

Original Research Article

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Impact of Foliar Application of Potassium on Quality of Pomegranate cv. Bhagwa

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ABSTRACT

A field study was carried out in the research field at College of Horticulture, Hiriyur, Karnataka during 2019-2020 to know the effect of foliar application of potassium on quality parameters of pomegranate (*Punica granatum* L.) cv. Bhagwa. The experiment comprised of thirteen treatments laid out in a randomized block design and replicated thrice. The foliar application of different potassium sources was carried out thrice as first spray at the time of flowering, second spray at forty days after flowering and third spray at forty days after the second spray. The results revealed that the maximum TSS (16.40⁰Brix), sugar: acid ratio (35.69), reducing sugars (14.51 %), non-reducing sugars (1.55 %), total sugars (16.14 %), juice pH (3.94), ascorbic acid (17.73 mg/ 100g FW) and anthocyanin content (8.98 mg/ 100g FW) with less acidity (0.45 %) was recorded in the fruits obtained in plants treated with foliar spray of 3 per cent K₂SO₄ compared to other treatments whereas lower values with higher acidity (0.72 %) was found in the control treatment *i.e.* water spray.

Keywords

Foliar application,
Potassium,
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Introduction

Pomegranate (*Punica granatum* L.) is one of the famous table fruits cultivated mainly in tropical and subtropical eco-systems as pomegranate tree is highly adaptive to a wide range of climate and soil conditions. It is

commonly known as 'Anar' in Hindi and 'Dalimbe' in Kannada. It is called the powerhouse of health as all parts of the plant like roots, bark, leaves, flower, rind and seeds are used for medicines since ancient times. There is a growing demand for good quality fruits both in the form of fresh and processed

products such as juice, syrup, anardana and wine (Varasteh *et al.*, 2009). Pomegranate fruits have a long shelf life at room temperature due to which it has carried on long journeys and highly utilized in desert climates as a source of water and nourishment (Langley, 2000). Pomegranate fruit is a rich source of potentially healthy bioactive compounds and mineral nutrients. Pomegranate withstands a considerable amount of drought, has versatile adaptability, less gestation period, low maintenance cost, steady and high yields, fine table and therapeutic values with better keeping quality and has very good export potential.

Potassium is well recognized as the essential plant nutrient with the strongest influence on many quality parameters of fruits and vegetables (Usherwood, 1985). Fruit size, appearance, colour, soluble solids, acidity, vitamin content, taste as well as shelf-life are significantly influenced by an adequate supply of potassium. Its role is well documented in photosynthesis, increasing enzyme activity, improving the synthesis of protein, carbohydrates and fats, translocation of photosynthates, enhancing their ability to resist pests and diseases and also potassium is considered as a major osmotically active cation of the plant cell (Mehdi *et al.*, 2007). Adequate K nutrition has been associated with increased yields, fruit size, increased soluble solids and ascorbic acid concentrations, improved fruit colour, increased shelf life and shipping quality of many horticultural crops (Lester *et al.*, 2005; Geraldson, 1985).

Foliar application of potassium is a recent technology in horticultural crops. Foliar application of nutrients has gained importance in recent years to rectify the deficiencies of nutrients, as sometimes soil application is not effective because some parts of nutrients leach down and some others do not become

available to the plants due to complex chemical and biochemical reactions in the soil. Secondly, foliar application of nutrients plays a regulatory role in physiological processes of plant and the availability of nutrients is easy and quick to the plants. Pomegranate production is governed by several factors like soil, climate, irrigation status, varieties, pest and disease situation and nutritional status of soil as well as the plant. So, the adoption of this recent technology has increased the productivity and post-harvest quality of pomegranate. Foliar application of potassium in pomegranate orchards helps in improving the yield and quality of the produce. Thus far, many studies have shown that supplementing soil potassium supply with foliar potassium applications during the fruit development period can improve fruit quality and that differences may exist among potassium compounds for foliar feeding (Lester *et al.*, 2005). Various sources of potassium salts are used for plant nutrition such as potassium chloride (KCl), potassium sulphate (K_2SO_4), mono-potassium phosphate (KH_2PO_4) and potassium nitrate (KNO_3) (Magen, 2004).

