Journal of Forestry Research and Management. Vol. 14 (2), 154-165; 2017, ISSN 0189-8418

www.frin.gov.ng/frin1/journals.html

COMPARATIVE ASSESSMENT OF SYNTHETIC PESTICIDE AND EXTRACT OF *Gliricidia sepium* (Jacq.) AS BIO-AGENT ON THE CONTROL OF INSECT PEST OF *Mansonia altissima* (A.Chev) SEEDLINGS

Ayeni, O.D[2*]; Onilude, Q.A[2]; Ibode, R.T[1]; Ehigiator, O.R[1]; Adeniyi, M.A[1] and Ajibade, Y.A[1]

[1]Federal College of Forestry, Jericho Hill, Ibadan, Nigeria

[2]Forestry Research Institute of Nigeria, Jericho Hill, Ibadan Nigeria.

*Correspondence Email: Ayeniolatunji62@yahoo.com

ABSTRACT

Extracts of plants/trees have been widely used to control agricultural pests in order to achieve an ecologically based pest management strategy. This study compared the effect of a chemical (pesticides) and a methanoic extract from *Gliricidia sepium* on the control of insect pest (*Godasa sidae*) of *Mansonia altissima* seedlings. This study was carried out at the Federal College of Forestry, Ibadan, Nigeria arranged in a completely randomized design (CRD) with 10 replicates per treatment (T_1- Control; T2- Application of *Gliricida sepium* methanoic extract once in a week; T3- Application of *Gliricida sepium* methanoic extract once in two weeks; T4- Application of *Gliricida sepium* methanoic extract once in three weeks; T5- Application of pesticides once in a week; T6- Application of pesticides once in two weeks; T7- Application of pesticides once in three weeks). Plant height, leaf production (leaf count), stem diameter, leaf area and pest were all monitored for twelve weeks. Data collected were subjected to ANOVA and DMRT (post mortem). Both the chemicals and the extracts were effective in the control of the studied insects compared to the untreated seedlings (control). The result revealed a significant difference at 5% level of probability among the treatments in terms of pests, plant height, stem diameter, leaf area and leaf production with highest mean value of 15.41cm observed for seedling height for Treatment 5 (application of pesticides once a week) followed by Treatment 2 (application of methanoic extract once a week) with mean value of 14.11cm. Treatment 5 also had the highest value of 0.49mm in stem diameter followed by treatment 2 with the mean value of 0.43mm while the result for leaf production also showed that treatment 5 had the highest value of 11numbers of leaves followed by treatment 2 with mean value of 10 numbers of leaves. Treatment 5 also performed better in leaf area with mean value of 55.75cm^2 followed by treatment 2 with the mean value of 46.76cm^2. It was concluded from this result that the application of *Gliricidia sepium* leaves methanoic extract once in a week to the seedlings was able to compete with the conventional pesticide in the resistance of insect pest attack on *Mansonia altissima*. However, due to the hazardous effect of pesticides on the environment, *Gliricidia sepium* leaves extract which is a potent pesticide should be adopted for the control of insect pest of *Mansonia altissima* at nursery stage. It was suggested that a similar study should be conducted using water and ethanol as solvent for the extraction of *Gliricidia sepium* for comparison with the established result of methanoic extract.

Keywords: Pesticides, Methanoic acid, *Gliricidia sepium*, Insect pest, *Mansonia altissima*

Introduction

Timber has been used throughout the history of mankind. From housing bridges and tools, timber has provided man with a broad range of building products and materials for construction (FAO, 2007). Reports from National Timber Development Council (2001) stated that wood is an environmentally friendly, housing materials which is suitable for construction and building finishes. In most cases, engineered wood products are produced using fast growing and often underutilized wood species from managed forests and tree farms (NTDC, 2001). *Mansonia altissima* which remains one of the best options to produce wood needed for these purposes belongs to the Sterculiaceae family. It is one of the most important indigenous hardwood species (Ukuhem, 2002). *Mansonia altissima* is an evergreen tree with a small dense, crown and branches that are almost horizontal at first, but later drooping. The cylindrical, generally straight bole can be branchless for up to 30cm and up to 100cm, occasionally even 150cm in diameter (Kucera, 1994). The tropical rainforest is a dense and luxuriant vegetation type and are the most biologically diverse terrestrial ecosystem (FAO, 2007).

