Original Research Article

EFFECT OF DIFFERENT PRE-SOWING TREATMENTS ON GERMINATION CHARACTERISTICS OF STRAWBERRY GUAVA (*Psidium cattleainum* Sabine)

ABSTRACT

Aim: The aim of the present study was to investigate the effect of different pre-sowing treatments on germination characteristics of strawberry guava (*Psidium cattleainum* Sabine)

Study Design: The experiment consisted of eleven treatments and three replications laid out in a Completely randomized design (CRD).

Place and Duration of Study: The study was conducted at Orchard Nursery, Department of Fruit Science, Horticulture College and Research Institute, Tamil Nadu Agricultural University, Coimbatore during April-June 2023.

Methodology: Seeds of *Psidium cattleainum* (strawberry guava) were collected from guava germplasm from an orchard and treated with different pre-sowing chemicals. After pre-sowing treatment, the seeds were sown and various germination characteristics and growth parameters were observed and recorded.

Results: The seeds treated with GA3 500ppm for 30 minutes took minimum days to germinate (20), with higher germination percentage (79.33%), maximum vigour index I, and vigour index II(708.6 and 584.23).The growth parameters such as seedling height, stem girth,and number of leaves, primary root length, number of lateral roots were recorded higher in GA3 500ppm followed by Thiourea 1%.The biomass production of seedlings was also higher in seeds treated with GA3 500ppm.

Conclusion: The seeds treated with GA3 500ppm for 30 minutes recorded higher germination characteristics, growth parameters and biomass production. So for quicker propagation of strawberry guava to be used as rootstock, seeds can be treated with 500ppm GA3 to obtain the large number of seedlings for the use of rootstock.

Keywords: Rootstock, Germination percentage, Vigour index, Presowing, Biomass production.

INTRODUCTION

Guava (*Psidium guajava* L.) is one of the major fruit crop grown in India. It belongs to the family Myrtaceae and the order Myrtales. In India, it is the fourth most important fruit crop in terms of area and production after mango, banana, and citrus. Guava occupies an area of 0.3 million hectares with an annual production of 4.5 million tonnes. In North India, Uttar Pradesh is considered as "Home of Guava" which stands first in the production of guava (5983.59 thousand MT). Besides, it is cultivated in Bihar, Maharashtra, Gujarat, Madhya Pradesh, Tamil Nadu, Rajasthan, Karnataka, West Bengal, Orissa, Kerala and Punjab. In Tamil Nadu, guava is cultivated in an area of 14.44 thousand hectares with a production of 363.07 thousand MT (INDIASTAT)

In recent years, guava fruits had a huge demand in the national as well as international market because it has a rich basket of bioactive compounds and nutrients. Though there is a huge demand in the market, but guava production is being hindered due to various problems such as the guava nematode-wilt complex. Nematodes and Fusarium species jointly parasitize the tree's root system, causing guava decline (Gomes *et al*., 2011). Unlike, the persistence of chemical nematicides is usually short in the tropics, due to run-off and leaching. Besides, many of the effective nematicides were banned from the markets owing to their risks to human health and the environment. So, alternative control measures should be adopted to control the nematode. No source of resistance to the nematode was found in *Psidium guajava*; however, sources of resistance were also identified in genotypes of *P. cattleianum* by Carneiro *et al*. (2007) and Miranda *et al*. (2012).

Almeida *et al.* (2009) identified *Psidium cattleianum* as resistant to this nematode and the disease complex. Therefore, to alleviate the nematode problem, alternative low-input, cost-effective and environment friendly management strategies will be utilizing *P. cattleianum* as root stock. Allahabad Safeda scions were grafted onto *Psidium cattleianum* were the tallest and gave the greatest yields (Teaotia and Phogat, 1971), When used as rootstocks *P. cattleianum* and *P. friedrichsthalianium* were compatible with P. *guajava* cv. Paluma (Carneiro *et al*., 2007). Vishwakarma *et al*. (2023) screened different wild species of guava with M.incognita inoculation and reported that *Psidium cattleianum* var. *cattleianum* and *P. cattleianum* var. *lucidum* were immune to both *M. incognita* (0 RGI score) and *F. oxysporum* f. sp. *psidii* (0% wilting).

