



CONTROLLING OF FRUIT SPLITTING IN POMEGRANATE (*PUNICA GRANATUM* L.) BY FOLIAR APPLICATION OF GROWTH REGULATOR AND NUTRIENTS

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ABSTRACT

Various growth regulators have been used to improve the quality of different fruit crops. Foliar spray of macro and micronutrients play an important role in vegetative growth, yield and fruit quality. In the present study, the influence of foliar application of growth regulators and nutrients on fruit splitting and fruit quality was evaluated. For that purpose, Naphthaleneacetic acid (NAA), Potassium nitrate (KNO₃) and Boric acid (H₃BO₃) at the rate of 40 ppm, 1% and 0.3% were used respectively. Spray of chemicals were applied in 2nd and 8th week from full bloom to yield in pomegranate cultivar 'Golden pearl'. The experiment was designed under Randomized Complete Block Design (RCBD) comprised with seven treatments and replicated thrice. Fruit splitting was reduced (48.68%) significantly with application of KNO₃ + Boric acid, while maximum fruit size (60.26 cm²), fruit weight (84gm), fruit grain weight (136.38gm), total soluble solid (TSS) 12.52% and yield (21.9kg/plant) were observed in KNO₃ + Boric acid. Moreover, peel weight was increased in control (60.66 gm) and minimum was observed in 48.62 gm in KNO₃ + Boric acid. Finally, it is concluded KNO₃ + Boric acid revealed best results against fruit splitting % and other fruit quality parameters. These findings show that application of KNO₃ + Boric acid significantly influences fruit quality of pomegranate when fruit are in the beginning stages of growth and development.

Keywords: fruit cracking, foliar application, growth regulators, minerals, pomegranate

INTRODUCTION

Pomegranate (*Punica granatum* L.) is one of the oldest known edible fruits, among the fruit mentioned in the Holy Quran. Though it is native to Iran but also grow widely in arid and semi-arid region throughout the world (Sarkhosh, 2006). Pomegranate top producing countries are Iran, USA, China, India, Israel, Egypt, Spain and Turkey (Korkmaz *et al.*, 2016). In Pakistan, Balochistan is the main producer of pomegranate although Khyber Pakhtunkhwa and Punjab are also producing with total producing an area of 7270 ha with an annual production of 36840 tonnes (Anonymous, 2017-18). Pomegranate mostly consumed as a fresh fruit, juice, syrup, jams, or in form of wine (Teksur, 2015).

Fruit cracking is one of the physical disorders anywhere pomegranate plants are grown (Galindo *et al.*, 2014). Cracked fruits drop its value for the fresh market and are also use

for processing only if not affected by fungi (Gharesheikhsbayat, 2006). It might be because of moisture imbalance as this fruit is very delicate to deviation in soil moisture content and persistent drought cause peel hardening and after that if heavy irrigation applied then fruit peel cracks. Cracking of fruit also affected by environment, inherited morphology, physiology and genetic features (Khadivi-Khub, 2014).

To increase the fruit production and to improve the quality of different fruit crops, various growth regulators have been valuably used in the current time. Several research studies described the impact of foliar spray of macro and micronutrients on vegetative growth, yield and fruit quality i.e. nitrogen, phosphorus, potassium and magnesium. Potassium (K) is an essential macronutrient in pomegranate and K concentration in peel and aril of pomegranate fruit was the highest compared with other macronutrients (Al-Maiman *et al.*, 2002; Mirdehghan *et al.*, 2007). On the other hand boron, zinc and calcium were extremely valuable in improving nutritional status, yield and fruit

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quality of pomegranate. Though, the results of foliar application of different chemicals on yield and fruit quality have been publicized by various researchers, the information of such effect on pomegranate fruit is very scanty. Therefore, the current study was undertaken to observe the effect of pre-harvest spray of some growth regulators and mineral nutrients on pomegranate tree to manage the fruit cracking.

MATERIALS AND METHODS

Plant materials

Ten year old pomegranate (*Punica granatum* L.) trees located in Horticultural Research institute, Faisalabad, (31.42°N, 73.09°E longitude, altitude 189 m) Pakistan. This area falls in a subtropical zone, with warm summer (May to August) and moderate winter (December to February). Approximately 370 mm annually rainfall recorded with relative humidity of 29.07%. Soil type of experimental farm was loamy, pH 8.1, contain organic carbon (0.86%), available phosphorus (8.1 ppm) and available potassium (200 ppm). The trees had been planted at 15×15ft layout and trained with three trunks. Data was recorded throughout the growing seasons of 2018-2020 (February-September). Trees were received the same horticultural management.