The leaf feeding noctuid moth *Godasa sidae* is the main insect pest of *Mansonia altissima*, that is why many tropical species such as *Pericopsis elata, Milicia excelsa, Mansonia altissima* etc 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 (Keogh, 1996).

Pesticides are chemical substances which when applied help to reduce the rate and attack of pests on farms, this helps increase yields of farms in drought periods. Though the chemicals appear too effective, their use is being discouraged due to associated human health and environmental problems such as pest resistance to insecticide, environmental pollution, high cost of purchase, non-availability as well as hazards to farmers (Talukder and Howse, 1995). These drawbacks have necessitated the need for sustainable alternatives that are easily biodegradable, environmentally friendly and safe to both producers and consumers (Ewete *et al.,* 1996; Akob and Ewete, 2007). The challenges of finding good alternative to replace these conventional insecticides have led to bio-prospecting of plants with natural insecticidal potentials. Some plants with their parts like leaves, stems, and roots that have been used include *Azardirachta indica, Piper guineense, Allium cepa, Anethum graveoslens, Senna species, Annona senegalensis* (Ewete *et al.,* 1996, Ofuya, 2001) among others.

Researchers in North America and around the world have been exploring natural alternatives to synthetic pesticides because of some risks associated with synthetic pesticides such as environmental persistence or negative health effects related to toxicity (Scott *et al.,* 2005). Another motivation behind this interest is the sheer cost of insecticides, which limit and

Journal of Forestry Research and Management. Vol. 14 (2), 154-165; 2017, ISSN 0189-8418

www.frin.gov.ng/frin1/journals.html

Plate 1: Mansonia altissima Seedlings

prevents many local farmers from purchasing them to protect their seedlings. The use of biological materials especially, plant materials are highly favored, since the materials can easily be applied without any technical knowledge. The effectiveness of botanical insecticides has been demonstrated in many studies (Aslan *et al.*, 2005). Many of the plants used as insecticides have been found safe for human consumption. Plant world comprises a store house of bio chemicals that could be tapped for use as insecticides and they are the richest source of renewable bio active 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 (Kabaru and Gichia 2001).

For this study however, effect of synthetic pesticides on *Mansonia altissima* pest (*Godasa sidae*) and extract from *Gliricida sepium* were compared with the view to suggest a better pesticides that protect the *Mansonia altissima* seedlings from attack.

MATERIALS AND METHOD

The study areas and procurement of materials

The experiment was carried out on the within the premises of Federal College of Forestry, Ibadan, Oyo State. The College is situated at Jericho in Ibadan North West Local Government area. It has annual rainfall of about 1300mm - 1500mm while the annual temperature is 26^0C and the average relative humidity is about 80 - 85% (FRIN metrological station, 2016). The seeds of *Mansonia altissima* were obtained from the seed store, Forestry Research Institute of Nigeria (FRIN) Ibadan, the leaves of *Gliricida sepium* was obtained from the Federal College of Forestry, Ibadan (FCF). The chemical used was obtained from an agro-chemical industry in Ibadan, river sand was obtained from the stream within FCF while the topsoil was obtained from the Agricultural technology Departmental farm of FCF. The Polythene

pots were purchased at the FCF nursery. Methanol was obtained from the Pharmacy Department, University of Ibadan.

