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Effect of Diatomaceous Earth on Chlorophyll Content of Leaves, Yield and Disease Occurrence in Pomegranate var. Kesar

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ABSTRACT

This study was conducted to know the effect of Diatomaceous Earth (DE) as source of silicon on chlorophyll content of leaves, yield and disease occurrence in pomegranate Var. Kesar. The highest value for chlorophyll 'a' 0.29 milligram/gram was recorded in T_9 (RDF + 900 kg/ha of DE) and T_7 (RDF + 300 kg/ha of DE), both chlorophyll 'b' 0.31 milligram/gram and total chlorophyll content 0.61 milligram/gram was recorded in T_7. Least values for chlorophyll 'a' 0.19 milligram/gram and total chlorophyll 0.33 milligram/gram noticed in T_3 (half of RDF) and for chlorophyll 'b' 0.11 milligram/gram recorded in T_1 (Absolute control). The treatment T_9 (RDF+ 900 kg/ha of DE) recorded higher number of fruits per plant 71.36, yield 21.33 kg per plant, followed by T_8 (RDF + 600 kg/ha of DE). Lowest anthracnose disease per cent coverage on fruits 19.06 per cent, least number of anthracnose disease infected fruits 10.20 observed in T_9 (RDF + 900 kg/ha of DE) and highest values recorded in T_1 (Absolute control) 31.16 per cent, 14.86 infected fruits respectively. Lowest bacterial blight per cent disease coverage on fruits 11.33 per cent, number of fruits infected 12.30, least lesions of bacterial blight per leaf 3.70 observed in T_9 (RDF + 900 kg/ha of DE) and highest values recorded in T_1 (Absolute control) 26.50 per cent, 14.40 infected fruits and 4.76 lesions per leaf respectively.

Key words: *Diatomaceous earth, Chlorophyll, Yield, Anthracnose and Bacterial blight.*

INTRODUCTION

Pomegranate (*Punica granatum* L.) is growing for its sweet-acidic fruits, ornamental and medicinal purposes. It belongs to order Punicaceae and 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 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.

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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.

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[8]. 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[15]. 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[8].

Similar work and results have been observed by Bhavya[5] in Bangalore Blue grapes; Kablan *et al*[11]., Vermeire *et al*[19]., and Kidane and Laing[14] in banana; Wang and Galleta[20], Miyake and Eiichi[16] in strawberry; Bosse *et al*[6]., Anderson *et al*[2]., Kaluwa *et al*[13]., Bekker *et al*[3]., Kaiser *et al*[12]., and Bertling *et al*[4]., in avocado; Cherif *et al*[7]., in cucumber; Ghasemi *et al*[10]., in Broad bean.

The main objective of this study is to know the effect of Diatomaceous earth (source of silicon) on chlorophyll content of leaves, yield and disease occurrence in pomegranate Var. Kesar.

MATERIAL AND METHODS

The present investigation was carried out to study the effect of Diatomaceous Earth on chlorophyll content of leaves, yield and disease occurrence in pomegranate Var. Kesar. The experiment was laid out on red loamy soil and in an established pomegranate orchard of 5 years old plants with spacing of 3.5m x 3.5m.

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.

Chlorophyll content of leaf was analysed by collecting the healthy, matured leaves after imposing the treatment. Chlorophyll 'a', 'b' and total chlorophyll content of leaf tissue were determined by using dimethyl sulphoxide (DMSO) as suggested by Shoaf and Lium[18].The harvested leaves were brought in polyethylene bags from field and were cut into small pieces. Known weight of sample (1g) was incubated in 7.0 ml DMSO at 65^0C for 60 minutes. After the incubation, supernatant was collected by decanting. Then the volume of supernatant was made up to 10 ml using DMSO.

The absorbance of extract was measured at 645 nano meter and 663 nano meter using DMSO as a blank in spectrophotometer. The chlorophyll 'a', chlorophyll 'b' and total chlorophyll content were calculated by using the following formula and expressed in milligram/gram.

$$\text{Chlorophyll a} = 12.7\ (A_{663}) - 2.69\ (A_{645})\ \frac{V}{1000 \times W}$$

$$\text{Chlorophyll b} = 22.9\ (A_{645}) - 4.68\ (A_{663}) \times \frac{V}{1000 \times W}$$

$$\text{Total chlorophyll} = 20.2\ (A_{645}) - 8.02\ (A_{663}) \times \frac{V}{1000 \times W}$$

Where,
A = Absorbance at specific wavelength like 645 and 663 nano meter
V = Final volume of chlorophyll extract
W = Fresh weight of tissue extracted

The fruits were harvested at matured stage. At the time of harvest, the total number of fruits produced per plant, weight of the total number of fruits per plant was recorded and later that is converted to yield per hectare.

The total number of fruits infected by anthracnose disease in labelled plants were counted in each treatment and the mean was calculated. Ten random fruits were selected from labelled plants, per cent coverage of anthracnose disease on fruits was recorded and mean was calculated.

