



Effect of Irrigation Methods on Growth, Development and Yield of High Density Orchard of Mango CV Maldah

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ABSTRACT

This research activity was conducted in a newly established high density mango orchard of cultivar Maldah. The age of the orchard was of 4-5 year old and the research activity was conducted at Directorate of Agricultural Research, Tarhara, Sunsari, Nepal during 2020 and 2021 i.e. for two consecutive years. Healthy saplings of Maldah obtained from Horticulture Research Unit nursery was planted at distance of 5m x 5m by square system of planting. At initial stage of growth, sprinkler irrigation method observed to be significantly highest with respect to plant height (238-241 cm), scion diameter (54-58 mm). But rootstock diameter observed to be highest with basin method (70-74 mm) followed by sprinkler irrigation (70-73 mm) as compared to other irrigation method. Similarly, canopy spread east west direction observed highest (180-195 cm) with sprinkler irrigation in first year but in second year maximum canopy spread in north south direction observed highest (170-186 cm) with surface irrigation. In first year highest number of fruit observed with sprinkler (16) and basin method (16), but in second year highest fruit weight was observed with basin method (25). Similarly, weight of individual fruit (545-645 gm) and yield per tree (7.9 – 12.53 kg) observed highest with sprinkler irrigation whereas highest TSS was observed with drip irrigation (22.33-23 °Brix) as compared to other irrigation methods.

So, from the two years of observation it can be concluded that sprinkler irrigation is ideal for obtaining maximum plant height and yield per tree at initial stage of growth i.e. third and fourth year tree.

Keywords: Mango, Irrigation Methods, Growth & Development

INTRODUCTION:

Mango (*Mangifera indica* L.) occupied a pre-eminent place amongst the fruit crops grown in Nepal. Mango occupies about 31% of the total area under fruits crops comprising of 51681 hectares with a total production of 466266 metric tons with productivity of 10.67 MT/ha (MoAD, 2020/21). Madhesh Pradesh (33392 ha) rank first followed by Lumbini (6092 ha) and Province no. 1 (5001 ha) with respect to total area under mango cultivation. In Madhesh Pradesh, Saptari district ranks first (9323 ha) with respect to total area under mango cultivation followed by Siraha (8151 ha.). Mango is cultivated in marginal land under rainfed condition in Nepal. Fertigation and irrigation is rarely practiced by farmers which lead to irregular or erratic flowering. Low fruit set as well as retention leading to low yield and fruits of poor quality are also the main problems in mango production.

Irrigation is an important measure which play important role in flowering, fruiting, yield and quality of mango. But in Nepal, mango is cultivated mostly in marginal land under rain fed condition and lack skill and knowledge of ideal irrigation method for gaining optimum yield. Therefore, the objective of this study is to identify ideal irrigation method and its application in orchard will certainly increase production and productivity of mango.

Irregular or erratic flowering, low fruit set as well as retention leading to low yield and fruits of poor quality are also the main problems in mango production. Irrigation is an important measure which can affect the flowering, harvesting, yield and quality of mango. Higher fruit retention, yield and quality of mango largely depend on irrigation, which is to be applied in appropriate time with adequate amount.

It is believed that irrigation from the time of fruit-set till the monsoons tends to prevent fruit drop and helps the fruits to improve in size and quality (Singh, 1968).

According to Hossain (1989) the need for irrigation of mango plant arises earlier during the drier part of year, from November to April, and lesser in summer (May to June) and the least in the rainy season and autumn (July-October).

Irrigation at Himachal, India at 20% and 40% depletion of available soil moisture increased yield at 87% and 79% compared to no irrigation (Ranbir *et al.*, 1998). A period of quiescence reinforced by low winter temperatures (mean 16°C) is a prerequisite for floral induction in mango in the dry-tropic of Australia (Bally *et al.*, 2000).

In South Florida, from a survey, it indicates that irrigation is a critical management for tropical fruit production (i.e., avocado, lime, mango, carambola, lychee, longan, mamey sapote and papaya) (Li *et al.*, 2000).

The drip irrigation is regarded as one of the highly efficient methods that allows limited water resource to be properly utilized. The method not only saves water but also applies fertilizer through emitters. The drip irrigation allows water near the plant roots either onto the soil surface or beneath the soil surface directly to the root zone area. This method has several advantages such as plant attains quick growth, controls weed, saves labor, applies direct nutrient to plants, increases yield with quality fruits. The drippers operate at a very slow rate; usually the discharge matches the soil infiltration rate which neither allows the surface flooding nor the runoff (Mirjat et al. 2011). Mango orchards are usually irrigated by conventional methods such as flood, basin, ring and furrow. However, some of the progressive growers have changed irrigation strategies and now they are irrigating their orchards with modern micro-irrigation methods such as drip and under tree sprinkler system (Dawn Todays paper, 2023).

