EFFECT OF SEED TREATMENT AND GROWING CONDITION ON THE GERMINATION AND SURVIVALITY OF CUSTARD APPLE (*ANNONA SQUAMOSA*L.) SEEDLINGS

Abstract

The study was carried out during the year 2018-2019 at the Fruit Research Station Imalia and in laboratory of Department of Horticulture, College of Agriculture, Jawaharlal Nehru KrishiVishwaVidyalaya, Jabalpur (M.P.). The experiment was laid out in Factorial Complete Randomized Design (FCRD) replicated thrice. The experiment consist of two factor viz. A- Three growing condition (G_3 - poly house, G_2-net house, G_1-open condition) and B- Six seed treatment (S_1 - water soaking, S_2-Cowurine, S_3-GA_3, S_4-KNO_3, S_5-Thiourea, S_6-Sodium Thiosulphate) having 18 treatment combinations. Observation were recorded on various aspects like days taken to 1st germination, days taken to 50 % germination, height of seedling, girth of stem, number of leaves, fresh weight of shoot and root, dry weight of shoot and root, root length, total length of seedling, number of roots/seedling, survival percent of seedling.

On the basis of present investigation, it is concluded that among the various seed treatments and growing condition, the growing condition of poly house and seed treatment with GA_3 500 ppm have been proved superior with respect to germination, growth and survival of seedling. Among various treatment combinations, G_3S_3 treatment combination (poly house and GA_3 500 ppm) found best over the rest of the treatment combinations with respect to germination parameters like minimum days taken to 1st germination (25.33) days taken to 50% germination (45.66), growth parameter like maximum - height of shoots (25.13cm), girth of stem (3.91mm) and number of leaves 18.91 at 160 DAS respectively, root length(15.13cm), number of roots/seedling(45.12), survival percentage of seedling (89.34%).The G_3S_4 (Polyhouse and $kNO_{3)}$ was found next best treatment combination in this respect.

Keyword: Custard Apple, Chemicals, Seed Treatment, Seed Germination and Survivality, Seedlings

INTRODUCTION

Custard apple (*Annona squamosa*L.) also known as Sitaphal 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 44 thousand ha with production of 367 thousand MT (Anonymous, 2017). It is found growing almost in all the tropical and subtropical regions mostly in wild form.Custard apple is rich source of Carbohydrate, Protein, Fiber and Mineral's like Calcium, Phosphorus, Iron and Vitamin. Custard apple appears to possess potent bioactive principles in most of its plant parts (Fruit, Seed and leaves).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.

The use of plant growth regulators in proper concentration with scarification may regulate seed germination and seedling growth behaviour in many fruit crops. Pre-sowing treatment with growth regulator 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 GA_3, IBA, and IAA enhance the germination, growth and survival of seedlings. GA_3 are used for weaking of the seed coat so that the emergence of radical and plumule is positively influenced for root and shoot formation. Thus, there is need to develop a suitable technology for improving germination and subsequent growth of seedlings for budding and grafting on it. Efforts for pre- sowing seed treatment with plant growth regulators (GA_3 and NAA), chemicals (KNO_3, H_2So_4, micronutrients mixture) and hot water treatment

have been made with varying germination and subsequent seedling vigour in various fruit crops (Hore and Sen, 1994 in bael, Ratan and Reddy, 2003 in custard apple, Dhanker and Singh, 1996 in aonla).Chemicals like Thiourea, Potassium nitrate and Sodium Thiosulphate are also used to improve the seed germination. Annonas are mostly grown by seeds either for seedling plants or vegetative propagation. In order to have uniform and prompt germination and to avoid the problem of uneven and irregular germination and to get sapling either for planting or to be used as rootstocks, the seed treatment of custard apple seed is of quite importance.

MATERIAL AND MATHODS

The present investigation was carried out at Fruit Research Station Imalia, Department of Horticulture, Collage of Agriculture, JNKVV, Jabalpur (M.P.) during the year 2018-19. The experiment comprised of Factor A (Three Growing conditions) Open condition G_1Net house, G_2Poly house and G_3. Factor B (Seed treatment)Water soaking (S_1), Cow Urine(S_2), GA_3 500 ppm (S_3), KNO_3 1% (S_4), Thiourea1% (S_5), Sodium Thiosulphate 250 ppm (S_6) having 18 treatment combinations.The experiment was laid out in poly bags in factorial completely randomized design with three replications. Observations were recorded using standard procedure and statistically analysed (Panse and Sukhatme (1963).

