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Original Research Article

Effect of Fertigation and Micronutrients Spray on Yield Characteristics of "Early Bhagwa" Pomegranate under Semi Arid Conditions of Rajasthan

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Keywords

Pomegranate, Fertigation, Micronutrients, Fruit weight, Yield

A B S T R A C T

A field experiment was conducted during 2015-17 at research farm of RARI, Durgapura – Jaipur in split plot design on Pomegranate cv Early Bhagwa'. The experiment consisted 12 treatment combinations with three doses of fertigation (100 , 75 and 50 % of RDF) and four micronutrient sprays (M_1 to M_4). The pooled data showed that treatment F_3 showed maximum fruit weight, number of fruits, fruit yield per plant and estimated yield per ha (167.03 g, 33.97, 5.66 kg and 3.54 t/ha, respectively). Whereas the minimum values (140.06 g, 27.28, 3.80 kg and 2.38 t/ha respectively) were found with the application of treatment F_1. The micronutrient treatment M_4 had the maximum fruit weight, number of fruits, fruit yield per plant and estimated yield per ha (156.96 g, 32.79, 5.15 kg and 3.22 t/ha, respectively), while treatment M_1 showed the minimum value of fruit weight, fruit yield per plant and estimated yield per ha (148.25, 4.45 kg and 2.78 t/ha) while treatment M_3 showed minimum number of fruits per tree 29.79.

Introduction

Pomegranate (*Punica granatum* L.) belongs to *Punicaceae* family and is one of the oldest known edible fruit. Pomegranates are widely grown in many tropical and subtropical countries, especially in the moderate climate of the Mediterranean regions (Solaheddin and Kader, 27). In addition, pomegranate trees have greater adaptability to adverse climatic conditions, such as drought tolerance and changing climate (Sepulveda *et al*., 21). Pomegranate fruit is increasingly recognised as a highly beneficial fruit with a unique combination of appealing appearance, good taste and high content of healthy metabolites (Seeram *et al.*, 20).

In India pomegranate is commercially cultivated in Maharashtra, Karnataka, Gujarat, Andhra Pradesh, Madhya Pradesh, Tamil Nadu and Rajasthan. Maharashtra is the leading state

with 78 thousands hectares area with annual production of 408 thousands MT and productivity of 6 MT/ha. In Rajasthan pomegranate is commercially cultivated in Jaipur, Ajmer, Alwar, Tonk, Sriganganagar, Kota, Jodhpur, Pali, Jalore, Banswara, Sawai Madhopur, Bhilwara, Jhunjhunu, and Sirohi disticts. In the state the area under pomegranate cultivation is 1.01 thousands hectares with production of 5.50 thousands MT and productivity of 5.4 MT/ ha. It contributes 0.7 % of total production

(Anonymous, 1). Fertigation ensures higher fruit yield by 50- 75 % along with saving of water and fertilizers by 40- 50 % besides reducing soil loss upto 20 % under fruit based land use systems and save time and labour, which makes fertigation economically viable (Sharda, 22). Fertigation allows to adopt the amount and concentration of the applied nutrients in order to meet the actual nutritional requirement of the crop throughout the growing season.

In recent years increasing productivity coupled with quality is becoming very essential to get more returns from unit area. The farmers are become aware about the value of quality production, as quality fruits fetches higher price in the market. To achieve the best quality pomegranate so many factors responsible viz. size, weight, sugar content, acids, color, flavor, etc. All these attributes response to so many practices, among these application of certain chemicals and micronutrients play important role. Foliar application of different micronutrients at proper stage helps in improving fruit yield characteristics of pomegranate. It also helps in correcting micronutrients deficiency and improves quality and physiochemical characteristics of pomegranate. The important tools used in quality production are providing balance nutrition, control of pest and diseases and maintaining the optimum crop load on the tree. The foliar application of nutrients for quality production of fruits is becoming very popular among the pomegranate growers. Among micronutrients, Zn, B and Fe have much significance due to poor nutrient status of soil.

So looking to the importance of these micronutrients and fertigation in the qualitative production of pomegranate this research experiment was conducted during the year 2015-16 and 2016-17 at the research farm of RARI, Durgapura, Jaipur.

Materials and Methods

The present investigation was conducted at the research farm of Rajasthan Agricultural Research Institute, Durgapura – Jaipur. The experiment was laid out on 3 year old pomegranate cv. Early Bhagwa in the split plot design. The plants were planted under square system of planting at a spacing of 4 x 4 m. The experiment had twelve treatments and each treatment had four replications.

