Response of PGRs and chemical substance in seeds dormancy breaking and seedling growth of custard apple (*Annona squamosa* L.) cv. Local cultivar

Roshan Lal Sahu[1*] and Gangaram Rana[2]
[1]Krishi Vigyan Kendra, Anjora, Durg, Chhattisgarh, 491001, India
[2]Department of Fruit Science, Indira Gandhi Krishi Viswavidyalaya, Raipur, Chhattisgarh, 492012, India
Email: [*]roshanhortfs84@gmail.com

Receipt: 27.10.2024 *Revised: 18.11.24* *Acceptance: 20.11.24*
DOI: 10.53552/ijmfmap.10.2.2024.24-31

ABSTRACT

Custard apple seeds take a long time to germinate due to their hard and thick seed coat which requires breaking. There are many plant growth regulators (PGRs) available for the purpose. An experiment was carried out to know the most suitable PGR for breaking seed dormancy and faster growth of seedlings during February to May 2023 at Krishi Vigyan Kendra, Anjora, Durg, Chhattisgarh, India. There were seven treatments having two PGRs and one chemical (GA_3, NAA, KNO_3,) and each PGR had two levels (500 and 1000 ppm) of seed soaking treatment for assessing seed germination and seedling growth related attributes. The Treatment GA_3 @1000 ppm was found the best among all treatments with respect to minimum number of days required for seed germination (35.02 DAS), 50% seed germination (49.44 %), seeds germination percentage (85.69%), survival percentage (91.43 %) and seedling height (15.29, 20.71 and 24.74 cm at 60, 75 and 90 DAS, respectively). Furthermore, seedling growth parameters such as number of leaves plant^{-1} (7.95, 9.31 and 10.38), collar diameter (0.29 & 0.39 cm) and root length (21.91 and 29.76 cm) at 60 and 90 DAS stages were also noted best in treatment GA_3 @1000 ppm. Additionally, the best performance of GA_3 @1000 ppm was also observed at 60 and 90 DAS in terms of fresh shoot weight (0.97 and 2.40 g), fresh root weight (0.15 and 0.44 g) and shoot and root ratio (0.60 and 1.17). Therefore, it was inferred from present experiment that GA_3 @1000 ppm should be used for breaking seed dormancy, optimum seed germination and better seedling growth related parameters in custard apple.

Keywords: Custard apple, dormancy, germination, PGRs, plant survival, seedling growth, shoot & root weight,

INTRODUCTION

Custard apple is a woody and semi-deciduous shrub and tree belonging to the family Annonaceae. It is propagated by different methods like seeds, grafting, budding, cutting etc. In India, farmers are propagating custard apple using many methods in which good and healthy planting material is very important. Custard apple seeds take a long time to germinate due to their hard and thick seed coat, which requires breaking, for which various methods were used by several researchers. Since the seed coat is hard and thick, there are many plant growth regulators (PGRs) available for breaking the seed dormancy (Sunder *et al.,* 2024, Pavithra *et al.,* 2018, Pandey and Bahadur, 2024). Seed germination is affected by many factors, including the type of substrate used, environmental factors such as oxygen, water,

temperature, and light. Some researchers observed that PGRs was effective in encouraging custard apple seed germination and growth (Rawat and Pandey 2019; Pravin *et al.*, 2021 and Rana *et al.*, 2020). Without the use of growth regulators, seeds showed poor response to germination and growth (Deeksha *et al.*, 2020). Seeds extracted from ripe fruits are used for sowing as the viability may be as short as few days, months, or at most a year and the seed viability depends upon storage environment. Recommended conditions for storing custard apple seeds are: temperatures between 15 and 20° C, low oxygen and ethylene tensions coupled with 10% carbon dioxide and a relative humidity of 85%–90% in the storage atmosphere. Pre-sowing seed treatment is a very useful method to improve seed germination and subsequent seedling growth in custard apple fruit species. Seed treatment is important for getting uniform and quick germination and to avoid the problem of uneven and irregular germination for obtaining plants for planting or for use as rootstock.

