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Effect of Irrigation Scheduling and Fertigation on Vegetative Growth of Pomegranate (*Punica granatum* L.) cv Bhagwa under Semi-Arid

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ABSTRACT

The field experiment to study the "Effect of Drip Irrigation Scheduling and Fertigation on Growth, Yield and Quality of Pomegranate (*Punica granatum* L.) cv Bhagwa" was conducted at Horticulture farm, Rajasthan Agricultural Research Institute, Durgapura (Jaipur-Rajasthan) during 2019-20 and 2020-21. The experiment comprised of 12 treatment combinations consisting of 3 drip irrigation levels (50%, 75% and 100% at PE level) and 4 fertigation levels (100%, 75%, 50% of recommended dose of fertilizers through drip and 100% of RDF as basal dose). The experiment was laid out in factorial Randomized Block Design. The experimental results revealed that among different treatment combinations maximum values for the Vegetative growth characters such as gain in plant height (Plant spread [(E-W) and (N-S)], LAI and minimum values for initiation of flowering (days) after pruning and fruit set to maturity (days) was found under the treatment $I_3 F_2$ (100% irrigation at PE level + 100 % RDF through drip) which was found the best for vegetative characteristics.

Keywords Pomegranate, Fertigation, Irrigation scheduling, Vegetative growth.

INTRODUCTION

Pomegranate (*Punica granatum* L., Punicaceae) is a shrub originated in central Asia regions, from Iran to the Himalayas in northern India, and is one of the oldest known fruit crops. Pomegranate is nowadays widely cultivated in commercial orchards in Iran, India, China, and Afghanistan and in many of the Mediterranean basin countries, including Turkey, Greece, Italy, France, Spain and Portugal (Artés *et al.* 2000, Holland *et al*. 2009, Matthaiou *et al.* 2014, Pekmezci and Erkan 2003). In India, it is extensively grown in Maharashtra (Nashik, Solapur, Ahmednagar, Pune, Sangli and Wardha districts) followed by Karnataka (Chitradurga, Bellary, Tumkur, Bijapur, Bagalkot), Gujarat (Kachchh, Banas Kantha, Mehsana). The other states where pomegranate is cultivated are Andhra Pradesh, Rajasthan, Uttar Pradesh, Haryana and Tamilnadu. Pomegranate fruits are traditionally eaten fresh or consumed in processed products such as juice, sherbets, jams, anardana (dried arils), jellies,

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carbonated drinks, syrups, garnish and deserts (Al-Maiman and Ahmad, 2002; Kays, 1999; Opara *et al.* 2009). Water and fertilizer management are two crucial aspects of fruit production, especially under areas of water scarcity. Rajasthan providing congenial environment for pomegranate holds a vast opportunity to harness the favorable conditions for quality pomegranate production. Application of fertilizers through drip along with the irrigation water i.e., fertigation not only saves the amount of water and fertilizers but also known to have positive influence on the quality of fruits by providing optimum amount of fertilizers at right stage and directly to the root zone of the plant. Irrigation water application under arid conditions had have been a major hurdle for the farmers. To manage this, the precise application of water through irrigation scheduling will help farmers to be able to estimate the amount and frequency of irrigation water. Keeping the above points under consideration, the present research experiment was conducted at Horticulture Farm, Rajasthan Agricultural Research Institute, Durgapura, Jaipur, Rajasthan, India.

MATERIALS AND METHODS

Experimental site and climate

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. This region has a typical semi-arid climate, characterized by hot dry summers and dry winters. The average rainfall of this region ranges from 500-700 mm per year. More than 90% of rainfall is received during July to September with scanty showers during winter months because of the western depression. The maximum temperature ranges from 28 to 45ºC during May and June, while in December and January, it falls below 3ºC, evaporation ranges from 1.3-17.5 mm/day.

Soil of the experimental field

In order to determine the physical and chemical properties and fertility of soil, the soil samples were collected with the help of screw auger up to the depth of 45 cm. The soil samples were taken from each treatment. The collected soil samples were mixed thoroughly on a clean piece of cloth and the bulk reduced by quartering so that about 500 g of composite sample was obtained.

