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Performance of drip irrigation on growth and development of horticultural crop at Ranwadi water shed

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ABSTRACT : The micro irrigation is one of the water saving method of irrigation being employed at large in various countries. Government of Maharashtra has given more emphasis to micro-irrigation system and adopting them on large scale to save water. Drip irrigation is a novel irrigation method in India. The advantage of drip irrigation is that liquid fertilizers can be added in the irrigation water. It also diminishes leaching of nutrients. The installation costs are too high for the production of most annual crops but the production of high value perennial crops is economically profitable. An experiment was conducted at Zonal Agricultural Research Station, Sindewahi, distt. Chandrapur, to study the performance of drip irrigation on growth and development of horticultural crops *viz.*, mango, sapota and cashew nut at Ranwadi Water shed during the year 2002-03 to 2004-05. The result revealed the effect of drip irrigation treatment on growth and development of mango, sapota and cashew nut. It was found that the treatment 40 litres water day^{-1} plant^{-1}through drip was found superior than all other other treatment in respect of height (30.33), canopy (1043) and diameter (2.92) stem of mango plant. In respect of sapota plant, treatment 60 litre waterday^{-1}plant^{-1} was found satisfactorily superior in respect of height (28.4), canopy (787) and diameter (2.82) stem of sapota plant. In respect of cashew nut plant the treatment 60 litre of water alternate day^{-1} plant^{-1} were found statistically significant and they were at par in case of height (33.70), canopy (1341) and diameter (3.18) stem of Cashew nut plant.

KEY WORDS : Drip irrigation, Horticultural crop, Perennial crops, Canopy

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The advent of increasing water scarcity in this century will observe less increase in irrigated land availability for food production than in the past. Novel irrigation technologies need to be tested under local environments and particularly in agricultural production systems of developing countries. While irrigation can benefit yields and enhance water use efficiency (WUE) in water limited environments, the potential for full irrigation is decreasing, with increased competition from the domestic and industrial sectors. Judicious use of water is very essential. One aim of irrigation is to replace the daily crop evapotranspiration. Different combinations of intensity, frequency and flow rates can be customized to meet varying irrigation needs within a field (Shock *et al.*, 2005).

Thus, the main challenge confronting both rainfed and irrigated agriculture is to improve WUE and sustainable water use for agriculture(Anonymous, 2007 and Abbey and Joyce, 2004). India is facing a tremendous challenge in meeting the food needs of rapidly growing population. There are small, medium and large scale irrigation systems. To this end, both irrigated and dry land cropping areas will have to be developed or improved in the future. However, these tasks will not be easy, the cost of developing large scale and medium scale level irrigation is by now sky rocketing. Therefore, efficient utilization of water resources and development of small scale irrigation schemes at family level is crucial for countries like India, which has a huge water resource: yet their population is chronically food insecure. Micro irrigation system was found to result in 30 to 70 per cent water savings in various orchard crops and vegetables along with 10 to 60 per cent increases in yield as compared to conventional methods of irrigation (Aujla *et al*., 2005; Gethe *et al*., 2006 and Hanson *et al*., 2003). It is prudent to make efficient use of water and bring more area under irrigation through available water resources. This can be achieved by

introducing advanced methods of irrigation and improved water management practices (Zaman *et al*., 2001).

Mango, sapota and cashew nut is dominant horticultural fruit crops in India. That is best suited for drip irrigation. However, no work has been done to study the effect of drip irrigation in eastern vidarbha zone of Maharashtra state having red sandy clay loam soil a monoculture paddy area. The present study was planned to evaluate the effect of amount of water through drip irrigation on growth and development of horticultural crop at Ranwadi water shade in Sindewahi tehsil (District- Chandrapur).

METHODOLOGY

Experimental site :

Field study was carried out at the research farm of Dr. Punjabrao Deshmukh Krishi Vidyapeeth, Akola situated in western Vidarbha zone at latitude of 79^0 39'E and longitude of 20^0 17' N at mean height of 222 m above the sea level. The horticultural crop namely mango, sapota and cashew nut were planted at Ranwadi microwatershade Zonal Agricultural Research Station Sindewahi District chandrapur (M.S.) in the year 1996-97. Plant to plant and row to row distance was 15×15 feet for Mango and Sapota crop and 20×20 feet spacing was for cashew nut. The study on this plantation of mango, sapota and cashew-nut was initiated in the year 2002-03 and continued till 2006-07.