A. Germination Parameters

1. Days taken to start first germination - Date of emergence of cotyledonary leaves was recorded and calculated form date of sowing.

2. Days taken to 50 % germination- The number of days were counted from the start of germination till 50 % germination.

3. **Percent of germination-**The percentage of total seeds germination in each treatment was recorded at 60 days after sowing.

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

B. Growth Parameters

1. Height of seedling (cm): Height was measured from ground level to the tip of opened leaf at 80, 100, 120, 140, 160 (DAS)

2. Girth of stem (mm): The girth of stem was measured with the help of digital verneercalipers just above the ground surface and the average was calculated at 80, 100, 120,140,160 (DAS)

3. Number of leaves /seedling: The total number of leaves per seedling was counted and the average was calculated, matured leaves were taken into account at 80,100,120,140,160 (DAS)

4. Survival percent of seedlings

The survival percentage of each treatment was recorded at 160 days after seed sowing. The survival percentage was calculated by using formula as given below:

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

RESULTS AND DISCUSSION

Days Taken to 1st Germination

The minimum (29.66) days was required for seed germination under G_3 (Poly house) while, it was maximum (55.16) days under G_1 (Open condition). This is due to high temperature and humidity in poly house which initiated the early germination. Different seed treatment also significantly affected the initiation of seed germination. The minimum days taken to initiate the germination was

recorded with S_3 (GA_3 500 ppm) while, the maximum days in S_1 (water soaking) i.e. seed soaking in water alone. Our results are also in the line of Rajamanickam*et al*. (2002), Ratan and Reddy (2004). The interaction of growing conditions and seed treatment showed significant effect on initiation of seed germination.The maximum days (60.66) days taken to 1st germination of seed were recorded under G_1S_1 (water soaking and open condition) and the minimum (25.33) days taken to initiate germination under the treatment combination G_3S_3 (poly house and GA_3 500 ppm). It is probably due to the synergistic combination of both the factors. Our results are also in the line of Verma*et al*.(2019).

Days Taken to 50 % Germination

The present research reveals that the growing conditions and seed treatment showed significant effect on germination of seed. The minimum days (51.16) were taken to 50% germination under the growing conditions G_3 (Poly house) and maximum (66.61) were taken under the condition G_1 (open condition). Initiation of seed germination was significantly affected by seed treatment. The minimum (53.44) were taken to 50% germination with S_3 (GA_3 500ppm) while, the maximum days (76.27) in S_1 (water soaking). Our results are also in the line of Rajamanickam*et al* (2002).The interaction effect of growing condition and seed treatment were found to have significant effect on 50% germination. The maximum days (72.00) taken to 50% germination were noted under the treatment combination of G_1S_1 (Open condition and water soaking).However, the minimum days (45.66) taken to 50 % germination were noted under the treatment combination of G_3S_3 (poly house and GA_3 500ppm). It is probably due to the synergistic combination of both the factors. Our results are also in the line of Verma*et al*.(2019).

Height of Seedling (cm)

Growing condition had significant effect on attaining maximum height of shoots (i.e. 7.40, 8.41, 12.35, 16.33 and 21.33 cm) respectively at 80, 100, 120, 140 and 160 DAS under the growing condition G3 (poly house) .Our result, are also in the line of Ngullie and Biswas (2017). As regards the seed treatment, maximum height of shoots (6.23, 7.06, 8.55, 11.76, and 14.02 cm) was recorded with S3 (GA_3 500 ppm) at 80, 100, 120, 140 and 160 DAS, respectively. 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 GA3 is known to enhance cell elongation. Our results are also in the line of Singh et al (2002). Interaction effect of growing condition and seed treatment showed maximum height of shoot i.e. 8.26, 9.40,15.11,18.91 and 25.13 at 80, 100, 120, 140 and 160 days after sowing , respectively at successive growth period under treatment combination G3S3 (poly house and GA3). Whereas, minimum height was recorded under G1S1 (open condition and water soaking). It may be due to synergistic effect of both factors. Our results are also in the line of Verma et al.(2019).

