RESEARCH ARTICLE

EFFECT OF SEED TREATMENT ON GERMINATION AND SURVIVABILITY OF CUSTARD APPLE

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Abstract: The experiment comprised of 14 treatments, viz. T_1 (control/without water soaking), T_2 (Water soaking), Gibberellic acid concentrations -T_3 (200 ppm), T_4 (300 ppm), T_5 (400 ppm), and chemicals viz.T_6 (Thiourea 0.5%), T_7 (Thiourea 0.75%), T_8 (Thiourea 1.00%), T_9 (KNO_3 0.5%), T_{10} (KNO_3 0.75%), T_{11} (KNO_3 1.00%), T_{12} (Sodium thiosulphet-150 ppm), T_{13} (Sodium thiosulphet-200ppm), T_{14} (Sodium thiosulphet-250 ppm) was conducted to study the effect of chemicals and plant growth regulators on germination, vigour of seedling and survivability of custard apple. Among the various treatments, GA_3, concentration at 400 ppm (T_5) was proved superior in respect to germination of custard apple seed as well as growth parameter and survival of custard apple seedling.

Keywords: Custard Apple, Chemicals, Plant growth regulators, Germination, Survival

INTRODUCTION

Custard Apple (*Annona squamosa* L.) belongs to the family Annonaceae and is one of the finest fruits introduced in India from tropical America. It is also found in wild form in many parts of India. In India, custard apple occupies an area of 29.87 thousand ha with production of 228.37 MT (Anonymous, 2015). It is found growing almost in all the tropical and sub tropical regions mostly in wild form .Andhra Pradesh is the major custard apple growing state along with Tamil Nadu, Orissa, Assam, U.P., M.P., Bihar and Rajasthan. Setten and Koek-Noorman (1992) observed that Annonaceae seeds undergoing dispersal have a small embryo that is considered underdeveloped and immature.

Seed germination of custard apple is uneven and irregular making sexual propagation difficult. Much experimental evidences support the concepts that specific endogenous growth promoting and inhibiting compounds are involved directly in the control of seed development, dormancy and germination (Black, 1980). Custard apple requires 35-50 days for potential germination (Hernandez, 1983). Irregular germination, in custard apple seeds may be due to dormancy or due to hard seed coat. Very limited work has been carried out on this aspect in India and in different parts of the world indicating, the utility of GA_3 from 150-500ppm and chemicals for getting better germination of custard apple seeds (Banker, 1987; Stino et al.,1996, Pawshe et al., 1997; Ratan and Reddy, 2004). Therefore, pre treatment of custard apple seed with water, different organics and chemicals is very important to improve germination. Considering the above problem the investigation was conducted to find out effect of water soaking, PGR and chemicals on seed germination and survivability of custard apple.

MATERIALS AND METHODS

The investigation was conducted at Horticulture Farm Maharajpur, Department of Horticulture, College of Agriculture, JNKVV, Jabalpur (M.P.).during 2014-15 under poly house condition in Randomized Block Design with three replication.The seeds were treated with chemicals and PGR as per treatments. The experiment comprised of 14 treatments viz. Without water soaking (control) -T_1, Water soaking- T_2, GA_3 -200 ppm- T_3, GA_3 -300 ppm- T_4, GA_3 -400 ppm- T_5, Thiourea -0.5 % - T_6, Thiourea -0.75 % - T_7, Thiourea -1.00 % - T_8, KNO_3 -0.5 % - T_9, KNO_3 -0.75 % - T_{10}, KNO_3-1.00 % - T_{11}, Sodium Thiosulphate -150 ppm- T_{12}, Sodium Thiosulphate -200 ppm - T_{13}, Sodium Thiosulphate-250 ppm- T_{14}. The seeds were soaked in water and as well as in GA_3 and different chemical solutions for 24 hours and grown in polybags under the polyhouse. One seed per poly bag was sown at 2-2.5 cm depth. The growth parameters were recorded at 30, 60, 90, 120 and 150 days after sowing. Five plants were randomly selected for observations and mean value was computed. The data were analyzed using standard statistical methods. (Panse and Sukhatme,1985).The length was measured with metre scale, width was with verniere calipers and weight with electronic weighing machine. The germination in each treatment was recorded at 60 days after sowing. Number of seedlings were counted and expressed as germination percentage.

