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Effects of Net Barrier and Synthetic Insecticides on *Phytolyma lata* (Homoptera: Psyllidae) Infestation, Growth and Survival of *Milicia excelsa* in the Field

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ABSTRACT

The effect of net barrier and synthetic insecticides on *Phytolyma lata* infestation, growth and survival of *Milicia excelsa* seedlings was investigated during the year 2010-2011 in Ibadan Southwest Nigeria. In a complete randomized design with three replications, a 2 m high netted barrier were laid out in unit plots of 15×15 m^2 using five treatments: Blue net+dimethoate+carbofuran, Green net+dimethoate+cabofuran, Blue net+dimethoate, Green net+carbofuran and dimethoate only (control). Plant height, stem diameter, number of branches, numbers of galls, *Pytolyma lata* density, plant mortality and survival of *Milicia* seedling were recorded at monthly interval for two years. The treatments showed a significant difference ($p<0.05$) over the control. The net barrier plants were free from *P. lata* infestation 12 months after planting. The combined treatments of blue net barrier, dimethoate and carbofuran recorded least number of galls (7.89%) on *Milicia* seedlings while combined treatments of green net, dimethoate and carbofuran recorded least population density of *P. lata* (13.59%). There was no significant difference ($p<0.05$) between the combined treatments of blue and green barrier nets on the plant growth, although blue net+dimethoate+carbofuran recorded highest plant height and stem diameter with mean of 122.50 cm and 1.03 mm, respectively. Integrated treated plots recorded 100% seedling survival while control plot recorded 54% seedling survival after two years. Integration of net barrier with carbofuran and dimethoate is economical and should be adopted for successful establishment of *Milicia* plantation.

Key words: Net barrier, synthetic insecticides, *Phytolyma lata*, *Milicia excelsa*, seedling survival, growth

INTRODUCTION

Milicia excelsa (Welw.) C.C. Berg. Iroko Moraceae is an important timber tree species in Africa. It is distributed across the entire Africa from Sierra Leone, through Central and East Africa to Mozambique (Taylor, 1960; Irvine, 1961; White, 1966; Keay, 1989). *M. excelsa* requires substantial moisture to grow well but not necessarily a high rainfall. Areas with 760-1520 mm mean annual rainfall are suitable for the species (Pukkala, 2000). However, the species has also been reported to grow well under mean annual rainfall as low as 700 mm.

M. excelsa is considered as a light-demanding pioneer tree species which regenerates in disturbed open areas and in logged forest (Hawthorne, 1995). *M. excelsa* wood is one of the most valuable timber species from all of West, Central and East Africa. The wood is extensively used due to its high durability and good working properties. There is considerable demand of *M. excelsa* timber products for decorative and structural uses. The wood is also used for making fences, equipment and other construction purposes, they represents a significant part of the timber and furniture export income to Ghana and Côte d'Ivoire (Nichols *et al*., 1998). The species also plays an important role in erosion control and soil fertility improvement. *M. excelsa* leaves are used as mulch and the species is a tremendous source of shade or shelter and is sometimes used as an avenue tree (ICRAF, 1992).

Several efforts to establish plantations of *Milicia* species by many farmers as well as researchers have been constrained severely by the gall forming psyllid, *Phytolyma lata* which attacks young growing tissues. *P. lata* attack is followed by foliage die-back down to the wood tissue which subsequently leads to total death of the plant in severe situation (Cobbinah and Wagner, 1995). However, the attacks decrease with age, as the old trees tend to be more resistant. According to Cobbinah (1993), a number of chemical have been evaluated for the management of *Phytolyma* attack on *Millicia* species in Ghana but little or no success was recorded. Moreover, other pest management strategies like cultural and biological methods have been implemented to lessen the damage caused by *P. lata* in many West African countries but none of the strategies has had satisfactory impact. In Nigeria, management of *P. lata* to achieve successful establishment of *M. excelsa* plantation has also proven difficult due to the hidden nature of the pest. According to Knipling (1972), integrated approach in Pest Management (IPM) has been encouraged by entomologists and ecologists for adoption in pest control over the years as it allow for a safer means of controlling pests. Therefore, this study assessed the effects of net barriers and synthetic insecticides on *Phytolyma lata* infestation, growth and survival of *Milicia excelsa* in early plantation.

MATERIALS AND METHODS

Experimental site: Field trials were carried out at Teaching and Research Farm of Federal College of Forestry Ibadan, for two years. The Federal College of Forestry Site is located on the latitude 7.50°N and longitude 3.90°E. The climate condition of the area is tropical with an annual rainfall range of 180-700 mm annum^{-1} while the annual temperature is 34.40°C and the daily humidity is about 60% (FRIN, 2011).

Construction of experimental materials: Wooden plank was used to construct a cage-like structure measuring 2×1 m (height and breadth) and was covered with mosquito net (16 mm) mesh leaving the bottom side open. Two colours of net were used (blue and green). A total of 12 cages were constructed with each colour of the net.

