EFFECT OF BIOREGULATOR ON GERMINATION AND EARLY SEEDLING GROWTH OF AFRICAN STAR APPLE (*CHRYSOPHYLLUM ALBIDUM G. DON*)

NJOKU, T.C.

Department of Crop Science & Biotechnology, Imo State University, Owerri, Nigeria.

Author's e-mail: tcnjoku2010@gmail.com

ABSTRACT

An experiment was conducted at Imo State University farm, Owerri to evaluate the effect of bioregulator on germination and early seedling growth of African star apple which serves as fruit, food, feed and environmental pollution control against climate change. Completely Randomized Design was used with four treatments and sixteen replicates. Different levels of coconut water served as treatments; 0 cl, 5 cl, 10 cl and 15 cl. They were sown after soaking in the solution for 24 hours in 64 polythene bags each containing 6 kg top soil. Data on germination and early seedling growth parameters were collected. Seedling height, number of leaves and leaf area were also collected 10 weeks after germination. Results showed that the highest germination percentage of 91 %, significantly (P<0.05) different from control was obtained from the solution containing 15 cl coconut water. Highest number of days to 50 % germination was 56 days obtained from solution containing 0 cl coconut water and differed significantly (P<0.05) from others. Solution containing 15 cl, 10 cl, and 5 cl coconut water gave the largest mean seedling leaf area of 56.70 cm^2, 32.99 cm^2, and 26.38 cm^2 respectively significantly (P<0.05) different from control at 10 weeks after planting. 15 cl coconut water gave the best result for germination and seedling growth of African star apple seed and therefore recommended.

Key words: African star apple, Bioregulator, Seeding growth, Germination.

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INTRODUCTION

Chrysophyllum albidum (G. Don) is a multi-purpose indigenous tropical forest fruit tree, belongs to the family Sapotaceae. It is recognized by farmers in the South East Nigeria where the trees are grown for its high content of ascorbic acid, irons and other minerals and vitamins (Ogunlade and Oluwafemi, 2021; Ibrahim *et al.*, 2021). The tree has an antimicrobial effect. The bark is used for the treatment of yellow fever, and malaria while the

leaves are used for the treatment of skin eruptions, diarrhoea and stomach-ache. It is a rich source of natural antioxidants, it has broad medicinal applications in ethnomedicine. (Kpodo *et al.*, 2021). The tree improves the soil nutrient content. Also, it is used to control climate change and other environmental management factors. *Chrysophyllum albidum* commonly called African star apple tree is endowed with potential for agro-forestry in the tropics. The fruit is a berry. The fruits are produced in considerable large quantities on the tree and are mostly under-utilized except for consumption in the fresh form.The fresh fruit pulp is suitable for jams and is eaten as snack by both old and young (Ogunlade and Oluwafemi, 2021). The fruit peel is chewed to turn it into gum.The fruit is rich in macro-nutrients, micro-nutrients and dietary phytochemicals. It has the potential to improve the human health, nutrition, food security and income of farmers who engaged in its production.

The kernel meal serves as feed for growing rabbits (Makinde *et al.*, 2020). The trees can be planted along the edges of home gardens and farms, roads and in the forest mainly for its fruits from which an edible pulp that contains the seed is found. It is a seasonal indigenous fruit tree and also a tropical fruit (Njoku, 2019). The trunks and other woody parts are used as fuel for cooking. Fruit shell absorbent of African star apple is an agricultural waste absorbent that can be used in the recovery of waste lubricating oil which will enhance greatly the nation's economy (Taiwo *et al.*, 2021). Its canopy does not affect crop growth, and the leaves contribute to soil fertility. More so, the leaf extracts in combination with bitter cola (*Garcinia kola*) produces antimicrobial activity against fungal diseases (Ewelike, *et al.*, 2021). The wood is suitable as fuel wood and for charcoal making. The trunk serve as timbers, suitable for poles, railway sleepers and general carpentry.

