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Original Article

Nursery pest resistance of *Mansonia altissima* seedlings to *Godasa sidae* attack in the rainforest ecological zone of Nigeria

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ABSTRACT

The establishment of plantations of *Mansonia altissima* has been constrained by the insect pest *Godasa sidae* that causes extensive damage to the seedlings in the nursery. This study was carried out at Forestry Research Institute of Nigeria nursery site, using One hundred and twenty seedlings with the aim to prevent *Godasa sidae* attack on *Mansonia altissima* seedlings in order to achieve an ecologically based pest resistance management strategy. Seedlings were placed in a screen house (represented by SHS); in the open treated with a methanoic extract from *Gliricidia sepium* once a week (represented by MTH); also, in the open treated with a chemical (pesticide) once a week (represented by CHM), all replicated 30 times. Growth data recorded were subjected to analysis of variance (ANOVA). The result revealed that the SHS, MTH and CHM were all effective in the control of the studied insect pests except the experimental control. However, the result revealed a significant difference at 5% level of probability among the treatments in terms of seedling height, collar diameter, and leaf production with highest mean value of 18.21 + 2.36 cm observed for seedling height for SHS, followed by CHM (17.05 + 2.18 cm) and MTH (16.80 + 2.16 cm). The values of collar diameter were 0.47+ 0.05mm, 0.46+ 0.03 mm and 0.44+ 0.03 mm for SHS, CHM and MTH respectively. Also, the mean number of leaves in each treatment was 23 + 3.23, 20 + 3.15 and 19 + 3.10 for SHS, CHM and MTH respectively. It was concluded that the screen house (SHS) performed best. However, because of cost implication, an alternative is suggested. Due to the hazardous effects of the chemical on the environment, the methanoic extract which can be a potent pesticide should be adopted for the control of insect pest of *Mansonia altissima* at nursery stage.

Keywords: Glasshouse, *Mansonia altissima*, methanolic extract, nursery pest, pesticides

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INTRODUCTION

The tropical rainforest is a dense and luxuriant vegetation type and the most biologically diverse terrestrial ecosystem containing different classes and types of tree species.[1] One of the tree species that can be found and of great importance is *Mansonia altissima*. *M. altissima* belongs to the Sterculiaceae family. It is an evergreen tree with a small dense, ovoid, crown, and branches that are almost horizontal at first, but later drooping. The cylindrical, generally straight bole can be branchless for up to 30 cm and up to 100 cm, occasionally even 150 cm in diameter.[2] It is one of the most important indigenous hardwood species known.[3] It is characteristic of the dense semi-deciduous forest in areas with about 1600 mm annual rainfall and a pronounced dry season. The southern limit of its distribution area largely corresponds with the transition of semi-deciduous forest to evergreen forest; to the north, its distribution extends to patches of dense forest in the savannah. The wood is used for general and high-class joinery, cabinetwork, furniture, turnery, decorative veneer, and handicrafts. It is also used in construction for doors and windows, in railway coaches and shop fittings, and for boxes and crates. Well-colored wood resembles American black walnut and is commonly used as a substitute for applications such as gun stocks and grips, musical instruments, and loudspeaker enclosures.

This species is currently subjected to habitat destruction and fragmentation as well as human pressure through intensive logging and changes in land use practices.[4] Exploitation of *M. altissima* is mainly done from the natural forest. The

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regeneration of this important tree species has proven to be inadequate to compensate for the rate of exploitation mainly due to attack of various insect pests. For instance, ambrosia beetles attack the bole of the standing tree. Caterpillars of the moth *Godasa sidae* may cause complete defoliation in nursery stage and also in plantations. Wood-boring caterpillars of *Eulophonotus* spp. may cause damage to the sapwood. Larvae of the polyphagous grasshopper *Zonocerus variegatus* may seriously attack the foliage of, especially older trees. In plantations, they may become serious pests.