Field establishment: The experimental plot measuring 15×15 m^2 was manually cleared with hoe and cutlass. Six months-old uniform sizes of *M. excelsa* seedlings were collected from the screen house at Forestry Research Institute of Nigeria and transplanted on un-tilled land at the spacing

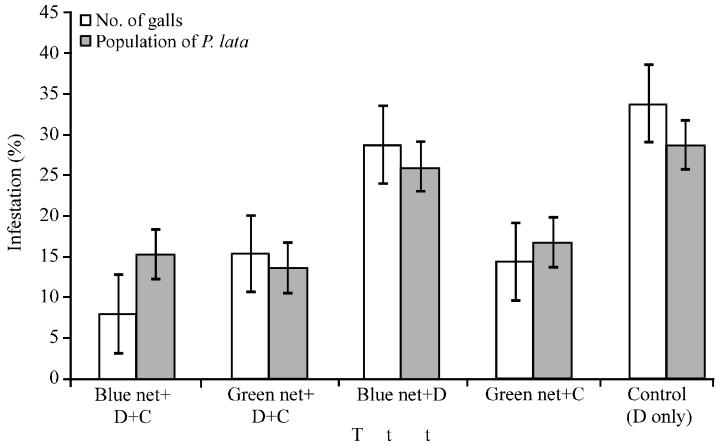

Fig. 1: Effect of different treatments on the infestation of *Milicia excelsa* by *Phytolyma lata*

of 2×2 m at the rate of 1 seedling per stand. The experiment was laid out in a Randomized Complete Block Design (RCBD) and replicated four times. The net barrier cages, colours blue and green were used to cover the plants immediately after transplanting except the control plot. The cages were randomly placed in four replicates per block (Fig. 1). N.P.K fertilizer was administered once to the plants four weeks after transplanting. The plots were weeded manually at four weeks intervals.

Treatment procedure: The procedure of integrating carbofuran (3 G), dimethoate and barrier nets was adopted from Onekutu (2011).

The treatments were as follows:

A: Blue net+dimethoate+carbofuran
B: Green net+dimethoate+carbofuran
C: Blue net+dimethoate
D: Green net+carbofuran
E: Dimethoate only

The integration of the treatments commenced 12 months after transplanting. The dimethoate was applied at the rate of 2.0 mL L^{-1} of water as a foliar spray while carbofuran (3 G) was applied to the soil at the rate of 10 g $plants^{-1}$ using ring methods both at 4 weeks interval. The application of the two insecticides was done separately at two weeks interval. The control plot were sprayed with only dimethoate at two weeks interval.

Data collection: Data were collected on plant height, stem diameter, numbers of galls, *Pytolyma lata* density and plant mortality at monthly interval for two years.

Data analysis: Data collected were subjected to Analysis of Variance (ANOVA) and significant means were separated using Duncan Multiple Range Test (DMRT).

RESULTS

Effect of different treatments on the infestation of *Milicia excelsa* by *Phytolyma lata*: Monthly application of dimethoate and carbofuran on the *M. excelsa* seedling after 12 months of covering with blue and green nylon nets reduced the infestation of *P. lata* significantly ($p<0.05$) by 25.74 and 19.31%, respectively compared to dimethoate only (control). The plants covered with blue net in addition with application of dimethoate and carbofuran recorded least number of galls (7.89%), followed by green net+carbofuran (14.32%). Plots treated with green net+dimethoate+carbofuran recorded least *P. lata* density (13.59%) followed by blue net+carbofuran+dimethoate (15.13%). The plots treated with only dimethoate (control) had highest number of galls and *P. lata* density 33.63 and 28.73%, respectively (Fig. 1).

Effect of different treatments on the growth of *M. excelsa*: The treatments showed a significant differences ($p<0.01$) on the growth of *M. excelsa* in plants height and stem diameter but there was no significant difference ($p>0.05$) on the number of branches. The integrated treatments of monthly application of dimethoate and carbofuran separately at two weeks interval on plants covered with blue net had the highest plant height (122.50 cm), followed by plants covered with green net (105.13 cn), however, they did not significant differ from each other. Similarly, integration of dimethoate and carbofuran on the plants covered blue net had the highest stem diameter (1.03 mm) followed by the green net (0.98 mm). The treatments did not show any significant difference on the number of branches. However, the plant covered with blue net in addition with the application of dimethoate and carbofuran had the highest number of branches (8.75) (Table 1).

Effect of different treatments on mortality and survival of *Milicia excels* seedlings: The barrier nets protected the *Milicia* seedlings from *Phytolyma* attack as to ensuring 100%. *Milicia excelsa* seedling survival at the end of the experiment resulting to zero mortality for the treatments integrated with net of both blue and green colours. The control experiment dimethoate only recorded 54% *Milicia* survival and 46% mortality (Fig. 2).

