INFLUENCE OF DATE OF SOWING AND LEVELS OF IRRIGATION ON THE GROWTH AND YIELD OF WATER MELON (*Citrullus lanatus*) GROWN IN RICE FALLOWS

By

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THESIS

Submitted in partial fulfilment of the requirement for the degree

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DECLARATION

I hereby declare that this thesis entitled "Influence of date of sowing and levels of irrigation on the growth and yield of watermelon (*Citrullus lanatus*) grown in rice fallows" is a bonafide record of research work done by me during the course of research and this thesis has not previously formed the basis for the award of any degree, diploma, associateship, fellowship, or other similar title of any other University or society to me.

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CERTIFICATE

Certified that this thesis entitled "Influence of date of sowing and levels of irrigation on the growth and yield of watermelon (<u>Citrullus lantus</u>) grown in rice fallows" is a record of research work done independently by Shri.Siby T. Neendissery 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 him.

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C E R T I F I C A T E

We the undersigned members of the advisory committe of shri.Siby.T.Neendissery, a candidate for the degree of Master of Science in Agriculture with major in Agronomy agree that the thesis entitled."Influence of date of sowing and levels of irrigation on the growth and yield of watermelon (*Citrullus lanatus*) grown in rice fallows" may be submitted by shri.Siby.T.neendissery,in partial fulfilment of the requirements for the degree.

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Dedicated to
my beloved parents

CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

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Introduction

INTRODUCTION

Water melon (*Citrullus lanatus*(Thumb)) is one of the cucurbitaceous vegetables cultivated during summer in central and northern districts of Kerala. The importance of this crop has long been accepted on account of its function as a thirst quencher. Hundred grams of water melon contains 75 gm of starch, 10 gm of protein, 599 iu of vitamin A, 6 mg of Thiamine, 0.05 mg of riboflavin, 7 mg of calcium and 7 mg of phosphorus. The cultivation of this crop has been found to be highly remunerative under irrigated conditions during summer and hence gaining popularity among the vegetable farmers of the State.

Water, a manageable input is one of the major factors influencing and usually restricting crop growth and food production. Efficeint use of water for crop production has been a major concern for centuries. Today, this concern is greater than everbefore, because of the rising needs for food and fibre coupled with decreasing supplies of water for agriculture. Hence, it becomes necessary to make all possible effort to maximise the production per every unit of water used for irrigation.

Kerala is endowed with plenty of rainfall. The mean annual rainfall of the State is about 3000 mm, but it is not well distributed. About 67 per cent of the annual rainfall is received during the southwest monsoon season. About 19 per cent falls in the post-monsoon season, from October to January, and the rest 14 percent in the pre monsoon months of February to May. Thus, the rainfall is effective only for a period of five to seven months, with a distinct dry spell occuring during the remaining period. Water is the most important factor restricting crop production throughout the State during this period.

Summer vegetables cannot be grown if proper irrigation facilities are not available. When water is at a premium vegetables of all types will usually get first priority. This is because they give high returns. Moreover, the useful product of water melon is the fruit which is sold on the basis of its fresh weight and appearance, two attributes which are particularly sensitive to shortage of water.

Water being relatively scarce in summer it should be managed so as to maximise crop productivity for each unit of water used by the plants. Here judicious application of the available water is most important.

The water requirements of any crop during summer vary according to the variation in the evaporative demand of the atmosphere. Evapotranspiration rate varies from place to place and from season to season. Since climate is a major component that determines its rate, scheduling of irrigation based on evaporation values is more practicable and measurements are simple as compared to other methods.

As both crop yield and water requirement are affected by climatic factors the water use efficiency also will vary with the season. It is possible to arrive at the best season which gives the highest water use efficiency and the most economic use of applied water.

The growth and yield of all crops vary greatly with the weather conditions that prevail during the growing season. A combination of temperature, sunshine duration, hummidity etc., determine the growth period, crop performance, and productivity. The effect of these meteorological parameter on the crop can be studied by varying the planting dates. Date of planting is a non-monetary input and by planting the crop at the correct time, the growth and yield of the crop can be enhanced, with no extra effort on the part of the farmers.

In Kerala, so far no detailed investigations have been undertaken to study the influence of date of sowing and levels of irrigation on the growth and yield of water melon grown in rice fallows. In view of the above, the present investigation was undertaken with the following objectives.

1. To study the influence of date of sowing on growth and yield of water melon in summer rice fallows.

2. To find out the optimum date of sowing water melon in summer.

3. To study the growth and yield response of water melon under different irrigation schedules.

4. To find out the optimum number and intervals of irrigation for water melon.

Review of Literature

REVIEW OF LITERATURE

Over the past few decades, research into crop weather relationship has received considerable attention. Simulating, analysing and assessing crop response to weather and climate have found an important place in research and operational field assessment. Numerous publications on specific aspects of weather and climate in relation to crop yields particularly, cereals, have appeared in recent times. However, not much work has been reported on the crop weather relationship of water melon. Water melon, a cucurbit vegetable requires plentiful supply of water. It is cultivated mainly during summer in the rice fallows and sandy river banks of North Kerala. Studies on the relationship between weather and water melon raised in the rice fallows are very meagre. Experimental evidence on the effect of time of planting on water melon is also not widely available. Hence, the relevant literature available on these aspects for water melon along with few other important crops is briefly reviewed.

2.1 Effect of date of sowing on growth and yield

Surlekov and Ivanov (1969) from an experiment on cucumber using cultivars Staro-zagorski longi and Donski - 175 sown on 20th and 30th April and 10th and 30th May, concluded that the April sowing produced plants with largest number of fruits, the highest mean fruit weight and the highest seed number and weight. Kartalov (1970) found that highest yield was obtained with the earliest sowing and planting date viz. 17th January and 22nd February respectively. Belik and Porokhaya (1973) obtained the highest yield for water melon sown on 20 - 24 March. In Southern Bulgaria cucumber sown outdoors on 20th April produced the highest yield of best quality seed (Surlekov and Ivanov, 1974). Musk melon planted during March took significantly a fewer days to ripen than the November planted crop (Nandapuri and Lal, 1978). Drews (1979) observed the fruit set and development in cucumber (cv-Trix) from February to July and found that small fruit gained 25 to 30 gm fruit weight per day. Daily growth in length and width varied between 20 - 30 mm and 2.5 - 3.5 mm respectively.

Kmiecik and Lisiewska (1981) from three year trial with cucumber sown in field in early or later May or early June observed that the average yield of commercial and processing cucumber were the highest with the earliest date of sowing.

Heij and Lint (1982) in an experiment with cucumber seedling planted in the green house on 13th or 27th December or 10th or 24th January and grown at 21 - 27 c day temperature and 12, 16 or 20 c night temperature found that the later planting produced more fruits than early planting.

Schroder and Drews (1982) concluded that date of planting generally controlled the earliness of the harvest. The total yields however, were little affected by the early planting date of cucumber.

The highest total yield produced by melons grown under tunnel was on April 10th planting or on April 1st sowing.Delayed sowing or planting reduced yields (Khristov,1983).

Asiegbu (1985) in a field experiment with fluted pumpkin to investigate the influence of planting date on growth and productive life of fluted pumpkin sown on May, June and August found that seedling emergence was lowest with August sowing. Plant growth and yield parameters were better for earlier than for late sowing.

Desai and Patil (1985) studied the effect of date of sowing on the expression of sex ratio and yield contributing parameters of water melon (cv Sugar Baby) and reported that male female sex ratio was lowest in plant sown on the earliest date (3.86) and the highest (8.48) in those sown on January 20th. The yield was highest in plants sown on December 30th and January 20th.

Jacob (1986) studied the effect of date of sowing on growth and yield of bitter gourd variety Priya and revealed that bitter gourd can be raised successfully in summer season by sowing on December 1st. Snake gourd sown on November 16th produced highest yield (Thankamani, 1987). Mohammed and Mohammed (1987) obtained the highest total yield for squash plant sown on March 1st.

Bruyn and Sande (1988) in a glass house trial using cucumber (cv Corena) planted on 15th July, 24th July, 12th August or 25th August reported that earlier planting gave the higher total yield (up to 17.6 Kg/m^2).Each week's delay in planting resulted in a loss of 1.7 kg/m^2.

Alvarez (1989) showed that musk melon sown in January, February, March and April achieved higher feminization rate than plants sown in May, June and July. Plants sown in September, October and November did not produce any pistilate flowers, where as the plants sown in December the feminization rate was intermediate.

2.2 Effect of weather on plant characters and yield

2.2.1 Plant characters

Danielson (1944) reported that stem elongation was retarded in 16 hours day length for cucumber grown in contracted diurnal photoperiods, 8, 12 and 16 hours, while the maximum stem elongation occured in the 8 hour day length. In contrast to this Hall (1949) reported that stem of long day plants attained a greater length than stem of short day plants.

Buttrose and Sedgley (1978) observed that in water melon, increasing light intensity and day length enhanced lateral growth, where as main shoot was less effected. Toki (1978) found that translocation and respiration were greatly affected by night temperature in cucumber. Heij (1981) reported that stem elongation increased with rise in temperature.

Lint and Heij (1982) with four plantings of glass house cucumber grown at three night temperatures observed that the number of nodes per stem increased with lower night temperature.

The relation is asymptotic towards full expression of elongation near 11 c . With later planting dates internodes were longer. Nelson et al. (1983) reported for buffalo gourd that vine growth appeared to be restricted when maximum air temperature was above 40 c.

Klapwijk (1987) studied the relationship between glass house temperature and the initiation and growth of leaves and fruits. He reported that growth is negligible at 15°c, but is greatly accelerated at temperature upto and above 30°c, provided moisture is adequate.Photosynthesis, however, is maximum at about 20°c.

Rietze and Wiebe (1987) reported that for cucumber cold temperature during light periods caused necrosis or death of the youngest leaves whereas cold temperature in the dark caused chlorosis only in the intervenal region of older leaves.

2.2.2 Yield characters

Tiedjens (1928) succeeded in materially changing the ratio of staminate to pistillate flowers in the cucumber by varying the amount of light to which the plants were exposed. Under reduced light intensity and short light duration the ratio of pistillate to staminate flowers tend to increase. Edmond (1930) working with cucumber " Extra long white spine" noted that seasonal variation in sex expression of cucumber could be attributed to change in day length.

Danielson (1944) concluded that when cucumber was grown in diurnal photoperiods of 8, 12, and 16 hours, maximum staminate flower production on the basis of total number of flower produced, occured in the short day.

Hall (1949) found that the peak of flower production occured 15 days earlier in cucumber treated with short days and about 50 per cent more flowers were formed in short day than in long day. Nitech et al. (1952) reported that high temperature and long days tend to keep the vine in the male phase whereas low temperature and short days enhance the early expression of female phase in Cucurbita pepo.

Miller and Ries (1958) reported that low temperature increased the length to diameter ratio of pickling cucumber fruits. Singh (1958) from his studies on ridge gourd and smootngourd showed that maximum number of male flowers appeared during rains.

Venketram (1963) reported tnat lesser light duration was more conductive for the female phase in snake gourd. He linked the observation, the node at which the first female flower was born with the sex ratio expression. This node number was observed to be an index of the sex ratio in that, the lower the node number, the higner was the female/male ratio.

Although low temperature and short day length usually induce female flower differentiation in cucumber, some varieties appeared to be insensitive (Matsuo, 1968). This view was supported by Fukushima *et al.*(1968). They showed that cultivars belonging to the South Chinese variety complex were sensitive to low temperature and short days, whereas those belonging to the North Chinese and European variety complexes were sensitive to low temperature.

Kamalanathan and Thamburaj (1970) studied the influence of weather factors on sex expression in pumpkin and the optimum time of sowing under Coimbatore condition. They found that the preflowering and flowering phase were governed mainly by day length and temperature. Cloudiness favoured the production of pistilate flowers.

Sharma and Nath (1971) worked with three varieties each of water melon, musk melon,snap melon and long melon and their results indicated that in rainy season, in all the three varieties of water melon, the sex ratio was highest during the period with an average of 28.78^{o}c temperature and 75.62 per cent relative humidity. In musk melon sex ratio was found to be positively correlated with temperature in green house and negatively with relative humidity in the field (Nandapuri *et al.*, 1976).

Ivanov (1978) from his field trial with cucumber sown on six different dates in April and May showed that there was a strong negative correlation between effective temperature and duration of all stages. Toki (1978) reported that a temperature regime of 16^{o}c for 4 hours from 17.00 to 21.00 hours in the evening followed by lower temperature of 10°c to 12°c for remaining night increased cucumber yield by 12 percent as compared with those of the conventional cultivation under normal night and day temperature. He also reported that in cucumber, respiration is greatly affected by night temperature.

Drews (1979) reported that low night temperature enhanced fruit set whereas high air temperature (35°c) and low relative humidity encouraged fruit drop. In cucumber, low night temperature (16°c) resulted in an increased yield, but delayed the start of yielding (Drews et al., 1980). They also reported that high temperature (23°c) caused early bearing. This was supported by Vooren (1980) and according to him increasing night temperature from 10°-20°c delayed maturity. At same time an increase in day temperature from 20°- 26°c also decreased earliness but insensitive to day length.

Slack and Hand (1981) reported that in cucumber the early fruit yield rose with increasing night temperature upto 23°c but showed no increase at day temperature above 22°c. Heij and Lint (1982) working with cucumber seedlings grown at 21°- 27°c temperature found that the later planting produced more fruits than early planting. Night temperature had only a slight effect on fruit number per stem, but there was an optimum near 16°c.

Heissner and Drews (1985) in studies on yield increase in green house cucumber in relation to temperature condition found that neither planting date nor night temperature affected the total yield but both affected earliness.

Experiment with the cucumber hybrid (cv TSKGA -77) showed that the temperature requirement in the post transplanting period varied with the growth stage. Upto mass flowering, day air temperature of 20° - 30° c night air temperature not below 12° c and soil temperature not below 17° c were required. During flowering and fruiting in natural light, optimal day, night and ground temperature combination were 25° - 27° c, 15° - 18° c and 17° c and 25° -27° c, 12° c and 25° c respectively (Palkin, 1987).

Dunlap (1988) examined the germination rate and final germination percentage of four cultivars of <u>Cucumis melon</u> in response to incubation temperature of 20°, 26° and 32° c and found that germination of cultivar TAM-Uvalde was constantly slow at 20° c, 26° c and 32° c

Uffelen (1988) in a glass house trial comparing the effect of different temperature regimes on cucumber revealed that raising the average 24 hour temperature by 1° c advanced harvest by 4 days when the rise was due to a higher night temperature. However, when the rise was due to an increase in day temperature, harvest was advanced by 12 days. A relatively high day temperature also increased plant vigour and there were fewer female flowers in the leaf axil thus reducing the number of fruitlets to be thinned.

In cucumber, efficiency of assimilated CO_2 conversion into dry matter depended on temperature and photoperiod. (Kuree *et al.*, 1989). Wacquant (1989) studied the effect of various environmental factors on the growth and development of melon and reported that high light levels are necessary for flower production. In cultivars Doublons and Vedrantiais, fruit development was faster and fruits were larger when the minimum night temperature was 19°c than when it was 15°c . Temperature above 35° - 45° c decreased the sugar content and increased the proportion of glassy fruits.

2.3 Effect of Irrigation

Water, the earth's most abundant compound is the single most important factor limiting crop yield throughout the world. Water available for agriculture is decreasing and this coupled with ever increasing demand of the growing population for food and fibre emphasize the need for attaining the maximum benefit from each unit of water used for irrigation.

Water melon, a cucurbitaceous vegetable requires plenty of water for higher production. During the past many decades, lot of works were done to study the effect of irrigation on cucurbits. However, there is little information available on the effect of irrigation on water melon. The literature pertaining to the studies on the effect of levels of irrigations on cucurbit vegetables are reviewed here under.

2.4 Effect of irrigation on growth attributes

Belik (1961) reported that optimum conditions for cucumber development during the early phase was 80 – 90 percent of full moisture capacity. Flocker et al.(1965) found that frequent and heavy irrigation increased the vine growth and succulence in melons. Irrigation during the entire growing season was more effective in cucumber than irrigation upto or after cropping started (Borna,1969).

Escobar and Gausman (1974) noticed that in Mexican squash the leaves of the plants under higher water stress were thicker and smaller, containing less water than the plants under lower water stress. Leaf area in cucumber was greatly reduced under water stress (Cummins and Kretchman,1974).

Tomitaka (1974) reported highest plant growth of cucumbers at a medium soil moisture level of pF2.0. Michael (1978) revealed that the soil moisture at about 15 cm depth should not be allowed to drop below 70 per cent of total available moisture for better growth of vegetable crops. Pai and Hukkeri(1979) observed that for good growth of vegetables the soil moisture should be maintained at or above 75 percent of availability in the active root zone.

Ortega and Kretchman (1982) noticed that for cucumber plants cv.Premier, a reduction in the rate of vine growth and the number of nodes when plants were subjected to stress for a period of one week. Growth was found to be completely inhibited after two weeks of stress. Thomas (1984) found that bitter gourd responded well to frequent irrigations and higher levels of fertilizers. Frequent irrigation at low depletion of available soil moisture was congenial for growth and development of cucurbits. However, heavy irrigations at frequent intervals were found to be detrimental for crop growth.

Desai and Patil (1984) reported that for water melon highest plant growth was obtained from plants irrigated at IW/CPE ratio of 1.0. Bhella (1988) studied the effect of trickle irrigation and black mulch on growth yield and mineral composition of water melon and reported greatest stem growth and early and that total yield obtained from plants grown with polythene mulch in combination with trickle irrigation.

Hegde (1988) indicated that for water melon frequent irrigation,when the soil matrix potential at 15 cm depth reached − 25 KPa, resulted in maximum dry matter accumulation and distribution, leaf area index (LAI),leaf area duration (LAD) and net assimilation rate (NAR),leading to higher fruit yield compared with irrigation at − 50 and − 70 KPa.

2.5 Effect of irrigation on yield and yield attributes

Mc Gillivray (1951) reported that yield of cantaloupes was increased by irrigation. However the size of the fruit or total soluble solids were not greatly affected by irrigation. The yield of cucumber was increased by an average of 16.7 per cent by irrigation before flowering, when soil moisture fell from 50 percent to 60 – 65 percent of field capacity (Frolich and Henkel, 1961).

Abolina *et al*. (1963) observed that the melon plants watered regularly produced greater number of female flowers. Flocker *et al*. (1965) obtained satisfactory yields of melon by irrigating when soil moisture tension at the 45 cm depth reached three bars. They observed that yield increase by irrigation was mainly due to increase in fruit size.

Molnar (1965) found that fruit set in melons was not improved but fruit drop was reduced by irrigation. He also observed that the dry matter content of the fruit was not reduced, and a favourable ratio of sugars resulted, which enhanced the quality of the fruits.

Downes (1966) reported that average yield of melon was increased when sprinkler irrigation at frequent intervals was practiced. Dunkel (1966) reported that highest yield of cucumber was obtained when soil moisture did not drop below 70 per cent of field capacity.

Bradley and Rhodeo (1969) concluded that irrigation at 7, 14 and 21 days interval was made very little difference to the yield of summer squash harvested frequently, but at the 21 day interval, the ones over yield was markedly reduced. Jassal *et al*.

(1970) reported that fruit weight and fruit yield were significantly increased in musk melon by weekly irrigation compared with fortnightly irrigation.

Neil and Zunino (1972) observed that higher irrigation rate with melon produced more and heavier melon with improved flavour and decreased firmness, but the dry matter content was unaffected.

Dimitrov (1973) showed that a field capacity of 60-70 per cent maintained over the entire season was the most economic treatment for melons. Hammet et al. (1974) found that a constant supply of moisture was necessary during the growth of cucumber especially during flowering and fruiting.

Jagoda and Kaniszewski (1975) observed the yield and fruit quality were appreciably improved by irrigation. Irrigation lowered fruit dry matter, vitamin C and sugar content in both fresh and processed cucumber (Krynska et al.,1976). Elkner and Radzikowska (1976) reported that irrigation particularly in years of low rainfall increased firmness, improved taste and reduced percentage of hollow cucumbers, but decreased dry matter, sugar, total N and nitrate N in the fruit. Highest percentage of sugar content in the fruit occurred in unirrigated plots irrigated at the lowest frequency (Caro and Linsalata, 1977)

Loomis and Crandall (1977) observed that moderate moisture stress in cucumber had no significant effect on the grade or on the number of poorly developed fruits. Singh and Singh (1978) reported that the yield increased by irrigation in crops like bitter gourd , round gourd and water melon was associated with increased number of fruits per plants and increased fruit weight.

