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Effect of Amino Acids and Silicon on Flowering and Yield of Pomegranate cv. Phule Bhagwa Super

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Field experiment was carried out during 2020-2021 to study the effect of amino acids and silicon on flowering, fruit characters and yield of pomegranate cv. Phule Bhagwa Super in a randomized block design with seven treatments which were replicated three times. The treatments were Potassium silicate 0.5% (T_1), Potassium silicate 1.0 % (T_2), Amino acids 150 ppm (T_3), Amino acids 200ppm (T_4), Amino acids 250 ppm (T_5), Water spray (T_6), Absolute control (T_7). Foliar sprays of each treatment except T_7 were applied twice. The first spray was taken one month before water holding for inducing *hasta bahar* (*hasta* flowering) and second spray was taken15 days after initial growth, but before flowering. The results revealed that all the parameters studied were significantly influenced due to foliar spraying of different concentrations of potassium silicate and amino acids. The treatment T_5 (amino acids 250 ppm) recorded maximum number of hermaphrodite flowers/ tree (147), sex ratio (33.3), fruit set(67.8%), number of fruit per tree (99.7), fruit weight (g) and yield per tree (35.3 kg) whereas the treatment T_4 (amino acids 200 ppm) recorded highest fruit weight (302.8g). The results suggested that spraying amino acids is more effective as compared to silicon as it produced more number of hermaphrodite flower, fruit set, fruit weight number of fruits per plant and yield per plant.

Introduction

Pomegranate (*Punica granatum* L.) has emerged as a potential fruit crop for the resource poor farmers due to its hardy nature, high yield and low input requirements (Rajkumar *et al.*, 2017). Besides hardy nature, fruits have better storage quality and nutritional values, it has high demand among consumers (Saroj and Kumar, 2019). This led to increase in area under pomegranate cultivation not only in Maharashtra, but in India as well. At present India's pomegranate production is 2845 thousand MT from an area of 234 thousand hectare (Saxena, 2019).Maharashtra is leading producer of pomegranate followed with an area of 147.91 thousand hectare and production of 1789.46 thousand MT (Saxena, 2019). Sex ratio is the most important factor in determining the fruit set and

ultimately yield of fruits in pomegranate. This is mainly influenced by environmental and physiological factors. Pomegranate fruit production requires the coordination of numerous key reproductive processes including flower development, pollination, bisexual and male flower types, and fruit set, fruit attributes related to size, flower vigour, flower receptivity and aril development (Wetzstein *et al.,* 2015). In pomegranate male flowers drop prematurely without setting fruit and only bisexual flowers set fruits (Yahya *et al.,* 2017).

In recent years, changing climatic conditions are posing a serious problem which is affecting sex ratio fruit set and thus yield and quality of pomegranate fruits. Use of biostimulants such as amino acids and silicon seems to be useful to combat such situation. However, there is flimsy information about the effect of amino acids and silicon on sex ratio, yield and quality of pomegranate. As pomegranate has assumed commercial status in Maharashtra, it felt necessary to generate data on the use of amino acids and silicon in pomegranate to improve the sex ratio, yield and quality.

Amino acids are well-known biostimulant which influences physiological functions of the plants as amino acids are basic ingredients in the process of protein synthesis (Al Saidand Kamal, 2008). Therefore, amino acid has positive effects on plant growth and development, yield, and significantly mitigates the injuries caused by abiotic stresses (Kowalczk and Zielony, 2008). Silicon application found beneficial for stimulating growth and fruiting in different fruit crops (Ahmed *et al.,* 2013). Therefore, the present investigation aimed to examine the effect of amino acids and silicon on flowering, yield and quality of pomegranate was undertaken.