Psidium cattleianum Sabine is a slow-growing evergreen tree, 2–4 m tall, commonly called cattley guava, Chinese guava, purple guava, and strawberry guava. It is indigenous to the lowlands of eastern Brazil and parts of Uruguay, Strawberry guava fruit has a pleasant, strawberry-like flavour when ripe, hence its common name. *P. cattleianum* is resistant to the nematode *Meloidogyne incognita*. No disease pathogens have been recorded on *P. cattleianum*, and it is known to be resistant to the rust fungus *Puccinia psidii* which affects *P. guajava*. Costa *et al.* (2023) conducted an research on identification of secondary metabolites related to *Psidium spp*. resistance against nematode *Meloidogyne enterolobii* and data analysis revealed that the substances regulated upon infection in were primarily hydrolysable tannins, lignans and also some terpenes, which may also act as inhibitors of *M. enterolobii* inoculation.

These characteristics of strawberry guava make it the one of ideal rootstock for guava. However,the availability of this root stock is not meeting the actual demand of grafted planting material in guava. Uowolo and Denslow (2008) stated that *P. cattleianum* does not form a persistent seed bank, and loses viability after 6.5 months. Based on the economic potential of the species and its ecological importance, studies are needed on conservation, and adequate storage (SILVA *et al*., 2011), and So, we conducted research to study the effect of different pre-sowing treatments on the rootstock strawberry guava (*Psidium cattleianum* Sabine) for overcoming dormancy, thus enabling their availability and use throughout the year for grafting with guava.

Materials and Methods

The experiment was conducted in orchard nursery, Department of Fruit science, Tamil Nadu Agricultural University, Coimbatore. The experiment was laid out in a Completely Randomized Design with eleven treatments and three replications.

Seeds were extracted from ripened fruits harvested from the mother plants maintained at guava germplasm in the Orchard which were collected and outdoors dried for one day and packed in butter paper. Then dried seeds were used for the study. Seeds were treated with different pre-sowing treatments for the germination study. The different treatments are: T1: GA_3 200ppm T2: GA_3 300ppm T3: GA_3 400ppm T4: GA_3 500ppm for 30 minutes. T5: Thiourea 0.5% T6: Thiourea 1% for 12 hours T7: KNO3 0.5% T8: KNO3: 1% for 12 hours T9: 5% Hcl for 10 minutes T10: 10% Hcl for 10 minutes T11: Control in water for 30 minutes.

For each replication, 50 seeds were sown in cocopeat media in 98 called portray, so a total of 1650 seeds were sown. Portrays were kept inside the shade net for effective germination.

Number of Days taken for germination and Germination Percentage

The germinating seeds were observed daily and the day on which the first germination of the seed was seen was considered as the number of days taken for germination for each treatment.

The germination percentage was calculated using the following formula:

$$\textbf{Germination Percentage(\%)} = \frac{\textit{Number of seeds germinated}}{\textit{Total number of seeds germinated}} \times 100$$

Growth Parameters

The growth parameters such as seedling height(cm), length of the primary root(cm), number of leaves and stem girth(mm) were measured from selected five seedlings of each treatment and mean was computed. The observations were recorded at 60 days from sowing.

The stem girth was measured with the help of Vernier calliper at 3cm height from the base of the seedling.

Leaf area was calculated by using conversion factor(k) given by Nava *et al*. (2014):

Leaf area (cm^2) = Length of leaf ×Width of leaf× k

Where k = 0.72581647

Biomass parameters

Fresh weight of total seedling, shoot (g), and root (g).

The five selected seedlings of each department were uprooted 90 days after sowing and adhered soil to the roots was washed thoroughly seedlings were shade dried to remove excess water and the weight of the total seedling, root, and shoot was taken on electric balance was recorded and mean was computed in grams.

Dry weight of total seedling, shoot (g) and root(g)

Freshly weighed seedlings, shoots, and roots were chopped and labelled properly and were kept in brown paper bags and oven dried at 60°C weight was measured and the average value was computed.

Seedling Vigour Index

Vigour index defines the state of health of seedlings and also the production of biomass of the plant. It was calculated using the formula given by Abdul-Baki and Anderson (1973):

Seedling Vigour Index I(cm) = Germination percentage × Length of the seedling(cm)

Seedling Vigour Index II (cm) = Germination percentage × Dry weight of seedling(g)

Vigour index I was calculated at 60 days after sowing and Vigour index was calculated at 90 days after sowing.