Materials and Methods

The field experiment was carried out at research farm of College of Horticulture, Hiriya in Chitradurga district. The experiment site comes under Central Dry Zone (Zone-4) of Karnataka and is situated at $13^{\circ} 57'$ North latitude and $70^{\circ} 37'$ Eastern longitude at an elevation of 606.1 m above the mean sea level. The experiment comprised of thirteen treatments laid out in a randomized block design and replicated thrice. Five years old (as on November 2019) pomegranate variety Bhagwa was used for conducting the experiment. The water-soluble fertilizers were dissolved in water and sprayed to the crop. 10g, 20g and 30g of each potassium sources were dissolved in one-litre water to make 1, 2

and 3 per cent solutions respectively and were applied as foliar spray.

Different treatments include T₁-Potassium sulphate 1%, T₂-Potassium sulphate 2%, T₃-Potassium sulphate 3%, T₄-Potassium nitrate 1%, T₅- Potassium nitrate 2%, T₆-Potassium nitrate 3%, T₇-Potassium schoenite 1%, T₈-Potassium schoenite 2%, T₉-Potassium schoenite 3%, T₁₀-Potassium phosphate 1%, T₁₁-Potassium phosphate 2%, T₁₂- Potassium phosphate 3% and T₁₃-Control *i.e.* water spray. All these treatments were applied as foliar application to the plants. Foliar application of different potassium sources was applied as first spray at the time of flowering, second spray at 40 days after flowering and third spray at 40 days after the second spray. Different quality parameters like TSS, sugar: acid ratio, titrable acidity, reducing sugars, non-reducing sugars, total sugars, ascorbic acid content, anthocyanin content and juice pH were recorded and analyzed as per the standard procedure. The data was subjected to statistical analysis for drawing conclusions (p=5%) as per Fisher and Yates (1963).

Results and Discussion

Quality of the fruit is a unit of the principal goals in any production systems apart targeting for highest yield per unit area. As in pomegranate apart from fruit weight, the quality is defined by total sugar, total soluble solids, anthocyanin and sugar ratio. It was observed that as the pomegranate fruit matures on the plant, a decrease in the titrable acidity and equal increase in TSS, pH and color intensity is observed (Kadler, 2006).

Foliar spray of various sources of potassium significantly influenced the fruit quality parameters of pomegranate (Table 1). Results of the present study on advancing the quality of pomegranate fruits indicated that foliar

spray of 3 per cent K₂SO₄(T₃) has recorded maximum TSS (16.40 ° Brix) by reducing the acidity content (0.45 %) and high sugar: acid ratio (38.28) which was significantly higher over other treatments, while the minimum TSS (13.83 ° Brix), highest acidity (0.72 %) and lowest sugar: acid ratio (16.99) were found in the control (T₁₃). Similar findings concerning increase in TSS, reduced acidity and high sugar: acid ratio were also reported by Khayyat *et al.*, (2012), Thirupathi and Ghosh (2015), Hamouda *et al.*, (2015) and Davarpanah *et al.*, (2017) in pomegranate. It may be due to the role of potassium in the synthesis of more carbohydrates and their translocation from leaves to fruits and accumulation of sugars and other soluble solids in fruits and also due to synthesis of more organic acids or by the role of potassium in advancing the maturity by improving the quality parameters at an early stage as quality parameters like TSS, acidity and sugars are influenced by harvesting stages. Such similar results are also reported in other crops like in sweet orange cv. Jaffa (Dalal *et al.*, 2017) and (Vijay *et al.*, 2016), mango (Vijayalakshmi and Srinivasan, 2000), grapes (Sharma and Sindhu, 2005), guava (Manivannan *et al.*, 2015), banana (Nandan *et al.*, 2011), ber (Yadav *et al.*, 2014) and in apple (Doroshenko *et al.*, (2005) and (Yousuf *et al.*, 2018).

