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Effect of GA_3 and cow urine on germination and morphology of custard apple

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Abstract
An investigation was conducted to the effect of GA_3 and cow urine on germination and morphology of custard apple. The result indicated that T_3 (400 ppm GA_3 and cow urine for 24hrs) took minimum days (31.50) to start germination, minimum days (64.75) for 50% seed germination and the highest germination percentage at 60 DAS (76.5%). The height of plant was recorded at. The maximum plant height *i.e.* 4.35, 8.25, 12.00 and 16.75 cm at 60, 90, 120 and 150 days after sowing, the maximum number of leaves per seedling *i.e.* 5.00, 8.39, 16.00 and 18.25 at 60, 90, 120 and 150 days after sowing and maximum girth of stem *i.e.* 2.64, 2.84, 3.11 and 3.77 at 60, 90, 120 and 150 days after sowing, respectively were recorded under the treatment T_3.The maximum length of seedling at 150 DAS *i.e.* 30.50 cm, maximum root length (20.50cm) and maximum number of roots per seedling (44.25) were recorded at under the treatment T_3.

Keywords: Sowing, germination, roots, leaves, height

Introduction
Custard apple (*Annona squamosa* L.) belongs to family Annonaceae and is one of the finest fruits gifted to India by tropical America. It is commonly found in India and cultivated an area of 22 thousand ha. with production of 174 MT (Anonymous, 2014) [1] Custard apple, popularly known as "Sitaphal" is grown mainly in the states of Andhra Pradesh, Assam, Tamil Nadu and Madhya Pradesh, it is grows wild in Deccan plateau and some parts of central India. Custard apple is generally classified as semi wild fruit by virtue of its spontaneous spread in forests, wastelands and other uncultivated places. It is hardy, tolerant to drought, salinity and saline irrigation water to certain extent. It grows very well even on a shallow soil. It also sheds off leaves during stress period to minimize the moisture loss from plant tissues through transpiration and thus a most appropriate fruit crop for rainfed region. It is considered as one of the delicious and nutritionally valuable fruits meant for table purpose. Fruits have an edible, soft, granular, juicy and sugary pulp with mild flavour and with slight acidity. Fruits are considered for their medicinal value besides their general use in ice cream, confectionery, certain milk products and in making preserves as jam, jelly and other products. It is considered as beneficial for cardiac disease, diabetes, hyperthyroidism and cancer. It contains about 28-55% of edible portion consisting of 73.30% moisture, 1.60% protein, 0.30% fat, 0.70% mineral matter, 23.90% carbohydrates, 0.20% calcium, 0.40% phosphorus, 1.0% iron, 12.40-18.15% sugar and 0.26-0.65% acidity with caloric value of 105 K cal/100g.

It is generally propagated by seed since there is little variability among seedlings. Maximum germination can be obtained by sowing of freshly extracted seed upto 20-30 days. The seeds of Annonaceae are albuminous ellipsoids and their length varies between 5 and 30 mm. They have a ruminate endosperm (Corner, 1976) [3]. The embryo is small, straight, with moderately developed embryonic axis, rudimentary plumule and a flat and thin cotyledon; which develops after the seed is formed (Corner, 1976) [3]. Setten and Koek-Noorman (1992) [12] observed that Annonaceae seeds undergoing dispersal have a small embryo that is considered underdeveloped and immature; immaturity requires time to complete embryo growth after seed dispersion. Meanwhile, Hayat (1963) [6] reported that the seeds of *A. squamosa* have a small embryo with two foliaceous, thin cotyledons that take one to three months to germinate.

Seed germination is the resumption of active growth of embryo that results in the emergence of the young plant. Seeds of many fruit crops remain ungerminated even under favourable conditions. Such kind of dormancy in seeds may be due to presence of hard and impermeable seed coat, germination inhibitors and improper development of embryo.