This experiment was laid out in Completely randomized design (CRD). The data collected were statistically analyzed by computing ANOVA at a 5% level of significance using R studio software version 4.3.1 with suitable packages.

RESULTS AND DISCUSSION

Number of days taken for germination and Germination percentage

The minimum number of days taken for germination in the present investigation was seen in GA_3 500 ppm (20.0) and maximum days were recorded in control (31.0). These results can be attributed to the activity of GA_3 on embryos causing de novo synthesis of enzymes such as amylase which is utilized for embryo growth and thereby enhancing the germination. Uravshi *et al.* (2020) also obtained the same results when guava seeds were treated with GA_3.

The germination percentage was recorded higher in seeds treated with GA_3 500ppm (79.33%) followed by Thiourea 1% (74.33%) and minimum germination percentage was recorded in control (34.66%) (Fig. 1). The higher germination percentage in seeds treated with GA_3 can be attributed to the fact that GA helps in breaking the seed dormancy and increases the activity of endogenous auxins and gibberellins like substances (Pawshe *et al*., 1997). These results are in close conformity with Gurung *et al*. (2013) in passion fruit and by Chandra and Govind (1990) in guava. Higher germination in thiourea-treated seeds can be due to the antagonized effect of thiourea on inhibitors present in the seed or due to the activity of increased cytokinin by thiourea which helps in overcoming the inhibiting effect of the seed coat (Hore and Sen, 1994).

Growth Parameters of seedlings

The growth parameters of strawberry guava seedlings showed a positive response to the pre-sowing treatments and are presented in (Table 2). One of the important characteristics of seedling growth is the height of the seedling and it was recorded highest in GA_3 500ppm (8.93cm) and lowest in Control (3.76cm). The maximum seedling length in GA-treated seeds can be due to the fact that it enhances nutrient uptake and increases the process of cell multiplication in internodal tissue causing increased seedling length (Barathkumar, 2019).

The maximum stem girth was observed in seeds treated with GA_3 500ppm(0.99mm) and minimum in control (3.76) (Fig. 2). Higher stem girth can also be attributed to the same fact as in the case of seedling length as observed by Dhankhar and Singh (1996) in aonla.

Leaf is the most important photosynthetic site of the plant as the plant derives its energy for its metabolic activities from leaves and its major function is carbon assimilation (Parab *et al.*, 2017). Regarding number of leaves and leaf area, seeds treated with GA_3 500ppm showed higher number of leaves (8.43) and higher leaf area(2.6cm^2) followed by thiourea 1% (8.26) and leaf area(2.4cm^2) (Fig. 3). The lowest values were seen in control. The favorable effect of thiourea might be due to the presence of the SH- group which has diverse biological activities such as the transport of photosynthates from source to sink (Meena et al, 2014).Similar results were also obtained by (Balai and Keshwa, 2011).

Regarding the length of the primary root and number of lateral roots, seeds treated with GA3 500ppm showed the highest length of root (3.7cm), number of lateral roots (7.66), and lower values were seen in control i.e., 1.36cm and 3.6 number of lateral roots. Higher values in GA-treated seeds might be due to the availability of a sufficient amount of gibberellic acid which in turn gives higher cell elongation and multiplication. These might be reflected in the increase in the length of roots and the higher number of secondary roots. These results are in close conformity with Nurunga et al. (2013) in passion fruit.

Biomass production of seedlings

The biomass production of seedlings is presented in (Table 3). Significant differences were observed between all the treatments for fresh weight and dry weight of root, shoot, and seedling. The highest fresh weight of the shoot was seen in seeds treated with GA3 500ppm (15.13g) as compared to the control (6.08g). Similarly, a higher fresh weight of root was also obtained in 500ppm GA3 (2.13g) as compared to the control (0.63) (Fig. 4). As a result of the higher fresh weight of root and shoot, the higher total fresh weight of seedling were also obtained in seeds treated with GA3 500ppm(17.26g) as compared to control(6.71g). These results might be due to the production of more photosynthesis and their translocation to the various parts of the plant. Similarly, because of the higher accumulation of photosynthesis the dry weight of total seedling, shoot, and root was also seen in GA treated as compared to control (Fig. 5).

