Bulletin of Pure and Applied Sciences.
Vol.38 B (Botany), No.1. Jan-Jun 2019: P.49-55

Print version ISSN 0970 4612
Online version ISSN 2320 3196
DOI: 10.5958/2320-3196.2019.00006.5
Available online at www.bpasjournals.com

Original Article

The effects of Growth Media on Germination and Early Seedling Development of *Annona Muricata Linn.*

C.A. Dada[1], J. Kayode[2*], S. Arowosegbe[3]

Author's Affiliation
[1]Department of Science Laboratory Technology (Biotechnology option), Ekiti State University, Ado-Ekiti.
[2]Department of Plant Science and Biotechnology, Ekiti State University, Ado-Ekiti.
[3]Department of Plant Science and Biotechnology, Ekiti State University, Ado-Ekiti.

***Corresponding Author:**
J. Kayode,
Department of Plant Science and Biotechnology, Ekiti State University, Ado-Ekiti.

E-mail:
tjoshua.kayode@eksu.edu.ng

Received on 23.01.2019
Accepted on 20.02.2019

Keywords:

Growth media, Germination, Seedling development, Medicinal plant, *Annona muricata.*

Abstract

Annona muricata Linn is one of the highly valued medicinal plants. Present study was subjected to six media viz: Top soil + sawdust, river sand + top soil, river sand + sawdust, sawdust only, top soil only and river sand only (control). Percentage germination (%), plant height (cm), number of leaves per plant, stem girth (cm) and leaf area (cm^2) were determined for three months. The results revealed that the highest mean germination of 80% was recorded in seeds sown in river sand + sawdust medium. While seeds sown in river sand + top soil and those sown on top soil only gave the same percentage of 40% which were the least percentage germination recorded. The results of this study also showed that seedlings planted on top soil only has the highest mean height of 19.12cm, leaf production of 11.33, stem girth of 1.50cm and leaf area of 31.20cm^2. This was followed by the seedlings planted on river sand + top soil medium with mean height, number of leaves, stem girth and leaf area of 17.78cm, 10.83, 1.32cm and 17.81cm^2 respectively. While the least seedling development was recorded in seedlings planted on river sand only which gave mean plant height, leaves production, stem girth and leaf area of 6.42cm, 3.67, 0.52cm and 9.8cm^2 respectively at three months after planting. It is therefore opined that river sand +sawdust was the most effective growth medium for enhancing best seed germination while top soil only was the most effective growth medium for enhancing best seedling development in *Annona muricata Linn*.

INTRODUCTION

Annona muricata Linn is one of the highly valued medicinal plants in Nigeria. It is small tree with low-branching and bushy slender upturned branches and about 5.0 to 9 m tall. The leaf is alternate, smooth, glossy, evergreen, dark green and lighter on the upper and lower surface respectively. The aroma is somewhat pineapple-like. Each fruits contains a single oval, smooth, hard black seed, 1.25-2cm with about 100-200 per fruit[1,2]. Germination of its seeds under sub-optimal condition has been found to be delayed for 2-3months but can occur in three weeks if condition is favourable and seedlings are usually ready for field transplant in 6-9 months[3].

A. muricata, called *sopsop or shawa shawa* in Nigeria[4], is a plant that has acceptable nutritional value as food products, source of medicinal and industrial product as well as contributing directly to food

security and supplementary household income for small- and medium-scale farmers[1]. The bark, leaves, fruits, roots, and fruit seeds of this tree have various medicinal uses. The fruit and juice is used against worms and parasites, to cool down fevers, to increase lactation after childbirth. The seeds can be crushed and then used against internal or external parasites, head lice, and worms .The tea prepared from the leaves are used as a sedative and a soporific (inducer of sleep) in the West Indies and Peruvian Andes[5]. *A. muricata* is used in medicinal herbal drugs to cure various diseases such as diarrhea, cough, hypertension, rheumatism, tumors, cancer, asthma, lactagogue (fruit), malaria, tranquilizer, skin rashes, parasites, liver problems, arthritis[6]. It contains a variety of components which attribute to the various biological activities. The roots and bark can be of aid for diabetes, but can also be used as a sedative.