Three levels of fertigation viz., 50 % (F_1), 75 % (F_2) and 100 % (F_3) of RDF was applied. The desired quantities of micronutrients were procured from different sources for the purpose of experiment and required quantities of these micronutrients were applied as foliar spray on individual plant.

Spray of Zinc sulphate ($ZnSO_4$) (containing 21% Zn) @ 0.4%
Spray of Boric acid (H_3BO_3) (containing 17.5% B) @ 0.4%
Spray of Ferrous sulphate ($FeSO_4$) (containing 20% Fe) @ 0.4%

Fruit weight was computed by considering average weight of six fruits and expressed in grams. Number of fruits per tree was recorded by counting the number of fruits per tree at the time of harvesting.

The yield of fruits under different treatments were determined on the basis of total weight of fruits harvested from a tree under each treatment and average yield per tree was calculated. The yield was expressed in kilogram per tree (kg/tree).

Results and Discussion

The observations on fruit weight, number of fruits, fruit yield per plant and estimated yield per ha is presented in Tables 1, 2, 3 and 4.

Fertigation was recorded to enhance fruit weight, number of fruits as well as yield (Table 1 to 4). The pooled data showed the highest fruit weight (167.03 g) (Table 1) for the treatment, F_3 (100 % RDF) which was 11.26 % higher than the treatment, F_2 (75 % of RDF) (150.13 g). Number of fruits per tree were also found maximum with the treatment F_3 (33.97 fruits/tree) and minimum with the treatment F_1 (27.28). Chauhan, (6) while fertigating kiwi reported that with relation to fruit weight the vines fertigated with recommended dose and 3/4th of recommended dose of N, P, K produced the fruits with maximum weight. This may be ascribed to the increased synthesis of metabolites due to higher nutrient levels and their translocation to the fruits. These results are also in accordance with the findings of Shirgure *et al* (23), Thakur and Singh (29) and Mahalakshmi *et al.,* (12), who observed increase in fruit weight with increasing level of N, P, K fertilizers with fertigation. Kavino *et al.,* (8) also reported highest bunch weight, hands per bunch and finger weight with 100 per cent of recommended dose of fertilizers applied through fertigation.

Highest estimated yield per ha (Table 4) was recorded for the treatment, F_3 (3.54 t/ha) which was 20.41 % higher than the treatment, F_2. Chauhan (6) reported vines fertigated with recommended dose and 3/4th of recommended dose of N, P, K fertilizers to give highest yield than those fertigated with lower doses of fertilizer i.e. ½ and 1/3rd of recommended dose of N, P, K fertilizers and the recommended dose of N, P, K in kiwifruit. These results are also in line with those of Reddy *et al.,* (17) and Raghupathie *et al.,* (14), who observed significant increase in crop yield of banana with increasing fertigation levels of N, P, K. The higher yields obtained under fertigation may be explained in light of the hypothesis formulated by Bussi *et al.,* (4), who suggested that fertigation results in higher yield due to direct effect of nutrient fertilizing timing and a reduction of nitrate leaching. Furthermore, fertigation was particularly suitable because of fractionated supplies, which very well met the nutrient requirement of crop at different growth stages. The direct application of fertilizers at the correct time through the irrigation system to the region where most of the feeder root develop, results in an increased yield. Kumar (9) also recorded significantly higher yield of apple with full dose of N, P, K fertigation. Suman (28) while carrying out fertigation in apple recorded highest yield with 100% recommended dose followed by 80 % recommended dose of fertilizers.

Effectiveness of zinc, boron and iron was found to be significant in increasing the yield characters of pomegranate. Present investigation clearly indicated that combined application of micronutrients (Zn + B + Fe) treatments had significant effect on yield parameters viz., fruit weight (g), number of fruits per plant, yield per plant (kg) and estimated yield (t/ha).