Seedling Vigour Index

The seedling vigor index is directly proportional to the germination percentage and overall growth of seedlings. Seedling Vigour Index I and Vigour Index II recorded from this investigation are shown in Table 1. Seed treated with GA3 500ppm was recorded with the highest vigor index I (708.6) and Vigour index II (584.23) as compared to the control (Fig. 6). These can be linked to the fact that in the present study, GA3 500ppm gave higher germination percentage, seedling length and dry weight of seedling.

Conclusion

Based on the results of the experiment it can be concluded that the strawberry guava seeds treated with GA_3 500 ppm for 30 minutes gave the maximum germination percentage (79.33%), higher growth parameters (height of the seedling (8.93cm); the number of leaves (8.43); higher leaf area (2.6cm^2); length of root (3.7cm), number of lateral roots (7.66)) and higher biomass production (fresh weight of shoot (15.13g)). So to break the dormancy of strawberry guava seed for quick mass propagation of strawberry guava seedling to be used as rootstock for commercial guava, strawberry guava seeds have to be treated with 500ppm GA_3 for 30 minutes.

Table. 1 Effect of pre-sowing seed treatments on germination parameters of strawberry guava seedlings

Treatment	Days taken for germination	Germination %	Seedling vigour index - I	Seedling vigour index - II
T1:GA_3 200ppm	27.5	59	328.66	238.23
T2: GA_3 300ppm	26	65	404.76	311.86
T3: GA_3 400ppm	24	70.37	508.86	398.16
T4: GA_3 500ppm	20	79.33	708.6	584.23
T5:Thiourea 0.5%	24.5	61.34	376.5	261.84
T6: Thiourea 1%	22	74.42	612.23	529.28
T7: KNO3 0.5%	25	69.39	480.26	373.08
T8: KNO3: 1%	24	73	523.16	452.74
T9: 5% Hcl	28	47.64	215.64	168.43
T10: 10% Hcl	29	41.72	163.83	131.39
T11: Control	31	34.84	129.86	82.46
Mean	25.5	61.42	404.76	321.06
SE d	1.46	1.93	17.92	16.61
CD(5%)	3.04	4	37.18	34.44

Table. 2 Effect of pre-sowing seed treatments on shoot and root parameters of strawberry guava seedlings

Treatment	Seedling height (cm)	Stem girth (mm)	Total No. of leaves	Leaf area (cm^2)	Length of primary root	No. of lateral roots
T1:GA_3 200ppm	5.56	0.62	5.93	1.73	2.14	4.46
T2: GA_3 300ppm	6.23	0.71	6.7	2.05	2.52	5.4
T3: GA_3 400ppm	7.23	0.81	7.46	2.25	2.90	6.43
T4: GA_3 500ppm	8.94	0.99	8.43	2.6	3.7	7.65
T5:Thiourea 0.5%	6.12	0.66	6.06	1.92	2.28	5.06
T6: Thiourea 1%	8.20	0.91	8.25	2.4	3.23	8.33
T7: KNO3 0.5%	6.94	0.74	7.03	2.17	2.70	5.96
T8: KNO3: 1%	7.16	0.81	8.3	2.35	3.16	6.93
T9: 5% Hcl	4.56	0.54	4.7	1.70	1.85	4.7
T10: 10% Hcl	3.94	0.46	3.9	1.58	1.71	4.05
T11: Control	3.76	0.36	3.5	1.43	1.36	3.6
Mean	6.24	0.69	6.39	2.01	2.50	5.69
SE d	0.24	0.03	0.29	0.1	0.06	0.28
CD(5%)	0.5	0.07	0.6	0.2	0.12	0.58

Table . 3 Effect of pre-sowing seed treatments on seedling biomass parameters of strawberry guava seedlings