Collected samples were brought to the laboratory and spread on a thick brown paper. Stones, pieces of roots, leaves and other decomposed organic residues were removed. Large lumps of moist soil were broken by hand. It was air dried at 20-25ºC and 20 to 60% relative humidity (Jackson 1973). After air drying soil samples were crushed gently in pestle and mortar and sieved through 92 mm sieve. Grounded samples were stored in glass containers. The grounded samples were mixed well before a sample was weighed for analysis. The soil of experimental field was loamy sand in texture, slightly alkaline in reaction, poor in organic carbon, low in available nitrogen and medium in available phosphorus and potassium status.

Vegetative growth characteristics

Gain in plant height (m) **:** The plant height was measured from the base of the plant to the highest point of the crown with help of measuring scale and expressed in meter.

Plant spread [E-W, N-S (m)]**:** Plant spread was measured in two opposite directions (E-W and N-S) with the help of measuring tape and average spread of the plant was calculated in meter.

Leaf area index **:** It was taken with the help of canopy analyzer (LP-80, LAI meter) between 10 AM-12 PM.

Initiation of flowering (days) **:** The number of days taken from pruning to bud appearance was observed on individual flower bud and expressed in days.

Fruit set to maturity duration (days) **:** The number of days taken from fruit set to complete harvest were recorded for individual fruit and expressed in days.

RESULTS

Gain in plant height (m)

The data depicted in Table 1 shows that the gain in

Table 1. Effect of drip irrigation levels and fertigation on gain in plant height (m), and plant spread [E-W, N-S (m)].

Treatments	Gain in plant height (m)			Plant spread (m)					
	Irrigation levels (I)			E-W			N-S		
	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled
I_1	0.66	0.70	0.68	0.66	0.70	0.68	0.68	0.72	0.70
I_2	0.80	0.85	0.82	0.80	0.85	0.82	0.84	0.90	0.87
I_3	0.91	0.97	0.94	0.91	0.97	0.94	0.88	0.93	0.91
SEm±	0.02	0.02	0.01	0.02	0.02	0.01	0.02	0.02	0.01
CD (5%)	0.05	0.06	0.04	0.05	0.06	0.04	0.05	0.06	0.04
				Fertigation levels (F)					
F_1	0.79	0.84	0.82	0.79	0.84	0.82	0.79	0.83	0.81
F_2	0.86	0.92	0.89	0.86	0.92	0.89	0.85	0.92	0.89
F_3	0.79	0.85	0.82	0.79	0.85	0.82	0.84	0.88	0.86
F_4	0.71	0.75	0.73	0.71	0.75	0.73	0.72	0.77	0.75
SEm±	0.02	0.02	0.01	0.02	0.02	0.01	0.02	0.02	0.02
CD (5 %)	0.05	0.07	0.04	0.05	0.07	0.04	0.06	0.07	0.04
				Interaction (I×F)					
I_1F_1	0.66	0.70	0.68	0.66	0.70	0.68	0.67	0.70	0.69
I_1F_2	0.72	0.77	0.74	0.72	0.77	0.74	0.72	0.78	0.75
I_1F_3	0.66	0.71	0.68	0.66	0.71	0.68	0.71	0.75	0.73
I_1F_4	0.59	0.63	0.61	0.59	0.63	0.61	0.61	0.65	0.63
I_2F_1	0.80	0.85	0.83	0.80	0.85	0.83	0.83	0.88	0.85
I_2F_2	0.87	0.93	0.90	0.87	0.93	0.90	0.89	0.97	0.93
I_2F_3	0.80	0.86	0.83	0.80	0.86	0.83	0.88	0.93	0.91
I_2F_4	0.72	0.76	0.74	0.72	0.76	0.74	0.76	0.82	0.79
I_3F_1	0.91	0.97	0.94	0.91	0.97	0.94	0.87	0.91	0.89
I_3F_2	0.99	1.06	1.03	0.99	1.06	1.03	0.94	1.01	0.97
I_3F_3	0.91	0.98	0.95	0.91	0.98	0.95	0.92	0.96	0.94
I_3F_4	0.82	0.87	0.84	0.82	0.87	0.84	0.79	0.84	0.82
SEm±	0.032	0.039	0.026	0.03	0.04	0.03	0.03	0.04	0.03
CD (5 %)	0.095	0.116	0.073	0.09	0.12	0.07	0.10	0.12	0.07

plant height was significantly influenced by drip irrigation levels in year 2019-20 and 2020-21. The highest gain in plant height was received in treatment I_3 i.e. 0.91 m and 0.97 m and minimum gain was received in I_1 i.e. 0.66 m and 0.70 m in 2019-20 and 2020-21 respectively. In the pooled data of both the years, treatments I_3 and I_1 showed the maximum (0.94 m) and minimum (0.68 m) gain plant height respectively.