Materials and Methods

The experiment was carried during the year 2020-2021 on pomegranate cv. Phule Bhagwa Super at Pomegranate Research and Technology transfer centre (PR&TTC), Lakhmapur, Tal. Satana, Dist. Nashik. Eighty four trees of uniform growth from the six year old orchard of pomegranate planted at the spacing of 4.5m × 3 m were selected. The experiment was conducted on *Hast bahar*. The experiment was set in Randomized Block Design with the seven treatments consisted of T_1(Potassium silicate 0.5%), T_2(Potassium silicate 1.0 %), T_3(Amino acids (foliar application) 150 ppm), T_4(Amino acids (foliar application) 200ppm), T_5(Amino acids (foliar application) 250 ppm), T_6(Water spray) and T_7(Absolute control). The treatment unit was comprised of four plants and the treatments were replicated three times. Foliar sprays of Potassium silicate and Amino acid with different concentrations were applied twice. The first spray was taken one month before water holding for inducing flowering in *hasta bahar* and second was taken15 days after initial growth but before flowering. For recording flowering characters, number of hermaphrodite flowers and number of male flowers per tree were counted and sex ratio was calculated according to following formula and was expressed in percentage -

$$\text{Sex ratio (\%)} = \frac{\text{Number of hermaphrodite flowers}}{\text{Number of male flowers}} \times 100$$

Fruit set percent was worked out according to following formula-

$$\text{Fruit set (\%)} = \frac{\text{Number of set fruits}}{\text{Total number of flowers}} \times 100$$

Number of fruits from selected trees were counted at every harvesting and cumulative mean value was expressed as number of fruits per tree. Similarly, fruit weight was computed from 10 randomly selected fruits and average was worked out. Fruit yield per tree was worked out by multiplying number of fruits per tree with average fruit weight and was expressed as kilogram (Kg) per tree.

Results and Discussion

Flowering parameters

Number of hermaphrodite flowers per tree

The data on number of hermaphrodite flower has been presented per tree in Table 1 and Fig. 1. The results showed that this parameter was significantly influenced due to spraying of potassium silicate and amino acids and number of hermaphrodite flowers ranged from 96.0 to 147.0. The treatment T_5(amino acids 250 ppm) recorded maximum number of hermaphrodite flowers per tree (147) and was at par with T_4 (amino acids 200 ppm) and T_3 (amino acids 150 ppm) which recorded 142 and 134 hermaphrodite flowers per plant. Lowest number of hermaphrodite flowers per plant (96) was recorded in treatment T_7 (control).

Number of male flowers per tree

As regards number of male flowers per tree presented in Table 1 and graphically in Fig 2, significant influence of the spraying of potassium silicate and amino acids and number of male flowers per tree ranged from 393.7 to 475.0. Significantly, maximum number of male flowers per tree (475) were recorded in treatment T_2(potassium silicate 1%) which was at par with treatment T_3 (455.7) i.e. amino acids 150 ppm. The minimum number of male flowers per tree were recorded in treatment control T_7 (393.7).

Sex ratio

As revealed from the data (Table 1 and Fig.3), the significant influence due to spraying of amino acids and potassium silicate was observed on sex ratio. The highest sex ratio (33.3) recorded in treatment T_5 i.e. amino acid 250 ppm and was at par with treatment T_4 i.e. amino acid 200 ppm (32.2) whereas the treatment T_7 i.e. control recorded minimum sex ratio (24.3).

Amino acids enhance biosynthesis of proteins, pigments and natural hormones such as IAA, gibberellins and ethylene. There is expression of genes involved in ethylene biosynthesis which seems to be linked to the formation of particular flower tissues and thus the treatment T_5(amino acid 250 ppm) would have recorded highest sex ratio.

Fruit set (%)

The data presented in Table 2 and Fig. 4 showed that applications of potassium silicate and amino acids significantly influenced fruit set in pomegranate cv. Phule Bhagwa Super. Fruit set is important yield-related parameter and significantly the highest percentage of fruit setting was recorded in treatment T_5(amino acids 250 ppm) which was 67.8% and was at par with treatmentT_2 (potassium silicate 1%) and T_3(amino acids 150 ppm) which registered 65.8% and 65.6% fruit set, respectively. Significantly the lowest fruit set was recorded in control (T_7) which was 60.5%. Similar results were reported by Faissal*et al., (*2014) in grapevines, Abd El- Rahman (2015); Khattab *et al.,* (2016) in mango; Moawad *et al.,* (2017) in Balady mandarin.

The positive effect of foliar sprays amino acids on increased fruit set could be attributed to improved pollen tube ovule penetration and delayed ovule senescence.