Based on chemotaxonomy approach, some plants of the Annonaceae family have anticancer activity. *Annona montana* contains monotetrahydrofuranic acetogenins which have toxicity to liver cancer (Roesker, *et al.,* 2007). *Annona squamosal,* containing ribosome-inactivating protein (RIP), an immunotoxin for the treatment of cancer (Sismindari, 1998). Based on this chemotaxonomy studies, plant that have close kinship are likely to contain similar compounds (Roesker, *et al.,* 2007) so, data from previous studies had showed that the plant *Annona muricata* (soursop) is a potent anticancer.

Growing media is defined as the mean where the roots of cultivated plants grow (Kampf, 2000). Their primordial function is to give support for plant growing (Kampf, 2000; Robert, 2000). The plant growing medium must be porous for root aeration and drainage and also capable of water and nutrient retention. Oxygen, of course, is required for all living cells. Mushroom compost, leaf mold, farmyard manure and other amendments may fulfil these requirements. Brundert and Schmidt (1982) stated that plants with higher water requirements grew more vigorously in leaf mold medium. A good growing medium would provide sufficient anchorage or support to the plant, serves as reservoir for nutrients and water, allow oxygen diffusion to the roots and permit gaseous exchange between the roots and atmosphere outside the root substrate (Argo, 1998; Abad et al., 2002).

Growing media plays important role for seed germination (Bhardwaj, 2014). Growing medium acts as a growing place and as a source of nutrient for plant growth. Media composition used influences the quality of seedlings (Wilson *et al.,* 2001). Dickens (2011) stated that low seedling propagation rates can be attributed to inadequate knowledge of their requirements including appropriate potting media that can be adopted to enhance their growth at the nursery

Generally, growth medium has been considered to be the most critical factor determining seedling quality in the nursery (Baiyeri and Mbah, 2006; Keyagha, *et al.,* 2016). Good medium is a basic requirement for producing healthy and thriving plants (Adams *et al.,* 2003). Seed germination is influenced by many factors such as the type of substrate used, environmental factors such as oxygen, water, temperature and for some plant species, light (Hartmann *et al.,* 2007). Nursery potting media influence quality of seedlings produced (Agbo and Omaliko, 2006). The quality of seedlings obtained from a nursery influences re-establishment in the field and the eventual productivity of an orchard (Baiyeri, 2006).

Akintoye, *et al.,* (2013) reported that choosing the most suitable growing media for a successful plant production is very important in potted plant growth, it plays three roles viz; to support plant in soil, hold and provide water and nutrients and enable plant roots to get sufficient amount of oxygen (Dewayne *et al.,* 2003). Some organic materials required to amend some physical and chemical characteristics of growth media in plant production include: the use of organic manure, saw dust, peat, paper water etc. (Cull, 1989; Shadanpour *et al.,* 2011; Aklibasinda *et al.,* 2011). Both physical and chemical characteristics of the growth media exert substantial effect on growth of plants. Among the physical characteristics, aeration and water holding capacity are probably the most important factors while among the chemical characteristics, nutritional status and salinity level have a crucial role on plant development (Dewayne *et al.,* 2003). A convenient growing media should not only supply physical, chemical and biological characteristics required by plants but also provide the conditions for

practical plant production e.g. easy to supply, suitable cost, lightness, easy processing and homogenous plant production (Mathur and Voising, 1996; Sahin *et al.,* 2002; Ingram *et al.,* 2003; Sahin and Anapali, 2006). It is important to know the nursery requirements of *Annona muricata* in order to produce quality seedlings that are capable of surviving when planted outside its natural environment. Hence, the objective of this study is to evaluate the effects of different growth media on the germination and seedling development of *Annona muricata.*

MATERIALS AND METHODS

Seed source

Fresh fruits of *Annona muricata* were collected from the parent plant from its natural habitat in Ipoti-Ekiti located in Ijero Local Government Area of Ekiti State Nigeria and were taken to the herbarium of the Department of Plant Science and Biotechnology, Ekiti State University, Ado-Ekiti, Nigeria for authentication.

Viability Test

Seeds were subjected to viability test by using Tetrasolium chloride according to International Seed Testing Association (ISTA, 2004).

