Effect Of Seed Treatments on SeedGermination Studies inRamphal (*Annona reticulata* L.)

Commented [d1]: Add authors name and designation

ABSTRACT

Commented [d2]: No need corrections

Annona reticulata L., commonly known as bullock's heart, is a tropical fruit-bearing tree belonging to the Annonaceae family. It is prized for its flavourful and nutritious fruit.The plants are used for anti-inflammatory, stress reliever, antimutagenic, curing wounds, anti-anxiety, and spasmolytic properties and have all been used. In this fruit, the seeds are poor due to seed dormancy, and viability is easily lost. To overcome this problem in bullock's heart, an experiment was laid out in the Floriculture unit, Department of Horticulture, Faculty of Agriculture, Annamalai University, Tamil Nadu on seed germination studies in Ramphal (*Annona reticulata* L.). Amongst the different pre-sowing seed treatments, treatment with Gibberellic Acid @ 1000 ppm significantly improved the germination percentage (90.63%) and reduced the number of days taken for initiation of seed germination (17.02 days), days taken for 50 percent of seed germination (22.44 days), span of seed germination (25.09 days) as compared to control. This experiment concluded that Gibberellic Acid @ 1000 ppm treated seeds have better seed germination characteristics.

Keywords: Bullock's heart, Annona reticulata, Gibberellic acid, seed treatment, seed germination.

INTRODUCTION

Commented [d3]: Add about importance of treatments like gibberellic acid

Commented [d4]: No need to add morphology of plant. Should explain about seed morphology and germination problem.

Commented [d5]: Add area, production, productivity of concern state and country

Commented [d6]: Add about seed germination process and seed priming process and their importance

Annona reticulata, commonly known as bullock's heart, is a tropical fruit-bearing tree belonging to the Annonaceae family. This species is native to the tropical regions of the Americas, with its origins traced back to the West Indies, Central America, and Northern South America. Over time, *Annona reticulata* has spread and naturalized across various parts of the world including Southeast Asia, Africa, and India, where it thrives in warm, tropical climates. *Annona reticulata* is prized for its flavourful and nutritious fruit. It is commonly consumed fresh, either scooped out of the skin with a spoon or blended into smoothies and desserts. Annona reticulata is a small, glabrous tree that grows in tropical conditions. It has many lateral branches and grows 6.0-7.5 m in height. The stems are cylindrical with shorter and brown-colored hairs and lenticels. Leaves are acute, oblong, lanceolate, rounded, cusped, or obtuse leaf-based. The upper surface of the leaves is glabrous and the lower surfaces have a few spreading hairs. *Annona reticulata* is heart-shaped with the surface rough and the ripening time color changed from yellow to yellowish red. Fruits are delicious and used for blood issues. The seeds are dark-colored with a smooth surface (Basappa*et al.,* 2024).The nutritional composition of 100 grams of bullock's heart fruit is as follows: 101 kcal, 25.2 g of carbohydrates, 2.4 g of fiber, 0.6 g of fat, 0.2 g of saturated fat, 1.7 g of protein, 33 IU of vitamin A, 19.2 mg of vitamin C, 0.1 mg of thiamine, 0.1 mg of riboflavin, 0.5 mg of niacin, 0.2 mg of vitamin B_6, 0.1 mg of pantothenic acid, 30 mg of calcium, 0.7 mg of iron, 18 mg of magnesium, 21 mg of

phosphorus, and 382 mg of potassium (Karande*et al.,*2023). *Annona spp* are commonly propagated through seeds and the seeds are poor due to seed dormancy, and viability is easily lost. To overcome this problem in ramphal, the study must improve germination characteristics.

