**Effect of different levels of cinder and vermicompost on germination and seedling growth of ~~Papaya~~ pawpaw *(Carica papaya c.v* Red lady*)* ~~its treatment~~treated ~~-~~with Gibberellic acid~~GA$_3$~~

Abstract

An experiment was conducted to find ~~out~~ suitable growth ~~hormone~~ hormones and growing medium for germination and seedling growth of ~~papaya~~pawpaw. The treatments included soaking the seeds of ~~papaya~~ pawpaw ~~variety~~ Red lady varieties in GA_3 (Gibberellic acid) (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 s~~S~~oil, 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 a Completely ~~randomized~~ randomised design nine ~~treatment~~ treatments with three replications. Findings indicated that treatment T_9 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

Carica p~~P~~apaya 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~~ pawpaw is also known by the ~~names~~name's papaw ~~or pawpaw~~. Growing media for use in container nurseries is available in two basic forms: ~~soil based~~soil-based and ~~organic based~~organic-based. Compared with ~~soil based~~soil-based media that has field soil as a major component, ~~organic based~~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~~plays 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~~ that triggers germination in fruits seed specially in ~~papaya~~pawpaw. Its widely used in the growing industry as a hormone to induce the production of larger bundles

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and bigger ~~specially~~ especially 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 the early stages of seed ~~germinations~~germination. 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~~ Pawpaw is normally propagated by seeds and it is ~~interested~~ interesting ~~by~~ to researchers due to the presence of gelatinous sarcotesta preventing germination **(Desai *et al.*, (2017).** Thus, this study ~~was taken~~took up to ~~to~~ study the objectives which are framed ; To estimate the different levels of cinder, vermicompost and cocopeat on germination~~.~~, and seedling growth of ~~papaya~~ pawpaw 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 seeds of Red Lady ~~papaya~~ pawpaw variety~~.~~ ~~Red Lady~~ w~~er~~e~~as~~ purchased from the authentic sources in Prayagraj. The treatments included soaking the seeds ~~of papaya variety Red lady~~ in GA_3(200ppm) for 24.00 hrs duration along with a control. Experiment was laid out in Completely randomized design nine treatment with three replications. The treatment combination viz.,

T_0 Soil, T_1 Soil+Vermicompost +Cinder (1:1:1)+ GA_3 200ppm, T_2 Soil+Vermicompost +Cinder (1:2:1) + GA_3 200ppm, T_3 Soil+Vermicompost +Cinder (1:1:2) + GA_3 200ppm, T_4Soil+Vermicompost +Cinder (2:1:1) + GA_3 200ppm, T_5 Cocopeat+Vermicompost +Cinder (1:1:1) + GA_3 200ppm, T_6Cocopeat +Vermicompost +Cinder (1:2:1) + GA_3 200ppm, T_7Cocopeat +Vermicompost +Cinder (1:1:2) + GA_3 200ppm, and T_8 Cocopeat +Vermicompost +Cinder (2:1:1) + GA_3 200ppm and T_9Soil+Cocopeat +Vermicompost +Cinder (1:1:1:1) + GA_3 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 w~~as~~e~~re~~ 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 the morning and evening. Treated *C. papaya* seeds were sown at 24.00 hrs in polythene bags which were properly filled, ~~labeled~~labelled with tags and placed as per layout. Generally, *C. papaya* plant~~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~~Pre-sowing-dip method was adopted for seeds treatment. Sufficient amount of g~~G~~rowth regulators of different concentrations were poured in required quantity into the ~~labeled~~labelled beakers.

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RESULTS AND DISCUSSION

The data are represented in the Table 1. It was clear that the effect of different levels of cinder and vermicompsot and seed treatment ~~with GA~~with GA3 showed significant results on germination and seedling growth of *C. p~~P~~apaya*. Gibberellic acid acts on the embryo and causes synthesis of hydrolyzing enzymes particularly the growth of an embryo and this hydrolyzed food is utilized for the growth of an embryo and there by ~~enhanced~~ enhances ~~the~~ germination. Similar findings were reported by **Bharche *et al.*~~,~~ (2010)~~:~~, Babu *et al.*, (2010) ~~in papaya~~ and Mishra *et al.*~~,~~ (2017) in papaya.** 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 T_9 Soil+Cocopeat +Vermicompost +Cinder (1:1:1:1) + GA_3 200ppm followed by T_8 Cocopeat +Vermicompost +Cinder (2:1:1) + GA_3 200ppm, T_1 Soil+Vermicompost +Cinder (1:1:1)+ GA_3 200ppm and T_2 Soil+Vermicompost +Cinder (1:2:1) + GA_3 200ppm. While the minimum days taken for completion of germination 15.27 respectively were recorded in T_0 (Soil). Gibberellic acid acts on the embryo and causes the 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) in papaya.** 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 T_9 Soil+Cocopeat +Vermicompost +Cinder (1:1:1:1) + GA_3 200ppm with 25.00 cm, followed by T_8 Cocopeat +Vermicompost +Cinder (2:1:1) + GA_3 200ppm, T_3 Soil+Vermicompost +Cinder (1:1:2) + GA_3 200ppm, T_2 Soil+Vermicompost +Cinder (1:2:1) + GA_3 200ppm and T_1 Soil+Vermicompost +Cinder (1:1:1)+ GA_3 200ppm. While the minimum seedling height 18.77 cm respectively were observed in T_0 (Soil). The increased height in GA_3 200 ppm seeds may be attributed to the reason that the endogenous levels of GA_3 synthesized by the papaya seedling might not be sufficient and external application of GA_3 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 seedlings (**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 T_9 Soil+Cocopeat +Vermicompost +Cinder (1:1:1:1) + $GA_3$200ppm with 13.53 cm, followed by T_8 Cocopeat +Vermicompost +Cinder (2:1:1) + GA_3 200ppm, T_3 Soil+Vermicompost +Cinder (1:1:2) + GA_3 200ppm, T_2 Soil+Vermicompost +Cinder (1:2:1) + GA_3 200ppm and T_1 Soil+Vermicompost +Cinder (1:1:1)+ GA_3 200ppm. While the minimum Number of leaves per seedling 9.22 respectively were observed in T_0 (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 nutrients for plant growth. Media composition used influences the quality of seedlings (**Wilson *et al.*, (2001).** Humic acids (vermicompost) applied in the medium increased plant height, leaf area and dry weight of peppers,

