NUTRIENT MANAGEMENT IN GERBERA (*Gerbera jamesonii* Bolus.) GROWN UNDER NATURALLY VENTILATED POLYHOUSE

by

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(2016-12-011)

THESIS

Submitted in partial fulfillment of the requirements for the degree of

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DEPARTMENT OF POMOLOGY AND FLORICULTURE

COLLEGE OF AGRICULTURE

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2018

DECLARATION

I, hereby declare that this thesis entitled "**Nutrient management in gerbera (*Gerbera jamesonii* Bolus.) grown under naturally ventilated poly house**" is a bonafide record of research work done by me during the course of research and the thesis has not previously formed the basis for the award to me of any degree, diploma, associateship, fellowship or other similar title, of any other University or Society.

Place: Vellayani
Date: 19-06-2018

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CERTIFICATE

Certified that this thesis entitled **"Nutrient management in gerbera (*Gerbera jamesonii* Bolus) grown under naturally ventilated poly house"** is a record of research work done independently by Miss. Anaswara S J under my guidance and supervision and that it has not previously formed the basis for the award of any degree, diploma, fellowship or associateship to her.

Place: Vellayani

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LIST OF ABBREVIATIONS AND SYMBOLS USED

%	-	per cent
&	-	and
ANOVA	-	Analysis of variance
CD	-	Critical difference
SEm(±)	-	Standard error of means
cm	-	centimeter
et al.	-	and co-workers/co-authors
Fig.	-	Figure
FYM	-	Farm yard manure
g	-	gram
i.e.	-	that is
kg	-	kilogram
KAU	-	Kerala Agricultural University
cm^2	-	Square centimeter
PGPR	-	Plant Growth Promoting Rhizobacteria
sp.	-	Species
Var	-	Variety
MAP	-	Months after planting
m^2	-	Square meter

INTRODUCTION

1. INTRODUCTION

Gerbera is a commercial ornamental plant belonging to family Asteraceae and known for its attractive flower throughout the world. It is an herbaceous perennial crop native to South Africa and Asia. Gerbera is most widely used for cut flower purpose in large scale all over the world. It has gained a position of fifth most used cut flower in the world after rose, carnation, chrysanthemum and tulip. Gerbera occurs in wide range of colours including yellow, orange, cream-white, pink, brick red, scarlet, salmon, maroon, terracotta and various other intermediate shades. These plants are generally grown in pots, beds, borders etc.

As gerbera is an important cut flower crop of great economic value, quality attributes of the flower is critical for fetching high market value. The best quality flowers are produced in protected environment in present day horticultural system to meet the international quality standards as it ensures protection from adverse climatic conditions, pests and diseases. Nutrients are second most important input next to water for better growth and development of the plants.

Growth of plants is highly influenced by the levels of nitrogen, phosphorous and potassium (Barad *et al.,* 2010). From cell division to development of vegetative and reproductive organs, nitrogen plays an irreplaceable role in plants. Production of quality blooms are also influenced by nitrogen. Phosphorous enhances production of stronger bud and flower development. It was also found to be vital in quicker plant maturity, photosynthesis and respiration. Optimum potassium nutrition enhances plant to tolerate drought, high light intensity, frost, and heat during the crop period. Also potassium in appropriate doses discourage attack of pest and diseases as it enhances the better consumption of nitrogen and phosphorous. Optimum doses of potassium enhance yield and quality of flowers.

The healthy growth of plant is favoured by all the fertilizer elements and deficiency of even one result in showing symptoms. The growth, yield and quality

of the cut flower are majorly influenced by the quality and quantity of applied fertilizer (Majumder *et al.,* 2014).

In this context, the present study "Nutrient management in gerbera (*Gerbera jamesonii* Bolus.) grown under naturally ventilated polyhouse" was undertaken with an objective of standardization of nutrient management schedule for *Gerbera jamesonii.*

REVIEW OF LITERATURE

2. REVIEW OF LITERATURE

Ornamental plant production has gained much economic importance and remarkable growth recently (Horvath *et al.*, 2006). Gerbera (*Gerbera jamesonii* Bolus.) is the latest sensation in the scenario of Kerala floriculture. It is commercially grown throughout the world in a wide range of climatic conditions. It has chromosome number 2n = 50 (Hedau *et al.*, 2012). It is a commercial ornamental plant belonging to family Asteraceae and is known for its exquisite shape and bewitching flowers (Deka and Talukdar, 2015). It is an herbaceous perennial crop and most widely used for cut flower purpose in large scale all over the world. Gerbera is also known as Transvaal daisy, Barberton or African daisy and it is available both in single and double flowers. Recently gerbera has gained a position of fifth most used cut flower in the world after rose, carnation, chrysanthemum and tulip (Ayemi *et al.*, 2017).

In spite of all the inputs, nutrients play an irreplaceable role resulting sustainable growth of the crops. Judicious use of fertilizers is critical for optimum performance of plants. The healthy growth of plant is favoured by all the fertilizer elements and deficiency of even one result in showing symptoms. The growth, yield and quality of the cut flower are majorly influenced by the quality and quantity of applied fertilizers (Majumder *et al.*, 2014). Among all the nutrients, nitrogen, phosphorous and potassium can be said as the major elements for better plant growth.

2.1. VARIETAL SELECTION OF GERBERA PLANTS

In a trial Irshana (2016) evaluated twenty varieties of *Gerbera jamesonii* for their performance under rain shelter in College of Agriculture, Vellayani. Outstanding among them were Double date (highest number of flowers, highest BC ratio), Beudine (highest mean life of flower in plant, highest mean number of ray florets, high quality flowers), Esmara (highest mean disc diameter), Aquamelon (highest mean number of ray florets) and Mammut (high quality flowers).

2.2. EFFECT OF VARIOUS FERTILIZER DOSES ON GROWTH AND FLOWERING OF GERBERA

Nitrogen is the major nutrient which is most mobile of all the mineral nutrients and growth, flower production and quality of the blooms are greatly influenced by nitrogen (George, 2012). Nitrogen is found as biologically combined with C, H, O and S and create amino acids, which aid in the production of proteins. Thus, it helps in the growth and development of plants. From cell division to development of vegetative and reproductive organs, nitrogen plays an irreplaceable role in plants (Srivastava *et al.*, 2017).

Functions of phosphorous include energy storage and transfer as ADP (Adenosine di phosphate) and ATP (Adenosine tri phosphate), DPN (Diphosphopyridine nucleotide) and TPN (Triphosphopyridine nucleotide). It aids in cell division, root development, flower initiation, seed development and fruit development (Uchida, 2000). According to George, (2012) supply of N and K get adversely affected if there is deficiency of phosphorous in soils. Calcium and zinc deficiency will be the resultant of high application of phosphorous.

Potassium is an essential element and its functions include, controlling the closing and opening of stomata, translocation of photosynthates for plant growth or storage in fruits or roots, improve disease resistance in plants, improve the size of grains and seeds etc. (Uchida, 2000). Amin *et al.* (2015) found that potassium activate enzymes are involved in photosynthesis. Optimum potassium nutrition enhances the plant to tolerate drought, high light intensity, frost, and heat during the crop period. Also appropriate potassium discourages attack of pest and diseases as it enhances the expert consumption of nitrogen and phosphorous. Ayemi *et al.* (2017) reported that the equilibrium between two forms of potassium was maintained in such a way that potassium gets dissolved in soil water and it was taken up by plant roots. After all exchangeable potassium gets released in to soil solution.

2.3. VEGETATIVE PRAMETERS

Kempana (2007) reported that highest plant spread of 56.4 cm was found in gerbera plants with a treatment of 35:25:85mg NPK plant^{-1} week^{-1}. According to Barad *et al.* (2010) under nitrogen levels of 20gm^{-2}, a maximum plant spread of 52.18 m^2 was observed under net house conditions when gerbera was grown to test the effect of NPK levels. Varuna (2012) evaluated recent varieties of gerbera (*Gerbera jamesonii* Bolus ex Hooker F.) under naturally ventilated poly house condition and highest plant spread was recorded as 363.99 cm. Irshana (2016) evaluated gerbera (*Gerbera jamesonii* Bolus) varieties for rain shelter cultivation, the results showed that the maximum plant spread was exhibited by variety Beaudine and it was found to be 197.82 cm at 2 months after planting. Mohanan (2016) analysed the performance of tissue culture plantlets of *Gerbera jamesonii* Bolus. as influenced by microbial inoculants and the maximum plant spread was observed for variety Esmara (186.61cm).

According to Bahattarcharjee (1981), a variation of 50.00-70.4 numbers of leaves were observed in gerbera. Jadhao *et al.* (2010) reported that number of leaves plant $^{-1}$ increased with increasing levels of nitrogen. Maximum growth was obtained with application of 30g nitrogen m^{-2} month^{-1} at monthly interval. Keditsu (2012) observed that highest number of leaves (13.21 plant^{-1}) were observed with a treatment 50% RDF (60:40:60 kg N, P_2O_5, K_2O ha^{-1}) + 25% pig manure + 25% FYM. Naveen *et al.* (2012) reported that vermi compost @100g plant $^{-1}$ + PSF@25g plant $^{-1}$ + Phytozeal @30mL L $^{-1}$+ recommended nutrient dosage (1 kg FYM+10:15:20g N, P_2O_5 and K_2O m^{-2}) increased number of leaves plant $^{-1}$. Amin *et al.* (2015) observed that maximum number of leaves (29.76) was observed in a treatment which contains 12.5g m^{-2} of phosphorous at the time of planting. Bellubbi (2015) reported that maximum number of leaves per plant (44.40) were observed with a treatment of NPK (150:137:190 g m^{-2}) + Vermicompost (5 t ha^{-1}). According to Deka and Talukdhar (2015) the variation of number of leaves among different cultivars of gerbera were recorded to be 30.34- 46.55. Fayz *et al.* (2016) reported that highest values for number of leaves

were found to be 13.1, 15.5 and 17.1 at 60, 90 and 120 days after planting respectively with a nutrient dose of NPK 20:20:15 gm^{-2}. Ayemi *et al.* (2017) found that maximum number of leaves was found to be 17.70 with a treatment of 17:25.5: 34g NPK m^{-2}. He also stated that maximum number of leaves was observed with higher doses of potassium. This may be due to peptide bond synthesis and protein, carbohydrate metabolism. Srivastava *et al.* (2017) observed that maximum number of leaves at 60 days after planting was found to be 7.15 when applied with 45 g NPK m^{-2} $month^{-1}$.

Nayak *et al.* (2005) observed that a mixture of NPK at 4:2:2 g pot^{-1} obtained maximum leaf area (130.95 cm^{2}). Keditsu (2012) found out a maximum leaf area (99.73cm^2) with a treatment of 50% RDF (60:40:60 kg N, P_2O_5, K_2O ha^{-1}) + 25% pig manure + 25% FYM in gerbera plants. Naveen *et al.* (2012) a recommended nutrient dosage of 1 kg FYM+10:15:20g N, P_2O_5 and K_2O m^{-2} increased leaf area. Bellubbi (2015) proved that maximum leaf area (138.17 cm^2) was observed in a treatment having NPK (150:137:190 g m^{-2}) + Vermicompost (5 t ha^{-1}).

Srivastava *et al.* (2017) observed that a maximum leaf length (14.39cm) and leaf breadth (6.38cm) were found with a treatment containing 45g NPK $m^{-2}month^{-1}$ in gerbera plants.

According to Kempana (2007) number of suckers per plant in gerbera was found to be highest ie, 5.9 with a treatment of 35:25:85 mg NPK $plant^{-1}$ $week^{-1}$. Patel (2012) reported that the maximum number of suckers (3.67) was produced by gerbera when treated with 6:1:2 N, P_2O_5, K_2O g pot^{-1}. Fayz *et al.* (2016) observed the maximum number of suckers were 6.3 with a treatment of 20:20:15 gm^{-2} in gerbera plants. Mohanan (2016) found that the maximum values for suckers $plant^{-1}$ in esmara variety was found to be 4.25. Ayemi et al. (2017) reported that maximum number of suckers $plant^{-1}$ was recorded as 6.47 with a treatment of 19:28.5:38 g NPK m^{-2}. He also stated that potassium was dissolved in soil water and this was absorbed by plant roots and resulted in maximum number

of suckers. Nitrogen helps in vegetative growth and it is the major component of nucleic acid and enzymes.

2.4. FLOWERING CHARACTERS

The maximum number of days taken for flowering was found to be 136.6 days and minimum days taken for flowering was 129.38 days in gerbera (Kedistu, 2012). Bellubi (2017) found out that the number of days taken for first flowering in gerbera was 94.40 with a nutrient treatment 150:137:190 NPK g m^{-2}+ 20 t ha^{-1} FYM and 93.40 with a nutrient treatment of NPK (150:137:190 g m^{-2}) + Vermicompost (5 t ha^{-1}). Naveen *et al.* (2012) reported that Vermi compost @100g plant $^{-1}$ + PSF@25g plant $^{-1}$ + Phytozeal @30mL L $^{-1}$+ recommended nutrient dosage (1 kg FYM+10:15:20g N, P_2O_5 and K_2O m^{-2}) reduced the number of days taken for first flower bud emergence. According to Fayz *et al.* (2016) the minimum number of days taken for flowering was observed as 51.4 days in gerbera with application of 20:17.5:20 NPK g m^{-2} and followed by 10:20:30NPK g m^{-2}.

According to Mehraj (2016), High variation in flowering was observed in varieties. The effect of fertilizer application had significant impact on number of days taken from bud initiation to harvest.

According to Sankar (2003), Peak flower production was observed up to five – six month after planting and later reduction in the flower production was observed. Irshana (2016) reported that rainy season was found to be the peak flowering period for gerbera under protected cultivation.

Bellubbi (2015) observed 16.23 days of flower longevity on plant with a nutrient treatment 150:137:190 NPK g m^{-2}+ 20 t ha^{-1} FYM and 16.67 days with a nutrient treatment NPK (150:137:190 g m^{-2}) + Vermicompost (5 t ha^{-1}). Fayz *et al.* (2016) proved that the flower longevity was highly influenced by various doses of NPK. Maximum flower longevity (23.5 days) was observed for nutrient application 20:20:15 NPK g m^{-2}. Srivastava *et al.* (2017) reported that gradual

increase of flower longevity (12.87-15.77 days) was observed with an application of fertilizer doses in between the range 0g -45g NPK m^{-2} $month^{-1}$.

2.5. FLOWER CHARACTERS

Gurav *et al.* (2004) reported that the application of 20:20:15g NPK m^{-2} $month^{-1}$ significantly produced flowers with larger diameter. Jawahar *et al.* (2007) observed that maximum diameter of the flower was obtained with N and P at the rate of 10 and 12.5g m^{-2} respectively. Barad *et al.* (2010) reported that NPK 20:10:20 g m^{-2} (2:1:2) resulted maximum flower diameter (10.4cm) in gerbera when they were tested for the effect of NPK levels under net house conditions. According to Kempana (2007) flower diameter 11.5cm was observed with a treatment of 35:25:85 mg $plant^{-1}$ $week^{-1}$ and which was the highest among all other treatments. Amin *et al.* (2015) reported that the highest flower diameter was observed with12.5g P_2O_5 m^{-2} and 15g K_2O m^{-2}. Fayz *et al.* (2016) reported that highest flower diameter (11.9cm) was observed with a nutrient dose 20:20:15 NPK gm^{-2}. Ayemi *et al.* (2017) found that 14.47cm was the highest value for flower diameter observed wit h a treatment 20:30:40g NPK m^{-2} in gerbera plant.

Kumar *et al.* (2013) reported that flower disc diameter of various varieties of gerbera when treated with different doses of fertilizers ranged from 0.90cm to 2.20cm. The maximum number of ray florets was found in gerbera variety Rosalin with 75.20 mean number of ray florets.

Irshana (2016) reported that variety Esmara was observed to possess largest diameter for flower disc (4.75cm). Variety Mammut and Double date had greenish yellow disc, variety Esmara had yellow coloured disc and Aquamelon and Beaudine varieties had black coloured flower disc. The colour of ray florets varied among varieties. It was found to be red in Beaudine, cream in Mammut, pink in both Esmara and Aquamelon and bicoloured flower with orange colour and yellow coloured tip was observed in Double date.

Barad *et al* (2010) observed maximum number of ray florets (240.50) under 20gm^{-2} nitrogen levels when gerberas were grown under net house conditions.

Srivastava *et al.* (2017) reported a gradual increase in the length and breadth of ray florets (from 3.15cm to 3.62cm and 0.71cm to 1.00cm) with an application of fertilizer doses in between the range of 0g -45g NPK m^{-2} month^{-1}.

Flower stalk length was highly influenced by the levels of macro nutrients. Longest flower stalk was observed with high levels of phosphorous and potassium (Amin *et al.*, 2015). Maximum stalk length of gerbera is a result of activation of ATP (Adenosine Triphosphate) by potassium which is the energy source for many chemical reactions as plants absorb potassium in ironic form (K+). Rapid growth is promoted by nitrogen as it serves as a constituent of nucleic acid which aided in growth. Cell wall development and growth were encouraged by phosphorous. A maximum stalk length (46.47cm) was observed in a treatment with nutrient doses of 20:30:40 g NPK m^{-2} (Ayemi *et al.*, 2017).

Barad *et al.* (2010) reported that highest length of flower stalk (50.03cm) was observed under a treatment NPK 20:10:20 g m^{-2} (2:1:2) when grown under net house conditions. Maximum stalk length was 29.8cm and minimum was 25.56cm (Kedistu, 2012). Srivastava et al. (2017) observed that a gradual increase in flower stalk length (44.81cm to 53.79cm) was observed with an application of fertilizer doses in between the range of 0g -45g NPK m^{-2} month^{-1}. Fayz *et al.* (2016) reported that length of flower stalk was highest with a nutrient treatment 20:20:15 NPK gm^{-2} and it was found to be 71.7cm.

According to Irshana (2016), a great variation on the girth of the flower stalk was observed according to the varietal difference. There was a wide variation (5.84 cm to 8.13cm) among different varieties of gerbera with reference to a study conducted by Kumar *et al.* (2013).

2.6. YIELD PARAMETERS

When N, P_2O_5 and K_2O at the rate of 2:4:1 g $plant^{-1}$ was applied the best results were obtained in *Gerbera jamesonii* var. Superba (Kamel et al., 1977). Gurav *et al.* (2004) reported that the interaction of 20:20:15g N:P:K m^{-2} $month^{-1}$ significantly produced more number of flowers $plant^{-1}$. Jawahar *et al.* (2007) reported that maximum number of flowers $plant^{-1}$ m^{-2} was recorded with improved floral characters when applied with higher levels of N and P (10gN+15g P_2O_5 m^{-2}). Maximum diameter and vase life of the flower were obtained with N and P levels 10gN+12.5g P_2O_5g m^{-2} and 5gN+15g P_2O_5 m^{-2} respectively. Barad *et al.* (2010) reported that maximum number of flowers produced in a year (21.63) under nitrogen levels of 20gm^{-2} when grown under net house to study the effect of NPK levels in gerbera. Amin *et al.* (2015) reported that number of flowers produced $plant^{-1}$ was best when treated with12.5g P_2O_5 m^{-2} and 15g K_2O m^{-2}.

2.7. POST HARVEST CHARACTERS

Post-harvest standard of flower is a phenomenon of physiological process which depends on water uptake, transpiration loss, water balance, respiration and varietal difference (Kumar *et al.*, 2013). Occlusions in the basal stem end may affect water uptake negatively (He *et al.*, 2006).

Mohariya *et al.* (2004) studied the effects of phosphorus (0, 7.5, 10 and 12.5g m^{-2}) and potassium (0, 10, 12.5 and 15 g m^{-2}) on the qualitative parameters of gerbera (*Gerbera jamesonii*). The highest vase life was obtained with application of 12.5 g P_2O_5 m^{-2} and 15 g K_2O m^2. Longchar *et al.* (2013) found out that FYM as organic substrate aided in extending vase life. Majumder *et al.* (2014) reported that 75% recommended fertilizer dosage (10:15:20g N, P_2O_5, K_2O m^{-2} + FYM 1kg $m^{-2}year^{-1}$ + vermi compost (300g m^{-2}) + Azospirillum (2g $plant^{-1}year^{-1}$) + PSB (2g $plant^{-1}$) resulted in highest values for vase life of the flower. According to Amin *et al.* (2015) vase life was best when treated with12.5g P_2O_5 m^{-2} and 15g K_2O m^{-2}. Srivastava *et al.* (2017) reported that a maximum vase life of gerbera flowers was found to be 15.64 days when treated with 45g NPK m^{-2} $month^{-1}$.

A study of Meeteren (1978) revealed that high vase life was found in the flowers with high water uptake. Srivastava *et al.* (2017) reported that water uptake by flower spikes ranged from 22.63 ml to 28.71 ml with an application of fertilizer doses in between the range of 0g- 45g NPK m^{-2} $month^{-1}$.

According to wani et al, 2017, the maximum fresh flower weight was observed as 12.5g.

2.8. PEST AND DISEASE INCIDENCE

Mc-Cann and Hausbeck (2018) reported that there were numerous diseases effecting plant health and petal quality in gerbera. Powdery mildew (*Podosphaera sp.*), botrytis blight and alternaria leaf spot are the major foliar diseases in gerbera. It was also found to be susceptible to host of root and crown rot diseases (*Fusarium sp., Phytophthora sp. and Pythium sp.*).

According to Sabir *et al.* (2012), Mites, whiteflies, aphids, Thrips and leaf miners are the major pests of gerbera.

From the study of Ayemi *et al.* (2017) it was proved that appropriate potassium levels discourages the insect damage and disease incidence in gerbera because of the proficient consumption of nitrogen and phosphorous. From a study conducted by Fanigliulo (2010) it was noticed that regular spray of acaricide (oberon) effectively controlled mites and whiteflies in ornamental crops.

