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Evaluation of different growing media and pre-sowing treatments on germination and growth of papaya

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Abstract
The experiment was conducted College of Horticulture & Research Station, IGKV, Jagdalpur, Bastar (C.G.) during autumn season 2021 to evaluate the "Effect of different growing media and pre-sowing treatment for sexual propagation of papaya under net house condition". The experiment was consisted of twelve treatments conducted in completely randomized design (CRD) with thrice replication. The result reveals that the treatment T_{10} was found maximum germination percent, survival percent, seedling height, no. of leaves plant^{-1}, stem girth, shoot length & minimum mortality percent while maximum root length was observed in treatment T_4. Minimum germination percent was founded in treatments T_1 at 15 DAS and at 20 DAS in treatment T_5, while lowest seedling height, no. of leaves plant^{-1}, stem girth, shoot length & root length was recorded in treatment T_1. Minimum survival percent & maximum mortality percent was observed in treatment T_7 during the experiment.

Keywords: GA_3, pond soil, vermicompost, germination & growth

Introduction
Papaya crop are scientifically known as *Carica papaya* L. belong to family Caricaceae is most important fruit plant of tropical region of the world origin of Tropical America (Hofmeyr, 1945) [19]. Papaya is ideal delicious fruit, nutritious, tasty fruit and more precious for digestible properties *i.e.* 100 gram of papaya contains 90 percent moisture, 9.5 percent carbohydrate, 4.5 percent calorific value, 0.5 percent proteins, 0.1 percent fat, 0.4 percent minerals, 0.01 percent calcium, 0.01 percent phosphorus, 0.4 mg Fe, 2022 IU of Vitamin A, 40 IU Vitamin B_1, 250 IU Vitamin B_2, 85 mg Vitamin C & 0.2 IU Vitamin B_3 (Ram, 2009) [22].
In India, papaya is being cultivated an area of about 138 thousand hectares having annual production of 5989 thousand MT with productivity of 43.39 MT ha^{-1} (Anonymous, 2017) [3]. In Chhattisgarh, papaya is cultivated in an area of about 13.98 thousand hectare with production of 377.38 thousand MT and productivity is 26.99 MT ha^{-1} Chhattisgarh, most 5 major papaya production districts *viz.*, Durg, Mahasamund, Raipur, Bilaspur and Bemetara (Anonymous, 2020) [2].
Papaya is commercial propagation of papaya is only through seeds as a viable option & meiosis division are takes place in course of fusion. Enhance the seed germination of papaya with activation of protease and alpha-amylase (Paleg, 1965) [21]. The slow germination of papaya seed is due to the presence of some inhibitors *i.e.* phenol compound (Desai *et al*., 2017) [15].
GA_3 is plant growth regulators that promote cell expansion and cell division act and during the seed germination process gibberellins act in the mobilization of seed reserves including starch, proteins & lipids, starch in the endosperm during germination. Hence, gibberellins are important germination promoters & gives higher seed germination & uniformity as a result improves the performance of seeds of papaya (Zanotti and Barros, 2014) [30].
Pond soils are rich in proportions of sand, silt and clay, which results in increased potential of the soil to grow vegetation in many ways like having high water holding capacity, effective drainage, supply of enormous organic matter & better aeration (Dash & Singh, 2019) [12]. Pond bottom soil pH can range from less than 4 to more than 9, but the best pH for pond soils is considered to be about neutral. A procedure for classifying pond soil based on the characteristics of horizons has been formulated (Boyd *et al*., 2002) [7].
Vermicompost is a peat-like material with high porosity, microbial activity, aeration, water holding capacity and drainage which makes it an excellent conditioner of soil (Edwards, 2009) [17]. It is a finely-divided mature peat-like material which is produced by a non-thermophilic process involving interactions between earthworms & microorganisms.

Earthworm reduces C:N ratio, increase humic acid content, cation exchange capacity & water soluble carbohydrates (Shristi *et al*., 2018) [27].