Procedure: Seeds of *Annona muricata* were divided into six group of 30 seeds each and were sown into black polythene bags separately filled with six media viz: Top soil and sawdust (1:1), river sand and top soil (1:1), river sand and sawdust (1:1), sawdust only, Top soil only and river sand only (control). The seed were lightly covered with the media after sowing and daily watered. The light coverage was for easy and safe removal for the examination of radicle initiation which was taken as germination of the species. These were daily monitored until epicotyls emerged from the growth media when seedling assessment commence. Germination initiation was observed for two (2) months when the total emergence were counted and recorded. Assessment of growth parameters commenced four (4) weeks after epicotyls emerged and was done fortnightly for three (3) months. The parameters assessed were seedling heights, stem girth, leaf production and leaf area.

Statistical Analysis

The data collected were subjected to one-way analysis of variance (ANOVA) and the means were separated at $P \leq 0.05$ using Duncan's Multiple Range Test (DMRT). All statistical analyses were done using SAS software, 1999 version.

RESULTS

Effects of different growth media on percentage germination of seeds of *Annona muricata*

Table 1 shows the effects of different growth media on percentage germination of *A. muricata*. The highest mean germination of 80% was recorded in seeds sown on river sand + sawdust medium. This was followed by seeds sown on T_1 constituting top soil + sawdust medium with 70% mean germination. From the results obtained, seeds sown on river sand + top soil and top soil only had the same mean germination of 40% which were the least percentage germination recorded. Seeds sown on sown on saw dust only and river sand only recorded 60% and 50% respectively.

Table 1: Effects of different growth media on percentage germination of seed of *A. muricata*

Growth media	Germination (%)
T_1 – Top soil + Sawdust	70
T_2 – River sand + Top soil	40
T_3 – River sand + Sawdust	80
T_4 – Sawdust only	60
T_5 – Top soil only	40
T_6 – River sand only	50

Effects of different growth media on seedlings height of *Annona muricata*

The results obtained in Table 2 revealed that the highest plant height of 19.12cm was recorded in seedlings sown on T_5 constituting of top soil only. Seedlings sown on river sand + top soil, top soil + sawdust, river sand + sawdust and sawdust only were significantly ($P < 0.05$) different with mean height of 17.78cm, 16.07cm, 13.48cm and 12.33cm respectively at three months after planting while the least seedling height of 6.42cm was recorded in those sown on river sand only.

Table 2: Effects of different growth media on plant height of *A. muricata*

Treatments	Plant height (cm) / month after planting		
	One	Two	Three
T_1 – Top soil + Sawdust	10.00^{d}	12.70^{c}	16.07^{c}
T_2 – River sand + Top soil	11.51^{b}	14.13^{b}	17.78^{b}
T_3 – River sand + Sawdust	10.87^{c}	12.34^{d}	13.48^{d}
T_4 – Sawdust only	8.75^{e}	11.74^{e}	12.33^{e}
T_5 – Top soil only	11.90^{a}	14.70^{a}	19.12^{a}
T_6 – River sand only	7.43^{f}	6.43^{f}	6.42^{f}

Values with the same letter(s) within the column are not significantly different at $P \leq 0.05$

Effects of different growth media on numbers of leaf of *Annona muricata*

Table 3 shows the effects of different growth media on leaf production in *A. muricata.* Results obtained revealed that the highest leaf production of 11.30 was recorded in T_5 which is made up of seedlings sown on top soil only. This was followed by those sown on river sand + top soil medium with mean value of 10.83. Seedlings sown on top soil + sawdust, river sand + sawdust and sawdust only recorded significant differences with mean value of 9.33, 6.00 and 5.00 respectively. Seedlings sown on river sand only had the least (3.67).

