http://www.bpasjournals.com

Print version ISSN 0970 0889
Online version ISSN 2320 3161
DOI 10.5958/2320-3161.2019.00001.4

Original Research Article

Bio-Science Research Bulletin
Vol. 35 No. 1, January - June 2019: P.01-06

The effects of Light Intensity on Seedling Growth of *Annona muricata* Linn.

Comfort A. Dada[1], Joshua Kayode[2]*, Sunday. Arowosegbe[2]

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, Nigeria.

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

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

Received: Dec 28, 2018
Revised: Jan 20, 2018
Accepted: Feb 5, 2019
Published: June 20, 2019

ABSTRACT

This study was carried out to investigate seedlings growth performance of *Annona muricata* Linn. as influenced by different light intensities. Seedlings of *A. muricata* were subjected to three (3) treatments via; growth in direct sunlight (control), in single layered mesh net and in double layered mesh net. Each of the experiment was replicated three (3) times in a Complete Randomized Design (CRD). The variables assessed were plant height, number of leaves, stem girth and leaf area. The data collected were subjected to one way analysis of variance (ANOVA). The results showed that there were significant differences among the treatments at 5% level of probability. Seedlings under direct sunlight had the highest mean height of 13.63cm, number of leaves (17.50cm), stem girth of 1.20cm and had the least leaf area of 11.30cm^2 at three month after transplantation. This was followed by the seedlings under single layered mesh net with mean height of 11.05cm, number of leaves (7.00), stem girth (0.78cm) and highest leaf area of 17.06cm^2 while the least plant height, number of leaves and stem girth was recorded in seedlings under double layered mesh net with mean values of 10.03cm, 5.83 and 0.68cm respectively. It is concluded that seedlings of *Annona muricata* under direct sunlight has better growth performance than those under single and double layered mesh net. Though, it had the least leaf area, it recorded the highest mean values in other parameters considered. Therefore, direct sunlight might be required in raising seedlings of this species.

KEYWORDS: *Annona muricata*, Seedlings growth, mesh net, light intensity

INTRODUCTION

Light is an important climatic factor that affects tree growth especially at the seedling stage and is one of the most important environmental factors that affect plant growth and establishment (Chanhsamone *et al.*, 2012). Light play important roles in photosynthesis (Adedoyin, 2005; Bolanle *et al.*, 2014), development of leaves and shoots (Wes, 2005), flower initiation and fruit set, fruit development and quality (Nwoboshi, 1983).

Seedlings of different trees have different light requirements. These differences in seedling reactions to light intensity are exceedingly important in tropical silviculture where reproduction of forests following logging depends on the presence of natural regenerations or seedlings establishment (Anjah, *et al.* 2013). Different plants have optimum light requirements as both deficient and excessive light intensities are injurious to plants (Manaker, 1981).

Recent initiatives are now concerned with the domestication and plantation development of important tree species, especially fruit species. This include *Annona muricata,* a highly valued medicinal plants in south west Nigeria Thus, the objective of this work is to investigate the best light intensity for the mass production of seedlings of this important species.

MATERIALS AND METHODS

Seedlings of *Annona muricata* at two–leaf stage were pricked into polythene pots filled with nursery topsoil and were exposed to three different light intensities under wooden frames (Mendi-Anjah, 2005). The frames used for the experiment were made with wood of 6 x 4 cm^2 in thickness. The dimension of each frame was 90 x 90 x 100 cm^3. The wooden frames were covered on all sides with single or double layers of synthetic green 1mm mesh net bought from local market to achieve varying levels of light intensities.

The light intensities within and outside the cages were measured using a Solex light meter (Model 100 LUX meter) for seven different days in the morning (8.00am), afternoon (1.00pm) and evening (6.00pm). The seedlings were allowed to stabilize for a period of one week before the commencement of data collection on seedling development. Three seedlings were placed in each box and the experiment was replicated three times.

