

Original Research Article

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Influence of GA₃ and Date of Sowing on Growth and Development of Custard Apple Seedlings

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ABSTRACT

A field experiment was conducted at fruit research station, Imliya, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur to study the influence of GA₃ and date of sowing on growth and development of custard apple seedlings. Significantly, maximum fresh weight of roots (0.75g), dry weight of root (0.20g) and total dry matter (0.37g) were obtained at 120 days after germination under 500ppm GA₃ treatment. Minimum of these attributes was registered with untreated seeds. Among different sowing dates, D₄ recorded maximum fresh weight of roots (0.87g), dry weight of roots (0.24g) and total dry matter (0.370g), while D₁ recorded minimum of these attributes. However, When seeds were treated with 500ppm GA₃ increased the height of the plants and maximum was recorded (4.24, 5.64, 9.79 and 12.86cm), girth of stem (1.20, 2.10, 2.93 and 4.68mm) and number of leaves per seedlings (4.18, 6.27, 9.42 and 13.86) at all stage of observations *i.e.* 30, 60, 90 and 120 days after sowing respectively. Whereas, treatment control gave minimum plant height, girth of stem and number of leaves per seedling at all the stage of observations. Interaction effect of GA₃ and date of sowing was found significant and maximum fresh weight, dry weight, total dry matter, plant height, girth of stem and number of leaves per seedling was recorded with D₄G₃.

Keywords

Custard apple,
GA₃, Fresh weight,
Dry weight, Plant
height, Stem girth

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Introduction

Custard apple (*Annona squamosa* L.) is one of the delicious fruits relished by many for table purpose, pleasant flavor; mild aroma and sweet taste have a universal acceptance. It is also known by different names such as sugar apple, Sharifa, Sitaphal and Attichaka in different parts of growing regions. It is widely cultivated in Andhra Pradesh, Maharashtra,

Karnataka, Bihar, Orissa, Assam and Tamil Nadu beside Madhya Pradesh and Chhattisgarh. It has gained commercial significance and exclusive orchards are emerging in Andhra Pradesh and Maharashtra. Custard apple is propagated both through seeds and vegetative methods. Seed propagation is even now widely followed resulting in great variability in seedling population. Seeds extracted from ripe fruits

are used for sowing. The use of plant growth regulators in proper concentration with scarification may regulate seed germination and seedling growth behavior in many fruit crops. Pre-sowing treatment of growth regulators could lead to increase seed germination and enhancement of seedling growth. A low concentration of plant growth regulators may be ineffective; on the other hand, higher concentration may inhibit the growth. Seed without use of growth regulators showed poor response for germination and subsequent growth. Plant growth regulators like GA₃, IBA, and IAA enhance the germination, growth and survival of seedlings. GA₃ are used for weakening of the seed coat so that the emergence of radical and plumule is positively influenced for root and shoot formation. Custard apple seed does not germinate immediately after extraction due to long period of dormancy. Therefore, seeds are sown in the rainy season after long period of storage for rising of seedlings. Looking to the above mentioned fact, the experiment was carried out to study the change in growth and development of custard apple seedlings after application of GA₃ concentrations and keeping different date of sowing.

Materials and Methods

The present investigation was carried out at fruit research station, Imalia, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (M.P.) during November 2013 to April 2014. Selected well ripened healthy and disease free 58 fruits of custard apple were taken for seed extraction. Seeds were separated from pulp and washed properly in clean water. Healthy and well developed seeds were selected from the extracted seeds. 720 seeds were taken for each treatment in each replication. The experiment consisted of two factor; *i.e.* factor (A) date of sowing which are denoted by D₁ (2nd Nov., freshly extracted seed), D₂ (5th Nov., 3 days after extracted seed), D₃ (8th

Nov., 6 days after extracted seed), D₄ (11th Nov., 9 days after extracted seed) and factor (B) GA₃ concentration; G₀ (control), G₁ (200 ppm), G₂ (400 ppm), G₃ (500 ppm). The preparation of GA₃ solutions (200, 400 and 500 ppm concentration) from 200 mg, 400 mg and 500 mg of GA₃ respectively were taken and each of dissolved separately in 5-10 ml of ethyl alcohol and then the volume was made to 1000 ml by adding distilled water. The extracted 50 seeds were soaked for 12 hours in GA₃ solutions of each concentration and water. Treatment of polythene bags were done with treated with the help of fungicide. The seeds were sown in polythene bags of (30 x 15cm) filled with a mixture of soil, sand, FYM in the ratio of 1:1:1. The sowing of custard apple seeds was done on 2nd November 2013. Watering and other operations were done as per requirements.

