Study on nutrient package for pomegranate (*Punica granatum* L.)

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ABSTRACT

An experiment was carried out during 2015-16 with specialty fertilizers of R.C.F. (Rashtriya Chemicals and Fertilizers Limited) on the fruit yield and quality of pomegranate in an orchard with a soil pH of 8.7 and EC of 0.40 (ds m⁻¹) in randomised block design (RBD). During the experiment the effects of foliar sprays of NPK 19:19:19 (Sujala), Micronutrient Fertilizer (Microla) and Phosphate Solubilising Bacteria (Biola) were studied. Sujala alone and in combination with Microla were applied with three and five sprays each respectively. Biola was applied only once before the application of foliar fertilizers through drenching method. The concentration of 0.5 % and 0.2 % of Sujala and Microla were used in the experiment respectively. The application of Recommended Dose of Fertilizer (RDF) along with each 5 sprays of Sujala and Microla recorded maximum yield (26.87 kg / plant), number of fruits (101.33) and average weight of fruit (272.00 g) followed by RDF along with Sujala, Microla (3 spray) and Biola.

Key words: Micronutrient, Pomegranate, RDF, Water soluble fertilizers, Yield.

INTRODUCTION

Pomegranate (*Punica granatum* L.) is one of the commercially important fruit crops of India. The total area under cultivation of pomegranate is 1.31 lakh ha and production is around 13.46 lakh tonnes (ICAR, 2014) in India. At present, Maharashtra is the leading state in acreage covering about 68.7 per cent of the area under pomegranate and around 70.2 per cent of total production. Being an export oriented fruit, the quality is very important in order to match the standards for international market.

Elements like nitrogen, phosphorus and potash play a vital role in promoting the plant vigour and production. The micro-nutrients viz. Fe, Zn, Mn, Cu and B are not only essential but they are equally important like macro-nutrients, in spite of their requirement in micro quantities. They are key elements in plant growth and development (Das, 2014 and Yadav and Solanki,2015). Biofertilizers have also been identified as major inputs for maintaining the soil health (Suryawanshi et al. 2013). Use of biofertilizers is one of the important components of integrated nutrient management, as they are cost effective and renewable source of plant nutrients. Also they supplement the chemical fertilizers. They are environmental friendly and play significant role in crop production (Hazarika and Ansari, 2007). Biofertilizers improve plant growth, fruit yield, nutrition, metabolism and rhizosphere enzyme activities of Pomegranate as reported by Afria *et al.* (1999), Vessey (2003), Aseria *et al.* (2008) and Mir *et al.* (2012).

The recent advances have also seen the use of biofertilizers along 100% water soluble fertilizers. The utilization of 100% water soluble fertilizers in cash crop has been considerably increased (Krishnan and Indiresh, 2015). NPK 19:19:19 grade is one of the 100% water soluble fertilizers which provides major macronutrients (N-P-K) in a balanced ratio to the plants. This fertilizer is being utilized either in drip or foliar form.

With a view to formulate/design a balanced nutrient package for pomegranate, the present work of research was undertaken. The study was executed with the aim to investigate the influence of spraying Water Soluble Fertilizer “Sujala”;Micronutrient Mixture “Microla” alone or in combination with biofertilizer “Biola” on pomegranate cultivar.

MATERIALS AND METHODS

The efficacy study was conducted at the Department of Horticulture, Mahatma Phule Krishi Vidyapeeth, Rahuri (Ahmednagar) Maharashtra, India (Latitude: 19° 23’ North, Longitude: 74° 38’ East) during the year 2015-16. The experiment comprised of eleven treatments, in which each treatment had three replicates (trees), in a RBD. Four years old “Phule Bhagwa Super” pomegranate variety at the spacing of 4.5 x 3.0 m were used in the experiment. All the trees had uniform growth characters at the time of experimentation. The fertilizer materials were provided by M/s Rashtriya Chemicals and Fertilizers Limited (RCFL). Biofertilizers under the trade name “Biola” a Phosphate Solubilising Bacteria (PSB); Micronutrient mixture “Microla” Maharashtra grade no. II : Zn: 3.0 ; Fe: 2.5 ; Cu:1.0; B:0.5; Mo: 0.1; Mn:1.0 (in %) and a 100 % water Soluble Fertilizer “Sujala” (NPK 19:19:19) were used in treatments.

