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Response of different soil moisture regimes on sweet cherry under Karewa land of Kashmir valley

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ABSTRACT

The field experiment was conducted to ascertain the soil moisture regime under drip irrigation for Karewa land in sweet cherry cv. Bigarreau Noir Grossa with reference to qualitative and quantitative attributes. Results indicated that maximum yield of 73.26 kg / tree was recorded with 80% ET as compared to 100% ET which registered only 64.73 kg/ tree yield. The minimum yield of 50.50 kg/tree was noted when irrigation level was maintained at 40% ET. Further, the maximum fruit weight (4.51 g) was achieved with 100% ET followed by 80% ET and it decreased gradually to a minimum of 3.08 g with 40% ET. As far as qualitative characters are concerned, the maximum TSS of 23.02°Brix was observed when the irrigation level was maintained at 80% ET. This treatment also gave the highest TSS: acid ratio indicating an improvement in fruit quality. Fruit cracking was significantly reduced by maintaining the irrigation regime in between 80% (2.72%) to 100% (1.96%) ET as compared to irrigation level maintained at 60% (10.91%) and 40% ET (16.25%), indicating 80% reduction in fruit cracking. Sweet cherry plant with irrigation level maintained at 80% ET showed better nutrient uptake. The leaf Fe, Mn, Cu and Zn contents were maximum with 80% ET followed by 100% ET and minimum was recorded with 40% ET.

Key words: Drip irrigation, Karewa land, soil moisture regime, sweet cherry.

INTRODUCTION

Among the stone fruits, cherry characteristically needs more chilling period to break its dormancy and thereby its cultivation is restricted to the temperate climate only. By virtue of temperate climate, 90% of the total cherry production of India is confined to Kashmir valley of Jammu and Kashmir state. Srinagar district of Jammu & Kashmir contributes more than 60 per cent of cherry production. The landscape at higher elevation is locally known as *Karewas* offers a good drainage condition, which is prerequisite for cherry plantation. Orchards on these *Karewas* are totally dependent on rainfall and no water management is practiced for irrigation in sweet cherry resulting in low productivity with small fruits having inferior quality. In Kashmir valley, 80 per cent rainfall occurs from November to April which does not coincide with the fruiting season. This leads to nutrient deficiency in general and Zn and B deficiencies in particular at flowering stage and causes pollination problem, fruit drop and cracking of fruits. It has been observed that the soil water stress of 8 bar at flowering reduces the yield by 53% and after flowering by 35%. Therefore, it was envisaged to translate the full potentiality of natural resources into economic yield by way of adopting precise water management through drip irrigation practices. The uses of drip irrigation in cultivation of various fruit crops have lead to increase in yield and quality. The water requirement is relatively more in sweet cherry during spring and early summer, when fruits are under the process of development. However, regular irrigation is essential during the reproductive phase as irregular moisture condition causes dropping of flowers and reduction in fruit size. This problem is more intense in commercial varieties such as Double and Mishri, which require precise water and fertilizer management to maintain the desired pulp: stone ratio. The present experiment was undertaken to evaluate the different water regimes on vegetative growth, quantative and qualitative characteristics and fruit cracking in sweet cherry under drip irrigation.

MATERIALS AND METHODS

The experiment was conducted on 22-year-old sweet cherry (cv. Bigarreau Noir Grossa, locally know as Mishri) orchard at *Karewa* land of Gootlibagh of Srinagar district planted at a distance of 5 m x 5 m. The detailed initial nutrient status under different strata has been presented in Table 1. The drip irrigation system was installed with pre-calibrated four emitters/ plant with a flow rate of 4 l/ h. These emitters were placed equidistantly in east, west, north and south directions at a distance of 30 cm from

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Table 1. Depthwise initial soil nutrient status of experimental orchard.

Depth of soil profile (cm)	pH (1: 2.5)	Available macronutrients (kg/ha)			Available micronutrients (ppm)			
		N	P	K	Zn	Cu	Mn	Fe
0-20	6.7	230	11.9	410	1.22	2.00	24.21	45.89
20-40	6.8	220	9.2	379	0.93	1.99	18.22	41.56
40-60	6.7	194	8.9	343	0.72	1.98	15.23	40.11
60-80	7.9	170	8.2	290	0.56	1.52	11.78	36.32

the main trunk. Four irrigation treatments on a daily basis replenishing of ET based on USWB class 'A' pan evaporation losses were under taken comprising of T_1= 100% ET, T_2 = 80% ET, T_3 = 60% ET and T_4 = 40% ET in randomized block design replicated four times and two plants were taken in each replication. The data was subjected to statistical analysis as per the method suggested by Gomez and Gomez (8).