Results indicated that reducing sugars, non-reducing sugars and total sugars were significantly varied among the treatments as influenced by the foliar spray of potassium sources (Table 2). Among the different treatments, application of foliar spray of 3 per cent K₂SO₄(T₃) has recorded maximum reducing sugar (14.51 %), non-reducing sugar (1.55 %) and total sugars (16.14 %) whereas minimum reducing sugar (11.56 %), non-reducing sugar (0.67 %) and total sugars (12.29 %) were recorded in the control (T₁₃). It might be because, potassium is known to

enhance photophosphorylation and dark reaction of photosynthesis resulting in increased accumulation of carbohydrates. The higher sugar content of fruits might be due to role of potassium in translocation of sugars from leaves to fruits and maybe be because of higher assimilating power of leaves over a long period resulting in increased availability of sugars in the fruits. These results are

similar with Hamouda *et al.*, (2015) and Tehranifar and Tabar (2009) in pomegranate, Vijayalakshmi and Srinivasan (2000), Kumar *et al.*, (2006) and Baiea *et al.*, (2015) in mango, Manivannan *et al.*, (2015) and Dutta (2004) in guava, Nandan *et al.*, (2011) in banana, Pandey and Singh (2016) in litchi, Doroshenko *et al.*, (2005) in apple and Lester *et al.*, (2007) in cantaloupe.

Table.1 Effect of foliar spray of different sources of potassium on quality parameters (TSS, acidity and sugar: acid ratio) of pomegranate cv. Bhagwa

Treatment	TSS (^o Brix)	Acidity (%)	Sugar: acid ratio
T ₁ - (K ₂ SO ₄ 1%)	15.97	0.48	32.56
T ₂ -(K ₂ SO ₄ 2 %)	16.24	0.47	34.20
T ₃ - (K ₂ SO ₄ 3 %)	16.40	0.45	35.69
T ₄ - (KNO ₃ 1%)	15.23	0.57	25.87
T ₅ - (KNO ₃ 2 %)	15.37	0.55	27.09
T ₆ - (KNO ₃ 3 %)	15.50	0.54	27.94
T ₇ - (K ₂ SO ₄ .MgSO ₄ 1%)	15.92	0.51	30.57
T ₈ - (K ₂ SO ₄ .MgSO ₄ 2 %)	16.11	0.49	32.10
T ₉ -(K ₂ SO ₄ .MgSO ₄ 3 %)	16.27	0.48	32.67
T ₁₀ -(KH ₂ PO ₄ 1 %)	14.78	0.65	22.37
T ₁₁ -(KH ₂ PO ₄ 2 %)	14.87	0.62	23.72
T ₁₂ -(KH ₂ PO ₄ 3 %)	15.11	0.60	24.76
T ₁₃ -Control (water)	13.83	0.72	16.99
S.Em ±	0.13	0.01	0.59
C.D. @ 5 %	0.37	0.03	1.74

Note:T₁ to T₁₃ – Foliar application

Table.2 Effect of foliar spray of different sources of potassium on quality parameters (reducing sugars, non-reducing sugars and total sugars) of pomegranate cv. Bhagwa

Treatments	Sugars		
	Reducing Sugars (%)	Non-reducing sugars (%)	Total sugars (%)
T ₁ - (K ₂ SO ₄ 1%)	14.22	1.43	15.72
T ₂ -(K ₂ SO ₄ 2 %)	14.35	1.44	15.87
T ₃ - (K ₂ SO ₄ 3 %)	14.51	1.55	16.14
T ₄ - (KNO ₃ 1%)	13.58	0.95	14.58
T ₅ - (KNO ₃ 2 %)	13.74	1.11	14.90
T ₆ - (KNO ₃ 3 %)	13.81	1.22	15.09
T ₇ - (K ₂ SO ₄ .MgSO ₄ 1%)	14.05	1.30	15.42
T ₈ - (K ₂ SO ₄ .MgSO ₄ 2 %)	14.11	1.36	15.54
T ₉ -(K ₂ SO ₄ .MgSO ₄ 3 %)	14.19	1.47	15.73
T ₁₀ -(KH ₂ PO ₄ 1 %)	13.54	0.87	14.45
T ₁₁ -(KH ₂ PO ₄ 2 %)	13.66	0.98	14.69
T ₁₂ -(KH ₂ PO ₄ 3 %)	13.78	1.01	14.84
T ₁₃ -Control (water)	11.56	0.67	12.29
S.Em ±	0.20	0.03	0.18
C.D. @ 5 %	0.60	0.08	0.53

