ASSESSMENT OF *KHAYA SENEGALENSIS* (MELIACEAE, (DESV.) A. JUSS) SEED EXTRACT ON THE INCIDENCE AND POPULATION OF *SYLEPTA DEROGATA* (F.) OF COTTON IN ZARIA, NIGERIA

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Abstract
Field trials were conducted at two locations in Samaru (11^0 $11^{''}$ N, 07^0 $38^{''}$ E and 686m above sea level) and Maigana (11^0 $10^{''}$ N, 07^0 $37^{''}$ E and 675m above sea level) both in northern guinea savannah ecological zone of Nigeria during 2016 wet season to assess the efficacy of three concentration of aqueous Khaya seed extract (KSE) (20%w/v, 30%w/v and 40%w/v) on the incidence and population of cotton leaf roller (Sylepta derogata F.). The experimental design was Randomized Complete Block Design. Four sprays at 2 weeks interval, beginning from nine WAS were applied. Data were recorded on the incidence and population of the leaf rollers. Significantly lower incidence of cotton leaf roller was recorded on Lambda cyhalothrin (5.06%) and 40%w/v KSE (9.91%) than 30%w/v KSE (20.54%), 20%w/v KSE (23.64%) and the untreated (29.20%). Similarly, the population of the cotton leaf roller recorded from spray application of Lambda cyhalothrin (1.27) and 40%w/v KSE (2.04) were significantly lower than 30%w/v KSE (3.14), 20%w/v KSE (3.45) and untreated control (4.62). Application of KSE were found to be more effective in reducing the incidence and population of cotton leaf roller on the cotton variety.

***Key Words**: Cotton Leaf Rollers, Maigana, Lambda cyhalothrin, Fibre*

Introduction

Cotton is an important cash crop grown in more than 90 countries, mainly in developing countries (Davis *et al*., 1998). Cotton is essentially produced for its fibre, which is universally used as textile raw material and an important commodity in the world economy (Aiken, 2006). In Nigeria, it forms an important cash crop of considerable economic importance cultivated for its fibre and oil. The average yield of the crop on farmers field is about 400-500Kg seed cotton per hectare which is below the genetic yield potential (2.5-3.0 tons/ha) of the commercial varieties (Ogunlela, 2004). This is constrained by the prevalence of pests (Obeng-Ofori, 2007; Brevault *et al*., 2009; Mapuranga *et al*., 2015) which causes the greatest yield loss annually and also affects fibre quality (Hussain and Tahir 1993; Nahunnaro *et al*., 2007), leading to a down turn of the fortunes of the textile industry.

The pest pressure due to which crop loss becomes very high, drives growers to adopt all tactics which may not be really suited to the given situation and may ensure failure of such efforts (Jothi, 2007). The cotton leaf roller is currently the major foliage moth causing serious damage on cotton crop, occurring throughout the rain-fed cotton-growing areas of Africa and Asia (Hill, 1983; Matthews, 1989). In Nigeria, the pest has been accorded higher status being the major foliage moth causing significant damage on cotton (Onu *et al*., 1989). The larvae feed on leaf margins causing the leaves to curl and droop by spinning webs around the curled leaves, within which they feed and shelter (Amatobi, 2007).

Several young larva may feed together within one curled leaf which may lead to skelerotization, defoliation, impaired bud formation and premature fruit ripening. The solar energy trapping efficiency of infested leaf is thus impaired leading to premature boll shedding with yield reduction ranging from 7-35% (Onu, 1989). The effect on yield will depend on the extent of defoliation, but locally serious infestations can retard plant growth. The yield losses have increasingly become widespread and unabated, and yield losses of up to 50% have been reported in the northwest ecological zone of Nigeria (Yahaya, 2008). The pest is readily controlled by parasitoids, especially *Apanteles spp*. (Odebiyi, 1982). Traditionally, physical containment of the crop, removal of the insects, and cultural practices such as crop rotation, intercropping and time of sowing have provided some degree of control in peasant communities and low-input agricultural systems (Gatehouse, 1991). However, modern high intensity agriculture, which has been responsible for large increases in lint yield, is dependent on the use of chemical pesticides (Yahaya *et al*., 2012). This is due to the fact that cotton is one of the most sensitive to pest attack and chemically intensive among all field crops (Pimentel *et al*., 1993; Abro, 2003; Greenberg *et al*., 2012). Undoubtedly, this strategy has numerous apparent drawbacks on both the environment and user (Yahaya *et al*., 2012). Application of insecticides particularly pyrethroids at 10-15 days interval in the absence of their parasites killed by the sprays has resulted in severe outbreak of sylepta in some areas (Matthews, 1989). This has prompted the need for the development of non-insecticidal alternatives that could be viable and effective, while also being compatible with the environment (Kranthi, 2016). Hence the desire for biopesticides from botanical sources rather than synthetic chemicals, using plants extract possessing pesticidal properties. Plants are the most efficient producers of phytochemicals in the environment, including secondary metabolites that are used by the plant in defense against phytophagous insects (Ahmad, 2007). Plant extracts have the advantage that they contain a mixture of compounds which may significantly reduce the chances of tolerance or resistance build-up by insect pests (Thacker, 2002). One of such plant is mahogany (*Khaya senegalensis*; Meliaceae) highly rich in limonoids (Paritala *et al*., 2015), and no exploitation recognized regarding its phytochemical constituents (Satti and Elamin 2012). The objective of the study was to evaluate the effect of different rates of KSE on the incidence and population of cotton leaf roller infesting Samcot-9.

