



Influence of Potting Media and GA₃ on Seed Germination and Seedling Growth of Guava (*Psidium guajava*) cv. Allahabad Safeda under Shade Net Condition

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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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: GA₃ 600 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

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600ppm) and different level of potting media viz., vermiculite, 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.

Keywords: Potting media; GA₃; seed germination; seedling growth; guava Allahabad safeda.

1. 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 [1]. There is a need to identify a suitable rootstock with good vigour and wider adaptability Praveen et al. [2]. 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 [3]. 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 [4]. 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 [5] and in Florida using layering [6], herbaceous cuttings from shoots under intermittent mist system [4] and grafting [7]. Different methods such as water soaking, scarification, and chemical treatment are used to break seed dormancy and to stimulate germination and seedling growth [8,9]. Acid scarification of seeds helps to break seed dormancy and improves germination [10,11] Germination is strongly affected by environmental conditions including temperature, water availability, light, etc. [12,13]. Imbibition of water is the first step in the germination process. Any deficiency of water during germination strongly limits seed germination [14,15]. 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).

2. MATERIALS AND METHODS

The present investigation entitled “Influence of potting media and GA₃ on seed germination and seedling growth of Guava (*Psidium guajava*) 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, cocopeat vermicompost 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 [16].

2.1 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.

2.2 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.

2.3 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

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

2.4 Growth Attributes

2.4.1 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.

2.4.2 Number of leaves per seedling

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

2.4.3 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.

2.4.4 Primary roots length (cm)

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

2.4.5 No. of secondary roots

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

2.4.6 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.

2.4.7 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.

2.4.8 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.

2.4.9 Dry weight of shoots (g)

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

2.4.9.1 Seedling vigour index I

Seedling vigour index I was calculated by adopting the method suggested by Abdul-Baki and Anderson [17].

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

2.4.9.2 Seedling vigour index II

It was computed by adopting the formula as suggested by Abdul-Baki and Anderson [17] 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.

3. 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 (*Psidium guajava*) 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 [18].

Hayes, [19] 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 [20].

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

Teketay [21] 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 GA₃ treated 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, [22] reported that treatment of mango cv. Alphonso kernel with GA₃ 500 ppm resulted in greater seedling height and internodal length. Increased shoots length 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 [22].

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., [24] reported similar results in *Annona squamosa*, Ramchandra and Govind, [25] in guava and Dinesh and Padmapriya [26]. 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. Reshmi et al., [27] reported similar results of GA₃ pre-soaking treatment to increase the stem girth in anola Dinesh and Padmapriya [26] in guava. Similar results of increased roots growth with GA₃ pre sowing treatment was reported by Pampanna and Sulikeri [28] 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, [29] and Dinesh and Padmapriya [26] 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 [28] in sapota and Kumawat et al. [30] in papaya and Boricha et al., [31]. The results are in close conformity with the findings of Patil et al. (2012) in citrus; Patil et al. [32] in jamun; Vasantha et al. [33] and Tandon et al. [34] 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 0.00 ppm.

Table 1. Influence of potting media and GA₃ on seed germination and seedling growth of guava (*Psidium Guajava*) 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
G ₁ : GA ₃ 0.00PPM		44.76	72.18	26.09	12.35	1.54	5.28	16.39
G ₂ : GA ₃ 400PPM		35.61	78.16	27.70	13.48	2.07	5.87	17.63
G ₃ : GA ₃ 500 PPM		30.68	83.81	28.75	14.39	2.62	6.26	18.67
G ₄ : 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
M ₁ : Vermiculite+ Garden Soil + Sand (1:1:1)		32.11	82.76	30.71	17.04	2.61	6.43	18.97
M ₂ : FYM + Garden Soil + Sand (1:1:1)		35.05	80.44	28.01	13.28	2.32	6.06	17.94
M ₃ : Cocopeat + Garden Soil + Sand (1:1:1)		36.38	78.69	25.67	10.79	2.13	6.02	17.76
M ₄ : 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 GA ₃)								
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	G ₁ : 0.00 ppm + M ₁ : Vermiculite + Garden soil + Sand	41.45	73.86	28.79	15.15	1.72	5.60	16.99
T ₂	G ₁ : 0.00 ppm + M ₂ : FYM + Garden soil + Sand	45.44	71.94	26.37	12.38	1.52	5.06	16.20
T ₃	G ₁ : 0.00 ppm + M ₃ : Cocopeat+ Garden soil + Sand	48.49	70.01	22.49	9.21	1.28	5.18	16.08