The fruit weight of pomegranate differed significantly with the sprays of zinc, boron and iron alone and in combination. The maximum pooled fruit weight (156.96 g) was recorded with M_4 (zinc sulphate @ 0.4 percent + boric acid @ 0.4 percent + ferrous sulphate @ 0.4 percent). It was followed by M2 and M3 treatments (153.25 and 151.17 g, respectively) while, the minimum were measured under treatment M1 (Table 1). The findings are similar to those reported by Singh *et al.,* (25) in aonla, Babu and Singh (3) in litchi, Saleh and Monen (19) in mango, Mollah *et al.,* (13) in papaya, Kumar and Shukla (10) in ber, Rawat *et al.,* (16) in guava and Trivedi *et al.,* (31) in guava and Sohrab *et al.,* (26) in pomegranate. The increase in fruit weight might be due to increased rate of

cell division and cell enlargement leading to more accumulation of metabolites in the fruit (Babu and Singh, 3).

The application of different micronutrients increased the number of fruits per tree (Table 2). The maximum number of fruits per plant (32.79) was recorded with treatment M4 (zinc sulphate @ 0.4 per cent + boric acid @ 0.4 per cent + ferrous sulphate @ 0.4 per cent). The increase in number of pomegranate fruits by application of micronutrient treatments may be due to increased fruit set and reduced fruit drop as a result of zinc, boron and iron spray could give higher number of fruits and consequently the yield. The present results are in conformity with the findings of Ebeed *et al.*, (7) in mango, Chaturvedi *et al.*, (5) in strawberry, Singh *et al.*, (24) in papaya, Kumar and Shukla (10) in ber, Sajid *et al.*, (18) in citrus, Trivedi *et al.*, (30) in guava and Rajkumar *et al.*, (15) in guava.

Table.1 Effect of fertigation and micronutrients on average fruit weight (g)

2015-16		2016-17	Pooled
FERTIGATION			
F_1	124.38	155.75	140.06
F_2	137.13	163.13	150.13
F_3	148.19	185.88	167.03
CD (0.05)	**5.64**	**7.85**	**8.85**
MICRONUTRIENTS			
M_1	133.92	162.58	148.25
M_2	136.67	169.83	153.25
M_3	135.42	166.92	151.17
M_4	140.25	173.67	156.96
CD (0.05)	**3.47**	**3.57**	**4.53**
INTERACTION (FXM)			
(T_1) F_1M_1	121.25	150.50	135.88
(T_2) F_1M_2	125.00	157.25	141.13
(T_3) F_1M_3	122.50	155.00	138.75
(T_4) F_1M_4	128.75	160.25	144.50
(T_5) F_2M_1	134.75	158.00	146.38
(T_6) F_2M_2	137.00	163.75	150.38
(T_7) F_2M_3	136.50	161.25	148.88
(T_8) F_2M_4	140.25	169.50	154.88
(T_9) F_3M_1	145.75	179.25	162.50
(T_{10}) F_3M_2	148.00	188.50	168.25
(T_{11}) F_3M_3	147.25	184.50	165.88
(T_{12}) F_3M_4	151.75	191.25	171.50
CD_1 (0.05)	**NS**	**NS**	**NS**
CD_2 (0.05)	**NS**	**NS**	**NS**

Table.2 Effect of fertigation and micronutrients on number of fruits per tree

2015-16		2016-17	Pooled
FERTIGATION			
F_1	29.13	25.44	27.28
F_2	32.69	30.06	31.38
F_3	34.63	33.31	33.97
CD (0.05)	**2.91**	**2.88**	**3.50**
MICRONUTRIENTS			
M_1	31.42	28.58	30.00
M_2	32.25	29.58	30.92
M_3	31.00	28.58	29.79
M_4	33.92	31.67	32.79
CD (0.05)	**1.61**	**1.60**	**2.04**
INTERACTION (FXM)			
(T_1) F_1M_1	29.50	25.50	27.50
(T_2) F_1M_2	28.25	24.50	26.38
(T_3) F_1M_3	27.00	23.00	25.00
(T_4) F_1M_4	31.75	28.75	30.25
(T_5) F_2M_1	31.50	28.50	30.00
(T_6) F_2M_2	33.75	30.50	32.13
(T_7) F_2M_3	31.75	30.00	30.88
(T_8) F_2M_4	33.75	31.25	32.50
(T_9) F_3M_1	33.25	31.75	32.50
(T_{10}) F_3M_2	34.75	33.75	34.25
(T_{11}) F_3M_3	34.25	32.75	33.50
(T_{12}) F_3M_4	36.25	35.00	35.63
CD_1 (0.05)	**NS**	**NS**	**NS**
CD_2 (0.05)	**NS**	**NS**	**NS**

Table.3 Effect of fertigation and micronutrients on yield per plant (kg)