Such seeds may require special treatments like scarification, soaking in water, growth regulators etc. to overcome dormancy. Gibberellins (GA_3) activate the embryonic vegetative growth, weakens the endosperm layer that involves the embryo and restricts its growth, and mobilizes the energetic reserves from the endosperm of cereals (Bewley, 1997 [2]; Taiz and Zeiger, 2006 [15]). Cereal embryo synthesizes and releases GA during the germination, which leads to the production and/or secretion of several hydrolytic enzymes involved in the solubilization of reserves, including α-amylase and β-amylase (Taiz and Zeiger, 2006) [15]. Keeping the above point in view, the present study was carried out to see the effect of GA_3 on germination, growth and survival of seedling.

2. Material and Methods

The ten treatments were plotted with four replications under poly house condition to examine seed germination and growth behaviour of custard apple. The experiment was carried out at Fruit Research Station, Imalia, JNKVV, Jabalpur during the year 2016-2017 Jabalpur is situated in "Kymore Plateau and Satpura Hills" Agro-climatic zone of Madhya Pradesh at 23.9ºN latitude and 79.58º east longitudes and an altitude of 411.78 meters above the mean sea level. The climate of Jabalpur region is semi-arid and subtropical having warm and dry spring summer and cool winter as main characteristics feature, in general the highest temperature reaches above 45°C and below 5°C respectively. The relative humidity varies from 70-80%. The average annual rainfall of about 1375, mm, which is mainly distributed from mid June to first week of October from south-west monsoon with occasional rain during winter.

2.1. Treatment Details

Notation	Concentration	Remark
T_1	GA_3- 200ppm	Seed soaking for 24hrs
T_2	GA_3-300 ppm	Seed soaking for 24hrs
T_3	GA_3-400 ppm	Seed soaking for 24hrs
T_4	GA_3-500 ppm	Seed soaking for 24hrs
T_5	Cow urine 10%	Seed soaking for 24hrs
T_6	Cow urine 20%	Seed soaking for 24hrs
T_7	Cow urine30%	Seed soaking for 24hrs
T_8	Cow urine40%	Seed soaking for 24hrs
T_9	Water 100%	Seed soaking for 24hrs
T_{10}	Control	Without soaking

3. Result and Discussion

3.1 Days to first germination

The result of present study indicated (Table 1) that in seed treated with different dose of GA_3 and cow urine for 24hrs, 400 ppm GA_3 (T_3) for 24 hours the minimum days (31.50) were taken to start germination while maximum days (53.50) were registered under control. These findings are supported by Dhankhar and Kumar (1996) [5].

3.2 Days to 50% germination

The result of present study indicated (Table 1) that in seed treated with different dose of GA_3 and cow urine for 24hrs. In the present study, 64.75 days was required for 50% seed germination under GA_3 at 400 ppm (T_3) while it was maximum 88.50 days taken to 50% germination under control (T_{10}). Similar results have been reported by Meena *et al.* (2003) [7] in papaya seed treated with GA_3 for germination and found maximum percentage of germination. The findings of Venkatrao (2005) [16] are also close to the conformity with the present findings.

3.3 Percentage of germination at 60 DAS

The result of present study indicated (Table 1) that in seed treated with different dose of GA_3 and cow urine for 24hrs. In the present study, significantly the highest germination percentage (76.5%) was obtained under the media T_3This finding is supported by Sinish *et al.* (2005) [13] who reported that Gibberellic acid concentration in the induced better germination percentage. Gibberellic acid concentration showed significant effect on percentage of germination at 60 DAS. The maximum germination percentage of 76.5 was recorded under T_3 and the minimum germination (%) was recorded under T_{10}. It might be due to GA3 which accelerate the activity of specific enzymes such as α-amylase, which have brought an increase in availability of starch assimilation resulting an early germination

Table 1: Influence of gibberellic acid and cow urine on days taken to start germination (days), Days taken to 50% germination and germination (%) at 60 DAS

Treatments	Days taken to start germination	Days to 50% germination	Percentage of germination in each treatment at 60DAS
T_1 (200 ppm GA_3)	35.75	70.50	64.75
T_2 (300 ppm GA_3)	34.75	67.75	71.25
T_3 (400 ppm GA_3)	31.50	64.75	76.5
T_4 (500 ppm GA_3)	33.50	65.00	72.5
T_5 (10 % cow urine)	33.00	69.75	67.25
T_6 (20 % cow urine)	36.50	68.25	65
T_7 (30 % cow urine)	41.50	72.75	68
T_8 (40 % cow urine)	45.50	79.75	67.25
T_9 (100 % water)	47.50	79.25	67.75