In this experiment, the response of different concentrations of GA₃ and different dates of sowing were evaluated for growth and development of custard apple seedlings. The experiment was laid out in factorial CRD as show in each treatment was replicated thrice randomly. The following observations were recorded at 120 days after sowing. Randomly selected three plants were tagged for following observations:

Fresh weight of root (g)
Dry weight of root (g)
Total dry matter production (g)

The following observations were recorded at 30, 60, 90 and 120 days after sowing. Randomly selected five plants were tagged for following observations:

Height of plant (cm) – Height was measured from ground level to the tip of opened leaf.

Girth of stem (mm) – The girth of stem was measured with the help of digital veneer

calipers just above the ground surface and the average was calculated.

Number of leaves per seedling – The total number of leaves per seedling was counted and the average was calculated. Matured leaves were taken into account.

Results and Discussion

The findings are briefly discussed and interpreted with the support of the finding of the previous research work.

Fresh weight of root (g)

The data presented in Table 2 showed that when seeds were treated with 500ppm GA₃, the fresh weight of roots with increased (0.75g) at 120 days after germination and it minimum (0.53g) when the seed are treated (G₀). The sowing date D₄ indicated the maximum fresh weight of root while the sowing date D₁ indicated the minimum fresh weight of root. On the other hand, when 500ppm GA₃ treated seed were sown in (G₃D₄) the fresh weight of roots was increased maximum (0.96g) and fresh weight of roots was minimum when untreated (G₀D₁) seeds were sown on 2nd November (FES). Increase in fresh weight of root with increasing GA₃

concentration may be due to increased auxin level in the roots which stimulated more root initiation, more nutrient uptake and root cell elongation, thus resulting into increased tap root length and number of secondary and fibrous roots and in return increased the fresh and dry weight. These results are in corroborated with the findings of Randhawa *et al.*, (1959), Shanmugavelu (1971) and (Ratan and Reddy (2004).

Dry weight of root (g)

The data regarding dry weight of roots as influenced by various concentrations of GA₃ and sowing dates presented in Table 2 indicated that the maximum dry weight of root (0.20g) was obtained at 120 days after germination under 500ppm GA₃ treatment and Minimum (0.11g) was observed under treatment G₀. Among different sowing dates D₄ recorded maximum (0.24g) dry weight of roots, while D₁ recorded minimum (0.08g) mean dry weight of roots. The interaction effect of GA₃ and dates of sowing was found significant. Under the combination of treatments G₃D₄ (0.29) significantly maximum dry weight of roots was found at 120 days after germination and minimum was found under G₀ D₁. Similar results were also reported by Shanmugavelu (1971).

Table.1 Details of treatment combinations

T ₁	D ₁ G ₀	FES + control	T ₉	D ₃ G ₀	6 day AES + control
T ₂	D ₁ G ₁	FES + 200ppm GA ₃	T ₁₀	D ₃ G ₁	6 day AES + 200ppm GA ₃
T ₃	D ₁ G ₂	FES + 400ppm GA ₃	T ₁₁	D ₃ G ₂	6 day AES + 400ppm GA ₃
T ₄	D ₁ G ₃	FES + 500ppm GA ₃	T ₁₂	D ₃ G ₃	6 day AES + 500ppm GA ₃
T ₅	D ₂ G ₀	3 day AES + control	T ₁₃	D ₄ G ₀	9 day AES + control
T ₆	D ₂ G ₁	3dayAES + 200ppm GA ₃	T ₁₄	D ₄ G ₁	9 day AES + 200ppm GA ₃
T ₇	D ₂ G ₂	3 day AES+ 400ppm GA ₃	T ₁₅	D ₄ G ₂	9 day AES + 400ppm GA ₃
T ₈	D ₂ G ₃	3 day AES + 500ppm GA ₃	T ₁₆	D ₄ G ₃	9 day AES + 500ppm GA ₃

*FES = freshly extracted seed

AES = after extracted seed

Table.2 Influence of GA₃ and date of sowing on fresh weight of root, dry weight of root and total dry matter production (g) at 120 day after germination

