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Effect of foliar application of nutrients and growth regulator on fruit cracking and yield of pomegranate Cv. Bhagwa

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Abstract

The experiment comprising of eleven treatments of nutrients and growth regulator was conducted on seven years old plants at Experimental Orchard of the Department of Horticulture, CCS Haryana Agricultural University, Hisar during the year 2019-20 to study the effect of urea, ZnSO₄ and NAA on fruit cracking and yield of pomegranate. The data were recorded on fruit cracking, number of fruits per plant, fruit yield, average fruit weight, fruit length, fruit breadth, fruit volume, and specific gravity. The recorded data were subjected to statistical analysis using RBD. The result of the experiment indicates that the foliar application of urea, ZnSO₄, and NAA had a significantly positive effect on most of the recorded parameters.

The maximum potential of pomegranate plants in respect number of fruits per plant (122.3), fruit length (8.10 cm), fruit breadth (7.20 cm), average fruit weight (252.3 g), fruit yield (30.8 kg/plant) and fruit volume (305 ml) was exploited to a maximum level and specific gravity (0.82 kg/m³) to a minimum level with foliar application of urea 1.0% + ZnSO₄ 0.5%. The lowest fruit cracking of pomegranate was recorded within the foliar application of ZnSO₄ at 0.5% concentration.

Keywords: Pomegranate, nutrients, growth regulator, fruit cracking, yield

Introduction

Pomegranate (*Punica granatum* L.) is an important fruit crop of the tropical and subtropical regions of the world. Among various arid fruits, it occupies second largest area after ber (Sutano *et al.*, 2017) [21]. It can tolerate a little frost and grows up to an altitude of 1600 meters from mean sea level (MSL), however, in humid areas its quality is not desirable. The tree is deciduous in area where the temperature is low in winter, but in tropical condition it is evergreen as partially deciduous. It can tolerate alkaline and wet soil. In India, total area under this fruit at present accounted to be 209 thousand ha with an annual production of 2442 thousand MT (Anonymous, 2017) [4]. Pomegranate is one of the more nutritional fruit and is capable of growing in different agro-climatic conditions ranging from tropical to sub-tropical. India is the largest cultivated in Maharashtra, Andhra Pradesh, Rajasthan, Gujarat, Karnataka, Tamil Nadu and UP. The most important cultivar in this belt is 'Bhagwa' which covers around 80 percent area under pomegranate in Maharashtra. Pomegranate fruit is increasingly recognized as highly beneficial fruit with a unique combination of appealing appearance, good taste and high content of healthy metabolites (Adams *et al.*, 2006) [2]. Pomegranate is one of the richest sources of Riboflavin. The edible part of the fruit is called arils which are eaten fresh and can be preserved as syrup or used for making jam. Anthocyanin in pomegranate arils is a rich source of antioxidants. The edible parts of fruit contain considerable amount of carbohydrates, proteins, minerals, vitamins, sugars and polysaccharides. The total sugars, reducing sugars, non-reducing sugars, ascorbic acid, acidity, and total soluble solids etc., are important components determining quality of fruit juice in pomegranate (Hasani *et al.*, 2012) [9]. The juice is considered useful for patients suffering from leprosy, dysentery and diarrhea also pomegranate juice contains higher levels of antioxidants than most other fruit juices. The antioxidants in pomegranate juice can help remove free radicals, protect cells from damage and reduce inflammation.

Cracking or splitting of fruits is a serious physiological disorder of pomegranate which affects yield and quality of fruits (Malhotra *et al.* 1983) [11].

Cracking is manageable through maintaining soil moisture and avoiding wide variation in soil moisture, application of adequate and regular irrigation during fruit growth, cultivation of tolerant varieties, use of growth regulators and micro nutrients has also been effective in managing fruit cracking in pomegranate (Reddy and Prasad, 2012) [17]. Plant growth regulator have given encouraging results in case of pomegranate fruit crop (Goswami *et al.*, 2013) [8]. Use of nutrients has also been reported effective in increasing yield of pomegranate (Davarpanah *et al.*, 2016) [5]. Therefore, effective nutrients and growth regulator management in pomegranate, which involves finding of appropriate rate, time and method of application as well as selection of suitable combination of fertilizers and growth regulator is required to get desired productivity with less fruit cracking. Although, the effect of foliar applied chemicals and growth regulator on yield and fruit cracking have been studied by many workers in different parts of the world and the information of such effect on pomegranate fruit is very scanty in case of Haryana and a little work is carried out on this crop. Keeping in view the above facts, the present investigation was carried out to complement the available information on this aspect under Hisar condition.