The data on fertigation levels found to be influencing the gain in plant height significantly in both the years i.e. 2019-20 and 2020-21 (Table 1). On the basis of data presented treatment F_2 resulted in the maximum gain in plant height (0.86 m and 0.92 m) and minimum gain in plant height was recorded by the treatment F_4 (0.71 m and 0.75 m) in 2019-20 and 2020-21 respectively. Pooled data for both the years showed that maximum (0.89 m) and minimum (0.73 m) gain in plant height was recorded in treatment F_2 and F_4 respectively.

Interaction effect (I × F) **:** Interaction effect of drip irrigation levels and fertigation presented in Table 1 showed significant effect on gain in plant height. On the basis of the found data, the maximum gain in plant height (0.99 m and 1.06 m) was recorded in I_3F_2 treatment combination in year 2019-20 and 2020-21 respectively. However, minimum plant height (0.59 m and 0.63 m) was recorded in I_1F_4 treatment combination in year 2019-20 and 2020-21 respectively. Pooled data for both the years showed that maximum gain in plant height (1.03 m) was recorded in the treatment I_3F_2 and minimum gain in plant height (0.61) was

Table 2. Effect of drip irrigation levels and fertigation on leaf area index, Initiation of flowering (days), Fruit set to maturity duration (days).

Treatments	LAI (Leaf Area Index) Irrigation levels (I)			Initiation of flowering after pruning (days)			Fruit set to maturity (days)		
	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled
I_1	2.18	2.23	2.20	15.52	15.37	15.45	169.08	174.92	172.00
I_2	2.48	2.54	2.51	15.22	15.13	15.17	159.25	165.09	162.17
I_3	2.60	2.64	2.62	15.19	15.01	15.10	153.75	159.69	156.72
SEm±	0.05	0.06	0.04	0.31	0.37	0.24	3.22	4.12	2.61
CD (5 %)	0.15	0.17	0.11	0.90	1.09	0.69	9.45	12.07	7.45
				Fertigation levels (F)					
F_1	2.37	2.42	2.40	15.38	15.21	15.30	160.67	166.63	163.65
F_2	2.58	2.62	2.60	15.16	15.03	15.10	155.33	161.08	158.21
F_3	2.48	2.53	2.51	15.29	15.13	15.21	158.22	164.18	161.20
F_4	2.24	2.31	2.28	15.42	15.30	15.36	168.56	174.37	171.47
SEm±	0.06	0.07	0.04	0.35	0.43	0.28	3.72	4.75	3.02
CD (5 %)	0.17	0.20	0.13	1.04	1.26	0.79	10.92	13.94	8.60
				Interaction (I×F)					
I_1F_1	2.13	2.18	2.16	15.59	15.41	15.50	169.06	174.99	172.02
I_1F_2	2.32	2.37	2.34	15.37	15.23	15.30	163.44	169.16	166.30
I_1F_3	2.23	2.28	2.26	15.50	15.33	15.41	166.48	172.41	169.45
I_1F_4	2.02	2.09	2.05	15.63	15.50	15.57	177.36	183.11	180.24
I_2F_1	2.43	2.49	2.46	15.29	15.17	15.23	159.23	165.15	162.19
I_2F_2	2.64	2.69	2.67	15.07	14.99	15.03	153.93	159.65	156.79
I_2F_3	2.54	2.60	2.57	15.20	15.09	15.15	156.80	162.72	159.76
I_2F_4	2.30	2.38	2.34	15.33	15.26	15.29	167.05	172.82	169.94
I_3F_1	2.55	2.59	2.57	15.26	15.05	15.15	153.73	159.75	156.74
I_3F_2	2.77	2.80	2.79	15.04	14.87	14.96	148.62	154.43	151.52
I_3F_3	2.66	2.70	2.68	15.17	14.97	15.07	151.38	157.40	154.39
I_3F_4	2.41	2.47	2.44	15.30	15.14	15.22	161.28	167.17	164.22
SEm±	0.10	0.12	0.08	0.61	0.74	0.48	6.45	8.23	5.23
CD (5 %)	0.29	0.35	0.22	1.80	2.18	1.38	18.91	24.15	14.90

I_1 - 50% irrigation at PE
I_2 - 75% irrigation of PE
I_3 - 100% irrigation of PE
F_1 - 100 % RDF as basal dose plant^{-1}
F_2 - 100 % RDF at weekly interval plant^{-1}
F_3 - 75 % RDF at weekly interval plant^{-1}
F_4 - 50 % RDF at weekly interval plant^{-1}

recorded in the treatment I_1F_4.