T ₄	G ₁ : 0.00 ppm + M ₄ : Vermicompost+ Garden soil + Sand	43.65	72.93	26.71	12.65	1.63	5.27	16.30
T ₅	G ₂ : 400 ppm + M ₁ : Vermiculite + Garden soil + Sand	32.89	80.30	30.06	16.77	2.32	6.02	18.06
T ₆	G ₂ : 400 ppm + M ₂ : FYM + Garden soil + Sand	36.73	77.44	27.56	13.00	2.01	5.78	17.31
T ₇	G ₂ : 400 ppm + M ₃ : Cocopeat+ Garden soil + Sand	37.49	75.59	25.54	10.07	1.83	5.72	17.42
T ₈	G ₂ : 400 ppm + M ₄ : Vermicompost+ Garden soil + Sand	35.34	79.31	27.65	14.09	2.13	5.94	17.75
T ₉	G ₃ : 500 ppm + M ₁ : Vermiculite + Garden soil + Sand	28.99	85.37	31.22	17.62	2.88	6.51	19.16
T ₁₀	G ₃ : 500 ppm + M ₂ : FYM + Garden soil + Sand	31.21	83.31	28.52	13.95	2.52	6.16	18.47
T ₁₁	G ₃ : 500 ppm + M ₃ : Cocopeat+ Garden soil + Sand	31.87	82.11	26.67	11.19	2.41	6.06	18.22
T ₁₂	G ₃ : 500 ppm + M ₄ : Vermicompost+ Garden soil + Sand	30.64	84.46	28.60	14.81	2.67	6.32	18.82
T ₁₃	G ₄ : 600 ppm + M ₁ : Vermiculite + Garden soil + Sand	25.12	91.52	32.78	18.61	3.53	7.59	21.68
T ₁₄	G ₄ : 600 ppm + M ₂ : FYM + Garden soil + Sand	26.80	89.06	29.58	13.80	3.21	7.26	19.80
T ₁₅	G ₄ : 600 ppm + M ₃ : Cocopeat+ Garden soil + Sand	27.66	87.05	27.96	12.69	2.99	7.11	19.33
T ₁₆	G ₄ : 600 ppm + M ₄ : 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 (*Psidium Guajava*) 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)	
G ₁ : GA ₃ 0.00PPM	9.62	3.28	1.30	0.27	1886.47	256.88	36.01	
G ₂ : GA ₃ 400PPM	14.01	4.42	1.54	0.63	2167.85	395.43	46.69	
G ₃ : GA ₃ 500 PPM	15.29	5.44	1.74	0.83	2411.68	525.93	55.23	
G ₄ : 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								
M ₁ : Vermiculite+ Garden Soil + Sand (1:1:1)	14.79	5.19	1.69	0.78	2551.58	502.70	53.20	
M ₂ : FYM + Garden Soil + Sand (1:1:1)	13.68	4.73	1.61	0.75	2260.18	450.16	48.65	
M ₃ : Cocopeat + Garden Soil + Sand (1:1:1)	12.65	4.51	1.56	0.60	2032.17	411.47	47.21	
M ₄ : 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	G ₁ : 0.00 ppm + M ₁ : Vermiculite + Garden soil + Sand	10.42	3.75	1.36	0.38	2126.46	305.08	38.88
T ₂	G ₁ : 0.00 ppm + M ₂ : FYM + Garden soil + Sand	9.64	3.27	1.30	0.23	1896.72	251.33	34.84
T ₃	G ₁ : 0.00 ppm + M ₃ : Cocopeat+ Garden soil + Sand	7.98	2.70	1.22	0.16	1574.43	200.57	32.23
T ₄	G ₁ : 0.00 ppm + M ₄ : Vermicompost+ Garden soil + Sand	10.44	3.40	1.32	0.31	1948.29	270.55	38.08
T ₅	G ₂ : 400 ppm + M ₁ : Vermiculite + Garden soil + Sand	16.54	4.76	1.63	0.71	2414.10	438.96	50.17
T ₆	G ₂ : 400 ppm + M ₂ : FYM + Garden soil	13.60	4.21	1.50	0.63	2134.26	374.32	46.58

