Original Research Article

Effect of Different Levels of Irrigation on Plant Growth and Yield of Mango cv. Langra.

ABSTRACT

The plants are dependent on monsoon not provides optimum crop yield and leads to crop failure. Artificial application of water to the effective root zone of crops, for an appropriate time gives significant results on plant growth and fruit yield in mango. In order to understand the effects of soil moisture content in mango the trial was conducted under the experimental area of BAU, Sabour, Bhagalpur during 2020-21 with five treatments *i.e.* T_1-[Control], T_2-[Water requirement at 25% of EP], T_3-[Water requirement at 50% of EP], T_4-[Water requirement at 75% of EP], T_5-[Water requirement at 100% of EP] along with four replications in RBD design. Treatment T_4-[Water requirement at 75% of EP]significantly performed better in respect of increasing in plantheight of 0.24 m, number of 695.00 fruits per plant and yield of 193.23 kg/per planas well as 19.32 t/ha. While the maximum increase in plant spread such as East-West and North-South direction of 0.25m and 0.23m respectively and maximum canopy volume of 1195.99 m^3 was recorded in treatment T_5-[Water requirement at 100% of EP].Treatment T_3-[Water requirement at 50% of EP] significantly performed better in fruit size, *i.e.* fruit length and fruit breadth of 10.00 cm and 8.20 cm respectively and also showed maximum fruit volume of 239.75 cc. On the basis of obtained results, it can be concluded that the application of T_4-[Water requirement at 75% of EP] played significant role in increasing in plant height, number of fruits as well as yield of mango cv. Langra.

Key words: Mango, irrigation, plant growth, fruit weight, fruit yield.

1. INTRODUCTION

Mango *(Mangifera indica* L.) belongs to the family Anacardiaceae, one of the delicious fruitsof commercial important.It is an indigenous to North-East India, North Burma in the foot hills of the Himalayas and is said to have originated in the Indo-Burma regions [1]. The ideal temperature range for mango is 24-30°C during the growing season, along with high humidity, rainfall range of 890- 1,015 mm in a year is considered as ideal for growing mango crops.

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Success of mango orchards depends upon availability of rain or artificial irrigation during critical periods of tree growth and fruit development. Fruit development period in mango takes place during the dry season. As per mango tree phenology, there are five stages of life cycle viz. flowering, fruit development, vegetative growth, root development, and dormancy. About 80 per cent water is required by tree during flowering and fruit development stages.
The irrigation requirement of mango trees mainly depends on agronomic and climatic factors of the particular zone [2]. Irrigation in mango is also associated with climate including humidity, rainfall and temperature. Mango orchards situated in humid tropics do not require irrigation irrespective of soil type while under dry climate having low humidity and high temperature; irrigation is needed at 15 days interval. The success of mango orchards especially during the period of plant growth and fruit development plays vital role in the sustainability of mango orchard. Mango tree is considered drought resistant to some extent; however, soil moisture influences the fruit size, quality as well as the drop of immature fruits. It is also observed that moisture deficit in soil results in early maturity to fruits resulting in poor quality. During fruit development period, under hot and dry climate, the irrigation prevents the drop of immature fruits. Fruits are of better size and juicier from irrigated plants than those from tree under deficit soil moisture.

The shortage of water during flowering and fruit development stage in soil may result in flower and fruit drop [3]. In mango fruiting period is considered to be the most sensitive period for water stress, water supply is most critical during the first six weeks of fruit developing process. Therefore, regular and timely irrigation of bearing plants becomes necessary.While selecting an irrigation system, it is important to consider available water resource, soil type, age and canopy of tree and climatic conditions of the area.Basin method of irrigation is generally designed for those areas have the sufficient water to apply to the orchard, this system of irrigation contains small circular basins are made around the tree trunks covered the whole canopy of tree. Meanwhile, climate change and expanding land use for crop production have increased the pressure on water resources. In agriculture for sustainable use of water, crop-specific and water-saving irrigation techniques that do not negatively affect crop productivity must be developed. Out of several biotic and a biotic factors, optimum water management is one of the most important factors that significantly influence productivity and fruit quality [4].

In the present investigation, an attempt was made to determine the effect of irrigation on plant growth, number of fruits and yield of mango under the heading "Effect of different levels of irrigation on plant growth characters and yield of mango cv. Langra".

