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Effect of seed treatments on germination, seedling vigour and growth rate of custard apple (*Annona squamosa*)

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Abstract

An experiment was carried out to study the effect of seed treatments on seed germination and seedling vigour of custard apple during 2015-16 at Nursery Unit, Main Garden, Department of Horticulture, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola by using completely randomized design with twelve treatments. The seeds treated with GA₃ 1000 ppm solution minimized the days (10.27) taken for germination and improved the germination percentage (83.33%). Similar trend was observed in growth parameters, Viz. seedlings height (23.33, 37.54 and 48.31 cm), girth of plant (0.46, 0.62 and 0.93 cm), number of leaves (17.37, 28.60 and 32.64), leaf area (76.42 cm²), fresh and dry weight of plant and survival percentage (72.81.%).

Keywords: GA₃, KNO₃, H₂SO₄, cow dung slurry, germination, vigour

Introduction

Custard apple is generally classified as semi arid fruit fit very well to the waste land utilization programme which is currently being emphasized by Government also as way for solving unemployment problem of people in rural area in semi arid region. 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 different parts of the world indicating, the utility of GA₃ from 150-500 ppm is helpful for getting better germination of custard apple seeds (Banker, 1987; Stino *et al.*, 1996; Pawshe *et al.*, 1997; Ratan and Reddy, 2004^a) [2, 26, 23, 24]. Therefore, pre treatment of custard apple seed with different organics and also chemicals is very important to improve germination.

Materials and Methods

The experiment was conducted at Nursery unit, Main Garden, Department of Horticulture, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during the year 2015 - 2016. The experiment was laid out in Completely Randomized Design with twelve treatments *viz.*, GA₃ – 500ppm, 1000ppm seed soaking for 24 hours in distilled water, KNO₃ (1%) and (2%) soaking for 24 hours in distilled water, 2 min. con. H₂SO₄ followed by seed soaking for 24 hours in distilled water, seed soaking for 24 and 48 hours in cow dung slurry, seed soaking in cow dung slurry for 24 and 48 hours followed by seed wrap for 72 hours in wet gunny bag, seed soaking in tap water for 24 hours and control (untreated), which were replicated three times.

Results and Discussion

The seed treatment with GA₃ 1000 ppm solution recorded the least number of days taken for germination (10.27 days), followed by T₁ (11.40 days) GA₃ 500 ppm. This might be due to fact that, GA₃ plays an important role in two stages for germination i.e. initial enzyme induction and activation of reserve food mobilizing system which help in enhancement of germination. The above results are conformity with Pawshe *et al.* (1997) [23] in custard apple, Gholap *et al.* (2000) [12] in anola and Ratan and Reddy (2004) [24] in custard apple. The germination count was significantly affected by various seed soaking treatments. The highest percentage of seed germination (83.33%) was noticed in GA₃ 1000 ppm which was found to be at par with T₁ (76.00%), T₄ (74.66%).

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Maximum germination percentage was recorded when seeds soaked in GA₃ might be due to fact that GA₃ involved in the activation of cytological enzymes with GA₃ stimulates seed germination of α -amylase enzyme which convert insoluble starch into soluble sugars and it also initiates the radical growth by removing some metabolic blocks. This might be due to fact that GA₃ play an important role in leaching out of the inhibitors into the soaking medium, might be due to GA₃ is a known growth regulator for breaking seed dormancy. This result are conformity with similar findings on germination enhancement in custard apple due to GA₃ treatment was reported by Pawshe *et al.* (1997) [23] in custard apple, Ratan and Reddy (2004) [24] in custard apple.

The significantly maximum seed vigour (84.03%) was noticed, when custard apple seeds were soaking with GA₃ 1000 ppm. The endogenous gibberellic acid synthesized by the seed embryo might not be sufficient and as such the external application probably have boosted the growth by increasing cell multiplication and cell elongation, resulting in rapid plant growth. The rapid and early germination have helped in producing vigorous growth of seedlings during subsequent period of growth. The results are in conformity with the findings of Zhao *et al.* (2004) [28] in papaya and Maiti *et al.* (2003) [18] in jackfruit.

Significantly maximum seed vigour index I (2385.5) was noticed when custard apple seeds were treated with GA₃ 1000 ppm solution (T₂) which was found to be at par with T₁ (2156.2) and T₄ (2090.52). Whereas, significantly maximum seed vigour index II (347.54) was also noticed in seed treated with GA₃ 1000 ppm (T₂) solution which was found to be at par with treatment T₁ (302.3). The higher vigour of seedling due to GA₃ pre-soaking can be correlated with higher seed germination, higher shoot length and root length and number of leaves has lead to over all assimilation and distribution of food material with the plant (Brain and Hemming, 1955) [5] and hence resulted in higher seedling vigour (Pampanna and Sulikeri, 1995) [22]. The results are in conformity with the findings of Pampanna and Sulikeri (1995) [22] in sapota; Kumar *et al.* (2011) [17], Padma Lay *et al.* (2013) [21] in papaya; and Gurung *et al.* (2014) [13] in passion fruit.