MATERIALS AND METHODS

The experiment of dormancy breaking of custard apple was carried out at Krishi Vigyan Kendra, Anjora, Durg, Chhattisgarh, India, under net house during February to May months, 2023. The experimental site is located in plains zone of Chhattisgarh at 20°54' and 21°32' north latitude & 81°10' and 81°36' east longitude. The district is 317 meters above mean sea level.

Seed of custard apple (*Annona squamosa* L.) were collected from local cultivars in Kanker District area of KVK, Kanker, Chhattisgarh. Seeds were extracted from freshly harvested fruits and stored for experiment. Rooting media were prepared which comprised of garden soil, sand and rotted FYM @ 2:2:1 ratio and were filled in poly bags (12cm x 10cm) of 50 microns thickness and seeds were soaked in PGRs and chemicals along with control (Table 1) for about 24 hours and then sown in pre-filled growing medium one seed per poly bags with 2-2.5 cm depth). All the poly bags were then kept under net house. The experiment was set up with randomized block design having three replications and 30 seeds were sown in each replicate, the total number of seeds in the experiment was 540.

Table 1: Plant growth regulators (PGRs) and chemical supplements

Symbol	Treatment details	Solution
T_0	Control	Distilled water
T_1	KNO_3 (0.5 %)	5g-Liter water^{-1}
T_2	KNO_3 (1 %)	10 g-Liter water^{-1}
T_3	GA_3 (500 ppm)	500 mg-Liter water^{-1}
T_4	GA_3 (1000 ppm)	1000 mg-Liter water^{-1}
T_5	NAA (250 ppm)	200 mg-Liter water^{-1}
T_6	NAA (500 ppm)	500 mg-Liter water^{-1}

After seed sowing evenly light watering was given to poly bags with rose can regularly and fungicide was sprayed with SAAF powder (Carbendazim 12% and Mancozeb 63% WP) 2g-L^{-1} during fungal infection.

Observations were recorded at 60, 75 and 90 DAS (days after sowing) on the parameters *viz.*, days taken to sprouting of seed germination, days taken to 50% seed germination, germination percentage (%),

survival percentage (%), seedling height (cm), number of leaves plant^{-1}, collar diameter (cm), root length (cm), fresh shoot weight (g), fresh root weight (g) and shoot and root ratio. Statistical analysis of data was carried out using MS-Excel, OPSTAT (Online statistical analysis software) for each observed character under study. Data investigation was analysed using randomised block design (RBD) (Gomez and Gomez,1985).

RESULT AND DISCUSSION

Seed germination and days taken to sprouting of seed germination (DAS): The statistical analysis of the observations on seed germination parameters has been presented in Table 2. A different pre-sowing seed treatment of custard apple seeds was found to have significant effect on seed germination. GA_3 at 1000 ppm took the fewest days (35.02) to start seed germination, followed by GA_3 (500 ppm) (35.36) and NAA (500 ppm) (37.44) in that order. While maximum time was taken under control treatment. Days needed for 50% of the seeds to germinate were significantly impacted by the various treatments. The least number of days (49.44) were needed for GA_3 (1000 ppm). But GA_3 (500 ppm) came next (52.20), and the control needed the most days (66.38).

The germination of custard apple seeds was significantly impacted by several treatments (Table 2). The GA_3 (1000 ppm) recorded the highest germination percentage (85.69%) when compared to other treatments, while the control group was lowest percentage (60.59%). Similar results were also reported by different researchers in custard apple Patel *et al.* (2017); Singh and Maheshwari, (2017); Lawhale *et al.* (2020); Pravin *et al.* (2021) and Rawat and Pandey (2019).

Survival percentage (%)

Significant variation in survival percentage was observed in the present study (Table 2) with the highest survival percentage (91.43%) recorded with soaking in GA_3 (1000 ppm) followed by GA_3 (500 ppm) (91.31%) and NAA (500 ppm) (90.04%) treatments. The lowest survival percentage (77.97%) was observed with control treatment. Rana *et al.* (2020), Jain *et al.* (2017), Yadav *et al.* (2018), and Rajput and Sharma (2020) all corroborated the current custard apple and Suja *et al.* (2016) in walnut seed germination and seedling growth under Kashmir valley conditions.