$$\text{Germination (\%)} = \frac{\text{Total no. of seeds germinated}}{\text{Total no of seeds sown}} \text{ X } 100$$

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The survival percentage of each treatment was recorded at 150 days after seed sowing.

$$\text{Survival percentage of seedlings} = \frac{\text{No. of survived seedling}}{\text{Total no. of seedlings}} \times 100$$

RESULT AND DISCUSSION

Days taken to start germination

The data pertaining to days taken to start germination revealed that almost all the treatments showed significant effect on days taken to start germination of seed over T_1 (control). The minimum days (29.73) were taken to germinate the seed of custard apple under T_5 which was found statistically at par with T_{11} (30.47), T_{10} (31.13), T_{12} (31.33), T_4 (31.40), T_3 (31.67), T_6 (31.87) T_7 (32.13) T_9 (32.27) and T_8 (32.53). The maximum days (38.00) were taken to start germination under T_1 (control). The increase in germination was due to GA_3. GA_3 has antagonistic effect on germination inhibitors (Brain and Heming 1958; Wareing et al., 1968) and endogenous gibberellins were reported to increase due to soaking (Mathur et al., 1971). GA_3 helps in synthesis of á-amylase which converts the starch into simple sugars. These sugars provide energy that is required for various metabolic and physiological activities. The result is in agreement with the findings of Shanmugavelu (1968) in jackfruit, Gupta (1989) in citrus, Babu et al. (2004) in papaya and Ratan and Reddy (2004) who reported that the GA_3 400 ppm took minimum time to germinate the seeds of Custard apple. The findings are supported by Pillewan et al. (1997) treatment with thiourea at 150 ppm for 24 hrs on higher seed germination. Ratan and Reddy (2003) reported that the Seed germination was highest with seed soaking at 1% potassium nitrate for 24 h.

Days taken to 50% germination

The data pertaining to days taken to 50% germination clearly showed that all the treatments significantly affected the days taken to 50% germination of seed over T_1 (control). GA_3 concentration of 400ppm recorded minimum days (37.40) for 50% germination which was statistically at par with T_{11} (37.60), T_{10} (37.93), T_{12} (38.40), T_4 (38.47), T_3 (38.53), T_6 (38.60), T_7 (38.67), T_9 (38.73), T_8 (38.80), T_{13} (39.07) and T_{14} (39.87). The maximum days (45.13) to achieve 50% germination were noted under T_1 (control).Initiation of seed germination was significantly affected by gibberellic acid. The findings are supported by Ynoue et al. (1999) who reported that the GA_3 150 ppm reduced the average time of germination on kiwi fruit seeds.

Percentage of germination in each treatment at 60 days

Data revealed that almost all the treatments showed significant effect on percentage of germination of seed at 60 DAS over T_1 (control). The maximum percentage of seeds germination (86.67%) was noted at 60 days after sowing under T_5 (GA_3 400ppm) which was found statistically at par with T_{11} (85.00%), T_{10} (83.33%), T_{12} (81.67%), T_4 (80.00%), T_3 (78.33%) and T_6 (77.07%) and T_7 (76.67). Whereas, the minimum percentage of seeds germination (64.41%) was under noted T_1 (control).These findings may be due to GA_3, which would have triggered the activity of specific enzymes that promoted early germination, such as α-amylase, which have brought an increase in availability of starch assimilation. Similar findings were reported by Wagh et al. (1998). And Plant growth regulators and some chemicals are widely used in increasing the seed germination percentage and for healthy growth. Similar findings were reported by Parmar et al. (2016).