Plant spread [E-W, N-S (m)]

East-West (E-W) **:** A perusal of data from Table 1 revealed that different irrigation levels significantly influenced the tree spread (E-W). Treatment I_3 recorded maximum gain in plant spread (0.91 m and 0.97 m) whereas treatment I_1 recorded minimum increase in plant spread (0.66 m and 0.70 m) in 2019-20 and 2020-21 respectively. The highest pooled mean value of gain in plant spread (E-W) of 0.94 m was registered by the treatment I_3 while the minimum pooled value of 0.68 m was registered in treatment I_1.

Further, a perusal of data from the same table revealed that fertigation levels significantly influenced the gain in tree spread (E-W). Treatment F_2 recorded maximum gain in East-West plant spread (0.86 m and 0.92 m) in 2019-20 and 2020-21 respectively. Whereas, treatment F_4 recorded minimum increase in plant spread (0.71 m and 0.75 m) in 2019-20 an 2020-21 respectively. The highest pooled mean value of gain in plant spread (E-W) of 0.89 m was registered by the treatment F_2 while the minimum pooled value of 0.73 m was registered in treatment F_4.

***Interaction effect (I × F)* :** A perusal of data regarding interaction of both the factors from the same table revealed that interaction of irrigation levels and fertigation levels significantly influenced the gain in tree spread (E-W). Treatment I_3F_2 recorded maximum gain in East-West plant spread (0.91 m and 1.06 m) in 2019-20 and 2020-21 respectively. Whereas minimum gain in tree spread (E-W) was recorded under the treatment I_1F_4 (0.59 m and 0.63 m) in 2019-20 and 2020-21 respectively. The highest pooled mean value of gain in plant spread (E-W) of 1.03 m was registered by the treatment I_3F_2 while the minimum pooled value of 0.61 m was registered in treatment I_1F_4.

***North-South (N-S)* :** A perusal of data from Table 1 revealed that different irrigation levels significantly influenced the tree spread (N-S). Treatment I_3 recorded maximum gain in plant spread (0.88 m and 0.93 m) whereas treatment I_1 recorded minimum increase in plant spread (0.68 m and 0.72 m) in 2019-20 and 2020-21 respectively. The highest pooled mean value of gain in plant spread (N-S) of 0.91 m was registered by the treatment I_3 while the minimum pooled value of 0.70 m was registered in treatment I_1.

Further, a perusal of data from the same table revealed that fertigation levels significantly influenced the gain in tree spread (N-S). Treatment F_2 recorded maximum gain in East-West plant spread (0.85 m and 0.92 m) in 2019-20 and 2020-21 respectively. Whereas, treatment F_4 recorded minimum increase in plant spread (0.72 m and 0.77 m) in 2019-20 and 2020-21 respectively. The highest pooled mean value of gain in plant spread (N-S) of 0.89 m was registered by the treatment F_2 while the minimum pooled value of 0.75 m was registered in treatment F_4.

***Interaction effect (I × F)* :** A perusal of data regarding interaction of both the factors from the same table revealed that interaction of irrigation levels and fertigation levels significantly influenced the gain in tree spread (N-S). Treatment I_3F_2 recorded maximum gain in North-South plant spread (0.94 m and 1.01 m) in 2019-20 and 2020-21 respectively. Whereas minimum gain in tree spread (N-S) was recorded under the treatment I_1F_4 (0.61 m and 0.65 m) in 2019-20 and 2020-21 respectively. The highest pooled mean value of gain in plant spread (E-W) of 0.97 m was registered by the treatment I_3F_2 while the minimum pooled value of 0.63 m was registered in treatment I_1F_4.

Leaf area index (LAI)

The data presented in Table 2 revealed that the different irrigation levels significantly affected the LAI, where mean maximum LAI (2.60 and 2.64) was obtained in treatment I_3 and minimum mean LAI (2.18 and 2.23) was found in treatment I_1 in year 2019-20 and 2020-21 respectively. Pooled data for both the years showed that the mean maximum (2.62) and mean minimum LAI (2.20) was observed in treatment I_3 and I_1 respectively.