MATERIALS AND METHODS

Commented [d7]: Add about varieties used

The experiment was conducted in the Floriculture unit, Department of Horticulture, Faculty of Agriculture, Annamalai University, Cuddalore, Tamil Nadu during the year 2024 (January - June). Selecting the seeds from uniform-sized quality and disease-free Ramphal fruits. The seeds are extracted after being washed in water and selected as good-quality seeds. The experiment is laid out in Completely Randomized Design (CRD) with 16 treatments and 3 replications. The different treatments like T_1 - Jeevamirtham @ 5%, T_2 - Jeevamirtham @ 10%, T_3 - Jeevamirtham @ 15%, T_4 - GA_3 @ 500 ppm, T_5 - GA_3 @ 1000 ppm, T_6 - GA_3 @ 1500 ppm, T_7 - KNO_3 @ 1000 ppm, T_8 - KNO_3 @ 2000 ppm, T_9 - KNO_3 @ 3000 ppm, T_{10} - H_2SO_4 @ 1%, T_{11} - H_2SO_4 @ 2%, T_{12} - H_2SO_4 @ 3%,

T_{13} - Thiourea @ 1%, T_{14} -Thiourea @ 2%, T_{15} - Thiourea @ 3% and T_{16} - Control. After the treated seeds were sowed in a 2-3 cm depth in polybags filled with media comprising red soil, sand, and FYM (2:1:1). Theobservationsaboutseedgerminationcharacteristicswererecorded daily up to 150 days after sowing *i.e.*germination percentage, days taken for initiation of seed germination, days taken for 50 percent of seed germination andspanofseedgermination.The experimental data recorded on various characteristics during the investigation were analyzed statistically using the method of analysis of variance (ANOVA) for Complete Randomized Design (CRD) by Fisher and Yates (1963). Analysis of variance (one-way classified data) for each characteristic was performed using 'WASP 2.0' software. The significance of various treatments was judged with the help of the "F" value (test) at a 5% level of significance. To elucidate the nature and the magnitude of effects, S.Ed and C.D. at a 5 per cent level of significance were included in the summary table.

RESULTS AND DISCUSSION

Commented [d8]: Result and discussion part is good and appropriate. The discussion part is suited to results. No need correction here.

The data relating to germination percentage, days taken for initiation of seed germination, days taken for 50 percent of seed germination, and span of seed germination in Ramphal as influenced by the different pre-sowing treatments are given in Table 1. The highest germination percentage (90.63) is registered in T_5 (GA_3 @ 1000 ppm) followed by T_8 (KNO_3 @ 2000 ppm) which showed 87.68 and the lowest germination percentage (50.18) was recorded in T_{16} (control). Gibberellic acid's antagonistic impact on germination may be the cause of the increase in germination (Brain and Hemming, 1958; Wareing *et al.,* 1968) and GA_3 has a role in the cytological enzyme activation process that triggers the α-amylase enzyme which transforms insoluble starch into soluble sugars. Energy from these sugars is needed for several metabolic and physiological processes connected to germination. The results conform with the earlier reports by Hazarika *et al.* (2023) in papaya, Hossain *et al.* (2023) in papaya, Sabarad*et al.* (2023) in wood apple, Anagha *et al.* (2024) in dragon fruit, Bahadure*et al.* (2024) in lime and Deshi *et al.* (2024) in apple.

The minimum days taken for initiation of seed germination is registered in T_5 (GA_3 @ 1000 ppm) followed by T_8 (KNO_3 @ 2000 ppm) which showed 17.02 days and 17.85 days respectively to T_{16} control (33.98 days). GA_3 synthesized by the enlarged embryo acts on the living cells and causes de nova synthesis of hydrolyzing enzymes particularly α-amylase and protease which converts the starch into simple sugars during germination (Paleg, 1965). The enzymes that weaken the seed coat and permit the axis to break through are the other enzymes that GA_3 activates. For the radicle to break through the endosperm and seed coat that limits its growth, GA_3 also increases cell elongation (Hartmann and Kester, 1979). The results conform with the earlier reports by Garg and Bahadur (2023) in guava, Hossain *et al.* (2023) in papaya, Anagha *et al.* (2024) in dragon fruit, Bahadure*et al.* (2024) in lime and Deshi *et al.* (2024) in apple.

T_5(GA_3 @ 1000 ppm)registeredtheminimum daystakenfor50percentofseedgermination(22.44) whereascontrolrecordedthemaximumnumberofdaystakenfor50percentofseedgermination(46.90). The reduction in the number of days required for 50% of germination may be due to the synergistic effects of these two inputs combined (GA_3 and soaking period) which enhance protoplasmic physio-chemical properties, respiration, nucleic acid metabolism, and other aspects of combined growth.GA_3 is thought to have enhanced the de novo synthesis of hydrolyzing enzymes, specifically protease and amylase. The food that had been hydrolyzed was then used to develop the embryo, which improved germination. Findings similar to the present study were reported by Hakimi *et al.* (2020) in avocado, Singh and Kaur (2021) in aonla, Harshita *et al.* (2021) in Indian blackberry, and Bahadure*et al.* (2024) in lime.

