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EFFECT OF DRIP IRRIGATION AND PLASTIC MULCH ON PERFORMANCE OF KINNOW AND SWEET ORANGE GROWN IN ARID REGIONS

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ABSTRACT
A field experiment was conducted during ten successive growing seasons (2004-2014) at Precision Farming Development Center, Agricultural Research Station, S.K. Rajasthan Agricultural University, Beechwal, Bikaner to evaluate the effect of drip irrigation and without and with black plastic mulch on the yield of Kinnow and sweet orange. All the drip irrigation regimes with plastic mulch produced a significantly higher yield as compared to surface irrigation. The highest yield of Kinnow (35.14 kg/plant) and sweet orange (33.23 kg/plant) were obtained under 1.0 volume water along with plastic mulch, respectively. But the yields were at par with the treatment of 0.8 volume along with plastic mulch. The yield of Kinnow and sweet orange under surface method of irrigation with and without mulch was 23.68 and 19.85 kg/plant and 20.17 and 15.56 kg/plant, respectively. Therefore, to achieve higher yield of Kinnow and sweet orange in western Rajasthan water should be applied @ 1.0 volume along with plastic mulch.

INTRODUCTION

Citrus fruit ranks third in area and production after banana and mango in India. Sweet oranges are the second largest citrus fruit cultivated in the country. In India, citrus occupies an area of 1,042.5 thousand hectares with annual production of 10,089.7 thousand MT (Tiwari *et al*., 2013). Maximum area under sweet oranges is in Andhra Pradesh followed by Maharashtra and Karnataka. Sweet oranges mature in 9-12 months. Being a non-climatric fruit, there is no improvement in colour, taste and flavour after harvesting. The Kinnow is a variety of citrus fruit cultivated extensively in India. It is a hybrid of two citrus cultivars- "King" (*Citrus nobilis*) x "Willow Leaf" (*Citrus deliciosa*). The Kinnow fruit is large and orange, with 12 to 25 seeds and a globular shape. It matures in January or February. This "Easy peel" citrus has assumed special economic importance and export demand due to its high juice, and its excellent aroma and taste. Its trees are highly productive and good net profit obtained from most of other fruit crops. For last few years, the water level in present bore wells and dug wells is declined alarmingly creating water shortage for sustaining the crop. Hence, proper irrigation water management by optimum use of available water resource in arid regions. Drip irrigation system is gradually gaining popularity among the citrus growers. The positive response of drip irrigation on plant growth and yield along with water economy is well studied in different citrus species in various citrus growing regions of the world (Barua *et al*., 2000 and Shirgure *et al*., 2004). Similarly, mulching practices in fruit crops ensures the better quality with high yield to the growers. Moreover, mulches reducing soil erosion, improving soil structure, organic matter, microbial flora, soil aeration, regulating soil temperature, conserving moisture *in-situ,* controlling weeds and reducing nutrient removal by weeds (Shirgure *et al*., 2005 and Bhanukar *et al*., 2015). Thus, the present investigation was planned to determine the effects of drip irrigation along with mulches on crop yield and economics of Kinnow and sweet orange in western Rajasthan.

MATERIALS AND METHODS

The experiment was conducted during ten successive growing seasons (2004-2014) at Precision Farming Development Center, SKRAU, Bikaner during 2004 to 2014 in the Kinnow and sweet orange orchard established during 2004 at high density spacing of 4x5m, respectively. The experiment was devised in factorial randomized block design with 3 replications. The experiment consisted of eight treatment combinations comprised of four volume of water (0.6, 0.8 and 1.0 through drip irrigation and another one 1.0 volume of water through surface irrigation) and two mulches (without mulch and with mulch). The experimental site had shallow soil depth having pH of 8.2, available N of 85.6 kg/ha, available P_2O_5 of 19.3 kg/ha and available K_2O of 195.6 kg/ha. Farmyard manure (75 kg/plant applied in December every year) and rec-

ommended dose of fertilizers (SSP 1.25 and MOP 0.4 kg/plant were applied in January and urea 0.625 kg/plant, out of this amount half dose applied in April and half in June) were applied in Kinnow and sweet orange basins every year. Fertilizer was placed in 15 cm deep trench opened in the basin 1.0 m away from tree trunk. Water requirement of Kinnow and sweet orange was estimated using pan evaporation and tree characteristic on daily basis, during the period of experiment irrigation were applied at 100, 80 and 60 per cent volume through drip irrigation system to the crops (Table 3). Irrigation schedule based on PET, crop factor and canopy coefficient at system efficiency 90.8 per cent. Total fruit yield and fruit number/tree were recorded as per treatment and the yield was expressed in kg/tree.