Table 3: Effects of different growth media on numbers of leaf of *A. muricata*

Treatments	Numbers of leaf / month after planting		
	One	Two	Three
T_1 – Top soil + Sawdust	3.50^{d}	5.67^{c}	9.33^{c}
T_2 – River sand + Top soil	4.67^{b}	6.83^{b}	10.83^{b}
T_3 – River sand + Sawdust	3.83^{c}	5.00^{d}	6.00^{d}
T_4 – Sawdust only	3.40^{e}	4.50^{e}	5.00^{e}
T_5 – Top soil only	5.17^{a}	7.50^{a}	11.33^{a}
T_6 – River sand only	2.67^{f}	3.33^{f}	3.67^{f}

Values with the same letter(s) within the column are not significantly different at $P \leq 0.05$

Effects of different growth media on stem girth of *Annona muricata*

The effects of different growth media on stem girth of *A. muricata* at the end of third month is shown in Table 4. Stem girth of the seedlings were significantly ($P < 0.05$) differed. The highest mean stem girth of 1.50cm was recorded in seedlings sown on top soil only and this was followed by the seedlings sown on river sand + top soil medium with mean stem girth of 1.32cm while the least mean stem girth in those seedlings sown on river sand only.

Table 4: Effects of different growth media on stem girth of *A. muricata*

Treatments	stem girth (cm) / month after planting		
	One	Two	Three
T_1 – Top soil + Sawdust	0.83^{bc}	0.93^{c}	1.11^{c}
T_2 – River sand + Top soil	0.87^{b}	1.02^{b}	1.32^{b}
T_3 – River sand + Sawdust	0.81^{c}	0.85^{d}	1.03^{d}
T_4 – Sawdust only	0.84^{bc}	0.84^{d}	0.93^{e}
T_5 – Top soil only	0.94^{a}	1.17^{a}	1.50^{a}
T_6 – River sand only	0.60^{d}	0.53^{e}	0.52^{f}

Values with the same letter(s) within the column are not significantly different at $P \leq 0.05$

Effects of different growth media on leaf area of *Annona muricata*

Effects of different growth media on leaf area of *A. muricata* differed significantly at $P < 0.05$ (Table 5). From the results obtained, seedlings sown on top soil only recorded the highest mean leaf area of 31.20cm. This was followed by T_2, that is, the seedlings sown on river sand + top soil medium (17.81cm) and the least value (9.36cm) was recorded in seedlings sown on river sand only. Statistical analysis ($P < 0.05$) showed that the values obtained were significantly different in the varying growth media.

Table 5: Effects of different growth media on leaf area of *A. muricata*

Treatments	leaf area (cm^2) / month after planting		
	One	Two	Three
T_1 – Top soil + Sawdust	10.53^{e}	15.77^{c}	16.45^{c}
T_2 – River sand + Top soil	15.74^{b}	17.03^{b}	17.81^{b}
T_3 – River sand + Sawdust	14.32^{c}	14.54^{d}	15.94^{d}
T_4 – Sawdust only	12.77^{d}	12.97^{e}	15.43^{e}
T_5 – Top soil only	21.34^{a}	30.14^{a}	31.20^{a}
T_6 – River sand only	8.85^{f}	9.70^{f}	9.36^{f}

Values with the same letter(s) within the column are not significantly different at $P \leq 0.05$

DISUSSION

There was a difference in the physical and chemical composition in the combination of top soil, river sand and sawdust media as the media varied in sand proportion and organic matter content. Consequently, the quantity and availability of air, moisture and nutrients to the seedlings. Baiyeri and Mbah (2006) reported that generally, growth media has been adjudged to be the most critical factor determining seedling quality in the nursery. Also, Baiyeri (2005) reported that the growth media physical properties can have a profound effect on the supply of water and air to the growing plants.

As observed in the present studies, the combination of river sand and sawdust medium supported the germination of *Annona muricata* than the other growth media used, the use of sawdust and its combination in this experiment corroborates the assertion by Adams *et al.,* (1998) that wood fibres are being used to increase air-filled porosity of mixture but the use of sawdust is limited due to their tendencies of fungal growth in fresh forms hence, a weathered sawdust used. Davies and Wilson (2005) also reported that sawdust has been found to be a good soil amendment because of its ability to improve soil properties.

The results shows that top soil only had the best performance on plant height, leaf production, stem girth and leaf area. The medium that gave better performance next to top soil only in the parameters

taken were the combination of top soil + river sand and top soil + sawdust respectively, this shows that top soil medium had better blend of physio-chemical properties needed by *Annona muricata*. This agreed with the opinion of Aderounmu (2010) who reported that top soil + river sand medium had highest germination and consistently produced highest leaf production and leaf area as an indication that the media had better blend of physio-chemical properties needed by *V. paradoxa.* Although the combination of sawdust + river sand supported the germination of *A. muricata* seeds, the reverse was the case on the effect of sawdust and its combination with river sand on the parameters taken as the media had no appreciable improvement on the seedlings height, leaf production, stem girth and leaf area of *A. muricata*. This is similar to the findings of Yang *et al.,* (2002) who reported that sawdust had negative effect on the growth of *Highbush blueberry* relative to unamended soil.