No. of leaves plant^{-1}

The number of leaves in plant^{-1} affected by various pre-sowing seed treatments is given in (Table 3). After 60, 75, and 90 days of sowing, it was found that the plants in the GA_3 (1000 ppm) treatment had more leaves (7.95, 9.31, and 10.38) than those in the GA_3 (500 ppm) (7.65, 8.80, and 10.01). The control was less leaves plant^{-1} (4.72, 6.31 and 7.08 respectively). Kumawat *et al.* (2014) in papaya seeds and Halder *et al.* (2023) in Indian olive seeds also noted that treating seeds with various chemicals resulted in the largest number of leaves and leaf size.

Collar diameter (cm)

Data regarding collar diameter at 60 and 90 days after sowing are presented in (Table 3). The maximum collar diameter at 60 and 90 days after sowing was recorded in GA_3 (1000 ppm) with the value of 0.29 and 0.39 cm, respectively, whereas it was followed by (0.28 and 0.37 cm,) in GA_3 (500 ppm). While, the minimum collar diameter as 0.26 and 0.33 cm under control. Similar results have been reported by Palepad *et al.* (2017), Rawat and Pandey (2019), Rajput and Sharma (2020) in custard apple and Muralidhara *et al.* (2023) in sapota.

Root length (cm)

Data on how various seed treatments effect root length are shown in (Table 3). At 60 and 90 DAS, the GA_3 (1000 ppm) treatment produced the longest root length of seedlings (21.91 & 29.76 cm), followed by NAA (500 ppm) with values (21.55 & 25.97 cm). The shortest root length (16.51 and 20.07 cm) was measured in control. Palepad *et al.* (2016); Singh and Maheswari (2017); Mane *et al.* (2019); Ara *et al.* (2022) and Dadhaniya *et al.* (2020) all noted that the elongation of the cells in the sub-apical area of roots was caused by the increase in osmotic uptake of nutrients brought on by the administration of various hormones.

Seedling height (cm)

Seedling height (cm) for treatments at 60, 75, and 90 days after sowing were recorded (Table 4). The highest seedling height was recorded in GA_3 (1000 ppm) (15.29, 20.71, and 24.74 cm, respectively), followed by GA_3 (500 ppm) (15.06, 19.79 & 23.44 cm, respectively). The lowest seedling heights were observed under control (10.10, 15.19, and 17.86 cm, respectively). Similar findings in custard apple have been reported by Patel *et al.* (2016); Bhowmick and Santhoshkumar (2023); Dey *et al.* (2022); Rawat and Pandey (2019); Lawhale *et al.* (2020) and Pravin *et al.* (2021).

Seedling fresh shoot and root weight (g)

The various pre-sowing treatments had a substantial impact on the fresh weight of the shoots and root of custard apple seeds, as shown in (Table 4). Following 60 and 90 days of seeding, the GA_3 (1000 ppm) showed the highest fresh weight of shoots (0.97 & 2.40 g) respectively. The treatment (control) resulted in a minimum fresh weight of shoots (0.62 & 1.37 g).

GA_3 (1000 ppm) produced the highest fresh weight of root (0.15 & 0.44 g) 60 and 90 days after sowing, followed by GA_3 (500 ppm) (0.14 & 0.43 g) respectively. In the control, the lowest fresh weight of root (0.07 & 0.21 g) was noted. Possible reason of increased fresh shoot & root weight (g) could be the overall growth of shoots and increased rate of photosynthesis, which result in higher fresh weight. The outcomes closely match the custard apple research conducted by Rajput and Sharma 2020; Rawat and Pandey 2019; Yadav *et al.*, 2018 and Patel *et al.*, 2016.

Shoot and root ratio

Analysis of the data revealed that the shoot to root ratio of seedlings (Table 4) was significantly impacted by the various seed treatments applied 60 and 90 days after sowing. Maximum in the GA_3 (1000 ppm) (0.60 & 1.17) and lowest shoot and root ratio of seedlings (0.42 & 0.75) was observed in control. Similar results are in agreement with the findings of Kumawat *et al.* (2014) in papaya, Rai *et al.* (2018) in khirni, Dev *et al.* (2020) in saucer-berry, Boricha *et al.* (2020) in guava and Lalitha *et al.* (2020) in aonla.

