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Effect of pruning intensity, crop load and fertigation on growth attributes in Pomegranate var. Bhagwa under Jaipur condition

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Abstract
The results of experiments showed that the maximum gain in average plant height (0.77 m), stem girth (0.75 cm) and plant spread in E-W *i.e.* 0.96 m and in N-S *i.e.* 0.94 m was recorded in F_1 (application of 100 per cent RDF through fertigation) followed by F_2 (75 per cent RDF through fertigation). The minimum gain in growth attribute like plant height (0.59 m), stem girth (0.57 cm) and plant canopy spread (E-W 0.68 m; and N-S 0.67 m) was recorded in treatment F_3. Most of growth attributes were also significantly influenced by pruning and crop load treatments. The plants which were subjected to heavy pruning recorded significantly higher plant height and canopy spread (E-W and N-S) followed by moderate pruning. The maximum gain in plant height (0.72 m) and plant canopy spread in E-W *i.e.* 0.79 m and in N-S i.e. 0.77 m were recorded in pruning treatment P_1. The different crop load treatments did not show significant difference on plant height and canopy spread.

Keywords: pruning intensity, fertigation, growth attributes, pomegranate, Jaipur

Introduction
Pomegranate (*Punica granatum* L.) is one of the most emerging fruit-crops of India. It is generally known in a distinct family (Punicaceae), which comprises only one genus (*Punica*) and two species; *P. granatum* and *P. protopunica* (Samir, 2010) [1]. Pomegranate is considered native to Iran, Afghanistan and Southern Pakistan's Baluchistan region to the Himalayas in Northern India. It has been widely cultivated throughout drier parts of South East Asia, Malaysia, the East Indies tropical Africa and India (Raj and Kanwar, 2008) [2]. In India, pomegranate is commercially cultivated in Solapur, Nasik, Ahmed Nagar, Dhule, and Latur districts of Maharashtra and to a smaller extent in Gujarat, Andhra Pradesh and Tamil Nadu. The different commercial varieties of pomegranates produced in the above places are Ganesh, Bhagwa, Mridula, Ruby and Arakta. The Bhagwa variety of pomegranate has attractive glossy red thick skin with high TSS. This is very popular among the farmers and is cultivated in large area because of the good shelf life, effective skin and aril color and tolerant to fruit cracking (Sheikh, 2006) [3]. Pruning is one of the important special horticultural practices in many fruit crops, which influences both yield and quality of fruit. Most types of trees are pruned to improve branch configuration and tree canopy, and thus make branches less likely to split under a heavy crop load, reduction in water sprouts to improve fruit quality, and/or to reduce the crop load which will improve the potential size of individual fruits. Fertigation through drip irrigation can yield a fertilizer savings in the range of 25 to 50 per cent (Haynes, 1985) [4]. Moreover, increasing prices of nitrogenous fertilizers and potential effects of excessive use of fertilizers on ground water quality make it necessary to use the fertilizers more efficiently without seriously reducing crop growth.

Material and Methods
The experiment was laid out at Horticulture Farm, RARI, Durgapura, Jaipur (Rajasthan). the region falls under Agro-Climatic Zone III- A (Semi-Arid Eastern Plain). Durgapura is situated at 26.5º North latitude, 75.47º East longitude and an altitude of 390 meters above Mean Sea Level in Jaipur district of Rajasthan. The experiment was conducted during January-August cropping season (Based on Ambe bahar flowering that occur in Febuary-March). The experiment, comprised of 18 treatment combination replicated four times, was laid out in split plot design with three fertigation treatments *i.e.* F_1 (100 %), F_2 (75 %) and F_3 (50 %) under main plots, two levels of pruning intensities *i.e.* P_1 (pruning of one year shoot to 25 %) and P_2 (pruning of one year shoot to 50 %)) and three levels of crop loads *i.e.* C_1 (20 fruits), C_2 (30 fruits) and C_3 (40 fruits) were added in sub plots. The fertigation schedule (250:125:125

& 500:125:125 g plant^{-1} year^{-1}) for three and four year old pomegranate plants was fixed based on the recommendation given by Pareek, (1982). For fertigation, the above fertilizers were divided as per the stage of crop growth and applied twice a week. Nitrogen, phosphorous and potassium were applied through urea (46 % N), phosphoric acid (54 % P_2O_5) and Muriate of Potash (60 % K_2O) for all the treatments.