RESULTS AND DISCUSSION

The yield of Kinnow and sweet orange were influenced significantly by drip irrigation levels and mulches. The highest (Table 1&2) yield of Kinnow (35.14 kg/plant) was obtained under the treatment of 1.0 volume of water along with mulch which was at par with the treatment of 0.8 volume and with mulch. Similarly, the highest yield of sweet orange (33.23 kg/plant) was recorded with 1.0 volume of water along with mulch which was at par with the treatment of 0.8 volume and with mulch. The yield differences was 26.0 and 17.67 kg/plant when compared with surface irrigation and without mulch. Further mean data showed that the lowest yield of Kinnow (19.85 kg/plant) and sweet orange (15.56 kg/plant) were recorded under surface irrigation along with without mulch. There was linear yield increase with increase in the amount of water applied. The higher yield in case of drip irrigation and mulch was probably due to optimum evapotranspiration demand met at critical growth stages under this system, a prerequisite for dry matter accumulation and its partitioning within the plant and produced of more number of fruits and increase in fruit size. Several researchers observed yield increase with drip irrigation due to better fruit retention and reduced fruit drop. Baura *et al*. (2000) reported that increase in yield under drip at optimum irrigation level with plastic mulch in Assam lemon. Shirgure *et al*. (2004) when irrigation equivalent to 0.8 of open pan evaporation in citrus under Nagpur. Similar results were found by Sujatha *et al*. (2006) in mango, Ghosh and Pal (2010) Panigrahi *et al*. (2010), Panigrahi *et al*. (2014) in

Table 1: Effect of drip irrigation and mulch on the yield of Kinnow (2004-2014).

Treatment (Volume)	Yield (kg/plant)		Mean
	Without mulch	With mulch	
1.0 (drip)	32.10	35.14	33.62
0.8 (drip)	29.67	33.50	31.58
0.6 (drip)	25.95	29.23	27.59
1.0 (Surface)	19.85	23.68	21.76
Mean	26.89	30.38	
	CD (Volume) = 4.53		CD (Mulch) = 1.68

Table 2: Effect of drip irrigation and mulch on the yield of sweet orange (2004-2014).

Treatment (Volume)	Yield (kg/plant)		Mean
	Without mulch	With mulch	
1.0 (drip)	27.96	33.23	30.59
0.8 (drip)	26.13	30.60	28.36
0.6 (drip)	24.67	26.74	25.70
1.0 (Surface)	15.56	20.17	17.86
Mean	23.58	27.68	
	CD (Volume) = 4.71		CD (Mulch) = 1.63

Table 3: Daily irrigation applied for Kinnow and sweet orange.

Month	Average water applied (litre/day/plant)(Volume)				Total water applied (litre/day/plant)(Volume)			
	1.0	0.8	0.6	1.0 Surface	1.0	0.8	0.6	1.0 Surface
May 11	78.57	62.85	47.14	78.57	2435.55	1948.44	1461.33	2435.55
June 11	70.86	56.69	42.51	70.86	2125.78	1700.62	1275.47	2125.78
July 11	45.99	36.79	27.59	45.99	1425.67	1140.54	855.40	1425.67
Aug. 11	34.14	27.31	20.48	34.14	1058.21	846.57	634.93	1058.21
Sept. 11	26.37	21.09	15.82	26.37	791.06	632.85	474.64	791.06
Oct. 11	29.01	23.20	17.40	29.01	899.17	719.34	539.50	899.17
Nov. 11	20.96	16.77	12.58	20.96	628.90	503.19	377.34	628.90
Dec. 11	12.57	10.06	7.55	12.57	389.81	311.85	233.89	389.81
Jan. 12	9.31	7.44	5.58	9.31	288.46	230.77	173.08	288.46
Feb. 12	16.13	12.90	9.68	16.13	467.78	374.22	280.67	467.78
Mar. 12	35.54	28.44	21.33	35.54	1101.87	881.50	661.12	1101.87
April 12	41.23	32.98	24.73	41.23	1237.00	989.6	742.2	1237.00
Total					12849.23	10279.38	7709.54	12849.23

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