CONCLUSION

It is concluded that among the different pre-sowing treatments, GA_3 at 1000 ppm had the highest performance in terms of germination, seedling growth, and survival. For farmers/nurserymen point of view, a concentration of 1000 ppm of GA_3 is recommended to obtain beneficial results.

ACKNOWLEDGEMENTS

Author (s) express heartfelt gratitude to the staff members and workers of Krishi Vigyan Kendra, Anjora, Durg, who provided proper guidance and advice at every stage of experimentation.

CONFLICT OF INTEREST STATEMENT

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

REFERENCES:

Ara, R., Khan, S.A.K.U., Mannan, M.A, and Rahim, M.A.2023. Evaluation of some rooting substances and cutting in propagation of fig (*Ficus arica*). *Int. J. Min. Fruits Med. Arom. Plants*, **9**(1):14-24.

Bhowmick, N. and Santhoshkumar, G.M. 2023. Effect of Indole-3-butaric acid on air-layering in jackfruit under the Sub-Himalayan Terai region of West Bengal. *Int. J. Min. Fruits Med. Arom. Plants,* **9**(2):215-218.

Boricha, U.K., Parmar, B.R., Parmar, A.B., Rathod, S.D., Patel, M.V. and Pandey, A.K. 2020. Effect of pre-sowing treatments on seed germination and seedling growth of guava. *Pharm. Innov.*, **9**(9): 431 – 433.

Dadhaniya, D.B., Kanzaria, D.R., Sejal, B., Dhara, T. and Varuti, P. 2020. Effect of time of sowing and chemical treatments on seedling growth of custard apple (*Annona squamosa* L.) cv. Sindhan. *Chem. Sci. Rev. Lett.*, **9**(33): 19 - 23.

Deeksha, S.T.R., Chanderia, U.K. and Dwivedi, B. S. 2020. Effect of different pre sowing treatments on seed germination and growth of custard apple (*Annona squamosa* L.) seedlings. *Int. J. Curr. Microbiol. Appl. Sci.*, **9**(11): 1806-1818.

Dev, R., Dayal, D. and Sureshkumar, M.2020. Gibberellic acid and potassium nitrate promote seed germination and growth of grey-leaved Saucer-berry (*Cordia Sinensis* Lam.) seedlings. *Int.J.Fruit Sci.*, **20**(2):937–S954.

Dey, A.N., Panda, M.R., Sharma, B. and Ghosh, A. 2022. Effect on germination of Latka (*Baccaurea sapida* Muell.Arg.) *Int. J. Min. Fruits Med. Arom. Plants*, **8**(1):30-34.

Gomez, K.A. and Gomez, A.A. 1985. Statistical procedures for agricultural research (2nd Ed.), John Wiley and Sons, New York, 680 pp.

Halder, A., Mukherjee, P.K., Gonmei G. and Deb, P.2023. Effect of seed treatment on seed germination and seedling growth of Indian Olive (*Elaeocarpus floribundus*). *Int. J. Min. Fruits Med. Arom. Plants*, **9**(1):77-81.

Jain, S., Sharma, T.R., Lal, N., Rangare, N.R., Kumar, B. and Shirukar, B. 2017. Effect of GA_3 and growing media on seedling vigour and physiological parameter of custard apple (*Annona squamosa* L.). *Int. J. Curr. Microbiol. Appl. Sci.*, **6**(8): 606- 615.

Kumawat, R., Maji, S. G. and Meena, D.C. 2014. Studies on seed germination and seedling growth of papaya (*Carica papaya* L.) cv. Coorg Honey Dew as influenced by media and chemicals. *J. Crop and Weed.*, **10**(2): 281-286.

Lalitha, K.R., Tank, R.V., Chawla, S.L. and Jena, S. 2020. Effect of chemicals on seed germination and seedling growth of aonla (*Emblica officinalis* Gaertn.). *Pharm. Innov.*, **9**(12): 239 – 243.

