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Effect of pre-sowing seed treatments and media mixtures on germination and seedling vigour of custard apple seedlings

N. Singh[1], Virendra Singh[1], D.K. Sarolia[2], R.A. Kaushik[1], H.R. Meena[3] and R.K. Jat[1]

1. Department of Horticulture, Rajasthan College of Agriculture, Maharana Pratap University of Agriculture & Technology, Udaipur (Rajasthan)-313001
2. ICAR-CIAH, Bikaner, (Rajasthan) -334006
3. ICAR- IISWC, Research Centre, Kota (Rajasthan) - 324002

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ABSTRACT : An experiment was carried out to study the effect of seed treatments {control; tap water soaked; hot water soaked; GA_3 (500 ppm); KNO_3 (1%) and H_2SO_4 (75%)} and different growing media mixtures {FYM : Garden Soil : Sand (1:2:1); Vermi-compost : Garden soil : Sand (1:2:1) and Vermiculite : Cocopeat: Perlite (1:2:1)}on germination and seedling vigour of custard apple under seedbed and poly bag conditions. Results revealed that presowing seed treatment with GA_3 @ 500 ppm and subsequently seed sown in Cocopeat: Vermiculite: Perlite (T_3G_3) media mixture gave higher stem diameter (3.55 cm), inter nodal length (1.85 cm), biomass (3.67 g), root: shoot (0.77) and seedling vigour index (1734) in poly bag condition and combination GA_3@ 500 ppm+ FYM : Garden Soil : Sand (T_3G_1) under seed bed condition with respect to maximum germination (54.69%), seedling height (17.9 cm), length of internodes (1.47 cm), biomass (2.56 g) and seedling vigour index (1410.77).

Key Words : Custard apple, *Annona squamosa* L., presowing seed, media, seedling vigour index.

Custard apple (*Annona squamosa* L.), belongs to the family Annonaceae, is one of the best tropical and sub-tropical fruits and believed to be a native of the West Indies (Ojha *et al*., 2005). It is cultivated in Andhra Pradesh (40,000 hectares), Maharashtra (35,000 hectares), Karnataka (20,000 hectares), Rajasthan (10,000 hectares), Bihar, Orissa, Assam and Tamil Nadu. Besides India it is common in China, Philippines, Egypt and Central Africa. In Rajasthan, it is naturally grown in the forests and also on marginal lands. Custard apple is the main source of income for the tribal people of South Rajasthan specially Udaipur, Dungarpur, Banswara, Chittorgarh, Pratapgarh and Sirohi districts (Kaushik *et al.*, 2008). Custard apple is a hardy tree and can be grown successfully in various kinds of soils and agro-climatic conditions and can tap a considerable volume of soil with its extensive root system under natural habitat. The usual means of propagation by seeds nevertheless; the tree can be multiplied by inarching, or by budding or grafting onto its own seedlings or onto soursop, sugar apple or pond apple rootstocks. The seeds of custard apple have hard endocarp due to this hard seed coat; its germination takes longer time 20 days to 6 months in natural conditions. Thus, there is need to find a suitable presowing seed treatment(s) and media mixture(s) for improving germination and subsequent growth of seedling for budding and grafting on it.

Materials and Methods

The experiment was conducted at the Horticulture Farm, Department of Horticulture, Rajasthan College of Agriculture, Udaipur from August 2012 to January 2013. In the present investigation 18 treatment combinations i.e., six pre-sowing seed treatment [control (T_0); tap water soaked (T_1); hot water soaked (T_2); GA_3 (500 ppm) (T_3); KNO_3 (1 %) (T_4) and H_2SO_4 (75 %) (T_5)] and three growing media mixture at the rate of 1:2:1, respectively [FYM: Garden Soil: Sand (G_1); (1:2:1) Vermicompost: Garden soil: Sand (G_2) and Vermiculite: Cocopeat: Perlite (G_3)] were tested under Factorial Completely Randomized Design. Seed soaking treatments duration in tape water for 12 hours and rest (hot water (60°C) and chemicals) for thirty minutes. Observations on germination (initiation, per cent and span), seedling height, stem diameter, number of leaves/seedling, length of internodes, biomass, root: shoot ratio, seedling vigour index [Vigour index (Abdul Baki and Anderson, 1973) = (Average root length in cm + Average shoot length in cm) × (Germination percentage)] were recorded as per standard methodology in 100 polybags in each treatment up to 90 days old seedlings under seed bed and poly bag conditions.