Material and Methods

Experimental Sites, Land Preparation and Experimental Lay-Out: The study took place during the 2016 wet season at two different locations situated in Institute for Agricultural Research (I.A.R) farm Samaru, (11^0 $11^'$ N, 07^0 $38^'$ E and 686m above sea level) and Kaduna State Agricultural Development Agency (K.A.D.A) research farm in Maigana (11^0 $10^'$ N, 07^0 $37^'$ E and 675m above sea level) both in northern guinea savannah ecological zone of Nigeria. The study areas have mean annual rainfall of 1016mm, maximum and minimum temperatures of 32.2°C and 23.5°C respectively. The field for the experiments were ploughed, harrowed and ridged at 0.90m inter-row spacing.

The treatments consisted of 3 concentrations of *Khaya* seed extracts (KSE) of 20% w/v, 30% w/v and 40% w/v (200g, 300g and 400g/L of water), an insecticidal check (Lambda-cyhalothrin 25g ai/litre EC) and untreated control replicated 4 times in a strip plot fitted into randomized complete block design (RCBD) with a plot size of 4.5m x 4.5m (Gross plot of 6 rows and 4.5m long) and 3.5m x 2.7m (Net plot of 4 rows and 3.5m long). Plots within replication were separated by a 1.5m alley while replications were separated by a 2.0m alley.

Seed Material and Sowing: The cotton variety used was SAMCOT-9 obtained from Cotton Research Programme of Institute for Agricultural Research (IAR). It's an erect, hairy and medium staple cultivated commercial variety adapted to the North-West cotton growing zone of Nigeria under rain-fed conditions. Maturity period is between 130-150 days with a potential yield of 1500-2000Kgha^{-1}. The seeds were treated with Dress Force 42WS (Imidacloprid 20% + Metalaxyl-M 20% + Tebuconazole 2%) 8g/Kg before sowing. Seeds were sown at 4 seeds per hole at a depth of 3cm, 90cm inter-row spacing and 45cm intra-row spacing on prepared ridges. Emerged seedlings were thinned to two plants per stand 3WAS. A mixture of Paraquat and Butachlor as Pre-emergence at the rate of 1 litre/ha was applied. Supplementary hoe weeding was done especially at the critical periods of weeds interference. Fertilizer was applied at the recommended rate of 60: 13: 25 Kg/ha using NPK 15:15:15 at 3WAS, and Urea was used for top dressing at 8WAS.

Preparation and Application of *Khaya* Seed Extract: Matured seeds of *K. senegalensis* collected around IAR and Savanna Forestry Research Station in Samaru, Zaria, were air-dried and pounded with a wooden pestle and mortar. The pounded seeds were pulverized and weighed into lots of 200g, 300g and 400g separately and soaked in 1000ml of tap water inside plastic bucket and allowed to stand for 48hrs but continuously stirred at 24hrs interval. The contents of each bucket were filtered with 500ml of water with the aid of a double-layer cheese cloth, after which 300ml of 5% w/v starch and flaked soap (50g each/1000ml of water) were added to each crude extract. The crude seed extracts were applied at the rate of 100ml/L of water (10% v/v) per plot while insecticidal check (Lambda cyhalothrin 2.5EC) was applied at the rate of 10ml/L of water (1%v/v) per plot with Knapsack sprayer with no application to untreated control. Four applications were carried out at 2weeks interval at different phenological stages of the crop.

Data collection and Analysis: Data were collected from twenty randomly selected plants from the net plot (9.45m^2) and number of plants with *Sylepta sp.* infestation were assessed, counted and percentage incidence was determined from total number sampled. Data on Sylepta population were obtained from three randomly selected rolled leaves per plant from five randomly selected plants, and number of larvae found on each leaf were counted. Data on percentage incidence were transformed using arcsine transformation while data on Sylepta population were transformed using square root transformation. All transformed data were subjected to analysis of variance (ANOVA) using Statistical Analysis System (SAS) software (version 9.0). Mean differences among treatments were separated using Students Newman's Keul test (SNK) at *P=0.05*.