The significantly maximum germination index (1.88) was noticed when seeds were treated with GA₃ 1000 ppm solution (T₂) which was found to be at par with T₁ (1.69), T₄ (1.51), T₃ (1.37) while minimum germination index was recorded in T₁₂ (0.76) over other treatments studied. This might be due to the fact that, the exogenous application of GA₃ antagonizes the effect of inhibitors and increases endogenous gibberellin like substances (Mathur *et al.* 1971) [19]. The findings are in line with Zanotti *et al.* (2014) [27] in papaya.

The maximum plant height (23.33, 37.54 and 48.31 cm @ 60, 120 and 180 days, resp.) was observed in GA₃ 1000 ppm solution followed by T₁. This might be due to fact that, the effect of gibberellic acid in increasing the osmotic uptake of nutrients and thereby causing cell multiplication and cell elongation reflects in greater internodal length, ultimately resulting in increase in plant height (Dohono and Walker, 1957) [10]. The results obtained in the present investigation are in close conformity with the results obtained by Dhinesh babu *et al.* (2010) [9]; Deb *et al.* (2010) [7] in papaya and Gurung *et al.* (2014) [13] in passion fruit.

The maximum number of leaves were recorded in treatment, T₂ i.e. GA₃ 1000 ppm at 60, 120, 180 DAS (17.37, 28.60 and 32.64). The maximum number of leaves might be due to higher growth of seedlings. The probable reason for increasing number of leaves might be due to activity of GA₃ at the apical meristem, resulting in more synthesis of nucleoprotein responsible for increasing leaf initiation. The observation analogues to these findings were reported by Jadhav *et al.*, (2015) in custard apple.

The maximum stem diameter (0.46, 0.62 and 0.93 at 60, 120 and 180 DAS, resp.) recorded when seeds were soaked in GA₃ 1000 ppm prior to sowing. The increase in diameter as result of GA₃ application might be due to the fact that, GA₃ increase somatic uptake of nutrients, causing cell elongation and thus increasing height of the plant (Feucht and Watson, 1958) [11]. GA application may be attributed to the cell multiplication and elongation in the cambium tissue (Shirrol *et al.*, 2005) [25]. The results are in concurrence with the findings of Hore and Sen (1995) [15] in beal, Dhankar and Singh (1996) [8] in aonla.

Table 1: Effect of seed treatment on germination and vigour of custard apple seedlings

	Days required for germination	Germination (%)	Seed vigour (%)	Seed vigour index- I	Seed vigour index- II	Germination index
T ₁ - GA ₃ 500 ppm soaking for 24 hours.	11.40	76.00 (61.06)	83.92 (66.19)	2156.2	302.3	1.69
T ₂ - GA ₃ 1000 ppm soaking for 24 hours.	10.27	83.33 (65.88)	84.03 (66.50)	2385.7	347.54	1.88
T ₃ - KNO ₃ (1%) soaking for 24 hours.	12.80	69.33 (56.51)	82.80 (65.59)	1909.44	261.02	1.37
T ₄ - KNO ₃ (2%) soaking for 24 hours.	12.47	74.66 (59.99)	82.97 (65.60)	2090.52	284.93	1.51
T ₅ - 2 minutes concentrated H ₂ SO ₄ followed by 24 hours soaking in distilled water.	18.07	56.66 (48.83)	74.17 (59.44)	1224.36	158.67	0.82
T ₆ - Cow dung slurry soaking for 24 hours.	14.40	62.67 (52.35)	73.74 (59.22)	1660.2	188.85	1.13
T ₇ - Cow dung slurry soaking for 48 hours.	14.20	60.67 (51.15)	75.95 (60.64)	1629.1	188.12	1.24
T ₈ - Cow dung slurry soaking for 24 hours followed by seed wrap for 72 hours in wet gunny bag.	13.93	71.33 (57.62)	80.35 (63.66)	1914.6	226.08	1.17
T ₉ - Cow dung slurry soaking for 48 hours followed by seed wrap for 72 hours in wet gunny bag.	13.67	62.00 (52.01)	82.99 (65.65)	1666.2	200.36	1.14
T ₁₀ - Cow urine soaking for 24 hours.	13.33	62.00 (51.94)	82.77 (65.46)	1813.7	202.84	1.25

