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Yield and quality parameters of pomegranate as affected by plant growth regulators and nutrients under mid-hill conditions of Kullu valley, Himachal Pradesh

LK SHARMA and SK UPADHYA*

ICAR- Krishi Vigyan Kendra (CSKHPKV)
Sundernagar, Mandi 175019 Himachal Pradesh, India
***Department of Horticulture, CSK Himachal Pradesh Krishi Vishvavidyalaya**
Palampur, Kangra 176062 Himachal Pradesh, India
Email for correspondence: lksharma72@rediffmail.com

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ABSTRACT

The present investigations were carried out to study the response of plant growth regulators and nutrients through foliar application at different concentrations viz GA_3 (10 ppm), IBA (10 ppm), boric acid (0.1%), KNO_3 (1.0%), $MgSo_4$ (1.0%) and multiplex (2.5 ml/litre of water) on yield and fruit quality of pomegranate cv Kandhari Kabuli. The experiment was laid out in a randomized block design with four replications for each treatment and three trees per replication. Nutrients were applied during bloom whereas plant growth regulators after full bloom. The results indicated that the highest fruit set (26.40%) and yield (20.82 tons/ha) were observed with the application of boric acid (0.1%) + KNO_3 (1.0%) + $MgSo_4$ (1.0%) closely followed by IBA (10 ppm). However lowest fruit set and yield (19.25% and 14.99 tons/ha respectively) were recorded under control. Application of IBA (10 ppm) resulted in better quality parameters in terms of fruit weight, diameter, TSS, acidity and total sugars etc closely followed by boric acid (0.1%) + KNO_3 (1.0%) + $MgSo_4$ (1.0%) but superior to the rest of the treatments including control. Treatments comprising application of boric acid (0.1%) + KNO_3 (1.0%) + $MgSo_4$ (1.0%) followed by IBA (10 ppm) proved effective in enhancing fruit set, yield and quality parameters of pomegranate.

Keywords: Pomegranate; growth regulators; nutrients; yield; fruit quality

INTRODCTION

Pomegranate (*Punica granatum* L) is one of the oldest known edible fruits and is capable of growing in different agro-climatic conditions ranging from the tropical to sub-tropical (Jalikop 2007). Its cultivation is gaining popularity in the sub-tropics to sub-temperate zone of Himachal Pradesh. In Himachal Pradesh the area under pomegranate is 2332 ha with a production of about 1986 MT (Anon 2015). Pomegranate cultivation is spread all over the country due to its hardy nature and high yield with low maintenance cost and good keeping quality (Khodade et al 1990). Recently its cultivation has been taken up on a large scale in Kullu valley of Himachal Pradesh where the summer season is long and dry and irrigation facilities are available. Foliar fertilization has advantage of low application rates, uniform distribution of fertilizer materials, easiest method of application and quick responses to applied nutrients (Khayyat et al 2007). Foliar feeding of nutrients especially calcium, boron, zinc and potassium singly or in combination is beneficial for accelerating development of growth characters, flowering, fruiting, quality and shelf-life of fruits (Aly and Isamail 2000). Application of boron to foliage results in higher fruit set, vegetative growth and yield in apple (Peryea et al 2003). NAA @ 40 ppm was found effective in increasing fruit set and quality parameters of pomegranate cultivar Bhagwa (Anawal et al 2015). Importance of synthetic plant growth regulators and nutrients in achieving higher yield and better quality of horticultural crops has been well recognized in recent times. However there has been very little work done on the use of plant growth regulators and nutrients in pomegranate crop. The present study was therefore carried out to find out the effects of plant growth

regulators and nutrients on the production and quality parameters of pomegranate.

MATERIAL and METHODS

The experiment was conducted at village Hurla of Kullu district, Himachal Pradesh during 2011-12 and 2012-13 on six-year old plants of pomegranate cultivar Kandhari Kabuli planted at a spacing of 12 × 10 feet. The altitude of the site ranged between 1150 to 1200 m amsl. The experiment was laid out in a randomized block design with four replications for each treatment and three trees per replication. The treatments comprised T_1 (GA_3 10 ppm), T_2 (IBA 10 ppm), T_3 (Boric acid 0.1% + KNO_3 1.0%), T_4 (Boric acid 0.1% + KNO_3 1.0% + $MgSo_4$ 1.0%), T_5 (Multiplex 2.5 ml/ litre of water) and T_6 (Control: water). Nutrients were applied during bloom and plant growth regulators after full bloom. Rest of the cultivation practices were as per the university's package of practices. Fruit set was calculated by using formula given by Westwood (1993). Fruit yield was recorded by removal of crop load during harvesting season as kg/tree based on 20 kg standard carton and later converted into tons/ha. The weight of fruit was taken with the help of a top pan balance. The unit sample consisted of ten fruits and the results were expressed as weight in grams per fruit. Fruit diameter was recorded with the help of Vernier caliper. The volume of fruit was determined by water displacement method and expressed as cc/fruit. Total soluble solids were determined using a hand refractometer, percentage of titratable acidity in fruit juice according to Anon (1995) and total sugars in the fruit pulp by phenol sulphuric method (Dubois et al 1956). The data pertaining to fruit set, yield and quality parameters were subjected to statistical analysis as per Gomez and Gomez (1984).