However, the leaf-feeding noctuid moth *G. sidae* is the main insect pest of *M. altissima* at the nursery stage, that is, why many tropical species such as *Pericopsis elata*, *Milicia excelsa*, and *M. altissima*, are difficult to establish in plantation because when planted in pure stands or in open environment, they usually become chlorotic and decline as they are being affected by insect pests and diseases.[5]

Researchers around the world have been exploring other alternatives to combat insect pests, alternative better than synthetic pesticides due to some risks associated with synthetic pesticides such as environmental persistence or negative health effects related to toxicity.[6] Another motivation behind this interest is the sheer cost of insecticides, which limits and prevents many local farmers from purchasing them to protect their seedlings. The use of biological materials, especially plant materials, is highly favored since the materials can easily be applied without any technical knowledge. The effectiveness of botanical insecticides has been demonstrated in many studies.[7,8] Many of the plants used as insecticides have been found safe for human consumption. Plant world comprises a storehouse of biochemicals that could be tapped for use as insecticides and they are the richest source of renewable bioactive organic chemicals. Botanical insecticide is a promising alternative in the protection of crops against insect pests. They are generally pest specific and relatively harmless to non-target organisms.[9]

For this study, however, the effect of glasshouse (GHS), synthetic pesticides on *M. altissima* pest (*G. sidae*), and a methanolic extract from *Gliricidia sepium* were compared with the view to suggest a better way to protect the *M. altissima* seedlings from attack.

MATERIALS AND METHODS

The Study Areas and Procurement of Materials

The experiment was carried out on within the premises of Federal College of Forestry (FCF), Ibadan, Oyo State. The college is situated at Jericho in Ibadan North West Local Government area. It has annual rainfall of about 1300–1500 mm while the annual temperature is 260°C and the average relative humidity is about 80–85%.[10] The seeds of *M. altissima* were obtained from the seed store, Forestry Research Institute of Nigeria, Ibadan, the leaves of *G. sepium* were obtained from the FCF, Ibadan.

Extraction Method and Method of Application

The fresh leaves of *G. sepium* were air-dried at room temperature for 3 weeks and later pulverized into powdered form. The powdered material of 300 g was exhaustively extracted with 600 mL of methanol. The plant material was soaked for 3 days to ensuring constant stirring to evenly distribute the powdered material in the solvent. This was filtered and the filtrate was evaporated to dryness at room temperature for 24 h. The dried extract then weighed to determine its actual value and stored. However, the preliminary phytochemical constituent of the extract was found in literature [Table 1]. The weight of the dried extract was 36.3 g which was diluted with 25 cl of distilled water. About 100 mL of the extract and the chemical were applied to the seedlings by the use of hand sprayer of 2 L capacity weekly early in the morning to avoid photodecomposition.

Experimental Design and Layout

The experimental design used was completely randomized design (CRD). The various treatment combinations used in this study included: T1 – seedlings in the open without any treatment (control); T2 – seedlings in GHS; T3 – seedlings in the open treated with a methanolic extract from *G. sepium* applied once a week (MTH); and T4 – seedlings in the open treated with a chemical (pesticide) once a week (CHM). Each treatment was replicated 30 times with the control also replicated 30 times to make a total number of 120 seedlings of *M. altissima*. Watering of plants was done and monitored daily. Growth assessment commenced 2 weeks after treatment application. Seedling height, stem diameter, leaf production, and leaf area were recorded at 2 weeks interval for 12 weeks.

Data Collection and Analysis

Estimation of the population densities of the pest was taken at 2 weeks interval for 12 weeks after spraying. The number of insects on seedlings was visually counted. All data were

Table 1: Phytochemical screening of the extract (qualitative)

S. No.	Phytoconstituents	Present/Absent
1.	Alkaloids	+ve
2.	Tannins	++ve
3.	Flavonoids	+ve
4.	Terpenoids	+ve
5.	Anthraquinones	+ve
6.	Saponins	++ve
7.	Cardiac glycosides	–ve

Source: Ayeni *et al*., 2017. +ve: Present; –ve: Absent; ++ve: Abundant analyzed using analysis of variance (ANOVA) in CRD to identify a significant difference between the effects of each of the treatments on the pest and growth variable assessed. Where significant, means were separated using Duncan multiple range test.

