ISBN: 2141 – 1778 jfewr ©2013 - jfewr Publications
E-mail:jfewr@yahoo.com

NURSERY PEST MANAGEMENT OF *PHYTOLYMA LATA* WALKER (SCOTT) ATTACK ON IROKO (*MILICIA EXCELSA* WELW C. C. BERG) SEEDLINGS

Olajuyigbe, S. O[1 *] and Adegeye A. O[1]

[1]Department of Forest Resources Management, University of Ibadan, Nigeria

***Email: lekito2001@yahoo.com**

ABSTRACT

The establishment of plantations of Milicia excelsa has been constrained by the gall-forming psyllid Phytolyma lata Walker (Scott) that causes extensive damage to young plants. We present findings of an experiment aimed at preventing Phytolyma attack on Milicia seedlings in the nursery using chemical control and physical barrier (screen house). Ninety, 6-month old seedlings of uniform growth were selected from a population of potted seedlings obtained from the same seed source. Thirty seedlings were placed in a screen house (SHS), while thirty seedlings (TRT) were placed in the open nursery under direct sunlight and treated fortnightly with a low concentration (0.05%) of water-based insecticide (Lambda-Cyhalothrin). As control (UNT), 30 seedlings were placed in the open nursery without any treatment. The survival, height and collar diameter of the seedlings were measured fortnightly for 24 weeks. After 10 weeks, the untreated seedlings were attacked by Phytolyma with evidence of leaf gall formation. Though, all UNT seedlings were attacked by the insect no, mortality was recorded during the study, while no gall formation occurred in the TRT and SHS seedlings. There was no significant difference in the collar diameter growth with 90.71%, 97.73%, and 115.48% increase in UNT, TRT and SHS seedlings, respectively. On the other hand, there were significant differences in the total height with 21.98%, 58.19%, increase in TRT and SHS, respectively; while UNT seedlings experienced a negative height growth of -0.27%. The provision of a physical barrier proved to be the most effective management strategy to prevent Phytolyma infestation, while chemical control was a successful alternative.

Key Words: Iroko, gall formation, screen house, Lambda-Cyhalothrin, *Phytolyma*

INTRODUCTION

Iroko (*Milicia excelsa* Welw C.C. Berg.) from Moraceae family is a large deciduous tree that grows between 30 to 50m in height, with a diameter ranging from 1.7 to 2m. The species develops an umbrella-like high crown, growing from a few thick branches. It is a dioecious, hardwood tree of great socio economic and cultural importance in Sub-Saharan Africa. It occurs in a wide range of climatic and edaphic environments and adapts to various ecological conditions, preferring well-drained soils and is intolerant to impeded drainage. It is an intense light demander and cannot stand very deep shading. This species is currently subjected to habitat destruction and fragmentation as well as human pressure through intensive logging and changes in land use practices (Ofori, 2007; Ouinsavi *et al*., 2005; Ouinsavi and Sokpon, 2010).

The distribution of *Milicia* spp. ranges from Senegal and Gambia in West Africa through Central and East Africa to Mozambique (Keay, 1989). Exploitation of *Milicia* spp. is mainly done from the natural forest, however, regeneration has proven to be inadequate to compensate for the rate of exploitation mainly due to its susceptibility to *Phytolyma lata* Walker (Scott) gall attack (White, 1996; Wagner *et al*., 1991). Furthermore, efforts at establishing plantations of *Milicia* spp. have been constrained by the gall forming psyllid (*P. lata*) that causes extensive damage to the shoots of young plants (Nichol *et al.*, 1999; Ofori and Cobinnah, 2007). The attack results in the formation of galls on young shoots, which then leads to dieback of foliage down to the woody tissue. This continuous attack disrupts physiological processes, causes growth reduction, and eventually kills seedlings in many cases (Ofori and Cobbinah, 2007; Wagner *et al.*, 1991; Cobbinah 1993). Heights of 6 month-old healthy seedlings have been found to vary between 65 and 105cm, and in 1 year, the plants may grow up to 1.8m high. The growth can however be reduced considerably because of their vulnerability to *Phytolyma* gall attacks. For instance, growth retardation were reported in 6-year-old seedlings in Ghana, where seedling height was less than 1.2m due to repeated *Phytolyma* gall attacks, while the less susceptible ones were over 6m in height (Ofori, 2007).

This study determined the control of *Phytolyma* insect pest attack on *Milicia excelsa* seedlings in the nursery using a systemic insecticide and a physical barrier (screen house). The study measured the influence of this control measures on the survival, total height and collar diameter of the seedlings.