Water requirement of sweet cherry plants was estimated according to the formula given by Doorenbos and Purohit (7). The water received through rain was taken into account, while deciding the quantity to be applied for successive irrigation in all treatments. The irrigation system was operated daily and was stopped 12 days before expected harvesting date and during harvesting and later on was continued upto start of leaf falling (last week of September). No irrigation was applied from October to April in both years because of the fact that sufficient rain had taken place during that period. The other cultural practices were given uniformly.

Observation on major growth parameters were recorded once in a year during 2nd week of July and expressed in centimetres. Plant height was measured from ground level to the plant terminal. Trunk girth was measured by measuring tape at a height of 20 cm above ground level. The plant spread for N-S and E-W directions were measured through measuring tape. Number of fruits, fruit length, width, weight and yield per plant were recorded as per standard procedures. TSS was determined from freshly strained and thoroughly stirred juice using hand refrectometer and results were expressed in °Brix. Total sugars and total acidity were determined by using the standard titratable procedures (AOAC, 1). Leaf samples were collected for leaf analysis as per the procedure outlined by Chapman (5). For macro- and micro-nutrients except nitrogen estimation, well ground leaf tissue was digested in di-acid mixture containing HNO_3 and $HClO_4$ in 9:4 ratio for P, K and micronutrients. The phosphorous content was determined by using ammonium molybdate: ammonium metavan date (Chapman and Pratt, 6) using double beam UV-VIS spectrophotometer (ECIL, India) while potassium was determined by using flame photometer (Jackson, 9) and micronutrients were estimated using atomic absorption spectrophotometer (ECIL 4141, India). For leaf N estimation, known weight of samples were digested with H_2SO_4 using 10:1 K_2SO_4 and $CuSO_4$ as digestion mixture and digested at 390°C till clear digest is obtained. Digested samples were subjected to distillation with 40% NaOH and liberated ammonia was collected in H_3BO_3 using mixed indicator. Finally liberated ammonia was titrated against 0.1 N H_2SO_4 and N content in the leaves was expressed in percentage.

RESULTS AND DISCUSSION

Different water regimes had significant effect on vegetative growth of cherry plants (Table 2). There was a significant difference in shoot growth in both the years. The shoot growth rate was prominently faster in the trees receiving irrigation to replenish 100% ET during the 1st year. However the same treatment had deleterious effect on new shoot growth in the 2nd year of the experiment as compared to 80% ET. Trees replenished with 80 and 60% ET had positive response on shoot growth in both the years but the treatment 100% ET had negative response. This might be due to excess water available to plant which subsequently altered the root rhizosphere as cherry plant is sensitive to wet feet condition. Data revealed that there was no difference in shoot growth when plant was replenished the water with 80% ET than that of 100% ET. The shoot growth was suppressed when plants were replenished by 60 and 40% ET. The increase in vegetative growth might be due to the continuous supply of water, which maintains the soil moisture at optimum level eliminating water stress to the plant resulting in better availability of nutrient as well as their effective utilization by plant. Tree spread increased significantly in term of E-W and N-S direction with 100% ET and 80% ET. The least increase in both the direction was observed in 40% ET. The pooled data with regards to tree girth did not show significant increase with any of the treatment. This result is in conformity with the findings of Banyal and Rehalia (3) who also observed

Table 2. Effect of different water regimes on vegetative growth of sweet cherry.

Treatment	Shoot growth (cm)			Increased in tree height (%)			Increase in tree spread (%) East-West			Increase in tree spread (%) North-South			Increased tree girth (%)		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
100% ET	26.00	25.33	25.66	7.80	8.90	8.35	6.30	6.73	6.51	6.33	7.23	6.78	4.23	4.36	4.30
80% ET	22.66	26.00	24.33	7.53	8.66	8.10	6.30	6.53	6.46	6.53	7.03	6.78	4.00	4.36	4.28
60% ET	20.66	23.00	21.83	6.96	7.63	7.30	5.96	6.23	6.13	6.23	6.60	6.41	4.20	4.13	4.06
40% ET	17.66	18.66	18.16	6.83	7.33	7.10	5.83	6.03	5.95	6.03	6.23	6.13	4.23	4.03	4.13
CD at 5%	1.52	1.96	1.79	0.52	0.42	0.67	0.19	0.31	0.28	0.23	1.66	0.44	NS	0.16	NS

A = 1st year; B = 2nd year; C = pooled

increased vegetative growth in different fruit crops by uniform distribution of soil water under drip irrigation.

