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Effect of Drip Irrigation on Physico-chemical Characteristics of Pomegranate Fruits in Arid Region

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Abstract: The effect of drip irrigation on physico-chemical characteristics of pomegranate fruits revealed that physical parameters of the fruit such as weight of fruit (g), juice content, both on fruit as well as aril weight basis, and seed content on fruit weight basis, were significantly higher in drip-irrigated plants as compared to control plants. Application of water through drip @ 8 L h^{-1} significantly reduced the cracking of fruits (20.9%) in comparison to control (50.8%). The chemical parameters such as TSS, total sugars, reducing sugars and pH of the juice decreased with increasing water under drip irrigation, whereas the acidity and non-reducing sugars increased.

Key words: Pomegranate, drip irrigation, fruit cracking, fruit quality.

Pomegranate *(Punica granatum* L.) is one of the important fruit crops gaining popularity in arid and semi-arid regions of India due to its hardy nature, high yield, low maintenance cost and good keeping quality (Khodade *et al.*,1990). Pomegranate requires supplemental irrigation, and water is a limiting factor for commercial cultivation in arid region (Prasad *et al.*,1997). In arid and semi-arid areas, underground water is the only source of irrigation during dry periods. For determining how much and when to irrigate the crop, the basic principle is to apply sufficient quantity of water to bring the soil up to field capacity at a depth and area commensurate with bulk of feeder zone. Under arid conditions drip irrigation is the most efficient method. However, the information on quality characters of pomegranate fruits, as affected by drip irrigation, is lacking. Therefore, the present studies were conducted to evaluate effects of drip irrigation on physico-chemical characteristics of pomegranate fruits under arid conditions.

Materials and Methods

This trial was conducted in six-year-old trees of pomegranate at Central Arid Zone Research Institute, Jodhpur, during 1995-96. The experiment was conducted in a randomized block design with four irrigation levels, i.e., 4 L h^{-1}, 8 L h^{-1} and 12 L h^{-1} through drip for three hours daily, at flowering and fruiting period and a control with basin irrigation system on pan evaporation basis @ 60 L m^{-2} area of the basin. All these treatments were replicated six times. Five fruits from each treatment, collected randomly at maturity stage, were brought to the laboratory in perforated polyethylene bags and analyzed for various physico-chemical characteristics. For physical parameters, weight of fruits, aril and rind per cent (fruit weight basis), juice and seed (both on fruit as well as aril weight basis) and cracking were recorded. Similarly, the chemical parameters such as acidity (citric acid), total sugars, reducing sugars, non-reducing sugars, TSS and pH of the juice were recorded. Total soluble

solids (TSS) were measured with the help of hand refractometer and expressed as °Brix. Titrable acidity of the juice was determined by titration method (AOAC, 1990). The total sugars were estimated as per method described by Yemm and Willis (1954) and reducing sugars were determined as per the method given by Nelson (1944). The pH of the juice was measured by pH meter. Statistical analysis was done as per the method described by Panse and Sukhatme (1985).

Results and Discussion

It is apparent from the data presented in Table 1 that there were significant differences in weight of the fruit and cracking per cent. The fruit weight was maximum (349.6 g) in 8 L h^{-1}, which was significantly higher over control (239.5 g), but there was no significant difference between 8 L h^{-1} and 12 L h^{-1} treatments. Similarly application of water @ 8 L h^{-1} through drip significantly reduced the cracking to a considerable extent. The fruit cracking under control was very high (50.8%) and was significantly reduced to 20.8% and 20.9% under 8 L h^{-1} and 12 L h^{-1}, respectively. The cracking in pomegranate is reported to be due to moisture imbalance in the soil and sudden change in the climate at the time of fruit maturity (Prasad *et al.*, 1997). Further, prolonged drought condition causes hardening of peel and if this is followed by heavy irrigation or rainfall, the pulp grows and it may result in cracking of the fruit (Chundawat, 1990). Thus, the reduction in fruit cracking with drip irrigation may be due to uniform distribution of water in the root zone throughout the growth and development stages of the plant.

