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EFFECTS OF HOT NEEM LEAF EXTRACT CONCENTRATIONS ON SOME MAJOR INSECT PESTS OF EARLY MATURING SOYBEAN IN ASABA AND THE IMPACT ON YIELD

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Abstract

Five hot neem leaf extract concentrations (5%, 10%, 15% and 20% and 0% untreated control) were evaluated in the field, during the early and late planting seasons of 2012 to determine their efficacy at the control of some major insect pests of soybean in Asaba, Southern Nigeria. The experiments were conducted in a randomized complete block design consisting of 5 treatments replicated three times. Data on insect prevalence were subjected to simple percentage calculation while yield data were subjected to analysis of variance and treatment means separated using Duncan Multiple Range Test (DMRT) at 5% level of significance. All Hot Neem leaf extract concentrations were able to effectively reduce the population of major insect pests of the crop. Pests population reduced with increase in the concentrations of the extracts. Control plots had 51 insect pests, 5% Hot Neem Extract (HNE) had 30, 10% HNE had 26, 15% 24 while 20% HNE had 18 insects. Late season planting recorded higher insect population, with the control having 66 insects while 20% had 16 insect pests. Highest yield was obtained at 20% HNE plots which had 113 undamaged seeds (2.0t/ha), followed by 10%, with 102 undamaged seeds (2.1 t/ha), 15%, had 76 (1.2 t/ha), 5%, had 77 (1.3 t/ha) while had 100 undamaged seeds 1.4 t/ha. The yield obtained in the late season was generally low perhaps due to sowing date effects. 20% HNE which performed better than other concentration evaluated is therefore recommended for farmers in the area for the control of major insect pests of soybean.

Keywords: *Neem extracts, soybean, percentage prevalence, concentration*

Introduction

Soybean, *Glycine max* (L) Merrill is an important grain legume in the drier savannah parts of the tropics and subtropical areas including Nigeria. It is rich in oil, protein and is used for both human and animal consumption as well as for industrial purposes, such as bio-fuels (Singh, 2010). The crop has an erect, bushy and annual growth and its form and structure varies vastly (Guo, 1993). The largest producer of soybean in both West and Central Africa is Nigeria where the bulk production is from Benue State (Root Oyekan and Dashiell, 1987). Generally speaking, Agriculture is confronted with the challenges of maximizing sustainable pest management strategies. Major constraints to optimal yield of soybean is the decimation and menace caused by insect pests like the stem feeders, leaf feeders, hemipteran pod sucking bugs, (Jakai, 1993; Arokoyo, Oyibe, Olowoniyan and Chindo, Sinclair, Kogan and McGlamery, 1997, Omoloye, Joda and Tobih, 2015).

In Nigeria, most farmers rely on synthetic pesticides for the control of pests and diseases of their crops. Incidentally, the cost of procuring these pesticides and their availability discourages most rural farmers thereby exposing their farms to the risk of heavy pest infestation which

sometimes result in drastic reduction in yield. Consequently, increasing public concerns and awareness to environmental hazards associated with the use of synthetic pesticides for the control of pests cannot be over-emphasized. In this regard, Neem (*Azadirachta indica* A. Juss) which is plant based bio-degradable, less toxic and environmental friendly is now being relied upon by some farmers as a result of its insecticidal properties against a number of pests. It was reported that aqueous extracts of neem seeds marginally reduced population density of flower thrips (*Megalurthrips sjostedti* and larvae of *Maruca vitrata* but had no effect on cowpea flower buds, flower damage and did not reduce the population density of pod sucking bugs. Meanwhile mean yield was marginally higher than the control (Ivbijaro and Bolaji, 1990).

Materials and Methods

Study area

The field experiments were carried out at the Faculty of Agriculture Teaching and Research Farm Delta State University, Asaba Campus, during the early (April – July) and late season (August – December) planting of 2012. The study area is located at Latitude 6° 14'N and Longitude 6° 49'E. Rainy season lasts between April and October with mean annual rainfall of 1500mm – 2000 mm with peak in July/September. Mean temperature is 23.3°C, maximum, while mean monthly soil temperature at 100cm depth is 28.3°C. Mean relative humidity is 77.2% with a monthly sunshine of 4.8 bars (Federal Ministry of Aviation Meteorological Station, Asaba, 2011).