Treatments	Fresh weight of root (g)	Dry weight of root (g)	Total dry matter production (g)
D ₁	0.45	0.08	0.199
D ₂	0.61	0.15	0.228
D ₃	0.71	0.18	0.261
D ₄	0.87	0.24	0.370
SEm±	0.00	0.003	0.004
CD at 5%	0.01	0.008	0.012
G ₀	0.53	0.11	0.168
G ₁	0.65	0.15	0.222
G ₂	0.71	0.18	0.292
G ₃	0.75	0.20	0.376
SEm±	0.00	0.003	0.004
CD at 5%	0.01	0.008	0.012
D ₁ G ₀	0.33	0.04	0.107
D ₁ G ₁	0.44	0.07	0.173
D ₁ G ₂	0.51	0.10	0.220
D ₁ G ₃	0.54	0.12	0.297
D ₂ G ₀	0.48	0.09	0.150
D ₂ G ₁	0.62	0.15	0.187
D ₂ G ₂	0.65	0.17	0.247
D ₂ G ₃	0.69	0.19	0.327
D ₃ G ₀	0.53	0.12	0.147
D ₃ G ₁	0.70	0.17	0.210
D ₃ G ₂	0.80	0.20	0.287
D ₃ G ₃	0.84	0.23	0.400
D ₄ G ₀	0.77	0.21	0.270
D ₄ G ₁	0.85	0.23	0.317
D ₄ G ₂	0.90	0.26	0.413
D ₄ G ₃	0.96	0.29	0.480
SEm±	0.00	0.006	0.008
CD at 5%	0.02	0.017	0.24

Table.3 Influence of GA₃ and date of sowing on plant height (cm) at different successive growth stages after germination

Treatments	Plant height (cm)			
	30 days after germination	60 days after germination	90 days after germination	120 days after germination
D₁	1.71	3.45	7.14	8.93
D₂	3.08	4.23	8.01	10.88
D₃	4.22	5.20	10.32	12.13
D₄	5.01	6.92	10.96	13.99
SEm±	0.04	0.06	0.09	0.12
CD at 5%	0.13	0.17	0.27	0.34
G₀	2.80	4.21	8.30	10.08
G₁	3.14	4.63	8.97	11.15
G₂	3.84	5.31	9.36	11.84
G₃	4.24	5.64	9.79	12.86
SEm±	0.04	0.06	0.09	0.12
CD at 5%	0.13	0.17	0.27	0.34
D₁G₀	1.18	3.24	6.50	7.44
D₁G₁	1.55	3.27	6.87	8.88
D₁G₂	1.82	3.51	7.36	9.53
D₁G₃	2.29	3.77	7.83	9.88
D₂G₀	2.45	3.85	6.60	9.68
D₂G₁	2.47	3.94	8.01	10.12
D₂G₂	3.62	4.31	8.30	11.57
D₂G₃	3.79	4.84	9.15	12.16
D₃G₀	3.66	4.03	9.95	10.91
D₃G₁	3.89	4.84	10.33	11.91
D₃G₂	4.36	5.89	10.50	12.14
D₃G₃	5.00	6.06	10.51	13.59
D₄G₀	3.92	5.73	10.18	12.32
D₄G₁	4.67	6.50	10.66	13.70
D₄G₂	5.59	7.55	11.30	14.14
D₄G₃	5.87	7.90	11.69	15.83
SEm±	0.09	0.12	0.18	0.24
CD at 5%	0.27	0.34	0.54	0.69

Table.4 Influence of GA₃ and date of sowing on girth of stem (mm) at different successive growth stages after germination

Treatments	Girth of stem (mm)			
	30 days after germination	60 days after germination	90 days after germination	120 days after germination
D₁	0.84	1.64	2.60	3.61
D₂	1.04	1.72	2.66	4.01
D₃	0.95	1.82	2.73	4.35
D₄	1.39	2.14	3.32	4.76
SEM±	0.01	0.04	0.64	0.04
CD at 5%	0.02	0.14	0.19	0.14
G₀	0.95	1.72	2.62	3.81
G₁	1.01	1.75	2.84	3.99
G₂	1.05	1.75	2.91	4.25
G₃	1.20	2.10	2.93	4.68
SEM±	0.01	0.04	0.64	0.04
CD at 5%	0.02	0.14	0.19	0.14
D₁G₀	0.69	1.66	2.35	3.25
D₁G₁	0.93	1.72	2.67	3.56
D₁G₂	0.77	1.33	2.73	3.79
D₁G₃	0.95	1.85	2.60	3.85
D₂G₀	0.99	1.58	2.41	4.18
D₂G₁	1.16	1.70	2.96	3.73
D₂G₂	1.05	1.75	2.64	3.76
D₂G₃	0.95	1.87	2.65	4.35
D₃G₀	0.99	1.71	2.73	3.82
D₃G₁	0.86	1.63	2.36	3.98
D₃G₂	0.95	1.64	2.93	4.52
D₃G₃	0.99	2.29	2.89	5.07
D₄G₀	1.15	1.93	3.03	4.01
D₄G₁	1.09	1.95	3.36	4.63
D₄G₂	1.42	2.28	3.33	4.94
D₄G₃	1.92	2.39	3.58	5.45
SEM±	0.02	0.09	0.13	0.09
CD at 5%	0.05	0.28	0.37	0.28

Table.5 Influence of GA₃ and date of sowing on number of leaves per seedling at different successive growth stages after germination