The minimum days taken for a span of seed germination observed in T_5 (GA_3 @ 1000 ppm) followed by T_8 (KNO_3 @ 2000 ppm) which showed 25.09 days and 26.74 days respectively than T_{16} control (50.71 days). The shortest number of days required for seed germination in seeds treated with GA_3 may be attributed to the fact that GA_3 initiates starch hydrolysis, whose translocation enables the completion of seed germination. Findings similar to the present study were reported by Harshita *et al.* (2021) in Indian blackberry, Singh and Kaur (2021) in aonla, and Bahadure*et al.* (2024) in lime.

Table 1. Effectofseedtreatmentsongerminationcharacteristics ofRamphalseedsat 150 DAS

Treatments	Germination percentage (%)	Days taken for initiationofseedgermination	Daystakenfor 50percentof seed germination	Span of seed germination (days)
T_1 -Jeevamirtham @ 5%	57.94 (49.57)	29.32	42.13	45.37
T_2 - Jeevamirtham @ 10%	55.33 (48.06)	30.00	43.44	46.88
T_3 - Jeevamirtham @ 15%	52.84 (46.63)	31.48	45.35	48.74

T_4 - GA_3 @ 500 ppm	79.75 (63.26)	22.01	28.98	31.83
T_5 - GA_3 @ 1000 ppm	90.63 (72.25)	17.02	22.44	25.09
T_6 - GA_3 @ 1500 ppm	82.40 (65.20)	20.92	27.36	30.13
T_7 - KNO_3 @ 1000 ppm	77.43 (61.64)	23.06	30.58	33.51
T_8 - KNO_3 @ 2000 ppm	87.68 (69.46)	17.85	24.14	26.74
T_9 - KNO_3 @ 3000 ppm	74.80 (59.87)	24.19	32.29	35.21
T_{10} - H_2SO_4 @ 1 %	66.63 (54.72)	26.94	37.18	40.22
T_{11} - H_2SO_4 @ 2 %	63.67 (52.94)	27.88	38.78	41.92
T_{12} - H_2SO_4 @ 3 %	60.85 (51.27)	28.61	40.68	43.87
T_{13} - Thiourea @ 1 %	71.96 (58.03)	25.11	33.92	36.90
T_{14} - Thiourea @ 2 %	85.10 (67.29)	19.64	25.75	28.44
T_{15} - Thiourea @ 3 %	69.65 (56.58)	26.11	35.60	38.55
T_{16} – Control	50.18 (45.10)	33.98	46.90	50.71
S.Ed	1.00 (0.70)	0.26	0.58	0.63
CD at 5 % (p = 0.05)	2.05 (1.43)	0.54	1.18	1.28

Note: Figures in parenthesis are arcsin transformation values

Commented [d9]: Please check analysis of variance, SEM should be there and CD is should be more or less three times that SEM

CONCLUSION

Commented [d10]: Conclusion part is good. No need corrections.

The findings from the present study, titledSeed Germination Studies in Ramphal (*Annona reticulata* L.), indicate that treating seeds with GA_3 at 1000 ppm significantly enhances germination parameters such as germination percentage, time to initiate germination, time to achieve 50% germination, and the overall germination period.Ramphal, also known as Bullock's heart, suffers from physical dormancy due to its hard seed coat, leading to poor germination rates. Treatment with KNO_3 at 2000 ppm also yielded favorable results, but GA_3 at 1000 ppm proved superior. It is recommended that farmers aiming for successful Ramphal cultivation adopt gibberellic acid at 1000 ppm as a pre-sowing treatment. This approach can improve both seed germination and early growth performance. This study confirms that gibberellic acid is the most effective solution for breaking dormancy and enhancing seed germination in Ramphal. These results demonstrate the potential of GA_3 as a reliable strategy to boost germination success.

REFERENCES

Anagha, P., Prakasha, D., Kulapati, H., Mallikarjun, A., Vijay, M., and Anand, N.(2024). Improving seed germination and seedling growth of dragon fruit (*Hylocereus undatus*) by PGRs. Indian Journal of Agricultural Sciences, 94(2), 187-191.

