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Improvement of Papaya Seed Germination by Different Growth Regulator and Growing Media under Net House Condition

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A B S T R A C T

Seed germination is the most important aspect for raising the nursery for successful seedling production of Papaya. The present study was carried out to explore the effect of different growth promoter with growing media on seed germination of Papaya. (*Carica papaya* L.) cv. Madhubindu under net house condition. The seeds of papaya were treated with different concentrations of GA_3 and cow urine and sowing in different growing Media's *viz.*, Coco peat, Vermicompost and Soil. Highly significant different was observed between the treatments. The results showed that the treatment combinations G_3M_1 [GA_3 @150 mg/l dipping for 12 hours and soil + cocopeat (1:1)] is significantly recorded highest germination percentage (84.00% and 95.00%) at 10 and 20 DAS, respectively and also recorded significantly minimum number of days (8.33) required 50 per cent germination. Whereas, treatment combination G_6M_1 [cow urine 10% dipping for 18 hours and soil + cocopeat (1:1)] recorded significantly the highest seed vigour index- I and II, dry weight of shoot and dry weight of root at 30 and 45 DAS. Similarly, the highest root: shoot ratio at 30 and 45 DAS and seed vigour index- II at 30 DAS was recorded in treatment combination G_5M_1 [cow urine 10% dipping for 12 hours and soil + cocopeat (1:1)].

Introduction

Papaya (*Carica papaya* L.) is 7th important fruit crop of the country after Mango, Citrus, Banana, Apple, Guava and Sapota. The fruit is extensively grown in various states of India, mainly in Andhra Pradesh, Gujarat, Karnataka, Madhya Pradesh, Maharashtra, West Bengal, Chhattisgarh, Tamil Nadu, Assam, and Kerala. Seed germination in Papaya is very slow, erratic and also incomplete. The cost of Papaya seed is also high so increasing germination percentage and producing more vigour seedling is a challenge of Papaya grower. The slow germination of papaya seed is due to the presence of some inhibitors like phenolic compound. Seed treatment is required to promote seed germination and reduce the germination time with suitable growing media. Gibberellic acid (GA_3) can stimulate rapid stem and root growth, induce mitotic division in the leaves of some plants, and increase seed germination rate. Cow urine contains about 1.21% N_2, 0.01% P_2O_5 and 1.35% K_2O (Subramaniyam, 2005), and also

contains physiologically active substances *viz.*, growth regulators, nutrients (Kamalam and Rajappan, 1989) and trace elements (Munoz, 1988). Growing Media is a substrate that provides the required elements and physical support to the growing plants. All soils used for media are not always perfect for the germination of seeds and subsequent growth of seedling. Seed germinate in containers have limited volume of soil and nutrients. Media should also have good water holding capacity, drainage and other physical and chemical properties. So it is desirable to provide such soil media or mixture, which fulfills the requirements for maximum seed germination and better seedling growth. The seeds of papaya are enclosed within a gelatinous sarcotesta (aril, or outer seed coat which is formed from the outer integument.) which can prevent germination (Yahiro, 1979). Before sowing of seeds is soaking in water or water soluable endogenous hormones has been reported to promote the germination. The objective of the study was to increase the seed germination and physiological development of papaya seedlings through applying the growth regulator with different growing media.

Materials and Methods

Present investigation was conducted at Horticulture Research Farm, Anand Agricultural University, Anand, from June-July during the year 2016. The experiment was laid out in a Completely Randomized Design (Factorial) with eighteen (18) treatment combinations and replicated thrice. Fully mature and healthy fruits of papaya cv. Madhubindu were collected. Seeds were extracted and shade drying till the seed were completely dried. These fresh seed were collected and subjected to different pre-sowing treatments. The treatments comprised of three levels of GA_3 and cow urine *i.e.* (G_1)- GA_3 @50 mg/l dipping for 12 hours, (G_2)- GA_3 @100 mg/l dipping for 12 hours, (G_3)- GA_3 @150 mg/l dipping for 12 hours, (G_4)- cow urine 10% dipping for 6 hours, (G_5)- cow urine 10% dipping for 12 hours, (G_6)- cow urine 10% dipping for 18 hours as well as three levels of growing medias *i.e.* (M_1)- soil + cocopeat (1:1), (M_2)- soil + vermicompost (1:1) and (M_3) soil + vermicompost + cocopeat (1:1:1). Observations were recorded in respect to first germination from the date of sowing up to germination of the first seedling, germination percentage at 10 and 20 DAS by counting number of papaya seeds germinated out of total seed dibbled. Seed vigour index – I at 30 and 45 DAS (germination percentage ^{x} length of seedlings), seed vigour index – II at 30 and 45 DAS (germination percentage ^{x} total dry weight of seedling) and root: shoot ratio at 30 and 45 DAS by dividing dry weight of roots by dry weight of shoots of five randomly selected seedlings and its average value was calculated.