The result of this study shows that river sand only medium has a negative effect on the seedling development of *A. muricata* as the least values in all the parameters taken were recorded in river sand only. This could be that river sand has no enough nutrient to support the development of *A. muricata* seedlings. This agreed with Wilson, *et al.,* (2001) who reported that growing medium should not only acts as a growing place but also a source of nutrients for plant growth.

CONCLUSION

The results of these studies have demonstrated that river sand +sawdust was the most effective growth medium for enhancing best seed germination while top soil only was the most effective growth medium for enhancing best seedling development in *Annona muricata Linn*. These findings imply that different growth media should be assessed on plant species of interest before recommending an appropriate growth media for such plant species.

REFERENCES

1. Abad, M., Noguera, P., Puchades, R., Maquieira, A. and Noguera, V. (2002). Physico-chemical and chemical properties of some coconut coir dusts for use as a peat substitute for containerised ornamental plants. Bioresour. Technol., 82: 241-245.
2. Argo, W. R. (1998). Root medium chemical properties. Hort. Technol., 8: 846-894.
3. Adams, B. A., Osikabor, B., Abiola, J. K., Jaycobs, O. J. and Abiola, I. O. (2003). Effect of Different Growing Media on the Growth of *Dieffenbachia maculate* in proceedings of the 21st Annual Conference of Horticultural Society of Nigeria (HORTSON). 134-135.
4. Adams, C. R., Bamford, K. M. and Early, M. P. (1998). Principles of Horticulture. 3rd Edition Butterworth – Heinemann. 127-148.
5. Aderounmu, A. F. (2010). Silvicultural requirements for regeneration of *Vitellaria paradoxa* (C. F. Gaertn) Hepper. Unpublished Ph.D Thesis, University of Ibadan, Ibadan, Nigeria.
6. Agbo, C. U. and Omaliko, C. M. (2006). Initiation and growth of shoots of *Gongronema latifolia* Beth stem cuttings in different rooting media. Afri. J. Biotechnol. 5: 425-428.
7. Akintoye, H. A., Adeoluwa, O. O. and Akinkunmi, O. Y. (2013). Effect of different growth media on the growth and flowering of Beefsteak begonia (*Begonia erythrophylla*). *Journal of Applied Horticulture,* 15(1): 57-61.
8. Aklibasinda, M., Tunc, T., Bulut, Y. and Sahin, U. (2011). Effect of different growing media on Scotch pine (*Pinus sylvestris*) production. *Journal Animal Plant Sciences,* 21(3): 535-541
9. Argo, W.R., 1998. Root medium chemical properties. Hort. Technol., 8: 846-894.
10. Baiyeri, K. P. (2005). Response of *Musa* Species to Macro-propagation: II: The effects of genotype, initiation and weaning media on sucker growth and quality in the nursery. Afr. J. Biotechnol. 4(3): 229-234.
11. Baiyeri, K. P. (2006). Seedling emergence and growth of pawpaw (*Carica papaya)* grown under different coloured shade polythene. Int. agrophys. 20: in press.
12. Baiyeri, K. P. and Mbah, B. N. (2006). Effects of soiless and soil based nursery media on the seedling emergence, growth and response to water stress of African bread fruit (*Treculia Africana* Decne). African Journal of Biotechnology 5, 1405-1410.