The soybean variety TGX 1987 – 91F used in the study was procured from International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria. The experiment consisted of five treatments namely: 0%, 5%, 10%, 15% and 20% of hot neem extract concentration, arranged in complete randomized complete block design and replicated three times. The experimental plots measured 4.5m x 0.5m with two seed sown per stand and later thinned to one, planted at 25cm depth, spaced 75cm x 10cm and separated by 1.0m meter pathway.

Preparation of Hot Neem Leaf Extract Concentrations

Fresh leaves of neem were collected and air dried at room temperature in the laboratory. The dried leaves were grounded to powder and weighed into 50g for 5%, 100g for 10%, 150g for 15% and 200g for 20% for each level of concentration. Each weighed extract was soaked in one litre hot (100°C) water for 24 hours before filtering through a clean muslin cloth with additional water added to make up one litre of filtrate. The experimental site was manually cleared and tilled before planting. Weeding commenced two weeks after planting and all farm were done manually. Application of neem extracts commenced one month after planting and continued weekly till first harvest but no synthetic pesticide was applied and no record of previous application of same. Neem extracts were applied early in the morning between the hours of 6:30am to 7:30am on a sunny day using a knapsack sprayer and spraying all plants parts to runoff.

Data collection and statistical analysis

Data on insect pests were collected as from 4 weeks (a day after spraying), running through the vegetative phase weekly till first harvest. Insect collection was done in early hours of the day when they were less mobile and active with a sweep net and hand picking. Collected insects were counted and recorded according to the plot treatments.

Data on seed damage were collected at 16 WAP. Pods were shelled and seeds were sorted into damaged and undamaged from respective plots. The seed lots were weighed thereafter with a Metler 1012 (0.01g) weighing balance. Data were also collected on plant height (cm), number of pods/plant, number of seed/pod, 100 seed weight (g) and grain yield ton/ha. The relative abundance of each insect species collected were identified with comparison with paratype and further identification from insect identification meusum, Crop Protection and Environmental Biology, Department, University of Ibadan, Ibadan, Nigeria.

Results

The effects of Hot Neem Leaf extract concentrations on the prevalence of insect pests of early maturing soybean are presented on Table 1. The results showed that *Cerotoma trifurcate* was the most prominent insect pest during the early and late planting season of 2012, while *Hypena scabra* was least observed insect in late planting. The Neem extracts were able to significantly reduce the population of insects when compared with the untreated plots of both early and late planting seasons. Higher concentrations showed better performance and efficacy on the insect pests of the crop. During the early planting, untreated plot had a total number of 51 insects, treated plots had 30, 26, 24, 18, insects at 5%, 10%, 15% 20% concentration respectively. Late plantings untreated plot had 66 insects, while treated plots recorded 45, 29, 17 and 16 insect pests at 5%, 10%, 15% and 20% concentrations respectively. Higher numbers of insects were collected during the late season than in the early season plantings. It does appear that 20% Hot Neem extract concentrations showed better performance at controlling the insect pests of the soybean crop.

Effect of hot Neem leaf extracts concentrations effects on yield and yield parameters on soybean

The results of yield and yield parameters of soybean in response to treatments with Neem extracts during the early and late plantings are presented in Tables 2 and 3. The two tables showed that the early planting performed significantly was better than late planting. There were significant differences ($P < 0.05$) among treatments in terms of number of pods, undamaged seeds, damaged seeds, 100 seed weight and seed yield of both early and late plantings. It was however, observed in Table 2 that 5% Hot neem leaf extract had highest mean plant height at harvest (45.56cm) while 20% Hot neem extract had the least mean height of 40.33cm. 20% Hot neem extract had highest pod yield (66.39), while the least mean pod yield was recorded at 5% concentration (53.00). 20% HNE concentration recorded the highest undamaged seeds (113.11) followed by 10% (102.67) while the least undamaged were recorded at 15% HNE (76.61) and (77.89) 5% HNE concentrations respectively. Varied degrees of damaged seeds were recorded at all the concentrations including the control but highest damaged seeds of (13.40) were recorded at 10% HNE while the least (10.70) was at 5% HNE concentrations (Table 2).