Abreu et al. (1978) obtained the highest average yield of 13.02 tha^{-1} when irrigation was applied at 0.7 atmosphere. Rudich et al.(1978) found that irrigation given during the fruit development stage resulted in an average yield increase of 24.5 and 13.5 tha^{-1} but did not affect fruit quality.

Doorenbos and Kassan (1979) found that in dry climate with moderate evaporation and little rainfall, water melon produced an acceptable yield (15 tha^{-1}) with one heavy irrigation in the beginning of the growing period, when the soil water over the full root zone is brought to field capacity.

Haynes and Herring (1980) reported that irrigation at 0.7 bar produced the highest yields of marketable squash. However, the number of marketable fruit was maximum with irrigation at 0.3 bar.

Chernovel (1980) reported that in cucumber the night irrigated plants gave the highest yield followed by evening, morning and midday irrigation. Henriksen (1980) showed that 60 percent more fruits were produced with irrigation than without irrigation. In general,irrigation improved quality and reduced the tendency towards spongy fruits, but did not improve fruit uniformity. Twice as many fruits per plant and upto three times greater weight of fruit per plant were obtained by irrigation. According to Katyal (1980) during dry weather weekly irrigations should be given in case of pumpkin and cucumber.

Ware and Collum (1980) showed that cucumber crop require a continous supply of moisture during the growing season. The most critical period occurs at the time of fruiting.

With musk melons, Kashi (1981) obtained maximum yield and enhanced solid content with irrigation intervals of 6 and 8 days. Ortega and Kretchman (1982) observed that in cucumber the rate of fruit growth was severely reduced in water stressed plants. Work done in ash gourd at the Agronomic Resarch Station, Chalakudy revealed that the number of fruits per plant and the weight of a single fruit increased with increase in the level of irrigation (ICAR, 1982). Smittle and Threadgill (1982) obtained the highest marketable fruit yeild of 24.2 tha^{-1} from applying irrigation at 0.3 bar soil water tension.

Mannini and Roncuzzi (1983) showed that irrigation at an interval of 3-6 days did not affect cucumber yield, but the volume of water applied was important. Tau <u>et al</u> .(1983) from their two year study on pickling cucumber found that the highest yield was obtained from multi harvest operations with irrigation at 60 percent available soil moisture level, while maximum yield was obtained with irrigation at 25 percent available soil moisture level in the once over harvest operation.

Pew and Gardner (1983) in trials with musk melons obtained higher yields, larger fruit size and earlier maturity by irrigating when soil moisture tensions at the 25cm depth reached 50 or 75 K Pa compared with 25 KPa. Chander and Mangal(1983) from their studies on musk melon found that the best growth and flowering was obtained from plots irrigated with 0.9 pan evaporation coefficient.

Desai and Patil (1984) in a trial with water melon (cv Sugar Baby) got the highest plant growth and the highest yield from plants irrigated at IW/CPE ratio of 1.0.

Lakshmanan (1985) observed no significant difference in yield between irrigating at 25, 50 and 75 percent depletion of available soil moisture for pumpkin,oriental pickling melon or ash gourd. Jacoo (1986) obtained high yield and growth for bitter gourd irrigated at IW/CPE ratio of 1.0

Hegde (1987a) in a trail with water melon (cv Arke Manik) showed that irrigation at - 25 KPa at a 15 cm depth resulted in highest fruit fresh weight and dry weight but the T.S.S content was not markedly influenced by the irrigation regime.

Mangal et al. (1987) working with musk melon reported in a two year trial, plot irrigated at 0.8 and 1.0 pan evaporation coefficient in the first year and at 0.6 and 0.8 pan evaporation coefficient, in the second year produced the highest yield. Mannini and Gallina (1987) reported that for cucumber the highest yields and individual furit weight in an unheated green house covered with corrigated ploythene obtained with irrigation at maximum evapotranspiration x 150%.

Asoegwu (1988) working with fluted pumpkin observed that irrigation prolonged the productive life of the crop and enhanced the leaf and pod yield. Irrigating every 6 days produced significantly higher number of seeds and the highest water use efficiency, while irrigating every 3 days gave the best leaf yield and the pod yield.

Pulekar and Patil (1988) in a two year study with water melon revealed that the yield of water melon was significantly increased due to irrigation scheduling at 10mm cumculative pan evaporation (3 days interval).

According to Stansell and Smittle (1989) the marketable fruit yield of summer squash was greatest and prolduction cost per kg of marketable fruit were least when the plants were irrigated at 25 KPa of soil water tension.

2.6 Method of irrigation

Bujanovaskaja(1970) observed that the root development in field grown cucumber was better following flood irrigation than following sprinkler irrigation or no irrigation.

Sharma and Dastnae(1970) emphasized that to achieve high irrigation efficiency, uniform water distribution and uniform high yields, check basin should be microlevelled. Goldberg and Shmueli (1970) in a three year irrigation trial for equal water consumption, observed that drip irrigation produced yields of melon twice as high as sprinkler irrigation.

Caro and Linsalata (1977) observed that furrow irrigation increased the yield and mean fruit weight in melon but did not affect the number of fruits/plant. Mondal (1978) conducted experiments with pitcher irrigation using water melon, musk melon and bottle gourd. The total yield of each of the three crops were highest with water replenished every 3rd, 4th and alternate days respectively.

Singh and Singh (1978) in a comparative irrigation study of drip and sprinkling at 5 days interval and furrow irrigation in bottle gourd, ridge gourd and water melon for vegetable production in a hot arid climate found that total yields of all the crops except ridge gourd were the highest with drip irrigation. Henriksen (1980) found that for ridge cucumbers there was no significant difference in yield and quality between drip irrigation and overhead manual watering.

Balakumaran _et al._ (1982) studied the comparative effect of pitcher irrigation and pot watering in cucumber and reported that yields were slightly higher in pot watered plots, but water economy was appreciably greater under pitcher irrigation. Reddy and Rao (1983) worked on the response of bitter gourd to pitcher and basin system of irrigation. The yield was highest (21.6Kg per 25m^2) on plots with pitcher filled every 4th day and lowest (15.9 kg per 25 m^2) on plots with basin filled every 5th day. Jacob (1986) found that in bitter gourd pitcher irrigated plots gave the lowest yield.

Mannini and Gallina (1987) reported that irrigation method had no effect on the yield of cucumber grown in unheated green house. Bhella (1988) working with water melon on cv Charlestong Gray obtained greatest stem growth and early and total yield from plants grown with polythene mulch in combination with trickle irrigation. Trickle irrigated plants produced shallow rooting near the trickle emitter, non-irrigated plants produced relatively extended, deep and diffused root.

Pulekar and Patil (1988) reported that among different methods of irrigation layout, ring and basin one side planting gave significantly higher yield of water melon.

2.7 Irrigation scheduling based on evaporation data

An evaporimeter is an instrument which integrates the effect of all the different climatic elements furnishing them their natural weightage (Dastnae, 1967). Evaporation values measured from a standard USWB class A open pan evaporimeter are extensively used for scheduling of irrigation using a suitable IW/CPE ratio (Sharma and Dastnae, 1969; Sharma et al. 1975; Vamadevan, 1980).

The applicability of different irrigation scheduling methods were critically reviewed by Prihar *et al.* (1975) and they observed that under Indian conditions, where instrumentation is limited, irrigation scheduling based on application to a fixed depth after the lapse of a given evaporation value from the USWB pan evaporimeter holds great promise.

Consumptive use of water which is the main part of water, requirement of a crop, is governed primarily by meteorological parameters. The high correspondence between water loss from an evaporimeter and potential evapotranspiration makes this approach attractive for irrigation scheduling, as the evaporation is easy to monitor and the necessary equipment is simple and easy to maintain (Doorenbos and Pruitt, 1977).

Singh and Singh (1978) reported high total yields with drip irrigation, at 65 per cent of the evaporation from a class A pan evaporometer in crops like bottle gourd, round gourd and water melon in loamy sand soils of hot arid regions. Studies on scheduling irrigation to bitter gourd and cucumber at the Agronomic Research Station, Chalakudy indicated that 3 cm irrigation at IW/CPE ratio of 0.4 was optimum for both the crops in summer rice fallows. (ICAR,1981). Similar studies in ash gourd recorded the highest yield at IW/CPE ratio of 1.0 which was on par with the IW/CPE ratio of 0.7.Both these were significantly superior to the IW/CPE ratio of 0.4 (ICAR, 1982). The crops were however raised under shallow water table conditions.

Desai and Patil (1984) found that of the four irrigation ratios (IW/CPE 0.6, 0.8, 1.0 and 1.2) good plant growth, fruit quality and the highest yield was obtained from water melon irrigated at IW/CPE ratio of 1.0. Srinivas et al.(1984) studied the effect of 4 (25, 50, 75 and 100 %) levels of evaporation replenishment under drip irrigation and furrow irrigation and indicated that replenishment of 25% evaporation loses under drip and 50 to 70 % evaporation loses under furrow irrigation, were optimum for realizing higher yields of water melon.

Thomas (1984) reported that for bitter gourd, irrigation at the IW/CPE ratio of 1.2 recorded the maximum net profit and net return/rupee invested followed by IW/CPE ratio of 0.8 in the case of bitter gourd grown in summer rice fallow. Jacob (1986) reported that the highest yield was recorded by IW/CPE ratio of 1.0 in the case of bitter gourd grown during summer.

The highest yield for snake gourd was obtained when irrigated at IW/CPE ratio of 1.0 (Thankamani,1987). Pulekar and Patil (1988) in a two year study revealed that the yield of water melon was significantly increased due to irrigation scheduling at 10 mm cumulative pan evaporation.

In water melon cultivars, practice of daily irrigation gave the highest yield, followed by irrigation at IW/CPE ratio of 0.90. Pitcher irrigation recorded the highest water use efficiency (0.27) while irrigation at IW/CPE ratio of 0.50 showed the maximum cost benefit ratio (KAU, 1991).

2.8 Consumptive use and water requirement

According to Whitaker and Davis (1962) irrigation water required for water melon and cucumber was 150 ha mm each and that for pumpkins and summer and winter squashes was 180 ha mm each. Dunkel (1966) showed that optimal yields of cucumber could be obtained, when 600 – 750 mm of water was applied.

Neil and Zunino (1972) reported that the maximum evapotransipration in irrigated cantaloups was 60 per cent of potential evapotranspiration and between flowering and fruit formation it was 55 per cent of potential evapotranspiration. The water uptake increased during fruit enlargement. At harvest, water uptake was 85 percent of potential evapotranspiration which declined to 55 per cent by mid harvest. The water uptake at successive growth stage of the melon crop was 560 m^3 ha^{-1} between germination and fruit set, 1008 m^3 ha^{-1} upto fruit enlargement, 882 m^3 ha^{-1} upto prematurity and 280m^3 ha^{-1} to harvest.

In an investigation to find out the relationship between development and water utilization in cucumber, Cselotel and Varga (1973) reported that during the period upto the beginning of flowering, the water up take was small, amounting to five liters per plant. In a 30 days period following the beginning of flowering the water uptake amounted to 30-31 litres per plant. In the subsequent 30 day period corresponding to full development of the fruits and the beginning of seed maturity, water uptake was 10-20 liters per plant.

In a study to find out the amount and nature of water consumption in musk melon plants, Konishi (1974) found that the total water consumption by a fruit bearing plant with a leaf area of about 11000 cm^2 was 85 - 90 liters. As the plant grows the ratio of total water consumption per plant to pan evaporation increased to a maximum at the netting stage and then declined with ageing. He also observed that young leaves transpired faster than old leaves and most of the transpiration occurred when soil pF was 1.6 to 2.00. Water consumption was less for the plants without fruits.

Tomitaka (1974) in studies in the cucumber observed that the evapotranspiration rate declined with a decrease in the soil moisture level. Pavlov (1976) observed that the highest yield of cucumbers (26.6 Kg m^{-2}) was obtained when 70 -100 l m^{-2} of water was applied during the plant growing phase in 20 - 23 individual irrigations, followed by 480 - 570 l m^{-2} during fruiting in 92-94 individual irrigations.

Loomis and Crandall (1977) in studies on the water consumption of cucumbers, observed that consumptive use increased during flowering and early fruiting and then leveled off during late harvest. The total amount of water used during the later two month period of crop growth ranged from 300 - 400 mm over each of the four years of the experiment. The ratio (Ke) of consumptive use to evaporation from a pan evaporimeter increased to a maximum of 1.5, 10 days after picking and then declined but still remained high when picking was terminated.

Doorenbos and Kassan (1979) showed that in the case of water melon, the water requirement for the total growing period for a 100 day crop ranged from 400 - 600 mm. Desai and Patil (1984) worked on the consumptive use and water requirement of water melon and found that the consumptive use increased as the irrigation levels increased from 0.6 to 1.2 IW/CPE ratios. The increased irrigation levels also increased the water requirement from 360 to 580 mm. The optimum water requirement for highest yield was 540 mm

Srinivas et al. (1984) working with water melon reported that an increase in evaporation replenishment increased the relative water content, osmotic potential and yield,and decreased water use efficiency and canopy temperature.

Thomas (1984) reported that the consumptive use increased with increase in the level of irrigation in the case of bitter gourd. According to Lakshmanan (1986), treatments which received frequent irrigation showed higher values of consumptive use through out the crop growth period in case of cucurbit vegetables. This was supported by Jacob (1986) and Thankamani (1987). Hegde (1987b) reported that for water melon, water use efficiency of the field increased with the decrease in irrigation frequency.

Safadal (1987) worked out the water consumption by winter squash at three different soil moisture tensions of 30, 50 and 80 KPa as 12.79, 12.75 and 12.44 cm. The corresponding values for the spring crop were 15.18 , 13.98 and 14.97 cm. Pulekar and Patil (1988) found that for irrigating water melon at 10mm cumulative pan evaporation required 580 liters of water per two plants.

2.9 Soil moisture depletion pattern

Whitaker and Davis (1962) reported that the root system of all the economic cucurbits is extensive but shallow. They found that root growth often equals or exceeds vine growth laterally and is very rapid and extensive in the upper 12 - 18 inches of soil. Vittum and Flocker (1967) pointed out that cucurbits are with medium or deep root systems that require large amount of water. Belik and Veselovskii (1975) reported that under irrigation, the main root mass in water melon was found in the 8.5 - 17 cm soil layer. Loomis and Crandall (1977) indicated that cucumbers extracted 50 percent of the total amount of water consumed from the upper 30 cm of the soil profile, 30 percent from the next 30 cm and 10 percent from the next 30 cm.

Zabara (1978) observed that in irrigated cucumbers the root distribution at bearing was 64.5 per cent at 0 - 10 cm depth, 28.5 per cent at 10 to 20 cm depth and 6.2 per cent at 20 to 30 cm depth. In the case of unirrigated cucumbers the figures were 53.7 per cent at 0 - 10 cm, 29 per cent at 10 to 20 cm and 14.9 per cent at 20 to 30 cm.

Doorenbos and Kassan (1979) reported that water melons can deplete soil water to a soil water tension of over two atmosphere, without the yield being affected. They found that the root system of water melon can be deep and extensive upto a depth of 1.5 to 2m. The active root zone where most of the water is extracted under adequate water supply is limited to the upper 1 to 1.5m.

Thomas (1984) revealed that in bitter gourd, the top 15cm of the soil layer accounted for 42 - 48 percent of the total moisture depleted. The moisture use from 15 to 30 cm layer was as high as that from the next 30cm soil layer below. The top 30cm layer contributed about 66.71 percent of total water use. Moisture depletion decreased rapidly with depth. It also observed that in comparison with wet regions, dry regions extracted more soil water from the lower soil layer. Similar observations were made by Lakshmanan (1985)

Ells <u>et al</u>.(1989)in a four year study on scheduling irrigation for cucumber concluded that the best combination of high yield, high water use efficiency and lowest number of irrigations was obtained by irrigating when 40% of the available water was depleted.

Materials and Methods

MATERIALS AND METHODS

The present investigation was carried out to study the influence of date of sowing and levels of irrigation on the growth and yield of water melon, variety Arka Jyothi grown in rice fallows. The experiment was conducted at the Rice Research Station, Mannuthy, Thrissur, Kerala during the period from November 1990 to April, 1991. The details of the materials used and techniques adopted during the course of the investigation are briefly described below.

1. Materials

1.1 Site, Climate and Soil

The experimental area is situated at 10° 32'N latitude and 76° 10'E longtitude and at an altitude of 22 M above the mean sea level. The area enjoys a typical warm humid tropical climate.

The data on the weather conditions during the crop growth period are presented in Table -1 and Figs 1,2 and 3.

Composite soil samples from 0 - 60 cm depth taken before commencement of experiment were used for the determination of physicochemical properties and the data are presented in Table-2.

1.2 Cropping history

The experimental site was double cropped wet land. The land was usually left fallow during the summer season.

TABLE - 1

Mean Weekly weather parameters for the crop growth period

Period No.	Date	Week No	Maximum temperature (°C)	Minimum temperature (°C)	Sunshine hours	Relative humidity (%)	Wind speed (km/h)	Total evaporation (mm)	Total rainfall (mm)
X	Oct.29-Nov. 4	44	29.1	22.4	3.1	86	2.9	14.4	184.2
XI	Nov.05-Nov.11	45	31.2	21.1	7.8	79	1.6	24.2	-
	Nov.12-Nov.18	46	31.1	22.8	5.3	79	1.5	20.2	0.6
	Nov.19-Nov.25	47	33.1	23.2	7.6	69	3.3	26.0	-
	Nov.26-Dec.02	48	31.8	23.4	5.8	64	10.9	34.7	0.8
XII	Dec.03-Dec.09	49	31.9	24.8	7.4	60	13.9	41.4	1.8
	Dec.10-Dec.16	50	31.9	22.3	8.3	57	9.3	44.1	-
	Dec.17-Dec.23	51	32.7	22.0	7.7	61	5.6	30.8	-
	Dec.24-Dec.31	52	32.5	23.5	8.2	57	10.5	56.2	-
I	Jan.01-Jan.07	1	33.1	22.1	7.8	67	2.6	31.2	3.9
	Jan.08-Jan.14	2	33.4	21.8	9.3	60	5.6	38.6	-
	Jan.15-Jan.21	3	33.4	23.6	8.4	58	8.5	48.4	-
	Jan.22-Jan.28	4	34.2	22.1	9.8	47	6.8	58.7	-
	Jan.29-Feb.04	5	34.5	21.4	9.2	58	5.0	47.0	-

Table 1 (Contd.)