Average fruit weight was maximum with 100% ET in both the years followed by 80% ET and least was in 40% ET (Table 3) indicating that plant of cherry does require precise water for better fruit size despite sensitive to water logged conditions. However, it was observed that the fruit of 100% ET showed shriveling after 3 days of harvesting and no such sign was noticed with other treatments. Hence, it is suggested to replace the evapo-transpiration of cherry plant with 80% ET for maintaining attractiveness of fruit and better shelf-life. The size of sweet cherry fruits is closely related to the content of water in the soil during last week before harvest (Blazkova *et al*., 4). Fruit width and length were also significantly higher with 100% ET followed by 80% ET. Increase in fruit weight under drip irrigation might be due to consistent moisture regimes in the root rhizosphere, which helps in optimum availability of different essential nutrients and its translocation to sink that accelerate the fruit growth.

Yield was significantly influenced by different water regimes (Fig. 1). The maximum yield of 73.26 kg/ ha was recorded with 80% ET as compared to 100% ET, which registered only 64.74 kg/ha and minimum was in 40% ET (50.50 kg/ha). Total yield in general decreased in 2nd year due to bad weather prevailing during the flowering, which restricted the bee activity for better pollination. It was further observed that an enhancement of yield by 44 and 28% was obtained under 80 and 100% ET, respectively as compared to 40% ET. An increase in yield under 80% ET might have resulted due to better water utilization (Manfrinato, 10), higher uptake of nutrient (Bafna *et al*., 2) and favourable effects on carbohydrate metabolism and better C: N ratio leading to more fruit production. Increase in apple yield under higher volume of water has also been reported by Rzekanowski and Rolbiecki (12).

It was found that the increase in TSS was maximum (23.04°Brix) when plant was replenished with 80% ET and was significantly superior over the other treatments. The results indicate that sweet cherry plants should be irrigated with 80% ET for better fruit quality. Cracking of fruits due to rain during harvesting is a serious problem and causes losses. The fruit cracking is believed to occur mainly because of sudden change in soil moisture content or due to rainfall after a long dry spell and this is common phenomenon in the Jammu and Kashmir resulting in huge losses. Most significant finding of the present experiment was reduction of fruit cracking from 16.25 to 1.96%. Replacing daily irrigation with 100 and 80% ET through drip reduced the fruit cracking to a great extent (Fig. 2). However the maximum cracking (16.25%) was observed with replenishing the irrigation at 40% ET followed by 60% ET (10.91%). Prasad *et al.* (11) also succeeded in reducing fruit cracking in

Table 3. Effect of different water regimes on physio-chemical composition of sweet cherry fruits.

Treatment	Fruit weight (g)			Fruit length (cm)			Fruit width (cm)			TSS (°Brix)			Acidity (%)			TSS:acid ratio		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
100% ET	4.53	4.50	4.51	1.80	1.80	1.80	1.90	1.91	1.90	22.00	21.50	21.75	0.64	0.66	0.65	34.31	32.61	31.79
80% ET	4.04	4.23	4.13	1.82	1.85	1.82	1.77	1.80	1.78	23.23	23.04	23.02	0.54	0.55	0.54	43.33	41.46	42.39
60% ET	3.50	3.69	3.59	1.72	1.74	1.72	1.81	1.81	1.80	20.81	22.46	21.40	0.60	0.64	0.61	34.89	35.14	35.01
40% ET	3.10	3.06	3.08	1.80	1.77	1.78	1.62	1.66	1.63	19.53	22.33	20.66	0.52	0.59	0.55	37.09	37.86	37.47
CD at 5%	0.25	0.14	0.14	0.15	0.02	0.07	0.23	0.05	0.09	1.70	0.68	1.55	0.05	0.04	0.04	3.59	3.73	3.27

A = 1st year; B = 2nd year; C = Pooled

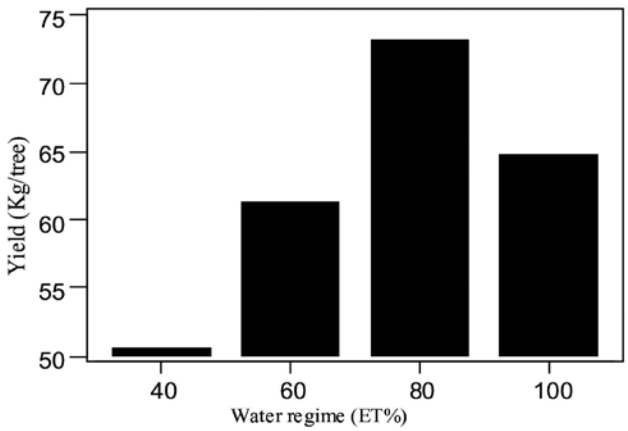

Fig. 1. Effect of different water regimes on fruit yield.

