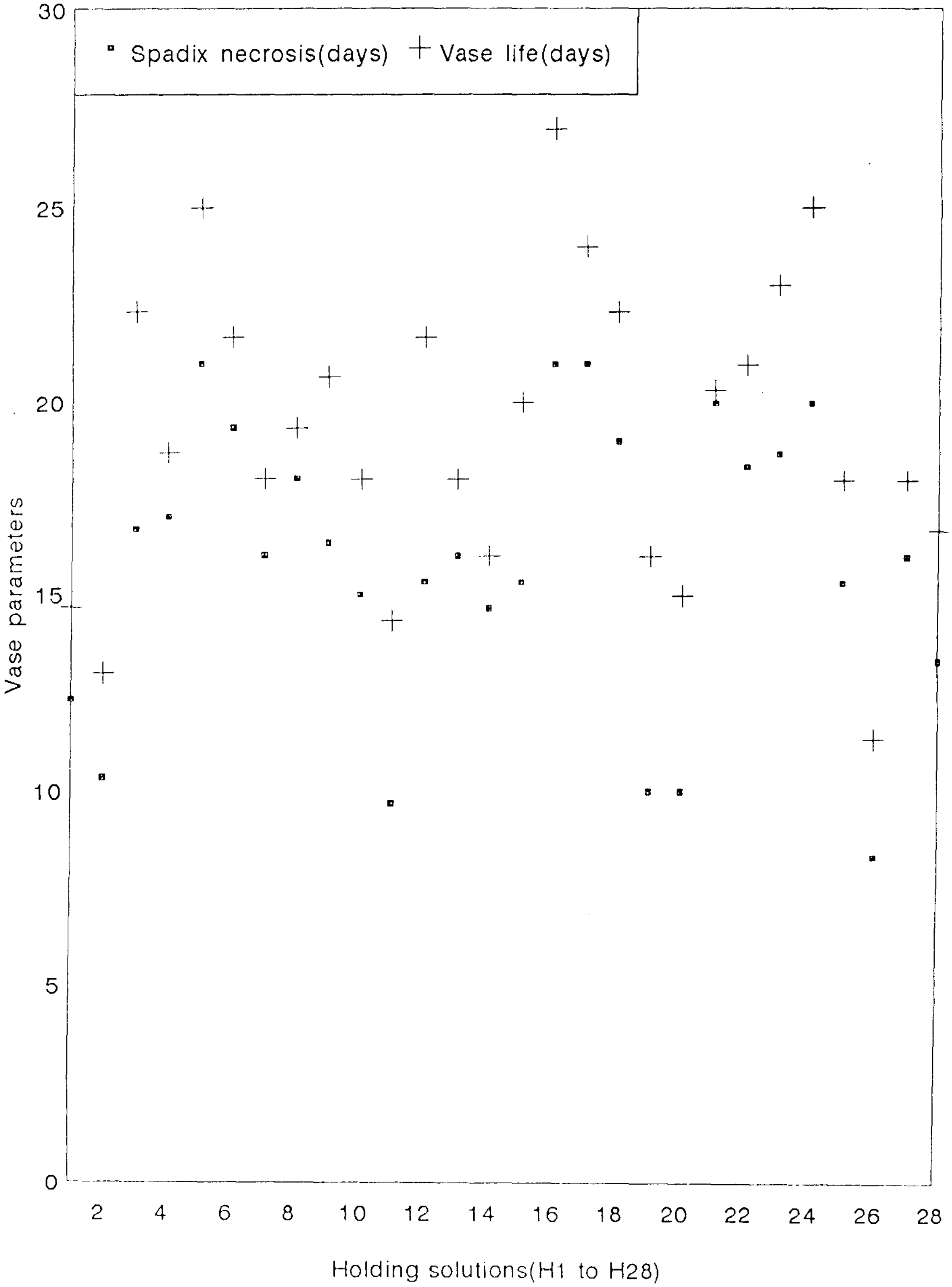


Fig.11. Effect of holding solutions on vase life of anthurium

4.9.3.6 Days to initiation of spadix necrosis

Different holding solutions had significant influence on days taken for the initiation of spadix necrosis. Spadix necrosis was late in the treatments with BA 20 ppm, 8-HQ 30 ppm and 8-HQ 40 ppm (after 21 days), which were significantly superior to the other treatments. Early spadix necrosis symptoms were noticed in absolute control (after 8.33 days).

4.9.3.7 Days to gloss loss

Treatments with different holding solutions had significant influence on the time taken to loss of gloss of the inflorescence. Gloss was retained for the maximum days of 23.33, by holding in BA 20 ppm, which was significantly superior. Early loss of gloss was noticed in absolute control (after 8.33 days).

4.9.3.8 Vase life of inflorescence

Different holding solutions had significant influence on the vase life of inflorescence. The maximum vase life was recorded by 8-HQ 30 ppm (27 days), which was on par with BA 20 ppm (25 days), Triadimefon 30 ppm (25 days) and 8-HQ 40 ppm (24 days) and was significantly superior to the rest of the treatments. The minimum vase life (11.33 days) was recorded in absolute control.

4.9.4 Combination of pulsing and holding solutions

Data on the effect of combinations of pulsing and holding solutions on the vase life and related parameters of anthurium flowers are presented in Table 35.

4.9.4.1 Physiological loss in weight (PLW)

Treatments involving different combinations of pulsing and holding solutions failed to influence the PLW of inflorescence significantly.

4.9.4.2 Uptake of vase solution

Different combinations of pulsing and holding solutions significantly influenced the uptake of vase solution. Maximum uptake was recorded in tap water control (19.33 ml) which was significantly superior to the rest of the treatments except distilled water. The uptake was minimum in the combination of pulsing with 8-HQ 400 ppm for 6 hrs + holding in sucrose 5 per cent (3.0 ml).

4.9.4.3 Change in pH of vase solution

Different treatment combinations of pulsing and holding solutions had significant influence on change in pH. The maximum increase (0.3) in pH was recorded by the treatments, pulsing in BA 50 ppm for 12 hrs + holding in sucrose 5 per cent and holding in tap water, which was significantly superior to the rest of the treatments. The maximum decrease in pH (-2.3) was noticed under the treatment combination of pulsing with 8-HQ 40 ppm + holding in sucrose 5 per cent.

4.9.4.4 Change in EC of vase solution

Different treatment combinations of pulsing and holding solutions have significantly influenced the change in EC. The maximum increase in EC (0.19 mS g^{-1}) was recorded by the treatment combination of pulsing in 8-HQ 40 ppm +

holding in sucrose 5 per cent, which was significantly superior to the rest of the treatments. The maximum decrease in EC was noticed under the treatment combination of BA 50 ppm 12 hrs pulsing + holding in sucrose 5 per cent (-2.80 mS g^{-1}).

4.9.4.5 Days to initiation of spathe blueing

There was significant influence of various combinations of pulsing and holding treatments on the days taken to initiate symptoms of spathe blueing. Spathe blueing was late (after 22.67 days) in the treatment combination of BA 20 ppm 12 hrs pulsing + holding in Bavistin 0.1 per cent, which was significantly superior to the rest of the treatments. Early spathe blueing (after 10.33 days) was noticed in absolute control.

4.9.4.6 Days to initiation of spadix necrosis

The days taken to the initiation of spadix necrosis was influenced by the treatment combinations. Late spadix necrosis was noticed in the treatment combination of BA 20 ppm 12 hrs pulsing + holding in Bavistin 0.1 per cent, which was on par with 8-HQ 400 ppm 6 hrs pulsing + holding in sucrose 5 per cent and tap water control and was significantly superior to the rest of the treatments. Early spadix necrosis was noticed in absolute control (after 8.33 days).

4.9.4.7 Days to gloss loss

There was significant influence of different treatment combinations on spathe gloss loss. Spathe gloss was retained for the maximum period (20 days) in the treatment combination of BA 20 ppm 12 hrs pulsing + holding in Bavistin 0.1 per cent, which was significantly superior to the rest of the treatments, except 8-HQ

Table 35. Effect of pulsing and holding solutions on vase life of anthurium

Treatment		Initial weight of inflo-rescence (g)	Final weight of inflo-rescence (g)	Physio-logical loss in weight (g)	Final volume of holding solution (ml)	Uptake of vase solution (ml)	Initial pH of vase solution	Final pH of vase solution	Change in pH of vase solution	Initial EC of vase solution (mS g^{-1})	Final EC of vase solution (mS g^{-1})	Change in EC of vase solution (mS g^{-1})	Days to spadix necrosis initiation	Days to spathe blueing initiation	Days to gloss loss	Vase life of inflo-rescence (days)
C_1	BA 20 ppm + 8-HQ 40 ppm + sucrose 5% holding	8.03	3.40	4.63	194.33	5.67	2.6	2.6	0.0	1.58	1.46	-0.12	12.33	17.00	14.33	18.00
C_2	BA 20 ppm + Bavistin 0.1% holding	8.36	5.86	2.50	185.67	14.33	2.6	2.7	0.1	0.97	0.83	-0.09	18.33	22.67	20.00	23.67
C_3	BA 20 ppm + sucrose 5% holding	11.16	5.36	5.80	190.67	9.33	2.5	2.5	0.0	1.74	1.57	-0.17	11.33	15.00	10.67	16.00
C_4	8-HQ 40 ppm + sucrose 5% holding	9.23	3.26	5.96	194.00	6.00	5.4	3.1	-2.3	0.03	0.22	0.19	13.00	16.00	13.33	17.00
C_5	BA 50 ppm 6 hrs pulse + sucrose 5% holding	10.40	5.36	5.03	193.67	7.33	2.1	2.4	0.3	3.53	0.73	-2.80	13.67	15.33	13.00	16.33
C_6	8-HQ 400 ppm 6 hrs pulse + sucrose 5% holding	7.50	5.36	2.13	197.00	3.00	6.8	5.7	-1.1	0.03	0.05	0.02	18.00	20.67	19.00	21.67
C_7	Parafin wax coating to spathe and spadix (holding in water)	8.86	3.10	5.76	186.00	14.00	6.9	6.0	-0.9	0.12	0.06	-0.06	11.00	13.67	11.67	14.67
C_8	Parafin wax coating to only spadix (holding in water)	7.60	3.00	4.60	185.00	15.00	6.8	5.7	-1.1	0.08	0.03	-0.05	12.00	13.33	12.00	11.33
C_9	Absolute control	7.20	1.83	5.36	-	-	-	-	-	-	-	-	8.33	10.33	8.33	11.33
C_{10}	Tap water control	6.56	2.76	3.80	180.67	19.33	6.6	6.9	0.3	0.03	0.12	0.09	16.00	17.00	17.00	18.00
C_{11}	Distilled water	6.43	2.10	4.33	182.67	17.33	6.5	6.1	-0.4	0.07	0.03	-0.04	13.33	15.67	13.33	16.67
	CD(0.05)	NS	2.74	NS	2.88	2.26	1.4	0.1	0.1	0.04	0.23	0.04	2.79	1.73	2.43	2.09

400 ppm 6 hrs pulsing + holding in sucrose 5 per cent. Early gloss loss was seen in absolute control (after 8.33 days).

4.9.4.8 Vase life of inflorescence

Vase life was significantly different in the different treatment combinations. The maximum vase life (23.67 days) was recorded by the treatment combination of BA 20 ppm 12 hrs pulsing + holding in Bavistin 0.1 per cent, which was significantly superior to the rest of the treatments except 8-HQ 400 ppm 6 hrs pulsing + holding in sucrose 5 per cent. The minimum vase life was recorded by absolute control (11.33 days).

4.10 Economics of cultivation

Data relating to the cost of cultivation and profitability estimates of anthurium are presented in Table 36 and the economics involved in anthurium production, under the influence of shade, nutrients and growth regulators are presented in Table 37 (Fig.12 and 13).

Data presented in Table 36 show the non-recurring and recurring expenses incurred and the sales realization through flowers and suckers during the experimental period. It is clear that even 18 month period is quite sufficient to meet the expenses incurred for anthurium cultivation, with an additional net profit of Rs.17,528.00 (Rupees Seventeen thousand five hundred and twenty eight only). Based on these facts, the estimated cost of production with the profitability estimates for initial three year period from 400 m^2 area (1975 plants) with a spacing of 45 x 45 cm is also given, which clearly shows the high amount of profit involved in anthurium cultivation.

Table 36. Cost of cultivation of anthuriuam (experimental period 18 months - January 1996 to June 1997)

Profitability estimates for an area of 400 m² (1975 plants) with 45 x 45 cm spacing

Expenditure	Experimental (18 months) (Rs.)	Estimated cost of production for 3 years (Rs.)		
		First year	Second year	Third year
I. Non-recurring				
a) Land development	1000/-	1000/-	-	-
b) Shade house (4 Nos.)	120000/-	120000/-	-	-
c) Pots (1975 of 9")	23700/-	23700/-	-	-
d) Potting mixture	5925/-	5 ~~2~~925/-	-	7900/-
e) Plant protection equipments (2 pumps)	1850/-	1850/-	-	-
f) Irrigation set (overhead sprinkler)	-	-	-	-
g) Planting material	41475/-	41475/-	-	-
Total A	193950/-	193950/-	-	7900/-
II. Recurring				
(I) Operational cost				
a) Manures and fertilizers	11100/-	7400/-	7400/-	7400/-
b) Growth regulators (BA)	34700/-	23200/-	23200/-	23200/-
c) Plant protection (chemicals)	17854/-	11902/-	11902/-	11902/-
d) Shade maintenance	220/-	147/-	294/-	294/-
e) Post harvest handling	-	-	500/-	3000/-
f) Labour charges	34760/-	23173/-	4950/-	23042/-
Total B	98634/-	65822/-	48246/-	68838/-
(ii) Interest on non-recurring and operational cost @ 15% per year (C)	45388/-	40466/-	27038/-	31438/-
Sales realization:				
Flowers	-	-	47400/-	158000/-
Suckers	355500/-	237000/-	474000/-	711000/-
Total D	355500/-	237000/-	521400/-	869000/-
Total cost of production A + B + C (E)	337972/-	300328/-	75284/-	108176/-
Net profit (D-E)	17528/-	-63328/-	446116/-	760824/-

Details of the cost of production per pot during the experimental period of 18 months are presented in Appendix 28.

Data presented in Table 37 show the number of suckers produced, flowers harvested, expenses incurred, receipt realized and net profit gained per plant during the experimental period.

The production of suckers was significantly influenced by shade and growth regulators. Nutrients and various interactions tried did not differ significantly. The highest shade intensity (80%) was significantly superior with respect to sucker production (3.53) over the other shade levels (70%, 60% and 50%). Both the concentrations of GA and BA were on par with each other but were significantly superior to both the concentrations of Ethephon with respect to sucker production.

Number of flowers harvested was not influenced significantly by shade, nutrients and growth regulators as well as their interactions, within the short period of flowering.

Expenses incurred were significantly influenced by the different shade levels and growth regulators due the higher price rates of shade nets and growth regulators. The amount spent on nutrients did not differ.

Receipts realized through the sale of the suckers and flowers were significantly influenced by the different shade levels and growth regulators. With the decline in shade intensity, the receipts also declined due to the reduction in the number of the suckers and flowers produced per plant and the low quality of suckers produced. The maximum receipt per pot (Rs.212.00) was under 80 per cent shade.

Table 37. Economics of cultivation of anthurium

Treatment	Suckers (Nos.)	Flowers (Nos.)	Expenditure (Rs.)	Receipt (Rs.)	Net profit (Rs.)
Shade (S)					
S_1	3.53	0.08	89.20	212.00	122.73
S_2	3.18	0.50	88.53	193.50	104.98
S_3	2.73	0.17	87.81	164.50	76.69
S_4	3.10	0.00	87.09	132.42	45.39
CD(0.05)	0.34	-	0.15	19.29	19.27
Nutrient (N)					
N_1	3.17	0.17	88.16	175.17	86.97
N_2	2.99	0.29	88.17	168.08	79.92
N_3	3.27	0.00	88.13	181.42	93.30
N_4	3.10	0.29	88.17	177.75	89.58
CD(0.05)	-	-	-	-	-
Growth regulator (G)					
G_1	3.52	0.00	87.98	194.88	106.89
G_1	3.40	0.06	88.30	188.13	99.83
G_3	3.34	0.44	88.26	194.88	106.56
G_4	3.29	0.13	89.00	185.63	96.67
G_5	2.54	0.25	87.68	139.50	51.82
G_6	2.69	0.25	87.72	150.63	62.91
CD(0.05)	0.42	-	0.19	23.62	23.61
S x N interaction					
S_1N_1	3.20	0.00	89.23	192.00	102.64
S_1N_2	3.17	0.17	89.24	191.00	101.76
S_1N_3	3.77	0.00	89.08	226.00	136.76
S_1N_4	3.97	0.17	89.24	239.00	149.76
S_2N_1	3.62	0.33	88.53	219.00	130.48
S_2N_2	3.07	0.83	88.53	189.00	100.48
S_2N_3	3.20	0.00	88.53	192.00	103.48
S_2N_4	2.82	0.83	88.53	174.00	85.48
S_3N_1	2.68	0.33	87.81	163.00	75.19
S_3N_2	2.78	0.17	87.81	168.00	80.19
S_3N_3	2.73	0.00	87.81	164.00	76.19
S_3N_4	2.72	0.17	87.81	163.00	75.19
S_4N_1	3.17	0.00	87.09	126.67	39.58
S_4N_2	2.93	0.00	87.09	124.33	37.25

Contd.

Table 37. Continued

Treatment	Suckers (Nos.)	Flowers (Nos.)	Expenditure (Rs.)	Receipt (Rs.)	Net profit (Rs.)
S_4N_3	3.37	0.00	87.09	143.67	56.80
S_4N_4	2.92	0.00	87.09	135.00	47.91
CD(0.05)	-	-	-	-	-
S x G interaction					
S_1G_1	3.75	0.00	89.04	225.00	135.78
S_1G_2	4.13	0.00	89.37	247.50	158.12
S_1G_3	4.15	0.00	89.15	249.00	159.60
S_1G_4	3.45	0.25	90.08	208.50	118.42
S_1G_5	2.50	0.25	88.76	151.50	62.74
S_1G_6	3.18	0.00	88.80	190.50	101.70
S_2G_1	3.68	0.00	88.33	220.50	132.17
S_2G_2	3.07	0.00	88.66	184.50	95.84
S_2G_3	3.50	1.75	88.68	220.50	131.82
S_2G_4	3.70	0.00	89.36	222.00	132.64
S_2G_5	2.67	0.75	88.04	165.00	76.96
S_2G_6	2.43	0.50	88.08	148.52	60.42
S_3G_1	3.40	0.00	87.66	204.00	116.34
S_3G_2	3.15	0.25	87.94	190.50	102.56
S_3G_3	2.65	0.00	87.96	159.00	71.04
S_3G_4	2.95	0.25	88.64	177.00	88.36
S_3G_5	2.08	0.00	87.32	124.50	37.18
S_3G_6	2.15	0.50	87.36	132.00	44.64
S_4G_1	3.25	0.00	86.89	130.00	43.26
S_4G_2	3.05	0.00	87.22	130.00	42.78
S_4G_3	3.05	0.00	87.24	151.00	63.76
S_4G_4	3.07	0.00	87.92	135.00	47.26
S_4G_5	2.93	0.00	86.60	117.00	30.40
S_4G_6	3.02	0.00	86.64	131.50	44.86
CD(0.05)	-	-	-	-	-
N x G interaction					
N_1G_1	3.50	0.00	87.98	196.00	107.84
N_1G_2	3.60	0.00	88.29	200.00	111.70
N_1G_3	3.38	0.25	88.32	188.50	100.18
N_1G_4	3.55	0.00	89.00	195.50	106.50
N_1G_5	2.48	0.00	87.68	133.00	45.32
N_1G_6	2.50	0.75	87.72	138.00	50.28

Contd.

Table 37. Continued

Treatment	Suckers (Nos.)	Flowers (Nos.)	Expenditure (Rs.)	Receipt (Rs.)	Net profit (Rs.)
N_2G_1	3.45	0.00	87.98	191.50	103.52
N_2G_2	3.38	0.25	88.30	187.50	99.20
N_2G_3	3.25	1.00	88.32	184.50	96.18
N_2G_4	3.05	0.25	89.00	168.50	79.50
N_2G_5	2.38	0.00	87.68	129.50	41.82
N_2G_6	2.43	0.25	87.72	147.00	59.28
N_3G_1	3.65	0.00	87.98	199.00	111.17
N_3G_2	3.35	0.00	88.30	184.50	96.20
N_3G_3	3.45	0.00	88.07	207.00	118.68
N_3G_4	3.35	0.00	89.00	185.00	96.18
N_3G_5	2.73	0.00	87.68	147.00	59.32
N_3G_6	3.07	0.00	87.72	166.00	78.28
N_4G_1	3.48	0.00	87.98	193.00	105.02
N_4G_2	3.28	0.00	88.30	180.50	92.20
N_4G_3	3.28	0.50	88.32	199.50	111.18
N_4G_4	3.23	0.25	89.00	193.50	104.50
N_4G_5	2.60	1.00	87.68	148.50	60.82
N_4G_6	2.78	0.00	87.72	151.50	63.78
CD(0.05)	-	-	-	-	-

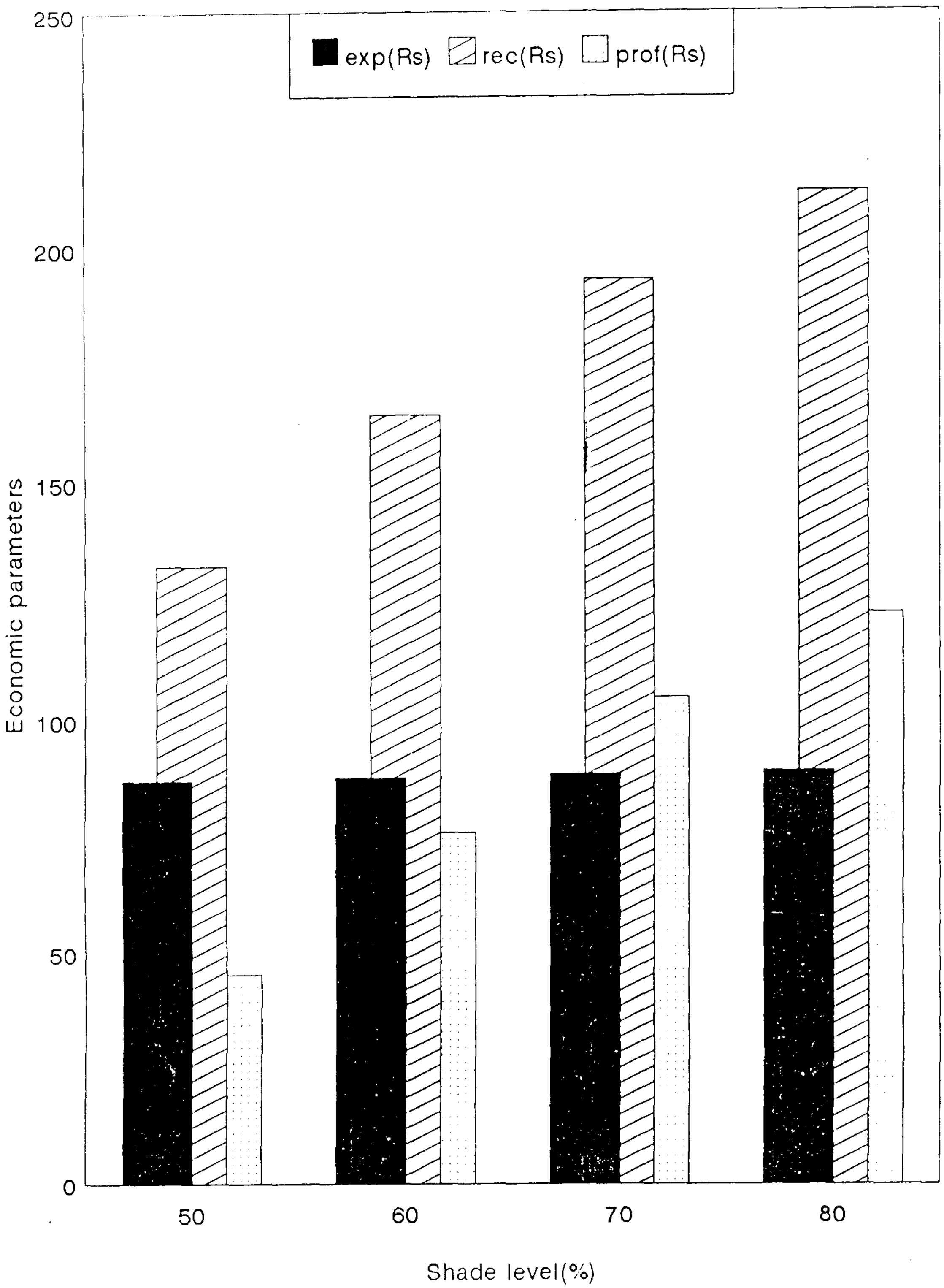


Fig.12. Economics of cultivation of *A. andreanum* 'Hawaiian Red' as influenced by shade

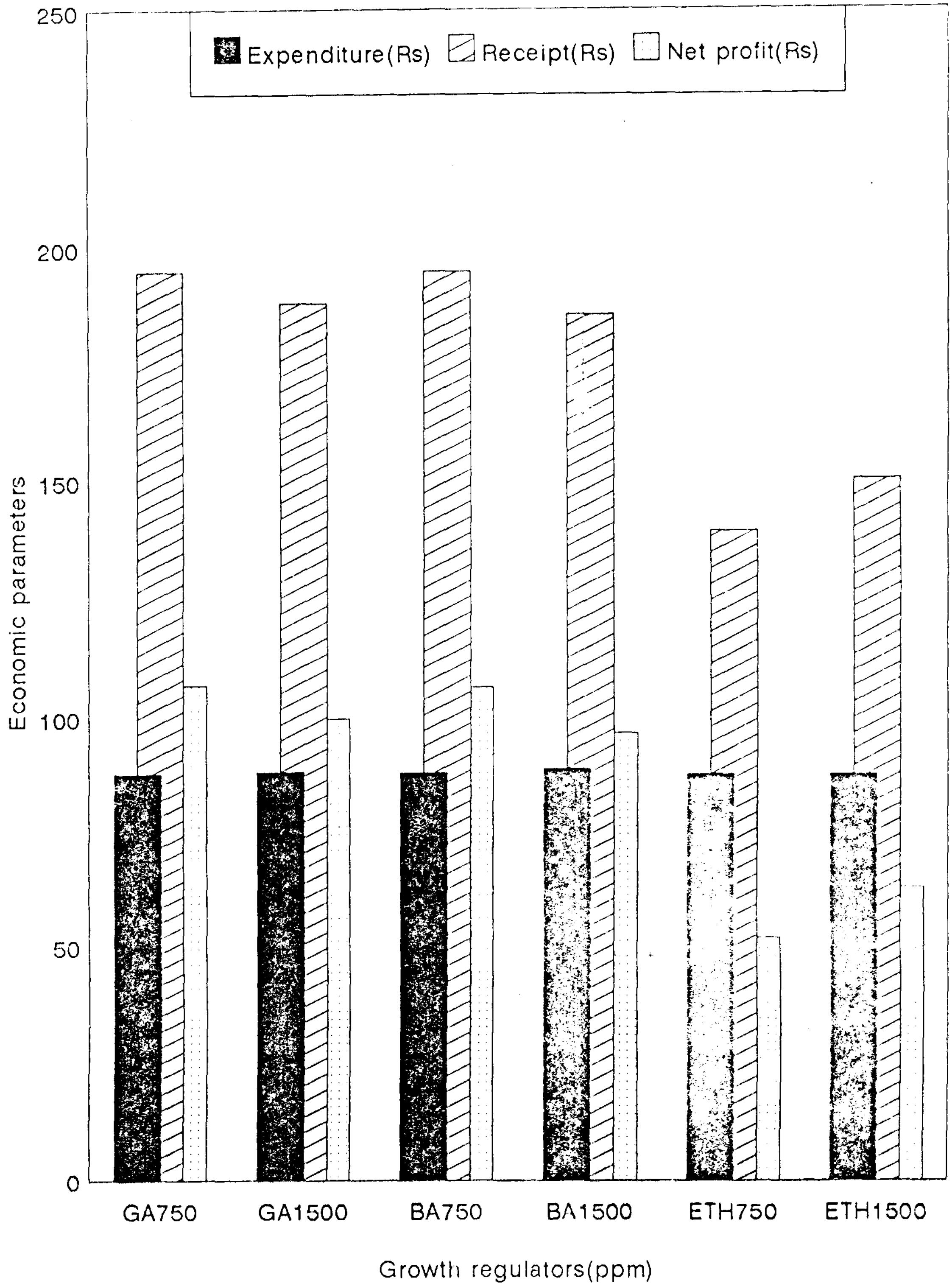


Fig.13. Economics of cultivation of *A. andreanum* 'Hawaiian Red' as influenced by growth regulators

The growth regulators tried also influenced the receipts realized significantly. Both the concentrations of GA and BA were significantly superior to both the concentrations of Ethephon and were on par with each other; with the lower concentration (750 ppm) of GA and BA recording equal amount of the receipts (Rs.194.88) per pot.

The net profit gained was significantly different under different shade levels and growth regulators, but was not influenced by nutrients and their respective interactions.

The maximum net profit was drawn from the plants grown under 80 per cent shade; Rs.122.73 per pot which was significantly superior to 60 and 50 per cent and was on par with 70 per cent. With the decline in shade, there was a clear trend of decrease in the number of suckers, reducing the net gain also. Considering the effect of growth regulators alone, 750 ppm GA and BA recorded the maximum net profit Rs.106.89 and 106.56 respectively. The treatment combination of 80per cent shade + Ohio solution + 750 ppm BA ($S_1N_4N_3$) recorded the maximum number of suckers (4.9), receipts (Rs.294.00) and net profit (Rs.204.60) per pot compared to all the other treatment combinations (Appendix 28), while the control under 60 per cent shade ($S_3N_0G_0$) recorded the lowest sucker production (1.7). The receipts (Rs.100.00) and net profit (Rs.13.44) were the lowest in the ontrol under 50 per cent shade ($S_4N_0G_0$).

Discussion

DISCUSSION

The results of the experiments conducted to optimize the levels of shade, nutrients and growth regulators to improve growth, to increase cut flower production and post harvest longevity of anthurium are discussed in this chapter.

Anthurium which has gained importance as a major cut flower of the modern world, belongs to the family Araceae and is an important tropical ornamental plant cultivated for its long lasting flower. The present experiment was intended to find out the otpimum shade level for growth, flowering and quality of flowers in this important commercial crop and to study the effects of foliar application of nutrients and growth regulators to enhance growth, reduce the juvenile phase and enhance the yield and quality of flowers. Studies were also conducted with an intention to standardise the proper stage of harvest and extend the vase life of cut flowers using various pulsing and holding solutions.

Anthurium requires warm greenhouse with shading from direct sunshine and a humid condition. In commercial practice, it is grown under partial shade. The intensity of light affects the morphological characters, flower production and quality of flowers. The range of light intensity required for plant growth is between 2000-6000 lux. The unsuitable growing conditions stimulate the development of abnormal spathe and spadix and reduced the productivity of the plant (Steen and Vijvosberg, 1973 and Leffering, 1975). Light intensity is an important factor regulating the bloom count also. The growth rate increased and average flower production rose from 5 to 12 flowers per plant when the plants were shaded so as to receive at least 45 per cent of available light. Commercially anthuriums are grown under 75 per cent shade in Hawaii (Higaki and Poole, 1978). Four shade levels (80%, 70%, 60% and 50%) were employed in the present study to evaluate their influence on growth and flowering of anthurium plants.

Anthurium needs adequate amount of fertilizers for proper growth and flowering. Among the major elements N, P, K and Ca markedly improve the yield and quality of flowers. Higaki and Poole (1978) recommended 14:14:12 complex fertilizer for *Anthurium andreanum* var. 'Ozaki' so as to get 448 kg N/ha/year. Singh (1987) suggested 16:16:16 complex fertilizer so as to supply 341 kg N/ha/year. Plants respond well to foliar application of fertilizers and in Hawaii, where anthurium is a major cut flower, this practice is increasing in popularity. Weekly (Boertje, 1978) and monthly (Higaki and Poole, 1978 and Nikado, 1994) applications have been recommended. Taking into account these factors, four different nutrient solutions, one the commonly used fertilizer complex (17:17:17) 1 per cent, and the Hoagland, Knop's and Ohio solutions with their full strength sprays at weekly interval were used in the present study.

Plant growth regulators are being increasingly used in anthurium and other flowering ornamentals for increasing growth, sucker production, reducing juvenile phase and for improving flower yield and quality. Anthurium inflorescence is normally produced by dominant central stem initially, and later, by lateral stems. Cultivars with many lateral shoots, while desirable for pot culture, tend to flower later than those with strong apical dominance. Stimulating earliar flowering of lateral shoots could result in shorter flowering time and higher flower counts. Light intensity and GA_3 concentrations are important in regulating anthurium flower counts (Leffering, 1975 and Henny and Hamilton, 1992). Foliar sprays of BA and

GA_3 increase the number of lateral buds developing in juvenile plants. The results of previous studies indicated that concentrations of GA_3 500 ppm and BA 1000 ppm may be more effective in juvenile plants for lateral shoot production (Higaki and Rasmussen, 1979 and Imamura and Higaki, 1988). Similar results were earlier reported with Ethephon also (Higaki and Rasmussen, 1979). Hence the present study aimed to find out the suitable concentration of growth regulator to produce anthurium plants with more number of suckers, early flowering, improved yield and better quality. Three growth regulators, viz., GA, BA and Ethephon with two concentrations each (750 ppm and 1500 ppm) were used for this purpose.

An export oriented variety, 'Hawaiian Red' was used for the study.

5.1 Influence of shade, nutrients and growth regulators on plant characters

The overall quality and productivity of anthurium plant is best determined by plant height, spread, number and size of leaves, number of suckers and branches; and number and size of flowers. Shade, nutrients and growth regulators were found to influence these characters in the present study.

5.1.1 Plant height

Plant height was significantly influenced by shade, nutrients and growth regulators. Shade has influenced height throughout the experimental period except in the first and last months. Considering the effect of shade alone, the maximum height per plant (5.68 cm) was recorded in 80 per cent shade. Percentage increase in height was maximum during pre-monsoon season and in the rest of the period, it was uniform under all the shade levels. These results are in conformity with the reports of Nakasone and Kamemoto (1962), Vonk Noordegraff (1968), Leffering (1975) and Lalithabai (1981) who reported that plant height increased with increasing shade intensities. As the shade intensity was higher, the amount of light received by the plants was quantitatively less. Plants exhibit basically two responses to shade. The "shade avoiders" generally tend to redirect their development in shade such that internode extension is favoured at the expense of leaf development, thereby allowing the young leaves to be kept out of shade (Smith, 1982). So the possible reason for increase in height of anthurium plants under higher shade intensity is the response to reductions in the total fluence rate (constant spectrum). Reduced light levels caused increased stem extension as a shade avoidance reaction, as in other plants.

In the second, third, sixth and seventh months of the experiment, height was influenced significantly by different nutrients. Fertilizer complex (17:17:17) recorded better height (5.46 cm) and was significantly superior to Hoagland, Knops and Ohio solutions. These results are in line with the reports of Bik (1976), Boertje (1978) and Nikado (1994), who reported increase in height in plants which have received optimum dose of N for their proper growth. In this experiment, optimum dose of N, P, K might have given by 1 per cent fertilizer complex, compared to other nutrient solution.

In anthurium, it has taken 8 months for growth regulators to show their significant influence on height of the plants. BA 750 ppm, which recorded the maximum height (6.11 cm) was the best compared to GA and Ethephon. The reports of Imamura and Higaki (1988) in anthrium and Shedeed *et al.* (1991) in aster, regarding the use of GA and BA are in line with the present findings. Cytokinins, most of them being adenine derivatives, are root produced regulators and oppose certain actions of ethylene, such that, they promote cell division and anabolic metabolism (Bruinsma, 1985). In the present studies, the application of BA must have led to increase in cell division, thereby increasing plant height.

5.1.2 Plant spread

Spread of the plant in EW and NS directions was significantly influenced by shade, while nutrients and growth regulators, failed to influence plant spread. Eighty per cent shade recorded the maximum plant spread in EW and NS directions having values 20.13 and 19.80 cm, respectively. The treatment combination of 80 per cent shade + Ohio solution + 1500 ppm BA recorded the maximum spread in NS, while, plant spread in EW direction was maximum under the treatment combination of 80 per cent shade + fertilizer complex + 750 ppm BA (28.7 cm). These results are in agreement with the reports of Nakasone and Kamemoto (1962) who found the optimum performance of anthurium under 75 per cent shade. These results are also in conformity with the earlier findings that under higher shade intensity, plant exhibits response as "shade avoiders", thereby favouring extension towards light and allowing the young leaves to be kept out of shade (Smith, 1982). The enhanced effect in combination with BA, due to its influence on cell division, further strengthenes this theory.

5.1.3 Number of leaves

The number of leaves produced per plant throughout the experimental period was significantly influenced by shade. Maximum number of leaves per plant was produced by 80 per cent shade (14.03). These results are in agreement with Smith (1982) who reported the plants alternative strategic response, employed by the "shade tolerators" which comprises of a transition to a highly conservative utilization of resources, commonly accompanied by structural and biochemical changes which enhance the efficiency of photosynthetic energy transduction and reduce respiratory losses.

Nutrients have not influenced leaf production significantly, and the effects of growth regulators were manifested only after five months. BA 750 ppm produced the maximum number of leaves per plant at the final stage of the experiment (14.02). Imamura and Higaki (1988) had reported earlier that both BA and GA_3 applications increased shoot development of juvenile anthurium plants. This might be the possible reason for the higher leaf production per plant as there are more number of shoots per plant, there are more number of leaves too. Higher shade intensity (80%) in combination with Ohio solution produced more number of leaves (18.03) during the last five month-period (December-April). These results are in conformity with that of Klapwijk and Spek (1988) who reported high leaf production around April in anthurium. The combination of the three favourable factors, 80 per cent shade + Ohio solution + 750 ppm BA, was the best (26.20) for leaf production compared to all the other combinations. These results are in line with those of Higaki and Rasmussen (1979) who obtained increased leaf production in anthurium by treating with BA.

5.1.4 Petiole length

The different shade levels and growth regulators significantly influenced the petiole length. Eighty per cent shade recorded maximum petiole length (9.29 cm). This might be possibly deu to the "shade avoider" response of plant to shade, leading to the extension of petiole (Smith, 1982). BA 750 ppm recorded the maximum petiole length (10.79 cm). As cytokinin causes cell division in plants, this must have led to increase in petiole length. These results are in line with the reports of Vonk Noordegraff (1968), but Imamura and Higaki (1988) could not find shoot elongation by BA application. The treatment combination of 80 per cent shade + Ohio solution + 1500 ppm BA recorded the maximum petiole length (14.00 cm).

5.1.5 Length and breadth of leaf

Leaf length and breadth were significantly influenced by the different levels of shade and growth regulators. Highest shade intensity (80%) recorded the maximum leaf length (7.76) and breadth (5.93 cm). These findings confirm the reports of Smith (1982) that response of "shade tolerators" lead to highly conservative utilization of resources, commonly accompanied by enhancement of photosynthetic energy, there by increase in leaf length and breadth, thereby increase in leaf area, for more photosynthesis. With decline in shade intensity, considerable decrease in length and breadth of leaves was observed.

BA 750 ppm recorded the maximum leaf length (8.33 cm) and breadth (6.49 cm). These results are in agreement with the theory put forth by Kulaeva (1979) that the treatment with BA stimulated growth of cotyledonary leaf of pumkin and led to the development of subcelluar structure. The treatment combinations did not differ significantly with respect to this character.

5.1.6 Leaf area

The different levels of shade and growth regulators have significantly influenced the index and total leaf area of the plants. The effect of nutrients did not differ significantly. With decline in shade intensity, leaf area also decreased significantly. The highest shade intensity (80%) recorded the maximum index leaf are (50.75 cm^2) and total leaf area (423.25 cm^2). The theory of "shade tolerator" response of plant leading to highly conservative utilization of resources and more photosynthesis, thereby producing more leaf area applies here also (Smith, 1982).

BA 750 ppm recorded the maximum index leaf area (59.60 cm^2) and total leaf area (517.56 cm^2) which is supported by the reports of Kulaeva (1979) that BA stimulates growth and Bruinsma (1985) that cytokinin caused cell division and promotes mobilization of protein and fat, which might have resulted in the maximum leaf area due to BA sprays during the present experiment. This clearly indicates that to have plants with broader leaves better to apply higher shade intensity with higher concentration of BA.

5.1.7 Number of branches

Anthurium plants started branching at the age of ten months, after six months of imposing treatments. Plants receiving higher shade intensity started branching one month earlier than the others. Eighty per cent shade level was the best for maximum branching (2.29 branch/plant). The present findings indicate that increased branching with reduced light levels prove that R:FR perception is important in shade acclimatization. According to Vinze-Prue (1977) reponse to low R:FR which is analogous to those of the shade avoiders, lead to reduced branching. This indicates that the response of anthurium is that of shade tolerators. These results are in line with the reports of Swapna (1996) on better shoot production in Philodendron, a shade loving plant, under 75 per cent shade.

Different nutrients tried did not differ significantly in the present experiment, but fertilizer complex at 1 per cent level recorded higher number of branches per plant compared to other nutrient solutions. GA 750 ppm was the best for more branching (2.37) among growth regulators. These results confirm the findings of Imamura and Higaki (1988) who reported that increasing concentration (0 to 500 ppm) of GA_3 showed an increase in lateral shoots of anthurium. This is due to the fact that GA has been involved in both cell division and cell elongation and can promote meristematic activity in whole plants (Jones, 1979). In the present studies, GA might have enhanced bud development in anthurium which led to more branching. The treatment combination of 80 per cent shade + fertilizer complex + 1500 ppm GA recorded the maximum branching (3.8).

5.1.8 Number of suckers

Though different shade levels and nutrients tried did not influence sucker production significantly, 80 per cent shade and Ohio solution showed comparatively better response. Growth regulators had significant influence on sucker production. BA 750 ppm produced maximum number of suckers (1.35) per plant. This is in line with the earliar findings of Imamura and Higaki (1988) who has found increase in number of lateral shoots with increase in concentration (0 to 1000 ppm) of BA in topped and intact plants of anthurium. Similar results were also reported by Higaki and Rasmussen (1979). The suckers have independant shoot and root system and BA has a prominant role in sucker production. This growth regulator, belonging to cytokinin group, is a root produced regulator which promote cell division and anabolic metabolism (Bruinsma, 1985). This might be the reason for more sucker production, by BA, while more branching was induced by GA. The treatment combination of 80 per cent shade + Ohio solution + 750 ppm BA produced the maximum number of suckers (2.5) per plant.

5.1.9 Growth behaviour

The growth behaviour of anthurium plants under varying environmental and cultural conditions has received very little attention and concern, so there is little scientific information available. To study the growth behaviour of anthurium plants under different levels of shade, nutrients and growth regulators, five important growth parameters viz., plant height, number of leaves, leaf area, number of suckers and number of branches produced per plant were selected and analysed using linear and compound growth models. Linear equations were drawn to compare the growth characteristics under the best treatments.

Analysis of growth rate of anthurium plants based on the important biometrical characters, viz., plant height, number of leaves, leaf area, number of suckers and branches produced during the experimental period revealed the maximum linear increase in plant height, number of leaves and leaf area per plant, by the application of the treatment combination of 80 per cent shade + Ohio solution + 750 ppm BA ($S_1N_4G_3$). The growth rate of $S_1N_4G_3$ combination was the best (13.50%) for number of leaves and with respect to other characters, it has shown consistent and positive progressive growth rate as compared to all the other treatment combinations. Some of the treatment combinations though, have shown superior growth behaviour in one or the other character, lack consistency in growth progress when all the five characters are considered together. With respect to the number of suckers and branches produced per plant, this combination though was not the best with respect to growth rate, the growth progress under this treatment was positive and comparatively better under all the other treatment combinations.

The treatment combination involving 80 per cent shade + Ohio solution + 1500 ppm BA ($S_1N_4G_4$) has also recorded growth behaviour equally good to that of 80 per cent shade + Ohio solution solution + 750 ppm BA ($S_1N_4G_3$). But considering the high cost of BA, the application of its higher concentration will not be beneficial. In general, 80 per cent shade level combined with both the concentrations of BA has shown consistent growth behaviour.

Present findings with respect to growth behaviour are similar to those reported by Higaki and Rasmussen (1979). They have reported consistent increase in the number of lateral buds developing on juvenile plants by the application of BA (>1000 ppm). Similarly, Imamura and Higaki (1988) have reported a linear increase in the number of shoots produced in topped plants with increasing concentration (0 to 500 ppm) of GA_3. The linear trend evident from the graphs (Fig.4) confirms their reports.

5.1.10 Fresh weight, dry matter content and shoot:root ratio

Dry matter production in anthurium plants under the influence of different levels of shade, nutrients, growth regulators and their interactions was necessary to study the proportion of different plant parts contributing to the whole plant dry matter and how it influences the shoot:root ratio. Anthurium plant is highly suckering in habit and under favourable agrotechniques, the photosynthetic material will be best utilized for higher sucker production and flower production. In this context, the present studies assume significance.

Fresh weight of whole plant was significantly influenced by the different levels of growth regulators only. BA 750 ppm recorded the maximum (27.52 g) fresh weight of whole plant, leaves, petiole and root. Since cytokinin is known to mobilize protein and fat and activate a number of enzymes participating in a wide range of metabolic reactions associated with protein synthesis (Kulaeva, 1979), it might have resulted in higher biomass production.

Different levels of shade, nutrients and growth regulators significantly influenced dry weight of plant. Sixty per cent shade was significantly superior with respect to dry matter production of whole plant (4.21 g). This may indicate that the optimum level of shade lies somewhere near 60 per cent to get maximum biological yield. But, the maximum leaf area was obtained under 80 per cent shade in the present study. According to Yoshida (1972) the area of leaf surface that intercepts solar radiation is the most important factor, and the photosynthetic efficiency of leaf per unit area is of secondary importance.

Ohio solution was significantly superior (4.26 g) in promoting dry weight of the whole plant. Possibly this is because the plants received N in nitrate form. Changes in the activity of nitrate reductase might have caused increase in biological yield (Whitelam *et al.*, 1979). BA 750 ppm was significantly superior (4.80 g), since cytokinin leads to cell division. This must have increased the number of cells per unit area of plant surface, thereby increasing the quantity of biological yield.

Only growth regulators significantly influenced the dry weight of leaves. BA 750 ppm recorded the maximum (1.66 g) dry weight of leaves. As mentioned earlier, BA has ultimately led to the increase in photosynthetic activity of leaf surface and storage of food material, thereby producing higher biological yield (Kulaeva, 1979).

Only different levels of growth regulators significantly influenced the fresh weight of petiole. BA 750 ppm has recorded significantly superior value (2.72 g). Dry weight was significantly influenced by different levels of shade, nutrients and growth regulators. Sixty per cent shade, 1 per cent fertilizer complex and BA 750 ppm recorded the maximum values of dry weight of petiole.

Fresh weight of roots was significantly influenced by growth regulators only. Among them, BA 750 ppm was the best (15.22 g). As anthurium has suckering habit, and the plants having this character with slow growth rate and low sucker production, divert their excess food material towards the roots. This has led to the increase in weight of fresh roots. Treatment combination of 60 per cent shade + 1 per cent fertilizer complex + 750 ppm BA recorded the maximum (44.85 g) fresh weight of roots. The shade levels, nutrients, growth regulators and shade x nutrient interaction had significant influence on dry weight of roots. Sixty per cent shade (2.48 g), Ohio solution (2.75 g) and BA 750 ppm (2.63 g) individually, recorded the maximum dry weight of roots. The treatment combination of 60 per cent shade + Ohio solution + 1500 ppm BA recoreded the maximum (0.64 g) dry weight of roots.