Material and Methods

The experiment was carried out at Instructional cum Research Farm, College of Horticulture & Research Station, Jagdalpur during autumn season 2021. The experiment was laid out in Completely Randomized Design with three replications & twelve treatments *i.e.* T_1 (G_1M_1-GA_3 @ 100 ppm + Pond soil 100%), T2 (G_1M_2-GA_3 @ 100 ppm + Pond soil 90% + Vermicompost 10%), T_3 (G_2M_1-GA_3 @ 150 ppm + Pond soil100%), T_4 (G_2M_2-GA_3 @ 150 ppm + Pond soil 90% + Vermicompost 10%), T_5 (G_3M_1-GA_3 @ 200 ppm + Pond soil 100%), T_6 (G_3M_2-GA_3 @ 200 ppm + Pond soil 90% + Vermicompost 10%), T_7 (G_4M_1-GA3 @ 250 ppm + Pond soil 100%), T_8 (G_4M_2-GA_3 @ 250 ppm + Pond soil 90% + Vermicompost 10%), T_9 (G_5M_1-GA_3 @ 300 ppm + Pond soil 100%), T_{10} (G_5M_2-GA_3 @ 300 ppm + Pond soil 90% + Vermicompost 10%), T_{11} (G_6M_1-GA_3 @ 350 ppm + Pond soil 100%) & T_{12} (G_6M_2-GA_3 @ 350 ppm + Pond soil 90% + Vermicompost 10%). During the experimental season, the average rainfall was 150.5 mm, with 6 rainy days, and the maximum temperature was 28.3 °C and the minimum temperature was 15.6 °C, with relative humidity of 53.3-93.6 percent from the last week of October to the last week of December, according to the meteorological observatory of S.G. college of agriculture and research station IGKV, Jagdalpur.

Result and Discussion

Germination

The seed germination percentage in papaya as influenced by various treatments was presented in Table 1 the data reveals that the maximum germination percentage of seed was found in T_{10} which was at par with treatment T_6 at 15 DAS & T_8 at 20 DAS during the study period among all treatments but minimum germination percentage was recorded in treatment T_1 & T_5. The highest germination percent was seen when seeds were soaked in gibberellic acid, which could be attributed to GA_3's involvement in the activation of cytological enzymes. This conclusion is consistent with Ramteke *et al.* (2015) [23], Deb *et al*. (2010) [14], Babu *et al*. (2010) [14], Barche *et al*. (2010) [6], Anjanawe *et al*. (2013) [1], and Amit Desai *et al*. (2017) [15] findings in papaya.

Survival

Survival percentages of seedling in papaya were influenced by treatments was presented in Table 1 the data exhibit that the highest survival percent was observed in T_{10} this was at par with treatment T_8. While minimum survival percentage was recorded in treatment T_7. The vermicompost and soil also supply nearly contact between the seed and media, root respiration, increases stable supply facilitates of moisture and inspire the survival percentages (Chatterjee and Choudhari 2007) [9]. These finally are in nearly conformity with reported of Bagul *et al*. (2018) [5], Barche *et al.* (2010) [6] and Ramteke *et al*. (2015) [23].

Mortality

Mortality percentages of papaya was presented in Table no. 1, the data reveals that the significantly treatment T_{10} was recorded lowest mortality percent which was on par with treatment T_8, T_{12}, T_9, T_2, T_3, T_4, T_5 and T_6 but highest mortality percent was recorded in the treatment T_7 The vermicompost and soil also supply nearly contact between the seed and media, root respiration, increases stable supply facilitates of moisture and inspire the minimum mortality percentage (Chatterjee and Choudhari 2007) [9]. Closely finding with reported of Bagul *et al*. (2018) [5].

Seedling height (cm)

Seedling height of papaya was presented in Table no. 2 the data showed that the treatment T_{10} was observed significantly taller seedling, which as par with treatments (T_5, T_6, T_8, T_3, T_{11}, T_{12}) at 30 DAS & T_4 at 45 DAS during the observation period, while smallest seedling height was reported in treatment T1. It was due to additional gibberellic acid, activated alpha-amylase when digested the available carbohydrate in to simple sugars that energy and nutritions were simply available to faster growing seedlings. Growth in plant height reason to GA_3 has also been reported by Shant and Rao (1973) [25]. The results are in conformity with the findings of Desai *et al*. (2017) [15] and Thiruppathi *et al*. (2020) [29].

No. of leaves seedling^{-1}

No. of leaves seedling^{-1} in papaya as influenced by various treatments was presented in Table no. 2 the data showed more number of leaves seedling^{-1} was significantly founded in treatment T_{10} which was found statistically at par with treatment (T_4, T_6) at 30 DAS & (T_4, T_{11}, T_3, T_9, T_8, T_1 & T_{12}) at 45 DAS. Lowest number of leaves seedling^{-1} was recorded in treatment T_1 during observation. More number of leaves force to that GA_3 helped in invigoration of plant physiology and biological process of seedlings and treatment effect of chemicals to from newly leaves as faster growth rate, the results are conformity of Sen *et al.* (1990) [24] in papaya seeds and Kalalbandi *et al* (2003) [20] in Kagzi lime. Vermicompost was maintaining of high water content in media, development of cell division and cell elongation in seedlings which had increased the number of leaves per seedlings by Soeigiman (1982) [28]. The reported are conformity with Man Bihari *et al*. (2009) [8] and Ramteke *et al.* (2015) [23].