Table 1: Effects of Hot Neem Leaf Extracts on the Percentage Prevalence of some Major Insect Pests of Soybean *(Glycine max)* **during 2012 Early and Late Season Planting in Asaba.**

Neem Extracts	*Insect Species*	*No. of insects*	*EARLY Prevalence (%) 100*	*No. of insects*	*LATE Prevalence (%) 100*
Untreated	Cerotoma trifurcate	*18*	*35.3*	*20 ,*	*30.3*
	Colaspis brunnea	*5*	*9. 9*	*17*	*25. 8*
	Odontota horni	*6*	*11.8*	*14*	*21.2*
	Podagrica furcicornis	*18*	*35.3*	*7*	*10.6*
	Pseudoplusia includens	*1*	*2.0*	*5*	*7.6*
	Hypena scabra	*3*	*5.9*	*3*	*4.5*
	Sub Total	*51*		*66*	
5%	Cerotoma trifurcate	*10*	*33.3*	*13*	*28.9*
	Colaspis brunnea	*1*	*3.3*	*14*	*31.1*
	Odontota horni	*8*	*26.7*	*7*	*15.6*
	Podagrica furcicornis	*8*	*26.7*	*3*	*15.6*
	Pseudoplusia includens	*2*	*6.7*	*2*	*6.7*
	Hypena scabra	*1*	*3.3*	*1*	*2.2*
	Sub Total	*36*		*45*	
10%	Cerotoma trifurcate	*7*	*26.9*	*9*	*31.0*
	Colaspis brunnea	*5*	*19.2*	*6*	*20.7*
	Odontota horni	*6*	*23.1*	*7*	*24.1*
	Podagrica furcicornis	*6*	*23.1*	*2*	*6.8*
	Pseudoplusia includens	*1*	*3.8*	*4*	*13.8*
	Hypena scabra	*1*	*3.8*	*1*	*3.4*
	Sub Total	*26*		*29*	
15%	Cerotoma trifurcate	*8*	*33.3*	*4*	*23.5*
	Colaspis brunnea	*2*	*8.3*	*2*	*11.8*
	Odontota horni	*4*	*4.2*	*0*	*0.0*
	Podagrica furcicornis	*1*	*45.8*	*5*	*29.4*
	Pseudoplusia includens	*1*	*4.2*	*3*	*17.6*
	Hypena scabra	*1*	*4.2*	*3*	*17.6*
	Sub Total	*24*		*17*	
20%	Cerotoma trifurcate	*4*	*22.2*	*3*	*18.8*
	Colaspis brunnea	*1*	*5.6*	*5*	*31.3*
	Odontota horni	*2*	*11.1*	*3*	*18.8*
	Podagrica furcicornis	*4*	*22.2*	*2*	*12.5*
	Pseudoplusia includens	*5*	*27.8*	*2*	*12.5*
	Hypena scabra	*2*	*11.1*	*1*	*6.3*
	Sub Total	*18*		*16*	
	Total	*EAR*		*LATE*	
	Grand Total	*51+104*		*66*	+

Highest 100 seed weight value of 13.7g was recorded at 10% HNE followed by the control plot 12.70g, while 5% had the least 100 seed weight of 10.70g. There were no significant ($P \geq 0.05$) difference between 15% and 20% concentrations in terms of damaged seed and 100 seed weights (Table 2). Table 3 showed the seed yield of soybean treated with hot neem extract at different concentrations. At the highest concentration of 20% HNE, the seed yield was 1.4t/ha which was significantly higher than other evaluated concentrations.

Table 2: Mean yield and yield related parameters of soybean after treatment with Neem leaf extracts during early planting season of 2012 in Asaba

Neem extract conc.	Plant height at harvest (cm)	No of Pods/plant	No of seeds per pod	No of undamaged seeds	Damaged seeds	100 seed weight (g)	Seed yield t/ha
0 (untreated)	41.28a	57.56ab	2a	100.50ab	12.90ab	12.70ab	1.4ab
5% Hot	44.56a	53.00b	2a	77.89b	10.70b	10.70b	1.3ab
10% Hot	41.39a	54.78b	2a	102.67ab	13.40a	13.70a	2.1a
15% Hot	40.44a	54.72b	2a	76.61b	12.10ab	12.10ab	1.3ab
20% Hot	40.33a	66.39a	2a	113.11a	11.70ab	11.00b	2.0a

*Means followed by the same letters are not significantly different at 5% level of probability Duncan's Multiple Range Test