Period. No.	Date	Week No.	Maximum tempera-ture (°C)	Minimum temperature (°C)	Sunshine hours	Relative humidity (%)	Wind speed (km/h)	Total evapor-ation. (mm)	Total rainfall (mm)
II	Feb.05-Feb.11	6	35.2	21,4	10.2	45	6.3	55.9	-
	Feb.12-Feb.18	7	36.4	21.0	10.5	50	5.5	58.6	-
	Feb.19-Feb.25	8	36.5	22.0	10.6	50	7.6	52.1	-
	Feb.26-Mar.04	9	36.6	24.4	9.5	63	6.0	48.7	-
III	Mar.05-Mar.11	10	35.6	24.7	7.7	71	4.6	36.8	1.8
	Mar.12-Mar.18	11	35.9	25.0	8.5	71	4.4	40.3	-
	Mar.19-Mar.25	12	36.1	24.0	9.3	66	4.8	45.0	-
	Mar.26-Apr.01	13	38.3	25.4	8.8	58	5.7	52.9	-
IV	Apr.02-Apr.08	14	36.1	24.2	9.4	66	5.4	44.6	23.0
	Apr.09-Apr.15	15	36.1	24.7	7.9	69	4.2	38.6	24.4
	Apr.16-Apr.22	16	35.5	25.8	9.3	69	4.8	37.4	1.4
	Apr.23-Apr.29	17	34.7	23.4	8.8	73	4.6	36.6	35.0
	Apr.30-May.06	18	34.6	25.7	6.8	71	4.0	33.9	-

Fig:1 - Weather condition during the crop period

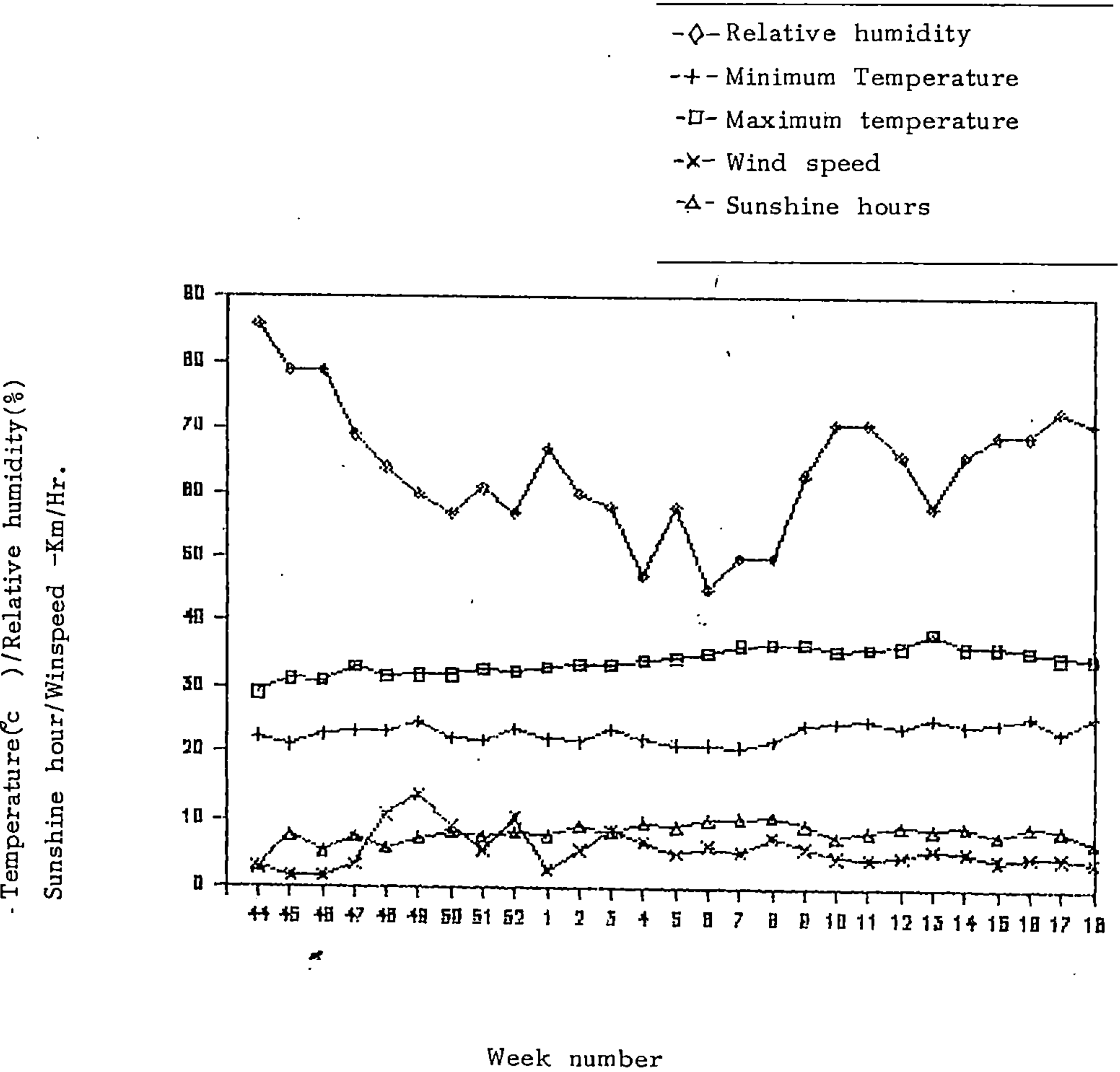


Fig:2 - Weekly evaporation(mm) during the crop period

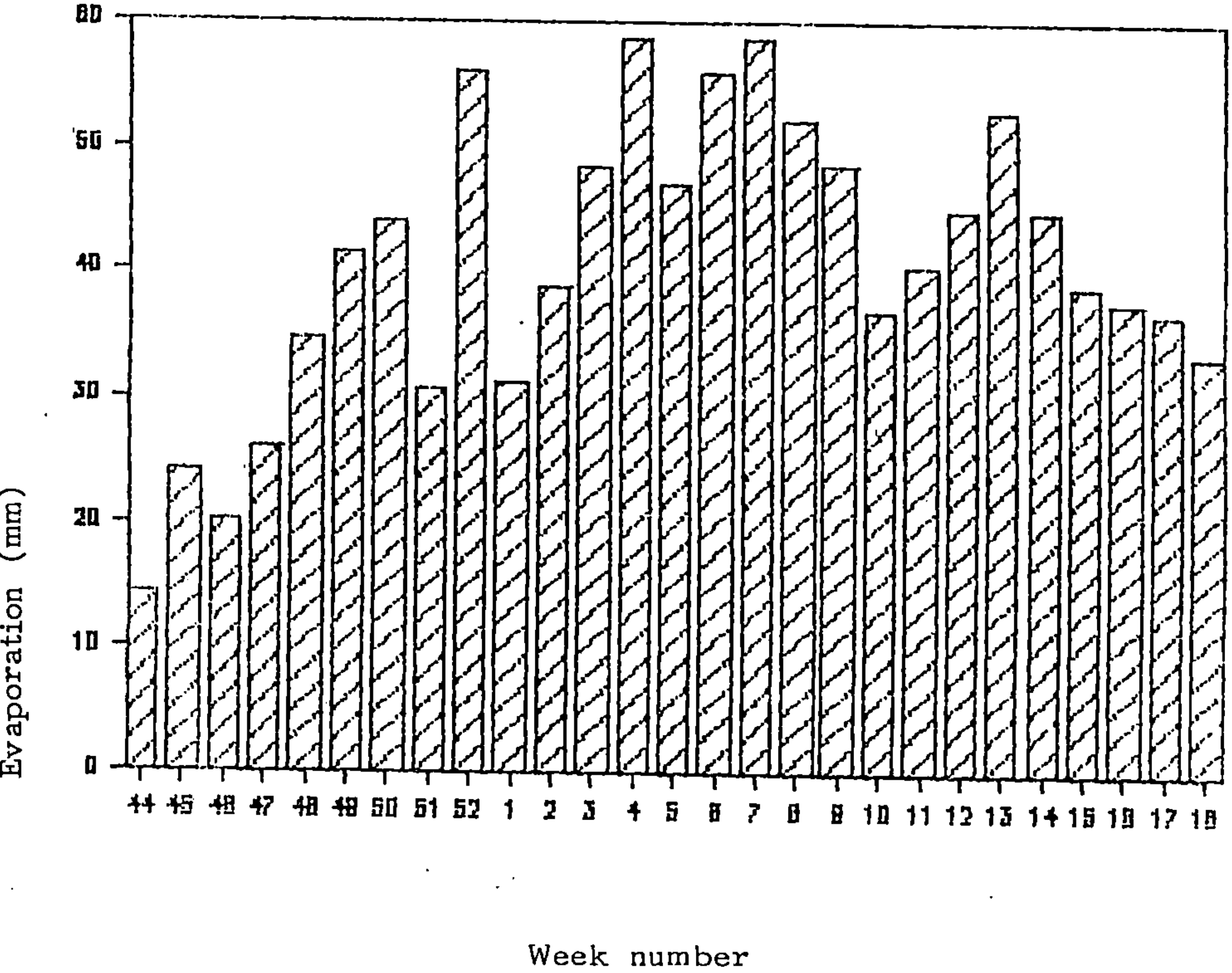


Fig: 3- Weekly rainfall(mm)during the crop period

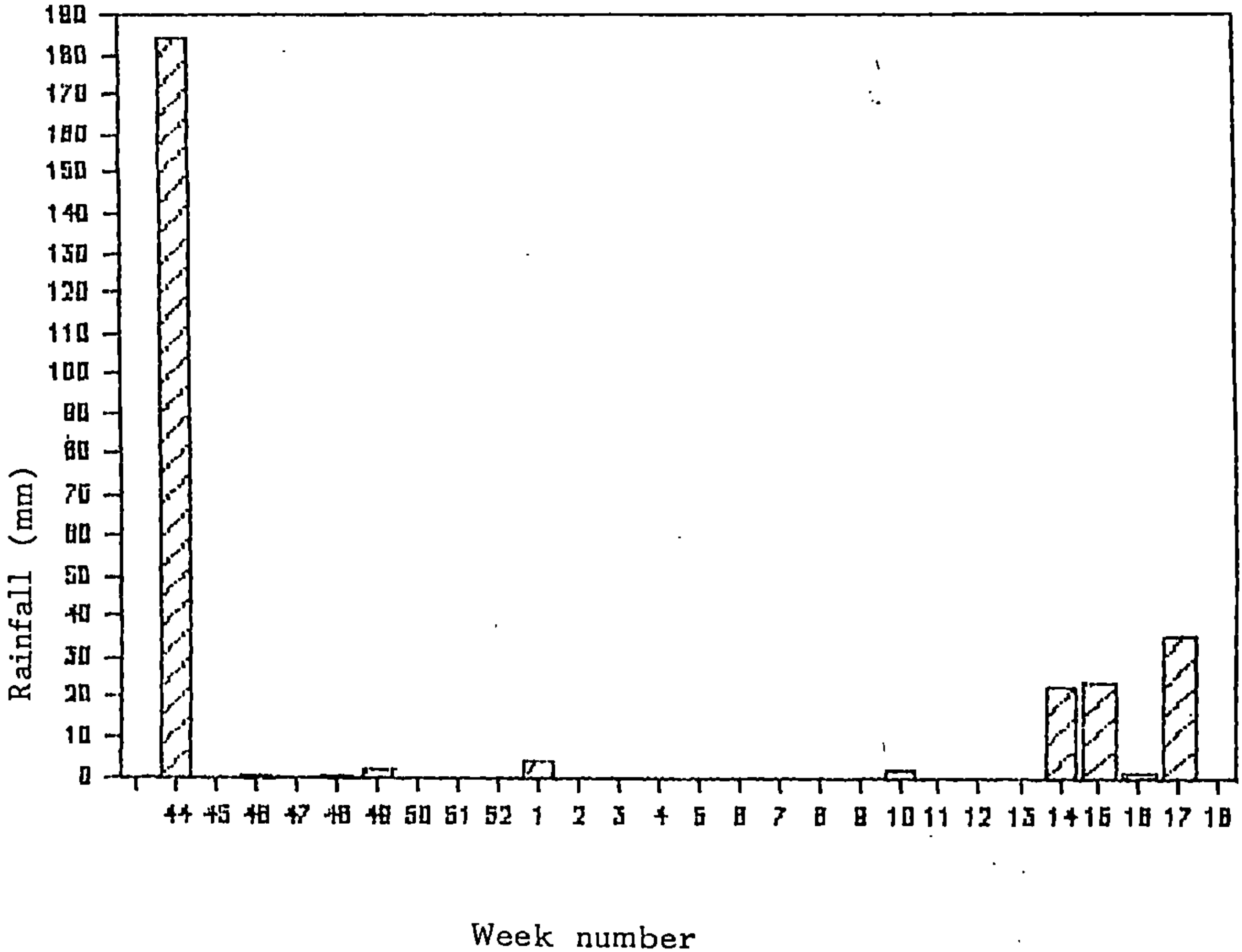


Table -2

Soil Charecteristics of the experimental site

1. Mechanical Composition

Fraction	Percent composition	Procedure adopted
Course Sand	26.43	Robinsons International pipette method (Piper, 1950)
Fine sand	24.12	
Silt	22.46	
Clay	27.31	
Texural class	Sandy clay loam	I.S.S.S System

2. Physical Constants of the soil

Constant	Value	Procedure adopted
Field Capacity (0.3 bars)	19.68 %	Pressure plate apparatus (Richard,1947)
Moisture percentage at 15 bars	11.32 %	Pressure plate apparatus (Richard,1947)
Bulk density ($g\ cm^{-3}$)	1.34	Core method (Blake, 1965)
Particle density ($g\ cm^{-3}$)	2.16	Pycnometer method (Blake, 1965)

3. Chemical Properties

Description of the properties	Value	Method employed
Organic Carbon (%)	0.331	Walkley and Black rapid titration method(Jackson,1958)
Available Nitrogen ($Kg\ ha^{-1}$)	233.8	Alkaline permangnate method (Subbiah and Asija, 1956)
Available Phosphorus ($Kg\ ha^{-1}$)	127.4	Chlorostannous reduced molybdophospherous blue colour method in hydrochloric acid System (Jackson, 1958)
Available Potassium ($Kg\ ha^{-1}$)	69.74	Flame photometry, Neutral normal ammonium acetrate

		extraction (Jackson, 1958)
Soil reaction (pH)	5.4	Soil water suspension of 1:2.5 (Jackson, 1958)
Electrical conductivity (mmhos cm^{-1})	0.40	Soil water extract of 1:2.5 (Jackson, 1958)

1.3 Season

The experiment was conducted during the period November, 1990 to April,1991.

1.4 Variety

Water melon, variety Arka Jyothi, selected for this investigation is an F1 hybrid developed by crossing water melon line IIHR 20 from Rajasthan and Crimson sweet from U.S.A released from Indian Institute of Horticulture, Bangalore. It is an early variety of 90 days duration. The fruits have bright crimson flesh with good texture, flavour and high sugar content and low seed content.

1.5 Manures and Fertilizers

Crop management practices were done as per the package of practices recommendations (KAU,1989). Farm yard manure at the rate of 20 tonnes per hectare was applied uniformly to all the pits as basal dose. Urea, super phosphate and Muriate of potash were used as fertilizers to supply the required quantity of nitrogen (at the rate of 70 Kg N per hectare), phosphorous (at the rate of 25 Kg P_2O_5 per hectare) and potassium (at the rate of 25 Kg K_2O per hectare) respectively. Nitrogen was applied in two splits, half as basal and the other half at the time of vining. The whole of P and K were applied basally.

2. Methods

2.1 Layout

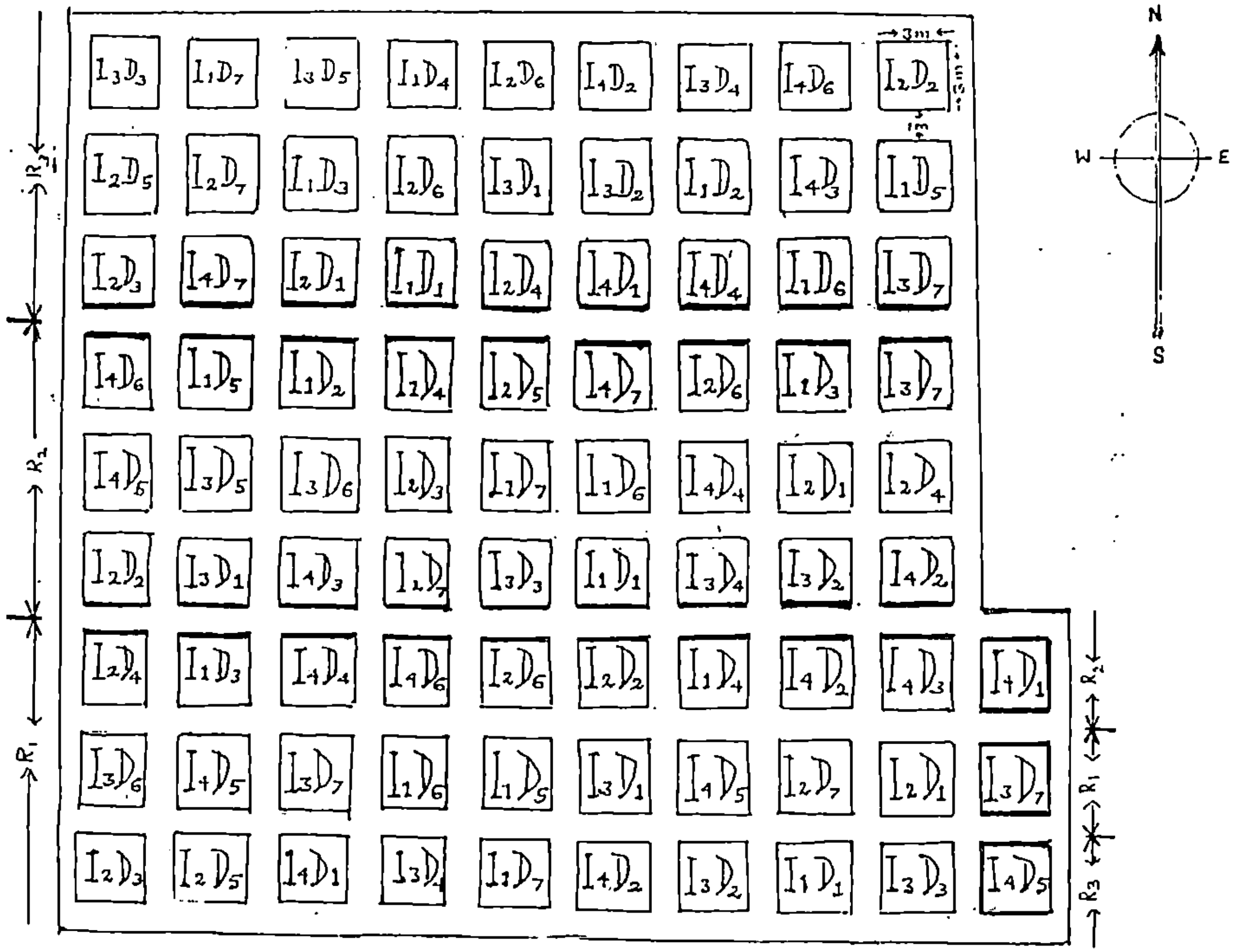
The experiment was laid out in split plot design. The treatments consisted of 7 dates of sowing in the main plot and 4 levels of irrigation in the sub plot. The layout plan is given in Fig -4.

Details of the treatments are given below.

Mainplot treatments (Sowing dates)	Notations
November 1st	D_1
November 16th	D_2
December 1st	D_3
December 16th	D_4
December 31st	D_5
January 15th	D_6
January 30th	D_7
Subplot treatments (Irrigation)	
Irrigation at IW/CPE ratio of 1.0 –	I_1
Irrigation at IW/CPE ratio of 0.75 –	I_2
Irrigation at IW/CPE ratio of 0.50 –	I_3
Control-pot watering – 1 pot/day/pit –	I_4

The plot size was 3m x 3m and there were 4 pits in each plot having 2 plants in each pit. The spacing given was 1.5m x 1.5m.

Fig: 4 - LAY OUT PLAN



Treatments

Date of sowing	Notation
November 1st	D1
November 16th	D2
December 1st	D3
December 16th	D4
December 31st	D5
January 15th	D6
January 30th	D7

Levels of irrigation	Notation
Irrigation at IW/CPE ratio of 1.0	I1
Irrigation at IW/CPE ratio of 0.75	I2
Irrigation at IW/CPE ratio of 0.50	I3
Control - pot watering 1 pot/day/pit	I4

There were three replications and the total number of plots were 84. The depth of irrigation was 30 mm.

2.3 Cultural operations

The land was ploughed well and then levelled. Plots of 3m x 3m size were taken leaving buffer strips of 1m width all around the plot. Area inside each plot was scrupulously levelled and four pits of 30 cm depth and 60 cm diameter were taken at a spacing of 1.5 m x 1.5 m

The pits were filled with top soil, and the recommended quantity of farm yard manure of 10 kg per pit. The basal dose of fertilizers were applied and mixed well with soil.

The seeds were soaked overnight in water and sown on the prescribed date of sowing. The seedlings were thinned to two plants per pit, two weeks after sowing. Nitrogen was top dressed at the time of vining. The plots were kept weed free throughout the crop growth period. Prophylactic spraying with Rogor was given at fortnightly intervals.

