The Pharma Innovation Journal 2023; 12(3): 1117-1121

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(3): 1117-1121

www.thepharmajournal.com
Received: 22-01-2023
Accepted: 25-02-2023

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Response of pomegranate *cv.* Bhagwa to irrigation scheduling and fertigation on flowering and fruiting characters under semi-arid conditions of Rajasthan

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Abstract
The field experiment 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 minimum values for Initiation of flowering (days) after pruning and Fruit set to maturity (days), Fruit cracking (%) and maximum Fruit Retention (%), Number of fruits plant^{-1}, Average fruit weight (g), Fruit diameter (cm) was found under the treatment I_3F_2 (100% irrigation at PE level + 100% RDF through drip) which was found the best for vegetative characteristics under two years of experimentation.

Keywords: Irrigation, fertigation, pomegranate, flowering, fruiting

Introduction
Irrigation water and nutrients are the most crucial inputs which directly affect the plant vegetative growth, development, yield and quality of product. Application of irrigation water and fertilizers together through drip is the most efficient way of applying water and nutrient to the plant root zone. These inputs are efficiently harnessed by plants as these are placed near root zone of the plant. For proper water management, scheduling of water is beneficial (Tan, 1980) [12]. Scheduling of irrigation is the process which helps an irrigator to determine the timing, frequency and quantity of water that is to be applied to the crop. The main task is to estimate crop water requirement in the perspective of growth stages of plant and climate (Tan and Layne, 1981) [13]. Pomegranate needs supplemental irrigation for proper growth and for commercial cultivation of pomegranate in dry and arid region, water itself is a limiting factor (Prasad *et al*., 1997) [8]. Through fertigation both water and fertilizer can be applied more precisely, in controlled quantity and at appropriate time and frequency directly to the root zone with drip irrigation as per the crop requirements at different growth stages (Yadav *et al*., 1998) [16]. Fertigation through drip can minimize the fertilizer usage up to 25-40 per cent (Kale, 1995; Hasan *et al*., 2007; Thakur *et al*., 2012) [3, 2, 14] and increased fertilizer use efficiency (Ranghaswami *et al*., 2006) [9].

Materials and Methods
The present study was conducted on five-year-old pomegranate plants *cv.* Bhagwa growing under high density planting system (3 m×3 m spacing), at the Horticulture Farm, Rajasthan Agricultural Research Institute, Durgapura, Jaipur. The experiment was conducted on 36 plants in randomized block design. The experiment comprised of 12 treatment combinations consisting of 4 fertigation levels (100%, 75%, 50% of recommended dose of fertilizers through drip and 100% of RDF as basal dose) and 3 drip irrigation levels (50%, 75% and 100% at PE level). The "*Mrig Bahar*" (June-July) crop had been chosen for the present experiment. Recommended dose of N, P and K used were applied @ 625, 250 and 250 g per plant respectively. Water soluble fertilizers were applied through drip irrigation system (fertigation). Amount of water soluble fertilizes were determined by calculating the amount of nitrogen, phosphorus and potassium in recommended dose. All fertilizers were applied in ten equal split doses at weekly interval (from 16 August to 30 October in both the years). Weighed quantity

of water soluble fertilizers (19:19:19) along with urea as per treatment requirement were mixed in water and injected through venturi meter. Pan Evaporation method was used for estimating crop water requirement (Mane *et al*., 2006) [6].

Initiation of flowering (days): The number of days taken from pruning to bud appearance were 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.

Fruit retention (%): Fruit retention per cent was calculated by following formula:

$$\text{Fruit retention (\%)} = \frac{\text{Total number of fruits at harvest}}{\text{Total number of fruit set}} \text{ X } 100$$

Number of fruits per plant: The total numbers of fruits were counted at each harvest. After the completion of harvest, the total number of fruits per plant was worked out.

Average fruit weight (g): The five fully matured fruits from each of the treatment combination were randomly selected at field level. Each fruit was weighed on top balance and average weight of fruit per treatment was computed and expressed in gram.

Fruit size (Diameter) (cm): Diameter of the randomly selected ten fruits in each treatment was recorded transversely and longitudinally with the help of vernier calipers in centimeter and the average was calculated.