2.MATERIALS AND METHODS

The present investigation was conducted in All India Co-ordinated Research Project on Fruits under the Department of Horticulture (Fruit and fruit Technology), BAU, Sabour, Bhagalpur, Bihar during 2020-21. The total five treatment combinations were taken *i.e.*T_1:[Control],T_2:[Water requirement at 25% of Evaporation], T_3:[Water requirement at 50% of Evaporation], T_4:[Water requirement at 75% of Evaporation],and T_5:[Water requirement at 100% Evaporation] with four replications under design RBD. The plant spacing of the trees was 10 cm × 10 cm in both sides.

Plant height

The plant height was measured in metre from ground surface to top of the tree vertically with the use of measuring tape along with bamboo pole before application of treatments and at the time of fruit maturity.

Plant spread

Plant spread was measured with the help of measuring tape on East-West and North-South direction. The distance between the extreme points were measured in meters with the help of measuring tape and noted in the notebook. The canopy spread was measured and the average of East-West and North-South spread was calculated.

Canopy volume (m^3)

It was measured by calculating East-West and North-South canopy spread and the height of the plant with the help of measuring tape. The tree canopy volume was calculated by using the following formula in the month of January.

$V=4/3\pi\ r^2h$

Where,

h= height of tree (m),

r= (sum of E-W and N-s direction (m/4),

V=Canopy volume (m^3).

Fruit weight (g)

The fruit weight was noted by selecting the five randomly mature fruits of each treatment of all four replications which were weighed carefully by electronic balance in gram and the average fruit weight was calculated by dividing five.

Number of fruits per tree

The total number of fruits per tree was recorded by counting the harvested mango fruits manually after attaining the maturity of fruit of every replication of each treatment.

Fruits yield (kg/tree)

The fruit yield of mango tree was calculated by multiplying the number of fruits per tree and average weight of mango fruit and then dividing the value by one thousand to convert in kg/tree.

Fruit size (cm)

The fruits were harvested at full maturity. Five fruits were selected randomly from each treatment of all replications and their ultimate length and breadth were recorded with the help of a vernier calliper in cm and average size was worked out.

Fruit volume (cc)

The five fruits under each treatment and each replication were taken out and mean volume was recorded replication wise. The volume of fruits was measured by water displacement method**.**

3. RESULTS AND DISCUSSION

The results obtained from the presentinvestigation as well as relevant discussion havebeen summarized under following heads

(a) Plant height (cm): The data presented in Table-1, showed that increased in tree height was noticed statistically non-significant effectamong the all treatments. But maximum tree height of 0.24 m was observed in T_4 (Water requirement at 75% of EP) minimum of 0.16m in treatment T_1 (control). This was happened due to the frequent application of water at set intervals, which maintains a consistent moisture regime in the soil and allows roots to remain active for longer period. The availability of nutrients and the translocation of food materials are also improved by maintaining constant moisture in the soil [5].Further, it was reportedthat the plant height of Anjou pears was expressively increased with increasing the irrigation up to some extent, however the over application of irrigation may reduce the plant growth, increase disease incidence and scar on the skin of fruit [6].The similar result was also confirmed by Lawand and Patil [7] in pomegranate, Mattar*et al*.[8] in mango, Kaushik *et al*.[9] in guava.

(b)Tree spread (m) and canopy volume (cm^3): The results of experimental data presented in Table-1, showed that the different levels of irrigation influenced the canopy volume of mango trees and it was clearly observed that the canopy volume increased by increasing the irrigation levels. The maximum canopy volume of 1195.99 m³ of mango trees were recorded in T_5 (Water requirement at 100% of EP) that was at par with the value of 1153.27 m³ in T_4(Water requirement at 75% of EP) whereas; minimum increase of 864.65 m^3 in T_1 (Control). The maximum increase in canopy area can be attributed to adequate moisture availability, which maintains the turgid pressure required for stomata opening for gaseous exchange, resulting in a higher photosynthetic rate [10].The maximum increment in canopy area, and canopy volume under higher irrigation levels might be due to better water utilization and uptake of nutrients adequately under that fevered soil moisture condition. The irrigation provides consistent moisture regime in soil which increases availability and translocation of nutrients and increases vegetative growth of plants, and due to non-availability of adequate moisture at the root zone of mango trees. The similar conformity of finding was reported by Lawand and Patil [7] in pomegranate, Kumar *et al.* [11] in mango.

