The Bioscan 11(4): 2359-2362, 2016 (Supplement on Agronomy)
AN INTERNATIONAL QUARTERLY JOURNAL OF LIFE SCIENCES
www.thebioscan.com

# EFFECT OF DIATOMACEOUS EARTH ON QUALITY OF POMEGRANATE VAR. KESAR

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**KEYWORDS**
Diatomaceous earth
Pomegranate
Quality

**Received on :**
11.08.2016

**Accepted on :**
26.10.2016

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**ABSTRACT**
Experiment was carried out to study the effect of soil application of Diatomaceous earth (as a source of silicon) on pomegranate Var. Kesar with 9 treatments. Quality parameters like fruit weight 298.66 gram, fruit volume 315.00 millilitre, fruit girth 82.69 millimetre, fruit length 83.68 millimetre, 100 aril weight 35.66 gram, total aril weight 203.66 gram, seed weight 15.00 gram, TSS 16.23 $^0$Brix, reducing sugars 11.13 per cent, total sugars 11.76 per cent, and juice percentage 71.36 per cent per 100 gram aril are recorded in $T_9$ (RDF + DE @ 900 Kg/ha) as highest values. Application of silicon will influence the yield and quality of pomegranate by providing absorption and translocation of nutrients by reducing plant stress.

## INTRODUCTION

This study is carried out to know the effect of Diatomaceous earth (source of silicon) on yield and quality of pomegranate Var. Kesar. Silicon is the most abundant element in the earth's crust region next to oxygen and comprises 28 per cent of its weight out of which 3-17 per cent is present in soil solution (Epstein, 1999). It is most commonly found in soils in the form of solution as silicic acid ($H_4SiO_4$) and is taken up directly as silicic acid (Ma *et al*., 2001). Being a dominant component of soil minerals it has many important functions in environment, although silicon is not considered as an essential plant nutrient because of its ubiquitous presence in the biosphere and most plants can be grown from seed to seed without its presence (Epstein, 1999).

Pomegranate (*Punica granatum* L.) is being grown from ancient times for its sweet-acidic fruits, ornamental and medicinal purposes. It belongs to order Punicaceae with family Punicaceae. Punica is only known genus of this family. The two species belongs to genus *Punica* are *Punica granatum* (cultivated one) and *Punica protopunica* (wild type). *Punica granatum* has been classified into two sub-species like *Punica chlorocarpa* and *Punica porophyrocarpa*.

It is indigenous to Iran and is cultivated extensively in mediterranean countries like Spain, Morocco, Egypt, Iran and Afghanistan. In India pomegranate is commercially cultivated in Maharashtra, Karnataka, Gujarat, Rajasthan, Tamil Nadu, Andhra Pradesh, Punjab and Haryana. In India, pomegranate occupies an area of 113.20 thousand hectares with a production of 745.00 thousand metric tons and productivity of 6.6 metric tons/ha. Maharashtra is the leading producer in India which produces 54.80 per cent of total production followed by Karnataka (20.20 %). In Karnataka, it is grown over an area of about 15.10 thousand hectares with 150.30 thousand metric tons production and productivity of 10.00 metric tons/ha (Anon, 2013).

Pomegranate is used as table fruit; for Preparation of juice, wine, jelly and syrup; for extraction of tannin and phenols; preparation of anarrab (pomegranate jam), anardana (seeds used as spice); rind powder is used in leather, pharmaceutical, dying and herbal industries.

The crop production of pomegranate can be increased by balanced nutrition on the profitable basis even though it is growing in the arid condition. The growth, yield and quality of pomegranate can be increased by application of manures and fertilizers because it is well respond to application of fertilizers.

Similar work and results have been observed by Bhavya (2010) in grape, Su *et al*. (2011) in apple, Tesfay *et al*. (2011) in avocado, Ghasemi *et al*. (2013) in broad bean, Nesreen *et al*. (2011) and Rodrigues *et al*. (2010) in beans, Stamatakis *et al*. (2003), Savvas (2009) and Anastasia *et al*. (2013) in tomato.