In table 3, 5% Hot Neem extract attained the highest plant height at harvest of 39.06 cm, followed by 10% Hot Neem extract 36.67 cm and untreated plots had the least plant height of 33.89cm. It was also observed in the late planting that 20% and 10% HNE had the highest number of pod yield (42.94 and 41.44t/ha respectively). The number of damaged seeds recorded in table 3 showed that 5% HNE had the least number (9.90), while 10% had the highest number of damaged seeds (12.57). Results on 100 seed weight also showed that HNE had the highest weight of 12.67g, while 5% HNE recorded lowest 100 seeds weight of 10g. The 100 seed yield t/ha followed similar trend. 5% HNE had the least value of 0.8g as seed yield which is significantly lower than 10%, 5%, 20% and the control.

Table 3: Mean yield and yield related parameters of soybean after treatment with Neem leaf extracts during late planting season of 2012 in Asaba

Neem extract conc.	Plant height at harvest (cm)	No of Pods/plant	No of seeds per pod	No of undamaged seeds	Damaged seeds	100 seed weight (g)	Seed yield t/ha
0 (untreated control)	33.89a	36.83ab	2.00a	62.28ab	11.77ab	11.67ab	1.2ab
5% Hot	39.06a	28.72b	2.00a	49.89b	9.90b	10.00b	0.8b
10% Hot	36.67a	36.09ab	2.00a	65.00ab	12.57a	12.67a	1.3ab
15% Hot	35.89a	36.06ab	2.00a	65.06ab	11.50ab	11.67ab	1.2ab
20% Hot	34.22a	42.94a	2.00a	80.22a	10.27ab	11.33ab	1.4a

*Means followed by the same letters are not significantly different at 5% level of probability Duncan's Multiple Range Test

Discussion

Neem extract which contains phyto chemical properties called Azadarchtin is known to be an anti-feedant with its derivatives reported to provide broad spectrum control over 200 species of phytophagous insects (Ascher, 1993; Xie, *et al*, 1995, Zenhnder and Warthen, 1998). The array of occurrence of soybean insect pests encountered in this study was significantly reduced by Hot Neem extracts (HNE) at varied concentrations. However, the efficacy and potency concentration appeared more effective than others evaluated.

Earlier studies revealed that the diverse effects of Azadarachtin on insect pests include feeding deterrence, reproduction disturbance and insect growth regulation. (Emosairue and Ukeh, 1996; Ivbijaro and Bolaji, 1990). The level of infestation of these insects reduced as the concentration levels of the neem leaf extracts increased. Results from insect prevalence table showed how various concentration levels of leaf extracts exerted control effect on the insect pests of the crop, though outright killing of the insect was not observed. Insects only showed avoidance to treated plots due to increased concentration levels. This corroborated earlier studies which reported that most insects avoid feeding on neem treated products due to phaodeterence or the presence of anti-nutritional factors (Emosairue and Ukeh; 1996, Schumtterer; 1995, Saxena, 1987; Jakai and Oyediran, 1991; Jakai, 1993).

The performance of the early season planting was better than that of late planting; probably due to planting dates effect. Singh (2010) noted that too late sowing of soybean results in drastic reduction in yield. According to the United States Agency for International Development in its Commercial Crop production series on growing early maturing soybean in the forest zone of Nigeria, recommends middle of July to the end of July for the planting of the crop. It went further to state that a timely sown soybean crop generally results in higher yields than late sown crops. According to Okonmah (2012), average plant height at harvest stands between 40cm to 50cm, depending on variety and prevailing environmental factors. The 100 seed weight and seed yield (t/ha) obtained in this study though low agreed with earlier findings of Adebisi, *et al.* (2013) and Okonmah (2012). Supporting the above; USAID Commercial Crop Production

Guide Series "Growing Soybeans in Nigeria" revealed that with good management practices, a grain yield of 1 to 2 t/ha is obtainable in Nigeria.

Conclusion

The study investigated the effects of Hot Neem Leaf Extract concentrations on the insect pests of early maturing soybean and its impact on yield and yield related parameters. Results showed that Hot Neem Leaf Extracts (HNE) were able to manage appreciably the insect pests of the crop. Higher concentration of 20% performed better than other concentration evaluated, therefore recommended for effective control of major insect pests of soybean in Asaba as it could be an alternative cheap source of insect pests control due to its availability, accessibility and environmental friendly properties.

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