The total number of bacterial blight disease infected fruits in the labelled plants were counted in each treatment and the mean was calculated. Ten random fruits were selected from labelled plants, per cent coverage of bacterial blight disease on fruits was recorded and mean was calculated. The number of lesions per leaf was counted in ten leaves of labelled plants and the average value was recorded.

RESULTS AND DISCUSSION

The chlorophyll content of leaves as influenced by Diatomaceous Earth on pomegranate Var. Kesar is presented in Fig. 1. The data indicates that, the influence of Diatomaceous Earth on chlorophyll content was significant.

The highest value for chlorophyll 'a' content (0.29 mg/g) was recorded in T_9 (RDF + 900 kg/ha of DE) and T_7 (RDF + 300 kg/ha of DE), while least value was recorded in T_3 (0.19 mg/g). The chlorophyll 'b' content was found non-significant, however higher value recorded in T_7 (0.31 mg/g) and least value recorded in T_1 (0.11 mg/g).

Significant difference in total chlorophyll content was observed. The highest total chlorophyll content was recorded in T_7 (0.61 mg/g), while lowest value (0.33 mg/g) was recorded in T_3 (half of RDF).

The plants which were applied with Diatomaceous Earth showed significantly superior results for chlorophyll 'a' and total chlorophyll. The increase in the leaf chlorophyll content was due to Diatomaceous Earth supplied as a source of silicon has lead to the reduced degradation of chlorophyll. These observations are in conformity with those of Ghasemi *et al*[10]., in Broad bean, Bhavya[5] in Bangalore Blue grapes and Wang and Galleta[20] in strawberry.

Results revealed the highest values for number of fruits per plant (71.36), yield kg per plant (21.33) and yield per hectare in tones (17.40) were found for the plants which were supplied with T_9 (RDF + 900 kg/ha of DE), and was on par with T_8 (RDF + 600 kg/ha of DE), whereas the lowest values were observed in the treatment T_1 with the values of 34.33, 6.60 and 5.36 respectively (Table 1).

The yield parameters *viz.* number of fruits per plant, yield (kg/plant) and yield per hectare were maximum in soil applied with Diatomaceous Earth when compared to control treatment. Increased yield might be attributed to leaf erectness which facilitated better penetration of sunlight leading to higher photosynthetic activity of plant, more formation of carbohydrates and more uptake of other nutrients. Similar results were also noticed by Ghasemi *et al*[10]., in broad bean, Bhavya[5] in Bangalore Blue grapes, Reaple and Laane[17] in papaya, Miyake and Eiichi[16] in strawberry and Adatia and Besford[1] in cucumber.

The data on disease incidence with respect to per cent disease coverage on fruits, number of fruits infected is presented in Table 2 and 3.

It was observed that there was significant difference between the treatments with respect to occurrence of anthracnose disease. Among the treatments, T_9 (RDF + 900 kg/ha of DE) recorded lowest (19.06 %) per cent disease coverage, while highest per cent disease coverage on fruits (31.16 %) was observed in T_1. T_9 (RDF + 900 kg/ha of DE) recorded lowest (10.20) number of fruits infected, while highest number of fruits infected (14.86) were observed in T_1.

Table 1: Effect of Diatomaceous Earth on yield of pomegranate var. Kesar

Treatments	Number of fruits per plant	Yield (kg/plant)	Yield (t/ha)
T_1 - Absolute control	34.33	6.60	5.36
T_2 - Recommended dose of fertilizer (RDF)	62.10	15.10	12.33
T_3 - Half of Recommended dose of fertilizer	44.56	10.73	8.73
T_4 - Half of RDF + 300 kg/ha of DE	51.83	13.36	10.86
T_5 - Half of RDF + 600 kg/ha of DE	56.93	14.10	11.50
T_6 - Half of RDF + 900 kg/ha of DE	54.73	15.33	11.40
T_7 - RDF + 300 kg/ha of DE	54.36	14.13	11.80
T_8 - RDF + 600 kg/ha of DE	65.73	15.60	12.73
T_9 - RDF + 900 kg/ha of DE	71.36	21.33	17.40
S.Em±	4.81	1.83	1.47
CD @ 5%	14.43	5.50	4.40