In South East Nigeria and Democratic Republic (DR) of Congo the edible caterpillars (*Nudaurelia oyemensis*) feed on the leaves of this plant. Bees forage the flowers for honey (Agroforestry Tree Database, 2020).. Extracts of the leaf, stem bark, seed and fruit pulp have anti-inflammatory and anthelmintic activities, and also used as analgesic (Odeyemi and Fawole, 2022). Furthermore, Erukainure, *et al.*, (2020) reported on bioactive compounds of African star apple and its modulatory effect on metabolic activities linked to type 2 diabetes in isolated rat psoas muscle. The oil from the inedible seed is characterized as an eco -

friendly oil for a sustainable environment than petroleum diesel oil based muds (Igbafe *et al.*, 2021). Despite the nutritional and industrial potentials, environmental pollution control, climate change control, biofuel production, bio-medicine and biotherapy potentials of this endangered tree species, certain factors have made the propagation and perpetuation of desirable variants of *Chrysophyllum albidum (G. Don)* particularly very difficult. The seed has a short viability and best sown as soon as it is ripe hence the seeds are known to be recalcitrant and storage can only improve longevity for about three months (Agroforestry Tree Database, 2020). Some viable seeds exhibit impervious seed coat which delay germination (Verheij and Lovenstein, 2004). The species produce four to five seed per fruit, but falls down when properly ripe. The seed is discarded after licking thereby seriously limiting the availability of planting materials.

Recent attempts to vegetatively propagate the African star apple did not succeed (Okafor, 1983; Okorie *et al.*, 2000). Efforts made to propagate the species vegetatively using rooting hormones or air layering has not been possible. These methods are time consuming and difficult requiring some technical skills. The above factors, in addition to seed dormancy period and hard coat have aggravated the propagation constraints in African star apple. Njoku and Okorie (2021) stress the role of bioregulator or growth regulator in flowering and fruit set. Bioregulator facilitates the germination and growth of some temperate tree crops (Wahdan *et al.*, 2011; Muchjajib *et al.*, 2014). In order to facilitate the germination of African star apple seeds, application of bioregulators particularly in seed germination is a necessity, hence it plays a vital role in reducing the number of days for seed germination mainly seeds with hard coat such as oil palm seed, coconut etc.

There is presently scarcity of information on the use of bioregulator on seed germination especially in indigenous tropical fruit tree crops (African star apple seed) to reduce seed dormancy period and germination duration. In addition, the performance of bioregulator in quickening the seedling growth need to be fully evaluated to ensure optimum healthy seedlings production hence there is a need for afforestation and plantation of this indigenous fruit which is at its verge of extinction.Therefore,the objective of this study is to evaluate the

effect of bioregulator on the germination and early seedling growth of African star apple seed.

MATERIALS AND METHODS

This experiment was conducted at the teaching and research farm of Imo State University Owerri, Imo State (Latitude $05^0$26'N, longitude 07^0 02'E and altitude 91 m above sea level). This part of the humid tropics in South - eastern Nigeria is characterized by a warm wet season in mid March to October, and a hot dry season in November to mid March. The annual precipitation ranges from 1,810 -2,260 mm and most of it falls during the wet season. There is a short duration drought of about 10 days in August. During the wet season, much of the day time has a near saturation point relative humidity with maximum and minimum temperatures of 30^0C and 21^0C respectively (NIMET, 2021).

The experiment was laid out in a Completely Randomized Design, with four treatments and sixteen replicates. The treatments were as follows: Untreated 0 cl (T_4), 5 cl Coconut water (T_3), 10 cl Coconut water (T_2), and 15 cl Coconut water (T_1). The seeds were soaked in the different levels of coconut solutions for 24 hours. 0 cl Untreated (T_4) serve as the control. The seeds were planted after treatments in sixty four polythene bags measuring 10 cm by 15 cm containing sterilized top soil of same quantity, rich in organic matter. The polythene bags were arranged under a shade, one seed per bag. The planting depth was 4.5 cm. Watering was carried out immediately after planting and subsequently once every two days because of the dry season. Seeds were weighed using a sensitive digital electronic weighing balance (Sartorius weighing balance model: FEM-100g/0.01g), the circumference and radius of the seeds were measured using a measuring tape before planting. The bioregulator used was different levels of coconut water (fresh harvest). Weeds were manually removed by hand (hand pulling or weeding) during the periodic inspections. Experiment was monitored and data were collected on the germination date, number of seeds germinated, percentage germination, number of days to 50 % germination, number of leaves per/plant, plant height, and leaf area. The statistical methods used for data analysis were Analysis of variance. Means were separated using Fishers Least Significant Difference (LSD at 5 %) procedure as in

statgraphic package version 16.0 model, and Duncans New Multiple Range Test (DNMRT). Percentages were calculated where appropriate (Gupta, 2011).