MATERIALS AND METHODS

3. MATERIALS AND METHODS

The thesis work on "Nutrient management in gerbera (*Gerbera jamesonii* Bolus) grown under naturally ventilated poly house" was carried out at the Department of Pomology and Floriculture, College of Agriculture, Vellayani during June 2017-2018. The study was under taken to assess the performance of five Gerbera varieties to different amount of fertilizer doses and to find out the best fertilizer dose for each variety. This study also aims for the standardization of nutrient management schedule for *Gerbera jamesonii* Bolus.

Five varieties of gerbera were selected for the experiment and were planted under rain shelter with a roofing of UV stabilisation and shade net is provided in the sides. Different doses of fertilizers were applied to the plants and these varieties were evaluated for vegetative and yield parameters, flowering characters, flower characters, post-harvest characters, pest and disease incidence and economics of cultivation.

3.1 LOCATION

This experiment was conducted at the Department of Pomology and Floriculture, College of Agriculture, Vellayani, Thiruvananthapuram (Plate 1a & 1b), Kerala during 2016-2018.

3.2 SEASON

The experiment was conducted from June 2016 to April 2018.

3.3 PLANTING MATERIAL

Uniform planting materials of the five varieties such as Double date, Beudine, Mammut, Esmara and Aquamelon, were collected from the Department of Pomology and Floriculture, College of Agriculture, Vellayani, Thiruvananthapuram.

3.4 PLANTING

Planting was done in 40 x40 cm polybags which contains soil, sand, coir pith mixed in 1:1:1 ratio. Along with the planting media, PGPR MIX I and PGPR MIX II were also added. Gerbera plants were dipped in 0.2% Bavistin before planting in the polybags. The experiment was followed under CRD experimental design. There were 30 treatments in this experiment which was replicated three

times with four plants per varieties per each treatment. Polybags were arranged systematically inside the poly house.

3.5 TREATMENTS

There were 30 treatments in this experiment with three replications. Treatments were given two months after planting.

a. Number of varieties (v = 5)

V_1- Beudine

V_2- Double date

V_3- Mammut

V_4- Esmara

V_5- Aquamelon

b. Nutrient treatments (n = 3)

N_1- 10:10:10 N, P_2O_5, K_2O g m^{-2} (1.6: 1.6: 1.6 N, P_2O_5, K_2O g $plant^{-1}$)

N_2- 15:15:15 N, P_2O_5, K_2O g m^{-2} (2.5: 2.5: 2.5 N, P_2O_5, K_2O g $plant^{-1}$)

N_3- 20:20:20 N, P_2O_5, K_2O g m^{-2} (3.3: 3.3: 3.3 N, P_2O_5, K_2O g $plant^{-1}$)

c. Level of split application of nutrients (s = 2)

S_1 – Monthly interval.

S_2 – Fortnightly interval.

Uniform application of dried cowdung at bimonthly interval at the rate of 30g $plant^{-1}$ and foliar fertilizer (13:27:27) @ 500mL $plant^{-1}$ were given at bimonthly interval as in the previous study which was conducted at department of Pomology and Floriculture.

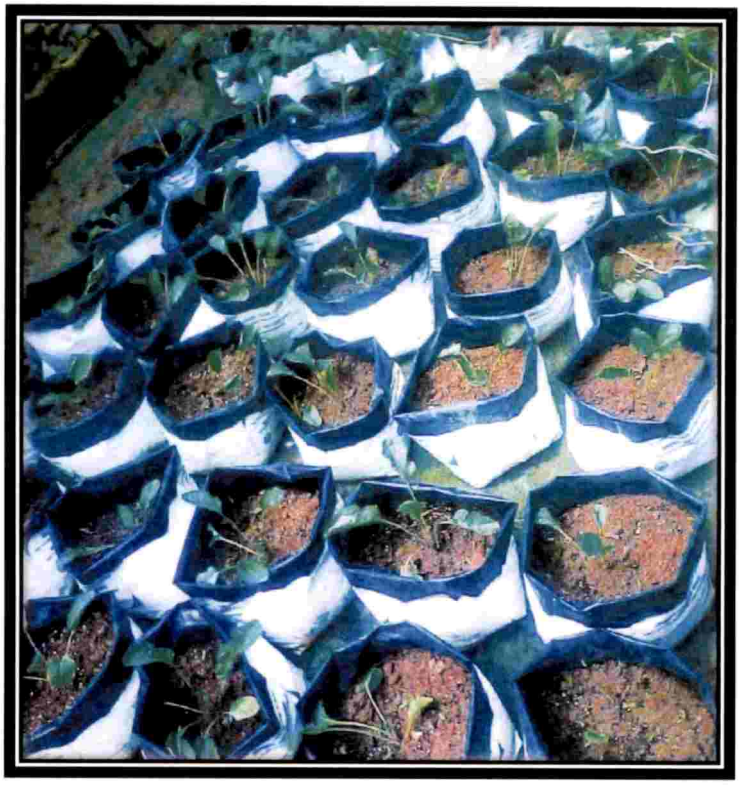

Plate 1a. Field view after planting

Plate 1b . General view of the experimental area

Plate 1c. General view of the experimental area

3.6 DETAILS OF THE VARIETIES UNDER STUDY

Table 1. Characteristics of varieties under study

Sl No.	Name of the Variety	Colour of disc florets	Colour of ray florets
1	Beaudine	Black	Red
2	Double date	Greenish yellow	Bi-colour (orange with yellow tip)
3	Mammut	Greenish yellow	Cream
4	Esmara	Greenish yellow	Pink
5	Aquamelone	Black	Pink

Beaudine

Double date

Mammut

Esmara

Aquamelon

Plate 2: Varieties under study

3.7 EXPERIMENTAL DESIGN AND LAYOUT

Varieties: Beudine, Double date, Mammut, Esmara, Aquamelon

Design: CRD

No. of treatments: 30

No. of replications: 3

No. of plants per varieties in a replication: 4

3.8 AFTER CULTIVATION

The experimental area was kept clean and hygiene by periodic removal of weeds throughout the observation period. Dried flowers and old leaves were removed to keep the experimental area clean. Watering of the plants was done in daily basis. Proper care against pest and diseases were done regularly. Periodic spray of oberon 0.4% (acaricide against mites) was done.

3.9 OBSERVATIONS

There were thirty treatments in this experiment which contain three replications for each treatment. Vegetative parameters were recorded at an interval of two months. Flowering characters and flower characters were observed according to the flowering nature of the plant. Other parameters such as yield parameters which include number of flowers produced plant^{-1} year^{-1} and yield of flowers in relation to season, post-harvest characters, pest and disease incidence and economics of cultivation were recorded throughout the period of experiment from three sampling plants in each treatment per replication.

3.9.1. Vegetative Parameters

Growth characters were observed on three plants per treatment in each replication. Observations were taken from two months after planting till a period of ten months during the crop growth.

3.9.1.1 Plant spread (cm)

Plant diameter was taken and circumference was calculated using the formula $2\pi r$ (r= radius). Plant spread is expressed in centimetres. First observation was taken one month after planting i.e., in July and bimonthly observations were taken there after till a period of ten months.

3.9.1.2. Number of leaves plant^{-1}

The number of leaves produced in each plant were counted and recorded from one month after from planting. Later observations were taken at bimonthly intervals.

3.9.1.3. Leaf area (cm^2)

Leaf area is measured by graphical method where the area of leaf was calculated by counting the squares in the graph.

3.9.1.4. Leaf length (cm)

Leaf length was measured as the distance from base of leaf to the tip of petiole of the longest leaf. Leaf length is expressed in centimeters.

3.9.1.5. Leaf breadth (cm)

Leaf breadth was measured from the expansive part of the leaf. Leaf breadth is expressed in centimeters.

3.9.1.6. Number of suckers plant^{-1}

Number of suckers, which were produced from each plant were recorded until the last observation.

3.9.2. Flowering Characters

3.9.2.1. Number of days taken for flowering

The observatory plants were regularly monitored for recording number of days taken from planting to first flower bud initiation in each treatment.

3.9.2.2. Number of days taken from bud initiation to harvest

The number of days taken from flower bud initiation to harvest of the flowers were recorded from the observation plants

3.9.2.3. Peak flowering period

Peak flowering period of each treatment was determined in such a way by recording the number of flowers produced in each treatment. The peak flowering period was determined with reference to the season.

3.9.2.4. Flower longevity on the plant

The life of the flower while it is attached to the plant was referred to as flower longevity on the plant. The number of days taken from the harvest maturity to the senescence stage was counted in each treatment.

3.9.3. Flower Characters

3.9.3.1. Flower diameter (cm)

Diameter of the fully opened flower was measured and recorded. Unit of measurement is centimetrs.

3.9.3.2. Diameter of the flower disc (cm)

Diameter of the flower disc was measured and recorded and expressed in centimeters.

3.9.3.3. Colour of the flower disc

The disc colour was observed and recorded in each treatment.

3.9.3.4. Number of ray florets

The total number of ray florets were counted and recorded in each treatments and expressed in numbers.

3.9.3.5. Colour of ray florets

The colour of the ray florets were observed and recorded for each of the treatment

3.9.3.6. Length of the ray florets (cm)

The length of the ray florets were calculated in such a way by measuring the distance from the point of attachment of petals from the base to the tip of the petal. Unit of measurement is centimeters.

3.9.3.7. Width of ray florets (cm)

Width of ray florets was calculated from the broadest part of the petal in each treatment. Unit of measurement is centimeters.

3.9.3.8. Length of flower stalk (cm)

Length of the flower stalk was determined by measuring distance from the base of flower stalk to the base of the flower head in each of the treatments. Unit of measurement is centimeters.

3.9.3.9. Girth of flower stalk (cm)

Circumference of the flower stalk constitutes the girth. Circumference of the flower stalk was measured, recorded and expressed in centimeters.

3.9.3.10. Visual appeal (scoring based on three characters: general appearance, Size of flower and colour development)

A panel of five judges were selected for the assessment. General appearance, size of the flower and colour development were observed and categorized in to three groups in five point basis as follows.

Average: 1-2

Good : 3-4

Very good: 5

The total score also calculated based up on five point basis in to three groups (Average, good, very good).

3.9.4. Yield Parameters

3.9.4.1. Number of flowers produced plant^{-1} year^{-1}

Each of the treatments was monitored and the total number of flowers produced was recorded plant^{-1} year^{-1}.

3.9.4.2. Yield of flowers in relation to season

Total flowers produced in each treatment were recorded and yield of flowers were determined with reference to the season.

3.9.5. Post Harvest Characters

3.9.5.1. Vase life

Assessment of vase life of flowers was done by using distilled water. Flowers were harvested at proper harvesting stage and kept in distilled water under room temperature. Number of days was calculated from the day of keeping flower in water till the withering symptoms of flower were shown. Days taken for drooping of flower heads, discolouration of the petals and petal fall were observed.

3.9.5.2. Water uptake

Amount of water in the beginning as well as at the end of the vase life experiment were recorded and the difference was calculated. Unit of measurement is milliliters (mL).

3.9.5.3. Physiological loss in weight

The weight of each flower before and after the vase life experiment was recorded and the difference was calculated. Unit of measurement is milligram (mg).

3.9.8. Pest and Disease Incidence

Plants were frequently observed for pests and diseases and plant protection chemicals were applied based up on the incidence.

3.10. ECONOMICS OF CULTIVATION

As the study aimed for standardization of nutrient management schedule for *Gerbera jamesonii*, all the treatments were associated with different doses of fertilizers. The cost of cultivation for each treatment was worked out for fertilizers (Urea, Rock phosphate, muriate of potash), farm yard manure, potting mixtures (sand, coir pith etc.), plant protection chemicals etc. The labour charges were associated with fertilizer application, weeding, plant protection etc., were also worked out as per the labour charges for the experiment. The yield of flowers was recorded in each season for calculating the economics of cultivation. Number of marketable suckers produced in each plant under the treatment was also considered for calculating the economics. The benefit: cost was estimated by using total cost of cultivation and gross income obtained.

3.11. STATISTICAL ANALYSIS

Data obtained for various parameters and nutrient contents in each treatment was statistically analysed. ANOVA (Analysis of variance) for Factorial CRD (completely randomized design) was worked out for the present experiment.

SCORE CARD

Sl.no	General appearance					Size of the flower					Colour development				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
$v_2n_1s_1$															
$v_2n_2s_1$															
$v_2n_3s_1$															
$v_2n_1s_2$															
$v_2n_2s_2$															
$v_2n_3s_2$															
$v_1n_1s_1$															
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$v_4n_3s_2$															
$v_5n_1s_1$															
$v_5n_2s_1$															
$v_5n_3s_1$															
$v_5n_1s_2$															
$v_5n_2s_2$															
$v_5n_3s_2$															

RESULTS

4. RESULTS

The thesis work on "Nutrient management in gerbera (*Gerbera jamesonii* Bolus) grown under naturally ventilated poly house" was carried out at the Department of Pomology and Floriculture, College of Agriculture, Vellayani during June 2017-June 2018. The study was under taken to assess the performance of five Gerbera varieties to different amount of fertilizer doses and to find out the best fertilizer dose for each variety. This study also aims for the standardization of nutrient management schedule for *Gerbera jamesonii* Bolus.

Uniform planting materials of *Gerbera jamesonii* Bolus. for five varieties were collected from Department of Pomology and Floriculture and planted under naturally ventilated poly house. Vegetative parameters, flowering characters, flower characters, yield parameters, post-harvest characters, plant analysis and soil analysis were recorded, statistically analysed and the results obtained are presented in this chapter.

4.1. VEGETATIVE PARAMETERS

4.1.1. Plant spread (cm)

The effect of treatments (varieties, nutrient treatments and level of split application of nutrients) on plant spread of *Gerbera jamesonii* Bolu.s under naturally ventilated poly house during 2 months after planting (MAP) to 10 MAP are presented in table 2a, 2 b, 2c and 2d.

The result showed that the effect of varieties on plant spread had significant impact from 2MAP- 10MAP. Variety Beaudine (V_1) was significantly superior in terms of plant spread (154.18cm at 2 MAP and 156.19cm at 4 MAP). From 6 MAP variety Mammut (V_3) was recorded higher values for plant spread *viz*., 148.93 cm at 6 MAP, and 152.01cm at 8MAP and 155.23cm at 10 MAP. Beaudine (V_1) variety at 4 MAP was found to be superior among all the varieties in terms of plant spread (156.19cm), which was found to be on par with Mammut (V_3) (151.67cm) and Esmara (V_4) (145.59cm) at 4 MAP. Significant effect of nutrient treatments on plant spread was observed from 2 MAP- 10 MAP.

Table 2a : Main effect of nutrient management on plant spread (cm) in *Gerbera jamesonii* Bolus.

	2 MAP	4 MAP	6 MAP	8 MAP	10 MAP
Varieties (V)					
V_1	154.18	156.19	148.57	149.56	151.53
V_2	111.64	133.05	115.14	123.21	125.55
V_3	131.56	151.67	148.93	152.01	155.23
V_4	149.52	145.59	141.84	149.78	149.50
V_5	132.55	140.99	142.11	146.75	150.43
CD	6.20	4.77	4.18	3.37	3.43
SEm (±)	2.19	1.69	1.48	1.19	1.21
Nutrient treatments (N)					
N_1	154.72	164.69	162.63	168.88	171.29
N_2	137.25	143.95	135.67	138.15	139.54
N_3	115.51	127.86	119.66	125.75	128.52
CD	4.80	3.70	3.24	2.61	2.66
SEm (±)	1.70	1.31	1.15	0.92	0.94
Level of split application of nutrients (S)					
S_1	141.76	148.86	140.60	146.47	148.71
S_2	130.02	142.14	138.03	142.05	144.19
CD	3.92	3.02	NS	2.13	2.17
SEm (±)	1.39	1.07	0.94	0.75	0.77

The highest value of plant spread was recorded at 10 MAP (171.29cm) with the nutrient treatment 10:10:10 N, P_2O_5, K_2O g m^{-2} (1.6: 1.6: 1.6 N, P_2O_5, K_2O g $plant^{-1}$) (N_1). Significant effect on level of split application of nutrients (S_1) on plant spread was found at 2, 4, 8, and 10 MAP. Monthly split application at fourth month was found to be superior (148.46cm).

The interaction effect of varieties and nutrient treatments in nutrient management on plant spread of *Gerbera jamesonii* Bolus was found to be significant throughout the crop period with significantly highest value for Beaudine with nutrient treatment 10:10:10 N, P_2O_5, K_2O g m^{-2} (v_1n_1) at 10 MAP (175.68cm).The result was found to be on par with v_3n_1 and v_5n_1.

The interaction effect of nutrient treatments and level of split application of the nutrients on plant spread of gerbera was found to be significant from 4 MAP. Significantly highest value was noted for 10:10:10 N, P_2O_5, K_2O g m^{-2} with level of split application of nutrients at monthly basis (n_1s_1) in all the months.

4.1.2. Number of leaves $plant^{-1}$

The effect of treatments (varieties, nutrient treatments and level of split application of nutrients on number of leaves $plant^{-1}$ of *Gerbera jamesonii* Bolus. under naturally ventilated poly house during 2 MAP to 10 MAP are presented in table 3a, 3b, 3c and 3d.

The number of leaves of gerbera showed significant difference between the varieties throughout the growth period. Variety Beaudine (V_1) recorded superior values from 2 MAP to 8 MAP with a highest mean number of leaves 13.31. Mammut (V_3) recorded significantly lower value (7.75). Significantly higher number of leaves was obtained with nutrient treatment 10:10:10 N, P_2O_5, K_2O g m^{-2} in all the months and higher value was obtained at 6 MAP (12.54) which was on par with n_2 (9.69). There was no significant difference between

treatments for the effect of level of split application of nutrients on number of leaves plant^{-1} in gerbera till 6 MAP.

Table 2b. Interaction effect of varieties and nutrient treatments in nutrient management on plant spread (cm) in *Gerbera jamesonii* Bolus

Treatments	2 MAP	4 MAP	6 MAP	8 MAP	10 MAP
v_1n_1	164.58	168.85	170.42	173.12	175.68
v_1n_2	150.23	158.48	146.67	146.65	149.50
v_1n_3	147.73	141.25	128.62	128.92	129.40
v_2n_1	117.51	142.60	143.25	154.12	157.81
v_2n_2	116.20	136.93	104.80	110.17	111.58
v_2n_3	100.50	119.63	97.36	105.35	107.27
v_3n_1	165.72	174.97	167.06	172.63	174.79
v_3n_2	129.27	145.44	146.34	146.90	150.27
v_3n_3	99.69	134.59	133.40	136.51	140.65
v_4n_1	165.2	167.26	164.16	171.68	173.06
v_4n_2	148.68	143.30	143.07	146.47	144.96
v_4n_3	134.66	126.21	118.31	131.18	130.48
v_5n_1	160.56	169.78	168.25	172.86	175.11
v_5n_2	141.15	135.59	137.40	140.58	141.38
v_5n_3	95.95	117.60	120.65	126.81	134.79
CD	10.74	8.27	7.25	5.84	5.95
SEm (±)	3.80	2.92	2.56	2.06	2.10

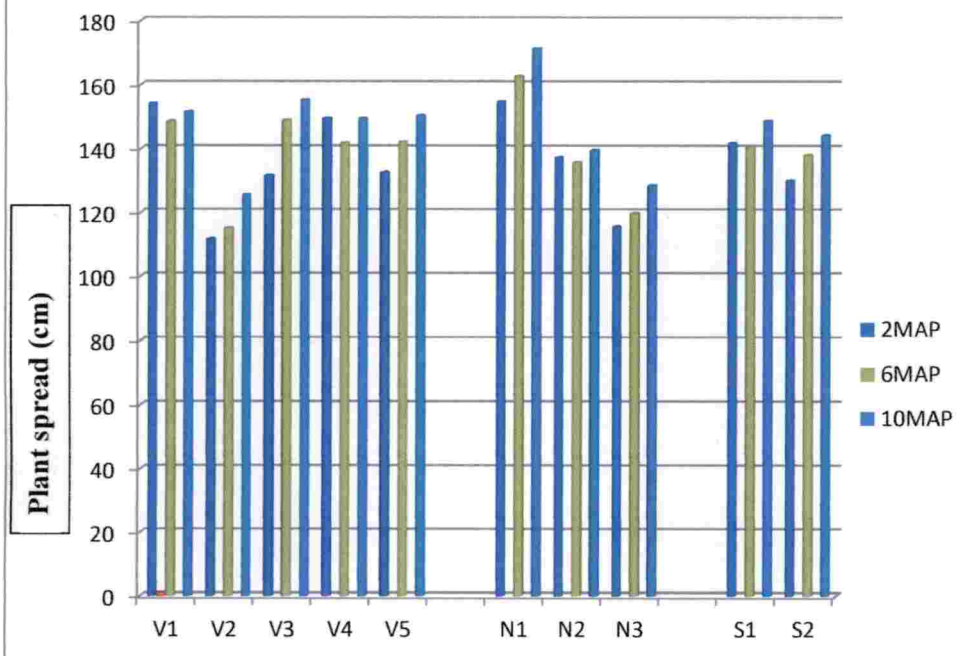

Figure 1. Main effect of nutrient management on plant spread (cm)

Table 2c. Interaction effect of varieties and level of split application of nutrients in nutrient management on plant spread (cm) in *Gerbera jamesonii* Bolus.

Treatments	2 MAP	4 MAP	6 MAP	8 MAP	10 MAP
V_1S_1	156.44	163.81	153.38	155.51	157.13
V_1S_2	151.92	148.58	143.76	143.62	145.93
V_2S_1	115.45	140.14	119.87	127.89	128.79
V_2S_2	107.84	125.97	110.40	118.54	122.31
V_3S_1	139.78	154.41	149.09	153.31	156.80
V_3S_2	123.34	148.92	148.77	150.71	153.67
V_4S_1	152.23	146.38	139.48	149.99	149.21
V_4S_2	146.80	144.80	144.21	149.57	149.79
V_5S_1	144.92	139.56	141.20	145.68	151.60
V_5S_2	120.18	142.42	143.00	147.82	149.25
CD	8.77	6.75	5.92	4.77	4.86
SEm (±)	3.10	2.39	2.09	1.70	1.70

Significantly higher value was observed for monthly split application of nutrients (S_1) at 8 MAP (10.95).