Table1.Effect of different levels ofirrigation on plant growth characters in mango cv.Langra

Treatments	Increase in plant height (m)	Increase in Plant spread (m)		Canopy volume (m^3)
		East-West	North-South	
T_1	0.16	0.17	0.14	864.65
T_2	0.20	0.19	0.16	1018.05
T_3	0.22	0.21	0.17	1075.63
T_4	0.24	0.22	0.21	1153.27
T_5	0.23	0.25	0.23	1195.99
SEm(±)	0.01	0.01	0.01	38.93
CD (P=0.05)	0.02	0.03	0.02	119.93
CV%	6.30	10.48	5.97	7.33

T_1: [Control],T_2:[Water requirement at 25% of Evaporation], T_3:[Water requirement at 50% of Evaporation], T_4:[Water requirement at 75% of Evaporation], and T_5: [Water requirement at 100% Evaporation]

(c)Fruit weight (g), fruit length (cm), fruit breadth(cm) and fruit volume (cc): The data presented in Table-2 indicated that the application of different levels of irrigation on mango tree could not showed significant result on fruit weight, fruit length and fruit volume. The maximum fruit weight of 285.08 g, fruit length of 10.00 cmand fruit volume of 239.73 cc was observed in treatment T_3 (Water requirement at 50% of EP) and the minimum of 274.65 g, 7.48 cm and 216.00 cc respectively in treatment T_5 (Water requirement at 100 % of EP).When the data put on statistical analysis the value oftreatment T_3 of fruit weight, fruit

length, and fruit volume was noticed at par in all treatments including control. This might be due to moisture supply is the most critical factor during the initial 42 days of fruit development period, drought can induce late-stage fruit dropping and reduce fruit mass via decreased cell and number. There is a negative correlation between the average fruit weight and fruit length byWei *et al.*[12]. It was contrary to the findings of observed by Malshe*et al.*[13] in Alphonso mango.

However, the value of fruit breadth was significantly showed maximum of 8.20 cm in the treatment T_3 (Water requirement at 50% of EP) and minimum in the treatment T_5 (Water requirement at 100% of EP),this finding was also closelyconfirmed by Wei *et al.*[12] in mango.

Table2. Effect of different levels of irrigation on fruit growth and fruit yield of mango cv. Langra.

Treatments	Fruit weight(g)	Fruit volume (cc)	Fruit size	
			Fruit length (cm)	Fruit breadth (cm)
T_1	281.63	233.25	9.68	7.13
T_2	284.13	236.00	9.83	7.63
T_3	285.08	239.75	10.00	8.20
T_4	277.98	224.00	9.53	7.83
T_5	274.65	216.00	7.48	7.03
SEm (±)	7.80	7.44	0.94	0.15
CD (P=0.05)	24.05	22.92	2.91	0.45
CV%	5.56	6.47	4.06	3.84

T_1: [Control],T_2:[Water requirement at 25% of Evaporation], T_3:[Water requirement at 50% of Evaporation], T_4:[Water requirement at 75% of Evaporation], and T_5: [Water requirement at 100% Evaporation]

(d)Number of fruits per tree: The data presented on Fig.-1exhibited that the number of fruits per tree was varied significantly for all the treatments. The maximum number of 695.00 fruits per plant was recorded in treatment T_4 (Water requirement at 75% of EP) while the minimum of 440.00 fruits per plant was produced by the treatment T_1 (Control). The effect of irrigation was positively correlated with the optimum quantity of water play a vital role in metabolism and nutrient uptake. Proper amount of water application boosts up the vigorous plant growth of mango which eventually maximize the number of fruits per plant and prolong presence of drought in the initial fruit development stage in the treatment T_1 (Control) which causes more drop that was the main reason. The similar results were obtained by Kumar *et al.* [11] in mango, Mirjat*et al.*[14] in mango, Subbaiah*et al.*[15] in mango, Wei *et al.* [12] in mango, Malshe*et al.* [13] in mango.