Height of shoot (cm)

The data on length of shoots recorded at 60, 90, 120, 150 days after sowing showed that almost all the treatments showed significant effect on length of shoots over T_1 (control) at 60, 90, 120 and 150 DAS. The significantly maximum shoot length of 6.54, 14.99, 23.64 and 38.49 cm were noted under T_5 (GA_3 400ppm) at 60, 90, 120 and 150 DAS, respectively. The minimum shoot length 4.67, 10.57, 15.99 and 22.77 cm were recorded under T_1 (without water soaking) at 60, 90, 120 and 150 days after seed sowing, respectively closely followed by T_2 treatments. Basically, plant height is a genetically controlled character. But, several studies have indicated that plant height can be increased by application of synthetic plant growth regulators. However, in the present investigation a significant difference in plant height was noticed by the application of different concentration of GA_3. GA_3 treatment apart from improving germination also increased the subsequent growth of seedling. This may be attributed to cell multiplication and elongation of cells in the cambium tissue of internodal region by GA_3 apparently activating the metabolic processes or nullifying the effect of an inhibitor on growth. Increase in shoot height due to GA_3 has also been reported by Ratan and Reddy (2004). Rajamanickam *et al*. (2004) reported that KNO_3, 0.5% KNO3 + 200 ppm GA_3 and 1% thiourea and sown on a sand medium.

Number of leaves per seedling

The data pertaining to number of leaves per seedling recorded at 60, 90, 120, 150 days after sowing showed that all the treatments have significant effect on number of leaves over T_1 at 60, 90, 120 and 150 DAS. The maximum number of leaves 7.63, 14.50, 27.13 and 38.57 were noted under T_5 (GA_3 400ppm) at 60, 90, 120 and 150 DAS, respectively. The minimum number of leaves of 5.27, 9.53,16.30 and 22.33 leaves were recorded under T_1 (without water soaking) at 60, 90, 120 and 150 days after seed sowing, respectively. The production of more number of leaves in GA_3 treatments may be due to the vigorous growth and more number of branches induced by GA_3 facilitates better harvest of sunshine by the plants to produce more number of leaves. Similar findings were also reported by Venkata Rao and Reddy (2005) in mango.

Girth of stem (mm)

Data pertaining to girth of stem as affected by different days showed that varies treatments had significant effect on stem girth over T_1 (control) at 60, 90, 120 and 150 DAS. The maximum stem girth of 1.79, 2.52, 3.17 and 4.08 (mm) were recorded under T_5 (GA_3 400ppm) at 60, 90, 120 and 150 days after sowing, respectively at 150 DAS. The maximum girth (4.08) noted under T_5 was found at par with T_{11} (3.88). The minimum stem girth of 1.19, 1.60, 2.77 and 3.10(mm) were recorded under T_1 (without water soaking) at 60, 90, 120 and 150 days after sowing. The increase in seedling girth by application of gibberellic acid was also reported by Venkata Rao and Reddy (2005) in mango.

Length of seedling (cm)

That various treatments showed significant effect on length of seedling over control ($T_{1)}$ at 150 days after sowing. The maximum seedling height of (61.63 cm) were recorded when seeds soaked in 400ppm concentration of GA_3 (T_5), whereas, minimum height of seedlings (38.92 cm) was recorded under control (T_1),. Gibberellins are well known for inter-nodal cell elongation, thereby leading to increase in seedling length. These findings are supported by Ratan and Reddy (2004).

Length of root (cm)

A perusal of data revealed that the different treatments showed significant effect on root length over T_1 (control) after 150 days. The maximum length of root (23.14 cm) was recorded under T_5 which was at par with T_{11} (21.44 cm), T_{10} (21.43 cm) T_{12} (20.71 cm) and T_4 (20.65 cm) while minimum length of root (16.15 cm) was recorded under T_1 (control).Exogenous application of GA_3 induced the activity of gluconeogenic enzymes during early stages of seed germination and this could be the reason for improved germination and vigour characteristics that is reflected in terms of increase in root length. Similar findings were also reported by Wagh et al. (1998). Rajamanickam et al. (2004) reported that KNO_3, 0.5% KNO_3 + 200 ppm GA_3. were recorded maximum root length in amla.