The interaction effect of varieties on nutrient treatment was found to be significant for 2, 4, 6 and 10 MAP. Beaudine variety obtained higher values for

number of leaves plant^{-1} at 2, 4 and 6 MAP and was 12.64, 12.50 and 14.52 respectively.

The interaction effect of varieties and level of split application of nutrients on number of leaves plant^{-1} was found to be significant at 6 MAP and 10 MAP.

Table 2d. Interaction effect of nutrient treatments and level of split application of nutrients in nutrient management on plant spread (cm) in *Gerbera jamesonii* Bolus.

Treatments	2 MAP	4 MAP	6 MAP	8 MAP	10MAP
n_1s_1	161.45	174.78	172.21	179.78	177.90
n_1s_2	147.98	154.60	153.05	162.80	159.86
n_2s_1	142.13	127.79	111.72	111.47	111.97
n_2s_1	132.37	160.11	159.59	167.61	164.34
n_3s_1	121.72	144.01	137.88	154.88	149.57
n_3s_2	109.70	111.71	101.45	102.16	101.95
CD	NS	5.23	4.58	3.76	3.69
SEm (±)	2.40	1.85	1.62	1.33	1.31

The highest value obtained at 6 MAP was 12.59 for variety Beaudine given level of split application of nutrients at fortnightly basis (v_1s_2).

The interaction effect of nutrient treatments and level of split application of nutrients on number of leaves plant^{-1} was found to be significant for all the months. Significantly higher values were obtained for nutrient treatment 10:10:10 N, P_2O_5, K_2O g m^{-2} with monthly split application of nutrients till 8 MAP. Significantly higher value was obtained for n_1s_1 at 6 MAP (13.69).

4.1.3. Leaf area (cm^2)

The effect of treatments (varieties, nutrient treatments and level of split application of nutrients) on leaf length of *Gerbera jamesonii* Bolus. under naturally ventilated poly house during 2 MAP to 10 MAP are presented table 4a, 4b, 4c and 4d.

Significant effect of varieties on leaf area was noticed from 2 MAP to 10 MAP. Variety Mammut (V_3) recorded highest value for leaf area at 2 MAP and 10 MAP ($87.82cm^2$). The effect of nutrient treatments on leaf area showed significant difference throughout the crop period. Nutrient treatment 10:10:10 N, P_2O_5, K_2O g m^{-2} (N_1) showed significantly superior values for all the months and $89.69cm^2$ was significantly highest value at 8 MAP. The effect of level of split application of nutrients was noticed to be significant throughout the crop period. Significantly highest value was obtained at 10 MAP ($83.44cm^2$).

Interaction of varieties and nutrient treatments was observed to be non-significant from 2 MAP to 8 MAP. Significantly higher values were recorded for Mammut variety treated with 10:10:10 N, P_2O_5, K_2O g m^{-2} ($92.45cm^2$) at 10 MAP (v_3n_1).

The interaction effect of varieties and nutrient treatment was found to be non-significant throughout the crop period.

Interaction effect of nutrient treatments and level of split application of nutrients was found to be significant throughout the crop growth except at 8 MAP. Significantly highest value was obtained when 10:10:10 N, P_2O_5, K_2O g m^{-2} nutrients was applied at fortnightly intervals ($87.07\ cm^2$) (n_1s_2).

4.1.4. Leaf length (cm)

The effect of treatments (varieties, nutrient treatments and level of split application of nutrients) on leaf length of *Gerbera jamesonii* Bolus. under naturally ventilated poly house during 2 MAP to 10 MAP are presented in table 5a, 5b, 5c and 5d.

Table 3a. Main effect of nutrient management on number of leaves in *Gerbera jamesonii* Bolus.

	2 MAP	4 MAP	6 MAP	8 MAP	10 MAP
Varieties (V)					
V_1	11.09	10.29	12.26	13.31	8.77
V_2	10.78	9.38	9.21	9.48	10.53
V_3	7.75	8.96	10.83	11.30	7.63
V_4	10.12	9.41	10.20	10.41	6.46
V_5	6.49	9.14	9.35	7.81	7.16
CD	1.49	0.30	0.44	1.03	0.36
SEm (±)	0.53	0.10	0.16	0.37	0.13
Nutrient treatments (N)					
N_1	10.72	10.87	12.54	12.16	8.90
N_2	8.56	9.11	9.69	10.20	8.07
N_3	8.45	8.33	8.89	9.03	7.36
CD	1.16	0.23	0.34	0.80	0.28
SEm (±)	0.41	0.08	0.12	0.28	0.10
Level of split application of nutrients (S)					
S_1	9.23	9.49	10.49	10.95	7.75
S_2	9.26	9.38	10.26	9.97	8.46
CD	NS	NS	NS	0.65	0.23
SEm (±)	0.33	0.07	0.10	0.23	0.08

Table 3b. Interaction effect of varieties and nutrient treatments in nutrient management on number of leaves in *Gerbera jamesonii* Bolus.

Treatments	2 Months	4 Months	6 Months	8 Months	10 Months
v_1n_1	12.64	12.50	14.52	14.76	10.57
v_1n_2	11.22	9.72	11.44	13.25	8.45
v_1n_3	9.42	8.67	10.83	11.93	7.29
v_2n_1	11.78	11.23	11.19	11.53	11.17
v_2n_2	11.33	8.86	8.74	9.36	11.50
v_2n_3	9.22	8.04	7.70	7.56	8.92
v_3n_1	10.83	9.95	13.03	13.89	8.71
v_3n_2	5.26	8.69	9.52	10.40	6.77
v_3n_3	7.15	8.23	9.95	9.60	7.41
v_4n_1	11.92	10.64	12.37	11.82	6.30
v_4n_2	9.28	9.16	10.01	9.98	6.67
v_4n_3	9.17	8.44	8.24	9.43	6.43
v_5n_1	6.44	10.01	11.58	8.78	7.75
v_5n_2	5.72	9.15	8.73	8.04	6.97
v_5n_3	7.31	8.26	7.73	6.61	6.76
CD	2.59	0.51	0.77	NS	0.63
SEm (±)	0.91	0.18	0.27	0.63	0.22

Table 3c. Interaction effect of varieties and level of split application of nutrients in nutrient management on number of leaves in *Gerbera jamesonii* Bolus.

Treatments	2 MAP	4 MAP	6 MAP	8 MAP	10 MAP
V_1S_1	11.07	10.49	11.93	13.37	7.70
V_1S_2	11.11	10.10	12.59	12.66	9.84
V_2S_1	10.97	9.39	9.49	9.98	9.80
V_2S_2	10.76	9.36	8.93	8.98	11.26
V_3S_1	7.61	8.80	11.06	11.53	7.26
V_3S_2	7.88	9.11	10.60	11.06	7.99
V_4S_1	10.10	9.65	10.57	10.95	6.34
V_4S_2	10.15	9.17	9.84	9.87	6.59
V_5S_1	6.57	9.12	9.38	8.34	7.67
V_5S_2	6.41	9.16	9.32	7.27	6.65
CD	NS	NS	0.62	NS	0.51
SEm (±)	0.75	0.15	0.22	0.52	0.18

Significant effect of varieties on leaf length of gerbera was noticed from 2 MAP to 10 MAP. Variety Beaudine (V_1) gained significantly higher value for leaf length at 4MAP (37.09cm). The effect of nutrient treatments on leaf length showed significant difference from 2MAP to 10 MAP. The nutrient treatment 10:10:10 N, P_2O_5, K_2O g m^{-2} (N_1) showed significantly superior values for all the months and 34.04cm was significantly higher value obtained at 4 MAP. The effect of level of split application of nutrients was noticed to be significant throughout the crop period. Significantly higher value (31.67cm) was observed at 4MAP.

Table 3d. Interaction effect of nutrient treatments and level of split application of nutrients in nutrient management on number of leaves in *Gerbera jamesonii* Bolus.

Treatments	2 MAP	4 MAP	6 MAP	8 MAP	10 MAP
n_1s_1	12.02	11.39	13.69	13.36	8.535
n_1s_2	9.42	10.35	11.38	10.95	9.26
n_2s_1	7.00	7.48	7.52	9.49	7.20
n_2s_1	10.13	10.75	11.86	10.92	8.95
n_3s_1	8.67	9.59	10.25	10.02	7.53
n_3s_2	8.24	7.06	7.53	8.03	7.19
CD	1.64	0.32	0.48	1.13	0.40
SEm (±)	0.58	0.11	0.17	0.40	0.14

The interaction effect of varieties and nutrient treatments was observed to be significant from 4MAP. Significantly higher value 42.33cm was obtained for variety Beaudine with nutrient treatment 10:10:10 N, P_2O_5, K_2O g m^{-2} at 4MAP (v_1n_1).

The interaction effect of varieties and level of split application of nutrients showed significant impact on leaf length from 6 MAP. Significantly superior values for leaf length were obtained at 6 MAP for Beaudine variety applied with a monthly interval of split application of nutrients (37.81cm) (v_1s_1).

The interaction effect of nutrient treatments and level of split application of nutrients were found to be significant from 2MAP to 10 MAP. Higher value was recorded for n_1s_1 (35.68cm) at 4MAP.

Table 4a. Main effect of nutrient management on leaf area (cm^2) in *Gerbera jamesonii* Bolus.

	2 MAP	4 MAP	6 MAP	8 MAP	10 MAP
Varieties (V)					
V_1	84.04	70.41	75.09	78.68	84.04
V_2	79.44	68.56	72.33	77.26	79.44
V_3	87.82	70.18	76.26	85.08	87.82
V_4	81.45	69.25	72.74	78.34	81.46
V_5	82.16	69.69	73.91	79.20	82.16
CD	1.14	0.61	0.83	NS	1.14
SEm (±)	0.40	0.22	0.29	1.94	0.43
Nutrient treatments (N)					
N_1	66.24	71.38	77.32	86.689	86.13
N_2	63.33	69.81	74.08	78.742	82.05
N_3	60.48	67.66	70.80	73.701	80.78
CD	0.42	0.46	0.65	4.26	0.88
SEm (±)	0.15	0.17	0.23	1.50	0.31
Level of split application of nutrients (S)					
S_1	63.46	69.84	74.81	82.78	83.44
S_2	63.24	69.40	73.32	76.65	82.53
CD	NS	0.39	0.52	3.48	0.72
SEm (±)	0.12	0.14	0.19	1.24	0.25

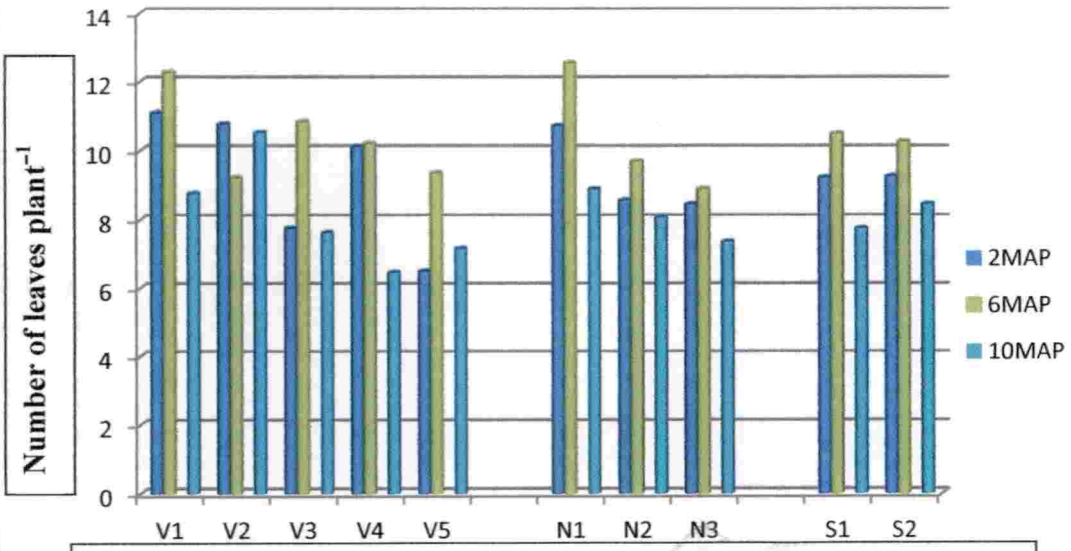

Figure 2. Main effect of nutrient management on number of leaves plant^{-1}

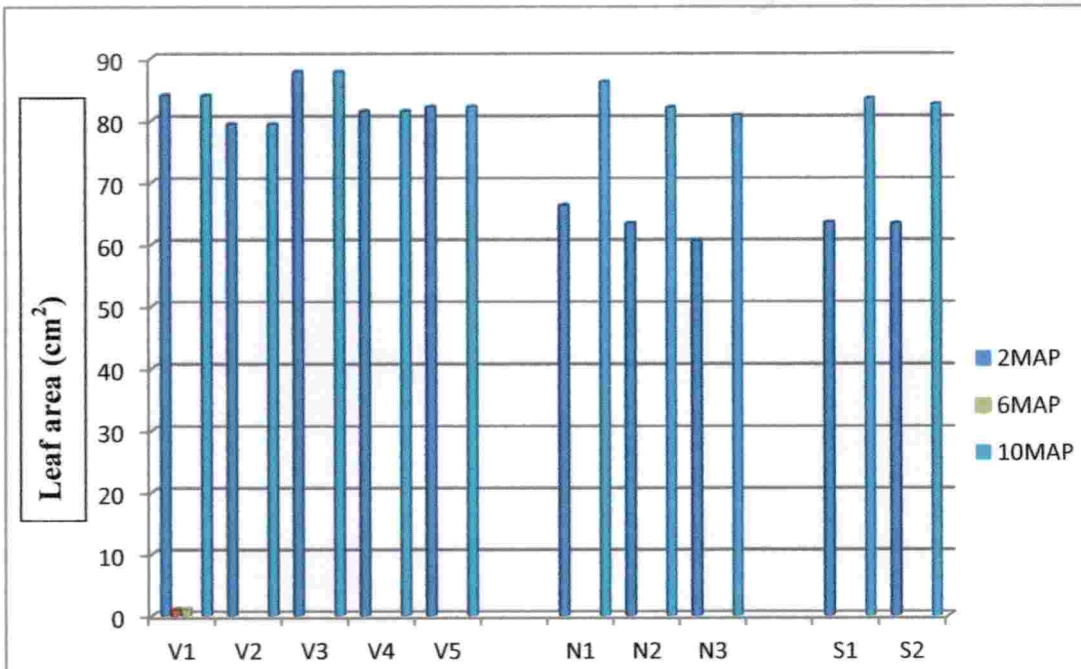

Figure 3. Main effect of nutrient management on leaf area (cm^2)

Table 4b. Interaction effect of varieties and nutrient treatments in nutrient management on leaf area (cm^2) in *Gerbera jamesonii* Bolus.

Treatments	2 MAP	4 MAP	6 MAP	8 MAP	10 MAP
v_1n_1	66.932	72.175	78.347	88.767	88.673
v_1n_2	64.093	70.603	75.105	71.484	82.998
v_1n_3	61.312	68.457	71.828	75.778	80.457
v_2n_1	64.543	70.322	75.583	83.453	84.073
v_2n_2	61.592	68.750	72.342	77.837	78.398
v_2n_3	58.698	66.603	69.065	70.465	75.857
v_3n_1	68.312	71.938	79.510	91.287	92.453
v_3n_2	65.473	70.367	76.268	85.670	86.778
v_3n_3	62.692	68.220	72.992	78.298	84.237
v_4n_1	65.653	71.012	75.990	84.543	82.362
v_4n_2	62.702	69.440	72.748	78.933	80.683
v_4n_3	59.808	67.293	69.472	71.555	81.333
v_5n_1	65.737	71.448	77.167	85.397	83.062
v_5n_2	62.785	69.877	73.925	79.787	81.383
v_5n_3	59.892	67.730	70.648	72.408	82.033
CD	NS	NS	NS	NS	1.97
SEm (±)	0.335	0.376	0.509	3.37	0.69

Table 4c. Interaction effect of varieties and level of split application of nutrients in nutrient management on leaf area (cm^2) in *Gerbera jamesonii* Bolus.

Treatments	2 MAP	4 MAP	6 MAP	8 MAP	10 MAP
V_1S_1	64.200	70.632	75.838	84.853	84.793
V_1S_2	64.025	70.191	74.349	72.499	83.292
V_2S_1	61.735	68.779	73.074	79.540	80.193
V_2S_2	61.487	68.338	71.586	74.963	78.692
V_3S_1	65.580	70.396	77.001	87.373	88.573
V_3S_2	65.405	69.954	75.512	82.797	87.072
V_4S_1	62.846	69.469	73.481	80.630	81.476
V_4S_2	62.597	69.028	71.992	76.058	81.443
V_5S_1	62.929	69.906	74.658	81.483	82.176
V_5S_2	62.680	69.464	73.169	76.911	82.14
CD	NS	NS	NS	NS	NS
SEm (±)	0.273	0.307	0.416	2.75	0.570

4.1.5. Leaf breadth (cm)

The effect of treatments (varieties, nutrient treatments and level of split application of nutrients) on leaf breadth of *Gerbera jamesonii* Bolus. under naturally ventilated poly house during 2 MAP to 10 MAP are presented in table 6a, 6b, 6c and 6d.

It was observed that the effect of varieties on leaf breadth of gerbera was significant from 2 MAP – 10 MAP. Variety Mammut (V_3) recorded significantly higher values for leaf breadth (11.03cm) at 10 MAP.

Table 4d. Interaction effect of nutrient treatments and level of split application of nutrients in nutrient management on leaf area (cm^2) in *Gerbera jamesonii* Bolus.

Treatments	2 MAP	4 MAP	6 MAP	8 MAP	10 MAP
n_1s_1	67.352	72.864	78.696	88.486	85.177
n_1s_2	65.119	69.894	75.943	84.893	87.073
n_2s_1	62.043	68.074	73.649	81.386	81.978
n_2s_1	64.615	71.541	74.506	76.098	82.119
n_3s_1	60.979	68.571	72.086	78.456	83.172
n_3s_2	59.982	66.751	69.516	68.946	78.395
CD	0.599	0.672	0.912	NS	1.25
SEm (±)	0.212	0.238	0.322	2.132	0.442

Analysis of data revealed that there was significant difference between varieties under study. Effect of nutrient treatments on leaf breadth was found to be significant from 2MAP-10 MAP. A significantly higher value of 12.35cm was observed at 4 MAP. The level of split application of nutrients on gerbera had a significant impact at 2 MAP and 4 MAP. Higher values were obtained when nutrients were applied at monthly interval (S_1) at 4 MAP (10.79cm).

The interaction effect of varieties and nutrient treatments on nutrient management of gerbera had a significant influence on leaf breadth throughout the crop period. Significantly higher values were obtained for Mammut treated with 10:10:10 N, P_2O_5, K_2O g at 4 MAP (13.85cm) (v_3n_1).

Table 5a. Main effect of nutrient management on leaf length in *Gerbera jamesonii* Bolus.

	2 MAP	4 MAP	6 MAP	8 MAP	10 MAP
Varieties (V)					
V_1	31.53	37.09	31.90	31.41	3.19
V_2	23.80	26.22	25.79	26.80	27.57
V_3	25.30	30.35	32.15	33.11	33.88
V_4	28.15	29.27	26.91	28.99	30.27
V_5	26.92	30.85	30.37	25.98	27.17
CD	1.56	0.66	1.07	0.47	0.82
SEm (±)	0.55	0.23	0.38	0.17	0.29
Nutrient treatments (N)					
N_1	30.38	34.04	32.42	31.39	32.63
N_2	26.21	30.31	29.17	28.96	30.33
N_3	24.82	27.92	26.74	27.41	28.28
CD	1.21	0.51	0.83	0.36	0.63
SEm (±)	0.43	0.18	0.29	0.13	0.22
Level of split application of nutrients (S)					
S_1	27.87	31.67	30.01	29.65	30.91
S_2	26.41	29.84	28.87	28.86	29.92
CD	0.99	0.42	0.67	0.30	0.52
SEm (±)	0.35	0.15	0.24	.11	0.18

Table 5b. Interaction effect of varieties and nutrient treatments in nutrient management on leaf length (cm) in *Gerbera jamesonii* Bolus.

Treatments	2 MAP	4 MAP	6 MAP	8 MAP	10 MAP
v_1n_1	35.43	42.33	35.04	34.23	35.23
v_1n_2	31.30	33.94	31.72	30.02	32.86
v_1n_3	27.85	35.00	28.93	29.97	31.49
v_2n_1	25.12	30.18	28.81	28.75	29.97
v_2n_2	22.78	27.21	25.57	26.79	28.08
v_2n_3	23.50	21.28	23.25	24.85	24.67
v_3n_1	29.24	35.25	33.29	36.02	37.96
v_3n_2	23.36	29.65	32.54	33.48	32.79
v_3n_3	23.31	26.14	30.61	29.83	30.89
v_4n_1	31.67	29.74	31.88	30.43	31.44
v_4n_2	26.89	29.80	25.91	28.70	30.68
v_4n_3	25.90	28.27	22.94	27.84	28.68
v_5n_1	30.45	32.71	33.08	27.55	28.55
v_5n_2	26.73	30.96	30.08	25.83	27.27
v_5n_3	23.57	28.89	27.95	24.57	25.70
CD	NS	1.14	1.85	0.81	1.42
SEm (±)	0.96	0.40	0.65	0.29	0.50

Table 5c. Interaction effect of varieties and level of split application of nutrients in nutrient management on leaf length (cm) in *Gerbera jamesonii* Bolus.

