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Effect of different grade and time of application of micronutrients on growth and yield of pomegranate cv. Bhagwa

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Abstract

An investigation entitled "Studies on different grades and time of application of micronutrient mixture on growth, yield and quality of pomegranate (*Punica granatum* L.) cv. Bhagwa" was carried out during the year 2021-22. The experiment was laid out with Randomized Block Design with 10 treatments and three replications. The outcome obtain revealed that treatment (T_9) RDF + Grade-1 chelated (12.5g) + Grade-2 (15g)/thrice showed better in terms of maximum incremental plant height (18.00 cm), incremental stem girth (1.17cm), plant spread in N-S (23.00cm) and E-W (25.67cm). The flowering attributes like, minimum days required for flower initiation (40.17) and days required for 50% flowering (20.50) and maximum total number of flowers per plant (183.50) were observed in treatment (T_6) RDF + Grade-2 @ 30g/ thrice while maximum days required for flower initiation (49.33) and days required for 50% flowering (27.67) and minimum total number of flowers per plant (158.43) was noticed in Treatment T_{10} (Control) respectively. The maximum number of fruits per plant (72.50), length of fruit (8.05cm), diameter of fruit (8.55cm), weight of fruit (260.90g), yield per plant (18.91kg) and yield per hectare (139.96q) were also observed maximum in treatment (T_6) RDF + Grade-2 @ 30g/ thrice compared to control.

Keywords: Pomegranate, Bhagwa, Grade I micronutrient, Grade II micronutrient

Introduction

Pomegranate (*Punica granatum* L.) is a popular fruit crop in arid and semiarid climates. It belongs to the Punicaceae family. It's one of the most well-known edible fruits. The Latin term "pomegranate" means "apple with numerous seeds." The pomegranate is regarded as a symbol of wealth and ambition (Duman *et al*., 2009) [7]. According to Smith (1976) [24] *Punica granatum* has 2n=2x=16, 18 chromosomes. This fruit crop's amazing flexibility is evident in how well it performs in both hotter (44 °C) and lower (-12 °C) temperatures (Westwood, 1978) [27].

India has first rank in terms of area and production in world. Spain has the highest productivity (18.5 t/ha), followed by the United States (18.3 t/ha). Spain's export contribution is (37.8%) of total exports despite its small size (2000 ha.) with the highest production (37,000 t), followed by Israel (23.5%) and the United States (15.5%) while India has lowest share in export (7%) (NHB, 2020-21). Pomegranate-growing states in India includes Maharashtra, Gujarat, Andhra Pradesh, Karnataka, Tamil Nadu, and a portion of Rajasthan. Maharashtra is known as bowl of pomegranate‟ producing more than 70% of the country's pomegranates followed by Karnataka and Andhra Pradesh. Pomegranate production in Maharashtra is primarily concentrated in western Maharashtra and Marathwada region like Solapur, Sangli, Pune, Ahmednagar, Nasik, Dhule, Aurangabad, Satara, Osmanabad and Latur. Bhagwa is the most popular and widely used pomegranate cultivar in the Maharashtra with largest area under cultivation. There are various names for this cultivar like Shendri, Jai Maharashtra, Kesar, Asthagandh, Mastani and Red Diana in Maharashtra.

In India, variety of soil type has deficit with different micronutrients. The deficit of micronutrients leads to stunted growth, chlorosis, and delayed maturity. Chelating agents are organic compounds that have the ability to trap other molecules or encapsulate metal ions such as Ca, Mg, Fe, Co, Cu, Zn, and Mn and then slowly release these metal ions so that they are available for plants to absorb upwards (Sekhon, 2003) [19]. Considering the concept of „Soil Nutrient Index‟ the soils of the study in parbhani area found in the category of „low fertility statuses for zinc (1.59), iron (1.50) and boron (1.48) micronutrient.

Material and Methods

The experiment entitled, "Studies on different grades and time of application of micronutrient mixture on growth, yield and quality of pomegranate (*Punica granatum* L.) cv. Bhagwa" was carried out during *Ambe bahar* 2021-22 under the agro climatic conditions of Parbhani at Department of Horticulture, VNMKV, Parbhani (Maharashtra). The experiment was laid out in Randomized Block Design (RBD) with ten treatments which are replicated thrice. The treatments were *viz*., (T_1) RDF + Grade-1 chelated @ 25g/ once, (T_2) RDF + Grade-1 chelated @ 25g/ twice, (T_3) RDF + Grade-1 chelated @25g/ thrice, (T_4) RDF + Grade-2 @ 30g/once, (T_5) RDF + Grade-2 @ 30g/ twice, (T_6) RDF + Grade-2 @ 30g/ thrice, (T_7) RDF + Grade-1 + Grade-2 (50:50)/once, (T8) RDF + Grade-1 + Grade-2 (50:50) twice, (T_9) RDF + Grade-1 + Grade-2 (50:50) thrice and (T_{10}) RDF only (control).