MATERIALS AND METHODS

Study site

The study was carried out at the forest nursery of the Department of Forest Resources Management, University of Ibadan, Nigeria (Longitude 3° 54'E Latitude 7° 26'N, 277m above sea level). The climate in Ibadan is West Africa tropical monsoon characterized by two seasons (wet and dry). The mean annual temperature is 22.4°C while mean annual precipitation is 1300mm. The temperature in the screen house ranged from 19°C at night to 35°C during the day.

Seedlings of *Milicia excelsa*

Fruits of *M. excelsa* were collected from an open grown female tree in the University of Ibadan campus. Seeds were extracted by soaking the fruits in water for approximately 48 hours and these seeds were sown in germination beds. The emerging seedlings were transplanted into poly pots at the three leaf stage and placed in the screen house to prevent pest attack. After 6 months, ninety seedlings of uniform growth were selected and transferred into large poly pots (50cm by 50cm) to ensure continuous, unrestricted root development. The seedlings were conditioned for two weeks before the commencement of the experiment.

Three treatments were used namely; seedlings placed in a screen house (physical barrier) (SHS), seedlings treated with a systemic insecticide (TRT) and untreated seedlings (UNT) as control. Thirty seedlings were placed in each treatment, and the 30 TRT seedlings were sprayed with a low concentration (0.05%) of water-based, systemic insecticide (Lambda-Cyhalothrin). The 30 TRT seedlings along with 30 UNT seedlings were placed 1 m apart in an open area in the nursery, while 30 SHS seedlings were placed in the screen house. The seedlings were allowed to acclimatize to the new environment and then fortnight measurements of the percentage survival, total height (THT), collar diameter (CD) was done.

for 24 weeks. The seedlings were watered daily, while the chemical treatment of TRT seedlings was done every two weeks, and the incidence of *Phytolyma* attack was monitored closely. The seedling total height (height from the base of plant to the tip of the shoot) and stem collar diameter (measured 5cm from the soil level) were measured using a metre rule and vernier mini caliper, respectively.

Statistical analysis

The relative growth rate (RGR) of seedling collar diameter or total height was calculated as shown in Eqn (1):

$$RGR = \frac{Ln\,(x_2) - Ln\,(x_1)}{t_2 - t_1} \qquad (1)$$

where x_1 and x_2 are the initial and final collar diameter (cm) or total height (cm), t_1 and t_2 are time (in weeks) representing the beginning and end of the period of experiment.The data were analysed using Analysis of variance (ANOVA) to determine whether seedling height or collar diameter growth varied significantly between the three treatments. Pairwise comparison was done using Holm Sidak test. Analyses were done using SYSTAT 11 statistical software. All tests were performed at 5% level of significance.

RESULTS

Evidence of *Phytolyma* attack became apparent after 10 weeks with gall formations on the leaves of all UNT seedlings. However, no mortality was recorded, as infested and damaged seedlings continued to re-sprout with the formation of new leaves and sometimes shoot, whenever the main stem had dieback. After 24 weeks, the mean number of leaves in each treatment was 7.58 ± 2.33, 17.89 ± 2.11 and 29.27 ± 2.02 for UNT, TRT and SHS seedlings, respectively.

The mean collar diameter recorded at the end of the experiment was 1.31 ± 0.03cm, 1.39 ± 0.03cm and 1.36 ± 0.02cm for UNT, TRT and SHS seedlings, respectively. After 24 weeks, collar diameter of UNT, TRT, SHS seedlings increased by 90.71%, 97.73% and 115.48%, respectively (Fig. 1a). However, there was no significant difference (P = 0.141) in the collar diameter growth of seedlings in the three treatments.

In the same vein, mean total heights were 93.27 ± 2.23 cm, 113.09 ± 2.3 cm and 154.55 ± 5.42cm, respectively. The total height of TRT and SHS seedlings increased by 21.98%, 58.19%, respectively, while UNT seedlings experienced a negative height growth of -0.27%, after 24 weeks (Fig. 1b). Consequently, there were significant differences (P = 0.001) in the total height of seedlings in the different treatments. The posthoc test showed that all three treatments differed from one another.