Similarly, the data presented revealed that the different fertigation levels significantly affected the LAI, where mean maximum LAI (2.58 and 2.62) was obtained in treatment F_2 and minimum mean LAI (2.24 and 2.31) was found in treatment F_4 in year 2019-20 and 2020-21 respectively. Pooled data for both the years showed that the mean maximum (2.60) and mean minimum LAI (2.28) was observed in treatment F_2 and F_4 respectively.

***Interaction effect (I × F)* :** Interaction effect of drip irrigation levels and fertigation presented in table showed significant effect on LAI. On the basis of the found data, the maximum LAI (2.77 and 2.80) was recorded in I_3F_2 treatment combination in year 2019-20 and 2020-21 respectively. However, minimum LAI (2.02 and 2.09) was recorded in I_1F_4 treatment combination in year 2019-20 and 2020-21 respectively. Pooled data for both the years showed that maximum LAI (2.79) was recorded in the treatment I_3F_2 and minimum LAI (2.05) was recorded in the treatment I_1F_4.

Initiation of flowering after pruning (days)

The data presented in Table 2 revealed that the different irrigation levels significantly affected the Initiation of flowering after pruning, where mean minimum days to Initiation of flowering after pruning

(15.19 and 15.01) was obtained in treatment I3 and maximum mean days to Initiation of flowering after pruning (15.52 and 15.37) was found in treatment I_1 in year 2019-20 and 2020-21 respectively. Pooled data for both the years showed that the mean minimum (15.10) and mean maximum days to Initiation of flowering after pruning (15.45) was observed in treatment I_3 and I_1 respectively.

Similarly, the data presented revealed that the different fertigation levels significantly affected the days to Initiation of flowering after pruning, where mean minimum days to Initiation of flowering after pruning (15.16 and 15.03) was obtained in treatment F_2 and maximum days to Initiation of flowering after pruning (15.42 and 15.30) was found in treatment F_4 in year 2019-20 and 2020-21 respectively. Pooled data for both the years showed that the mean minimum (15.10) and mean maximum days to Initiation of flowering after pruning (15.36) was observed in treatment F_2 and F_4 respectively.

Interaction effect (I × F) **:** Interaction effect of drip irrigation levels and fertigation presented showed significant effect on days to Initiation of flowering after pruning. On the basis of the found data, the minimum days to Initiation of flowering after pruning (15.04 and 14.87) was recorded in I_3F_2 treatment combination in year 2019-20 and 2020-21 respectively (Table 2). However, maximum days to Initiation of flowering after pruning (15.63 and 15.50) was recorded in I_1F_4 treatment combination in year 2019-20 and 2020-21 respectively. Pooled data for both the years showed that minimum days to Initiation of flowering after pruning (14.96) was recorded in the treatment I_3F_2 and maximum days to Initiation of flowering after pruning (15.57) was recorded in the treatment I_1F_4.

Fruit set to maturity duration (days)

The data presented in Table 2 revealed that the different irrigation levels significantly affected the days for fruit set to maturity, where mean minimum days for fruit set to maturity (153.75 and 159.69) was obtained in treatment I_3 and maximum mean days for fruit set to maturity (169.08 and 174.92) was found in treatment I_1 in year 2019-20 and 2020-21 respectively. Pooled data for both the years showed that the mean minimum (156.72) and mean maximum days for fruit set to maturity (172.00) was observed in treatment I_3 and I_1 respectively.

Similarly, the data presented revealed that the different fertigation levels significantly affected the days for fruit set to maturity, where mean minimum days for fruit set to maturity (155.33 and 161.08) was obtained in treatment F_2 and maximum days for fruit set to maturity (168.56 and 174.37) was found in treatment F_4 in year 2019-20 and 2020-21 respectively. Pooled data for both the years showed that the mean minimum (158.21) and mean maximum days for fruit set to maturity (171.46) was observed in treatment F_2 and F_4 respectively (Table 2).

Interaction effect (I × F) **:** Interaction effect of drip irrigation levels and fertigation presented in Table 2 showed significant effect on days for fruit set to maturity. On the basis of the found data, the minimum days for fruit set to maturity (148.62 and 154.43) was recorded in I_3F_2 treatment combination in year 2019-20 and 2020-21 respectively. However, maximum days for fruit set to maturity (177.36 and 183.11) was recorded in I_1F_4 treatment combination in year 2019-20 and 2020-21 respectively. Pooled data for both the years showed that minimum days for fruit set to maturity (151.52) was recorded in the treatment I_3F_2 and maximum days for fruit set to maturity (180.24) was recorded in the treatment I_1F_4.

