

Effect of different levels of cinder and vermicompost on germination and seedling growth of Papaya (*Carica papaya c.v Red lady*) its treatment with GA₃

Abstract

An experiment was conducted to find out suitable growth hormone and growing medium for germination and seedling growth of papaya. The treatments included soaking the seed of papaya variety Red lady in GA₃(200ppm) for 24.00 hours except for control. The perforated polythene bags of 4 x 5 cm size (150 gauges thickness) were used for sowing. The bags were filled with a mixture of Soil, Vermicompost, Cinder and Cocopeat in the ratio of 1:1:1, 1:2:1, 1:1:2 and 2:1:1. Experiment was laid out in Completely randomized design nine treatment with three replication. Findings indicate that treatment T₉ Soil +Cocopeat +Vermicompost +Cinder (1:1:1:1) +GA₃ 200ppm performed best in terms of growth parameters *viz.*, germination (77.37), days taken for completion of germination (15.27), seedling height (25.00 cm), number of leaves per seedling (13.53 cm), diameter of seedling (cm) (1.03), Leaf area (cm²) (97.64cm), Chlorophyll content (SPAD Value) (54.97), Length of longest tap root (4.52 cm) and Survival (%) (83.27) under Prayagraj agro-climatic condition.

INTRODUCTION

Papaya is a tropical fruit of the family Caricaceae that is highly nutritious and has medicinal properties. A tropical fruit crop with rapid growth, continuous fruiting cycle, and evergreen nature. It is an exceptionally wholesome, refreshing, and delicious tropical fruit that belongs to the Caricaceae family. Native to tropical America, papaya is also known by the names papaw or pawpaw. Growing media for use in container nurseries is available in two basic forms: soil based and organic based. Compared with soil based media that has field soil as a major component, organic based media (a base of organic materials that may be compost, peat, coconut coir, or other organic materials, mixed with inorganic ingredients) promotes better root development. In temperate areas, nurseries can choose from a wide range of commercial products for their growing media, including peat moss, vermiculite, and perlite, and premixed blends of these ingredients. Most nurseries in the tropics, however, do not have easy and affordable access to these materials, and even nurseries in temperate areas are seeking to replace some of these ingredients with more local and sustainable materials. In the tropics, growers often create their own media using locally available ingredients (Bharadwaj, 2014). Gibberellic acid play a vital role in plants specially in fruits crops for example grapes, papaya etc. Cell growth and cell elongation of plants specially in horticultural crops (Bharadwaj, 2014). Gibberellic acid can be used as a seed dormancy breaker. Gibberellic acid is a very potent hormone to trigger germination in fruits seed specially in papaya. Its widely used in the growing industry as a hormone to induce the production of larger bundles and bigger specially Thompson seedless in grapes and papaya (Bharadwaj, 2014) and Mishra *et al.*, (2017). Gibberellic acid (also called Gibberellin A₃, GA, and GA₃) is a hormone found in plants and fungi. GA₃ appears mainly to induce the activity of the gluconeogenic enzymes during early stages of seed germinations. Cow urine contains about 1.21% N₂, 0.01% P₂O₅ and 1.35%

K2O (Subramaniyam, 2005) with micronutrients Fe, Mn, Zn and Cu (Yawalkar, 1996). Media is a substrate that provides the required elements and physical support to the growing plants. Propagation media used in raising horticultural plants in the nursery are mostly organic or inorganic in nature. Papaya is normally propagated by seed and it is interested by researchers due to the presence of gelatinous sarcotesta preventing germination **Desai et al., (2017)**. Thus, this study was taken upto to study the objectives which are framed ; To estimate the different levels of cinder, vermicompost and cocopeat on germination , seedling growth of papaya and also to estimate the cost of cultivation of different treatments.

MATERIALS AND METHODS

The experiment was conducted at the Department of Horticulture, Sam Higginbottom Institute of Agriculture, Technology and Sciences, Prayagraj, during the year 2023. The seed of papaya variety, Red Lady was purchased from the authentic sources in Prayagraj. The treatments included soaking the seed of papaya variety Red lady in GA₃(200ppm) for 24.00 hrs duration along with a control. Experiment was laid out

in Completely randomized design nine treatment with three replication. The treatment combination viz.,

