

Influence of potting media and GA₃ on seed germination and seedling growth of Guava (*Psidium guajava*) cv. Allahabad safeda under shade net condition

ABSTRACT

The results of present investigation revealed that among the different potting media treatments, M₁: Vermiculite + Garden soil + Sand was found to be most beneficial for improving took days to germination, germination percentage, height of the seedling, number of leaves seedling⁻¹, stem diameter, primary roots length (cm), number of secondary roots, fresh and dry shoots weight, fresh and dry roots weight, seed vigor index – I and II and leaf area (cm). In present investigation, application of G₃: GA₃600 ppm significantly enhanced the seed germination and seedling growth viz., Days to germination(25.12), germination percentage(91.52%), height of the seedling(32.78cm), number of leaves seedling⁻¹(18.61), stem diameter(3.53), primary roots length (7.59cm), number of secondary roots(21.68), fresh and dry shoots weight(16.71g and 6.51g), fresh and dry roots weight(1.93g and 1.31g), seed vigour index – I (3000.11) and II(699.87)and leaf area(66.33 cm²).The effect of interaction of different level of GA₃ (0.00, 400, 500 and 600ppm) and different level of potting media viz., vermicuilite, garden soil, sand, FYM, cocopeat and vermincompost (1:1:1 ratio) on seed vigour index - I. The maximum seed germination, days to germination, and seedling growth, seed vigour index I & II and leaf area was found in treatment GA₃ 600 PPM + Vermiculite + Garden soil + Sand. The effect of interaction of GA₃ and potting media was found significant for seed germination, days to germination, and seedling growth, seed vigour index I & II and leaf area of guava cv. Allahabad safeda seedling under shade net condition.

Key words: - Potting media, GA₃, seed germination, seedling growth, Guava Allahabad safeda

INTRODUCTION

Seed propagation is necessary for raising rootstocks for grafting and budding practices. Graft success and vigour of graft largely depends on quality of rootstock. Huge variability in growth pattern of seedling plantation has been reported in guava (**Shashikumar, 2010**). There is a need to identify a suitable rootstock with good vigour and wider adoptability **Praveen et al. (2017)**. Seeds of guavas for industrial purposes are generally considered a waste product. Their use in propagation is restricted to breeding programs or rootstock production for grafting of scion cultivars. However, in countries that do not use high technology, guava is still propagated by seed, without grafting. Plants that are produced by seed are referred to as seedlings, which is the simplest propagation method of guava trees. It is an undesirable feature in commercial orchards, as it causes low productivity and fruit quality (**Pereira, 1990**). In addition, seedlings have a higher juvenility period, delaying entry into production, because they need between two and four years to bloom. Vegetative propagation In Florida, until 1948, 160 ha of guava crops were grown, and all trees were obtained from seed (**Kuperberg, 1953**). With the emergence of more productive cultivars and the need to perpetuate their characteristics, studies on vegetative propagation were carried out in California using roots cuttings (**Webber, 1944**) and in Florida using layering (**Ruehle, 1948**), herbaceous cuttings from shoots under intermittent mist system (**Kuperberg, 1953**) and grafting (**Nelson, 1954**). Different methods such as water soaking, scarification, and chemical treatment are used to break seed dormancy and to stimulate germination and seedling growth (**Brijwal and Kumar 2013; Dawood 2018**). Acid scarification of seeds helps to break seed dormancy and improves germination (**Essien 2004; Maldonado-Arciniegaset al. 2018**) Germination is strongly affected by environmental conditions including temperature, water availability, light, etc. (**He et al. 2013; Humphries et al. 2018**). Imbibition of water is the first step in the germination process. Any deficiency of water during germination strongly limits seed germination (**Cavallaroet al. 2014; Lamichhaneet al. 2018**). Gibberellin is a very potent hormone whose natural occurrence in plants controls their development. Gibberellins are in the third place with 17 % share among the most commonly used herbal hormones within the natural plant growth regulators. It regulates growth; application of very low concentrations can have profound effect. GA3 is the most

commonly used Gibberellin; it has number of effects on plant growth and development **Singh et al. (2022)**. It can stimulate rapid stem and roots growth, induce mitotic division in the leaves of some plants and increase seed germination rates. Gibberellins are known to influence both cell division and cell enlargement (**Adams et al. 1975**).