T ₇	+ Sand G ₂ : 400 ppm + M ₃ : Cocopeat+ Garden soil + Sand	11.80	4.16	1.45	0.54	1930.30	355.49	42.64
T ₈	G ₂ : 400 ppm + M ₄ : Vermicompost+ Garden soil + Sand	14.10	4.55	1.56	0.66	2192.72	412.96	47.39
T ₉	G ₃ : 500 ppm + M ₁ : Vermiculite + Garden soil + Sand	15.49	5.76	1.83	0.88	2665.66	566.87	57.40
T ₁₀	G ₃ : 500 ppm + M ₂ : FYM + Garden soil + Sand	15.28	5.28	1.73	0.81	2375.63	507.32	54.77
T ₁₁	G ₃ : 500 ppm + M ₃ : Cocopeat+ Garden soil + Sand	15.05	5.10	1.67	0.78	2189.69	482.83	52.38
T ₁₂	G ₃ : 500 ppm + M ₄ : Vermicompost+ Garden soil + Sand	15.34	5.62	1.75	0.85	2415.75	546.71	56.37
T ₁₃	G ₄ : 600 ppm + M ₁ : Vermiculite + Garden soil + Sand	16.71	6.51	1.93	1.31	3000.11	699.87	66.33
T ₁₄	G ₄ : 600 ppm + M ₂ : FYM + Garden soil + Sand	16.18	6.18	1.93	1.14	2634.10	667.67	58.40
T ₁₅	G ₄ : 600 ppm + M ₃ : Cocopeat+ Garden soil + Sand	15.78	6.06	1.89	0.92	2434.25	607.01	61.59
T ₁₆	G ₄ : 600 ppm + M ₄ : 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

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 Mota et al. [35] and Abirami et al. [36] 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 (Aslanpour et 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. [37], Ramteke et al. [38], Rakibuzzaman et al. [39] and Nandini and Singh [40] in papaya.

4. 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).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Shashikumar Standardization of softwood grafting in guava (*Psidium guajava* L.). M. Sc. (Hort.) Thesis, Univ. Agric. Sci., Dharwad; 2010.
2. Praveen Jholgiker, Manga Bade, Anil Sabard. Germination studies in different guava (*Psidium guajava* L.) cultivars. Int.J.Curr.Microbiol.App.Sci. 2017;6(5):2826-2829.
3. Pereira FM. Factors affecting guava production and quality with special reference to São Paulo, Brazil. Acta Horticulturae, The Hague. 1990;275:103-109.
4. Kuperberg J. Rooting guava (*Psidium guajava* L., c. Supreme) stem cuttings in a hydroponic mist-type plant propagator. Florida State Horticultural Society, Bradenton. 1953:220-223.
5. Webber HJ. The guava and its propagation. California Avocado Society, Santa Ana. 1944;29:40-43.
6. Ruehle GD. A rapid method of propagation the guava. California Avocado Society, Santa Ana 1948;33:108-112.
7. Nelson RO. Propagation of guavas by graftage. Florida State Horticultural Society, Bradenton. 1954:228-231.
8. Brijwal M, Kumar R. Studies on the seed germination, and subsequent seedling growth of guava (*Psidium guajava* L.). Indian Journal of Agricultural Research. 2013;47:347-352.
9. Dawood MG. Stimulating plant tolerance against abiotic stress through seed priming. In Rakshi A, Singh H (Eds.). Advances in Seed Priming. 2018:147-183.
10. Essien EP. Breaking of seed coat dormancy in guava. Tropical Science. 2004;44:4-42.
11. Maldonado-Arciniegas F, Ruales C, Caviedes M, Ramírez DX, León-Reyes A. An evaluation of physical, and mechanical scarification methods on seed germination of *Vachellia macracantha* (Humb. & Bonpl. ex Willd.) Seigler & Ebinger. Acta Agronómica. 2018;67:120-125.
12. He MX, Du XF, Chen L, Lu XY, Lan HY. Effects of salt, alternating temperature, and hormone treatments on seed germination, and seedling establishment of *Suaeda aralocaspica* (Chenopodiaceae) dimorphic seeds. Chinese Journal of Ecology. 2013;32:45-51.
13. Humphries T, Chauhan BS, Florentine SK. Environmental factors effecting the germination, and seedling emergence of two populations of an aggressive agricultural weed *Nassella trichotoma*. Plos One. 2018;13:e0199491.
14. Cavallaro V, Maucieri C, Barbera AC. *Lolium multiflorum* Lam. cvs germination under simulated olive mill wastewater salinity, and pH stress. Ecological Engineering. 2014;71:113-117.
15. Lamichhane JR, Debaeke P, Steinberg C, You MP, Barbetti MJ, Aubertot JN. Abiotic, and biotic factors affecting crop seed germination, and seedling emergence: a conceptual framework. Plan and Soil. 2018;432:1-28.
16. Panse VC, Sukhatme PV. Statistical methods for agricultural workers. ICAR, New Delhi; 1967.
17. Abdul-baki A, Anderson JD. Vigour determination in soybean seed by multiple criteria. Crop Sci. 1973;13:630-633.
18. Kumari R, Sindhu SS, Sehrawat SK, Dudi OP. Germination studies on Aonla (*Embllica officinalis* Gaertn). Haryana J Hort. Sci. 2007;36(1-2):9-11.
19. Hayes WB. Fruit Growing in India. Kitabistan, Allahabad. 1953:22-23.
20. Padma L., Basvaraju GV, Sarika G, Amrutha N. Effect of seed treatments to enhance seed quality of papaya (*Carica papaya* L.) cv. surya. Global J. Biol., Agric. Health Sci. 2013;2(3):221-225.
21. Teketay D. Germination of *Acacia origena*, *A. pilispina* and *Pterolobium stellatum* response to different presowing seed treatment, temperature and light. J Arid environ. 1998;14(3-4):551-560.
22. Aaltla HB, Srihari D. Influence of presowing treatments on germination, growth and vigour of mango cv. Alphonso. Asian J Hort. 2013;8(1):122-125.
23. Vishwakarma Deepshikha. Effect of growing media and GA3 on seed germination, growth and survival of acid lime (*Citrus aurantifolia*, Swingle) var. kagz. Dept. of Hort. JNKVV. College of Agri. MP; 2012.
24. Archana C, Jadhav YL, Bhagure, Raundal RM. Effect of PGR, chemicals and plant extract on seed germination and seedling growth of custard apple (*Annona*