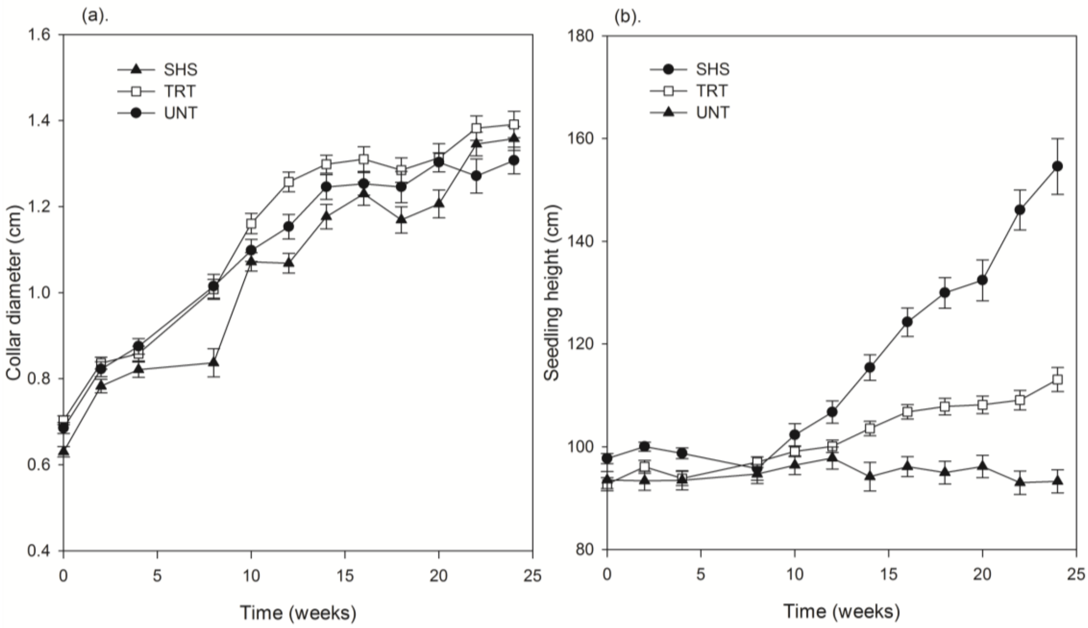

Figure 1a and b: Seedling collar diameter and total height growth curves for *Milicia excelsa* under three treatments in a nursery (screen house enclosure (SHS), fortnight spraying of systemic insecticide (TRT) and untreated seedlings (UNT); means with S.E. bars).

There were significant differences (P = 0.001) in the RGR of collar diameter of the seedlings. However, the post hoc test showed that there was no difference in the mean RGR of collar diameter of seedlings in the SHS (0.30 ± 0.02cm cm^{-1} $week^{-1}$) and TRT (0.34 ± 0.02cm cm^{-1} $week^{-1}$) treatments, which both differed from UNT seedlings (0.03 ± 0.001) (Fig. 2a). On the other hand, there were significant differences (P = 0.001) in the RGR of seedling heights for all treatments (Fig. 2b). The mean height RGR were 4.34 ± 0.03cm cm^{-1} $week^{-1}$, 4.53 ± 0.02cm cm^{-1} $week^{-1}$, 5.02 ± 0.05cm cm^{-1} $week^{-1}$ for UNT, TRT and SHS seedlings, respectively.

A 100% survival rate was recorded in all treatments for the duration of the experiment, however all 30 UNT seedlings showed signs of fungal infection and dieback after 24 weeks. No gall formation attack was observed in the TRT and SHS treatments, except for stem wilting which occurred in 3 seedlings among the TRT seedlings.