Stem girth (mm)

Stem girth seedling^{-1} was measured & showed in the Table no. 3 the data reveals that the highest stem girth was reported in T_{10} which was as par with (T_4,T_6 &T_9) at 30 DAS & (T_4, T_9, T_{12}, T_6, T_{11}, T_5, T_3 & T_{11}) at 45 DAS. However, the lowest stem diameter was recorded under treatment T_1. The expansion in stem girth as result of gibberellic acid application for due to the effect that, GA_3 increase somatic uptake of nutrients, causing cell multiplication and thus maximum elevation of the seedlings (Feucht and Watson, 1958) [18]. Gibberellic acid treated may be attributed to the cell division and elongation in the seedling tissue (Shirol *et al*. 2005) [26]. The results are in conformity with the finding of Choudhary *et al*. (2020) [11].

Shoot length (cm)

Shoot length was presented in Table no. 3 the data showed that the treatment T_{10} was founded significantly maximum shoot length but minimum shoot length was observed in treatment T_1 during investigation. The highest shoot length might be attributed to the conductive effect of this media composition on water holding capacity porosity, soil aeration and supplying substantial amount of nutrient specially N_2 and other micronutrients for excellent root and shoot development over soil alone (Chopde *et al*., 1999) [10]. Finding is closely related with the Dayeswari *et al*. (2017) [13] in papaya.

Root length (cm)

The root length in papaya as influenced by various treatments was presented in Table 3 data revealed that the root length (4.02 cm & 10.61 cm) were found significantly highest in T_4 while the lowest root length was recorded in treatment T_1. The vermicompost and soil also supply nearly contact between the seed and media, root respiration, increases stable supply facilitates of moisture and inspire the growth of tap roots (Chatterjee and Choudhari 2007) [9]. This reported is closely associated with the Ramteke *et al.* (2015) [23] in papaya.

Table 1: Influence of different growing media & pre-sowing treatment on plant emergence (%) & mortality %

Treatment details			Germination percentages (%)		Survival %	Mortality %
			15 DAS	20 DAS		
T_1	:	G_1M_1-GA_3 @ 100 ppm + Pond soil (100%)	53.30	62.22	75.19	24.81
T_2	:	G_1M_2-GA_3 @ 100 ppm + Pond soil (90%) + Vermicompost (10%)	59.97	64.44	89.63	10.37
T_3	:	G_2M_1-GA_3 @ 150 ppm + Pond soil (100%)	55.53	62.22	89.17	10.83
T_4	:	G_2M_2-GA_3 @ 150 ppm + Pond soil (90%) + Vermicompost (10%)	60.00	66.67	89.93	10.07
T_5	:	G_3M_1-GA_3 @ 200 ppm + Pond soil (100%)	57.77	60.00	88.89	11.11
T_6	:	G_3M_2-GA_3 @ 200 ppm + Pond soil (90%) + Vermicompost (10%)	62.20	68.89	89.93	10.07
T_7	:	G_4M_1-GA_3 @ 250 ppm + Pond soil (100%)	55.53	66.67	70.00	30.00
T_8	:	G_4M_2-GA_3 @ 250 ppm + Pond soil (90%) + Vermicompost (10%)	64.40	68.89	90.30	9.70
T_9	:	G_5M_1-GA_3 @ 300 ppm + Pond soil (100%)	57.73	62.22	89.26	10.74
T_{10}	:	G_5M_2-GA_3 @ 300 ppm + Pond soil (90%) + Vermicompost (10%)	68.84	75.56	91.41	8.84
T_{11}	:	G_6M_1-GA_3 @ 350 ppm + Pond soil (100%)	59.97	66.67	80.00	20.00
T_{12}	:	G_6M_2-GA_3 @ 350 ppm + Pond soil (90%) + Vermicompost (10%)	55.73	64.44	89.63	10.37
SEm±			2.66	2.40	0.36	1.63
C.D.5%			7.76	7.01	1.05	4.75

Table 2: Influence of different growing media & pre-sowing treatment on seedling height (cm), no. of leaves plant & stem girth (mm)