Girth of Stem (mm)

Significantly maximum girth of stem (1.11, 2.33, 2.75, 3.14 and 3.42 mm) was recorded at 80, 100, 120, 140 and 160 DAS in G3 (poly house) whereas, minimum girth under treatment G1 (open condition and water soaking). As regards seed treatment, the significantly maximum girth of stem (0.91, 2.01, 2.50, 2.82 and 2.85mm) was recorded with S3 (GA_3 and 500 ppm) and minimum girth of stem was recorded in S1 (water soaking). Our result is also in the line of Singh *et al*. (2004) and Meena and Jain (2005), Verma et al. (2019). Interaction effect of growing conditions and seed treatment showed significant effect on girth of stem. The maximum girth of stem 1.30, 2.72, 3.01, 3.51, 3.91 was noted under the combination of growing condition and seed treatment G3S3 (poly house and GA_3). Whereas, minimum girth of stem 0.75, 1.73, 2.11, 2.12, 2.53 was noted under the

combination of growing condition and seed treatment G1S1 (open condition and water soaking). It may be due to synergistic effect of both factors. Our results are also in the line of finding of Verma et al. (2019).

Number of Leaves /Seedling

The data regarding number of leaves per seedling as influenced by different growing conditions and seed treatment indicated that the maximum mean number of leaves per seedling was produced by the seedlings grown in G3 (poly house) (6.92, 9.47, 11.31, 13.80 and 16.37 at 80,100,120, 140 and 160 days after sowing. Whereas, treatment G1 (water soaking) recorded minimum mean number of leaves per seedling at all the stage of observations. Among different seed treatments, S3 (GA_3 500ppm) encouraged leaf production and gave significantly maximum (7.38, 9.68, 10.67, 13.54 and 16.25) number of leaves /seedling at 80, 100, 120, 140 and 160 days after 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 which facilitates better harvest of sunshine by the plants to produce more number of leaves. Similar findings were also reported by Chandore*et al*.(2016), Thamer HR and AL Falahy (2014).It may be due to synergistic effect of both factors. Our results are also in the line of Verma *et al*.(2019).

Root length (cm)

The growing conditions significantly influenced the mean root length and the maximum (12.127) root length was recorded under conditions G3 (poly house condition) followed by treatments G2 (11.26) and minimum (10.42) in treatment G1 (Control).

The seed treatment also influenced root length of at 160 days after seed sowing. Among the treatments, S3 (GA_3 500 ppm) recorded maximum (14.12) root length followed by treatment S4 KNO3 1% (13.38). The treatment S1 (Control) recorded minimum (9.15) root length of seed.

The data regarding interaction effects showed that the maximum (15.13) root length was recorded under the treatment combination of G3S3 (poly house condition and (GA3 500 ppm). The minimum (8.47) was recorded under the treatment combination G1S1 (open condition and water soaking).

Number of roots /seedling

The growing conditions significantly influenced the mean number of roots/seedling and the maximum (40.34) was recorded under conditions G3 (poly house condition) followed by treatments G2 (37.11) and minimum (31.02) in treatment G1 (Control).

The seed treatment also influenced number of roots/seedling at 160 days after seed sowing. Among the treatments, S3 (GA_3 500 ppm) recorded maximum (39.80) number of roots/seedling followed by treatment S4 KNO3 1% (33.89). The treatment S1 (Control) recorded minimum (32.89) number of roots/seedling.

The data regarding interaction effects showed that the maximum (45.12) no. of roots/seedling was recorded under the treatment combination of G3S3 (poly house condition and (GA_3 500 ppm). The minimum (26.16) was recorded under the treatment combination G1S1 (open condition and control).

Survival Percentage of Seedling

The growing conditions significantly influenced the mean survival percentage of seedling and the maximum (85.28) was recorded under conditions G3 (poly house condition) followed by treatments G2 (82.50) and minimum (76.83) in treatment G1 (Control).