The recorded data were analyzed statistically using various techniques as described by Panse and Sukhatme (1985). The treatment means were compared with C.D. at 5 per cent level.

Results and Discussion

As per the results, the significant different was observed between the treatment on seed germination and seedling growth attributes.

Effect of growth regulators on seed germination

Treatments G_3 (GA_3 @150 mg/l dipping for 12 hours) significantly took the minimum days (7.55 and 9.44) for first germination and 50 per cent germination, respectively this results were supported by Kumawat *et al.*, (2014) in papaya. This treatment also recorded significantly highest germination percentage (77% and 87% at 10 and 20 DAS, respectively). Similar trends were also

obtained by Deb *et al.,* (2010). 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) (Table 1).

Effect of growing media on seed germination

Media M_1 [soil + cocopeat (1:1)] significantly took the minimum days (7.55 and 9.05) required for first germination and 50 per cent germination, respectively as compared to rest of medias. Similar results were obtained by Kumawat *et al.,* (2014) and Mandal *et al.,* (2015) in papaya when they used cocopeat as ingredients of growing media. And also recorded significantly highest germination percentage (77.89% and 88.28%) at 10 and 20 DAS, respectively as compared to the rest of the Medias.

These results were in close agreement with Mandal *et al.,* (2015) and Ramteke *et al.,* (2015) in papaya when they used cocopeat as ingredients of growing media. 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 of seeds (Bisla *et al.,* 1984).

Interaction effect of growth regulators and growing media on seed germination

Interaction effect of G_3M_1 [GA_3 @ 150 mg/l dipping for 12 hours and soil + cocopeat (1:1)] recorded significantly the minimum days (8.33) required for 50% germination as compared to rest of the combinations. Similar results were also obtained by Kumawat *et al.,* (2014) in papaya. Treatment combination G_3M_1 also recorded significantly highest germination percentage (84.00% and 95.00%) at 10 and 20 DAS, respectively as compared to rest of the combinations. Similar results were also obtained by Deb *et al.,* (2010) and Kumawat *et al.,* (2014) in papaya and Patil *et al.,* (2012) in Rangpur lime. It might be due to GA_3 acts on the embryo and causes synthesis of hydrolysing enzymes particularly amylase and protease and this hydrolysed food is utilized for grown of embryo and thereby enhanced the germination (Paleg, 1965) and retention of more water and air by media helped in quick and early enzymatic action for synthesis of metabolites for cell multiplication and also enhanced the breakdown of the seed coat resulting in the transformation of embryo into a seedling early enough (Hasan *et al.,* 2010) which is helpful for increasing germination of seeds (Table 2).

Effect of growth regulators on seedling growth attributes

Treatments G_6 (cow urine 10% dipping for 18 hours) were recorded significantly the maximum seed vigour index- I. (1518 cm and 2868 cm), seed vigour index- II (130 g and 216 g) at 30 and 45 DAS, respectively as compared to rest of treatments. These results were in close agreement with Ambika *et al.,* (2014) in cereals and Ambika and Balakrishnan (2015) in cluster bean. This treatment also recorded significantly maximum dry weight of shoot (0.85 g and 1.45 g), dry weight of root (0.73 g and 1.18 g) at 30 and 45 DAS, respectively as compared to rest of treatments. Whereas, the treatment G_5 (cow urine 10% dipping for 12 hours) was recorded significantly the highest root: shoot ratio (0.90 g and 0.91 g) at 30 and 45 DAS, respectively as compared to rest of the treatments. These results were in close agreement with the results of Sutheesh *et al.,* (2016) in sandal wood. It might be due to the cow urine was maintaining of high water content in cell, increased cell division and cell elongation which increased the germination and overall growth of the seedlings which may helped to increase seed vigour and dry weight of root and shoot of seedlings.