Treatments	2 MAP	4 MAP	6 MAP	8 MAP	10 MAP
v_1s_1	32.34	32.130	37.81	31.75	34.42
v_1s_2	30.71	31.67	36.37	31.06	31.96
v_2s_1	24.33	26.02	28.94	26.87	27.72
v_2s_2	23.27	25.73	23.50	26.72	27.42
v_3s_1	26.59	32.94	31.55	34.31	34.53
v_3s_2	24.01	31.36	29.14	31.90	33.23
v_4s_1	28.52	28.20	29.20	28.85	30.55
v_4s_2	27.78	25.62	29.34	29.13	29.98
v_5s_1	27.54	30.78	30.85	26.48	27.32
v_5s_2	26.29	29.96	30.86	25.48	27.03
CD	NS	NS	0.93	0.66	1.16
SEm (±)	0.78	0.53	0.33	0.24	0.41

There was significant difference between the treatments regarding interaction effect of varieties and level of split application of nutrients. When fertilizers were applied at monthly interval Mammut (V_3) variety recorded significantly higher value (11.45cm) at 4 MAP.

Significant effect of nutrient treatment and level of split application of nutrients was noticed throughout the crop period. Leaf breadth showed significantly superior values for n_1s_1 throughout the crop period with a higher value 13.57cm at 4MAP.

Table 5d. Interaction effect of nutrient treatments and level of split application of nutrients in nutrient management on leaf length (cm) in *Gerbera jamesonii* Bolus.

Treatments	2 MAP	4 MAP	6 MAP	8 MAP	10 MAP
n_1s_1	32.58	35.68	34.61	32.41	34.47
n_1s_2	28.18	32.41	30.23	30.38	30.79
n_2s_1	25.71	28.86	25.94	28.23	29.11
n_2s_1	26.72	31.76	32.39	29.70	31.56
n_3s_1	25.31	30.46	29.49	28.32	29.14
n_3s_2	24.34	25.37	23.98	26.50	27.43
CD	1.71	0.72	1.17	0.51	0.90
SEm (±)	0.61	0.26	0.41	0.18	0.32

4.1.6. Number of suckers plant^{-1}

The effect of treatments (varieties, nutrient treatments and level of split application of nutrients) on number of suckers plant^{-1}of *Gerbera jamesonii* Bolus. under naturally ventilated poly house during 2 MAP to 10 MAP are presented in table 7a, 7b, 7c and 7d.

The results disclosed that varieties significantly differed from each other for the number of suckers produced plant^{-1}. Significantly higher number of suckers plant^{-1} was produced by variety Mammut (V_3) (2.59) at 6 MAP and found to be on par with variety Esmara (V_4) (2.44). The effect of nutrient treatments on number of suckers produced plant^{-1} was observed to be significant throughout the crop period and higher values were observed for nutrient treatment 10:10:10 N, P_2O_5, K_2O g m^{-2} (N_1) with a mean value of 2.97 suckers plant^{-1}. The effect of split application of nutrients was observed to be significant only at 6 MAP.

Table 6a. Main effect of nutrient management on leaf breadth (cm) in *Gerbera jamesonii* Bolus

	2 MAP	4 MAP	6 MAP	8 MAP	10 MAP
Varieties (V)					
V_1	8.71	9.67	8.36	8.85	9.85
V_2	8.31	10.44	8.81	9.43	10.53
V_3	9.93	10.10	8.47	9.70	11.03
V_4	10.11	10.74	8.53	8.57	9.06
V_5	9.35	10.07	8.81	9.00	9.52
CD	0.29	0.37	0.24	0.29	0.34
SEm (±)	0.10	0.13	0.09	0.10	0.12
Nutrient treatments (N)					
N_1	10.68	12.35	9.71	10.66	12.02
N_2	9.19	9.99	8.36	8.84	9.33
N_3	7.99	8.28	7.71	7.84	8.65
CD	0.22	0.28	0.19	0.22	0.26
SEm (±)	0.08	0.10	0.06	0.08	0.09
Level of split application of nutrients (S)					
S_1	9.51	10.79	8.61	9.09	9.98
S_2	9.06	9.62	8.58	9.13	10.02
CD	0.18	0.23	NS	NS	NS
SEm (±)	0.06	0.08	0.05	0.06	0.08

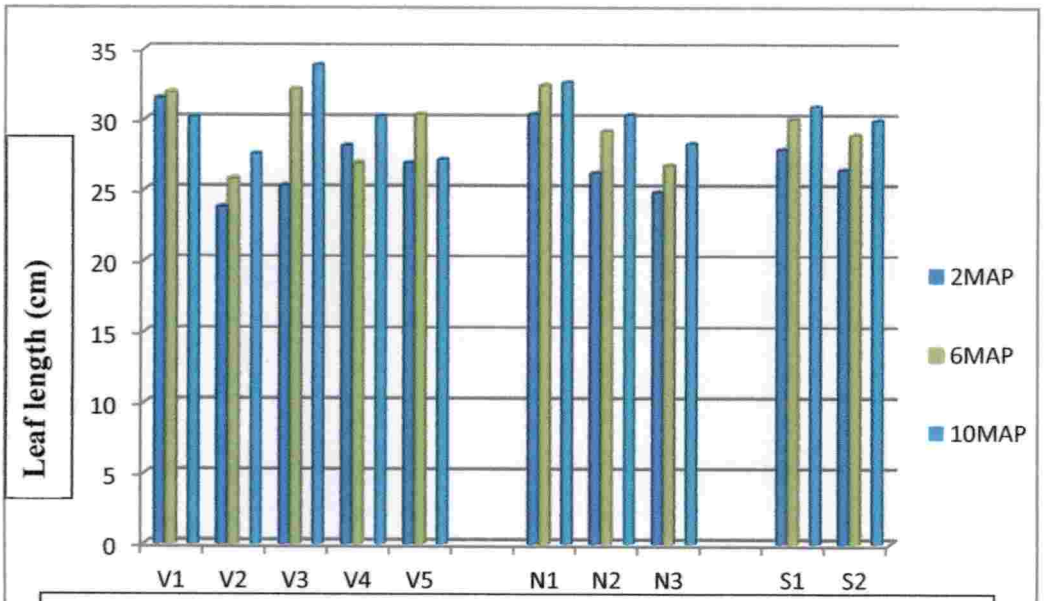

Figure 4. Main effect of nutrient management on leaf length (cm)

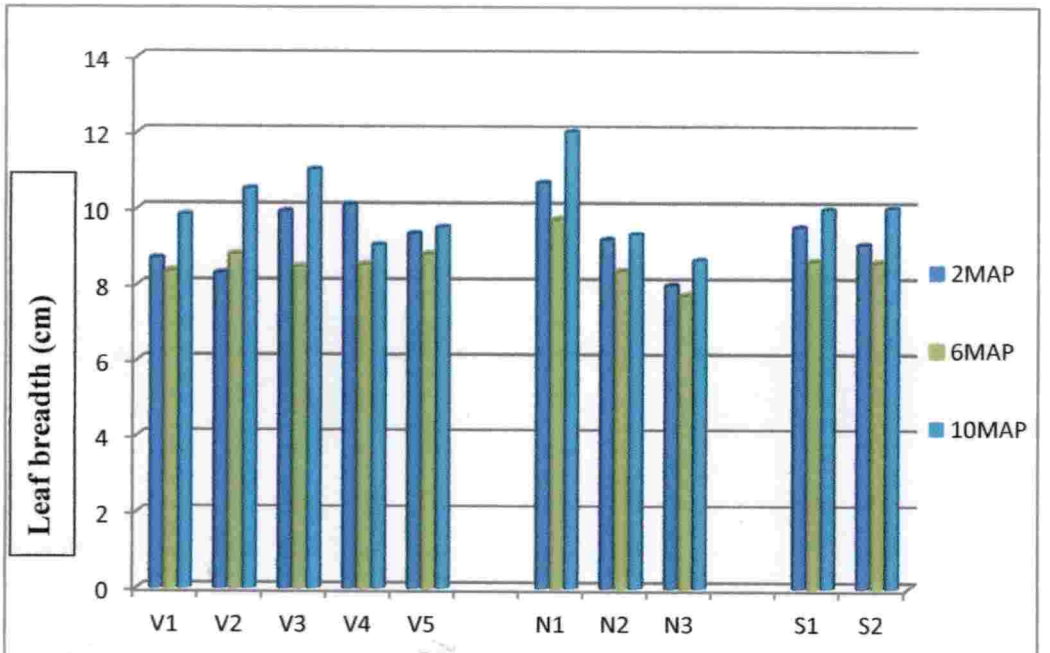

Figure 5. Main effect of nutrient management on leaf breadth (cm)

Table 6b. Interaction effect of varieties and nutrient treatments in nutrient management on leaf breadth (cm) in *Gerbera jamesonii* Bolus.

Treatments	2 MAP	4 MAP	6 MAP	8 MAP	10 MAP
v_1n_1	9.55	10.81	9.08	10.26	11.89
v_1n_2	8.88	9.87	8.15	8.37	9.35
v_1n_3	7.70	8.34	7.84	7.92	8.32
v_2n_1	8.87	12.57	10.40	11.78	13.70
v_2n_2	8.03	10.25	8.24	8.78	9.28
v_2n_3	8.07	8.51	7.80	7.72	8.60
v_3n_1	11.96	13.85	9.51	11.62	13.73
v_3n_2	10.22	9.82	8.30	9.34	10.00
v_3n_3	7.62	6.61	7.60	8.13	9.34
v_4n_1	11.63	12.22	9.77	9.28	9.82
v_4n_2	9.57	10.07	8.55	8.72	9.01
v_4n_3	9.13	9.95	7.28	7.70	8.37
v_5n_1	11.39	12.27	9.81	10.34	10.96
v_5n_2	9.25	9.94	8.578	8.97	9.00
v_5n_3	7.41	7.99	8.04	7.70	8.60
CD	0.50	0.63	0.42	0.50	0.59
SEm (±)	0.18	0.22	0.15	0.18	0.21

Table 6c. Interaction effect of varieties and level of split application of nutrients in nutrient management on leaf breadth (cm) in *Gerbera jamesonii* Bolus.

Treatments	2 MAP	4 MAP	6 MAP	8 MAP	10 MAP
V_1S_1	8.82	10.23	8.30	8.95	9.69
V_1S_2	8.60	9.12	8.41	8.75	10.02
V_2S_1	8.38	10.87	9.11	9.35	10.50
V_2S_2	8.26	10.02	8.51	9.51	10.55
V_3S_1	10.49	11.45	8.21	9.60	10.94
V_3S_2	9.38	8.74	8.73	9.79	11.11
V_4S_1	10.21	10.68	8.36	8.47	9.04
V_4S_2	10.01	10.80	8.70	8.66	9.09
V_5S_1	9.66	10.70	9.09	9.06	9.73
V_5S_2	9.04	9.43	8.52	8.95	9.31
CD	0.41	0.52	0.34	NS	NS
SEm (±)	0.14	0.18	0.12	0.14	0.17

Table 6d. Interaction effect of nutrient treatments and level of split application of nutrients in nutrient management on leaf breadth (cm) in *Gerbera jamesonii* Bolus.

Treatments	2 MAP	4 MAP	6 MAP	8 MAP	10 MAP
n_1s_1	11.13	13.57	10.39	11.22	12.42
n_1s_2	10.24	11.12	9.03	10.09	11.63
n_2s_1	9.16	9.72	7.46	7.42	7.82
n_2s_1	9.22	10.26	9.27	10.26	10.84
n_3s_1	8.25	9.07	8.00	8.62	9.70
n_3s_2	7.72	7.49	7.43	7.05	7.59
CD	0.32	0.40	0.26	0.31	0.37
SEm (±)	0.11	0.14	0.09	0.11	0.13

Significantly higher value was recorded for monthly split application of nutrients (S_1) (2.42).

The interaction effect of varieties and nutrient treatments was observed to be significant only during 8MAP. Beaudine treated with 10:10:10 N, P_2O_5, K_2O g m^{-2} (v_1n_1) recorded 3.01 mean number of suckers which was found to be on par with v_2n_1 (2.75) and v_3n_1 (2.74).

Significant effect of interaction of varieties and level of split application of nutrients was observed at 8 MAP. Significantly higher value was noted for double date variety when fertilizers were applied at monthly interval ie, v_2s_1 (2.39) and this value was found to be on par with v_3s_1 (2.35), v_1s_1 (2.30), v_1s_2 (2.30) and v_1s_2 (2.09).

The interaction effect of nutrient treatments and level of split application of nutrients were found to be significant throughout the crop period. Significantly

higher values were observed for n_1s_1 for all the observations. The highest number of suckers (3.35) was recorded by n_1s_1 at 6 MAP.

Table 7a. Main effect of nutrient management on number of suckers plant^{-1} in *Gerbera jamesonii* Bolus.

	2 MAP	4 MAP	6 MAP	8 MAP	10 MAP
Varieties (V)					
V_1	2.09	2.19	2.31	2.28	2.00
V_2	1.60	2.08	2.37	2.26	2.02
V_3	1.77	2.37	2.59	2.21	2.15
V_4	2.23	2.22	2.44	2.13	1.90
V_5	1.63	1.87	2.00	2.01	1.93
CD	.024	0.20	0.19	0.19	NS
SEm (±)	0.08	0.07	0.07	0.07	0.11
Nutrient treatments (N)					
N_1	2.03	2.63	2.97	2.66	2.46
N_2	1.87	2.02	2.20	2.08	1.96
N_3	1.69	1.78	1.86	1.80	1.59
CD	0.18	0.15	0.15	0.15	0.23
SEm (±)	0.07	0.05	0.05	0.05	0.08
Level of split application of nutrients (S)					
S_1	1.85	2.18	2.42	2.21	2.07
S_2	1.87	2.11	2.26	2.15	1.94
CD	NS	NS	0.12	NS	NS
SEm (±)	0.05	0.04	0.04	0.04	0.07

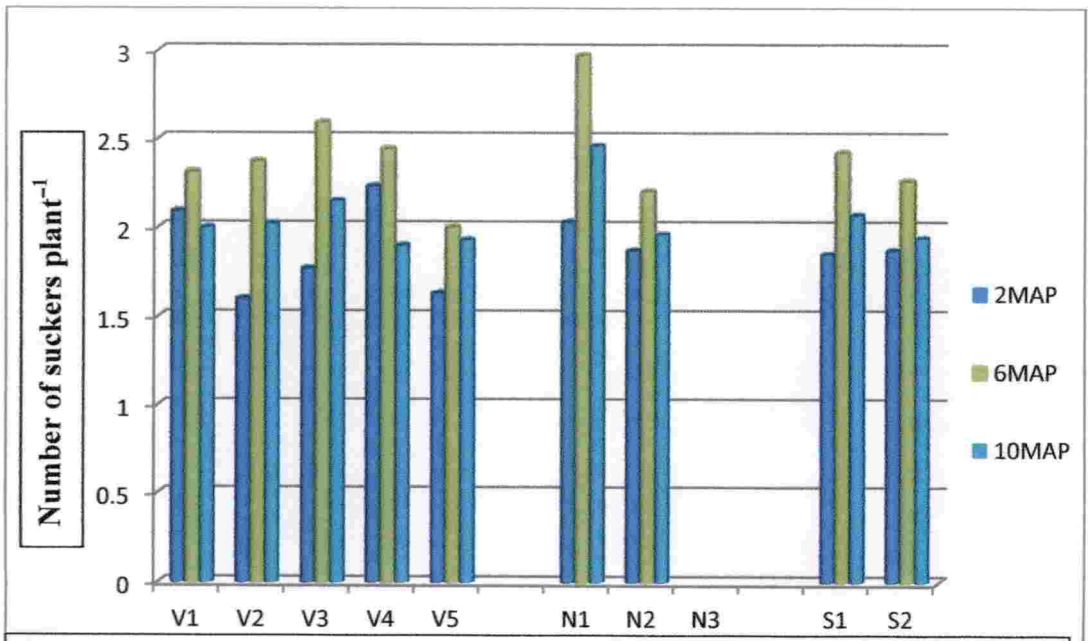

Figure 6. Main effect of nutrient management on number of suckers plant^{-1}

Table 7b. Interaction effect of varieties and nutrient treatments in nutrient management on number of suckers plant^{-1} in *Gerbera jamesonii* Bolus.

Treatments	2 MAP	4 MAP	6 MAP	8 MAP	10 MAP
v_1n_1	2.15	2.67	2.75	3.01	2.63
v_1n_2	2.00	2.00	2.25	2.08	1.83
v_1n_3	2.14	1.90	1.93	1.74	1.54
v_2n_1	1.89	2.69	3.19	2.75	2.50
v_2n_2	1.61	1.97	2.22	2.13	2.07
v_2n_3	1.31	1.57	1.71	1.92	1.50
v_3n_1	2.00	2.81	3.21	2.74	2.71
v_3n_2	1.78	2.29	2.54	2.20	2.17
v_3n_3	1.53	2.00	2.03	1.71	1.58
v_4n_1	2.38	2.67	3.19	2.39	2.17
v_4n_2	2.14	2.12	2.17	2.01	1.83
v_4n_3	2.17	1.89	1.96	2.00	1.71
v_5n_1	1.75	2.32	2.53	2.41	2.29
v_5n_2	1.83	1.72	1.82	1.99	1.88
v_5n_3	1.31	1.56	1.66	1.63	1.63
CD	NS	NS	NS	0.33	NS
SEm (±)	0.15	0.12	0.12	0.12	0.18

Table 7c. Interaction effect of varieties and level of split application of nutrients in nutrient management on number of suckers plant^{-1}in *Gerbera jamesonii* Bolus.

Treatments	2 MAP	4 MAP	6 MAP	8 MAP	10 MAP
V_1S_1	2.06	2.16	2.40	2.30	2.14
V_1S_2	2.13	2.22	2.22	2.26	1.86
V_2S_1	1.68	2.12	2.48	2.39	2.06
V_2S_2	1.52	2.03	2.27	2.14	1.99
V_3S_1	1.76	2.45	2.78	2.35	2.33
V_3S_2	1.78	2.28	2.41	2.09	1.97
V_4S_1	2.21	2.30	2.42	2.02	1.89
V_4S_2	2.24	2.15	2.46	2.25	1.92
V_5S_1	1.56	1.86	2.04	2.01	1.92
V_5S_2	1.70	1.88	1.96	2.00	1.94
CD	NS	NS	NS	0.33	NS
SEm (±)	0.12	0.10	0.12	0.12	0.18

Table 7d. Interaction effect of nutrient treatments and level of split application of nutrients in nutrient management on number of suckers plant^{-1}in *Gerbera jamesonii* Bolus.

Treatments	2 MAP	4 MAP	6 MAP	8 MAP	10 MAP
n_1s_1	2.22	2.95	3.35	2.92	2.78
n_1s_2	1.85	2.31	2.59	2.40	2.13
n_2s_1	1.48	1.44	1.54	1.57	1.60
n_2s_1	2.27	2.60	2.86	2.59	2.31
n_3s_1	1.87	2.14	2.38	2.15	1.82
n_3s_2	1.51	1.43	1.33	1.45	1.38
CD	0.26	0.22	0.21	0.21	0.33
SEm (±)	0.09	0.08	0.07	0.07	0.12

4.2. FLOWERING CHARACTERS

The effect of treatments (varieties, nutrient treatments and level of split application of nutrients) on flowering characters of *Gerbera jamesonii* Bolus. under naturally ventilated poly house are presented in table 8a, 8b, 8c and 8d.

4.2.1. Number of days taken for flowering

The varieties showed a significant effect on number of days taken for flowering in gerbera. Significantly lowest mean number of days was taken by variety Esmara (V_4) (21.48 days) and highest mean number of days was taken by variety Mammut (V_3) (35.23 days). Nutrient treatments was also influenced the character significantly. The lowest mean number of days taken when 10:10:10 N, P_2O_5, K_2O g m^{-2} (N_1) nutrient treatment was applied to the plants (25.20 days). Significantly lower mean number of days was taken when the fertilizers were applied at monthly intervals (S_1) (27.87 days).

Table 8a. Main effect of nutrient management on flowering characters in *Gerbera jamesonii* Bolus.