MATERIALS AND METHODS

The present investigation entitled “**Influence of potting media and GA₃ on seed germination and seedling growth of Guava (*Psidiumguajava*) cv. Allahabad safeda under shade net condition**” was carried out during rainy season in the year 2022-2023 at Horticulture Research Farm, Department of Horticulture, Naini Agriculture Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (U.P.). Seeds were sown in the poly bag (9x12 inch sized) at Horticulture Research Farm SHUATS, Prayagraj under shade net condition. For study, a total 500 seeds of guava were sown on 23rd July 2022. The experiment comprised of different concentration of GA₃ water soaking *viz.*, GA₃ 0.00 ppm, GA₃ 400 ppm, GA₃ 500 ppm and GA₃ 600 ppm and four different growing media vermiculite, garden soil, fym, cocopeatvermicompost having 16 treatment combinations. The experiment was laid out in poly bags in factorial randomized block design (RBD) (4x4) with three replications. Observations were recorded using standard procedure and statistically analysed. The mean value of data was subjected to analysis of variance as described by **Panse and Sukhatme (2000)**.

Observations recorded:

The following observations were recorded during the experimental period. The observations pertaining to germination and vegetative growth characters were recorded at 60 days interval for a total period of 240 days after application of treatments.

Days required for initiation of germination:

In each treatment the day on which first germination of seed was initiated from the date of sowing considered as days required for initiation of germination. The number of days required for initiation of germination was calculated.

Germination percentage:

After completion of entire germination, the percentage of germination was calculated. The germinated seeds in each treatment were counted at an interval of two days and after completion of germination, the total numbers of germinated seeds were

$$\text{Germination (\%)} = \frac{\text{Number of seeds germinated}}{\text{Total Number of seeds put for germination}} \times 100$$

Growth Attributes:**Height of seedling (cm):**

Height of the stem was measured from base to growing tip of the main stem in centimeter. A meter scale was used for this purpose. It was measured for all the five plants which were tagged and later on averaged.

Number of leaves per seedling:

The total number of fully grown leaves was counted of all the five tagged plants and average was calculated.

Stem diameter (cm):

Initial diameter of stem of tagged five plants was measured separately with the help of digital vernier caliper at 30 day of sowing the seed. Thereafter, periodical observations of diameter of stem were measured at 15 days interval for a total period of 45 days.

Primary roots length (cm)

Length of tap roots was computed using a measuring tape after uprooting guava seedling.

No. of secondary roots

The number of secondary roots was manually counted and averaged for five guava seedlings.

Fresh weight of seedling (g):

All the five tagged plants are selected in each treatment and fresh weight was measured by electronic balance and average weight was calculated.

Dry weight of seedling (g):

The seedlings which were selected for fresh weight were dried in oven at 60°C for 48 hours. After drying, the dry weight of seedling was measured by electronic balance and average weight calculated.

Dry weight of roots (g):

The seedlings which were selected for fresh weight were dried in oven at 60°C for 48 hours. After drying, roots separated from the seedling and dry weight of roots was measured by electronic balance and average weight calculated.

Dry weight of shoots (g):

The dry weight of shoots was calculated by subtracting dry weight of roots from dry weight of seedling.

Seedling vigour index I:

Seedling vigour index I was calculated by adopting the method suggested by **Abdul-Baki and Anderson (1973)**

$$\text{Seedling vigour index I} = \text{Germination (\%)} \times \text{total seedling length (cm)}.$$

Seedling vigour index II:

It was computed by adopting the formula as suggested by **Abdul-Baki and Anderson (1973)** and expressed in whole number:

$$\text{Seedling vigour index-II} = \text{Germination (\%)} \times \text{seedling dry weight (g)}$$

subtracted from total number of seeds sown and percentage of germination was calculated.