Table.1 Effect of different growth regulator and growing media on seed germination and physiological development of papaya seedlings (Carica papaya L.) cv. Madhubindu

Treatments	No. of days required for first germination	No. of days required for 50% germination	Germination percentage		Seed vigour index-I (cm)		Seed vigour index-II (g)		Dry weight of shoot (g)		Dry weight of root (g)		Root: shoot ratio (g)	
			10 DAS	20 DAS	30 DAS	45 DAS	30 DAS	45 DAS	30 DAS	45 DAS	30 DAS	45 DAS	30 DAS	45 DAS
G_1	8.66	10.88	58.77	81.00	1215	2533	79	140	0.58	0.95	0.38	0.76	0.66	0.81
G_2	7.88	9.88	61.11	83.33	1373	2477	103	162	0.77	1.07	0.47	0.86	0.61	0.80
G_3	7.55	9.44	77.00	87.00	1462	2579	114	214	0.77	1.40	0.53	1.04	0.68	0.76
G_4	8.55	11.67	59.55	82.55	1308	2392	100	166	0.68	1.13	0.52	0.85	0.79	0.81
G_5	8.33	10.66	57.44	83.11	1468	2730	126	200	0.79	1.35	0.71	1.05	0.90	0.91
G_6	9.22	11.00	53.11	81.77	1518	2868	130	216	0.85	1.45	0.73	1.18	0.85	0.87
S.Em. ±	0.25	0.27	1.69	1.05	46.35	53.65	2.43	6.00	0.02	0.04	0.01	0.03	0.02	0.02
C.D. at 5%	0.72	0.78	4.85	3.01	132.9	153.8	6.97	17.21	0.06	0.11	0.04	0.08	0.06	0.05
M_1	7.55	9.05	77.89	88.28	1679	2900	126	214	0.82	1.35	0.62	1.07	0.75	0.83
M_2	9.77	12.89	45.61	77.16	1079	2219	88	151	0.64	1.09	0.49	0.85	0.77	0.83
M_3	7.77	9.83	59.89	83.83	1415	2670	112	183	0.77	1.23	0.56	0.95	0.73	0.82
S.Em. ±	0.17	0.19	1.19	0.74	32.59	37.94	1.71	4.24	0.01	0.02	0.01	0.02	0.01	0.01
C.D. at 5%	0.51	0.55	3.43	2.12	94.02	108.8	4.93	12.17	0.04	0.08	0.03	0.06	NS	NS
C.V %	9.05	7.70	8.31	3.79	9.99	6.19	6.67	9.81	8.57	9.87	8.10	9.67	8.63	7.17
Interaction G × M	NS	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.

Table.2 Interaction effect of growth regulators and growing media on seed germination and physiological development of papaya seedlings (*Carica papaya* L.) cv. Madhubindu