RESULTS AND DISCUSSION

The result of the research on effect of seed treatments on number of days to 50 % germination showed that coconut water as a bioregulator had the ability to increase rate of germination and growth of the plant. Treatments influenced the number of days to 50 % germination in African star apple seeds (Table 1).The untreated seed had the highest number of days to 50 % germination which is different from others. The experiment was conducted under the same condition. Soil was collected from the same place, dried and sieved to get rid of stones and other substances, same size of seeds were used. but there were differences in the number of days to 50 % germination. Also percentage germination of the African star apple seeds support the result. The highest percentage seed germination was 91.7 % obtained from 15 cl coconut water. This was followed by 75 % germination obtained from 10 cl coconut water in 35 and 42 days respectively, while the least mean value was obtained from control with 50 % germination in 56 days. The obtained result indicated that there were differences between treated and untreated seeds in terms of germination. This may be as a result of the coconut water which contained some growth hormones responsible for seed germination. Also coconut water has gibberellic acid which increases germination of seeds and root development, in addition to vegetative growth (Njoku and Okorie, 2015).

Furthermore, effect of bioregulator on mean plant height showed significant ($P<0.05$) differences among the treatments. At 10 weeks after planting, 15 cl coconut water reached a pick mean height of 10.6 cm, and was followed by 10 cl coconut water with mean height of 5.6 cm which were significantly ($P<0.05$) different from the control (Table 1). Similarly, treatments had effect on the mean number of leaves. 10.8 number of leaves were obtained by 15 cl coconut water and this was significantly ($P<0.05$) different from all others (Table 1). Seedlings that received coconut water were different from control in terms of leaf area, plant height and percentage germination. Analysed result indicated that all seedlings that received

coconut water treatments were significantly (P< 0.05) different from control which received zero coconut water. The obtained results were in harmony with the work of Okunlola *et al.*, (2011); Njoku and Okorie (2015). Coconut water contains amino acid, minerals and vitamins that provide an uncontaminated nutritional supplement for bacteria important to plant growth, bacteria such as Rhizobacteria which exerts a positive influence on the plant growth especially under stress conditions. The bacteria also promote strong root systems and more rapid growth and development (Okunlola *et al.*, 2011).

CONCLUSION

Coconut water has proved to be a bioregulator and also a natural organic compound by influencing the germination and early seedling growth of African star apple seed. It can also be seen as a plant growth regulator and a fertilizer hence it contains calcium, magnesium and other minerals essential for plant growth and development. Finally, coconut water serves as hormone since it contains cytokinin and gibberellin which is responsible for seed germination and seedling growth as seen from the result. Therefore, fresh coconut water had the ability to facilitate the germination of seeds and seedling growth especially seeds with hard coat. Application of 15 cl fresh coconut water is hereby recommended for germination and early seedling growth of African star apple seed.

REFERENCES

Agroforestry Tree Database, (2020). Species information - Chrysophyllum albidum. World Agroforestry Centre, Nairobi Kenya. Retrieved April 5, 2020, from http//www.worldagroforestry.org/resources/databases/agroforestree.

Erukainure, O. I., Salau, V. F., Xiao, X., Matsabisa., M.G and Koorbanally, N. A (2020). Bioactive compounds of African star apple (Chrysophyllum albidum G. Don) and its modulatory effect on metabolic activities linked to type 2 diabetes in isolatedrat psoas muscles. Journal of Food Biochemistry 10.1111/fbc. 13576. https://doi.org/10.1111/jfbc.13576

Ewelike, N. C., Okammadu, J. C., Ogwudire, V. E and Nnadozie, R. I. (2021). In-vitro antimicrobial activity of methanolic and aqueous leaf extracts of Chrysophyllum albidum (African star apple) and Garcinia kola (Bitter kola). GSC Biological and pharmaceutical Sciences, 14(03): 249-253. https://doi.org/10.30574/gscbps.2021.14.3.0092

Gupta, S.C (2011). Fundamentals of statistics 6th edition.

Ibrahim, H., Haruna, A and Abdulalahi, N (2021). Proximate and Elemental Analysis of African Star Apple (Chrysophyllum albidum). Journal of Applied Sciences and Environmental Management, 25(2):253-256. https://doi.org/10.4314/jasem.v25i2.18

Igbafe, S., Azuokwu, A. A. and Igbafe, A.I.(2021) . Production and Characterization of Eco-Friendly Oil Based Mud from Synthetic Bio- Lubricants from Chrysophyllum albidum Seed Oil. Engineering and Technology Research Journal, 6(2):40-47. https://doi.org/10.47545/etrj.2021.6.2.083

Kpodo, F. M., Darko., D. A Essuman, E. K.and Kortei (2021). Antioxidants and physiochemical properties of Chrysophyllum albidum fruit at different ripening stages.African Journal of Food , Agriculture, Nutriution and Development, 21(9:) 18694- 18710. https://doi.org/10.18697/ajfand.104.19055