T₀ Soil, T₁ Soil+Vermicompost +Cinder (1:1:1)+ GA₃ 200ppm, T₂ Soil+Vermicompost +Cinder (1:2:1) + GA₃ 200ppm, T₃ Soil+Vermicompost +Cinder (1:1:2) + GA₃ 200ppm, T₄Soil+Vermicompost +Cinder (2:1:1) + GA₃ 200ppm, T₅ Cocopeat+Vermicompost +Cinder (1:1:1) + GA₃ 200ppm, T₆Cocopeat +Vermicompost +Cinder (1:2:1) + GA₃ 200ppm, T₇Cocopeat +Vermicompost +Cinder (1:1:2) + GA₃ 200ppm, and T₈ Cocopeat +Vermicompost +Cinder (2:1:1) + GA₃ 200ppm and T₉Soil+Cocopeat +Vermicompost +Cinder (1:1:1:1) + GA₃ 200ppm. The polythene bags (4 x 5 cm 150 guage) were purchased from local market of Prayagraj. The perforated polythene bags of 4 x 5 cm size (150 gauges thickness) were used for sowing. The bags were filled with a mixture of Soil, Vermicompost, Cinder and Cocopeat in the ratio of 1:1:1, 1:2:1, 1:1:2 and 2:1:1. Before sowing the seeds in the polythene bags, soil were treated with fungicide, i.e. copper oxychloride @ 2%. Two seeds were sown in each polythene bags. Regular watering with water-cane was done gently in morning and evening. Treated papaya seeds were sown at 24.00 hrs in polythene bags which were properly filled, labeled with tags and placed as per layout. Generally, papaya crop is irrigated at 8-10 days interval in winter and 4-5 days in summer season depending upon the climatic changes and the soil. Irrigation was provided to seeds sown in polythene bags using water-cane and maintained the proper moisture level. Pre sowing-dip method was adopted for seed treatment. Sufficient amount of Growth regulators of different concentrations were poured in required quantity into the labeled beakers.

RESULTS AND DISCUSSION

The data are represented in the Table 1. It was clear that the effect of different levels of cinder and vermicompost and seed treatment with GA₃ showed significant results on germination and seedling growth of Papaya. Gibberellic acid acts on the embryo and causes synthesis of hydrolyzing enzymes particularly growth of embryo and this hydrolyzed food is utilized for growth of embryo and there by enhanced the germination. Similar finding were reported by **Bharche et al., (2010)**, **Babu et al., (2010)** in papaya and **Mishra et al., (2017)**. It might due to the reason

that media containing organic manures possess organic acid within them. Therefore, more available moisture and some acids may have helped in minimum days to germination and better germination percentage. Similar results were reported by **Prasana et al., (2014)** in mango. Whereas, the maximum days taken for completion of germination (15.27) was recorded in T₉ Soil+Cocopeat +Vermicompost +Cinder (1:1:1:1) + GA₃ 200ppm followed by T₈ Cocopeat +Vermicompost +Cinder (2:1:1) + GA₃ 200ppm, T₁ Soil+Vermicompost +Cinder (1:1:1)+ GA₃ 200ppm and T₂ Soil+Vermicompost +Cinder (1:2:1) + GA₃ 200ppm. While the minimum days taken for completion of germination 15.27 respectively were recorded in T₀ (Soil). Gibberellic acid acts on the embryo and causes synthesis of hydrolyzing enzymes particularly growth of embryo and this hydrolyzed food is utilized for growth of embryo and there by enhanced the germination. Similar finding were reported by **Bharche et al., (2010)**, **Babu et al., (2010)** in papaya and **Mishra et al., (2017)**. It might due to the reason that media containing organic manures possess organic acid within them. Therefore, more available moisture and some acids may have helped in minimum days to germination and better germination percentage. Similar results were reported by **Prasana et al., (2014)** in mango. Whereas maximum seedling height was observed in T₉ Soil+Cocopeat +Vermicompost +Cinder (1:1:1:1) + GA₃ 200ppm with 25.00 cm, followed by T₈ Cocopeat +Vermicompost +Cinder (2:1:1) + GA₃ 200ppm, T₃ Soil+Vermicompost +Cinder (1:1:2) + GA₃ 200ppm, T₂ Soil+Vermicompost +Cinder (1:2:1) + GA₃ 200ppm and T₁ Soil+Vermicompost +Cinder (1:1:1)+ GA₃ 200ppm. While the minimum seedling height 18.77 cm respectively were observed in T₀ (Soil). The increased height in GA₃ 200 ppm seeds may be attributed to the reason that the endogenous levels of GA₃ synthesized by the papaya seedling might not be sufficient and external application of GA₃ might have boosted growth by increasing cell multiplication and cell elongation resulting in better plant growth **Mishra et al., (2017)**. Growing medium not only acts as a growing place but also as a source of nutrient for plant growth. Media composition used influences the quality of seedling **Wilson et al., (2001)**. Humic acids (vermicompost) applied in the medium increased plant height, leaf area and dry weight of peppers, tomatoes and marigold **Arancon et al., (2004)**. While as maximum Number of leaves per seedling was observed in T₉ Soil+Cocopeat +Vermicompost +Cinder (1:1:1:1) + GA₃200ppm with 13.53 cm, followed by T₈ Cocopeat +Vermicompost +Cinder (2:1:1) + GA₃ 200ppm, T₃ Soil+Vermicompost +Cinder (1:1:2) + GA₃ 200ppm, T₂ Soil+Vermicompost +Cinder (1:2:1) + GA₃ 200ppm and T₁ Soil+Vermicompost +Cinder (1:1:1)+ GA₃ 200ppm. While the minimum Number of leaves per seedling 9.22 respectively were observed in T₀ (Soil). Increase in number of leaves might be due to the reason that GA₃ helps in invigoration of physiological process of plant and stimulatory effect of chemicals to form new leaves at a faster rate **Mishra et al., (2017)**. Growing medium not only acts as a growing place but also as a source of nutrient for plant growth. Media composition used influences the quality of seedling **Wilson et al., (2001)**. Humic acids (vermicompost) applied in the medium increased plant height, leaf area and dry weight of peppers, tomatoes and marigold **Arancon et al., (2004)**. The maximum diameter of seedling (cm) was observed in T₉ Soil+Cocopeat +Vermicompost +Cinder (1:1:1:1) + GA₃ 200ppm with 1.03 cm, followed by T₈ Cocopeat +Vermicompost +Cinder (2:1:1) + GA₃ 200ppm, T₃ Soil+Vermicompost +Cinder (1:1:2) + GA₃ 200ppm, T₂ Soil+Vermicompost +Cinder (1:2:1) + GA₃ 200ppm and T₁ Soil+Vermicompost +Cinder (1:1:1)+ GA₃ 200ppm. While the minimum diameter of seedling (cm) 0.50 respectively were observed in T₀ (Soil). The increase in diameter as a result of GA₃ application might be due to the fact that GA₃ increase somatic uptake of nutrients causing cell