Fruit Cracking (%): The per cent incidence of fruit cracking was calculated as below

$$\text{Fruit cracking (\%)} = \frac{\text{Number of cracked fruits per plant}}{\text{Total number of fruits borne on individual plant}} \text{ X } 100$$

Results

Table 1: The data regarding Initiation of flowering after pruning of pomegranate plant as affected by drip irrigation levels and fertigation and their interaction

Treatments	Initiation of flowering after pruning (days)	fruit set to maturity (days)	Fruit retention (%)	number of fruits plant^{-1}	average fruit weight (g)	Fruit diameter (cm)	Fruit cracking (%)
Irrigation Levels (I)							
I_1	15.45	172.00	75.91	64.39	278.09	7.54	13.21
I_2	15.17	162.17	78.01	67.28	284.11	8.08	11.25
I_3	15.10	156.72	79.20	69.30	287.16	8.42	10.80
SEm±	0.24	2.61	1.23	1.05	4.47	0.13	0.19
CD (5%)	NS	NS	NS	NS	12.75	0.36	0.55
Fertigation Levels (F)							
F_1	15.30	163.65	77.50	66.69	282.57	7.75	12.15
F_2	15.10	158.21	78.83	68.84	285.69	8.50	10.80
F_3	15.21	161.20	78.00	67.34	284.09	8.23	11.67
F_4	15.36	171.47	76.50	65.09	280.14	7.57	12.38
SEm±	0.28	3.02	1.42	1.22	5.17	0.15	0.22
CD (5%)	NS	NS	NS	NS	14.72	0.42	0.63
Interaction (IxF)							
I_1F_1	15.50	172.02	75.71	64.10	277.55	7.30	13.65
I_1F_2	15.30	166.30	77.00	66.16	280.61	8.00	12.14
I_1F_3	15.41	169.45	76.19	64.73	279.04	7.75	13.12
I_1F_4	15.57	180.24	74.73	62.57	275.16	7.12	13.91
I_2F_1	15.23	162.19	77.80	66.98	283.56	7.81	11.63
I_2F_2	15.03	156.79	79.13	69.13	286.69	8.56	10.34
I_2F_3	15.15	159.76	78.30	67.63	285.08	8.30	11.17
I_2F_4	15.29	169.94	76.80	65.37	281.12	7.63	11.85
I_3F_1	15.15	156.74	78.99	68.99	286.60	8.14	11.17
I_3F_2	14.96	151.52	80.34	71.21	289.76	8.92	9.93
I_3F_3	15.07	154.39	79.49	69.66	288.14	8.65	10.73
I_3F_4	15.22	164.22	77.97	67.33	284.13	7.95	11.38
SEm±	0.48	5.23	2.45	2.11	8.95	0.25	0.38
CD (5%)	NS	NS	NS	NS	25.50	0.72	1.09

I1 - 50% irrigation at PE
I2 -.75% irrigation of PE
I3 - 100% irrigation of PE
F1 - 100% RDF as basal dose plant^{-1}
F2 - 100% RDF at weekly interval plant^{-1}
F3 - 75% RDF at weekly interval plant^{-1}
F4 - 50% RDF at weekly interval plant^{-1}

Initiation of flowering after pruning (days)

The data regarding Initiation of flowering after pruning of pomegranate plant as affected by drip irrigation levels and fertigation and their interaction are presented in Table 1. The data revealed that the different irrigation levels did not affect the Initiation of flowering after pruning significantly.

However, 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 also did not show significant effect on the days to Initiation of flowering after pruning. However 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 x F): Interaction effect of drip irrigation levels and fertigation presented did not show any significant effect on days to Initiation of flowering after pruning. However, On the basis of the 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 regarding days for fruit set to maturity of pomegranate plant as affected by drip irrigation levels and fertigation and their interaction are presented in Table 1. The data revealed that the different irrigation levels did not show any significant effect on the days for fruit set to maturity, however, 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 did not show any significant effect on the days for fruit set to maturity. However, pooled data for both the years showed that the mean minimum (158.21) and mean maximum days for fruit set to maturity (171.46) were observed in treatment F_2 and F_4 respectively.

Interaction effect (I x F): Interaction effect of drip irrigation levels and fertigation presented in table did not show any significant effect on days for fruit set to maturity. However, on the basis of the pooled data for both the years showed that minimum days for fruit set to maturity (151.52) were recorded in the treatment I_3F_2 and maximum days for fruit set to maturity (180.24) were recorded in the treatment I_1F_4.

Fruit Retention (%)
The data on fruit retention (%) of pomegranate plant as affected by drip irrigation levels, fertigation and their interaction are presented in table 1. As obvious from the table that irrigation levels did not show any significant effect on the fruit retention in pomegranate. However, pooled data of both the years showed that the mean maximum and minimum fruit retention (79.20% and 75.91%) was found under treatments I_3 and I_1 respectively.
As presented in the table that fertigation levels did not show any significant effect on the fruit retention in pomegranate. However, pooled data of both the years showed that the mean maximum and minimum fruit retention (78.83% and 76.50%) was found under treatments F_2 and F_4 respectively.

Interaction effect (I x F): Interaction effect of fertigation and drip irrigation levels presented in table did not show any significant effect on fruit retention. However, the pooled data for both the years showed that maximum fruit retention (80.34%) was recorded in the treatment I_3F_2 and minimum fruit retention (74.73%) was recorded in the treatment I_1F_4.