2.4 Irrigation

A presowing irrigation was given uniformly to all pits with 10 litres of water (ie, one pot). There after 10 litres of water ie,(one pot) was given daily upto the 20th day after sowing. From 21st day onwards irrigations were scheduled when the cumulative pan evaporation values attained 30 mm, 40 mm and 60 mm

Details of the irrigation treatment

Treatments Sowing Date	Irrigation	Total Number of irrigation	Interval of irrigation (days)	Quantity of water applied (mm)	Pre-treat-ment irrigation (mm)	Effective rainfall (mm)	Total quantity of water used (mm)
DI	I_1	13	5-8	390	200	114.7	704.7
	I_2	10	7-11	300	200	114.7	614.7
	I_3	7	9-14	210	200	114.7	524.7
	I_4	daily	-	500	200	114.7	814.7
D2	I_1	17	4-8	510	200	4.3	714.3
	I_2	11	6-11	420	200	4.3	624.3
	I_3	8	8-14	300	200	4.3	504.3
	I_4	daily	-	620	200	4.3	824.3
D3	I_1	16	4-8	480	200	3.4	683.4
	I_2	11	6-10	330	200	3.4	533.4
	I_3	8	8-12	240	200	3.4	443.4
	I_4	daily	-	570	200	3.4	773.4

Table -3 (Contd.)

Treatments: Sowing Date	Irrigation	Total Number of irrigation	Interval of irrigation (days)	Quantity of water applied (mm)	Pre-treatment irrigation (mm)	Effective rainfall (mm)	Total quantity of water used (mm)
D4	I_1	16	4-7	480	200	3.4	683.4
	I_2	11	5-8	330	200	3.4	533.4
	I_3	7	8-12	210	200	3.4	413.4
	I_4	daily	-	560	200	3.4	763.4
D5	I_1	16	3-7	480	200	3.4	683.4
	I_2	12	6-9	360	200	3.4	563.4
	I_3	8	8-12	240	200	3.4	443.4
	I_4	daily	-	540	200	3.4	743.4
D6	I_1	14	4-9	420	200	28.4	648.4
	I_2	10	6-13	300	200	28.4	528.4
	I_3	7	8-15	210	200	28.4	438.4
	I_4	daily	-	520	200	28.4	748.4

Table -3 (Contd.)

Treatments Sowing Date	Irrigation	Total Number of irrigation	Interval of irrigation (days)	Quantity of water applied (mm)	Pre-treatment irrigation (mm)	Effective rainfall (mm)	Total quantity of water used (mm)
	I_1	13	4-8	390	200	50.2	640.2
	I_2	9	7-10	270	200	50.2	520.2
D7	I_3	6	8-13	180	200	50.2	430.2
	I_4	daily	-	500	200	50.2	750.2

respectively for the IW/CPE ratios 1.0, 0.75 and 0.50. Graduated bucket of 15 liters capacity was used to supply water to the plots.

For the treatment I_4 10 litres of water was applied per pit per day till the end of the experiment.

The details of the irrigation are presented in Table-3.

2.5 Harvesting

The fruits were harvested as and when they matured, the maturity being judged by visual observation. The harvesting was completed by 90 days after sowing.

2.6 Observation

2.6.1 Biometric Observation

(a) Length of vine

The length of the vine in cm was recorded at 30 and 60 days after sowing.

(b) Node at which the first female flower appeared

The node at which the first female flower appeared was counted from the cotyledon node and recorded.

(c) Days to picking maturity

The female flowers per plot were tagged at the time of opening and the number of days taken from flowering till harvest was noted and the mean worked out.

(d) Days taken for the first female flower to open

The number of days taken by the first female to open from the date of sowing was recorded.

(e) Number of female flowers

The number of female flowers produced per plant at 30 and 60 days after sowing was counted.

(f) Number of male flowers

The number of male flowers produced per plant at 30 and 60 days after sowing was counted.

(g) Sex ratio

The male to female flower ratio was recorded .

(h) Number of fruit per plot

The number of fruits harvested from each plot was counted and recorded.

After harvest, 10 fruits were randomly selected from each treatment for recording the following measurements.

(i) Weight of fruit

Weight of 10 fruits were recorded in Kg and the mean weight worked out.

(j) Girth of fruit

Girth was recorded from the middle of the fruit in cm and averaged for the 10 fruits.

(k) Number of seeds per fruit

Number of seeds contained in each fruit was counted and the average for 10 fruits worked out.

(l) Hundred seed weight

Seeds extracted from the ripe fruits were washed and dried uniformly, hundred bold seeds were selected from each treatment and the weight recorded in g.

(m) T.S.S (° Brix)

Total soluble solids of the fruits were estimated using a pocket refractometer and the average for 10 fruits worked out.

(n) Yield

Total weight of fruit harvested from each plot was recorded and the yield in tonnes per hectare was worked out.

(c) Total dry matter production

Total dry matter production in g per plant was worked out.

2.6.2 Water use efficiency

Water use efficiency was worked out by dividing the total crop yield by the amount of water used and is expressed in kg ha^{-1} mm^{-1}.

2.6.3 Soil moisture studies

(a) Soil sampling

Soil samples were collected at three depths, 0 to 15 cm, 15 to 30 cm, and 30 to 60 cm using an auger, before and 24 hours after irrigation. Moisture estimations were made by gravimetric method and expressed as percentage on oven dry basis.

(b) Consumptive use

Consumptive use was computed from the soil moisture depletion data. The potential evapotranspiration for the period " 24 hours after irrigation " was computed from class A pan evaporation data. The effective rainfall determined based on the soil moisture content and the potential evapotranspiration were also taken in to account for computing consumptive use. Seasonal consumptive use was calculated by summing up the consumptive use values for each sampling interval.

(c) Moisture depletion pattern

The average relative soil moisture depletion from each soil layer in the root zone was worked out for each irrigation interval. The potential evapotranspiration values for the 24 hours after each irrigation, extrapolated from the class A pan evaporation data were added to the depletion in the first layer and the total loss from each layer was determined on percentage basis at the end of the period.

2.7 Meteorological observations

The daily values of meteorological factors recorded at the meteorological observatory of College of Horticulture, Vellanikkara were collected.

2.8 Statistical Analysis

The data obtained were subjected to statistical scrutiny and interpreted adopting the methods suggested by Panse and Sukhatane (1954).

Simple linear correlation between two important yield characters, and the weekly weather parameters for the overlapping periods from 1 to 13 weeks after sowing were worked out.

The yield characters selected are

1. Yield per plot in Kg

2. Total dry matter production in g

The weather elements used for the study were maximum temperature, temperature range and relative humidity. Multiple linear regression equations were developed between the two yield characters and weather elements. A comparison between yield per plot in Kg and total dry matter production in g estimated from these regression equations and the actuals is also made.

Results

RESULTS

During the course of the investigation, observation on various biometric characters were recorded to study the influence of dates of sowing and levels of irrigation on the growth and yield of water melon cv Arka Jyothi in rice fallows. The data were subjected to statistical analysis and the results are presented below. The notations used in the result are as follows

D_1 November 1st sowing

D_2 November 16th sowing

D_3 December 1st sowing

D_4 December 16th sowing

D_5 December 31st sowing

D_6 January 15th sowing

D_7 January 30th sowing

I_1 Irrigation at IW/CPE ratio of 1.0

I_2 Irrigation at IW/CPe ratio of 0.75

I_3 Irrigation at IW/CPE ratio of 0.50

I_4 Control pot watering 1 pot/day/pit

DAS Days after sowing

1. Biometric Observations

1.1 Length of vine

The mean values of length of vine recorded at 30 and 60 DAS are presented in Table-4 and its anlalysis of variance in Appendix- I.

Length of vine was significantly affected by different dates of sowing. The crop sown on November 16th, D_2 recorded the

Table - 4

Length of vine at 30 and 60 days after sowing

Treatments	Vine length (cm) 30 DAS	60 DAS
Date of sowing		
D1	53.36	687.27
D2	57.46	692.22
D3	53.58	675.62
D4	52.27	669.62
D5	49.79	664.17
D6	47.82	659.56
D7	46.34	654.39
SEM±	0.499	1.73
CD	1.537	5.36
Irrigation		
I_1	53.57	684.40
I_2	49.58	661.45
I_3	48.60	658.72
I_4	54.33	686.20
SEM±	0.386	1.33
CD	1.1036	3.81

highest vihe length of 57.46 cm 30 DAS, followed by the treatment D_3 which was on par with the treatments D_1 and D_4. The sowing date D_7 recorded the lowest vine length and was significantly inferior to D_5 and D_6.

At 60 DAS, the crop sown on November 16th, D_2 produced the highest vine length of 692.22cm, which was on par with treatment D_1. This was followed by treatment D_3 and was significantly superior to D_4 and D_5. The sowing date D_7 recorded the lowest vine length, and was on par with treatment D_6

As evident from the table, the length of vine at 30 days after sowing and at 60 DAS was significantly influenced by irrigation. The pot watering method, I_4 recorded the highest vine length of 54.33cm and 686.20 cm. at 30 DAS and at 60 DAS respectively, which was on par with treatment I_1. Vine length decreased with the decreasing levels of irrigation and I_3 recorded the lowest vine length which was on par with I_2, both at 30 and 60 days after sowing.

The interaction effect between date of sowing and levels of irrigation on vine length recorded at 30 and 60 DAS was not significant.

1.2 Node at which the first female flower appeared

The data pertaining to the node at which the first female flower appeared are given in Table- 5 and its analysis of variance in Appendix - II.

As clear from the table, the node at which the first female

Table - 5

Days taken for first female flower to appear, node at which the first female flower was produced and the days to picking maturity

Treatments	Days taken for first female flower to appear	Node at which first female flower was produced	Days to picking maturity
Date of sowing			
D1	30.17	11.27	46.44
D2	32.39	12.41	45.07
D3	31.64	10.75	47.68
D4	30.08	10.55	44.03
D5	30.39	10.05	43.94
D6	30.83	9.88	43.85
D7	27.83	9.74	42.58
SEM±	0.193	0.295	0.451
CD	0.595	0.90	1.39
Irrigation			
I_1	29.63	10.12	44.31
I_2	31.33	10.92	45.61
I_3	31.30	11.36	46.09
I_4	29.62	10.26	43.64
SEM±	0.128	0.29	0.14
CD	0.366	0.42	0.42

flower appeared showed significant variation depending on the different dates of sowing. The date of sowing treatment D_7 took the least number of nodes for the female flower production. However it was on par with D_6, D_5 and D_4. The treatment D_2 took significantly more number of nodes for female flower production, followed by the treatment D_1, which was on par with the treatment D_3.

The irrigation treatment I_1 took the least number of nodes for female flower production. However it was on par with I_4. The treatment I_3 took significantly more number of nodes for female flower production, followed by the treatment I_2.

The interaction effect of irrigation and date of sowing on node at which the first female flower appeared was not significant.

1.3. Days to picking maturity

The mean number of days taken to attain picking maturity from flowering are shown in Table-5 and its analysis of variance in Appendix-II.

The date of sowing D_3 took the maximum number of days to reach picking maturity, which was on par with D_1. This was followed by the treatment D_2, but it was on par with D_4 and D_5. The least number of days was taken by D_7 which was on par with D_6.

The irrigation treatment I_4 took the least numbewr of days to reach picking maturity, followed by I_1, I_2, I_3.

The interaction effect of irrigation and date of sowing on picking maturity was not significant.

1.4 Days taken for the first female flower to open

The data pertainingtothe mean number of days taken for the first female flower to open are given in Table-5 and the analysis of variance in Appendix-II.

As evident from the table, the dates of sowing significantly influenced the number of days taken for female flower production. The date of sowing D_2 took more number of days for production of female flower, which was followed by the treatment D_3 and D_6 respectively. The dates of sowing D_5, D_1 and D_4 were on par and they took 30.39, 30.17 and 30.08 days respectively for female flower production. The treatment D_7 took significantly the least number of days for production of female flowers.

Higher levels of irrigation hastened the female flower production. The treatment I_4 produced female flowers earlier than all other treatments and it was on par with I_1. The treatment I_2 significantly,took more days for female flower production and was on par with I_3.

The interaction effect of date of sowing and levels of irrigation on days taken for the first female flower to open was not significant.

1.5 Number of female flowers produced at 30 and 60 days after sowing

The data on the total number of female flowers produced at 30 and 60 DAS are given in Table-6 and the analysis of variance in Appendix-III. Illustrations are given in Figs 5 and 6.

At 30 DAS, the highest number of female flowers were produced by the treatment D_2. There was no significant difference among other dates of sowing with respect to female flower production.

Among the different dates of sowing, the treatment D_2 produced the maximum number of female flowers at 60 days after sowing and was on par with D_1. The dates of sowing D_3 and D_4 were on par. The treatment D_7 produced the least number of female flowers, but was on par with D_5 and D_6.

The total number of female flowers produced at 30 DAS increased progressively with higher levels of irrigation. ie, I_4 and I_1. The treatments I_2 and I_3 produced significantly less number of female flowers.

Among the levels of irrigation, a similar trend was noticed at 60 DAS, with respect to female flower production. The frequently irrigated treatments I_4 and I_1 recorded the highest value. The treatmets I_2 and I_3 produced less number of female flowers and were inferior to I_4 and I_1.

The interaction effect of date of sowing and levels of irrigation on the total number of female flowers produced at 30

Table - 6

Number of female flowers produced at 30 and 60 days after sowing

Treatment		numoer of female flowers 30 DAS	60 DAS
Date of sowing			
	D1	0.71	6.81
	D2	1.58	7.28
	D3	0.62	6.27
	D4	0.66	5.89
	D5	0.58	5.54
	D6	0.52	5.39
	D7	0.38	5.18
	SEM±	0.18	0.179
	CD	0.55	0.55
Irrigation			
	I_1	0.95	6.30
	I_2	0.47	5.92
	I_3	0.44	5.61
	I_4	1.15	6.38
	SEM±	0.09	0.09
	CD	0.26	0.28

Fig: 5 - Effect of date of sowing on the number of female flowers produced at 30 and 60 days after sowing

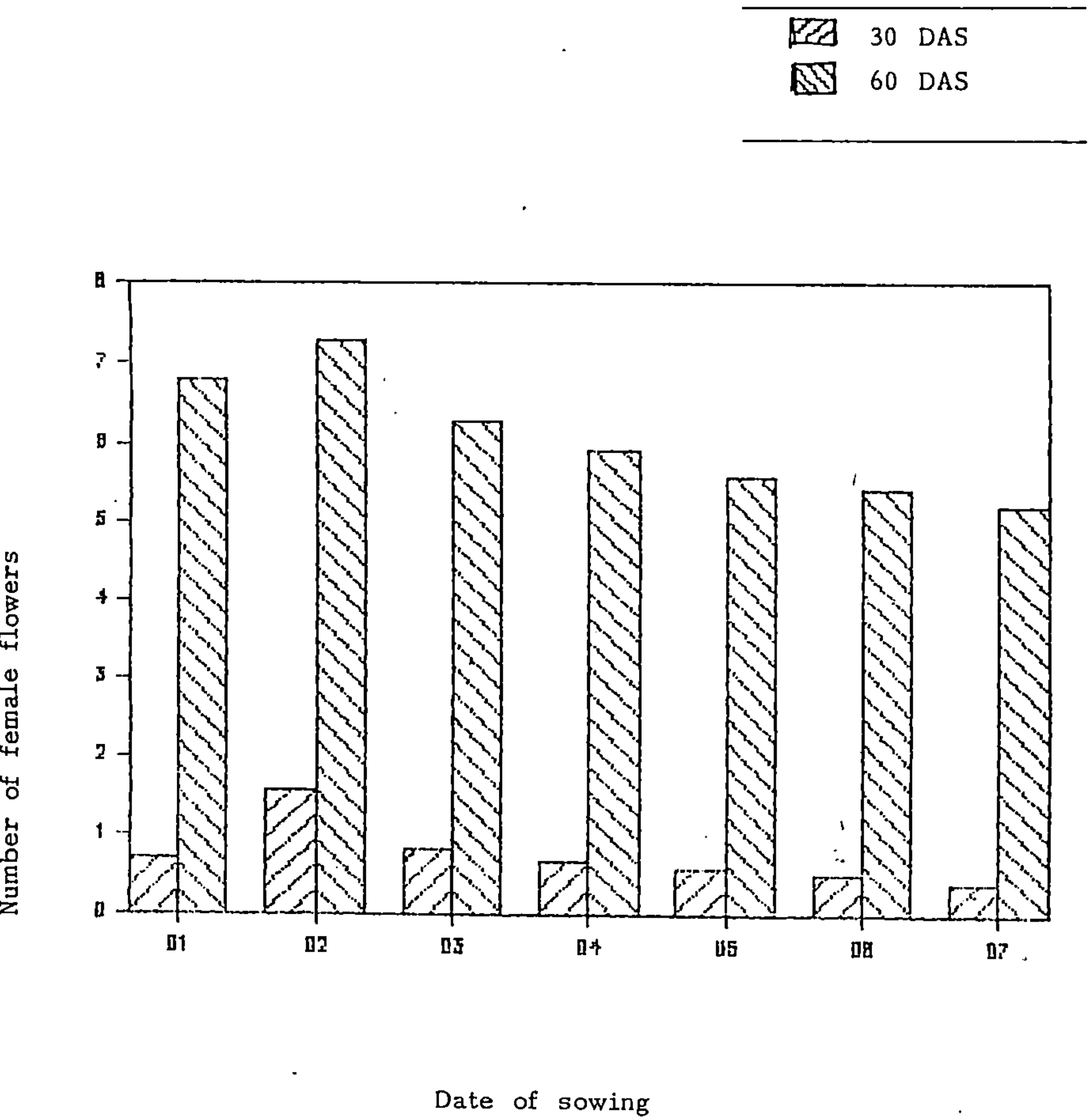
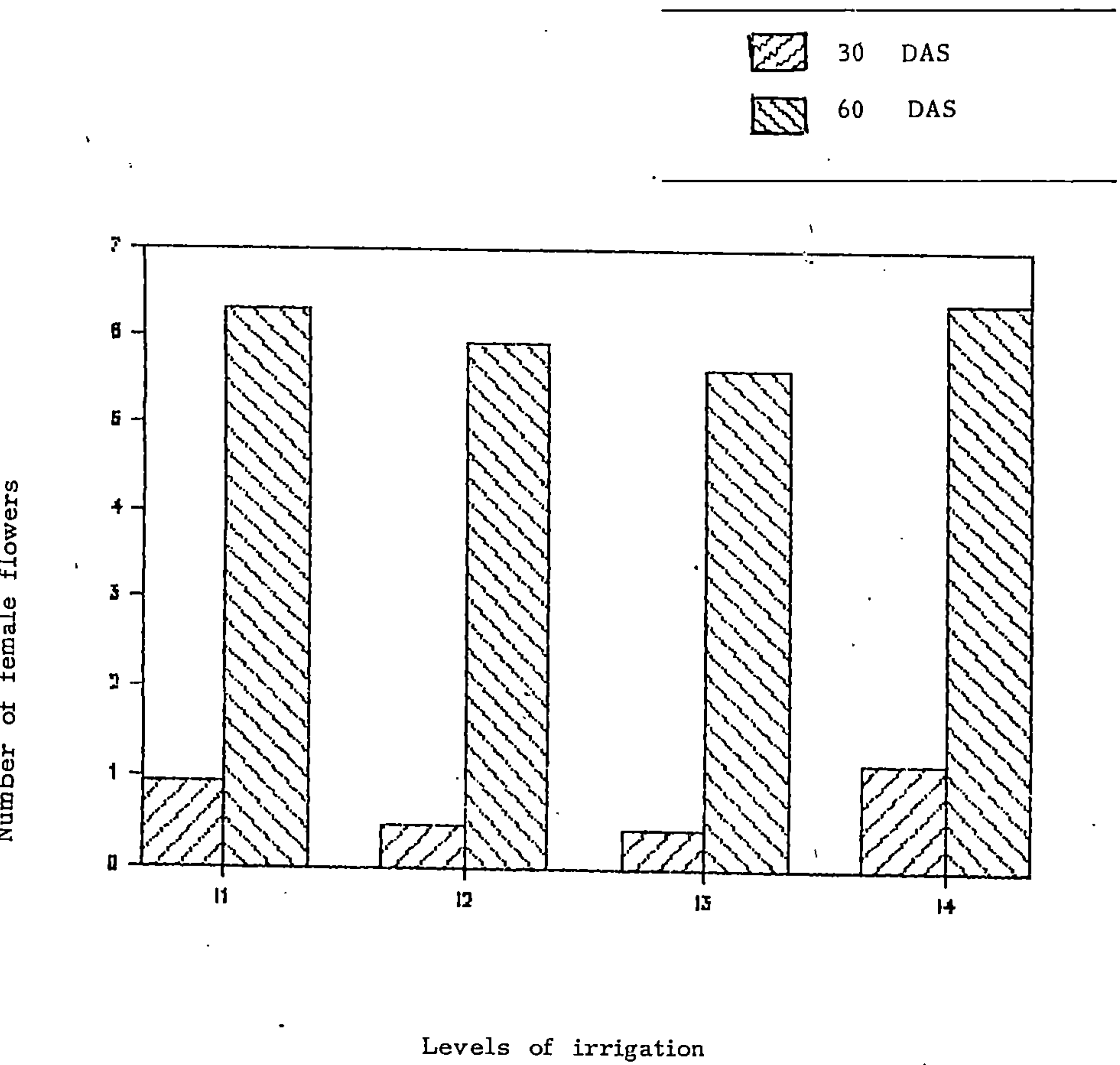


Fig: 6 - Effect of irrigation on the number of female flowers produced at 30 and 60 days after sowing.



and 60 DAS was not significant.