Recommended fertilizer schedule below given at different stages

Nutrient Plant^{-1}	Stage of application							
	Vegetative stage (September-November)		Stress period (December)		Flowering to fruit set stage (January-February)		Fruit development stage (March-May)	
	2015	2016	2015	2016	2015	2016	2015	2016
N(g)	150	300	-	-	50	100	50	100
P(g)	50	50	-	-	62.5	62.5	12.5	12.5
K(g)	25	25	-	-	37.5	37.5	62.5	62.5

Result and Discussion

The plant height and girth were significantly different among the fertigation treatments during 2015-16 and 2016-17 (Table 1). The highest gain in plant height was recorded in the treament F_1 *i.e.* 0.74 and 0.80 m during 2016 and 2017, respectively while least increase in treatment F_3 was observed *i.e.* 0.56 and 0.61 m during the same years. Among the pooled data the highest gain in plant height was recorded in treatment F_1 (0.77 m) followed by treatment F_2 (0.71 m) and the least gain in plant height was estimated in treatment F_3 (0.59 m). The plant height was significantly influenced by pruning treatments during 2015-16 and 2016-17. The maximum gain in plant height was estimated in treatment P_2 *viz.*, 0.69 m and 0.75 m during 2015-16 and 2016-17, respectively. The minimum gain in plant height 0.63 and 0.69 m were recorded in treatment P_1 during 2015-16 and 2016-17, respectively. The maximum pooled value (0.72 m) and minimum value (0.66 m) of gain in plant height was recorded in treatment P_2 and P_1, respectively. The gain in plant height was not influenced by various level of treatment of crop load during both the years. However, the pooled value for gain in plant height was recorded maximum (0.72 m) and minimum (0.65 m) in treatment C_1 and C_3, respectively. The gain in stem girth was significantly influenced by different level of fertigation treatments. The treatment F_1 recorded the maximum gain in stem girth (0.71 and 0.78 cm) during 2015-16 and 2016-17, respectively (Table 1). The lowest gain in stem girth of plant was registered in treatment F_3 (0.55 and 0.60 cm) during 2015-16 and 2016-17, respectively. The pooled mean value of gain in stem girth showed that the treatment F_1 recorded the maximum (0.75 cm) and treatment F_3 recorded minimum (0.57 cm) gain in stem girth. The gain in stem girth was not influenced by different level of pruning treatments and crop load. Different fertigation treatments showed significant difference for canopy spread during 2015-16 and 2016-17 (Table 2). Similar to the present results, significant increase in plant growth characters were also reported in pomegranate by Rao and Subramanyam (2009) [5] and Ganpat (2001) [6]. The enhanced growth parameters observed in the present study could be attributed to the optimal availability of moisture regime and the nutrients at root zone. Also observed that drip fertigation at frequent intervals provides a consistent moisture regimes and nutrient pool in the soil and therefore, roots remain active for a longer period and increased the availability of nutrients and translocation of food materials which accelerate the vegetative growth of plant parts besides maintaining the soil moisture as well as temperature at optimum level. Significant increase in plant height and stem girth observed in the present investigation might be due to the better utilization of resources like water and nutrients through fertigation system (Padmavathamma, 1993; Karuthamani, 2010; Krishnamoorthy, 2012) [8, 9, 10]. The maximum gain in canopy spread (E-W**)** was recorded in treatment F_1 *viz*. 0.97 m and 0.95 m during 2015-16 and 2016-17, respectively. While the minimum gain in canopy spread (E-W**)** was recorded in treatment F_3 *viz.* 0.69 and 0.67 m during the same years. The pooled mean value of gain in canopy spread (E-W**)** was recorded maximum (0.96 m) in treatment F_1 while minimum (0.68 m) was recorded in treatment F_3. The maximum gain in canopy spread (E-W**)** was recorded in treatment P_2 (0.90 m and 0.88 m) during 2015-16 and 2016-17, respectively. Whereas, the treatment P_1 recorded the minimum gain (0.80 and 0.78 m) in canopy spread (E-W**)** during both the years. The highest pooled mean value of plant spread (E-W**)** of 0.89 m was registered by the treatment P_2 while the minimum pooled value of 0.79 m was recorded in treatment P_1. There was no significant effect on gain in canopy spread (E-W) by different levels of crop load in 2015-16 and 2016-17. However, the highest pooled mean value of plant spread of 0.88 m was registered by the treatment C_1 followed by treatment C_2 treatment with values of 0.86 m. The lowest pooled mean spread was registered in C_3 treatment *i.e.* 0.78 m. The maximum gain in canopy spread (N-S**)** was recorded in treatment F_1 *viz*., 0.94 m and 0.95 m during 2015-16 and 2016-17,respectively. While the minimum gain in canopy spread (N-S**)** was recorded in treatment F_3 *viz.* 0.67 m and 0.68 m during the same years. The pooled mean value of gain in canopy spread (N-S**)** was recorded maximum (0.94 m) in treatment F_1 while minimum (0.67 m) was recorded in treatment F_3. The maximum gain in canopy spread (N-S**)** was recorded in treatment P_2 (0.87 m and 0.88 m) during 2015-16 and 2016-17, respectively. Whereas, the treatment P_1 recorded the minimum gain (0.78 m and 0.77 m) in canopy spread during both the years, respectively. The highest pooled mean value of gain in canopy spread (N-S**)** of 0.87 cm was registered by the treatment P_2 while the minimum pooled value of 0.77 m was registered in treatment P_1. Several reports on the same line were reported in coffee by Karuthamani (2010) [12] and in mango by Rashmi *et al.* (2005) [11] and Srinivas (2006) [12] in which, the canopy spread was enhanced by higher levels of N, P and K.