The main objective of this study is to know the effect of Diatomaceous earth (source of silicon) on yield and quality of pomegranate Var. Kesar.

## MATERIALS AND METHODS

The present investigation was carried out in the farmer's field during 2013-2014 to study the effect of Diatomaceous Earth on yield and quality of pomegranate Var. Kesar. The experiment was laid out on red loamy soil and in an established

pomegranate orchard of 5 year old plants with spacing of 3.5 m x 3.5 m.

The source of silicon used is Diatomaceous earth (DE), applied as basal dose to the respective treatment in this experiment. The dosage of DE used in this experiment was 300, 600 and 900 kg/ha. DE was applied after bahar treatment as whole basal application and recommended dose of fertilizer at the interval of 0, 45 and 90 days after bahar treatment.

Nitrogen was applied in the form of urea (46% N), phosphorous applied in the form of Diamonium phosphate (18% N: 46% P: 0% K), and potassium applied in the form of muriate of potash (60% K). These nutrients were applied to the respective treatment according to the package of practice (400:200:200 g NPK/Plant) of UHS, Bagalkot.

The design adopted for the experiment was Randomised Block Design (RBD) with nine treatments. The experiment was replicated thrice and treatments are $T_1$ - Absolute control, $T_2$ - Recommended dose of fertilizer (400:200:200 g NPK/plant), $T_3$ - Half of Recommended dose of fertilizer, $T_4$ - Half of RDF + 300 kg/ha of DE, $T_5$ - Half of RDF + 600 kg/ha of DE, $T_6$ - Half of RDF + 900 kg/ha of DE, $T_7$ - RDF + 300 kg/ha of DE, $T_8$ - RDF + 600 kg/ha of DE and $T_9$ - RDF + 900 kg/ha of DE.

The number of flowers per plant was recorded at fortnightly interval after imposing the treatments and mean values of five plants was recorded.

The fruits were harvested at matured stage. For recording fruit characteristics like fruit weight, fruit volume, fruit length and fruit girth mean value is taken from five fruits. Fruit weight was taken in terms of grams. Fruit volume is recorded by taking the amount of water displaced by the fruit when the fruit was placed in water filled beaker and expressed in millilitre. Fruit length was measured from the fruit pedicel to the opposite end using digital verniercalifer and fruit girth also recorded by using digital verniercalifer, both are expressed in millimetre.

Quality parameters were recorded in terms of Total soluble solids (°B), Titrable Acidity (%), TSS:Acid ratio, Reducing sugars (%), Nonreducing sugars (%), Total sugars (%), Seed weight (g), Rind weight (g), Juice percentage (%) and aril colour.

The total soluble solids (TSS) of pomegranate juice was measured by hand refractrometer with respect to treatments and expressed in degree brix (°B). A known volume of juice sample was taken and titrated against standard NaOH using phenolphthalein indicator. The appearance of pink colour was marked as the end point. The value was expressed in terms of citric acid as per cent acidity of juice and expressed in per cent (Graca Miguel *et al.,* 2004). TSS:Acid ratio was calculated by dividing total soluble solids by titrable acidity. Reducing sugar was estimated as per the Dinitro Salicylic acid (DNSA) method (Miller, 1959). The value obtained was expressed as per cent on fresh weight basis and expressed in per cent. The per cent of nonreducing sugar was obtained by subtracting the values of reducing sugar from that total sugar and multiply the same with 0.95 as correction factor and expressed in per cent.

The total sugar in the sample was estimated by same method as that of reducing sugar after inversion of the nonreducing sugar using dilute hydrochloric acid and expressed in per cent. The seeds of the pomegranate were collected in each treatment and weight was recorded in gram. From each fruit the arils were weighted using a weighing balance and observation was recorded in gram.