2015-16		2016-17	Pooled
FERTIGATION			
F_1	3.64	3.97	3.80
F_2	4.50	4.90	4.70
F_3	5.13	6.19	5.66
CD (0.05)	**0.45**	**0.57**	**0.66**
MICRONUTRIENTS			
M_1	4.23	4.68	4.45
M_2	4.45	5.07	4.76
M_3	4.24	4.81	4.52
M_4	4.77	5.53	5.15
CD (0.05)	**0.26**	**0.26**	**0.33**
INTERACTION (FXM)			
(T_1) F_1M_1	3.58	3.84	3.71
(T_2) F_1M_2	3.55	3.86	3.70
(T_3) F_1M_3	3.32	3.56	3.44
(T_4) F_1M_4	4.09	4.61	4.35
(T_5) F_2M_1	4.27	4.50	4.39
(T_6) F_2M_2	4.65	4.99	4.82
(T_7) F_2M_3	4.34	4.83	4.58
(T_8) F_2M_4	4.73	5.28	5.01
(T_9) F_3M_1	4.84	5.68	5.26
(T_{10}) F_3M_2	5.14	6.36	5.75
(T_{11}) F_3M_3	5.04	6.04	5.54
(T_{12}) F_3M_4	5.50	6.69	6.09
CD_1 (0.05)	**NS**	**NS**	**NS**
CD_2 (0.05)	**NS**	**NS**	**NS**

Table.4 Effect of fertigation and micronutrients on estimated yield per hectare (t/ha)

2015-16		2016-17	Pooled
FERTIGATION			
F_1	2.27	2.48	2.38
F_2	2.81	3.06	2.94
F_3	3.21	3.87	3.54
CD (0.05)	**0.28**	**0.36**	**0.41**
MICRONUTRIENTS			
M_1	2.64	2.92	2.78
M_2	2.78	3.17	2.97
M_3	2.65	3.01	2.83
M_4	2.98	3.46	3.22
CD (0.05)	**0.16**	**0.16**	**0.21**
INTERACTION (FXM)			
(T_1) F_1M_1	2.24	2.40	2.32
(T_2) F_1M_2	2.22	2.41	2.31
(T_3) F_1M_3	2.08	2.22	2.15
(T_4) F_1M_4	2.56	2.88	2.72
(T_5) F_2M_1	2.67	2.81	2.74
(T_6) F_2M_2	2.91	3.12	3.01
(T_7) F_2M_3	2.71	3.02	2.87
(T_8) F_2M_4	2.96	3.30	3.13
(T_9) F_3M_1	3.02	3.55	3.29
(T_{10}) F_3M_2	3.22	3.97	3.59
(T_{11}) F_3M_3	3.15	3.78	3.46
(T_{12}) F_3M_4	3.44	4.18	3.81
CD_1 (0.05)	**NS**	**NS**	**NS**
CD_2 (0.05)	**NS**	**NS**	**NS**

The effects of micronutrients on yield of pomegranate fruits are presented in Table 3 and Table 4. The data showed that the application of different micronutrients significantly increased the yield of pomegranate fruits. Amongst the various micronutrient treatments attempted the maximum yield of 5.15 kg/tree and 3.22 tonnes/ha was recorded at zinc sulphate @ 0.4 per cent + boric acid @ 0.4 per cent + ferrous sulphate @ 0.4 per cent treatment (M_4). Which was followed by M_2 (Ferrous

sulphate @ 0.4 per cent) and M_3 (Boric acid @ 0.4 per cent), having values of (4.76 kg/tree and 2.97 tonnes/ha), and (4.52 kg/tree and 2.83 tonnes/ha) respectively. However, the minimum fruit yield (4.45 kg/tree and 2.78 tonnes/ha) was recorded in treatment M_1.

The increase in yield of pomegranate fruits by application of micronutrient treatments may be due to its leads to improvement in yield contributing characters like size and weight of fruits, fruit set percent, fruit retention per cent as evident by the present study which finally increased the yield. Increased fruit set and reduced fruit drop as a result of zinc, boron and iron spray could give higher number of fruits and consequently the yield. The present results are in conformity with the findings of Ebeed *et al.,* (7) in mango, Chaturvedi *et al.,* (5) in strawberry, Singh *et al.,* (24) in papaya, Kumar and Shukla (10) in ber, Sajid *et al.,* (18) in citrus, Trivedi *et al.,* (30) in guava, and Rajkumar *et al.,* (15) in guava.

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