The pomegranate plants age of 8 years were grown on medium black soil which having uniform growth and vigour were subjected to bahar treatment by withholding irrigation. The various operations like land preparation, removal and disposal of diseased fruits of previous bahar was done. All the plants were pruned uniformly to remove the last season's growth, disease; pest infected branches and dried branches. The RDF (625:250:250g NPK/tree) was applied to every treatment after 45 days of withholding water, after that first light irrigation was applied. Nitrogen is applies in two split doses with one month interval while Phosphorus and Potash were applied as single dose For preparation of chelated micronutrient @25g/tree, mixing 25g of Grade-1 chelated in 4 lit of water and drenching was done similarly for Grade-2 micronutrient @30g/tree, 30g of Grade-2 micronutrient was dissolved in 4 lit. Water and spray as foliar application.

Treatments T_1, T_4 and T_7 applied as one time immediately after full flowering. Treatments T_2, T_5 and T_8 exercised as spray/drench twice at fortnight interval after full flowering. Likewise Treatments T_3, T_6 and T_9 applied three times with the fine sprayer. Grade-1 and Grade-2 micronutrients are applied as soil and foliar application respectively.

Result and Discussion

The perusal of the data presented in Table 1 and Table 2 regarding growth and yield of pomegranate as influence by different grades and time of application of micronutrient are discussed below.

Table 1: Effect of different grade and time of application of micronutrients on plant growth and flower characters in pomegranate cv. Bhagwa.

Treat. No.	Treatment	Increment in height of plant (cm)	Increment in Girth of stem (cm)	Incremental canopy spread (cm)		Days required for flower initiation	Days required to 50% flowering	Total number of flowers plant^{-1}
				(N-S)	(E-W)			
T_1	RDF + Grade-1 chelated @ 25g/ once	7.33	0.98	15.67	16.67	44.33	24.33	163.83
T_2	RDF + Grade-1 chelated @ 25g/ twice	8.67	1.03	17.67	18.00	43.17	24.00	165.83
T_3	RDF + Grade-1 chelated @ 25g/ thrice	12.67	1.06	19.33	21.00	42.83	22.67	175.17
T_4	RDF + Grade-2 @ 30g/ once	9.33	0.86	16.00	17.33	41.50	21.83	169.17
T_5	RDF + Grade-2 @ 30g/ twice	14.67	1.08	17.67	18.67	40.50	20.83	176.17
T_6	RDF + Grade-2 @ 30g/ thrice	16.33	1.10	21.00	22.00	40.17	20.50	183.50
T_7	RDF + Grade-1 + Grade-2 (50:50)/once	9.00	1.03	15.33	17.33	42.67	22.50	166.83
T_8	RDF + Grade-1 + Grade-2 (50:50)/twice	11.33	0.95	18.67	18.33	42.33	22.33	169.33
T_9	RDF + Grade-1 + Grade-2 (50:50)/thrice	18.00	1.17	23.00	25.67	40.83	21.17	182.17
T_{10}	RDF only. (control)	7.00	0.85	11.00	12.33	49.33	27.67	158.43
S.E. ±		1.81	0.05	2.08	2.17	0.54	0.51	0.80
CD at 5%		5.39	0.15	6.19	6.46	1.61	1.52	2.37

Plant height (cm)

The treatment T9 (RDF + Grade-1 chelated @25g + Grade-2 @ 30g (50:50 each)/thrice) showed significantly maximum increment in plant height (18.0 cm), however minimum increment in plant height (7.00 cm) was observed in T10 (control). It might be due to simulative effects of zinc and iron may be the source of the increase in plant vegetative growth. Since zinc and iron are involved in the synthesis and production of chlorophyll, a plant's full capacity for photosynthetic activity is increased (Meena *et al*., 2014) [15]. According to a prior study by Singh *et al*., (2002) [21] noticed that combined use of zinc, boron, and copper increased plant height, spread, and trunk girth in anole due to the stimulatory effects of zinc and boron on cell division and cell elongation. These findings are also in close agreement with those of Shekar *et al*., (2010) [20].

Girth of stem (cm)

The treatment T9 showing significantly maximum increment in stem girth (1.17 cm), however minimum increment in stem girth (0.85 cm) is observed in T10 (control). According to Vandana *et al*., (2017) [26], the stimulation effect of zinc and iron may be the cause of the rise in vegetative growth of plants. The overall amount of photosynthetic activity is raised in plants as a result of several factors involved in chlorophyll synthesis and production Meena *et al*., (2014) [15]. According to Singh *et al*., (2002) [21], combined applications of zinc, borax, and copper increased plant height, spread and stem girth in aonla. Zinc and boron stimulates cell division and cell elongation. This finding is in close agreement with Hatwar (2003) [12], who suggested that improvements in growth character with the use of micronutrients may be caused by increased photosynthetic activity and other factors.