Number of roots per seedling

The data revealed that various treatments showed significant effect on number of roots over T_1 (control) after 150 days. The maximum number of (48.70) roots per seedling was recorded under T_5 which was at par with T_{11} (46.47), T_{10} (45.73), T_{12} (43.80) and T_4 (41.13) while minimum number of root was recorded under T_1 (31.27). Vigrous root growth due to GA_3 might have resulted in more production of photosynthates and their translocation through phloem to the root zone, which might be responsible for improving the root growth. Similar findings were reported by Wagh et al. (1998).

Fresh and dry weight of shoot and roots (g)

A perusal of data indicated that the fresh weight of roots was significantly affected by different treatments over T_1 (control).The maximum fresh weight of roots (1.92 g) was recorded under T_5 and found significantly at par with T_{11} (1.75 g), while the minimum fresh weight of roots (1.09 g) was noted under T_1 (control).

It is also clear that dry weight of roots was significantly affected by the various treatments. The maximum dry weight of roots was (0.66 g) was recorded under treatment T_5 which was found statistically at par with T_{11} (0.59 g), T_{10} (0.56 g) and T_{12} (0.52 g) while minimum (0.28 g) in T_1.

It is evident from data that all the treatments significantly affected the fresh weight of shoots over T_1 (control). The maximum fresh weight of shoots (7.23 g) was recorded under treatment T_5 which was significantly superior over rest of the treatments and minimum fresh weight of shoots (3.37 g) was noted under treatment T_1 (control)..

The various treatments also showed great influence on dry weight of shoots over T_1 (control) at 150 days after sowing. The maximum dry weight of shoot (1.87 g) was recorded under treatment T_5 which was found to be significantly superior over rest of the treatments and minimum dry weight of shoot (0.92 g) was noted in treatment T_1.

Increase in fresh weight of roots is due to the influence of GA_3 on different plant parts, which could be due to its effect in stimulating cell division, cell elongation, auxin metabolism, cell wall plasticity and permeability of cell membrane leading to enhanced growth. Increase in the dry weight of different plant parts due to improved mobilization of nutrients due to the application of GA_3, which promotes plant growth and development. The findings are agreement with the findings of Rahemi and Baninasab (2000). A part from that at 400 ppm maximum polyembryony is observed which gives rise to maximum biomass per plant. This result is in agreement with the findings of Hore and Sen (1995) in which he reported that at 400 ppm maximum polyembryony is found in acid lime. Plant growth regulators and some chemicals are widely used in increasing fresh and dry weight of root or shoot. Similar findings were reported by Parmar et al. (2016).

Table 1. Effect of seed treatment on Days taken to start germination, Days taken to 50% germination and germination percentage at 60 (DAS).

Treatments		**Days taken to start germination**	**Days taken to 50% germination**	**Percentage of germination at 60 DAS**
Control	T_1	38.00	45.13	64.41
Water soaking	T_2	33.80	40.67	70.00
GA_3 -200 ppm	T_3	31.67	38.53	78.33
GA_3 -300 ppm	T_4	31.40	38.47	80.00
GA_3 -400 ppm	T_5	29.73	37.40	86.67
Thiourea -0.5 %	T_6	31.87	38.60	77.07
Thiourea -0.75 %	T_7	32.13	38.67	76.67
Thiourea -1.00 %	T_8	32.53	38.80	72.19
KNO_3 -0.5 %	T_9	32.27	38.73	73.33
KNO_3 -0.75 %	T_{10}	31.13	37.93	83.33
KNO_3-1.00 %	T_{11}	30.47	37.60	85.00
Sodium Thiosulphate -150 ppm	T_{12}	31.33	38.40	81.67
Sodium Thiosulphate -200 ppm	T_{13}	32.87	39.07	71.67
Sodium Thiosulphate-250 ppm	T_{14}	33.13	39.87	71.08
S.Em ±		1.07	0.85	4.29
C.D 5% level		3.11	2.48	12.48

Table 2. Effect of seed treatment on length of shoots (cm)