Fruit and yield parameters

Number of fruits per tree

As observed from the data presented in Table 2 and Fig. 5), significant influence of foliar sprays of potassium silicate and amino acids on number of fruits per tree was observed. The treatment T_5(amino acids 250 ppm) produced the highest number of fruits per tree (99.7) which was on par with the treatment T4 (amino acids 200 ppm) producing 92.5 fruits per tree. Least number of fruits (77.0) was recorded in the control treatment(T_7).

Table.1 Effect of different spraying treatments on number of hermaphrodite flowers,number of male flowers, sex ratio and fruit set in pomegranate cv. Phule Bhagwa Super.

Treatment	Treatment detail	Number of hermaphrodite flower per tree	Number of male flower per tree	Sex ratio (%)	Fruit set (%)
T_1	Potassium silicate 0.5%	112.0	436.7	25.6	63.8
T_2	Potassium silicate 1%	125.0	475.0	26.3	65.8
T_3	Amino acids 150 ppm	134.0	455.7	29.3	65.5
T_4	Amino acids 200 ppm	142.0	440.3	32.2	65.6
T_5	Amino acids 250 ppm	147.0	441.0	33.3	67.8
T_6	Water spray	102.0	407.7	25.0	61.9
T_7	Control	96.0	393.7	24.3	60.5
	S. E. ±	6.53	6.47	0.98	1.45
	C.D. @ 5%	20.13	19.94	3.01	4.46

Table.2 Effect of different spraying treatments on fruit set (%), number of fruits per tree, fruit weight (g), yield (kg/tree) in pomegranate cv. Phule Bhagwa Super

Treatment	Treatment detail	Number of fruits per tree	Fruit weight (g)	Yield (Kg/tree)
T_1	Potassium silicate 0.5%	79.8	286.6	22.9
T_2	Potassium silicate 1%	88.9	279.6	24.8
T_3	Amino acids 150 ppm	91.7	281.9	25.8
T_4	Amino acids 200 ppm	92.5	302.8	28.1
T_5	Amino acids 250 ppm	99.7	292.3	29.3
T_6	Water spray	79.3	278.0	22.7
T_7	Control	77.0	276.0	21.9
	S. E. ±	2.36	5.21	0.99
	C.D. @ 5%	7.28	16.04	3.05

Fig.1 Effect of different spraying treatments on number of hermaphrodite flowers per tree