Design and treatments

The present research was conducted under Randomized Complete Block Design (RCBD) with seven different treatments including the control and replicated three times. Treatments were used as follows: T₁= Control, T₂= KNO₃ (1%), T₃ = NAA (40ppm), T₄= Boric acid (0.5%), T₅= Zinc Sulphate (0.3%), T₆= KNO₃ (1%) + Boric acid (0.3%).

Foliar spray was applied in a clear day during the morning hours to increase efficiency. First treatment was applied in 2nd week of flowering and second application was applied after 8th week of flowering. Fruits were harvested at mid-September. At harvesting time number of fruits per tree in each treatment was calculated and the fruit yield (kg) per tree was noted. The weight of fruit was noted at harvesting time with weighting balance and the mean of fruit weight was expressed in grams (g). The data in respect of fruit splitting/cracking was determined via totaling the No. of fruits, which were tagged, periodically at the end of each month and showed in percentage. Average fruit size (cm²) was measured with the help of vernier caliper. Average fruit weight (gm) and arial weight (gm)

and peel weight (gm) was calculated with digital weighing balance. The total soluble solids (TSS) was documented via using digital refractometer.

Statistical analysis

Statistix (8.0) software was used for all statistical analyses. An Analysis of variance (ANOVA) was performed for applied treatments and differences between the treatments were compared by Least significant difference test (LSD) was tested at 5% significance level (Steel, 1997).

RESULTS AND DISCUSSION

Fruit splitting (%)

Spray of various nutrients might be decreased the splitting with the increase of peel elasticity due to addition of nutrients like Potassium, Zinc and Boron in the cells (Marschner, 1995). The mean of fruit split incidence was 48.68 by foliar application of 1% KNO₃ + 0.3 5% of Boric acid. These treatments were significantly effective on the fruit splitting incidence ratio (Table 1). Specifically, 1% KNO₃ + 0.3% Boric acid, 0.3% Zinc Sulphate and 0.5% Boric acid lead to considerably lesser ($P < 0.05$) fruit splitting occurrence as compared to control. Foliar nutrient spray rises the elasticity and cell wall absorptivity of the fruit rind (Singh *et al.*, 1993). Boron helps in translocation of photosynthetic products as well as synthesis of cell wall components thus strengthening the cell wall of fruit. Potassium is found to be effective in maintaining cell turgidity by regulating osmotic balance. So, it is possible that combined application of these chemicals minimized the cracking incident by strengthening the cell wall of pomegranate fruits by maintaining cell turgidity and regulating osmotic balance (Sharma *et al.*, 2007). Our conclusion is in line with prior studies (Sharma *et al.*, 2011; Sheikh *et al.*, 2012; Korkmaz *et al.*, 2015) who reported the decrease in fruit cracking incidence in pomegranate with the foliar application of boric acid and potassium as compared to control.

Fruit size (cm²)

Fruit size had significant difference as affected by spraying of 1% KNO₃ + 0.3% Boric acid (60.26 cm²). Potassium (K) and boric acid treatment increased fruit size significantly as compared to control or other treatments (Table 1). The possible reason for increase in the fruit length and diameter might be due to fact that mineral nutrients have an indirectly participate in accelerating the process of cell

division and cell elongation due to which the size of fruit might have enhanced. Khayyat *et al.*, (2007) described that potassium enlarged date palm fruit length rather than control. El-Rhman (2010) described that $ZnSO_4$ considerably improved fruit diameter and mass as compared to the control.

Fruit weight (g)

Our findings indicated that, highest fruit weight (150 gm) and lowest (84 gm) was gained in 1% KNO_3 + 0.3% Boric acid and in control, respectively (Table 1). The increase in fruit weight might be attributed to rapid increase in the size of cells or it is also due the fact that foliar application of boron increased the fruit weight by maintaining the level of auxins in various parts of the fruits which helped in increasing the fruit growth (Kaur, 2017). Application of potassium nitrate also increased fruit weight that was in line with Khayyat *et al.* (2008) on barberry and Hoda *et al.* (2013) on Pomegranate.

Arial weight (g)

Fruit grain weight reached to the maximum value (136.38gm) by the use of 1% KNO_3 + 0.3% Boric acid while the minimum value (108.46gm) was obtained in untreated trees. Kumar *et al.* (2016) reported that plant growth regulators and micronutrients were significantly affected on fruit quality in pomegranate. Elham Fattahi *et al.* (2021) reported that treatment of KNO_3 significantly increased the total weight of arils. The lowest amount of this trait was detected in the untreated fruits (control) with mean of 142.08 g.