T_{10} (Control)	53.50	88.50	64
SEm±	0.97	3.77	2.23
CD at 5%	3.53	13.69	8.10

3.4 Plant Height

The result of present study indicated (Table 2) that in seed treated with different dose of GA_3 and cow urine for 24hrs The height of plant was recorded at 60, 90, 120 and 150 days after sowing. The significantly maximum plant height (i.e. 4.35, 8.25, 12.00 and 16.75 cm), respectively were recorded at successive growth stages under the treatment T_3. However, the minimum plant height was recorded under treatment T_{10} at all the growth stages of observation. It was due to additional GA_3, activated α-amylase which digested the available carbohydrate Increase in plant height due to GA_3 has been reported by Ratan and Reddy (2004) [11] GA_3 promote the growth of the plant by the promotion of cell elongation. These results demonstrated that the application of plant growth regulators to the seedlings might be a useful way of enhancing growth of mango seedling and reducing the time and cost of seedling production Mobli *and* Baninasab (2008) [8].

Table 2: Influence of gibberellic acid and cow urine on Shoot Length

Treatment details	Shoot Length (cm)			
	60 DAS	90 DAS	120DAS	150 DAS
T_1 (200 ppm GA_3)	4.00	6.38	10.50	15.83
T_2 (300 ppm GA_3)	4.20	7.33	11.75	15.70
T_3 (400 ppm GA_3)	4.35	8.25	12	16.75
T_4 (500 ppm GA_3)	3.55	5.15	10.85	15.25
T_5 (10% cow urine)	2.25	4.23	10.25	15.50
T_6 (20% cow urine)	2.05	4.35	9.53	14.50
T_7 (30% cow urine)	2.08	3.63	10.65	14.75
T_8 (40%cow urine)	2.43	4.10	9.68	15.00
T_9 (100%water)	2.45	4.50	8.65	14.65
T_{10} (Control)	1.58	3.00	8.45	14.90
SEm±	0.27	0.38	0.52	0.65
CD at 5%	0.97	1.39	1.90	2.36

3.5 Number of leaves per seedling

The result of present study indicated (Table 3) that in seed treated with different dose of GA_3 and cow urine for 24hrs. The present research reveals that the effect of GA_3 showed significant effect on number of leaves. The maximum number of leaves per seedling was observed under treatment T_3 (5.00, 8.39, 16.00 and 18.25) at 60, 90, 120 and 150 days after sowing. Whereas treatment T_{10} was recorded minimum number of leaves per seedling at all the stages of observations. The results have been reported by Venkatarao (2005) [16] in mango revealed that seed fortification with GA 400 ppm performed well even under nursery condition recording the higher leaf number and stem circumference.

Table 3: Influence of gibberellic acid and cow urine on number of leaves per seedling

Treatment	Number of leaves per plant			
	60 DAS	90DAS	120 DAS	150 DAS
T_1 (200 ppm GA_3)	4.50	7.81	15.25	18.00
T_2 (300 ppm GA_3)	4.95	7.99	15.50	17.84
T_3 (400 ppm GA_3)	5.00	8.39	16.00	18.25
T_4 (500 ppm GA_3)	4.36	7.50	15.75	16.50
T_5 (10% cow urine)	4.50	6.72	15.64	17.14
T_6 (20% cow urine)	3.50	7.62	15.75	16.25
T_7 (30% cow urine)	3.55	7.80	15.25	16.50
T_8 (40%cow urine)	3.29	7.64	15.00	17.75
T_9 (100%water)	3.19	7.54	15.25	16.50
T_{10} (Control)	3.07	6.75	13.50	15.00
SEm±	0.35	0.28	0.97	0.66
CD at 5%	1.27	1.01	3.52	2.40

3.6 Girth of stem

Significantly maximum girth (Table 4) of stem (2.64, 2.84, 3.11 and 3.77) was recorded at 60, 90, 120 and 150 days after sowing in T_3 (GA_3 400 ppm) whereas minimum girth under treatment T_{10}. The beneficial effect of GA_3 was probably due to cell elongation and quicker multiplication of cells after the germination. Results are in conformity with the findings of Venkatrao (2005) [16] and Dalal *et al*. (2002) [4], they reported that GA_3 gave the highest percentage of germination and enhance the plant growth or morphological parameter of seedling in fruit crops like Mango, Aonla, Rangpur lime, etc.