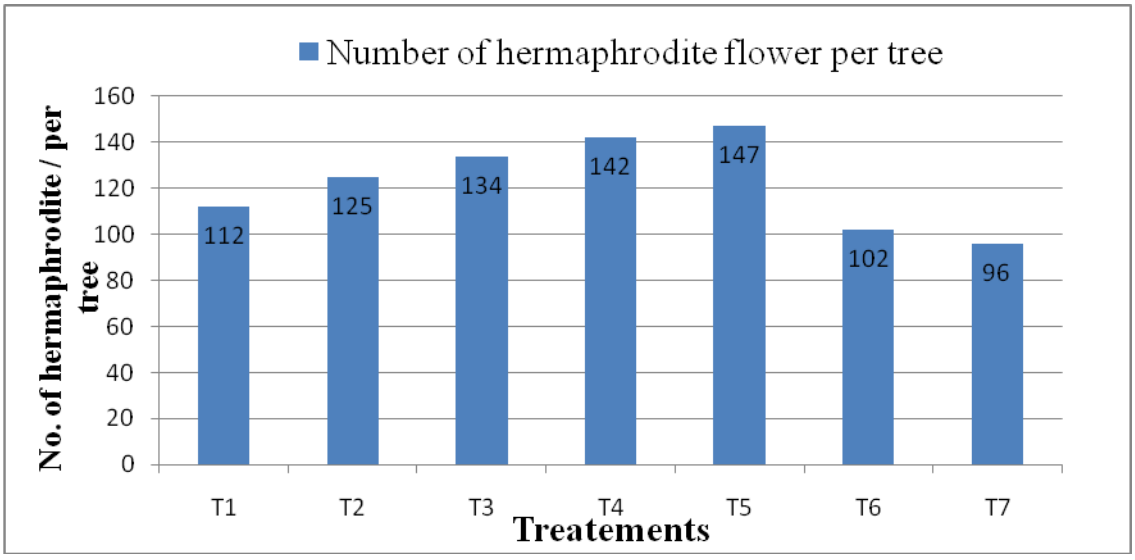


Fig.2 Effect of different spraying treatments on number of male flowers per tree

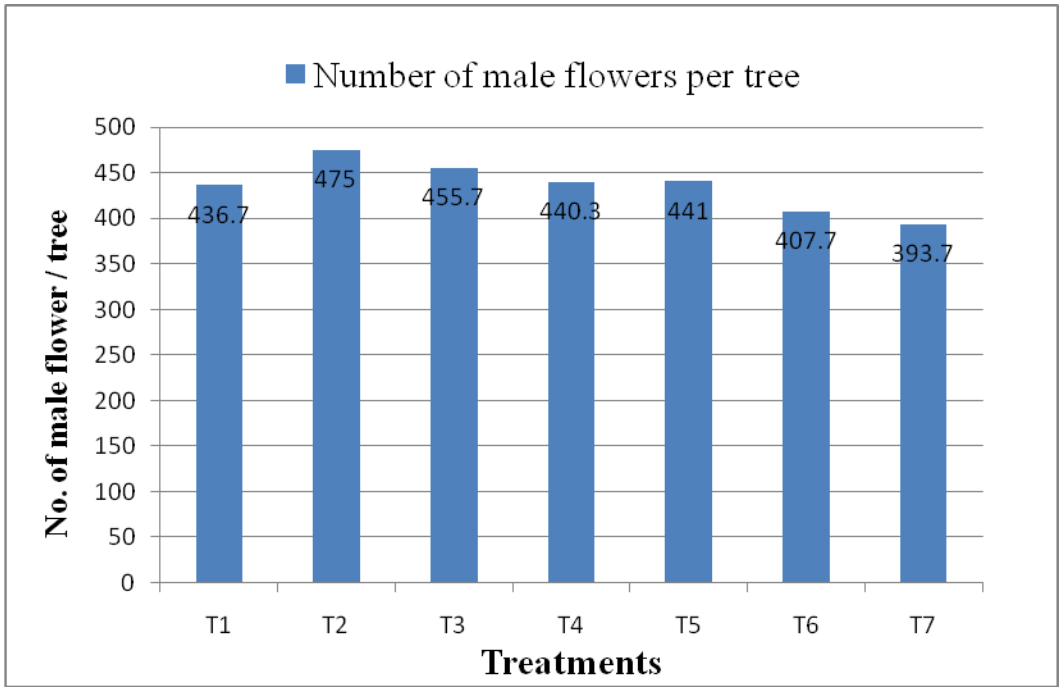


Fig.3 Effect of different spraying treatments on number of sex ratio

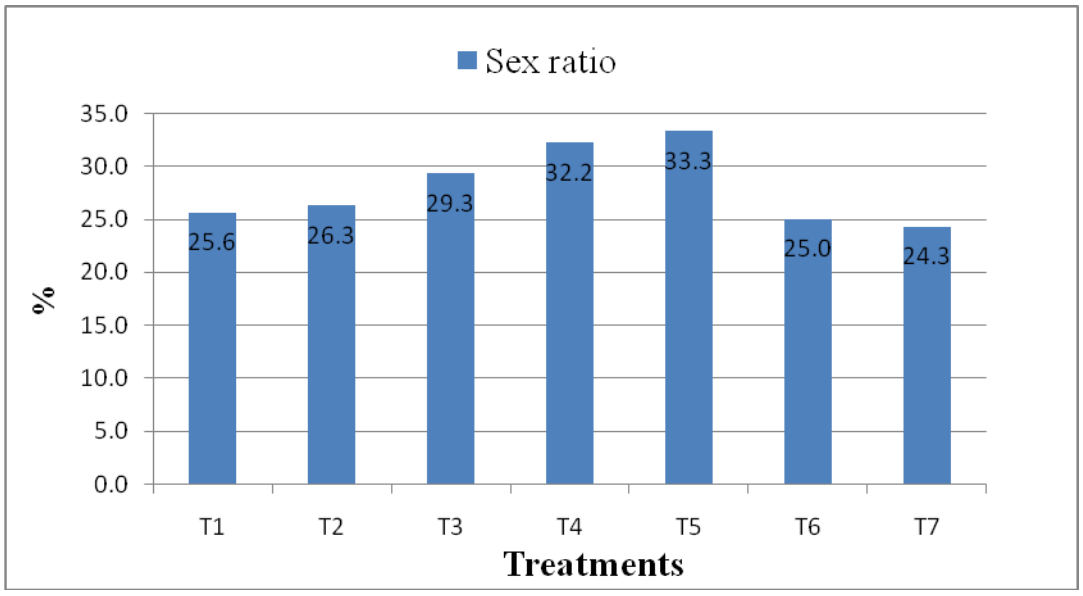


Fig.4 Effect of different spraying treatments on fruit set (%)