1.6 Number of male flowers produced at 30 and 60 days after sowing

The mean number of male flowers produced per plant at 30 and 60 DAS are presented in Table_7 and its analysis of variance table is given in Appendix_III .

At 30 DAS, the highest number of male flowers were produced by the crop sown on November 16th, D_2 followed by the treatment D_1. The treatment D_3, D_4 and D_5 were on par and were inferior to D_2 and D_1. The treatment D_7 produced the least number of male flowers, followed by the treatment D_6.

But at 60 DAS, the trend was different with respect to male flower production. The highest number of male flowers were produced by the treatment D_6 and was on par with D_5 and D_7. The treatment D_4 and D_3 were on par. The crop sown on November 1st, D_1 produced the least number of male flowers followed by the treatment D_2.

The highest number of male flowers produced at 30 DAS by the treatment receiving the highest levels of irrigation ie, I_4 and I_1. The treatments I_2 and I_3 produced significantly less number of male flowers.

Among the different levels of irrigation, a similar trend was noticed at 60 DAS, with respect to male flower production. The frequently irrigated treatments I_4 and I_1 recorded the highest value and were significantly different from each other,

Table - 7

Number of male flowers produced at 30 and 60 days after sowing

Treatment		Number of male flowers	
		30 DAS	60 DAS
Date of sowing			
	D1	9.85	26.84
	D2	12.15	30.55
	D3	9.23	37.12
	D4	8.72	38.48
	D5	8.69	46.12
	D6	8.34	46.38
	D7	7.69	41.24
	SEM±	0.22	0.578
	CD	0.70	1.78
Irrigation			
	I_1	9.40	39.25
	I_2	8.68	37.28
	I_3	8.53	37.22
	I_4	10.34	40.50
	SEM±	0.089	0.23
	CD	0.256	0.67

with I_4 registering the highest value for male flower production. The treatments I_2 and I_3 were on par and were ingferior to I_4 and I_1.

The interaction effect of date of sowing and levels of irrigation on the male flower production was not significant.

1.7 Sex ratio

The mean value of sex ratio for the different treatments are given in Table_ 8 and the analysis of variance is given in Appendix_IV. Illustrations are given in Figs- 7 and 8.

There was significant difference in the value of sex ratio among different dates of sowing. The lowest male female flower ratio value was obtained from the crop sown on November 16th, D_2, which was on par with D_1. The sex ratio value progressively increased with later dates of sowing D_3, D_4, D_5, D_6 and D_7 respectively and were significantly different from each other, with D_7 registering the highest value for sex ratio.

The mean values of male female flower ratio value significantly decreased with increasing levels of irrigation. The lowest sex ratio was obtained from the treatment I_4 and progressively increased with lower levels of irrigation viz I_1, I_2 and I_3 respectively.

The interaction effect was significant. The highest sex ratio value was recorded by the treatment combination $D_7 \times I_3$.

Table - 8

Sex ratio

Treatment		Sex ratio
Date of sowing		
	D1	4.09
	D2	4.06
	D3	5.91
	D4	6.59
	D5	8.29
	D6	8.60
	D7	8.75
	SEM±	0.05
	CD	0.16
Irrigation		
	I_1	6.45
	I_2	6.76
	I_3	6.87
	I_4	6.34
	SEM±	0.01
	CD	0.05

Table - 8(a)

Combined effect of date of sowing and levels of irrigation on sex ratio

Treatments	I_1	I_2	I_3	I_4
D1	4.05	4.14	4.22	3.98
D2	3.98	4.12	4.16	3.98
D3	5.80	6.10	6.20	5.55
D4	6.32	6.80	6.90	6.38
D5	8.13	8.37	8.62	8.06
D6	8.36	8.89	8.92	8.24
D7	8.53	8.95	9.08	8.45

SEM± 0.049

CD 0.14

Fig: 7 - Effect of date of sowing on sex ratio

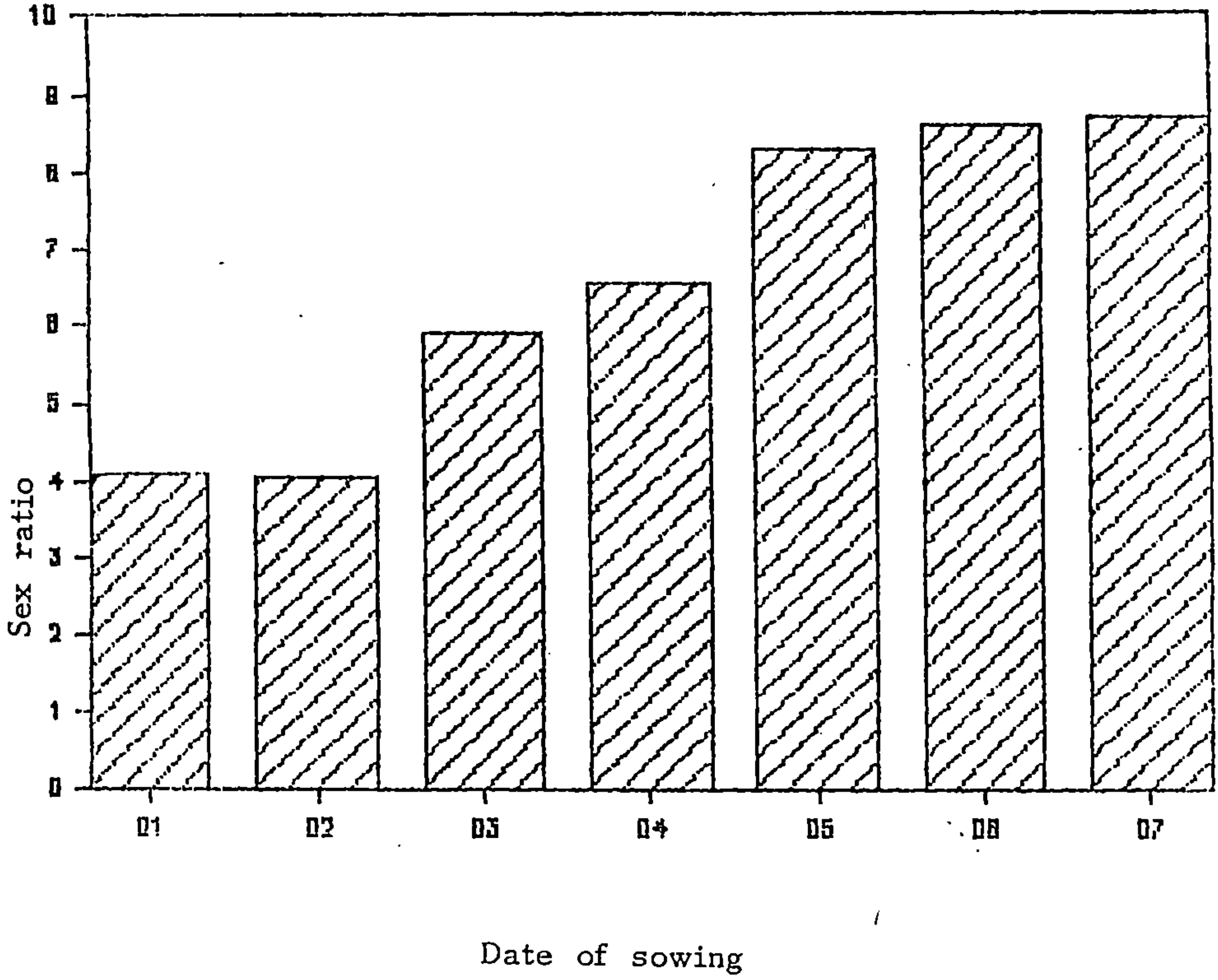
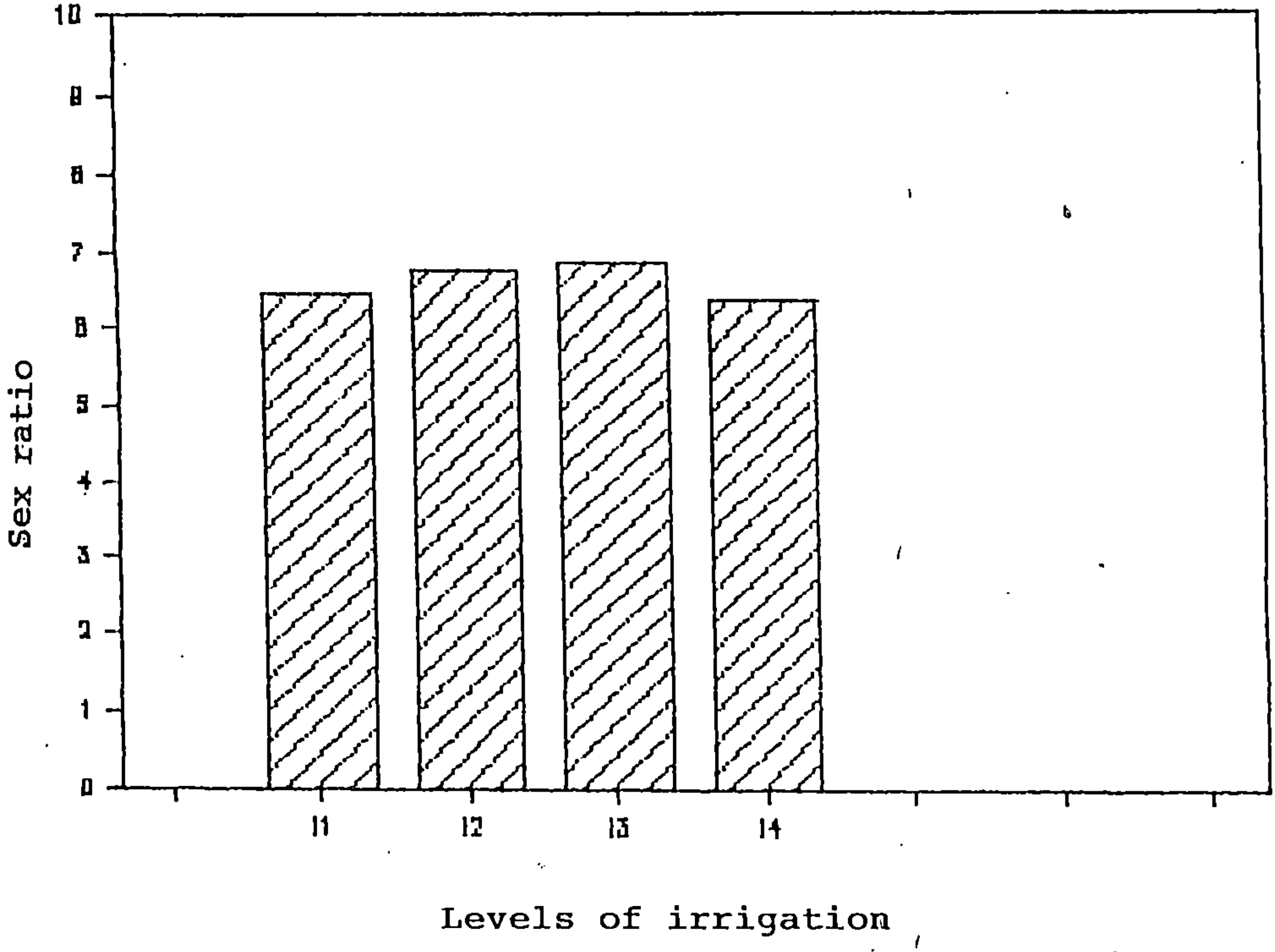


Fig. 6 Effect of irrigation on sex ratio



1.8 The Number of fruits per plot

The mean number of fruits produced per plot are presented in Table-9 and the analysis of variance is given in Appendix-VI. Illustrations are given in Figs- 9 and 10

With respect to number of fruits per plot, the crop sown on November 16th ,D_2 produced the maximum number of fruits per plot(10 fruits). The treatments D_4, D_1, D_3, D_5, D_6 were on par and were significantly inferior to D_2. The treatment D_7 produced the lowest number of fruits per plot.

Among the different levels of irrigation treatment I_4 produced the maximum number of fruit per plot which was on par with I_1. The treatment I_2 and I_3 were on par and were significantly inferior to I_4 and I_1.

The interaction effect was not significant.

1.9 Weight of fruit

The mean weight of fruits for the different treatments are given in Table - 9 and the analysis of variance is given in Appendix-VI. Illustrations are given in Figs - 9 and 10.

The date of sowing D_2 recorded the highest mean weight of fruit (3.60Kg) which was on par with D_3, followed by the date D_1. The treatments D_4, D_5 and D_6 were on par and were inferior to D_2, D_3 and D_1. The lowest value for mean weight of fruit was recorded by D_7 (3.20Kg).

The mean weight of fruits was highest for the irrigation treatment I_4 (3.53Kg) which was on par with I_1. The treatments

Table - 9

Weight of fruit and number of fruits per plant

Treatments	Weight of fruit (Kg)	Number of fruits per plot
Date of sowing		
D1	3.40	8.08
D2	3.60	10.00
D3	3.50	7.75
D4	3.38	8.16
D5	3.29	7.75
D6	3.26	7.75
D7	3.20	7.41
SEM±	0.0404	0.196
CD	0.124	0.601
Irrigation		
I_1	3.50	8.57
I_2	3.25	7.47
I_3	3.23	7.51
I_4	3.53	8.90
SEM±	0.032	0.261
CD	0.093	0.747

Fig: 9- Effect of date of sowing on the number of fruits per plot/ weight of fruit(Kg) and girth of fruit(cm)

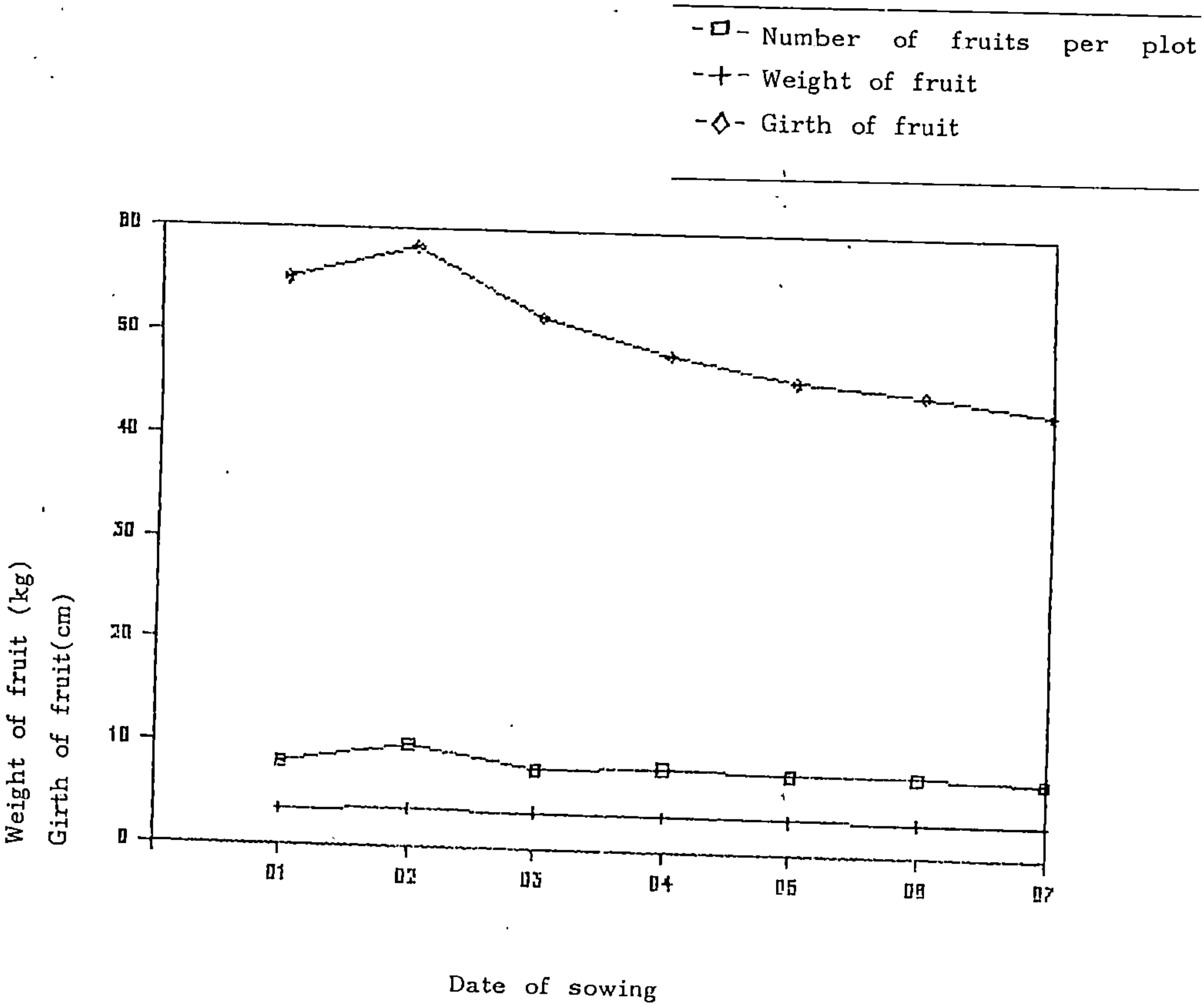
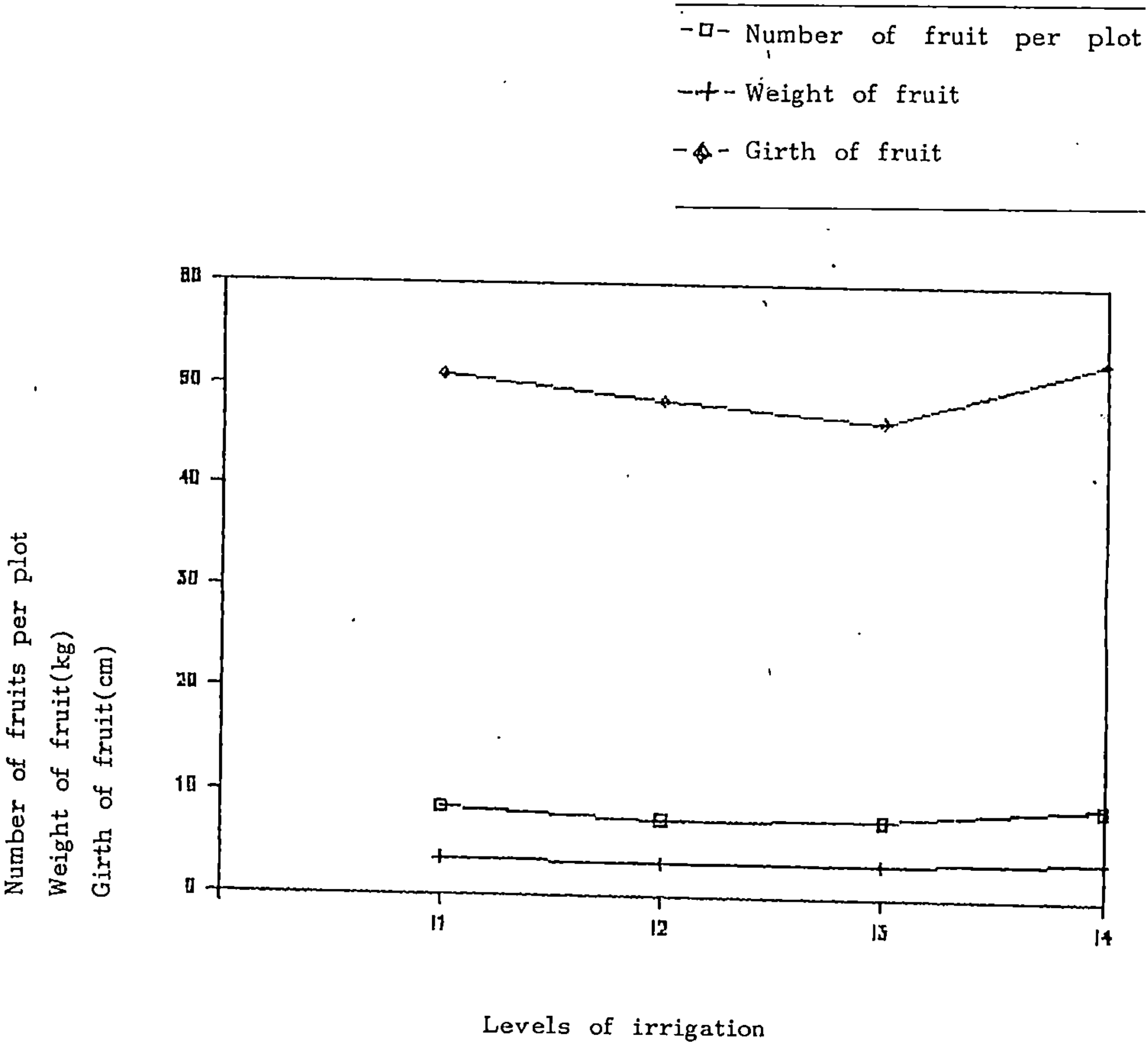


Fig: 10 - Effect of irrigation on the number of fruits per plot/ weight of fruit(kg) and girth of fruit(cm)



par and were significantly inferior to I_4 and I_1.