	Number of days take for flowering	Number of days taken from bud initiation to harvest	Flower longevity on the plant
Varieties (V)			
V_1	28.83	10.36	7.98
V_2	23.99	8.35	6.94
V_3	35.23	12.12	6.76
V_4	21.48	13.99	7.31
V_5	31.81	10.03	6.76
CD	0.66	0.14	0.11
SEm (±)	0.23	0.05	0.04
Nutrient treatments (N)			
N_1	25.20	10.51	7.49
N_2	28.41	10.88	7.15
N_3	31.20	11.55	6.81
CD	0.51	0.11	0.08
SEm (±)	0.18	0.04	0.03
Level of split application of nutrients (S)			
S_1	27.87	10.98	7.18
S_2	28.66	10.98	7.13
CD	0.42	NS	NS
SEm (±)	0.15	0.03	0.02

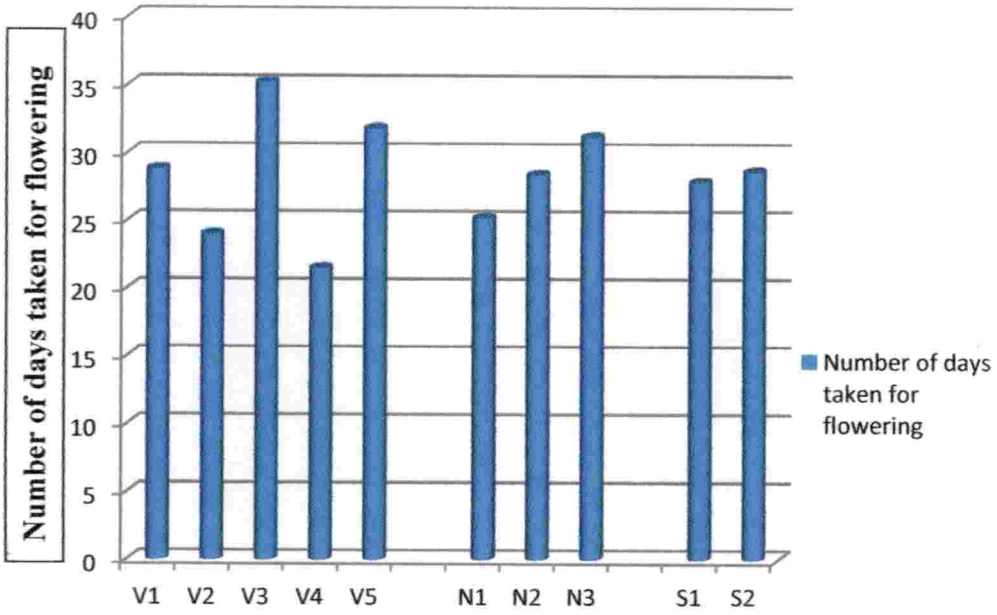

Figure 7. Main effect of nutrient management on number of days taken for flowering

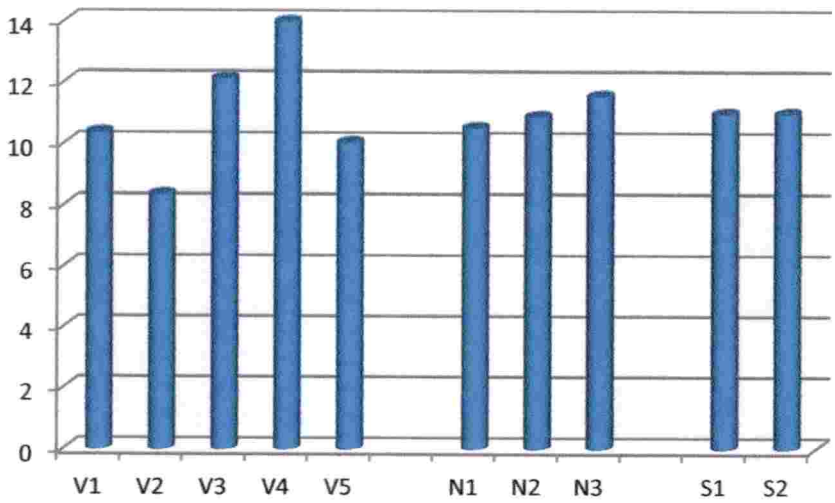

Figure 8. Main effect of nutrient management on number of days taken from bud initiation to harvest

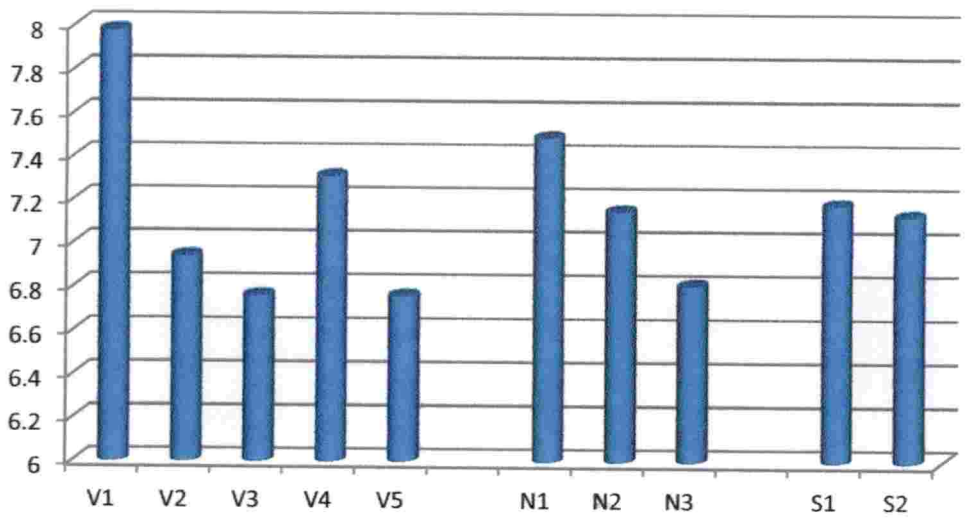

Figure 9. Main effect of nutrient management on flower longevity on the plant

Table 8b. Interaction effect of varieties and nutrient treatments in nutrient management on flowering characters in *Gerbera jamesonii* Bolus.

Treatments	Number of days taken for flowering	Number of days taken from bud initiation to harvest	Flower longevity on the plant
v_1n_1	26.002	10.368	8.360
v_1n_2	29.463	10.303	8.028
v_1n_3	31.035	10.402	7.557
v_2n_1	21.152	8.180	7.202
v_2n_2	24.083	8.333	6.947
v_2n_3	26.732	8.530	6.680
v_3n_1	31.563	11.688	7.207
v_3n_2	36.163	12.087	6.713
v_3n_3	37.962	12.757	6.358
v_4n_1	18.957	13.273	7.688
v_4n_2	21.302	13.822	7.247
v_4n_3	24.168	14.880	6.988
v_5n_1	28.302	9.035	6.992
v_5n_2	31.035	9.847	6.813
v_5n_3	36.102	11.202	6.482
CD	1.140	0.247	NS
SEm (±)	0.403	0.087	0.065

Table 8c. Interaction effect of varieties and level of split application of nutrients in nutrient management on flowering characters in *Gerbera jamesonii* Bolus.

Treatments	Number of days taken for flowering	Number of days taken from bud initiation to harvest	Flower longevity on the plant
V_1S_1	29.17	10.41	7.99
V_1S_2	28.49	10.31	7.97
V_2S_1	23.91	8.39	6.96
V_2S_2	24.07	8.30	6.93
V_3S_1	34.94	12.12	6.79
V_3S_2	35.52	12.24	6.73
V_4S_1	20.59	14.01	7.34
V_4S_2	22.36	13.98	7.28
V_5S_1	30.75	9.99	6.80
V_5S_2	32.87	10.06	6.72
CD	0.93	NS	NS
SEm (±)	0.33	0.07	0.05

The interaction of varieties and nutrient treatments significantly influenced the number of days taken for flowering. The lowest number of days was taken by Esmara when applied with 10:10:10 N, P_2O_5, K_2O g m^{-2} nutrient dose.

The interaction of varieties and level of split application of nutrients was also significant. Esmara recorded the lowest mean number of days for flowering (20.59) when monthly split application of the nutrients was done.

Regarding the interaction between nutrient treatments and level of split application of the nutrients, application of 10:10:10 N, P_2O_5, K_2O g applied at monthly interval recorded lowest number of days taken for flowering (10.22).

Table 8d. Interaction effect of nutrient treatments and level of split application of nutrients in nutrient management on flowering characters in *Gerbera jamesonii* Bolus.

Treatments	Number of days taken for flowering	Number of days taken from bud initiation to harvest	Flower longevity on the plant
n_1s_1	23.63	10.22	7.66
n_1s_2	26.76	10.80	7.32
n_2s_1	30.83	11.36	6.91
n_2s_1	25.99	10.40	7.39
n_3s_1	29.16	11.37	6.95
n_3s_2	33.24	11.74	6.67
CD	0.72	0.16	0.12
SEm (±)	0.26	0.06	0.04

4.2.2. Number of days taken from bud initiation to harvest

It was found that the main effect of varieties and nutrient treatment had significant effect on number of days taken from bud initiation to harvest. The lowest number of days was taken by variety Mammut (8.35) and nutrient treatment 10:10:10 N, P_2O_5, K_2O g (10.51 days). The effect of level of split application of nutrients was found to have no significant effect on the character.

The interaction effect of varieties and nutrient treatments had significantly lowest value for Double date variety when treated under 10:10:10 N, P_2O_5, K_2O g m^{-2} nutrient levels (8.81).

The interaction of nutrients and level of split application of nutrients had significant effect on number of days taken from bud initiation to harvest with lowset number of days taken when 10:10:10 N, P_2O_5, K_2O g fertilizers were applied at monthly intervals.

4.2.3. Peak flowering period

Rainy season was observed to be the peak flowering period in gerbera under naturally ventilated poly house.

4.2.4. Flower longevity on the plant

The main effect of varieties and nutrient treatments were observed as significant for flower longevity on the plant. Highest flower longevity on the plant was recorded for variety Beaudine (7.98 days) and nutrient treatment 10:10:10 N, P_2O_5, K_2O g m^{-2} (7.49 days).The main effect of level of split application of nutrients was found to be non- significant.

Interaction effect of varieties and nutrient treatments and interaction effect of varieties and level of split application of nutrients were observed to be non-significant.

The interaction effect of nutrient treatments and level of split application of nutrients had significant effect on flower longevity on the plant with highest mean value 7.66 days for 10:10:10 N, P_2O_5, K_2O g m^{-2} nutrients applied at monthly intervals.

4.3. FLOWER CHARACTERS

The effect of treatments (varieties, nutrient treatments and level of split application of nutrients) on flower characters of *Gerbera jamesonii* Bolus. under naturally ventilated poly house are presented in table 9a, 9b, 9c and 9d.

4.3.1. Flower diameter (cm)

The effect of varieties on flower diameter differed significantly. Mammut (10.43cm) and Beaudine (10.40cm) recorded higher values on par. The nutrient treatments also significantly influenced flower diameter. Application of 10:10:10 N, P_2O_5, K_2O g m^{-2} resulted in significantly higher value (9.87cm). There was no significant difference observed for level of split application of nutrients on flower diameter.

The interaction effect of variety and nutrient treatment was significant. Mammut (10.99cm) was found to be superior when applied with 10:10:10 N, P_2O_5, K_2O g m^{-2}.

The interaction effect of variety and level of split application of nutrients were observed to be significant. Mammut variety applied with monthly split application of nutrients was observed as significantly superior (10.60cm) and found to be on par with v_1s_2 (10.45cm).

The interaction of nutrient treatment and level of split application of nutrients was observed as significant for all the treatments. Highest value was being recorded by n_1s_1 (10.15cm).

4.3.2. Diameter of the flower disc (cm)

The main effect of varieties on diameter of flower disc was observed to have significant effect. Highest mean flower disc diameter was observed for variety Mammut (2.65cm). The mean values for nutrient treatment and level of

Table 9a. Main effect of nutrient management on flower characters in *Gerbera jamesonii* Bolus.

	Flower diameter	Flower disc diameter	Length of ray florets	No. of ray florets	Stalk girth	Stalk length	Width of ray florets
Varieties (V)							
V_1	10.40	2.36	4.24	55.90	2.29	69.45	0.69
V_2	8.80	2.33	3.34	51.49	2.14	40.47	0.75
V_3	10.43	2.65	3.77	51.79	2.27	51.32	0.87
V_4	9.85	2.36	4.38	55.63	2.21	45.05	0.66
V_5	8.75	2.23	3.35	53.26	1.99	45.91	0.88
CD	0.15	0.09	0.08	0.93	0.04	0.78	0.03
SEm (±)	0.05	0.03	0.03	0.33	0.01	0.28	0.01
Nutrient treatments (N)							
N_1	9.87	2.73	4.10	58.09	2.26	53.07	0.85
N_2	9.57	2.59	3.81	53.03	2.18	50.82	0.77
N_3	9.07	2.44	3.53	49.72	2.09	47.44	0.69
CD	0.12	0.07	0.06	0.72	0.03	0.61	0.02
SEm (±)	0.04	0.25	0.02	0.25	0.01	0.22	0.01
Level of split application of nutrients (S)							
S_1	9.55	2.64	3.85	54.50	2.19	50.82	0.78
S_2	9.46	2.54	3.78	52.73	2.17	50.06	0.77
CD	NS	0.06	0.05	0.59	0.02	0.50	NS
SEm(±)	0.03	0.02	0.02	0.21	0.01	0.18	0.01

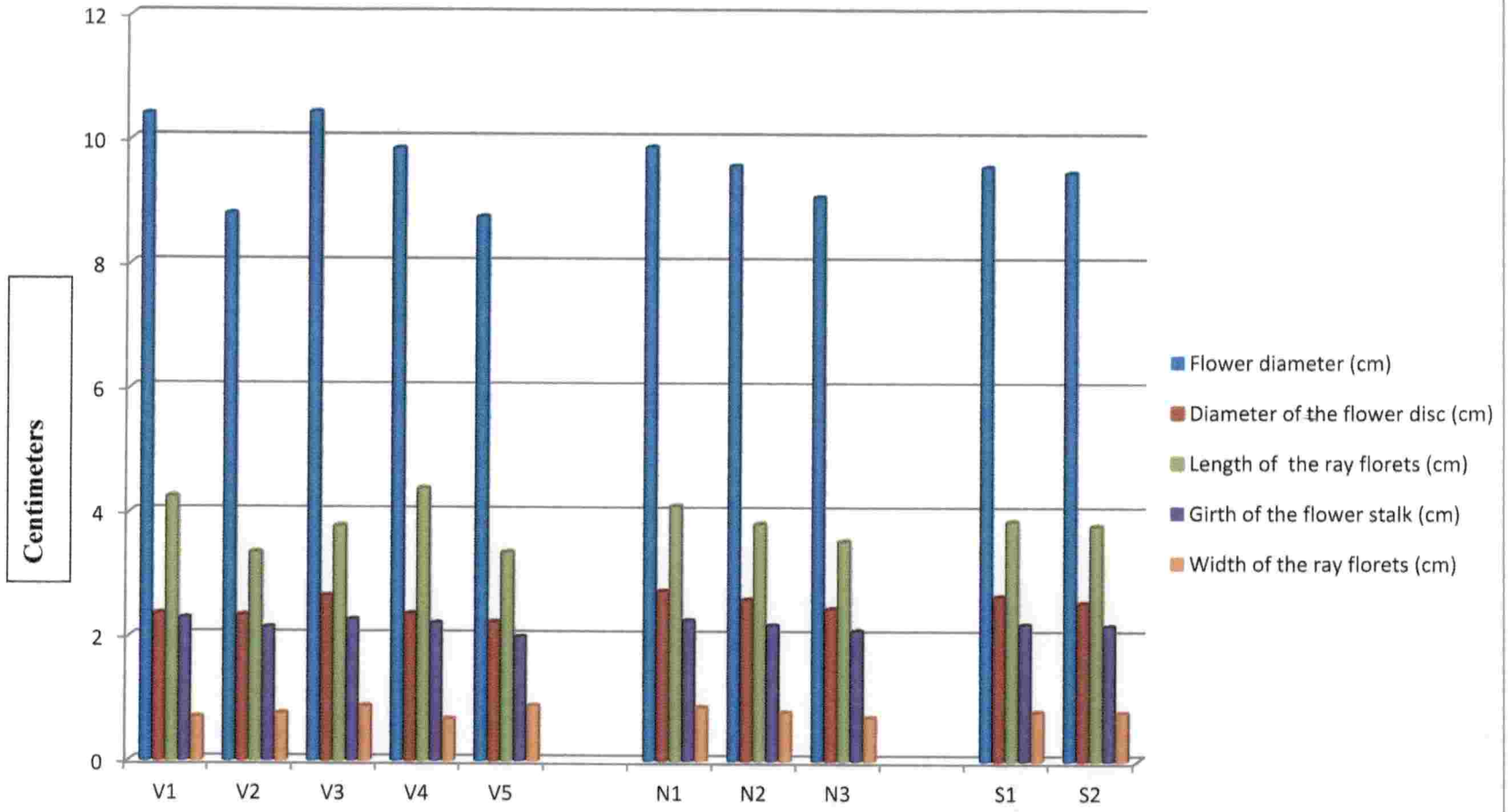

Figure 10. Main effect of nutrient management on flower characters

Table 9b. Interaction effect of varieties and nutrient treatments in nutrient management on flower characters in *Gerbera jamesonii* Bolus.

Treatments	Flower diameter (cm)	Flower disc diameter (cm)	Length of ray florets (cm)	No. of ray florets	Stalk girth (cm)	Stalk length (cm)	Width of ray florets (cm)
v_1n_1	10.61	2.54	4.61	62.21	2.36	75.26	0.80
v_1n_2	10.69	2.29	4.26	54.50	2.28	71.32	0.68
v_1n_3	9.90	2.27	3.86	51.01	2.22	61.79	0.60
v_2n_1	8.38	2.36	3.50	54.95	2.25	42.88	0.89
v_2n_2	8.04	2.40	3.32	51.41	2.15	40.35	0.74
v_2n_3	7.83	2.23	3.19	48.12	2.03	38.19	0.64
v_3n_1	10.99	2.78	4.06	54.78	2.33	52.85	0.95
v_3n_2	10.43	2.66	3.77	51.92	2.26	52.02	0.89
v_3n_3	9.88	2.53	3.49	48.66	2.21	49.10	0.78
v_4n_1	10.37	3.56	4.69	61.18	2.27	47.32	0.68
v_4n_2	9.87	3.32	4.41	54.31	2.20	44.40	0.66
v_4n_3	9.32	3.21	4.04	51.40	2.14	43.45	0.64
v_5n_1	9.03	2.43	3.66	57.35	2.10	47.05	0.96
v_5n_2	8.83	2.29	3.31	53.00	1.99	45.99	0.89
v_5n_3	8.41	1.97	3.07	49.43	1.87	44.69	0.79
CD	0.26	0.16	0.14	1.61	NS	1.36	0.04
SEm (±)	0.09	0.06	0.05	0.57	0.02	0.48	0.02

split application of nutrients were significantly different for all the treatments. Highest mean values was obtained for the nutrient treatment 10:10:10 N, P_2O_5, K_2O g m^{-2} with a mean flower disc diameter 2.73cm. Monthly level of split application of nutrients was found to be significantly superior with a mean value of 2.64cm.

Interaction of variety and nutrient treatment showed significant impact on flower disc diameter with a highest mean value 3.56cm for v_4n_1. But there was no significant difference between the interaction effect of varieties and level of split application of nutrients on diameter of the flower disc.

Interaction effect of nutrient treatments and level of split application of nutrients had significant effect on flower disc diameter. n_1s_1 (2.88cm) recorded significantly superior mean value.

4.3.3. Colour of the flower disc

Variations in the colour of the flower disc were observed among the varieties. Black coloured flower disc was observed for the varieties Beaudine and Aquamelon, greenish yellow colour for Double date and variety Mammut and Esmara exhibited yellow coloured flower disc.

4.3.4. Number of ray florets

Significant difference was observed on the effect of varieties on number of ray florets in gerbera. Variety Beaudine (55.90) and Esmara (55.63) were on par. The effect of nutrient treatments and level of split application of nutrients were observed to have significant effect on number of ray florets and the highest mean value obtained was 58.09 for n_1 and 54.50 for s_1 respectively.

Number of ray florets of the flowers exhibited significant variation due to the interaction between nutrient treatments and varieties. v_1s_1 exhibited highest mean number of florets (62.21) and which was found to be on par with v_4n_1 (61.18).

Table 9c. Interaction effect of varieties and level of split application of nutrients in nutrient management on flower characters in *Gerbera jamesonii* Bolus.

Treatments	Flower diameter (cm)	Flower disc diameter (cm)	Length of ray florets (cm)	No. of ray florets	Stalk girth (cm)	Stalk length (cm)	Width of ray florets (cm)
V_1S_1	10.36	2.40	4.29	57.69	2.298	70.17	0.70
V_1S_2	10.45	2.33	4.20	54.11	2.274	68.75	0.69
V_2S_1	8.05	2.39	3.35	52.42	2.170	41.20	0.75
V_2S_2	8.12	2.27	3.32	50.56	2.117	39.75	0.76
V_3S_1	10.60	2.69	3.80	52.35	2.276	51.62	0.88
V_3S_2	10.26	2.61	3.75	51.22	2.262	51.02	0.87
V_4S_1	9.97	3.44	4.44	56.45	2.220	44.20	0.65
V_4S_2	9.73	3.28	4.32	54.81	2.190	45.11	0.67
V_5S_1	8.76	2.25	3.38	53.59	1.992	46.13	0.90
V_5S_2	8.75	2.22	3.32	52.93	1.980	45.69	0.86
CD	0.21	NS	NS	1.31	NS	NS	NS
SEm (±)	0.07	0.05	0.04	0.46	0.019	0.39	0.01

Statistical analysis revealed that there was significant difference due to the interaction between the varieties and level of split application of nutrients on number of ray florets in gerbera. A highest mean value of 57.69 ray florets were observed when monthly split application of nutrients were given for variety Beaudine and which was on par with 56.45 ray florets in v_4s_1.

The interaction of nutrient treatment and level of split application of nutrients were found to be statistically significant on number of ray florets. Significantly higher mean number of ray florets (60.18) were observed when monthly split application of 10:10:10 N, P_2O_5, K_2O g nutrient levels were given.

4.3.5. Colour of ray florets

There was a wide variation exhibited by gerbera in colour of ray florets. Bicoloured orange colour flower with a yellow tip was observed in variety Double date. Red colour in Beaudine, Cream colour in Mammut and pink colour in Aquamelon were recorded.

4.3.6. Length of the ray florets (cm)

Length of the florets showed significant difference between nutrient treatments and level of split application of nutrients. The highest mean value observed was 4.38cm (v_4), 4.10cm (n_1) and 3.85cm (s_1).

The interaction effect of varieties on nutrient treatments was recorded to be significant for all the treatments. A significantly highest mean length of ray florets 4.69 cm was observed in variety Esmara applied with 10:10:10 N, P_2O_5, K_2O g m^{-2} nutrients and which was on par with 4.61cm on Beaudine variety with 10:10:10 N, P_2O_5, K_2O g m^{-2}.

There was no significant difference on interaction effect of varieties and level of split application of nutrients.

The interaction effect of nutrient treatments and level of split application of nutrients were found to be statistically significant with a highest mean value of 4.26 cm in Beaudine variety when fertilizers were applied at monthly interval.

4.3.7. Width of ray florets (cm)

Varieties were found to have significant effect on width of ray florets. Aquamelon(0.88cm) which was on par with variety Mammut (0.87cm) for mean width of ray florets. The effect of nutrient treatments on width of ray florets was found to be significant. Highest mean value (0.85cm) was obtained applied with 10:10:10 N, P_2O_5, K_2O g m^{-2}. Effect of level of split application of the nutrients showed there was no significant difference.