Extraction Method and Method of Application

The fresh leaves of *Gliricidia sepium* was air dried at room temperature for three weeks and later pulverized into powdered form. The powdered material of 300g was exhaustively extracted with 600mL of methanol. The plant material was soaked for three days to ensuring constant stirring in order to evenly distribute the powdered material in the solvent. This was filtered and the filtrate was evaporated to dryness at room temperature for 24 hours. The dried extract then weighed to determine its actual value and stored. However, Preliminary phytochemical screening was carried out on the extract to determine its phyto-constituents such as alkaloids, flavonoids, saponins, tannins, terpenoids using standard procedures (Table 1). The weight of the dried extract was 36.3g which was diluted with 25cl of distilled water. About 100mL of the extract and the chemical were applied to the seedlings by the use of hand sprayer of 2 litres capacity weekly early in the morning to avoid photo decomposition.

Table 1: PHYTOCHEMICAL SCREENING OF THE EXTRACT (QUALITATIVE)

S/N	Phyto-constituents	Present/Absent
1	Alkaloids	+ve
2	Tannins	++ve
3	Flavonoids	+ve
4	Terpenoids	+ve
5	Anthraquinones	+ve
6	Saponins	++ve
7	Cardiac Glycosides	-ve

Key: +ve = present;-ve = absent;++ve: abundant

Source: Department of Pharmaceutical Chemistry, University of Ibadan

EXPERIMENTAL DESIGN AND LAYOUT

The experimental design used was Completely Randomized Design (CRD). The various treatment combinations used in this study included: T_1- Control; T2- Application of *Gliricidia sepium* methanoic extract once in a week; T3- Application of *Gliricidia sepium* methanoic extract once in two weeks; T4- Application of *Gliricidia sepium* methanoic extract once in three weeks; T5- Application of pesticides once in a week; T6- Application of pesticides once in two weeks; T7- Application of pesticides once in three weeks. There were seven (7) treatments in this study and each treatment was replicated ten (10) times to make a total number of seventy

seedlings of *Mansonia altissima*. Watering of plants was done and monitored daily. Growth assessment commenced two weeks after treatment application. Seedling height, stem diameter, leaf production and leaf area were recorded at two weeks interval for twelve (12) weeks.

DATA COLLECTION AND ANALYSIS

Estimation of the population densities of the pest were taken at 2 weeks interval for 12 weeks after spraying. Number of insects on seedlings was visually counted. All data were analysed using Analysis of Variance (ANOVA) in CRD to identify 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 (DMRT).

RESULTS AND DISCUSSION

Table 1: Mean number of *insect pest (Godasa sidae)* found on *M. altissima* seedlings treated with pesticides, extract and untreated seedlings

	Weeks after treatments					
Treatments	**2**	**4**	**6**	**8**	**10**	**12**
T1	4.20^{a}	5.60^{a}	5.66^{a}	6.10^{a}	6.00^{a}	5.20^{a}
T2	1.40^{bc}	1.60^{e}	0.60^{c}	0.00^{c}	0.00^{c}	0.00^{c}
T3	2.42^{d}	2.00^{b}	1.86^{b}	1.15^{b}	0.66^{bc}	0.42^{bc}
T4	2.50^{d}	2.12^{b}	1.08^{c}	0.98^{c}	0.80^{b}	0.62^{b}
T5	1.10^{b}	0.20^{e}	0.00^{c}	0.00^{c}	0.00^{c}	0.00^{c}
T6	1.50^{c}	1.22^{cd}	0.90^{c}	0.64^{c}	0.00^{c}	0.00^{c}
T7	1.65^{c}	1.46^{c}	1.00^{c}	0.68^{c}	0.42^{b}	0.00^{c}

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

Comparison of effects on Insect pests

Table 1 shows the effect of the treatments on *M. altissima* seedlings. Seedlings treated with both the chemicals and extracts were able to reduce and later eliminate the insect *Godasa sidae* found on the treated seedlings, with treatment 5 and treatment 2 showing high efficacy (Table 1). At six (6) weeks after spraying, no insect was found on treated seedlings of *M. altissima*. The results obtained from this study showed that application of chemical once a week (T5) to *M. altissima* seedlings gave the best among other chemical rates (T6 and T7) while application of extract of *Gliricidia sepium* once a week (T2) gave the best among other extract application rates (T3 and T4) (Table 1).