Number of fruits plant^{-1}
The data on number of fruits of pomegranate plant as affected by drip irrigation levels, fertigation and their interaction are presented in Table 1. As obvious from the table that irrigation levels did not show any significant effect on the number of fruits in pomegranate. However, pooled data of both the years showed that the mean maximum and minimum number of fruits (69.30 and 64.39) was found under treatments I_3 and I_1 respectively.
As presented in the table that fertigation levels did not show any significant effect on the number of fruits in pomegranate. However, pooled data of both the years showed that the mean maximum and minimum number of fruits (68.84 and 65.09) was found under treatments F_2 and F_4 respectively.

Interaction effect (I x F): Interaction effect of drip irrigation levels and fertigation presented in table did not show any significant effect on no. of fruits. However, pooled data for both the years showed that maximum number of fruits (71.21) was recorded in the treatment I_3F_2 and minimum number of fruits (62.57) was recorded in the treatment I_1F_4.

Average fruit weight (g)
The data on average fruit weight of pomegranate as affected by drip irrigation levels, fertigation and their interaction are presented in table. As obvious from the table that irrigation levels significantly affected the average fruit weight in pomegranate. Pooled data of both the years showed that the maximum and minimum average fruit weight (279.66 g and 276.52 g) was found under treatments I_3 and I_1 respectively.
As presented in the table that fertigation levels significantly affected the average fruit weight in pomegranate. Pooled data of both the years showed that the maximum and minimum average fruit weight (285.69 g and 280.14 g) was found under treatments F_2 and F_4 respectively.

Interaction effect (I x F): Interaction effect of drip irrigation levels and fertigation presented in table showed significant effect on average fruit weight. Pooled data for both the years showed that maximum average fruit weight (289.76 g) was recorded in the treatment I_3F_2 and minimum average fruit weight (275.16 g) was recorded in the treatment I_1F_4.

Fruit diameter (cm)
The data on average fruit diameter of pomegranate as affected by drip irrigation levels, fertigation and their interaction are presented in Table 1. As obvious from the table that irrigation levels significantly affected the average fruit size in pomegranate. Pooled data of both the years showed that the maximum average fruit size (8.42 cm) was found under the treatment I_3 which was found at par with the treatment I_2 and minimum average fruit size (7.54 cm) was found under treatment I_1.
As presented in the table that fertigation levels significantly affected the average fruit size (diameter) in pomegranate. Pooled data of both the years showed that the maximum average fruit size (8.50 cm) was found under treatment F_2 which was found to be at par with the treatment F_3 and

minimum average fruit size (7.57 cm) was found under treatment F_4.

Interaction effect (I x F): Interaction effect of drip irrigation levels and fertigation presented in table showed significant effect on average fruit size. Pooled data for both the years showed that maximum average fruit size (8.92 cm) was recorded in the treatment I_3F_2 which was found to be at par with I_3F_3 and minimum average fruit size (7.12 cm) was recorded in the treatment I_1F_4.

Fruit cracking (%)

The data regarding fruit cracking (%) of pomegranate plant as affected by drip irrigation levels and fertigation and their interaction are presented in Table 1. The data revealed that the different irrigation levels significantly affected the fruit cracking (%). Pooled data for both the years showed that the mean minimum fruit cracking (10.80%) was observed in treatment I_3 which was found at par with I_2 while mean maximum fruit cracking (13.21%) was found in I_1 respectively.

Similarly, the data presented revealed that the different fertigation levels significantly affected the Fruit cracking (%). Pooled data for both the years showed that the mean minimum (10.80%) and mean maximum Fruit cracking (12.38%) was observed in treatment F_2 and F_4 respectively.

Discussion

Different drip irrigation levels and fertigation levels significantly affected the flowering and fruiting characters *viz.* number of flowers and number of fruits with minimum fruit cracking. It is evident from the data presented in the table that higher fertigation levels recorded maximum number of flowers and number of fruits, maximum fruit diameter with minimum fruit cracking.

It is clear from the findings that various fertigation levels influences the flowering and fruiting pattern in pomegranate. This might be possibly because of the availability of ample quantity of soil nutrients and increased leaf area available for photosynthesis. The fertigation treatments imposed in the first year would have influenced emergence of more number of flowers per plant only in the second or later years. The results obtained in present investigation are in line with findings of Mongi Zekri and Koo (2003) [7]. Further, treatment receiving higher doses of fertilisers resulted in early flowering, which can be attributed to faster vegetative growth and accumulation of higher amount of photosynthates in the leaves. Due to faster metabolic process, plants tend to create new sink, as a result it would have had early flowering in higher fertigation levels (Mahadevan *et al.*, 2018b) [5].