The seed treatment also influenced survival percentage of seedling at 160 days after seed sowing. Among the treatments, S3 (GA_3 500 ppm) recorded maximum (39.80) survival percentage of seedling followed by treatment S4 KNO_3 1% (38.32). The treatment S1 (Control) recorded minimum (32.89) survival percentage of seedling.

The data regarding interaction effects showed that the maximum (89.34) survival percentage of seedling was recorded under the treatment combination of G3S3 (poly house condition and (GA_3 500 ppm). The minimum (73.80) was recorded under the treatment combination G1S1 (open condition and control.

CONCLUSION-

On the basis of present investigation ,it is concluded that among the various seed treatments and growing condition, the growing condition of poly house and seed treatment with GA_3 500 ppm have been proved superior with respect to germination, growth and survival of seedling. Among various treatment combinations, G_3S_3 treatment combination (poly house and GA_3 500 ppm) found best over the rest of the treatment combinations with respect to germination parameters like minimum days taken to 1st germination(25.33) days taken to 50% germination(45.66), growth parameter like maximum - height of shoots (8.26, 9.40, 15.11, 18.91 and 25.13cm), girth of stem (1.30, 2.72, 3.01,3.51 and 3.91mm) and number of leaves 8.26, 9.40,15.11, 18.91 and 25.13 at 80, 100,120, 140 and 160 DAS, respectively, root length(15.13cm), number of roots/seedling(45.12), survival percentage of seedling (89.34%). The G_3S_4 (Poly house and KNO_3) was found next best treatment combination.

Table 1: Effect of Seed Treatment and Growing Condition on Days Taken to Start 1st Germination and 50% Germination of Custard Apple.

	Treatments	Days taken to start 1st germination	Days taken to 50% germination
Growing Condition			
G_1	Open condition	55.16	66.61
G_2	Net house condition	43.88	56.77
G_3	Poly house condition	29.66	51.16
	SE(m)±	0.23	0.15
	CD at 5% level	0.67	0.44
Seed Treatment			
S_1	Water soaking	47.88	76.27
S_2	Cow urine	44.22	61.22
S_3	GA_3 500 ppm	37.33	53.44
S_4	KNO_3 1%	41.11	55.00
S_5	Thiourea(1%)	43.11	57.33
S_6	Sodium thiosulphate 250 ppm	43.77	59.33
	SE(m)±	0.33	0.21
	CD at 5% level	0.95	0.62
Interaction			
G_1S_1	Open condition + Water soaking	60.66	72.00
G_1S_2	Open condition + Cow urine	58.00	70.33
G_1S_3	Open condition + GA_3 500 ppm	48.33	61.66
G_1S_4	Open condition + KNO_3 (1%)	52.66	63.33

G_1S_5	Open condition+ Thiourea(1%)	55.00	65.00
G_1S_6	Open condition + Sodium Thiosulphate 250ppm	56.33	67.33
G_2S_1	Net house + Water soaking	48.00	60.33
G_2S_2	Net house+Cow urine	46	59.33
G_2S_3	Net house +GA_3 500ppm	38.33	53.00
G_2S_4	Net house +KNO_3 (1%)	42.33	54.00
G_2S_5	Net house+ Thiourea (1%)	43.66	56.33
G_2S_6	Net house+ Sodium Thiosulphate 250ppm	45.00	57.66
G_3S_1	Poly house+Water soaking	35.00	56.00
G_3S_2	Poly house +Cow urine	28.66	54.00
G_3s_3	Poly house +GA_3 500 ppm	25.33	45.66
G_3S_4	Poly house+ KNO_3 (1%)	28.33	47.66
G_3S_5	Polyhouse + Thiourea (1%)	30.66	50.66
G_3S_6	Polyhouse + Sodium thiosulphate 250 ppm	30.00	53.00
	SE(m)±	**0.57**	**0.37**
	CD at 5% level	**1.647**	**1.08**

Table2: Effect of Seed Treatment and Growing Condition on Height (cm) of Custard Apple Seedlings.