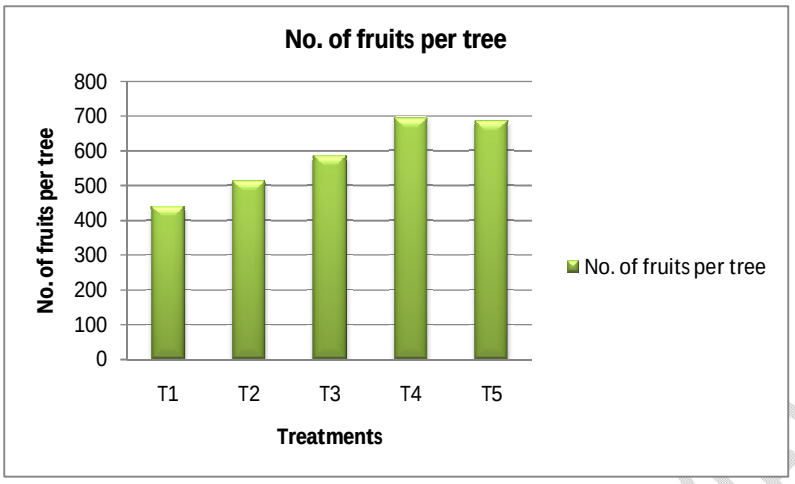

Fig1. No. of fruits per tree, SEm (±): 41.87, CD 5%:128.99, CV%:14.33

(e)Fruit yield (kg/tree and t/ha): The data related to fruit yield (kg/tree) was presented in fig-2 and fruit yield (t/ha) in fig-3 and it was indicated that the maximum yield of 193.23 kg per plant (19.32 t/ha) was found in treatment T_4 (Water requirement at 75% of EP) and minimum of 123.26 kg per plant (12.33 t/ha) in T_1 (Control). It might be due to the causes of positive effect of irrigation on the numbers of fruit per plant. The irrigated treatments increased fruit yield which was happen due to crop a higher load rather than larger fruit size[12]. It may be due to more fruit retention and yield has positive correlation so that the maximum yield was found in T_4. Further, Speer *et al.*[15]reported that the increasing levels of irrigation also increased yield in Valencia orange. Water deficit in the early stage of fruit development leads to increased fruit drop. The similar finding was also proposed by Pavel and Valliers [3],Subbaiah*et al.* [16]in mango, Kumar *et al.*[11] in mango and Rao *et al.* [17].

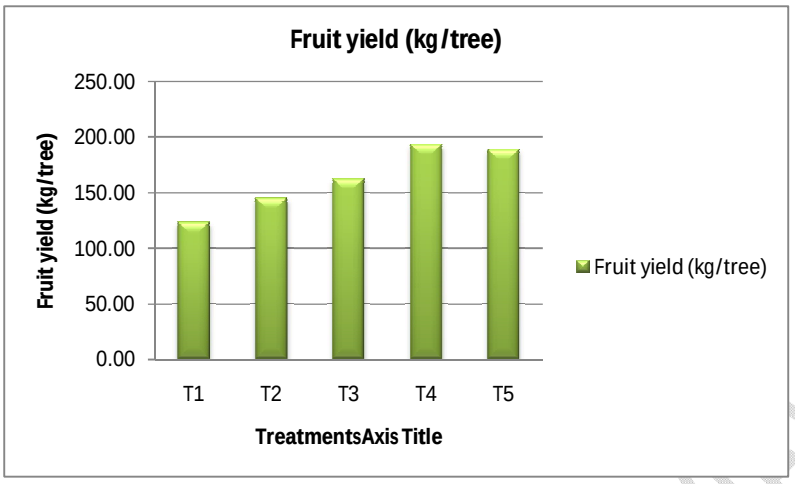

Fig.-2. Fruit yield (kg/tree),SEm (±): 9.74, CD 5%:30.01, CV%:11.92

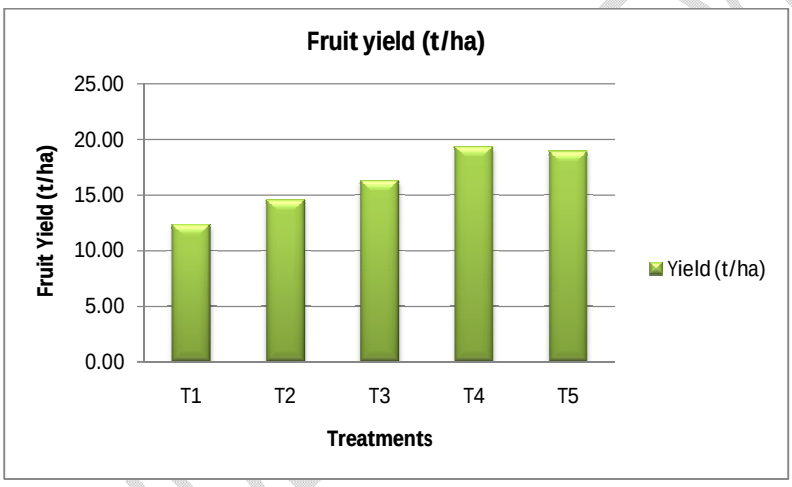

Fig.- 3. Fruit yield (t/ha), SEm (±): 0.97, CD 5%:3.00, CV%:11.92

4.CONCLUSION

On the basis of above-mentionedfindings, it may be concluded that the frequent and appropriate application of water at the effective root zone of plant provided sufficient moisture that plays an important role with respect to plant growth and yield of mango cv. Langra. The water requirement at 75% of evaporation rate found best treatment with respect to yieldand saved 25 % irrigation water as compared to water requirement at100% of Evaporation.

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