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Effect of Growing Media and GA_3 on Germination and Growth of Papaya (*Carica papaya* L.) c.v. Tiwan-7

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

A field experiment entitled Effect of growing media and GA_3 on germination, growth and establishment of papaya (*Carica papaya* L.) c.v. Tiwan-7 at the Horticulture Research Farm, Department of Horticulture, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj. The experiment was laid out in Randomized Block Design (RBD) with three replications and 10 (9+1 Control) treatments. The experiment consisted of germination, growth of Papaya. Among the various treatments, application of GA_3 @ 150 ppm dipping for 12 hrs. + Soil + Cocopeat + Vermicompost (1:1:1) took shortest days to seed germination (13.15) and germination percentage (85.44 %) respectively. With respect to seedling growth parameters viz. sapling height (8.47, 13.70, 25.66 and 38.44 cm at 30, 45, 60 and 75 days, respectively), number of leaves (6.90, 9.10, 12.15

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and 18.89 at 30, 45, 60 and 75 days, respectively), stem diameter (mm) (4.05, 5.80, 6.10 and 7.05 at 30, 45, 60 and 75 days respectively), leaf area cm2(51.48), roots to shoot ratio (4.50) was obtained best under of GA_3 @ 150 ppm dipping for 12hrs. + Soil + Cocopeat + Vermicompost (1:1:1). From the successful germination and development of growth performance of papaya seedlings, it can be concluded that papaya seeds treated with GA_3 @ 150 ppm dipping for 12hrs. + Soil + Cocopeat + Vermicompost (1:1:1) significantly increased the various seed germination parameters along with seedling growth parameters as compared to other treatments and hence, termed as best treatment, while the poorest and inferior among all was observed under T0-Control.

Keywords: GA_3; cocopeat; vermicompost; growth; germination; papaya.

1. INTRODUCTION

"Papaya (*Carica papaya* L.) is an important fruit crop of tropical world and has long been known as wonder fruits of the tropics. It gives higher production of fruits per hectare and income next to banana. It belongs to the family Caricaceae and is native of Tropical America. It was introduced into India in the 16th century. It is grown in almost all tropical and subtropical countries of the world and occupies a unique place amongst the fruit crops grown in India. It can be cultivated in a temperature range of 25-35˚C". (Ram, 2007) Papaya is a herbaceous plant because the stem does not have much wood and remains soft and green until its death. The leaves are large, 50-70 cm wide. Some plants have perfect (with female and male organs) flowers but other plants have flowers with only one sex (female or male). Fruit pear-shaped, pendant and with lots of seeds.

"In India, papaya is being cultivated an area of about 138.4 thousand hectares having annual production of 5989.88 thousand metric tonnes with productivity of 43.30 mt/ha. Andhra Pradesh is leading state in papaya production followed by Gujarat, Karnataka, Madhya Pradesh, Maharashtra and Chhattisgarh. In Chhattisgarh, papaya is cultivated in an area of about 14.40 thousand hectares with production of 381.42 thousand metric tonnes and productivity is 26.48 mt/ha. And the top five major papaya producing districts of Chhattisgarh are Durg, Mahasamund, Raipur, Bilaspur and Bemetara" [1]. "It is highly valued for its digestive properties. The nutritive and medicinal properties of papaya are well known. 100 g edible portion of papaya contains moisture 89.6 %, carbohydrate 9.5%, proteins 0.5%, fat 0.1%, calorific value 4.0%, minerals 0.4%, calcium 0.01%, phosphorus 0.01%, iron 0.4 mg, carotene (Vit A) 2020 IU, thiamine (Vit B) 40 IU, riboflavin (Vit B_{12}) 250 IU, nicotinic acid 0.2 IU" [2].