The following growth variables were assessed; total seedling height, stem collar diameter, leaf production and leaf area measured at two-week interval and were evaluated for three months. The data collected were subjected to analysis of variance (ANOVA) and Duncan Multiple Range Test (DMRT) was used to separate the means at $p \leq 0.05$.

RESULTS

Table 1 shows the mean values of light intensities taken within and outside the cages used in this study which were used to determine the % light interception and exposure received in each treatment. The exposure received by the single-layered mesh treatment, double-layered mesh treatment and the control were 74.85%, 49.97% and 100% respectively.

The results obtained shows that 100% each of the seedlings survived both under the single-layered and double-layered mesh treatments while only 66.67% of the seedlings survived in the control experiment at 30 days after transplanted (Table 2).

Table 1: Mean values of light intensities received in different light treatments for *Annona muricata*

Treatments	Light intensities (%)*	
	Interception	Exposure
Single-layered mesh net	25.15	74.85
Double-layered mesh net	50.03	49.97
Control	0.00	100

Figures are means values of seven days readings

Table 2: Percentage (%) survival of *Annona muricata* seedlings in different light treatments

Treatments	Percentage (%) survival at 30-days after transplant
Single-layered mesh net	100
Double-layered mesh net	100
Control	66.67

The effect of light intensity on seedling height was shown in Table 3. Results obtained revealed that the highest mean plant height of 13.63cm was observed in the seedlings under the control experiment while seedlings under single-layered and double-layered mesh treatments had mean heights of 11.05cm and 10.03cm respectively at three (3) months after transplanting. Seedlings under the control experiment performed better at one (1) month after transplanting (6.73cm), seedlings under single-layered mesh treatment performed better at two (2) months after transplanting (8.33cm).This was not significantly different from the seedlings under the control experiment (8.27cm). Statistical analysis revealed that there were significant differences among the plant heights of *A. muricata* exposed to the three different light intensities at three (3) months after transplantation.

Table 3: Effects of different light treatments on seedling height of *A. muricata*

Treatments	Seedling height (cm) / month after planting		
	One	Two	Three
Single-layered mesh net	6.22^{c}	8.33^{a}	11.05^{b}
Double-layered mesh net	6.43^{b}	7.93^{b}	10.03^{c}
Control	6.73^{a}	6.43^{b}	13.63^{a}

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

Table 4: Effects of different light treatments on number of leaf of *A. muricata*

Treatments	Number of leaf / month after planting		
	One	Two	Three
Single-layered mesh net	3.17a	4.67^{b}	7.00^{b}
Double-layered mesh net	2.50^{b}	3.83^{c}	5.83^{c}
Control	3.17^{a}	5.00^{a}	17.50^{a}

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

Table 4 revealed that the highest mean number of leaves were recorded in the control experiment from the first month to the third month after transplantation (3.17, 5.00 and 17.50) respectively. This was followed by those under single-layered mesh treatment (7.00) while the seedlings under double-layered mesh treatment had the least mean number of leaves (5.83) at three (3) months after transplantation. Statistical analysis revealed that significant differences abound in the number of leaves under the three different treatments.

The highest mean stem girth of 1.20cm was recorded in the control experiment (Table 5). This was followed by seedlings under single-layered mesh treatment (0.78cm) while the least stem girth from the first month to the third month after transplantation were recorded in the seedlings under double-layered mesh treatment (0.55cm, 0.67cm and 0.68cm respectively). Results in Table 5 revealed that light intensities had significant effect (at $P \leq 0.05$) on stem girth at first, second and third months after transplantation as significant differences exist among the values obtained in the three treatments used in this study.