Treatment	Fresh weight of seedling(g)	Dry weight of seedling(g)	Fresh weight of shoot(g)	Dry weight of shoot(g)	Fresh weight of root(g)	Dry weight of root(g)
T1:GA_3 200ppm	10.54	4.03	9.58	3.65	0.96	0.38
T2: GA_3 300ppm	12.62	4.78	11.36	4.24	1.26	0.54
T3: GA_3 400ppm	15.23	5.65	13.6	4.94	1.63	0.71
T4: GA_3 500ppm	17.26	7.36	15.13	6.13	2.13	1.23
T5:Thiourea 0.5%	11.87	4.26	10.77	3.82	1.10	0.44
T6: Thiourea 1%	16.85	7.12	14.84	6.06	2.00	1.06
T7: KNO3 0.5%	13.97	5.38	12.54	4.74	1.43	0.63
T8: KNO3: 1%	16.05	6.2	14.13	5.18	1.92	1.01
T9: 5% Hcl	9.20	3.54	8.36	3.21	0.84	0.32
T10: 10% Hcl	8.09	3.15	7.41	2.91	0.68	0.24
T11: Control	6.71	2.39	6.08	2.26	0.63	0.12
Mean	12.58	4.89	11.25	4.28	1.32	0.61
SE d	0.4	0.17	0.36	0.15	0.06	0.03
CD(5%)	0.84	0.35	0.75	0.31	0.12	0.08

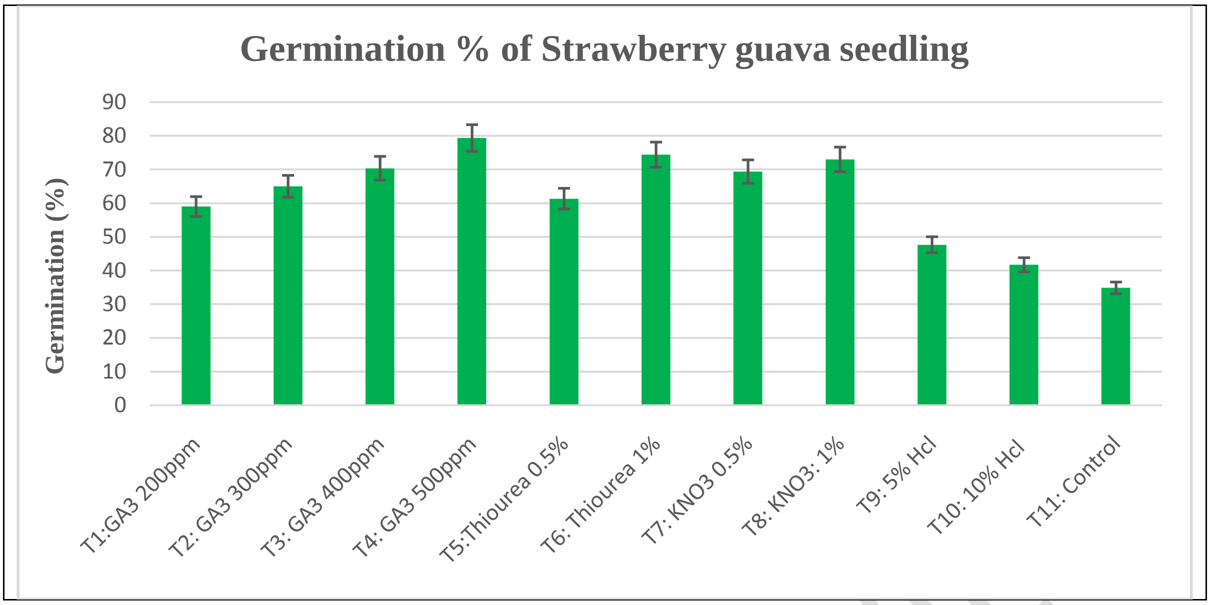

Fig. 1 Effect of pre sowing treatments on germination (%) of strawberry guava seedling