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The recommended dose of fertilizers (625 N:250 P:250 K gm/tree) was applied commonly to all the treatments. The experiment was initiated with the application of biofertilizer, Biola one litre was diluted in 10 litre of water and a quantity of around 100 ml/tree was applied near the root zone i.e. 8-10 cm depth in shallow circular trench under the plant canopy and covered with the top soil. After the application, the tree were irrigated through the drip system with four drippers with a discharge capacity of 2 LPH (litre per hour) around the trees.

The product Sujala and Microla were applied through foliar spray early in the morning as per the treatment mention in Table 1. The solutions of Sujala and Microla were sprayed on alternate day to avoid chemical reaction. It was also not mixed with any other agrochemicals like Pesticides, Plant Growth Regulators etc. The spraying at different growth stages were done according to the Table 2. The periodical observations like initiation of flowering were taken according to the growth of the tree. The fruit characters like number of fruits per tree (g), average weight of fruits (g), yield per tree (kg) and fruit drop (%) were observed. The fruit drop was observed based on the fruit harvested. The biochemical analyses of fruits viz. Total Acidity (%) and Total Soluble Sugars-TSS (‘B’) were done after the harvest of the crop.

The soil used for the experiment was sandy loam in texture, alkaline in reaction (pH=8.70), poor in available Nitrogen (220 Kg/ha), low in available Phosphorus (21 Kg/ha) and medium in available Potassium (269 Kg/ha). pH was determined with a pH meter (Page et al., 1982) and Electrical conductivity was measured by using electrical conductivity meter (Page et al., 1982). Available Phosphorus was measured by spectrophotometer (Olsen, 1982). Potassium was determined by using flame photometer (Knuensden et al., 1982). The chemical properties of the soil for the experiment are presented in Table 3.

RESULTS AND DISCUSSION

Results showed that with the application of Sujala, Microla and Biola there has been a significant difference in the characters like initiation of flowering (days), average weight of fruits (g), fruit yield/tree (kg), fruit yield (t/ha), total soluble solids (TSS Brix) and fruit drop (%) (Table 4). The application of recommended dose of fertilizers (RDF) along with each 5 sprays of Sujala and Microla recorded maximum Fruit yield (26.87 kg / plant), number of fruits (101.33) and average weight of fruit (272.00 g) followed by RDF along with Sujala, Microla (3 spray) and Biola. Growth parameter wise results are discussed below.

Initiation of flowering: Significant differences were observed between the treatments. Out of 11 treatments, T7 (43.67) showed early flowering followed by T10 (44.33) and others.

Fruit yield (kg/tree): Data presented in Table 4 shows that, significantly higher fruit yield (26.87 Kg/tree) was found with five sprays of each Sujala and Microla at the rate of 0.5 % and 0.2 %, respectively followed by treatment of Sujala and Microla (3 sprays) with Biola. The obtained result (Microla) is in line with the findings of Khorsandi (2009) and Kumar et al. (2017) where it showed that the foliar spray of Zn increases the yield and quality of pomegranate fruits. Increase in fruit yield due to use of Phosphate Solubilizing Bacteria (Biola) was also reported by Medhi et al. (2007) in Mandarin crop.

Similar results had been reported that foliar spray of Mn increased fruit yield in ‘Ganesh’ variety of pomegranate (Bambal et al., 1991). Balakrishnan et al. (1996) reported that foliar application of 0.25% each of zinc sulfate, manganese sulfate and iron sulfate combined with 0.15% boric acid, significantly increased yield of pomegranate fruit.

Number of fruits/tree: Data in Table 4 indicate that the number of fruits/tree reached to the maximum in treatment combination of Sujala and Microla (5 sprays) with an average (101.33), while the minimum number of fruits (85.33) were

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**Table 1: Treatment details.**

| Trt no. | Treatment details |
|--------|-------------------|
| T1     | RDF (625 N :250 P: 250 K gm/tree) |
| T2     | RDF + Sujala @ 5 ppm (3 sprays) |
| T3     | RDF + Microla @ 2 ppm (3 sprays) |
| T4     | RDF + Sujala @ 5 ppm + Microla @ 2 ppm (3 sprays) |
| T5     | RDF + Sujala @ 5 ppm + Microla @ 2 ppm (5 sprays) |
| T6     | RDF + Microla @ 2 ppm (5 sprays) |
| T7     | RDF + Biola* (drenching) |
| T8     | RDF + Sujala @ 5 ppm (3 sprays)+ Biola* (drenching) |
| T9     | RDF + Microla @ 2 ppm (3 sprays) + Biola* (drenching) |
| T10    | RDF + Sujala @ 5 ppm + Microla @ 2 ppm (3 sprays)+ Biola* (drenching) |

*100 ml in 1 litre water.