A drip irrigation system was fitted to the above horticultural plantation. Seven main treatments of a) T_1 - Basin irrigation (control method) at field capacity 10 days interval based on the evaporation and considering the 5 cm depth and five days irrigation scheduling (Nalayin *et al.*, 2006), T_2 - 40 litres water per alternate day per plant, T_3 -40 litres water per day per plant, T_4 - 48 litres water per alternate day per plant, T_5- 48 litres water per day per plant, T_6 – 60 litres water per alternate day per plant and T_7- 60 litres water per day per plant (Komilov *et al.*, 2002).

Fertilizer doses and other package and practices recommended by Dr. Panjabrao Deshmukh Krishi vidyapeeth, Akola were provided equally to all treatments in June-July, Sept.-Oct. and Jan-Feb.

Fertiliser doses	N in g	P in g	K in g
Mango	720	900	300
Sapota	900	450	400
Cashew-nut	900	450	400

Experimental materials and design :

Randomized Block Design was applied and placement of drippers and irrigation hours for different water application was given as :

- For 40 litre application – Dripper per plant = 8 LPH(2 no) + 4LPH (1 no) irrigation hours- 2 hrs.
- For 48 litre application – Dripper per plant = 8 LPH(3 no) irrigation hours- 2 hrs.
- For 60 litre application – Dripper per plant = 16 LPH(1 no) + 4LPH (1 no) irrigation hours- 3 hrs.

Irrigation system :

The water source was the bore well and it was prepared near the embankment pond which was constructed for recharging of the bore well. Four plant each of mango, sapota and cashew nut for each treatment were selected for study, Water was applied to the plant through drip irrigation system by doing the calibration of the drippers, each dripper discharged two, four, eight and sixteen litre of water per hour as stated above and the water through drip was applied as per treatment. Plants were irrigated from October to March for the year 2002-03 to 2006-07. Drippers were attached to drip line according to water requirement and for every row separate line were placed for providing irrigation to the plant. The plants were irrigated from the month of October to the start of rainy season but the observation on the growth of the plant was recorded form the October to the march as this period is having good growth.

Methods of observation :

Four plant each of mango, sapota and cashew nut for each treatment were selected for study. As per treatments which were planned, monthly observation of height, canopy and diameter of the plant were taken. All the four plants per treatment for replication were considered for recording the observations on development and growth of the plants.

RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Effect of drip irrigation treatment on growth and development of mango :

The data pertaining to the growth and development of the mango plant are reported in Table 1 and 2. The treatment differences were observed significant. From the Table 2 it is observed that the treatment-3 *i.e.* 40 litres/day^{-1} per plant through drip was found statistically superior than all other treatment in respect of height (30.33 cm), canopy (1043cm^2) and diameter (2.92 cm) of stem of mango plants.

There was 89.56 per cent increase in height, 107.36 per cent increase in canopy and 71.76 per cent increase in diameter of the stem over control of the mango plant. Effect of drip irrigation treatment including control on height, canopy and diameter of mango plants are depicted Fig.4, 5 and 6, respectively. Polynomial correlation between diameter and canopy of mango plant as depicted in Fig.1 with fairly good value of R^2 equal to 0.937 shows data variation has been

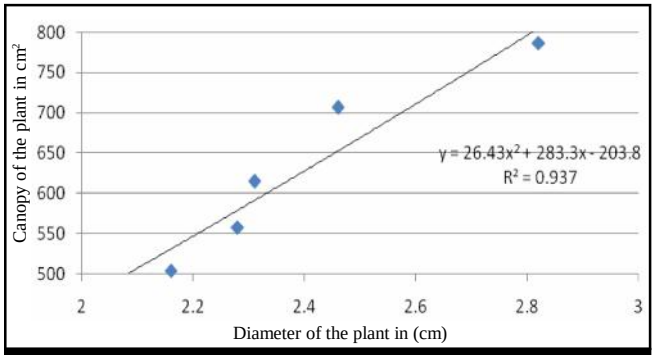

Fig. 1 : Correlation between the diameter and canopy of the mango plant

explained by the model with good fit.