Treatment details			Seedling height (cm)		No. of leaves plant^{-1}		Stem girth (mm)	
			30 DAS	45 DAS	30 DAS	45 DAS	30 DAS	45 DAS
T_1	:	G_1M_1-GA_3 @ 100 ppm + Pond soil (100%)	9.94	22.76	6.00	8.33	1.66	3.06
T_2	:	G_1M_2-GA_3 @ 100 ppm + Pond soil (90%) + Vermicompost (10%)	11.21	23.53	6.44	9.33	1.96	3.18
T_3	:	G_2M_1-GA_3 @ 150 ppm + Pond soil (100%)	13.67	29.49	7.11	9.78	2.3	3.72
T_4	:	G_2M_2-GA_3 @ 150 ppm + Pond soil (90%) + Vermicompost (10%)	12.21	33.73	7.78	9.89	2.72	4.13
T_5	:	G_3M_1-GA_3 @ 200 ppm + Pond soil (100%)	14.25	28.28	6.78	8.67	2.22	3.73
T_6	:	G_3M_2-GA_3 @ 200 ppm + Pond soil (90%) + Vermicompost (10%)	14.27	26.97	7.56	9.89	2.69	3.92
T_7	:	G_4M_1-GA_3 @ 250 ppm + Pond soil (100%)	12.72	27.11	6.33	8.66	1.93	3.16
T_8	:	G_4M_2-GA_3 @ 250 ppm + Pond soil (90%) + Vermicompost (10%)	14.23	29.81	6.67	9.33	2.27	3.64
T_9	:	G_5M_1-GA_3 @ 300 ppm + Pond soil (100%)	12.80	31.51	7.00	9.67	2.47	4.03
T_{10}	:	G_5M_2-GA_3 @ 300 ppm + Pond soil (90%) + Vermicompost (10%)	14.33	34.03	8.11	10.22	2.73	4.16
T_{11}	:	G_6M_1-GA_3 @ 350 ppm + Pond soil (100%)	12.86	30.59	6.11	9.89	2.19	3.77
T_{12}	:	G_6M_2-GA_3 @ 350 ppm + Pond soil (90%) + Vermicompost (10%)	13.71	31.29	6.11	9.22	2.43	4.01
SEm±			0.51	0.78	0.28	0.54	0.09	0.20
C.D.5%			1.48	2.29	0.81	1.11	0.27	0.59

Table 3: Influence of different growing media & pre-sowing treatment on shoot length (cm) & root length (cm)

Treatment details			Shoot length (cm)		Root length (cm)	
			30 DAS	45 DAS	30 DAS	45 DAS
T_1	:	G_1M_1-GA_3 @ 100 ppm + Pond soil (100%)	7.12	15.39	2.82	7.37
T_2	:	G_1M_2-GA_3 @ 100 ppm + Pond soil (90%) + Vermicompost (10%)	7.79	16.09	3.42	7.44
T_3	:	G_2M_1-GA_3 @ 150 ppm + Pond soil (100%)	9.97	20.78	3.70	8.71
T_4	:	G_2M_2-GA_3 @ 150 ppm + Pond soil (90%) + Vermicompost (10%)	8.19	23.12	4.02	10.61
T_5	:	G_3M_1-GA_3 @ 200 ppm + Pond soil (100%)	10.60	20.34	3.64	7.93
T_6	:	G_3M_2-GA_3 @ 200 ppm + Pond soil (90%) + Vermicompost (10%)	10.76	21.06	3.51	7.84
T_7	:	G_4M_1-GA_3 @ 250 ppm + Pond soil (100%)	9.17	19.74	3.56	7.37
T_8	:	G_4M_2-GA_3 @ 250 ppm + Pond soil (90%) + Vermicompost (10%)	10.52	20.31	3.71	9.50
T_9	:	G_5M_1-GA_3 @ 300 ppm + Pond soil (100%)	9.58	23.96	3.22	7.57
T_{10}	:	G_5M_2-GA_3 @ 300 ppm + Pond soil (90%) + Vermicompost (10%)	11.04	27.03	3.29	8.22
T_{11}	:	G_6M_1-GA_3 @ 350 ppm + Pond soil (100%)	9.39	23.10	3.47	7.49
T_{12}	:	G_6M_2-GA_3 @ 350 ppm + Pond soil (90%) + Vermicompost (10%)	10.60	24.19	3.11	7.66
SEm±			0.42	0.67	0.15	0.31
C.D.5%			1.24	1.94	0.44	0.90