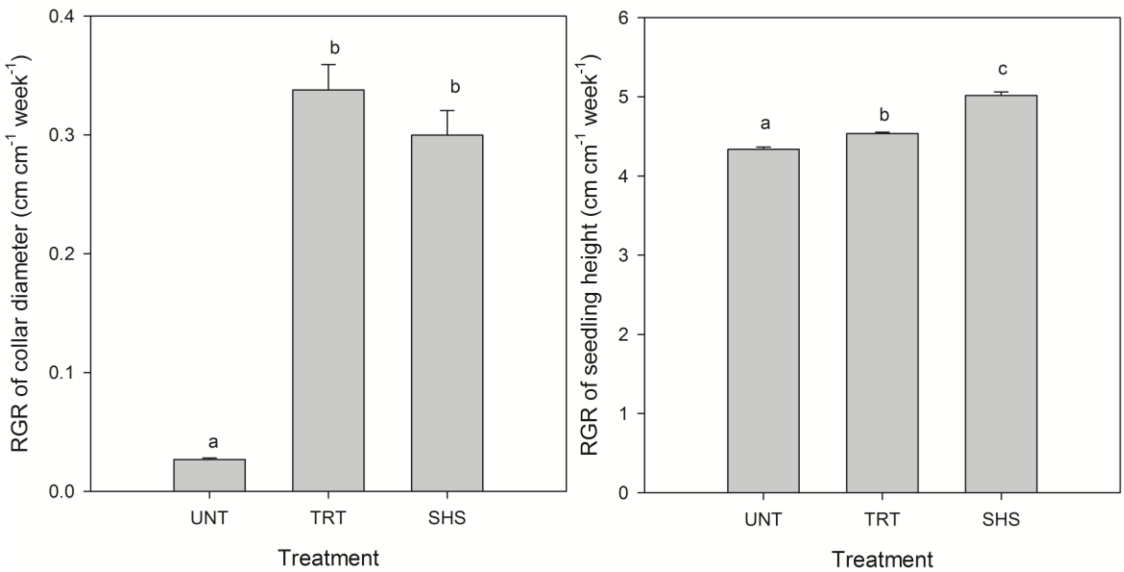

Figure 2a and b: Mean (with S.E. bars) relative growth rate (RGR) of collar diameter and height for *Milicia excelsa* seedlings under three treatments in a nursery (screen house enclosure (SHS), fortnight spraying of systemic insecticide (TRT) and untreated seedlings (UNT).

DISCUSSION

The height growth of seedlings in all treatments was similar until the 10th week (Fig. 1a), when gall formation became noticeable on leaves of UNT seedlings. The height growth of SHS seedlings from this point on differed significantly from the other treatments (Fig. 2). The psyllids laid eggs on the UNT and this resulted in galls which within *c.* 2 weeks began to rupture and then adults insects emerged from the seedlings (Nichols *et al.,* 1999). Thus, the chemical treatment was effective in preventing the laying of eggs on TRT seedlings, as the seedlings were placed 1m apart from the UNT seedlings, yet there was no occurrence of gall formation. Mean total height of plants growing in the screen house (SHS) was significantly higher than TRT, while height growth retardation was observed in UNT seedlings similar to the findings of Agyeman *et al.* (2009).

On the other hand, the mean collar diameter was not significantly different suggesting that the diameter growth was not affected by *Phytolyma* attack. Infact, it was observed that TRT seedlings had a higher collar diameter suggesting that the exposure to direct sunlight might have a strong influence on diameter growth. The height growth suppression corroborates the findings of Ofori (2007) that *Phytolyma* attack restricts height growth of *Milicia* to <1.2m, as the mean height of UNT seedlings as at the point of termination of the experiment was 93.26cm.

The RGR of seedling height increased following the pattern UNT< TRT <SHS seedlings, while the RGR of collar diameter of TRT seedlings was highest. The low RGR of UNT seedlings (especially, collar diameter growth) could be due to the need for accumulation of anti-herbivore chemical compounds in the plant tissue (Agyeman *et al*., 2009; Lambers and Poorter 1992). Furthermore, it has been shown that leaf damage from insect pest attack results in down-regulation of photosynthetic gene expression, which may provide an adaptive response in the plant to minimize photosynthetic losses (Bilgin *et al*., 2010).

The small number of leaves found on UNT seedlings (7.58 ± 2.33) as compared to the TRT and SHS seedlings could be attributed to the pest influence on the physiological processes in the *Milicia* seedlings. Growth of seedlings is strongly linked to foliage quality and quantity, while pest attack results in a removal of available nutrients (Cobbinah, 1983). This results in a reduction in foliage production as well as height growth retardation as observed in UNT seedlings (Agyeman *et al.*, 2009*)*. Furthermore, infestation of UNT seedlings accelerated leaf yellowing and shedding of leaves. Leaf chlorosis reduces the photosynthetic area leading to a drastic reduction of carbohydrate synthesis resulting in poor growth (Olajuyigbe *et al.*, 2012; Pinkard and Mohammed, 2006). Some other factors affecting the growth of UNT seedlings include formation of secondary defence chemicals, die-back due to fungal attack and development of morphological defence structures against pest infestation (Agyeman *et al.*, 2009; Nichols *et al.*, 1999).

Several systemic insecticides have been evaluated in the past for the control of *Phytolyma spp*. Some of which include; cis-azodrin, dichrotophos, methyl phosphorodithioate, phorate, dimethoate, solvoires, cypermethrin, and neem-based extract (Azadirachtin 0.03% EC). Despite these efforts, chemical control has only been recommended for limited use in the nursery (Cobbinah, 1983; Ofori and Cobbinah, 2007). In this study, the use of low concentration of Lambda-Cyhalothrin (every fortnight) proved to be effective in complete prevention of *Phytolyma* attack. However, economic and environmental considerations may not permit the use of chemicals as it may not be sustainable for use outside the nursery (under plantation conditions). Furthermore, the phytotoxicity level of the chemical used was not assessed, though the concentrations and frequency of application were low. At present, the most effective method of preventing psyllid attack is the use of a physical barrier e.g. a screen house, mesh covered cages etc. and this may not also be sustainable in large scale plantation establishment. Therefore, it is essential that seedlings attain a significant height before they are transplanted into the field and special silvicultural management techniques must be adopted to ensure survival and establishment of *Milicia* stands (Nichols *et al*., 1999; Ofori and Cobbinah, 2007).