elongation and thus increasing height of the plant (Faucht and Watson, 1958). Similar, results were also recorded by Dhankar and Singh (1996) in aonla and Bharche et al., (2010) in papaya Mishra et al., (2017). Growing medium not only acts as a growing place but also as a source of nutrient for plant growth. Media composition used influences the quality of seedling Wilson et al., (2001). Humic acids (vermicompost) applied in the medium increased plant height, leaf area and dry weight of peppers, tomatoes and marigold Arancon et al., (2004). The maximum Leaf area (cm²) was observed in T₉ Soil+Cocopeat +Vermicompost +Cinder (1:1:1:1) + GA₃ 200ppm with 97.64 cm, followed by Cocopeat +Vermicompost +Cinder (2:1:1) + GA₃ 200ppm, Cocopeat +Vermicompost +Cinder (1:2:1) + GA₃ 200ppm and Cocopeat +Vermicompost +Cinder (1:1:2) + GA₃ 200ppm. While the minimum Leaf area (cm²) 56.51 respectively were observed in T₀ (Soil). Increase in number of leaves might be due to the reason that GA₃ helps in invigoration of physiological process of plant and stimulatory effect of chemicals to form new leaves at a faster rate Mishra et al., (2017). Growing medium not only acts as a growing place but also as a source of nutrient for plant growth. Media composition used influences the quality of seedling Wilson et al., (2001). Humic acids (vermicompost) applied in the medium increased plant height, leaf area and dry weight of peppers, tomatoes and marigold Arancon et al., (2004). Whereas, the maximum Chlorophyll content (SPAD Value) (54.97) was recorded in T₉ Soil+Cocopeat +Vermicompost +Cinder (1:1:1:1) + GA₃ 200ppm followed by T₈ Cocopeat +Vermicompost +Cinder (2:1:1) + GA₃ 200ppm, T₄ Soil+Vermicompost +Cinder (2:1:1) + GA₃ 200ppm and T₃ Soil+Vermicompost +Cinder (1:1:2) + GA₃ 200ppm. While the minimum Chlorophyll content (SPAD Value) 44.71 respectively were recorded in T₀ (Soil). This seems to be the effect of mobilization of water and nutrients transported at higher rate which might have promoted more production of photosynthetic product and translocated them to various plant parts which might have resulted in better growth of the seedlings and hence more fresh and dry weight. These findings are in agreement with the results obtained by Lay et al. (2015) in papaya. The different levels of GA₃ did not affect significantly to increase chlorophyll content. Whereas, the maximum Length of longest tap root (cm) (6.50) was recorded in T₉ Soil+Cocopeat +Vermicompost +Cinder (1:1:1:1) +GA₃ 200ppm followed by T₈ Cocopeat +Vermicompost +Cinder (2:1:1) +GA₃ 200ppm, T₂ Soil+Vermicompost +Cinder (1:2:1) +GA₃ 200ppm and T₁ Soil+Vermicompost +Cinder (1:1:1)+GA₃ 200ppm. While the minimum Length of longest tap root (cm) 4.52 respectively were recorded in T₀ (Soil). This might be due to the fact that, GA₃ increases somatic uptake of nutrients, causing cell elongation and thus increasing the length of tap root and number of secondary roots. Mishra et al., (2017). Whereas, the maximum Survival (%) (83.27) was recorded in T₉ Soil+Cocopeat +Vermicompost +Cinder (1:1:1:1) +GA₃ 200ppm followed by T₈ Cocopeat +Vermicompost +Cinder (2:1:1) +GA₃ 200ppm, T₈ Cocopeat +Vermicompost +Cinder (2:1:1) +GA₃ 200ppm, T₂ Soil+Vermicompost +Cinder (1:2:1) +GA₃ 200ppm and T₁ Soil+Vermicompost +Cinder (1:1:1)+GA₃ 200ppm. While the minimum Survival (%) 58.64 respectively were recorded in T₀ (Soil). This might be due to GA₃ that was cause of weakening of the seed coat so that the emergence of radical and plumule positively influence to the root and shoot initiation. Beside this, GA₃ also helps in cell expansion and its elongation resulting better root and shoot growth, which supports and encourage better survival of the seedlings (Rahangdale, 2015).