RESULTS AND DISCUSSION

The data pertaining to effect of different level of GA₃ (0.00, 400, 500 and 600ppm) on **seed germination and seedling growth** of guava cv. Allahabad safeda seedling under shade net condition are presented in table 1. The result for the **seed**

germination and seedling growth showed significant different for the various treatment. However the maximum days to germination (26.25) was recorded for the treatment G4: GA₃ 600 ppm. Whereas the minimum days to germination 44.76 was found in treatment G1: GA₃ 0.00ppm. The result for the seed germination and seedling growth parameters of guava seedling (*Psidiumguajava*) cv Allahabad safeda under shade net condition showed significant different for the various treatment. However the maximum germination (%) (89.40), height of the seedling (cm) (30.078), number of leaves seedling⁻¹ (15.17), stem diameter (cm) (3.28), primary roots length (cm) (7.35), number of secondary roots (20.26), fresh weight of shoots (g) (16.26), dry weight of shoots (g) (6.26), fresh weight of root (g) (1.93), dry weight of roots (g) (1.11), seed vigour index-I (2691.29), seed vigour index- II (658.80) and leaf area (cm) (62.18) was recorded for the treatment G₄: GA₃ 600 ppm. GA₃ enhanced seed germination, which might have antagonized the effect of inhibitors present in anola seeds (**Kumari et al. 2007**).

Hayes, (1953) reported that acid scarification of guava seeds shortened the germination period without adverse effect on germination percentage. The increase in germination percentage with GA₃ might be due to involvement of GA₃ in the activation of cytological enzymes along with increase in cell wall plasticity and better absorption of solvents (**Padma lay et al. 2013**).

Reported that decreased germination percentage at higher water temperature could be attributed to embryo damage.

Teketay (1998) reported lower availability of O₂ with higher water temperature which resulted in destruction of certain enzymatic component leading to poor germination percentage. Increased seedling length in GA₃treated seedlings might be due to the stimulating effect on cell wall to release and transmit its calcium into cytoplasm that provides a condition for absorption of water by increase in cell size and growth.

Aatla and Srihari, (2013)reported that treatment of mango cv. Alphonso kernel with GA₃ 500 ppm resulted in greater seedling height and internodal length. Increased shootslength with GA₃ treatment might be because it activated amylase, which digested the available carbohydrate into simple sugars so that energy and nutrition were easily available to faster growth of seedling (**Vishwakarma, 2013**).

GA₃ increased cell division and cell growth apparently leading to increased development of young leaves. Therefore, from the present study it is evident that the maximum number of leaves per seedling with GA₃ may be attributed to increase the physiological process and stimulatory action of GA₃ to form new leaves at faster rate. **Archana et al., (2015)** reported similar results in *Annonasquasmosa*, **Ramchandra and Govind, (1990)** in guava and **Dinesh and Padmapriya (2022)**. The maximum stem girth of seedling obtained from GA₃ treated seeds might be due to the fact that GA₃ treatment enhanced the rate of cell division and cell elongation of stem portion. **Reshmiet al., (2007)** reported similar results of GA₃ pre-soaking treatment to increase the stem girth in aonla **Dinesh and Padmapriya (2022)** in guava. Similar results of increased roots growth with GA₃ pre sowing treatment was reported by Pampanna and **Sulikeri (2001)** in sapota cv. Kalipatti. The maximum roots length in case of seedling obtained from GA₃ pre-soaked seeds might due to increase the elongation of the cells in the sub apical region of the roots as reported by **Salisbury and Ross, (1988)** and **Dinesh and Padmapriya (2022)** in guava. This might be due to proper level of gibberellic acid which might be resulted in rapid cell division, elongation and multiplication process in seedlings that has reflected increase in primary roots length and increasing number of secondary roots. Similar results are in agreement with the findings of **Pampanna and Sulikeri (2001)** in sapota and **Kumawat et al. (2014)** in papaya and **Boricha et al., (2020)**. The results are in close conformity with the findings of **Patilet al. (2012)** in citrus; **Patilet al. (2018)** in jamun; **Vasantha et al. (2014)** and **Tandon et al. (2019)** in tamarind. The above results are in harmony with those of **Mohamed et al. (2010)** who found that foliar spraying of Sour orange and Volkamer lemon rootstocks with GA₃ at 200 and 400 ppm significantly increased stem length and diameter and leaf area in comparison with untreated seedlings. Whereas the minimum germination (72.18%), height of the seedling (cm) (26.09), number of leaves seedling⁻¹ (12.35), stem diameter (cm) (1.54), minimum primary roots length (cm) (5.28), number of secondary roots (16.39), fresh weight of shoots (g) (9.62), dry weight of shoots (g) (3.28), fresh weight of root (g) (1.30), dry weight of roots (g) (0.27), seed vigour index-I (1886.47), seed vigour index- II (256.88) and leaf area (cm) (36.01) was found in treatment G₁: GA₃ 0.00ppm.