Treatments		**Length of shoots (cm)**			
		60 DAS	**90 DAS**	**120 DAS**	**150 DAS**
Control	T_1	4.67	10.57	15.99	22.77
Water soaking	T_2	4.94	10.67	16.18	25.17
GA_3 -200 ppm	T_3	5.57	11.73	18.74	29.72
GA_3 -300 ppm	T_4	5.79	11.90	18.89	30.21
GA_3 -400 ppm	T_5	6.54	14.99	23.64	38.49
Thiourea -0.5 %	T_6	5.55	11.65	18.46	29.60
Thiourea -0.75 %	T_7	5.54	11.61	18.29	29.57
Thiourea -1.00 %	T_8	5.47	11.40	17.69	28.18
KNO_3 -0.5 %	T_9	5.51	11.42	18.00	28.31
KNO_3 -0.75 %	T_{10}	5.92	12.15	19.69	31.31
KNO_3-1.00 %)	T_{11}	5.97	12.61	20.39	32.07
Sodium Thiosulphate -150 ppm	T_{12}	5.89	12.14	19.65	30.37
Sodium Thiosulphate -200 ppm	T_{13}	5.19	11.39	16.91	28.09
Sodium Thiosulphate-250 ppm	T_{14}	5.14	10.70	16.72	26.04
S.Em ±		0.26	0.41	0.90	1.01
C.D 5% level		0.76	1.20	2.61	2.95

Table 3. Effect of seed treatment on girth of stem (mm)

Treatments		**Girth of stem (mm)**			
		60 DAS	**90 DAS**	**120 DAS**	**150 DAS**
Control	T_1	1.19	1.60	2.77	3.10
Water soaking	T_2	1.24	1.70	2.84	3.20
GA_3 -200 ppm	T_3	1.49	2.20	3.08	3.53

GA_3 -300 ppm	T_4	1.52	2.22	3.09	3.67
GA_3 -400 ppm	T_5	1.79	2.52	3.17	4.08
Thiourea -0.5 %	T_6	1.48	2.15	2.99	3.47
Thiourea -0.75 %	T_7	1.47	2.13	2.97	3.40
Thiourea -1.00 %	T_8	1.38	2.00	2.90	3.34
KNO_3 -0.5 %	T_9	1.45	2.03	2.95	3.37
KNO_3 -0.75 %	T_{10}	1.58	2.27	3.12	3.78
KNO_3-1.00 %	T_{11}	1.69	2.28	3.13	3.88
Sodium Thiosulphate -150 ppm	T_{12}	1.54	2.25	3.10	3.70
Sodium Thiosulphate -200 ppm	T_{13}	1.36	1.99	2.87	3.31
Sodium Thiosulphate-250 ppm	T_{14}	1.26	1.85	2.86	3.26
S.Em ±		0.10	0.14	0.04	0.10
C.D 5% level		0.28	0.40	0.13	0.28

Table 4. Effect of seed treatment on number of leaves per seedling

Treatments		**Number of leaves per seedling**			
		60 DAS	**90 DAS**	**120 DAS**	**150 DAS**
Control	T_1	5.27	9.53	16.30	22.33
Water soaking	T_2	5.70	9.70	17.60	25.17
GA_3 -200 ppm	T_3	6.57	10.87	21.70	30.40
GA_3 -300 ppm	T_4	6.63	11.63	21.50	31.47
GA_3 -400 ppm	T_5	7.63	14.50	27.13	38.57
Thiourea -0.5 %	T_6	6.50	10.80	20.73	30.27
Thiourea -0.75 %	T_7	6.37	10.67	20.67	29.73
Thiourea -1.00 %	T_8	6.27	10.43	18.07	27.13
KNO_3 -0.5 %	T_9	6.30	10.47	20.40	29.00
KNO_3 -0.75 %	T_{10}	6.83	12.53	22.93	32.27
KNO_3-1.00 %	T_{11}	6.87	13.00	24.37	32.67
Sodium Thiosulphate -150 ppm	T_{12}	6.73	11.77	22.57	32.13
Sodium Thiosulphate -200 ppm	T_{13}	6.07	10.37	17.93	27.07
Sodium Thiosulphate-250 ppm	T_{14}	6.00	10.30	17.80	25.40
S.Em ±		0.18	0.36	1.05	1.07
C.D 5% level		0.51	1.04	3.05	3.11

