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Impact of cold concentrations of neem leaf extract and their efficacy on some identified insect pests associated with soybean (*Glycine max* (l) Merrill) in Asaba, Nigeria

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Abstract

Abstract

This study identified and categorized some insect pests associated with soybean and the damage caused during the early and late planting seasons of 2021. Five treatments (50g, 100g, 150g, 200g Neem Leaf Cold Extract and Control were laid out using Randomized Complete Block Design with four replicates, while data on insects were calculated to know their relative abundance (%) after being subjected to identification and classification. Thirteen insect species from 5 orders and 8 families were identified at early planting, while 9 insect species from 4 orders and 4 families were identified at late planting season. Insects of the orders; *Coleoptera, Lepidoptera, Hemiptera, Orthoptera* and *Diptera* were identified. *Coleoptera* had a higher prevalence level. Pest infestation was higher at late planting. Damages caused by insect pests ranged from leaf defoliation, leaf scarification, and sap-sucking to pod sucking. Neem leaf cold extract (NLCE) concentrations had efficacy in controlling insect pests associated with soybean. Insect population was reduced from 51 to 24 and 66 to 21 insect numbers at early and late planting repectively with 200g NLCE. Yield parameters in early planting were significantly different ($p > 0.05$) from late planting. 100g NLCE recorded 1.9 t/ha seed yield as the highest yield, while 150g and 200g NLCE with Control had 1.4 t/ha respectively at early planting. Yield from early planting did better compared to late planting. Farmers are advised to use Neem Leaf Cold Extract to control insect pests associated with soybean in Asaba. 100g, 150g and 200g concentrations are recommended.

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Introduction

Soybean (*Glycine max* (L) Merrill) is of the family Fabaceae. Nigeria has a large area under soybean cultivation. Over 600,000 ha producing above 900kg/ha-1 is attained annually (FAO, 2009).

The crop is of high importance to Nigeria because both humans and animals depend on it for survival. It is mainly used for food, feed, medicinal and other purposes (Hymowitz, 2004). Its oil is very rich in protein, also serving as raw material for industrial biofuels (Singh, 2010).

Nigerian soybean production is mainly in the Northern parts, but due to high demand, Southern farmers are now growing the crop. Like most other crops, soybean is widely affected by a wide range of various insect pests. Insect orders – Orthoptera, Coleoptera, Lepidoptera and Hemiptera are major pests that affect the crop, defoliating leaves and boring into pods (Arokoyo *et al.* 1997, Ogbinaka and Tobih, 2015).

Farmers in Nigeria mainly depend on conventional pesticides (chemicals) for controlling insect pests. The distance and prize of procuring such chemicals discourage rural settlers from obtaining such pesticides; in order to protect their crops, cultural methods and use of natural products (botanicals) are becoming common among them. Plant products like neem extracts are becoming very popular amongst farmers due to their efficacy in controlling major pests associated with crops (Amaugo and Emosairue, 2003; Egho and Ilondu, 2012).

Materials and methods

Location

Field experiments (two) were conducted in July for the early season and October 2021 for the late season at the Teaching and Research Farm of Agronomy Department in Delta State University, Anwai-Asaba campus.

Asaba's location is Latitude 6° 14'N and Longitude 6° 49'E of the equator, which lies in the typical rainforest zone with a hot, humid climate and Bimodal rainfall pattern. Rainy Season is April to October with an annual rainfall of 1500mm to 2000mm with peak rainfall from July to September, Mean temperature of 23.3 °C with a maximum temperature of 37 °C. At a depth of 100cm, it has a mean temperature of 28.3 °C; with 77.2% mean relative humidity. It has monthly average sunshine of 4.8bars (Federal Ministry of Aviation Meteorological Station Asaba, 2020).

Experimental design/planting material

A Randomized Complete Block design (RCBD) with four replicates laid out in a pre-fallowed piece of land was used for the experiment. Each block measured 4.5m by 0.5m and was separated by a 10cm path. The planting material was TGX 1987-91F Soybean variety obtained from the International Institute of Tropical Agriculture, Ibadan. The variety was a medium maturity variety. Seeds were sown at a depth of 2.5cm at a recommended plant spacing of 75cm by 10cm. 2 seeds per stand were planted and thinned down to 1 plant per stand leaving a plant population of 20 plants per plot.

Application of treatment commenced four weeks after transplanting and continued till harvest. Treatments application was done in the hours of 6-7 am on sunny days with knapsack sprayer.