	Treatments	**Height of seedlings (cm) at different stage**				
		80 days	**100 days**	**120 days**	**140 days**	**160 days**
	Growing Condition					
G_1	Open condition	6.21	6.75	7.63	10.88	12.33
G_2	Net house condition	6.66	7.71	9.161	12.35	16.29
G_3	Poly house condition	7.40	8.41	12.35	16.33	21.33
	SE(m)±	0.06	0.03	0.02	0.03	0.04
	CD at 5% level	0.18	0.10	0.06	0.09	0.13
	Seed Treatment					
S_1	Water soaking	6.23	7.06	8.55	11.76	14.02
S_2	Cow urine	6.52	7.17	8.88	12.01	14.60
S_3	GA3 500 ppm	7.46	7.17	11.51	15.38	20.13
S_4	$KNO_3$1%	7.05	7.96	10.53	14.59	19.01
S_5	Thiourea (1%)	6.74	7.68	9.64	13.15	19.01
S_6	Sodium thiosulphate	6.55	7.35	9.16	12.31	15.46

	SE(m)±	0.09	0.05	0.03	0.048	0.06
	CD at 5% level	0.25	0.15	0.09	0.138	0.18
Interaction						
G_1S_1	Open condition + Water soaking	5.66	6.26	6.83	9.66	10.12
G_1S_2	Open condition + Cow urine	6.06	6.40	7.00	10.16	10.71
G_1S_3	Open condition +GA_3 500 ppm	6.76	7.70	9.06	12.13	15.14
G_1S_4	Open condition + KNO_3(1%)	6.10	6.90	7.93	11.67	15.12
G_1S_5	Open condition+ Thiourea	6.40	6.73	7.66	11.00	13.12
G_1S_6	Open condition + Sodium Thiosulphate 250ppm	6.30	6.53	7.30	10.66	11.12
G_2S_1	Net house +Water soaking	6.03	7.03	8.16	10.66	14.03
G_1S_2	Net house + Cow urine	6.23	7.20	8.80	10.86	14.18
G_2S_3	Net house + GA_3 500ppm	7.36	8.46	10.36	15.11	20.13
G_2S_4	Net house +KNO_3 (1%)	7.16	8.20	9.46	14.19	18.14
G_2S_5	Net house+ Thiourea (1%)	6.63	7.83	9.13	12.13	16.12
G_2S_6	Net house+ Sodium Thiosulphate 250ppm	6.56	7.56	9.03	11.15	15.12
G_3S_1	Poly house+Water soaking	7.00	7.90	10.66	14.95	17.91
G_3S_2	Poly house +Cow urine	7.26	7.93	10.86	15.00	18.91
G_3s_3	Poly house +GA_3 500 ppm	8.26	9.40	15.11	18.91	25.13
G_4S_4	Poly house+ KNO_3 (1%)	7.90	8.80	14.19	17.93	23.78
G_5S_5	Poly house + Thiourea (1%)	7.20	8.50	12.13	16.33	22.14
G_6S_6	Poly house + Sodium thiosulphate 250ppm	6.80	7.96	11.15	15.11	20.13
	SE(m)±	**0.15**	**0.09**	**0.05**	**0.08**	**0.11**
	CD at 5% level	**0.44**	**0.26**	**0.16**	**0.23**	**0.11**

Table 3: Effect of Seed Treatment and Growing Condition on Girth of Stem (mm) of Custard Apple Seedlings

	Treatment	**Girth of Stem (mm) at Different Days**				
		80 Days	**10 Days**	**120 Days**	**140 Days**	**160 Days**
	Growing Condition					
G_1	Open condition	0.93	2.15	2.53	2.98	2.95
G_2	Net house condition	1.00	2.27	2.65	2.96	3.14
G_3	Poly house condition	1.11	2.33	2.75	3.14	3.42