The interaction between varieties and nutrient treatments was significant. Highest width of ray florets (0.96cm) were observed for Aquamelon variety applied with 10:10:10 N, P_2O_5, K_2O g m^{-2} nutrient levels.

The effect of interaction between varieties and level of split application of nutrients was not significant.

The interaction of effect of nutrient treatments and level of split application of nutrients was significant. Greatest width of ray florets (0.90cm) was observed for nutrient treatment 10:10:10 N, P_2O_5, K_2O g m^{-2} applied at monthly interval.

4.3.8. Length of the flower stalk (cm)

The effect of varieties on length of flower stalk was significant. The highest mean length of flower stalk was observed in Beaudine (69.45cm). The main effect of nutrient treatments and level of split application of nutrients were found to be significant. Highest value was obtained for 10:10:10 N, P_2O_5, K_2O g m^{-2} nutrient treatment (53.07cm) and monthly split application of nutrients (50.82cm).

Table 9d. Interaction effect of nutrient treatments and level of split application of nutrients in nutrient management on flower characters in *Gerbera jamesonii* Bolus.

Treatments	Flower diameter (cm)	Flower disc diameter (cm)	Length of ray florets (cm)	No. of ray florets	Stalk girth (cm)	Stalk length (cm)	Width of ray florets (cm)
n_1s_1	10.15	2.88	4.26	60.18	2.31	54.98	0.90
n_1s_2	9.60	2.59	3.95	56.01	2.22	51.16	0.81
n_2s_1	9.30	2.49	3.65	52.26	2.09	49.27	0.71
n_2s_1	9.84	2.70	3.98	53.80	2.26	52.36	0.83
n_3s_1	9.19	2.54	3.64	51.07	2.17	48.21	0.72
n_3s_2	8.95	2.34	3.42	48.38	2.02	46.67	0.66
CD	0.16	0.10	0.09	1.02	0.04	0.86	0.03
SEm (±)	0.06	0.04	0.03	0.36	0.02	0.30	0.01

The interaction between varieties and nutrient treatments was significant for all the treatments. Highest mean value was observed for variety Beaudine combined with 10:10:10 N, P_2O_5, K_2O g m^{-2} nutrients (75.26cm). The interaction between varieties and level of split application of nutrients was not significant.

When nutrient treatment 10:10:10 N, P_2O_5, K_2O g m^{-2} was applied at monthly intervals was found to have longer flower stalk (54.98cm).

4.3.9. Girth of flower stalk (cm)

Significant difference was observed for girth of flower stalk due to main effect of variety, nutrient treatments and level of split application of nutrients. Highest mean flower stalk was observed in Beaudine (2.29cm) and Mammut (2.27cm). Highest mean girth (2.26cm) was observed when applied with 10:10:10 N, P_2O_5, K_2O g m^{-2} nutrient treatment and monthly split application of nutrients (2.19cm).

The interaction effect of varieties and nutrient treatment and varieties and level of split application of nutrients was observed to be non-significant.

The interaction effect of nutrient treatments and level of split application of nutrients was found as significant with higher value 2.31cm when 10:10:10 N, P_2O_5, K_2O g m^{-2} nutrient treatment was applied at monthly intervals.

4.3.10. Visual appeal

The visual appeal was recorded based on three characters such as general appearance, size of the flower and colour development. Kruskal wallis H test was followed which was an alternative to one way ANOVA. Highest mean rank was observed for variety Beaudine when treated with 10:10:10 N, P_2O_5, K_2O g m^{-2} at monthly intervals. Ranks were given according to the mean rank obtained in the chi- square test. It was found to be highest for $v_1n_1s_1$ (Table 10).

Table 10. Visual appeal(scoring based on three Characters: general appearance, size of flower and colour development)

Treatment	General appearance	Size of the flower	Colour development	Rank
$v_2n_1s_1$	122.10	124.60	123.50	2
$v_2n_2s_1$	81.80	98.50	104.50	9
$v_2n_3s_1$	31.00	47.30	95.00	16
$v_2n_1s_2$	94.50	107.20	104.50	6
$v_2n_2s_2$	43.70	72.90	95.00	14
$v_2n_3s_2$	25.20	34.50	43.80	22
$v_1n_1s_1$	140.50	124.60	142.50	1
$v_1n_2s_1$	94.50	107.20	95.00	8
$v_1n_3s_1$	31.00	60.10	69.40	17
$v_1n_1s_2$	122.10	107.20	114.00	3
$v_1n_2s_2$	94.50	107.20	56.60	11
$v_1n_3s_2$	31.00	28.20	43.80	25
$v_3n_1s_1$	131.30	107.20	104.50	4
$v_3n_2s_1$	94.50	60.10	95.00	12
$v_3n_3s_1$	43.70	34.50	43.80	24
$v_3n_1s_2$	94.50	107.20	95.00	8
$v_3n_2s_2$	56.40	85.70	43.80	15
$v_3n_3s_2$	19.40	28.20	25.50	27
$v_4n_1s_1$	103.70	107.20	104.50	5
$v_4n_2s_1$	56.40	72.90	31.00	18
$v_4n_3s_1$	43.70	34.50	25.50	23
$v_4n_1s_2$	103.70	107.20	104.50	5
$v_4n_2s_2$	69.10	60.10	95.00	13
$v_4n_3s_2$	43.70	21.90	69.40	20
$v_5n_1s_1$	103.70	107.20	104.50	5
$v_5n_2s_1$	103.70	107.20	56.60	10
$v_5n_3s_1$	69.10	34.50	20.00	21
$v_5n_1s_2$	103.70	107.20	95.00	7
$v_5n_2s_2$	69.10	34.50	43.80	19
$v_5n_3s_2$	43.70	28.20	20.00	26
Chi-Square	110.762	113.709	113.166	
Df	29	29	29	
Asymp. Sig.	.000	.000	.000	

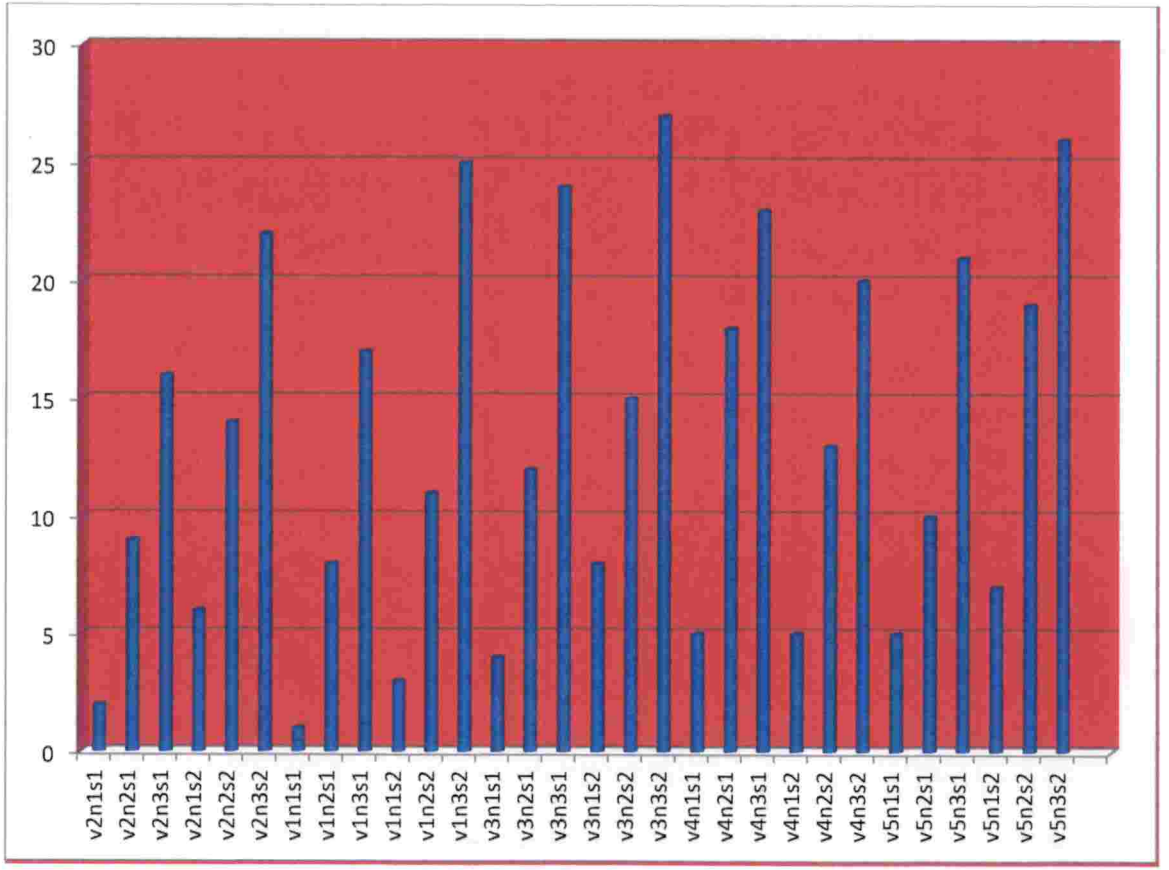

Figure 11. effect of nutrient management on visual appeal (scoring based on three characters: general appearance, Size of flower and colour development)

4.4. YIELD PARAMETERS

The effect of treatments (varieties, nutrient treatments and level of split application of nutrients) on yield parameters of *Gerbera jamesonii* Bolus. under naturally ventilated poly house are presented in table 11a, 11b, 11c and 11d.

4.4.1. Number of flowers produced plant^{-1} year^{-1}

The main effect of varieties, nutrient treatments and level of split application of nutrients on number of flowers produced plant^{-1} year^{-1} was found to be significant. Higher number of flowers were produced by Esmara (17.70).The nutrient treatment 10:10:10 N, P_2O_5, K_2O g m^{-2} showed more number of flowers plant^{-1} year^{-1} (19.51). Higher number of flowers produced plant^{-1} year^{-1} for monthly split application of nutrients (14.65).

The interaction effect of varieties and nutrient treatments yielded highest number of flowers were produced plant^{-1} year^{-1} for Esmara applied with 10:10:10 N, P_2O_5, K_2O g m^{-2} (23.70).

The effect of interaction of varieties and level of split application of nutrients were found to have no significant difference on number of flowers produced plant^{-1} year^{-1}.

The interaction of nutrient treatments and level of split application of the nutrients was found to be significant for number of flowers produced plant^{-1} year^{-1} and the highest value obtained was recorded as 21.71 when 10:10:10 N, P_2O_5, K_2O g m^{-2} nutrients were applied at monthly interval.

4.4.2. Yield of flowers in relation to season

The effect of varieties on yield of flowers both in summer and rainy season was significant for variety Esmara. A mean value of 11.26 flowers was produced in rainy season and 6.41 flowers were produced in summer season which differed significantly from each other. When the effect of nutrient treatments were considered, a significantly higher value was obtained at rainy (11.87) and summer (7.63) seasons with 10:10:10 N, P_2O_5, K_2O g m^{-2} nutrient

treatment. The effect of level of split application of nutrients was found as significant only during rainy season with higher yield of flowers at rainy season when nutrients were applied at monthly intervals (9.41).

Table 11a. Main effect of nutrient management on yield parameters characters in *Gerbera jamesonii* Bolus.

	Number of flowers produced plant^{-1} year^{-1}	**Yield of flowers in rainy season**	**Yield of flowers in summer season**
Varieties (A)			
V_1	16.18	10.36	5.87
V_2	15.05	9.50	5.40
V_3	8.68	5.69	2.98
V_4	17.70	11.26	6.41
V_5	14.00	8.76	5.23
CD	0.66	0.41	0.32
SEm (±)	0.23	0.15	0.11
Nutrient treatments (B)			
N_1	19.51	11.87	7.63
N_2	13.02	8.45	4.50
N_3	10.43	7.02	3.40
CD	0.50	0.31	0.25
SEm (±)	0.18	0.11	0.09
Level of split application of nutrients (C)			
S_1	14.65	9.41	5.24
S_2	13.99	8.82	5.12
CD	0.42	0.25	NS
SEm (±)	0.15	0.09	0.07

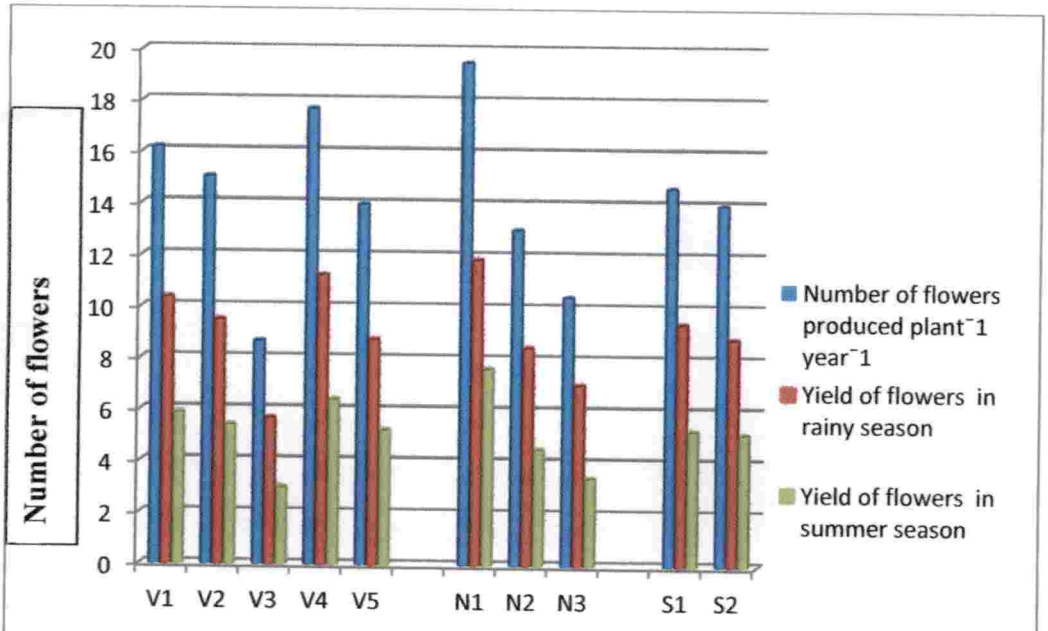

Figure 12. Main effect of nutrient management on yield parameters

Table 11b. : Interaction effect of varieties and nutrient treatments in nutrient management on yield parameters *in Gerbera jamesonii* Bolus.

Treatments	Number of flowers produced plant^{-1} year^{-1}	Yield of flowers in rainy season	Yield of flowers in summer season
v_1n_1	23.00	13.87	9.13
v_1n_2	14.33	9.08	5.37
v_1n_3	11.20	8.11	3.12
v_2n_1	20.25	12.59	7.71
v_2n_2	13.83	9.12	4.25
v_2n_3	11.08	6.78	4.25
v_3n_1	11.50	7.25	4.25
v_3n_2	7.62	5.25	2.37
v_3n_3	6.91	4.58	2.33
v_4n_1	23.70	14.00	9.62
v_4n_2	15.95	10.41	5.54
v_4n_3	13.45	9.37	4.08
v_5n_1	19.12	11.67	7.45
v_5n_2	13.37	8.37	5.00
v_5n_3	9.50	6.25	3.25
CD	1.14	0.71	0.55
SEm (±)	0.40	0.25	0.20

Table 11 c. Interaction effect of varieties and level of split application of nutrients in nutrient management on yield parameters in *Gerbera jamesonii* Bolus.

Treatments	Number of flowers produced plant^{-1} year^{-1}	Yield of flowers in rainy season	Yield of flowers in summer season
V_1S_1	16.11	10.19	5.89
V_1S_2	16.25	10.52	5.86
V_2S_1	15.57	9.78	6.02
V_2S_2	14.33	9.22	4.79
V_3S_1	8.89	5.75	3.14
V_3S_2	8.47	5.64	2.83
V_4S_1	18.03	12.17	5.86
V_4S_2	17.39	10.36	6.97
V_5S_1	14.47	9.17	5.30
V_5S_2	13.52	8.36	5.16
CD	NS	0.58	0.45
SEm (±)	0.32	0.21	0.16

Table 11d. Interaction effect of nutrient treatments and level of split application of nutrients on yield parameters in in *Gerbera jamesonii* Bolus.

Treatments	Number of flowers produced plant^{-1} year^{-1}	Yield of flowers in rainy season	Yield of flowers in summer season
n_1s_1	21.71	12.78	8.87
n_1s_2	17.31	10.97	6.39
n_2s_1	6.86	4.95	1.93
n_2s_1	19.18	11.95	7.08
n_3s_1	15.38	10.49	4.92
n_3s_2	5.48	3.55	1.90
CD	0.72	0.45	0.35
SEm (±)	0.25	0.16	0.12

When the interaction effect of varieties and nutrient treatments were considered, high yield of flowers were observed for Esmara with an application of 10:10:10 N, P_2O_5, K_2O g m^{-2} nutrients both in rainy (14.00) and summer (9.62) seasons. In both the seasons, the value was found to be on par with Beaudine with an application of 10:10:10 N, P_2O_5, K_2O g m^{-2} nutrients with a mean value of 13.87 at rainy seasons and 9.13 at summer seasons.

In the interaction effect of varieties and level of split application of nutrients, both rainy and summer seasons were found to have significant effect on yield of flowers in relation to season. Higher value was obtained for monthly split

application of nutrients in Esmara at rainy season (12.17). Higher number of flowers were produced for Esmara variety with a fortnight interval of split application of nutrients at summer season (6.97).

The interaction effect of nutrient treatments and level of split application of nutrients recorded significantly higher values when 10:10:10 N, P_2O_5, K_2O g m^{-2} nutrients were applied at monthly intervals both at rainy (12.78) and summer seasons (8.87).

4.5. POST HARVEST CHARACTERS

The effect of treatments (varieties, nutrient treatments and level of split application of nutrients) on post harvest characters of *Gerbera jamesonii* Bolus. under naturally ventilated poly house are presented in table 12a, 12b, 12c and 12d.

4.5.1. Vase life

The varieties had a significant impact on vase life of gerbera flower. Variety Esmara (7.61) and Beaudine (7.54) exhibited highest mean values for vase life. Nutrient treatments had significant influence on vase life with a highest mean value of 7.40 days when 10:10:10 N, P_2O_5, K_2O g m^{-2} nutrients were applied.The effect of level of split application of nutrients on vase life was found to be non-significant.

The result of interaction effect of varieties on nutrient treatments and varieties on level of split application of nutrients showed that there was no significant interaction between the treatments.

The interaction effect of nutrient treatments and level of split application of nutrients was found to have significant effect on vase life with a higher value of 7.68 days when 10:10:10 N, P_2O_5, K_2O g m^{-2} nutrient treatment was applied at monthly intervals.

Table 12a. Main effect of nutrient management on post harvest characters in *Gerbera jamesonii* Bolus.

	Vase life	**Water uptake(mL)**	**Physiological loss in weight(g)**
Varieties (A)			
V_1	7.54	13.12	16.11
V_2	6.06	10.97	18.81
V_3	7.10	10.00	22.26
V_4	7.61	12.59	17.01
V_5	5.87	7.69	18.72
CD	0.20	0.38	1.87
SEm (±)	0.07	0.14	0.66
Nutrient treatments (B)			
N_1	7.40	11.87	18.66
N_2	6.80	10.94	16.75
N_3	6.25	9.80	20.33
CD	0.15	0.30	1.45
SEm (±)	0.05	0.10	0.51
Level of split application of nutrients (C)			
S_1	6.87	10.97	18.43
S_2	6.79	10.77	18.73
CD	NS	NS	NS
SEm (±)	0.04	0.08	0.418

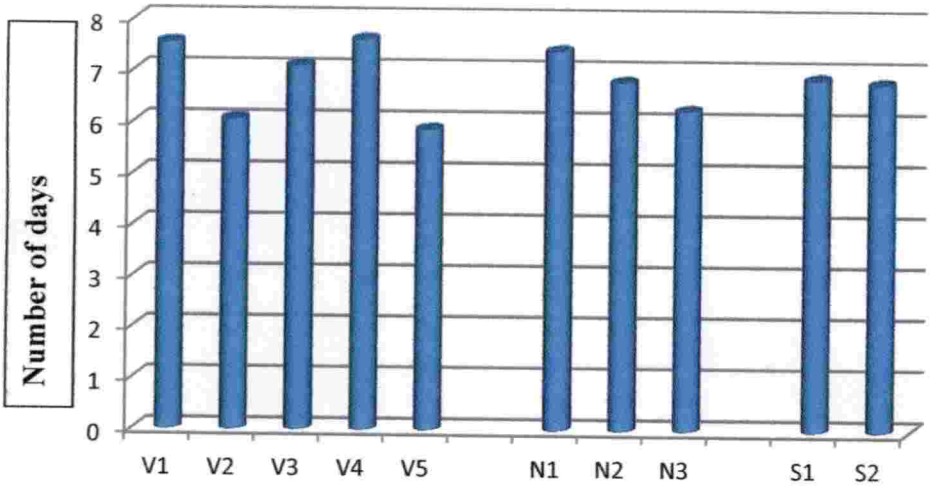

Figure 13. Main effect of nutrient management on vase life

Table 12b. Interaction effect of varieties and nutrient treatments in nutrient management on post harvest characters in *Gerbera jamesonii* Bolus.