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**Table 2:** Spray schedule for Sujala and Microla.

| Spray No. | Growth stages |
|-----------|---------------|
| I         | Initiation of sprouting |
| II        | Initiation of flowering |
| III       | Thirty days after second spray |
| IV        | Thirty days after third spray |
| V         | During fruit setting |

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**Table 3:** Chemical properties of soil.

| Parameters     | Values |
|----------------|--------|
| EC dSm⁻¹       | 0.40   |
| pH             | 8.70   |
| Avl. N (kg ha⁻¹) | 220   |
| Avl. P (kg ha⁻¹) | 21    |
| Avl. K (kg ha⁻¹) | 269   |
| Fe (mg kg⁻¹)   | 4.58   |
| Mn (mg kg⁻¹)   | 17.74  |
| Zn (mg kg⁻¹)   | 3.80   |
| Cu (mg kg⁻¹)   | 14.28  |
obtained from untreated trees. These findings are in line with the findings as reported by Hasani et al. (2012) and Sheikh and Manjula (2009) on pomegranate.

**Total Soluble Solids (TSS):** The effect of different sprayed treatment on TSS is presented in Table 4. A significant increase in TSS in comparison to the control were obtained in T7 (15.13) followed by T11 (15.01), T6 (14.77) and T10 (14.76). These results were in agreement with those obtained by Ramezanian et al. (2009), Hasani et al. (2012), Hoda et al. (2013) and Korkmaz et al. (2015) who found that foliar micronutrient increased TSS (Brix) in pomegranate.

**Average weight of fruits (g):** Data in Table 4 indicate that average weight of fruit increased significantly with application of the combination of Sujala and Microla in T7 (272.00) over control treatment followed by T11 (255.67), T10 (252.33) and T6 (246.00). These results were in harmony with those obtained by Afria et al. (1999) and Al Rawi et al. (2012) who found that combination of micronutrient increased average weight of fruits in pomegranate. Khorsandi et al. (2009) reported increased average weight of fruits indicating a direct impact on yield depending on number of fruit retained.

**Total acidity (%):** Data in Table 4 also indicate that acidity % was not affected by any of treatment application. However, it was higher in T1 (0.36).

**Fruit drop (%):** The effect of the different treatments on fruit drop percentage is presented in Table 4. A significant decrease in fruit drop percentage in T7 (0.46), T5 (0.92), T6 (0.58) and T11 (0.55) were obtained as compared to control. The highest percentage of fruit drop was observed from untreated trees at all the stages of fruit growth. These results were in agreement with those obtained by Eiada et al. (2013) where it was reported that fruit drop percentage in pomegranate got reduced by application of micro nutrients. The results obtained were also in agreement with Davarpanah et al. (2016) on pomegranate where the fruit drop percentage reduced by the application of micronutrients.

**CONCLUSION**

Considering the results obtained during the span of six months of the experiment, it can be concluded that balanced utilization of nutrient package could contribute to quality and quantity of Pomegranate fruits. The balanced use of fertilizer packages which includes biofertilizers, micronutrient and 100% water soluble fertilizers increases fruit yield and also reduces fruit drop (0.46 %). The package of nutrient also increases TSS (15.13%B) and enhances the crop productivity by 24.56 % over control. In addition the lowest yield of pomegranate yield was obtained in RDF