Results and Discussion

Effect of Aqueous *Khaya* Seed Extract on the Incidence of *Sylepta derogata* on Cotton at Samaru and Maigana in 2016 Wet Season.

There were significant differences (P≤0.05) on the incidence of leaf roller on cotton both in Samaru and Maigana with the applications of different rates of KSE 2weeks post spray application (Table 1 and Figure 1). At Samaru, both Lambda cyhalothrin (5.7%) and 40%w/v KSE (9.5%) recorded similar and significantly lower (P≤0.05) incidence of leaf rollers than the other KSE (30%w/v; 18.5%, 20%w/v; 20.4%) and untreated control (30.0%) which had higher incidence. Similarly, at Maigana, significantly lower (P≤0.05) incidence of leaf roller were recorded from Lambda cyhalothrin (4.4%) and 40%w/v KSE (10.3%) than 30%w/v KSE (20.7%), 20%w/v KSE (28.8%) and untreated control (28.5%).

The result of the two locations combined followed similar trends with Lambda cyhalothrin (5.1%) and 40%w/v KSE (9.9%) having significantly lower (P≤0.05) incidence of leaf roller than 30%w/v KSE (19.6%), 20%w/v KSE (24.6%) and untreated control (29.3%) which recorded highest incidence. However, all the KSE resulted in significantly lower (P≤0.05) incidence of leaf roller than untreated control. The result indicated that use of KSE at rate as high as 40%w/v was effective as Lambda cyhalothrin in reducing the incidence of cotton leaf roller. This could be as a result of more concentration of the active ingredient limonoid especially in 40% w/v KSE. This compound is known to possess potent anti-insect properties (Paritala *et al.*, 2015) as well as antimicrobial properties (Govindachari and Krishna Kumari 1998; Roy and Saraf, 2006), hence the better efficacy. Yahaya *et al.* (2012) reported about 21% infestation of Samcot-9 variety by cotton leaf roller under natural condition 80DAS. Application of Kaolin particle formulation on cotton have been found to significantly reduce the incidence of *Spodoptera littoralis*, *Sylepta derogata* and *Earias spp*. on treated plants (Alavo *et al.,* 2010). Application of insecticidal spray on Samcot-9 variety planted at different sowing dates has also shown to significantly lower incidence of leaf roller than in unsprayed plants (Kuchinda *et al.,* 2002).

Table 1: Effect of K*haya* seed extract on Incidence of leaf roller on cotton in Samaru and Maigana during the 2016 wet season

	Mean Incidence of Sylepta 2weeks after treatment (%)		
Treatment	Samaru	Maigana	Combined
KSE (%w/v)			
20	20.4b	28.8a	24.6b
30	18.5b	20.7b	19.6b
40	9.5c	10.3c	9.9c
Lambda cyhalothrin	5.7c	4.4d	5.1d
Untreated control	30.0a	28.5a	29.3a
SE±	2.106	2.477	1.679
Significance	*	*	*
Mean	16.8	18.5	17.7

Means followed by same letter(s) within the same column are not different statistically at *P=0.05* using SNK.
*= Significant at (P≤0.05).

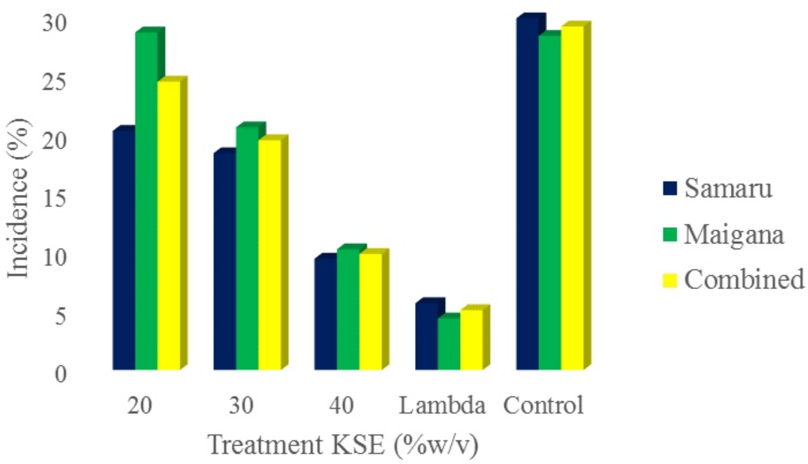

Fig. 1: Mean percentage incidence of *Sylepta derogata* as affected by KSE, Insecticidal check and control

Effect of Aqueous *Khaya* Seed Extract on the Population of *Sylepta derogata* on Cotton at Samaru and Maigana in 2016 Wet Season.