Lawhale, M., Khadse, A., Gawali, K., Dhok, P. and Sarda, A. 2020. Effect of seed treatment on germination and physiology of custard apple (*Annona squamosa* L.) at seedling stage. *Int. J. Chem. Stud.*, **8**(5): 2201 - 2205.

Mane, S.B., Jugnake, M.O., Parse, R.N. and Naglot, U.M. 2019. Study on pre-sowing treatments of custard apple (*Annona squamosa* L.) root growth. *Int. Arch. Appl. Sci.*, **10**(3): 40-43.

Muralidhara, B. M., Rajendiran, S., Madhu, G. S., Rani, A. T., Deekshith, D. and Mithun, P. M.2023. Effect of pre-sowing treatments on germination, growth and vigour attributes of white Sapote (*Casimiroa edulis*). *Indian J. Agric. Sci*., **93**(6): 664–667.

Palepad, K.B., Bharad S.G. and Bansode, G.S. 2017. Effect of seed treatments on

germination, seedling vigour and growth rate of custard apple (*Annona squamosa* L.). *J. Pharmacogn. Phytochem.*, **6**(5): 20-23.

Palepad, K.B., Bharad S.G., Bansode, G.S. and Reshma, U.R. 2016. Seed germination and seedling growth studies in custard apple. *Adv. life sci.*, **5**(13): 5509-5512.

Pandey, A. and Bahadur, V. 2023. Effects of different plant growth regulators on seed germination, seedling growth and establishment of papaya (*Carica papaya*) cv. Pusa Nanha. *J. adv. biol*., **27**(6): 717-724.

Patel, D.D., Gaikwad, S.S. and Patel, K.D. 2016. Effect of seed priming treatments on germination and seedling vigour of custard apple (*Annona squamosa* L.). *Current Hort.*, **4**(2): 21–24.

Patel, M.S., Nurbhanej, K.H., Patel, V.S., Vihol, A.N. and Gohel, B.C. 2017. Effect of media and GA3 on seedling growth of custard apple (*Annona squamosa* L.) cv. Sindhan. *Int. J. Chem. Stud.*, **5**(5): 1717-1723.

Pavithra, S., G.S.K. Swamy, G.J. Suresh, Vishnuvardhana, S.V. Patil and Halesh, G.K. 2018. Effect of growth regulators and chemicals on germination of Surinam Cherry (*Eugenia uniflora* L.) seeds. *Int.J.Curr.Microbiol.App.Sci*., **7**(09): 546-551.

Pravin; Krishna, V.N.P.S., Sivaram, G.T., Jayaprada M. and Sireesha. Y.2021. Studies on influence of plant growth promoting hormone and chemicals on germination, growth and vigour of seedlings in custard apple (*Annona squamosa* L.) cv. Balanagar. *Pharm. Innov.*, **10**(9): 587-591.

Rai, R., Samir, M., Srivastava, R. and Uniyal, S. 2018. Improving seed germination and seedling traits by presowing treatments in Khirni (*Manilkara hexandra*) *Bull. Env. Pharmacol. Life Sci.*, **7** (4): 77 - 81.

Rajput, K. and Sharma, T.R. 2020. Effect of organic and inorganic sources on seed germination, growth and survival of custard apple (*Annona squamosa* L.) seedlings. *J. Pharmacogn. Phytochem.*,**9**(6): 552-556.

Rana, GR., Sahu, R. L. and Deb, P. 2020. Effect of various treatments on breaking seed dormancy and germination enhancement in custard Apple (*Annona reticulata* L.) local cultivar. *J. Pharmacogn. Phytochem.*, **9**(3): 787-789.

Rawat, U.S. and Pandey, C.S. 2019. Effect of seed treatment on germination and survivability of custard apple. *J. Plant. Sci.*, **11**(2): 65 - 71.

Singh, J.S. and Maheswari, T.U. 2017. Influence of pre-sowing seed treatments on the performance of soursop (*Annona muricata* L.) seedlings. *Plant Arch.*, **17**(2): 1215-1218.