Bahadure, A. B., Nagre, P. K., Paithankar, D. H., Ingle, Y. V., and Bharad, S. G.(2024). Assessment of various plant growth substances on germination rates and seedling vigor in

acid lime seedlings (*Citrus aurantifolia* Swingle) cv. PDKV lime. International Journal of Advanced Biochemistry Research, 8(3), 753-756.

Basappa, K. S., Raghava, S., and Umesha, S. (2024). Prevalence of phytochemical and pharmacological properties; furthermore, a miraculous healing plant in the contemporary time, *Anonna reticulata*. Pharmacognosy Communications, 14(1), 2-12.

Brain, P. W., and Hemming, H. G.(1958).Complementaryactionofgibberellicacidand auxinin peainternodeextension. Annals ofBotany, 22, 1-7.

Deshi, K. E., Ogbuka, G. I., Nanbol, K. K., and Satdom, S. M.(2024). The effect of varying concentrations of gibberellic acid (GA_3) under refrigeration on the breaking of dormancy and seedling growth of apple (*Malus domestica* Borkh.) seeds in Jos Plateau State, Nigeria. IOSR Journal of Agriculture and Veterinary Science, 17(1), 23-27.

Fisher, R. A., and Yates, F. (1963).StatisticaltablesforBiological,Medicaland AgriculturalResearch. Oliver and Boyd Edinburgh,86.

Garg, K., and Bahadur, V. (2023). Influence of potting media and GA_3 on seed germination and seedling growth of guava (*Psidium guajava*) cv. Allahabad Safeda under shade net condition. International Journal of Plant and Soil Science, 35(16), 393-403.

Hakimi, N., Shivakumar, B. S., Lakshmana, D., Ganapathi, M., and Adivappar, N.(2020). Effect of plant growth regulators and chemicals on seedgermination,vigourindexandmortalityofavocado(*Perseaamericana*Mill.). InternationalJournalofCurrentMicrobiologyandAppliedSciences,9(8), 3640-3645.

Harshita Mali, Mool Chand Jain, Rakesh Kumar Yadav, Pooja Sharma and KuldeepSingh. (2021).GerminationofIndianblackberry[*Syzygiumcuminii*(L.)Skeels] asaffectedbypre-sowingseedtreatment.InternationalJournalofCurrent MicrobiologyandApplied Sciences,10(1),3392-3400.

Hartmann, H. T., and Kester, D. E. (1979). Plant Propagation: Principles and practices. Fourth Edition, Prentice Hall of India. Ltd. 407.

Hazarika, B., Gogoi, S., Das, R. T., and Bordoloi, A.(2023). Studies on seed germination, growth and vigour of papaya seedlings cv. 'Sapna' as influenced by growth regulators and propagation media. The Pharma Innovation Journal, 12(11), 2387-2391.

Hossain, F., Islam, N., Ali, S., Kayes, A., and Choudhury, S. (2023). GA_3 and growing medium influence papaya seed germination and seedling growth. Trends in Horticulture, 6(2), 3263.

Karande, P. S., Haldankar, P. M., Khandekar, R. G., Malshe, K. V., and Mane, A. V.(2023). Effect of seed treatment on germination and growth of bullock's heart (Annona reticulata L.) seedling. The Pharma Innovation Journal, 12(12), 1379-1382.

Paleg,L.(1965).PhysiologicaleffectsofgibberellinsAnnualsReviewsofPlantPhysiology,16, 291-322.

Sabarad, S. R., Manu Kumar, H. R., Sabarad, A. I., and Chandan, K. (2023). Influence of seed priming on germination and seedling growth of wood apple (*Limoniaacidissima* L.). The Pharma Innovation Journal, 12(3), 2120-2124.

Singh, S. and Kaur, A. (2021). Effect of various treatmentson seedgermination and seedling vigour of aonla cv. Chakaiya. Indian Journal ofAgriculturalResearch, 55(5), 614-618.

Wareing, C., Brewbaker, B., and Crawford, D. J. (1968). The activity of endogenousgrowth regulators in lettuce in relation to seed germination. American Journal Botany, 54, 314-317.