Whole plant dry matter percentage was significantly influenced by the different levels of shade, nutrients and shade x nutrient interactions. Dry matter per cent value was highest under 70 per cent shade (19.25%), Ohio solution (21.41%) and 70 per cent shade x Ohio solution (26.38%). This is in agreement with the reports of Smith (1982) that low R:FR ratio simulating the quality of shade and light, led to increase in stem dry weight and changes in activity of nitrate reductase. The maximum dry matter percentage (40.16%) was obtained under the treatment combination of 60 per cent shade + Ohio solution + 750 ppm BA.

The different shade levels, nutrients and shade x nutrient interactions significantly influenced the dry matter percentage of roots. Maximum values of 22.97, 25.72 and 35.17 percentage were recorded by 70 per cent shade, Knop's solution and 70 per cent shade x Ohio solution, respectively. The treatment combination of 70 per cent shade + Knop's solution + 1500 ppm BA recorded the highest (39.97%) percentage of root dry matter. This clearly indicates for better dry matter production optimum shade level lies between 60 to 70 per cent with nitrate nitrogen source of fertilizer and BA for promotion of metabolic activity.

The shoot:root ratio on fresh weight basis was significantly influenced only by different levels of nutrients. Maximum being recorded by Knop's solution (1.11). The maximum ratio was recorded (1.53) by treatment combination of 80 per cent shade + Knop's solution + 1500 ppm GA.

The shoot:root ratio on dry weight basis was significantly influenced by different levels of shade, nutrients and shade x nutrient interactions. The maximum values of 1.03, 1.10 and 1.54 were recorded under 80 per cent shade, fertilizer complex and 50 per cent shade x Hoagland solution interaction respectively. The treatment combination of 80 per cent shade + Knop's solution + 750 ppm Ethephon recorded the maximum value (2.15) among the different combinations. These findings are in agreement with the report of Smith (1982) that the plant response as "shade tolerators" comprises of a transition to highly conservative utilization of resources and therefore can be considered to be acclimative in nature.

5.2 Leaf characters as influenced by shade, nutrients and growth regulators

In anthurium, under normal growing conditions, every leaf produces one flower which ultimately decides the yield. So, the study of leaf characters which indirectly influence flower production is important. Similarly, the studies on stomatal characters are important in relation to the response of plants to stress, light intensity, temperature and hormonal levels.

The different shade levels and growth regulators significantly influenced the LAI. Maximum (0.43) LAI was recorded under 70 per cent shade and BA 750 ppm (0.51). The treatment combination of 70 per cent shade + 1 per cent fertilizer complex + 1500 ppm BA recorded the maximum value (0.89) for leaf area index. It seems that 70 per cent shade is sufficient and optimum for anthurium plants to receive stable quantity of reduced light and required fluence rate thereby leading to leaf development and maintenance of leaf area (Smith, 1982). This resulted in increased photosynthesis with increasing LAI (Yoshida, 1972).

Specific leaf weight (SLW), number of days from leaf emergence to unfurling and unfurling to maturity were not influenced by the different shade, nutrients and growth regulators tried, while, the period from leaf maturity to senescence, significantly varied. Sixty per cent shade was significantly superior (124.42 days) among shade levels; among nutrients Ohio solution was the best (125.46 days); among growth regulators, BA 1500 ppm (127.44 days), and among the treatment combinations, 70 per cent shade + 1 per cent fertilizer complex + 750 ppm BA was the best (137.00 days). The possible explanation for the present findings that the optimum shade level lies in between 60 to 70 per cent for these characters is that, the stable fluence rate is at this shade level for leaf development and photosynthetic activity which is supplemented with nitrate N source from Ohio solution. In addition to this, BA is well known as a root produced regulator which opposes certain actions of ethylene and promote cell division and anabolic metabolism and postpones symptoms of senescence (Brunsma, 1985).

Nutrients, growth regulators and shade x nutrient interaction recorded significant influence on total leaf longevity. Ohio solution recorded the maximum longevity (149.46 days) and BA 1500 ppm was the best (152.81 days), among the growth regulators. The interaction of 60 per cent shade x Ohio solution was better with longevity of 152.83 days. The treatment combination of 70 per cent shade + 1 per cent fertilizer complex + 750 ppm BA recorded the maximum total leaf longevity (161.00 days). The period between leaf maturity and senescence seems to have a major role in total longevity of the leaf. Hence the explanation that 70 per cent shade supplies steady fluence rate and BA delays senescence thereby increasing the total longevity of the leaf, applies to this also.

In anthurium, the newly emergent, unfurled leaf is soft, tender and green upper surface. During the stage of unfurling to maturity, it gradually gets thicker and hard and, as the chlorophyll content increases, it turns dark green in colour. The total duration of the leaf ranges between 4 and 6 months (Mercy and Dale, 1993). As the aging starts, yellow patches appear on the leaf, margins become necrotic, leaf surface turn rough and dry, and within a short span of 3 to 5 days, senescence takes place.

Different shade levels, nutrients and growth regulators did not influence the stomatal distribution and size significantly. The maximum stomatal index (18.37) was seen under the treatment combination involving 80 per cent shade + 1 per cent fertilizer complex + 1500 ppm BA. The length of stomata ranged between 171 to 207 μ and the breadth, between 63.00 to 83.40 μ. These results are in line with the reports of Bindu (1992) who studied the stomatal distribution and the size of five commercially important anthurium varieties.

The number of leaves senescence per plant was significantly influenced by different levels of shade, growth regulators and shade x nutrient interaction during different months of the experimental priod. But there was no particular trend in nature of senescence under the different treatments.

5.3 Root characters

Anthurium produces aerial roots which absorb moisture and to some extent, nitrogen from atmosphere, besides providing anchorage. Information on the root distribution pattern is important for the effective application of fertilizers and for carrying out various cultural operations.

The different levels of shade, nutrients and growth regulators have significantly influenced the number of aerial roots produced by anthurium plants during the different months of the experimental period. The maximum total number of aerial roots (56.43) was produced under 80 per cent shade. As the intensity of shade declined, the aerial root production also decreased proportionately. Fertilizer complex sprays had significant superiority (0.62) over the other nutrient solutions and BA 750 ppm recorded the maximum number of aerial roots (6.31) per plant. As there was more leaf area under 80 per cent shade which led to more photosynthetic activity of plants, the excess food material is being transferred towards the development of roots also. Since BA is a derivative of the cytokinin group and its external application, in addition to its natural availability in the plant, might have resulted in the production of higher number of aerial roots by the plant.

The number of primary roots produced by the plant was significantly influenced by the different shade levels, growth regulators and shade x nutrient interaction. Maximum number of primary roots (11.13) was recorded under 80 per cent shade. Among growth regulators, BA 1500 ppm, (12.69) and among the interactions, S_1N_4 (13.67), recorded the maximum number of primary roots. The treatment combination of 80 per cent shade + Ohio solution + 750 ppm BA recorded the maximum (18.00) number of primary roots. The above treatments were also superior with respect to the number of secondary roots.

The different shade levels, growth regulators and shade x nutrient interaction had significantly influenced the length and spread of roots. Maximum root length (13.08 cm) was under 60 per cent shade, BA 1500 ppm (14.31 cm) and interaction S_3N_2 (15.33 cm). The treatment combination of 60 per cent shade + Ohio solution + 1500 ppm BA was superior (19.00 cm). Root spread was maximum (13.04 cm) under 80 per cent shade; BA 1500 ppm (14.00 cm) and interaction S_1N_4 (14.83 cm) compared to other treatments. The treatment combination of 60 per cent shade + Ohio solution + 1500 ppm BA recorded the maximum root spread (19.00 cm).

From the present findings, it is clear that the higher shade intensity favours the number and spread of roots. With respect to the absorption of nutrients, number and spread are more important than the length of roots. Among the growth regulators higher concentration of BA (1500 ppm) was better for the number and spread of roots.

5.4 Flowering pattern and inflorescence characters

Anthurium inflorescences are normally produced by a dominant central stem initially and later, by lateral stems. Cultivars with many lateral shoots, while desirable for pot culture, tend to flower later than those with strong apical dominance. Stimulating earlier flowering of lateral shoots could result in shorter production and higher flower counts. Therefore, the variations in the flowering pattern, time taken to start flowering, type and number of flowers produced per plant, duration of the different stages in inflorescence development, sizes of spathe, length of inflorescence stem and spadix, etc. as influenced by the different levels of shade, nutrients, growth regulators and their interactions were studied in detail. The results revealed that these parameters were not influenced by the treatments significantly.

The first flowering at the age of approximately eight months was noticed in the treatment involving 50 per cent shade in combination with 750 ppm GA. Approximately 30 days later, the plants under the other shade levels (80%, 70% and 60%) also started flowering. These findings are in agreement with the report of Smith (1982) that the seasonability of flowering and bud dormancy induction in nature is convincing evidance of the strategic value of light intensity. He further stated that application of gibberellins shortens the juvenile period in several plants, from many years to a few months. The older the plants, less gibberellin need be applied, which suggests that their juvenility may be due to a low level of endogenous gibberellins. It seems likely, therefore, that the presence of gibberellins is a prerequisite for floret evocation in all plants. The beneficial effects of gibberellins in flowering in ornamental plants have been reported earlier. Nakasone and Kamemoto (1962) reported that light intensity and GA_3 concentration are important factors in regulating anthurium bloom count. Dutta *et al.* (1993) reported early flowering in Chrysanthemum with GA_3 sprays and Suma (1993) reported that GA 50 and 100 ppm hastened flowering in Gerbera.

The production of small and few flowers initially during present studies is in line with the reports of Vonk Noordegraff (1968); Bik and Straver (1980) and Imamura and Higaki (1984).

The inflorescence of normal spathe and spadix were produced from the age of 13 months. There was a gap of approximately five months period between the production of stalkless and normal inflorescences. The normal inflorescences were first produced under 80 per cent shade followed by 70, 60 and 50 per cent shade levels. The interactions S_1N_4 (80 per cent shade x Ohio solution) and S_2G_3 (70 per cent shade x 750 ppm BA) produced comparatively better number of inflorescence and early flowering compared to other interactions. For the production of normal flowers higher shade intensity is a favourable factor.

The present findings of flowering pattern are in line with the earlier reports of Leffring (1975) who reported that *Anthurium andreanum* Linden produced more blooms when grown under higher light intensity, and also of Henny and Hamilton (1992) who reported flowering of anthurium following treatment with gibberellic acid (0 to 500 ppm).

The period between emergence of the two successive inflorescence was significantly influenced by shade. Among different shade levels, 70 per cent shade has recorded the maximum influence (43.96 days).

The various levels of growth regulators significantly influenced the period between inflorescence emergence to spathe unfurling. With respect to this, BA 750 ppm recorded the maximum period (16.88 days). GA has -recorded lower values. The possible reason for this might be that BA leads to cell division, while GA leads to cell elongation thereby leading to faster growth and development of inflorescence.

Different levels of growth regulator, influenced significantly the duration between spathe unfurling to its senescence also. BA 1500 ppm recorded the maximum duration (35.81 days). The treatment combination involving 80 per cent shade + Hoagland solution + 1500 ppm BA recorded the maximum period of 53 days between spathe unfurling and senescence. Similarly, the growth regulators also have influenced the inflorescence longevity in the field significantly. BA 1500 ppm recorded maximum longevity (59.44 days). Continuous cell division by BA application might have led to the increase in longevity. The treatment combination involving 80 per cent shade + Hoagland solution + 1500 ppm BA recorded superior longevity (86 days) among the treatment combinations. Similar trend in the different stages of inflorescence development was reported by Klapwijk and Spek (1984).

During the present investigation period of 18 months, plants in some of the treatments did not flower, probably because of the slow growth character of the variety (Hawaiian Red) selected for study. This confirms the report of Klapwijk and

Spek (1988) that some cultivars such as Hawaii show very slow bloom development but have yielded heavily.

Similarly, during the present studies, it was observed that, in general, flower development was irregular, this confirms the report of Vonk Noordegraff (1973) who reported that initially flower development is irregular and from a certain age of the plant, each leaf can produce a flower. Since the plants have only started flowering and yet to reach steady flowering stage, we are unable to draw conclusions of the effect of the treatments applied on flower production and quality from the present studies.

5.5 Pigment conent

Most of the reported evidences show that the concentration of chlorophyll per unit weight of leaf increases with shading, which ultimately influences the photosynthetic rate and plant growth to a considerable extent. Similarly, varying light intensities also influence flower colour which, in turn, determines the flower quality. Taking into account these facts studies were undertaken to know the influence of shade, nutrients and growth regulators on chlorophyll and anthocyanin content in anthurium.

The different shade levels and growth regulators have significantly influenced the content of chlorophyll, but nutrients and interactions did not differ significantly. Eighty per cent shade level recorded the maximum content of chlorophyll 'a' (3.86 mg g^{-1} fresh weight); 'b' (2.80 mg g^{-1} fresh weight) and 'total' (6.66 mg g^{-1} fresh weight); while chlorophyll 'a' was highest under Ethephon 750 ppm, Chlorophyll 'b' and total chlorophyll were maximum under Ethephon

1500 ppm, 2.94 mg g^{-1} fresh weight and 6.6 mg g^{-1} fresh weight, respectively. The highest Chlorophyll 'a' content was under the treatment combination involving 70 per cent shade + Ohio solution + 750 ppm Ethephon (6.0 mg g^{-1} fresh weight), Chlorophyll 'b' content was the highest under treatment combination involving 60 per cent shade + fertilizer complex + 750 ppm Ethephon (3.7 mg g^{-1} fresh weight) and total chlorophyll was the highest under the treament combination involving 60 per cent shade + Ohio solution + 750 ppm Ethephon (8.8 mg g^{-1} fresh weight).

There was a clear trend of decrease in chlorophyll content with the decreasing intensity of shade, when the effect of shade alone was considered. Similar results were also reported by some of the earlier workers in different crops, viz., cocoa (Guers, 1971); pineapple (Radha, 1979); coconut intercrops (Lalithabai, 1981); and Philodendron (Swapna, 1996).

Chlorophyll 'b' is formed from chlorophyll 'a' in the dark by thermo-chemical action. The illumination allows labelling of chlorophyll 'a', but, it is not necessary for transformation of chlorophyll 'a' into chlorophyll 'b'. The balance between formation and degradation determines the amount present in the leaves. It is more reasonable to assume that chlorophyll 'a' and 'b' are formed concurrently from some common precursor than to assume that chlorophyll 'b' is formed from chlorophyll 'a'. The reaction is probably an oxidation and the acting enzymes is controlled by a specific gene. Chlorophyll biosynthesis is centred in the plastids (Shlyk, 1971). This fact supports the present findings with respect to the content of chlorophyll 'a', 'b' and 'total' in anthurium leaves at the flowering stage.

The different shade levels, nutrients and growth regulators as well as their respective interactions had not influenced the anthocyanin content significantly.

5.6 Leaf nutrient content

Horticultural practitioners have realized for decades that foliar application of fertilizers have potential benefits. We were interested in examining the leaf nutrient content and plant uptake dynamics of foliar applied nutrients (macro and micro) in anthurium for several reasons. First, little is known about the effectiveness of foliar nutrient applications in anthurium. Second, anthurium being a high value crop, many growers routinely apply foliar nutrients to nutrient-sufficient plants believing that this practice could be beneficial and economical, despite and emperical evidance. The objective of present experiment was to quantify the leaf nutrient content and plant uptake of macro and micro nutrients in anthurium to learn if sufficient nutrient could enter the leaf to make a physiological difference to plant.

Growth, differentiation and reproduction in higher plants can only proceed normally if the acquisition of all the essential elements is accomplished. Therefore, information about the critical leaf nutrient concentration and uptake of nutrients by plant constitutes a prominent part of the study.

The different levels of shade and growth regulators have significantly influenced N content in leaf. Eighty per cent shade recorded the maximum value (1.62%) and among growth regulators, BA 750 ppm recorded the maximum value (1.57%). The treatment combination of 60 per cent shade + Hoagland solution + 750 ppm Ethephon recorded the maximum (2.29%) for N content in leaf. These results are in confirmation with the reports of Higaki *et al.* (1992) who reported that N content in leaf of anthurium is between 1.70 to 2.11 per cent. The higher N content under 80 per cent shade and 750 ppm BA treatments is probably due to the higher photosynthetic rate which led to the better growth of plants and absorption of nutrients under these treatments.

None of the treatments significantly influenced the P content in leaf. The treatment combination involving 80 per cent shade + fertilizer complex + 1500 ppm Ethephon recorded the maximum P content (0.36%). This is in confirmity with the report of Higaki *et al.* (1992) who reported that P content in leaf varies from 0.21 per cent to 0.58 per cent.

The different levels of shade and shade x nutrient interactions have significantly influenced the K content in leaf. The maximum value was recorded under 80 per cent shade (1.96%). The interactions 70 per cent shade x Ohio solution (S_2N_4) and 60 per cent shade x fertilizer complex (S_3N_1) were superior with maximum value of K content in leaf (2.09%). These results are in line with the reports of Higaki *et al.* (1992) who reported that K content in anthurium leaf range from 2.05 per cent to 3.16 per cent. The treatment combination involving 60 per cent shade + fertilizer complex + 1500 ppm GA was superior (2.44%). This is further strengthened by the hypothesis that light may cause stomata to open and absorption of K^+ may be the primary mechanism of light stimulated stomatal opening (Lauchli, 1972).

Only under different shade levels, Ca content in the leaf was significantly different. Sixty per cent shade recorded the maximum Ca content (1.49%). The treatment combination of 60 per cent shade + Ohio solution + 1500 ppm Ethephon retained the maximum Ca content in leaves (2.79%). The present level of Ca content in leaf is higher than that reported by Higaki *et al.* (1992) they found the range of Ca content in leaf as between 0.46 per cent to 0.75 per cent. The higher Ca content in leaf might be due to the application of dolomite during experimental period and limited distribution of Ca^{++} from leaves because of its immobility in the phloem and the capacity of Ca accumulation by leaf tissues (Lauchli, 1972).

None of the treatments significantly influenced the Mg content in leaf. The treatment combination involving 70 per cent shade + Ohio solution + 750 ppm GA retained the maximum Mg content in leaf (0.82%). This level is higher than that reported by Higaki *et al.* (1992) (0.28 per cent to 0.35 per cent). The higher level of Mg may be due to the application of dolomite during experimental period.

Only the different levels of shade significantly influenced Cu and Mn content in leaves. The maximum Mn (470.63) and Cu (21.17 ppm) contents, respectively were recorded under 80 per cent shade. The treatment combination involving 70 per cent shade + Hoagland solution + 750 ppm GA recorded the maximum Mn content in leaves (819.00 ppm). The treatment combination 80 per cent shade + Knop's solution + 750 ppm Ethephon recorded highest Cu content (137.00 ppm).

Different shade levels and nutrients have significantly influenced the Fe content in leaves. Under 80 per cent shade, maximum retention of Fe was noticed (775.17 ppm), while Hoagland solution recorded superior Fe content in leaves (585.38 ppm). The treatment combination involving 80 per cent shade + Hoagland solution + 750 ppm GA recorded the highest Fe content in leaves (1381.00 ppm). Though Higaki *et al.* (1992) have mentioned about the analysis of Mn, Fe, Zn and Co in the second young mature leaf of anthurium, their level in leaves have not been discussed.

The different shade levels and shade x nutrient interactions have significantly influenced the sulphur content in leaves. Eighty per cent shade retained the maximum levels of S (150.42 ppm). With decline in shade intensity, there was proportionate decrease in the level of S in leaves. The interaction 60 per cent shade + fertilizer complex recorded superior S content (169.33 ppm). The treatment combination involving 80 per cent shade + Knop's solution + 750 ppm GA recorded the highest level of S in leaves (198.00 ppm). These results are in line with that of Higaki *et al.* (1992) who have reported that the critical level of S in leaves of anthurium ranged between 0.19 per cent to 0.21 per cent.

5.7 Nutrient uptake

Shade and growth regulators significantly influenced N uptake by plants. Eighty per cent shade, (0.53 g per plant) and BA 1500 ppm individually recorded the highest N uptake (0.53 g). The treatment combination involving 80 per cent shade + Ohio solution + 1500 ppm BA recorded the highest N uptake of 1.17 g per plant. This clearly shows that light not only has a controlling influence on ion transport in leaves by providing the energy for active transport across cellular membranes, also affects ionic movements through activation of the phytochrome system. The optimum light intensity required by the plant favours these reactions.

There was no significant difference in P uptake under the influence of different shade levels, nutrients, growth regulators and their respective interactions. While, K uptake was significantly influenced by different levels of shade and growth regulators. Eighty per cent shade recorded the maximum K uptake per plant (0.68 g), and among the growth regulators, BA 750 ppm recorded the highest K uptake per plant (0.65 g). The treatment combination involving 80 per cent shade +

Ohio solution + 750 ppm BA recorded the highest K uptake per plant (1.31 g). These findings are in agreement with that of Lauchli (1972) that light enhanced the rate of K^+ absorption by corn leaf tissue. He has proposed the hypothesis that the role of light might be to provide the energy for the enhanced uptake of K^+ through synthesis of ATP in cyclic photophosphorylation.

Shade and growth regulators significantly influenced Ca uptake by the plant. Eighty per cent shade recorded the maximum (0.43 g) Ca uptake per plant, while BA 1500 ppm was superior for Ca uptake (0.43 g) per plant. The treatment combination involving 70 per cent shade + fertilizer complex + 1500 ppm BA recorded the maximum Ca uptake by plant (0.87 g). There was no significant variation in Mg uptake by the plants under the influence of different shade levels, nutrients, growth regulators and their respective interactions.

The present results of nutrient uptake by the plant are in line with the reports of Sonneveld and Voogt (1993) who examined nutrient concentration in plant by analysing youg fully grown leaves of anthurium. During present findings, though the uptake of P and Mg was not influenced significantly, a similar trend of uptake of N, K and Ca by plants was followed. As the shade level declined, there was a proportionate decrease in uptake of these nutrients. Higher uptake of nutrients under 80 per cent shade and BA application explains the better growth of plants under these treatments.

5.8 Post harvest studies

Anthuriums are generally harvested when the spadix is fully developed. Pre harvest and post harvest factors influence the longevity of cut flowers.

Senescence is generally associated with the plugging of stem vascular tissues accompanied by the loss in weight, visible changes including spathe gloss loss, necrosis of spadix, blueing of spathe, stem collapse and abscission of spathe and spadix from the stem (Akamine, 1976).

Various growth regulators and floral preservatives are increasingly used in anthurium and other cut flowers to extend their vase life by pulsing and holding treatments. Pretreatments with silver nitrate soltuion (4 mg/l 40 min) is reported to increase the vase life by 40 to 60 per cent (Paull, 1987). Hence studies were undertaken to standardize the proper stage of harvest and to extend the vase life of anthurium flowers using various pulsing and holding solutions.

5.8.1 Stage of harvest and size of spathe

For better vase life and quality, the flowers should be harvested at the optimum development stage. Flowers harvested at immature stage do not develop properly in holding solution after harvest. If harvested late, flowes last only for a short duration. In the present study, it was seen that the stage of harvest and the size of the inflorescence influenced the vase life and other related parameters. Among the five stages of harvest with respect to the extent of opening of the true flowers on spadix, viz., unopened flowers, 1/3rd flowers opened, 2/3rd flowers opened 3/4th flowers opened and all the flowers opened, inflorescence with 1/3rd flowers opened on spadix showed optimum PLW, uptake of vase solution, change in pH and EC leading to the late initiation of spadix necrosis, longer period of gloss retention, and the maximum vase life. Such flowers with medium to large spathe, were better with respect to the above aspects than inflorecence with small spathe.

The minimum PLW (4.03 g) was in the inflorescence with 2/3rd flowers opened on spadix which was significantly superior to the other stages. The minimum PLW was recorded by inflorescence having small spathe (2.93 g) which was significantly superior over infloresence with medium and large spathe. The maximum uptake of vase solution was recorded in inflorescence having flowers 3/4th opened on spadix (19.00 ml) which was significantly superior over other stages of harvest of inflorescences. Similarly, significantly higher uptake was recorded in inflorescence having small size spathe (18.00 ml).

The maximum increase in pH (0.3) was caused by inflorescence having 1/3rd and all the flowers opened on spadix which was significantly superior over other stages of development of inflorescence. Similarly, inflorescence with small spathe recorded the maximum increase in pH (0.5) of the vase solution. The stage of harvest or size of spathe did not have any influence on the change of EC of the vase solution.

Spathe blueing was late in the inflorescence having 1/3rd flowers opened on spadix (after 22.33 days) and medium and large spathe (after 22.00 days). The gloss retention was significantly maximum (upto 20 days) under the stage of harvest with 1/3rd and 2/3rd flowers opened while it was significantly highest in inflorescence with medium and large spathes (upto 21.00 days). Inflorescence harvested with 1/3rd flowers opened on spadix recorded significantly highest vase life (23.33 days) and the medium and large spathes were significantly superior over small spathe which recorded highest vase life period of 23.00 days.

From the present findings, it is clear that the proper stage of harvest of anthurium inflorescence is when 1/3rd flowers opened on spadix and with medium to large spathe, so as to get the optimum physiological loss in weight, uptake of vase solution, change in pH and EC, which will lead to the late spathe blueing and spadix necrosis initiation thereby high gloss retention for a longer period and the extension of vase life of inflorescence to the maximum extent.

Present findings are in agreement with the report of Kamemoto (1962) that when 3/4th of the length of spadix had changed colour, large and medium sized flowers kept better. But our results do not fall in the line of results reported by Kalkaman (1983) who stated that vase life is the largest in flowers, cut when the spadix was almost competely white. This might be probably because cultivars also greately differ in their post harvest life.

5.8.2 Pulsing treatments

Pulsing is a short term treatment given to the cut flowers before packing and it improves the quality of cut flowers. Its effect normally lasts for the entire shelf-life of the flower, even when the flowers are held in water. In the present study, anthurium flowers were pulse treated with growth regulators and chemicals for 6 and 12 hours. The vase life could be improved from 8 days in control to 19 days in treatment with BA 50 ppm for 12 hrs.

The minimum PLW (1.13 g) was recorded by pulse treatment with BA 50 ppm for 12 hrs., which was significantly superior to the other pulse treatments and control. The uptake of vase solution was medium in this treatment, without any significant change in pH and EC. As a result initiation of spathe blueing and spadix necrosis were delayed in this treatment (after 19.00 and 19.00 days, respectively). This treatment also recorded the maximum retention (upto 18.00 days) of spathe gloss and maximum vase life (20.00 days) compared to the other treatments.

These results are in conformity with that of Shirakawa *et al.* (1964) who reported that pulse treatment with 10 ppm N-6-Benzyladenine, to anthurium cut flowers before shipment reduced the injury during shipment and extended the holding period of flowers. The treatment with BA is found to generally impart some tolerance to chilling injury and extend the usable period by reducing the respiration rate of flowers. Earlier reports of Paull and Goo (1982 and 1985); Paull *et al.* (1985) and Paull (1987) highlight the promising role of $AgNO_3$ in extending vase life of anthurium cut flowers. The present findings show that treatment with BA is superior to $AgNO_3$.

5.8.3 Holding solutions

The post harvest longevity of cut flowers could be extended to the maximum by keeping them in different holding solutions. In the present studies, holding solution with different chemicals and growth regulators were used to extend the shelf life of flowers.

There was no significant influence of different holding solutions on PLW. The minimum value was recorded by holding in 8-HQ 40 ppm. But the treatments significantly influenced the uptake of vase solution. Maximum uptake (35.00 ml) was recorded by Benzoic acid 500 ppm. The increase in pH was maximum in Bavistin 0.2 per cent (1.2) and the maximum increase in EC was observed in the treatment involving phosjet-40 0.2 per cent (1.65 mS g^{-1}).

Spathe blueing was delayed to the maximum extent under the treatment 8-HQ 30 ppm (after 26.00 days) and spadix necrosis, in BA 20 ppm, 8-HQ 30 and 40 ppm (upto 21.00 days), while, BA 20 ppm recorded the maximum period (23.33 days) of gloss retention. Vase life was maximum in 8-HQ 30 ppm (27.00 days), followed by BA 20 ppm (25.00 days) and Triadimefon 30 ppm (25.00 days).

Considering the above factors, BA 20 ppm, 8-HQ 30 ppm and Triadimefon 30 ppm are superior and equally good as holding solutions. The present findings are in line with the earlier reports of Shirakawa *et al.* (1964) on extending the vase life of anthurium by BA treatment and Larsen and Cromarty (1967) who stated that senescence of cut flowers caused by plugging of stem vascular tissues by microorganisms, could be inhibited by the use of 8-Hydroxyquinoline citrate.

In the present findings, the extension of vase life by 7 to 10 days over control might be due to the reduction in the rate of respiration of flowers induced by BA, inhibition of microorganism plugging by 8-HQ and reduction in the rate of respiration, transpiration and inhibition of microorganism injury by the use of triadimefon. These results confirm the use of various preservatives, chemicals and growth regulators as suggested by Akamine and Goo (1975) and Lee and Kim (1994) for the extension of shelf life of cut flowers.

5.8.4 Effect of pulsing and holding treatments

Taking into account the effect of various pulsing and holding treatments tried, efforts were made to further increase the vase life by combining the two.

Different combinations significantly influenced the uptake of vase solution, change in pH and EC, days to initiate spathe blueing and spadix necrosis and vase life of the inflorescence.

Minimum PLW was recorded by a combination involving 8-HQ 400 ppm pulsing for 6 hrs + holding in sucrose 5 per cent (2.13 g). The treatment combination involving BA 20 ppm + Bavistin 0.1 per cent holding was found to be superior with respect to late spathe blueing initiation (after 22.67 days), late spadix necrosis initiation (after 18.33 days), maximum gloss retention (upto 20.00 days) and maximum vase life of 23.67 days.

5.9 Economics

The 18 month period of the experiment was enough to meet the expenses incurred for anthurium cultivation with the additional net profit of Rs.17,528/- from the 400 m^2 area (1975 plants) used for the experiment with a spacing of 45 x 45 cm. With this spacing, approximately 49,400 plants can be accommodated per hectare which will fetch a net profit of Rs.4,38,200/- in just 18 month period. As the age of the plant advances, the expenditure on plant will comparatively be reduced and the margin of profit will increase to a greater extent because of the number of suckers and flowers produced per plant will be high.

Higher shade intensity (80 per cent) produced maximum number of suckers (3.53) per plant. Though GA 750 ppm recorded the maximum (3.52) number of suckers per plant, the quality (growth) of sucker produced by BA 750 ppm was superior to GA, thereby giving a better price. The number of flowers harvested within the limited period of experiment was not much, thereby attracting not much attention. Due to the higher price rates of growth regulators, the expenses differed significantly among the treatments.

The recepits realized per plant was high under 80 per cent shade due to the good quality and larger number of suckers produced. Similarly, BA 750 ppm recorded equally good amount of receipts to that of GA 750 ppm. After working out the net profit from expenses incurred and receipts realized, it was found that maximum net profit could be achieved by employing 80 per cent shade + GA 750 ppm or BA 750 ppm. The treatment combination of 80 per cent shade + Ohio solution + BA 750 ppm recorded the maximum number of suckers (4.9), maximum receipts (Rs.294.00) per pot and maximum net profit (Rs.204.00) per pot compared to all the other treatment combinations. Similar findings regarding high net profit in anthurium cultivation were reported by earlier workers (Singh, 1987 and Antoine, 1994). Based on the results of the present study, it is evident that anthurium cultivation is highly profitable in the tropical climate of Kerala.

The results of the present investigations have emerged with successful agro techniques for growing anthuriums under Kerala conditions. The different levels of shade, nutrients and growth regulators have significantly influenced the various growth parameters, viz., plant height, plant spread, leaf production, leaf area and the related parameters, branching and sucker production. The higher shade intensity (80%) has dominated with respect to the majority of the parameters studied during the present investigations. Though nutrients were on par with each other, fertilizer complex, due to its easy availability and ready formulations, could be preferred to spray on anthurium at 1 per cent level. Among growth regulators, both the levels of BA were significantly superior over GA and Ethephon. But considering the high cost, BA 750 ppm spray would be economical. As a treatment combination 80 per cent shade + Ohio solution + 750 ppm BA gave the best results for anthurium cultivation with respect to the better plant growth higher sucker production, early flowering and maximum net profit. This can be recommended for cultivation.

For maximum vase life of anthurium it is better to harvest the inflorescence at 1/3 flowers opened on spadix with medium to large spathe. Pulsing in BA 50 ppm for 12 hours extended the vase life to the maximum. Among holding solutions, 8-HQ 30 ppm, BA 20 ppm and Triadimefon 30 ppm were equally good with respect to high gloss with vase life. The present investigations also indicated the scope for further studies employing combination of growth regulators for maximum flower yield.

Summary

SUMMARY

The results of the investigations on optimization of shade, nutrient and growth regulator for cut flower production in *Anthurium andreanum* var. 'Hawaiian Red', carried out at the Department of Pomology and Floriculture, College of Horticulture, Vellanikkara, during the year 1995-97 are summarised below.

1. The height of the plant was significantly influenced by shade and growth regulators. Maximum height of 5.68 cm was recorded in 80 per cent shade and among the growth regulators, maximum plant height of 6.11 cm was recorded in the treatment with BA 750 ppm. Treatment combination of 70 per cent shade + Knop's solution + 750 ppm BA was found to be the best for maximum plant height (7.60 cm).

2. Only different shade levels have significantly influenced plant spread in EW and NS directions. As the shade intensity increased, the plant spread in both the directions increased significantly. Maximum plant spread in EW (20.13 cm) and NS (19.80 cm) directions was recorded under 80 per cent shade. The treatment combination 80 per cent shade + Ohio solution + 1500 ppm BA recorded maximum spread in EW (26.00 cm) and that in NS was maximum (28.70 cm) under 80 per cent shade + 1 per cent fertilizer complex + 750 ppm BA.

3. The mean number of leaves produced per plant was significantly influenced by the different levels of shade, growth regulators and shade x nutrient interactions. Maximum number of leaves was produced under 80 per cent shade

(14.03); BA 750 ppm (14.02) and 80 per cent shade x Ohio solution (18.03). Treatment combination of 80 per cent shade + Ohio solution + 750 ppm BA was the best for highest leaf production (26.20).

4. Significantly maximum petiole length was recorded under 80 per cent shade (9.29 cm); Hoagland solution (8.60 cm) and BA 750 ppm (10.79 cm). Treatment combination 80 per cent shade + Ohio solution + 1500 ppm BA was found to be superior to have leaves with longer petiole (14.00 cm).

5. Leaf length and breadth were significantly influenced by the different levels of shade and growth regulators. Eighty per cent shade produced longest (7.76 cm) and broadest (5.93 cm) leaves, compared to the other shade levels. BA 750 ppm was the best for maximum leaf length (8.33 cm) and breadth (6.49 cm). The treatment combination 60 per cent shade + Hoagland solution + 750 ppm BA produced the longest leaves (10.50 cm) while 60 per cent shade + fertilizer complex + 750 ppm BA produced the broadest leaves (8.00 cm).

6. Shade and growth regulators significantly influenced leaf area. Index leaf area was maximum under 80 per cent shade (50.75 cm^2) while total leaf area was maximum under 70 per cent shade (423.25 cm^2). BA 750 ppm recorded the maximum values, 59.60 cm^2 and 517.56 cm^2, for index and total leaf area, respectively. Maximum index leaf area (90.90 cm^2) was recorded by the treatment combination of 80 per cent shade + Hoagland solution + 1500 ppm BA, while, maximum total leaf area was recorded by 70 per cent shade + 1 per cent fertilizer complex + 1500 ppm BA (872.00 cm^2).

7. Maximum number of branches (2.29) was produced under 80 per cent shade, and among growth regulators; by GA 750 ppm (2.37). Treatment combination involving 80 per cent shade + 1 per cent fertilizer complex + 1500 ppm GA recorded superior branching (3.8) over other treatment combinations.

8. Maximum suckers were produced under 80 per cent shade and among growth regulators, by BA 750 ppm (1.35) and the 80 per cent shade (1.25), Ohio solution interaction (1.73). Treatment combination of 80 per cent shade + Ohio solution + 750 ppm BA was superior (2.50) among the treatment combinations with respect to sucker production.

9. Growth rate with respect to plant height was significantly highest under the treatment combination, 60 per cent shade + Hoagland soltuion + 750 ppm BA (12.20%). R^2 was maximum under the combination involving 70 per cent shade + Hoagland solution + 1500 ppm Ethephon ($S_2N_2G_6$).

   The rate of production of leaves was the highest in the treatment combination 80 per cent shade + Ohio solution + 750 ppm BA (13.50%), while R^2 value was the highest in 80 per cent shade + Knop's solution + 1500 ppm GA ($S_1N_3G_2$) combination (0.99).

   Growth rate with respect to leaf area was superior in the treatment combination 80 per cent shade + Ohio solution + 1500 ppm BA (18.85%) and R^2 value was the highest in 70 per cent shade + Hoagland solution + 1500 ppm Ethephon ($S_2N_2G_6$) combination (0.94).

   Rate of production of suckers was the maximum in the treatment combination 70 per cent shade + fertilizer complex + 750 ppm GA (9.14%), while R^2

was the maximum in 70 per cent shade + 1 per cent fertilizer complex + 750 ppm GA ($S_2N_1G_1$) combination (0.94).

The rate of production of branches per plant was the highest in the treatment combination 50 per cent shade + Knop's solution + 1500 ppm GA (12.98%) and R^2 value was the highest (0.78) in control under 80 per cent shade ($S_1N_0G_0$) and 80 per cent shade + fertilizer complex + 750 ppm Ethephon ($S_1N_1G_5$) treatment combinations (0.78).

Different parameters showed linear growth rate during the experimental period. The treatment combination involving 80 per cent shade + Ohio solution + 750 ppm BA ($S_1N_4G_3$) was the best with consistant and positive growth behaviour with respect to the parameters studied.

10. Dry matter percentage of whole plant and roots was the highest under 70 per cent shade, 19.25 and 22.97 respectively, while, leaf dry matter (20.53%) and petiole dry matter percentages were the highest under 50 per cent shade. Significantly maximum percentages of dry matter of whole plant and roots, 21.41 and 25.72, respectively, were recorded by Ohio and Knop's solutions, respectively. Ratio of dry matter content of shoot and root was the highest under 80 per cent shade (1.03); among the nutrients in 1 per cent fertilizer complex sprays (1.10), among interactions, under 50 per cent shade + Hoagland solution (1.54) and under 80 per cent shade + Knop's solution + 750 ppm Ethephon (2.15), among the treatment combinations.

11. Leaf area index was significantly maximum under 70 per cent shade (0.43), BA 750 ppm (0.51) and treatment combination of 70 per cent shade + 1 per

cent fertilizer complex + 1500 ppm BA (0.89). Leaf characters such as specific leaf weight, durations of leaf emergence to unfurling and unfurling to maturity were not influenced by the treatments.

Duration of leaf from maturity to senescence was significantly superior under 60 per cent shade (124.42 days), among nutrients in Ohio solution (125.46 days); and among growth regulators, BA 1500 ppm (127.44 days) and in the interaction involving 50 per cent shade x Knop's solution (124.33 days). The combination of 70 per cent shade + 1 per cent fertilizer complex + 750 ppm BA recorded the maximum duration of leaf (137.00 days) from maturity to senescence.

Ohio solution (149.46 days), BA 1500 ppm (152.81 days) and interaction 60 per cent shade x Ohio solution (152.83 days) recorded the maximum values for total leaf longevity. The treatment combination of 70 per cent shade + 1 per centfertilizer complex + 750 ppm BA recorded the maximum total leaf longevity (161.00 days).

Stomatal frequency and size were not influenced by any of the treatments.

12. Shade, nutrients and growth regulators significantly influenced aerial root production. Highest number of aerial roots per plant were produced by 80 per cent shade (total 56.28); 1 per cent fertilizer complex (0.62) and BA 750 ppm (6.31).

    The number of primary and secondary roots (11.3 and 72.29, respectively) produced were significantly highest under 80 per cent shade; BA 750 ppm (12.69 and 80.63, respectively) and the interaction 80 per cent shade x Ohio solution (13.67 and 98.50, respectively). Similarly, the combination 80 per cent shade + Ohio solution + 750 ppm BA recorded the highest number of primary (18.00) and secondary (142.00) roots per plant.

Maximum root length was recorded under 60 per cent shade (13.08 cm); BA 1500 ppm (14.31); interaction 60 per cent shade x Hoagland solution (15.33) and the treatment combination 60 per cent shade + Ohio solution + 1500 ppm BA (19.00 cm).

Root spread was significantly highest under 80 per cent shade (13.04 cm); BA 1500 ppm (14.00 cm) and interaction involving 80 per cent shade x Ohio solution (14.83 cm). The treatment combination of 60 per cent shade + Ohio solution + 1500 ppm BA (19.00 cm) produced the highest value for root spread among the treatment combinations.

13. The different parameters related to the production of flowers viz. duration to start flowering, number of stalkless small inflorescence, number of normal inflorescence, interval between the production of stalkless and normal inflorescence, inflorescence stalk length, spathe length and breadth, spadix length and the number of inflorescence produced during the different months of the experimental period were not influenced significantly by the application of various levels of shade, nutrients and growth regulators.

The duration of successive inflorescence emergence was significantly highest in the treatment involving BA 750 ppm (16.88 days). Days taken from spathe unfurling to senescence was the highest under BA 1500 ppm (35.81 days). Similarly, BA 1500 ppm recorded the highest inflorescence longevity in the field (59.44 days), while the treatment combination of 80 per cent shade + Hoagland solution + 1500 ppm BA was superior (86.00 days) with respect to inflorescence longevity.

14. The total chlorophyll and its components 'a' and 'b' were significantly influenced by the different shade levels and growth regulators. The maximum content of chlorophyll; 'total', 'a' and 'b' was recorded under 80 per cent shade level, 6.66, 3.86 and 2.80 mg g^{-1} fresh weight, respectively. Under Ethephon 1500 ppm the maximum values of 6.66, 3.72 and 2.94 mg g^{-1} fresh weight of 'total', 'a' and 'b' chlorophyll content, respectively, were recorded. The treatment combination of 60 per cent shade + Ohio solution + 750 ppm Ethephon recorded the maximum total chlorophyll content (8.8 mg g^{-1} fresh weight). Anthocyanin content was not influenced significantly by the different treatments.

15. Leaf nutrient content was significantly influenced by different levels of shade and growth regulators. Nitrogen content was significantly higher under 80 per cent shade (1.62%), and BA 750 ppm (1.57%). Treatment combination of 60 per cent shade + Hoagland solution + 750 ppm Ethephon recorded the maximum (2.9%) N content in leaf. Phosphorus content in leaf was not significantly influenced by any of the treatments.

Potassium content in leaf was significantly higher under 80 per cent shade (1.96%). The interaction of 70 per cent shade x Ohio solution recorded the maximum K content (2.09%). Treatment combination of 60 per cent shade + 1 per cent fertilizer complex + 1500 ppm GA recorded the maximum K content (2.44%).

Calcium content in leaf was the maximum under 60 per cent shade (1.49%). Treatment combination involving 60 per cent shade + Ohio solution + 1500 ppm Ethephon retained the maximum Ca content (2.79%). None of the treatments significntly influenced Mg and Zn contents in leaf.

Eighty per cent shade recorded the maximum Mn (470.63 ppm), Cu (21.17 ppm), Fe (585.38 ppm) and S (150.42 ppm) contents in leaf. The interaction of 80 per cent shade x 750 ppm BA recorded the highest S content (169.33 ppm). The treatment combination, 70 per cent shade + Hoagland solution + 750 ppm BA ($S_2N_2G_3$), recorded the highest values of Mn (819.00 ppm). Seventy per cent shade + Ohio solution + 750 ppm GA recorded the highest Zn content in leaf (403.00 ppm), 80 per cent shade + Knop's solution + 750 ppm Ethephon the highest Cu content (137.00 ppm), 80 per cent shade + Hoagland solution + 750 ppm GA the highest Fe content (1381.00 ppm) and 80 per cent shade + Knop's solution + 750 ppm GA, the highest S content in leaf (198.00 ppm).

16. Shade and growth regulators significantly influenced the nutrient uptake by plant. Uptake of Nitrogen, Potassium and Calcium were the highest under 80 per cent shade, 0.53 g, 0.68 g and 0.43 g per plant, respectively. BA 750 ppm recorded the highest uptake of K (0.65 g) while BA 1500 ppm recorded the highest uptake of N and Ca, 0.53 g and 0.43 g per plant, respectively.

There was no significant difference in the uptake of P and Mg under different treatments.

The treatment combination of 80 per cent shade + Ohio solution + 750 ppm BA recorded the maximum nutrient uptake of N, P. K and Mg (1.2, 0.21, 1.31 and 0.38 g/plant, respectively), while, Ca uptake was the maximum (0.76 g/plant) under the same combination of shade and nutrient but with higher level of BA, (1500 ppm).

17. Stage of harvest and size of spathe have significantly influenced the PLW, uptake of vase solution, change in pH, days to spathe blueing, spadix necrosis, gloss loss and vase life.

Significantly maximum PLW was recorded by the inflorescence having all the flowers opened on spadix (5.46 g). Similarly, inflorescence with large size spathes showed highest PLW (6.767 g). Maximum uptake of vase solution was in inflorescence with 3/4th flowers opened on spadix (19.00 ml), while it was maximum in inflorescence with small spathe (18.00 ml). Infloresence having 1/3rd flowers opened on spadix and inflorescence with small spathe caused, the maximum increase in pH (0.3 and 0.5, respectively).

In inflorescences having 1/3rd flowers opened on spadix, the spathe blueing and gloss loss were late (20.00 and 22.33 days, respectively) and it also had the longest vase life (23.33 days). Spadix necrosis started first in inflorescence with 3/4th flowers opened on spadix (after 19.00 days). As far as influence of spathe size was concerned, inflorescence with medium and large spathe lasted long.

18. Pulsing treatments significantly increased the vase life of anthurium flowers. The days to start the symptoms of spathe blueing, spadix necrosis and gloss loss were maximum delayed (19, 19 and 18 days, respectively) in the pulsing treatment with BA 50 ppm for 12 hrs. The maximum vase life (20.0 days) was also observed in this treatment.

19. The different holding solutions tried have significantly influenced the vase life and the different parameters related to vase life. Significantly late spathe blueing symptoms were noticed (after 26.00 days) under the treatment involving 8-HQ 30 ppm as holding solution, while, spadix necrosis was significantly late in the treatments involving BA 20 ppm, 8-HQ 30 and 40 ppm as holding solutions (after 21.00 days). Retention of gloss was maximum in BA 20 ppm as holding solution (upto 23.33 days). As far as vase life was concerned, maximum days was recorded by 8-HQ 30 ppm as holding solution (27.00 days), and it was followed by BA 20 ppm (25.00 days) and Triadimefon 30 ppm (25.00 days), which were on par and were significantly superior over the rest of the treatments.

20. Combination of treatments involving pulsing and holding solutions did not prolong the vase life significantly.

21. Economics involved in anthurium cultivation was significantly influenced by shade and growth regulators. Maximum net profit per pot (Rs.204.60) was recorded by the treatment combination involving 80 per cent shade + Ohio solution + 750 ppm BA, during the period of 18 months.