The combined effect of dates of sowing and levels of irrigation on the weight of fruit was not significant.

1.10 Girth of fruit

The mean values for the girth of fruit are given in Table-10 and the analysis of variance is given in Appendix- IV. Illustrations are given in Figs - 9 and 10.

The date of sowing D_2 produced fruits with the highest girth (58.38 cm) . The treatments D_3, D_1 and D_4 were on par and were inferior to D_2. This was followed by D_5, D_6, D_7 but significantly different from each other with D_7 registering the lowest girth.

The mean girth of fruit was highest for the irrigation treatment I_4 (52.86cm) which was on par with I_1. The treatments I_2 and I_3 were on par and were inferior to I_4 and I_1.

The interaction effect was not significant.

1.11 Number of seeds per fruit

The data relating to the mean number of seeds per fruit are given in Table - 11 and the analysis of variance is given in Appendix-V.

The treatment D_2 produced the highest number of seeds per fruit which was on par with D_1, D_2, D_3, D_4, D_5 and D_6. The treatment D_7 produced the lowest number of seeds per fruit but was on par with treatment D_6.

Table - 10

Girth of fruit

Treatment	girth of fruit (cm)
Date of sowing	
D1	55.03
D2	58.38
D3	51.87
D4	48.36
D5	45.98
D6	44.85
D7	43.34
SEM±	0.4130
CD	1.2924
Irrigation	
I_1	51.16
I_2	48.07
I_3	46.65
I_4	52.86
SEM±	0.2874
CD	0.8213

Table - 11

Number of seeds per fruit and hundred seed weight

Treatments	Seeds per fruit	100 seed weight (g)
Date of sowing		
D1	481.91	6.43
D2	500.33	6.44
D3	476.58	6.50
D4	472.75	6.51
D5	462.41	6.82
D6	453.41	7.26
D7	409.00	7.44
SEM±	15.19	0.014
CD	46.81	0.044
Irrigation		
I_1	473.85	6.77
I_2	452.09	6.80
I_3	464.71	6.82
I_4	470.14	6.78
SEM±	12.25	0.0117
CD	35.02	0.033

Table - 11(a)

Combined effect of date of sowing and levels of irrigation on hundred seed weight (g)

Treatments	I_1	I_2	I_3	I_4
D1	6.46	6.41	6.43	6.45
D2	6.44	6.44	6.45	6.46
D3	6.52	6.51	6.51	6.48
D4	6.68	6.65	6.66	6.62
D5	6.84	6.78	6.82	6.88
D6	7.28	7.18	7.15	7.42
D7	7.41	7.44	7.45	7.40

SEM± 0.0309

CD 0.08

The irrigation treatments I_1, I_4, I_3 and I_2 were on par. The highest value was recorded by I_1 (473.85).

The interaction effect was not significant.

1.12 Hundred seed weight

The mean values for the hundred seed weight are given in table - 11 and the analysis of variance is given in appendix-V .

The crop sown on January 30th, D_7 was significantly superior to other treatments. This was followed by D_6 and D_5 and are significantly different from each other with D_6 registering the higher value. The treatments D_4 and D_3 were on par and were superior to D_2 and D_1, which were on par.

The irrigation treatment I_3 was significantly superior to other treatments and on par with I_2 . The treatment I_4 and I_1 were on par and were significantly inferior to I_2 and I_3.

The interaction effect of date of sowing and levels of irrigation had a significant influence on hundred seed weight and the highest value was recorded by the treatment combination, $D_7 \times I_3$ and the lowest by $D_1 \times I_2$.

1.13 Total soluble solids

The mean values of T.S.S are presented in Table -12 and its analysis of variance in Appendix-V.

The T.S.S content was not significantly affected by different dates of sowing.. The January 15th date of sowing produced the fruits with highest T.S.S content but was par with

Table - 12

T.S.S of fruit

Treatment		T.S.S. of fruit
Date of sowing		
	D1	11.75
	D2	11.83
	D3	11.75
	D4	11.66
	D5	11.75
	D6	12.00
	D7	11.91
	SEM±	0.14
	CD	0.409
Irrigation		
	I_1	11.52
	I_2	12.09
	I_3	12.61
	I_4	11.00
	SEM±	0.133
	CD	0.421

all other treatments. The sowing date, D_4 produced the fruits with lowest T.S.S content

As evident from the Table, the T.S.S content was significantly influenced by irrigation. The treatment I_3 produced the fruits with highest T.S.S content (12.61%) followed by I_2 and was significantly inferior to I_3. The lowest T.S.S content was recorded in treatment I_4 and was significantly inferior to the treatment I_1.

The interaction effect of irrigation and date of sowing on T.S.S content of the fruit was not significant.

1.14 Yield

Mean values of the yield in Kg per plot and Kg per ha are given in Table - 13 and the analysis of variance is given in Appendix-VI. Illustrations are given in Figs - 11 and 12.

Among the dates of sowing, the highest yield was produced by the second date of sowing D_2 which was significantly superior to other date of sowing. This was followed by treatment D_1 and D_3 and were significantly different from each other. The treatments D_4 and D_5 were on par. The treatment D_7 produced the lowest yield and was on par with D_6.

The treatment I_4 recorded the highest yield and was on par with treatment I_1 . The treatment I_2 and I_3 were on par and were significantly inferior to treatments I_4 and I_1.

The interaction effect of irrigation and date of sowing was not significant.

Table - 13

Yield in Kg per plot, Kg per ha and total dry matter production (g)

Treatments	yield Kg/plot	yield Kg/ ha	Total dry matter production (g)
Date of sowing			
D1	31.25	34721.83	179.55
D2	34.12	37892.91	188.25
D3	29.49	32772.75	168.60
D4	28.45	31596.75	165.31
D5	28.16	31295.71	162.66
D6	27.95	31064.33	156.00
D7	27.18	30207.91	150.90
SEM±	0.2890	320.92	1.106
CD	0.89	988.88	3.40
Irrigation			
I_1	31.56	35065.71	179.07
I_2	27.57	30621.23	161.37
I_3	27.00	29999.57	148.98
I_4	31.94	35486.19	179.87
SEM±	0.333	371.219	0.41
CD	0.95	1060.83	1.19

Table - 13(a)

Combined effect of date of sowing and levels of irrigation on total dry matter production (g)

Treatments	I_1	I_2	I_3	I_4
D1	194.50	170.46	155.70	197.56
D2	202.36	185.80	163.60	201.23
D3	184.10	158.17	147.73	184.40
D4	178.00	158.16	147.40	177.60
D5	173.50	157.06	145.00	175.10
D6	164.03	150.53	144.26	165.20
D7	157.17	149.30	139.17	158.00

SEM ± 1.11

CD 3.16

Fig: 11 - Effect of date of sowing on the yield(tha^{-1})

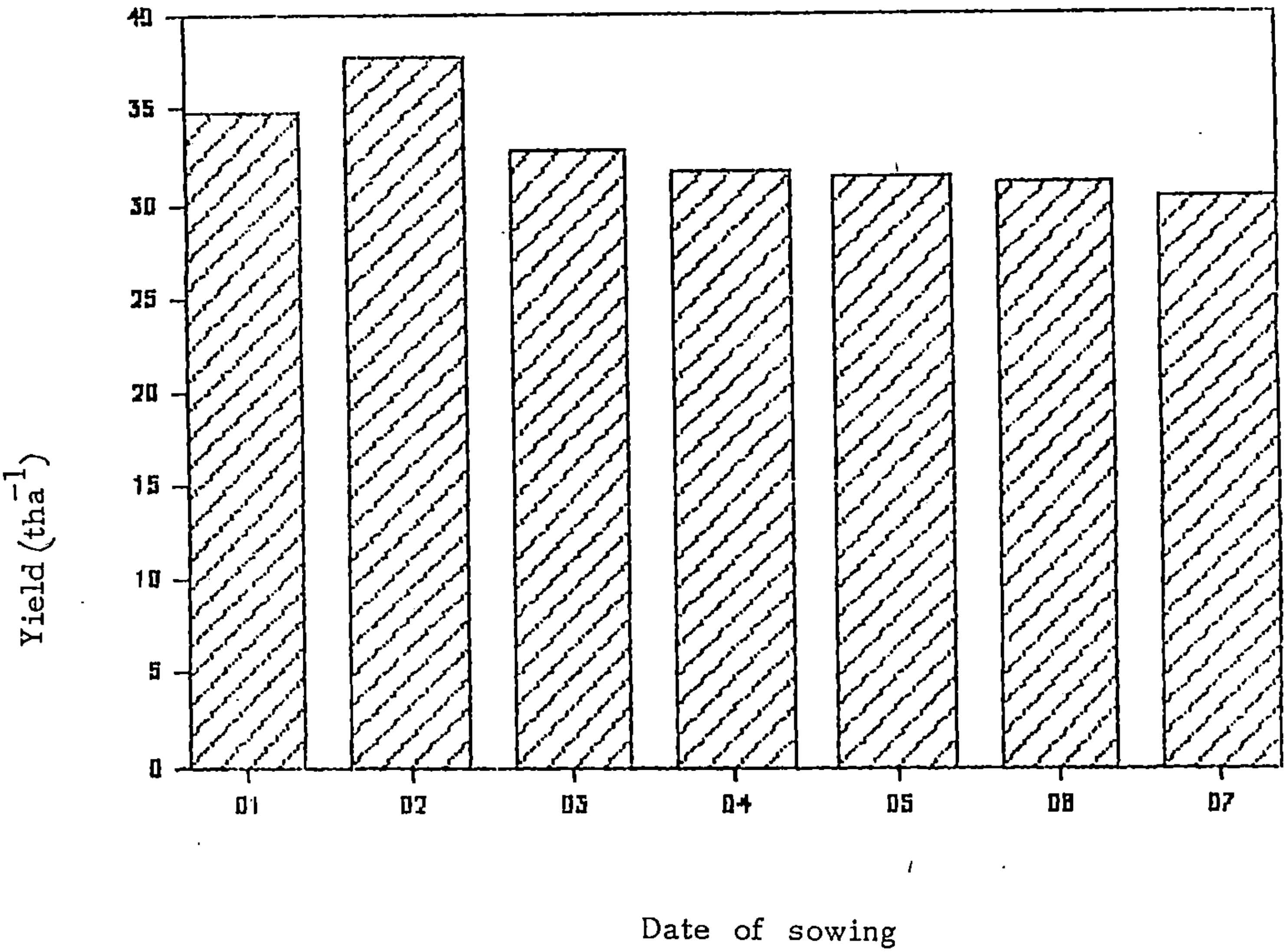
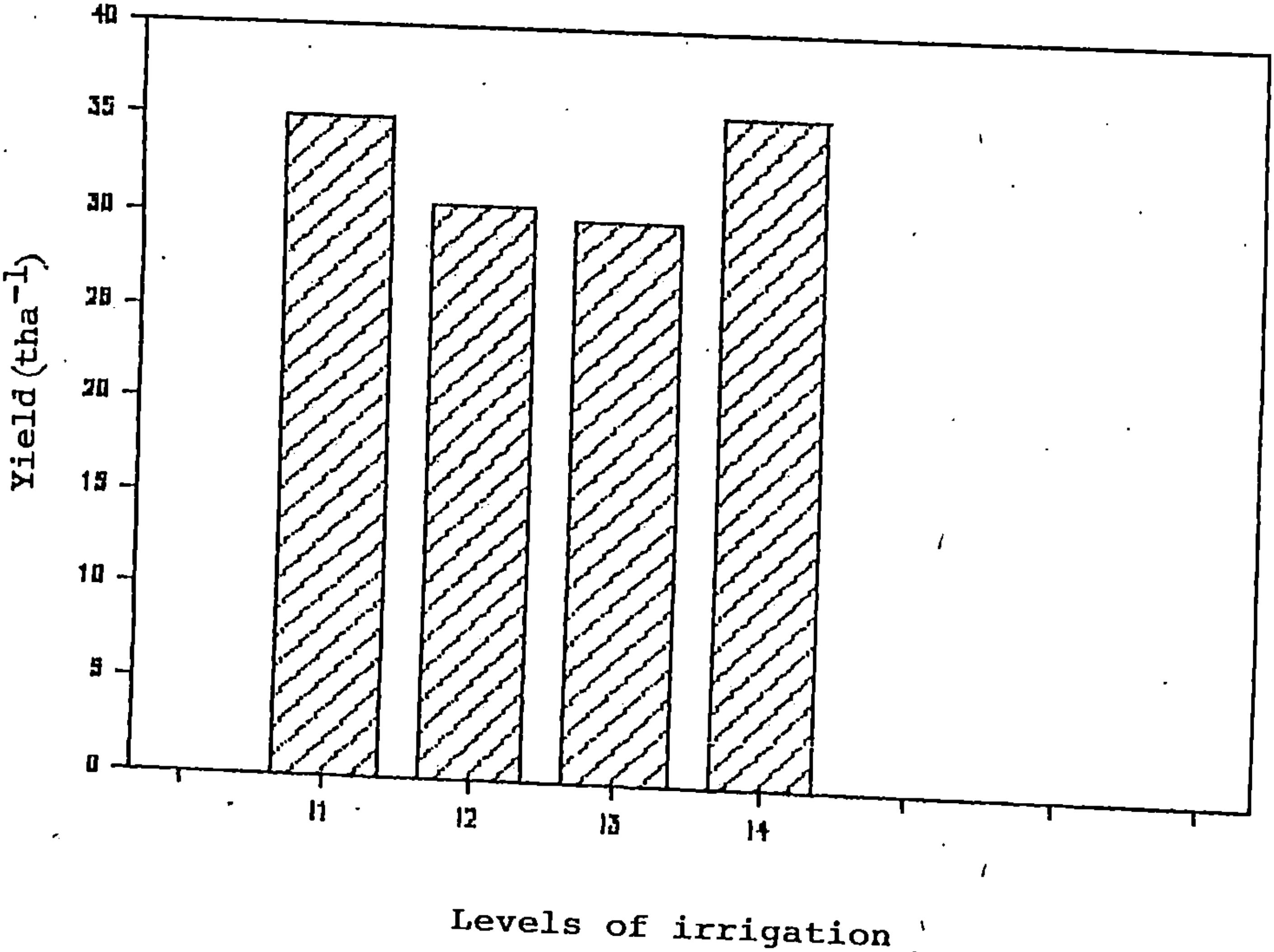


Fig: 12 - Effect of irrigation on the yield (tha^{-1})



1.15 Total dry matter production

The total dry matter produced by the plant is given in Table-13 XV and the analysis of variance is given in Appendix-VI.

The crop sown on November 16th, D_2 was significantly superior to all other dates of sowing with respect to total dry matter production and this was followed by the treatment D_1. The treatments D_3 and D_4 were on par and were significantly inferior to D_2 and D_1. These were followed by D_5, D_6 and D_7 and were significantly different from each other.

Irrigation treatments significantly influenced the total dry matter production per plant and the highest value was recorded by I_4 which was on par with I_1. The treatment I_2 was significantly lower than the treatments I_4 and I_1. The least value was recorded by I_3 which was significantly inferior to all other treatments.

The interaction effect of date of sowing and levels of irrigation has significant influence on total dry matter production. The highest value was produced by $D_2 \times I_1$.

2. Field water use efficiency

Mean values of the field water use efficiency in kg ha mm^{-1} and the corresponding water used for different treatments are given in Table - 14 and the analysis of variance table is provided in the Appendix-VII.

The date of sowing D_2 recorded the significantly the highest value (57.88 kg ha mm^{-1}) with respect to water use efficiency.

Table – 14

Mean table for the water applied and field water use efficiency

Treatments	Total water applied (mm)	Field water use efficiency kg ha mm^{-1}
Date of sowing		
D_1	664.7	53.12
D_2	668.8	57.88
D_3	608.4	55.71
D_4	598.4	54.72
D_5	608.1	52.67
D_6	590.9	53.82
D_7	585.2	52.85
SEM±	–	0.819
CD	–	2.52
Irrigation		
I_1	679.68	51.52
I_2	559.68	54.69
I_3	456.80	65.73
I_4	773.97	45.63
SEM±	–	0.929
CD	–	2.65

The dates of sowing D_3, D_4, D_6, D_1 and D_7 were on par and were significantly inferior to D_2. The date of sowing D_5 recorded the lowest value (52.67 kg ha mm^{-1}) and was significantly inferior to all other treatments.

The irrigation treatment I_3 registered the highest water use efficiency of 65.73 kg ha mm^{-1} which was significantly superior to other treatments. The treatment I_2 recorded the next highest water use efficiency followed by I_1 and I_4 and were significantly different from each other.

The interaction effect was not significant.

3. Soil moisture studies

3.1 Consumptive use

The mean values for consumptive use from the 21st day after sowing are given in Table-15. The calculation of consumptive use from the daily irrigated plots was not possible. The consumptive use was worked out by gravimetric method from soil moisture studies for the irrigation treatments at different dates of sowing. The highest consumptive use was observed in D_2(402.90 mm) followed by D_1, D_4, D_3, D_5, D_6 and D_7.

Among the irrigation treatments the highest values were recorded by I_1 (432.40 mm) followed by I_2 (355.94 mm) and I_3 (298.05 mm).