Treatments	Vase life	Water uptake (mL)	Physiological loss in weight(g)
v_1n_1	8.120	14.68	18.16
v_1n_2	7.50	13.12	12.16
v_1n_3	7.00	11.57	18.00
v_2n_1	6.63	11.86	16.16
v_2n_2	6.04	11.05	17.83
v_2n_3	5.50	9.99	22.43
v_3n_1	7.67	10.35	20.76
v_3n_2	7.12	10.31	22.11
v_3n_3	6.50	9.35	12.91
v_4n_1	8.20	14.25	19.03
v_4n_2	7.62	12.61	14.83
v_4n_3	7.00	10.92	17.16
v_5n_1	6.37	8.23	19.16
v_5n_2	5.87	7.64	16.83
v_5n_3	5.37	7.20	20.17
CD	NS	0.66	3.23
SEm (±)	0.12	0.24	1.45

4.5.2. Water uptake (mL)

The effect of varieties on water uptake was observed to be significant from the results. The highest mean value was noted for the variety Beaudne (13.12mL). When the nutrient treatment 10:10:10 N, P_2O_5, K_2O g m^{-2} was applied on plants,

highest water uptake by the flowers was noted (11.87mL). The effect of level of split application of nutrients on water uptake was found to have no significant impact

The interaction of varieties and nutrient treatments were observed to have a significant impact on water uptake by flowers. Highest mean value was recorded for Beaudine (14.68 mL) and Esmara (14.25 mL) exhibited highest value for vase life when applied with 10:10:10 N, P_2O_5, K_2O g m^{-2} nutrient levels. The interaction of varieties and level of split application of nutrients were observed as non-significant from the result.

The interaction effect of nutrient treatments and level of split application of nutrients on water uptake was found as significant with a higher value of 12.37mL when 10:10:10 N, P_2O_5, K_2O g m^{-2} was applied at monthly intervals.

4.5.3. Physiological loss in weight (g)

When the effect of varieties on physiological loss in weight was considered, it was found to have significant effect. The lowest mean value was obtained for variety Beaudine (16.11g) and Esmara (17.01 mL). When the effect of nutrient treatments was considered, significantly lower value was obtained for 15:15:15 N, P_2O_5, K_2O g m^{-2} nutrient treatment (16.75g). The effect of level of split application of nutrients was found as non-significant for the character.

The interaction effect of varieties and nutrient treatments on physiological loss in weight was recorded to have significant effect. Significantly lower values were observed for variety Beaudine with an application of 15:15:15 N, P_2O_5, K_2O g m^{-2} nutrient treatment (12.16g).it was found to be on par with v3n3 (12.91g) and v4n2 (14.83g).

The interaction of varieties and level of split application and nutrient treatments and level of split application of nutrients of the nutrients resulted in no significant difference on physiological loss in weight.

Table 12c. Interaction effect of nutrient treatments and level of split application of nutrients in nutrient management on post harvest characters in *Gerbera jamesonii* Bolus.

Treatments	Vase life	Water uptake (mL)	Physiological loss in weight(g)
n_1s_1	7.68	12.37	18.94
n_1s_2	7.12	11.37	18.37
n_2s_1	6.45	10.34	16.73
n_2s_1	7.21	11.55	16.78
n_3s_1	6.50	10.20	19.62
n_3s_2	6.05	9.40	21.05
CD	0.22	0.42	NS
SEm (±)	0.07	0.15	0.72

4.6. PEST AND DISEASE INCIDENCE

There was no major incidence of pest and diseases found throughout the experiment. Only minor infestation of mites and snails were noted.

4.7. ECONOMICS OF CULTIVATION

The B: C ratio for 1000m^2 area was calculated. The ratio was found to be highest for variety Esmara with 10:10:10 N, P_2O_5, K_2O g m^{-2} (1.6: 1.6: 1.6 N, P_2O_5, K_2O g $plant^{-1}$) nutrient treatment applied at monthly intervals (1.92). The net income obtained for the treatment was Rs. 1057918. This value was followed by B: C ratio 1.83 for $v_1n_1s_1$ and 1.60 for $v_5n_1s_1$.

Table 13. Economics of cultivation of *Gerbera jamesonii* Bolus.

Treatment	Cost of cultivation	Net income	BC ratio
$V_2N_1S_1$	551457	865209.67	1.57
$V_2N_2S_1$	553763	560820.08	1.01
$V_2N_3S_1$	555813	-107896.58	-0.19
$V_2N_1S_2$	555557	725693.00	1.30
$V_2N_2S_2$	560169	533580.50	0.95
$V_2N_3S_2$	564269	-272602.83	-0.48
$V_1N_1S_1$	551457	1011043.00	1.83
$V_1N_2S_1$	553763	758736.75	1.37
$V_1N_3S_1$	555813	-139146.58	-0.25
$V_1N_1S_2$	555557	819443.00	1.47
$V_1N_2S_2$	560169	481497.17	0.86
$V_1N_3S_2$	564269	-204894.50	-0.36
$V_3N_1S_1$	551457	214168.00	0.39
$V_3N_2S_1$	553763	118111.750	0.21
$V_3N_3S_1$	555813	-279771.58	-0.50
$V_3N_1S_2$	555557	121526.33	0.22
$V_3N_2S_2$	560169	64830.50	0.12
$V_3N_3S_2$	564269	-324686.17	-0.58
$V_4N_1S_1$	551457	1057918.00	1.92
$V_4N_2S_1$	553763	800403.42	1.45
$V_4N_3S_1$	555813	43145.08	0.078
$V_4N_1S_2$	555557	840276.33	1.51
$V_4N_2S_2$	560169	611705.50	1.09
$V_4N_3S_2$	564269	-53852.83	-0.09
$V_5N_1S_1$	551457	880834.67	1.60
$V_5N_2S_1$	553763	404570.08	0.73
$V_5N_3S_1$	555813	-149563.25	-0.27
$V_5N_1S_2$	555557	710068.00	1.28
$V_5N_2S_2$	560169	314830.50	0.56
$V_5N_3S_2$	564269	-251769.50	-0.44

Plate 3: Vase life study in gerbera

DISCUSSION

5. DISCUSSION

Gerbera (*Gerbera jamesonii* Bolus.) is the latest sensation in the scenario of Kerala floriculture. It is commercially grown throughout the world in a wide range of climatic conditions (Hedau *et al.*, 2012). The best quality gerbera flowers can be produced under protected conditions. Gerbera is a highly demanded crop in world market throughout the year. As many parts of India receives moderate climate throughout the year, a great scope exists for commercial production of gerbera. International quality standards can be satisfied by growing gerbera under protective structures throughout the year.

Nutrients are second most important input next to water for better growth and development of the plants. Judicious use of fertilizers is critical for optimum performance of plants. From cell division to development of vegetative and reproductive organs, nitrogen plays an irreplaceable role in plants. Production of quality blooms are also influenced by nitrogen. Phosphorous enhances production of stronger bud and flower development besides its critical role in early root development. It was also found to be vital in quicker plant maturity, photosynthesis and respiration. Optimum potassium nutrition enhances plant to tolerate drought, high light intensity, frost, and heat during the crop period. Also appropriate potassium discourages attack of pest and diseases as it enhances the expert consumption of nitrogen and phosphorous

Application of optimum doses of nitrogen, phosphorous and potassium fertlizers found to have positive impact on growth and flowering of gerbera plants. Excess application or deficiencies of these elements adversely affect the plant. Production of export quality flowers were favoured by better adoption of an optimum combination of various cultural factors. Generally the nutrient levels were enhanced by NPK nutrition resulting in better plant growth and there by stimulate better photosynthetic activity leading to higher carbohydrate synthesis. It was found to be favourable for source to sink partitioning of nutrients.

Present study entitled "Nutrient management in gerbera (Gerbera jamesonii Bolus.) grown under naturally ventilated poly house" was carried out at department of Pomology and Floriculture, College of Agriculture, Vellayani during 2016-2018 with an objective of standardization of nutrient management schedule for *Gerbera jamesonii*. The results of the present study is discussed in this chapter. The effect of nutrient management on vegetative parameters, flowering characters, flower characters, yield parameters and post-harvest characters were taken in to consideration.

5.1. EFFECT OF NUTRIENT MANAGEMENT ON VEGETATIVE PARAMETERS

The present study revealed that the plant spread was influenced by varieties. Variety Beaudine possessed the highest plant spread among all other varieties at 2MAP and 4 MAP. From 8 MAP onwards the highest plant spread was observed for variety Mammut. Singh *et al.* (2014) reported that the variation in plant spread among different cultivars may be due to the difference in leaf size and larger leaf sized varieties possessed more plant spread and vice versa. Soni and Godara (2017) reported that variation in the plant spread may be due to additive gene effect and this variation can be due to varietal character. Similar results were reported by Thomas *et al.* (2004).

Application of various fertilizer doses resulted in significant difference in plant spread. Highest plant spread was observed with the fertilizer dose 10:10:10 N, P_2O_5, K_2O g m^{-2} throughout the crop growth. Similar results were obtained by Singh *et al* (2014).The spreading nature of the plants may be due to considerable nutrient availability as reported by Fayz *et al.* (2016). This result was in accordance with findings of Srivastava *et al.* (2017).

Level of split application of nutrients had a significant impact on plant spread in gerbera. Monthly split application of the nutrients showed highest plant spread throughout the crop growth. This may be due to the supply of sufficient quantity of fertilizers at proper time interval promoting physiological activities

such as photosynthesis and cell division ultimately stimulating the better plant growth (Deshmukh *et al.*, 2018).

The interaction of varieties and nutrient treatments, varieties and level of split application of nutrients, nutrient treatments and level of split application had significant impact on plant spread of gerbera.

Palanisamy *et al.* (2017) reported that a maximum plant spread was observed with application of 15:10:30 NPK g m^{-2} $month^{-1}$.this may be due to uniform availability of higher level of macronutrients throughout the growth period of gerbera. These results were in accordance with findings of Srivastava *et al.* (2017).

Varieties had a significant influence on number of leaves $plant^{-1}$ throughout the growth period with highest mean number of leaves $plant^{-1}$ for variety Beaudine (13.31). This character may be due to varietal difference and inherent nature of each variety. Similar results were reported by Santos *et al.* (2015).

Different nutrient treatments significantly influenced the number of leaves $plant^{-1}$ in gerbera. According to Palanisamy *et al.* (2017) increase in mineral constituents resulted in more number of leaves as nitrogen plays an irreplaceable role as the main constituent of amino acids and co- enzymes. Khosa *et al.* (2011) reported that application of macronutrients on gerbera increased number of leaves and also higher dose of macronutrients from the optimum level caused production of less number of leaves in gerbera. Similar results were obtained by Kacperska (1985) and was confirmed in the present study also.

Level of split application of nutrients had significant impact on number of leaves plant-1 from 8 MAP. These results was in accordance with Fayz *et al.* (2016). The variation in number of leaves might be due to insufficient nutrient availability at earlier stage of plant growth and differences in nutrient uptake by different varieties.

The present study revealed that the interaction effect of varieties and nutrient treatments had significant impact on number of leaves plant^{-1} except at 8 MAP. This might be due to the effect of application of higher doses of nutrients from the optimum level in gerbera. Similar findings were recorded by Amin *et al.* (2015).

The interaction effect of varieties and level of split application of nutrients was found to be significant only at 6 MAP and 8 MAP. The interaction effect of nutrient treatments and level of split application of the nutrients were found to have significant effect. These observations emphasized the importance of optimum application of nutrients at timely intervals.

The present experiment revealed that the varieties, nutrient treatments and level of split application of nutrients had significant effect on leaf area of gerbera. An increase in leaf area was caused due to increase in cell division enhanced by production of cytokinin due to proper macronutrient availability in the soil (Hirose *et al.*, 2007). This result was in conformity with findings of Palanisamy *et al.* (2017)

The interaction effect of varieties and nutrient treatments was found to be non-significant except at 10 MAP. The interaction effect of varieties and level of split application of nutrients was found to be not significant throughout the experiment.

When interaction effect of nutrient treatments and level of split application of nutrients were considered, minimum leaf area was observed for 20:20:20 N, P_2O_5, K_2O g m^{-2} applied at fortnightly intervals. Higher NPK concentration from the required level always resulted in poor performance of the plants. This result was in conformity with findings of Hassanein (2015).

Leaf length is influenced by N, P_2O_5, K_2O concentrations in gerbera. Photosynthetic efficiency of the plant is enhanced by increased leaf length. The varieties, nutrient treatments and level of split application of the nutrients were found to have significant effect on leaf length. This might be due to the fact that

growth parameters always show variations due to varietal nature. Proper nutrient availability enhanced each variety to perform at its maximum level if nutrients were supplied at regular intervals.

The interaction effect of varieties and nutrient treatments and varieties and level of split application of nutrients were found to be significant at 4 MAP and 6 MAP respectively. There was no significant difference on leaf length at 2 MAP. This might be due to the irregular availability of nutrients in the soil at early stages of growth of the plant as reported by Fayz *et al.,* (2016).

The interaction effect of nutrients and level of split application of nutrients was found to be significant throughout the experiment. The lowest leaf breadth was obtained when 20:20:20 N, P_2O_5, K_2O was applied at fortnightly interval basis as higher doses of fertilizers resulted in inferior performance of plants. This result was in conformity with the findings of Khosa *et al.* (2011).

The effect of varieties and nutrient treatments on leaf breadth was found to be significant throughout the crop period. Level of split application of nutrients was found to be significant only till 6 MAP.

As various combinations of N, P_2O_5, K_2O showed significant effect, it might be due to absolute balance between nitrogen and organic carbon equilibrium. The leaf breadth also increased by proper phosphorous availability. Similar results were obtained by Mer (2014).

The interaction effect of varieties and nutrient treatments revealed that an increase in leaf breadth was observed in all the treatments. But, the higher values for leaf length were observed when the varieties were treated with optimum level of fertilizers. This might be due to adverse effect in growth parameters when fertlizers were applied at higher concentrations.

The interaction effect of varieties and level of split application of the nutrients were not significant from 8MAP.

Interaction of nutrient treatments and level of split application of nutrients were found to have significant effect on leaf breadth in gerbera.

Varieties and nutrient treatments had significant effect on number of suckers produced plant^{-1}. The variation in number of suckers produced plant^{-1} might be due to varietal difference and inherent nature of each variety. Similar results were reported by Santos *et al.* (2015).

The maximum number of suckers were observed with 10:10:10 N, P_2O_5, K_2O g m^{-2} at 6MAP. It might be due to adequate availability of nutrients at exact stages of growth (Fayz *et al.*, 2016).number of suckers increased when nutrient levels were applied till the optimum. Higher dose from the optimum level of nutrients resulted in production of less number of suckers plant^{-1}.

The interaction of varieties and nutrient treatments and varieties and level of split application of nutrients had no significant effect on number of suckers produced plant^{-1}.

The interaction of nutrient treatments and level of split application of nutrients were found to be significant throughout the experiment. Palanisamy *et al.* (2017) reported that number of suckers produced in gerbera was found to be maximum when 15:10:30 N, P_2O_5, K_2O g m^{-2} were applied at monthly intervals. Similar results were obtained by Fayz *et al.* (2016).

5.2. EFFECT OF NUTRIENT MANAGEMET ON FLOWERING CHARACTERS OF GERBERA

From the present study it was revealed that the varieties, nutrient treatments and level of split application of nutrients had significant effect on number of days taken for flowering. This might be due to the differences in flowering nature of each variety. The nutrient treatment 10:10:10 N, P_2O_5, K_2O g m^{-2} recorded minimum number of days taken for flowering. This result was in conformity with findings of Deshpande *et al.* (2005). Days taken for flowering depend up on the phosphorous and potassium rates. The study recorded minimum

number of days taken for flowering when applied with 12.5g P_2O_5 m^{-2}.similar results were obtained by Nayak *et al.* (2005) with a mixture of NPK @ 4, 2, and 2 g pot^{-1} decreased the number of days taken for flowering. Nitrogen application at optimum levels contributed to acceleration of development of growth and reproductive phases. It might have accelerated protein synthesis and thus early flower development (Patil and Dhaduk, 2009).

In the present study it was observed that the interaction effect of varieties and nutrient treatments and varieties and level of split application of nutrients had significant effect on number of days taken for flowering. This might be due to the uptake of nutrients that aided in simultaneous transport of cytokinins to axillary bud. It resulted in breakage of apical dominance and allocation of photosynthates towards economic parts and aided in hormonal balance in the plant system. This helped in early transformation from vegetative to reproductive phase (Bellubbi, 2015).

The effect of nutrient treatments and level of split application of the nutrients were observed to be significant. This might be due to the balanced nutrition which favoured early transformation from vegetative phase to reproductive phase. Similar results were obtained by Palanisamy *et al.* (2017).

The present study revealed that the total number of days taken from bud initiation to harvest varied significantly among varieties and nutrient treatments. This might be due to varietal differences and optimum nutrient availability.

The study revealed that the effect of interaction between nutrient treatments and level of split application of the nutrients was significant. This result was in accordance with findings of Deshpande *et al.* (2005). Potassium favours flower growth and development and optimum dose helped to reduce number of days taken from bud initiation to harvest.

Result of the present study revealed that varieties and nutrient treatments had significant effect on flower longevity on the plant. According to Nell (1995) the longevity of the potted plants get affected by the variety grown and the

fertilizer treatments applied. Application of macronutrients resulted in increase in flower longevity by 40-50% in chrysanthemum.

Level of split application of nutrients, interaction effect of varieties and nutrient treatments and interaction effect of varieties and level of split application of nutrients were found to have no significant effect on flower longevity on the plant.

The interaction effect of nutrient treatments and level of split application of nutrients were found to be significant on flower longevity on the plant with highest value being recorded by application of 10:10:10 N, P_2O_5, K_2O g m^{-2} at monthly intervals (7.66days). It may be due to the availability of balanced nutrition which increased the longevity of flower in the plant.

5.3. FLOWER CHARACTERS

The study revealed that varieties and nutrient treatments had significant effect on flower diameter in gerbera. Bigger ray florets and inherent nature of individual varieties might have resulted in higher flower diameter (Biswal *et al.*, 2017). Optimum use of fertilizers resulted in highest flower diameter according to Palanisamy *et al.* (2017).

Interaction of varieties and nutrient treatments showed significant difference and highest value was obtained for Mammut with application of 10:10:10 N, P_2O_5, K_2O g m^{-2} nutrients. According to Palanisamy *et al.* (2017) the diameter of the flower depends up on petal length and girth. It might be due to the inherent nature of the varieties in response to constant availability of nitrogen both in NH_4 and NO_3 forms.

Interaction of varieties and level of split application and interaction of nutrient treatments and level of split application of nutrients were found to have significant effect on diameter of the flower.

Diameter of the flower disc has direct relationship with flower diameter. While considering the main effects, variety Mammut, 10:10:10 N, P_2O_5, K_2Og m^{-2}

nutrient treatment and monthly split application of nutrients recorded higher values for diameter of the flower disc.

Various colour differences of flower disc in varieties might be caused due to presence of optimum doses of potassium (Deshpande *et al.,* 2005).

The present study revealed that the effect of varieties, nutrient treatments and level of split application of nutrients was significant on number of ray florets. Increase in mineral constituents might have increased more number of ray florets in gerbera (Naik *et al.,* 2006). The interaction effect of all the other factors was also found to have significant effect on number of ray florets produced.

Flower colour of gerbera is a derivative of carotenoids and flavonoids (Tyrach and Horn, 1997). Different colours of the ray florets might be due to inherent character of individual varieties.

The main effects and interaction effects of all three factors significantly influenced the length of ray florets produced except the interaction effect of varieties and level of split application of nutrients. The improvement in this parameter might be due to balanced uptake of nitrogen, phosphorous and potassium by plants (George, 2012), and also due to synergistic action of nutrients when applied together.

The present study revealed that the width of ray florets got significantly influenced by main effect and interaction effect of all the three factors except main effect of level of split application of nutrients, and interaction effect of varieties and level of split application of nutrients. This might be due to balanced fertilisation of the plants and also inherent nature of the varieties.

Significant effect of the main factors and interaction of factors except interaction of varieties and level of split application of the nutrients were observed for length of the flower stalk.

Stalk length is generally referred as a genetic factor and it differed among cultivars. Differences might be caused due to amount of food materials reserved

in the flower stalk (Biswal *et al.*, 2017). Production of growth promoting substance such as gibberillic acid might have contributed in increasing the length of flower stalk (George, 2012).

Girth of the flower stalk was significantly influenced by main effects of varieties, nutrient treatments and level of split application of nutrients and interaction effect of nutrients and level of split application of nutrients.

According to Biswal *et al.* (2017) difference in flower stalk girth might be due to amount of food materials reserved in the flower stalk Palanisamy *et al.* (2017) reported that enhanced uptake of nutrients especially nitrogen due to the combination of NO_3^- and NH_4^+ might have increased the girth of the flower stalk. Similar results were obtained by Nayak *et al.* (2005) with application of 2:2:2 g NPK pot^{-1}.

Commercial value of gerbera flower is generally determined by the visual appeal of the flowers. When visual appeal of the flowers were determined by using three factors (general appearance, size of the flower and colour development) highest mean rank was observed for variety Beaudine when treated with 10:10:10 N, P_2O_5, K_2Og m^{-2} at monthly intervals. This might be due to the availability of optimum level of nutrients at the right stage of flower development for the plants

5.4. YIELD PARAMETERS

The total number of flower produced $plant^{-1}$ $year^{-1}$ was found to be highest for Esmara variety from this study. The nutrient treatment 10:10:10 N, P_2O_5, K_2Og m^{-2} and monthly split application of nutrients produced significantly higher number of flowers $plant^{-1}$ $year^{-1}$.

Deshpande *et al.* (2005) found out that increase in potassium application increased the amount of flowers produced in gerbera. Naik *et al.* (2006) reported that an increase in the vegetative parameters resulted in production and accumulation of maximum photosynthates led to the production of more number

of plants. According to Palanisamy *et al.* (2017) a rise in the amount of mineral constituents might have aided in the production of more number of flowers and balanced nutrition aided in production of more number of flowers.

From the present study it was revealed that the yield of flowers was found to be higher during rainy season compared to summer season. This might be due to the drop in temperature inside the poly house which favoured for flowering.

5.5. POST HARVEST CHARACTERS

The present study revealed that the vase life of the flower was significantly influenced by the main effect of varieties and nutrient treatments and interaction effect of nutrient treatments and level of split application of nutrients.

According to Barooah (2009) the vase life of flower was highly influenced by NPK concentrations in plants. The variations in vase life were noted among the varieties. This may be attributed to difference in number of thick walled cells in xylem and phloem or lack of complex ring of secondary thickening in the flower peduncle. This result was in accordance with findings of Kedistu (2013). According of Fayz *et al.* (2016) the difference in vase life might be due to differences in senescing behaviour of the varieties which produce large amount of ACC and ethylene forming enzymes.