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* Originals not seen

Appendices

APPENDIX-1

Weather data of the experiment site

Year	Month	Total rainfall (mm)	Mean relative humidity (%)	Mean sunshine (hrs)	Mean temperature (°C)	
					Maximum	Minimum
1996	January	0.0	53	9.4	33.1	22.4
	February	0.0	53	9.9	34.7	23.4
	March	0.0	60	9.3	36.4	24.3
	April	152.0	73	8.3	34.6	25.0
	May	95.4	77	7.7	32.8	25.2
	June	440.3	85	4.7	30.5	23.8
	July	588.2	90	2.7	28.8	23.1
	August	310.0	87	3.7	29.1	23.6
	September	391.6	84	4.3	29.2	23.7
	October	219.3	82	6.0	30.1	22.9
	November	222.1	72	7.1	31.5	23.6
	December	60.4	68	6.8	30.5	21.8
1997	January	0.0	62	9.6	32.0	22.9
	February	0.0	61	9.3	33.9	21.8
	March	0.0	60	9.6	35.7	24.0
	April	8.2	67	9.4	35.2	24.5

APPENDIX-2

Environmental parameters recorded under different shade levels (from imposing of treatment)

Month	50% shade			60% shade			70% shade			80% shade		
	Temper-ature (°C)	Relative humidity (%)	Light intensity (Lux)	Temper-ature (°C)	Relative humidity (%)	Light intensity (Lux)	Temper-ature (°C)	Relative humidity (%)	Light intensity (Lux)	Temper-ature (°C)	Relative humidity (%)	Light intensity (Lux)
1996												
January	33.8	58	41400	33.9	59	36200	34.1	60	31700	34.1	64	19800
February	35.7	57	42780	35.8	58	37100	35.9	59	33400	35.9	61	21300
March	37.2	63	48300	37.4	64	40700	37.7	66	36200	37.8	69	26400
April	35.3	76	48990	35.5	77	30900	35.6	79	36800	35.9	81	27100
May	34.0	80	47610	34.3	81	39400	34.5	81	36100	34.8	83	26400
June	31.2	87	46080	31.5	87	38300	31.7	88	35200	32.1	90	24200
July	29.4	86	46230	29.8	88	38500	30.0	90	35300	30.3	94	24500
August	29.6	88	48240	29.8	89	40100	30.1	90	35600	30.2	92	26300
September	29.7	86	49600	30.2	87	42200	30.4	88	36100	30.6	90	27200
October	30.7	86	52060	30.9	87	44100	31.3	88	36800	31.6	89	26400
November	32.2	73	614.00	32.5	75	48200	32.7	77	37800	32.9	79	28300
December	31.1	70	58300	31.6	71	50300	31.8	73	38400	31.9	75	28400
1997												
January	32.6	64	63100	32.9	66	51400	33.4	68	41200	33.6	69	30200
February	34.3	63	61400	34.6	64	53700	34.9	66	42200	35.0	68	30300
March	36.1	62	62800	36.5	63	54500	36.8	64	43100	36.9	65	31400
April	35.8	68	60200	35.9	69	51900	36.1	71	42800	36.4	72	30700

APPENDIX- 3

Composition of nutrient solutions

Sl. No.	Components	Complex fertilizer	Hoagland solution (mg/l)	Knop's solution (mg/l)	Ohio solution (mg/l)
1	KNO_3	N : P : K 17 : 17 : 17	506	250	658
2	$Ca(NO_3)_2.4H_2O$	Mixture, ready company product	1180	1000	-
3	$MgSO_4.7H_2O$	-	493	250	501
4	KH_2PO_4	-	136	250	-
5	Ammonium Sulphate	-	-	-	110
6	Monocalcium phosphate	-	-	-	252
7	Calcium sulphate	-	-	-	1215
8	Ferrous sulphate	-	-	-	125
9	Manganese sulphate	-	-	-	1% solution prepared separately

APPENDIX-4

Treatment combinations

Sl.No.	80% shade level	70% shade level	60% shade level	50% shade level
1	$S_1N_1G_1$	$S_2N_1G_1$	$S_3N_1G_1$	$S_4N_1G_1$
2	$S_1N_1G_2$	$S_2N_1G_2$	$S_3N_1G_2$	$S_4N_1G_2$
3	$S_1N_1G_3$	$S_2N_1G_3$	$S_3N_1G_3$	$S_4N_1G_3$
4	$S_1N_1G_4$	$S_2N_1G_4$	$S_3N_1G_4$	$S_4N_1G_4$
5	$S_1N_1G_5$	$S_2N_1G_5$	$S_3N_1G_5$	$S_4N_1G_5$
6	$S_1N_1G_6$	$S_2N_1G_6$	$S_3N_1G_6$	$S_4N_1G_6$
7	$S_1N_2G_1$	$S_2N_2G_1$	$S_3N_2G_1$	$S_4N_2G_1$
8	$S_1N_2G_2$	$S_2N_2G_2$	$S_3N_2G_2$	$S_4N_2G_2$
9	$S_1N_2G_3$	$S_2N_2G_3$	$S_3N_2G_3$	$S_4N_2G_3$
10	$S_1N_2G_4$	$S_2N_2G_4$	$S_3N_2G_4$	$S_4N_2G_4$
11	$S_1N_2G_5$	$S_2N_2G_5$	$S_3N_2G_5$	$S_4N_2G_5$
12	$S_1N_2G_6$	$S_2N_2G_6$	$S_3N_2G_6$	$S_4N_2G_6$
13	$S_1N_3G_1$	$S_2N_3G_1$	$S_3N_3G_1$	$S_4N_3G_1$
14	$S_1N_3G_2$	$S_2N_3G_2$	$S_3N_3G_2$	$S_4N_3G_2$
15	$S_1N_3G_3$	$S_2N_3G_3$	$S_3N_3G_3$	$S_4N_3G_3$
16	$S_1N_3G_4$	$S_2N_3G_4$	$S_3N_3G_4$	$S_4N_3G_4$
17	$S_1N_3G_5$	$S_2N_3G_5$	$S_3N_3G_5$	$S_4N_3G_5$
18	$S_1N_3G_6$	$S_2N_3G_6$	$S_3N_3G_6$	$S_4N_3G_6$
19	$S_1N_4G_1$	$S_2N_4G_1$	$S_3N_4G_1$	$S_4N_4G_1$
20	$S_1N_4G_2$	$S_2N_4G_2$	$S_3N_4G_2$	$S_4N_4G_2$
21	$S_1N_4G_3$	$S_2N_4G_3$	$S_3N_4G_3$	$S_4N_4G_3$
22	$S_1N_4G_4$	$S_2N_4G_4$	$S_3N_4G_4$	$S_4N_4G_4$
23	$S_1N_4G_5$	$S_2N_4G_5$	$S_3N_4G_5$	$S_4N_4G_5$
24	$S_1N_4G_6$	$S_2N_4G_6$	$S_3N_4G_6$	$S_4N_4G_6$
25	$S_1N_0G_0$	$S_2N_0G_0$	$S_3N_0G_0$	$S_4N_0G_0$

APPENDIX-5

Vase life evaluation criteria

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a. Rating scale of visual spadix conditions

Score	Spadix conditions
1	No blemishes
2	Spadix top showing slight discoloration, browning
3	Spadix top showing definite browning
4	Tip definitely browning and drying out, less than 10% of total length affected
5	Tip necrotic and dried out, greater than 10% of total length affected

In this case score 4 and 5 definitely discourage purchase

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b. Rating scale for spathe blueing (or blackening)

Score	Spathe discoloration description
1	None fresh cut appearance - no blueing
2	Slight - less than 5% blueing
3	Moderate - 5 to 10% blueing
4	Severe - greater than 10% blueing

Flowers with scores of 3 and 4 are unsaleable

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c. Rating scales for spathe conditions - Gloss

Score	Spathe gloss condition
1	No loss - high gloss, fresh harvest condition
2	Slight loss - not objectionable
3	Moderate loss - slight gloss remaining
4	Severe loss - flat, no gloss, wilting of spathe lobes

Flowers will be rejected if conditions 3 and 4 prevail

APPENDIX- 6
PLANT HEIGHT

S	N	G	E	MONTH 1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	0	0	4	1.4	1.8	2.2	3.0	3.0	3.0	3.1	3.1	3.4	3.4	3.7	4.3	4.6	5.5
2	0	0	3	1.9	2.0	2.3	2.7	3.0	3.2	3.4	3.6	3.8	3.8	4.2	4.8	5.0	5.9
3	0	0	2	1.0	1.6	2.3	2.5	2.9	3.0	3.1	3.5	4.0	4.0	4.1	4.3	4.3	4.4
4.	0	0	1	1.1	1.6	2.3	2.4	2.6	2.8	2.9	3.0	3.1	3.1	3.5	3.8	4.0	4.3
1	1	1		2.1	2.7	3.3	3.4	3.8	3.9	3.9	4.0	4.1	4.1	4.2	4.4	4.4	4.6
1	1	2		2.3	2.8	3.7	3.8	4.1	4.2	4.2	4.4	4.5	4.5	4.6	4.7	4.7	4.8
1	1	3		1.8	2.1	3.5	3.5	3.9	3.9	4.0	4.1	4.6	4.6	4.7	4.9	6.8	6.9
1	1	4		1.6	2.5	3.0	3.3	3.5	3.6	3.8	3.9	4.4	4.4	4.6	4.9	5.4	4.4
1	1	5		1.8	2.7	3.2	3.7	3.8	3.9	4.2	4.2	4.5	4.5	4.9	5.4	5.9	5.9
1	1	6		1.7	2.6	3.1	3.4	3.8	3.9	4.3	4.3	4.6	4.6	4.8	5.3	6.2	6.5
1	2	1		1.6	2.3	3.1	3.3	3.5	3.5	3.6	3.6	3.8	3.8	4.0	4.2	4.7	4.7
1	2	2		1.6	2.1	2.8	3.4	3.8	3.8	3.8	3.8	3.9	3.9	4.0	4.2	4.5	5.0
1	2	3		1.9	2.7	3.0	3.6	3.8	3.9	4.0	4.0	4.2	4.2	4.7	5.2	5.5	5.2
1	2	4		1.9	2.5	3.1	3.2	3.5	3.6	3.9	3.9	4.2	4.2	4.7	5.2	5.9	7.0
1	2	5		1.8	2.2	2.8	3.2	3.5	3.6	3.7	3.7	3.9	3.9	4.5	5.1	5.9	6.1
1	2	6		1.4	2.6	3.4	3.8	4.0	4.1	4.1	4.1	4.3	4.3	4.8	5.5	5.8	6.0
1	3	1		1.9	2.7	3,6	3.9	4.0	4.0	4.0	4.0	4.0	4.0	4.1	4.1	4.3	4.6
1	3	2		1.7	2.0	3.2	3.9	4.1	4.1	4.2	4.2	4.3	4.3	4.3	4.4	4.5	4.6
1	3	3		1.5	1.8	3.0	4.0	4.1	4.1	4.3	4.3	4.6	4.6	4.9	5.0	5.0	6.2
1	3	4		1.3	1.9	2.8	3.0	3.3	3.8	4.1	4.1	4.4	4.4	4.4	4.4	5.6	5.6
1	3	5		1.7	1.9	3.0	3.5	4.0	4.1	4.2	4.2	4.6	4.6	4.8	5.2	5.5	6.2
1	3	6		1.7	2.0	2.7	3.5	3.7	4.8	3.9	3.9	4.0	4.0	4.1	4.1	4.2	4.6
1	4	1		1.5	1.9	3.0	3.2	3.5	3.5	3.6	3.6	3.8	3.8	3.9	3.9	4.3	4.8
1	4	2		1.5	2.2	2.8	2.9	3.0	3.4	3.9	3.9	4.1	4.1	4.3	5.6	5.3	5.3
1	4	3		1.4	1.8	2.8	4.2	4.3	4.3	4.5	4.5	4.8	4.8	5.0	5.6	5.8	5.8
1	4	4		1.3	1.9	2.9	3.6	4.0	4.0	4.3	4.3	4.8	4.8	5.8	6.7	7.0	7.0
1	4	5		1.7	1.9	2.7	3.0	3.3	3.6	3.8	3.8	4.1	4.1	5.4	4.8	5.9	6.7
1	4	6		1.4	1.6	2.7	3.2	3.5	3.6	3.9	3.9	4.0	4.0	5.2	4.4	4.4	4.9
2	1	1		1.6	1.9	2.8	2.8	3.0	3.0	3.7	3.7	3.9	3.9	3.9	3.9	3.9	4.4
2	1	2		1.5	2.4	3.1	3.8	4.0	4.2	4.5	4.5	4.7	4.7	4.8	4.9	4.9	5.4
2	1	3		1.7	2.6	3.1	4.1	4.4	4.4	4.6	4.6	4.9	4.9	4.9	4.9	5.0	6.0
2	1	4		1.7	2.4	3.1	3.6	4.3	4.4	4.4	4.4	4.8	4.9	5.0	5.2	5.3	6.0
2	1	5		1.5	1.8	3.0	3.5	4.2	4.4	4.4	4.4	4.9	5.0	5.3	5.5	5.5	6.4
2	1	6		1.1	2.0	2.8	3.5	3.8	3.9	3.9	3.9	4.2	4.3	4.6	5.1	5.4	6.7
2	2	1		1.4	1.9	2.9	3.0	3.5	3.5	3.6	3.6	3.7	3.7	3.9	3.7	3.8	4.6
2	2	2		1.4	2.3	3.0	3.1	3.3	3.5	3.5	3.5	3.8	3.8	3.8	3.9	4.1	4.6
2	2	3		1.1	2.1	2.8	3.8	3.9	3.9	4.1	4.1	4.6	4.7	5.0	5.2	5.4	5.4
2	2	4		1.5	1.7	2.4	3.0	3.9	3.9	4.0	4.0	4.6	4.7	4.7	4.7	5.1	5.1
2	2	5		1.5	1.8	2.6	2.9	3.4	3.6	4.0	4.0	4.2	4.2	4.2	4.3	4.3	5.0
2	2	6		1.8	2.0	2.6	2.7	3.3	3.4	3.8	3.8	4.1	4.1	4.4	4.7	5.6	5.7
2	3	1		1.6	2.1	3.0	3.3	3.6	3.7	3.9	3.9	4.1	4.1	4.2	4.4	4.6	4.9
2	3	2		1.8	2.0	2.9	3.6	3.3	3.4	3.8	3.8	4.2	4.2	4.4	4.8	5.0	5.5
2	3	3		1.7	2.0	2.9	3.6	3.9	3.9	4.2	4.2	4.4	4.5	4.9	5.0	5.0	7.6
2	3	4		1.5	2.0	3.1	3.4	3.8	3.9	4.0	4.0	4.4	4.6	4.9	5.2	5.3	6.3
2	3	5		1.2	2.3	3.0	3.4	3.5	3.6	3.8	3.8	4.1	4.1	4.8	4.9	4.9	5.4
2	3	6		1.2	1.6	2.9	3.1	3.9	3.9	4.0	4.0	4.2	4.2	4.7	5.5	5.6	5.8
2	4	1		1.4	1.5	2.9	3.3	3.6	3.8	3.9	3.9	4.0	4.1	4.1	4.1	4.1	5.5
2	4	2		1.4	1.9	2.8	3.0	3.2	3.4	3.8	4.0	4.0	4.0	4.1	4.6	4.9	5.0
2	4	3		1.3	2.2	2.8	3.6	3.6	3.8	4.0	4.3	4.4	4.5	4.9	5.0	5.1	5.7
2	4	4		1.6	2.0	2.9	4.0	4.1	4.2	4.5	4.7	4.8	4.8	5.2	5.3	5.3	5.9
2	4	5		1.8	2.2	3.1	3.4	3.9	3.9	4.0	4.2	4.6	4.8	4.8	4.9	5.4	6.3
2	4	6		1.8	2.6	3.2	3.3	3.7	3.8	3.9	4.3	4.6	4.7	5.0	5.6	5.7	6.6
3	1	1		1.2	2.2	3.4	3.5	3.5	3.5	3.5	3.5	3.6	3.6	3.6	3.6	3.7	4.1
3	1	2		0.9	2.0	2.8	3.2	4.0	4.0	4.0	4.0	4.1	4.1	4.2	4.3	4.4	5.1
3	1	3		1.0	1.8	3.2	3.4	3.7	3.8	4.0	4.3	4.4	4.4	4.6	4.8	5.2	7.2
3	1	4		1.2	1.9	2.4	2.9	3.5	3.6	3.9	4.5	4.8	4.8	4.8	4.8	4.8	6.9
3	1	5		1.0	1.9	2.6	3.1	3.5	3.6	3.7	3.7	3.8	2.8	3.9	4.1	4.1	4.7
3	1	6		1.0	2.2	2.8	3.6	3.8	3.9	4.4	4.5	4.9	4.9	3.6	6.2	6.2	7.4
3	2	1		1.1	1.9	3.1	3.5	3.5	3.7	4.0	4.0	4.1	4.1	4.2	4.2	4.9	5.3
3	2	2		0.9	2.0	3.0	3.1	3.2	3.3	3.7	3.7	3.8	3.8	4.0	4.2	4.3	4.6
3	2	3		0.9	1.8	3.1	3.2	3.9	3.9	4.2	4.4	4.6	4.7	5.8	6.0	6.3	7.3
3	2	4		1.0	1.6	2.9	3.2	3.5	3.6	4.0	4.5	4.6	4.7	4.9	5.1	5.4	5.9
3	2	5		1.2	1.8	2.0	2.7	3.6	3.7	4.0	4.0	4.2	4.3	4.4	4.7	4.7	4.7
3	2	6		0.9	1.4	2.5	2.8	2.8	2.9	3.0	3.8	3.9	3.9	4.0	4.2	4.6	4.8
3	3	1		1.0	2.2	3.1	3.3	3.4	3.6	3.7	3.8	3.9	3.9	4.0	4.6	4.2	4.2
3	3	2		1.3	2.3	2.5	2.8	3.2	3.4	3.5	3.7	3.9	4.0	4.0	4.1	4.1	4.0
3	3	3		1.0	1.7	3.7	2.9	3.2	3.8	3.9	4.0	4.2	4.3	4.3	4.3	4.8	6.1
3	3	4		1.1	2.6	2.9	3.4	3.9	4.3	4.4	4.6	4.9	4.9	5.0	5.1	5.2	5.3
3	3	5		1.1	2.3	2.4	2.6	3.0	3.8	3.8	4.1	4.5	4.5	4.8	5.1	5.1	6.1
3	3	6		1.1	2.0	2.8	3.2	3.3	3.7	3.9	4.0	4.5	4.5	4.5	4.5	4.6	4.8

Contd.

Appendix-6. Continued

S	N	G	E	1	2	3	4	5	6	7	8	9	10	11	12	13	14
				MONTH													
3	4	1		1.1	2.0	2.5	2.9	3.2	3.4	3.4	3.7	3.9	3.9	4.0	4.0	4.4	4.7
3	4	2		1.1	1.4	2.0	2.9	2.6	2.8	3.0	3.1	3.3	3.4	3.5	3.7	3.8	3.9
3	4	3		1.5	1.6	2.9	3.0	3.3	3.5	3.7	3.9	4.4	4.5	4.5	4.6	4.9	4.9
3	4	4		1.0	1.9	2.0	3.9	3.2	3.6	3.9	4.2	4.4	4.4	4.9	5.6	5.7	5.8
3	4	5		1.4	2.0	2.2	2.7	3.0	3.1	3.3	3.6	3.8	3.9	3.9	3.9	3.9	5.0
3	4	6		1.0	2.0	2.4	2.7	3.4	3.8	4.0	4.3	4.6	4.6	5.0	5.0	5.2	6.9
4	1	1		1.6	2.7	3.0	3.2	3.3	3.6	3.6	3.6	3.6	36	3.6	3.6	3.6	4.2
4	1	2		1.2	2.2	2.7	2.9	3.0	3.5	3.5	3.6	3.6	3.6	3.6	3.6	3.6	4.0
4	1	3		1.1	1.2	2.2	2.8	3.2	3.4	3.8	3.9	3.9	3.9	3.9	4.1	5.2	5.0
4	1	4		1.2	2.0	3.1	3.2	3.2	3.6	1.6	3.6	3.6	3.6	3.8	4.0	4.0	4.4
4	1	5		1.5	1.9	2.9	2.9	3.0	3.4	3.4	3.4	3.4	3.5	3.6	3.6	3.8	3.4
4	1	6		1.4	2.3	2.6	2.9	3.0	3.2	3.2	3.2	3.2	3.2	3.3	3.4	3.6	3.6
4	2	1		1.5	2.0	2.9	3.4	3.4	3.5	3.5	3.5	3.8	3.9	4.2	4.6	4.6	4.9
4	2	2		1.8	2.0	2.7	3.2	3.6	3.6	3.6	3.6	3.6	3.6	3.7	3.7	4.6	5.7
4	2	3		1.2	2.4	2.8	3.0	3.1	3.2	3.2	3.5	3.7	3.8	3.8	4.3	4.7	6.2
4	2	4		1.1	1.6	2.5	2.6	2.7	3.0	3.1	3.1	3.4	3.6	3.9	4.2	4.2	4.8
4	2	5		1.3	2.2	2.8	3.1	3.5	3.6	3.6	4.6	3.6	3.7	3.7	3.7	4.0	4.2
4	2	6		1.5	2.2	2.3	2.8	2.9	3.1	3.1	3.1	3.3	3.4	4.0	4.5	4.6	4.8
4	3	1		1.5	2.0	3.0	3.3	3.3	3.6	3.6	3.6	3.6	3.6	3.7	3.8	4.0	5.2
4	3	2		1.2	1.8	2.9	3.1	3.4	3.6	3.6	3.6	3.6	3.6	3.8	4.0	4.7	5.3
4	3	3		1.4	1.8	2.7	2.8	2.9	3.1	3.1	3.5	3.7	3.8	4.2	4.7	4.9	6.6
4	3	4		1.6	2.1	2.8	2.9	2.9	3.0	3.2	3.3	3.8	3.8	4.2	4.5	4.8	5.8
4	3	5		1.3	1.7	2.0	2.3	2.5	3.0	3.2	3.3	3.3	3.4	3.4	3.4	3.8	4.3
4	3	6		1.6	2.4	2.9	3.0	3.2	3.3	3.3	3.4	3.4	3.4	3.4	3.4	3.7	4.2
4	4	1		1.9	2.1	2.7	3.1	2.1	3.2	3.2	3.2	3.2	3.2	3.4	3.5	4.1	4.7
4	4	2		1.6	1.9	2.8	2.8	3.8	2.9	3.0	3.1	3.1	3.1	3.2	3.3	3.3	4.0
4	4	3		1.5	1.8	2.3	2.8	2.9	3.0	3.0	3.2	3.2	3.3	3.3	3.4	3.4	4.5
4	4	4		1.3	1.9	2.4	2.5	3.6	3.0	3.0	3.2	3.2	3.3	4.0	4.5	4.6	5.4
4	4	5		1.6	2.0	2.2	2.4	2.5	2.1	3.1	3.3	3.4	3.5	3.6	3.8	4.61	5.1
4	4	6		1.5	1.9	2.4	3.0	3.1	3.4	3.4	3.5	3.6	3.6	4.0	4.4	4.4	4.9
Treated mean				1.5	2.1	2.9	3.3	3.6	3.6	3.6	3.9	4.1	4.1	4.3	4.5	4.8	5.4
Control mean				1.3	1.5	8.3	2.6	2.8	3.0	3.1	3.3	3.5	3.5	3.8	4.0	4.2	5.0
CD treated vs Control				NS	NS	0.8	1.0	1.2	1.0	0.9	1.0	0.9	1.0	NS	NS	NS	NS

APPENDIX- 7
PLANT SPREAD EAST WEST

S	N	G	E	MONTH 1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	0	0	4	6.9	7.4	8.4	10.3	10.1	11.6	9.5	9.2	12.6	15.7	16.9	15.6	16.5	17.3
2	0	0	3	7.4	8.9	10.2	12.4	11.5	14.9	15.5	15.7	16.8	11.9	17.6	14.3	15.5	16.8
3	0	0	2	6.8	8.2	10.0	13.9	13.4	16.6	17.0	16.6	16.1	10.0	17.6	15.2	15.9	18.5
4.	0	0	1	7.5	8.4	9.8	13.6	17.9	18.5	20.6	16.8	21.4	15.4	24.0	21.7	26.7	29.2
1	1	1		8.2	9.4	10.3	11.5	15.8	17.0	18.0	16.8	20.1	14.9	22.2	21.4	21.8	22.3
1	1	2		5.9	7.2	9.6	12.3	14.5	15.8	17.2	15.2	19.7	13.7	20.7	21.4	21.9	22.4
1	1	3		8.0	9.1	10.4	11/7	14.6	17.9	17.2	17.5	19.0	15.2	24.3	21.0	21.2	21.6
1	1	4		7.8	8.9	9.8	11.2	13.9	13.1	13.3	14.6	12.1	13.6	18.6	14.4	12.9	15.0
1	1	5		6.8	8.2	9.3	10.5	14.6	13.4	13.7	13.3	12.9	14.4	17.2	17.7	14.8	15.5
1	1	6		6.1	6.9	8.2	9.5	14.5	17.1	13.9	15.0	17.7	15.9	22.1	20.8	20.0	24.9
1	2	1		7.5	8.4	9.0	10.3	13.6	16.8	15.7	15.1	18.9	15.6	21.2	20.9	22.7	24.1
1	2	2		5.4	6.2	7.8	9.7	12.6	13.2	11.8	12.2	15.4	17.2	19.2	18.2	18.1	22.2
1	2	3		6.4	7.3	8.6	10.2	13.2	13.1	11.7	12.8	17.0	18.3	22.4	18.0	19.7	24.0
1	2	4		7.5	8.1	9.6	11.7	13.6	13.9	11.9	12.5	11.4	14.4	17.9	12.1	14.3	15.6
1	2	5		8.0	9.4	8.8	12.4	14.7	16.1	13.8	14.3	16.3	15.5	19.4	14.4	19.5	16.9
1	2	6		8.1	9.2	10.8	13.0	14.2	17.1	15.7	16.0	18.6	20.7	25.1	19.6	25.9	25.8
1	3	1		6.8	9.2	9.5	12.0	12.9	16.4	15.4	14.3	17.0	17.6	20.3	15.4	20.3	19.9
1	3	2		7.2	8.2	9.5	11.2	13.1	14.6	11.6	13.9	15.3	17.3	21.5	17.5	19.7	21.2
1	3	3		6.4	7.8	8.2	9.2	12.2	11.9	8.5	9.2	12.4	13.9	17.4	13.1	17.2	19.5
1	3	4		7.3	7.9	8.6	10.2	13.2	12.7	11.6	10.8	14.3	15.6	17.0	12.2	14.6	14.3
1	3	5		8.1	9.4	10.8	12.6	13.1	16.1	13.9	16.4	16.7	18.0	23.0	17.2	22.9	20.9
1	3	6		6.8	7.4	9.2	11.0	12.3	14.6	12.9	14.3	17.0	18.6	22.5	17.2	25.0	25.8
1	4	1		6.9	8.0	9.4	11.5	11.5	14.9	14.2	14.1	19.9	18.4	23.6	20.5	25.0	26.0
1	4	2		8.2	8.6	9.4	10.2	11.5	12.9	11.4	12.2	15.2	16.3	13.7	17.5	16.5	23.4
1	4	3		6.8	7.6	8.9	10.7	11.0	12.8	10.8	10.8	11.8	15.1	16.5	11.2	14.0	13.2
1	4	4		6.8	7.3	8.2	9.8	11.3	11.9	11.0	12.8	14.8	15.8	21.3	14.9	17.4	18.3
1	4	5		8.4	9.4	11.1	13.3	13.8	14.4	15.2	11.9	14.7	16.1	19.4	12.6	13.9	14.4
1	4	6		8.1	9.3	10.6	13.7	15.7	15.5	15.8	15.0	15.1	17.7	19.5	12.9	15.0	15.9
2	1	1		8.4	9.8	12.6	15.3	16.4	17.0	15.5	16.8	20.4	21.0	24.7	21.1	23.7	23.6
2	1	2		6.8	7.9	9.4	13.5	17.6	17.1	16.6	17.6	21.6	23.0	27.6	23.2	22.0	24.1
2	1	3		8.0	9.2	11.0	13.1	14.0	13.6	13.1	14.7	16.9	20.2	24.0	20.0	23.6	22.4
2	1	4		6.6	7.4	8.9	11.4	12.2	11.4	10.0	14.4	16.4	39.5	21.4	19.3	21.6	19.5
2	1	5		7.4	8.3	10.2	12.0	11.3	10.7	9.9	11.1	12.7	16.3	13.0	13.3	14.5	12.3
2	1	6		7.8	8.9	11.0	13.1	11.5	11.1	14.7	11.4	17.2	14.0	17.1	12.0	13.6	10.1
2	2	1		7.4	8.2	10.8	12.4	11.4	14.8	12.9	15.0	18.6	19.6	24.6	20.0	20.9	13.3
2	2	2		6.8	7.8	8.9	11.2	13.4	12.9	11.0	13.5	16.3	18.9	22.7	16.5	18.6	19.3
2	2	3		7.3	8.4	9.6	11.6	11.8	11.6	10.1	11.4	12.8	17.0	13.4	14.2	15.5	13.0
2	2	4		8.2	9.6	11.4	14.1	12.1	12.6	13.9	14.1	16.4	18.1	20.9	16.3	17.5	16.2
2	2	5		8.2	9.8	11.3	14.7	15.3	16.1	13.0	15.4	18.3	17.7	21.1	17.4	16.8	18.0
2	2	6		6.9	7.8	9.6	13.9	15.0	15.5	16.2	13.1	14.6	16.3	17.4	12.7	12.2	13.6
2	3	1		7.8	8.8	11.2	13.8	17.4	17.6	15.4	16.4	19.8	20.4	24.3	22.3	23.9	25.4
2	3	2		6.9	7.8	9.4	13.4	16.3	15.6	11.6	14.1	18.5	20.3	23.7	22.7	22.3	24.5
2	3	3		8.1	9.4	10.6	12.0	12.8	13.0	10.0	12.7	15.8	17.4	20.8	10.3	18.2	18.3
2	3	4		8.0	9.1	10.1	11.1	10.8	10.0	10.6	10.1	13.0	16.2	19.7	17.8	14.9	16.8
2	3	5		8.1	9.0	9.9	12.1	12.0	11.8	11.0	11.0	11.7	16.2	18.3	13.6	14.1	18.6
2	3	6		8.2	9.1	10.3	12.5	12.6	13.5	13.3	12.9	12.3	15.0	17.3	12.4	13.1	11.5
2	4	1		6.8	8.2	9.4	11.8	13.0	14.3	12.7	15.7	16.4	17.7	23.1	19.5	17.8	20.2
2	4	2		8.2	9.3	10.4	13.1	14.2	14.6	12.3	14.9	16.6	19.2	24.6	29.6	18.9	19.5
2	4	3		8.3	9.2	10.3	11.5	14.5	14.8	12.2	13.7	17.9	19.2	22.8	20.1	21.2	17.9
2	4	4		6.8	8.4	11.2	13.1	13.9	13.9	12.3	15.0	15.9	10.0	22.5	10.0	20.1	21.5
2	4	5		6.8	8.0	9.3	10.6	10.7	12.9	11.7	16.0	17.3	10.2	22.1	13.7	11.8	15.7
2	4	6		6.8	7.6	8.9	12.6	21.8	13.6	13.3	13.5	14.3	15.2	16.2	14.9	14.1	13.4
3	1	1		7.2	8.1	9.4	13.6	14.2	14.6	14.1	14.5	15.7	16.0	21.4	12.7	15.2	16.3
3	1	2		7.3	8.4	9.8	12.8	15.7	18.2	17.9	18.6	22.4	22.4	27.2	15.2	21.4	24.0
3	1	3		6.8	8.1	9.3	11.9	15.2	16.8	15.3	18.0	19.8	18.3	22.6	23.2	19.2	22.9
3	1	4		7.0	8.2	10.1	11.7	12.9	13.0	12.4	10.9	16.3	16.7	21.9	19.6	15.6	17.8
3	1	5		6.9	7.8	10.3	12.6	14.6	18.2	13.5	16.2	19.0	20.9	24.0	16.4	22.2	21.8
3	1	6		8.4	9.8	11.1	13.9	14.1	15.2	12.5	12.6	17.6	18.5	23.8	21.3	18.4	19.8
3	2	1		8.1	9.6	11.0	12.5	13.6	14.9	13.1	11.6	13.6	16.4	18.5	17.3	15.1	15.1
3	2	2		7.6	8.8	10.6	12.8	14.8	18.9	15.6	17.8	21.2	22.5	26.4	13.5	23.4	23.1
3	2	3		7.2	8.2	9.8	11.5	13.4	13.9	13.3	15.5	17.1	21.5	25.5	23.9	21.8	23.7
3	2	4		6.6	7.4	8.9	10.3	10.7	10.5	10.1	9.8	12.5	14.8	19.7	19.5	12.8	13.9
3	2	5		6.8	7.7	8.2	9.4	11.3	10.5	10.7	11.0	14.3	15.3	19.9	14.9	14.0	15.5
3	2	6		7.6	9.4	10.2	12.2	17.1	15.3	17.2	16.8	17.0	21.7	13.7	12.7	14.9	12.7
3	3	1		9.1	9.4	11.2	13.6	15.5	16.1	11.6	14.1	15.7	17.5	21.4	14.5	11.2	13.8
3	3	2		7.8	8.9	10.2	11.4	14.0	13.6	11.7	14.2	18.2	17.3	22.9	12.8	14.9	17.3
3	3	3		6.9	7.5	10.4	11.8	5.4	16.2	15.0	15.2	15.1	19.1	23.8	16.7	17.4	15.5

Contd.

Appendix-7. Continued

S	N	G	E	MONTH 1	2	3	4	5	6	7	8	9	10	11	12	13	14
3	3	4		7.3	8.5	9.6	12.1	12.2	13.9	13.3	13.8	14.1	18.8	23.4	16.7	15.1	15.6
3	3	5		7.4	8.1	9.8	12.0	10.3	14.1	12.1	13.9	15.5	17.9	23.6	16.4	12.2	14.1
3	3	6		8.0	9.2	10.0	11.3	10.8	11.8	10.9	11.2	14.0	17.2	21.7	15.3	14.5	12.6
3	4	1		6.9	7.6	8.1	9.2	9.3	10.0	10.3	8.9	11.1	13.6	19.8	12.7	8.3	9.8
3	4	2		7.4	8.3	9.6	11.1	11.2	12.3	13.1	12.3	14.2	19.9	24.0	12.3	14.2	14.9
3	4	3		7.8	8.6	9.8	11.6	12.2	15.5	13.5	15.8	19.0	21.8	26.0	13.6	20.3	21.4
3	4	4		7.2	8.3	9.3	10.6	11.8	11.8	10.1	13.4	12.1	16.6	20.7	18.3	15.3	16.2
3	4	5		7.0	8.1	9.2	10.1	11.5	12.8	12.6	11.4	15.1	17.1	25.3	15.0	15.4	·19.5
3	4	6		6.8	7.4	8.1	8.7	11.1	10.5	11.1	10.3	12.3	16.4	23.4	12.8	15.1	15.0
4	1	1		9.1	9.5	11.2	13.1	10.9	11.0	8.5	9.1	8.4	10.8	20.1	15.6	9.9	11.5
4	1	2		8.2	10.1	12.0	14.1	13.8	15.5	10.8	11.1	10.6	14.2	22.7	9.0	11.5	12.5
4	1	3		8.1	9.6	11.4	13.2	11.6	11.3	9.2	9.3	7.4	13.1	22.0	12.5	10.2	12.8
4	1	4		7.8	8.6	10.2	12.3	13.7	12.9	7.9	8.3	8.6	12.2	21.9	11.9	12.0	13.0
4	1	5		9.0	9.4	10.8	12.5	13.3	12.7	7.7	7.7	8.4	12.3	20.4	11.4	10.7	11.0
4	1	6		7.6	8.5	9.8	11.4	10.1	10.0	7.6	5.7	6.5	10.0	21.1	9.4	8.3	10.3
4	2	1		7.4	8.2	9.6	11.4	14.1	13.7	11.0	10.0	11.4	13.6	23.0	7.1	14.0	14.3
4	2	2		7.6	8.6	11.0	12.3	13.8	13.7	10.7	12.5	190.7	15.8	23.4	13.7	16.7	21.1
4	2	3		7.8	8.9	10.8	12.4	11.3	12.9	11.4	13.7	13.7	18.9	24.2	15.6	20.1	22.0
4	2	4		7.0	8.4	9.6	11.5	12.4	11.7	11.0	11.5	11.2	15.3	21.8	18.4	14.2	17.5
4	2	5		7.4	8.6	10.3	12.6	12.4	12.7	11.5	14.3	14.1	14.5	121.9	14.8	19.7	16.9
4	2	6		6.6	7.8	8.8	9.7	9.9	9.3	10.8	12.7	11.5	15.5	22.7	19.0	14.6	17.2
4	3	1		8.2	9.4	11.3	15.3	13.6	12.6	9.7	10.6	9.7	13.2	21.9	14.0	12.8	16.3
4	3	2		8.0	9.3	11.4	14.7	15.3	12.6	11.4	10.5	9.4	12.0	22.4	13.3	12.1	11.2
4	3	3		8.2	9.3	11.1	13.2	13.7	13.2	12.3	12.7	13.1	16.8	22.2	11.5	16.4	19.3
4	3	4		7.9	8.8	10.6	13.2	13.5	13.9	10.5	11.1	13.1	16.7	24.1	15.9	17.1	17.7
4	3	5		9.1	9.3	10.8	13.7	14.4	12.3	9.8	9.1	8.0	13.7	22.1	14.9	14.5	14.7
4	3	6		7.7	8.9	11.2	13.7	14.1	10.4	10.0	10.0	8.1	14.0	13.4	21.5	11.9	13.7
4	4	1		8.2	9.6	11.1	13.6	11.6	12.1	10.4	11.1	8.4	11.6	13.2	12.6	12.6	23.4
4	4	2		7.9	9.2	12.0	14.7	13.8	11.9	10.7	9.1	8.7	12.0	19.5	11.8	9.9	12.6
4	4	3		6.8	8.2	10.3	12.3	11.8	10.2	9.0	7.4	6.6	12.7	22.2	9.4	11.2	11.4
4	4	4		7.0	8.4	11.3	13.8	14.3	11.6	10.5	9.7	12.5	13.9	23.6	10.8	18.0	18.4
4	4	5		7.3	8.5	10.4	11.9	12.0	11.6	11.3	12.3	11.2	14.1	21.3	15.8	15.1	15.5
4	4	6		7.2	8.3	10.6	12.2	15.7	13.3	11.3	11.7	13.9	17.0	23.5	16.9	19.5	19.9
Treated mean				7.4	8.5	10.0	12.1	13.2	13.7	12.3	12.9	14.6	16.6	21.5	15.9	16.7	17.6
Control mean				7.1	8.2	9.6	12.5	13.2	15.4	15.6	14.5	16.7	13.2	19.0	16.7	18.6	20.4
CD treated vs Control				NS	NS	NS	NS	NS	NS	6.9	NS	NS	7.2	NS	NS	NS	NS

APPENDIX- 8
PLANT SPREAD NORTH-SOUTH

S	N	G	E	MONTH 1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	0	0	4	5.8	6.6	7.6	8.7	10.8	12.6	11.0	11.1	15.2	17.4	20.6	18.2	17.8	21.5
2	0	0	3	6.0	6.6	8.4	9.2	11.1	13.0	13.6	15.1	16.8	15.6	20.8	19.7	20.4	23.4
3	0	0	2	6.0	7.1	8.2	9.1	13.3	12.0	10.9	14.2	14.4	17.4	18.0	19.0	21.3	21.9
4	0	0	1	6.4	8.3	10.4	11.8	14.7	16.2	15.6	14.8	20.5	12.2	24.0	21.9	21.2	22.5
1	1	1		6.5	7.2	8.8	10.7	12.1	13.3	13.6	12.6	16.5	19.1	23.0	20.6	22.8	25.9
1	1	2		6.6	7.5	8.7	10.4	12.8	12.4	13.6	13.9	18.0	18.4	13.1	22.6	24.9	26.5
1	1	3		6.6	7.6	9.0	9.5	13.0	12.0	10.8	12.6	16.6	20.0	23.1	18.0	16.9	20.2
1	1	4		6.6	7.7	9.0	10.2	10.4	11.0	10.3	9.7	11.7	16.1	15.5	12.7	14.3	13.9
1	1	5		6.6	7.9	8.8	10.3	11.4	11.1	8.6	9.1	10.7	14.3	17.1	13.3	15.7	18.7
1	1	6		6.6	8.0	8.8	9.5	10.4	9.2	9.4	9.6	11.1	13.4	21.2	10.8	8.7	9.8
1	2	1		6.6	8.0	9,.1	11.1	13.8	12.1	12.4	11.1	11.8	12.4	16.8	15.3	14.3	14.6
1	2	2		6.6	8.0	9.9	11.1	16.5	15.6	14.5	18.0	20.7	22.2	26.0	22.1	23.3	25.5
1	2	3		6.6	8.1	9.6	11.5	112.5	15.1	13.9	14.5	18.1	17.5	19.2	17.0	18.1	19.4
1	2	4		6.7	7.1	8.0	9.1	10.8	10.3	10.1	14.1	14.5	15.7	21.1	16.8	16.5	14.3
1	2	5		6.7	7.3	8.6	11.1	12.3	11.2	8.1	12.4	16.4	17.0	23.4	20.3	18.2	22.7
1	2	6		6.8	7.9	8.8	10.5	10.8	12.4	12.3	13.1	16.5	17.2	19.3	17.2	19.3	20.0
1	3	1		6.8	8.0	9.3	10.7	13.2	10.5	11.0	10.9	13.5	13.4	19.6	13.4	12.9	14.1
1	3	2		6.8	8.2	9.0	9.5	10.6	9.1	9.4	10.0	10.6	15.9	19.7	14.8	14.7	14.9
1	3	3		6.9	7.4	8.3	9.9	10.5	9.1	8.8	9.4	11.7	14.1	23.2	13.4	13.8	11.0
1	3	4		6.9	7.5	8.5	9.8	10.9	10.2	9.3	10.1	13.1	19.6	16.0	21.2	13.9	14.6
1	3	5		6.9	7.8	8.3	9.1	8.9	10.4	10.1	11.0	13.7	16.8	22.1	14.7	14.2	14.9
1	3	6		6.9	7.8	8.9	10.9	13.5	16.3	14.6	18.2	21.9	22.9	25.5	24.0	20.8	25.7
1	4	1		6.9	7.8	9.3	14.4	12.0	11.2	6.5	7.1	8.5	10.2	23.0	10.1	11.2	11.5
1	4	2		6.9	8.2	10.4	12.7	10.9	10.6	10.7	15.4	15.2	15.5	22.0	13.5	11.5	19.6
1	4	3		6.9	8.4	9.1	11.4	14.2	13.5	11.5	14.1	10.1	19.4	23.9	20.0	17.6	21.5
1	4	4		6.9	8.4	11.2	13.0	13.5	12.4	10.8	13.6	16.1	16.6	23.1	20.4	18.9	21.3
1	4	5		6.9	9.2	11.4	13.1	15.9	16.5	16.2	14.2	17.7	10.6	18.2	14.6	14.2	17.1
1	4	6		7.0	7.6	8.2	8.8	8.1	8.7	8.5	9.4	12.7	15.7	17.6	17.5	15.5	17.5
2	1	1		7.0	8.1	8.9	9.6	10.8	8.8	9.2	11.4	11.4	14.0	23.3	12.9	12.5	12.7
2	1	2		7.0	8.3	9.5	10.5	12.1	12.8	13.2	16.0	18.0	20.4	25.6	21.3	21.2	23.7
2	1	3		7.1	8.2	10.3	14.4	14.0	14.1	14.9	11.8	14.7	15.0	17.9	13.7	12.7	14.1
2	1	4		7.1	8.3	8.9	9.6	9.6	11.3	10.6	11.7	11.7	15.5	23.0	14.5	12.8	17.1
2	1	5		7.2	7.8	8.5	10.3	14.6	12.0	10.0	11.2	12.6	12.9	17.8	12.5	15.1	3.1
2	1	6		7.2	7.9	9.1	12.7	13.3	14.6	10.8	15.6	16.8	18.7	14.7	22.4	22.0	22.6
2	2	1		7.2	8.1	10.2	12.4	13.0	12.7	12.0	15.4	17.6	20.7	24.8	21.5	22.7	21.4
2	2	2		7.2	8.6	10.2	12.0	11.8	9.9	7.4	6.5	7.6	9.0	22.2	6.0	8.6	10.4
2	2	3		7.3	8.0	8.8	9.5	14.8	14.0	14.9	18.8	17.1	23.2	21.3	23.4	24.6	23.4
2	2	4		7.3	8.0	9.1	10.6	12.5	12.3	9.8	11.0	11.7	13.0	17.1	10.7	12.4	16.6
2	2	5		7.3	8.2	9.4	11.4	14.1	13.1	14.3	11.3	14.5	14.0	17.9	13.1	13.1	15.0
2	2	6		7.3	8.2	9.6	10.7	11.7	12.9	12.4	13.9	18.0	21.7	26.6	19.0	20.0	21.3
2	3	1		7.3	8.4	9.9	11.1	9.3	12.3	9.2	11.2	10.3	14.7	23.0	14.1	15.6	19.0
2	3	2		7.3	8.6	10.2	11.8	14.0	15.4	13.6	15.0	18.3	17.4	25.0	17.3	16.0	15.8
2	3	3		7.3	8.6	10.4	12.7	12.0	14.2	13.9	15.3	14.7	11.1	17.2	13.9	12.8	16.7
2	3	4		7.4	8.1	10.0	11 .0	12.8	11.4	11.5	10.7	15.2	14.0	21.0	13.6	16.3	17.3
2	3	5		7.4	8.2	9.4	10.2	11.1	11.3	10.3	13.0	15.6	18.4	25.2	12.0	15.8	17.3
2	3	6		7.4	8.2	9.8	11.6	11.3	9.8	9.1	9.9	8.1	12.2	17.4	10.9	11.9	13.7
2	4	1		7.4	8.4	9.3	10.3	11.0	11.6	11.1	12.0	14.9	17.4	24.5	14.2	14.6	16.0
2	4	2		7.4	8.5	9.4	10.6	14.0	11.9	8.3	9.5	8.9	13.2	22.7	11.6	13.7	15.0
2	4	3		7.4	8.5	9.6	12.6	14.1	11.8	11.6	13.0	13.0	16.5	24.3	15.3	18.3	20.7
2	4	4		7.4	8.6	9.6	12.3	11.1	10.4	11.7	13.0	13.1	15.3	21.4	15.7	12.8	14.0
2	4	5		7.5	8.1	9.6	10.4	10.8	12.4	12.1	15.5	16.3	19.0	24.4	15.6	14.8	14.9
2	4	6		7.5	8.2	10.6	12.0	11.6	9.9	13.5	7.1	12.0	14.0	17.7	14.1	11.0	9.7
3	1	1		7.5	8.6	9.4	10.3	10.9	13.7	13.0	13.9	14.7	19.4	23.0	14.1	15.3	13.4
3	1	2		7.5	8.6	9.8	12.9	14.0	14.5	13.0	13.7	18.7	17.2	24.8	20.4	20.6	21.5
3	1	3		7.5	8.6	10.1	11.3	14.8	7.0	9.0	11.5	12.1	12.0	23.7	10.0	13.1	15.9
3	1	4		7.5	9.0	10.4	12.2	12.4	11.6	12/1	13.4	17.4	18.4	22.8	20.1	20.9	22.9
3	1	5		7.6	8.1	10.4	11.8	10.8	9.3	9.8	9.7	11.2	14.2	19.4	12.0	12.6	11.9
3	1	6		7.6	8.4	9.3	10.6	11.5	13.2	12.1	12.8	15.8	17.2	25.3	18.6	16.5	19.6
3	2	1		7.6	8.4	9.4	10.4	12.7	12.7	11.6	13.7	14.2	11.0	18.3	13.9	14.2	15.9
3	2	2		7.6	8.5	10.2	11.3	13.2	15.0	17.2	15.0	18.0	14.9	21.6	20.3	20.5	22.0
3	2	3		7.6	8.5	10.2	14.9	18.4	18.1	20.0	17.3	22.3	12.3	25.6	23.7	25.4	28.7
3	2	4		7.6	8.8	9.8	14.2	12.9	15.4	15.5	13.8	18.0	19.0	21.5	12.0	21.9	21.2
3	2	5		7.6	8.8	10.1	14.1	13.4	14.8	12.4	11.7	15.2	14.7	19.3	15.8	17.9	20.1
3	2	6		7.7	8.7	9.9	12.5	12.4	11.6	11.1	12.1	12.1	13.8	23.0	14.9	17.1	18.6
3	3	1		7.8	8.1	9.0	9.7	12.7	13.9	10.6	10.8	15.9	17.5	20.1	16.7	19.1	20.7
3	3	2		7.8	8.9	10.6	11.7	11.1	9.2	10.5	12.1	11.4	13.1	23.0	13.7	16.4	15.6
3	3	3		7.8	8.9	11.1	12.6	14.3	11.2	8.2	8.1	9.5	12.8	23.6	11.4	11.1	14.0
3	3	4		7.8	9.4	10.0	10.4	14.6	16.1	14.3	14.8	19.4	21.3	25.3	20.0	23.3	25.9
3	3	5		7.9	9.2	11.1	12.8	10.2	11.4	10.7	14.5	17.4	16.9	22.3	19.5	18.6	21.8
3	3	6		8.0	8.8	9.8	13.2	15.9	15.0	15.1	14.0	15.8	15.1	20.3	13.9	15.0	16.0

Contd.