13. Bhardwaj, R. L. (2014). Effect of growing media on seed germination and seedling growth of papaya cv 'Red Lady'. African Journal of Plant Science, 8(4), 178-184.
14. Brundert, W and Schmidt, K. (1982). Organic composts in hydroculture and watering method. Dentscher Gertenban., 36: 904-906.
15. Cull, D. C. (1989). Alternative to peat as container media: Organic resources in UK. *Acta Hort.,* 126: 69-81.
16. Davis, J. G. and Wilson, C. R. (2005). Choosing a soil amendment. Colorado State University Cooperative Extension. Horticulture, No. 7235
17. Dewayne, L. L, Richard, W. H. and Thomas, H. Y. (2003). Growth Media for Container Grown Ornamental Plants. The Environmental Horticulture Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida, BUL 241.
18. Dickens, D. (2011). Effect of propagation media on the germination and seedling performance of *Irvingia wombulu* (Vermoesen): American Journal Biotechnology and Molecular Sciences ScienceHUβ, available at http://www.scihub.org/AJBMS.
19. Hartmann, H. T., Kester, D. E., Davies, F. T. and Genve, R. I. (2007). Hartmann and Kester's plant propagation, principles and practices. Seventh edition. Prentice-Hall of India Private Limited. Pp. 880.
20. Joseph, A. J. (2014). Influence of Seed Treatments on Germination and Seedling Growth of Soursop (*Annona muricata*). *Journal of Biology,* Agriculture and Healthcare Vol. 4, No. 21.
21. Kampf, A.N. (2000). The Substrate Commercial Production of Ornamental Plants. Farm Progress-Agriculture's Leading Publisher, Guaiba, Brazil, Pages: 254. Robert, R. (2000). Horticultural Substrates: Possibilities and Limits of its Composition and Use, Examples of Research, Industry and Consumption: Substrates for Plants the Basis of Plant Production in Containers. Genesis Publications, Port Alegre, Brazil, pp: 209-215.
22. Keyagha, E. R., Uwakwe, J. C., Cookey, C. O., Emma-Okafor, L. C., Obiefuna, J. C., Alagba, R. A., Ihejirika, G. O and Ogwudire, V. E. (2016). Effect of Different Growing Media on the Growth a nd Development of *Irvingia wombulu* in Owerri, South Eastern Nigeria. Int'l Journal of Agric. And Rural Dev.
23. Leana, Palande (2010). Soursop. Retrieved online from Buzzle. Com, June 2013
24. Mathur, S. P. and Voisin, B. (1996). The use of compost as green house growth media. Final report, *Ministry of Environment and Energy,* Ontario.
25. Mortor, J. F. (1980): Caribbean and Latin American Folk Medicine and its Influence in the United States. Q. J. Crude Drug Res. 18(2): 57-75.
26. Roesker, R., Catharino, R. R., Malta, L. G. (2007). Antioxidant activity of *Annona crassiflora*: Characterization of major components by electrospray ionization mass spectrometry, *Food Chemistry* 104: 1048-1054.
27. Sahin, U. and Anapali, O. (2006). Addition of pumice affects physical properties of soil used for container grown Plants. *Agric Conspec. Sci.,* 71, 59-64.
28. Sahin, U., Anapali, O. and Ercisli, S. (2002). Physic-chemical and physical properties of some substrates used in horticulture *Gartenbauwissenschaft*, 67, 55-60.
29. SAS. (1999). Proprietary software release 8.2 SAS Institute Inc. NC, USA.
30. Schultes, R. E. and Raffau, F. (1990). The healing forest: Medicinal and Toxic Plants of the Northwest Amazonia. Portland: R.F. Dioscorides Press.
31. SCUC (2006), *Annona*: *A. cherimoga, A. muricata, A. reticulate, A. senegalensis and squamosal,* field Mannual for Etension Workers and Farmers, University of Southampton, *Southampton UK.*
32. Shadanpour, F. A., Mohammadi, T. and Hashemi, K. M. (2011). Marigold: The possibility using vermicompost as the growth medium. *Journal Ornamental Horticultural Plants,* 1(3), 153-160.
33. Sismindari, Hussana, A., Mubarika, S., (1998). Squensing of DNA Superkoil Double Helix with In Vitro method from *Annona squamosa* L.
34. Wilson, S. B., Stoffella, P. J. and Graetz, D. A. (2001). Use of compost as a media amendment for containerized production of two subtropical perennials. J. Environ. Hortic. 19, 37-42.
35. Yang, W. Q., Goulart, B. L., Demchak, K. and Li, Y. (2002). Interactive effects of mycorrhizal inoculation and organic soil amendments on nitrogen acquisition and growth of highbush blueberry. J. Amer. Soc. Hort. Sci. 127(5), 742-748.