Effect of drip irrigation treatment in growth and development of sapota plant :

The data regarding the growth and development in respect of sapota plant are reported in Table 3 and 4. In respect of sapota it is observed that the treatment-6 *i.e.* 60 litre waterday^{-1} per plant was found statistically superior than all other treatment in respect of height (28.4 cm), canopy (787cm^2) and diameter (2.82 cm)of stem of sapota plant (Table 4). The difference in the treatment was significant. There was 74.23 per cent increase in height, 89.65 per cent increase in canopy and 57.54 per cent increase in diameter of the stem over control

Table 1 : Effect of drip irrigation treatments on growth parameter of mango plants

Treatments	Mean height (cm)		Mean canopy (m^2)		Mean diameter (cm)	
	1st Oct.	31thMarch	1st Oct.	31thMarch	1stOct.	31thMarch
T_1	201	217	9.73	9.78	9.65	11.35
T_2	205	222	9.92	9.98	9.84	11.85
T_3	232	262	11.70	11.80	11.94	14.86
T_4	228	225	9.76	9.83	10.15	12.69
T_5	230	258	11.12	11.21	11.56	14.44
T_6	228	253	10.90	10.98	10.26	13.05
T_7	211	230	9.81	9.876	9.11	11.44

Table 2: Effect of drip irrigation treatments on height, canopy, diameter of stem of mango plants

Treatments	Height (cm)		Canopy (cm^2)		Diameter of stem (cm)		Survival %
	Mean	Per cent increase over control	Mean	Per cent increase over control	Mean	Per cent increase over control	
T_1	16.0	–	503	–	1.7	–	100
T_2	17.0	6.25	586	12.92	2.01	18.023	100
T_3	30.33	89.56	1043	107.36	2.92	71.76	100
T_4	22.0	37.5	738	46.71	2.54	49.41	100
T_5	28.0	75.0	962	91.25	2.88	69.41	100
T_6	25.0	56.25	872	73.36	2.78	63.53	100
T_7	19.00	18.75	660	31.21	2.33	37.05	100
'F" test	Sig.		Sig.		Sig.		
S.E. ±	2.56		173		0.34		
C.D.	7.19		487		0.95		
C.V. %	19.75		36.64		24.09		

Table 3 : Effect of drip irrigation treatments on growth parameter of sapota plants

Treatments	Mean height(cm)		Mean canopy (m^2)		Mean diameter(cm)	
	1st Oct.	31thMarch	1st Oct.	31thMarch	1stOct.	31thMarch
T_1	185	197.36	2.56	2.60	6.22	8.01
T_2	187	200.10	2.59	2.64	6.30	8.32
T_3	198	221.8	2.74	2.81	6.72	9.18
T_4	192	210	2.65	2.71	6.46	8.74
T_5	179	199.8	2.46	2.51	6.88	9.19
T_6	214	238.4	2.94	3.02	7.22	10.04
T_7	206	221	2.82	2.87	6.87	9.18

of the sapota plant (Siag *et al.*, 2010). Effect of drip irrigation treatment including control on height, canopy and diameter of sapota plants are depicted in Fig. 4, 5 and 6, respectively. Polynomial model was developed to establish the correlation between diameter and canopy of mango plant in Fig. 2 with fairly good value of R^2 equal to 0.937 shows data variation has been explained by the model with good fit.

Growth and production of peach trees were monitored under furrow, surface and subsurface drip and micro jet irrigation systems for different irrigation scheduling. Higher water use efficiency, yield and larger trees growth were reported under surface and subsurface drip as compare to

Table 4 : Effect of drip irrigation treatments on height, canopy, diameter of stem of sapota plants

Treatments	Height (cm)		Canopy (cm^2)		Diameter of stem (cm)		Survival %
	Mean	Per cent increase over control	Mean	Per cent increase over control	Mean	Per cent increase over control	
T_1	16.30	–	415	–	1.79	---	100
T_2	17.10	4.90	440	6.0	2.02	12.8	100
T_3	27.8	70.55	707	70.0	2.46	37.43	100
T_4	22.05	38.65	558	34.5	2.28	27.37	100
T_5	24.8	52.14	615	48.2	2.31	29.06	100
T_6	28.4	74.23	787	89.65	2.82	57.54	100
T_7	19.0	19.02	504	21.20	2.16	55.87	100
'F" Test	NS		Sig		Sig		
SEm ±	3.46		76.0		0.15		
CD	9.74		213.4		0.42		
CV %	27.04		22.70		11.4		