Appendix-8. Continued

S	N	G	E	MONTH 1	2	3	4	5	6	7	8	9	10	11	12	13	14
3	4	1		8.0	9.0	10.2	12.7	13.7	13.2	12.1	15.7	17.0	19.9	23.9	17.2	19.5	18.5
3	4	2		8.0	9.1	10.2	11.6	12.1	11.5	8.8	12.8	15.7	17.1	21.6	17.0	18.2	18.7
3	4	3		8.0	9.1	11.0	13.7	11.8	12.0	14.2	12.2	16.5	18.3	22.5	16.9	17.8	17.6
3	4	4		8.0	9.1	11.3	13.4	13.1	10.7	11.3	11.0	10.8	11.8	22.8	12.2	11.5	13.4
3	4	5		8.0	9.2	10.3	12.4	12.4	10.4	10.0	8.9	7.7	11.7	16.0	8.7	10.9	13.4
3	4	6		8.0	9.2	10.6	13.0	14.2	13.8	13.9	13.2	15.1	16.8	22.6	16.1	15.8	16.0
4	1	1		8.0	9.2	10.6	11.6	14.9	15.3	13.2	17.9	15.8	18.1	21.5	16.3	18.6	18.1
4	1	2		8.0	9.2	10.6	13.9	14.2	12.5	11.5	13.0	13.2	15.9	20.0	13.4	13.2	15.1
4	1	3		8.0	9.3	10.1	11.5	12.9	12.7	11.6	12.3	15.9	16.9	22.8	18.5	17.7	19.2
4	1	4		8.1	9.0	10.1	12.2	15.6	16.9	16.7	15.2	20.6	15.4	21.7	22.8	24.2	20.8
4	1	5		8.1	9.0	10.2	11.8	13.9	12.0	10.6	14.4	13.8	16.2	23.7	19.2	28.5	19.9
4	1	6		8.1	9.2	11.2	23.1	13.8	12.0	7.5	7.9	5.8	9.7	21.2	9.0	11.7	12.9
4	2	1		8.1	9.4	10.8	12.7	13.0	11.1	11.6	13.3	13.9	16.6	24.1	17.9	17.6	17.1
4	2	2		8.1	9.4	11.0	13.5	16.3	15.3	12.7	13.9	14.9	16.1	22.4	15.5	13.6	14.9
4	2	3		8.1	9.4	11.3	13.1	12.6	12.0	9.6	7.7	9.1	14.1	23.1	12.7	12.0	15.5
4	2	4		8.1	9.4	11.6	14.5	14.7	16.2	14.2	15.9	19.4	21.2	26.5	23.0	22.6	24.9
4	2	5		8.1	9.5	11.2	13.5	10.0	9.1	8.2	8.4	12.0	15.7	24.0	17.6	18.1	17.5
4	2	6		8.2	9.2	10.0	11.2	11.1	11.1	10.8	12.6	13.0	16.2	21.7	14.6	14.2	16.6
4	3	1		8.2	9.2	10.8	12.3	13.9	14.3	9.0	9.5	9.7	9.9	23.4	9.9	9.9	12.0
4	3	2		8.2	9.3	10.4	13.7	11.5	8.9	6.3	6.5	8.9	11.2	18.0	9.5	10.9	11.4
4	3	3		8.2	9.3	11.3	13.3	13.8	9.2	9.7	10.7	10.2	12.5	23.0	13.3	13.7	12.1
4	3	4		8.2	9.4	10.4	14.0	16.0	17.1	16.7	19.0	23.0	21.2	27.3	22.6	24.0	25.4
4	3	5		8.2	9.4	10.8	12.8	13.7	13.3	13.4	12.8	15.5	15.3	22.9	12.9	12.9	12.0
4	3	6		8.3	9.5	12.2	14.1	14.1	15.2	14.6	15.9	18.6	19.1	24.0	18.9	17.0	21.0
4	4	1		8.3	9.6	11.0	12.3	12.8	12.5	12.1	13.3	17.0	20.6	25.7	17.3	18.3	17.0
4	4	2		8.3	9.6	11.7	13.3	11.6	12.8	10.	12.7	13.3	15.5	24.5	15.3	17.9	18.1
4	4	3		8.3	9.8	12.8	15.5	17.1	14.8	15.8	15.9	19.1	22.3	25.0	21.8	21.3	24.9
4	4	4		8.4	9.0	11.4	12.0	11.9	11.1	11.2	12.2	12.6	14.3	17.0	18.0	11.8	11.3
4	4	5		8.4	9.3	11.0	13.8	10.8	10.0	11.0	9.4	10.7	14.6	19.7	14.4	14.6	14.5
4	4	6		8.4	9.7	11.3	14.4	12.9	11.2	8.0	10.1	9.5	12.2	23.0	11.4	12.9	14.0
Treated mean				7.4	8.6	9.9	11.7	12.6	12.3	11.5	12.5	14.4	16.0	21.9	15.8	16.5	17.7
Control mean				7.2	6.5	10.0	12.4	14.6	14.4	14.6	14.0	16.8	12.5	19.6	17.4	16.9	20.5
CD treated vs Control				NS	2.3	3.1	5.15	NS	NS	7.1	NS	NS	8.3	NS	NS	NS	NS

APPENDIX-9
NUMBER OF LEAVES PER PLANT

S	N	G	E	MONTH 1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	0	0	4	4.2	5.2	6.2	7.2	7.2	7.9	5.5	5.6	6.4	6.2	6.8	5.7	6.0	6.4
2	0	0	3	4.1	5.1	5.6	7.1	8.3	7.6	8.5	10.1	11.2	11.9	11.3	8.8	8.9	8.1
3	0	0	2	4.9	5.3	6.6	7.9	8.6	7.5	8.4	8.9	8.0	8.3	7.7	6.0	6,2	5.4
4	0	0	1	5.0	5.0	5.7	6.0	6.7	6.4	7.7	8.5	7.7	6.5	6.6	6.2	8.0	8.4
1	1	1		5.7	5.8	6.2	6.7	7.2	8.5	9.8	10.7	10.8	9.4	8.7	7.2	7.5	8.7
1	1	2		4.3	5.7	6.6	7.2	8.6	9.1	10.2	11.3	11.5	9.0	8.9	8.8	10.0	11.6
1	1	3		4.2	4.7	6.6	7.3	8.7	9.3	10.4	9.9	12.1	11.1	12.3	13.6	13.5	14.6
1	1	4		4.3	5.6	6.3	7.0	8.2	10.1	10.7	10.9	12.5	12.8	15.0	11.8	12.8	12.8
1	1	5		4.6	5.6	6.5	7.0	7.3	7.7	6.9	6.8	6.6	7.2	7.9	8.1	8.3	8.3
1	1	6		4.7	5.9	6.7	7.8	8.5	7.4	7.6	8.1	8.1	8.6	8.1	6.8	7.5	8.4
1	2	1		4.7	5.5	6.5	7.6	8.1	8.8	7.6	9.4	10.6	10.9	12.0	10.9	12.4	14.2
1	2	2		5.0	5.5	6.4	7.0	7.7	9.3	9.1	9.3	9.9	11.4	12.2	11.8	12.5	13.9
1	2	3		4.8	5.0	5.9	6.6	7.1	9.1	10.1	11.1	14.7	14.3	15.2	15.2	14.7	16.2
1	2	4		4.7	5.5	6.1	6.9	7.9	8.2	9.5	8.6	10.5	9.3	9.1	9.3	8.4	8.9
1	2	5		4.1	5.2	6.3	7.0	8.1	7.6	8.8	8.4	9.7	10.1	10.0	9.0	9.0	10.9
1	2	6		4.3	5.9	6.6	7.2	9.1	8.5	10.5	11.6	11.5	13.8	11.3	12.7	13.2	116
1	3	1		4.7	5.5	6.9	7.5	7.7	9.0	7.9	8.7	10.2	11.5	12.5	10.2	10.0	11.5
1	3	2		4.6	5.2	6.3	6.8	8.0	9.1	6.8	7.1	7.6	9.9	9.9	8.7	9.0	10.3
1	3	3		4.2	5.4	6.5	7.0	7.6	9.1	12.4	12.2	15.7	16.9	17.0	15.8	17.0	18.4
1	3	4		4.8	5.5	6.1	7.1	8.6	10.7	12.8	13.0	14.5	15.9	16.6	14.8	15.0	17.2
1	3	5		4.5	5.5	6.2	6.5	7.5	8.5	10.4	9.9	11.1	10.1	11.8	10.2	11.3	12.9
1	3	6		4.6	5.7	7.0	7.6	7.9	8.2	10.2	11.2	12.6	13.0	13.6	12.2	13.2	16.5
1	4	1		4.3	5.9	6.4	7.5	8.6	7.8	9.5	10.6	11.6	13.5	14.5	12.9	13.1	13.2
1	4	2		4.9	5.8	6.8	10.2	11.4	13.4	12.6	16.3	17.0	18.0	17.4	17.6	18.8	18.9
1	4	3		4.8	5.4	6.5	7.6	8.8	13.0	14.7	16.9	21.3	17.3	10.8	18.8	20.4	26.2
1	4	4		4.2	5.2	5.7	6.8	8.5	9.9	13.5	16.6	18.7	17.9	17.3	15.4	17.7	20.9
1	4	5		4.0	5.3	6.6	6.9	9.4	9.6	9.2	10.4	12.2	12.6	11.0	10.7	10.2	12.4
1	4	6		4.5	5.5	6.5	6.5	7.3	8.3	10.3	9.4	11.9	17.1	13.0	11.9	12.7	16.7
2	1	1		4.8	6.0	6.8	7.5	8.8	8.3	9.7	10.6	12.7	14.2	14.8	14.4	13.9	13.9
2	1	2		4.4	5.5	6.7	8.0	7.7	9.2	9.4	10.4	10.0	11.0	10.4	9.2	9.9	10.5
2	1	3		4.8	5.7	7.0	8.1	9.1	9.2	13.7	14.0	17.0	15.3	14.3	14.1	17.5	17.6
2	1	4		4.9	5.8	7.3	7.6	9.5	7.6	11.5	12.2	15.1	17.0	16.6	15.8	19.5	19.6
2	1	5		4.5	5.8	6.8	7.1	7.4	6.7	8.9	9.1	9.5	11.0	11.0	9.8	11.8	12.4
2	1	6		4.6	5.5	5.7	6.6	7.3	6.7	8.6	9.5	11.0	12.7	13.3	12.5	13,4	15.5
2	2	1		4.2	5.8	6.2	6.5	7.0	6.3	7.4	9.3	12.1	13.9	12.4	11.2	18.1	12.7
2	2	2		4.2	6.0	6.0	6.1	6.2	5.2	8.7	9.4	12.9	12.9	10.1	7.9	7.9	7.0
2	2	3		4.3	5.6	6.3	6.5	7.3	9.2	11.0	11.8	12.4	14.1	13.6	11.8	12.1	10.4
2	2	4		4.2	5.6	6.2	7.1	8.3	8.2	11.6	12.5	15,.3	16.6	15.5	15.2	14.9	13.7
2	2	5		5.1	5.2	5.9	6.9	7.4	7.2	9.0	9.2	11.5	13.3	12.7	13.1	12.0	8.9
2	2	6		4.5	5.1	5.9	7.4	8.1	7.4	9.9	11.8	12.8	13.8	11.4	10.8	11.2	11.7
2	3	1		4.5	5.6	6.2	7.9	8.6	8.2	8.6	10.6	11.6	13.8	13.3	10.9	10.6	11.1
2	3	2		4.8	5.0	6.4	7.7	9.4	9.4	9.4	8.8	12.2	11.7	10.2	8.9	9.7	9.8
2	3	3		4.8	5.9	6.8	7.8	9.5	8.4	11.1	10.6	12.3	14.1	13.2	12.8	13.6	14.7
2	3	4		4.6	5.7	6.6	7.7	9.3	10.7	11.0	11.5	14.4	16.1	12.5	13.1	14.4	13.0
2	3	5		4.6	5.6	6.3	6.8	6.8	6.6	7.9	8.3	9.5	11.5	9.1	9.5	9.4	9.9
2	3	6		4.6	5.6	6.4	7.4	8.3	6.9	7.6	9.1	8.2	12.6	8.2	8.0	8.7	8.6
2	4	1		4.1	5.1	5.9	5.9	6.6	6.5	7.4	8.1	9.3	12.7	9.7	10.1	12.3	13.9
2	4	2		4.7	5.4	5.9	6.5	7.0	6.6	6.9	7.7	7.9	8,.7	7.4	6.4	6.8	7.4
2	4	3		4.3	5.7	6.3	7.5	8.3	8.6	10.3	11.5	14.8	15.8	14.0	14.6	13.2	14.3
2	4	4		5.6	6.0	6.1	8.1	9.3	11.2	12.0	11.7	16.3	16.5	15.2	13.4	14.7	10.3
2	4	5		4.4	5.2	6.0	7.2	8.2	7.3	8.3	9.3	9.8	10.6	9.6	8.6	10.3	10.0
2	4	6		4.6	4.8	6.1	7.6	9.0	7.8	8.6	10.6	9.6	12.4	12.2	9.6	12.5	11.0
3	1	1		5.1	5.1	5.8	6.6	7.5	6.4	6.6	7.4	9.3	11.3	9.9	9.3	10.5	9.9
3	1	2		4.9	5.6	6.3	7.4	8.6	6.2	9.1	9.9	11.6	12.5	10.9	11.0	11.4	12.1
3	1	3		4.1	5.5	6.2	6.9	8.1	8.1	10.0	10.5	11.0	14.2	12.8	12.2	11.7	12.2
3	1	4		4.7	5.7	6.2	7.0	7.6	6.7	7.2	7.8	7.7	12.0	10.7	10.4	9.6	10.8
3	1	5		5.1	5.5	6.2	6.2	6.7	4.9	6.3	6.2	7.8	7.5	7.9	5.6	6.4	7.9
3	1	6		4.5	5.8	6.8	6.8	8.2	6.2	6.7	7.3	8.8	9.8	9.0	8.8	9.6	9.4
3	2	1		4.9	6.1	6.6	7.3	8.3	6.7	9.3	9.9	13.5	17.2	13.8	14.2	14.8	17.4
3	2	2		4.6	5.8	6.5	6.5	5.0	4.8	6.1	7.3	11.4	10.9	10.8	11.0	11.6	11.5
3	2	3		4.3	5.6	6.3	7.6	9.7	7.6	7.9	8.8	9.8	11.6	11.0	10.3	12.5	12.4
3	2	4		4.7	5.3	5.8	7.2	8.1	8.9	10.7	10.7	11.9	14.3	15.2	14.2	13.9	16.2
3	2	5		4.8	5.1	5.1	6.2	6.7	6.0	7.9	7.7	9.3	8.7	9.1	6.7	8.4	7.3
3	2	6		4.3	4.5	5.3	5.3	6.6	5.9	7.8	9.1	10.7	14.8	11.6	11.2	10.8	12.3
3	3	1		4.0	6.0	6.5	7.7	8.0	6.2	6.6	7.6	9.2	11.7	12.9	10.5	10.1	11.6
3	3	2		5.1	5.8	6.6	7.4	8.1	6.4	6.6	7.7	10.5	10.9	10.4	11.4	8.7	9.0
3	3	3		4.8	5.0	5.6	6.5	7.7	7.4	8.4	8.0	9.5	10.6	12.5	10.2	10.6	10.3
3	3	4		4.8	5.7	6.3	7.0	8.2	7.8	8.1	9.0	10.3	11.0	10.2	9.5	10.5	9.9
3	3	5		4.6	5.3	6.3	6.7	6.5	5.7	6.6	7.6	7.7	8.0	7.4	6.0	7.4	6.1
3	3	6		4.6	6.0	6.4	7.1	7.0	6.1	6.3	7.5	7.5	6.8	7.3	6.3	7.6	7.5

Contd.

Appendix-9. Continued

S	N	G	E	MONTH 1	2	3	4	5	6	7	8	9	10	11	12	13	14
3	4	1		4.8	5.4	5.4	5.8	5.5	6.3	7.7	9.6	10.8	16.4	13.0	10.5	11.4	12.8
3	4	2		5.3	5.3	5.6	5.7	6.0	4.8	6.4	8.2	9.8	11.0	10.4	9.0	9.8	8.7
3	4	3		4.8	5.6	5.6	7.3	6.7	7.2	6.9	8.8	9.6	10.0	9.0	7.2	8.1	7.8
3	4	4		4.9	5.4	6.1	6.8	7.3	6.5	8.4	9.5	12.4	14.6	11.6	10.8	11.7	10.5
3	4	5		5.3	5.4	5.4	6.0	6.0	5.3	7.6	9.4	11.5	13.6	9.7	8.4	7.9	9.2
3	4	6		5.6	5.6	6.2	7.2	7.7	7.3	7.3	7.9	8.0	7.1	8.0	6.7	6.7	8.1
4	1	1		5.5	5.7	6.5	6.7	6.5	6.2	6.1	6.6	6.6	7.5	8.2	9.8	12.1	12.1
4	1	2		5.8	5.9	7.2	6.9	7.2	6.6	7.0	6.9	5.5	7.8	7.2	7.5	8.5	11.1
4	1	3		5.4	5.9	7.2	7.6	7.7	6.0	8.2	6.6	6.7	8.3	7.9	7.4	9.2	11.1
4	1	4		5.6	6.6	6.6	6.4	8.0	9.1	7.7	7.3	7.9	12.9	9.1	10.1	11.0	12.7
4	1	5		5.3	6.2	6.8	6.5	7.6	6.9	7.9	6.7	5.6	9.3	10.1	8.6	9.8	13.6
4	1	6		5.5	5.9	7.0	7.8	8.6	8.2	8.3	10.9	10.1	8.9	10.9	11.7	12.4	13.0
4	2	1		5.3	5.3	6.4	6.2	6.5	6.8	6.6	8.7	7.2	8.7	10.3	9.4	10.5	13.2
4	2	2		5.5	5.5	6.2	7.8	7.6	6.3	10.0	10.6	10.0	11.2	11.0	11.6	12.7	12.8
4	2	3		5.3	5.3	6.1	6.2	8.1	7.8	9.5	10.7	10.0	13.9	10.2	11.2	11.5	12.8
4	2	4		5.6	5.9	6.7	6.6	7.9	7.5	9.9	8.7	7.8	8.1	6.9	7.0	9.0	9.0
4	2	5		5.8	6.3	7.1	6.3	6.5	6.5	8.3	8.0	5.2	6.5	6.1	5.9	7.3	7.0
4	2	6		5.7	6.1	7.2	8.0	7.8	7.6	8.4	9.6	8.9	10.3	11.1	11.8	15.8	14.9
4	3	1		5.5	6.2	7.3	8.3	6.2	5.6	5.6	8.5	7.0	10.9	10.6	11.2	12.1	11.8
4	3	2		5.8	6.2	7.4	7.2	7.1	6.3	7.8	7.8	8.8	10.3	8.5	8.4	10.7	11.1
4	3	3		5.7	6.6	7.0	7.3	7.0	6.3	7.7	8.5	8.8	12.0	9.9	10.3	11.9	12.6
4	3	4		5.4	6.5	7.5	7.4	6.6	7.8	7.2	8.5	9.4	12.2	8.1	10.3	15.1	12.0
4	3	5		5.5	6.2	7.1	7.1	7.3	7.4	8.2	8.5	8.0	12.4	10.3	10.4	14.0	15.2
4	3	6		5.6	5.6	6.2	6.5	6.5	8.0	7.0	8.2	9.7	9.0	10.0	9.0	12.5	14.2
4	4	1		5.3	6.2	7.5	7.7	6.3	6.1	5.6	7.4	8.9	11.7	13.1	10.6	14.7	15.9
4	4	2		5.3	5.4	6.2	6.8	6.5	5.6	5.0	5.6	7.4	9.8	9.0	9.5	11.5	14.2
4	4	3		5.3	5.4	6.3	6.8	6.8	9.7	6.5	7.2	7.7	8.3	8.3	8.1	9.3	11.0
4	4	4		5.2	5.9	6.5	6.7	7.5	7.7	8.1	9.4	8.5	9.9	9.3	8.8	11.4	11.5
4	4	5		5.2	5.3	7.4	7.5	8.7	8.2	9.2	9.3	9.7	10.4	8.7	8.7	11.5	12.0
4	4	6		6.2	6.3	6.8	9.7	6.5	7.2	7.7	8.3	8.3	8.1	11.5	9.3	12.5	11.0
Treated mean				4.9	5.6	6.4	7.1	7.7	7.7	8.7	9.4	10.6	11.9	11.3	10.6	11.6	12.2
Control mean				4.8	5.1	6.0	7.0	7.7	7.3	7.5	8.2	8.3	8.2	6.8	6.7	7.3	7.0
CD treated vs Control				NS	1.2	NS	NS	2.9	2.9	NS	NS	NS	7.2	6.7	6.8	7.7	8.3

APPENDIX: 10
LEAF PETIOLE LENGTH

S	N	G	E	MONTH 1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	0	0	4	3.9	4.4	4.0	4.2	4.2	4.6	5.2	5.8	6.8	8.5	3.0	7.1	7.3	9.0
2	0	0	3	5.6	4.9	3.6	3.5	4.2	4.4	4.8	6.0	6.3	7.6	4.8	7.4	8.1	8.0
3	0	0	2	4.9	4.4	4.2	3.9	5.2	5.1	6.3	6.3	6.5	8.4	5.2	6.9	7.0	7.7
4	0	0	1	5.6	6.0	5.5	3.8	5.1	4.5	5.2	5.4	6.4	7.4	5.3	5.3	5.8	7.1
1	1	1		4.2	4.8	5.6	5.6	5.7	5.5	6.6	5.4	6.7	8.0	4.5	5.5	6.1	6.7
1	1	2		5.0	5.8	5.6	6.7	6.3	6.0	6.9	6.5	7.2	8.2	4.8	6.9	6.6	7.1
1	1	3		4.7	5.3	6.0	7.1	7.7	6.7	7.5	7.1	9.6	10.1	5.8	10.7	11.0	12.1
1	1	4		5.1	5.7	5.4	7.1	6.2	6.4	6.4	6.8	9.5	9.6	5.6	9.9	9.9	9.5
1	1	5		5.3	5.9	5.0	4.9	6.0	7.1	8.2	7.6	9.6	9.9	4.5	9.5	10.3	10.0
1	1	6		4.7	5.4	4.7	4.8	5.8	6.6	8.0	8.2	9.3	9.4	5.0	8.4	10.1	8.9
1	2	1		4.8	5.6	4.4	5.3	5.2	5.2	5.4	5.2	5.9	6.7	4.3	6.7	6.5	7.4
1	2	2		4.6	5.2	4.3	5.0	5.4	5.8	6.2	5.4	6.2	7.4	4.9	6.3	6.9	7.4
1	2	3		4.2	4.5	3.8	4.7	5.3	5.8	6.6	6.1	7.9	9.6	8.0	8.9	10.6	10.9
1	2	4		5.0	5.5	4.3	5.1	6.3	6.2	7.2	7.2	8.8	10.9	4.8	10.9	11.5	12.0
1	2	5		4.9	5.4	4.7	4.3	5.1	5.3	6.0	6.3	7.0	8.2	3.8	7.8	9.3	9.4
1	2	6		4.6	4.9	5.2	4.4	5.3	4.8	5.6	7.1	8.1	8.7	6.2	8.5	9.5	11.1
1	3	1		4.0	4.6	4.5	6.2	6.2	5.2	5.3	4.8	4.7	6.3	3.8	6.3	6.6	6.9
1	3	2		5.0	5.6	5.5	6.1	6.2	6.2	6.1	5.9	6.8	7.9	3.6	7.8	8.1	7.4
1	3	3		5.0	5.6	5.5	6.1	6.2	6.2	6.1	5.9	6.8	7.9	3.6	7.8	8.1	7.4
1	3	4		4.5	5.1	4.9	5.2	5.6	5.5	6.6	7.0	8.4	10.5	5.7	10.6	11.2	11.9
1	3	5		4.1	4.6	4.4	5.6	5.0	4.9	6.6	6.6	7.0	7.9	6.4	7.6	8.3	9.2
1	3	6		3.9	4.5	3.5	3.9	4.8	4.7	6.3	7.6	7.4	7.3	5.4	8.1	8.8	8.6
1	4	1		3.7	4.2	4.0	4.1	4.1	3.6	3.7	4.5	4.9	5.6	5.9	61.	7.1	7.8
1	4	2		4.7	5.1	4.1	3.9	4.3	4.4	4.8	4.9	5.2	7.3	5.1	6.1	6.6	7.1
1	4	3		4.9	5.3	4.1	5.4	5.8	7.0	6.2	7.3	7.8	9.4	7.2	8.8	10.3	10.0
1	4	4		4.2	4.7	3.7	4.0	4.8	4.7	5.5	7.2	7.4	9.2	10.2	10.9	10.7	12.3
1	4	5		4.5	4.9	4.0	4.4	5.7	5.5	6.5	8.2	8.4	9.4	6.6	10.0	13.4	13.0
1	4	6		4.1	4.7	4.0	3.7	4.9	5.0	5.2	5.8	6.5	8.5	3.5	8.3	9.0	9.1
2	1	1		4.3	4.8	4.5	4.5	4.2	4.2	4.7	5.5	5.4	6.0	4.2	6.4	6.1	7.2
2	1	2		4.6	5.1	4.7	5.8	5.3	4.9	4.9	4.9	5.6	7.0	4.5	6.3	6.5	7.2
2	1	3		5.2	5.7	5.3	6.0	6.4	6.0	5.8	6.2	6.6	8.0	7.3	7.6	7.2	7.4
2	1	4		5.0	5.5	4.7	6.2	5.6	5.4	6.1	5.6	8.1	10.4	7.7	10.4	11.0	12.0
2	1	5		5.3	6.0	5.3	4.4	5.9	5.3	5.5	6.2	7.5	10.1	7.5	10.5	11.4	12.3
2	1	6		4.8	5.3	4.0	4.3	4.9	5.0	6.0	6.9	7.6	8.2	4.6	9.0	9. 5	9.9
2	2	1		5.4	6.0	4.6	4.9	4.3	4.2	5.7	6.3	7.4	9.0	7.0	7.0	8.3	8.7
2	2	2		4.9	5.2	4.3	5.1	4.5	4.3	4.3	4.5	5.0	7.8	5.2	5.4	5.7	6.4
2	2	3		6.0	6.7	5.4	4.3	5.0	5.5	4.9	5.7	4.9	7.7	3.4	6.5	5.1	5.4
2	2	4		4.9	5.4	4.6	4.8	5.3	5.8	6.5	8.5	8.6	10.5	6.0	11.0	11.4	10.4
2	2	5		4.8	5.3	4.7	3.8	4.9	5.3	5.6	5.8	7.5	9.5	7.0	8.8	8.4	8.8
2	2	6		3.9	4.2	3.7	4.3	4.2	4.2	5.4	5.7	6.6	7.7	6.9	6.9	6.3	6.4
2	3	1		4.3	4.7	3.7	5.9	5.1	4.6	5.2	5.6	7.3	8.1	8.0	8.9	9.2	9.3
2	3	2		4.2	5.9	5.3	4.6	6.4	6.0	6.6	6.1	6.8	8.6	8.1	8.2	7.8	7.5
2	3	3		5.3	5.5	5.8	6.6	5.9	5.8	6.4	5.3	5.7	7.0	6,6	8.1	6.7	6.5
2	3	4		5.0	5.8	5.5	5.7	6.6	6.3	7.2	8.2	9.2	10.3	7,0	11,6	11.6	11.1
2	3	5		5.4	5.7	5.5	3.9	6.7	5.7	5.1	8.2	8.6	10.9	16.5	10.6	10.3	5.3
2	3	6		5.3	6.0	5.0	3.9	5.1	4.9	4.9	6.8	6.8	8.3	5.2	8.2	7.8	9.3
2	4	1		5.5	6.0	4.3	4.4	4.7	4.2	4.5	5.6	6.3	8.0	4.5	6.7	7.4	7.5
2	4	2		1.8	4.8	4.3	4.7	3.8	4.8	4.4	5.0	4.6	6.9	5.7	7.3	8.1	8.0
2	4	3		4.5	5.9	4.7	5.1	5.0	4.9	5.2	5.3	5.9	6.8	6.1	6.4	6.3	5.3
2	4	4		5.3	5.3	4.7	4.9	5.3	5.5	6.4	7.2	7.8	9.1	5.7	10.0	9.3	10.0
2	4	5		4.8	5.4	4.3	5.6	6.5	5.1	6.5	6.7	8.0	9.3	7.0	8.2	9.1	0.3
2	4	6		4.8	6.3	5.9	4.7	6.4	5.6	6.4	7.3	7.3	9.4	7.2	8.9	8.3	8.9
3	1	1		5.7	6.1	4.9	4.9	4.7	5.3	5.6	6.8	7.0	7.4	5.8	9.3	9.9	10.1
3	1	2		5.5	6.0	6.2	5.9	5.8	5.6	5.3	5.1	5.3	5.4	3.4	5.8	6.1	7.5
3	1	3		5.6	6.2	6.2	6.1	5.9	5.5	5.4	5.4	5.7	7.9	4.4	7.9	7.6	7.9
3	1	4		5.2	5.6	7.1	7.1	6.9	7.5	6.8	8.3	8.6	10.5	4.9	11.4	11.4	14.2
3	1	5		5.5	6.6	5.3	6.6	5.9	6.1	5.5	7.0	7.7	6.5	8.7	10.0	9.5	8.9
3	1	6		5.1	5.6	4.4	4.2	4.4	4.5	5.2	5.8	6.8	7.1	5.4	8.0	6.9	7.6
3	2	1		5.0	5.4	5.8	5.8	6.0	6.2	6.9	7.0	7.9	9.6	5.8	10.0	9.8	10.1
3	2	2		5.3	5.9	5.1	5.4	5.6	5.5	5.7	6.9	8.0	5.6	7.8	8.1	8.4	9.4
3	2	3		4.9	5.5	5.4	4.6	5.9	6.0	6.4	6.2	7.5	4.3	7.2	7.5	7.6	7.8
3	2	4		5.4	6.1	5.4	4.7	6.0	6.2	8.0	8.7	9.3	10.8	4.5	12.1	11.9	12.4
3	2	5		4.9	5.5	5.3	5.3	5.4	5.8	7.2	8.3	8.3	9.3	4.4	9.8	10.2	10.6
3	2	6		4.2	4.7	4.8	4.5	4.6	4.1	4.6	4.4	6.5	6.4	5.3	6.9	6.7	6.5
3	3	1		4.3	4.9	4.4	5.5	4.5	4.1	4.8	5.9	6.5	7.0	4.4	7.3	7.3	7.5
3	3	2		6.8	8.2	7.1	6.7	6.4	6.3	6.0	5.7	6.3	6.6	5.8	6.9	6.4	7.2
3	3	3		5.9	6.9	6.3	6.2	6.2	5.9	6.3	5.6	6.1	6.3	5.3	5.6	5.8	5.7
3	3	4		4.6	5.5	6.0	5.4	5.4	5.3	5.9	6.2	7.5	8.6	6.6	8.7	9.2	9.0

Contd.

Appendix-10. Continued

S	N	G	E	MONTH													
				1	2	3	4	5	6	7	8	9	10	11	12	13	14
3	3	5		4.9	5.7	5.7	5.9	5.6	5.8	6.2	6.9	8.1	8.9	7.3	8.1	8.4	8.1
3	3	6		4.4	5.1	5.5	4.2	5.1	4.8	5.7	6.5	6.8	7.3	4.5	7.2	6.8	7.6
3	4	1		5.6	6.5	6.2	5.0	5.9	5.2	6.3	7.9	7.1	8.9	5.0	7.1	7.2	8.2
3	4	2		4.2	4.8	4.0	4.7	4.6	4.8	4.2	4.8	5.4	7.4	5.7	6.4	6.5	7.0
3	4	3		4.3	5.1	5.2	4.0	4.8	4.6	4.3	3.6	4.2	6.0	4.1	5.1	4.8	4.5
3	4	4		4.2	4/8	4.6	4.4	4.9	4.8	5.5	6.7	6.9	7.9	9.0	8.1	7.5	8.7
3	4	5		4.7	5.5	5.1	4.6	5.0	5.9	6.4	7.0	8.7	11.3	5.4	10.5	9.0	9.9
3	4	6		4.8	5.6	5.0	4.3	4.8	4.4	5.5	5.7	6.2	8.2	4.5	7.3	7.1	8.4
4	1	1		4.3	5.0	5.1	4.3	4.7	5.1	6.6	7.6	7.7	8.1	5.0	9.5	8.0	10.6
4	1	2		5.7	6.3	5.4	4.9	4.8	3.8	3.0	3.3	3.7	5.6	2.5	4.8	4.6	4.7
4	1	3		5.2	5.7	6.1	5.0	6.7	5.2	4.7	5.1	4.9	6.1	3.6	5.1	4.8	5.4
4	1	4		5.2	5.8	5.6	4.5	5.2	3.6	4.1	4.2	3.8	5.4	4.4	4.8	4.7	5.5
4	1	5		5.1	5.8	5.6	4.7	5.6	4.7	3.2	3.6	4.2	5.1	6.3	5.4	5.7	6.7
4	1	6		5.1	5.7	5.4	4.7	5.4	4.2	2.7	3.5	3.0	5.4	5.3	4.0	4.4	4.9
4	2	1		5.0	5.6	4.8	4.9	4.4	2.7	2.6	2.5	2.5	3.0	5.1	3.3	3.7	4.1
4	2	2		7.2	8.4	6.3	5.4	5.8	4.8	4.9	4.1	4.6	6.4	5.1	6.4	5.7	6.9
4	2	3		5.4	6.2	5.9	5.3	5.3	4.6	4.8	4.8	5.6	7.2	4.4	6.0	6.9	7.7
4	2	4		4.3	5.2	5.2	5.3	4.8	4.4	5.3	6.5	6.2	8.2	6.7	6.7	8.2	8.9
4	2	5		4.8	6.0	5.3	5.5	4.7	4.1	4.6	5.6	5.5	8.3	5.6	6.3	7.4	8.3
4	2	6		6.5	7.2	6.6	5.7	5.4	5.0	5.8	6.9	7.2	7.9	4.7	6.5	7.0	7.9
4	3	1		4.7	6.0	5.2	4.7	5.3	4.9	5.7	6.1	6.0	7.9	5.1	8.0	7.1	7.7
4	3	2		5.6	6.1	6.2	4.4	5.3	4.7	3.3	4/2	4/1	6/7	5.7	6.6	6.5	7.5
4	3	3		5.1	5.6	6.4	6.0	5.8	5.6	4.3	3.2	4.1	6.2	3.7	4.2	5.7	5.5
4	3	4		5.3	6.0	6.3	5.9	6.2	5.3	5.6	5.9	5.7	7.6	4.0	6.9	8.1	9.0
4	3	5		4.6	5.1	5.8	4.9	5.5	4.7	4.3	6.2	6.1	6.8	4.3	7.2	7.4	8.3
4	3	6		5.8	6.4	6.4	5.7	6.2	5.4	4.6	4.1	4.0	6.4	3.5	6.2	5.5	6.2
4	4	1		6.0	6.7	6.9	5.8	6.6	5.2	3.8	4.7	4.2	6.4	2.8	5.0	6.2	6.6
4	4	2		5.6	6.2	6.2	5.1	5.2	4.4	4.4	4.7	3.4	5.6	5.0	4.5	5.5	6.5
4	4	3		5.8	6.4	5.5	4.6	5.9	4.9	4.6	3.3	3.6	6.2	3.5	4.0	4.7	5.8
4	4	4		5.3	5.8	5.4	5.0	5.2	4.9	2.9	2.9	3.0	5.9	3.5	5.1	4.1	4.6
4	4	5		5.6	6.1	6.6	5.1	5.4	5.1	5.5	4.7	5.3	8.7	3.1	7.9	7.5	9.1
4	4	6		5.1	5.5	4.9	5.1	5.5	5.5	5.3	6.1	5.0	7.6	4.0	5.7	6.5	7.2
Treated mean				4.9	5.8	5.2	5.1	5.4	5.2	5.5	5.9	6.5	7.9	8.4	7.6	7.9	8.3
Control mean				5.0	4.9	4.3	3.8	4.7	4.6	5.3	5.9	6.5	7.7	8.3	6.7	7.0	7.9
CD treated vs Control				NS	NS	1.9	2.2	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

APPENDIX-11
LEAF LENGTH

S	N	G	E	MONTH 1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	0	0	4	2.3	3.6	3.0	4.5	4.3	4.4	4.2	6.0	5.7	8.1	7.4	7.1	7.6	8.0
2	0	0	3	3.3	4.1	3.5	3.7	4.5	5.6	4.1	5.6	6.3	7.7	8.1	8.0	7.9	7.6
3	0	0	2	3.4	3.5	3.5	4.4	5.0	5.2	5.3	5.6	6.4	8.4	8.4	6.8	7.3	6.8
4.	0	0	1	3.0	4.4	3.8	4.0	4.9	4.1	4.1	4.8	5.5	6.9	6.4	5.3	4.9	6.3
1	1	1		3.6	4.5	4.2	5.2	5.7	3.9	5.5	5.9	5.7	6.8	6.5	5.1	5.4	5.9
1	1	2		3.6	4.4	4.3	5.5	6.1	5.8	5.5	6.7	5.9	7.0	7.1	6.2	6.1	5.6
1	1	3		4.2	4.9	4.2	6.7	7.0	7.0	6.5	7.7	7.7	9.1	9.8	10.7	9.1	9.5
1	1	4		3.5	4.3	4.3	6.0	6.4	6.0	6.1	6.6	7.5	9.0	8.9	8.3	8.4	8.4
1	1	5		3.9	4.7	4.3	5.6	6.2	6.2	7.0	7.9	8.3	9.3	9.9	9.3	9.1	9.4
1	1	6		3.6	4.6	4.0	5.6	6.3	6.0	6.0	7.7	8.3	8.9	8.2	8.3	8.8	8.1
1	2	1		3.0	4.3	3.8	5.0	5.6	5.0	4.9	5.0	5.2	6.8	6.2	6.1	6.1	6.2
1	2	2		3.4	4.3	3.6	4.5	4.9	4.6	4.9	5.6	5.3	6.2	5.8	5.7	6.2	6.2
1	2	3		3.5	3.9	3.6	4.8	6.7	6.2	6.3	7.9	7.3	9.3	10.0	9.3	9.0	9.1
1	2	4		4.3	4.3	4.1	5.1	6.2	5.7	6.5	7.8	8.0	10.3	10.4	9.6	9.9	10.4
1	2	5		3.5	4.0	3.9	4.9	5.3	5.1	5.1	5.9	5.9	7.8	8.2	7.6	7.1	8.2
1	2	6		3.4	3.9	3.8	4.2	5.5	4.7	5.4	7.3	6.9	8.4	6.8	7.9	8.3	8.9
1	3	1		3.7	4.0	3.8	5.0	5.1	4.6	4.8	5.1	4.5	5.6	5.9	5.9	5.5	5.5
1	3	2		3.7	4.7	4.0	5.2	5.9	5.3	5.6	5.7	6.7	7.2	7.5	7.0	6.8	6.8
1	3	3		3.7	4.3	4.3	5.6	5.5	5.9	6.2	8.0	7.6	9.7	10.1	9.5	9.21	10.0
1	3	4		3.7	4.7	4.0	5.2	5.9	5.3	5.6	5.7	6.7	7.2	7.5	7.0	6.8	6.8
1	3	5		3.7	4.3	4.3	5.6	5.5	5.9	6.2	8.0	7.6	9.7	10.1	9.5	9.2	10.0
1	3	6		4.5	4.0	3.9	5.4	5.8	6.0	6.2	6.7	6.7	7.1	7.2	7.1	7.6	7.4
1	4	1		4.0	4.2	3.6	5.5	5.5	5.1	7.0	6.6	6.7	7.6	8.1	7.7	7.9	7.9
1	4	2		3.9	4.4	3.3	4.0	5.2	3.7	5.6	4.2	4.6	5.7	6.4	4.9	5.8	6.7
1	4	3		3.3	3.9	3.2	4.4	4.9	4.1	4.0	5.5	4.8	6.2	6.8	5.3	6.1	5.7
1	4	4		4.2	4.4	4.0	5.7	6.2	6.0	5.7	6.9	6.6	7.6	8.2	7.4	7.9	7.7
1	4	5		3.7	4.2	3.8	5..1	6.0	4.8	5.5	6.9	6.3	8.0	8.3	7.4	8.9	9.0
1	4	6		3.4	4.3	3.2	4.5	5.7	5.6	5.5	7.7	7.5	8.4	10.3	8.7	10.2	9.1
2	1	1		3.4	3.0	3.7	5.7	5.7	5.4	4.8	7.1	6.2	7.9	8.0	7.7	7.4	8.5
2	1	2		4.0	3.9	4.1	5.4	5.4	4.5	4.5	5.6	4.5	8.7	5.6	5.5	6.1	5.9
2	1	3		3.9	4.3	3.9	5.3	5.8	4.9	4.8	5.8	5.3	6.0	6.7	6.3	6.0	6.0
2	1	4		3.7	4.8	3.8	6.0	5.5	5.3	4.8	7.1	6.1	7.9	7.4	7.1	6.9	6.6
2	1	5		4.2	4..4	4.1	5.6	5.8	5.6	5.7	7.8	7.7	9.1	10.2	9.0	9.1	8.8
2	1	6		4.6	4.9	4.5	5.7	5.4	5.7	5.5	7.5	7.6	9.9	9.5	9.5	8.6	9.0
2	2	1		3.8	4.1	4.1	5.3	4.7	5.3	5.5	7.8	7.4	7.9	9.8	9.1	9.0	9.1
2	2	2		4.0	4.5	4.1	4.2	4.5	5.5	5.5	7.2	6.8	8.3	8.9	8.4	8.3	7.9
2	2	3		3.2	4.0	3.6	4.4	3.9	4.0	4.1	4.7	4.7	5.3	7.0	4.7	4.9	4.6
2	2	4		3.5	4.2	3.8	5.2	3.7	5.5	4.1	4.9	4.6	6.4	5.9	5.4	4.9	4.5
2	2	5		3.2	4.8	4.0	5.2	4.8	6.0	6.0	7.8	7.8	9.6	10.3	9.9	9.7	8.7
2	2	6		4.1	4.6	4.6	4.5	5.6	5.2	7.0	6.6	8.1	8.4	7.7	7.6	7.2	7.2
2	3	1		3.9	3.9	3.6	4.5	4.5	4.6	5.0	6.7	5.6	6.6	7.8	6.9	6.3	6.3
2	3	2		4.1	4.5	3.6	5.4	4.8	4.9	5.1	7.1	6.7	7.4	8.1	7.8	8.2	8.1
2	3	3		3.7	4.6	4.6	5.1	5.2	5.3	5.3	7.1	6.3	6.6	6.9	7.4	6.2	6.8
2	3	4		3.9	4.6	4.4	6.0	4.9	4.8	4.5	6.1	5.1	5.7	6.0	5.4	5.8	5.4
2	3	5		3.6	4.9	4.4	5.4	6.1	6.1	6.4	8.1	7.5	9.4	9.7	9.3	9.6	10.0
2	3	6		3.9	4.6	4.5	5.0	5.2	5.6	5.5	7.6	7.3	8.5	9.5	9.9	9.5	9.4
2	4	1		3.7	4.8	4.2	5.5	4.7	4.9	5.3	7.0	6.1	7.8	7.7	7.4	7.8	7.6
2	4	2		3.0	4.1	4.0	5.3	4.3	4.3	4.4	6.4	5.3	7.0	6.5	6.7	7.4	6.1
2	4	3		3.2	4.0	3.6	4.2	4.3	4.0	4.1	5.8	4.7	5.8	5.8	6.2	6.4	6.1
2	4	4		3.0	4.6	4.0	5.0	5.4	4.8	4.4	4.9	5.6	6.3	6.2	5.4	5.9	4.6
2	4	5		2.9	4.6	4.1	25.0	6.3	5.6	5.8	5.8	6.8	8.0	8.6	8.1	8.2	8.2
2	4	6		3.4	4.9	4.1	25.3	5.6	5.7	5.6	6.5	7.0	8.5	8.4	8.4	8.3	7.7
3	1	1		4.2	4.2	5.1	4.5	6.4	5.5	5.1	6.2	7.0	7.9	8.7	7.9	8.0	7.2
3	1	2		4.3	4.4	4.3	4.8	5.5	5.4	4.8	5.8	6.6	7.6	8.8	8.9	8.4	8.8
3	1	3		4.5	4.5	4.4	4.8	5.3	5.0	4.6	4.6	5.4	5.4	6.1	5.2	5.1	6.0
3	1	4		3.9	4.5	4.1	4.8	5.2	5.0	4.6	4.8	5.7	6.5	7.1	7.0	6.4	6.7
3	1	5		3.9	4.9	4.7	6.2	7.4	5.6	6.3	6.8	7.9	9.4	10.4	10.1	9.8	10.0
3	1	6		4.1	4.6	4.3	5.8	6.6	5.1	5.6	6.5	7.5	8.1	9.2	7.9	9.0	8.7
3	2	1		3.9	4.3	3.7	4.7	5.5	4.6	5.3	5.2	7.6	7.9	8.1	6.8	6.6	6.8
3	2	2		4.1	4.7	4.2	5.3	6.8	5.9	5.3	7.6	8.9	9.4	8.7	9.0	9.1	9.0
3	2	3		4.6	4.6	4.1	5.4	5.8	4.9	5.3	4.5	5.9	7.1	7.5	6.9	6.8	7.2
3	2	4		3.9	4.7	4.9	4.8	5.6	4.9	5.3	4.7	6.0	6.5	5.9	6.2	6.0	5.9
3	2	5		3.2	4.7	4.6	5.4	6.7	6.8	7.0	6.8	8.5	11.5	11.8	10.9	10.9	10.5
3	2	6		3.4	4.3	4.1	5.2	5.9	5.8	6.0	6.6	7.2	9.6	10.5	9.3	9.5	9.1
3	3	1		3.8	3.9	3.9	4.3	4.2	4.0	4.3	5.1	5.7	7.3	6.3	6.1	6.2	6.3
3	3	2		3.9	4.1	3.5	4.3	5.0	4.3	4.4	5.5	6.0	6.9	6.6	6.3	6.8	6.4
3	3	3		3.5	5.5	4.8	5.3	7.4	5.4	4.9	5.4	6.3	6.9	7.4	6.8	5.9	5.0
3	3	4		4.0	5.0	4.4	5.1	5.8	4.5	5.1	4.8	5.1	6.1	6.9	5.8	5.8	5.2
3	3	5		2.9	4.7	4.4	5.0	5.8	4.8	5.5	5.4	6.5	9.2	8.4	7.7	7.4	7.5

Contd.