| Trt no. | Treatments | Initiation of flowering (days) | No. of fruits/tree | Avg weight of fruits (g) | Yield/ tree (kg) | Yield/tree (t/ha) | TSS (Brix) | Total acidity (%) | Fruit drop (%) |
|--------|------------|-------------------------------|--------------------|-------------------------|-----------------|------------------|-----------|----------------|----------------|
| T1     | RDF (62.5N:25P:25K gm/tree) | 46.17                          | 22.50              | 85.33                   | 235.00          | 21.57            | 15.96     | 14.02           | 0.36           |
| T2     | RDF + Sujala @ 5 ppm (3 sprays) | 46.50                          | 22.67              | 89.67                   | 240.00          | 22.55            | 16.68     | 14.46           | 0.33           |
| T3     | RDF + Microla @ 2 ppm (3 sprays) | 47.50                          | 22.06              | 94.50                   | 217.67          | 22.66            | 16.32     | 14.33           | 0.34           |
| T4     | RDF + Sujala @ 5 ppm + Microla @ 2 ppm (3 sprays) | 47.00                          | 21.74              | 91.83                   | 229.00          | 22.74            | 16.83     | 14.77           | 0.35           |
| T5     | RDF + Sujala @ 5 ppm (5 sprays) | 46.33                          | 26.89              | 88.00                   | 239.00          | 22.76            | 15.97     | 14.77           | 0.35           |
| T6     | RDF + Microla @ 2 ppm (5 sprays) | 47.50                          | 21.59              | 89.33                   | 246.00          | 21.87            | 15.97     | 14.77           | 0.35           |
| T7     | RDF + Sujala @ 5 ppm + Microla @ 2 ppm (5 sprays) | 43.67                          | 26.83              | 101.33                  | 272.00          | 22.87            | 16.83     | 14.22           | 0.33           |
| T8     | RDF + Biola* (drenching) | 46.77                          | 21.93              | 86.50                   | 233.00          | 22.30            | 16.32     | 14.76           | 0.33           |
| T9     | RDF + Sujala @ 5 ppm + Biola* (drenching) | 44.50                          | 21.15              | 90.00                   | 240.00          | 22.44            | 16.23     | 14.76           | 0.35           |
| T10    | RDF + Microla @ 2 ppm + Biola* (drenching) | 44.37                          | 25.23              | 91.77                   | 252.33          | 23.64            | 17.36     | 14.76           | 0.35           |
| T11    | RDF + Sujala @ 5 ppm + Microla @ 2 ppm + Biola* (drenching) | 44.83                          | 24.21              | 96.00                   | 256.77          | 25.67            | 15.01     | 15.01           | 0.35           |

SE +/- 0.97  SE +/- 2.85  CD @ 5%  31.97  0.90  1.82  0.62  0.31  0.16  0.04  0.16

NS  NS  NS  NS  NS  NS  NS  NS  NS  NS
treatment (15.96 t/ha). From the results of the present study, it can be concluded that spraying Sujala19:19:19 and Microla at five times followed by treatment Sujala @ 5 ppm and Microla @ 2 ppm (3 sprays) with Biola with drenching has an efficient effect on improving the yield contributing characters of pomegranate fruit and also the quality over the normal farmers practises.

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REFERENCES
Al-Rawi, W., Jassim, N. M., Al-Hadethi, M. E. and Al-Kasab, M. J. (2012). Effect of foliar Application of manganese, zinc and calcium in leaf mineral content of Salemy pomegranate trees. *Egyptian Journal of Applied Sciences*, 27(10): 583-594.

Aseria, G.K.; NeelamJaina, Jitendra Panwarb, Raocand, A. V. and Meghwal, P. R. (2008). Biofertilizers improve plant growth, fruit yield, nutrition, metabolism and rhizosphere enzyme activities of Pomegranate (*Punica granatum* L.) in Indian Thar Desert. *Scientia Horticulturae*, 117-2 (26): 130–135.

Afria B.S., Pareek C.S., Garg, D.K., Singh K. (1999). Effect of foliar spray of micronutrients and their combinations on yield of pomegranate. *Ann. Arid Zone*, 38(2):189-190.

Balakrishnan, K., Venkatesan, K., Sambandamurti, S. (1996). Effect of foliar application of Zn, Fe, Mn and B on yield and quality of pomegranate cv. Ganesh. *Orissa Journal of Horticulture*, 24 (1): 33-35.

Bambal, S.B., Wavhal, K.N., Nasalkar, S.D. (1991). Effect of foliar application of micro-nutrients on fruit quality and yield of pomegranate (*Punica granatum* L. cv. Ganesh). *Maharashtra Journal of Horticulture*, 5 (2): 32-36.

Das, S. K. (2014). Role of micronutrient in rice cultivationand management strategy in organic agriculture—A Reappraisal. *Agricultural Sciences*, 5: 765-769.

Eiada A. Obaid and Mustafa Eiada A. Al-Hadethi. (2013). Effect of foliar application with manganese and zinc on pomegranate growth, yield and fruit quality. *Journal of Horticultural Science & Ornamental Plants*, 5 (1): 41-45.