Table 5. Effect of seed treatment on fresh weight of roots (g), Dry weight of roots (g), fresh weight of shoots (g) and Dry weight of shoots (g) at 150 days after sowing

Treatments		**Fresh weight of roots (g)**	**Dry weight of roots (g)**	**Fresh weight of shoots (g)**	**Dry weight of shoots (g)**
Control	T_1	1.09	0.28	3.37	0.92
Water soaking	T_2	1.13	0.32	4.06	0.95
GA_3 -200 ppm	T_3	1.46	0.49	4.63	1.16
GA_3 -300 ppm	T_4	1.48	0.51	4.70	1.17
GA_3 -400 ppm	T_5	1.92	0.66	7.23	1.87
Thiourea -0.5 %	T_6	1.41	0.42	4.58	1.15
Thiourea -0.75 %	T_7	1.34	0.38	4.56	1.14
Thiourea -1.00 %	T_8	1.30	0.35	4.54	1.05
KNO_3 -0.5 %	T_9	1.31	0.37	4.42	1.11

KNO_3 -0.75 %	T_{10}	1.60	0.56	4.85	1.20
KNO_3-1.00 %	T_{11}	1.75	0.59	4.91	1.23
Sodium Thiosulphate -150 ppm	T_{12}	1.53	0.52	4.80	1.19
Sodium Thiosulphate -200 ppm	T_{13}	1.29	0.34	4.29	1.03
Sodium Thiosulphate-250 ppm	T_{14}	1.20	0.33	4.09	1.00
S.Em ±		0.08	0.05	0.14	0.06
C.D 5% level		0.23	0.14	0.41	0.19

Table 6. Effect of seed treatment on Length of seedling (cm), length of root (cm), number of roots per seedling and survival percentage of seedlings at 150 days after sowing.

Treatments		**Length of seedling (cm)**	**Length of root (cm)**	**No. of roots per seedling**	**Survival percentage**
Control	T_1	38.92	16.15	31.27	66.67
Water soaking	T_2	42.78	17.61	35.27	70.67
GA_3 -200 ppm	T_3	49.66	19.94	39.80	78.00
GA_3 -300 ppm	T_4	50.86	20.65	41.13	76.00
GA_3 -400 ppm	T_5	61.63	23.14	48.70	86.67
Thiourea -0.5 %	T_6	49.57	19.64	39.47	71.33
Thiourea -0.75 %	T_7	48.99	19.41	39.33	87.67
Thiourea -1.00 %	T_8	46.75	18.57	38.07	73.33
KNO_3 -0.5 %	T_9	47.49	19.11	38.87	77.33
KNO_3 -0.75 %	T_{10}	53.07	21.43	45.73	80.00
KNO_3-1.00 %	T_{11}	53.51	21.44	46.47	83.33
Sodium Thiosulphate -150 ppm	T_{12}	51.08	20.71	43.80	74.00
Sodium Thiosulphate -200 ppm	T_{13}	46.41	18.32	37.53	72.67
Sodium Thiosulphate-250 ppm	T_{14}	44.31	17.93	37.13	74.67
S.Em ±		1.44	1.01	3.06	2.58
C.D 5% level		4.17	2.93	8.90	7.51

Survival percentage of seedlings

The data revealed that various treatments have great influence on survival percentage of seedling over T_1 (control) at 150 DAS. Data indicates that maximum survival percentage (87.67) was recorded under T_7 which was found statistically at par with T_5 (86.67) and T_{11} (83.33) whereas minimum survival percentage of (66.67) under T_1 (without water soaking) at 150 days after sowing. The finding was supported by Meena et al. (2003). Survival percentage in aonla 100 days old seedlings were significantly highest in the 1% KNO3 treatment. The finding was supported by Purbey and Meghwal (2005).

CONCLUSION

Based on the present investigation, it is concluded that GA_3, concentration at 400 ppm (T_5) was proved superior in respect to germination of custard apple seed as well as growth parameter and survival of custard apple seedling.

Application of research

The findings are useful to custard apple growers and as well as for other crop.

Research Category

Horticulture

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