Appendix-11. Continued

S	N	G	E	MONTH 1	2	3	4	5	6	7	8	9	10	11	12	13	14
3	3	6		3.8	4.5	4.5	5.2	6.3	5.4	6.0	5.4	7.1	8.4	8.3	6.9	7.8	6.9
3	4	1		4.2	4.3	4.0	4.6	6.1	4.7	5.3	6.1	6.5	7.2	8.3	7.0	6.8	7.0
3	4	2		4.3	5.0	4.3	4.9	5.9	5.1	6.0	6.5	6.3	8.3	8.5	7.1	7.4	6.8
3	4	3		3.5	4.0	4.0	4.1	4.6	4.3	4.0	4.2	4.9	5.9	7.2	5.5	5.7	5.4
3	4	4		4.1	3.9	3.7	3.8	4.3	3.7	3.5	3.1	4.1	5.1	5.4	4.3	4.2	4.2
3	4	5		4.4	3.9	3.9	4.5	5.9	5.1	5.2	5.9	6.7	7.7	8.8	7.8	7.6	7.3
3	4	6		3.6	4.0	4.2	5.0	5.7	5.8	5.9	6.4	7.6	9.8	9.9	8.8	9.4	9.9
4	1	1		4.2	4.4	4.3	4.3	5.2	4.5	4.5	5.2	6.0	7.9	8.1	6.0	7.0	7.4
4	1	2		3.7	3.9	3.8	4.6	5.5	5.1	6.3	6.9	8.7	9.1	8.3	7.5	7.6	7.5
4	1	3		4.3	5.0	4.3	4.4	4.7	3.9	3.5	3.6	4.2	3.9	4,6	4,6	5,0	5,0
4	1	4		4.3	4.7	4.6	4.4	5.7	5.0	4.9	4.8	4.9	5.5	5.4	4.9	5.2	5.7
4	1	5		4.1	4.4	4.3	4.4	5.4	4.2	4.0	4.0	4.1	4.7	4.8	4.4	5.1	6.0
4	1	6		4.5	4.1	4.2	4.7	5.6	4.5	3.2	3.7	3.9	4.9	5.7	4.4	5.3	6.2
4	2	1		4.9	4.6	4.0	4.3	5.0	3.8	3.0	3.7	4.1	4.7	4.3	4.1	4.4	4.8
4	2	2		4.7	4.3	4.1	4.4	3.9	2.7	3.2	2.7	3.1	3.7	4.0	3.1	3.9	4.3
4	2	3		5.1	4.0	4.6	4.4	7.5	4.6	4.7	4.7	4.6	5.4	7.0	5.6	5.6	5.7
4	2	4		3.9	4.3	4.6	5.2	5.5	4.3	4.3	4.9	5.4	6.5	6.3	5.3	6.2	7.7
4	2	5		4.1	4.2	4.1	5.0	5.5	4.7	4.7	5.6	5.6	6.8	7.8	6.7	7.1	7.7
4	2	6		4.0	3.9	3.7	4.8	5.1	4.0	4.0	5.1	5.0	6.2	6.8	6.0	5.7	6.5
4	3	1		4.1	4.7	4.5	5.1	5.4	4.5	4.6	6.8	5.7	7.0	7.1	5.4	6.3	7.1
4	3	2		4.5	4.6	3.8	4.6	5.7	4.4	4.7	4.9	4.9	7.0	8.1	6.1	6.6	7.5
4	3	3		4.7	4.7	4.3	4.8	5.1	5.1	3.8	4.3	4.4	5.8	6.0	5.2	5.7	6.4
4	3	4		4.6	4.8	4.6	5.1	3.7	4.3	4.3	4.3	4.2	4.7	5.0	4.2	4.7	5.7
4	3	5		4.6	5.3	5.0	5.4	6.6	5.2	4.9	6.0	5.6	7.2	7.4	6.9	6.5	6.8
4	3	6		4.0	4.6	4.6	5.3	6.0	5.2	4.8	5.5	5.7	6.6	7.0	6.3	6.5	7.0
4	4	1		4.2	4.9	4.3	5.0	6.1	4.4	3.8	3.7	4.1	5.1	6.1	4.8	5.2	5.5
4	4	2		4.0	5.0	4.4	5.0	5.4	4.0	3.8	4.2	3.6	4.9	4.5	4.1	4.9	5.4
4	4	3		4.2	4.2	4.1	5.1	4.7	4.3	4.4	3.3	3.5	4.5	5.5	4.4	4.7	5.0
4	4	4		3.8	4.1	4.5	5.6	5.8	4.5	4.0	3.7	3.4	4.4	5.8	3.4	3.4	4.8
4	4	5		4.3	4.3	3.8	4.7	5.6	4.5	3.0	3.6	3.2	4.2	4.8	4.2	4.4	4.1
4	4	6		4.5	4.3	4.3	5.0	4.9	4.2	4.3	5.1	5.2	6.8	7.2	6.9	7.0	7.9
Treated mean				3.9	4.4	4.1	5.4	5.5	5.0	5.0	5.8	3.7	7.1	7.6	6.8	6.9	7.1
Control mean				3.0	3.9	3.4	4.1	47	4.8	4.4	5.5	5.9	7.7	7.5	6.8	6.9	7.2
CD treated vs Control				1.4	1.1	1.1	NS	2.0	NS	NS	NS	2.8	NS	NS	NS	NS	NS

APPENDIX- 12
LEAF BREADTH

S	N	G	E	MONTH 1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	0	0	4	2.1	3.4	3.9	3.1	3.3	3.5	3.7	3.9	4.5	5.3	4.3	5.5	5.3	5.9
2	0	0	3	2.5	3.3	3.0	2.5	3.4	3.3	3.6	4.6	4.5	5.0	5.9	5.9	6.0	5.8
3	0	0	2	2.6	2.8	2.7	3.2	3.8	4.1	4.0	5.0	4.9	6.1	6.2	5.7	5.9	5.4
4	0	0	1	2.6	3.5	3.1	2.9	3.8	3.5	3.8	3.9	4.4	4.5	4.4	4.0	4.2	4.9
1	1	1		3.0	3.5	3.7	3.4	3.8	3.7	4.4	3.7	5.0	4.4	4.5	3.5	4.0	4.1
1	1	2		3.0	3.5	3.5	3.8	4.0	3.9	4.1	4.5	4.5	4.6	4.6	4.2	4.2	4.4
1	1	3		3.1	4.0	4.3	3.8	5.0	4.7	5.2	5.3	6.5	6.3	7.7	7.7	6.8	7.7
1	1	4		3.2	3.5	4.0	3.8	4.4	4.0	4.8	5.6	6.2	6.2	7.7	7.7	6.8	7.7
1	1	5		3.1	4.0	4.0	4.0	4.4	4.6	5.3	5.6	5.8	7.7	7.3	7.4	7.2	7.2
1	1	6		3.1	3.9	3.7	4.1	4.8	4.8	5.6	5.7	6.5	6.8	6.5	6.1	6.4	6.0
1	2	1		2.2	3.4	3.4	3.0	4.2	3.5	3.7	3.6	4.0	4.0	4.3	4.2	4.6	4.4
1	2	2		2.6	3.6	4.2	2.9	3.7	3.3	3.7	3.4	3.6	3.8	4.2	4.1	4.4	4.5
1	2	3		2.7	3.3	3.4	3.4	4.7	4.8	5.1	5.0	5.6	7.0	7.2	6.7	7.1	7.0
1	2	4		3.3	3.4	3.5	3.7	4.8	4.6	5.1	5.3	5.4	7.2	6.9	8.0	7.9	8.2
1	2	5		2.8	3.3	3.5	3.7	3.8	3.8	4.0	4.8	5.8	5.7	5.9	5.7	5.9	6.4
1	2	6		2.9	3.0	3.4	3.3	4.1	3.8	4.3	5.2	5.4	5.8	5.8	5.8	6.1	6.8
1	3	1		3.2	3.3	3.0	3.2	3.8	3.2	3.2	3.4	4.2	4.0	4.1	5.9	4.1	4.1
1	3	2		3.4	3.6	3.7	4.0	4.0	3.2	4.0	4.2	4.7	4.7	5.0	5.4	5.0	5.0
1	3	3		3.1	3.4	3.6	4.1	3.8	4.3	4.9	5.7	6.0	6.8	6.7	7.3	6.8	7.3
1	3	4		3.6	3.5	3.4	3.5	3.9	4.0	4.4	4.6	3.4	4.9	5.1	5.0	5.9	5.7
1	3	5		3.3	3.0	3.2	3.8	3.7	3.6	4.8	4.7	4.8	4.8	5.1	6.0	5.5	5.8
1	3	6		3.1	2.8	2.7	3.1	3.3	3.1	3.3	3.0	3.3	3.9	4.1	4.2	4.1	5.9
1	4	1		3.6	3.0	3.1	3.0	3.2	3.0	3.0	3.4	3.8	4.0	3.8	4.2	4.5	4.2
1	4	2		3.3	3.6	3.4	3.7	4.2	4.2	4.0	4.4	4.7	4.9	5.2	6.0	5.9	5.9
1	4	3		3.0	3.3	3.4	3.8	4.5	3.7	4.1	4.6	4.9	4.5	5.7	6.1	6.5	7.1
1	4	4		2.3	3.2	3.2	3.3	4.2	4.2	4.8	5.7	5.9	6.1	7.5	7.1	7.1	6.9
1	4	5		2.9	3.1	3.3	3.4	4.7	4.0	4.3	4.4	4.9	4.8	5.5	5.8	6.4	6.8
1	4	6		3.2	3.2	3.5	3.7	4.0	4.2	3.4	3.7	3.7	3.9	3.7	4.2	4.5	4.7
2	1	1		3.2	3.5	3.0	3.7	12.9	3.3	3.8	3.8	3.8	4.1	4.3	4.0	3.7	3.8
2	1	2		3.1	3.6	3.9	3.9	3.7	3.6	3.8	4.0	4.5	4.7	4.3	5.0	4.9	4.9
2	1	3		3.4	3.5	3.3	4.0	4.4	4.0	4.6	5.4	5.9	6.6	7.4	7.0	6.6	6.8
2	1	4		3.6	4.1	3.8	3.8	3.9	4.0	4.6	5.5	5.6	7.0	6.4	6.9	7.1	7.0
2	1	5		3.0	3.4	3.3	4.0	2.8	4.0	4.6	5.2	5.8	6.1	6.7	6.9	6.7	6.8
2	1	6		3.0	3.7	3.5	3.6	3.6	3.7	4.2	5.2	5.4	5.8	6.1	5.6	6.5	5.9
2	2	1		2.8	3.2	3.3	3.6	2.9	3.0	3.0	2.9	3.9	3.3	4.2	3.5	3.6	3.5
2	2	2		3.1	3.3	3.4	3.9	3.0	3.1	3.1	3.1	3.6	4.2	3.7	2.8	3.6	3.0
2	2	3		2.7	3.8	3.4	3.8	3.6	5.0	5.0	5.3	5.8	7.1	7.3	7.3	7.9	6.8
2	2	4		3.2	3.5	3.6	3.2	3.6	4.2	4.7	4.7	5.1	5.6	6.5	5.8	5.6	5.4
2	2	5		2.7	2.9	2.9	3.7	3.2	3.1	3.9	3.9	5.6	4.8	5.2	4.8	4.8	4.7
2	2	6		3.1	2.9	3.1	3.3	3.5	3.6	4.2	4.7	5.1	5.1	5.7	5.7	5.6	6.2
2	3	1		3.0	3.3	3.6	3.5	3.8	3.7	4.2	4.5	4.4	4.6	5.2	4.9	4.8	4.9
2	3	2		3.1	3.4	2.8	4.2	3.1	3.4	3.9	3.5	3.9	3.9	4.0	3.6	3.9	3.6
2	3	3		3.1	3.9	3.7	4.3	4.1	4.2	4.8	5.3	6.5	7.0	7.2	7.3	7.4	7.4
2	3	4		3.3	3.7	3.5	3.8	3.6	4.4	4.4	5.0	5.7	6.4	6.9	7.7	7.4	7.5
2	3	5		3.4	3.7	3.6	3.4	4.0	4.2	4.1	4.5	4.8	8.5	5.2	5.6	5.6	6.0
2	3	6		2.7	3.2	3.2	3.3	3.1	3.7	3.8	4.2	3.8	8.1	4.9	4.8	5.0	4.8
2	4	1		2.7	2.9	2.9	3.4	3.2	3.1	3.4	3.2	3.4	4.1	4.0	4.2	4.3	4.7
2	4	2		2.7	3.0	3.3	3.6	3.6	3.5	3.5	5.1	3.5	4.1	4.6	3.9	4.2	3.7
2	4	3		2.4	3.5	3.7	3.7	5.0	4.6	4.7	5.1	5.2	5.5	6.4	6.1	6.2	6.4
2	4	4		3.0	3.7	3.6	3.7	4.3	4.6	4.5	4.7	5.8	6.6	6.7	6.4	6.7	6.0
2	4	5		3.4	3.7	4.0	3.1	4.7	4.2	4.2	4.9	4.9	5.9	6.6	6.3	6.0	5.6
2	4	6		3.3	3.4	3.6	3.1	4.2	4.2	4.0	4.0	5.0	5.7	6.5	6.9	6.3	6.7
3	1	1		3.5	3.4	3.6	3.5	3.8	3.3	3.3	3.4	3.9	3.8	4.0	3.9	3.6	4.2
3	1	2		3.0	3.4	3.1	3.7	4.4	3.4	3.6	3.8	4.0	4.4	4.7	4.5	4.3	4.8
3	1	3		2.9	3.6	3.7	4.6	5.6	4.2	4.9	5.3	6.3	6.8	7.8	7.8	7.8	8.0
3	1	4		3.5	3.6	3.6	4.1	4.6	4.2	4.4	4.6	5.6	6.3	7.1	6.0	6.6	6.4
3	1	5		3.0	3.2	3.1	3.3	3.8	3.7	3.9	4.5	4.9	5.3	5.2	5.1	5.1	5.3
3	1	6		3.4	3.7	3.7	4.2	4.9	4.7	5.2	4.7	5.9	6.8	7.1	6.7	6.8	7.3
3	2	1		3.3	3.5	3.5	3.8	4.3	3.7	3.8	3.7	4.1	5.0	5.6	5.2	4.6	5.3
3	2	2		3.0	3.5	3.8	3.7	4.2	3.4	3.6	3.5	3.8	4.4	4.8	4.2	6.2	4.4
3	2	3		2.7	3.9	3.6	3.9	5.2	4.9	6.0	6.1	6.8	8.0	8.9	8.3	10.9	8.2
3	2	4		2.8	3.3	3.2	3.9	4.1	3.7	4.6	5.8	5.8	6.7	8.1	7.3	9.5	7.0
3	2	5		2.8	3.1	3.6	3.5	3.4	3.2	3.3	3.5	3.9	4.1	5.1	4.9	4.8	4.7
3	2	6		3.2	3.2	2.9	3.3	3.6	3.2	3.4	4.0	4.4	4.7	4.8	4.8	5.0	4.6
3	3	1		3.2	4.2	3.6	3.9	4.3	3.6	3.9	4.0	4.4	4.5	5.1	4.0	3.9	4.2
3	3	2		3.2	3.7	3.5	3.7	3.8	3.0	3.7	3.8	4.1	4.3	5.1	3.8	4.0	4.0
3	3	3		2.7	3.4	3.4	3.5	4.3	3.1	4.3	4.4	5.2	6.1	6.2	6.1	5.3	6.3

Contd.

Appendix-12. Continued

S	N	G	E	1	2	3	4	5	6	7	8	9	10	11	12	13	14
				MONTH													
3	3	4		2.9	3.7	3.5	3.5	4.5	4.0	5.0	4.4	5.5	6.7	6.8	6.0	6.0	5.0
3	3	5		3.7	3.7	3.4	3.5	4.4	3.5	4.7	5.0	5.0	5.6	6.1	5.5	5.6	5.4
3	3	6		3.1	3.7	3.4	3.8	4.3	3.8	5.1	5.1	4.8	5.9	6.3	5.3	6.3	5.7
3	4	1		3.0	3.2	3.4	3.1	3.1	3.1	3.3	3.6	3.9	4.3	4.9	3.9	3.7	4.0
3	4	2		3.2	3.3	3.1	2.9	3.1	2.6	3.9	2.7	2.9	3.4	3.6	3.0	3.3	3.4
3	4	3		3.5	3.2	3.2	3.2	3.9	3.6	4.3	4.8	4.7	5.3	6.3	5.2	5.2	5.7
3	4	4		2.8	3.2	3.4	3.5	4.0	4.7	4.6	4.1	6.3	7.0	7.6	6.0	6.5	7.0
3	4	5		3.3	3.3	3.4	3.4	3.8	3.6	3.7	3.8	4.3	5.5	5.7	4.9	5.4	5.6
3	4	6		3.0	3.2	3.3	3.7	3.9	4.0	4.8	5.1	5.2	6.2	7.2	6.2	3.8	6.7
4	1	1		3.4	4.1	3.4	3.0	4.0	3.3	2.8	3.1	2.9	3.0	3.5	3.1	3.9	5.9
4	1	2		3.4	3.9	3.3	3.3	4.4	3.6	4.0	3.8	4.0	3.9	4.1	3.7	4.1	4.3
4	1	3		3.7	3.4	3.4	3.1	3.8	3.3	3.2	3.4	3.2	3.8	3.7	3.5	3.2	4.5
4	1	4		3.6	3.2	3.4	3.5	4.2	3.4	3.1	3.2	3.5	3.4	4.3	3.3	4.1	4.7
4	1	5		4.0	3.3	3.0	3.3	3.9	3.3	2.8	3.3	3.9	3.4	3.2	3.1	3.5	3.5
4	1	6		3.6	3.5	3.0	3.4	3.5	2.6	2.5	2.0	2.5	2.7	2.7	2.5	2.9	3.1
4	2	1		3.7	3.1	3.7	3.4	6.5	3.4	4.1	3.5	2.6	3.9	5.1	4.3	3.9	4.7
4	2	2		3.2	3.6	3.3	3.6	4.3	3.3	3.6	3.8	4.3	4.8	4.6	4.4	5.1	4.7
4	2	3		3.3	3.4	3.1	4.0	4.3	3.4	4.3	4.1	4.7	4.9	5.5	5.1	5.5	6.0
4	2	4		3.4	3.0	2.8	3.6	3.8	3.4	4.0	3.9	3.9	4.9	4.9	4.4	4.5	5.2
4	2	5		3.5	3.8	3.5	4.1	3.9	3.6	4.3	4.8	4.7	5.1	5.0	4.4	4.9	4.9
4	2	6		3.7	3.5	3.0	3.3	4.2	3.4	4.1	4.3	4.7	5.1	5.5	5.1	5.0	5.3
4	3	1		3.8	3.5	3.7	3.7	3.9	3.5	3.2	3.3	3.6	4.1	4.0	3.9	4.3	4.9
4	3	2		3.8	3.5	3.5	3.7	4.4	3.7	3.6	3.5	3.3	3.4	3.8	3.4	3.7	4.3
4	3	3		3.8	4.0	3.9	3.0	4.3	4.2	4.4	4.5	4.7	4.5	5.4	5.0	5.0	5.6
4	3	4		3.6	3.3	3.7	3.9	4.5	4.0	4.2	4.7	4.8	4.5	5.4	4.8	5.0	5.6
4	3	5		3.2	3.6	3.8	3.8	5.0	3.8	3.5	3.1	3.3	3.7	4.1	3.5	4.0	4.5
4	3	6		3.5	3.8	3.5	3.8	4.5	3.7	3.9	3.2	3.0	3.5	3.7	3.4	4.1	3.8
4	4	1		3.2	3.1	3.0	3.9	5.2	3.4	3.3	3.6	2.8	3.2	3.6	3.4	3.6	3.7
4	4	2		3.1	3.2	3.2	3.8	3.6	3.6	3.8	3.0	2.4	3.4	4.4	2.3	3.0	3.6
4	4	3		3.5	3.3	3.1	3.8	3.8	3.2	2.7	3.1	2.6	3.9	3.1	3.1	3.1	3.0
4	4	4		3.6	3.5	3.4	4.0	4.1	3.4	3.7	4.0	4.2	4.8	5.2	5.2	5.4	6.1
4	4	5		2.8	3.6	3.1	3.6	4.4	4.1	4.5	4.7	4.0	5.5	5.5	4.2	4.1	5.1
4	4	6		3.0	3.6	3.6	4.0	4.7	4.1	4.0	4.8	4.7	5.3	5.7	5.0	4.9	5.9
Treated mean				3.2	3.4	3.4	4.3	4.2	3.7	4.7	4.3	4.6	5.1	5.4	5.1	5.3	5.4
Control mean				2.4	3.2	3.2	2.9	3.6	3.6	3.8	4.3	4.6	5.2	5.2	5.3	5.3	5.5
CD treated vs Control				0.9	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

APPENDIX- 13
INDEX LEAF AREA

S	N	G	E	MONTH 1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	0	0	4	6.1	11.2	9.2	12.6	16.5	18.5	19.0	29.4	31.3	49.1	46.2	44.6	50.3	58.8
2	0	0	3	8.5	10.1	11.0	9.9	17.2	16.6	17.6	29.9	32.9	45.7	50.9	57.7	36.5	54.9
3	0	0	2	10.0	10.3	9.6	14.8	20.4	23.9	23.4	33.1	37.8	60.7	60.2	45.5	51.7	48.8
4	0	0	1	9.4	15.6	12.5	12.0	19.0	15.4	17.4	19.7	26.2	32.3	31.3	22.8	22.2	32.7
1	1	1		11.1	15.9	15.4	27.8	21.8	20.5	24.9	22.9	29.3	29.6	30.4	18.4	22.5	24.7
1	1	2		10.1	13.9	15.3	20.9	25.0	23.1	23.6	31.0	27.9	33.9	33.6	27.1	25.9	25.6
1	1	3		13.6	19.8	18.1	22.0	35.9	33.8	35.4	42.8	51.9	59.1	77.5	76.2	64.0	74.7
1	1	4		9.8	15.0	17.4	22.6	28.8	24.6	30.3	42.6	47.2	54.5	70.0	54.7	56.4	53.8
1	1	5		12.3	18.8	17.1	22.6	28.3	27.3	37.5	46.3	54.1	67.5	75.4	72.0	68.6	71.0
1	1	6		11.3	18.0	14.0	23.4	32.0	30.6	40.7	46.0	56.1	72.1	56.0	51.1	56.5	50.5
1	2	1		7.5	14.2	13.1	15.3	24.5	19.8	19.6	20.3	22.9	28.8	31.3	28.4	31.0	31.0
1	2	2		9.3	13.2	11.3	13.2	18.6	15.8	18.3	20.0	19.9	23.6	25.0	34.9	28.4	29.9
1	2	3		10.4	13.1	12.5	16.9	32.0	32.0	33.5	41.1	42.7	68.1	72.0	57.6	65.2	65.6
1	2	4		14.9	15.5	14.6	16.68	32.7	28.4	34.2	44.5	46.7	77.9	73.2	82.6	83.0	90.9
1	2	5		9.9	14.9	13.9	19.9	21.5	21.0	22.8	32.4	31.0	49.0	52.9	46.8	45.4	43.8
1	2	6		9.1	12.2	12.7	14.1	22.0	19.0	23.9	39.5	38.4	50.0	41.7	46.1	51.4	62.2
1	3	1		12.1	13.5	11.8	16.4	19.8	14.9	15.6	19.8	20.4	24.3	24.8	24.3	24.4	23.9
1	3	2		14.4	17.3	15.7	21.3	24.3	18.4	22.7	24.5	32.2	28.3	39.2	35.9	37.0	37.6
1	3	3		11.4	15.1	15.5	25.5	22.2	27.9	32.3	47.8	49.1	62.2	70.1	74.6	63.8	77.4
1	3	4		17.3	12.8	12.9	18.9	22.7	24.4	27.6	31.7	46.5	36.7	38/2	36.2	50.7	44.1
1	3	5		13.5	12.7	12.0	22.1	23.4	19/6	30.0	35.5	34.0	34.9	38.2	53.1	45.2	49.5
1	3	6		12.2	11.0	9.6	12.8	14.1	11.9	12.7	13.2	16.7	23.4	25.2	22.6	27.6	35.0
1	4	1		11.7	11.9	9.8	13.4	16.0	12.7	12.5	19.6	19.8	27.8	21.8	21.7	24.0	25.7
1	4	2		13.8	17.1	15.7	26.8	33.1	32.9	31.1	46.0	44.1	39.0	12.5	12.7	59.8	59.6
1	4	3		10.6	14.1	13.0	20.8	28.0	18.7	24.6	32.7	32.4	48.6	48.7	46.7	62.2	69.5
1	4	4		9.7	14.7	10.8	15.6	26.8	25.3	29.8	48.4	49.9	59.0	83.0	68.8	76.4	67.5
1	4	5		10.7	12.9	11.1	17.1	27.4	22.2	23.3	36.3	34.6	43.8	58.0	64.5	47.8	66.0
1	4	6		13.0	13.1	15.1	19.9	25.5	19.8	16.2	22.8	18.3	25.2	24.1	26.9	31.2	29.5
2	1	1		12.8	15.5	11.9	14.6	15.1	16.6	19.5	24.5	21.6	27.1	30.9	27.5	24.9	24.8
2	1	2		12.1	17.5	10.9	19.5	21.7	19.6	19.2	30.5	29.4	39.4	34.6	38.5	36.6	36.7
2	1	3		15.2	15.6	13.8	24.3	26.6	25.1	27.6	40.5	47.67	70.6	79.7	66.0	65.5	62.9
2	1	4		16.6	20.1	17.7	23.0	21.7	24.3	26.8	44.3	44.2	75.3	62.3	70.0	65.5	67.2
2	1	5		11.5	14.3	13.5	21.7	18.6	21.9	26.2	41.0	43.4	49.5	67.1	65.3	72.0	64.3
2	1	6		12.5	16.5	13.8	21.7	17.0	22.0	24.6	40.5	39.3	53.1	58.4	50.8	58.1	50.3
2	2	1		9.9	11.9	12.3	15.3	11.6	12.3	13.2	15.0	19.9	18.3	27.7	17.9	19.5	16.7
2	2	2		11.0	14.4	13.3	16.1	12.0	14.7	13.7	16.1	17.5	29.6	14.0	20.2	18.6	14.4
2	2	3		8.9	19.2	14.9	22.2	18.3	31.3	31.5	43.3	49.4	73.5	79.6	76.6	75.6	66.0
2	2	4		12.5	16.8	18.1	22.1	17.8	27.2	28.2	37.7	35.2	48.4	49.3	47.5	45.3	44.4
2	2	5		14.0	11.1	10.6	14.1	14.8	14.7	20.9	27.6	31.1	34.0	43.3	35.8	32.4	32.4
2	2	6		15.1	14.5	11.6	16.2	18.0	19.3	23.7	36.9	38.8	41.6	50.3	51.3	52.5	58.4
2	3	1		11.1	16.0	16.3	18.5	20.2	20.3	23.6	35.5	29.9	34.8	38.8	38.5	31.6	31.0
2	3	2		12.6	16.8	16.6	17.6	16.1	16.7	18.1	23.4	21.0	24.4	26.4	21.0	27.7	21.6
2	3	3		11.4	19.2	26.5	25.8	26.0	26.5	32.5	45.7	52.0	70.2	73.8	69.6	75.3	78.7
2	3	4		13.4	17.5	15.8	23.2	19.6	20.6	25.3	41.6	44.1	59.0	71.8	69.2	78.0	79.8
2	3	5		12.4	18.0	15.6	19.2	19.0	21.8	23.5	35.5	31.4	47.6	49.1	48.1	49.8	53.2
2	3	6		8.6	13.3	12.8	15.6	14.1	16.5	17.1	30.0	22.1	38.2	35.1	34.5	39.4	32.2
2	4	1		9.3	12.2	10.3	14.6	14.3	11.9	14.6	20.4	17.2	24.4	24.3	28.2	29.4	30.6
2	4	2		8.1	13.8	13.2	14.4	20.5	17.6	16.6	17.0	24.1	27.6	31.2	23.5	27.2	18.8
2	4	3		7.8	16.1	15.6	19.4	33.2	27.6	30.4	34.2	42.0	53.1	64.7	57.6	58.5	62.3
2	4	4		10.6	18.5	14.1	20.1	25.4	27.0	26.5	36.1	44.8	60.1	60.5	58.5	60.5	51.1
2	4	5		15.1	20.5	21.0	20.0	30.3	24.1	21.2	34.1	35.4	50.4	60.0	50.5	49.6	43.1
2	4	6		14.1	15.1	16.0	14.5	25.6	23.3	23.7	31.8	35.0	47.5	62.8	59.9	67.7	56.7
3	1	1		16.3	15.3	16.1	17.0	21.8	16.8	15.6	16.0	22.9	21.4	26.9	21.2	19.7	27.2
3	1	2		12.7	16.1	13.1	19.1	23.4	17.3	16.7	18.7	23.2	29.9	46.4	33.3	19.3	33.9
3	1	3		12.2	18.1	18.2	29.9	45.0	26.6	33.0	41.3	54.4	69.1	87.1	83.2	81.4	82.8
3	1	4		14.6	17.1	16.0	23.5	32.5	23.9	27.3	30.3	44.3	51.7	66.8	48.7	63.8	57.3
3	1	5		12.4	13.2	11.6	16.4	21.8	18.9	22.2	27.9	16.2	47.7	40.5	38.6	38.6	40.4
3	1	6		14.3	17.3	15.8	22.6	33.5	28.5	36.2	31.9	48.9	66.9	72.8	63.8	65.4	75.8
3	2	1		20.3	16.3	16.5	20.0	25.2	18.9	22.3	18.4	23.4	35.3	44.2	36.7	32.5	38.9
3	2	2		12,1	17.1	18.7	18.4	23.7	17.4	19.4	17.1	13.4	30.7	31.9	26.0	25.7	27.3
3	2	3		8.6	18.4	16.8	21.7	35.6	34.3	43.2	43.0	59.4	93.9	106.0	92.0	94.9	82.0
3	2	4		11.7	15.0	13.4	21.1	25.1	28.8	28.8	40.3	44.3	70.9	89.5	70.8	72.6	65.4
3	2	5		14.4	12.7	13.7	14.8	16.3	13.9	14.1	46.2	21.5	25.0	39.8	33.4	31.2	30.8
3	2	6		12.8	13.3	10.6	15.0	19.4	14.6	16.2	23.6	28.5	36.3	35.3	31.7	36.4	33.6
3	3	1		11.8	23.5	18.0	20.9	28.1	20.3	20.7	23.2	30.5	34.6	41.1	27.7	24.3	23.9
3	3	2		13.2	29.2	17.6	19.0	22.1	13.8	19.4	20.4	22.3	27.1	38.1	24.3	25.6	24.9
3	3	3		9.5	14.3	13.6	17.5	25.4	15.6	24.3	23.9	30.7	60.6	54.5	52.6	42.2	50.8
3	3	4		11.2	12.1	16.5	18.5	29.4	22.2	32.0	29.1	41.4	60.4	61.3	46.6	50.7	40.9

Contd

Appendix-13. Continued

S	N	G	E	MONTH 1	2	3	4	5	6	7	8	9	10	11	12	13	14
3	3	5		16.7	16.1	13.8	16.1	27.0	18.0	27.4	31.6	34.0	43.3	52.8	41.0	40.5	40.6
3	3	6		14.6	18.8	13.7	18.5	24.0	20.9	33.2	37.0	34.5	35.5	59.7	40.6	43.3	40.9
3	4	1		14.3	13.7	15.1	13.3	15.7	14.9	15.3	16.5	20.3	27.4	38.2	22.9	22.7	23.8
3	4	2		13.4	13.1	11.9	11.3	13.9	10.4	10.5	9.7	12.8	11.8	21.8	13.1	15.0	16.0
3	4	3		15.6	13.6	13.3	15.4	20.0	19.2	25.3	30.3	33.3	44.1	60.8	43.6	42.2	44.9
3	4	4		10.4	14.0	14.4	18.1	23.8	30.1	31.4	36.3	51.2	72.9	86.8	64.3	68.8	67.3
3	4	5		14.2	15.2	15.0	15.2	20.2	17.7	18.2	21.7	29.4	49.7	51.8	34.2	43.6	46.1
3	4	6		11.1	12.7	13.3	15.0	20.4	23.4	26.9	38.7	41.1	66.8	77.2	48.0	43.4	70.6
4	1	1		14.8	20.9	14.7	13.4	20.3	14.0	11.1	12.0	14.5	13.5	19.0	16.1	21.6	21.7
4	1	2		15.2	18.5	15.3	14.8	25.2	18.6	20.3	21.0	22.5	25.0	27.5	21.6	25.5	29.0
4	1	3		19.0	15.1	14.9	13.9	21.8	14.8	13.6	16.2	15.6	21.1	21.1	16.6	15.3	31.4
4	1	4		16.8	13.1	14.3	16.4	23.5	15.4	10.4	12.1	13.8	16.2	27.5	16.3	14.7	33.7
4	1	5		19.7	15.4	12.1	14.3	20.0	13.9	9.2	13.3	13.3	17.4	16.0	11.1	16.0	17.7
4	1	6		17.2	14.5	12.5	17.5	14.0	7.3	9.0	6.3	8.8	11.4	12.4	8.9	11.4	14.0
4	2	1		19.4	12.9	17.7	15.6	48.8	16.0	20.6	20.4	19.2	4.1	40.1	26.3	23.8	32.1
4	2	2		13.0	15.9	15.4	19.1	25.3	14.7	16.0	21.3	25.8	34.8	33.6	26.3	25.3	47.1
4	2	3		12.9	15.2	14.8	21.6	24.5	18.7	23.4	25.7	29.6	37.7	46.1	36.9	42.0	51.1
4	2	4		14.2	12.5	10.6	17.6	22.0	11.2	16.5	3.9	24.4	28.5	36.1	38.4	37.0	37.8
4	2	5		14.9	18.0	15.1	20.8	21.3	16.4	20.1	4.8	27.2	39.5	37.9	25.5	31.9	36.1
4	2	6		17.5	16.9	11.9	15.7	24.3	18.6	20.1	4.3	25.3	39.5	51.9	33.3	37.3	45.7
4	3	1		17.5	16.7	16.5	18.3	21.6	19.2	12.6	14.6	17.2	25.2	25.3	21.1	26.0	33.4
4	3	2		17.2	17.0	15.9	18.9	25.6	16.2	15.8	15.7	15.0	16.4	19.4	15.1	18.1	26.1
4	3	3		17.8	23.2	19.6	21.1	24.5	22.0	21.8	27.8	27.2	33.9	44.3	36.6	33.7	40.1
4	3	4		15.6	16.1	17.6	21.5	27.8	22.5	21.7	29.5	30.8	36.2	43.0	35.4	37.4	46.1
4	3	5		13.4	18.1	18.2	19.5	32.0	17.0	11.4	12.2	14.6	19.7	24.5	18.5	22.4	28.0
4	3	6		14.3	19.5	16.2	19.4	24.9	15.1	15.1	15.1	11.8	19.0	17.8	15.6	23.0	26.9
4	4	1		13.3	13.7	12.9	20.1	30.4	15.4	15.0	12.3	11.0	16.4	21.9	15.2	17.9	20.1
4	4	2		12.9	13.9	14.9	23.5	20.0	18.2	19.0	12.9	13.1	22.0	34.1	8.4	11.0	19.5
4	4	3		15.3	14.4	12.2	18.6	22.2	15.4	8.4	12.6	9.5	20.9	15.8	10.8	14.5	13.4
4	4	4		16.4	15.9	14.8	20.1	24.7	13.8	18.0	29.1	25.0	34.7	41.0	40.8	42.1	40.7
4	4	5		10.2	16.5	11.8	16.5	25.2	20.6	22.3	29.3	18.4	28.5	30.2	23.6	25.6	35.9
4	4	6		10.1	15.0	16.5	22.4	24.3	23.5	21.5	28.4	32.7	39.6	53.4	30.6	39.3	54.0
Treated mean				12.9	15.6	14.4	18.7	23.7	20.2	22.3	27.7	30.4	40.8	46.4	40.4	43.8	43.7
Control mean				8.5	11.8	10.5	9.8	18.2	18.6	19.3	28.0	32.0	46.9	47.1	42.6	45.2	48.8
CD treated vs Control				8.3	8.3	7.5	9.8	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

APPENDIX- 14

TOTAL LEAF AREA (cm^2)

S	N	G	E	MONTH 1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	0	0	4	62	64	70	79	90	116	148	169	172	172	172	172	179	187
2	0	0	3	44	63	77	89	124	136	160	194	200	200	200	200	230	240
3	0	0	2	56	66	102	117	166	206	245	245	261	361	454	553	553	590
4.	0	0	1	43	62	74	90	124	171	189	197	271	289	442	442	498	522
1	1	1		55	74	89	100	108	119	119	119	119	250	205	220	234	242
1	1	2		52	73	84	109	132	133	141	164	164	200	200	200	239	. 251
1	1	3		36	48	61	77	89	102	102	138	165	192	201	235	281	288
1	1	4		46	53	63	71	84	110	110	114	126	161	181	181	213	226
1	1	5		51	54	65	77	93	157	190	231	369	369	434	434	434	502
1	1	6		69	82	91	105	128	136	177	177	269	269	269	286	286	120
1	2	1		41	57	72	86	127	130	157	157	198	212	212	212	212	221
1	2	2		38	57	66	74	78	80	126	167	167	282	282	282	353	366
1	2	3		56	67	84	93	121	140	140	156	156	217	241	241	241	251
1	2	4		68	78	96	106	119	139	139	146	162	223	223	223	234	251
1	2	5		46	64	81	94	127	169	270	270	444	527	534	534	650	693
1	2	6		79	88	96	115	149	198	253	259	313	363	389	389	399	433
1	3	1		64	76	84	91	114	134	191	191	232	232	299	299	348	358
1	3	2		61	73	84	92	97	101	126	139	161	170	85	185	213	226
1	3	3		49	68	73	87	105	105	123	134	153	206	228	228	234	244
1	3	4		70	85	100	181	181	226	282	282	443	469	531	531	543	551
1	3	5		53	61	73	95	128	202	242	312	483	483	605	605	641	730
1	3	6		34	58	64	82	119	156	262	406	505	515	515	515	673	737
1	4	1		43	60	74	79	141	146	146	189	252	270	270	270	270	305
1	4	2		59	72	87	87	107	126	160	160	205	332	332	332	356	368
1	4	3		39	50	59	72	72	85	85	88	113	113	141	141	156	169
1	4	4		63	81	90	99	118	120	146	167	210	251	269	269	269	299
1	4	5		52	71	84	109	111	140	144	174	174	213	213	213	241	253
1	4	6		71	87	105	131	157	165	277	289	430	430	430	430	640	701
2	1	1		81	99	125	129	172	172	275	306	438	579	579	579	800	872
2	1	2		67	85	98	105	111	111	165	173	189	268	268	268	412	435
2	1	3		61	76	79	98	110	110	153	189	246	334	367	367	421	458
2	1	4		37	56	61	66	72	72	86	116	170	202	202	202	314	332
2	1	5		46	72	73	75	76	76	122	133	193	193	193	193	193	225
2	1	6		36	61	76	80	94	152	210	245	274	400	400	400	424	488
2	2	1		51	75	86	105	126	126	238	272	373	433	433	433	433	511
2	2	2		71	73	81	95	102	102	139	144	213	275	275	289	289	323
2	2	3		68	76	85	109	121	133	193	263	302	343	343	343	360	390
2	2	4		49	67	77	108	122	122	131	201	234	298	298	298	298	370
2	2	5		62	66	90	111	138	138	138	138	167	203	203	203	221	255
2	2	6		50	71	85	111	151	174	247	247	340	466	466	466	526	605
2	3	1		61	80	94	118	148	187	195	215	296	458	458	498	598	676
2	3	2		57	75	86	95	95	95	125	139	176	271	271	290	290	304
2	3	3		41	54	64	79	91	91	103	148	148	309	309	309	337	357
2	3	4		38	50	58	58	68	68	81	95	115	198	198	209	273	292
2	3	5		42	51	57	65	75	75	80	93	98	121	121	121	131	149
2	3	6		34	46	55	76	103	112	163	203	343	396	396	429	429	490
2	4	1		58	66	68	108	138	169	190	190	361	373	373	373	451	488
2	4	2		63	79	96	120	150	150	171	202	220	260	260	260	329	341
2	4	3		61	69	90	111	146	146	165	229	229	365	365	365	536	552
2	4	4		37	47	53	67	87	87	102	148	184	216	216	216	222	240
2	4	5		82	84	95	109	129	129	132	145	189	271	271	271	294	316
2	4	6		69	80	93	114	141	141	189	205	244	270	270	273	284	262
3	1	1		73	98	119	140	194	194	257	278	305	515	632	686	686	718
3	1	2		69	86	94	111	131	131	142	160	160	368	368	368	368	412
3	1	3		64	69	80	80	91	91	121	121	147	147	163	163	192	228
3	1	4		63	73	89	89	134	139	152	171	242	311	311	311	365	384
3	1	5		89	108	117	132	157	157	214	225	305	426	426	440	459	477
3	1	6		57	97	91	91	93	93	118	138	191	191	191	196	212	228
3	2	1		39	62	74	101	171	171	184	223	282	460	460	460	656	703
3	2	2		55	64	71	100	123	146	198	198	280	418	501	501	501	597
3	2	3		54	58	59	77	85	85	111	111	144	144	157	157	203	241
3	2	4		62	65	74	74	99	99	129	159	202	346	346	346	346	410
3	2	5		48	94	103	128	136	136	144	167	215	297	346	346	346	365
3	2	6		66	78	92	107	122	122	126	148	209	222	221	221	229	267
3	3	1		47	50	58	74	104	104	128	128	173	239	392	392	408	479
3	3	2		54	70	80	92	127	127	134	160	213	255	255	255	305	376
3	3	3		69	80	94	100	100	100	125	156	159	172	172	172	228	242
3	3	4		96	102	114	114	114	121	166	166	166	196	196	196	251	270
3	3	5		53	61	63	68	68	80	101	132	156	297	297	297	317	345

Contd.

Appendix-14. Continued

S	N	G	E	MONTH 1	2	3	4	5	6	7	8	9	10	11	12	13	14
3	3	6		66	79	82	84	88	88	102	119	139	160	160	160	172	202
3	4	1		78	89	90	115	115	124	124	184	210	228	228	228	266	342
3	4	2		51	58	68	80	92	92	150	187	339	488	488	488	549	613
3	4	3		72	74	74	83	83	83	125	166	225	323	323	323	323	355
3	4	4		68	70	78	93	103	103	103	125	129	129	199	199	199	237
3	4	5		49	63	74	93	107	107	119	136	136	154	154	154	163	182
3	4	6		108	112	125	128	128	128	128	134	134	146	158	184	233	245
4	1	1		92	94	113	117	124	124	132	132	132	190	190	197	222	236
4	1	2		76	84	102	109	111	111	127	127	129	162	162	162	190	220
4	1	3		78	79	91	99	99	117	120	134	134	183	183	183	240	275
4	1	4		104	119	119	121	153	168	168	168	176	261	261	272	286	304
4	1	5		69	82	89	94	109	109	118	118	118	159	168	168	181	202
4	1	6		107	112	131	143	183	183	185	237	237	237	317	338	356	374
4	2	1		65	67	84	85	90	94	94	138	138	189	238	238	277	297
4	2	2		68	69	79	111	111	111	195	210	210	253	253	274	323	399
4	2	3		73	73	81	83	124	124	151	155	155	261	261	289	297	384
4	2	4		79	84	96	98	125	125	173	173	173	184	184	187	250	283
4	2	5		101	107	117	129	134	134	170	170	170	220	220	220	273	287
4	2	6		102	108	126	140	140	140	150	167	167	202	222	237	241	375
4	3	1		89	99	116	134	134	134	134	178	178	240	240	249	265	350
4	3	2		104	113	134	137	137	137	170	170	197	246	246	246	323	393
4	3	3		91	100	107	113	113	113	141	164	173	284	284	298	355	422
4	3	4		69	89	107	109	109	129	129	145	157	211	211	251	357	367
4	3	5		81	95	109	109	114	116	128	133	133	217	217	219	302	314
4	3	6		61	70	78	84	84	106	106	124	141	141	163	163	226	260
4	4	1		66	79	97	102	102	102	102	125	144	206	252	252	296	308
4	4	2		76	78	88	98	98	100	100	108	124	172	172	178	207	233
4	4	3		81	83	97	107	107	146	202	221	234	253	253	253	304	339
4	4	4		52	63	70	73	93	97	106	137	153	193	193	193	258	270
4	4	5		51	52	84	86	115	115	136	139	152	178	178	178	292	311
4	4	6		47	49	58	62	75	75	97	113	113	113	116	116	156	169

APPENDIX-15
BRANCHES

S	N	G	E	MONTH 6	7	8	9	10	11	12	13	14
1	0	0	4	0.0	0.0	1.0	1.1	1.1	1.3	1.2	1.5	1.5
2	0	0	3	0.0	0.2	1.0	1.6	1.9	1.6	1.4	1.1	1.4
3	0	0	2	0.0	0.0	1.0	1.2	1.4	1.3	1.2	1.4	1.4
4	0	0	1	0.0	0.2	1.5	1.9	1.9	1.8	1,3	1,6	1.9
1	1	1		0.0	2.2	2.2	2.2	3.0	2.8	2.0	2.3	3.4
1	1	2		0.0	3.2	3.2	3.4	3.6	3.6	2.6	3.0	3.8
1	1	3		0.0	2.2	2.2	2.5	3.2	2.9	2.4	2.4	2.4
1	1	4		0.7	2.2	2.2	2.2	3.0	2.5	2.0	2.0	2.0
1	1	5		0.0	0.5	0.8	1.4	1.4	1.1	1.6	1.6	1.6
1	1	6		0.0	0.5	0.7	1.2	1.8	1.7	1.3	1.3	1.5
1	2	1		0.4	0.6	0.9	1.9	3.1	2.7	2.0	2.3	2.4
1	2	2		0.0	2.0	2.0	2.0	2.9	3.2	2.5	2.5	2.5
1	2	3		0.0	2.1	2.1	2.1	2.7	2.6	2.3	2.6	2.6
1	2	4		0.0	1.2	1.4	1.4	1.9	1.5	1.3	1.4	1.4
1	2	5		0.0	1.1	1.4	1.4	1.4	1.5	1.2	1.4	1.4
1	2	6		0.0	1.0	1.0	1.0	1.7	1.9	1.5	1.5	1.9
1	3	1		0.4	1.4	1.5	1.8	2.4	2.2	1.6	2.2	2.6
1	3	2		0.9	1.6	1.8	1.8	2.4	2.4	2.4	2.4	2.4
1	3	3		0.3	2.6	2.6	2.6	3.0	2.5	2.2	2.5	2.5
1	3	4		0.2	2.0	2.2	2.4	3.6	2.5	2.3	2.3	2.4
1	3	5		0.3	1.5	1.7	1.8	2.3	2.2	1.9	1.9	1.9
1	3	6		0.3	1.5	1.8	1.9	2.5	2.4	2.6	2.6	2.6
1	4	1		0.6	2.0	2.2	2.4	3.0	2.6	2.8	2.5	2.8
1	4	2		1.0	2.1	2.3	2.8	4.2	3.4	2.6	2.6	2.6
1	4	3		0.0	1.7	2.3	2.9	4.0	3.8	2.0	2.4	2.4
1	4	4		0.0	1.8	2.8	2.8	3.3	3.1	2.0	2.0	2.1
1	4	5		0.3	0.8	2.4	1.7	2.2	2.0	1.4	1.7	1.7
1	4	6		0.3	0.8	1.4	1.6	2.4	2.9	2.1	2.1	2.1
2	1	1		0.0	2.1	2.1	2.1	3.7	2.8	2.3	2.3	2.8
2	1	2		0.5	1.7	1.9	2.4	2.2	2.8	2.1	2.3	2.3
2	1	3		0.0	2.0	2.1	2.3	3.2	3.3	2.5	2.5	2.5
2	1	4		0.0	1.8	2.2	2.3	3.8	3.4	2.1	2.1	2.4
2	1	5		0.0	0.2	1.0	1.5	1.7	2.0	1.8	1.8	1.8
2	1	6		0.0	0.8	1.4	1.4	1.7	2.2	1.6	1.7	1.9
2	2	1		0.0	1.4	1.6	1.8	2.9	2.9	2.1	2.9	2.5
2	2	2		0.0	1.1	1.7	1.9	3.0	2.6	2.1	2.1	2.1
2	2	3		0.0	1.0	1.2	1.2	2.6	2.6	1.4	1.8	1.8
2	2	4		0.0	1.0	1.2	1.5	3.4	2.7	1.5	1.7	2.3
2	2	5		0.0	0.2	1.0	1.5	2.2	2.2	1.7	2.7	2.0
2	2	6		0.0	0.7	1.0	1.3	2.3	2.3	1.4	1.4	1.4
2	3	1		0.8	1.8	1.8	1.9	3.1	3.2	2.7	2.8	2.8
2	3	2		0.0	1.7	1.8	1.9	3.6	3.0	2.3	2.3	2.6
2	3	3		0.0	1.2	1.4	1.4	3.6	3.1	1.7	1.7	2.1
2	3	4		0.7	2.0	2.0	2.0	3.5	2.6	1.8	1.8	1.8
2	3	5		0.0	0.4	1.0	1.3	2.8	2.0	1.7	1.8	1.8
2	3	6		0.0	0.2	1.0	1.1	2.2	1.8	1.4	1.4	1.6
2	4	1		0.0	0.9	1.2	1.4	2.7	2.6	2.1	1.9	1.9
2	4	2		0.0	0.9	1.2	1.4	2.3	1.8	1.6	1.6	1.6
2	4	3		0.0	0.3	2.0	2.3	2.8	2.3	1.7	2.0	2.4
2	4	4		0.2	0.6	1.2	1.4	2.9	1.4	1.8	2.1	2.1
2	4	5		0.0	0.0	1.0	1.2	2.2	1.9	1.5	1.5	1.5
2	4	6		0.0	0.1	1.0	1.3	2.4	2.0	1.3	1.7	1.7
3	1	1		0.0	2.5	1.7	1.7	2.9	2.6	2.0	1.9	2.0
3	1	2		0.0	1.5	2.0	2.0	2.9	3.1	1.9	1.9	2.1
3	1	3		0.0	1.0	1.2	1.4	2.7	2.2	2.0	1.6	1.8
3	1	4		0.0	0.3	1.0	1.5	1.9	1.8	1.6	1.3	1.4
3	1	5		0.0	0.2	1.1	1.3	1.8	1.6	1.3	1.4	1.4
3	1	6		0.0	1.6	2.8	3.0	3.6	3.4	3.1	2.4	1.4
3	2	1		0.0	1.2	2.3	2.9	2.8	2.6	3.0	4.0	2.0
3	2	2		0.0	0.7	1.2	1.2	2.0	2.0	1.6	1.0	1.3
3	2	3		0.0	0.9	1.0	1.4	2.3	3.1	1.5	2.0	2.0
3	2	4		0.0	0.2	1.2	1.2	1.3	1.5	1.0	1.4	1.4
3	2	5		0.0	0.2	1.0	1.2	1.9	2.4	1.4	1.5	1.6
3	2	6		0.0	0.7	2.0	2.0	2.5	3.3	2.1	2.3	2.3
3	3	1		0.0	1.1	2.2	2.2	2.6	3.0	1.0	1.6	1.9
3	3	2		0.0	1.6	2.0	2.3	2.8	2.6	1.5	1.8	1.9
3	3	3		0.0	1.3	1.7	1.7	2.3	2.7	1.6	1.6	1.8
3	3	4		0.0	0.4	1.1	1.7	1.8	1.8	1.4	1.5	1.5

Contd.