Treatments and application treatments

1. Untreated (Control)
2. 50g Concentration of Neem Leaf Cold Extract (NLCE)
3. 100g Concentration of Neem Leaf Cold Extract (NLCE)
4. 150g Concentration of Neem Leaf Cold Extract (NLCE)
5. 200g Concentration of Neem Leaf Cold Extract (NLCE)

Preparation of neem leaf cold extract (NLCE)

Neem Fresh leaves were air-dried in the Agronomy Laboratory of Delta State University. The leaves on grounding turned to powder form. The powdered Neem leaves were measured and weighed with an

electronic weight into the following;

50g, 100g, 150, 200g Neem leaf

The 50g Neem leaf cold extract was prepared by soaking 50g of powder paste in a litre of cold distilled water for 24hours, filtered with a muslin cloth. Additional water was put in to obtain 1 litre filtrate. The same process was repeated for 100g, 150g and 200g.

Results

Insect species associated with soybean in Asaba

13 insect species of soybean were collected in Asaba and identified in the early season and 9 in the late-season during the study. These insect species belong to five (5) different Orders *Coleoptera, Lepidoptera, Hemiptera, Orthoptera* and *Diptera*. The most prevalent 6 insect species in both seasons were noted as major pests associated with soybean.

Table 1. Identified and categorized insect pests of soyabean.

Insect order	scientific names of species	Season	Status	Insect family	Parts attacked
Lepidoptera	*Psuedoplusia includens*	E&L	M	Nactuidae	leaves
Lepidoptera	*Anticarsia gemmatalis*	E&L	M	Erebidae	leaves
Lepidoptera	*Hypena scabra*	E&L	M	Erebidae	leaves
Hemiptera	*Acrosternum hilar*	E	m	Pentatomidae	pods/seeds
Hemiptera	*Euschistus servus*	E&L	m	Pentatomidae	pods/seeds
Coleoptera	*Ceratomatrifurcate*	E&L	M	Caccinellidae	leaves
Coleoptera	*Colaspis brunnea*	E&L	M	Chrysomelidae	leaves
Coleoptera	*Odontota horni*	E&L	M	Chrysomelidae	leaves
Coleoptera	*Apion begnignum*	E	m	Apionidae	leaves
Coleoptera	*Podagrica fuscicornis*	E&L	M	Chrysomelidae	leaves
Diptera	*Delia platura*	E	m	Anthomylidae	pods/seeds
Diptera	*Melanoplus differentialis*	E	m	Acrididae	leaves
Orthoptera	*Melanoplus femurrubrum*	E&L	m	Acrididae	leaves

^E = early, ^^ L = late, *m = minor,

**M =major.

Table 1 shows the identified insect orders, scientific names, planting season, Insect families and plant part attacked. The *Coleopterans* were the most predominant insect pest, followed by *Lepidoptera, Hemipteran* with *Dipteran* having the least occurrence.

It was observed that in the both planting season, insects collected from the control plots were more in number as compared with plots of formulated Cold Neem Extracts were applied. Fifty one (51) and 66 numbers of insects was counted, respectively, in the control plots. Table 2, which showed the effect of Neem Leaf Cold Extract on pest population, showed that *Cerotoma trifurcate* and *Podagrica fuscicornis* were the most predominant, having 18 insects each with a percentage prevalence 35.3% under the control plot and 10 insects each with 27.8% prevalence under 50g NLCE. *Podagrica fuscicornis* showed more resistance to the various Neem Leaf Cold Extracts, having the highest percentage population abundance of 18(35.5%) Control plot, 10(27.8%) 50g NLCE, 9(34.6%) 100g NLCE, 11(37.9%) 150g NLCE, 7(29.1%) 200g NLCE. In Tables 3, the insects collected were 115, *Hypena scabra* had the least occurrence in the early season while *Antacarsia gemmatalis* was the least in the late season. Higher concentrations were also found to be more effective in reducing soybean insect pests. Table 2 and Table 3 showed how the insect population reduced from 36 insects in 50g NLCE to 24 insects in 200g NLCE.

Effects of neem leaf cold extract concentrations on yield parameters of soybean in Asaba

The result on yield parameters, when treated with Neem Leaf Cold Extracts at both season plantings, are in Tables 3 and 4, which shows that early planting performed better than late planting.

Table 2. Effects of neem leaf cold extracts on % prevalence of insect pests of soybean (*Glysine max*) in early planting.