However, in overall, chemical application exhibited a higher efficacy compared to the extract of *Gliricidia sepium* application (Table 1). This might be as a result of active ingredient

of the extract being easily volatilized especially in the sun, thereby resulting in their limited efficacy (Ware, 2000). This study however, supported the work of Olaniran, *et al*, (2013), who revealed in his study that a chemical (Deltamethrin) had higher efficacy compare to biological insecticides.

The study also revealed that extracts of *Gliricidia sepium* treated seedlings sustained populations of the insect pests compare to the chemicals treated seedlings. The insect pests were unable to feed on the plants indicating antifeedant activity of the extracts causing starvation or migration to untreated seedlings (control). However, increase in the population densities of insects in the untreated seedlings suggest migration from treated seedlings. Sadek (2003), in his work, observed that larvae of *Spodotera litoralis* moved gradually from food treated with *Adhatoda vasica* extract to the untreated food. 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 (Isman 2008; Oparaeke 2006).

Comparison of effects on seedling height

The result of the effects of the different treatments on *Mansonia altissima* height is presented in Table 3. For the period of assessment, significant difference ($P<0.05$) was observed in the seedling height among the treatment used (Table 3). Treatment 5 (application of pesticides once in a week) gave the best performance on seedling height with a mean value of 15.41cm, followed by Treatment 2 (application of bio-extract once in a week) with a mean value of 14.11cm while the least mean seedling height value of 10.29cm was observed for Treatment 1 (Control). Though treatment 5 performed best in terms of seedling height, Treatment 2 also did well as it was not affected by the attack of insect pest as it contains Tannins, Saponins and Flavonoids etc. According to Ford, (1987), in his study, he found Tannins, Saponins and Flavonoids to be effective in the control of insect pest. The *Mansonia altissima* seedlings in Treatment 3 (Application of *Gliricidia sepium* methanoic extract once in two weeks) and Treatment 4 (Application of *Gliricidia sepium* methanoic extract once in three weeks) were affected by the insect pest. However, with the hazardous effects of chemical later on, also, with the ability of the application of bio-extract once a week to compete with the chemical to resist the attack of insect pest on the seedlings height suggest a better performance by the Treatment 2.

Table 3: Analysis of variance (ANOVA) for Plant height and Stem diameter

		Plant height				Stem diameter			
SV	**DF**	**SS**	**MS**	**F**	**P-value**	**SS**	**MS**	**F**	**P-value**
Treatment	6	196.95	32.82	10.75	0.0001*	0.07369	0.01228	2.5442	0.0286*
Error	63	192.29	3.05			0.30414	0.00483		
Total	69	389.24				0.37783			

NOTE: * Significant at a level of 5% of probability

Table 4: Analysis of variance (ANOVA) for Number of leaf and leaf area

		No of Leaf				Leaf Area			
SV	**DF**	**SS**	**MS**	**F**	**P-value**	**SS**	**MS**	**F**	**P-value**
Treatment	6	369.20	61.53	62.94	0.0001*	176.9454	29.4909	10.5440	0.0001*
Error	63	61.59	0.98			192.2940	3.0523		
Total	69	430.79				369.2394			

NOTE: * Significant at a level of 5% of probability

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 5 (application of pesticides once in a week) gave the highest performance in terms of stem diameter with the mean value of 0.49cm, followed by Treatment 2 (application of bio-extract once in a week) with the mean value of 0.43cm (Table 5). The result showed the application of *Gliricida sepium* extract on the seedlings weekly had a positive effect on the stem. The least performance was recorded in Treatment 4 (application of bio extract once in three weeks) with the mean value of 0.40cm as it was greatly affected by insect pest (Table 5). Stem diameter is one of the useful morphological measures of seedlings quality as it reflects seedlings durability. Seedlings with larger diameter are better supported and resist bending better than those with smaller diameter (Yakubu *et al*, 2010). So by the time those with larger diameter get to the field, they perform better than others.