Appendix-15. Continued

S	N	G	E	MONTH 6	7	8	9	10	11	12	13	14
3	3	5		0.0	0.6	1.2	1.3	1.5	2.1	1.6	1.8	1.8
3	3	6		0.0	1.3	2.0	2.0	3.3	3.2	3.1	2.2	2.4
3	4	1		0.0	0.1	1.7	2.2	2.4	2.1	1.4	4.0	2.0
3	4	2		0.0	0.6	1.3	1.6	2.1	3.4	1.9	1.3	1.6
3	4	3		0.0	0.3	1.0	1.5	2.1	2.5	1.7	1.9	1.9
3	4	4		0.0	0.3	1.3	1.6	2.2	2..2	1.6	1.5	1.6
3	4	5		0.0	0.0	1.0	1.1	1.2	1.9	1.0	1.3	1.4
3	4	6		0.0	1.3	1.8	1.8	2.1	2.6	2.0	1.7	2.1
4	1	1		0.0	1.6	1.6	1.8	2.4	2.0	2.1	1.7	1.8
4	1	2		0.0	0.6	1.0	2.2	2.7	1.5	1.4	1.6	2.2
4	1	3		0.0	1.8	2.3	2.6	2.6	2.6	1.6	1.9	2.0
4	1	4		0.0	0.9	1.6	2.1	2.9	2.4	2.1	1.1	2.2
4	1	5		0.0	1.8	1.8	1.8	3.0	2.3	2.0	1.9	2.0
4	1	6		0.0	1.3	2.6	2.7	3.4	3.1	1.9	1.6	2.0
4	2	1		0.0	1.9	2.0	2.0	2.9	2.4	2.5	1.9	2.2
4	2	2		0.0	0.9	1.9	2.5	2.5	2.2	2.3	1.7	2.1
4	2	3		0.0	1.2	2.6	2.7	3.1	2.1	2.0	1.5	2.0
4	2	4		0.0	0.6	1.7	2.1	2.1	2.1	2.1	2.1	2.1
4	2	5		0.0	0.1	1.4	1.7	1.4	1.5	1.6	1.6	1.7
4	2	6		0.0	1.9	2.5	2.7	3.2	2.3	2.2	2.6	2.6
4	3	1		0.0	0.0	2.0	2.0	2.7	2.3	1.8	1.8	1.9
4	3	2		0.0	1.5	2.0	2.3	2.6	2.3	1.7	1.4	1.4
4	3	3		0.0	0.7	1.7	2.4	2.7	2.5	2.0	1.6	1.9
4	3	4		0.0	1.2	2.2	2.2	3.0	2.4	1.9	2.0	2.3
4	3	5		0.0	1.1	2.2	2.8	3.5	2.8	2.0	2.4	2.4
4	3	6		0.0	1.3	2.4	3.0	2.7	3.0	2.0	1.7	1.9
4	4	1		0.0	1.1	1.4	2.9	3.1	3.0	2.4	1.7	1.8
4	4	2		0.0	0.7	2.1	2.2	2.3	2.3	2.1	2.0	2.0
4	4	3		0.0	0.0	1.0	1.5	2.1	1.9	1.5	1.5	1.8
4	4	4		0.0	0.3	2.1	2.5	2.8	2.9	1.9	1.9	1.9
4	4	5		0.0	1.4	2.2	2.2	2.8	2.4	1.4	1.8	1.8
4	4	6		0.0	0.0	2.2	2.4	3.0	2.5	1.8	1.6	1.9
Treated mean				0.1	1.1	1.7	1.9	2.6	2.5	1.9	1.9	2.0
Control mean				0.0	0.1	1.1	1.5	1.6	1.5	1.3	1.4	1.5
CD treated vs Control				NS	1.7	1.5	NS	1.7	1.5	1.3	NS	1.2

APPENDIX- 16
SUCKERS

S	N	G	E	MONTH 2	3	4	5	6	7	8	9	10	11	12	13	14
1	0	0	4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.3
2	0	0	3	0.0	0.0	0.0	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.5	0.5
3	0	0	2	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3
4	0	0	1	0.0	0.0	0.0	0.1	0.1	0.2	0.2	0.2	0.2	0.4	0.4	0.4	0.6
1	1	1		0.0	0.0	0.0	0.0	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
1	1	2		0.0	0.0	0.0	0.0	0.4	0.4	0.4	0.5	0.5	0.7	0.7	0.7	0.7
1	1	3		0.0	0.0	0.0	0.4	0.4	0.4	0.5	0.5	0.5	1.1	1.1	1.1	1.1
1	1	4		0.0	0.0	0.0	0.0	0.3	0.3	0.3	0.5	0.5	1.0	1.0	1.3	1.3
1	1	5		0.0	0.0	0.	0.1	0.1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
1	1	6		0.0	0.0	0.0	0.0	0.0	01	0.1	0.1	0.1	0.5	0.5	0.5	0.6
1	2	1		0.0	0.0	0.0	0.1	0.4	0.4	0.4	0.4	0.4	0.8	0.9	1.1	1.4
1	2	2		0.0	0.0	0.0	0.0	0.0	0.4	0.4	0.4	0.6	0.6	0.7	1.0	1.6
1	2	3		0.0	0.0	0.0	0.2	0.2	0.2	0.2	0.5	0.5	0.5	0.5	1.2	1.4
1	2	4		0.0	0.0	0.0	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.6	0.7
1	2	5		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.4	0.4	0.6	0.7
1	2	6		0.0	0.0	0.0	0.6	0.6	0.6	0.6	0.6	0.6	0.8	0.8	0.8	1.0
1	3	1		0.0	0.0	0.0	0.0	0.3	0.3	0.3	0.5	0.6	0.6	0.6	0.8	0.9
1	3	2		0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.5	0.5	0.5	0.5	0.7	1.2
1	3	3		0.0	0.0	0.0	0.1	0.4	0.4	0.4	0.6	0.7	0.7	0.7	0.9	1.7
1	3	4		0.0	0.0	0.0	0.2	0.9	0.9	0.9	1.0	1.0	1.5	1.5	1.5	1.8
1	3	5		0.1	0.0	0.1	0.0	0.1	0.1	0.1	0.2	0.2	0.4	0.4	0.4	1.1
1	3	6		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.4	0.4	0.5	0.5	0.6	1.5
1	4	1		0.0	0.1	0.6	0.1	0.3	0.3	0.3	0.3	0.4	0.5	0.5	0.6	1.2
1	4	2		0.0	0.0	0.0	0.6	0.7	0.7	0.7	0.9	1.0	1.0	1.0	1.0	2.0
1	4	3		0.0	0.0	0.0	0.1	1.1	1.2	1.2	1.2	1.2	1.4	1.4	1.7	2.5
1	4	4		0.0	0.0	0.1	0.2	0.3	0.4	0.4	0.5	1.2	1.2	1.2	1.8	2.1
1	4	5		0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.5	0.8	1.1
1	4	6		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.1	0.5	0.7	1.1	1.5
2	1	1		0.0	0.0	0.0	0.1	0.4	0.4	0.4	0.8	0.8	1.0	1.1	1.5	1.6
2	1	2		0.0	0.0	0.1	0.0	0.2	0.2	0.2	0.2	0.2	0.6	0.9	1.0	1.0
2	1	3		0.0	0.0	0.1	0.2	0.3	0.3	0.3	0.9	1.2	1.4	1.5	1.5	1.5
2	1	4		0.0	0.0	0.0	0.3	0.8	0.8	0.8	0.8	1.4	1.4	1.7	2.1	2.1
2	1	5		0.0	0.0	0.0	0.0	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.4	1.0
2	1	6		0.0	0.0	0.0	0.0	0.1	0.4	0.4	0.4	0.5	0.5	0.5	0.5	0.8
2	2	1		0.0	0.0	0.0	0.1	0.4	0.4	0.4	0.6	0.6	0.7	0.7	1.0	1.2
2	2	2		0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.2	0.7	0.7	1.0	1.0
2	2	3		0.0	0.0	0.0	0.0	0.2	0.2	0.2	0.7	0.7	0.8	0.9	1.1	1.4
2	2	4		0.0	0.0	0.0	0.1	0.3	0.5	0.5	0.8	0.8	0.9	1.0	1.2	1.2
2	2	5		0.0	0.0	0.0	0.0	0.1	0.2	0.2	0.4	0.4	0.7	0.7	0.7	0.9
2	2	6		0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.3	0.3	0.6	0.6	0.6	0.6
2	3	1		0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.3	0.3	0.4	0.4	0.6	0.7
2	3	2		0.0	0.0	0.0	0.3	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
2	3	3		0.0	0.0	0.0	0.0	0.7	0.7	0.7	0.8	0.8	0.9	1.1	1.1	1.9
2	3	4		0.0	0.0	0.1	0.1	0.5	0.5	0.5	0.6	0.6	0.6	1.1	1.5	1.5
2	3	5		0.0	0.1	0.0	0.0	0.1	0.1	0.1	0.3	0.3	0.5	0.5	0.7	0.8
2	3	6		0.0	0.0	0.1	0.1	0.1	0.2	0.2	0.3	0.3	0.3	0.4	0.7	0.7
2	4	1		0.0	0.0	0.0	0.0	0.3	0.3	0.3	0.5	0.5	0.5	0.8	1.2	1.2
2	4	2		0.0	0.0	0.0	0.0	01.	0.1	0.1	0.2	0.2	0.2	0.5	0.8	0.8
2	4	3		0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.5	0.5	0.8	0.8	1.4	1.4
2	4	4		0.0	0.0	0.2	0.4	0.5	0.5	0.5	0.7	0.9	1.1	1.2	1.4	1.4
2	4	5		0.0	0.0	0.1	0.1	0.2	0.2	0.2	0.4	0.4	0.5	0.7	0.9	0.9
2	4	6		0.0	0.0	0.2	0.2	0.2	0.4	0.4	0.4	0.4	0.8	0.8	0.8	1.0
3	1	1		0.0	0.0	0.0	0.1	0.5	0.5	0.5	0.5	0.5	0.9	0.9	1.2	1.2
3	1	2		0.0	0.0	0.0	0.0	0.6	0.6	0.6	0.6	0.6	0.7	0.7	1.2	1.3
3	1	3		0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	1.3	1.3
3	1	4		0.0	0.0	0.0	0.1	0.7	0.7	0.7	0.7	0.7	0.7	0.7	1.1	1.1
3	1	5		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.4	0.5
3	1	6		0.0	0.0	0.0	0.1	0.1	0.2	0.2	0.3	0.3	0.4	0.4	0.5	0.5
3	2	1		0.0	0.0	0.0	0.2	0.9	0.4	0.4	0.7	1.3	1.3	1.6	1.6	1.8
3	2	2		0.0	0.0	0.0	0.2	0.9	0.4	0.4	0.7	1.3	1.3	1.6	1.6	1.8
3	2	3		0.0	0.0	0.0	0.0	0.2	0.2	0.2	0.5	0.6	0.8	0.8	1.0	1.0
3	2	4		0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.4	0.4	0.8	0.8	0.8	1.2
3	2	5		0.0	0.0	0.0	0.0	0.1	0.2	0.2	0.6	0.7	0.9	1.1	1.2	1.4
3	2	6		0.0	0.0	0.0	0.0	0.2	0.2	0.2	0.5	0.5	0.5	0.5	0.5	0.5
3	3	1		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.4	0.4	0.6	0.8	1.1
3	3	2		0.0	0.0	0.0	0.1	0.2	0.2	0.3	0.4	0.4	0.8	1.0	1.1	1.3
3	3	3		0.0	0.0	0.0	0.1	0.3	0.3	0.4	0.6	0.6	1.1	1.1	1.1	1.1
3	3	4		0.0	0.0	0.0	0.0	0.3	0.3	0.3	0.3	0.3	0.4	0.6	1.0	1.0
3	3	5		0.0	0.0	0.0	0.0	0.3	0.3	0.5	0.5	0.5	0.5	0.5	0.7	0.9

Contd.

Appendix-16. Continued

S	N	G	E	MONTH 2	3	4	5	6	7	8	9	10	11	12	13	14
3	3	6		0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.5
3	4	1		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.2	0.4	0.4
3	4	2		0.0	0.0	0.0	0.0	0.3	0.3	0.4	0.6	0.8	0.8	0.8	1.2	1.3
3	4	3		0.0	0.0	0.0	0.0	0.4	0.4	0.5	0.5	0.7	0.7	0.7	1.1	1.2
3	4	4		0.0	0.0	0.1	0.1	0.1	0.1	0.2	0.3	0.3	0.3	0.4	0.7	0.7
3	4	5		0.0	0.0	0.0	0.0	0.2	0.2	0.4	0.8	0.8	0.8	0.8	0.8	0.9
3	4	6		0.0	0.0	0.1	0.1	0.3	0.3	0.3	0.3	0.4	0.4	0.5	0.8	0.9
4	1	1		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.4	0.4	0.4	0.4	0.4
4	1	2		0.0	0.0	0.1	0.0	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.6	0.7
4	1	3		0.0	0.0	0.0	0.2	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.8	1.4
4	1	4		0.0	0.0	0.0	0.2	0.6	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
4	1	5		0.0	0.0	0.1	0.2	0.5	0.5	0.5	0.5	0.7	1.0	1.0	1.3	1.5
4	1	6		0.0	0.0	0.0	0.2	0.6	0.6	0.6	0.6	0.6	0.7	0.7	0.7	0.9
4	2	1		0.0	0.0	0.0	0.6	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.8	1.3
4	2	2		0.0	0.0	0.0	0.1	0.8	0.8	0.8	0.8	0.8	0.9	1.1	1.1	1.1
4	2	3		0.0	0.0	0.0	0.2	0.6	0.6	0.6	0.6	0.6	0.6	0.6	1.0	1.1
4	2	4		0.0	0.1	0.0	0.3	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.1	1.2
4	2	5		0.0	0.0	0.1	0.0	0.4	0.4	0.4	0.4	0.7	0.8	0.8	1.1	1.2
4	2	6		0.0	0.0	0.0	0.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
4	3	1		0.0	0.0	0.0	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.4
4	3	2		0.0	0.0	0.0	0.4	0.4	0.4	0.4	0.4	0.4	0.5	0.5	1.0	1.4
4	3	3		0.0	0.0	0.0	0.1	0.4	0.6	0.6	0.6	0.6	0.8	0.9	1.4	1.4
4	3	4		0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.2	0.2	0.5	0.8	1.3	1.3
4	3	5		0.0	0.0	0.0	0.0	0.4	0.4	0.4	0.4	0.4	0.5	0.9	1.3	1.3
4	3	6		0.0	0.0	0.0	0.0	0.2	0.2	0.2	0.2	0.2	0.6	0.6	1.0	1.0
4	4	1		0.0	0.0	0.0	0.1	0.4	0.4	0.4	0.4	0.4	1.0	1.0	1.0	1.3
4	4	2		0.0	0.0	0.0	0.3	0.4	0.6	0.6	0.6	0.6	0.6	0.6	0.6	1.2
4	4	3		0.0	0.0	0.0	0.2	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	1.4
4	4	4		0.0	0.0	0.0	0.1	0.4	0.6	0.6	0.6	0.6	0.6	0.6	0.6	1.1
4	4	5		0.0	0.0	0.0	0.3	0.5	0.5	0.5	0.5	0.5	0.6	0.6	0.6	0.6
4	4	6		0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.3	0.3	0.3	0.4	0.8
Treated mean				0.0	0.0	0.02	0.12	0.33	0.36	0.37	0.5	0.5	0.7	0.7	0.9	1.1
Control mean				0.0	0.0	0.0	0.1	0.1	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3
CD treated vs Control				NS	NS	NS	NS	NS	NS	NS	0.7	0.8	0.9	0.9	0.9	1.1

APPENDIX-17
PLANT WEIGHT (g)

S	N	G	E	Fresh wt. whole plant	Dry wt. of whole plant	Fresh wt. of leaves	Dry wt. of leaves	Fresh wt. of petiole	Dry wt. of petiole	Fresh wt. of roots	Dry wt. of roots
1	0	0	4	18.84	3.28	8.11	1.36	1.62	0.24	19.11	0.68
2	0	0	3	23.29	4.35	10.52	1.81	2.09	0.30	10.68	2.24
3	0	0	2	35.70	6.24	9.90	1.49	3.07	0.56	22.73	4.19
4.	0	0	1	12.48	2.26	4.68	0.96	1.30	0.14	6.50	1.16
1	1	1		17.77	2.70	4.36	0.83	2.27	0.20	11.14	1.67
1	1	2		21.05	3.09	6.52	1.17	2.34	0.23	12.19	1.69
1	1	3		33.84	4.74	10.12	1.88	3.08	0.32	20.64	2.54
1	1	4		32.22	4.40	8.08	1.48	3.10	0.32	21.04	2.60
1	1	5		28.49	4.51	8.91	1.74	3.10	0.33	16.48	2.44
1	1	6		14.50	2.77	6.10	1.01	1.86	0.18	6.54	0.96
1	2	1		12.94	1.99	5.48	0.86	1.30	0.17	6.16	0.96
1	2	2		13.49	1.86	4.11	0.76	1.64	0.12	7.74	0.98
1	2	3		24.33	3.54	7.20	1.23	2.23	0.24	14.90	2.07
1	2	4		25.85	3.55	7.92	1.45	2.70	0.26	15.23	2.84
1	2	5		18.19	2.80	5.48	1.02	2.10	0.20	10.61	1.58
1	2	6		17.97	2.86	6.19	1.11	2.10	0.20	9.68	1.56
1	3	1		12.75	1.78	5.28	0.93	1.42	0.14	6.05	0.91
1	3	2		16.36	2.53	7.60	1.36	2.30	0.24	6.46	0.93
1	3	3		20.62	4.11	8.14	1.65	3.82	0.29	16.66	2.17
1	3	4		22.36	3.71	8.43	1.56	2.50	0.24	11.43	1.91
1	3	5		15.83	2.39	8.01	1.22	1.21	0.22	6.61	0.95
1	3	6		16.40	2.30	7.60	1.11	1.60	0.17	7.20	1.04
1	4	1		19.46	2.88	6.98	1.02	1.67	0.17	10.81	1.69
1	4	2		23.68	3.72	10.54	1.70	2.18	0.29	10.96	1.73
1	4	3		30.34	4.02	10.98	1.73	2.52	0.26	16.84	2.03
1	4	4		15.44	2.34	6.34	1.16	1.12	0.20	7.98	0.98
1	4	5		16.00	2.51	7.84	1.32	1.30	0.23	6.86	0.96
1	4	6		15.03	2.13	6.00	1.05	1.21	0.16	7.82	0.92
2	1	1		14.07	1.87	7.86	1.09	1.08	0.14	5.18	0.64
2	1	2		18.62	2.49	8.32	1.39	1.90	0.29	8.40	0.81
2	1	3		19.94	2.85	10.08	1.51	1.40	0.30	8.46	1.04
2	1	4		21.64	2.97	8.50	1.38	2.01	0.23	11.13	1.36
2	1	5		19.95	3.06	7.68	1.32	2.08	0.23	10.19	1.51
2	1	6		18.97	3.01	8.12	1.38	1.65	0.24	9.20	1.39
2	2	1		16.51	2.57	5.42	0.95	2.03	0.19	9.06	1.43
2	2	2		19.86	3.05	8.32	1.33	2.11	0.24	9.43	1.48
2	2	3		23.69	2.57	12.01	1.14	2.06	0.35	9.62	1.08
2	2	4		15.44	2.22	6.12	1.04	1.64	0.19	7.68	0.99
2	2	5		20.32	2.55	8.48	1.26	2.03	0.25	9.81	1.04
2	2	6		16.73	2.51	8.12	1.25	1.50	0.22	7.11	1.05
2	3	1		13.82	3.65	6.60	1.07	1.16	0.17	6.06	2.41
2	3	2		25.39	4.07	11.97	1.89	2.30	0.32	11.12	2.76
2	3	3		22.46	4.82	10.94	1.64	1.90	0.32	9.60	2.86
2	3	4		19.93	4.71	7.69	1.36	2.16	0.25	10.08	3.10
2	3	5		17.79	3.81	6.80	1.19	1.84	0.20	9.15	1.42
2	3	6		13.09	2.88	6.39	0.98	1.10	0.16	5.60	1.74
2	4	1		15.94	4.45	5.24	0.93	1.60	0.16	9.10	3.36
2	4	2		15.33	4.25	4.20	0.74	1.70	0.13	9.43	3.38
2	4	3		25.44	6.90	8.86	1.47	2.90	0.30	13.68	5.13
2	4	4		21.83	6.01	9.11	1.43	1.80	0.26	10.92	4.32
2	4	5		19.03	4.95	6.54	1.11	1.98	0.20	10.51	3.64
2	4	6		27.31	6.01	8.39	1.44	2.80	0.29	16.12	4.28
3	1	1		24.15	3.49	8.04	1.23	3.19	0.29	12.92	1.97
3	1	2		12.98	1.85	4.93	0.82	1.15	0.14	6.90	0.89
3	1	3		70.62	10.56	16.71	3.37	9.06	1.68	44.85	5.51
3	1	4		20.32	3.48	7.06	1.22	2.02	0.23	11.26	2.03
3	1	5		13.90	2.17	4.79	0.86	1.28	0.15	7.83	1.16
3	1	6		13.51	4.99	8.61	1.55	3.42	0.56	19.48	2.88
3	2	1		14.51	2.29	5.35	0.90	1.34	0.15	7.82	1.24

Contd.

Appendix-17. Continued

S	N	G	E	Fresh wt. whole plant	Dry wt. of whole plant	Fresh wt. of leaves	Dry wt. of leaves	Fresh wt. of petiole	Dry wt. of petiole	Fresh wt. of roots	Dry wt. of roots
3	2	2		12.06	2.01	4.31	0.71	1.08	0.11	6.69	1.19
3	2	3		42.07	7.18	12.82	1.28	4.19	0.18	25.09	3.71
3	2	4		20.56	3.11	8.12	1.34	1.98	0.21	10.46	1.56
3	2	5		10.74	1.95	4.82	0.80	1.31	0.13	7.61	1.02
3	2	6		16.23	2.28	6.82	1.10	1.81	0.19	7.60	0.99
3	3	1		13.65	3.46	6.14	1.01	1.43	0.14	6.08	2.31
3	3	2		15.35	3.71	7.48	1.29	1.77	0.20	6.10	2.22
3	3	3		28.56	5.66	8.65	1.92	2.79	0.51	17.12	3.43
3	3	4		19.27	3.50	6.14	1.16	2.13	0.35	11.00	1.99
3	3	5		16.86	3.34	7.24	1.20	1.80	0.34	7.82	1.80
3	3	6		20.30	4.97	8.73	1.47	2.25	0.24	9.32	3.26
3	4	1		13.56	2.07	5.18	0.86	1.25	0.14	7.16	1.07
3	4	2		17.27	2.79	6.56	1.13	1.61	0.18	9.10	1.48
3	4	3		18.88	7.58	7.03	2.63	1.65	0.70	10.20	4.25
3	4	4		52.70	10.56	14.44	1.76	4.81	0.31	33.45	8.49
3	4	5		14.63	3.17	5.51	0.96	1.36	0.16	7.82	2.03
3	4	6		23.36	4.77	8.70	1.56	2.16	0.23	12.50	2.99
4	1	1		17.03	2.54	5.14	1.11	1.68	0.17	10.21	1.26
4	1	2		14.90	2.35	5.23	1.21	1.45	0.19	8.22	0.95
4	1	3		17.55	2.51	6.83	1.31	1.60	0.21	9.12	0.99
4	1	4		24.47	3.05	6.98	1.36	2.30	0.28	15.19	1.44
4	1	5		15.04	2.49	6.90	1.31	1.30	0.27	6.84	0.91
4	1	6		17.36	2.74	7.56	1.38	1.70	0.30	8.10	1.06
4	2	1		12.93	2.32	5.14	1.19	1.68	0.20	6.11	0.93
4	2	2		13.02	2.19	5.82	1.22	1.31	0.19	5.89	0.78
4	2	3		22.38	2.60	9.88	1.28	2.36	0.18	10.14	1.14
4	2	4		23.45	2.77	7.81	1.32	2.64	0.24	13.00	1.21
4	2	5		15.03	2.41	6.15	1.34	1.83	0.23	7.35	0.84
4	2	6		16.30	2.41	6.02	1.29	1.92	0.21	8.43	0.91
4	3	1		13.50	3.51	5.03	1.19	1.81	0.19	6.66	2.13
4	3	2		11.80	3.16	5.93	1.28	1.19	0.19	4.68	1.68
4	3	3		14.78	3.49	6.82	1.34	1.34	0.26	6.62	1.89
4	3	4		17.30	4.13	7.30	1.38	1.75	0.32	8.25	2.43
4	3	5		14.86	3.32	6.74	1.29	1.52	0.24	6.69	1.79
4	3	6		17.08	3.58	6.18	1.22	1.80	0.21	9.10	2.15
4	4	1		12.21	3.29	4.00	0.98	1.12	0.15	7.09	2.16
4	4	2		15.96	3.56	5.11	1.08	1.53	0.16	9.22	2.32
4	4	3		16.75	3.60	5.19	1.12	1.65	0.17	9.91	2.31
4	4	4		15.21	3.60	6.71	1.28	1.20	0.21	7.30	2.11
4	4	5		14.52	3.65	5.54	1.31	1.60	0.24	7.38	2.10
4	4	6		14.76	3.49	5.18	1.12	1.80	0.19	7.78	2.18
Treated mean				22.58	4.03	8.30	1.40	2.02	0.31	12.25	2.07
Control mean				19.48	3.50	7.28	1.28	2.00	0.25	10.42	1.96
CD treated vs Control				NS	NS	NS	1.10	NS	NS	NS	NS

APPENDIX-18
DRY MATTER

S	N	G	E	Leaf dry wt.	Leaf moisture	Leaf-DW petiole	Leaf-M petiole	Root DW (%)	Root M (%)	Plant DW(%)	Plant M(%)	fw rat shoot	fw rat root	dw rat shoot	dw rat root
1	0	0	4	16.77	83.23	14.82	85.18	18.44	81.56	17.41	82.59	51.65	48.35	48.78	51.22
2	0	0	3	17.20	82.80	14.85	85.15	20.97	79.03	18.68	81.32	84.14	45.86	48.51	51.49
3	0	0	2	17.25	82.75	18.24	81.76	18.43	81.57	17.48	82.52	36.33	63.67	32.85	67.15
4	0	0	1	20.51	79.49	10.77	89.23	17.85	82.15	18.11	81..89	47.92	52.08	48.67	51.33
1	1	1		19.04	80.95	8.81	91.19	14.99	85.01	15.19	84.81	37.31	62.69	38.15	61.85
1	1	2		17.94	82.06	9.93	90.17	13.86	86.14	14.68	85.32	42.10	57.90	45.31	54.69
1	1	3		18.58	81.42	10.39	89.61	12.31	87.69	14.01	85.99	39.21	60.99	46.42	53.58
1	1	4		18.32	81.08	10.32	89.68	12.36	87.64	15.66	86.34	34.70	65.30	40.91	59.09
1	1	5		19.53	80.47	10.65	89.35	14.81	85.19	15.84	84.16	42.16	57.84	45.90	54.10
1	1	6		16.56	83.54	9.68	90.32	14.68	85.32	19.10	80.90	84.90	45.10	65.34	34.66
1	2	1		15.69	84.31	13.08	86.92	15.58	84.42	15.38	84.62	52.40	47.60	51.76	48.24
1	2	2		18.49	81.51	7.32	92.68	12.66	87.34	13.79	86.21	42.62	57.38	47.31	52.69
1	2	3		17.08	82.92	10.76	89.24	13.89	86.11	14.55	85.45	38.76	61.24	41.52	58.48
1	2	4		18.31	81.69	9.63	90.37	12.08	87.92	13.73	86.27	41.08	58.92	48.17	51.83
1	2	5		18.61	81.39	9.52	90.48	14.89	85.11	15.31	84.61	41.67	58.33	43.57	56.43
1	2	6		17.93	82.07	9.52	90.48	16.12	83.88	15.97	84.03	46.13	53.87	45.64	54.36
1	3	1		17.61	82.39	14.14	85.86	15.04	84.96	15.53	84.47	52.55	47.45	54.04	45.96
1	3	2		17.81	82.11	10.43	89.57	14.40	85.60	15.46	84.54	60.51	39.49	63.24	36.76
1	3	3		20.27	79.73	7.59	92.41	13.03	86.97	14.36	85.64	41.79	58.21	47.96	52.04
1	3	4		18.51	81.49	9.60	90.40	16.71	83.29	15.59	84.41	48.88	51.12	48.54	51.48
1	3	5		15.06	84.94	18.18	81.82	14.37	85.63	15.09	84.91	58.24	41.76	68.25	31.75
1	3	6		14.60	85.40	10.62	89.38	14.17	85.83	14.02	85.98	56.10	43.90	55.65	44.35
1	4	1		14.61	85.39	10.18	89.82	15.63	84.37	14.80	85.20	44.45	55.55	41.32	58.68
1	4	2		16.13	83.87	13.20	86.70	15.78	84.22	15.71	84.29	53.72	46.28	53.50	46.50
1	4	3		15.76	84.24	10.32	89.68	12.05	87.95	13.29	86.71	44.31	85.69	49.50	50.50
1	4	4		18.30	81.70	17.86	82.14	12.29	87.72	15.16	84.84	48.32	51.68	58.12	41.88
1	4	5		16.84	83.16	17.69	82.31	13.99	86.01	15.69	84.31	57.12	42.88	61.75	38.25
1	4	6		17.50	82.50	13.22	86.78	11.76	88.24	14.27	85.27	47.97	52.03	56.81	43.19
2	1	1		13.87	86.13	12.96	87.04	12.48	87.52	13.29	86.71	63.54	36.46	65.78	34.22
2	1	2		16.71	83.29	15.26	84.74	9.64	90.36	13.37	86.63	54.89	45.11	67.47	32.53
2	1	3		14.98	85.02	21.43	78.57	12.29	87.71	14.29	85.71	57.57	42.43	63.51	36.49
2	1	4		16.24	83.76	11.44	88.56	12.22	87.78	13.72	86.28	48.57	51.43	54.21	45.79
2	1	5		17.19	82.81	11.06	88.94	14.82	85.18	15.34	84.66	48.92	51.08	50.65	49.35
2	1	6		16.99	83.01	14.55	85.45	15.11	84.89	7.33	92.67	51.50	48.50	53.82	46.18
2	2	1		17.53	82.47	9.36	90.64	15.78	84.20	15.57	84.43	45.12	54.58	44.36	55.63
2	2	2		15.99	84.01	11.37	88.63	15.69	84.31	15.36	84.63	52.18	47.82	51.48	48.52
2	2	3		9.49	90.51	16.99	83.01	11.23	88.70	18.85	81.13	59.39	40.61	57.98	42.02
2	2	4		16.99	83.01	11.58	88.42	12.89	87.11	14.38	85.32	50.26	48.74	55.41	44.59
2	2	5		14.86	85.14	12.31	87.69	10.60	89.40	12.55	87.45	51.72	48.28	51.24	40.78
2	2	6		15.27	84.73	14.67	85.33	14.77	85.23	15.00	85.00	57.50	42.50	58.17	41.83
2	3	1		16.21	83.79	14.66	85.33	39.77	60.23	26.47	73.53	56.15	43.85	33.97	66.03
2	3	2		15.79	84.21	13.91	86.09	24.82	75.18	19.57	80.43	56.20	43.80	44.47	55.53
2	3	3		14.99	85.01	16.84	83.11	29.72	70.21	21.46	79.54	57.26	42.74	40.66	59.33
2	3	4		17.68	82.32	11.57	88.43	30.75	69.25	23.48	76.37	49.42	50.58	34.16	65.82
2	3	5		17.50	82.50	10.87	89.13	26.45	73.55	21.42	78.58	48.57	51.43	36.48	63.58
2	3	6		15.39	84.66	14.55	85.45	31.07	68.93	22.14	77.86	57.22	42.78	39.88	60.42
2	4	1		17.75	82.25	10.00	90.00	36.92	63.08	27.92	72.08	42.91	57.09	24.50	75.50
2	4	2		22.38	77.62	7.65	92.35	35.84	64.16	27.72	72.48	38.49	61.51	21.47	79.53
2	4	3		16.59	83.41	10.34	89.66	37.60	62.50	27.12	72.88	46.23	53.77	25.65	74.35
2	4	4		15.70	84.30	14.44	85.56	39.56	60.44	27.53	72.47	49.98	50.02	28.12	71.88
2	4	5		16.97	83.03	10.10	89.90	34.63	65.37	26.01	73.99	44.77	55.23	26.47	73.53
2	4	6		17.16	82.84	10.36	89.64	26.55	73.45	72.00	78.00	40.97	59.03	28.78	71.22
3	1	1		15.30	84.70	9.09	90.91	15.25	84.75	14.45	85.55	46.50	53.50	43.55	56.45
3	1	2		16.63	83.37	12.17	87.83	12.90	87.10	14.48	85.54	46.84	53.16	51.89	48.11
3	1	3		20.17	79.83	18.54	81.46	12.30	87.70	14.95	85.05	36.49	63.51	47.82	52.18
3	1	4		17.28	82.28	11.50	88.50	18.03	81.97	17.13	82.87	44.59	55.41	41.67	58.33
3	1	5		17.95	82.05	11.72	88.28	14.82	85.18	15.61	84.39	43.67	56.33	46.54	53.46
3	1	6		18.00	82.00	16.37	83.63	14.78	85.22	15.84	84.16	38.18	61.82	42.28	57.72
3	2	1		16.82	83.18	11.19	88.81	15.86	84.04	14.78	84.22	46.11	53.89	45.85	54.15
3	2	2		16.47	83.53	10.32	89.68	17.79	82.21	16.67	83.33	44.53	55.47	40.80	59.20
3	2	3		10.42	89.58	9.08	90.92	14.80	85.20	17.55	82.45	40.43	59.57	49.73	50.27
3	2	4		16.50	83.50	10.61	89.39	14.91	85.09	15.13	84.87	49.12	50.88	49.84	50.16
3	2	5		16.60	83.40	9.92	90.08	13.40	86.60	14.19	85.81	44.61	55.39	47.69	52.31
3	2	6		16.13	83.87	10.50	89.50	13.03	86.97	14.05	85.95	53.17	46.83	56.58	43.42
3	3	1		16.45	83.55	9.79	90.21	37.99	62.01	25.35	74.05	55.46	44.54	33.24	66.76
3	3	2		17.25	82.25	11.30	88.70	36.39	63.61	24.17	75.83	60.26	38.74	40.16	59.82
3	3	3		22.20	17.80	18.28	81.72	20.03	79.97	19.61	81.39	41.06	51.94	38.40	60.60
3	3	4		18.89	81.11	16.43	83.57	18.09	81.91	18.15	81.85	44.92	55.08	43.14	56.86
3	3	5		16.57	83.43	18.89	81.11	23.02	76.98	19.80	80.19	53.62	46.38	46.11	53.89

Contd

Appendix-18. Continued

S	N	G	E	Leaf dry wt.	Leaf moisture	Leaf-DW petiole	Leaf-M petiole	Root DW (%)	Root M (%)	Plant DW(%)	Plant M(%)	fw rat shoot	fw rat root	dw rat shoot	dw rat root
3	3	6		16.84	83.16	10.67	89.33	35.05	64.95	24.48	75.52	54.09	45.9`1	34.44	65.59
3	4	1		16.60	83.40	11.20	88.80	14.94	85.06	15.23	84.77	47.32	52.68	48.31	51.61
3	4	2		17.23	82.77	11.80	88.20	16.26	83.24	16.16	83.84	47.31	52.69	50.17	49.83
3	4	3		23.19	76.81	10.90	89.10	41.66	58.36	40.16	59.85	45.97	54.03	43.93	56.07
3	4	4		12.19	87.81	6.44	93.56	25.38	74.62	20.04	79.96	36.53	63.47	19.60	80.40
3	4	5		17.42	82.58	11.76	88.24	25.96	74.04	21.44	78.56	46.77	53.23	35.56	64.44
3	4	6		17.93	82.07	10.65	89.35	23,84	74.16	20.44	79.58	46.49	53.51	37.53	62.47
4	1	1		22.59	78.41	10.12	89.88	12.34	87.66	14.68	85.32	40.05	59.95	50.39	49.61
4	1	2		23.14	76.86	13.10	86.90	11.56	88.47	15.77	84.23	44.83	55.17	59.57	40.43
4	1	3		19.18	80.82	13.13	86.88	10.85	89.15	14.30	85.71	48.03	51.97	60.66	39.44
4	1	4		19.34	80.66	12.17	87.83	9.36	90.65	12.46	87.54	37.92	67.08	53.44	46.56
4	1	5		18.98	81.02	20.77	79.23	13.30	84.70	16.50	83.44	54.52	45.48	63.45	36.55
4	1	6		18.25	81.75	17.65	82.35	13.05	86.99	15.78	84.22	53.34	46.67	61.75	38.69
4	2	1		23.15	76.85	11.91	88.09	15.22	84.78	17.94	82.06	52.75	47.25	59.91	40.09
4	2	2		20.96	79.04	14.50	85.50	13.24	86.76	16.82	83.18	57.76	45.24	64.38	35.62
4	2	3		12.96	87.04	7.63	92.37	11.27	88.76	11.62	88.38	54.69	45.31	56.15	43.85
4	2	4		16.90	83.10	9.90	90.91	9.31	90.89	11.71	88.19	44.56	55.44	56.32	43.68
4	2	5		21.79	78.21	15.01	84.97	11.43	86.67	16.03	83.97	51.10	48.90	65.14	34.86
4	2	6		21.43	78.57	10.94	88.06	11.84	82.16	14.72	85.28	48.80	51.50	62.24	37.76
4	3	1		23.66	76.34	10.49	89.53	31.98	68.02	26.00	74.00	50.67	49.33	39.32	60.66
4	3	2		21.58	78.42	15.97	84.03	35.90	64.10	26.69	73.31	51.34	39.66	46.67	53.33
4	3	3		19.65	80.35	19.40	80.60	28.55	71.45	23.61	76.39	55.21	44.71	45.85	54.15
4	3	4		18.90	81.10	18.29	81.71	29.45	70.55	23.87	26.13	52.31	47.69	41.16	58.84
4	3	5		19.14	80.86	15.79	84.21	26.76	73.24	22.34	77.66	54.98	45.02	46.08	53.98
4	3	6		19.74	80.26	11.67	88.33	23.63	76.37	20.96	79.04	46.72	53.28	39.94	60.06
4	4	1		24.50	75.50	13.69	86.61	30.47	69.53	26.94	73.06	41.97	58.07	34.35	65.65
4	4	2		21.17	78.83	10.46	89.54	25.16	74.84	22.45	77.53	41.87	58.13	34.83	65.17
4	4	3		21.58	78.42	10.30	89.70	23.31	76.69	21.49	78.51	40.84	59.16	35.83	64.17
4	4	4		19.08	80.92	17.50	82.50	28.90	71.10	23.67	76.33	52.01	47.99	41.36	58.61
4	4	5		24.53	75.47	15.00	85.00	28.46	71.54	15.14	84.86	49.17	50.83	42.47	57.53
4	4	6		21.62	78.38	10.56	89.44	28.02	71.98	23.64	76.36	47.29	52.71	37.54	62.46
Treated mean				18.85	82.13	12.45	87.55	19.46	80.54	18.00	82.00	48.76	51.24	47.07	52.93
Control mean				17.93	82.06	14.66	85.33	18.92	81.08	17.92	82.08	47.51	52.49	44.70	55.30
CD treated vs Control				NS	NS NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

APPENDIX-19

LEAF PARAMETERS

S	N	G	E	LAI	SLW	Leaf emer-unfurr	Leaf unfun-matu	Leaf mat-sene	Leaf period
1	0	0	4	0.17	0.05	16	9	113	138
2	0	0	3	0.25	0.07	16	8	114	139
3	0	0	2	0.22	0.06	14	9	121	144
4.	0	0	1	0.17	0.05	14	9	115	138
1	1	1		0.20	0.03	13	13	122	148
1	1	2		0.26	0.05	17	9	122	148
1	1	3		0.61	0.05	12	14	133	159
1	1	4		0.54	0.04	14	13	130	157
1	1	5		0.26	0.06	19	9	108	130
1	1	6		0.26	0.06	19	9	108	136
1	2	1		0.27	0.03	14	13	110	137
1	2	2		0.28	0.04	14	12	108	134
1	2	3		0.24	0.04	14	9	113	136
1	2	4		0.48	0.04	16	10	121	147
1	2	5		0.32	0.04	11	11	119	144
1	2	6		0.24	0.06	14	13	115	142
1	3	1		0.39	0.04	14	11	113	138
1	3	2		0.27	0.05	14	12	111	137
1	3	3		0.26	0.04	12	11	114	137
1	3	4		0.68	0.04	14	12	125	151
1	3	5		0.44	0.05	14	12	126	152
1	3	6		0.39	0.05	14	9	117	140
1	4	1		0.24	0.08	14	12	115	141
1	4	2		0.27	0.07	12	14	126	152
1	4	3		0.60	0.03	14	9	121	144
1	4	4		0.71	0.05	14	12	128	154
1	4	5		0.75	0.03	14	12	129	155
1	4	6		0.30	0.05	12	11	119	142
2	1	1		0.40	0.04	16	6	119	141
2	1	2		0.30	0.06	16	7	104	127
2	1	3		0.27	0.06	14	13	104	131
2	1	4		0.71	0.04	16	7	130	153
2	1	5		0.89	0.03	11	13	137	161
2	1	6		0.46	0.04	14	14	107	134
2	2	1		0.47	0.04	14	13	109	136
2	2	2		0.35	0.05	14	14	106	133
2	2	3		0.21	0.05	14	9	105	128
2	2	4		0.47	0.03	14	14	128	156
2	2	5		0.48	0.04	16	9	126	151
2	2	6		0.32	0.05	16	9	108	133
2	3	1		0.40	0.04	14	14	108	136
2	3	2		0.33	0.04	14	12	124	150
2	3	3		0.25	0.08	14	9	125	148
2	3	4		0.58	0.04	14	13	127	154
2	3	5		0.66	0.03	14	12	128	154
2	3	6		0.32	0.04	15	11	125	151
2	4	1		0.36	0.03	14	9	127	150
2	4	2		0.30	0.04	14	12	121	147
2	4	3		0.15	0.04	16	7	124	147
2	4	4		0.49	0.04	16	7	130	153
2	4	5		0.50	0.05	14	12	132	158
2	4	6		0.37	0.03	14	13	117	144
3	1	1		0.60	0.03	14	9	125	148
3	1	2		0.33	0.04	11	13	121	145
3	1	3		0.32	0.03	11	13	123	147
3	1	4		0.76	0.06	14	10	125	149
3	1	5		0.41	0.03	14	10	125	149
3	1	6		0.21	0.03	14	13	121	148
3	2	1		0.40	0.04	14	9	125	149
3	2	2		0.51	0.03	19	8	124	151
3	2	3		0.24	0.04	14	13	124	151

Contd.