- squamosa*). Asian J Hort. 2015;10(1):184-186
25. Ramchandra, Sheogovind. GA₃, thiourea, ethanol and acid treatment in relation to seed germination and seedling growth in guava (*Psidium guajava* L.). Prog. Hort. 1990;22(1-4).
 26. Dinesh A, Padmapriya S. Effect of different pre-sowing treatments on seed germination, seed coat morphology and survival of guava (*Psidium guajava* L.). Journal of Pharmacognosy and Phytochemistry. 2022;11(3):265-269
 27. Rashmi K, Sindhu SS, Sehrawat SK, Dudi OP. Germination studies in aonla (*Emblica officinalis* G.). Haryana J. Hort. Sci. 2007;36(1-2):9-11.
 28. Pampanna Y, Sulikeri GS. Effect of growth regulators on seed germination and seedling growth of sapota. Karnataka J Agric. Sci. 2001;14(4):1030-1036.
 29. Salisbury FB, Ross CW. Plant physiology. CBS Publishers and Distributors, Delhi. 1988:319-329.
 30. Kumawat R, Maji S Govind, Meena DC. Studies on seed germination and seedling growth of papaya (*Carica papaya* L.) cv. Coorg Honey Dew as influenced by media and chemicals. J Crop and Weed. 2014;10(2):281-286.
 31. Boricha Urvashi K, Parmar BR, Parmar AB, Sheetal D Rathod, Patel MV, Pandey AK. Effect of pre-sowing treatments on seed germination and seedling growth of guava. The Pharma Innovation Journal. 2020;9(9):431-433.
 32. Patil H, Tank RV, Bennurmath P, Gotur M. Effect of seed treatment and foliar spray of chemical substances on seedling growth of jamun (*Syzygium cumini* L.). Int. J Chem. Stud. 2018;5(5):1676-1680.
 33. Vasantha PT, Vijendrakumar RC, Guruprasad TR, Mahadevamma M, Santosh KV. Studies on effect of growth regulators and biofertilizers on tamarind (*Tamarindus indica* L.). Plant Archives. 2014;14(1):155-160.
 34. Tandon K, Gurjar PKS, Lekhi R, Soni D. Effect of organic substances and plant growth regulators on seed germination and survival of tamarind (*Tamarindus indica* L.) seedlings. Int. J Curr. Microbiol. App. Sci. 2019;8(2):2270-2274.
 35. Campos Mota L, Van Meeteren U, Blok C. Comparison of physical properties of vermicompost from paper mill sludge and green compost as substitutes for peat based potting media. Acta Hort. 2009;819:227-234.
 36. Abirami K, Rema J, Mathew PA, Srinivasan V, Hamza S. Effect of different propagation media on seed germination, seedling growth and vigour of nutmeg (*Myristica fragrans* Houtt.). J. Med. Plants Res. 2010;4:2054-2058.
 37. Arvind RK, Patel KM, Upadhyay NV. Effect of different growing media and containers on growth of seedlings of papaya (*Carica papaya* L.) cv. Madhubindu. Trends Biosci. 2015;8(1):231-235.
 38. Ramteke V, Paithankar DH, Kamatyanatti M, Baghel MM, Chauhan J, Kurrey V. Seed germination and seedling growth of papaya as influenced by GA₃ and propagation media. Int. J Farm Sci. 2015;5(3):74-81.
 39. Rakibuzzaman M, Maliha M, Dina A, Raisa I, Uddin AFM. Evaluation of growing media for seedling emergence and seedling growth of Red Lady papaya. Int. J Bus. Soc. Sci. Res. 2019;7(4): 27-30.
 40. Nandini S, Singh SK. Effect of growing media on seed germination and growth parameters of papaya seedlings. J Hort. Pest Sci. 2021;1(1):36-45.

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