"Cocopeat is also becoming very popular material as a growing media. It has an excellent pore space (25-30 per cent) and fine structure required for proper growth and development of seedlings. Moreover, it is a rich source of nutrients and can easily be mixed with other growing media. Vermiculite is the micaceous mineral which expands significantly when heated. Chemically it is hydrated magnesium, aluminium, iron, silicate. When expanded it is very light in weight. It is neutral in reaction and has good buffering properties. It is insoluble in water. Vermiculite is available in 4 Grades, out of which the Horticultural Grade No. 2 should be used for rooting and No. 4 for seed germination". (Edwards, 2009)

"Vermicompost is a peat-like material with high porosity, aeration, drainage, water holding capacity and microbial activity, which make it an excellence soil conditioner" [3]. There are many reports available in the literature, which indicates that vermicompost contain plant growth regulating materials, such as humic acid Muscsolo et al., [4] and plant growth regulators like auxin, gibberellins and cytokinins Tomati et al., [5], which are responsible for increase in plant growth and yield of many crops [6]. "It is used as a media for propagation but should be mixed with soil in proper combination" [3]

Gibberellins were discovered during scientific studies on diseases of rice caused by the fungus *Gibberella fujikuroi.* The effects of GA_3 were studied on different plants. Gibberellins support seed germination between many other effects by alpha-amylase which breaks down starch. Released sugars support the embryo growth until it becomes autotrophic. The positive influence of gibberellins on the germination of many non-dormant seeds has been proved many times. Thus, this study aimed to study the effect of growing media and GA_3 on germination, growth and establishment on papaya. To estimate the economics of different treatments.

2. MATERIALS AND METHODS

This experiment was conducted to study the effect of growing media and GA_3 on germination, growth and establishment on papaya was conducted during February to May during the summer season of the year 2023-24 at Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom, University of Agriculture, Technology and Sciences, Prayagraj (Uttar Pradesh) which is located at 25° 39' 42"N latitude, 81° 67 56" E longitude, and 98 m altitude above the mean sea level (MSL). This area is situated on the right side of the river Yamuna by the side of Prayagraj Rewa Road about 5 km away from Prayagraj (U.P) city. The experiment was laid out in Randomized Block Design which consisting of ten treatments with T_0 – Control, T_1 – GA_3@50ppm dipping for 12hrs.+Soil+ Cocopeat (1:1), T_2 – GA_3@50ppm dipping for 12hrs. + Soil +Vermicompost (1:1), T_3 - GA_3@50ppm dipping for 12hrs. + Soil + Cocopeat + Vermicompost (1:1:1), T_4 - GA_3@100ppm dipping for 12hrs. + Soil + Cocopeat (1:1), T_5 - GA_3@100ppm dipping for 12hrs. + Soil + Vermicompost (1:1), T_6 - GA_3@100ppm dipping for 12hrs. + Soil + Cocopeat + Vermicompost (1:1:1), T_7 - GA_3@150ppm dipping for 12hrs. + Soil + Cocopeat (1:1), T_8 - GA_3@150ppm dipping for 12hrs. + Soil + Vermicompost (1:1), T_9 - GA_3@150ppm dipping for 12hrs. + Soil + Cocopeat + Vermicompost (1:1:1).

3. RESULTS AND DISCUSSION

3.1 Germination Parameter

3.1.1 Days to germination

“The data regarding the effect of different growth media and GA_3 on the imbibition period of papaya seed has been presented in the Table 1. The perusal of data revealed that the imbibition period was significantly affected by various growth media and GA_3. The least imbibition period (13.15 days) was recorded with GA_3@150ppm dipping for 12hrs. + Soil + Cocopeat + Vermicompost (1:1:1) (T_9) over rest of the treatments, which was significantly superior than other treatments except treatment T_6, which was found to be statistically at par”[3].

It might be due to GA_3 helped in physically breaching, thereby removing physiological barriers associated with the impermeable seed coats that cause seed dormancy (Mayer and Mayber 1963). Similar results are also obtained by Patil et al. [7] in rangpur lime and Kumawat et al. [8] in papaya.

3.1.2 Germination percentage (%)

The data regarding the effect of different growth media and GA_3 on the germination % of papaya seed has been presented in the Table 1.