Suja N. Qureshi, M.S. Wani and Kousar Javaid.2016.Effect of stratification and gibberellic acid on seed germination and seedling growth of walnut under Kashmir valley conditions. *Indian J. Hort.*, **73**(2): 171-176.

Sunder,S., Singh,D. and Kundu,S.2024.Effect of seed treatment on germination of custard apple (*Annona squamosa* L.). *Int. J. Adv. Biochem. Res.*, **8**(7): 487-489.

Yadav, R.S., Sharma, T.R., Pandey, S.K. and Maske, G. 2018. Effect of GA3 and cow urine on growth and physiology of custard apple at seedling stage. *Pharm. Innov.*,**7**(7): 395- 397.

Table 2: Effect of PGRs in seed germination parameters of custard apple cv. Local cultivar

Treatments	Days taken to sprouting of seed germination (DAS)	Days taken to 50% seed germination (DAS)	Germination percentage (%)	Survival percentage (%)
Control	41.94	66.38	60.59	77.97
KNO_3 (0.5 %)	38.14	58.77	68.33	81.97
KNO_3 (1 %)	37.78	57.04	69.42	82.89
GA_3 (500 ppm)	35.36	52.20	83.98	91.31
GA_3 (1000 ppm)	35.02	49.44	85.69	91.43
NAA (250 ppm)	37.46	56.70	75.41	89.11
NAA (500 ppm)	37.44	56.35	77.13	90.04
SE(m)±	**0.958**	**1.522**	**1.615**	**1.965**
C.D.at 5%	**2.933**	**4.662**	**4.945**	**6.019**

Table 3: Effect of PGRs in No. of leaves plant^{-1}, collar diameter (cm) and root length (cm) of custard apple cv. Local cultivar

Treatments	No. of leaves plant^{-1}			Collar diameter (cm)		Root length (cm)	
	60	75	90	60	90	60	90
Control	4.72	6.31	7.08	0.26	0.33	16.51	20.07
KNO_3 (0.5 %)	6.42	7.57	8.92	0.27	0.34	17.86	23.63
KNO_3 (1 %)	6.55	7.57	9.19	0.27	0.35	18.07	24.34
GA_3 (500 ppm)	7.65	8.80	10.01	0.28	0.37	21.55	25.97
GA_3 (1000 ppm)	7.95	9.31	10.38	0.29	0.39	21.91	29.76
NAA (250 ppm)	7.14	8.59	9.88	0.27	0.35	20.71	25.85
NAA (500 ppm)	7.22	8.66	9.95	0.28	0.36	21.61	26.42
SE(m)±	**0.276**	**0.241**	**0.301**	**0.010**	**0.014**	**0.659**	**0.458**
C.D.at 5%	**0.844**	**0.737**	**0.920**	**N/A**	**N/A**	**2.017**	**1.404**

Table 4: Effect of PGRs in seedling growth parameters of custard apple cv. Local cultivar

Treatments	Seedling height (cm)			Fresh shoot weight (g)		Fresh root weight (g)		Shoot and root ratio	
	60	75	90	60	90	60	90	60	90
Control	10.10	15.19	17.86	0.62	1.37	0.07	0.21	0.42	0.75
KNO_3 (0.5 %)	13.77	17.88	20.88	0.78	1.60	0.12	0.25	0.50	0.82
KNO_3 (1%)	13.84	18.36	21.70	0.81	1.62	0.12	0.26	0.52	0.83
GA_3 (500 ppm)	15.06	19.79	23.44	0.94	2.29	0.14	0.43	0.58	1.15
GA_3 (1000 ppm)	15.29	20.71	24.74	0.97	2.40	0.15	0.44	0.60	1.17
NAA (250 ppm)	14.63	18.84	22.32	0.84	1.94	0.13	0.32	0.54	0.97
NAA (500 ppm)	14.89	19.35	22.87	0.89	2.14	0.14	0.33	0.56	1.05
SE(m)±	**0.427**	**0.542**	**0.774**	**0.026**	**0.065**	**0.004**	**0.012**	**0.047**	**0.202**
C.D.at 5%	**1.306**	**1.660**	**2.372**	**0.079**	**0.198**	**0.013**	**0.037**	**N/A**	**N/A**