Note:T₁ to T₁₃– Foliar application

Table.3 Effect of foliar spray of different sources of potassium on quality parameters (juice pH, ascorbic acid and anthocyanin) of pomegranate cv. Bhagwa

Treatment	Juice pH	Ascorbic acid (mg/100g FW)	Anthocyanin (mg/100g FW)
T ₁ - (K ₂ SO ₄ 1%)	3.87	17.16	8.31
T ₂ -(K ₂ SO ₄ 2 %)	3.90	17.40	8.60
T ₃ - (K ₂ SO ₄ 3 %)	3.94	17.73	8.98
T ₄ - (KNO ₃ 1%)	3.74	15.54	7.42
T ₅ - (KNO ₃ 2 %)	3.78	15.72	7.59
T ₆ - (KNO ₃ 3 %)	3.79	15.94	7.70
T ₇ - (K ₂ SO ₄ .MgSO ₄ 1%)	3.81	16.58	7.88
T ₈ - (K ₂ SO ₄ .MgSO ₄ 2 %)	3.84	16.84	8.01
T ₉ -(K ₂ SO ₄ .MgSO ₄ 3 %)	3.86	17.07	8.18
T ₁₀ -(KH ₂ PO ₄ 1 %)	3.65	15.18	7.19
T ₁₁ -(KH ₂ PO ₄ 2 %)	3.69	15.32	7.26
T ₁₂ -(KH ₂ PO ₄ 3 %)	3.71	15.45	7.33
T ₁₃ -Control (water)	3.48	14.31	6.18
S. Em. ±	0.04	0.19	0.11
C. D. @ 5%	0.11	0.55	0.32

FW- Fruit weight

Note: T₁ to T₁₃– Foliar application

The results gained in the present investigation under different potassium sources found significant concerning juice pH, ascorbic acid and anthocyanin content (Table 3). Among the different treatments, foliar spray of 3 per cent K₂SO₄(T₃) has recorded maximum pH (3.94), ascorbic content (17.73 mg/100g FW)

and anthocyanin content (8.98 mg/100g FW) while minimum pH (3.48), ascorbic content (14.31 mg/100g FW) and anthocyanin content (6.18 mg/100g FW) were recorded in the control (T₁₃). It was recorded that maximum acidity was found in the control treatment thereby decreasing the pH and it may be due

to decreased cell size and cell division due to lighter turgor pressure and internal auxin content whereas minimum acidity was found in plants treated with potassium and this might be due to the function of potassium in the synthesis of more carbohydrates and their translocation from leaves to fruits and accumulation of sugars which enhanced the pH, making the juice less acidic and increased ascorbic acid with foliar application of potassium might be related with improved sugar metabolism and also due to role of potassium in activating the synthesis of ascorbic acid somewhere between D-Glucose to L-Ascorbate. The results were in line with Heshi *et al.*, (2001), Khayyat *et al.*, (2012), Thirupathi and Ghosh (2015) and Hamouda *et al.*, (2015) in pomegranate, Dalal *et al.*, (2017) and Vijay *et al.*, (2016) in sweet orange cv. Jaffa, Manivannan *et al.*, (2015) in guava, Altindisli *et al.*, (1999) in grapes, Yadav *et al.*, (2014) in berand Baiea *et al.*, (2015) in mango. Also, it was reported that a positive correlation exists between potassium concentration and anthocyanin content which play a crucial role in anthocyanin synthesis through increasing the translocation of sugars into fruits, as well as acting as a cofactor and stimulator of some enzymes like UDP-galactose: flavonoide-3-o-glicosyl transferase. A similar opinion was expressed by Davarpanah *et al.*, (2017).

It may be concluded from the investigation that the increased quality parameters of the pomegranate fruit is an unit of the principal goals in any production systems apart targeting for highest yield per unit area. As in pomegranate apart from fruit weight, the quality of fruit is also defined by total sugar, total soluble solids, anthocyanin and sugar ratio. The results of the present study revealed that foliar spray of various sources of potassium thrice during the crop growth period was found better not only for achieving good yields but also quality parameters of

pomegranate fruit and the foliar spray of 3 per cent K₂SO₄ was found superior compared to other treatments.

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