The maximum germination percentage (85.44%) was recorded in treatment T_9 (GA_3@150ppm dipping for 12hrs. + Soil + Cocopeat + Vermicompost (1:1:1)) which was found significantly higher over rest of the treatments except T_6 which was found statistically at par.

Increase in germination percentage is might be due to GA_3 which acts on the embryo and causes synthesis of hydrolysing enzymes particularly amylase and protease and this hydrolysed food is utilized for growth of embryo and thereby enhanced the germination (Paleg, 1965). Similar results were also obtained by Deb et al. (2010) in papaya. “It might be due to the media containing organic manures possess organic acid within them. Therefore, more available moisture and some acids may have helped in better germination percentage” [9]. These results were in close agreement with Mandal et al. [10] and Ramteke et al. [11] in papaya when they used cocopeat as ingredients of growing media.

3.2 Growth Parameters

3.2.1 Plant height (cm)

The data pertaining to plant height (cm) in different treatment combinations was recorded and are presented in table 2. Critical analysis of data displayed in table clearly marked out the obvious difference among the treatments with respect to plant height. Significant differences were observed amongst the treatments with respect to plant height of Papaya.

Significantly the maximum plant height of 38.44 cm at 75 days after sowing was recorded at T_9 [GA_3@150ppm dipping for 12hrs. + Soil + Cocopeat + Vermicompost (1:1:1)] followed by T_6 [GA_3@100ppm dipping for 12hrs. + Soil + Cocopeat + Vermicompost (1:1:1)] of 37.94 cm, respectively, whereas minimum plant height of 30.23 cm was recorded in T_0 [Control].

Table 1. Effect of growing media and GA_3 on germination and survival % of papaya

Treatment Symbol	Treatment combinations	Days to Germination	Germination %
T_0	Control	20.45	65.56
T_1	GA_3@50ppm Soil+ Cocopeat	18.00	71.48
T_2	GA_3@50ppm + Soil +Vermicompost	17.93	73.66
T_3	GA_3@50ppm + Soil + Cocopeat + Vermicompost	14.97	80.23
T_4	GA_3@100ppm + Soil + Cocopeat	18.96	67.94
T_5	GA_3@100ppm + Soil + Vermicompost	18.19	69.09
T_6	GA_3@100ppm + Soil + Cocopeat + Vermicompost	14.62	83.37
T_7	GA_3@150ppm + Soil + Cocopeat	16.09	76.46
T_8	GA_3@150ppm + Soil + Vermicompost	15.68	78.94
T_9	GA_3@150ppm + Soil + Cocopeat + Vermicompost	13.15	85.44
	F-test	**S**	**S**
	SEm(±)	0.49	2.30
	CD (p=0.05)	1.46	6.84

Table 2. Effect of growing media and GA3 on growth of papaya

Treatment Symbol	Treatment combinations	Plant height (cm) 75 DAS	Leaves/plant 75 DAS	Stem Diameter (mm) 75 DAS	Leaf area (cm^2)
T_0	Control	30.23	14.89	5.87	40.20
T_1	GA_3@50ppm Soil+ Cocopeat	34.66	15.29	6.66	47.90
T_2	GA_3@50ppm + Soil +Vermicompost	35.15	15.87	6.73	48.48
T_3	GA_3@50ppm + Soil + Cocopeat + Vermicompost	36.19	17.49	6.96	50.10
T_4	GA_3@100ppm + Soil + Cocopeat	33.30	14.78	6.13	44.50
T_5	GA_3@100ppm + Soil + Vermicompost	33.89	15.10	6.62	45.86
T_6	GA_3@100ppm + Soil + Cocopeat + Vermicompost	37.94	17.96	7.01	50.56
T_7	GA_3@150ppm + Soil + Cocopeat	35.50	16.00	6.80	48.97
T_8	GA_3@150ppm + Soil + Vermicompost	35.78	16.30	6.88	49.50
T_9	GA_3@150ppm + Soil + Cocopeat + Vermicompost	38.44	18.89	7.05	51.48
	F-test	**S**	**S**	**S**	**S**
	SEm(±)	1.12	0.48	0.23	1.41
	CD (p=0.05)	3.31	1.43	0.68	4.18

It might be due to the cocopeat provides adequate nutrients and enhances both the physical and biological properties and the water holding capacity of soil [12]. These results were also in conformity with the finding of Kumawat et al. (2014) in papaya when they used cocopeat as ingredients of growing media.