Table 5: Effects of different light treatments on stem girth of *A. muricata*

Treatments	stem girth (cm) / month after planting		
	One	Two	Three
Single-layered mesh net	0.75[a]	0.76[b]	0.78[b]
Double-layered mesh net	0.55[c]	0.67[c]	0.68c
Control	0.68[b]	0.83[a]	1.20[a]

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

Table 6: Effects of different light treatments on leaf area of *A. muricata*

Treatments	leaf area (cm^2) / month after planting		
	One	Two	Three
Single-layered mesh net	10.84[a]	14.19[a]	17.06[a]
Double-layered mesh net	9.52[b]	12.05[b]	16.11[b]
Control	8.31[c]	11.10[c]	11.30[c]

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

Seedlings under the single-layered mesh treatment recorded the highest mean leaf area from the first to the third month after transplantation (10.84cm^2, 14.19 cm^2 and 17.06 cm^2 respectively). These were followed by the seedlings under double-layered mesh treatment from the first month to the third month with 9.52 cm^2, 12.05 cm^2 and 16.11 cm^2 respectively. While the least mean leaf area were recorded in the seedlings under the control experiment from the first month to the third month after transplantation with 8.31 cm^2, 11.10 cm^2 and11.30 cm^2 respectively. Significant differences exist among the values obtained throughout the period of experiment under the three different treatments used in this study.

DISCUSSION

The single layered mesh treatment reduced light by about 25%, and double layered treatment by about 50% thereby providing 75% and 50% light intensities respectively while the seedlings grown in the open nursery, which served as the control, received 100% light intensity. *Annona muricata* performed differently under the different light intensities to reveal its light requirement as different plants has different light requirement, thus supporting the previous assertion by Droppelmann *et al.* (2000) and Anjah *et al.* (2013) that seedlings of different tree species have different light requirements. For example, *B. aegyptiaca* is found to do well in full light intensity compared to the performance of other plants. Also, Study by Gyimah *et al.* (2003) observed variation in the light requirements of three tropical tree species (*Bombax buonopozense, Khaya ivorensis* and *Cedrella odorata*) for effective growth and physiological processes. Ashton, *et al.,* (2006) also reported that seedlings of rain forest trees exhibit different traits in response to varying amount of light intensity.

Results obtained from this study revealed that seedlings in the control experiment consistently showed better performances in most of the parameters examined as 100% light intensity greatly enhanced seedlings height, number of leaves and stem girth, while seedlings exposed to the double-layered mesh treatment (i.e. 50% light intensity) had poorer performance in most of the parameters considered. These tend to suggest that *Annona muricata* has low tolerance to shade. The findings agreed with the results of George *et al*. (2012) who reported highest growth performance (plant height, stem girth, leaves and biomass) in full light intensity on *Salvia officinalis* seedlings. Adeoye and Onyekwelu (2014) also reported highest number of leaves and biomass on early growth of *P. biglobosa* seedlings under 100% light intensity. Similarly, Mendi-Anjah (2005) reported that vigorous morphological growth was observed in seedlings of *Ricinodendron heudelotii* that were exposed to

100% light intensity as against those shaded. Otsamo (2000) reported that in a study comparing *Anisoptera marginata, Shorea parvifolia* and *Peronema cenescens* planted in a closed stand of *Acacia mangium* plantation the fastest growth were observed at the gap centre where light intensity was highest. Gutterman (1994) reported that light is of ecological significance for the survival mechanism of some plant species. Similarly Adelusi and Aileme (1998) reported that when light is limiting, formation of chlorophyll is seriously impaired.

It was also revealed in this study that the leaf area of *A. muricata* seedlings increased with shading. The ability of this species to possessed broad leaves under shade could be that the leaf of this plant responded physiologically to light inhibition during the early stage of establishment. This support the previous finding of Olajuyigbe (2015) who reported that seedlings of *Entandrophragma angolense* exposed to 25% light intensity had the strongest response of leaf area.

CONCLUSION

This study revealed that the early stages of development of *A. muricata* were mostly hindered by shade especially under light intensity as low as 50% and thus suggest that *A. muricata* require full light intensity for enhanced growth at seedling stage. Also, low light intensity promoted triggers broad leaves production in this plant as revealed in this study.