Results and Discussion

A perusal of data recorded from germination to 90 days old seedlings and presented in Table-1&2, clearly

indicated that poly bag condition respond better over seed bed condition on various attributes viz.—

Germination (%) : The pre-sowing seed treatments and growing media mixture had significant influenced on germination percentage of custard apple seeds. Among the combinations the maximum germination (at 30 DAS) was recorded in T_3G_1 (GA_3 Treated + FYM: Garden Soil: Sand) in poly bag (61.82 %) and seed bed (54.69 %) conditions. The increase in percentage of germination as a result of GA_3 application in present study might be due to the fact that GA_3 plays a key role in initiation of germination. When the dried seeds imbibe moisture, gibberellins appears in the embryo and is translocated to the aleurone layer, where it activates enzyme which converts starch into sugars and weakening of the seed coats and allowing roots tips to burst. Pundhir and Mohammed (1988) reported that pre-sowing treatment with GA_3 100 ppm proved to be best treatment to improve seed germination of papaya cultivar Honey Dew. The rate of increase in germination percentage of custard apple seeds was significantly influenced by different growing media. The possible reason might be due to germination behaviour as G_1 (FYM: Garden Soil: Sand) have suitable physical properties and good water holding capacity that supports the germination of custard apple seeds. Kumar and Mohammed (1997) also found that growing media with FYM proved to be best treatment to improve seed germination of *bael* seeds. The findings of the study supported and corroborated the findings of Narayan *et al.* (2005) in aonla and Navneet *et al*. (2013) in papaya.

Initiation of germination and Span of germination: Pre sowing seed treatment and media mixture did not affect significantly germination initiation and span of germination days in both the conditions. However, earlier germination initiation (19.00 & 20.89 days) and short span (59 & 63 days) were recorded in GA_3 @ 500 ppm + FYM: Garden Soil: Sand (T_3G_1) treatment in poly bag and seed bed condition, respectively. The reduction in number of days required for initiation of germination due to the GA_3 treatment is supported by Gholap *et al*. (2000) who observed that GA_3 as a pre sowing treatment in *aonla* initiated germination in shortest time (15.33 days) and 200 ppm GA_3 seed treatment reduced the number of days required for the germination of *bael* seeds (Hore and Sen, 1985).

Height of seedling: Pre-sowing seed treatments and growing media had significant influenced seedling height of custard apple. Among the treatment combinations the maximum seedling height was recorded under T_3G_2 in poly bag (21.08 cm) and T_3G_1 (17.9 cm) in seed bed conditions. The increase in height of seedling as a result of GA_3 application might be due to the fact that GA_3 increased osmotic uptake of nutrients, causing cell elongation and thus increasing height of seedling (Feucht and Watson, 1958). The results have been supported by Gharge *et al*. (2011) who obtained maximum seedling height in custard apple due to seed treatment with GA_3. Similarly, Chopde *et al*. (1999) obtained maximum seedling height in custard apple due to Cocopeat media mixture provided congenial conditions for better growth and development of seedlings.

Diameter of stem: Maximum stem diameter of custard apple seedling was recorded under T_3G_3 treatment in poly bag (3.55 cm) and T_3G_2 (2.81 cm) in seed bed condition. The present results might be due to the facts that GA_3 treatment resulted in greater cell division and elongation at the stem portion; present results are supported by Pundhir and Mohammed (1988) in papaya cv. Honey Dew. Further, media mixture improved water holding capacity, availability of nutrient for seedling growth and development. Panwar *et al*. (2004) also obtained maximum stem diameter in *ber* due to FYM application. Similar results were also recorded by Narayan *et al.* (2005) in aonla.

Number of leaves: Maximum number of leaves was recorded under T_3G_2 in poly bag (10.60) and T_3G_3 (7.48) in seed bed condition, while minimum in T_0G_3 treatment combination in both the conditions i.e., poly bag (5.75) and in T_1G_1 treatment combination in seed bed (5.55) condition. The increase in number of leaves as a result of seed treatment with GA_3 might be due to the fact that the activity of GA_3 at apical meristem resulting in more synthesis of nucleoprotein responsible for increasing leaf nutrient and expansion (Simao *et al.*, 1960). The increase in number of leaves as a result of application of vermicompost might be due to the fact that the activity of vermicompost is reported to have bioactive principles which are considered to be beneficial for root growth and this has been hypothesized to result in greater root initiation, increased biomass, enhanced growth and development (Bachman and Metzger, 2008) and also balanced composition of nutrients (Zaller, 2007). The findings of the study supported and corroborated the findings of Singh and Narayan (2015) in Aonla.