Plant Spread (cm)

The significantly increment in N-S and E-W canopy spread was recorded in T_9 (23.00 and 25.67cm respectively), while significantly minimum spread was recorded in treatment T_{10}, control (11.00 and 12.33cm respectively). This might be the stimulatory actions of zinc and iron may be the source of the increase in plant vegetative growth. Since both components are necessary for the synthesis and production of chlorophyll, plants have more comprehensive photosynthetic activities. Due to the stimulatory effects of zinc and boron on cell division and cell elongation, Singh *et al*., (2002) [21] found that the combined application of zinc, borax, and copper improved plant spread in anole. These findings are also closely in line with Shekar *et al*., (2010) [20].

Days required for flower Initiation

The significantly minimum days requirement for flower initiation (40.17) was recorded in treatment T6 (RDF + Grade-2 @ 30g/thrice) while maximum days required for flower initiation was recorded in Control, T_{10} (49.33). This might due to iron is attributed with a clear function in the production of chlorophyll molecules, and zinc is thought to have boosted the synthesis of auxin in the plants, which may have contributed to the early flowering. Similarly, boron controls the movement and metabolism of carbohydrates, the formation of cell walls, and the creation of RNA (Ram and Bose, 2000) [17].

Days required to 50% flowering

The significantly minimum days requirement for 50% flowering of pomegranate (20.50) was recorded in treatment T_6 while significantly maximum days required for 50% flowering was recorded in control, T_{10} (27.67). Early flowering may have resulted from zinc enhancing the synthesis of auxin in the plants, while iron is attributed with playing a significant part in the synthesis of chlorophyll molecules. Similarly, boron controls RNA production, cell wall formation, and the metabolism and transport of carbohydrates (Ram and Bose, 2000) [17]. Likewise, it's possible that the synergistic effects of numerous micronutrients contributed significantly to the rise in physiological activity that caused the pomegranate to flower early, Comparable findings in mango were reported by Ghanta and Mitra (1993) [11], Banik and Sen (1997) [5], Singh and Maurya (2004) [24], and Sarolia *et al*. (2007) [18], in guava, supporting the current work.

Total number of flowers

Maximum total number of flowers (183.50) per plant was observed in treatment T6 while the minimum total number of flowers (158.43) was recorded in T_{10} (control). This might due to zinc and boron, two important components involved in reproduction, play a crucial role in enhancing FBI which results in an increased number of flowers and flowering panicles, may account for the increase in the overall number of flowering panicles during the time of the investigation. Similar findings were reported by Chandra and Singh (2015) [6], who hypothesized that zinc was a necessary component for the activation of a number of proteinase and dehydrogenase enzymes as well as for the manufacture of auxin, a phytohormone that encourages blooming and fruit development in many plants.

Table 2: Effect of different grade and time of micronutrient application on fruits and yield characters of pomegranate cv. Bhagwa.

Treat. No.	Treatment	Number of fruits plant-1	Weight of fruit (gm)	Length of fruit (cm)	Diameter of fruit (cm)	Fruit yield/tree (kg)	Fruit yield/ hectare (q)
T_1	RDF + Grade-1 chelated @25g/ once	57.27	222.50	6.70	7.03	12.74	94.27
T_2	RDF + Grade-1 chelated @25g/ twice	58.83	236.30	7.07	7.29	13.90	102.88
T_3	RDF + Grade-1 chelated @25g/ thrice	63.40	240.83	7.44	7.79	15.27	112.99
T_4	RDF + Grade-2 @ 30g/ once	59.67	226.73	6.95	7.10	13.53	100.13
T_5	RDF + Grade-2 @ 30g/ twice	65.87	253.83	7.66	8.08	16.72	123.72
T_6	RDF + Grade-2 @ 30g/ thrice	72.50	260.90	8.05	8.55	18.91	139.96
T_7	RDF + Grade-1 + Grade-2 (50:50)/once	60.17	231.83	7.10	7.28	13.95	103.23
T_8	RDF + Grade-1 + Grade-2 (50:50)/twice	62.63	236.83	7.13	7.71	14.84	109.78
T_9	RDF + Grade-1 + Grade-2 (50:50)/thrice	69.83	252.43	7.47	8.03	17.62	130.42
T_{10}	RDF only. (control)	49.73	213.30	6.38	6.78	10.61	78.52
S.E. ±		0.99	1.61	0.10	0.08	0.25	1.84
CD at 5%		2.96	4.77	0.29	0.25	0.74	5.47