The data pertaining to effect of different level of potting media viz., vermiculite, garden soil, sand, FYM, cocopeat and vermicompost (1:1:1 ratio) on seed germination and seedling growth of guava cv. Allahabad safeda seedling under shade net condition are presented in table 1. The result for the days to germination showed significant different for the various treatment. However the maximum days to germination (32.11) was recorded for the treatment M₁: Vermiculite + Garden Soil + Sand (1:1:1). Whereas the minimum days to germination 36.38 was found in treatment M₃: Cocopeat + Garden Soil + Sand (1:1:1). The result for the seed germination and seedling growth showed significant different for the various treatment. However the maximum germination (%) (91.52), height of the seedling (cm) (30.71), number of leaves seedling⁻¹ (17.04), stem diameter (cm) (2.61), primary roots length (cm) (6.43), number of secondary roots (18.97), fresh weight of shoots (g) (14.79), dry weight of shoots (g) (5.19), fresh weight of shoots (g) (1.69), dry weight of roots (g) (0.78), seed vigour index-I (2551.58), seed vigour index- II (502.70) and leaf area (cm) (53.20) was recorded for the treatment M₁: Vermiculite+ Garden Soil + Sand (1:1:1). Whereas the minimum germination (%) (70.01), height of the seedling (cm) (25.67), height of the seedling (cm) (25.67), number of leaves seedling⁻¹(10.79), stem diameter (cm) (2.13), primary roots length (cm) (6.02), number of secondary roots (18.27), fresh weight of shoots (g) (12.65), dry weight of shoots (g) (4.51), fresh weight of root (g) (1.56), dry weight of roots (g) (0.60), seed vigour index-I (2032.17), seed vigour index- II (411.47) and leaf area (cm) (47.21) was found in treatment M₃: Cocopeat + Garden Soil + Sand (1:1:1). Vermicompost is reported to have bioactive principles which are considered to be beneficial for root growth and this has been hypothesized to result in greater root initiation, higher germination, increased biomass, enhanced growth and development (**Bachman and Metzger, 2008**) and also balanced composition of nutrients (**Zaller, 2007**). This result is akin to the findings of **Campos Motaet al. (2009)** and **Abiramiet al. (2010)** who suggested that since coir dust is low in nutrients when mixed with vermicompost, provides a better growth medium for plant establishment.

The effect of interaction of different level of GA₃ (0.00, 400, 500 and 600ppm) and different level of potting media viz., vermiculite, garden soil, sand, FYM, cocopeat and vermicompost (1:1:1 ratio) on germination and seedling growth parameter of guava.