Treatments	Number of leaves per seedling			
	30 days after germination	60 days after germination	90 days after germination	120 days after germination
D₁	2.82	4.07	7.02	9.86
D₂	2.95	5.28	7.40	10.40
D₃	3.44	5.33	8.21	12.37
D₄	3.71	6.02	10.02	15.17
SEm±	0.07	0.07	0.09	0.15
CD at 5%	0.20	0.20	0.28	0.45
G₀	1.93	3.84	6.53	9.96
G₁	3.11	4.98	8.01	11.44
G₂	3.70	5.61	8.69	12.54
G₃	4.18	6.27	9.42	13.86
SEm±	0.07	0.07	0.09	0.15
CD at 5%	0.20	0.20	0.28	0.45
D₁G₀	2.22	3.11	5.11	7.14
D₁G₁	2.58	3.92	6.92	9.77
D₁G₂	3.03	4.38	7.55	10.77
D₁G₃	3.44	4.88	8.51	11.77
D₂G₀	1.40	3.99	6.42	8.99
D₂G₁	2.88	5.24	7.33	9.99
D₂G₂	3.55	5.66	7.55	10.83
D₂G₃	3.99	6.22	8.33	11.81
D₃G₀	1.77	3.87	6.87	10.96
D₃G₁	3.44	5.24	7.96	11.74
D₃G₂	3.99	5.62	8.69	12.48
D₃G₃	4.55	6.59	9.33	14.33
D₄G₀	2.33	4.40	7.73	12.77
D₄G₁	3.55	5.51	9.85	14.25
D₄G₂	4.21	6.77	10.99	16.10
D₄G₃	4.77	7.40	11.51	17.55
SEm±	0.14	0.14	0.19	0.31
CD at 5%	0.41	0.41	0.57	0.90

Total dry matter production (g)

The data for various treatments with respect to the dry matter recovery are summarized in

Table 2. G₃ (500ppm GA₃) was found to record maximum (0.37g) dry matter, followed by G₂ (0.29g) and the minimum (0.168g) in G₀ (control).

Girth of stem (mm)

The findings of stem girth were recorded at different intervals and data summarized in Table 4. When seeds were treated with 500ppm GA₃ increased the mean girth of stem at all stage of observations (1.20, 2.10, 2.93 and 4.68mm) at 30, 60, 90 and 120 days after sowing respectively. Whereas, seeds placed in the rooting media in intervals (30, 60, 90 and 120days) the fourth sowing date is D₄ gave maximum girth (1.39, 2.14, 3.31 and 4.76mm) at different intervals respectively. The interaction of GA₃ and sowing date (G₃D₄) maximum mean stem girth (1.92, 2.39, 3.58 and 5.45) at 30, 60, 90 and 120 days was recorded. While girth was observed when untreated seeds sown. The gibberellic acid increases the girth of stem in custard apple mainly due to cell elongation, increase in cell size and rapid cell division. Due to this, the elongation of internodes will takes place, hence the girth of stem will increase. These results are in agreement with the findings of Harshavardhan and Rajsekhar (2012) and (Meena and Jain, 2012).

Number of leaves per seedling

The data as regarded number of leaves per seedling as influenced by different concentration of GA₃ and sowing dates presented in Table 5 indicated that the maximum mean number of leaves per seedlings was produced by the seedling treated with 500ppm GA₃ (4.18, 6.27, 9.42 and 13.86) at 30, 60, 90 and 120 days after sowing whereas treatment control gave minimum mean number of leaves per seedling at all the stage of observations. Among different sowing dates, D₄ encouraged leaf production and gave significantly maximum (3.71, 6.03, 10.02 and 15.17) mean number of leaves per seedling at 30, 60, 90 and 120 days after sowing respectively. The treatment combination G₃D₄ produced maximum

number of leaves per seedling (i.e. 4.77, 7.40, 9.42 and 17.55) at 30, 60, 90 and 120 days after sowing. While number of leaves was reduced when untreated seeds sown. Increase in a number of leaves in GA₃500 ppm might be due to the maximum height of seedlings under this treatment. This also helps in invigoration of physiological process of plant and stimulatory effect of chemicals to form new leaves at faster rate as suggested by Shaban (2010). The production of more number of leaves in gibberellic acid treatments may be due to the vigorous growth with more number of branches and leaves which in turn facilitates better harvest of sunshine by the plants to produce more photosynthates. The above results are in conformity with the findings of Pampanna *et al.*, (1995) and (Pal and Dhaka, 2010).

On the basis of findings, it could be concluded that the GA₃ (500ppm) is the best as compare to other GA₃ concentrations for influencing the growth and development of seedling. As regards, the sowing dates, D₄ were found to be the most suitable sowing date under study for growth and development. However, the G₃D₄ gave the most superior results.

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