Makinde, O. J., Aremu, A., Alabi, O, J., Jiya, E. Z and Tamburawa, M. S.(2020). Evaluation of differently processed African star apple (Chrysophyllum cainito) kernel meal as feed for growing rabbits. Nigerian Journal of Animal Production, 44(4):150 - 159. https://doi.org/10.51791/njap.v44i4.572

Muchjajib S.I., U. I. Muchjajib, M. J umee, (2014). Effect of GA and NAA application and fruit wrapping on yield and quality of Java apple (Zyzygium samarangens (Blum) Merrill and Perry) Acta Horticulture. 1130, 225-230. https://doi.org/10.17660/ActaHortic.2016.1130.33

Njoku, T. C. and Okorie , H. A. (2021). Effect of application of Gibberellin on African pear (Dacryodes edulis (G. Don) HJ Lam) flowering, fruiting and fruit set. Journal of Agriculture and Food Sciences, 19(1):18-30. https://doi.org/10.4314/jafs.v19i1.2

Njoku, T. C. (2019). Tropical Fruit Trees Phenology. Springfield Publishers Ltd., New Owerri, Nigeria.

Njoku, T. C. and Okorie , H. A. (2015). Effect of growth regulators on African pear (Dacryodes edulis (G. Don) HJ Lam) fruit set. 20th Annual Conference of IPAN, Awka Anambra State. October 25-29, 2015.

NIMET, (2021): Nigerian Metrological Agency. Seasonal Rainfall Prediction. https://fscluster.org/sites/default/files/documents/2021_seasonal_climate_prediction_0.pdf

Odeyemi, O. M and Fawole, O. A. (2022). African Star Apple (Chrysophyllum albidum).. https://www.researchgate.net/publication/365729679_African_Star_Apple_Chrysophyllum_albidum/citation/download

Ogunlade, A. O and Oluwafemi, G. I. (2021). Production and Evaluation of jam produced from plum and African Star Apple blends. Food Research, 5(4) 93-98. https://doi.org/10.26656/fr.2017.5(4).031

Okafor, J. C (1983). Varietal Delimitation on Dacryodes edulis (G. Don) HJ Lam. Int. Tree Crop Journal. 2: 255- 265. https://doi.org/10.1080/01435698.1983.9752759

Okorie, H. A. , Ndubuizu, T. O. C. and Janssens, M. J. J (2000). Studies on the Pomology of the African pear (Dacryodes edulis (G. Don) HJ Lam) in Nigeria. Acta Horticulture 531, 207-211. https://doi.org/10.17660/ActaHortic.2000.531.33

Okunlola, A.I., Adebayo, R.A and Orimogunje, A.D. (2011). Methods of breaking seed dormancy, germination and early seedling growth of African locust bean (Partia biglobosa (Jacq) Benth). Journal of Horticulture and Forestry, 3(1):1-6.

Taiwo, E., Oluwatosin T and Olayinka, S. (2021). Potential of African Star Apple (Chrysophyllum albidum) Fruit Shell Adsorbent in Recovery of Valuable Hydrocarbons for Spent Engine Oil. International Journal of Engineering and Technologies, 20, 9-22. https://doi.org/10.56431/p-z1fu71

Verheij, E. and Lovenstein, H. (2004). A nurseryman and his trees. Agro special 1. Agromisa Foundation Wageningen, the Netherlands. 9 - 18.

Wahdan, M.T., S.E. Habib, M.A Bassal, and E.M. Qaoud. (2011). Effect of some chemicals on growth, fruiting, yield and fruit quality of "Succary Abiad" Mango cv. American science Journal. Suez Canal University (7I2): 651-658.

APPENDIX

Table 1: Effect of bio-regulators on germination and early seedling growth of African star apple (*Chrysophyllum albidum* (G. Don))

Treatment	Days to 50 % Germination	Percentage (%) Germination	Plant Height (cm)	Number of leaves	Leaf area (cm^2)
15 cl	35	91.7	10.6^{a}	10.8^{a}	56.70^{a}
10 cl	42	75	5.6^{ab}	2.0^{b}	32.99^{ab}
5 cl	49	66.7	2.0^{b}	2.0^{b}	26.38^{c}
0 cl	56	50	2.0^{b}	2.0^{b}	9.28^{d}
LSD			8.76	6.28	0.09

Means in the same column, having the same letter(s) are not significantly different at ($P<0.05$)