Table 4: Influence of gibberellic acid and cow urine on girth of stem

Treatment	Girth of stem (mm)			
	60 DAS	90 DAS	120 DAS	150 DAS
T_1 (200 ppm GA_3)	2.26	2.66	2.82	3.42
T_2 (300 ppm GA_3)	2.46	2.70	2.95	3.47
T_3 (400 ppm GA_3)	2.64	2.84	3.11	3.77
T_4 (500 ppm GA_3)	2.34	2.54	3.06	3.41
T_5 (10% cow urine)	2.27	2.45	3.02	3.43
T_6 (20% cow urine)	2.18	2.20	2.97	3.25
T_7 (30% cow urine)	1.85	2.21	2.92	3.27
T_8 (40%cow urine)	1.93	2.38	2.76	3.18
T_9 (100%water)	2.10	1.92	2.78	3.30
T_{10} (Control)	1.74	1.89	2.43	2.97
SEm±	0.07	0.07	0.25	0.09
CD at 5%	0.26	0.26	0.92	0.34

3.7 Length of seedling

The result of present study indicated (Table 5) that in seed treated with different dose of GA_3 and cow urine for 24hrs. The present results demonstrated that the effect of gibberelic acid showed significant effect on length of seedling at 150 days after sowing. The maximum length of seedling i.e. 30.50 cm was recorded at successive growth stages under the treatment T_3. However, the minimum length of seedling 20.00 cm was recorded under treatment T_{10} (control). These findings are supported by Taiwo (2004) [14] and Parasana *et al.* (2012) [10].

3.8 Root Length

The result of present study indicated (Table 5) that in seed treated with different dose of GA_3 and cow urine for 24hrs. In the present study, significantly root length (20.50cm) was obtained under treatment T_3 (GA_3 at 400 ppm) and minimum root length (16.25) was obtained under treatment T_{10} i.e. control at 150 days after sowing. The maximum root length under the treatment which has absorbed more food material and might be increased cell division by mitosis which adds new cells and elongation of already existing cells by enlargement of the vacuoles. The findings are supported by Ozguven and Nikpeyma (1995) [9] and Wagh *et al.* (1998) [17].

3.9 Number of roots per seedling

The result of present study indicated that in seed treated with different dose of GA_3 and cow urine for 24hrs. The present work demonstrated that the effect of gibberelllic acid on number of roots per seedling. The maximum number of roots per seedling (44.25) was observed under T_3 (GA_3 at 400 ppm) at 150 days after sowing whereas, treatment T_{10} was recorded minimum mean number of roots per seedling (38.00) at 150 days after sowing. Vigorous root growth due to GA_3 might be responsible for improving the root growth. The findings were supported Dhankhar and Kumar (1996) [5].

Table 5: Influence of gibberellic acid and cow urine on length of seedling, root length and number of roots at 150 days after sowing

Treatment details	Length of seedling (cm) at 150 DAS	Root length (cm) at 150 DAS	Number of roots per seedling at 150 DAS
T_1 (200 ppm GA_3)	21.75	18.50	39.50
T_2 (300 ppm GA_3)	22.75	19.75	43.50
T_3 (400 ppm GA_3)	30.50	20.50	44.25
T_4 (500 ppm GA_3)	27.00	18.25	43.00
T_5 (10% cow urine)	23.75	17.00	42.25
T_6 (20% cow urine)	22.75	17.75	39.00
T_7 (30% cow urine)	21.25	17.25	40.00
T_8 (40%cow urine)	20.75	18.50	42.50
T_9 (100%water)	22.50	17.50	41.50
T_{10} (Control)	20.00	16.25	38.00
SEm±	1.64	1.08	1.56
CD at 5%	4.89	3.94	5.66

4. Conclusion

It can be concluded that treatment T_3 (400 ppm GA_3 and cow urine for 24hrs) was the best among the all for all the parameters.

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