The minimum days to germination (25.12 days) was found in treatment T₁₃ G₄: 600 ppm+ M₁: Vermiculite + Garden soil + Sand. Whereas the maximum days to germination (48.49) was recorded in treatment G₁: 0.00 ppm+ M₃: Cocopeat+ Garden soil + Sand. The maximum germination percentage (91.52), height of the seedling (32.78), number of leaves seedling⁻¹(18.61), stem diameter (3.53), primary roots length (cm) (7.59), number of secondary roots (21.68), fresh and dry shoots weight (16.71 & 6.51), fresh and dry roots weight (1.93 & 1.31), seed vigour index –I and II (3000.11 & 699.87) and leaf area (cm) (66.33) was found in treatment T₁₃ G₄: 600 ppm+ M₁: Vermiculite + Garden soil + Sand. Whereas the minimum germination percentage (70.01), height of the seedling (2.53, 10.19, 15.44 and 22.49), number of leaves seedling⁻¹ (9.21), stem diameter (1.28), primary roots length (cm) (5.06), number of secondary roots (16.99), fresh and dry shoots weight(17.98 & 2.70), fresh and dry roots weight(1.22 and 0.16), seed vigour index –I and II (1574.43 and 200.57) and leaf area cm² (32.23) was recorded in treatment G₁: 0.00 ppm+ M₃: Cocopeat+ Garden soil + Sand. Cocopeat and peatmoss which are rich in coconut waste and other biodegradable material enhance the soil fertility and nutrients available for overall seedling production (**Raja et al., 2018**). It also provides desirable vegetative growth and increases the number of leaves and leaf area (**Aslanpouret al., 2018**). It might be due to the successful use of lightweight growing media, cocopeat and peatmoss maintains sufficient aeration for the root zone it has air pockets or pores to supply oxygen to plant roots and allow for drainage. Oxygen plays a critical role in determining root orientation as well as root metabolic status. Similar results were obtained by **Arvind et al. (2015)**, **Ramteke et al. (2015)**, **Rakibuzzaman et al. (2019)** and **Nandini and Singh (2021)** in papaya.

CONCLUSION

It is concluded that treatment T₁₃ G₄: 600 ppm+ M₁: Vermiculite + Garden soil + Sand recorded minimum days to germinations (25.12), maximum days to germinations (91.52), height of the seedling (cm) (32.78), number of leaves seedling⁻¹ (18.61), stem diameter (3.53cm), primary roots length (7.59cm) , number of secondary roots (21.68), fresh weight of shoots (16.71g) , dry weight of shoots (6.51g), fresh weight of roots

(1.93g), dry weight of roots (1.31g) , seed vigour index-I (3000.11), seed vigour index-II (699.87), leaf area (66.33cm²).

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Table 1: Influence of potting media and GA₃ on seed germination and seedling growth of Guava (*PsidiumGuajava*) cv. Allahabad safeda under shade net condition.