CONCLUSION

The exploitation of *Milicia excelsa* from the natural forest without adequate replenishment, primarily due to the attack of *Phytolyma lata*, has raised serious concerns for the conservation of the species. Consequently, lack of regeneration (both natural and artificial), poses a major challenge for the management of this important forest resource. The development of plantations for future supplies of timber and also to lessen the pressure is inevitable. Therefore, it is expedient that an integrated pest management system that combines chemical, silvicultural, modern propagation techniques as well as improved genetic selection be introduced. The provision of a physical barrier (screen house) proved to be the most effective management strategy to prevent *Phytolyma* infestation, while chemical control (at low concentration) was a successful alternative.

ACKNOWLEDGEMENTS

We appreciate the support and assistance provided by Happy Adinoyi, Oparonke Ibukun and the technical staff in the Forest Nursery and Wood Workshop Section of the Department of Forest Resources Management University of Ibadan, Nigeria. Also special thanks to Dr. A. O. Oluwadare and Dr. Adejoke Akinyele for their inputs during the experiment.

REFERENCES

Agyeman, K., Ofori, D. A., Cobbinah, J. R. and Wagner, M. R. (2009). Influence of *Phytolyma lata* (Homoptera: Psyllidae) on seedling growth of *Milicia excelsa*. *Ghana Journal of Forestry*, 25: 28-41.

Bilgin, D. D., Zavala, J. A., Zhu, J., Clough, S. J., Ort, D. R. and De Lucia, E. H. (2010). Biotic stress globally down regulates photosynthesis genes. *Plant, Cell and Environment* 33:1597–1613.

Cobbinah, J. R. (1983). Evaluation of five insecticides for the control of *Phytolyma lata*. Technical Bulletin of the Forest Research Institute, Ghana. 3, 35–41.

Keay, R. W. J. (1989). Trees of Nigeria. Clarendon Press, Oxford, pp. 287–304.

Lambers, H. and Poorter, H. (1992). Inherent variation in growth rate between higher plants. A search for physiological causes and ecological consequences. In: *Advances in Ecological Research* 23. Begon, M., Fitter, A. H. (eds.), pp. 187-261.

Nichols, J. D., Agyeman. V. K., Agurgo, B. F., Wagner, M. R. and Cobbinah, J. R. (1999). Pattern of seedling survival in tropical African tree *Milicia excelsa. Journal of Tropical Ecology* 15(4): 451-461.

Ofori, D. A. (2007). *Milicia excelsa* (Welw.) C.C. Berg. Internet Record from Protabase. Louppe, D., Oteng-Amoako, A. A. and Brink, M. (Eds.). PROTA (Plant Resources of Tropical Africa/Resources végétales de l'Afrique tropicale), Wageningen, Netherlands. http://database.prota.org/search.htm. Accessed 20 June 2012.

Ofori, D. A. and Cobbinah, J. R. (2007). Integrated approach for conservation and management of genetic resources of *Milicia* species in West Africa. *Forest Ecology and Management* 238: 1–6.

Olajuyigbe, S. O., Jimoh, S. O., Adegeye, A. O. and Mukhtar, R. B. (2012). Drought stress on early growth of *Diospyros mespiliformis* Hochst ex A. Rich in Jega, Northern Nigeria. *Nigerian Journal of Ecology* 12:71-76.

Ouinsavi, C., Sokpon, N. and Bada, O. (2005). Utilization and traditional strategies of in situ conservation of Iroko (*Milicia excelsa* Welw. C.C. Berg) in Benin. *Forest Ecology and*

Ouinsavi, C. and Sokpon, N. (2010). Morphological variation and ecological structure of Iroko (*Milicia excelsa* Welw. C.C. Berg) populations across different biogeographical zones in Benin. *International Journal of Forestry Research* 1-10.

Pinkard, E. A. and Mohammed, C. L.

Management, 207 (3): 341–350.

(2006). Photosynthesis of *Eucalyptus globulus* Labill. with Mycosphaerella leaf disease. *New Phytologist* 170:119–129.

Wagner, M. R., Atuahene, S. K. N. and Cobbinah, J. R. (1991). *Forest Entomology in WestTropical Africa: Forest Insects of Ghana*. Kluwer, Dordrecht, 210 pp.