	SE(m)±	0.009	0.006	0.004	0.005	0.004
	CD at 5% level	0.02	0.01	0.01	0.01	0.01
	Seed Treatment					
S_1	Water soaking	0.83	1.91	2.20	2.49	2.80
S_2	Cow urine	0.91	2.01	2.50	2.82	2.85
S_3	GA_3 500 ppm	1.15	2.65	2.95	3.43	3.62
S_4	$KNO_3$1%	1.14	2.60	2.89	3.20	3.36
S_5	Thiourea	1.05	2.27	2.75	3.15	3.25
S_6	Sodium thiosulphate	1.00	2.05	2.58	3.08	3.14
	SE(m) ±	0.01	0.009	0.006	0.007	0.006
	CD 5% level	0.03	0.02	0.01	0.02	0.01
Interaction						
G_1S_1	Open condition + Water soaking(24 hrs)	0.75	1.73	2.11	2.12	2.53
G_1S_2	Open condition + Cow urine	0.88	1.83	2.29	3.05	2.32
G_1S_3	Open condition +GA_3 500 ppm	1.01	2.60	2.89	3.32	3.46
G_1S_4	Open condition + KNO_3 (1%)	1.07	2.58	2.83	3.19	3.18
G_1S_5	Open condition+ Thiourea	0.95	2.23	2.60	3.15	3.11
G_1S_6	Open condition + Sodium Thiosulphate 250ppm	0.91	1.94	2.46	3.08	3.09
G_2S_1	Net house +Water soaking	0.80	2.00	2.17	2.65	2.73
G_2S_2	Net house+Cow urine	0.84	2.07	2.48	2.32	3.09
G_2S_3	Net house +GA_3 500ppm	1.15	2.65	2.96	3.46	3.50
G_2S_4	Net house + KNO_3(1%)	1.13	2.60	2.91	3.18	3.24
G_2S_5	Net house + Thiourea (1%)	1.06	2.26	2.84	3.11	3.18
G_2S_6	Net house + Sodium Thiosulphate 250ppm	1.01	2.07	2.54	3.06	3.11
G_3S_1	Poly house + Water soaking	0.93	2.05	2.31	2.71	3.13
G_3S_2	Poly house +Cow urine	1.00	2.11	2.73	3.08	3.14
G_3S_3	Poly house +GA_3 500 ppm	1.30	2.72	3.01	3.51	3.91
G_3S_4	Poly house+ KNO_3 (1%)	1.24	2.63	2.92	3.23	3.65
G_3S_5	Poly house + Thiourea (1%)	1.15	2.32	2.81	3.19	3.45
G_3S_6	Poly house + Sodium thiosulphate 250ppm	1.08	2.15	2.75	3.11	3.24
	SE(m)±	**0.009**	**0.015**	**0.010**	**0.013**	**0.011**
	CD at 5% level	**0.02**	**0.04**	**0.03**	**0.03**	**0.03**

Table 4: Effect of Seed Treatment and Growing Condition on No. of Leaves (mm) of Custard Apple Seedlings

	Treatment	No. of Leaves/Seedling at Different Days				
		80 days	100 days	120 days	140 days	160 days
	Growing Condition					
G_1	Open condition	6.48	7.64	8.25	9.99	12.66
G_2	Net house condition	6.52	8.23	9.47	11.40	13.93
G_3	Poly house condition	6.92	9.47	11.31	13.80	16.37
	SE(m)±	0.03	0.02	0.02	0.07	0.03
	CD at 5% level	0.08	0.07	0.07	0.21	0.09
	Seed Treatment					
S_1	Water soaking	6.08	7.48	8.81	10.36	13.18
S_2	Cow urine	6.22	8.01	9.21	10.60	14.57
S_3	GA_3 500 ppm	7.38	9.68	10.67	13.54	16.25
S_4	KNO_3 (1%)	7.06	8.69	10.08	12.58	15.03
S_5	Thiourea (1%)	6.61	8.53	9.68	11.8	14.02
S_6	Sodium thiosulphate 250 ppm	6.48	8.29	9.54	11.44	12.88
	SE(m)±	0.04	0.03	0.03	0.10	0.04
	CD at 5% level	0.12	0.10	0.10	0.29	0.13
Interaction						
G_1S_1	Open condition + Water soaking(24 hrs)	6.03	6.83	7.5	8.23	10.83
G_1S_2	Open condition + Cow urine	6.13	7.06	7.9	9.0	13.89
G_1S_3	Open condition +GA_3 500 ppm	7.03	9.10	9.12	12.08	14.37
G_1S_4	Open condition + KNO_3(1%)	6.76	7.90	8.82	11.08	13.08
G_1S_5	Open condition+ Thiourea (1%)	6.53	7.66	8.16	10.08	12.33
G_1S_6	Open condition + Sodium Thiosulphate 250ppm	6.40	7.30	8.00	9.5	11.50
G_2S_1	Net house +Water soaking	6.13	7.20	8.40	10.53	13.77
G_1S_2	Net house+Cow urine	5.99	7.86	9.11	10.80	14.83
G_2S_3	Net house +GA_3 500ppm	7.30	9.56	10.37	13.08	15.46
G_2S_4	Net house + KNO_3(1%)	7.13	8.43	9.75	11.66	14.08
G_2S_5	Net house+ Thiourea (1%)	6.36	8.23	9.70	11.20	13.41
G_2S_6	Net house+ Sodium Thiosulphate 250ppm	6.23	8.10	9.47	11.16	12.04