Appendix-19.Continued

S	N	G	E	LAI	SLW	Leaf emer-unfurr	Leaf unfun-matu	Leaf mat-sene	Leaf period
3	2	4		0.73	0.02	16	11	128	155
3	2	5		0.56	0.04	19	8	128	155
3	2	6		0.22	0.03	19	8	117	144
3	3	1		0.38	0.03	14	9	121	144
3	3	2		0.38	0.03	14	13	115	142
3	3	3		0.25	0.05	14	9	119	142
3	3	4		0.45	0.05	14	13	127	154
3	3	5		0.34	0.04	14	12	128	154
3	3	6		0.25	0.04	14	14	114	142
3	4	1		0.28	0.04	14	9	119	142
3	4	2		0.35	0.04	11	9	129	149
3	4	3		0.19	0.06	14	9	131	154
3	4	4		0.30	0.05	16	7	130	153
3	4	5		0.61	0.04	14	9	133	156
3	4	6		0.36	0.02	14	9	133	156
4	1	1		0.22	0.05	11	12	126	149
4	1	2		0.26	0.06	12	11	111	134
4	1	3		0.25	0.05	18	11	111	140
4	1	4		0.21	0.06	18	11	124	153
4	1	5		0.27	0.07	14	12	119	145
4	1	6		0.32	0.05	18	11	113	142
4	2	1		0.20	0.07	14	9	113	136
4	2	2		0.40	0.04	18	11	119	148
4	2	3		0.31	0.05	23	9	118	150
4	2	4		0.36	0.05	11	12	122	145
4	2	5		0.33	0.05	18	11	125	154
4	2	6		0.28	0.05	14	12	118	144
4	3	1		0.30	0.03	18	11	118	147
4	3	2		0.38	0.06	14	12	128	154
4	3	3		0.29	0.06	11	12	122	145
4	3	4		0.36	0.04	14	12	130	156
4	3	5		0.39	0.05	16	7	126	149
4	3	6		0.40	0.05	12	11	119	142
4	4	1		0.34	0.06	8	11	121	140
4	4	2		0.25	0.05	12	11	125	148
4	4	3		0.33	0.05	16	13	123	152
4	4	4		0.24	0.06	12	14	126	152
4	4	5		0.34	0.04	11	12	128	151
4	4	6		0.29	0.06	12	11	118	141
Treated mean				0.38	0.05	14.3	10.9	12.1	146.3
Control mean				0.20	0.06	15.0	9.6	116	140
CD treated vs Control				0.39	NS	NS	NS	NS	16.5

APPENDIX- 20
SENESCENCE

S	N	G	E	MONTH 1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	0	0	4	1.2	0.7	0.4	0.0	0.1	1.1	2.0	3.0	2.2	1.4	2.0	1.3	1.2	0.6
2	0	0	3	2.1	0.2	0.8	0.1	0.3	1.6	2.1	2.0	1.3	1.6	2.4	1.8	1.0	1.2
3	0	0	2	1.3	0.0	0.8	0.1	0.1	2.0	2.3	2.0	1.0	1.9	2.0	1.5	1.3	0.9
4	0	0	1	1.0	0.5	0.7	0.2	0.5	2.4	1.6	1.5	0.7	1.9	1.8	1.8	0.9	1.7
1	1	1		0.6	0.1	1.0	0.2	0.8	1.7	2.2	2.5	2.0	2.4	2.1	2.0	1.2	1.4
1	1	2		1.8	0.1	1.2	0.1	0.6	2.0	2.6	2.1	1.9	2.0	2.4	3.0	1.7	1.8
1	1	3		2.0	0.0	1.2	0.2	0.2	2.0	2.7	2.6	2.1	1.5	3.0	2.8	1.3	1.4
1	1	4		1.5	0.0	1.2	0.4	0.4	2.0	3.1	2.3	2.4	1.5	2.8	2.8	1.2	1.4
1	1	5		1.7	0.1	0.8	0.2	0.5	2.0	2.6	2.4	1.3	1.7	1.5	2.0	1.2	0.9
1	1	6		1.5	0.0	0.9	0.2	0.0	1.7	2.0	2.2	1.4	1.0	1.6	2.3	1.0	0.9
1	2	1		2.0	0.0	1.0	0.5	0.1	1.4	2.3	2.2	1.9	2.3	2.2	1.8	1.5	0.9
1	2	2		1.9	0.0	0.8	0.3	0.5	1.7	2.4	2.4	2.3	2.0	2.3	2.3	1.3	1.5
1	2	3		2.6	0.2	1.2	0.0	0.5	1.5	2.8	2.6	2.2	1.9	2.9	2.6	1.8	0.9
1	2	4		2.1	0.2	1.2	0.2	0.1	1.6	2.1	2.2	2.0	1.3	2.8	1.8	1.4	0.7
1	2	5		2.2	0.2	1.2	0.1	0.2	1.4	2.1	2.0	1.5	1.1	1.3	2.1	1.1	0.8
1	2	6		1.8	0.0	1.0	0.7	0.6	2.0	2.6	2.1	1.4	0.4	1.0	1.8	1.3	0.5
1	3	1		2.1	0.0	1.4	0.5	0.8	1.7	3.1	2.3	2.6	2.3	2.3	2.1	1.8	1.5
1	3	2		2.5	0.0	0.9	0.4	0.4	1.7	2.7	2.7	2.8	2.2	2.1	2.2	1.5	0.6
1	3	3		2.0	0.0	1.3	0.5	0.4	2.1	2.8	1.0	2.2	2.0	3.1	2.6	1.3	0.7
1	3	4		1.7	0.0	1.0	0.8	0.3	1.7	3.3	2.1	2.3	2.1	3.0	2.2	1.6	0.6
1	3	5		2.2	0.1	1.2	0.6	0.2	2.1	2.7	2.3	1.0	1.1	1.8	1.3	1.1	0.7
1	3	6		2.2	0.1	1.0	0.9	0.4	2.2	2.4	2.2	1.3	1.4	1.5	1.3	1.5	0.5
1	4	1		2.1	0.0	1.1	0.5	0.5	2.2	2.7	2.5	2.0	2.1	2.8	1.3	1.5	1.0
1	4	2		2.4	0.3	1.3	0.6	0.3	2.0	3.4	2.6	2.2	2.4	2.5	1.6	1.6	1.2
1	4	3		2.3	0.0	1.3	0.3	0.0	1.5	4.0	2.5	1.8	2.4	3.0	2.1	1.6	1.7
1	4	4		1.9	0.0	1.2	0.1	0.1	1.8	2.8	2.5	1.5	2.4	1.9	2.3	1.5	0.7
1	4	5		1.9	0.0	1.0	0.2	0.1	2.1	2.5	2.5	1.2	1.7	1.5	1.3	1.3	0.7
1	4	6		2.0	0.0	1.1	0.3	0.0	1.8	2.2	2.5	1.5	1.4	1.5	1.2	1.5	1.2
2	1	1		1.9	0.0	1.5	0.6	0.5	1.6	2.4	2.4	2.1	2.3	2.6	2.5	1.3	1.3
2	1	2		2.0	0.1	1.4	0.5	0.4	1.5	2.7	2.8	2.4	2.6	2.9	2.4	1.6	1.7
2	1	3		2.3	0.3	1.5	0.5	0.6	1.3	2.8	2.3	1.4	2.0	2.7	1.9	1.4	0.9
2	1	4		2.5	0.2	1.5	0.6	0.1	1.8	2.6	1.7	1.3	1.5	2.6	2.0	1.3	0.7
2	1	5		2.0	0.1	1.6	1.2	0.4	1.8	2.3	2.5	1.1	1.1	1.8	1.1	1.2	0.7
2	1	6		2.2	0.0	1.2	1.2	0.3	1.4	2.0	1.9	1.2	1.4	1.7	1.3	0.9	0.9
2	2	1		1.6	0.0	1.3	1.6	0.3	1.6	2.2	2.4	1.8	2.0	2.4	2.5	1.0	2.1
2	2	2		1.7	0.1	1.4	1.3	0.7	2.2	2.0	2.4	2.6	2.2	2.6	3.4	1.4	2.1
2	2	3		2.2	0.1	1.5	0.8	0.3	2.1	2.4	2.0	1.3	2.2	2.8	1.7	1.7	1.5
2	2	4		2.2	0.3	1.0	0.5	0.1	1.6	2.4	2.0	1.5	2.1	2.5	2.6	1.7	1.8
2	2	5		2.0	0.0	2.2	0.4	0.1	1.1	2.1	2.4	1.5	1.1	1.9	1.9	0.9	1.2
2	2	6		2.3	0.1	1.4	0.2	0.1	2.0	2.3	2.3	1.1	1.3	1.9	2.1	1.1	1.7
2	3	1		2.0	0.1	1.0	0.4	0.3	1.8	2.4	1.9	2.2	1.6	2.8	2.3	1.6	1.3
2	3	2		1.9	0.3	1.2	0.1	0.0	1.8	2.5	2.5	2.5	2.3	2.9	2.8	1.2	1.7
2	3	3		1.7	0.1	1.4	0.3	0.2	1.7	3.0	1.2	2.0	1.6	2.6	2.2	1.4	1.1
2	3	4		1.8	0.1	1.4	0.2	0.4	1.6	3.1	1.5	1.4	1.5	2.8	2.1	1.2	1.4
2	3	5		1.3	0.0	1.8	0.5	0.4	1.9	2.4	2.2	1.4	1.3	2.1	1.2	1.3	1.1
2	3	6		1.7	0.0	1.8	0.8	0.2	1.9	2.0	2.5	1.4	1.3	1.6	1.3	0.7	1.3
2	4	1		1.3	0.0	1.2	1.0	0.3	1.5	2.3	2.6	2.0	1.9	2.3	1.7	1.5	0.6
2	4	2		2.0	0.0	1.3	0.9	0.2	1.8	2.5	2.2	2.5	2.5	2.4	2.4	1.2	1.7
2	4	3		1.4	0.5	2.0	0.8	0.0	1.2	2.9	2.0	1.4	1.7	2.7	2.4	1.5	1.2
2	4	4		1.7	0.0	1.4	0.6	0.4	1.5	3.3	2.1	1.3	2.0	3.7	2.4	1.9	1.5
2	4	5		1.8	0.0	1.3	0.4	0.0	1.7	2.7	2.1	1.0	1.5	1.9	1.2	1.1	1.5
2	4	6		2.0	0.4	1.5	0.6	0.3	1.4	2.4	2.2	1.0	0.9	1.7	1.8	1.2	1.0
3	1	1		2.0	0.0	1.1	0.3	0.3	1.9	2.2	2.6	1.7	2.6	2.4	2.3	1.5	0.9
3	1	2		1.9	0.0	1.0	0.5	0.3	2.7	2.1	2.6	1.8	1.8	2.9	2.3	1.4	1.9
3	1	3		2.5	0.2	0.8	0.1	0.1	2.1	2.4	2.6	1.2	1.9	3.2	2.3	1.6	1.4
3	1	4		2.1	0.3	0.9	0.0	0.2	2.4	2.3	2.9	1.5	2.2	2.8	2.1	1.5	1.7
3	1	5		2.4	0.2	1.2	0.6	0.5	2.3	2.0	2.8	1.1	2.3	1.5	1.8	1.1	0.8
3	1	6		2.1	0.1	1.1	0.4	0.0	2.4	1.8	2.2	1.1	1.6	0.2	1.3	1.3	1.8
3	2	1		2.1	0.0	1.3	0.4	0.4	2.5	2.7	2.6	1.9	1.9	2.2	2.2	1.0	1.1
3	2	2		2.1	0.0	1.3	0.7	0.9	2.5	1.9	2.7	2.1	2.1	2.4	2.2	0.9	0.6
3	2	3		1.8	0.1	0.7	0.2	0.1	1.6	2.8	1.6	1.3	2.4	2.5	1.6	2.0	0.4
3	2	4		2.1	0.2	1.0	0.0	0.0	1.4	3.3	1.8	1.3	2.3	2.5	2.3	1.6	0.5
3	2	5		2.1	0.2	1.2	0.0	0.2	1.9	2.3	2.3	1.4	2.2	1.8	1.4	1.3	1.4
3	2	6		2.1	0.5	1.0	0.3	0.2	1.7	2.0	2.3	1.1	1.6	0.8	1.9	1.4	1.4
3	3	1		2.0	0.0	1.4	0.2	0.5	2.5	2.3	2.7	2.4	2.5	2.4	2.6	1.8	1.7
3	3	2		2.3	0.0	1.7	0.0	0.1	2.6	2.2	2.5	1.6	2.7	2.7	2.5	1.2	2.0
3	3	3		2.0	0.1	1.3	0.1	0.1	2.7	2.3	1.6	1.7	2.5	2.2	2.2	1.7	1.4
3	3	4		1.6	0.0	1.3	0.0	0.2	2.8	2.8	1.7	1.4	2.3	2.9	2.3	1.8	1.9
3	3	5		1.7	0.0	1.5	0.3	0.9	2.6	1.9	2.3	1.5	2.7	1.5	1.6	1.1	2.1

Contd.

Appendix-20. Continued

S	N	G	E	MONTH 1	2	3	4	5	6	7	8	9	10	11	12	13	14
3	3	6		1.7	0.0	1.2	0.0	0.1	2.0	2.0	2.7	1.	2.0	1.4	1.2	1.3	1.1
3	4	1		1.3	0.0	1.0	0.6	0.8	2.7	2.6	2.3	1.5	1.6	1.3	2.2	2.2	1.6
3	4	2		1.2	0.1	0.7	0.6	0.3	2.8	2.3	2.7	1.7	2.1	1.5	2.5	1.3	1.9
3	4	3		1.3	0.3	0.9	0.2	0.2	2.6	2.4	2.8	1.5	2.8	1.7	2.2	1.3	1.1
3	4	4		1.1	0.1	1.1	0.0	0.4	3.0	2.1	2.6	1.0	2.3	2.4	2.2	1.4	1.3
3	4	5		1.8	0.2	1.2	0.4	0.3	3.0	2.2	2.5	1.3	1.7	1.2	1.2	1.7	1.7
3	4	6		1.7	0.2	1.1	0.3	0.2	2.5	1.9	2.4	0.7	2.0	1.3	1.4	1.3	1.2
4	1	1		1.5	0.0	1.2	1.4	1.1	2.2	2.3	2.2	2.5	2.1	2.0	1.5	0.7	1.0
4	1	2		1.4	0.3	1.2	1.3	0.9	1.9	2.2	2.1	2.2	1.8	1.6	1.6	1.5	1.5
4	1	3		1.4	0.1	1.0	1.4	1.5	2.4	3.0	2.5	1.3	2.1	2.3	1.9	1.1	1.4
4	1	4		1.5	0.0	1.4	1.0	1.8	2.3	3.2	2.5	1.3	2.3	2.9	2.0	1.1	1.5
4	1	5		1.5	0.0	1.2	1.1	0.8	2.4	2.9	2.5	1.1	1.4	2.2	0.9	0.7	1.0
4	1	6		1.3	0.0	0.8	1.7	1.0	2.4	2.7	2.1	1.6	1.7	1.1	1.0	0.7	1.0
4	2	1		1.2	0.1	1.2	0.1	0.2	2.1	2.9	2.0	1.7	2.1	2.1	2.1	1.7	1.4
4	2	2		1.6	0.2	1.2	1.6	0.7	2.1	2.2	2.2	2.0	2.0	2.0	2.0	1.8	1.0
4	2	3		1.0	0.5	1.1	0.9	0.7	2.0	2.8	2.0	1.4	2.3	2.6	2.2	1.9	1.6
4	2	4		1.3	0.6	1.3	0.9	0.4	2.0	3.1	2.2	1.4	2.1	2.2	2.2	1.5	1.4
4	2	5		1.4	0.0	1.2	0.9	0.3	1.8	2.8	2.2	0.8	1.9	1.5	1.3	0.7	1.4
4	2	6		1.7	0.0	1.3	0.6	0.4	2.1	2.5	2.0	0.9	1.1	1.4	1.6	0.7	1.7
4	3	1		1.9	0.0	1.2	0.8	1.0	1.7	2.8	1.4	1.6	2.2	1.9	2.0	1.4	0.9
4	3	2		1.2	0.0	1.2	0.2	0.7	2.3	2.2	2.1	1.7	1.9	1.9	1.8	1.6	1.5
4	3	3		1.0	0.2	1.5	0.7	1.1	2.0	2.3	1.9	0.8	2.4	2.2	2.3	1.0	1.0
4	3	4		1.0	0.1	1.4	0.4	0.5	1.9	2.4	2.2	1.1	2.6	2.7	2.7	1.1	0.8
4	3	5		1.0	0.2	1.3	0.3	1.0	2.7	2.8	2.9	0.7	1.5	0.9	0.9	1.5	1.2
4	3	6		1.7	0.2	1.2	0.6	1.2	2.4	2.8	2.4	0.7	1.8	1.8	1.5	0.7	1.1
4	4	1		1.2	0.0	1.0	1.1	1.0	2.4	2.8	2.1	2.6	2.0	1.7	1.4	1.1	1.0
4	4	2		1.3	0.1	1.2	1.1	1.7	2.3	2.3	1.5	1.7	2.2	1.8	1.0	1.7	0.8
4	4	3		1.8	0.4	1.2	0.7	1.9	2.9	1.6	1.7	1.2	2.8	1.7	2.2	2.0	0.5
4	4	4		1.4	0.4	1.0	0.4	0.8	2.3	3.4	2.0	0.8	2.1	2.3	1.9	2.1	0.6
4	4	5		1.5	0.0	1.1	0.0	0.1	2.1	2.6	1.8	0.8	1.2	1.1	2.2	1.0	0.6
4	4	6		1.5	0.2	1.3	0.3	0.2	1.5	2.9	1.5	1.3	1.8	1.1	1.3	0.8	0.8
Treated mean				1.8	0.12	1.2	0.5	0.4	2.0	2.5	2.2	1.6	2.0	2.1	1.9	1.3	1.2
Control mean				1.9	0.3	0.7	0.1	0.2	1.8	2.0	2.1	1.3	1.7	2.0	1.5	1.1	1.1
CD treated vs Control				1.0	0.4	0.7	1.0	NS	NS	1.1	NS	NS	NS	NS	NS	NS	NS

APPENDIX- 21

NUMBER OF AERIAL ROOTS

S	N	G	E	MONTH													
				1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	0	0	4	2.4	2.5	3.7	3.4	4.9	3.6	2.0	3.0	1.6	2.8	3.0	1.4	1.0	1.2
2	0	0	3	2.0	3.1	4.1	4.6	4.6	4.8	3.3	3.2	2.8	6.1	4.8	0.4	0.0	0.0
3	0	0	2	1.0	2.6	3.3	3.2	2.9	2.7	2.6	3.9	1.8	4.9	5.2	0.4	0.4	0.7
4	0	0	1	1.0	2.2	4.1	1.7	2.8	1.7	1.8	0.7	1.8	4.2	5.3	0.7	0.0	0.0
1	1	1		2.7	4.2	6.4	5.7	7.2	3.6	4.0	3.3	2.0	3.4	4.5	2.4	2.1	3.8
1	1	2		2.3	4.2	5.8	5.7	8.6	4.2	3.9	4.4	2.6	4.8	4.8	2.1	1.2	1.7
1	1	3		3.2	2.5	4.2	4.2	6.7	2.4	3.3	3.9	2.7	4.1	5.8	1.7	1.8	2.9
1	1	4		1.3	3.4	5.5	5.7	6.5	3.8	3.0	4.4	2.9	3.5	5.6	1.6	1.4	2.1
1	1	5		2.9	3.3	5.4	5.9	7.9	5.7	4.0	4.0	4.0	4.2	4.5	2.5	3.8	0.8
1	1	6		3.7	3.5	4.0	4.6	8.2	5.1	3.0	3.8	3.5	3.8	5.0	4.1	3.3	3.6
1	2	1		2.0	4.4	4.0	5.5	7.4	4.7	4.0	4.0	2.0	4.1	4.3	1.0	0.0	0.0
1	2	2		2.1	4.1	4.6	5.6	7.4	4.1	3.5	3.7	2.2	4.5	4.9	1.4	0.6	1.4
1	2	3		0.8	4.0	3.8	5.3	6.6	4.4	3.9	3.7	4.3	7.6	8.0	2.0	2.2	2.6
1	2	4		0.5	1.4	4.3	4.9	7.0	4.0	3.3	3.7	2.5	5.4	4.8	1.2	1.6	1.9
1	2	5		3.1	2.2	4.7	5.3	7.2	4.6	3.5	3.6	3.0	4.5	3.8	3.8	2.0	0.0
1	2	6		0.8	2.8	5.2	5.7	8.4	5.7	4.5	6.1	2.4	6.3	6.2	2.2	1.5	1.5
1	3	1		0.5	2.7	5.8	8.8	8.4	6.3	4.0	4.0	1.7	4.2	3.8	1.5	0.6	0.6
1	3	2		2.1	3.1	5.8	7.3	7.3	6.7	4.1	3.4	2.9	3.7	3.6	1.1	1.0	0.3
1	3	3		2.6	4.2	5.2	6.8	6.0	4.7	4.1	5.7	2.9	7.8	5.7	1.7	1.3	0.0
1	3	4		2.3	3.2	5.8	8.1	7.3	6.3	4.2	6.4	4.2	7.7	6.4	0.0	0.6	0.0
1	3	5		3.4	3.4	4.6	6.1	7.1	5.4	4.5	5.8	3.4	4.9	5.4	1.6	0.0	0.6
1	3	6		1.3	3.3	3.4	7.1	7.2	7.4	4.3	7.6	3.0	8.0	5.9	0.6	0.0	0.0
1	4	1		2.1	3.6	5.2	7.1	7.7	5.0	4.0	6.4	4.0	5.6	5.1	1.3	0.2	0.5
1	4	2		2.5	3.7	4.7	8.6	7.4	5.9	5.1	6.1	3.9	5.5	7.2	3.0	0.0	0.0
1	4	3		1.7	3.0	6.4	10.0	8.9	7.2	6.6	9.0	5.4	6.6	10.2	1.6	0.4	0.0
1	4	4		0.7	2.4	5.2	7.3	6.9	4.8	3.6	5.4	4.6	4.9	6.6	1.4	0.0	1.0
1	4	5		1.9	3.0	5.6	5.4	7.5	7.5	3.9	6.3	4.0	4.4	3.5	1.2	0.4	1.8
1	4	6		2.2	4.1	6.8	5.5	7.6	5.2	3.2	4.0	2.5	6.1	4.2	1.4	0.7	0.4
2	1	1		1.7	3.0	6.3	7.5	5.9	5.1	4.8	4.6	2.3	4.1	4.5	0.0	0.4	0.0
2	1	2		2.0	3.2	6.7	9.0	7.3	6.6	5.0	5.9	3.1	6.4	7.3	1.0	0.0	0.0
2	1	3		2.1	2.5	4.6	6.7	4.8	3.3	3.4	5.6	2.4	6.4	7.7	0.0	0.0	0.0
2	1	4		1.6	4.8	4.8	5.7	5.2	3.3	2.9	6.6	2.8	6.9	7.5	0.8	0.0	0.0
2	1	5		1.9	2.6	3.5	4.4	3.8	4.4	2.5	5.5	3.5	6.0	4.6	1.7	0.0	0.0
2	1	6		1.8	2.8	4.0	5.5	4.6	5.0	4.4	6.4	4.4	6.0	7.0	0.3	0.0	0.0
2	2	1		1.5	2.3	4.5	3.9	3.7	3.4	1.7	4.6	1.3	5.6	5.2	0.0	0.0	0.0
2	2	2		1.5	3.0	4.4	4.7	3.9	3.5	1.5	2.7	1.5	3.6	3.4	0.2	0.2	0.0
2	2	3		3.5	3.3	4.9	5.3	4.1	3.9	3.7	4.9	1.7	4.4	6.0	0.2	0.0	0.0
2	2	4		2.1	1.9	5.1	5.4	5.2	4.1	2.8	4.8	3.8	7.3	7.0	0.0	1.0	0.0
2	2	5		3.7	2.1	4.3	7.0	7.5	7.8	5.0	7.5	3.8	8.1	6.9	0.9	0.0	0.0
2	2	6		3.9	2.3	4.7	5.5	4.7	3.7	4.0	5.1	3.0	6.8	8.0	1.3	0.0	0.0
2	3	1		2.1	3.8	5.9	5.9	7.3	5.7	4.2	6.4	3.3	5.8	8.1	0.8	0.0	0.0
2	3	2		3.5	4.2	5.9	5.9	6.3	4.7	4.0	5.0	2.6	6.5	6.6	0.6	0.0	0.4
2	3	3		0.9	3.0	5.4	5.4	5.0	5.0	3.2	4.9	2.4	7.7	7.3	0.4	0.0	0.0
2	3	4		0.4	2.8	5.1	3.2	5.1	3.4	2.3	4.1	2.3	4.7	6.5	0.8	0.0	0.0
2	3	5		0.7	2.9	4.1	3.7	4.2	3.6	2.5	3.5	1.7	5.4	5.2	0.6	1.0	0.0
2	3	6		1.5	2.4	3.6	5.5	4.4	5.0	3.5	5.4	1.9	5.8	4.5	0.0	0.6	0.0
2	4	1		2.0	2.2	3.2	5.2	5.1	4.0	2.1	3.7	2.0	5.0	5.7	1.7	0.0	0.0
2	4	2		2.4	2.9	3.7	5.0	7.7	4.8	4.0	3.4	2.9	6.3	6.1	1.4	0.2	0.0
2	4	3		1.7	3.2	6.4	4.9	7.8	4.5	3.4	4.4	3.8	6.2	5.7	1.0	0.5	0.0
2	4	4		1.8	3.1	5.1	6.3	8.5	5.2	2.8	3.2	3.0	6.6	7.0	2.0	0.2	0.0
2	4	5		1.0	2.7	5.2	4.9	7.2	4.6	4.3	4.1	2.9	5.5	7.2	0.0	1.2	0.6
2	4	6		1.7	2.7	5.9	6.0	8.0	6.2	4.3	3.8	4.6	5.8	5.8	1.1	0.2	0.0
3	1	1		2.4	2.1	4.9	1.8	3.7	1.5	1.7	2.6	1.7	3.5	3.4	0.4	0.0	0.0
3	1	2		1.4	2.4	4.7	4.0	4.3	1.6	2.3	2.2	1.9	4.8	4.4	0.0	1.0	0.0
3	1	3		2.3	2.2	4.8	3.0	3.7	2.9	3.5	3.0	4.0	4.7	5.9	0.2	0.0	0.0
3	1	4		2.4	3.0	4.5	2.0	2.6	2.1	2.1	2.8	4.3	5.4	6.5	1.0	0.0	0.0
3	1	5		2.5	2.3	3.4	3.2	3.2	2.2	2.6	2.3	3.5	3.5	5.4	0.8	0.6	0.0
3	1	6		2.3	2.9	4.6	5.0	5.9	3.5	2.9	3.4	3.7	5.0	5.8	0.0	0.6	0.0
3	2	1		1.7	3.1	4.9	4.0	5.5	3.2	2.9	1.4	2.9	6.4	5.6	0.6	0.0	0.0
3	2	2		2.3	1.9	3.2	2.4	3.3	1.9	1.7	1.1	2.4	6.0	4.3	0.0	0.0	0.0
3	2	3		1.3	2.1	4.7	3.2	5.1	3.1	3.2	4.2	3.7	5.1	4.5	0.0	0.6	0.0
3	2	4		1.3	1.9	4.3	3.5	3.7	2.9	1.6	2.4	3.4	5.0	4.4	0.8	0.4	0.0
3	2	5		1.3	2.7	4.4	3.8	4.1	2.8	2.5	2.6	3.4	4.5	5.3	0.5	0.0	0.0
3	2	6		1.3	1.7	4.0	2.7	3.2	2.1	2.8	2.4	3.0	3.8	4.4	0.6	0.4	0.0
3	3	1		2.1	4.6	5.0	3.5	2.7	3.0	2.0	3.3	3.8	3.9	5.8	0.0	0.0	0.0
3	3	2		0.9	2.4	4.5	29.	3.9	1.0	3.0	3.5	3.4	4.3	5.3	0.4	0.6	0.0
3	3	3		2.3	2.0	5.5	2.1	3.2	1.6	2.4	3.6	2.8	5.5	6.6	1.0	0.4	0.0
3	3	4		0.8	2.8	3.8	3.5	3.6	3.1	3.5	4.6	4.4	6.3	7.3	1.6	0.0	0.0
3	3	5		2.1	2.4	4.4	3.7	2.5	2.7	3.5.	2.4	3.6	3.7	4.5	1.4	0.2	0.0

Contd.

Appendix-21. Continued

S	N	G	E	MONTH 1	2	3	4	5	6	7	8	9	10	11	12	13	14
3	3	6		0.2	3.2	3.1	3.9	4.4	3.6	3.3	4.4	3.0	4.9	5.0	0.4	0.0	0.0
3	4	1		1.9	2.3	2.5	3.1	3.9	2.8	2.6	2.2	2.5	5.4	5.7	0.9	1.0	0.0
3	4	2		1.0	1.6	3.6	2.3	2.5	1.5	0.4	0.7	2.5=6	3.7	4.7	0.3	0.0	0.0
3	4	3		0.8	1.7	4.3	2.8	3.4	2.4	3.3	3.2	3.2	4.6	9.0	0.8	0.2	0.0
3	4	4		1.8	2.7	3.3	2.0	4.0	2.4	1.9	2.0	3.4	5.9	5.4	0.4	1.3	0.0
3	4	5		2.8	2.4	6.1	1.9	3.7	2.8	3.0	2.5	1.9	4.8	4.5	0.2	0.1	0.0
3	4	6		1.6	2.4	4.4	4.0	6.0	4.4	2.7	3.4	3.4	4.3	5.0	1.1	0.2	0.0
4	1	1		1.4	3.2	6.9	2.1	3.7	2.1	2.0	1.0	2.4	3.1	2.5	0.0	0.0	0.0
4	1	2		2.9	2.4	4.2	4.9	3.2	1.1	1.8	1.5	2.3	2.8	3.6	0.0	0.0	0.0
4	1	3		2.6	2.5	6.7	6.3	3.8	2.7	2.6	3.8	2.0	3.7	4.4	0.0	0.0	0.0
4	1	4		2.6	3.1	6.0	4.8	4.3	2.5	2.0	2.0	3.4	6.0	6.3	0.0	0.0	0.0
4	1	5		1.7	3.4	5.7	4.6	3.6	2.5	1.2	1.6	1.1	4.4	5.3	0.0	0.0	0.0
4	1	6		3.2	2.8	4.6	4.9	4.2	4.2	1.5	1.2	2.6	3.6	5.1	0.0	0.0	0.0
4	2	1		2.9	2.7	5.5	4.6	3.8	2.7	1.3	1.7	4.2	5.1	5.1	0.0	0.9	0.0
4	2	2		2.0	3.5	5.6	5.2	3.5	2.0	1.2	0.6	3.2	4.1	4.4	0.0	0.0	0.0
4	2	3		2.0	3.0	5.3	4.8	3.5	2.7	2.0	1.0	4.5	4.5	6.7	2.0	0.0	0.0
4	2	4		2.1	2.3	4.9	1.2	1.9	1.5	1.1	0.7	4.6	5.3	5.6	0.2	0.0	0.0
4	2	5		2.5	2.8	6.5	3.1	2.2	1.4	0.5	1.6	4.5	4.3	4.7	0.6	0.0	0.0
4	2	6		1.1	3.4	5.9	3.4	2.2	1.9	1.3	1.8	4.0	5.3	5.1	0.0	0.0	0.0
4	3	1		2.4	2.4	6.1	6.4	4.6	2.0	2.6	2.2	3.5	4.9	5.7	0.0	0.0	0.0
4	3	2		1.2	1.8	6.0	6.1	2.7	2.0	0.5	1.3	1.9	5.6	3.7	0.0	0.0	0.0
4	3	3		2.7	2.1	5.5	4.7	2.6	1.8	1.6	2.7	3.8	6.3	4.0	0.0	0.0	0.0
4	3	4		2.1	1.7	4.6	3.3	1.5	1.1	0.8	1.2	2.2	4.7	4.3	0.0	0.0	0.0
4	3	5		2.7	3.2	6.3	4.5	4.3	2.1	0.7	0.5	1.4	4.3	3.5	0.0	0.0	0.0
4	3	6		2.6	3.2	6.0	4.9	4.0	1.7	1.4	2.2	3.3	4.0	2.8	0.0	0.0	0.0
4	4	1		1.6	2.9	5.5	4.4	3.7	1.3	2.0	1.5	2.0	4.9	5.0	0.0	0.2	0.0
4	4	2		1.8	2.6	4.6	3.6	1.6	1.6	0.2	0.5	1.5	3.1	3.5	0.0	0.0	0.0
4	4	3		1.4	2.4	5.8	2.7	2.3	2.3	0.8	1.1	2.8	3.1	3.5	0.6	0.0	0.0
4	4	4		1.6	2.3	3.7	2.1	2.5	1.6	0.8	1.8	1.9	3.8	3.1	1.4	0.0	0.0
4	4	5		1.6	3.0	4.8	3.1	2.0	2.7	1.3	1.5	2.7	3.9	4.0	0.0	0.0	0.0
4	4	6		1.4	2.2	5.0	2.6	4.9	2.9	1.8	2.0	2.2	4.0	3.7	0.7	0.0	0.0
Treated mean				1.9	2.8	4.9	4.8	4.9	3.6	2.8	3.5	3.0	5.1	5.4	0.8	0.4	0.3
Control mean				1.6	2.6	3.8	3.2	3.8	3.2	2.4	2.7	2.0	4.5	4.6	0.7	0.3	0.5
CD treated vs Control				NS	NS	3.0	3.8	NS	NS	NS	NS	2.5	NS	NS	NS	NS	NS

APPENDIX-22
ROOT CHARACTERS

S	N	G	E	No.of Primary roots	No. of secondary roots	Maximum root length	Root spread
1	0	0	4	11	45	14.0	12.0
2	0	0	3	9	39	16.0	11.0
3	0	0	2	12	51	18.0	14.0
4.	0	0	1	6	22	12.0	9.0
1	1	1		9	53	13.0	14.0
1	1	2		8	49	11.0	13.0
1	1	3		14	108	14.0	15.0
1	1	4		14	101	16.0	16.0
1	1	5		9	50	13.0	11.0
1	1	6		11	58	14.0	12.0
1	2	1		9	56	10.0	12.0
1	2	2		9	47	11.0	11.0
1	2	3		12	62	10.0	13.0
1	2	4		13	74	12.0	14.0
1	2	5		8	51	13.0	11.0
1	2	6		9	55	13.0	11.0
1	3	1		7	48	8.0	9.0
1	3	2		8	49	8.0	8.0
1	3	3		12	78	16.0	15.0
1	3	4		12	81	14.0	14.0
1	3	5		10	61	14.0	12.0
1	3	6		11	63	15.0	13.0
1	4	1		12	74	14.0	13.0
1	4	2		12	79	14.0	14.0
1	4	3		18	142	17.0	17.0
1	4	4		17	133	16.0	16.0
1	4	5		12	84	13.0	15.0
1	4	6		11	79	14.0	14.0
2	1	1		8	41	11.0	12.0
2	1	2		7	40	10.0	10.0
2	1	3		14	128	15.0	16.0
2	1	4		15	132	16.0	17.0
2	1	5		10	68	16.0	14.0
2	1	6		12	74	18.0	15.0
2	2	1		8	28	11.0	8.0
2	2	2		6	31	10.0	8.0
2	2	3		12	70	13.0	12.0
2	2	4		13	66	14.0	11.0
2	2	5		10	62	12.0	10.0
2	2	6		9	51	10.0	12.0
2	3	1		6	32	12.0	11.0
2	3	2		7	32	11.0	10.0
2	3	3		14	102	16.0	16.1
2	3	4		15	118	17.0	17.0
2	3	5		10	56	13.0	10.0
2	3	6		12	64	15.0	14.0
2	4	1		8	39	11.0	10.0
2	4	2		8	42	13.0	12.0
2	4	3		17	71	13.0	12.0
2	4	4		10	63	12.0	12.0
2	4	5		9	50	14.0	10.0
2	4	6		11	56	11.0	12.0
3	1	1		12	66	15.0	17.0
3	1	2		11	59	12.0	14.0
3	1	3		15	122	16.0	14.0
3	1	4		14	102	15.0	14.0
3	1	5		9	61	14.0	10.0
3	1	6		10	69	16.0	12.0
3	2	1		12	86	16.0	14.0
3	2	2		14	81	14.0	13.0
3	2	3		11	84	18.0	16.0
3	2	4		12	71	16.0	14.0

Contd.

Appendix-22. Continued

S	N	G	E	No.of Primary roots	No. of secondary roots	Maximum root length	Root spread
3	2	5		10	58	14.0	12.0
3	2	6		11	62	14.0	13.0
3	3	1		8	44	10.0	12.0
3	3	2		9	48	12.0	11.0
3	3	3		14	62	12.0	13.0
3	3	4		12	60	13.0	14.0
3	3	5		9	37	9.0	10.0
3	3	6		6	31	8.0	11.0
3	4	1		7	46	9.0	10.0
3	4	2		8	60	8.0	11.0
3	4	3		10	71	13.0	12.0
3	4	4		15	110	19.0	19.0
3	4	5		10	49	10.0	13.0
3	4	6		11	58	11.0	13.0
4	1	1		6	21	7.0	10.0
4	1	2		6	23	8.0	9.0
4	1	3		7	28	11.0	9.0
4	1	4		6	26	12.0	9.0
4	1	5		5	22	8.0	10.0
4	1	6		7	23	9.0	11.0
4	2	1		6	28	11.0	10.0
4	2	2		7	31	12.0	11.0
4	2	3		9	39	14.0	13.0
4	2	4		11	44	13.0	12.0
4	2	5		9	48	13.0	12.0
4	2	6		8	43	13.0	11.0
4	3	1		10	41	11.0	12.0
4	3	2		10	46	12.0	13.0
4	3	3		12	71	14.0	12.0
4	3	4		13	69	12.0	13.0
4	3	5		9	41	13.0	10.0
4	3	6		8	38	11.0	11.0
4	4	1		9	43	11.0	12.0
4	4	2		8	41	11.0	10.0
4	4	3		10	52	10.0	11.0
4	4	4		11	48	12.0	12.0
4	4	5		10	49	10.0	11.0
4	4	6		8	48	8.0	10.0
Treated mean				9.50	39.25	15.0	11.5
Control mean				10.15	60.55	12.56	12.30
CD treated vs Control				NS	50.21	6.23	NS

APPENDIX-23

FLOWERING PATERN AND INFLORESCENCE CHARACTERS

S	N	G	E	Infl. Ini pro days	Stalk less infl nos.	Normal infl nos.	Prd b/w s & n infl	Prd b/w succ infl	Prod of emer to unfur	Prod of unful. to scensc	Total prod of infl	Infl stalk length cm	Spathe length cm	Spathe width cm	Spadix length cm
1	0	0	4	294	17	0	0	30	21	42	68	0	0.0	0.0	0.0
2	0	0	3	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0
3	0	0	2	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0
4.	0	0	1	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0
1	1	1		0	0	0	0	0	0	0	0	0	0.0	0.0	0.0
1	1	2		0	0	0	0	0	0	0	0	0	0.0	0.0	0.0
1	1	3		0	0	0	0	0	0	0	0	0	0.0	0.0	0.0
1	1	4		232	5	0	0	30	20	52	75	0	0.0	0.0	0.0
1	1	5		235	2	0	0	60	18	41	62	0	0.0	0.0	0.0
1	1	6		288	4	0	0	30	17	43	71	0	0.0	0.0	0.0
1	2	1		262	3	0	0	90	22	46	81	0	0.0	0.0	0.0
1	2	2		0	0	0	0	0	0	0	0	0	0.0	0.0	0.0
1	2	3		282	2	0	0	30	24	51	82	0	0.0	0.0	0.0
1	2	4		265	5	1	120	30	26	53	86	28	6.5	4.5	2.6
1	2	5		291	2	0	0	30	18	48	66	0	0.0	0.0	0.0
1	2	6		289	3	0	0	30	17	42	68	0	0.0	0.0	0.0
1	3	1		0	0	0	0	0	0	0	0	0	0.0	0.0	0.0
1	3	2		0	0	0	0	0	0	0	0	0	0.0	0.0	0.0
1	3	3		0	0	0	0	0	0	0	0	0	0.0	0.0	0.0
1	3	4		295	4	0	0	30	18	49	74	0	0.0	0.0	0.0
1	3	5		290	6	0	0	30	19	41	68	0	0.0	0.0	0.0
1	3	6		290	3	0	0	30	18	43	69	0	0.0	0.0	0.0
1	4	1		263	2	0	0	90	16	36	59	0	0.0	0.0	0.0
1	4	2		228	20	6	150	30	23	43	78	30	7.0	4.6	4.2
1	4	3		285	4	0	0	30	19	46	81	0	0.0	0.0	0.0
1	4	4		288	10	0	0	30	24	52	84	0	0.0	0.0	0.0
1	4	5		294	2	1	150	30	18	46	71	26	5.0	4.5	2.6
1	4	6		0	0	0	0	0	0	0	0	0	0.0	0.0	0.0
2	1	1		0	0	0	0	0	0	0	0	0	0.0	0.0	0.0
2	1	2		236	3	0	0	30	16	45	65	0	0.0	0.0	0.0
2	1	3		265	2	1	215	215	26	52	78	22	6.0	3.5	2.8
2	1	4		232	5	0	0	30	19	48	74	0	0.0	0.0	0.0
2	1	5		0	0	0	0	0	0	0	0	0	0.0	0.0	0.0
2	1	6		284	0	1	140	90	24	51	79	19	5.0	3.2	2.6
2	2	1		235	3	0	0	30	21	39	76	0	0.0	0.0	0.0
2	2	2		0	0	0	0	0	0	0	0	0	0.0	0.0	0.0
2	2	3		238	10	4	110	30	26	52	84	28	6.0	4.5	2.9
2	2	4		234	3	0	0	30	19	44	70	0	0.0	0.0	0.0
2	2	5		0	0	0	0	0	0	0	0	0	0.0	0.0	0.0
2	2	6		295	6	1	90	30	23	46	74	21	4.0	3.2	2.5
2	3	1		0	0	0	0	0	0	0	0	0	0.0	0.0	0.0
2	3	2		0	0	0	0	0	0	0	0	0	0.0	0.0	0.0
2	3	3		229	6	0	0	30	18	41	69	0	0.0	0.0	0.0
2	3	4		230	4	0	0	60	16	37	71	0	0.0	0.0	0.0
2	3	5		232	5	0	0	30	18	40	68	0	0.0	0.0	0.0
2	3	6		0	0	0	0	0	0	0	0	0	0.0	0.0	0.0
2	4	1		0	0	0	0	0	0	0	0	0	0.0	0.0	0.0
2	4	2		236	2	0	0	270	19	41	72	0	0.0	0.0	0.0
2	4	3		238	4	2	105	30	24	48	81	22	5.4	3.8	2.6
2	4	4		264	3	0	0	60	22	44	76	0	0.0	0.0	0.0
2	4	5		312	5	3	90	60	19	42	72	18	6.0	4.0	2.8
2	4	6		291	2	0	0	30	18	41	68	0	0.0	0.0	0.0
3	1	1		0	0	0	0	0	0	0	0	0	0.0	0.0	0.0
3	1	2		0	0	0	0	0	0	0	0	0	0.0	0.0	0.0
3	1	3		324	2	0	0	30	21	43	69	0	0.0	0.0	0.0
3	1	4		278	3	0	0	30	18	41	66	0	0.0	0.0	0.0
3	1	5		0	0	0	0	0	0	0	0	0	0.0	0.0	0.0
3	1	6		490	0	2	0	28	24	46	78	28	7,0	4.2	3.0
3	2	1		0	0	0	0	0	0	0	0	0	0.0	0.0	0.0
3	2	2		496	0	1	0	18	2`1	41	70	18	5.0	3.2	2.4
3	2	3		285	30	0	0	30	16	36	61	0	0.0	0.0	0.0
3	2	4		298	80	0	0	30	21	38	68	0	0.0	0.0	0.0
3	2	5		332	3	0	0	30	18	32	55	0	0.0	0.0	0.0
3	2	6		295	6	0	0	28	22	41	74	0	0.0	0.0	0.0
3	3	1		0	0	0	0	0	0	0	0	0	0.0	0.0	0.0
3	3	2		0	0	0	0	0	0	0	0	0	0.0	0.0	0.0
3	3	3		318	1	0	0	0	18	38	68	0	0.0	0.0	0.0

Contd.

Appendix-23. Continued

S	N	G	E	Infl. Ini pro days	Stalk less infl nos.	Normal infl nos.	Prd b/w s & n infl	Prd b/w succ infl	Prod of emer to unfur	Prod of unful. to scensc	Total prod of infl	Infl stalk length cm	Spathe length cm	Spathe width cm	Spadix length cm
3	3	4		296	3	0	0	30	21	42	66	0	0.0	0.0	0.0
3	3	5		0	0	0	0	0	0	0	0	0	0.0	0.0	0.0
3	3	6		0	0	0	0	0	0	0	0	0	0.0	0.0	0.0
3	4	1		0	0	0	0	0	0	0	0	0	0.0	0.0	0.0
3	4	2		0	0	0	0	0	0	0	0	0	0.0	0.0	0.0
3	4	3		296	4	0	0	22	16	36	62	0	0.0	0.0	0.0
3	4	4		284	2	1	120	30	18	41	69	23	6.0	4.1	3.0
3	4	5		318	1	0	0	0	18	36	61	0	0.0	0.0	0.0
3	4	6		256	1	0	0	0	16	33	59	0	0.0	0.0	0.0
4	1	1		230	2	0	0	26	18	33	62	0	0.0	0.0	0.0
4	1	2		0	0	0	0	0	0	0	0	0	0.0	0.0	0.0
4	1	3		228	1	0	0	0	17	31	64	0	0.0	0.0	0.0
4	1	4		0	0	0	0	0	0	0	0	0	0.0	0.0	0.0
4	1	5		262	7	0	0	30	18	33	61	0	0.0	0.0	0.0
4	1	6		0	0	0	0	0	0	0	0	0	0.0	0.0	0.0
4	2	1		288	2	0	0	30	19	35	65	0	0.0	0.0	0.0
4	2	2		0	0	0	0	0	0	0	0	0	0.0	0.0	0.0
4	2	3		0	0	0	0	0	0	0	0	0	0.0	0.0	0.0
4	2	4		0	0	0	0	0	0	0	0	0	0.0	0.0	0.0
4	2	5		0	0	0	0	0	0	0	0	0	0.0	0.0	0.0
4	2	6		0	0	0	0	0	0	0	0	0	0.0	0.0	0.0
4	3	1		0	0	0	0	0	0	0	0	0	0.0	0.0	0.0
4	3	2		0	0	0	0	0	0	0	0	0	0.0	0.0	0.0
4	3	3		228	1	0	0	0	21	38	74	0	0.0	0.0	0.0
4	3	4		234	1	0	0	0	20	32	72	0	0.0	0.0	0.0
4	3	5		298	1	0	0	0	18	36	61	0	0.0	0.0	0.0
4	3	6		0	0	0	0	0	0	0	0	0	0.0	0.0	0.0
4	4	1		0	0	0	0	0	0	0	0	0	0.0	0.0	0.0
4	4	2		236	3	0	0	60	21	39	66	0	0.0	0.0	0.0
4	4	3		232	2	0	0	30	24	39	68	0	0.0	0.0	0.0
4	4	4		0	0	0	0	0	0	0	0	0	0.0	0.0	0.0
4	4	5		0	0	0	0	0	0	0	0	0	0.0	0.0	0.0
4	4	6		0	0	0	0	0	0	0	0	0	0.0	0.0	0.0
Treated mean				159.7	2.1	03	13.4	22.6	11.3	24.0	40.3	2.9	0.7	0.5	0.4
Control mean				73.5	1.8	0	-	7.5	5.2	10.5	17.0	0	0	0	0
CD treated vs Control				NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

APPENDIX- 24
PIGMENT CONTENT

S	N	G	E	Chlo a	Chlo b	Total Chlo	Antho
1	0	0	4	3.1	2.1	5.2	0.0
2	0	0	3	3.5	2.7	6.2	0.0
3	0	0	2	3.8	3.1	6.9	0.0
4.	0	0	1	3.3	2.0	5.3	0.0
1	1	1		3.5	2/3	5.8	0.0
1	1	2		4.5	3.4	7.9	0.0
1	1	3		3.9	3.0	6.9	0.0
1	1	4		4.3	3.0	7.3	0.0
1	1	5		4.7	3.4	8.1	0.0
1	1	6		4.8	3.6	8.4	0.0
1	2	1		3.2	2.2	5.4	0.0
1	2	2		2.3	1.7	4.0	0.0
1	2	3		2.7	2.0	4.7	0.0
1	2	4		4.3	3.2	7.5	5.2
1	2	5		2.9	2.3	5.2	0.0
1	2	6		4.4	3.3	7.7	0.0
1	3	1		2.5	1.8	4.3	0.0
1	3	2		3.6	2.6	6.2	0.0
1	3	3		4.4	3.0	7.4	0.0
1	3	4		4.5	3.2	7.7	0.0
1	3	5		4.9	3.5	8.4	0.0
1	3	6		3.7	2.7	6.4	0.0
1	4	1		3.7	2.6	6.3	0.0
1	4	2		3.8	2.7	6.5	4.7
1	4	3		3.2	2.1	5.3	3.7
1	4	4		4.7	3.5	8.2	0.0
1	4	5		4.4	3.1	7.5	0.0
1	4	6		3.7	2.9	6.6	0.0
2	1	1		3.0	2.7	5.7	0.0
2	1	2		3.6	3.1	6.7	0.0
2	1	3		3.1	2.7	5.8	5.8
2	1	4		3.4	2.6	6.0	0.0
2	1	5		3.9	2.9	6.8	0.0
2	1	6		3.9	3.2	7.1	4.2
2	2	1		4.0	2.9	6.9	0.0
2	2	2		3.0	2.6	5.6	0.0
2	2	3		2.9	2.3	5.2	6.5
2	2	4		3.4	2.6	6.0	0.0
2	2	5		3.3	2.9	6.2	0.0
2	2	6		4.1	3.6	7.7	4.3
2	3	1		3.0	2.3	5.3	0.0
2	3	2		2.7	2.1	4.8	0.0
2	3	3		3.7	2.8	6.5	0.0
2	3	4		2.9	2.3	5.2	0.0
2	3	5		3.4	2.9	6.3	0.0
2	3	6		3.1	2.4	5.5	0.0
2	4	1		2.8	2.2	5.0	0.0
2	4	2		2.8	1.9	4.7	0.0
2	4	3		3.1	2.8	5.9	5.1
2	4	4		3.5	2.7	6.2	0.0
2	4	5		6.0	1.2	7.2	4.6
2	4	6		4.3	3.3	7.6	0.0
3	1	1		3.7	3.0	6.7	0.0
3	1	2		3.6	3.0	6.6	0.0
3	1	3		3.8	1.7	5.3	0.0
3	1	4		2.9	2.5	5.4	0.0
3	1	5		4.3	3.7	8.0	0.0
3	1	6		3.3	2.8	6.1	3.6
3	2	1		3.2	2.3	5.5	0.0
3	2	2		2.8	2.5	5.3	0.0
3	2	3		3.5	2.9	6.4	4.8

Contd.