Table 5 : Effect of drip irrigation treatments on growth parameter of cashew-nut plants

Treatments	Mean height (cm)		Mean canopy (m^2)		Mean diameter (cm)	
	1st Oct.	31thMarch	1st Oct.	31thMarch	1stOct.	31thMarch
T_1	222	233	14.44	14.50	11.97	13.54
T_2	228	242	15.00	15.08	13.50	15.51
T_3	208	228	13.82	13.93	12.35	15.11
T_4	242	265	16.86	16.99	15.06	18.24
T_5	220	237	15.56	15.65	13.80	16.34
T_6	230	251	16.53	16.65	14.66	17.72
T_7	212	228	14.57	14.64	12.76	14.98

Table 6 : Effect of drip irrigation treatments on height, canopy, diameter of stem of cashew nut plants

Treatments	Height (cm)		Canopy (cm^2)		Diameter of stem (cm)		Survival %
	Mean	Per cent increase over control	Mean	Per cent increase over control	Mean	Per cent increase over control	
T_1	21.00	–	517	–	1.57	–	100
T_2	24.4	16.21	630	21.80	2.01	28.00	100
T_3	29.90	42.57	1114	115.5	2.76	75.79	100
T_4	33.70	60.52	1341	159.4	3.18	102.54	100
T_5	27.67	31.76	846	63.63	2.54	61.78	100
T_6	31.92	51.95	1214	134.81	3.07	95.54	100
T_7	26.83	21.72	738	42.80	2.22	41.40	100
'F" test	Sig.	–	Sig.	–	Sig.	–	–
S.E. ±	4.45	–	121	–	0.32	–	–
C.D.	12.49	–	326	–	0.90	–	–
C.V. %	21.05	–	21.94	–	22.33	–	–

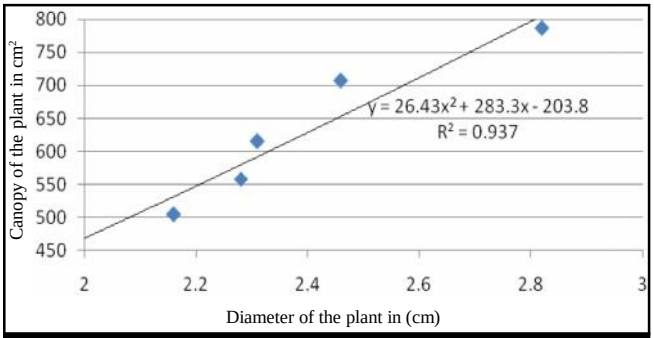

Fig. 2 : Correlation between the diameter and canopy of the Sapota plants

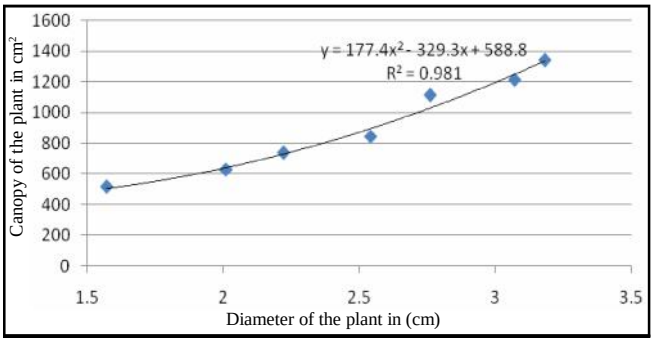

Fig. 3 : Correlation between the diameter and height of the Cashewnut plants

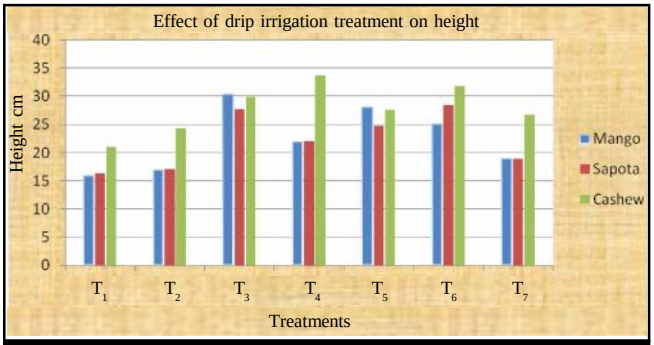

Fig. 4 : Effect of drip irrigation treatment on height of mango, sapota and cashewnut