RESULTS and DISCUSSION

Data on yield and physico-chemical quality parameters of pomegranate for 2011-12 and 2012-13 were pooled and are given in Table 1.

Fruit set and yield

The data reveal that significantly higher fruit set (26.40%) and yield (20.82 tons/ha) were observed with the application of T_4 (Boric acid 0.1% + KNO_3 1.0% + $MgSo_4$ 1.0%) which were found statistically at par with the treatment IBA (10 ppm) (24.70% and 19.36 tons/ha respectively). However lowest fruit set and yield (19.25% and 14.99 tons/ha respectively) were recorded under control. This may be due to better physiology of developing fruits in terms of better supply of water, nutrients and other compounds necessary for their proper growth and development which resulted in better fruit set, improved size and ultimately greater yield. Roy et al (2006) reported that application of nutrients especially boron played an important role in the pollen germination and elongation of pollen tube in deciduous fruits hence resulted in increased fruit set and yield. Beneficial effects of NAA and GA_3 were also recorded by Ghosh et al (2009) in Ruby and Anawal et al (2015) in Bhagwa cultivar of pomegranate.

Quality parameters

The foliar application of plant growth regulators and nutrients had significant effect on physical and chemical quality parameters of the fruits. Application of T_2 (IBA 10 ppm) resulted in maximum fruit weight (304.60 g), fruit diameter (85.42 mm), fruit volume

Table 1. Effect of foliar application of plant growth regulators and nutrients on yield and physico-chemical quality parameters of pomegranate

Treatment	Fruit set (%)	Yield (tons/ha)	Fruit weight (g)	Fruit diameter (mm)	Fruit volume (cc)	TSS (°B)	Titrable acidity (%)	Reducing sugars (%)	Total sugar (%)
T_1	23.20	18.32	302.00	81.80	281.51	15.50	0.44	7.41	10.12
T_2	24.70	19.36	304.60	85.42	285.80	16.40	0.60	7.82	10.22
T_3	22.50	17.28	301.10	82.85	282.60	15.70	0.54	7.57	10.19
T_4	26.40	20.82	303.20	83.90	282.92	15.40	0.62	7.73	10.14
T_5	21.00	16.24	300.02	80.65	280.26	15.20	0.58	7.35	10.09
T_6	19.25	14.99	295.40	78.46	278.00	14.50	0.52	7.25	10.06
$CD_{0.05}$	1.80	2.20	2.58	2.09	2.90	0.33	0.28	0.39	0.25

T_1: GA_3 10 ppm, T_2: IBA 10 ppm, T_3: Boric acid 0.1% + KNO_3 1.0%, T_4: Boric acid 0.1% + KNO_3 1.0% + $MgSo_4$ 1.0%, T_5: Multiplex 2.5 ml/litre of water, T_6: Control (water)

(285.80 cc), TSS (16.40°B), acidity (0.60%) and total sugars (10.22%) closely followed by T_4 (Boric acid 0.1% + KNO_3 1.0% + $MgSo_4$ 1.0%) but superior to the rest of the treatments including control. The increase in fruit weight, diameter and volume might be due to immediate absorption of auxins which increased the endogenous auxin level that resulted in cell elongation thereby accelerating the development of fruits. These results are in line with those of Adi and Prasad (2012) and Goswami et al (2013) in Ganesh and Sindhuri cultivars of pomegranate. Increase in total soluble solids, fruit acidity and total sugars with the application of IBA might be due to better formation and translocation of carbohydrates which improved the fruit quality. Similar results in pomegranate were found with the application of 10 and 25 ppm NAA by Venkatesan and Mohideen (1994). It could be concluded that the treatments comprising application of boric acid (0.1%) + KNO_3 (1.0%) + $MgSo_4$ (1.0%) followed by IBA (10 ppm) are effective in increasing fruit set, yield and quality parameters of pomegranate.

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