Level of GA ₃		Days to germinations	Germination (%)	Height of the seedling (cm)	Number of leaves seedling ⁻¹	Stem diameter (cm)	Primary roots length (cm)	No. secondary roots
G1: GA ₃ 0.00PPM		44.76	72.18	26.09	12.35	1.54	5.28	16.39
G2: GA ₃ 400PPM		35.61	78.16	27.70	13.48	2.07	5.87	17.63
G3: GA ₃ 500 PPM		30.68	83.81	28.75	14.39	2.62	6.26	18.67
G4: GA ₃ 600 PPM		26.25	89.40	30.07	15.17	3.28	7.35	20.26
F-Test		S	S	S	S	S	S	S
S.Ed. (±)		0.372	0.252	0.227	0.029	0.029	0.027	0.069
C.D. at 0.5%		0.761	0.515	0.464	0.063	0.015	0.055	0.140
Level of Potting media		Days to germinations	Germination (%)	Height of the seedling (cm)	Number of leaves seedling ⁻¹	Stem diameter (cm)	Primary roots length (cm)	No. secondary roots
M1: Vermiculite+ Garden Soil + Sand (1:1:1)		32.11	82.76	30.71	17.04	2.61	6.43	18.97
M2: FYM + Garden Soil + Sand (1:1:1)		35.05	80.44	28.01	13.28	2.32	6.06	17.94
M3: Cocopeat + Garden Soil + Sand (1:1:1)		36.38	78.69	25.67	10.79	2.13	6.02	17.76
M4: Vermicompost + Garden Soil + Sand (1:1:1)		33.76	81.67	28.23	14.28	2.46	6.24	18.27
F-Test		S	S	S	S	S	S	S
S.Ed. (±)		0.372	0.252	0.227	0.029	0.015	0.027	0.069
C.D. at 0.5%		0.761	0.515	0.464	0.063	0.029	0.055	0.140
Int. (Due to potting media x GA₃)								
Treatment No.	Treatment details	Days to germinations	Germination (%)	Height of the seedling (cm)	Number of leaves seedling ⁻¹	Stem diameter (cm)	Primary roots length (cm)	No. secondary roots
T ₁	G1: 0.00 ppm + M1: Vermiculite + Garden soil + Sand	41.45	73.86	28.79	15.15	1.72	5.60	16.99
T ₂	G1: 0.00 ppm + M2: FYM + Garden soil + Sand	45.44	71.94	26.37	12.38	1.52	5.06	16.20
T ₃	G1: 0.00 ppm + M3: Cocopeat+ Garden soil + Sand	48.49	70.01	22.49	9.21	1.28	5.18	16.08
T ₄	G1: 0.00 ppm + M4: Vermicompost+ Garden soil + Sand	43.65	72.93	26.71	12.65	1.63	5.27	16.30
T ₅	G2: 400 ppm + M1: Vermiculite + Garden soil + Sand	32.89	80.30	30.06	16.77	2.32	6.02	18.06
T ₆	G2: 400 ppm + M2: FYM + Garden soil + Sand	36.73	77.44	27.56	13.00	2.01	5.78	17.31
T ₇	G2: 400 ppm + M3: Cocopeat+ Garden soil + Sand	37.49	75.59	25.54	10.07	1.83	5.72	17.42
T ₈	G2: 400 ppm + M4: Vermicompost+ Garden soil + Sand	35.34	79.31	27.65	14.09	2.13	5.94	17.75
T ₉	G3: 500 ppm + M1: Vermiculite + Garden soil + Sand	28.99	85.37	31.22	17.62	2.88	6.51	19.16
T ₁₀	G3: 500 ppm + M2: FYM + Garden soil + Sand	31.21	83.31	28.52	13.95	2.52	6.16	18.47
T ₁₁	G3: 500 ppm + M3: Cocopeat+ Garden soil + Sand	31.87	82.11	26.67	11.19	2.41	6.06	18.22
T ₁₂	G3: 500 ppm + M4: Vermicompost+ Garden soil + Sand	30.64	84.46	28.60	14.81	2.67	6.32	18.82
T₁₃	G4: 600 ppm + M1: Vermiculite + Garden soil + Sand	25.12	91.52	32.78	18.61	3.53	7.59	21.68
T ₁₄	G4: 600 ppm + M2: FYM + Garden soil + Sand	26.80	89.06	29.58	13.80	3.21	7.26	19.80
T ₁₅	G4: 600 ppm + M3: Cocopeat+ Garden soil + Sand	27.66	87.05	27.96	12.69	2.99	7.11	19.33
T ₁₆	G4: 600 ppm + M4: Vermicompost+ Garden soil + Sand	25.40	89.97	29.97	15.56	3.40	7.44	20.21
F-Test		S	S	S	S	S	S	S
S.Ed. (±)		0.744	0.503	0.227	0.051	0.029	0.054	0.137
C.D. at 0.5%		1.522	-	0.464	0.109	0.058	0.111	0.281

Table 2: Influence of potting media and GA₃ on seed germination and seedling growth of Guava (*PsidiumGuajava*) cv. Allahabad safeda under shade net condition.