REFERENCES

1. Adedoyin T. (2005): Climates and Dune Fixation records of Biological survey.pp27
2. Adelusi, A. A. and Aileme, J. D. (1998). Effects of light and nitrogen limitation on the photosynthesis apparatus and accessory pigment of cowpea (*Vigna maniguienlata*) Nigeria Journal of Botany 11: 45-51.
3. Adeoye, I. A. and Onyekwelu, J. C. (2014). Effect of different light intensities on germination and early growth of *Parkia biglobosa* (Jacq Berth). Proceedings of the 4thBiannual conference of the Forests and Forest Products Society, 23-26 April, pp. 57-65.
4. Anjah, G. M., Focho, A. D. and Dondjang, J. P. (2013). The effects of sowing depth and light intensity on the germination and early growth of *Ricinodendron heudelotii*. African Journal of Agricultural Research. 8(46): 5854-5858
5. Ashton, M. S., Singhakumara, B. M. P. and Gamage, H. K. (2006). Interaction between light and drought affect performance of Asian tropical tree species that have differing topographic affinities. Forest Ecology and Management 221, 42-51.
6. Bolanle, O.T., Yakubu, F.B., Williams, O.A., Yahaya, D.K. and Asaba, L.O. (2014). Seedling growth performance of *Kigelia africana* (LAM) BENTH as influenced by light intensities. European Journal of Agriculture and Forestry Research, 2(3):1-13.
7. Chanhsamone, P., Don, K. L., Silavanh, S., Yeona, D. P., Wai, M. H. and Edwin, A. C. (2012). Effect of light intensities on growth performance, biomass allocation and chlorophyll content of five tropical deciduous seedlings in Lao PDR. Journal of Environmental Science and Management, 1(1): 60-67.
8. Droppelmann, K. J., Lehmann, J., Eprath, J. E. and Berliner P. R. (2000). Water use efficiency and uptake patterns in a run-off Agroforestry system in an arid environment. Agroforestry System, 49(3): 223-243.
9. George, Z., George, S., George, K. and Elein, K. (2012). Influence of light intensity on growth and physiological characteristics of common sage (Salvia offinalis). Brazilian Archives of Biology and Technology, 55(1): 89-95.
10. Gutterman Y. (1994). Strategies of seed dispersal and germination in plants inhabiting deserts. Botanical Review. 60(4): 71-80.
11. Gyimah R, Nakao T, Oo, M. Z. (2003) Effects of light intensity and nutrient on growth and electron transport rate of tropical trees (*Bombax buonopozense, Khaya ivorensis* and *Cedrela odorata*) found in Ghana. Bulletin of the Faculty of Agriclulture, Miyazaki University. 49 (1&2): 69-78.

12. Manaker, G. H. (1981). Interior Plantscapes: Installation, Maintenance, and Management. Englewood Cliffs, NJ: Prentice Hall Inc. 83 p.
13. Mendi-Anjah, G. N. (2005). Regeneration studies in the Aguli Forest Reserve, Northwest Cameroon with emphasis on *Ricinodendron heudelotii* (Bail.) Pierre et Pax. Unpublished Ph.D Thesis, University of Ibadan, Ibadan, Nigeria. 206pp.
14. Nwoboshi L. C. (1982).*Tropical Silviculture, Principles and Techniques*, University Press, Ibadan, Nigeria. 333pp.
15. Olajuyigbe, S. (2015). Effect of shade and drought stress on early growth and biomass accumulation of Tiama Mahogany (*Entandrophragma angolense*) seedlings. Academic Journal of Science. 04 (01): 27-36.
16. Otsamo R. Integration of indigenous tree species into fast growing forest plantations on *Imperata* grasslands in Indonesia. Unpublished Doctoral Thesis, University of Helsinki, Helsinki, Finland. 2000.
17. Wes, H. (2005). An assessment of biomass feedstock and research opportunities;:A technical assessment report, Stanford University, p13.