Material and Methods

The experiment was carried out at Experimental Orchard and in Post-Harvest Technology Laboratory of the Department of Horticulture, CCS Haryana Agricultural University, Hisar during the year 2019-20. These plants were earmarked in January 2019 for collecting the data on various yield parameters. Hisar has a typical semi-arid climate with hot and

dry summer and extremely cold winter. The mean monthly maximum and minimum temperatures show an extensive range of variations both during summer and winter months. The eleven fertilizer and growth regulator treatments in different combinations were laid out in randomized block design with three replications. Seven years old uniformly grown trees spaced at 5x5 m were selected for the present study. Plants were kept under uniform orchard management practices during the study, where all the cultural practices were carried out as per package of practices. The observations were recorded on fruit cracking (%), number of fruits per plant, average fruit weight (g), fruit yield (kg/plant), fruit length (cm), fruit breadth (cm), fruit volume (ml) and specific gravity (kg/m³). The recorded data were subjected to statistical analysis by using the technique of analysis of variance.

Results and Discussion

Fruit cracking (%), fruit yield and yield attributes: The data regarding fruit cracking are presented in (Table 1) revealed the effect of different nutrients and growth regulator and their combination which significantly reduce fruit cracking per cent by using all sprayed substances compared to control. In this concern the less cracking (22.3%), were recorded on the trees sprayed ZnSO₄ at 0.50%, whereas the highest ones (35.3%) were obtained in control during the studied season, respectively. Beside zinc sulphate fruit cracking also reduced significantly with growth regulator T₇ (NAA at 40 ppm) (24.3%) in comparison to control. The more cracking per cent was recorded in the treatments with T₂, T₃, T₈, T₉, T₁₀, T₁₁.

Table 1: Effect of nutrients and growth regulator on yield parameters of pomegranate cv. Bhagwa

No	Treatment	Fruit cracking (%)	No. of fruits/plant	Average fruit weight (g)	Fruit yield/plant (kg)
T ₁	Control	35.3	105.3	220.6	23.2
T ₂	0.5% Urea	31.3	111.6	227.3	25.3
T ₃	1% Urea	32.6	112.3	230.6	25.9
T ₄	0.25% ZnSO ₄	23.0	113.6	233.3	26.5
T ₅	0.50% ZnSO ₄	22.3	115.0	235.6	27.1
T ₆	20 ppm NAA	25.6	118.6	243.3	28.8
T ₇	40 ppm NAA	24.3	120.3	245.6	29.5
T ₈	0.5% Urea+0.25% ZnSO ₄	28.3	116.6	237.6	27.7
T ₉	0.5% Urea+0.5% ZnSO ₄	27.0	117.3	240.3	28.2
T ₁₀	1% Urea +0.25% ZnSO ₄	29.6	121.6	249.3	30.3
T ₁₁	1% Urea +0.5% ZnSO ₄	29.0	122.3	252.3	30.8
	C.D. at 5%	4.2	3.9	4.6	1.9

The data in (Table 1) revealed that the different treatments *viz.*, urea, zinc sulphate singly or their combination and naphthalene acetic acid (NAA) had significant effect on number of fruits per plant. The highest number of fruits per plant was (122.3) obtained from the plant sprayed with foliar application of urea with zinc sulphate treatment T₁₁ (1% urea +0.5% ZnSO₄) which was closely followed by T₁₀, T₇, T₆. Minimum number of fruits per plant was recorded in control (105.3). It is clear from the data that all the treatments significantly influenced number of fruits per plant.