From each fruit 100 arils were weighted using a weighing balance and observation was recorded in each treatment in gram. The arils of the fruit were taken out and the rind portion was weighed using a weighing balance in gram. The arils of the fruits were taken out and the juice from the arils of each fruit was squeezed by using a muslin cloth. This extracted juice was taken in a measuring cylinder and observations were recorded for each fruit in each treatment and expressed in per cent per 100 g.

Organoleptic evaluation of fresh pomegranate fruits was carried out. The fruit characters like colour, taste and overall acceptability of pomegranate fruits were evaluated on a five point hedonic scale using following score card. The mean scores given by judges used for statistical analysis.

| Hedonic scale | Score |
|---|---|
| Highly acceptable | 4.0-5.0 |
| Acceptable | 3.0-4.0 |
| Fairly acceptable | 2.0-3.0 |
| Poorly acceptable | 1.0-2.0 |
| Not acceptable | 1 |

## RESULTS AND DISCUSSION

Maximum values for fruit characters like weight (298.66 g), volume (315.00 ml), girth (82.69 mm), length (83.68 mm), 100 aril weight (35.66 g), total aril weight (203.66 g), seed weight (15.00 g) and rind weight (107.00 g) were recorded in $T_9$ (RDF + 900 kg/ha DE). The lowest values were recorded in treatment $T_1$ 193.99 g, 197.43 ml, 70.90 mm, 70.13 mm, 26.00 g, 113.33 g, 9.00 g and 65.66 g respectively (Table 1 and 2). This might be due to cell division in the initial stages and later due to cell expansion associated with movement of water and other metabolites into the cell causing increase in overall weight, volume, length, girth, total aril weight, 100 aril weight, seed weight and rind weight of the fruit. Similar results were noticed by Ghasemi *et al*. (2013) in broad bean, Nesreen *et al*. (2011) in beans and Bhavya (2010) in grape.

The maximum TSS (16.23 °B) was found in $T_9$ (RDF + 900 kg/ha DE), which was on par with the treatment $T_8$ (RDF + 600 kg/ha DE), $T_7$ (RDF + 300 kg/ha DE),$T_6$ (half of RDF + 900 kg/ha DE) and $T_5$ (half of RDF + 600 kg/ha DE), while the lowest TSS (13.56 °B) was observed in the treatment $T_1$. The maximum sugars to acid ratio (21.03) was recorded in the treatment $T_9$ (RDF + 900 kg/ha DE), while the minimum value (5.86) was observed in the treatment $T_1$ (Table 3). Silicon helped in synthesis of more sugars in the fruit and thus helped in increasing total soluble solids. The results are in accordance with Bhavya (2010) in Bangalore Blue grapes, Rodrigues *et al*. (2010) in beans, Savvas (2009) and Stamatakis *et al*. (2003) in tomato.

Significant difference was noticed with respect to titrable acidity of the fruit. Minimum acidity (0.85 %) was found in $T_9$ (RDF + 900 kg/ha DE) which was on par with the treatment $T_6$ (half of RDF + 900 kg/ha DE), $T_5$ (half of RDF + 600 kg/ha DE) and $T_8$ (RDF + 600 kg/ha DE); while the maximum acidity (2.34 %)