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tomatoes and marigold (**Arancon *et al.*, (2004).** The maximum diameter of seedling (cm) was observed in T_9 Soil+Cocopeat +Vermicompost +Cinder (1:1:1:1) + GA_3 200ppm with 1.03 cm, followed by T_8 Cocopeat +Vermicompost +Cinder (2:1:1) + GA_3 200ppm, T_3 Soil+Vermicompost +Cinder (1:1:2) + GA_3 200ppm, T_2 Soil+Vermicompost +Cinder (1:2:1) + GA_3 200ppm and T_1 Soil+Vermicompost +Cinder (1:1:1)+ GA_3 200ppm. While the minimum diameter of seedling (cm) 0.50 respectively ~~were~~ was observed in T_0 (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); Mishra *et al.*, (2017)** in *C. 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 seedlings (**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 (cm^2) was observed in T_9 Soil+Cocopeat +Vermicompost +Cinder (1:1:1:1) + GA_3 200ppm with 97.64 cm, followed by Cocopeat +Vermicompost +Cinder (2:1:1) + GA_3 200ppm, Cocopeat +Vermicompost +Cinder (1:2:1) + GA_3 200ppm and Cocopeat +Vermicompost +Cinder (1:1:2) + GA_3 200ppm. While the minimum Leaf area (cm2) 56.51 respectively were observed in T_0 (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 seedlings (**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 T_9 Soil+Cocopeat +Vermicompost +Cinder (1:1:1:1) + GA_3 200ppm followed by T_8 Cocopeat +Vermicompost +Cinder (2:1:1) + GA_3 200ppm, T_4 Soil+Vermicompost +Cinder (2:1:1) + GA_3 200ppm and T_3 Soil+Vermicompost +Cinder (1:1:2) + GA_3 200ppm. While the minimum Chlorophyll content (SPAD Value) 44.71 respectively were recorded in T_0 (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 *C. 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 T_9 Soil+Cocopeat +Vermicompost +Cinder (1:1:1:1) +GA3 200ppm followed by T_8 Cocopeat +Vermicompost +Cinder (2:1:1) +GA3 200ppm, T_2 Soil+Vermicompost +Cinder (1:2:1) +GA3 200ppm and T_1 Soil+Vermicompost +Cinder (1:1:1)+GA3 200ppm. While the minimum Length of longest tap root (cm) 4.52 respectively were recorded in T_0 (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 T_9 Soil+Cocopeat +Vermicompost +Cinder (1:1:1:1) +GA3 200ppm followed by T_8 Cocopeat +Vermicompost +Cinder (2:1:1) +GA3 200ppm, T_8 Cocopeat +Vermicompost +Cinder (2:1:1) +GA3 200ppm, T_2 Soil+Vermicompost +Cinder (1:2:1) +GA3 200ppm and T_1 Soil+Vermicompost +Cinder (1:1:1)+GA3 200ppm. While the minimum Survival

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(%) 58.64 respectively were recorded in T_0 (Soil). This might be due to GA3 that ~~was~~ caused ~~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 GA_3 on germination and seedling growth of *C. Ppapaya*.

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**

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Table 2: Effect of different levels of cinder, vermicompost and GA_3 on germination and seedling growth of *C. 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

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CONCLUSION

Based on the above findings, it is concluded that treatment T_9 Soil+Cocopeat +Vermicompost +Cinder (1:1:1:1) + GA3 200ppm performed best in terms ~~of~~ of germination percentage (77.37%), ~~days~~ days taken for completion of germination (15.27), and growth parameters were seedling height (25.00 cm), number of leaves per seedling (13.53), the diameter of seedling (1.03cm), Leaf area (97.64cm^2), 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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