Table 1: Effect of different treatments on the growth of *Milicia excelsa*

Treatments	Plant height	Stem diameter	No. of branches
Blue net+dimethoate+ carbofuran	122.50^{a}	1.03^{a}	8.75^{a}
Green net+dimethoate+carbofuran	105.13^{a}	0.98^{a}	5.50^{ab}
Blue net+dimethoate	75.72^{b}	0.72^{b}	4.75^{ab}
Green net+carbofuran	73.35^{b}	0.67^{b}	4.00^{ab}
Dimethoate only	47.20^{b}	0.62^{b}	3.50^{b}
GA	84.78	0.80	5.30
CV%	22.28	16.27	56.63
Level of significance	**	**	Ns

Mean values followed by of the same letter in a column are not significantly different at 5% level of probability, **Significant at 1% level of probability, NS: Not significant, GA: General average, CV%: Percentage coefficient of variation

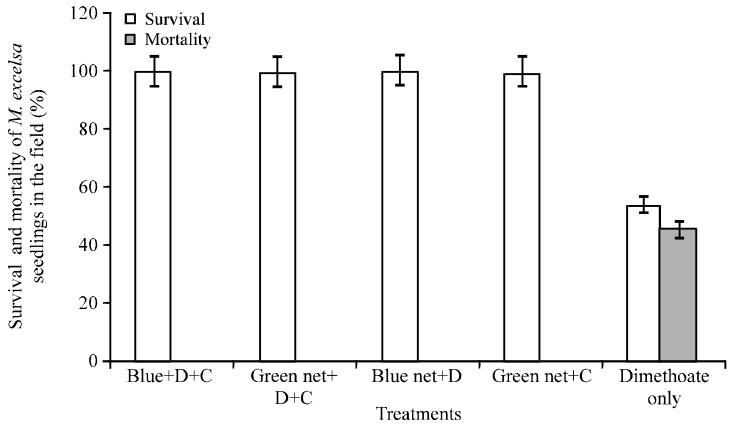

Fig. 2: Effect of different treatments on the mortality and survival of *Milicia excelsa* seedlings

DISCUSSION

Integration of barrier nets of blue and green colours with synthetic inscticides (dimethoate and carbofuran) against *P. lata* infestation on *Milicia excelsa* showed a very highly promising control measure of *P. lata* on *M. excelsa* at the early stage in the field. The integrated approach of blue and green net barrier recorded a significant success over the use of synthetic insecticides only (control) on the rate of infestation by *P. lata*. The *M. excelsa* plants covered with the blue and green nets did not have any infestation for a period of one year. This results corroborate the earlier report by Rahaman and Prodhan (2007) that zero pests infestation was observed in cucumber plants under the net barrier. The *M. excelsa* attained a height of 1.12 and 1.10 m on the blue and green nets, respectively at the end of one year. This result validates the earlier report by Ofori and Cobbinah (2007) that the less susceptible ones may grow up to 1.8 m high in a year. It also implies that the shading by the net did not affect the plant growth through reduction in light intensity that may be required by the plant. This study also revealed that nylon net (16 mesh) used is adequate in preventing the adult *P. lata* from gaining access to the plant to lay eggs. Moreover, it implies that the first instar nymphs that usually initiate gall formation is not active crawler which can migrate from one plant to another. Furthermore, the colours of the nets (blue and green) could serve as deterrence to *P. lata* in identifying *M. excelsa* plant. Moreover, the covering of *Milicia* seedling with the nets in the field reduces the intensity of sunlight on the plant thereby enhancing the increase in plant height. This view is in line with the report by Wagner *et al.* (1996) that at the lowest levels of sunlight (18%) seedlings were 50% taller than in 57% sunlight and 100% taller than in full sunlight. This implies that *M. excelsa* seedlings do not require full sunlight for growth. There was 100% survival of *Milicia* seedlings covered with nets after two years. This implies that net barriers (16 mesh) can adequately protect *Milicia* plants from *P. lata* attack for a very long period if proper maintenance and other control measures are incorporated.

Therefore, use of barrier nets in the field is a promising approach in the management of *P. lata* infestation for successful plantation establishment. The barrier will protect the plant from early attack that subsequently leads to death of the plant in severe situation. At a year old, the root system has developed and it will facilitate regeneration after the attack and subsequently prevent die back of the plant stem shoot. Ofori and Berg (2007) reported that the regeneration rate of *Milicia* in Ghana during the 1980s was anticipated to be about 29,000 m^3 $year^{-1}$. This implies that *M. excelsa* has ability to regenerate.

Use of barriers are environmentally friendly way of keeping pests large or small from attacking valuable crops. Use of barrier nets has been successfully used by several scientists to control insect pests of vegetable and fruits in the garden. Apart from the environmental and health safety, net barrier are cost efficient compare to use of chemicals.

CONCLUSION

The use of net barrier was found to provide adequate protection from *P. lata* attack. A physical barrier preventing the adults from reaching the stem to lay their eggs is a potential control method and since mosquito netting is widely available in Nigeria it could be easily procured by farmers for such purpose. Subsequent incorporation of the systemic insecticides such as carbofuran after some times when the net is getting worn out is ideal and is environmentally safe and should be adopted for raising *Milicia excelsa* seedling in the field.

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