Treatment combination	No. of days required for 50% germination	Germination percentage		Seed vigour index-I (cm)		Seed vigour index-II (g)		Dry weight of shoot (g)		Dry weight of root (g)		Root: shoot ratio (g)	
		10 DAS	20 DAS	30 DAS	45 DAS	30 DAS	45 DAS	30 DAS	45 DAS	30 DAS	45 DAS	30 DAS	45 DAS
G_1M_1	9.33	73.33	82.00	1470	2472	93	156	0.72	1.06	0.42	0.83	0.58	0.78
G_1M_2	13.66	40.33	75.00	872	2320	56	106	0.41	0.77	0.34	0.65	0.81	0.84
G_1M_3	9.66	62.66	86.00	1302	2808	86	158	0.62	1.02	0.38	0.81	0.61	0.81
G_2M_1	9.00	80.00	88.67	1710	2523	105	186	0.70	1.17	0.49	0.92	0.70	0.78
G_2M_2	11.33	41.33	76.67	1125	2205	100	128	0.81	0.91	0.50	0.76	0.62	0.83
G_2M_3	9.33	62.00	84.00	1283	2704	104	172	0.82	1.14	0.42	0.90	0.51	0.80
G_3M_1	8.33	84.00	95.00	1661	2733	113	233	0.74	1.40	0.44	1.06	0.60	0.75
G_3M_2	11.00	67.00	77.00	994	2172	88	173	0.67	1.28	0.47	0.97	0.70	0.75
G_3M_3	9.00	80.00	89.00	1729	2833	142	234	0.91	1.53	0.69	1.10	0.76	0.77
G_4M_1	9.00	82.00	93.66	1659	3024	104	205	0.67	1.24	0.44	0.95	0.75	0.77
G_4M_2	15.66	39.33	73.00	947	1620	80	118	0.62	0.95	0.48	0.66	0.78	0.80
G_4M_3	10.33	56.66	81.00	1319	2533	115	175	0.77	1.21	0.65	0.96	0.85	0.87
G_5M_1	9.33	76.66	86.66	1731	3136	172	248	1.03	1.60	0.96	1.26	0.96	0.97
G_5M_2	12.66	43.00	81.00	1257	2445	99	177	0.62	1.21	0.59	0.98	0.95	0.96
G_5M_3	10.00	52.66	81.66	1416	2609	108	176	0.74	1.23	0.58	0.92	0.79	0.81
G_6M_1	9.33	71.33	83.66	1841	3515	170	259	1.06	1.66	0.97	1.43	0.92	0.95
G_6M_2	13.00	42.66	80.33	1275	2553	102	203	0.72	1.43	0.55	1.10	0.77	0.79
G_6M_3	10.66	45.33	81.33	1439	2536	117	186	0.77	1.26	0.67	1.03	0.86	0.89
S. Em.±	0.47	2.93	1.81	80.29	92.93	4.21	10.39	0.03	0.07	0.02	0.05	0.03	0.03
C.D. at 5%	1.35	8.41	5.21	230.3	266.5	12.07	29.81	0.10	0.20	0.07	0.15	0.10	0.09

Effect of growing media on seedling growth attributes

Media M_1 [soil + cocopeat (1:1)] significantly recorded the maximum seed vigour index- I (1679 cm and 2900 cm), seed vigour index- II (126 g and 214 g), dry weight of shoot (0.82 g and 1.35 g), dry weight of root (0.62 g and 1.07 g) at 30 and 45 DAS, respectively as compared to rest of media.

This result was in close agreement with Kumawat *et al.*, (2014) and Ramteke *et al.*, (2015) in papaya when they used cocopeat as ingredients of growing media.

This might be attributed due to general improvement in the physical and chemical properties of the rooting medium (Dilip *et al.*, 1994).

Interaction effect growth regulators and growing media on seedling growth attributes

Interaction effect of G_6M_1 [cow urine 10% dipping for 18 hours and soil + cocopeat (1:1)] recorded significantly the highest seed vigour index- I (1841 cm and 3515 cm), dry weight of shoot (1.06 g and 1.66 g), dry weight of root (0.97 g and 1.43 g) at 30 and 45 DAS, respectively and also recorded significantly the maximum seed vigour index- II (259 g) at 45 DAS as compared to rest of combinations. Whereas, the treatment combination G_5M_1 [cow urine 10% dipping for 12 hours and soil + cocopeat (1:1)] recorded significantly the highest seed vigour index- II (172 g) at 30 DAS and also recorded the significantly highest root: shoot ratio (0.96 g and 0.97 g) at 30 and 45 DAS, respectively

than rest of the combinations. These results were closely associated with the findings of Sutheesh *et al.,* (2016) in sandal wood. It might be due to the cow urine contains physiologically active substances *viz.,* growth regulators, nutrients (Josef and Nair, 1989) and trace elements (Munoz, 1988) and media provided better condition like aeration and porosity for proper growth and development of seedlings which helped to increase seed germination and height of the seedlings ultimately leads to increase seed vigour and dry weight of root and shoot of seedlings.

On the basis of the results obtained in this study, it is concluded that the growth regulators and growth media significantly influence the seed germination and seedling growth. The treatment combination G_6M_1 [cow urine 10% dipping for 18 hours and soil + cocopeat (1:1)] is found superior and most effective for better physiological development of papaya seedlings over the rest of the treatment combinations.

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