REASEARH ARTICLE

Yield and fruit quality of pomegranate (Punica granatum L.) grown in laterite soil under drip and basin irrigation during summer

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Abstract: The pomegranate is considered as one of the hardy fruit plants and has an ability to thrive under rainfed condition. However, for higher production of quality fruits, it requires water particularly during summer months. For harnessing maximum efficiency from the drip system of irrigation, amount of water to be applied should be quantified. But no systematic research in this direction has been carried out to find out the exact quantity of water to be applied for higher production of quality pomegranate in laterite soil of West Bengal. With the above objective an investigation was therefore made in this direction. The treatment included as drip irrigation for 1, 2, and 3 hours duration at two days interval, with and without straw mulching, basin irrigation @15 litres water/plant weekly with straw mulching and life saving irrigation with straw mulching. Thereby consisting of 8 (eight) irrigation treatments in the experiment. The experiment was laid out in a randomized complete block design with six replications. The results from two consecutive years of experimentation revealed that fruit yield was highest (16.8 kg/ plant) from the plant, received water through drip for 3 hours + without mulching followed by drip watering for one hour + mulching (13.6 kg/plant) which resulted maximum water use efficiency of 292.2 kg/ha/cm. In respect of fruit quality, juice quantity and total soluble sugar (TSS) content were improved due to different irrigation treatments. Foliar N, P K status was varied due to different irrigation treatments and it was maximum in the plants received water through drip for 3 hours + without mulching and minimum from basin watered plants. The drip irrigated plants had less fruit cracking as compared to basin irrigated plants.

Keywords: Pomegranate, drip irrigation, water use efficiency, yield, fruit quality.

INTRODUCTION

The pomegranate (*Punica granatum* L), is a popular fruit of tropical and subtropical regions, belonging to the family punicaceae. It is one of the important minor 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. It is grown in diverse climate and soil condition. It could be grown successfully even in poor and marginal soils by adopting proper cultural practices. The laterite soil is considered as poor soil due to low organic matter and nutrient contain and having low water holding capacity. However, Tarai and Ghosh (2006) reported that pomegranate can be commercially cultivated in the laterite soil. Although, pomegranate is

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considered as one of the hardy fruit plants and has an ability to thrive under rainfed condition, for higher production of quality fruits, it requires water particularly during summer months. In laterite zone, not only low annual precipitation, the ground water availability for irrigation during the summer months is also a problem. In such critical situation, irrigation through drip is considered to be the viable and most economical approach. Previous experiments showed that drip irrigation saves 50-66% water and increase yield 30-40% compared to flooding irrigation (Behnia, 1999; Chopadae *et al*., 2001). For harnessing maximum efficiency from the drip system of irrigation, amount of water to be applied should be quantified. But research work in this direction has not been carried out earlier for pomegranate, grown in laterite soil of West Bengal. Besides, most of the drip irrigation study on pomegranate was made on the basis of Pan Evaporation or water depletion method, where actual quantity of water to be applied through drip during the fruit growth period has not been mentioned (Srinivas, 1995; Agrawal and Agrawal, 2007) which is very essential for a grower. Therefore, an investigation was, done to find out the actual quantity of water to be applied per plant through drip irrigation during the fruit growth period.