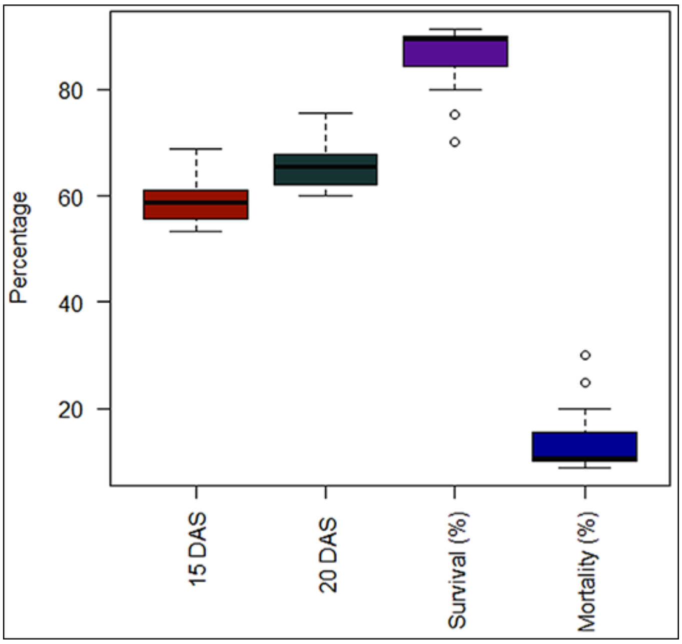

Fig 1: Box plot of plant emergence (%) and mortality (%) of papaya

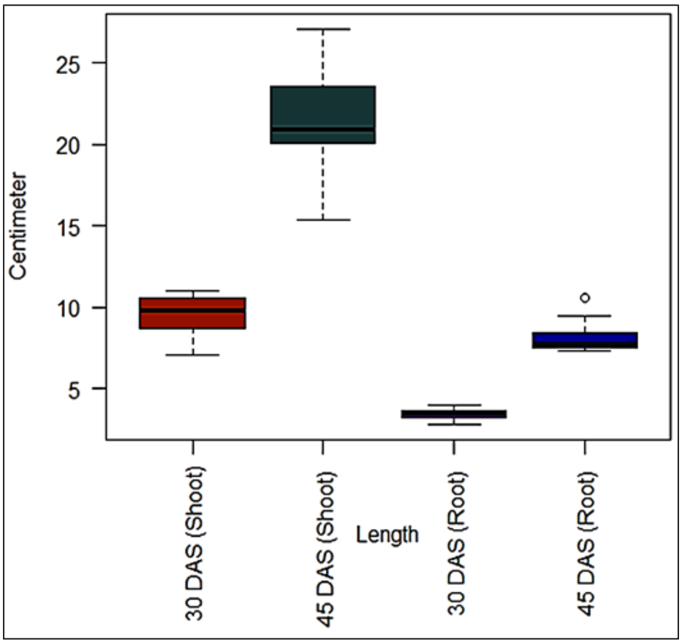

Fig 2: Box plot of shoot length (cm) root length (cm) of papaya

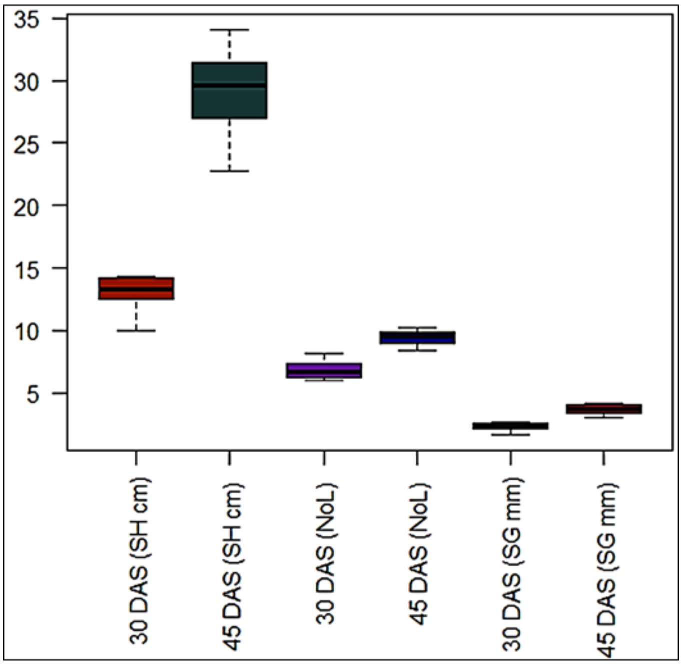

Fig 3: Box plot of seedling height (cm), no. of leaves plant^{-1} and stem girth (mm) of papaya

Conclusion

According to the current study of data the treatment T_{10} was found superior in term germination percent, survival percent & minimum mortality percent no. of leaves plant^{-1} seedling height stem girth & shoot length However, maximum length of root was recorded in T_4 (4.02 &10.61 cm) compare to other treatments.

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