3.2.2 Numbers of leaves of papaya

The data pertaining to numbers of leaves per plant in different treatment combinations was recorded and are presented in table 2. Critical analysis of data displayed in table clearly marked out the obvious difference among the treatments with respect to numbers of leaves per plant. Significant differences were observed amongst the treatments with respect to number of leaves per plant of papaya.

Significantly the maximum numbers of leaves 18.89 at 75 days after sowing was recorded at T_9 [GA_3@150ppm dipping for 12hrs. + Soil + Cocopeat + Vermicompost (1:1:1)] followed by T_6 [GA_3@100ppm dipping for 12hrs. + Soil + Cocopeat + Vermicompost (1:1:1)] of 17.96, respectively, whereas minimum numbers of leaves 14.89 was recorded in T_0 [Control].

This might be due to combination of this media provided better condition like aeration and porosity for proper growth and development of seedlings leads to increase number of leaves. These results were in close agreement with Ramteke et al. [13] in papaya when they used cocopeat as ingredients of growing media.

3.2.3 Stem diameter (mm)

The data pertaining to Stem diameter (mm) in different treatment combinations was recorded and are presented in table 2. Critical analysis of data displayed in table clearly marked out the obvious difference among the treatments with respect to Stem diameter. Significant differences were observed amongst the treatments with respect to stem diameter of papaya.

Significantly the maximum stem diameter (mm) 7.05 mm at 75 days after sowing was recorded at T_9 [GA_3@150ppm dipping for 12hrs. + Soil + Cocopeat + Vermicompost (1:1:1)] followed by T_6 [GA_3@100ppm dipping for 12hrs. + Soil + Cocopeat + Vermicompost (1:1:1)] of 7.01 mm, respectively, whereas minimum stem diameter (mm) 5.87 mm was recorded in T_0 [Control].

This may be attributed due to general improvement in the physical and chemical properties of the rooting medium (Dilip et al. 1994). This results were in close confirmity with finding of Bhardwaj [14] and Ramteke et al. [13] in papaya when they used cocopeat as ingredients of growing media.

3.2.4 Leaf area cm^2

The data pertaining to leaf area cm^2 in different treatment combinations was recorded and are presented in table 2. Critical analysis of data displayed in table clearly marked out the obvious difference among the treatments with respect to leaf area m^2. Significant differences were observed amongst the treatments with respect to leaf area m^2 of papaya.

Significantly the maximum leaf area cm^2 51.48 was recorded at T_9 [GA_3@150ppm dipping for 12hrs. + Soil + Cocopeat + Vermicompost (1:1:1)] followed by T_6 [GA_3@100ppm dipping for 12hrs. + Soil + Cocopeat + Vermicompost (1:1:1)] of 50.56, respectively, whereas minimum leaf area cm^2 40.20 was recorded in T_0 [Control].

This might be due to the presence of growth promoting substances (auxins) and nutrients in cow urine which helped to increase leaf area. These results were in close agreement with Vanangamudi and Vanangamudi (2003) in tamarind and Shivamurthy and Patil [15] in wheat [16-19].

4. CONCLUSION

Based on the results of the present study, it is concluded that, treatment T_9 (GA_3@150ppm dipping for 12hrs. + Soil + Cocopeat + Vermicompost (1:1:1)) performed best in terms of Germination, growth of papaya and the maximum survival % was also obtained in this treatment.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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