Spray applications of different rates of KSE recorded significantly lower (P≤0.05) population of cotton leaf roller in Samaru and Maigana 2weeks post spray application (Table 2 and Figure 2). At Samaru, both Lambda cyhalothrin (1.7) and 40%w/v KSE (2.4) recorded similar and significantly lower (P≤0.05) population of leaf roller than the other KSE (30%w/v (3.7), 20%w/v (4.1)) and untreated control (5.8) which had higher population. Similarly, at Maigana, significantly lower (P≤0.05) population of leaf roller were recorded from Lambda cyhalothrin (0.8) and 40%w/v KSE (1.7) than 30%w/v KSE (2.6), 20%w/v KSE (2.8) and untreated control (3.4).

The result of the two locations combined followed similar trends with Lambda cyhalothrin (1.3) and 40%w/v KSE (2.1) having significantly lower (P≤0.05) population of leaf roller than 30%w/v KSE (3.2), 20%w/v KSE (3.5) and untreated control (4.6) which recorded highest population. The result showed that all the KSE resulted in significantly lower (P≤0.05) population of leaf roller than untreated control, which indicated that the use of KSE at rate as high as 40%w/v was effective when compared with Lambda cyhalothrin in reducing the population of cotton leaf roller. Onu (1990) reported that *S. derogata* population was affected by planting dates with early sown cotton having higher population than late sown cotton. Ch. Sammaiah *et. al*. (2014) reported that Bt cotton recorded lower population of *S. derogata* than Non-Bt cotton under two years of extensive field survey of insect defoliators of cotton in Warangal (India). Lin *et al*. (2015) reported that population densities of *S. derogata* under field plots trial were 46–110 times greater on velvetleaf than on cotton, while commercial field trials indicated that *S. derogata* density and leaf damage were 79–90 % and 83–94 % lower in cotton fields inter-planted with sprayed velvetleaf strips than without them when used as a trap crop.

Table 2: Effect of *Khaya* seed extract on Population of leaf roller on cotton in Samaru and Maigana during the 2016 wet season

	Mean Population of Sylepta 2weeks after treatment		
Treatment	Samaru	Maigana	Combined
KSE (%w/v)			
20	4.1b	2.8a	3.5b
30	3.7b	2.6b	3.2b
40	2.4c	1.7c	2.1c
Lambda cyhalothrin	1.7c	0.8d	1.3d
Untreated control	5.8a	3.4a	4.6a
SE±	0.467	0.120	0.246
Significance	*	*	*
Mean	3.5	2.3	2.9

*= (P≤0.05). Means followed by same letter(s) within the same column are not different statistically at *P=0.05* using SNK.

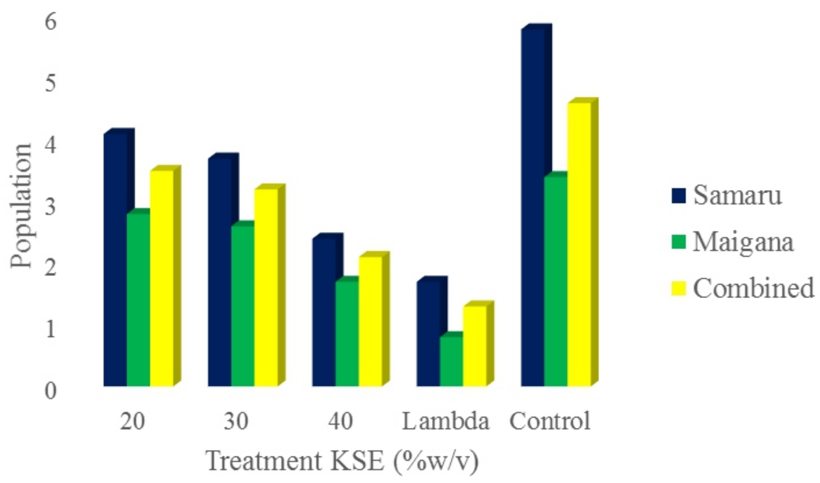

Fig. 2: Mean population of *Sylepta derogata* as affected by KSE, Insecticidal check and control

Conclusion

Application of aqueous KSE in this study was found to be effective in reducing the incidence and population density of cotton leaf roller on SAMCOT 9 variety, especially at 40%w/v. This was comparable to the synthetic insecticidal check and showed its potential as a good alternative for reducing cotton leaf roller infestation on cotton. This can be considered for incorporation into an IPM strategy for effective management of cotton leaf roller.

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