**Table 1: Effect of Diatomaceous earth on fruit weight, volume, girth and length of fruits of pomegranate Var. Kesar**

| Treatments | Weight (g) | Volume (ml) | Girth (mm) | Length (mm) |
|---|---|---|---|---|
| $T_1$ - Absolute control | 193.99 | 197.43 | 70.90 | 70.13 |
| $T_2$ - Recommended dose of fertilizer (RDF) | 246.86 | 272.20 | 76.48 | 76.26 |
| $T_3$ - Half of Recommended dose of fertilizer | 239.75 | 258.30 | 76.35 | 76.26 |
| $T_4$ - Half of RDF + 300 kg/ha of DE | 260.63 | 283.30 | 78.47 | 80.75 |
| $T_5$ - Half of RDF + 600 kg/ha of DE | 247.90 | 263.83 | 76.32 | 79.26 |
| $T_6$ - Half of RDF + 900 kg/ha of DE | 255.36 | 284.40 | 71.93 | 77.95 |
| $T_7$ - RDF + 300 kg/ha of DE | 264.08 | 296.63 | 79.17 | 80.67 |
| $T_8$ - RDF + 600 kg/ha of DE | 232.41 | 255.50 | 76.33 | 75.91 |
| $T_9$ - RDF + 900 kg/ha of DE | 298.66 | 315.00 | 82.69 | 83.68 |
| S.Em± | 16.91 | 18.52 | 2.11 | 1.99 |
| CD @ 5% | 50.72 | 55.54 | 6.34 | 5.99 |

**Table 2: Effect of Diatomaceous earth on aril, seed and rind weight of pomegranate Var. Kesar**

| Treatments | 100 aril weight (g) | Total aril weight (g) | Seed weight (g) | Rind weight (g) |
|---|---|---|---|---|
| $T_1$ - Absolute control | 26.00 | 113.33 | 9.00 | 65.66 |
| $T_2$ - Recommended dose of fertilizer (RDF) | 29.66 | 151.66 | 13.33 | 102.66 |
| $T_3$ - Half of Recommended dose of fertilizer | 29.33 | 132.33 | 10.33 | 74.00 |
| $T_4$ - Half of RDF + 300 kg/ha of DE | 31.00 | 145.33 | 13.00 | 90.00 |
| $T_5$ - Half of RDF + 600 kg/ha of DE | 31.66 | 152.00 | 13.66 | 83.00 |
| $T_6$ - Half of RDF + 900 kg/ha of DE | 33.66 | 156.33 | 14.66 | 106.33 |
| $T_7$ - RDF + 300 kg/ha of DE | 31.00 | 161.00 | 13.33 | 91.00 |
| $T_8$ - RDF + 600 kg/ha of DE | 34.66 | 173.33 | 14.00 | 107.00 |
| $T_9$ - RDF + 900 kg/ha of DE | 35.66 | 203.66 | 15.00 | 86.00 |
| S.Em± | 1.77 | 8.76 | 1.15 | 8.80 |
| CD @ 5% | 5.31 | 26.27 | 3.47 | 26.40 |

**Table 3: Effect of Diatomaceous earth on quality of pomegranate Var. Kesar**

| Treatments | TSS ($^0$B) | Titrable acidity (%) | TSS:Acid ratio | Reducing sugars (%) | Non reducing sugars (%) | Total sugars (%) | Juice percentage /100 g |
|---|---|---|---|---|---|---|---|
| $T_1$ - Absolute control | 13.56 | 2.34 | 5.86 | 9.36 | 0.20 | 9.50 | 53.28 |
| $T_2$ - Recommended dose of fertilizer (RDF) | 14.60 | 1.92 | 8.38 | 9.56 | 0.65 | 10.23 | 61.73 |
| $T_3$ - Half of Recommended dose of fertilizer | 13.76 | 1.70 | 8.32 | 9.46 | 0.35 | 9.80 | 60.98 |
| $T_4$ - Half of RDF + 300 kg/ha of DE | 14.33 | 1.49 | 9.95 | 9.80 | 0.39 | 10.16 | 62.22 |
| $T_5$ - Half of RDF + 600 kg/ha of DE | 14.80 | 1.28 | 14.19 | 9.80 | 0.41 | 10.16 | 63.50 |
| $T_6$ - Half of RDF + 900 kg/ha of DE | 15.03 | 1.28 | 14.53 | 10.03 | 0.66 | 10.66 | 64.09 |
| $T_7$ - RDF + 300 kg/ha of DE | 15.53 | 1.70 | 14.75 | 10.33 | 0.56 | 10.86 | 64.66 |
| $T_8$ - RDF + 600 kg/ha of DE | 15.60 | 1.28 | 14.96 | 10.46 | 0.60 | 11.03 | 65.83 |
| $T_9$ - RDF + 900 kg/ha of DE | 16.23 | 0.85 | 21.03 | 11.13 | 0.64 | 11.76 | 71.36 |
| S.Em± | 0.50 | 0.18 | 2.88 | 0.12 | 0.03 | 0.11 | 2.29 |
| CD @ 5% | 1.50 | 0.53 | 8.64 | 0.34 | 0.08 | 0.36 | 6.87 |