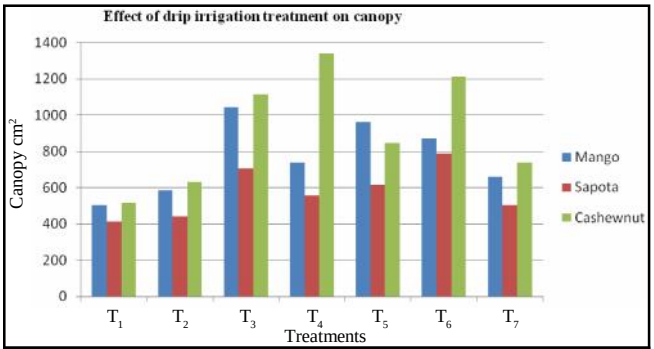

Fig. 5 : Effect of drip irrigation treatment on canopy of mango, sapota and cashewnut

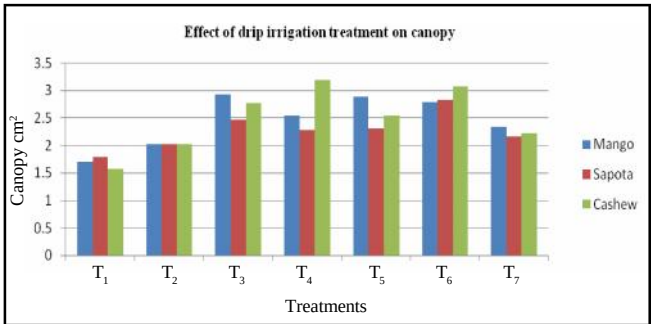

Fig. 6 : Effect of drip irrigation treatment on diameter of mango, sapota and cashewnut

micro jet irrigation systems and furrow irrigation Bryla *et al.* (2003). Saving in irrigation water and greater net profit due to drip irrigation in banana production has been reported by Kanannavar (2009); Pawar *et al.* (2010) and Gunduz*et al.* (2011).

Effect of drip irrigation treatment in growth and development of cashew nut plant :

The data pertaining to the development and growth in respect of cashew nut plant in different treatment of drip irrigation are reported in Table 5 and 6. The treatment difference in relation to the cashew nut plants was significant. In this study it is observed that plants irrigated with treatment- 4 *i.e.* 60 litre water alternate day^{-1} perplant was found statistically significant and superior in case of height (33.70 cm), canopy (1341 cm^2) and diameter (3.18 cm) of stem of cashew nut plant.

The increase was observed in drip irrigation treatment-4 in height, canopy and diameterof the stem to the tune of 62.52 per cent, 159.4 per cent and 102.54 per cent, respectively over control of the cashew nut plant. Polynomial model was developed to establish the correlation between the diameter and canopy of cashew nut plant depicted in Fig. 3 with fairly good value of R^2 equal to 0.981shows data variation has been explained by the model with good fit.Effect of drip irrigation treatment including control on height, canopy and diameter of cashew nut plants are depicted in Fig. 4, 5 and 6, respectively. More or less similar results were obtained by Sankaranarayan *et al.*, 2011 on Bt cotton.

Conclusion :

There was significant difference in the growth and development of the horticultural plant due to application of irrigation water through drip irrigation at Ranwadi micro water shed, at Zonal Agricultural Research Station. Sindewahi Distt. Chandrapur. Out of three crop cashew nut plant had shown more response by treatment-4 over control followed by mango crop with treatment-3 *i.e.* 40 litres water per day per plant and sapota with treatment-6 *i.e.* 60 litres

water per alternate day per plants compared to control treatment. Drip irrigation method facilitate the water and air proportion suitable for the growth of plant and based on the evopotranspiration plant gets the desired quantity of water.

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