Table 5: Mean of the effects of different level of treatments on the growth of *Mansonia altissima* seedlings**.**

Treatment	Plant height	Stem diameter	Leaf production	Leaf area
T1	10.29^{c}	0.39^{b}	4^{e}	20.68^{cd}
T2	14.11^{a}	0.43^{a}	10^{b}	29.70^{d}
T3	$11.08b^{c}$	0.41^{b}	6^{c}	26.76^{b}
T4	12.43^{b}	0.40^{b}	5^{d}	22.02^{e}
T5	15.41^{a}	$0.49a^{b}$	11^{a}	37.26^{a}
T6	12.17^{b}	0.39^{b}	9^{b}	21.83^{c}
T7	11.19^{bc}	0.38^{b}	6^{c}	21.35^{c}

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

Comparison of effects on leaf production

The results of analysis of variance (ANOVA) on the effects of the different treatments on leaf production of *Mansonia altissima* was significant at 5% level of probability ($P<0.05$, 0.0001) (Table 4). Treatment 5 (application of pesticides weekly) gave the best performance with a mean value of 11 numbers of leave at the termination of the study followed by Treatment 2 (application of bio extract once in a week) with a mean value of 10 numbers of leaves (table 5) which indicated that the bio extract 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 methanoic extract of the *Gliricidia sepium* contained the necessary compound which was able to control the attack of insect pest of *Mansonia altissima* seedlings. However, this work therefore, supported the work of Rahil *et al*, (2008) who stated that the plant extract is effective on the control of insect pest of some forest tree species.

Journal of Forestry Research and Management. Vol. 14 (2), 154-165; 2017, ISSN 0189-8418