Length of internodes: Pre-sowing seed treatments and growing media had significant influence on length of internodes of custard apple. Among the combinations the maximum length of internodes was recorded under T_3G_3 in poly bag (1.85 cm) and T_3G_1 (1.47 cm) in seed bed condition, while minimum (1.42 & 1.23 cm) in T_1G_1 in poly bag and seed bed conditions, respectively. Possible explanation for maximum length of internodes

Table-1: Combined effect of pre-sowing seed treatments and media on various attributes of custard apple in poly bag condition.

Treatments	Germination Attributes			Seedling height (cm)	Stem dia (mm)	Number of leaves	Length of internodes (cm)	Biomass (g)	Root/Shoot ratio	Seedling vigour index
	%	Initiation (Days)	Span (Days)	90 Days	90 Days	90 Days	90 Days			
T_0G_1	48.16	26.00	71.00	14.46	2.68	6.80	1.46	1.63	0.56	1085.13
T_0G_2	35.24	27.00	77.00	16.00	2.43	6.66	1.43	2.03	0.60	1238.57
T_0G_3	35.23	24.00	76.00	14.43	2.16	6.26	1.63	2.22	0.73	1203.94
T_1G_1	41.78	22.00	69.00	14.65	2.69	5.75	1.42	1.93	0.66	1171.23
T_1G_2	41.78	24.00	73.00	17.20	2.69	6.00	1.50	2.33	0.57	1298.70
T_1G_3	41.78	22.00	72.00	16.72	2.65	6.35	1.55	3.17	0.98	1593.07
T_2G_1	48.16	21.00	67.00	17.76	2.97	7.00	1.60	2.24	0.70	1457.91
T_2G_2	41.78	22.00	72.00	16.65	2.91	7.00	1.60	2.73	0.65	1327.56
T_2G_3	41.78	21.00	68.33	14.86	2.65	6.20	1.46	2.73	0.78	1277.53
T_3G_1	61.82	19.00	59.00	20.52	3.18	8.25	1.68	2.75	0.63	1612.31
T_3G_2	48.15	20.00	64.00	21.08	3.30	10.60	1.63	3.62	0.74	1769.11
T_3G_3	48.15	19.00	61.00	20.35	3.55	10.00	1.85	3.67	0.77	1734.00
T_4G_1	41.78	22.00	61.00	18.90	3.06	7.14	1.62	2.57	0.59	1452.62
T_4G_2	41.78	25.00	64.00	18.01	3.00	6.25	1.58	2.76	0.72	1491.58
T_4G_3	48.15	23.02	67.00	16.92	2.78	7.60	1.54	3.14	0.80	1465.60
T_5G_1	48.15	19.00	60.00	20.17	3.13	7.75	1.56	2.49	0.63	1581.04
T_5G_2	35.24	20.00	64.00	18.96	3.20	7.66	1.57	2.75	0.66	1515.63
T_5G_3	41.78	20.00	63.00	17.42	3.10	7.00	1.57	3.35	0.88	1581.04
SEm±	0.50	0.61	1.47	0.30	0.05	0.14	0.03	0.05	0.005	25.13
CD at 5%	1.45	NS	NS	0.86	0.16	0.41	0.09	0.14	0.016	72.08

Treatment details:

Presowing seed: T_0 (Control); T_1 (tap water soaked); T_2 (hot water soaked); T_3 (GA_3 500 ppm); T_4 (KNO_3 1%) and T_5 (H_2SO_4 75%)

Growing media: G_1 (FYM: Garden Soil: Sand); G_2 (Vermicompost: Garden soil: Sand) G_3(Vermiculite: Cocopeat: Perlite)

Table-2: Combined effect of pre-sowing seed treatments and media on various attributes of custard apple in seed bed condition.