Table 1: Effect of different levels of cinder, vermicompost and GA₃ on germination and seedling growth of Papaya.

Treatments No.	Germination (%)	Days taken for completion of germination	Seedling height (cm)			Number of leaves per seedling			Diameter of seedling (cm)			Leaf area (cm ²)		
			30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS
T ₀	47.05	22.94	6.71	12.18	18.77	4.03	6.08	9.22	0.15	0.27	0.50	15.33	28.77	56.51
T ₁	74.08	16.40	9.88	16.34	22.84	6.13	9.19	12.39	0.26	0.53	0.97	36.33	46.45	81.77
T ₂	75.72	16.63	9.31	16.80	22.73	6.38	9.49	12.52	0.28	0.53	0.79	32.67	48.54	82.47
T ₃	68.00	17.52	9.95	15.69	21.67	6.07	8.75	12.28	0.24	0.50	0.77	31.38	51.56	85.00
T ₄	58.00	18.23	7.67	13.77	19.81	4.96	7.49	10.71	0.18	0.35	0.57	28.39	51.79	85.43
T ₅	54.51	19.51	8.01	13.84	19.83	5.24	7.33	10.73	0.18	0.33	0.57	28.53	52.15	80.07
T ₆	51.33	19.21	7.45	14.00	20.36	5.18	7.19	10.53	0.17	0.32	0.54	33.97	54.08	83.44
T ₇	61.17	17.89	9.65	15.54	21.76	5.18	8.20	11.87	0.23	0.45	0.62	31.64	51.15	83.82
T ₈	71.38	16.41	9.91	17.10	22.04	6.39	9.77	13.15	0.31	0.56	1.00	33.53	55.74	96.82
T ₉	77.37	15.27	10.66	17.74	25.00	6.58	9.87	13.53	0.33	0.60	1.03	35.05	59.17	97.64
F-Test	S	S	S	S	S	S	S	S	S	S	S	S	S	S
S.Ed.(±)	2.16	0.65	0.21	0.61	0.60	0.14	0.19	0.27	0.01	0.01	0.03	0.80	1.79	1.43
C.D. at 0.5%	4.54	1.38	0.44	1.28	1.27	0.29	0.40	0.57	0.02	0.03	0.07	1.69	3.78	3.00
CV	4.15	4.49	2.92	4.89	3.45	3.06	2.80	2.84	6.97	4.47	5.69	3.22	4.41	2.10

Table 2: Effect of different levels of cinder, vermicompost and GA₃ on germination and seedling growth of papaya.

Treatments No.	Chlorophyll content (SPAD Value)	Length of longest tap root (cm)	Survival (%)
T ₀	44.71	4.52	58.64
T ₁	48.02	5.49	80.69
T ₂	48.44	5.38	86.15
T ₃	50.62	5.26	75.64
T ₄	51.65	5.16	66.30
T ₅	47.67	5.48	61.19
T ₆	47.63	5.51	59.54
T ₇	49.87	6.14	71.60
T ₈	53.85	6.16	82.36
T ₉	54.97	6.50	83.27
F-Test	S	S	S
S.Ed.(±)	0.80	0.19	0.99
C.D. at 0.5%	1.69	0.41	2.09
CV	1.98	4.32	1.68

CONCLUSION

Based on the above finding, it is concluded that treatment T₉ Soil+Cocopeat +Vermicompost +Cinder (1:1:1:1) + GA₃ 200ppm performed best in terms of germination percentage (77.37%), days taken for completion of germination (15.27), and growth parameters were seedling height (25.00 cm), number of leaves per seedling (13.53), diameter of seedling (1.03cm), Leaf area (97.64cm²), Chlorophyll content (SPAD Value) (54.97), Length of longest tap root (4.52cm) and Survival percentage (83.27%) under Prayagraj agro-climatic condition.

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