**Table 4: Organoleptic scores for colour, taste and overall acceptability of pomegranate Var. Kesar**

| Treatments | Rind colour | Aril colour | Taste | Overall acceptability |
|---|---|---|---|---|
| $T_1$ - Absolute control | 2.16 | 2.66 | 2.83 | 2.83 |
| $T_2$ - Recommended dose of fertilizer (RDF) | 2.90 | 3.30 | 3.40 | 3.36 |
| $T_3$ - Half of Recommended dose of fertilizer | 3.76 | 3.23 | 3.66 | 3.66 |
| $T_4$ - Half of RDF + 300 kg/ha of DE | 3.83 | 3.86 | 3.73 | 3.76 |
| $T_5$ - Half of RDF + 600 kg/ha of DE | 3.26 | 4.23 | 4.30 | 4.10 |
| $T_6$ - Half of RDF + 900 kg/ha of DE | 3.10 | 2.73 | 3.46 | 3.16 |
| $T_7$ - RDF + 300 kg/ha of DE | 4.16 | 4.43 | 4.06 | 4.00 |
| $T_8$ - RDF + 600 kg/ha of DE | 3.93 | 4.23 | 4.36 | 4.06 |
| $T_9$ - RDF + 900 kg/ha of DE | 4.56 | 4.60 | 4.20 | 4.40 |
| S.Em± | 0.18 | 0.20 | 0.17 | 0.14 |
| CD @ 5% | 0.55 | 0.63 | 0.54 | 0.45 |

was noticed in the treatment $T_1$ (Table 3). The decrease in acidity might be due to increase in the total soluble solids and it was also because of silicon which might have either involved in fast conversion of metabolites into sugar and their derivatives. Similar observations were made by Su *et al*. (2011) in apple, Bhavya (2010) in Bangalore Blue grapes, and Stamatakis *et al*. (2003) in tomato.

Maximum reducing sugar (11.13 %) and total sugar (11.76 %) content was found in the fruits of $T_9$ (RDF + 900 kg/ha DE), while the minimum reducing sugar (9.36 %) and total sugar (9.50 %) content was noticed in the treatment $T_1$ (Table 3). With respect to nonreducing sugar, maximum content (0.66 %) was found in the fruits of $T_6$ (Half of RDF + 900 kg/ha DE), while the minimum content of nonreducing sugar (0.20 %) was noticed in the treatment $T_1$.

This progressive increase could be related to increase in total soluble solids. The similar result was obtained by Bhavya (2010) in Bangalore Blue grapes, Su *et al*. (2011) in apple and Stamatakis *et al*. (2003) in tomato.

The highest juice percentage (71.36) was observed in $T_9$ (RDF + 900 kg/ha DE) which was on par with the treatment $T_8$ (RDF + 600 kg/ha DE) and $T_7$ (RDF + 300 kg/ha DE), while the minimum juice percentage (53.28) was noticed in the treatment $T_1$ (Table 3). Silicon application had led to the increased fruit size, fruit weight and aril weight so that has given the highest result for juice per cent. Similar result was obtained by Bhavya (2010) in Bangalore Blue grapes.