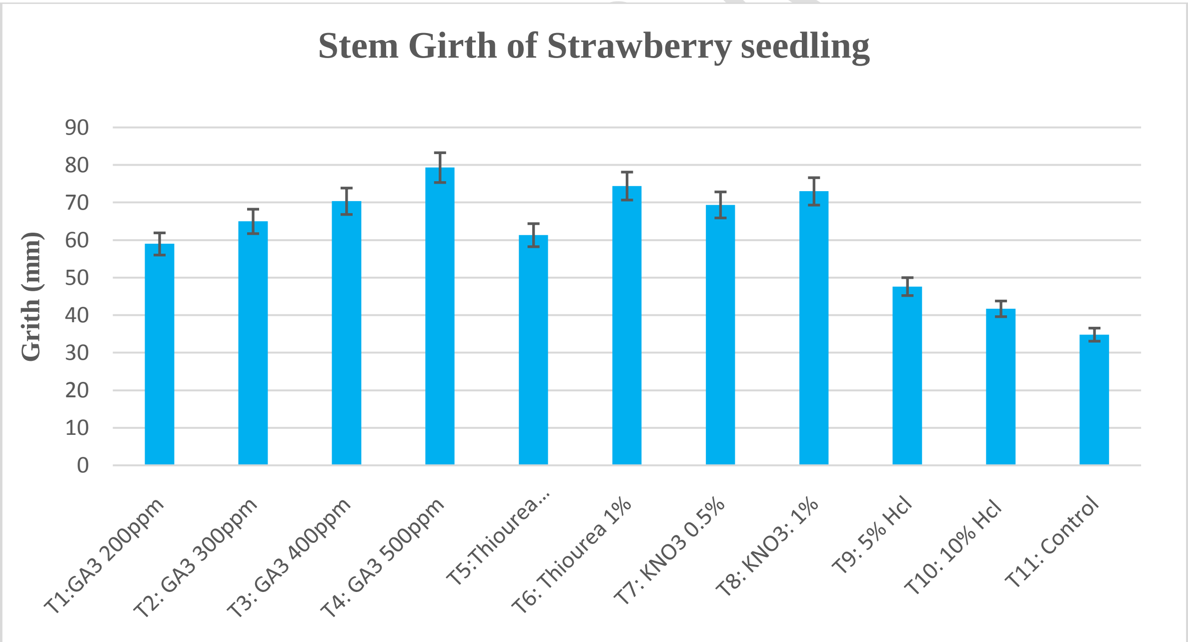

Fig. 2 Effect of pre sowing treatments on stem grith (mm) of strawberry guava seedling

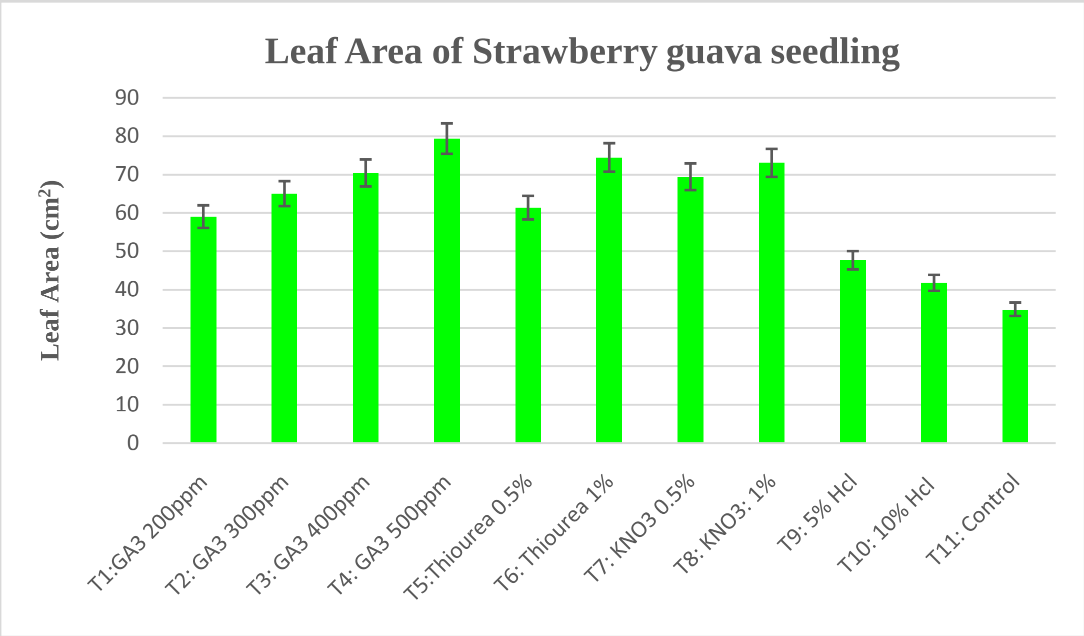

Fig. 3 Effect of pre sowing treatments on leaf area (cm^2) of strawberry guava seedling.