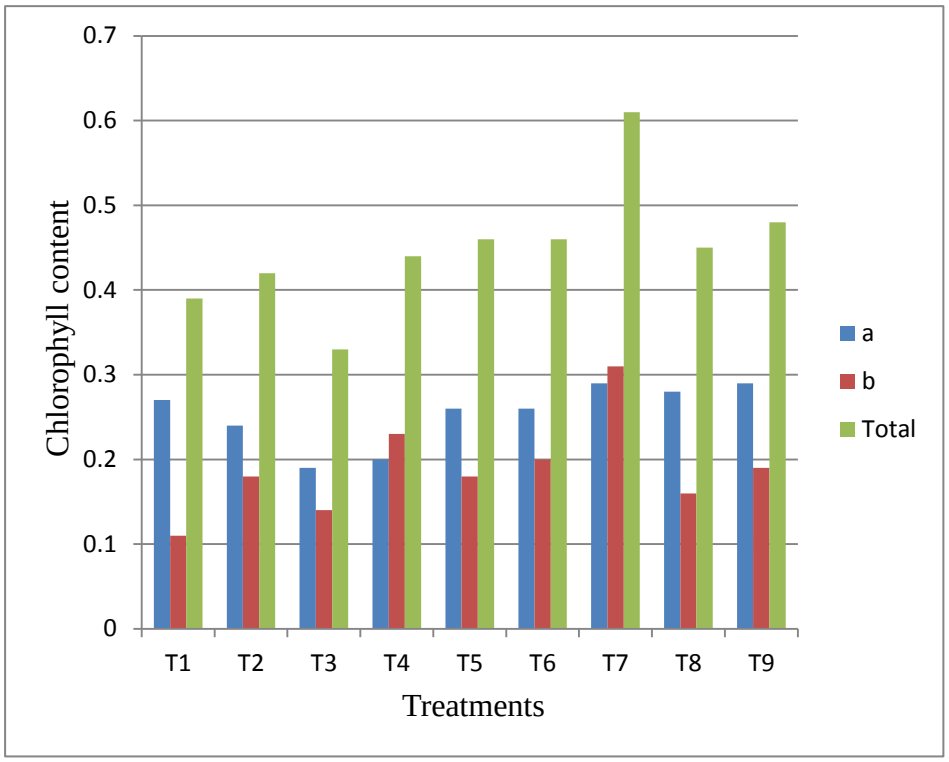
Table 2: Effect of Diatomaceous earth on anthracnose disease of pomegranate var. Kesar

Treatments	Per cent area covered by the disease on fruits	Number of fruits infected
T_1 - Absolute control	31.16	14.86
T_2 - Recommended dose of fertilizer (RDF)	27.73	12.06
T_3 - Half of Recommended dose of fertilizer	29.86	12.86
T_4 - Half of RDF + 300 kg/ha of DE	25.10	11.46
T_5 - Half of RDF + 600 kg/ha of DE	23.10	12.00
T_6 - Half of RDF + 900 kg/ha of DE	22.50	12.26
T_7 - RDF + 300 kg/ha of DE	20.63	10.93
T_8 - RDF + 600 kg/ha of DE	21.30	10.93
T_9 - RDF + 900 kg/ha of DE	19.06	10.20
S.Em±	2.31	0.64
CD @ 5%	6.94	1.93

Table 3: Effect of Diatomaceous earth on bacterial blight disease of pomegranate var. Kesar

Treatments	Per cent infection on fruits	Number of fruits infected	Number of lesions per leaf
T_1 - Absolute control	26.50	14.40	4.76
T_2 - Recommended dose of fertilizer (RDF)	23.40	13.10	4.20
T_3 - Half of Recommended dose of fertilizer	17.03	12.86	4.16
T_4 - Half of RDF + 300 kg/ha of DE	12.00	13.06	4.30
T_5 - Half of RDF + 600 kg/ha of DE	24.33	12.83	3.83
T_6 - Half of RDF + 900 kg/ha of DE	21.40	12.96	4.03
T_7 - RDF + 300 kg/ha of DE	24.70	13.83	4.26
T_8 - RDF + 600 kg/ha of DE	21.13	13.16	3.73
T_9 - RDF + 900 kg/ha of DE	11.33	12.30	3.70
S.Em±	3.00	0.35	0.19
CD @ 5%	9.00	1.06	0.59

Fig. 1: Effect of Diatomaceous Earth on chlorophyll content of pomegranate var. Kesar



T_1-Absolute control T_4-Half of RDF + 300 kg/ha of DE T_7- RDF + 300 kg/ha of DE
T_2-Recommended dose of fertilizer T_5- Half of RDF + 600 kg/ha of DE T_8- RDF + 600 kg/ha of DE
T_3-Half of Recommended dose of fertilizer T_6- Half of RDF + 900 kg/ha of DE T_9- RDF + 900 kg/ha of DE

The data on occurrence of bacterial blight disease presented in Table 3. Among the treatments, T_9 (RDF + 900 kg/ha of DE) recorded lowest per cent disease coverage on fruits (11.33 %), lowest number of fruits infected (12.30) and least lesions per leaf (3.70), while highest per cent disease coverage on fruits (26.50 %), highest number of fruits infected (14.40) and maximum number of lesions per leaf (4.76) were observed in T_1.

The plants which were applied with T_9 (RDF + 900 kg/ha of DE), T_8 (RDF + 600 kg/ha of DE) and T_7 (RDF + 300 kg/ha of DE) has recorded lowest disease incidence compared to control.

Silicon deposited on the tissue surface acts as physical barrier and prevents physical penetration, makes the plant cells less susceptible to enzymatic degradation by fungal pathogens. This mechanism was supported by the positive correlation between the Silicon content and the degree of suppression of disease. Silicon functions as a signal to induce the production of phytoalexin[9]. Similar results were noticed by Kablan *et al*[11]., Kidane and Laing[14] and Vermeire *et al*[19]., in banana; Bosse *et al*[6]., Kaluwa *et al*[13]., and Bertling *et al*[4]., Bekker *et al*[3]., Kaiser *et al*[12]., Anderson *et al*[2]., in avocado and Cherif *et al*[7]., in cucumber.

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