The results indicate that there was a significant difference among the treatments with respect to rind colour, aril colour, taste and overall acceptability. Significantly maximum score was recorded in $T_9$ (RDF + 900 kg/ha of DE) with respect to rind colour, aril colour and overall acceptability, whereas minimum score with respect to rind colour, aril colour and overall acceptability was noticed in $T_1$. Regarding taste, the treatment $T_8$ (RDF + 600 kg/ha of DE) recorded the maximum score and minimum score was noticed in $T_1$ (Table 4) This was due to increased antioxidant capacity under stress condition for colour, silicon helped in synthesis of more sugars in the fruit and thus helped in increasing total soluble solids has given the good taste and overall acceptability. Similar results were observed by Anastasia *et al*. (2013) in tomato, Tesfay *et al*. (2011) in avocado, Bhavya (2010) in Bangalore Blue grapes, Savvas (2009) and Rodrigues *et al*. (2010) in beans. From this study it can be concluded that the treatment $T_9$ is useful to pomegranate to get the higher yield and quality.

## ACKNOWLEDGMENT

The authors acknowledge the Agripower Australia for funding to carry out this experiment as part of network project under UAS, Bengaluru.

## REFERENCES

**Anastasia, E., Giannakoula and Ilias, I. F. 2013.** The effect of water stress and salinity on growth and physiology of tomato (*Lycopersicon esculentum* mill.). *Arch. Biol. Sci., Belgrade.* **65(2):** 611-620.

**Anonymous. 2013.** Indian horticulture data base, http://www.nhb.gov.in

**Bhavya, H. K. 2010.** Effect of foliar silicic acid and boron in Bengaluru Blue grapes, *M. Sc. (Hort.) Thesis*, Univ. Agric. Sci., Bengaluru, p. 95.

Epstein, E., 1999, Silicon-Annual review on plant physiology. *Pl. Mol. Biol.* **50:** 641-644.

**Ghasemi, A., Ejraei, A. and Rajaei, M. 2013.** Effect of Silicon on vegetative and generative performance of Broad Bean (*Vicia faba* L.). *J. Nov. Appl. Sci.* **2(5):** 881-884.

**Graca Miguel, Susana Dandlen, Dulce Antunes, Alcinda Neves and Denise Martins 2004.** The Effect of two methods of Pomegranate (*Punica granatum* L.) juice extraction on quality during storage at 4°C. *J. Biomed. Biotechnol.* **5:** 332-337.

**Ma, J. F., Goto, S., Tamai, K. and Ichii, M., 2001.** Role of root hairs and lateral roots in silicon uptake by rice. *Plant Physiol.* **127:** 1773-1780.

**Miller, G. L. 1959.** Use of Dinitro salicylic acid reagent for determination of reducing sugar, *Anal. Chem.* **31:** 426.

**Nesreen, H., Baker, A., Eladl, M. and Mohsen, M. A. 2011.** Use of silicate and different cultivation practices in alleviating salt stress effect on bean plants. *Australian J. Basic & Applied Sci.* **5(9):** 769-781.

**Rodrigues, F. A., Duarte, H. S. S., Rezende, D. C., Filho, J. A., Korndrofer, G. H. and Zambolim, L. 2010.** Foliar spray of potassium silicate on the control of angular leaf spot on beans. *J. Pl. Nutr.* **33(14):** 2082-2093.

**Savvas, D. 2009.** Effect of silicon and salinity on fruit yield and quality of tomato grown hydroponically. *Acta Hort.* **609:**136-140.

**Stamatakis, A., Papadantonakis, N., Simantiris, N., Kefalas, P. and Savvas, D. 2003.** Effects of silicon and salinity on fruit yield and quality of tomato grown hydroponically. *Acta Hort.* **609:** 141-147.

**Su, X. W., Wei, S. C., Jiang, Y. M. and Huang, Y. 2011.** Effects of silicon on quality of Apple fruit and mangnese content in plants on acid soils. *Shandong Agric. Sci.* **6(1):** 23-28.

**Tesfay, S. Z., Bertling, I. and Bower, J. P. 2011.** Effects of postharvest potassium silicate application on phenolics and other anti-oxidant systems aligned to avocado fruit quality. *Postharvest Biol. Tec.* **60(2):** 92-99.