DISCUSSION

It is apparent from the data presented in Tables 1 – 2 given above that different treatments had significant influence on vegetative growth parameters. The increase in the growth rate of plant height and canopy in drip irrigation might be due to the continuous supply of water to the plant. This sustains the soil moisture at optimal level reducing water stress to the plant resulting in superior vigour (Subramanian *et al.* 1997). Agrawal and Agrawal (2007) found that the growth parameters like plant height and canopy spread of pomegranate was improved under trickle irrigated plants as compared to the control i.e. surface irrigation. Prasad *et al.* (2003) also found that plants irrigated through drip were vigorous than the basin irrigation system. Bhardwaj *et al.* (1995), Maas and

Van Der (1996) also reported that vegetative growth of the plants was found to be influenced positively by even distribution of water in the soil through drip irrigation to fruit trees at young age. Plant height and canopy spread were significantly better under drip irrigation at alternate day over conventional method in aonla (Chandra and Jindal 2001). The results obtained in the present study are in conformism with those reported by Dubey (1993) in Guava, Chandra (2000) in aonla and ber and Ojha (2000) in aonla plus guava cropping models at early stage of plant growth.

Among various fertigation levels higher doses of fertilizer showed higher, plant height, plant spread and leaf area index. It might be owing to the poised use of fertilizers ascribed to better nutritional environment in the rhizosphere besides in plant system. Nitrogen, phosphorus and potassium are the most crucial of all mineral nutrients for growth and development of the plant as it is the foundation of ultimate components of all living matter *per se* (Throughton *et al.* 1974). The increased vegetative growth of the plant could be credited to the regulated supply of N to the active root zone of the plant which might have caused minimum time lag between application and uptake of nutrients resulting in better cell turgidity which had led to cell enlargement and better cell wall development thus resulting in better plant vigour (Viers 1972). Abundant nitrogen supply with ample opportunity for carbohydrate synthesis is well-known to boost vegetative growth and reduce flowering (Corbesier *et al.* 2002). The high endogenous ratio of carbohydrate to nitrogen (C : N ratio) promotes flowering whereas high nitrogen availability resulting low C:N ratio promotes vegetative growth (Bernier *et al.* 1981, Rideout *et al*. 1992). Fertigation consequences in increase in height of the plant, number of new shoots emerged from pruned branches, shoot length and canopy spread to the quick response of food material absorbed by the roots and transmission of the same to the main trunk of such trees, moreover, in such tress of the carbohydrates and nitrogen were utilized for the vegetative growth, thereby, causing stimulated production of height of the plants, more number of new shoots, shoot length and increased canopy spread (Singh 2012). Baruah and Mohan (1991) told that potassium application increases vegetative growth parameters such as LAI in banana. Both nitrogen and potassium may be introduced nutrient for foliar growth and development. Klein *et al.* (1989) studied the response of Starking Delicious apple tree to four nitrogen fertigation levels through drip irrigation (50, 150, 250 and 400 kg N ha^{-1}) and observed that vegetative growth was found positively correlated with the amount of nitrogen used. The present research is in close conformity with the study findings of Shirgure *et al.* (2001) in Nagpur mandarin, Meena *et al.* (2018) at Durgapura in pomegranate, Kumar *et al.* (2013) in guava.

It is apparent from the observed data that higher levels of drip irrigation significantly influenced the vegetative growth characteristics in pomegranate. When the irrigation water is applied through drip, plant may benefit maximum from regular frequent fertigation as contrasting to conventional basal application. In banana plant height, stem girth and leaf area index increased with nitrogen fertigation through drip (Srinivas 1997). Similarly Sharma *et al.* (2005) witnessed that growth attributes were higher in plants receiving fertilizers through drip as compared to soil application of fertilizers in pomegranate. The present investigation is in line of the Agrawal *et al.* (2005) in papaya and Singh *et al.* (2006) in pomegranate.

CONCLUSION

Since water and nutrient are the most crucial inputs for optimum growth of a plant, after thorough study of these components with regard to the crop and the environmental conditions, it may be concluded that among various irrigation and fertigation levels, treatment I_3F_2 (100% irrigation at PE level + 100 % RDF through drip) was found the best for vegetative characteristics in pomegranate under semi-arid conditions of Rajasthan.

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