3.2 Soil moisture depletion

Mean values of soil moisture depletion are given in Table-16 and illustrated in Fig., 13. In all the treatments upper most

Table - 15

Mean consumptive use (mm)

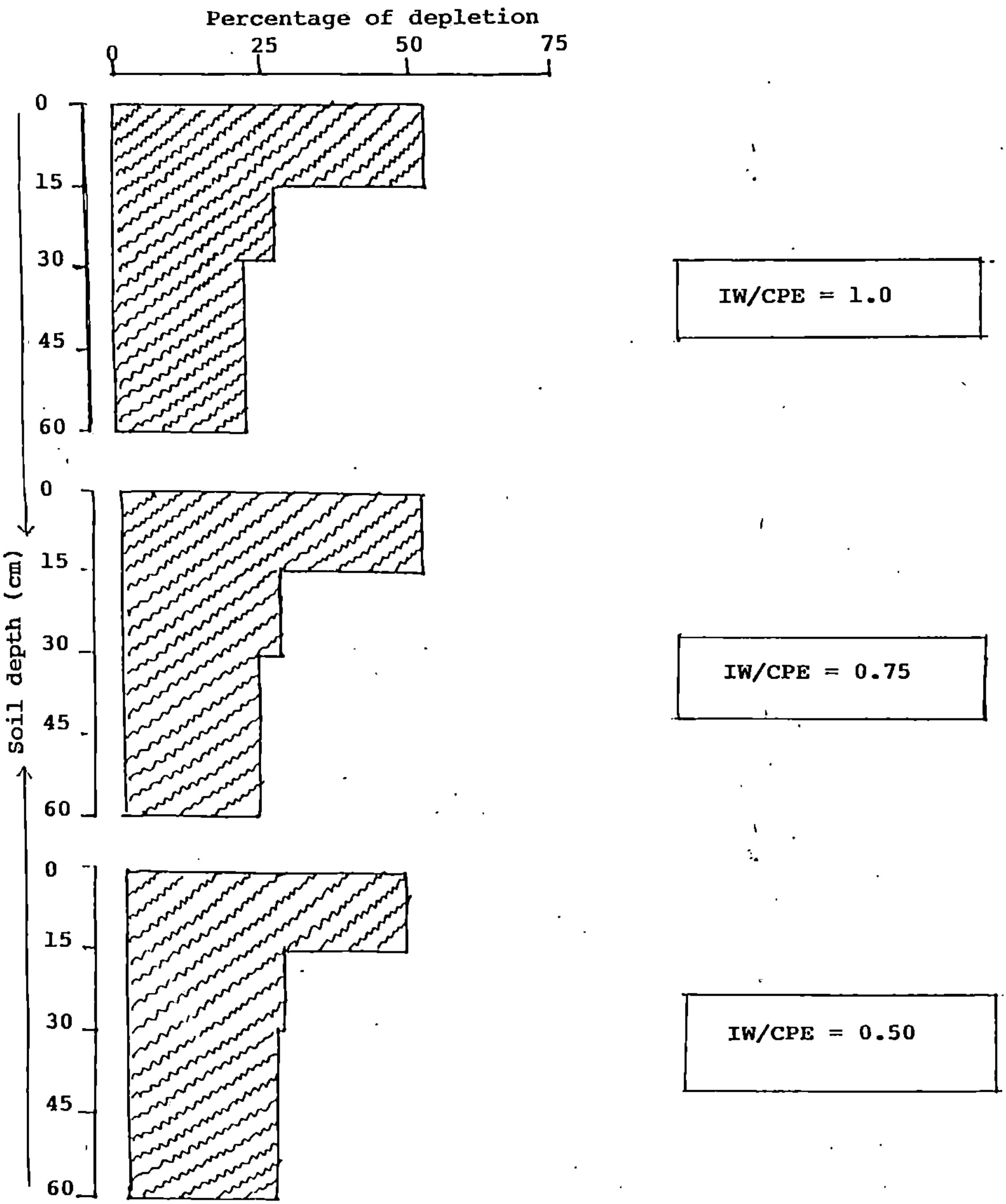
Treatments	I_1	I_2	I_3	Mean
D_1	440.79	387.28	291.71	373.26
D_2	451.28	398.51	358.94	402.90
D_3	457.39	329.16	288.96	358.50
D_4	463.81	368.62	282.47	371.63
D_5	424.96	342.21	299.50	355.50
D_6	411.66	340.76	284.34	345.58
D_7	377.14	325.07	280.45	327.57
Mean	432.40	355.94	298.05	-

Table - 16

Relative moisture depletion from different soil layers in percentage

Treatments	Relative Soil moisture depletion		
	0-15cm	15-30cm	30-60cm
I_1	53.71	26.70	21.12
I_2	51.43	26.83	22.75
I_3	47.81	27.12	26.01
D_1	50.37	27.69	23.46
D_2	52.13	27.75	22.68
D_3	50.86	26.45	22.07
D_4	50.69	26.42	22.89
D_5	49.50	27.13	23.42
D_6	49.80	26.42	23.84
D_7	49.84	26.29	23.98

Fig. 15 Soil moisture depletion p



layer (0 – 15 cm) recorded the maximum moisture depletion. It accounted for 47.81 to 53.71 percent of the moisture depletion. This was followed by the second layer (15-30cm) and then by the third. Among the three irrigation levels, moisture depletion was more from the deeper layer in the drier regimes. The later sowing dates extracted more moisture from the deeper layer than the earlier sowing dates.

4. Crop Weather Relationship

Simple correlation between yield per plot (kg), total dry matter production (g) and three weekly weather elements for overlapping periods 1 to 13 weeks after sowing was carried out. The three weather elements used for the study were maximum temperature, temmperature range and relative humidity. It was found that the temperature range during flowering and early fruit development (3rd to 7th week), maximum temperature during fruit development (7th to 10th week) and relative humidity during maturity (11th to 13th week) negatively correlated with yield. While for total dry matter production there was a negative correlation between temperature range during flowering (3rd to 5th week), maximum temperature during fruit development and early maturity (8th to 11th week) and relative humidity during maturity (11th to 13th week). The correlation coefficients for the period are given in Table 17.

The regression equation for yield was y=-0.39771(Tmax)-0.54749 (Tran)-0.051334(RH)+52.625534 and the regression equation for total dry matter production was y=-3.2010(Tmax)-3.7480(Tran)+0.11661(RH)+314.307648.

The multiple correlation coefficient for yield was 0.878 and for total dry matter production was 0.953

The estimated values for yield and total dry matter production using the regression equation and the actual values are given in Table-18 and Fig-14 and 15.

Table - 17

Correlation coefficients between yield per plot (kg), total dry matter production(g) and weather elements

Crop character	Weather element	Period (week)	Stage of the crop	correlation coefficient
Total yield (t ha^{-1})	Maximum temparature	7-10	Fruit development	-0.865*
"	Temparature range	3-7	Flowering and early fruit development	-0.857*
"	Relative humidity	11-13	Maturity	-0.783*
Total dry matter production(g)	Maximum temparature	8-11	Fruit development and early maturity	-0.902**
"	Temparature range	3-5	Flowering	-0.940**
"	Relative humidity	11-13	Maturity	-0.789*

* significant at 5 percent level
** significant at 1 percent level

Table -18

Actual yield per plot(kg), and total dry matter production(g) with the corresponding values estimated from the regression equation.

Date of sowing	Yield per plot(kg)		Total dry matter production(g)	
	Actual	Estimated	Actual	Estimated
D_1	31.25	31.20	179.55	182.14
D_2	34.12	32.01	188.25	181.51
D_3	29.49	31.01	168.60	173.73
D_4	28.45	28.63	165.31	166.01
D_5	28.160	27.86	162.66	162.73
D_6	27.95	27.41	156.00	152.56
D_7	27.18	27.55	150.90	152.60

g: 14 - Actual yield in Kg per plot and corresponding estimated values from the regression equation.

-□- Actual yield

-+- Estimated yield

= -0.39771(Tmax)- 0.54749(Tran)-0.51334(RH)+ 52.625534

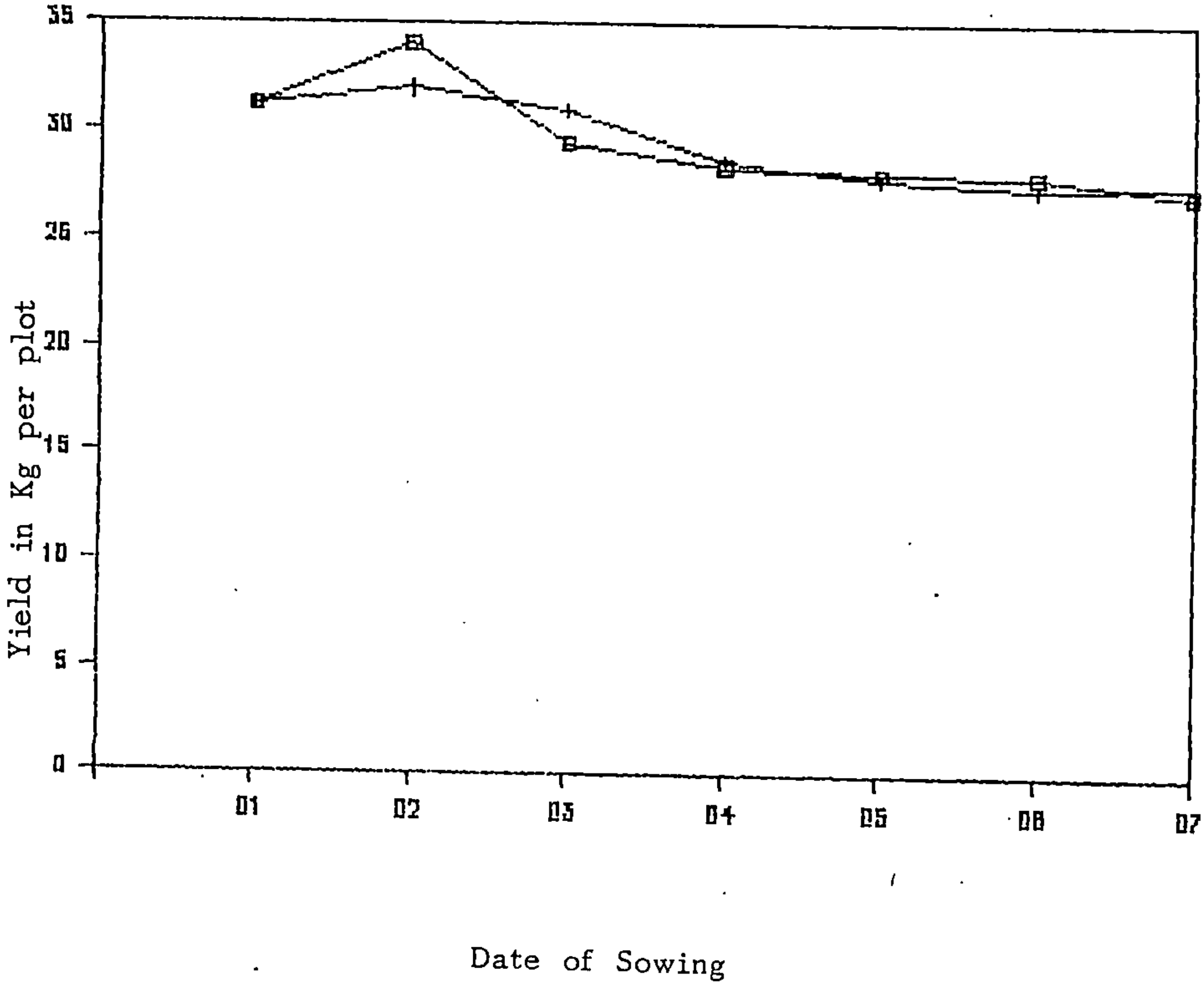
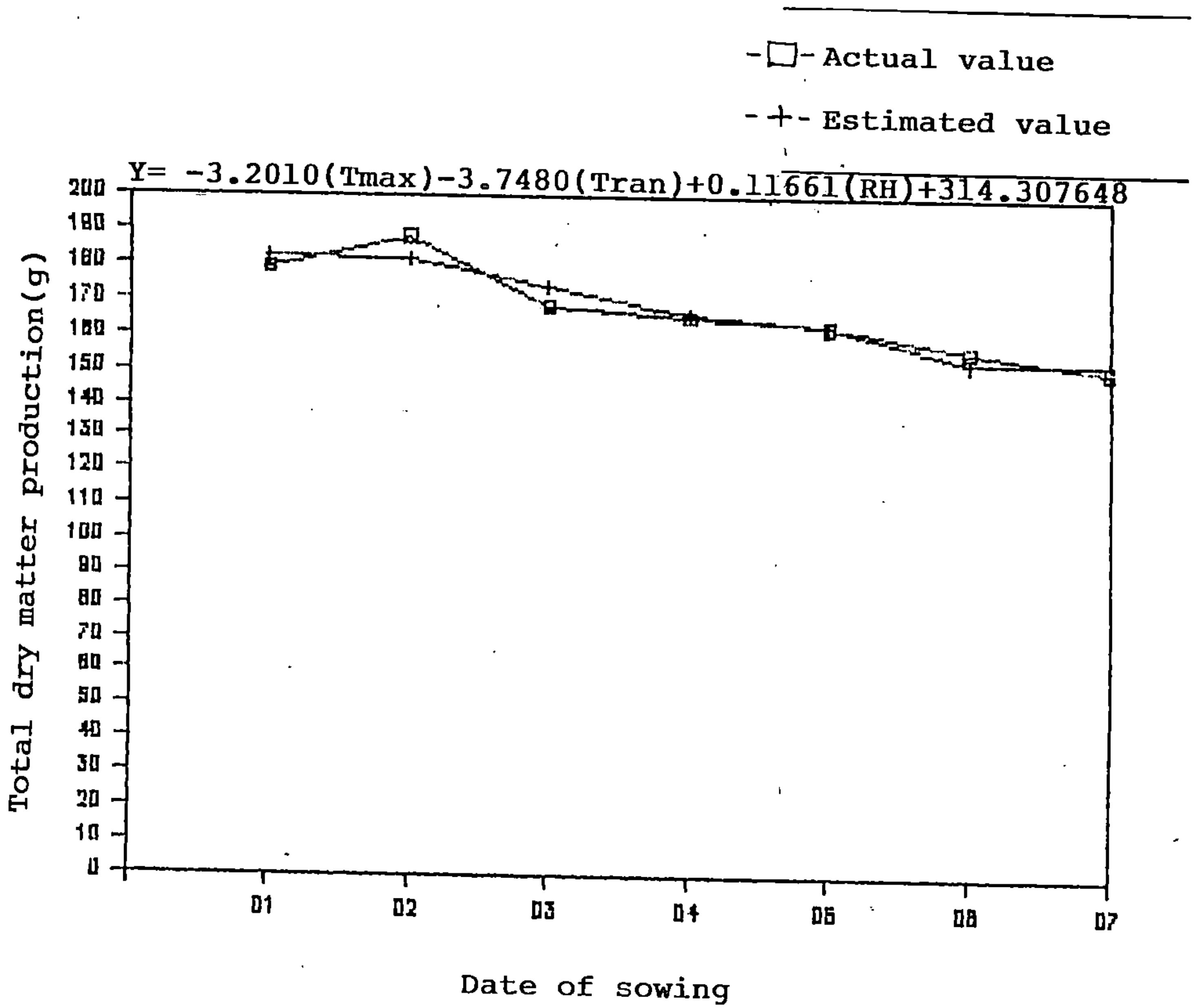


Fig: 15 - Actual total dry matter production(g) and corresponding estimated values from the regression equation.



DISCUSSION

The present investigation was taken up to study the influence of date of sowing and levels of irrigation on the growth and yield of water melon , cv Arka Jyothi in rice fallows. The results obtained are discussed below :

1. Biometric observations

1.1 Length of vine

The November sowing resulted in a significant increase in vine length at 30th and 60th days after sowing than over the later sowings. This may be due to the optimum weather conditions which prevailed during the growing period of November sown plants. The growth difference due to variation in climate was noted by Hall (1949), Surlekov and Ivanov (1978) and Heij (1981) in cucumbers, Buttrose and Sedgley (1978) and Desai and Patil (1984) in water melon.

Irrigation exerted a significant influence on the length of vine, recorded at 30th and 60th day of sowing. The highest vine length was noticed in the conventional irrigation treatment and the lowest in the treatment IW/CPE ratio of 0.50, which received the lowest quantity of water. Water deficit is likely to affect two vital processes of growth viz, cell division and cell enlargement, and according to Begg and Turner (1976), cell enlargement is more affected resulting in poor growth. This is in agreement with the findings of Flocker et al. (1965) in cantaloups and Yamashita et al. (1982) in cucumber.

Interaction between date of sowing and irrigation was not significant on the length of vine, at 30th and 60th day after sowing.

1.2 Node at which the first female flower appeared

There was a decrease in node number with later sowing dates. The November 16th sowing took significantly more number of nodes for female flower production. Position of female flower on the vine depends on day length and night temperature (Nitch et al. 1952).

The plants receiving more frequent irrigation produced female flowers at a lower node. The plants irrigated at IW/CPE ratio of 0.50 produced female flowers at a significantly higher node than the other treatments. This was expected, as the frequently irrigated plants start flowering at an early date.

1.3 Days to picking maturity

The treatment D_3 (crop sown on December 1st) took more number of days to reach picking maturity than the other treatments. Vooren and Challa (1978) indicated that in cucumbers, earliness was strongly affected by planting dates and night temperatures. December sown plants experienced lower night temperatures (21.1°C to 23.4°C) than the earlier and later sowings and this may have resulted in delayed maturity. Similar observations were made by Drews et al.(1980), Heij(1981) and Slack and Hand (1981) in cucumber and Jacob(1986) in bitter gourd.

Treatments receiving higher levels of irrigation reached picking maturity earlier . The irrigation treatment I_4 took significantly the lowest number of days to reach picking maturity. The fruit development depends on the conditions prevailing during the period of fruit development. During this period considerable amount of water and carbohydrates are transported into the developing fruit (Kaufman, 1972). So the treatments receiving higher levels of irrigation would have better fruit development and might reach maturity faster than drier regimes. Similar results were reported by Pew and Gardner (1983).

1.4 Days taken for the first female flower to appear

The plants sown during December exhibited delay in the onset of flowering than the later sowings. Temperature and daylength affected the preflowering phase and cloudiness favoured the production of female flowers (Kamalanathan and Thamburaj, 1970). The later sowings experienced high cloud cover, since the sunshine recorded during the period ranged from 6.8 to 9.4 hours/day. This may have been the reason for earlier flower production in later sowings. Influence of date of sowing on female flower production has been reported by Edmond (1930) in cucumber. Sharma and Nath (1971) in water melon, musk melon, snap melon and long melon.

Plants receiving higher levels of irrigation produced the female flowers earlier. Larson (1975) stated that a slight water stress can reduce the rate of appearance of female primordia. This was evident in the work of Molnar (1965) in melons. Thomas (1984) noted that there was a trend to hasten flowering at higher levels of irrigation in bitter gourd.

1.5 Number of female flowers produced at 30 and 60 days after sowing

In both the two stages, the plants sown during November produced greater number of female flowers than the plants sown later. This may be due to the lower temperature (21.1°c-23.4°c) experienced during November than the later periods. Effects of low temperatures and day length on female flower production was reported by Edmond (1930), Nitch <u>et al</u>. (1952), Venketram (1963), Matsuo(1968), Kamalanathan and Thamburaj (1970) and Cantliffee (1981) in cucurbit vegitables.

Female flowers produced at 30 and 60 days after sowing was significantly influenced by irrigation. Treatmants receiving frequent irrigation produced more female flowers than those receiving less frequent irrigation. This is in tune with the observations made by Abolina <u>et al</u>. (1963) that regularly watered plants produced greater number of female flowers. Water stress during inflorescence development reduced the number of primordia and hindered the development of these into fertile florets (Kaufman, 1972 and Begg and Turner, 1976). This view is in agreement with the observations made by Molnar (1965) that in melons irrigation increased female flower production.

1.6 Number of male flowers produced at 30 and 60 days after sowing

At 30 days after sowing, the early sown plants produced more male flowers than the later sown plants. But the trend was different at 60 days after sowing, where later sown plants produced more male flowers than the early sown plants. Edmond (1930) working with cucumber noted that seasonal variation in sex expression of cucumber could be attributed to the change in day length. High temparature and long days tend to keep the vine in the male phase in Cucurbita pepo. The January sown plants were exposed to high temperature than the early sown plants. Similar results were put forward by Venketram (1963), Matsuo(1968) and Cantuffe (1981).

At all the stages, male flower production was significantly influenced by irrigation. Water stress during inflorescence development reduced the number of primordia and the development of these into fertile florets (Kaufman, 1972 and Begg and Turner, 1976). This might have been the reason for the higher production of male flowers in frequently irrigated plants.