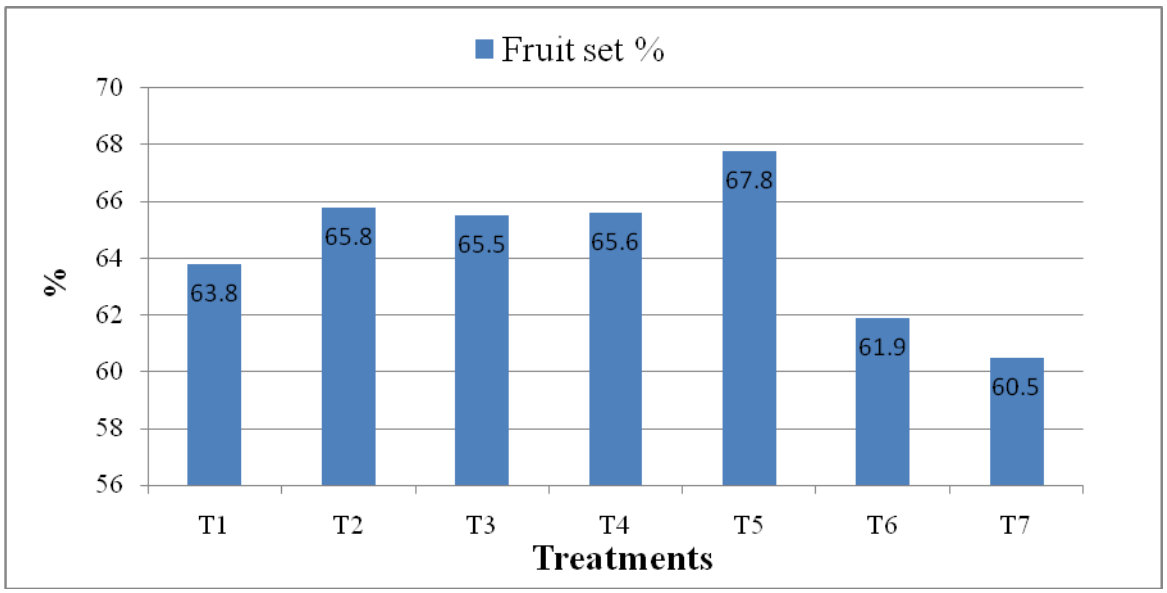


Fig.5 Effect of different spraying treatments on number of fruits per tree

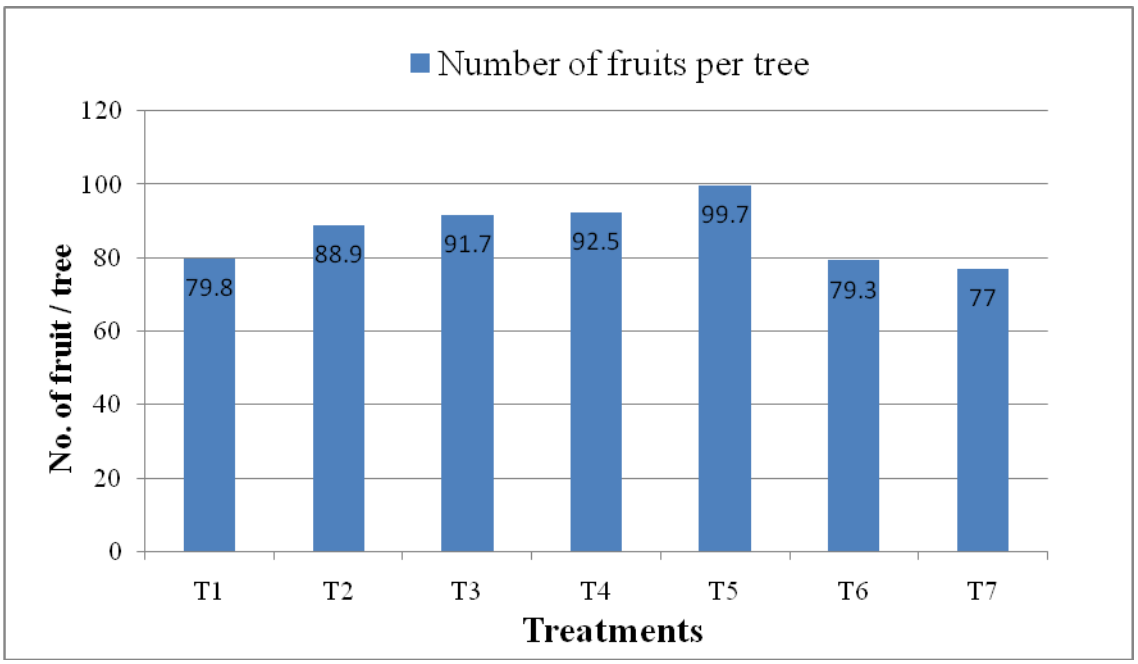