Treatment	Germination Attributes			Seedling height (cm)	Stem diameter (mm)	Number of leaves	Length of internodes (cm)	Biomass (g)	Root/Shoot ratio	Seedling vigour index
	%	Initiation (Days)	Span (Days)	90 Days	90 Days	90 Days	90 Days			
T_0G_1	35.23	27.55	78.00	12.81	2.23	6.30	1.27	1.61	0.60	985.56
T_0G_2	28.10	27.00	81.00	14.69	2.26	6.29	1.23	1.82	0.59	1126.98
T_0G_3	35.23	25.45	79.00	13.65	2.28	5.55	1.26	1.92	0.65	1083.69
T_1G_1	35.24	22.55	73.00	13.71	2.44	5.99	1.29	1.69	0.60	1060.60
T_1G_2	41.78	24.00	74.00	14.65	2.41	5.98	1.28	1.93	0.55	1094.27
T_1G_3	35.24	27.45	77.00	15.83	2.33	6.42	1.34	2.22	0.61	1227.51
T_2G_1	35.23	21.89	69.00	15.81	2.29	6.23	1.29	2.25	0.62	1236.17
T_2G_2	41.78	26.00	70.00	14.49	2.31	6.23	1.34	2.19	0.67	1166.42
T_2G_3	35.23	24.12	74.00	15.32	2.46	6.83	1.29	2.39	0.68	1237.61
T_3G_1	54.69	20.89	63.00	17.90	2.73	7.18	1.47	2.56	0.63	1410.77
T_3G_2	41.78	22.00	66.00	16.98	2.81	6.98	1.39	2.46	0.66	1363.15
T_3G_3	48.15	22.12	66.00	17.31	2.78	7.48	1.41	2.41	0.65	1381.43
T_4G_1	41.78	23.89	67.00	15.39	2.46	6.94	1.37	2.44	0.72	1278.49
T_4G_2	48.15	23.00	65.00	16.21	2.51	6.52	1.31	2.35	0.67	1305.91
T_4G_3	41.78	26.12	71.00	15.48	2.56	7.11	1.37	2.44	0.68	1252.52
T_5G_1	41.78	21.79	70.33	16.93	2.66	6.63	1.42	2.36	0.65	1344.87
T_5G_2	48.16	21.00	65.00	15.29	2.46	6.68	1.40	2.29	0.68	1240.01
T_5G_3	41.78	23.22	66.66	16.41	2.53	6.48	1.37	2.41	0.68	1330.44
SEm±	0.47	1.08	1.61	0.31	0.04	0.13	0.03	0.04	0.002	25.05
CD at 5%	1.37	NS	NS	0.88	0.11	0.40	NS	0.13	0.008	71.86

in custard apple seedlings might be due to synergistic combination of pre-sowing seed treatment with GA_3 and cocopeat based media for growth of the seedlings. The increased length of internodes as a result of GA_3 application might be due to the fact that gibberellins increase the plant height as a result of osmotic uptake of nutrients causing cell elongation and increase the length of internodes of the seedling (Feucht and Watson 1958). Sen and Ghunti (1976) also observed that seed treatment with 100 ppm GA_3 gave better growth of seedling of papaya.

Biomass: Among all the treatment combinations the maximum biomass of seedlings was recorded under T_3G_3 combination in poly bag (3.67 g) and T_3G_1 (2.56 g) in seed bed condition, while minimum in T_0G_1 (1.63 g) in both the conditions. The increase in weight of plant as a result of GA_3 application might be due to the fact that GA_3 increased osmotic uptake of nutrients causing cell elongation and thus increasing height and weight of plant. The present findings are supported by Ratan and Reddy (2004). In case of growing media, custard apple seedlings produced higher biomass because better physical properties and optimum water holding capacity (Abirami *et al.*, 2010.).

Root : Shoot Ratio: Among the treatment combinations the maximum root/shoot ratio of seedlings was recorded under T_1G_3 in poly bag (0.98) and T_4G_1 in seed bed (0.72) condition, tap water (T_1) and KNO_3 (T_4) treatment probably due to proportionally low shoot and high root length registered maximum ratio and subsequently sown in growing media produced better physical properties and optimum water holding capacity cocopeat (polybag) and FYM (seed bed). The present findings are supported by Chopde *et al.* (1999).

Seedling Vigour Index: The combination of pre sowing seed treatments and growing media had significant effect on seedling vigour index. Maximum seedling vigour index was recorded under T_3G_3 in poly bag (1734) and T_3G_1 (1410.77) under seed bed condition, while minimum in T_0G_1 in both the conditions. GA_3 treatment increased internodal length in growing seedling and shoot, but enhanced feeder rootlets that facilitate to increase uptake and achieved buddable height of the seedling (Raja *et al*., 2001) and different media mixture enhances porosity, water holding and availability and supplied to the growing seedling (Abirami *et al.*, 2010) .

Thus, pre-sowing seed treatment with 500 ppm GA_3 with vermiculite: cocopeat: perlite media for poly bags and FYM: garden soil: sand (1:2:1) for seed bed, respectively resulted in higher germination and vigour of custard apple seedlings.

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