A close relationship existed between vase life and amount of water uptake by flowers. The flowers that exhibited higher vase life was found to have higher water uptake (Fayz *et al.*, 2016). Significant difference was observed for the main effects except level of split application of nutrients and interaction effect of varieties and level of split application of nutrients. Higher accumulation of metabolic sugars might have aided better water uptake capacity in flowers (Biswal *et al.*, 2017).

5.6. PEST AND DISEASE INCIDENCE

There was no major incidence of pest and diseases found throughout the experiment. This may be due to the protective environment inside the poly house

and proper potassium fertilization which enable plants to get resistant to various pests and diseases.

5.7. ECONOMICS OF CULTIVATION

Attainment of higher BC ratio was attributed to the production of high quality flowers and suckers. BC ratio analysis showed that Esmara applied with treatment 10:10:10 N, P_2O_5, K_2Og m^{-2} nutrient dose at monthly intervals recorded highest value (1.92) for BC ratio.

FUTURE LINE OF WORK

Gerbera jamesonii Bolus. performed well in Kerala conditions when grown in poly houses. Refinement of standardisation of agro techniques for gerbera can be performed under Kerala conditions for enhancing the flower production. Yield can be maximised and good quality flowers can be produced to meet the international standards.

SUMMARY

6. SUMMARY

The thesis work entitled "Nutrient management in gerbera (*Gerbera jamesonii* Bolus.) grown under naturally ventilated poly house" was carried out at the Department of Pomology and Floriculture, College of Agriculture, Vellayani during 2016-2018. The study was to assess the performance of five gerbera varieties to different doses of fertilizers with a view to find out the best fertilizer dose for each variety. This study also aimed for the standardization of nutrient management schedule for *Gerbera jamesonii*Bolus. Different nutrient treatments (N, P_2O_5, K_2O) were applied to the varieties at monthly and fortnightly interval. The experiment was laid out in completely randomised design consisting of thirty treatment combinations and three replications.

The salient findings of the above studies are summarized in this chapter

- While considering the main effect of varieties on plant spread, Beaudine had significantly highest value at 4 MAP (156.19cm). The highest value of plant spread was recorded at 10 MAP (171.29cm) with the nutrient treatment 10:10:10 N, P_2O_5, K_2O g m^{-2}. Significantly highest value for plant spread was obtained when the nutrient treatments were applied at monthly intervals
- The interaction effect of varieties and nutrient treatments had significantly highest value at 10 MAP (175.68cm) when variety Beaudine was treated with 10:10:10 N, P_2O_5, K_2O g m^{-2}. When the interaction of varieties and level of split application of the nutrients were considered, highest values were obtained for Beaudine variety with application of nutrient treatments at monthly intervals throughout the crop period.
- The results revealed that variety Beaudine, nutrient treatment 10:10:10 N, P_2O_5, K_2O g m^{-2} and monthly split application of nutrients produced more number of leaves $plant^{-1}$ in gerbera.
- The main effect of varieties, nutrient treatments and level of split application of nutrients was significant on leaf area. The leaf area

continued to increase throughout the crop period. Variety Mammut, nutrient treatment 10:10:10 N, P_2O_5, K_2O g m^{-2} and monthly split application of nutrients recorded highest values for leaf area.

- Variety Beaudine showed significantly higher value for leaf length at 4MAP (37.09cm). The nutrient treatment 10:10:10 N, P_2O_5, K_2O g m^{-2} showed significantly superior values for all the months and 34.04cm was the highest value obtained at 4 MAP. Monthly split application of nutrients was found to have significantly higher value for all the months.
- When the interaction effect of nutrients and level of split application of the nutrients were considered, nutrient treatment 10:10:10 N, P_2O_5, K_2O g m^{-2} with monthly split application of nutrients had higher values throughout the crop period.
- Variety Mammut recorded significantly higher values for leaf breadth (11.03cm) at 10 MAP. Effect of nutrient treatments on leaf breadth was found to be significant from 2MAP to 10 MAP. A significantly higher value of 12.35cm was observed at 4 MAP. When main effect of level of split application of nutrients was considered, higher values were obtained when nutrients were applied at monthly interval at 4 MAP (10.79cm).
- The nutrient treatment 10:10:10 N, P_2O_5, K_2O g m^{-2} with monthly split application of nutrients had higher values for leaf breadth throughout the crop period.
- The main effect of varieties and nutrient treatments had significant effect on number of suckers produced $plant^{-1}$.
- The nutrient treatment 10:10:10 N, P_2O_5, K_2O g m^{-2} with monthly split application of nutrients had higher values for suckers produced $plant^{-1}$ from 4 MAP and highest mean value was noted at 6 MAP (3.35).
- When the flowering character of the plant was considered, significantly lowest mean number of days was taken by variety Esmara (21.48 days) for flowering. The lowest mean number of days was taken when 10:10:10 N, P_2O_5, K_2O g m^{-2} nutrient treatment was applied to the plants (25.20 days).

Significantly lower mean number of days was taken when the fertilizers were applied at monthly intervals (27.87 days).

- The lowest number of days was taken by Esmara when applied with 10:10:10 N, P_2O_5, K_2O g m^{-2} nutrient dose. The lowest number of days was taken by Esmara when applied with 10:10:10 N, P_2O_5, K_2O g m^{-2} nutrient dose. Esmara recorded the lowest mean number of days for flowering (20.59) when monthly split application of the nutrients was done.
- It was found that the main effect of varieties and nutrient treatment was significant on number of days taken from bud initiation to harvest. The lowest number of days was taken by variety Mammut (8.35) and nutrient treatment 10:10:10 N, P_2O_5, K_2O g (10.51 days).
- Highest flower longevity on the plant was recorded for variety Beaudine (7.98 days) and nutrient treatment 10:10:10 N, P_2O_5, K_2O g m^{-2} (7.49 days).The main effect of level of split application of nutrients was found to be non- significant.
- While considering the flower characters of gerbera, the main effect of variety recorded significantly higher values for flower diameter and diameter of the flower disc for variety Mammut. Significantly higher values for length of the ray florets were found to be 4.38cm for Esmara. Number of ray florets, girth of the flower stalk and length of the flower stalk were found to be highest for Beaudine. The highest value for width of the ray florets was observed for Aquamelon
- All the flower characters of gerbera recorded highest values when applied with treatment 10:10:10 N, P_2O_5, K_2O g m^{-2} nutrient dose. Monthly level of split application of nutrients was found to have highest values except flower diameter and width of the ray florets which were found as non-significant.
- Black coloured flower disc was observed for the varieties Beaudine and Aquamelon, greenish yellow colour for Double date and variety Mammut and Esmara exhibited yellow coloured flower disc.

- Bicoloured orange colour flower with a yellow tip was observed in variety Double date. Red colour in Beaudine, Cream colour in Mammut and pink colour in Aquamelon were recorded.
- When scoring was done for general appearance, size of the flower and colour development, highest mean rank was obtained for Beaudine applied with 10:10:10 N, P_2O_5, K_2O g m^{-2} at monthly intervals for all the three characters.
- The study revealed that the yield of the flowers were highest for variety Esmara when main effect of varieties on yield parameters were considered. Nutrient treatment 10:10:10 N, P_2O_5, K_2O g m^{-2} and monthly split application of nutrients recorded highest values for yield parameters.
- The effect of varieties and nutrient treatments was significant on post-harvest characters (vase life, water uptake and physiological loss in weight). Significantly high value for vase life was obtained by Esmara and Beaudine with highest water uptake. Physiological loss in weight was lowest for Beaudine.
- The nutrient treatment 10:10:10 N, P_2O_5, K_2O g m^{-2} recorded highest value for vase life, water uptake and lowest value for physiological loss in weight.
- The BC ratio was observed to be highest for Esmara variety (1.92) with 10:10:10 N, P_2O_5, K_2O g m^{-2} nutrient levels and monthly split application of nutrients.

FUTURE LINE OF WORK

Gerbera jamesonii Bolus. Preformed so well in Kerala conditions when grown in poly houses. Refinement of standardisation of agro techniques for gerbera can be performed under Kerala conditions for enhancing the flower production. Yield can be maximised and good quality flowers can be produced to meet the international standards.

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Appendices

APPENDIX I: Interaction effect of varieties, nutrient treatments and level of split application of nutrients in nutrient management on plant spread (cm) in *Gerbera jamesonii* Bolus

Treatments	2 MAP	4MAP	6MAP	8 MAP	10 MAP
$v_2n_1s_1$	173.48	177.02	170.42	177.11	179.76
$v_2n_2s_1$	144.75	146.15	124.97	122.29	122.06
$v_2n_3s_1$	151.10	168.26	164.76	167.13	169.55
$v_2n_1s_2$	155.67	160.68	170.43	169.12	171.60
$v_2n_2s_2$	155.71	170.81	168.36	171.01	176.94
$v_2n_3s_2$	144.37	114.25	92.48	90.71	89.25
$v_1n_1s_1$	118.59	158.08	157.67	167.59	172.03
$v_1n_2s_1$	121.95	134.31	79.245	81.82	79.42
$v_1n_3s_1$	105.82	128.02	122.66	134.26	134.94
$v_1n_1s_2$	116.44	127.11	128.81	140.65	143.59
$v_1n_2s_2$	111.89	139.54	130.35	138.52	143.74
$v_1n_3s_2$	95.18	111.26	72.05	76.44	79.61
$v_3n_1s_1$	171.27	179.27	177.05	180.85	180.61
$v_3n_2s_1$	150.97	132.57	122.01	122.03	126.90
$v_3n_3s_1$	97.08	151.40	148.21	157.05	162.90
$v_3n_1s_2$	160.17	170.66	157.08	164.40	168.96
$v_3n_2s_2$	107.56	158.32	170.66	171.75	173.64
$v_3n_3s_2$	102.31	117.78	118.58	115.96	118.41
$v_4n_1s_1$	176.76	180.55	178.25	182.88	183.38
$v_4n_2s_1$	138.49	116.65	118.86	119.56	115.51
$v_4n_3s_1$	141.43	141.93	121.32	147.52	148.77
$v_4n_1s_2$	153.63	153.96	150.06	160.48	162.75
$v_4n_2s_2$	158.87	169.95	167.27	173.38	174.41
$v_4n_3s_2$	127.89	110.48	115.30	114.85	112.19
$v_5n_1s_1$	167.14	178.97	177.64	181.05	183.10
$v_5n_2s_1$	154.48	109.28	113.52	114.12	113.44
$v_5n_3s_1$	113.14	130.43	132.44	141.86	158.26
$v_5n_1s_2$	153.99	160.60	158.87	164.66	167.11
$v_5n_2s_2$	127.81	161.91	161.29	167.04	169.32
$v_5n_3s_2$	78.75	104.76	108.85	111.77	111.32
CD	15.19	11.69	10.25	8.26	8.41
SEm (±)	5.37	4.13	3.62	2.92	2.97

APPENDIX II: Interaction effect of varieties, nutrient treatments and level of split application of nutrients in nutrient management on number of suckers plant^{-1} in *Gerbera jamesonii* Bolus

Treatments	2 Months	4 Months	6 Months	8 Months	10 Months
$V_2n_1S_1$	2.28	3.00	3.00	3.28	3.00
$V_2n_2S_1$	2.00	2.33	2.50	2.75	2.25
$V_2n_3S_1$	1.61	1.28	1.61	1.42	1.50
$V_2n_1S_2$	2.38	2.72	2.88	2.75	2.17
$V_2n_2S_2$	2.28	2.19	2.58	2.19	1.92
$V_2n_3S_2$	2.00	1.61	1.28	1.28	1.18
$V_1n_1S_1$	2.28	3.02	3.80	3.25	3.00
$V_1n_2S_1$	1.50	2.36	2.58	2.25	2.00
$V_1n_3S_1$	1.28	1.69	1.64	1.50	1.67
$V_1n_1S_2$	1.94	2.25	2.80	2.75	2.46
$V_1n_2S_2$	1.50	1.64	2.00	2.42	1.50
$V_1n_3S_2$	1.11	1.49	1.42	1.42	1.50
$V_3n_1S_1$	2.28	3.25	3.89	3.03	3.00
$V_3n_2S_1$	1.72	2.37	2.53	2.44	2.42
$V_3n_3S_1$	1.28	1.39	1.72	2.05	2.17
$V_3n_1S_2$	2.28	3.19	3.36	2.36	2.17
$V_3n_2S_2$	1.72	2.72	2.72	1.96	1.83
$V_3n_3S_2$	1.33	1.28	1.33	1.46	1.33
$V_4n_1S_1$	2.46	3.00	3.30	2.53	2.50
$V_4n_2S_1$	2.28	2.33	3.07	2.25	1.83
$V_4n_3S_1$	1.83	1.61	1.43	1.28	1.17
$V_4n_1S_2$	2.45	2.62	2.92	2.75	2.50
$V_4n_2S_2$	2.33	2.28	2.54	2.25	2.00
$V_4n_3S_2$	2.00	1.50	1.39	1.75	1.42
$V_5n_1S_1$	1.78	2.48	2.78	2.50	2.42
$V_5n_2S_1$	1.72	2.17	2.28	2.32	2.17
$V_5n_3S_1$	1.39	1.25	1.28	1.61	1.50
$V_5n_1S_2$	2.28	2.19	2.36	2.36	2.25
$V_5n_2S_2$	1.50	1.84	2.07	1.92	1.83
$V_5n_3S_2$	1.11	1.277	1.25	1.33	1.42
CD	NS	0.48	0.47	0.46	NS
SEm (±)	0.20	0.17	0.17	0.16	0.26

APPENDIX III: Interaction effect of varieties, nutrient treatments and level of split application of nutrients in nutrient management on flower characters in *Gerbera jamesonii* Bolus

Treatments	Flower diameter (cm)	Flower disc diameter (cm)	Length of ray florets (cm)	No. of ray florets	Stalk girth (cm)	Stalk length (cm)	Width of ray florets (cm)
$v_2n_1s_1$	11.13	2.69	4.79	64.23	2.39	79.34	0.85
$v_2n_2s_1$	10.10	2.38	4.43	60.18	2.32	71.18	0.76
$v_2n_3s_1$	10.18	2.08	4.16	57.18	2.19	67.71	0.62
$v_2n_1s_2$	11.21	2.49	4.36	51.83	2.38	74.93	0.73
$v_2n_2s_2$	9.77	2.44	3.92	51.68	2.31	63.44	0.62
$v_2n_3s_2$	10.03	2.10	3.80	50.33	2.13	60.13	0.58
$v_1n_1s_1$	8.52	2.61	3.66	57.00	2.34	44.41	0.96
$v_1n_2s_1$	8.25	2.11	3.33	52.90	2.15	41.35	0.81
$v_1n_3s_1$	7.80	2.31	3.18	50.16	2.00	40.30	0.63
$v_1n_1s_2$	8.27	2.48	3.46	52.66	2.31	40.41	0.84
$v_1n_2s_2$	7.82	2.25	3.21	50.12	2.17	38.89	0.66
$v_1n_3s_2$	7.84	2.21	3.17	46.12	1.89	37.49	0.61
$v_3n_1s_1$	11.24	2.89	4.24	56.10	2.37	54.09	1.00
$v_3n_2s_1$	10.73	2.66	3.87	53.46	2.29	51.60	0.89
$v_3n_3s_1$	10.32	2.55	3.49	50.91	2.21	50.87	0.80
$v_3n_1s_2$	10.54	2.77	4.04	52.93	2.32	53.17	0.98
$v_3n_2s_2$	10.23	2.64	3.66	50.04	2.24	49.90	0.83
$v_3n_3s_2$	9.52	2.41	3.33	47.27	2.18	48.30	0.73
$v_4n_1s_1$	10.67	3.70	4.83	65.01	2.30	49.22	0.68
$v_4n_2s_1$	10.06	3.42	4.55	57.35	2.24	45.41	0.67
$v_4n_3s_1$	9.66	3.24	4.25	50.56	2.18	42.07	0.60
$v_4n_1s_2$	10.08	3.40	4.57	58.06	2.22	46.71	0.71
$v_4n_2s_2$	9.58	3.39	4.24	53.79	2.18	43.69	0.66
$v_4n_3s_2$	9.15	3.03	3.83	49.00	2.11	43.21	0.62
$v_5n_1s_1$	9.19	2.51	3.77	58.55	2.13	47.83	0.99
$v_5n_2s_1$	8.86	2.35	3.55	56.16	2.07	46.27	0.94
$v_5n_3s_1$	8.54	2.24	3.16	52.51	1.89	45.41	0.88
$v_5n_1s_2$	9.13	2.34	3.45	53.49	2.09	46.58	0.90
$v_5n_2s_2$	8.54	1.98	3.19	49.70	1.96	45.15	0.82
$v_5n_3s_2$	8.27	1.95	2.95	49.15	1.78	44.22	0.75
CD	0.36	NS	NS	2.27	0.09	1.92	0.06
SEm (±)	0.12	0.08	0.07	0.08	0.03	0.68	0.02

NUTRIENT MANAGEMENT IN GERBERA (*Gerbera jamesonii* Bolus.) GROWN UNDER NATURALLY VENTILATED POLYHOUSE

by

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THESIS

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ABSTRACT

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The thesis work entitled "Nutrient management in gerbera (*Gerbera jamesonii* Bolus.) grown under naturally ventilated poly house" was carried out at the Department of Pomology and Floriculture, College of Agriculture, Vellayani during 2016-2018. The study was to assess the performance of five gerbera varieties to different doses of fertilizers with a view to find out the best fertilizer dose for each variety. This study also aimed for the standardization of nutrient management schedule for *Gerbera jamesonii*Bolus. Five varieties were selected for the study (V_1- Beaudine, V_2- Double date, V_3- Mammut, V_4- Esmara, V_5- Aquamelon). Different nutrient treatments (N_1- 10:10:10 N, P_2O_5, K_2O g m^{-2}, N_2- 15:15:15 N, P_2O_5, K_2O g m^{-2}, N_3- 20:20:20 N, P_2O_5, K_2O g m^{-2}) were applied to the varieties at monthly and fortnightly interval. The experiment was laid out in completely randomised design consisting of thirty treatment combinations and three replications.

The study revealed that variety Beaudine was significantly superior in terms of vegetative parameters *viz.,* plant spread (156.19cm) at 4 MAP, number of leaves (13.31) at 8 MAP and leaf length (37.09cm) at 4MAP. Variety Mammut was significantly superior in leaf breadth (11.03cm) at 10 MAP and number of suckers $plant^{-1}$(2.59) at 6 MAP. The nutrient treatment 10:10:10 N, P_2O_5, K_2O g m^{-2} produced significantly higher plant spread (171.29cm) at 10 MAP, number of leaves (12.54) at 6 MAP, leaf length (34.04cm) at 4 MAP, leaf breadth (12.35cm) at 4 MAP and number of suckers $plant^{-1}$ (2.97) at 6 MAP. The level of split application of nutrients s_1 showed significantly superior values for plant spread (148.86cm) at 4 MAP, number of leaves (10.95) at 8MAP, leaf length (31.67cm) at 4 MAP, leaf breadth (10.79cm) at 4MAP and number of suckers $plant^{-1}$ (2.42) at 6MAP. The variety Esmara when treated with 10:10:10 N, P_2O_5, K_2O g m^{-2} at monthly interval of split application of nutrients recorded significantly highest value for plant spread (183.38cm) at 10 MAP. Variety Beaudine treated with 10:10:10 N, P_2O_5, K_2O g m^{-2} (1.6: 1.6: 1.6 N, P_2O_5, K_2O g $plant^{-1}$)at monthly interval of split application of nutrients recorded significantly higher values for

number of leaves (15.23) at 6MAP and leaf length (46cm) at 4 MAP. Variety Mammut treated with 10:10:10 N, P_2O_5, K_2O g m^{-2} split application of nutrients at monthly intervals recorded significantly higher values for leaf breadth (15.74cm) at 4 MAP and number of suckers $plant^{-1}$ (3.89) at 6 MAP.

Regarding the flowering characters, Variety Esmara treated with 10:10:10 N, P_2O_5, K_2O g m^{-2} of split application of nutrients at monthly intervals recorded the lowest value for number of days taken for flowering (17) and variety Double date treated with 15:15:15 N, P_2O_5, K_2O g m^{-2} at fortnightly interval of split application of nutrients recorded lowest value for number of days taken from bud initiation to harvest (7.9) and there was no significant difference on flower longevity on the plant.

In flower characters, Mammut variety supplied with a combination of 10:10:10 N, P_2O_5, K_2O g m^{-2} fertilizers at monthly interval of split application of nutrients recorded highest flower diameter (11.24cm) and width of ray florets (1.00cm).There was no significant difference observed for flower disc diameter and length of the ray florets. Esmara variety with a combination of 10:10:10 N, P_2O_5, K_2O g m^{-2} fertilizers at monthly interval of split application of nutrients recorded the highest number of ray florets (65.01).Beaudine variety with a combination of 10:10:10 N, P_2O_5, K_2O g m^{-2} fertilizers at monthly interval of split application of nutrients recorded the highest stalk girth (2.39cm) and stalk length (79.34cm).

In yield parameters, highest number of flowers produced $plant^{-1}year^{-1}$(25.75) and higher yield of flowers in relation to season (15.25) at rainy season was recorded for variety Esmara treated with a combination of 10:10:10 N, P_2O_5, and K_2O g m^{-2} with a split application of nutrients at monthly intervals.

The vase life of flowers and water uptake showed no significant difference among the treatment combinations

All the five varieties while treated with 10:10:10 N, P_2O_5, K_2O g m^{-2} at monthly intervals resulted high values for vegetative, flower and flowering characters. The best performance for Beaudine followed by Esmara and Aquamelon. BC ratio was highest for Beaudine.

Future line of work may be standardisation of agrotechniques for gerbera under Kerala conditions.