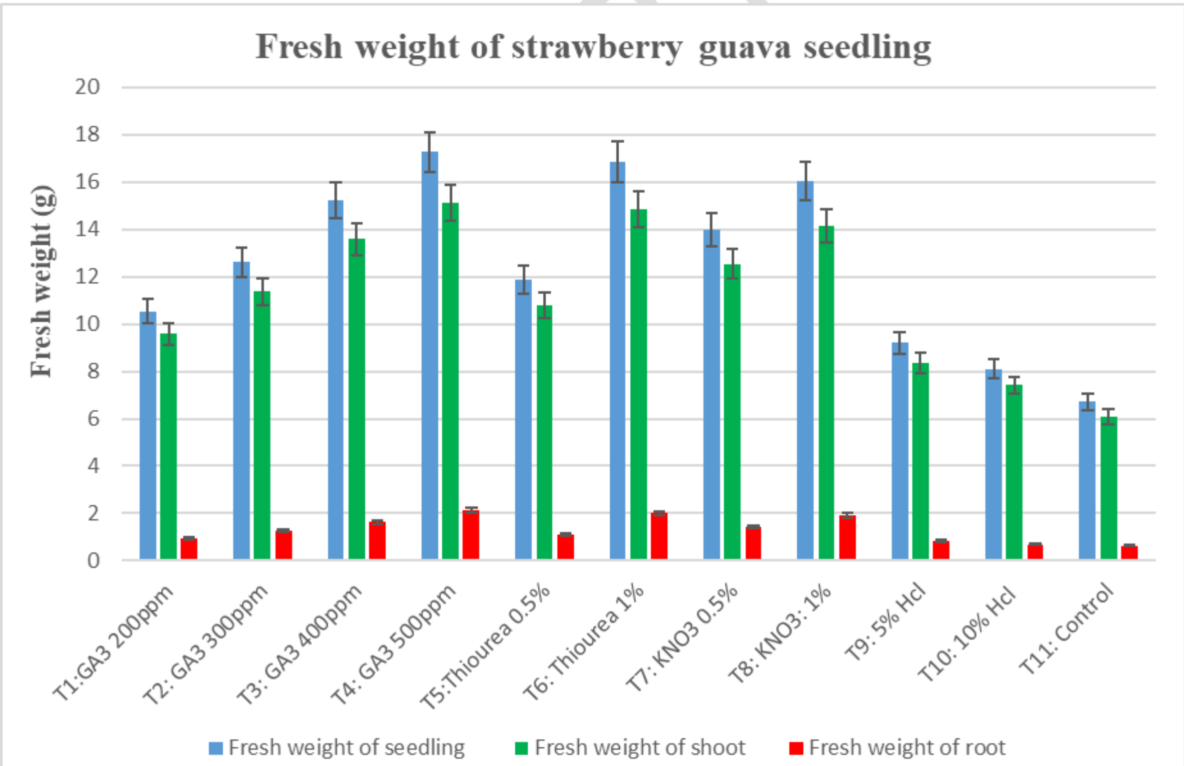

Fig.4 Effect of pre sowing treatments on fresh weight of seedling, shoot and root of strawberry guava seedling