www.frin.gov.ng/frin1/journals.html

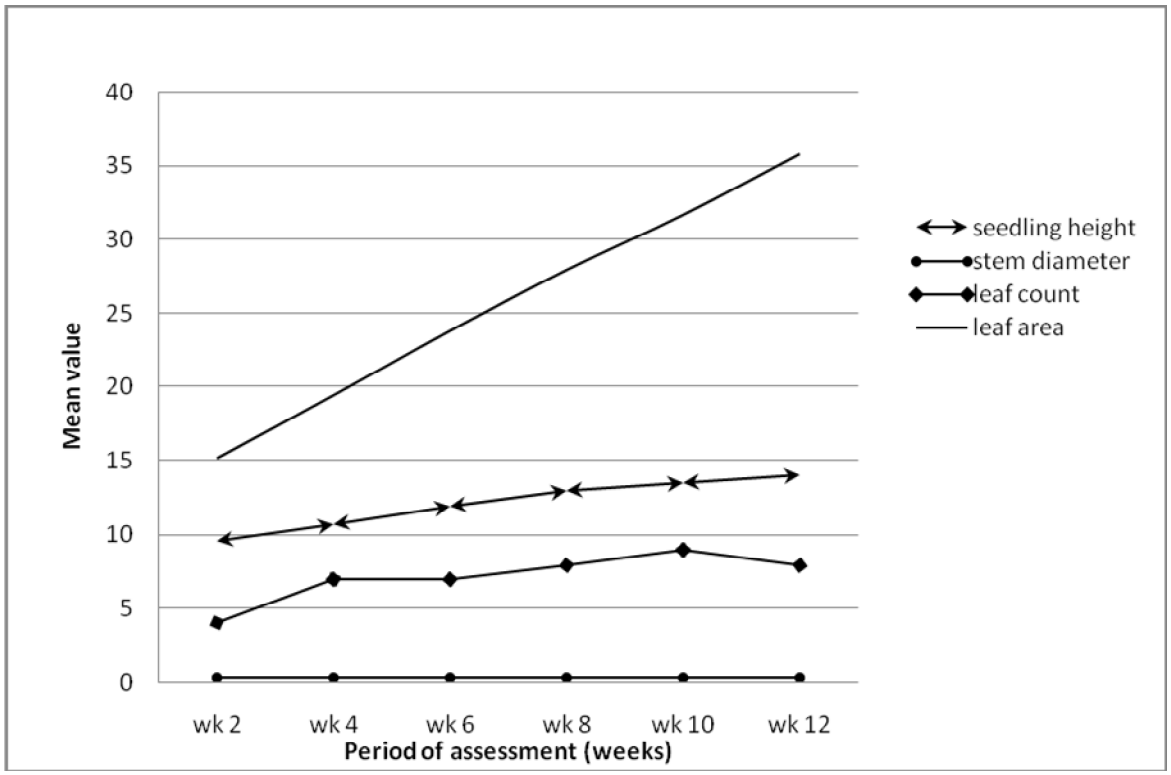

Fig 2: Mean of the effect of the different treatments on *Mansonia altissima* seedlings growth

Comparison of effects on leaf area

From the result obtained from the analysis of variance, there was significant difference ($P<0.05$, 0.0001) in the leaf area among the treatments at 5% level of probability as shown in table 4. The result also showed that Treatment 5 (application of pesticides once in a week) had the highest mean value of 37.29cm^2 (table 5) which was followed by Treatment 2 (application of methanoic extract once in a week) with the mean value of 29.70cm^2 (table 5). The result revealed that the application of the bio-agent once a week on the seedlings was able to control the insect pest attack on the seedlings. The result obtained indicated that the methanoic extract of *Gliricidia sepium* leaves contained compounds able to inhibit the activity of insect pest on the seedlings of *Mansonia altissima*. Thus, the bio agent was able to compete with the chemical. This work therefore supports the work of Falvey (1982) who stated that *Gliricidia sepium* extract is effective in controlling the insect attack on *Mansonia altissima* seedlings.

CONCLUSION AND RECOMMENDATION

Conclusion

The results of this study have shown that the chemical used for this study gave the best performance against insect-pest of *Mansonia altissima* when applied once a week. Also, *Gliricidia sepium* methanoic extract showed that it is an effective bio- agent on the control of insect pest of *Mansonia altissima* when applied weekly to the *Mansonia altissima* seedlings. However, due to the hazardous effects of most of these chemicals on the environment and the problems of pesticide resistance, negative effects on non-target organisms including man and the environment, treatment 2 (application of methanoic extract once a week) which gave better performance against the insect pest of *Mansonia altissima* were suggested for use. Intended end use of *Mansonia altissima* can be economically viable and sustainably hastened with the use *Gliricidia sepium* methanoic 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 T2 (application of the bio-agent once in a week) should be adopted for the control of insect pest of *Mansonia altissima*.
2. Since the *Gliricidia sepium* is a potent insecticide, its use in controlling insect pest is highly recommended to seedlings at nursery stage.
3. A similar study should be conducted using water as the solvent for the extraction of *Gliricidia sepium* to see if it will be as effective as the methanoic extract.

REFERENCES

Akob, C.A and F.K. Ewete(2007): The efficacy of ashes of four locally used plant materials against *Sitophilus zeamais* (Coleoptera: Curculionidae) in Cameroon. *International Journal of Tropical Insect Science*: 27(1): 21-26.

Aslan, I., Calmasur, O., Sahin F., and Caglar, O. (2005): Insecticidal effects of essential plant oils against *Ephestaiku ehnielia* (Zell), *Lasoderma serricome* (F.) and *Sitophilus granaries* (L.). *Journal of Plant Diseases and Protection. 112: 257-267.*

Ewete, F.K., J.I. Arnasan, J. Larson and B.J. R. Philogene (1996): Biological activities of extracts from traditionally used Nigerian plants against European corn borer, *Ostrinia nubilalis* (H.). *Entomol. Exp. Appl.* 80: 531-537.

