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INFLUENCE OF DRIP FERTIGATION ON QUALITY AND YIELD PARAMETERS OF MANGO (*MANGIFERA INDICA*)

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Abstract– A study was conducted at ICAR-Central Institute of Agricultural Engineering, Bhopal during 2011 to 2018 to find out the effect of irrigation and fertigation scheduling on the growth, yield and quality of mango (cv. Amrapali). The results revealed that the maximum plant height (1.94 m), circumference of rootstock (63.7 cm) and scion were higher under 100% irrigation level whereas maximum yield (35.82 kg plant^{-1} and 12.22 t ha^{-1}) was obtained under 100% irrigation with 100% fertigation. Fruit weight, gross returns and benefit cost ratio were found higher (Rs. 231 g, 71,640 ha^{-1} and 1.49 respectively) under hundred per cent irrigation and hundred per cent fertigation treatment. However, the TSS of the fruit was not affected significantly due to irrigation and fertigation as well as their interaction effect. The study recommends for the adoption of drip treatment of 100 % irrigation and 100% fertigation for techno-economic advantage.

INTRODUCTION

India stands first in the global mango production with a total production of 213 lakh tonnes with maximum area covered in Maharashtra and Andhra Pradesh (Ganeshmurthy *et al.,* 2018). The best growing environment for mango crop is under tropical and subtropical conditions. For enhancing its productivity, water and plant nutrients are the two key inputs.

Mango can be cultivated under rainfed conditions however,deficit or excess rainfall will severely influence the crop production. In black soils due to poor permeability of soils excess water leading to reduction in crop production is a common problem. Apart from this, the calcareous nature of black soils severely hampers the nutrient availability to the plants (Biswas and Lalit, 2012). On the other hand, the ground water withdrawal is increasing very rapidly in India. It is a known fact that the predominant user of available water is agriculture sector. To minimize the wastage of water in agriculture sector, the scientific methods of water application systems such as micro irrigation is the game changer for better on-farm water management practices. These systems are being adopted in mostly in horticultural crops and of late in field crops such as sugarcane, cotton, wheat, chickpea etc. (Gandhi *et al.,* 2021). The research findings and benefits reaped by the farmers clearly indicates the advantage of adopting micro irrigation systems for higher water productivity, enhanced fertilizer use efficiency, reduced energy, reduced labour etc. The average penetration rate of micro irrigation in India is about 19 per cent. Drip irrigation along with fertilizer application has proven to be more advantageous interms of costly input saving apart from enhanced nutrient use efficiency (Rao *et al.,* 2017). It is therefore, the present study was taken up with the objective to investigate the influence of drip irrigation and fertigation levels on mango quality and yield.

MATERIALS AND METHODS

The experiments were laid out in the year 2011 at research farm of Central Institute of Agricultural Engineering, Bhopal with factorial randomized block design having six treatment combinations which include three irrigation level (100, 80 and 60%) along with two fertigation level (100 and 75% water soluble fertilizers) and replicated thrice. Each replication consisted of five mango plants. Water soluble fertilizers urea phosphate (17:44:00), urea (46:00:00) and sulphate of potash (00:00:50) were used for fertigation and applied weekly by adopting

fertigation schedules. Different plant parameters and yield data were recorded. The total soluble solids (TSS) of mango fruit were recorded by using hand refractometer (Erma, Japan). The relative economics of drip and different fertigation levels along with man power required for the irrigation, fertigation and weeding in each treatment were calculated. Based on the marketable quality of the produce in different treatments during the study period years and market rate fluctuations, the gross income was calculated. The cost of production per each treatment varied due to variation in the input cost, it is therefore, the net income werecalculated by deducting the cost of production under each treatmentfrom the gross income under it.

RESULTS AND DISCUSSION

The treatment wise data collected for 7 years were pooled and the findings of data analysis under different treatments are presented below:

Plant morphological and yield parameters

The maximum plant height was recorded as 1.94 m under D1 (100% irrigation) followed by 80% and 60% irrigation. Under fertigation levels, maximum plant height 1.82 m was recorded in F1 (100% fertigation) as compared to F2 (75% fertigation). The interaction effect of irrigation and fertigation levels was non-significant (Table 1). At different irrigation levels, circumference of rootstock and scion were also maximum (63.69 and 49.80 cm) under D1 (100% irrigation) as compared to D2 (80% irrigation) and D3 (60% irrigation). Under fertigation levels, F1 (61.36 and 43.25 cm) recorded maximum rootstock and scion as compared to F2. The interaction effect of irrigation and fertigation levels was non-significant in case of rootstock and scion. Among various level of irrigation, maximum fruit yield per plant and yield per ha was recorded in D1 (100% irrigation) 35.52 kgplant^{-1} and 12.12 tha^{-1} as compared to D2 (80% irrigation) and D3 (60% irrigation). Further, under fertigation level maximum fruit yield 36.12 kgplant^{-1}and 12.32 tha^{-1} was obtained in F1 (100% fertigation) followed by F2 (75% fertigation). Among the interaction effect yield per plant and yield (tha^{-1}) was obtained higher in D1F1 (100% irrigation with 100% Fertigation) 35.82 kgplant^{-1}and 12.22 tha^{-1} a followed by D2F1 (80% irrigation with 100% Fertigation) 34.22 kgplant^{-1} and 11.78 tha^{-1} and minimum yield obtained under D3F2 (60% irrigation with 75 % Fertigation) 29.47 kgplant^{-1} and 10.74 tha^{-1}, respectively. The main reason for the highest yield under 100% irrigation and 100% fertigation is due to the fact that the higher plant growth parameters were obtained under this