The data regarding average fruit weight are presented in (Table 1). Application of different concentrations of urea, zinc sulphate singly or their combination and NAA as foliar spray significantly influenced the average fruit weight. The data indicates that the average fruit weight values under various treatments ranged between 220.6 g to 252.3 g. The maximum fruit weight (252.3 g) was recorded in T₁₁ (1% urea +0.5% ZnSO₄), which was closely followed by treatment T₁₀ (249.3

g) whereas, the minimum fruit weight (220.6 g) was observed in control. The data indicate that nutrients combined foliar application at high concentration increase fruit weight than compare to NAA or urea and zinc sulphate single application. Data presented in (Table 1) showed the effect of urea, zinc sulphate and NAA spraying singly or combined at different concentration on fruit yield per plant of pomegranate. In general view, data showed that all treatments significantly increased the yield per tree compared to control. The highest yield (30.8 kg) per tree were recorded on the trees that sprayed with combined foliar application of nutrients T₁₁ (1% urea +0.5% ZnSO₄) which was statistically at par with T₁₀ (30.3 kg), T₇ (29.5 kg), while the minimum yield (23.2 kg) per tree were recorded in control.

The result of present investigation indicates that foliar application of 0.50% ZnSO₄ was quite effective in minimizing fruit cracking (Table 1) in pomegranate. The reduce of fruit cracking by foliar application of ZnSO₄ might be attributed to

the fact that zinc plays an important role in activation of enzymes and promotes cell division. It also strengthens cell wall and reduces formation of abscission layer. These findings are in conformity with Singh *et al.* (1990) [20] who reported that adequate quantities of $ZnSO_4$ helped in maintaining the cell wall permeability and elasticity in the epicarp tissue which prevented its hardening in pomegranate fruit. The results of present study are in conformation with the findings of Obaid and Al-Hadethi (2013) [14] who reported that foliar application with zinc reduced the per cent of splitting fruits in Salemy pomegranate cultivars. The minimum splitting value was observed by using the highest concentration of $ZnSO_4$ (3%). Kumar *et al.* (2017) [10] who reported that foliar application of boron or zinc reduced fruit cracking in cv. Jodhpur Red of pomegranate.

The productivity of pomegranate crops and fruit growth depend on many internal and environmental factors (e.g., carbon supply, crop load, hormones, mineral nutrients, temperature, and light) and genotype (Xia *et al.*, 2009) [22]. zinc as a micronutrient plays significant role in growth and productivity of pomegranate (Saini *et al.*, 2019) [18], it is an important microelement essential for plants due to its involvement in the formation of tryptophan, a precursor of auxin thus helps in reducing fruit drop. Use of zinc at higher level increased the foliar zinc content which finally stimulates the endogenous production of auxin thereby reducing fruit drop (Meena *et al.*, 2014) [13].

The results of present study indicate that the foliar application of 1% urea+0.5% $ZnSO_4$ was quite effective in increasing all the yield characters, *i.e.*, average fruit weight, number of fruits per plant, fruit yield significantly (Table 1). The

improved yield with foliar application of nutrients might be due to their effects in increasing the chlorophyll content of leaves and on balancing the nutritional condition, translocation of metabolites from source to the sink as and when essential and photosynthetic efficiency which might be accountable for obtaining more average fruit weight, increasing fruit size, number of fruits and yield of the crop. The increase in the fruit weight by zinc spray was due to the significant increase in the fruit width and length also the increases in the number of fruits per plant by zinc spray might be due to the increased auxin production which reduce fruit drop. Zinc acts as catalyst in the oxidation and reduction processes and it is also of great importance in the sugar metabolism. Davarpanah *et al.* (2016) [5] who reported that foliar application of Zn and B fertilizers, alone or combined, increased significantly fruit yield in pomegranate by increasing number of fruits per plant. Obaid *et al.* (2013) [14] reported spraying zinc and manganese exhibited favorable effect on increasing yield in pomegranate, these results are also in line with those obtained by El-Seginy *et al.* (2003) [7] and Abd-Ella and El-Sisi (2006) [1] They reported that foliar spraying chelated mixture of Zn, Mn and Fe increased fruit set, fruit weight and as a result increased the yield. Masoud *et al.* (2019) [12] who reported that foliar application of $ZnSO_4$ singly or combine with nutrients and growth regulator significantly increased yield in pomegranate it is because of $ZnSO_4$ plays a great role in plant growth, yield and fruit quality as a result of affecting many physiological processes in plant life and activating a large number of enzymes, nucleic acid metabolism and protein biosynthesis.