RESULTS AND DISCUSSION

The mean number of insect pest (*Godasa sidae*) found on *Mansonia altissima* is presented in table 2 while the analysis of variance (ANOVA) for plant height and stem diameter, the mean effects of different levels of treatment on the growth of *Mansonia altissima* seedlings and analysis of variance for leaf production were presented in table 3, 4 and 5 respectively.

Comparison of Effects on Insect Pests

Table 2 shows the effect of the treatments on *M. altissima* seedlings. Seedlings placed in the GHS (T1) were not attacked by the insect pest throughout the duration of the study. Seedlings treated with both the chemicals (T3) and extracts (T4) were able to reduce and later eliminate the insect *G. sidae* found on the treated seedlings, with treatment 4 showing high efficacy [Table 1]. At 6 weeks after spraying, no insect pest was found on treated seedlings except on treatment 3 and the control [Table 1]. The results obtained from this study showed that treatment 2 (GHS) gave the best among other treatments. Then, it was followed by treatment 4 (CHM) and then by treatment 3 (MTH).

However, in overall, seedlings placed in the GHS performed best. However, the chemical (CHM) application exhibited a higher efficacy compared to the extract of *G. sepium* application (MTH) [Table 1]. This might be as a result of the active ingredient of the extract being easily volatilized, especially in the sun, thereby resulting in their limited efficacy.

Table 2: Mean number of *insect pest* (*Godasa sidae*) found on *Mansonia altissima* seedlings

	Weeks after treatments					
Treatments	**2**	**4**	**6**	**8**	**10**	**12**
T1	2.24^d	2.68^d	4.48^d	6.20^d	6.60^d	7.20^d
T2	0.00^a	0.00^a	0.00^a	0.00^a	0.00^a	0.00^a
T3	1.40^b	1.16^b	0.80^b	0.40^{ab}	0.00^a	0.00^a
T4	1.10^b	1.00^b	0.00^a	0.00^a	0.00^a	0.00^a

Mean with the same superscript alphabets is not significantly different at 5% level of probability

This study, however, supported the work of Olaniran *et al*.[11] and Ayeni *et al*.[8] who revealed in their study that a chemical as insecticide had higher efficacy compare to biological insecticides. Although the result revealed that the botanical insecticides were not effective at the early weeks of spraying when compare with the chemical application, delayed effect is reported to be one of the major problems of botanical insecticides.[12,13]

Comparison of Effects on Seedling Height

The result of the effects of the treatment GHS, CHM, and MTH on *M. altissima* seedling height is presented in Table 3. For the period of assessment, a significant difference ($P < 0.05$) was observed on the seedling height among the treatment used [Table 3]. Treatment 2 (GHS) gave the best performance on seedling height with a mean value of 15.41 ± 2.36 cm followed by treatment 4 (CHM) with a mean value of 17.05 ± 2.18 cm while the least mean seedling height value of 16.80 ± 2.16 cm was observed for treatment 3 while the mean value of 8.24 ± 0.74 cm was observed for treatment 1 (control) [Table 4]. Although treatment 2 performed best in terms of seedling height, treatment 4 also did well as it was not affected by the attack of insect pest as it contains tannins, saponins, flavonoids, etc. The *M. altissima* seedlings in treatment 3 (MTH) were affected by the insect pest. However, with the hazardous effects and toxicity nature of the chemical (CHM) used, also, with the ability of the plant extract (MTH) to compete with the chemical in resisting the attack of insect pest on the seedlings height indicated a better performance by the Treatment 3 (MTH).