Hazarika, B. N. and Ansari, S.(2007). Biofertilizers in fruit crops - A Review. *Agric. Rev.*, 28(1):69-74

Hoda A. Khalil and Hoda S.H. Aly. (2013). Cracking and fruit quality of pomegranate (*Punica granatum*) as affected by pre-harvest sprays of some growth regulators and mineral nutrients. *Journal of Horticultural Science & Ornamental Plants*, 5 (2): 71-76.

ICAR: http://www.icar.org.in/Vision%20202050+%20NRC,%20Sholapur

Khorsandi, F., AlaeiYazdi, F., Vazifehshenas, M.R. (2009). Foliar zinc fertilization improves marketable fruit yield and quality attributes of pomegranate. *Int. J. Agr. Biol.*, 11 (6): 766-770.

Knudsen, D., Peterson, G. A., and Pratto, P. F. (1982). Lithium, Sodium and Potassium. In: Page, A. L., Miller, R. H. and Keey, D. R. (eds). Methods of Soil Analysis Part 2. *American Society of Agronomy*, 9: 228-238.

Korkmaz, N., Askin, M.A. (2015). Effects of calcium and boron foliar application on pomegranate (*Punica granatum* L.) fruit quality yield, and seasonal changes of leaf mineral nutrition. *Acta Hortic.*, 1089: 413–422.

Krishnan, A. and Indiresh, K. M.(2015). Effect of water soluble fertilizers on qualitativeParameters of tomato. *The Asian Journal of Horticulture*, 10 (1): 41-44.

Kumar Kuldipl, Joon, M. S., Yadav, R. and Daulta, B. S. (2017). Effect of growth regulators and micronutrients on fruit cracking and fruit yield in pomegranate. *Indian J. Agric. Res.*, 51 (3): 272-276.

Hasani, M., Zamani, Z.,Savaghebi, G. and Fatahi, R. (2012). Effects of zinc and manganese as foliar spray on pomegranate yield, fruit quality and leaf minerals. *Journal of Soil Science and Plant Nutrition*, 12 (3): 471-480.

Medhi, B. K., Saikia, A. J., Bor S. C., Hazarika, T. K. and Barbora, A. C. 2007. Integrated use of concentrated organic manures, biofertilizers and inorganic NPK on yield, quality and nutrient content of khasi mandarin (*Citrus reticulata blanco*). *Indian J. Agric. Res.*, 41(4): 235 -241.

Mir, M., Hassan G.I., Sheikh K.I, Sharma S.K. (2012). Impact of biofertilizers on growth, nutrient uptake, yield, metabolism and rhizosphere enzyme activities of pomegranate (*Punica granatum* L.) cv. ‘Kandhari Kabuli’. *Applied Biological Research*, 14 (2): 168-175.

Olsen, S. R., andSommers, L. E. (1982). Phosphorus. In: Page, A. L., Miller, R. H. &Keey, D. R. eds. Methods of Soil Analysis Part 2. *American Society of Agronomy*, 9: 403-427.

Page, A. L., Miller, R. H. and Keey, D. R. eds. Methods of Soil Analysis Part 2. American Society of Agronomy Madison, Wisconsin, USA.

Ramezanian, A., M. Rahemi., and Vazifehshenas, M. R.,(2009). Effect of foliar application ofcalcium chloride and urea on quantitative and qualitative characteristics of pomegranatefruits. *Sciencia Horticulturae*, 121: 171-175.

Sheikh, M.K., Manjula, N. (2009). Effect of split application of N and K on growth and fruiting in ‘Ganesh’ pomegranate (*Punica granatum* L.). *Acta Hortic.*, 818: 213-217.

Davarpanaha, S., Ali Tehraniifar, GholahmhosseinzDavarynejada, Javier Abadiab, Reza Khorasanica. (2016). Effects of foliar applications of zinc and boron nano-fertilizers on pomegranate (*Punica granatum* cv. Ardestani) fruit yield and quality.*ScienciaHorticulturae*, 1–8.

Suryawanshi, R. K., Yadaw K.N and Verma. U. (2013). Importance of bio-fertilizers in agriculture. *Rashtriya Krishi*, 8(1): 21-23.

Vessey, J.K. (2003). Plant growth promoting rhizobacteria as bio-fertilizers. *Plant Soil*, 571-586.

Yadav, M. K. and Solanki, V. K. (2015). Use of micronutrients in tropical and sub-tropical fruit crops. *Afr. J. Agric. Res.*, 416-422.