Table 2: Effect of nutrients and growth regulator on fruit length, fruit breadth, fruit volume and specific gravity of pomegranate cv. Bhagwa

No	Treatment	Fruit length (cm)	Fruit breadth (cm)	Fruit volume (ml)	Specific gravity (kg/m^3)
T ₁	Control	6.60	6.03	230	0.95
T ₂	0.5% Urea	7.06	6.20	240	0.94
T ₃	1% Urea	7.30	6.30	246	0.93
T ₄	0.25% $ZnSO_4$	7.35	6.43	236	0.98
T ₅	0.50% $ZnSO_4$	7.40	6.50	247	0.95
T ₆	20 ppm NAA	7.70	6.86	256	0.95
T ₇	40 ppm NAA	7.80	6.91	265	0.92
T ₈	0.5% Urea+0.25% $ZnSO_4$	7.50	6.66	272	0.87
T ₉	0.5% Urea+0.5% $ZnSO_4$	7.60	6.76	280	0.85
T ₁₀	1% Urea +0.25% $ZnSO_4$	7.91	7.10	292	0.85
T ₁₁	1% Urea +0.5% $ZnSO_4$	8.10	7.20	305	0.82
	C.D. at 5%	0.20	0.20	14.7	0.1

Fruit size, fruit volume and specific gravity: Length, breadth and fruit volume of fruits (Table 2) were recorded significantly maximum under the treatment T₁₁-1%Urea + 0.5% $ZnSO_4$ (8.10 cm, 7.20 cm, 305 ml, respectively), which was closely followed by the treatment T₁₀- 1%Urea +0.25% $ZnSO_4$ (7.91 cm) fruit length, (7.10 cm) fruit breadth and fruit volume were (292 ml).The minimum fruit length, breadth and fruit volume of fruits were observed under the treatment control (6.60 cm, 6.03 cm, 230 ml, respectively).The data (Table 2) indicate the effect of various chemicals and their combination and plant growth regulator on specific gravity of pomegranate. The significantly minimum specific gravity (0.82 kg/m^3) was recorded with the treatment T₁₁-1%Urea + 0.5% $ZnSO_4$, which was statistically at par with treatment T₁₀- 1%Urea +0.25% $ZnSO_4$, However the maximum specific gravity (0.95 kg/m^3) recorded under treatment control.

The results of present study indicate that the foliar application of 1% urea+0.5% $ZnSO_4$ was quite effective in increasing size of fruits (fruit length and breadth) and fruit volume (Table 2).

Zinc as a micro or minor nutrient or trace element plays important role in improving the size of fruits due to involvement of zinc in the formation of tryptophan which is a precursor of indole acetic acid synthesis, therefore increased tissue growth and development. It has significant role in starch metabolism and acts as co-factor for several enzymes which influences nucleic acid metabolism, photosynthesis reaction and protein biosynthesis (Alloway, 2008) [3]. These findings are in close conformity with the findings of Rani and Brahmachari (2001) [16] who noticed that the size (length and breadth) of fruits was significantly influenced by the use of micronutrient spray. The increase in size of fruits by foliar application of nutrients might be because it improved the internal physiology of developing fruit in terms of better supply of water, nutrients, and other compounds vital for their proper growth and development (Dutta and Banik, 2007) [6], the Increases in fruit diameter have been attributed to the role of zinc on the synthesis of tryptophan (Sahota and Arora 1981), therefore affecting cell elongation and division. Rana

and Rawat (2016) ^[15] who noticed maximum value for fruit volume by foliar application of ZnSO₄ and boron in pomegranate which might be due to zinc has been identified as component of almost 60 enzymes and it has a role in synthesis of growth promoter hormone (auxin). It is directly associated with improvement of fresh weight of fruits (Shivanandam *et al.*, 2007) ^[19].

Conclusion

Foliar application of 0.5% ZnSO₄ significantly reduced the fruit cracking of pomegranate to a minimum level and was found quite effective in minimizing fruit cracking per cent in pomegranate. The maximum potential of pomegranate plants in respect of number of fruits per plant, size of fruits (fruit length and breadth), fruit volume, average fruit weight and fruit yield per plant was exploited to a maximum level and specific gravity to a minimum level with foliar application of 1.0% urea + 0.5% ZnSO₄.

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