1.7 Sex ratio

Among the different dates of sowing sex ratio shows an ascending trend with later sowings. The date of sowing D_7 recorded the highest sex ratio. In water melon (cv Sugar Baby) male female ratio was lowest in plants sown on the earlier date and the highest in those sown on January 20th (Desai and Patil, 1985). The increase in male female flower ratio with later sowing is due to higner production of male flowers by the later sowings.

Irrigation exerted a significant influence on the sex ratio expression. The treatment I_3 recorded the highest sex ratio followed I_2, I_1 and I_4. The increase in male female flower ratio with decreasing levels of irrigation is due to less production of female flowers by the treatment receiving low levels of irrigation.

The interaction effect of date of sowing and levels of irrigation on sex ratio expression is significant. The highest sex ratio value was recorded by the treatment combination $D_7 \times I_3$.

1.8 Number of fruits per plot

The plant sown on November 16th produced considerably higher number of fruits than the later sown plants. The lowest number of fruits was produced by the crop sown on January 30th. This was expected, as the November sown plants produced more female flowers. Difference in number of fruits due to difference in sowing date have been reported by Surlekov and Ivanov (1969), Heij and Lint (1982) and Desai and Patil (1984). This variation may have been due to the effect of night temparature and day length (Miller and Ries, 1958 and Heij and Lint, 1982).

The plants irrigated with greater quantity of water, induced the production of more fruits per plot. This is in agreement with the work of Henricksen (1980) in cucumber, Desai and Patil (1984) in water melon and Thomas (1984) in bitter gourd. The decreased fruit production in water stressed plants may have also resulted from reduced flower production. (Kaufman, 1972) and incresed fruit drop (Molnár, 1965).

1.9 Weight of fruits

The plants sown in late November produced fruits with higher mean weight (3.60 Kg) than the later sown plants. The favourable climatic conditions prevailed during the later November may be the reason for the larger fruit weight. Similar variation in fruit weight due to difference in planting date was reported by Ivanov and Surlekov (1969).

The more frequently irrigated plants produced fruits with higher weights (3.53Kg) than those irrigated less frequently. Frequent irrigation might have increased the availability and supply of plant nutrients resulting in better grwoth and translocation of photosynthates to fruits and fruit weight incresed. In fruits and vegetables, the fresh weight often continued to increase even after the increase in dry weight ceased(Begg and Turner, 1976). Since the size and weight of fruit at this stage depended on plant water potential to a greater extent,water deficit had a strong influence on fruit size and fruit weight, than the dry weight. This view is endorsed by the work of Niel and Zunino (1972), Caro and Linsalata (1977), Doorenbos and Kassan (1979) in melons and Thomas (1984) in bitter gourd.

1.10 Girth of fruit

Among the dates of sowing the November 16th sown plants produced fruits with higher girth (58.38cm) than the later sown plants. This may due to the availabilty of more favourable climatic conditions for vigorous growth of fruits in the early sowing period.

The fruit girth increased with soil wetness and the highest girth was recorded by the treatment I_4. Soil water availability affected fruit size by altering the internal plant water status. Effect of water deficit on fruit enlargement probably resulted from decreased turgor pressure in the fruit tissues and during severe stress, from reduced production of photosynthates for growth. Similar results were reported by Flocker et al.(1965) and Doorenbos and Kassan (1979) in melons and Thomas (1984) in bitter gourd.

1.11 Number of seeds per fruit

The earlier sown plants produced more seeds per fruit compared to the later sown plants. The effect of sowing date on seed production was reported by Suriekov and Ivanov (1969) in cucumber.

The plants receiving higher levels of irrigation produced significantly more seeds per fruit than those receiving lower levels of irrigation. The highest value was recorded by the conventionally irrigated plants. Water shortage at the time of flowering may have resulted in the reduction of number of seeds produced per fruit.

The interaction effect of date of sowing and irrigation on number of seeds per fruit was not significant.

1.12. Hundred seed weight

Among the date of sowing, the later sown plants recorded greater hundred seed weight than the earlier ones. The highest was by the plants sown on January 30th (7.44g). This increase in the hundred seed weight might have been due to the reduction in the number of seeds per fruit.

Irrigation also significantly influenced the hundred seed weight. The plants receiving lower levels of irrigation recorded greater hundred seed weight than those receiving higher levels of irrigation.

The interaction effect of date of sowing and levels of irrigation had a significant influence on hundred seed weight and the highest value was recorded by the treatment combination $D_7 \times I_3$ and the lowest by $D_1 \times I_2$.

1.13 T.S.S. of the fruit

Date of sowing did not significantly influence the T.S.S of the fruit. The various levels of irrigation exerted significant influence on the total soluble solid content of the fruit. The plants which received the lowest quantity of irrigation water recorded higher values. With increasing levels of irrigation, there was a continuous downward trend in the total sugar content of the fruit. The highest value of (12.61%) was recorded by I_3 and the increased sugar content under low water availability may be due to the increased starch hydrolysis with increasing moisture stress (Gates, 1968). Possibly the increase in the net rate of starch hydrolysis with increasing moisture stress results from an increase in the amount of asparagine, because asparagine, which activates the enzyme amylase (Hartt,1934) was found to increase, with a decrease in moisture content (Petric and Wood. 1938).

The interaction effect of date of sowing and irrigation was not significant.

1.14 Yield

The plants sown on November 16th produced significantly higher yield (34.72 t ha^{-1}) than the others. There was a continous downward trend in yield with the subsequent planting dates. The lowest yield was produced by the plants sown on January 30th (30.20 t ha^{-1}). This decreasing trend in yield in later plantings can be attributed to a more or less similar trend in yield attributes like size, weight and number of fruits per plant. This is to be expected, since fruit yield is the ultimate manifestation of the cumulative effect of these characters. Effect of sowing date on yield was recorded by Kartalov (1970) and Kmiecik and Lisiewska (1981) in cucumbers and by Khristov (1983) and Desai and Patil (1984) in melons.

The highest fruit yield was obtained with plants receiving the highest quantity of water. This was by conventional irrigation (daily irrigation) and was on par with IW/CPE ratio of 1. The treatment I_2 (IW/CPE ratio of 0.75) and I_3 (IW/CPE ratio of 0.50) were on par and significantly inferior to I_4 and I_1. The difference in fruit yield among irrigation treatments were the consequence of similar decrease in the yield components like girth, weight and the number of fruits. Water melons benifits from liberal applications of water which was observed by many earlier workers(Dimitrov, 1973; Desai and Patil, 1984). In water melon, practice of daily irrigation gave the highest yield (KAU, 1991).

The interaction effect of date of sowing and irrigation on the yield was not significant.

Multiple regression equation developed between the yield per plot and the weather parameters could explain about 77 percent of the total variation in the yield per plot. Fig-14 shows that estimated yields per plot from the multiple regression equation are in general agreement with the actual values.

1.15 Total dry matter production

The plants sown in November 16th showed vigrous growth and yield, accumulated significantly higher total dry matter than the other sowings. This could be due to the fact that the sunshine duration and temperature conditions were optimum for the plants in this particular treatment than any other treatments. The later sowings recorded a progressive reduction in dry matter production. This reduction can be attributed to variation in climate as reported by Hall (1949). Photosynthesis of the crops is influenced by the cliamate experienced by the plant and this in turn influence the dry matter production by the plant.

There was a significant effect of irrigation on dry matter production in water melon. The irrigation treatments receiving larger quantity of water accumulated more dry matter per plant (188.25 g) than other treatments. Water melon requires high soil moisture and its growth is greatly reduced by soil moisture stress (Dimitrov, 1973). Photosynthesis is the basic process for the build up of organic substances by the plant, whereby, sunlight provides the energy required for reducing CO_2 to sugar as the end product of the process. This sugar serves as the building material for all other organic components of the plant. Therefore the effectiveness of photosynthesis of the crop determines the amount of dry matter production. The less frequently irrigated plants would produce less dry matter, as reduction in water content brings about a similar reduction in the photosynthetic efficiency (Arnon, 1975). A similar trend was noted by Thomas (1984) in bitter gourd and by Lakshmanan (1983) in pumpkin, ash gourd and melon.

Multiple regression equation developed between the total dry matter production and the weather elements could explain, about 91 percent of the total variation in the total dry matter production. Fig. 15 shows that the estimated total dry matter production from the multiple regression equation are in general agreement with the actual values.

2. Field water use efficiency

The water use efficiency was higher for the earlier sown plants than the later sown ones, with the highest being recorded by November 16th planting 57.86 Kg ha mm^{-1}. Since the total yield was higher for November 16th sowing, the water use efficiency also showed a correspondingly high value. The effect of sowing dates on water use efficiency was reported by Desai and Patil (1984) in melons.

The number of irrigations and the amount of water used were considerably reduced by irrigation at decreasing IW/CPE ratio. The field water use efficiency increased with decrease in the levels of irrigation. The treatment I_3 gave the highest water efficiency of 67.04 Kg ha mm^{-1}.

Field water use efficiency increased with decreasing frequency of irrigation as there was a large saving in water in relation to increase in yield. A similar result was obtained by Jacob(1986) in bitter gourd and Thankamani (1987) in snake gourd. Stress during any phase of growth and development considerably reduced field water use efficiency as there was a large decrease in yield component in relation to saving in the water used.

The interaction effect of date of sowing and irrigations on the water use efficiency was not significant.

3. Soil moisture studies

3.1 Consumptive use

The highest consumptive use was recorded by D_2 (402.9mm) followed by D_1, D_4, D_3, D_5, D_6 and D_7. The consumptive use differs with the date of sowing due to the difference in temperature, wind, humidity and other mateorological parameters experienced by the crop. Similar result has been reported by Desai and Patil (1984) in melons.

Consumptive use was always higher in the case of the wet regimes compared to the dry regimes. The highest value was recorded by I_1 (432.4 mm) which was the most frequently irrigated treatment. With the increase in frequency of irrigation a favourable condition was created for high evapotranspiration. Similar reports were put forward by Tomitaka (1974), Desai and Patil (1984), Thomas (1984) and Lakshmanan (1985).

3.2 Soil moisture depletion pattern

The soil moisture depletion from the deeper soil layers was more in later sowings. This may due to the effect of the climatic conditions prevailing at that time.

The maximum soil moisture depletion was from the 0 - 15 cm layer in all the treatments. This may be because of the higher loss due to evaporation and also the result of extraction of soil moisture by the roots of the plant. The moisture depletion decreased with depth. There was relatively more depletion from the lower depths in drier regimes. This may be because of better development of roots to the lower soil layers in the drier regimes. Similar observations were made by Loomis and Crandall (1977) in cucumber, Thomas (1984) in bitter gourd and Lakshmanan (1985) in pumpkin, ash gourd and melons.

Summary

SUMMARY

The present investigation was carried out at the Rice Research Station, Mannuthy, Thrissur during the period from November 1990 to April 1991 to study the influence of date of sowing and levels of irrigation on the growth and yield of watermelon *Citrullus lanatus* grown in rice fallows.

The experiment was laid out in split plot design with three replications. There were seven main plot treatments of different dates of sowing and four sub plot treatment of different levels of irrigation. Observations on various morpholcgical characters, flowering and yield attributes were recorded during the course of investigation. From the moisture studies, water use efficiency, consumptive use and soil moisture depletion pattern were worked out . The daily weather elements recorded at the meteorological observatory were collected to work out the crop weather relationship.

The salient results are summarised below:-

1. The length of vine was significantly higher for the daily irrigated plants compared to other irrigation treatments. The crop sown on November 16th produced plants with the highest vine length.

2. The irrigation treatment IW/CPE ratio of 1 took the least number of nodes for female flower production.

3. The daily irrigated plants took significantly less days to reach picking maturity and with respect to date of sowing,

References

January sown plants took the least number of days to reach picking maturity.

4. The daily irrigated plants produced female flowers earlier than all other irrigation treatments. The later sown plants took significantly less days for female flower production.

5. At all the stages, daily irrigated plants produced more female flowers. The crop sown on November 16th consistantly produced more female flowers than the later sowings.

6. The daily irrigated plants produced more male flowers at 30 and 60 DAS, November 16 sown plants produced more male flowers at 30 DAS. But at 60 DAS January 16 sown plants produced more male flowers.

7. The male female flower ratio significantly decreased with increasing levels of irrigation. The lowest sex ratio value was obtained from crop sown on November 16th .

8. Maximum number of fruits per plot were recorded from the daily irrigated plants. The crop sown on November 16th produced significantly higher number of fruits.

9. The daily irrigated plants and the November 16th sowing gave significantly higher fruit weight.

10. The girth of fruit was also higher in daily irrigated plants. The highest girth of fruit was recorded from crop sown on November 16th .

11. The irrigation treatment IW/CPE ratio of 1.0 and the crop

sown on November 16th produced more seeds per fruit.

12. The irrigation treatment IW/CPE ratio of 0.50 and the crop sown on January 30th gave the highest 100 seed weight.

13. The irrigation treatment IW/CPE ratio of 0.50 produced the fruits with the highest T.S.S content.

14. The highest yield was recorded by the daily irrigated plants which was on par with treatment IW/CPE ratio of 1. The crop sown on November 16th gave significantly higher yield.

15. The total dry matter production was also higher for the daily irrigated plants and the crop sown on November 16th.

16. The plants irrigated at IW/CPE ratio of 0.5, showed the highest water use efficiency. Maximum water use efficiency was recorded from crop sown on November 16th .

17. The consumptive use was seen to increase with frequency of irrigation.

18. The soil moisture depletion was higher from the top 15cm of the soil layer. There was relatively more depletion from the lower depths in drier regimes.

19. The crop weather relationship studies showed that the temperature range during flowering and early fruit development (3rd to 7th week), maximum temperature during fruit development (7th to 10th week) and relative humidity during maturity (11th-to 13th week) negatively correlated with yield. While for total dry matter production there was a negative correlation between

temperature range during flowering (3rd to 5th week), maximum temperature during fruit development and early maturity (8th to 11th week) and relative humidity during maturity (11th to 13th week).

It may be concluded from the study that the optimum time of sowing for water melon at Mannuthy and surroundings is middle of November. A reduction in yield was observed when the crop was sown either earlier or later than November middle. It was also observed that the conventional method of pot watering (1 pot of 10 litre capacity per day per pit) recorded the highest yield. This was at par with the yield obtained when irrigation was given at IW/CPE ratio of 1.0.

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* Orginals not seen.

Appendices

Appendix - I

Analysis of variance for length of vine at 30 and 60 days after sowing

Source	Degrees of freedom	Mean Squares Length of vine	
		30 DAS	60 DAS
Replication	2	21.90	366.623
Factor (A)	6	173.909**	2924.590**
Error	12	2.981	36.327
Factor (B)	3	170.597**	4487.598**
AB	18	2.253	6.895
Error	42	3.132	37.395

* Significant at 5 percent level
** Significant at 1 percent level

Appendix - II

Analysis of variance for days taken for the first female flower to appear, node at which the first female flower was produced and the days to picking maturity

Source	Degrees of freedom	Mean Squares		
		Days taken for first female flower to appear	Node at which first female flower was produced	Days to picking maturity
Replication	2	0.303	8.591	0.355
Factor (A)	6	25.049**	10.561**	35.421**
Error	12	0.440	1.046	2.446
Factor (B)	3	19.937**	7.071**	26.941**
AB	18	0.370	0.188	0.347
Error	42	0.346	0.466	0.471

* Significant at 5 percent level

** Significant at 1 percent level

Appendix - III

Analyis of veriance for total number of female flowers at 30 and 60 days after sowing and total number of male flowers at 30 and 60 days after sowing

Source	Degrees of freedom	Mean Squares			
		Total number of female flowers		Total number of male flowers	
		30 DAS	60 DAS	30 DAS	60 DAS
Replication	2	0.379	3.867	7.879	88.234
Factor(A)	16	1.832**	7.205**	25.207**	731.882**
Error	12	0.390	0.386	0.633	4.020
Factor(B)	3	2.640**	2.635**	14.331**	44.591**
AB	18	0.280	0.214	0.290	1.276
Error	42	0.175	0.210	0.170	0.167

* Significant at 5 percent level
** Significant at 1 percent level

Appendix - IV

Analysis of variance for sex ratio and girth of fruit

Source	Degrees of freedom	Mean Squares	
		Sex ratio	girth of the fruit
Replication	2	0.050	56.087
Factor (A)	6	49.475**	376.029**
Error	12	0.036	2.047
Factor (B)	3	1.215**	168.572**
AB	18	0.039**	1.388
Error	42	0.007	1.734

* Significant at 5 percent level
** Significant at 1 percent level

Appendix - V

Analysis of variance for number of seeds per fruit, hundred seed weight and T.S.S content of fruit

Source	Degrees of freedom	Mean squares		
		Number of seeds per fruit.	100 seed weight	T.S.S content of fruit
Replication	2	4948.94	0.001	1.476
Factor(A)	6	10010.829**	1.978**	0.159
Error	12	2770.788	0.003	0.212
Factor(B)	3	1899.440**	0.012	10.317**
AB	18	2192.718**	0.008**	0.577
Error	42	3155.190	0.003	0.456

* Significant at 5% level
** Significant at 1% level

Appendix - VII

Analysis of variance for field water use efficiency.

Source	Degrees of freedom	Mean squares
		Field water use efficiency
Replication	2	44.13
Factor (A)	6	42.60**
Error	12	4.03
Factor (B)	3	1494.8**
AB	18	11.23
Error	42	9.07

* Significant at 5 percent level
** Significant at 1 percent level

INFLUENCE OF DATE OF SOWING AND LEVELS OF IRRIGATION ON THE GROWTH AND YIELD OF WATER MELON (*Citrullus lanatus*) GROWN IN RICE FALLOWS

By

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ABSTRACT OF THE THESIS

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ABSTRACT

An experiment was conducted at the Rice Research Station, Mannuthy, Thrissur during the period from November 1990 to April 1991 to study the influence of date of sowing and levels of irrigation on the growth and yield of watermelon (*Citrullus lanatus*) grown in rice fallows.

The experiment was laid out in split plot design with three replications. The treatment consisted of seven dates of sowing (November 1st, November 16th, December 1st, December 16th, December 31 st, January 15 th and January 30 th) in the main plot and four levels of irrigation (IW/CPE ratio of 1.0, IW/CPE ratio of 0.75, IW/CPE ratio of 0.50, pot watering -1 pot per day per pit) in the sub plot.

Observations on various morphological characters, flowering and yield attributes were recorded during the course of investgation. Soil moisture observations were taken before, and 24 hours after irrigation to compute consumptive use and soil moisture depletion. The daily values of various weather elements recorded at the meteorological observatory were collected to work out the crop weather relationship.

The plants irrigated daily (10 litre/pit/day) were superior to others with regard to vine length, date of picking maturity, date and number of male and female flower production, number of fruits, fruit girth, weight, yield and total dry matter

production, but was on par with IW/CPE ratio of 1.0. Irrigation at IW/CPE ratio of 1.0 was superior with regard to the number of nodes for female flower production and number of seeds per fruit. Irrigation treatment IW/CPE ratio of 0.50 recorded the highest sex ratio, hundred seed weight and T.S.S. content. The crop sown on november 16th was superior to others with regard to most of the crop characters.

The crop weather relatioship studies showed that the temperature range during flowering and early fruit development (3rd to 7th week), maximum temperature during fruit development (7th to 10th week) and relative humidity during maturity (11th to 13th week) negatively correlated with yield. While for total dry matter production there was a negative correlation between temperature range during flowering (3rd to 5th week), maximum temperature during fruit development and early maturity (8th to 11th week) and relative humidity during maturity (11th to 13th week).

It was found that irrigation and sowing date has a significant effect on overall growth and yield of the crop. The highest yield was recorded in crop sown on November 16th irrigated daily (10 litre/pit/day). The best performance may be attributed to the optimum weather conditions during the crop period and the effective utilisation of water.

From the soil moisture studies it is evident that the consumptive use increased with the frequency of irrigation. The top 15cm of the soil layer accounted for the highest soil moisture depletion. The depletion was more from the deeper layers in the drier regimes. The water use efficiency was highest for the plants irrigated at IW/CPE ratio of 0.5, sown on November 16th.

Results of the present experiment indicate that at Mannuthy and surroundings water melon can be successfully raised in rice fallows if irrigated daily (10 litre/pit/day.) and sown in the middle of November.