Level of GA ₃		Fresh weight of shoots (g)	Dry weight of shoots (g)	Fresh weight of roots (g)	Dry weight of roots (g)	Seed vigour index -I	Seed vigour index -II	Leaf area (cm)
G1: GA ₃ 0.00PPM		9.62	3.28	1.30	0.27	1886.47	256.88	36.01
G2: GA ₃ 400PPM		14.01	4.42	1.54	0.63	2167.85	395.43	46.69
G3: GA ₃ 500 PPM		15.29	5.44	1.74	0.83	2411.68	525.93	55.23
G4: GA ₃ 600 PPM		16.26	6.26	1.93	1.11	2691.29	658.80	62.18
	F-Test	S	S	S	S	S	S	S
	S.Ed. (±)	0.191	0.047	0.009	0.060	9.499	6.956	0.539
	C.D. at 0.5%	0.392	0.097	0.019	0.124	19.437	14.233	1.103
Level of Potting media								
M1: Vermiculite+ Garden Soil + Sand (1:1:1)		14.79	5.19	1.69	0.78	2551.58	502.70	53.20
M2: FYM + Garden Soil + Sand (1:1:1)		13.68	4.73	1.61	0.75	2260.18	450.16	48.65
M3: Cocopeat + Garden Soil + Sand (1:1:1)		12.65	4.51	1.56	0.60	2032.17	411.47	47.21
M4: Vermicompost + Garden Soil + Sand (1:1:1)		14.06	4.96	1.65	0.72	2313.37	472.72	51.05
	F-Test	S	S	S	S	S	S	S
	S.Ed. (±)	0.191	0.047	0.009	0.060	9.499	6.956	0.539
	C.D. at 0.5%	0.392	0.097	0.019	0.124	19.437	14.233	1.103
Int. (Due to potting media x GA₃)								
Treatment No.	Treatment details							
T ₁	G1: 0.00 ppm + M1: Vermiculite + Garden soil + Sand	10.42	3.75	1.36	0.38	2126.46	305.08	38.88
T ₂	G1: 0.00 ppm + M2: FYM + Garden soil + Sand	9.64	3.27	1.30	0.23	1896.72	251.33	34.84
T ₃	G1: 0.00 ppm + M3: Cocopeat+ Garden soil + Sand	7.98	2.70	1.22	0.16	1574.43	200.57	32.23
T ₄	G1: 0.00 ppm + M4: Vermicompost+ Garden soil + Sand	10.44	3.40	1.32	0.31	1948.29	270.55	38.08
T ₅	G2: 400 ppm + M1: Vermiculite + Garden soil + Sand	16.54	4.76	1.63	0.71	2414.10	438.96	50.17
T ₆	G2: 400 ppm + M2: FYM + Garden soil + Sand	13.60	4.21	1.50	0.63	2134.26	374.32	46.58
T ₇	G2: 400 ppm + M3: Cocopeat+ Garden soil + Sand	11.80	4.16	1.45	0.54	1930.30	355.49	42.64
T ₈	G2: 400 ppm + M4: Vermicompost+ Garden soil + Sand	14.10	4.55	1.56	0.66	2192.72	412.96	47.39
T ₉	G3: 500 ppm + M1: Vermiculite + Garden soil + Sand	15.49	5.76	1.83	0.88	2665.66	566.87	57.40
T ₁₀	G3: 500 ppm + M2: FYM + Garden soil + Sand	15.28	5.28	1.73	0.81	2375.63	507.32	54.77
T ₁₁	G3: 500 ppm + M3: Cocopeat+ Garden soil + Sand	15.05	5.10	1.67	0.78	2189.69	482.83	52.38
T ₁₂	G3: 500 ppm + M4: Vermicompost+ Garden soil + Sand	15.34	5.62	1.75	0.85	2415.75	546.71	56.37
T₁₃	G4: 600 ppm + M1: Vermiculite + Garden soil + Sand	16.71	6.51	1.93	1.31	3000.11	699.87	66.33
T ₁₄	G4: 600 ppm + M2: FYM + Garden soil + Sand	16.18	6.18	1.93	1.14	2634.10	667.67	58.40
T ₁₅	G4: 600 ppm + M3: Cocopeat+ Garden soil + Sand	15.78	6.06	1.89	0.92	2434.25	607.01	61.59
T ₁₆	G4: 600 ppm + M4: Vermicompost+ Garden soil + Sand	16.35	6.28	1.97	1.06	2696.71	660.67	62.38
	F-Test	S	S	S	NS	S	NS	S
	S.Ed. (±)	0.383	0.095	0.019	0.121	18.998	13.919	1.078
	C.D. at 0.5%	0.784	0.194	0.038	-	38.874	-	2.206