Fig.6 Effect of different spraying treatments on fruit weight (g)

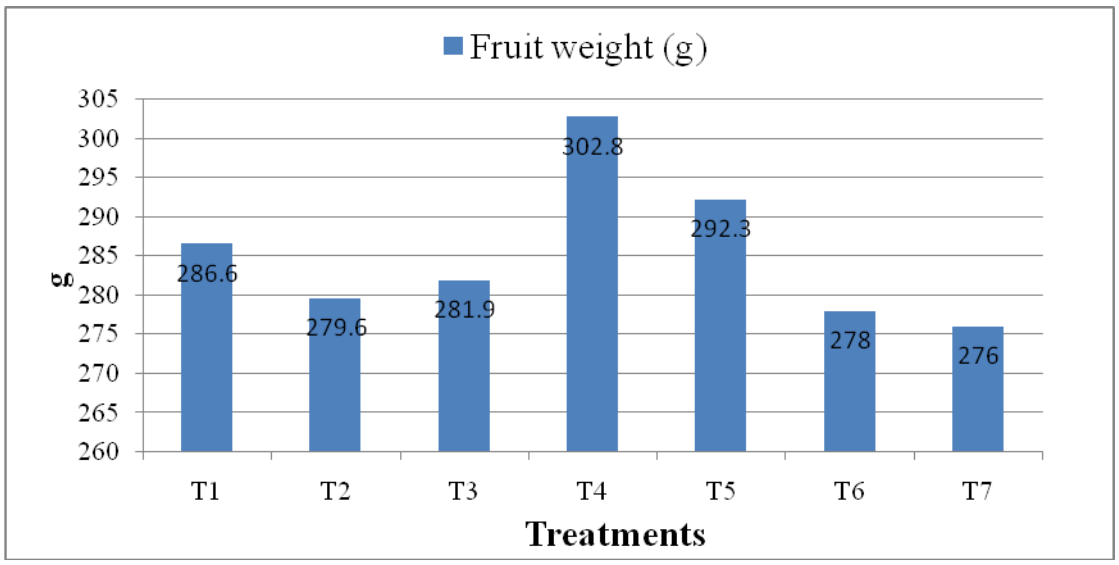
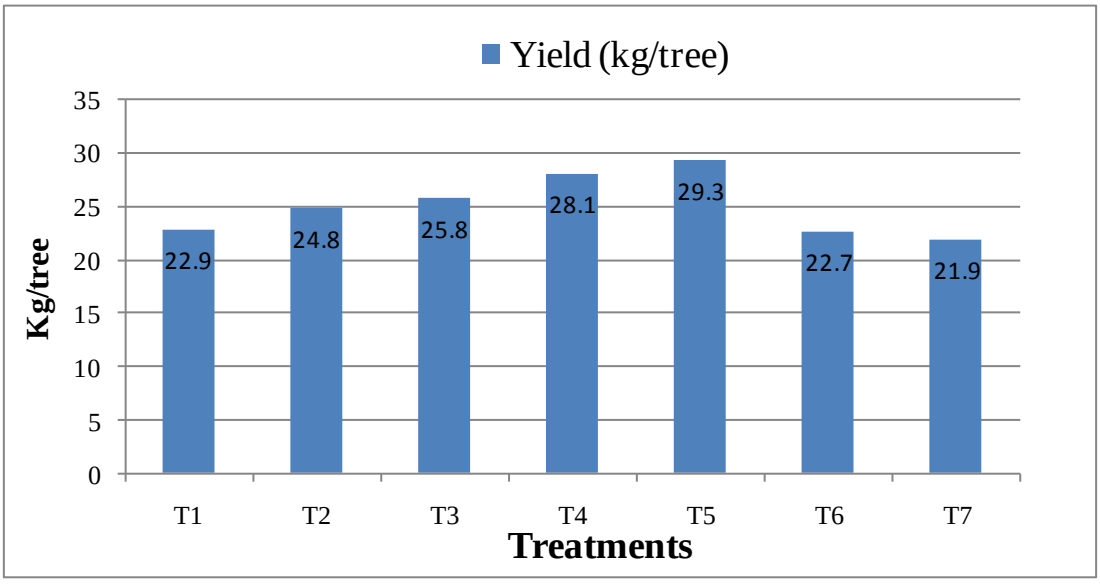