T ₁₁ - Tap water soaking for 24 hours.	14.40	71.33 (57.82)	80.91 (64.15)	1688.5	218.87	1.28
T ₁₂ - Control (untreated).	21.87	52.66 (46.51)	70.17 (56.93)	1131.88	136.07	0.76
'F' test	Sig	Sig	Sig	Sig	Sig	Sig
SE(m)±	0.26	2.68	1.23	116.56	16.74	0.19
CD at 5 %	0.76	7.86	4.23	340.22	48.87	0.54

Table 2: Effect of seed treatment on growth characters of custard apple seedling

Treatments	Height of seedlings (cm)			Number of leaves per plant			Stem diameter (cm)			Leaf area (cm ²)	Absolute growth rate (g/day)	Relative growth rate (g/day)	Survival percentage (%)
	60 DAS	120 DAS	180 DAS	60 DAS	120 DAS	180 DAS	60 DAS	120 DAS	180 DAS				
T ₁	22.84	36.64	46.51	17.05	27.40	30.87	0.414	0.589	0.827	74.18	0.068	0.10	72.64 (58.47)
T ₂	23.33	37.54	48.31	17.37	28.60	32.64	0.456	0.620	0.926	76.42	0.078	0.11	72.81 (58.58)
T ₃	19.84	35.80	44.88	14.51	25.93	28.91	0.376	0.551	0.743	69.54	0.050	0.087	69.84 (56.68)
T ₄	21.24	35.85	46.19	15.39	26.80	29.78	0.399	0.593	0.778	71.19	0.053	0.090	71.28 (57.59)
T ₅	15.89	27.19	37.61	11.41	22.20	25.21	0.337	0.492	0.685	65.09	0.034	0.084	60.57 (51.10)
T ₆	17.01	33.75	42.93	12.79	26.80	27.35	0.379	0.572	0.720	66.42	0.041	0.089	58.80 (50.06)
T ₇	17.71	34.17	43.41	12.93	27.40	28.94	0.390	0.578	0.731	66.88	0.042	0.089	61.53 (51.66)
T ₈	18.13	34.72	44.33	13.72	27.67	29.31	0.392	0.577	0.739	67.53	0.043	0.089	66.23 (54.48)
T ₉	18.42	35.14	44.92	14.44	27.60	28.99	0.402	0.591	0.741	68.52	0.044	0.089	66.70 (54.75)
T ₁₀	18.84	37.31	46.13	14.16	25.87	28.50	0.395	0.579	0.750	69.61	0.045	0.090	68.91 (56.11)
T ₁₁	17.84	28.51	42.99	13.69	26.73	27.80	0.352	0.551	0.713	71.35	0.039	0.085	65.23 (53.86)
T ₁₂	14.97	26.55	35.51	11.13	21.47	22.97	0.312	0.470	0.652	62.67	0.019	0.058	50.57 (45.32)
'F' test	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig
SE(m)±	0.77	0.48	0.34	0.52	0.60	0.44	0.017	0.023	0.019	0.57	0.0016	0.0019	1.375
CD at 5 %	2.26	1.40	1.01	1.51	1.76	1.28	0.052	0.068	0.056	1.67	0.0048	0.0056	4.038

The average leaf area found maximum when seeds were treated with GA₃ 1000 ppm (76.42 cm²) followed by GA₃ 500 ppm (74.18 cm²). Probably the maximum height of plant helps in invigoration of physiological process of plant and stimulatory effect of chemicals to form new leaves at faster rate. The results are conformity with the findings of Chandra and Govind (1990)^[6] in guava, and Barche *et al.* (2010)^[3]; Meena and Jain (2012)^[20] in papaya.

The absolute growth rate found significantly maximum when seeds were treated with GA₃ 1000 ppm (0.078 g/day) followed by seed treatment with (T₁) GA₃ 500 ppm (0.068 g/day). Similarly, the relative growth rate found significantly maximum when seeds were treated with GA₃ 1000 ppm (0.11 g/day) followed by seed treatment with (T₁) GA₃ 500 ppm (0.10 g/day), while minimum absolute growth rate (0.058 g/day) recorded in control (T₁₂). Maximum growth rate associated when the seeds were soaked in GA₃ 1000 ppm prior to sowing. This might be due to the fact that, GA₃ improve the rate of photosynthesis and cause greater accumulation of photosynthetes (Alvin, 1960)^[1] which leads to increase in dry matter of plant and significant improvement in growth rate.

The effect of seed treatments was found to be significant for survival percentage in custard apple. However, maximum survival percentage was observed in the treatment (T₂) GA₃ 1000 ppm solution (72.81%) which was found to be at par with T₁ (72.64%), T₄ (71.28%), T₃ (69.84%), T₁₀ (68.91%), T₉ (66.70%). This might be due to, quicker root and shoot

development and making the seedling stouter with standing the transplanting shock and resisting root diseases. The result is conformity with the Barche *et al.* (2010)^[3] in papaya.

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