Number of fruits per plant

The treatment T_6 was recorded maximum number of fruits (72.50) per plant while minimum number of fruits (49.73) per plant was recorded in T_{10}, control. This might due to reduced fruit drop may have contributed to an increase in fruit set and fruit retention percentage. According to Nijjar (1985) [16], Zn is necessary for inhibiting the establishment of the abscission layer, which reduces fruit drop before harvest. In guava, Trivedi *et al*., (2012) [25]. Obtained similar results to those of the present study. The application of zinc and boron prevents fruit from dropping and increases fruit retention, which may be because zinc is crucial for the production of IAA (Alloway, 2008) [3].

Weight of fruit (g)

The treatment T6 was recorded significantly superior weight of fruit (260.90 g) while minimum weight of fruit (213.30 g) was recorded in T10 control. The application of boron may have boosted the rate of cell division and cell enlargement, which resulted in a greater accumulation of metabolites in the fruit and improved photosynthetic translocation, which may have contributed to the rise in fruit weight and volume (Abd-Allah, 2006) [1]. The results echo those published in 2007 by Babu and Yadav in Kinnow and 2008 by Meena *et al*., [15] in Ber.

Length of fruit (cm)

The treatment T6 was recorded significantly superior length of fruits (8.05 cm) while minimum length of fruits (6.38 cm) was recorded in T10 control. It believes that boron foliar sprays increased fruit length and diameter, which may have benefited rapidly expanding meristematic tissues. Cell division, development, and glucose metabolism may also be impacted. Similar results were achieved in pomegranates by Bambal (1991) [4], who reported that boron administration increases fruit diameter and supports the current findings. Singh and Brahmachari (1999) [28] found a similar finding with guava.

Diameter of fruit (cm)

The treatment T_6 was recorded significantly superior diameter of fruits (8.55 cm) while minimum length of fruits (6.78cm) was recorded in T_{10} control. This might due to zinc, boron, and iron treatment may have increased fruit diameter since they have a stimulatory effect on plant metabolism. The findings conflict with observations made in guava by. The larger size and weight of the fruits brought on by the foliar application of zinc, boron, and iron were clearly responsible for the increase in output.

Yield per plant (kg)

The treatment T6 was recorded maximum yield of fruits per plant (18.91kg) while minimum yield of fruits per plant (10.61kg) was recorded in T_{10} control. The significant increase in fruit production (kg/tree) is the result of a combination of factors, including an increase in fruit number, decrease in fruit drop and an increase in fruit weight as a result of the direct and indirect effects of micronutrient foliar spraying on pomegranate cv. Bhagwa. It is generally known that micronutrients like Zn and B stimulate the production of starch in plants, followed by the quick transfer of carbohydrates. The physiological processes in the current experiment may have been impacted by the foliar application of micronutrients, increasing pomegranate cv. Bhagwa output. The outcomes are consistent with those of Banik and Sen (1997) [5], Dutta and Dhua (2002) [8], Singh *et al*., (2003) [22], Ghanta and Mitra (1993) [11], Sarolia *et al*., (2007) [18], Gaur *et al*., (2014) [9], and Kavitha *et al*., (2000) [29] in the papaya and mango categories, respectively.

Yield per hectare (q)

The treatment T_6 was recorded significantly superior yield of fruits per hectare (139.96q) while minimum yield of fruits per hectare (78.52q) was recorded in T_{10} control. It is widely known that micronutrients like Zn and B trigger plant growth by promoting the production of starch and then the quick transfer of carbohydrates. Micronutrients applied via foliar spray may have had an impact on the physiological processes in the current experiment, increasing pomegranate cv. Bhagwa yield. The findings are consistent with those of Banik and Sen (1997) [5], Dutta and Dhua (2002) [8], Singh *et al*., (2003) [22] in the study of mango, Ghanta and Mitra (1993) [11] in the study of banana, Sarolia *et al*., (2007) [18] and Gaur *et al*., (2014) [9] in the study of guava, and Kavitha *et al*., (2000) [13] in the study of papaya.

Conclusion

Among the different treatment combination, treatment (T_9) RDF + Grade-1 chelated and Grade-2 micronutrient @ 15g and 12.5g/tree respectively at fortnightly thrice application showing better in plant height, plant spread and stem girth of pomegranate. Treatment (T_6) RDF + Grade-2 micronutrient @ 30g/tree at fortnightly three times foliar application showing superior in days required for flower initiation, days required for 50% flowering, total number of flowers per plant, number of fruits per plant, length of fruit (cm), diameter of fruit (cm), weight of fruit (g) and yield attributes *viz*., yield per plant (kg) and yield per hectare (q).

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