Table 1. Growth and yield parameters influenced by drip irrigation and fertigation

Treatments	Plant height (m)	Circumference of rootstock (cm)	Circumference of Scion(cm)	Yield per plant (kg)	Yield (tha^{-1})
Irrigation levels					
D1	1.94	63.69	49.80	35.52	12.12
D2	1.86	60.25	44.41	32.92	11.23
D3	1.82	59.47	42.94	30.70	10.47
Conventional	1.85	6.20	43.92	30.55	10.41
SEM±	0.28	1.88	1.63	1.42	0.40
p = 0.05	NS	NS	NS	4.20	1.23
Fertigation levels					
F1	1.82	61.36	43.25	36.12	12.32
F2	1.73	60.24	40.14	32.23	10.99
SEM±	0.14	1.24	1.21	0.82	0.34
p = 0.05	NS	NS	NS	2.45	1.05
Interaction					
D1F1	1.88	62.53	46.52	35.82	12.22
D1F2	1.83	61.96	44.97	33.48	11.56
D2F1	1.84	60.25	43.83	34.22	11.78
D2F2	1.79	60.24	42.28	31.58	11.11
D3F1	1.82	60.41	43.09	31.41	11.40
D3F2	1.78	59.85	41.54	29.47	10.74
SEM±	0.65	1.78	1.74	1.23	0.43
p = 0.05	NS	NS	NS	3.65	1.30

Table 2. Physico-chemical properties of mango influenced by drip irrigation and fertigation

Treatments	Fruit Weight (g)	Fruit Length (mm)	Fruit width (mm)	Volume (ml)	TSS (%)
Irrigation levels					
D1	231	9.1	6.6	212.6	22.8
D2	226	8.7	5.3	209.5	21.3
D3	221	7.8	4.7	200.6	21.0
SEM ±	3.20	0.56	0.86	3.36	0.89
P = 0.05%	9.58	NS	NS	10.05	NS
Fertigation levels					
F1	230	9.3	6.4	211.7	22.3
F2	224	8.9	5.2	204.0	21.6
SEM ±	1.59	0.43	0.59	2.30	0.56
P = 0.05%	1.75	NS	NS	6.90	NS
Interaction					
D1F1	230	9.2	6.5	212.1	22.5
D1F2	227	9.0	5.9	208.4	22.2
D2F1	228	9.0	5.8	210.6	21.8
D2F2	222	8.8	5.2	206.8	21.4
D3F1	225	8.5	5.5	206.1	21.6
D3F2	222	8.3	4.9	202.4	21.3
SEM ±	2.45	1.30	0.74	1.95	0.53
P = 0.05%	7.32	NS	NS	5.82	NS

treatment. The finding are in corroboration with the studies conducted by Wei *et al.,* 2017 in mango crop and Singh *et al.,* 2012 in guava crop.

Mango fruit parameters

Under different irrigation level maximum fruit weight, i.e. 231 g was recorded under D1 (100% irrigation) as compared to D2 (80% irrigation) and D3 (60% irrigation). Further, in fertigation level F1 (100%) maximum fruit weight (230 g) was obtained as compared to F2 (224 g). However, the interaction of irrigation and fertigation levels was significant on fruit weight. Fruit length and width were not affected significantly due to different irrigation and fertigation levels and their interaction effect. Maximum fruit volume (212.6 ml) was recorded under D1 (100% irrigation) as compared to D2 and D3. At different fertigation levels, F1 obtained maximum fruit volume (211.7 ml) followed by F2 (204.0 ml). However their interaction effect was significant on fruit volume. TSS of the fruit was not affectsignificantly due to irrigation and fertigation as well as their interaction effect. This may be due to accumulation of nutritional elements that are responsible for increasing TSS was not vary with irrigation and fertigation treatments. Similar trends were observed in pomogranite by Martínez-Nicolás, *et al.,* (2019).

Economic analysis

From the economic analysis it was found that, among the treatment combinations the net profit under D1F1 treatment is about 20 per cent higher over conventional at a Benefit Cost ratio of 1.49 (Table 3).

Table 3. Economics (Rs.ha^{-1}) as influenced by drip irrigation and fertigation

Treatments	Cost of cultivation	Net returns	BCR
D1F1	48,250	23,390	1.49
D1F2	45,250	21,710	1.48
D2F1	46,750	21,690	1.46
D2F2	43,250	19,910	1.46
D3F1	43,750	19,070	1.44
D3F2	40,750	18,190	1.45
Conventional	42,450	18,578	1.43

The investigations indicated that the maximum plant height, circumference of rootstock and scion were higher under D1 100% irrigation level whereas maximum yield was obtained under D1F1 (100% irrigation with 100% fertigation) and gross return and benefit cost ratio was also found to be higher under D1F1.

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