G_3S_1	Poly house + Water soaking	6.23	8.40	10.53	12.33	14.95
G_3S_2	Poly house +Cow urine	6.53	9.11	10.80	12.00	15.00
G_3s_3	Poly house +GA_3 500 ppm	7.83	10.37	12.53	15.46	18.91
G_3S_4	Poly house+ KNO_3 (1%)	7.30	9.75	11.66	15.00	17.19
G_3S_5	Poly house + Thiourea (1%)	6.93	9.70	11.20	14.33	16.33
G_3S_6	Poly house + Sodium thiosulphate 250ppm	6.83	9.47	11.16	13.67	15.11
	SE(m)±	**0.07**	**0.06**	**0.06**	**0.17**	**0.03**
	CD at 5% level	**0.21**	**0.18**	**0.17**	**0.51**	**0.09**

Table 5: Effect of Seed Treatment and Growing Condition on Custard Apple Seedlings.

	Treatments	**Root length (cm)**	**No. of roots / seedling**	**Survival % of seedling**
	Growing Condition			
G_1	Open condition	10.42	31.02	76.83
G_2	Net house condition	11.26	37.11	82.50
G_3	Poly house condition	12.12	40.34	85.28
	SE(m)±	0.011	0.060	0.057
	CD at 5% level	0.032	0.174	0.164
	Seed Treatment			
S_1	Water soaking	9.15	32.89	78.35
S_2	Cow urine	9.54	33.89	79.14
S_3	GA_3 500 ppm	14.12	39.80	85.00
S_4	$KNO_3$1%	13.38	38.32	83.75
S_5	Thiourea (1%)	11.35	36.91	82.46
S_6	Sodium Thiosulphate 250 ppm	10.06	35.14	80.49
	SE(m)±	0.01	0.08	0.11
	CD at 5% level	0.04	0.24	0.23
Interaction				
G_1S_1	Open condition + Water soaking(24 hrs)	8.46	26.13	73.80
G_1S_2	Open condition + Cow urine	9.16	28.14	74.19
G_1S_3	Open condition +GA_3 500 ppm	13.12	35.15	80.54
G_1S_4	Open condition + KNO_3(1%)	12.12	34.13	79.14

G_1S_5	Open condition+ Thiourea(1%)	10.13	32.46	78.15
G_1S_6	Open condition + Sodium Thiosulphate 250ppm	9.53	30.13	75.14
G_2S_1	Net house +Water soaking	9.13	35.14	80.14
G_2S_2	Net house+ Cow urine	9.46	35.11	81.12
G_2S_3	Net house +GA_3 500ppm	14.13	39.14	85.12
G_2S_4	Net house +KNO_3(1%)	13.26	39.050	84.01
G_2S_5	Net house+ Thiourea (1%)	11.56	38.130	82.80
G_2S_6	Net house+ Sodium Thiosulphate 250ppm	10.03	36.117	81.79
G_3S_1	Poly house Water soaking	9.86	37.41	81.12
G_3S_2	Poly house +Cow urine	10.00	38.41	82.11
G_3S_3	Poly house +GA_3 500 ppm	15.13	45.12	89.34
G_3S_4	Poly house+ KNO_3 (1%)	14.76	41.79	88.11
G_3S_5	Poly house + Thiourea (1%)	12.36	40.15	86.43
G_3S_6	Poly house + Sodium Thiosulphate 250ppm	10.63	39.17	84.55
	SE(m)±	**0.02**	**0.14**	**0.13**
	CD at 5% level	**0.07**	**0.42**	**0.40**

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