Comparison of Effects on Stem Diameter

The result of ANOVA showed a significant difference ($P < 0.05$) in the stem diameter of seedlings used for this study [Table 3]. The result of the analysis revealed that treatment 2 (GHS) gave the highest performance in terms of collar diameter with the mean value of 0.47 ± 0.05 cm followed by treatment 4 (CHM) with the mean value of 0.46 ± 0.03 [Table 4]. The result showed that the application of *G. sepium* extract on the seedlings weekly had a positive effect on the stem. The least performance was recorded in treatment 1 (control) with the mean value of 0.23 ± 0.02 as it was greatly affected by insect pest [Table 4]. Collar diameter is one of the useful morphological measures of seedlings quality as it reflects seedling's durability. Seedlings with larger diameter are better supported and resist bending better than those with smaller diameter.[14] Hence, by the time

Table 3: Analysis of variance for plant height and stem diameter

SV	DF	SS	MS	F	*P*-value	SS	MS	F	*P*-value
Treatment	3	246.67	82.22	57.9	0.0025*	268.34	89.45	87.70	0.0021*
Error	116	164.58	1.42			118.40	1.02		
Total	119	411.25				386.74			

*Significant at a level of 5% of probability. SV: Stem volume, DF: Degree of freedom, SS: Sum of squares, MS: Mean square

Table 4: Mean of the effects of different level of treatments on the growth of *Mansonia altissima* seedlings

Treatments	Plant height (cm)	Stem diameter (mm)	Leaf production
T1	8.24±0.74[d]	0.23±0.02[d]	10±2.24
T2	18.21±2.36[a]	0.47±0.05[a]	23±1.23
T3	16.80±2.16[b]	0.44±0.03[ab]	19±1.10
T4	17.05±2.18[b]	0.46±0.03[b]	20±1.15

Mean with the same superscript alphabets is not significantly different at 5% level of probability

Table 5: Analysis of variance for leaf production

SV	DF	SS	MS	F	*P*-value
Treatment	3	246.67	82.22	57.9	0.0025*
Error	116	164.58	1.42		
Total	119	411.25			

*Significant at a level of 5% of probability. SV: Stem volume, DF: Degree of freedom, SS: Sum of squares, MS: Mean square

those with larger diameter get to the field, they perform better than others.

Comparison of Effects on Leaf Production

The results of ANOVA on the effects of the different treatments on leaf production of *M. altissima* were significant at 5% level of probability ($P < 0.05$, 0.0001) [Table 5]. Treatment 2 (GHS) gave the best performance with a mean value of 23 numbers of leave at the termination of the study followed by treatment 4 (CHM) with a mean value of 20 numbers of leaves [Table 4] and treatment 3 (MTH) showed 19 numbers of leaves at the end of the experiment which indicated that the bioextract used in controlling the attack of the insect pest was effective when applied once a week to the seedlings while the least production was observed in treatment 1 (control) which showed that the leaves of the seedlings were greatly attacked by insect pest. The result obtained in this study revealed that the methanolic extract of the *G. sepium* contained the necessary compound which was able to control the attack of insect pest of *M. altissima* seedlings. However, this study therefore is in agreement with the result of the work by[12,15] who stated that the some plant extracts are effective and useful in the control of insect pests of some forest tree species.

CONCLUSION

The results of this study have shown that the GHS system used for this study gave the best performance against insect pest of *M. altissima*. Furthermore, *G. sepium* methanolic extract (MTH) showed that it is an effective bioagent on the control of insect pest of *M. altissima* when applied weekly to the *M. altissima* seedlings. However, due to the cost implication involved in setting up the screen house, as most of the farmers cannot afford it. Furthermore, due to the hazardous effects of most of these chemicals (CHM) on the environment and the problems of pesticide resistance, negative effects on non-target organisms including man and the environment, treatment 3 (application of methanolic extract once a week) which gave values close to the application of chemical is hereby suggested as a better way to attack the insect pest of *M. altissima* as most of the farmers can easily afford the bioagents if it is available. Intended end use of *M. altissima* can be economically viable and sustainably hastened with the use of *G. sepium* methanolic extract to wade off insect pest attack at nursery stage so that optimum growth can be achieved during plantation establishment.

RECOMMENDATION

1. Based on the result obtained, it was recommended that T3 (MTH) should be adopted for the control of insect pest of *M. altissima*
2. Since the *G. sepium* is a potent insecticide, its use in controlling insect pest is highly recommended to seedlings at nursery stage.

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