Application of water through drip also caused significant increase in juice and seed content on fruit weight basis (Table 1). The maximum juice content (53.7%) was obtained in plants irrigated at 12 L h^{-1}, which was at par with 8 L h^{-1} (53.6%). Similar trend was also obtained with the seed content (Table 1). The increase in juice content might be due to higher absorption of water and minerals from the soil (Nath *et al.*, 1999).

The aril content was significantly higher in 8 L h^{-1} (63.4%) and 12 L ha^{-1} (63.9%) over control (56.7%). The rind (%), on the contrary, was in reverse order, being 36.6% in 8 L ha^{-1} and 43.3% in control (Table 1). The increase in aril content may be because of increase in fruit size and number of arils. Similar findings were also reported by Patel and Patel (1998).

Table 1. Physical parameters of the fruit as affected by drip irrigation

Treatment	Fruit weight (g)	% juice (fruit weight basis)	% seed (fruit weight basis)	% rind (fruit weight basis)	% aril (fruit weight basis)	% juice in aril	% seed in aril	% cracked fruits
Control	239.5	47.5	9.2	43.3	56.7	77.8	22.2	50.8
4 L h^{-1}	299.3	50.7	9.4	39.9	60.1	81.8	18.2	38.9
8 L h^{-1}	349.6	53.6	9.8	36.6	63.4	84.6	15.4	20.8
12 L h^{-1}	348.4	53.7	10.2	35.9	63.9	85.0	15.0	20.9
F test	**	**	**	**	**	**	**	**
CD (0.05)	3.28	0.67	0.21	0.77	0.74	0.75	0.59	0.33

** Significant at 1%.

Table 2. Chemical parameters of the fruit as affected by drip

Treatment	% total sugars	% reducing sugars	% non-reducing sugars	pH	TSS (°Brix)	% acidity
Control	13.77	12.85	1.32	3.43	19.0	0.3036
4 L h^{-1}	13.57	12.20	1.37	3.27	17.9	0.3212
8 L h^{-1}	13.54	12.18	1.36	3.15	17.0	0.3436
12 L h^{-1}	13.30	11.93	1.37	3.02	16.8	0.3619
F. Value	**	**	*	*	**	**
CD (0.05)	0.05	0.62	0.064	0.027	0.81	0

** - Significant at 1%, * - Significant at 5%.

As far as the juice content on aril weight basis is concerned, the trend was in increasing order under drip-irrigated plants. The juice content on aril weight basis was as high as 85.0% in 12 L h^{-1}, which was significantly more than the control (77.8%). On the other hand, the seed contents were in decreasing order in drip-irrigated plants (Table 1).

In drip-irrigated plants, the TSS was low as compared to control. The maximum TSS (19.0°Brix) was recorded in control, whereas it was 16.8°Brix in 12 L h^{-1} (Table 2). The lower content of TSS in drip-irrigated plants could be because of more absorption of water by the plant, resulting in a little increase in water content of juice (Subramanium *et al.*, 1997).

The highest total sugars were recorded in control (13.77%) and lowest (13.30%) in 12 L h^{-1}. A similar trend was also obtained with reducing sugars, but the content of non-reducing sugars were in the increasing order (Table 2).

The titrable acidity was lowest (0.3036%) in control and the highest (0.3619%) in 12 L h^{-1}. The differences among the treatments were also significant. The pH value of the juice was in decreasing order in drip-irrigated plants (Table 2).

It is concluded that the pomegranate plants irrigated through drip irrigation system @ 8 L h^{-1} for three hours daily during flowering and fruiting period under arid conditions improved the physico-chemical characteristics of fruits by increasing the size of fruits, juice content and also by reducing the fruit cracking to a considerable extent.

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