The Data on effect of severity of pruning and fruit load in pomegranate on plant height revealed that irrespective of fruit load, the increase in height with sever pruning than light pruned tree. There was no significant difference in respect of plant height with different fruit load irrespective of pruning. The interaction between pruning and fruit load was also not significant. The practice like pruning significantly increased the vegetative growth, this factor probably due to an optimization of light and environment inside the tree likely to promote photosynthesis rate. Moreover, the lower the fruit load could improve the distribution of available mineral

elements within aerials part of trees. Similar findings were correlated with finding of Nath (1994) who revealed that in Assam lemon the plant growth with respect to tree height and spread of the tree were increased with the severity of pruning. Lal (2008) [15] reported that the mango tree height responded more to pruning of branches existing on main trunk compared to unpruned one. Ervin (1979) [14] also made same observation

Table 1: Effect of fertigation, pruning and crop load on gain in plant height and plant girth

Treatments	Gain in Plant Height (m)			Gain in stem Girth (cm)		
	2015-16	2016-17	Pooled	2015-16	2016-17	Pooled
Fertigation (F)						
F_1 (100%)	0.74	0.80	0.77	0.71	0.78	0.75
F_2 (75%)	0.68	0.74	0.71	0.66	0.72	0.69
F_3 (50%)	0.56	0.61	0.59	0.55	0.60	0.57
SEm±	0.01	0.02	0.01	0.01	0.02	0.01
C.D. (P=0.05)	0.05	0.06	0.04	0.05	0.06	0.04
Pruning (P)						
P_1 (25%)	0.63	0.69	0.66	0.61	0.67	0.64
P_2 (50%)	0.69	0.75	0.72	0.67	0.73	0.70
SEm±	0.01	0.03	0.02	0.01	0.02	0.03
C.D. (P=0.05)	0.04	0.06	0.05	NS	NS	NS
Crop Load (C)						
C_1 (20 fruits)	0.69	0.75	0.72	0.66	0.73	0.70
C_2 (30 fruits)	0.67	0.73	0.70	0.65	0.71	0.68
C_3 (40 fruits)	0.62	0.68	0.65	0.60	0.66	0.63
SEm±	0.02	0.03	0.02	0.02	0.02	0.03
C.D. (P=0.05)	NS	NS	NS	NS	NS	NS

Table 2: Effect of fertigation, pruning and crop load on gain in canopy spread in East-West (E-W) and North-South (N-S)

Treatments	Canopy spread (E-W) (m)			Canopy Spread (N-S) (m)		
	2015-16	2016-17	Pooled	2015-16	2016-17	Pooled
Fertigation (F)						
F_1 (100%)	0.97	0.95	0.96	0.94	0.95	0.94
F_2 (75%)	0.89	0.87	0.88	0.86	0.87	0.86
F_3 (50%)	0.69	0.67	0.68	0.67	0.68	0.67
SEm±	0.02	0.02	0.02	0.02	0.03	0.02
C.D. (P=0.05)	0.06	0.06	0.06	0.06	0.05	0.06
Pruning (P)						
P_1 (25%)	0.80	0.78	0.79	0.78	0.77	0.77
P_2 (50%)	0.90	0.88	0.89	0.87	0.88	0.87
SEm±	0.02	0.02	0.02	0.02	0.02	0.02
C.D. (P=0.05)	0.05	0.05	0.05	0.05	0.04	0.05
Crop Load (C)						
C_1 (20 fruits)	0.89	0.87	0.88	0.86	0.87	0.86
C_2 (30 fruits)	0.87	0.85	0.86	0.85	0.84	0.84
C_3 (40 fruits)	0.79	0.77	0.78	0.77	0.76	0.77
SEm±	0.02	0.02	0.02	0.02	0.02	0.02
C.D. (P=0.05)	NS	NS	NS	NS	NS	NS

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