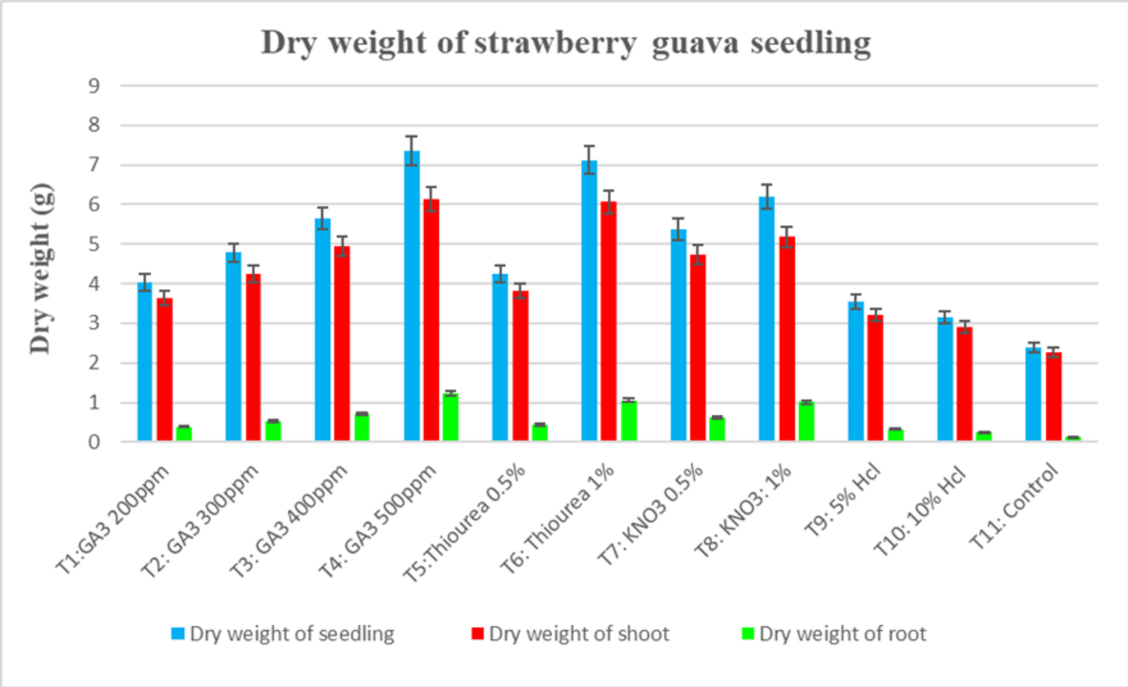

Fig.5 Effect of pre sowing treatments on dry weight of seedling, shoot and root of strawberry guava seedling

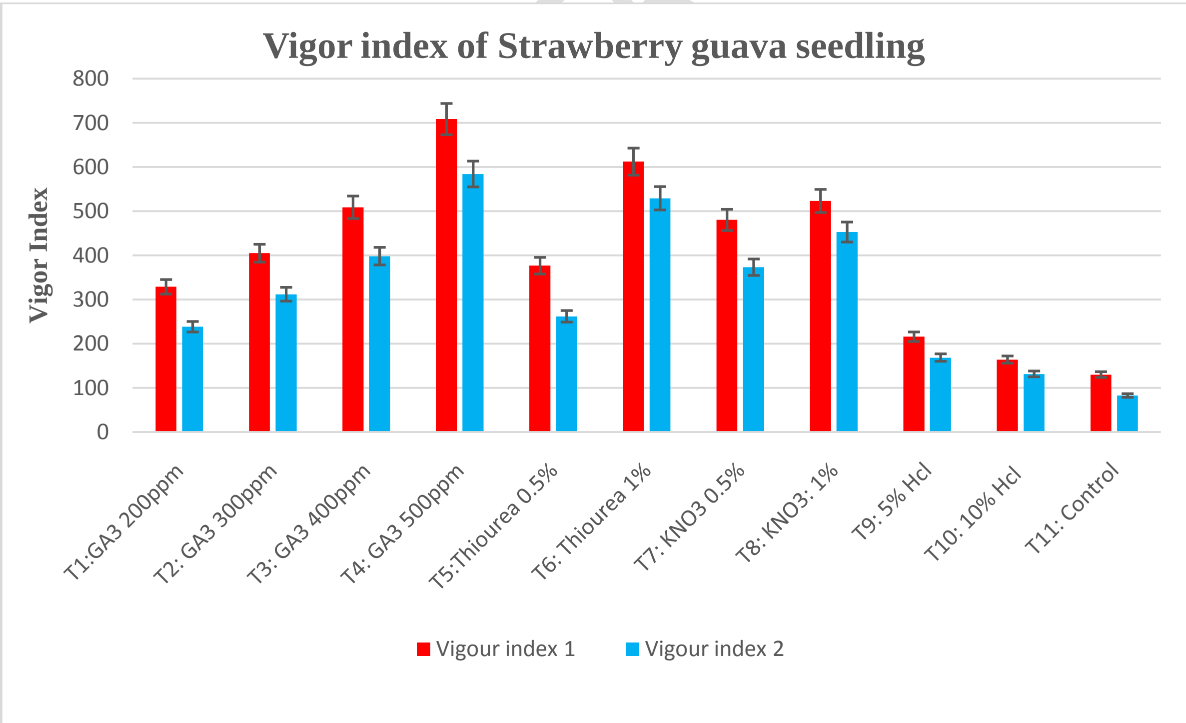

Fig.6 Effect of pre sowing treatments on Vigour index I and Vigour index II of strawberry guava seedling

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