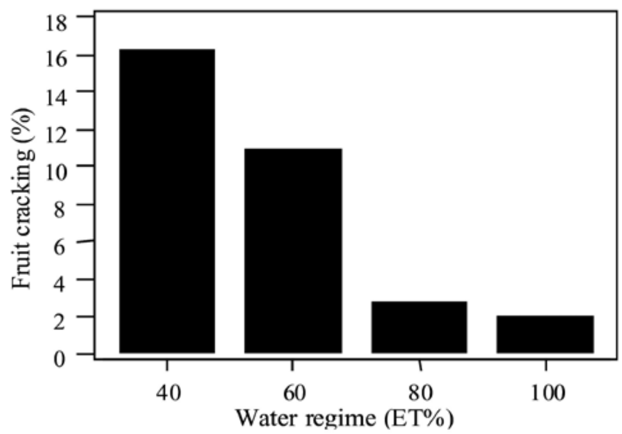

Fig. 2. Effect of different water regime on fruit cracking.

pomegranate under drip irrigation which supports the present finding.

The leaf N content was found to be maximum with 80% ET followed by 100% ET. Leaf N content was low during the 1st year of experiment compared to 2nd year. Results indicated that the continuous supply of nitrogenous fertilizer helps in nutrient build up in the cherry plants under optimum moisture regimes. It is interesting to note that the leaf nitrogen content was below the standard value in cherry leaf despite supply of full dose of N. This clearly suggests that the nitrogen dose recommended and practiced should be relooked for 25-year-old cherry plants. However, leaf P in all the treatments was found to be in sufficient range, while leaf K was sufficient in range upto 60% ET. The plants replenished water with 40% ET showed leaf K in deficient range. Hence, it is suggested that irrigation in sweet cherry must be replenished with 60% ET and above for better macro-nutrient uptake. As far as micronutrient content is concerned, leaf Fe, Mn, Cu and Zn was maximum with 80% ET followed by 100% ET and minimum was recorded with 40% ET. The leaf Fe, Cu and Mn were sufficient in range in all the treatments. However, the leaf Zn content was sufficient in 80 and 60% ET range and water replenished with 100 and 40% ET showed Zn deficiency (Tables 4 & 5).

The present finding indicate that sweet cherry plants cultivated on *Karewa* lands of Kashmir valley should be irrigated on a daily basis replenishing of

Table 4. Effect of different water regime on leaf macro-nutrient composition of sweet cherry.

Treatment	Nitrogen			Phosphorus			Potassium		
	1st year	2nd year	Pooled	1st year	2nd year	Pooled	1st year	2nd year	Pooled
ET (100%)	2.09	2.15	2.10	0.22	0.27	0.23	1.65	1.71	1.68
ET (80%)	2.35	2.39	2.35	0.26	0.28	0.26	1.72	1.83	1.77
ET (60%)	2.01	2.13	2.03	0.20	0.25	0.20	1.59	1.64	1.61
ET (40%)	1.93	2.17	1.98	0.18	0.23	0.18	1.33	1.46	1.39
CD at 5%	0.07	0.08	0.05	0.02	0.02	0.02	0.08	0.02	0.07

Table 5. Effect of different water regime on leaf micro-nutrient composition of sweet cherry.

Treatment	Fe			Cu			Zn			Mn		
	1st year	2nd year	Pooled	1st year	2nd year	Pooled	1st year	2nd year	Pooled	1st year	2nd year	Pooled
ET (100%)	195.67	203.33	199.50	15.66	15.66	15.66	20.00	17.00	18.50	68.33	68.33	68.33
ET (80%)	213.33	220.00	216.67	15.66	15.66	15.66	23.33	24.00	23.66	65.66	69.00	67.33
ET (60%)	193.33	198.33	195.83	15.66	15.66	15.66	19.66	21.00	20.33	57.66	60.33	59.00
ET (40%)	191.00	197.67	194.33	12.33	14.00	13.16	16.66	16.66	16.66	54.00	58.00	56.00
CD at 5%	9.07	15.97	8.24	1.52	NS	1.25	1.88	3.64	2.00	2.92	2.90	3.00

80% ET in order to achieve high yield, better quality, attractive fruit size and minimum fruit cracking.

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