Table 1. Effect of some growth regulators and mineral nutrients on fruit splitting, fruit size, fruit weight and Arial weight of pomegranate

Treat ment	Fruit Splitting (%)	Fruit size (cm2)	Fruit wt. (g)	Arial wt. (gm)
T1	85.9a	264.26f	84d	108.46d
T2	63.24b	411.48e	110c	119.89c
T3	62.58b	463.48d	108c	124.52b
T4	57.3c	564.78a	135b	127.9b
T5	54.56d	503.93c	139b	130.67a
T6	48.68e	535.59b	147a	136.38a

Means followed by the same letter are not significantly different from each other at 5% level of significance Probability at LSD Test.

Peel Weight (g)

The data of effect of different treatments on peel weight is significantly ($P < 0.05$) differed (Table 2). Results indicated the maximum value in control (60.66 gm) while minimum peel weight

(48.62 gm) was obtained by application of 1% KNO_3 + 0.3% Boric acid following as 1% KNO_3 and 0.5% Boric. Previously, Khayyat *et al.* (2012) reported that peel weight significantly affected by application KNO_3 (250 mg L⁻¹).

Total soluble solids (TSS %)

The data of showed significant ($P > 0.05$) results as compared to control with the spray of different chemicals on Pomegranate. Highest TSS % obtained in 1 KNO_3 % + 0.3% Boric acid @) with 12.52% while the minimum TSS contents were recorded in control (10.25%) following by 40ppm NAA and T₅ 0.3% Zinc Sulphate with the value of 11% and 11.24%, respectively. The highest TSS recorded by foliar application of nutrients might be due to lesser utilization of sugars in metabolic processes because of reduced respiration. Increase in TSS might be due to the fact that boron helped in trans-membrane sugar transport. Our results agree with Gupta *et al.* (1990). Kumar *et al.* (2020) stated that application of different nutrients alone or in combination had a significant effect on TSS. Total soluble solid contents (13.50°Brix) were improved with the combination of KNO_3 (1%) + Boron (0.4%).

Table 2. Effect of some growth regulators and mineral nutrients on Peel weight, TSS and yield/plant

Treatment	Peel wt. (gm)	TSS (%)	Yield/ plant (kg)
T ₁	48.62d	10.25f	8.4f
T ₂	50.49b	12.27b	13.30e
T ₃	53b	11.24d	13.93d
T ₄	60.66a	11e	18.63b
T ₅	60.01a	11.83c	14.59c
T ₆	60.14a	12.52a	21.9a

Means followed by the same letter are not significantly different from each other at 5% level of significance Probability at LSD Test.

Yield/plant (kg)

Significantly differences were detected within treatments in fruit yield/plant. Foliar application of 1% KNO_3 + 0.3% Boric acid resulted in significantly ($P > 0.05$) higher yield (21.9 kg/plant) than application of control 8.4 kg/plant (Table 2). No other significant treatment differences in yield were detected at either site. Foliar application of KNO_3 and $MgSO_4$ increased yield in 'Kandhari' and 'Beedana' pomegranate (Singh *et al.*, 1993). Our findings are also confirmed by the Gurung *et al.* (2016), they reported that foliar application of Boron (0.1%) improved fruit yield attribute with better fruit quality. These results are in accordance with the findings of Sharma and Belsare (2011), Sheikh and Manjula (2012), Davarpanah (2016) and Korkmaz *et al.* (2016)

who concluded that foliar spray of boric acid significantly increased the yield per plant in pomegranate.

CONCLUSION

Based on our findings, we concluded that foliar application of boric acid, potassium nitrate and magnesium sulphate in combination significantly increased number of fruits per plant, fruit weight, yield per plant, number of arils per fruit and juice content in pomegranate. Moreover, the lowest cracking percentage was also noted in this treatment. Foliar application of chemicals in combination of KNO₃ and Boric acid is recommended for the control of fruit cracking and improve fruit quality. Foliar spray can be applied 2nd and 8th week from full bloom to yield.

AUTHOR'S CONTRIBUTION

Amina: Conducted research and wrote the manuscript

M. Z. Rashid: Provided technical services

M. A. Rashid: Reviewed the manuscript

S. Ahmad: Planned and conducted experiment

M. Ullah: Recorded Data of experiment from field

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