Therefore, the research was carried out to obtain the following objectives:

- To identify idle irrigation method for mango orchard.
- To enhance production and productivity of mango orchard through proper application of irrigation.

METHODOLOGY

This research activity was conducted in a newly established high density mango orchard of cultivar Maldah. The age of the orchard was of 4-5 year old and the research activity was conducted during 2020 and 2021 i.e. for two consecutive years. Healthy saplings of Maldah obtained from Horticulture Research Unit nursery was planted at distance of 5m x 5m by square system of planting and grown adopting standard orchard management practices recommended by Nepal Agricultural Research Council. Two saplings was used for each treatment and replicated four times in a Randomized Complete Block Design. The treatments given are as follows:

T1 : Drip irrigation at 75% pan evaporation replenishment

T2 : Sprinkler irrigation

T3 : Basin irrigation

T4 : Flooding

T5 : Control (Rainfed)

Soil type: Clay

Soil pH: 5.5

Average Plant Height: 7.2 ft

Method of application irrigation:

Drip irrigation: Single line drip system consisted of (18 mm diameter and 70 m length) with two drippers per plant. On third and fourth year old plant, average of dripper discharge at pressure 15m was 8 litre/hour and two drippers were placed per tree at a distance of 40-50 cm on each side of the tree. To identify the moisture stress in soil, two tension-meter was installed in such a way that it represents the whole area occupied by drip irrigation in all four replications. When the tension-meter reading reaches 15 cbars then the plant is irrigated by drip irrigation. In winter irrigation stopped from October and again irrigation resumes from January until the fruit get matured.

Sprinkler irrigation: Two sprinklers were installed for the plants of all four replications. The height of sprinkler nozzle was kept 3 ft for uniform supply of water to the canopy and soil surface of each plant. To identify the moisture stress in soil, two tension-meter was installed in such a way that it represents the whole area occupied by sprinkler irrigation in all four replications. When the tension-meter reading reaches 15 cbars then the plant is irrigated by sprinkler irrigation. In winter irrigation stopped from October and again irrigation resumes from January until the fruit get matured.

Basin irrigation method: Square shape basin is prepared 1 meter apart from tree trunk. Soil is lifted at the base of tree trunk and made slope towards outer line of basin. Water was irrigated at fortnightly interval in winter till October month. From January to February crop is irrigated at fortnightly interval and then from March to April the crop was irrigated at weekly interval.

Flood irrigation: In this method whole plot was irrigated by flooding and the soil in such a way that the water did not come in contact with base of stem directly by maintaining complete drainage. Water was irrigated at fortnightly interval in winter till October month. From January to February crop is irrigated at fortnightly interval and then from March to April the crop was irrigated at weekly interval.

Observation on plant height, Scion diameter, rootstock diameter, canopy spread (east to west and north to south in cm), total number of fruit per plant, number of fruit, fruit weight, fruit yield per tree, fruit diameter, fruit length, total soluble solids and titrable acidity.

RESULT AND DISCUSSION

This experiment was carried out for two consecutive years (2020 and 2021) at an experimental plot established at Horticulture Research Unit to identify idle irrigation method to increase production and productivity of mango. The age of the plant was 3 and 4 year when it started bearing. Observation revealed significant result with different parameters like plant height, scion diameter, rootstock diameter, canopy spread, total number of fruit per plant, individual fruit weight, yield per tree, fruit diameter in first year, fruit length and TSS as stated in table 1 & 2.

Plant height revealed significant result and maximum plant height was observed when tree was irrigated with sprinkler irrigation in both year i.e. 238 and 241 respectively. It also revealed significant result in both the year and maximum scion diameter was obtained by sprinkler irrigation i.e. 54 mm and 58 mm and minimum with control i.e. 35 and 42 mm respectively. Similarly rootstock diameter also produced highest result (70 & 73 mm) when tree irrigated with sprinkler irrigation in both year and similar result was obtained in basin irrigation method (70 mm and 73 mm). Canopy spread in east-west direction also revealed significant result with sprinkler irrigation (180 cm and 195 cm). But similar result was observed with north – south direction when irrigated with basin irrigation (170 cm and 186 cm). At the same time, highest number of fruit was observed to be with sprinkler (16) and basin irrigation (16) method in first year. But in second year maximum number of fruit produced when irrigated with basin method i.e. 25 numbers. But weight of individual fruit was observed highest with sprinkler irrigation (545 gm and 645 gm) in both year respectively. Sprinkler irrigation also revealed significant result with fruit yield per plant and produced 7.9 kg and 12.53 kg in both year respectively. Similarly, maximum fruit diameter observed with drip (6.2 mm) and basin irrigation (6.2mm) in first year, but in second year revealed non-significant result with all the treatments. But fruit length observed to be significant when tree irrigated with basin method (7.2 cm and 6.8 cm) in first and second year respectively. But highest TSS was observed with drip irrigation in both year i.e. 23 and 22.33 °Brix.