MATERIALS AND METHODS

The trial was conducted on 7 year old plants of pomegranate cultivar "Ruby" in the orchard of a Private Farm at Jhargram, Paschim Medinipur, West Bengal, India during two successive seasons of 2010 and 2011. The treatment included as : Irrigation through drip for 1, 2 and 3 hours at every two days interval, with and without straw mulching, thus consisting 6 treatments; basin irrigation @ 15 litre water / plant weekly with straw mulching and life savings irrigation with straw mulching; thereby consisting 8 (eight) irrigation treatments altogether in the experiment. The experiment was conducted in Randomized Complete Block Design with six replications. There were two drippers / plant with discharge rate was 2.5 litres /hour/dripper, i.e. one plant received 5 litre of water in one hour. Uniform cultural practices were made in all the plants. The data on fruit yield/plant was calculated in both the years of study and statistically analysed. Physico-chemical analysis of fruit was based on 5 randomly selected mature fruits from each plant. The methods as described in A.O.A.C. (1990) was followed for chemical analysis of the fruits. The physico-chemical attributes were studied during the years of 2010 and 2011 and average have been calculated. The fruit cracking in percentage was observed at fruit maturity. The leaf N, P and K were determined by using micro-kjeldahal method, vandomolbdo-phosphoric acid method and flame photometer respectively.

RESULTS AND DISCUSSION

The results present in Table 1 clearly indicated that the fruit yield was significantly improved due to irrigation treatments. Highest average yield of 16.8 kg was obtained from the plant received irrigation for 3 hours *i.e.* 15 litres/plant at 2 days interval without mulching followed by mulching + drip irrigation for 1 hour *i.e.* 5 litres/plant at 2 days interval (13.6 kg/plant) and lowest yield (8.1 kg / plant) was recorded from the plant received the lowest amount of water. The result was in consonance with the findings of Prasad *et al.* (2003) in pomegranate who found that 8 litre water per hour through drip for three hours daily at flowering and fruiting period resulted in highest yield under arid region of Rajasthan.

Different irrigation treatments had significant influence on weight of fruits (Table 2). The plants which received irriga-

Table 1: Effect of irrigation and mulching on fruit yield of pomegranate cv. Ruby grown in laterite soil

Treatment	Amount of water applied per plant during the crop period (Average)	Total rainfall received during the crop period (January – May) (Average)	Amount of Water added (cm) during crop period (January to May) Irrigation + rainfall)	Fruit yield/ Plant (kg)			Average fruit yield/ha (kg)	Water use efficiency kg/ha/cm
				2010	2011	Average		
T_1 : Drip irrigation for 1 hour	220 litre	550 ml	57.44	12.4	7.6	10.0	11,100.00	193. 2
T_2 :Drip irrigation for 2 hour	440 litre	550 ml	59.89	18.2	7.8	13.0	14,430.00	240.9
T_3 : Drip irrigation for 3 hours	660 litre	550 ml	62.33	21.0	12.6	16.8	18,648.00	299.2
T_4 : T_1 + Straw mulching	220 litre	550 ml	57.44	14.2	12.9	13.6	15,096.00	262.8
T_5 : T_2 + Straw mulching	440 litre	550 ml	59.89	16.6	7.8	12.2	13,542.00	226.1
T_6 : T_3 + Straw mulching	660 litre	550 ml	62.33	15.5	6.1	10.8	11,988.00	192.3
T_7 : Basin Watering + Mulching	300 litre	550 ml	58.33	10.1	10.6	10.3	11,433.00	196.0
T_8 : Life saving irrigation + Mulching	150 litre	550 ml	56.67	10.4	5.8	8.1	8,991.00	158.7
LSD at 5%	-	-	-	0.5	0.4	0.4	-	-

Table 2: Effect of irrigation and mulching on physic-chemical composition of fruits and foliar NPK status of pomegranate grown in laterite soil.