Similarly, the interaction between fertigation levels and irrigation levels were found to be quite superior to their individual effect. The data clearly revealed that fertigation and drip irrigation levels significantly influenced the flowering and fruiting characteristics (number of fruits, fruit size, average fruit weight, volume of fruit). The present results are in line with the findings of Villasurda and Baluyut (1990) [15], Athani *et al*. (2005a) [1], Kumawat *et al*., 2017 [4] in guava and Sarolia *et al*., (2010) [10, 11] in guava.

Conclusion

Among treatment combinations, treatment I_3F_2 (100% irrigation at PE level + 100% RDF through drip) recorded maximum fruit size (diameter), average fruit weight and minimum fruit cracking which remained statistically at par with I_3F_3 (100% irrigation at PE level + 75% RDF through drip).

Acknowledgment

The author and approved by the Sri Karan Narendra Agriculture University, Jobner, Jaipur, thus I want to thank the institution for rendering the required facilities for successful completion of the present work. I am further thankful to Department of Science and Technology, New Delhi for providing financial assistance for the present research work.

References

1. Athani SI, Prabhuraj HS, Ustad AI, Swamy GSK, Patil PB, Kotikal YK. Effect of organic and inorganic fertilizers on vegetative growth parameters, fruit characters, quality and yield of 'Sardar' guava. 1st International Guava Symposium, Dec. 5-8, CISH, Lucknow; c2005a. p. 70.
2. Hasan M, Sirohi NPS, Kumar V, Sharma MK, Singh AK. Performance evaluation of different irrigation scheduling methods for peach through efficient fertigation system network. VII International Symposium on Temperate Zone fruit in the Tropics and Subtropics, Acta Horticulture; c2007. p. 662.
3. Kale SS. Irrigation water and N fertilizer management through drip irrigation for brinjal in Entisol. M.Sc. (Ag.) Thesis, Mahatma Phule Krishi Vidyapeeth, Rahuri (M.S.); c1995.
4. Kumawat KL, Sarolia DK, Kaushik RA, Jodha AS. Effect of irrigation and fertigation scheduling on growth, flowering, yield and economics of guava *cv*. Lalit under ultra high density planting system. Indian Journal of Horticulture. 2017;74(3):362-368.
5. Mahadevan A, Kumar S, Swaminathan V, Gurusamy A, Sivakumar T. Effect of pruning and drip fertigation on flowering character of Guava (*Psidium guajava* L.) *cv.* Lucknow 49. International Journal of Chemical Studies. 2018b;6(4):2425-2427.
6. Mane MS, Ayare BL, Magar SS. Principles of Drip Irrigation System, Jain Brothers, New Delhi; c2006. p. 24-87.
7. Mongi Zekri RC, Koo J. Use of controlled-release fertilizers for young citrus trees. Scientific Horiculture. 2003;49(3-4):233-241.
8. Prasad RN, Bankar GJ, Vaishishtha BB. Problems and prospects of pomegranate cultivation in arid region. Symposium on Recent Advances in Management of Arid Ecosystems, Jodhpur, 1997, March 3-5.
9. Ranghaswami MV, Arunadevi K, Selvaraj PK, Kumar V. Optimal irrigation and fertigation scheduling on mulberry yield and water use efficiency. 7th International Micro Irrigation Congress, September 10-16 2006, PWTC, Kuala Lumpur; c2006. p.1-14.
10. Sarolia DK, Singh V, Kaushik RA, Ameta KD, Pareek S. Effect of micro irrigation on growth, yield and quality of Sardar guava under semi arid conditions of Rajasthan. Book of Abstracts, 4th Indian Horticulture Congress, Nov. 18-21, New Delhi; c2010. p.158-59.
11. Sarolia DK, Singh V, Kaushik RA, Ameta KD, Pareek S. Effect of micro irrigation on growth, yield and quality of

Sardar guava under semi arid conditions of Rajasthan. Book of Abstracts, 4th Indian Horticulture Congress, Nov. 18-21, New Delhi; c2010. p. 158-59.
12. Tan CS. Estimating crop evapotranspiration for irrigation scheduling. Agriculture Canada. 1980;25(4):26-29.
13. Tan CS, Layne REC. Application of a simplified evapotranspiration model for predicting irrigation requirements of peach. Horticultural Science. 1981;16(2):172-173.
14. Thakur N, Sharma Y, Singh SK. Drip irrigation and fertigation in fruits crops. Book of Abstracts, 5th Indian Horticulture Congress, November 6-9, 2012 held at, Ludhiana; c2012. p. 218.
15. Villasurda PJ, Baluyut NM. Growth and yield of guava (*Psidium guajava* L.) as affected by different levels and sources of organic and inorganic fertilizers. USM College of Agriculture Research Journal, Philippines. 1990;1:18-33.
16. Yadav JSP, Singh AK, Rattan RK. Water and nutrient management in sustainable agriculture, Fertilizer News. 1998;43(12):103-117.