Fig.7 Effect of different spraying treatments on yield (kg/tree)



These findings are in agreement with Rehmani *et al.*, (2017) in Kesarmango; Abd El-Hamid *et al.*, (2015) in Alphonse mango and Mekawy (2019) in Superior Seedless grapevines and El- Gioushy (2016) in Washington naval orange.

The increased number of fruits per tree might be attributed to the increase in fruit set, especially due to foliar sprays of amino acids.

Fruit weight (g)

Data presented in Table 2 and in Fig. 6 showed significant influence of spraying of potassium silicate and amino acids. Significantly the highest fruit weight of 302.8 g was observed in treatment T_4(amino acids 200 ppm) and it was followed by treatment T_5(amino acids 250 ppm) which recorded 292.3 g fruit weight. The lowest fruit weight of

276.0 g was observed in control (T_7). Similar results were also reported by Ahmed *et al.,* (2015) and Masoud *et al.,* (2018) in pomegranate and Rehmani *et al.,* (2017) in mango cv. Kesar; Abd El-Hamid *et al.,* (2015) in Alphonse mango and Roshdy (2014) in Grand Naine banana; Belal *et al.,* (2016) in Flame Seedless grapevines and Mekawy (2019) Superior Seedless grapevines.

Yield (kg/tree)

As evident from the data presented in Table2 and in Fig. 7, the spraying of potassium silicate and amino acids significantly influenced fruit yield. The treatment T_5(amino acids 250 ppm) recorded the highest yield of 35.3kg per tree and it was at par with treatment T_4(amino acids 200 ppm) which recorded 34.2 kg yield per tree. The results are in close agreement with Wassel *et al.,* (2015) who observed increase in yield in Wanderful pomegranate. Similarly, Rehmani *et al.,* (2017) in mango cv. Kesar ; Abd El-Hamid *et al.,* (2015) in Alphonse mango and Belal *et al.,* (2016) and Hussein (2018) in Flame Seedless grapevines; and Mekawy (2019) in Superior Seedless grapevines; Fathy Abo- Zaid *et al.,* (2019) on grapevines.

Increase in yield of pomegranate might be due to increase in fruit weight and number of fruits per tree, especially due to spraying of amino acids.

The field study conducted to the examine the influence of foliar application of amino acids and silicon with different concentrations on pomegranate cv. Phule Bhagwa Super revealed that the application of amino acids 250 ppm (T_5) was more effective in increasing the number of hermaphrodite flower per tree, fruit set and yield whereas highest fruit weight was observed in amino acids 200 ppm (T_4) suggesting that use of amino acids in more useful than potassium silicate.

Thus, it can be concluded that the foliar application of 250 ppm amino acids twice at one month before water holding for inducing bahar treatment and second 15 days after initial growth but before flowering valuable to get maximum hermaphrodite flowers, sex ratio more number of fruits per tree, fruit weight and fruit yield per tree.

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