Treatment	Fruit Weight (g)	Fruit diameter (cm)	Juice (%)	T.S.S. (^{0}B)	Acidity (%)	Reducing sugar (%)	Foliar status			Fruit cracking (%)
							Nitrogen (%)	Phosphorus (mg %)	Potassium (%)	
T_1 : Drip irrigation for 1 hour	158	7.2	70.0	12.8	0.40	10.1	1.42	87.0	1.10	7.7
T_2 :Drip irrigation for 2 hour	179	7.5	72.9	12.9	0.40	10.2	1.55	95.0	1.37	7.5
T_3 : Drip irrigation for 3 hours	196	7.7	75.3	13.6	0.45	10.1	1.70	106.0	1.65	5.5
T_4 : T_1 + Straw mulching	190	7.6	75.2	13.4	0.38	10.0	1.50	88.0	1.41	1.6
T_5 : T_2 + Straw mulching	171	7.4	71.6	12.7	0.39	9.9	1.53	88.0	1.47	6.4
T_6 : T_3 + Straw mulching	150	7.2	70.1	12.3	0.37	9.9	1.44	106.0	1.37	9.4
T_7 : Basin Watering + Mulching	155	7.0	69.2	13.0	0.40	10.1	1.53	98.0	1.26	14.2
T_8 : Life saving irrigation + Mulch-	160	7.0	69.0	13.1	0.46	10.1	1.20	99.5	1.20	16.3
LSD at 5%	5.8	N.S.	1.1	0.2	N.S.	N.S.	0.15	3.1	0.10	-

tion through drip for 3 hours + without mulching born the heaviest fruit (196 g) with maximum fruit diameter (7.7 cm) followed by the plants received drip irrigation for one hour with straw mulching (190 g weight with 7.6 cm size). It was interesting to note that more water through drip without straw mulching resulted in higher yield and fruit weight and size as compared to same amount of water with mulching. It is obvious that mulching increases soil water availability; however for pomogrante little water stress is needed for flower induction and fruiting. Therefore, drip irrigation for 3 hours with mulching might results low water stress. Under good water availability vegetative growth increases with new leaves and flushes. Therefore, immature leaves act as sinks other than fruits. It may cause reduced dry matter accumulation of fruits resulting less fruit weight. On the other hand lower yield in straw mulched plants may be attributed to less availability of water from the system where straw itself may acted as a barrier for quick availability of drip water during the dry months. Therefore, soil water availability under each treatment and the relationship in between soil water availability and yield should be investigated. According to results observed in this study mulching the drip irrigated plants of pomegranate grown in laterite soils in West Bengal, India is not useful. If mulch materials are used, less amount of water can be used. Similar results were reported by Sulochanamma *et al.,* (2005).

Application of water through drip also caused significant increase in juice content on fruit weight basis. The maximum juice content (75. 3%) was recorded with the application of drip water for 3 hours with no mulching closely followed by drip watering for 1 hour with mulching. The result is in line with the findings of Prasad *et al.,* (2003) who also noted higher juice content in drip irrigated plants. Regarding fruit quality improvement due to irrigation treatments as presented in Table 2, revealed that the TSS was significantly improved and maximum TSS (13.6^0B) was obtained from the plant received drip irrigation for 3 hours with no mulching.

One of the most beneficial effects of drip irrigation as compared to basin irrigation was the improvement of foliar N, P and K status and reduction of fruit cracking. The pants drip irrigated for 3 hours + no mulching showed highest N, P and K values as compared to basin irrigated plants (Table 2). It was reported that higher foliar N, P, K status is always associated with the higher fruit yield (Ghosh, 2012). Fruit cracking was noted lower in drip irrigated plants as compared to basin irrigated plants (Table 2). Reduced fruit cracking in drip irrigated pomegranate plants was also noted by Prasad *et al*., (2003).

The amount of water applied through drippers under various treatments and the rainfall received during summer months (January to May) are presented in Table 1. It is clear from the data that water use and water use efficiency were distinctly differed due to various irrigation treatments and straw mulching. The data revealed that maximum water use was under T_3 (drip irrigation for 3 hours) and T_6 (drip irrigation for 3 hours + straw mulching) but highest water use efficiency was obtained from T_3 (299.2) i.e., by adding 1 cm water 299. 2 kg fruit yield / ha was obtained. The findings is in agreement with the results of Pampattiwar *et al*., (1993) who obtained highest water use efficiency (306 kg fruits /ha) by applying 19.8 cm water per year. It is also clear from the results that straw mulching was not helpful in increasing water use efficiency in pomegranate.

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