Appendix-24. Continued

S	N	G	E	Chlo a	Chlo b	Total Chlo	Antho
3	2	4		3.0	2.7	5.7	0.0
3	2	5		3.7	3.1	6.8	0.0
3	2	6		4.0	3.4	7.4	0.0
3	3	1		2.4	1.7	4.1	0.0
3	3	2		3.1	2.3	5.4	0.0
3	3	3		1.9	1.6	3.5	0.0
3	3	4		3.5	3.0	6.5	4.7
3	3	5		4.0	3.3	7.3	0.0
3	3	6		3.2	2.7	5.9	0.0
3	4	1		2.7	2.3	5.0	0.0
3	4	2		2.5	2.0	4.5	0.0
3	4	3		2.3	2.4	5.7	0.0
3	4	4		4.5	3.5	8.0	0.0
3	4	5		4.4	4.4	8.8	0.0
3	4	6		4.4	3.6	8.0	0.0
4	1	1		2.2	2.5	4.7	0.0
4	1	2		2.8	2.7	5.5	0.0
4	1	3		2.4	2.5	4.9	0.0
4	1	4		2.6	1.6	4.2	0.0
4	1	5		2.0	1.9	3.9	0.0
4	1	6		2.9	2.1	5.0	0.0
4	2	1		2.9	2.0	4.9	0.0
4	2	2		2.7	1.7	4.4	0.0
4	2	3		2.6	1.6	4.2	0.0
4	2	4		3.3	2.2	5.5	0.0
4	2	5		3.1	2.4	5.5	0.0
4	2	6		3.4	2.9	6.3	0.0
4	3	1		2.7	1.7	4.4	0.0
4	3	2		2.5	1.6	4.1	0.0
4	3	3		3.3	2.4	5.7	0.0
4	3	4		2.6	1.8	4.4	0.0
4	3	5		3.4	2.0	5.4	0.0
4	3	6		3.0	1.9	4.9	0.0
4	4	1		2.7	1.9	4.6	0.0
4	4	2		2.6	1.7	4.3	0.0
4	4	3		3.2	2.4	5.6	0.0
4	4	4		3.3	2.0	5.3	0.0
4	4	5		2.9	1.8	4.7	0.0
4	4	6		3.3	2.7	6.0	0.0
Treated mean				3.4	2.6	6.0	0.6
Control mean				3.4	2.5	5.9	0.0
CD treated vs Control				NS	NS	NS	NS

APPENDIX-25
LEAF NUTRIENT CONTENT

S	N	G	E	Con N(%)	Con P(%)	Con K(%)	Con Ca(%)	Con Mg(%)	Con Mn ppm	Con Zn ppm	Con Cu ppm	Con Fe ppm	Con S ppm
1	0	0	4	1.148	0.305	2.063	1.230	0.618	408	200	17	560	144
2	0	0	3	0.714	0.305	1.875	1.088	0.614	272	160	8	297	116
3	0	0	2	0.504	0.260	1.750	1.276	0.656	385	129	10	308	122
4.	0	0	1	0.490	0.220	1.500	0.853	0.511	216	141	11	201	80
1	1	1		1.428	0.345	1.750	0.765	0.157	266	169	19	580	116
1	1	2		1.624	0.315	2.375	1.106	0.604	494	211	15	652	152
1	1	3		2.044	0.315	1.813	1.295	0.643	632	221	13	593	152
1	1	4		1.848	0.310	1.875	1.225	0.619	314	195	16	958	114
1	1	5		1.584	0.365	1.811	1.367	0.631	501	199	13	662	152
1	1	6		1.456	0.365	2.000	1.102	0.610	241	175	13	1084	122
1	2	1		1.470	0.330	2.063	1.259	0.619	307	211	15	1381	140
1	2	2		1.554	0.300	2.063	1.188	0.612	265	178	12	1060	130
1	2	3		2.072	0.285	2.063	1.166	0.622	444	214	23	1137	158
1	2	4		1.946	0.305	2.031	1.246	0.606	481	200	14	956	160
1	2	5		1.554	0.280	1.875	1.114	0.607	172	206	13	1028	130
1	2	6		1.428	0.305	1.688	1.507	0.664	362	199	19	761	166
1	3	1		1.484	0.340	1.938	1.672	0.665	525	231	11	919	138
1	3	2		1.526	0.340	1.938	1.420	0.609	623	247	15	717	192
1	3	3		2.044	0.350	1.938	1.331	0.629	676	231	12	587	144
1	3	4		1.792	0.325	2.063	1.446	0,.651	703	191	51	686	172
1	3	5		1.344	0.330	2.031	1.403	0.643	499	214	137	654	156
1	3	6		1.176	0.335	2.125	1.517	0.684	549	228	11	629	154
1	4	1		1.456	0.290	1.938	1.223	0.641	431	216	21	531	132
1	4	2		1.372	0.350	2.000	1.315	0.647	366	160	13	642	176
1	4	3		1.890	0.330	2.063	1.036	0.603	461	165	11	529	142
1	4	4		1.988	0.275	2.000	1.289	0.643	468	186	10	616	146
1	4	5		1.456	0.345	1.675	1.396	0.684	632	199	13	449	148
1	4	6		1.224	0.345	1.875	1.279	0.618	533	206	18	624	150
2	1	1		1.316	0.270	1.750	1.225	0.632	372	205	17	454	168
2	1	2		1.204	0.335	1.813	1.307	0.617	625	206	9	538	180
2	1	3		1.652	0.305	1.750	1.352	0.646	478	207	10	501	164
2	1	4		2.456	0.285	1.500	1.337	0.635	422	198	9	588	134
2	1	5		1.106	0.325	1.688	1.565	0.652	522	245	10	513	162
2	1	6		1.148	0.315	1.658	1.271	0.642	623	239	9	519	136
2	2	1		1.316	0.340	1.625	1.015	0.560	376	209	9	527	140
2	2	2		1.320	0.285	2.000	1.182	0.595	263	194	12	499	160
2	2	3		1.624	0.315	1.906	0.948	0.570	819	145	9	357	144
2	2	4		1.526	0.280	2.094	1.192	0.596	531	365	9	414	174
2	2	5		1.218	0.295	2.031	1.253	0.608	399	190	11	549.	130
2	2	6		1.092	0.325	2.031	1.177	0.589	439	227	11	692	130
2	3	1		1.316	0.280	2.031	1.525	0.588	281	191	11	469	120
2	3	2		1.204	0.260	2.125	1.487	0.677	425	275	8	67.5	110
2	3	3		2.002	0.255	1.969	1.379	0.644	298	187	8	447	106
2	3	4		1.918	0.275	2.005	1.376	0.607	443	209	9	454	108
2	3	5		1.428	0.295	1.969	1.346	0.622	619	183	9	466	122
2	3	6		1.176	0.280	1.812	1.495	0.661	325	231	10	478	140
2	4	1		1.232	0.355	2.000	2.463	0.822	458	403	15	950	128
2	4	2		1.274	0.270	2.500	0.994	0.596	451	169	8	451	272
2	4	3		1.408	0.245	2.000	1.069	0.658	323	177	8	342	140
2	4	4		1.484	0.275	2.175	1.351	0.669	441	176	8	437	118
2	4	5		1.092	0.280	2.182	1.392	0.616	544	223	8	391	112
2	4	6		1.064	0.250	2.000	1.095	0.609	479	177	8	407	172
3	1	1		0.994	0.335	2.031	1.303	0.644	376	195	8	448	148
3	1	2		1.518	0.325	2.438	1.475	0.656	473	277	9	465	116
3	1	3		1.372	0.260	2.063	1.324	0.643	353	192	9	423	118
3	1	4		1.596	0.340	2.063	1.145	0.619	219	154	8	330	134
3	1	5		1.302	0.285	1.875	2.416	0.697	372	219	9	407	116
3	1	6		1.162	0.280	2.063	1.749	0.688	535	213	8	308	147
3	2	1		1.232	0.310	1.938	1.499	0.675	338	197	8	413	112
3	2	2		1.162	0.280	2.000	1.517	0.665	353	166	8	449	150
3	2	3		1.498	0.215	1.688	1.444	0.688	316	211	7	366	138
3	2	4		1.134	0.300	1.813	1.640	0.589	392	198	8	411	172
3	2	5		2.296	0.285	1.938	1.475	0.665	325	104	9	451	182
3	2	6		2.114	0.315	2.188	1.374	0.641	256	183	9	411	136
3	3	1		1.106	0.275	2.00	1.566	0.659	586	139	11	500	182
3	3	2		1.358	0.262	1.875	1.515	0.641	230	431	10	246	178
3	3	3		1.274	0.265	2.063	1.560	0.535	473	183	10	419	146
3	3	4		1.288	0.275	1.844	1.435	0.649	389	215	9	495	144

Contd.

Appendix-25. Continued

S	N	G	E	Con N(%)	Con P(%)	Con K(%)	Con Ca(%)	Con Mg(%)	Con Mn ppm	Con Zn ppm	Con Cu ppm	Con Fe ppm	Con S ppm
3	3	5		1.484	0.280	1.811	1.344	0.639	388	235	12	420	120
3	3	6		1.249	0.220	1.688	1.324	0.622	394	220	10	404	116
3	4	1		1.484	0.275	1.938	1.322	0.619	357	197	7	419	122
3	4	2		1.470	0.255	1.938	1.518	0.665	364	198	9	443	102
3	4	3		1.386	0.240	1.625	0.984	0.644	405	236	8	430	126
3	4	4		1.442	0.248	1.656	1.354	0.624	265	185	8	575	106
3	4	5		1.344	0.225	1.750	1.489	0.631	397	259	8	337	126
3	4	6		1.302	0.246	1.844	2.792	0.817	484	209	6	305	126
4	1	1		0.868	0.305	1.500	1.173	0.587	312	198	10	522	90
4	1	2		1.344	0.285	1.594	1.038	0.641	342	179	10	408	68
4	1	3		1.218	0.270	1.531	0.990	0.680	422	204	10	360	110
4	1	4		1.442	0.295	1.688	1.111	0.585	391	299	11	309	114
4	1	5		1.148	0.245	1.438	0.860	1.598	368	191	12	318	108
4	1	6		1.008	0.230	1.406	0.971	0.517	298	187	10	342	118
4	2	1		1.064	0.300	1.594	1.102	0.603	291	196	10	282	98
4	2	2		1.008	0.300	1.438	1.364	0.615	305	198	10	317	102
4	2	3		1.330	0.285	1.531	1.119	0.586	396	204	10	367	102
4	2	4		0.980	0.295	1.625	1.202	0.515	368	195	10	351	94
4	2	5		1.722	0.230	1.656	0.960	0.516	313	186	11	343	84
4	2	6		1.568	0.210	1.594	1.015	0.489	316	168	10	398	80
4	3	1		0.954	0.205	1.563	1.145	0.609	311	201	10	405	82
4	3	2		1.176	0.230	1.688	1.275	0.614	368	188	8	408	96
4	3	3		1.106	0.220	1.719	0.983	0.625	444	205	9	419	112
4	3	4		1.092	0.245	1.781	1.119	0.585	397	192	8	391	100
4	3	5		1.120	0.190	1.594	0.883	0.539	318	183	9	368	120
4	3	6		1.218	0.205	1.625	0.981	0.540	308	192	10	367	112
4	4	1		1.064	0.260	1.500	1.103	0.689	305	178	11	287	90
4	4	2		1.176	0.305	1.438	1.138	0.624	316	191	10	269	88
4	4	3		1.162	0275	1.688	0.985	0.640	382	201	9	261	90
4	4	4		1.176	0.270	1.781	1.140	0.618	368	192	8	217	122
4	4	5		1.022	0.240	1.531	0.978	0.461	253	181	7	211	90
4	4	6		0.994	0.200	1.594	1.035	0.498	283	168	8	205	90
Treated mean				1.385	0.285	1.849	1.290	0.618	415	202	12.3	509	130
Control mean				0.714	0.273	1.797	1.112	0.607	320	157	11.5	341	116
CD treated vs Control				0.813	NS	NS	NS	NS	NS	103	NS	383	NS

APPENDIX- 26
PLANT NUTRIENT UPTAKE

S	N	G	E	rem N (g)	rem P (g)	rem K (g)	rem Ca(g)	rem Mg(g)
1	0	0	4	0.63	0.13	0.83	0.58	0.30
2	0	0	3	0.10	0.04	0.26	0.15	0.09
3	0	0	2	0.07	0.04	0.24	0.17	0.09
4.	0	0	1	0.08	0.04	0.24	0.14	0.08
1	1	1		0.29	0.07	0.35	0.16	0.03
1	1	2		0.56	0.13	0.83	0.38	0.21
1	1	3		0.81	0.13	0.72	0.51	0.25
1	1	4		0.68	0.11	0.69	0.45	0.23
1	1	5		0.25	0.04	0.29	0.22	0.10
1	1	6		0.25	0.06	0.35	0.19	0.11
1	2	1		0.55	0.12	0.77	0.47	0.23
1	2	2		0.60	0.12	0.79	0.16	0.24
1	2	3		0.98	0.13	0.97	0.60	0.29
1	2	4		0.33	0.05	0.34	0.21	0.10
1	2	5		0.27	0.05	0.33	0.20	0.11
1	2	6		0.37	0.08	0.43	0.39	0.17
1	3	1		0.42	0.10	0.55	0.47	0.19
1	3	2		0.39	0.09	0.49	0.36	0.15
1	3	3		0.96	0.17	0.91	0.63	0.30
1	3	4		0.65	0.12	0.75	0.53	0.24
1	3	5		0.30	0.07	0.46	0.32	0.14
1	3	6		0.42	0.12	0.75	0.54	0.24
1	4	1		0.51	0.10	0.68	0.43	0.23
1	4	2		0.78	0.20	1.14	0.75	0.37
1	4	3		0.20	0.21	1.31	0.66	0.38
1	4	4		1.17	0.16	1.17	0.76	0.38
1	4	5		0.52	0.12	0.58	0.50	0.23
1	4	6		0.39	0.11	0.57	0.39	0.19
2	1	1		0.13	0.03	0.23	0.13	0.07
2	1	2		0.37	0.10	0.56	0.40	0.19
2	1	3		0.94	0.17	0.99	0.77	0.37
2	1	4		0.95	0.19	0.98	0.87	0.41
2	1	5		0.23	0.07	0.36	0.33	0.14
2	1	6		0.29	0.08	0.43	0.32	0.16
2	2	1		0.61	0.16	0.75	0.47	0.26
2	2	2		0.42	0.09	0.63	0.37	0.19
2	2	3		0.51	0.10	0.59	0.29	0.18
2	2	4		0.56	0.10	0.76	0.43	0.20
2	2	5		0.26	0.06	0.43	0.27	0.13
2	2	6		0.22	0.07	0.41	0.24	0.12
2	3	1		0.44	0.09	0.68	0.51	0.20
2	3	2		0.32	0.07	0.56	0.39	0.18
2	3	3		0.68	0.09	0.67	0.47	0.22
2	3	4		0.75	0.11	0.78	0.54	0.22
2	3	5		0.27	0.06	0.37	0.25	0.12
2	3	6		0.21	0.05	0.33	0.27	0.12
2	4	1		0.42	0.12	0.67	0.83	0.28
2	4	2		0.48	0.10	0.84	0.37	0.22
2	4	3		0.58	0.10	0.78	0.42	0.26
2	4	4		0.65	0.12	0.93	0.59	0.27
2	4	5		0.25	0.06	0.49	0.31	0.14
2	4	6		0.29	0.07	0.55	0.30	0.17
3	1	1		0.30	0.10	0.61	0.39	0.20
3	1	2		0.49	0.10	0.78	0.47	0.21
3	1	3		0.46	0.08	0.63	0.40	0.20
3	1	4		0.39	0.08	0.51	0.28	0.15
3	1	5		0.16	0.03	0.23	0.29	0.08
3	1	6		0.20	0.05	0.36	0.30	0.12
3	2	1		0.46	0.16	0.73	0.56	0.25
3	2	2		0.34	0.08	0.58	0.44	0.19
3	2	3		0.30	0.04	0.33	0.29	0.13

Contd.

Appendix-26. Continued

S	N	G	E	rem N (g)	rem P (g)	rem K (g)	rem Ca(g)	rem Mg(g)
3	2	4		0.29	0.08	0.47	0.30	0.15
3	2	5		0.36	0.04	0.30	0.23	0.10
3	2	6		0.56	0.08	0.58	0.37	0.17
3	3	1		0.36	0.09	0.06	0.50	0.21
3	3	2		0.31	0.06	0.43	0.35	0.15
3	3	3		0.35	0.07	0.56	0.32	0.15
3	3	4		0.29	0.06	0.41	0.32	0.15
3	3	5		0.23	0.04	0.28	0.21	0.10
3	3	6		0.19	0.03	0.25	0.20	0.09
3	4	1		0.60	0.11	0.78	0.53	0.25
3	4	2		0.42	0.07	0.56	0.44	0.19
3	4	3		0.23	0.04	0.27	0.16	0.11
3	4	4		0.41	0.07	0.47	0.38	0.18
3	4	5		0.25	0.04	0.32	0.28	0.12
3	4	6		0.16	0.03	0.23	0.35	0.10
4	1	1		0.22	0.08	0.38	0.29	0.15
4	1	2		0.28	0.06	0.34	0.22	0.14
4	1	3		0.25	0.06	0.31	0.22	0.13
4	1	4		0.50	0.10	0.59	0.39	0.20
4	1	5		0.33	0.07	0.42	0.25	0.17
4	1	6		0.25	0.06	0.35	0.24	0.14
4	2	1		0.31	0.09	0.47	0.33	0.19
4	2	2		0.28	0.09	0.41	0.38	0.17
4	2	3		0.41	0.09	0.48	0.35	0.18
4	2	4		0.26	0.08	0.44	0.32	0.40
4	2	5		0.21	0.03	0.20	0.12	0.06
4	2	6		0.24	0.03	0.24	0.16	0.08
4	3	1		0.45	0.10	0.74	0.54	0.29
4	3	2		0.40	0.08	0.58	0.44	0.21
4	3	3		0.30	0.06	0.46	0.26	0.17
4	3	4		0.34	0.08	0.55	0.34	0.18
4	3	5		0.43	0.07	0.61	0.32	0.20
4	3	6		0.50	0.08	0.66	0.40	0.22
4	4	1		0.27	0.07	0.38	0.28	0.17
4	4	2		0.34	0.09	0.41	0.32	0.18
4	4	3		0.28	0.07	0.40	0.23	0.15
4	4	4		0.23	0.05	0.35	0.22	0.12
4	4	5		0.24	0.06	0.36	0.23	0.11
4	4	6		0.27	0.05	0.53	0.28	0.13
Treated mean				0.41	0.09	0.55	0.37	0.19
Control mean				0.22	0.06	0.39	0.26	0.14
CD treated vs Control				NS	NS	NS	NS	NS

APPENDIX- 27

Irrigation and leachate water analysis

Sl.No.	Chemical properties	Irrigation water sample	Leachat water sample
1	pH	5.6	5.9
2	EC (mS/ml)	0.750	0.406
3	N (%)	0.259	0.237
4	P (%)	0.082	0.187
5	K (%)	0.172	0.250
6	Ca (%)	0.042	0.050
7	Mg (%)	0.061	0.059
8	Mn (ppm)	7	9
9	Zn (ppm)	7	5
10	Cu (ppm)	0.4	0.7
11	Fe (ppm)	13	6
12	S (ppm)	356	50

APPENDIX-28

Details of the cost of production per pot during the experimental period of 18 months

Sl. No.	Item of expenditure	Unit/pot	Rate/unit (Rs.)	Qty/pot/18 months	Amount (Rs.)
1	Shade house construction cost	0.2 m^2	30,000/100m^2	-	6.00
2	Shade net	0.4 m^2	35.00/m^2	-	7.00
3	Earthen pot (9")	1	12.00/pot	1	12.00
4	Potting mixture	1.8 kg	1.65/kg	1	3.00
	a) Brick pieces	0.2 kg	1.00/kg	-	0.20
	b) Charcoal	0.1 kg	11.00/kg	-	1.10
	c) Coconut husk	0.3 kg	1.00/kg	-	0.30
	d) Sand	0.5 kg	0.40/kg	-	0.20
	e) Wood shavings	0.1 kg	10.00/kg	-	1.00
	f) FYM	0.2 kg	1.00/kg	-	0.20
5	Equipments -2 spray pumps				
	a) 3.5 l pump	1	1250/Nos	-	0.28
	b) 1.0 l pump	1	600/Nos	-	0.14
6	Overhead sprinkler unit	0.2 m^2	25/m^2	-	0.50
7	Planting material	1	21/plant	-	21.00
8	Manures & fertilizers				
	a) FYM	20/g/pot/month	1/kg	360 g	0.36
	b) Fertilizer	2/g/pot/month	6/kg	36 g	0.22
	c) Green care	2/g/pot/month	140/kg	36 g	5.04
9	Growth regulators				
	a) GA	4 mg/plant/month	120/g	72 mg	8.64
	b) BA	4 mg/plant/month	244/g	72 mg	17.54
	c) Ethephon	4 mg/plant/month	0.64/ml	72 mg	0.05
10	Plant protection chemicals				
	a) Fungicides	0.02 ml/p/m	0.50/ml	9.04 ml	4.52
	b) Pesticides	0.02 ml/p/m	0.50/ml	9.04 ml	4.52
11	Cost of maintenance	-	-	-	0.25
12	Labour charges				
	a) Potting/repotting	0.01/pot	110/labour	-	1.10
	b) Daily work	0.15/pot	110/labour	-	16.50
13	Sales realization				
	a) Flower	4	6/flower	-	24.00
	b) Suckers	3	60/suckers	-	180.00

APPENDIX-29

ANALYSIS OF VARIANCE FOR THE EFFECT OF DIFFERENT TREATMENTS

Character (source)	DF	1	2	3	4	5	6	7	8	9	10	11	12	13	14
		Treatment mean some of squares (months)													
Plant height															
S	3	1.46	0.34	0.70	1.59	2.21	1.61	2.43	1.98	3.86	3.55	4.23	4.63	5.54	3.50
N	3	0.02	0.41	0.53	0.31	0.33	0.45	0.34	0.18	0.23	0.10	0.03	0.02	0.12	0.04
G	5	0.04	0.02	0.29	0.27	0.16	0.09	0.14	0.29	0.65	0.76	1.41	2.15	2.52	4.86
SxN	9	0.08	0.18	0.09	0.11	0.08	0.11	0.07	0.13	0.09	0.16	0.27	0.36	0.43	1.07
SxG	15	0.02	0.06	0.10	0.13	0.12	0.11	0.08	0.13	0.12	0.14	0.14	0.22	0.45	0.72
NxG	15	0.02	0.06	0.02	0.07	0.09	0.10	0.06	0.08	0.05	0.07	0.20	0.27	0.30	0.67
Plant spread EW															
S	3	0.93	2.08	8.10	15.07	7.29	29.89	53.33	67.87	202.00	90.19	29.85	81.59	115.42	97.55
N	3	0.52	0.71	1.30	3.02	4.48	9.72	6.85	5.59	9.73	4.51	1.31	14.92	11.87	5.85
G	5	0.25	0.49	0.44	1.75	6.14	10.88	7.59	5.51	13.42	8.01	7.67	9.12	15.50	29.22
SxN	9	0.36	0.30	0.80	3.59	7.10	3.74	5.75	9.94	10.66	6.85	5.51	13.27	24.84	32.07
SxG	15	0.43	0.65	0.84	1.33	2.78	5.24	5.34	6.37	12.65	9.89	18.73	26.37	31.69	30.73
NxG	15	0.35	0.33	0.40	1.24	6.40	2.78	4.78	5.06	5.08	2.56	6.15	4.95	6.19	7.83
Plant Sprea NS															
S	3	2.06	3.08	7.82	12.98	4.00	27.17	51.79	43.62	146.81	99.01	61.17	115.41	106.14	82.09
N	3	0.64	0.82	2.57	3.15	7.07	8.51	6.79	6.09	10.18	14.02	5.19	9.57	1.80	20.94
G	5	8.13	0.27	0.59	2.29	6.50	6.63	7.90	9.65	17.14	10.84	5.78	25.56	27.20	28.26
SxN	9	0.32	0.35	0.40	2.24	3.31	2.90	6.16	9.31	11.18	7.52	5.24	16.48	18.30	23.07
SxG	15	0.38	0.43	0.72	2.63	1.72	5.41	4.90	8.27	16.61	17.32	16.09	28.67	24.36	40.91
NxG	15	0.51	0.68	1.19	2.95	2.99	4.72	5.17	6.44	5.46	2.06	5.88	9.31	5.07	6.39
No. of leaves															
S	3	4.76	1.04	2.66	1.16	5.94	29.75	38.62	34.17	88.68	48.66	57.74	32.83	28.18	51.86
N	3	0.08	0.41	1.16	0.94	0.52	1.22	0.98	3.83	12.18	10.92	5.85	2.80	2.68	5.98
G	5	0.06	0.06	0.13	0.60	1.48	5.97	14.16	11.53	26.41	24.33	28.59	30.07	29.67	33.07
SxN	9	0.16	0.13	0.14	0.40	1.46	1.10	4.87	6.09	9.94	15.44	14.22	13.68	19.57	31.60
SxG	15	0.10	0.15	0.18	0.24	0.73	2.43	2.53	2.37	6.46	7.56	6.36	9.18	10.93	10.86
NxG	15	0.09	0.09	0.12	0.43	0.92	0.56	1.26	1.43	1.23	0.79	1.16	0.62	2.91	3.11
Petiole length															
S	3	2.73	3.71	7.98	0.45	0.17	2.97	14.19	16.06	34.32	19.35	19.78	36.98	37.02	26.08
N	3	0.84	0.52	2.76	3.15	2.55	0.47	0.42	0.22	2.04	1.15	0.74	0.51	0.85	1.33
G	5	0.24	0.53	0.60	1.90	1.27	1.71	2.22	8.53	12.53	14.08	17.42	22.57	26.31	30.73
SxN	9	0.46	0.85	0.45	1.22	0.90	1.57	2.53	1.93	3.10	3.22	3.39	2.73	4.31	5.22
SxG	15	0.67	0.33	0.16	0.57	0.36	0.55	0.49	1.01	1.07	1.30	1.54	1.86	2.33	2.45
NxG	15	0.32	0.29	0.34	0.51	0.35	0.28	0.90	0.75	0.72	0.85	1.45	1.35	1.54	1.55
Leaf length															
S	3	1.61	0.36	0.76	19.80	2.57	3.26	9.00	23.87	20.89	27.77	23.57	33.45	21.16	17.05
N	3	0.47	1.19	0.43	12.87	0.42	0.11	0.93	0.91	1.65	1.00	1.36	1.33	0.64	1.19
G	5	0.08	0.12	0.13	10.37	1.30	2.06	2.40	6.73	7.69	15.41	16.63	18.33	19.25	19.27
SxN	9	0.14	0.17	0.16	16.19	1.44	0.53	0.67	1.76	1.09	2.01	2.36	1.76	1.56	2.31
SxG	15	0.15	0.11	0.09	6.48	0.19	0.45	0.47	0.58	0.68	0.97	1.57	1.56	1.40	1.61
NxG	15	0.08	0.03	0.12	5.03	0.32	0.48	0.20	0.63	0.79	1.43	1.25	1.46	0.93	0.9
Leaf breadth															
S	3	1.03	0.04	0.10	50.88	0.22	0.75	45.33	3.72	8.72	11.24	12.25	16.22	12.22	6.36
N	3	0.43	0.51	0.14	53.75	1.43	0.08	40.12	0.12	1.28	0.46	0.65	0.38	2.14	0.29
G	5	0.03	0.06	0.08	52.98	1.15	1.44	26.65	4.33	6.42	10.87	12.64	13.55	14.71	13.33
SxN	9	0.09	0.10	0.23	51.18	1.47	0.38	40.47	0.80	0.74	2.08	1.23	1.27	1.94	0.87
SxG	15	0.04	0.09	0.05	51.90	0.97	0.21	37.05	0.35	0.48	0.88	1.17	1.08	1.29	1.32
NxG	15	0.05	0.05	0.10	50.60	0.93	0.23	38.07	0.32	0.68	0.66	0.75	0.49	0.49	0.58
Index leaf area															
S	3	68.44	11.50	7.32	3.13	152.7	165.1	418.2	1438.5	1386.1	2384.2	2791.1	3381.7	2625.5	1458.8
N	3	70.76	27.25	12.34	27.48	15.36	10.74	23.78	24.9	73.1	174.2	202.6	97.6	90.4	87.1
G	5	2.34	4.83	6.00	40.73	83.73	153.50	249.80	598.9	966.2	2424.3	2877.1	2577.7	3050.6	2860.2
SxN	9	6.58	7.74	10.47	33.53	101.74	29.99	56.01	100.9	89.2	218,2	220.0	179.0	201.9	260.1
SxG	15	5.09	5.73	4.05	10.95	37.62	27.96	42.83	74.9	111.7	198.9	339.4	297.0	240.8	280.6
NxG	15	4.32	4.53	5.84	7.53	34.41	28.68	29.76	42.8	86.7	178.4	211.0	194.4	145.2	138.2
Tota; leaf area															
S	3	3960	1899	2015	868	253	2735	7020	9566	44927	52476	57281	53261	48450	53857
N	3	672	1090	1720	1562	1764	1425	1518	228	1915	551	368	157	749	377
G	5	64	27	31	224	1069	3739	13593	14046	44935	72193	88366	96325	121572	185697
SxN	9	231	264	150	396	982	1128	2717	4525	7832	13798	15635	15355	25269	27994
SxG	15	194	145	185	437	901	1446	2422	3044	4943	11699	16495	18100	23033	24819
NXG	15	142	132	217	377	660	656	849	1903	3471	3571	4038	4630	8246	7115

Appendix-29. Continued

Character (source)	DF	1	2	3	4	5	6	7	8	9	10	11	12	13	14
		Treatment mean some of squares (months)													
Branches															
S	3						0.30	2.71	1.38	2.00	1.03	0.10	0.31	0.61	1.17
N	3						0.09	1.77	0.18	0.14	0.32	0.17	0.01	0.07	0.26
G	5						0.05	2.59	1.16	1.27	2.37	1.71	1.11	1.17	0.90
SxN	9						0.05	0.13	0.36	0.33	0.37	0.38	0.19	0.19	0.08
SxG	15						0.02	0.34	0.36	0.22	0.44	0.36	0.20	0.38	0.22
NxG	15						0.01	0.26	0.15	0.13	0.20	0.12	0.16	0.17	0.07
Number of suckers															
S	3		0.004	0.002	0.005	0.06	0.08	0.14	0.10	0.01	0.02	0.05	0.13	0.12	0.29
N	3		0.004	0.002	0.003	0.009	0.02	0.06	0.06	0.01	0.05	0.03	0.09	0.001	0.12
G	5		0.001	0.001	0.030	0.02	0.22	0.21	0.24	0.31	0.45	0.44	0.55	0.96	0.82
SxN	9		0.004	0.003	0.005	0.01	0.07	0.005	0.04	0.04	0.09	0.06	0.11	0.23	0.41
SxG	15		0.001	0.004	0.005	0.01	0.03	0.02	0.02	0.03	0.06	0.09	0.09	0.13	0.18
NxG	15		0.001	0.004	0.003	0.01	0.05	0.03	0.04	0.04	0.06	0.08	0.08	0.06	0.06
Leaf senescence															
S	3	1.66	0.03	0.60	0.60	0.96	2.58	0.76	0.49	1.12	0.93	1.36	0.53	0.19	0.72
N	3	0.20	0.03	0.11	0.26	0.19	0.40	0.13	0.30	0.12	0.15	0.32	0.27	0.23	0.06
G	5	0.07	0.05	0.04	0.17	0.15	0.06	0.66	0.25	2.70	1.70	4.57	2.14	0.57	0.29
SxN	9	0.43	0.01	0.05	0.33	0.16	0.22	0.22	0.18	0.17	0.16	0.14	0.33	0.05	0.66
SxG	15	0.08	0.01	0.06	0.05	0.10	0.04	0.17	0.09	0.17	0.21	0.13	0.22	0.10	0.10
NxG	15	0.11	0.01	0.03	0.14	0.11	0.11	0.05	0.21	0.05	0.11	0.07	0.13	0.09	0.09
Aerial roots															
S	3	0.70	3.24	6.03	51.39	88.18	56.48	30.96	68.78	1.07	11.03	14.21	10.63	5.33	7.69
N	3	1.54	0.61	0.65	2.45	2.24	1.66	0.42	2.37	0.40	3.48	0.10	0.57	0.87	1.33
G	5	0.70	0.37	0.72	1.86	1.31	2.28	1.23	2.55	1.86	2.68	5.90	0.21	0.45	0.03
SxN	9	1.00	0.41	0.72	4.13	2.52	1.89	0.71	3.69	2.73	1.25	1.77	0.85	3.73	1.48
SxG	15	0.43	0.47	0.48	0.84	0.76	0.55	0.57	0.27	0.55	0.99	0.95	0.39	0.56	0.08
NxG	15	0.31	0.49	1.66	0.90	1.07	0.65	0.41	1.01	0.54	0.90	1.66	0.49	0.50	0.26

LD, LAI, SW, RC	DF	E-U	U-M	M-S	TL P	TLA	TLW	LA	SLW	PR N	SRN	RS	RL
S	3	1.14	2.92	126.70	96.25	47911	35.80	0.05	0.0007	33.12	4785	21.98	23.34
N	3	21.03	4.23	286.8	143.8	9.8	25.5	0.002	0.0002	3.95	623	3.42	2.79
G	5	2.53	3.26	377.8	411.9	122531	190.5	0.15	0.00009	55.36	4112	22.43	28.70
SxN	9	9.46	3.26	85.02	89.69	25656	28.18	0.03	0.0001	15.41	1516	12.05	21.43
SxG	15	3.49	3.02	25.57	29.43	22970	32.86	0.02	0.0001	4.38	391.3	3.19	2.53
NxG	15	4.21	2.73	15.27	13.61	7757	13.45	0.009	0.0001	1.21	213.4	1.73	2.41

Infl . cha	DF	Infl ini	Stalk less	Normal	Dur b/w S&N	Dur Succ	E-U	U-S	Long field	Stalk length	Spathe length	Spathe width	Spad leng
S	3	48399	27.28	1.11	4684	6396	198.3	1544	3179	120.7	7.34	3.51	1.83
N	3	18923	10.95	1.25	2647	2340	113.7	441	1183	110.0	6.42	3.32	1.67
G	5	58184	14.26	0.47	1608	451	353.3	1654	4486	41.26	2.35	1.07	0.57
SxN	9	17524	10.24	0.58	1226	1230	80.40	295	961	38.4	1.89	0.94	0.53
SxG	15	23168	8.08	0.98	2826	1356	111.3	516	1286	91.56	5.20	2.43	1.26
NxG	15	17219	9.15	0.62	1338	1845	88.87	344.3	1143	56.53	3.52	1.65	0.81

Sto cha and pig dry matter	DF	St No	St len	St bre	Ch a	Ch b	Ch tot	Anth	WP dw	L dw	LP dw	R dw
S	3	126	0.12	0.87	4.12	2.63	12.75	6.51	7.71	0.04	0.04	5.45
N	3	117	0.09	0.28	0.45	0.48	1.66	2.07	9.67	0.25	0.05	9.25
G	5	144	0.06	0.16	2.08	1.17	6.09	5.16	9.29	0.75	0.09	3.13
SxN	9	48.03	0.29	0.33	0.55	0.27	1.22	1.98	2.85	0.07	0.02	2.75
SxN	15	70.43	0.30	0.16	0.24	0.37	0.95	3.32	3.15	0.22	0.04	1.08
NxG	15	73.27	0.11	0.17	0.49	0.34	1.38	2.43	0.59	0.07	0.01	0.35

Fre & Dw Wt (%)	DF	LD wt	LM	LP dw	LP m	R dw	R m	WP dw	WP m	FWR S	FWR R	DWR S	DWR R
S	3	83.25	82.43	21.77	21.43	347.3	353.3	92.61	95.52	112.4	119.1	353.4	335.8
N	3	9.96	10.85	32.75	32.83	1152	1128	308	307	228	253	1044	1064
G	5	3.42	3.07	12.87	13.01	13.34	12.71	6.68	6.38	46.39	51.30	73.74	67.20
SxN	9	5.29	5.19	15.04	15.11	160.96	156.47	50.59	48.55	74.15	73.01	462.8	451.1
SxG	15	7.53	8.20	10.47	10.51	6.27	6.46	10.71	10.22	35.60	35.15	23.41	21.88
NxG	15	8.61	9.01	8.79	8.75	21.38	22.02	7.91	8.37	17.20	22.27	20.66	18.32

Appendix-29. Continued

Lf Nut cont	DF	N	P	K	Ca	Mg	Mn	Zn	Cu	Fe	S
S	3	0.82	0.01	0.73	0.71	0.010	97853	1408	842	873518	11784
N	3	0.07	0.004	0.01	0.05	0.005	15831	1157	241	95551	507
G	5	0.27	0.001	0.03	0.07	0.001	14092	1096	143	17956	192
SxN	9	0.004	0.001	0.08	0.07	0.005	24189	822	224	71151	1173
SxG	15	0.10	0.001	0.02	0.08	0.006	8751	886	136	6331	279
NxG	15	0.06	0.003	0.01	0.07	0.005	9987	819	172	9215	133

	DF	Nutrient uptake					Economics				
		N	P	K	Ca	Mg	Suck	Flow	Expen	Rec	Ne Prof
S	3	0.23	0.009	0.33	0.09	0.01	2.56	1.15	19.91	29067	27493
N	3	0.001	0.0005	0.05	0.03	0.004	0.32	0.46	00.00	761	766
G	5	0.16	0.001	0.20	0.07	0.03	2.65	0.40	3.78	9367	9129
SxN	9	0.01	0.002	0.07	0.03	0.009	0.53	0.23	0.00	1791	1796
SxG	15	0.04	0.001	0.04	0.02	0.005	0.44	0.58	0.008	1624	1622
NxG	15	0.04	0.001	0.02	0.01	0.003	0.08	0.38	0.01	302	301

Vase life study	DF	Iw	FW	PLW	FV S	UVS	I pH	F pH	C pH	I Ec	F Ec	C Ec	Sp blu	Spd ne	Gl lo	Vase life
Harvest stage	7	10.7	2.4	3.69	39.5	39.5	0.0	0.04	0.04	0.0	0.0	0.0	43.5	36.2	60.8	43.5
Pulse treatment	16	3.6	6.7	8.1	2739	22.1	2.7	2.5	0.16	0.0	0.001	0.001	9.8	11.8	7.9	9.8
Holding solution	27	7.1	5.8	2.9	1374	191.9	10.0	8.2	1.2	0.538	0.659	0.304	40.1	38.0	38.9	41.5
Combination of pulse & holding solution	10	5.5	6.3	5.5	7229	104.1	17.0	13.9	1.36	3.08	0.879	1.57	25.6	24.6	28.5	25.6

OPTIMIZATION OF SHADE, NUTRIENTS AND GROWTH REGULATORS FOR CUT-FLOWER PRODUCTION IN ANTHURIUM

By

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ABSTRACT OF A THESIS

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ABSTRACT

Experiments were conducted at the Department of Pomology and Floriculture, College of Horticulture, Vellanikkara, during 1995-1997 to optimize the shade, nutrients and growth regulators for cut flower production in *Anthurium andreanum* var. 'Hawaiian Red'.

The effects of three growth regulators, viz., GA, BA and Ethephon with two concentration each, 750 ppm and 1500 ppm, in combination with four nutrients, viz., 1% fertilizer complex, Hoagland solution, Knop's solution and Ohio solution, were assessed at four levels of shade, viz., 80, 70, 60 and 50 per cent. Post harvest studies were also carried out with an objective to prolong the longevity of cut blooms, following different stage of harvest and giving different pulsing and holding treatments.

Results revealed that the different levels of shade and growth regulators significantly influenced all the morphological characters of the plant, viz., height, spread, number of leaves, leaf area, petiole length, number of branches and suckers.

Plant height was significantly superior under 80 per cent shade (5.68 cm), 1 per cent fertilizer complex sprays (5.46 cm) and BA 750 ppm sprays (6.11 cm), were superior individually. The superior treatment combination was 70 per cent shade + Knop's solution + 750 ppm BA (7.60 cm).

The maximum plant spread (EW - 20.13 cm and NS - 19.80 cm) was under 80 per cent shade. Eighty per cent shade + Ohio solution + 1500 ppm BA recorded the maximum EW spread (26 cm), while NS spread was maximum

(28.70 cm) in the treatment combination involving 80 per cent shade + 1 per cent fertilizer complex + 750 ppm BA.

The best values of growth parameters were recorded under 80 per cent shade and 750 ppm BA, viz., 14.03 and 14.02, respectively, for number of leaves (9.29 and 10.79 cm, respectively) for petiole length, leaf length (7.76 and 8.33 cm, respectively), leaf breadth (5.93 cm and 6.49 cm, respectively), index leaf area (50.75 cm^2 and 59.60 cm^2, respectively). Total leaf area (423.25 cm^2 and 517.56 cm^2, respectively) and LAI (0.43 and 0.51, respectively) were maximum under 70 per cent shade and BA 750 ppm. The superior combinations for these parameters were 80 per cent shade + Ohio solution + 750 ppm BA, for highest number of leaves (26.20); 80 per cent shade + Ohio solution + 1500 ppm BA for highest petiole length (14.00 cm); 60 per cent shade + Hoagland solution + 750 ppm BA for maximum leaf length (10.50 cm) and 60 per cent shade + 1 per cent fertilizer complex + 750 ppm BA for maximum leaf breadth (8.0 cm). The treatment combination involving 70 per cent shade + 1500 ppm BA with Hoagland solution was the best for maximum index leaf area (90.90 cm^2) while same with 1 per cent fertilizer complex was the best for total leaf area (872.00 cm^2) and LAI (0.89).

Branching started only after 6 months from the commencement of the experiment. It was one month earlier under 80 per cent and 70 per cent shade levels. Significantly superior branching was observed under 80 per cent shade (2.29), fertilizer complex (2.13) and GA 750 ppm (2.37), individually. Treatment combination involving 80 per cent shade + 1 per cent fertilizer complex + 1500 ppm GA recorded the maximum branching (3.80).

Sucker production was the best under 80 per cent shade (1.35) and 750 ppm BA (1.35). Treatment combination involving 80 per cent shade + Ohio solution + 750 ppm BA produced the maximum number of suckers (2.5) per plant.

Growth behaviour with respect to height, number of leaves, leaf area, number of suckers and branches showed a linear trend. The linear growth rate was consistent and positive under the treatment combination of 80 per cent shade + Ohio solution + 750 ppm BA.

Dry matter production was significantly superior under higher shade intensity and lower concentration of BA. The dry weight ratio of shoot:root was the highest (2.15) under the treatment combination of 80 per cent shade + Knop's solution + 750 ppm Ethephon.

Leaf longevity was significantly highest (161 days) in the treatment combination, 70 per cent shade + 1 per cent fertilizer complex + 750 ppm BA.

Stomatal distribution and size were not influenced significantly by the treatments. Leaf senescence, though was influenced significantly, no particular trend was observed.

The aerial root production decreased significantly with decrease in shade intensity. Primary and secondary roots and root spread were the highest under 80 per cent shade and BA 1500 ppm. Maximum root length was observed under 60 per cent shade.

Flowering with small stalkless flowers was first observed under 50 per cent shade with GA 750 ppm, at the age of 8 months. Inflorescence with normal size were produced at the age of 13 months, first under 80 per cent shade followed by 70 per cent, 60 per cent and 50 per cent. The time taken for various stages of flower development and the number of inflorescence produced per plant were not influenced significantly.

Chlorophyll content in leaf was significantly influenced by shade levels. There was a decrease in chlorophyll content with decrease in intensity of shade. Eighty per cent shade and 1500 ppm Ethephon was superior with respect to the content of green pigments. The highest total chlorophyll content was observed in the treatment combination involving 60 per cent shade + Ohio solution + 750 ppm Ethephon (8.8 mg g^{-1} fresh weight). Anthocyanin content was not influenced by any of the treatments or combinations.

The leaf nutrient content and uptake of nutrients was maximum under 80 per cent shade and BA 750 ppm, individually.

Post harvest studies showed that the right stage of harvest of inflorescence was when 1/3 flowers were open on the spadix. Inflorescence harvested at this stage with medium to large size spathe lasted for a longer period (23.33 days). Among the pulsing treatments, BA 50 ppm for 12 hrs, recorded maximum vase life (20.00 days).

Among the different holding solutions tried, 8-HQ 30 ppm, BA 20 ppm and Triadimefon 30 ppm recorded the optimum values of PLW, uptake of vase solution, change in pH and EC, and recorded late spathe blueing, late spadix necrosis and high gloss retention. Highest vase life period (27.00 days) was recorded in 8-HQ 30 ppm (25.00 days) and Triadimefon 30 ppm (25.00 days). Among the combinations tried, BA 20 ppm + Bavistin 0.1 per cent showed longest vase life (23.67 days).

Maximum net profit per pot (Rs.204.60) was recorded by the treatment combination involving 80 per cent shade + Ohio solution + 750 ppm BA.