CONCLUSION

This research activity was conducted in a newly established high density mango orchard of cultivar Maldah. The age of the orchard was of 4-5 year old and the research activity was conducted during 2020 and 2021 i.e. for two consecutive years. Healthy saplings of Maldah obtained from Horticulture Research Unit nursery was planted at distance of 5m x 5m by square system of planting. At initial stage of growth, sprinkler irrigation method observed to be significantly highest with respect to plant height (238-241 cm), scion diameter (54-58 mm). But rootstock diameter observed to be highest with basin method (70-74 mm) followed by sprinkler irrigation (70-73 mm) as compared to other irrigation method. Similarly, canopy spread east west direction observed highest (180-195 cm) with sprinkler irrigation in first year but in second year maximum canopy spread in north south direction observed highest (170-186 cm) with surface irrigation. In first year highest number of fruit observed with sprinkler (16) and basin method (16), but in second year highest fruit weight was observed with basin method (25). Similarly, weight of individual fruit (545-645 gm) and yield per tree (7.9 – 12.53 kg) observed highest with sprinkler irrigation whereas highest TSS was observed with drip irrigation (22.33-23 °Brix) as compared to other irrigation methods.

So, from the two years of observation it can be concluded that sprinkler irrigation is idle for obtaining maximum plant height and yield per tree at initial stage of growth i.e. third and fourth year tree.

Table 1(a): Effect of Irrigation Methods Carried out on Growth and Development of Mango

Treatment Name	Plant Height (cm)		Scion Diameter (mm)		Rootstock diameter (mm)		Canopy spread (cm)			
	2020	2021	2020	2021	2020	2021	East-west		North-South	
							2020	2021	2020	2021
T1:Drip irrigation	222	235	49	53	65	69	140	163	144	159
T2 : Sprinkler irrigation	238	241	54	58	70	73	180	195	165	177
T3 : Basin irrigation	230	242	53	57	70	74	150	177	170	186
T4 : Flooding	180	195	47	55	58	64	135	151	138	154
T5 : Control (Rainfed)	178	189	35	42	46	51	100	109	105	112
CV%	0.39	1.08	1.83	1.44	2.18	4.41	1.9	1.73	1.36	1.93
F value	**	**	*	**	*	*	*	*	*	*
SEM	0.58	1.68	0.65	0.54	0.94	2.04	0.99	1.95	1.4	2.16

Table 1(b): Effect of Irrigation Methods Carried out on Growth and Development of Mango

Treatment Name	Total No. of fruit		Wt. of individual fruit (gm)		Yeild per tree (kg/tree)		Fruit Diameter (mm)		Fruit length (cm)		TSS		TA	
	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021
T1:Drip irrigation	12	22	297	545	3.5	11.99	6.2	5.7	6.5	6.4	23	22.33	0.6	0.77

T2 : Sprinkler irrigation	16	23	545	645	7.9	12.53	5.8	5.3	6.9	6.5	20	20.33	0.83	0.75
T3 : Basin irrigation	16	25	375	432	4.5	10.81	6.2	5.8	7.2	6.8	19	19.66	0.66	0.86
T4 : Flooding	11	18	270	425	3.2	7.65	6.1	5.8	7.1	6.2	20	20.33	0.56	0.66
T5 : Control (Rainfed)	14	17	338	545	4.1	5.57	4.6	4.9	6.7	6.4	17	18	0.53	0.73
CV%	2.69	1.57	5.54	0.24	5.03	2.82	0.79	3.1	2.54	3.27	2.16	1.89	11.65	14.57
F value	**	**	*	**	*	*	**	NS	*	*	*	*	NS	NS
SEM	0.27	0.23	14.14	0.90	0.17	0.19	0.08	7.8	0.12	0.15	0.92	0.66	0.072	0.067

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