Falvey J.L (1982): *Gliricidia maculata*- a review. *International Tree Crops Journal, 2(1):1-14.*

FAO, (2007): State of the world's forests 2005. George Tyler Miller (1 January 2004). Sustaining the Earth: An Integrated Approach. Thomson/Brooks/Cole. pp. 211– 216. ISBN 978-0-534-40088-0.

FRIN (2016): Forestry Research Institute of Nigeria, metrological report, 2016.

Isman, M.B. (2008): Botanical insecticides: for richer, for poorer. *Pest management science*, 64, 8-11.

Kabaru, J.M. and Gichia, L. (2001) Insecticidal activity of extracts derived from different parts of the mangrove tree Rhizophora mucronata (Rhizophoraceae) Lam. against three arthropods. *African Journal of Science and Technology*, 2.

Keogh R.M., (1996): A consortium support model for greatly increasing the contribution of quality tropical hard wood plantation to sustainable environment. Teak 200.

Kucera, B.J (1994): A hypothesis relating current annual height increment to juvenile wood formation in Norway spruce, wood and fibre science, 26 (1): 152-167.

National Timber Development Commission (2001): Environmentally Friendly Housing Using Timber – Principles. FWPRDC 2001/First Edition – January 2001.

Ofuya, T.I (2002): *Beans, insects and man*. Inaugural Lecture Series 35, The Federal University of Technology, Akure, Nigeria 45 pp.

Olaniran, O. A; Alao,F.O and Adebayo, T.A (2013): Control of foliage pests of roselle (*Hibiscus sabdariffa* L.) using plant extracts of *Tephrosia vogelii* and *Azardiractha indica* in Ogbomoso, Nigeria. *Transnational J. of Sci. and Techn*., June 2013 edition vol.3, No.6, ISSN 1857-8047.

Oparaeke, A.M. (2006): The potential for controlling *Maruca vitrata* Fab. and *Clavigralla tomentosicollis* Stal. using different concentrations and spraying schedules of *Syzigiumaromaticum* (L.) Merr and Perr on cowpea plants. *Journal of Plant Sciences*, 1, 132-137.

Rahila, N; Mussarat, A; Shagufta A; Abdul Hameed, S and Nighat S (2008): Insecticidal, Nematicidal and Antibacterial Activities of *Gliricidia sepium*. *Pak. J. Bot., 40(6): 2625-2629, 2008.*

Sadek, M.M. (2003) Antifeedant and toxic activity of *Adhatoda vasica* leaf extract against *Spodoptera littoralis* (Lep., Noctuidae). *Journal of Applied Entomology*, 127, 396-404.

Scott I.M., N. Gagnon., L. Lesage., B.J.R Philongene., and J.T Arnason., (2005): efficacy of botanical insecticides from piper species (piperaceae) extracts for control of European chafer (Coloepteran; Scarabacideae). *Journal of economic Enthomology 98: 845-855.*

Talukder, F. A. and Howse, P.E. (1994): Repellent, toxic and food protectant effects of pithraj, *Aphanamixis polystachya* extracts against pulse beetle, *Callosobruchus chinensis*in storage. *J. Chem. Ecol. 20: 900-908*

Ukuhem, (2000): Response of indigenous Adult Birds to ingestion of *Mansonia altissima*. A post graduate Diploma Thesis submitted to the department of Annual sc. RSUST, Port Harcourt.

Ware, G.W. (2000): *The Pesticide Book*. Thompson Publications, Fresno, California.

Yakubu, B.L; Mbonu,O.A; and Nda, A.J (2012): Cowpea (*Vigna unguiculata*) pest control methods in storage and recommended pesticides for efficiency: A review. *J. Biol. Agric. Healthcare* 2: 27-33.