Treatments	Types of insects	Insects number	Prevalence (%)
Control			
	Cerotoma trifurcate	18.01	35.3
	Colaspis brunnea	5 .1	9.9
	Odontota horni	6.0	11.8
	Podagrica furcicornis	18 .1	53.3
	Pseudoplusia includens	1 .1	2.0
	Hypena scabra	3 .0	5.9
	Sub Total	51.31	
50g NLCE			
	Cerotoma trifurcate	10 .1	27.8
	Colaspis brunnea	2.9	8.3
	Odontota horni	6. 1	16.7
	Podagrica furcicornis	10 .0	27.8
	Pseudoplusia includens	5 .01	13.9
	Hypena scabra	2 .2	5.6
	Sub Total	36.41	
100g NLCE			
	Cerotoma trifurcate	5.9	23.1
	Colaspis brunnea	2.1	7.7
	Odontota horni	3.0	11.5
	Podagrica furcicornis	9.1	34.6
	Pseudoplusia includens	3.0	11.5
	Hypena scabra	3.0	11.5
	Sub Total	26,0	
150g NLCE			
	Cerotoma trifurcate	8.0	27.6
	Colaspis brunnea	2	6.9
	Odontota horni	4	13.8
	Podagrica furcicornis	11	37.9
	Pseudoplusia includes	2	6.9
	Hypena scabra	2	
	Sub Total	29	
200g NLCE			
	Cerotoma trifurcate	10.1	41.7
	Colaspis brunnea	3.0	12.5
	Odontota horni		12.5
	Podagrica furcicornis	7.2	29.1
	Pseudoplusia includens	1.O	4.1
	Hypena scabra	-	
	Sub Total	24.3	

The parameters did not show significant differences ($p>0.05$) among the treatments in Plant height (cm) at harvest, Pods Yield Numbers, Seeds Per Pods Numbers, Number of undamaged seeds and Control plots of both plantings. However, it was observed in Table 4 that 200g NLCE had the highest (47.83cm) mean height at harvest with 100g NLCE having the least height mean of 37.22cm. The least Pods yield recorded was in 50g NLCE (43.06) and it also had the least number of undamaged seeds (64.39). The mean number of damaged seeds, 100 (g) seed weight, seed yield (t/ha) among treatments including control plots, showed significant differences ($p>0.05$).

50g NLCE recorded the least damaged seeds 10.97. 100g NLCE had an average yield of 2.0 t/ha, 200g NLCE, 150g NLCE and Control plots also had an average of 1.4 each with 50g NLCE having the least yield of 1.1 at early planting. Table 5, which showed yield parameters of late-season planting, also showed similar trends as in Table 4 but lower figures were recorded showing lower performance except for seeds

number per pods, which had a uniform number of 2. 100g NLCE and Control plot recorded the least value in plant height, having 32.78 & 33.89 respectively. At late planting, 100g NLCE had the maximum pod yield (41.44), whereas 50g NLCE had the lowest pod yield (28.72). 50g NLCE recorded the least undamaged seeds number of 39.33. Late planting which recorded a lower yield, had 100g NLCE having 1.4 t/ha as the highest yield, while the control plot had a yield of 1.2 t/ha with 50g NLCE having the least yield of 0.7t/ha.

Table 3. Effects of neem leaf cold extracts on % prevalence of insect pests of soybean (Glysine max) in late planting.

Treatments	Types of insects	NO. OF INSECTS	PREVALENCE (%)
Control			
	Cerotoma trifurcate	20	30.2
	Colaspis brunnea	17	25.9
	Odontota horni	14	21.1
	Podagrica furcicornis	7	10.7
	Pseudoplusia includens	5	7.5
	Antacarsia gemmatalis	3	4.6
	Sub Total	66	
50g NLCE			
	Cerotoma trifurcate	8	17.4
	Colaspis brunnea	10	21.7
	Odontota horni	9	19.6
	Podagrica furcicornis	9	19.6
	Pseudoplusia includens	7	15.2
	Antacarsia gemmatalis	3	6.5
	Sub Total	46	
100g NLCE			
	Cerotoma trifurcate	9	34.6
	Colaspis brunnea	4	15.4
	Odontota horni	2	7.7
	Podagrica furcicornis	3	11.5
	Pseudoplusia includens	4	15.4
	Antacarsia gemmatalis	4	15.4
	Sub Total	26	
150g NLCE			34.6
	Cerotoma trifurcate	6	15.4
	Colaspis brunnea	2	7.7
	Odontota horni	5	11.5
	Podagrica furcicornis	7	15.4
	Pseudoplusia includes	1	15.4
	Antacarsia gemmatalis	2	34.6
	Sub Total	23	
200g NLCE			
	Cerotoma trifurcate	6	28.6
	Colaspis brunnea	5	23.8
	Odontota horni	3	14.3
	Podagrica furcicornis	4	19.0
	Pseudoplusia includens	1	4.8
	Antacarsia gemmatali	2	9.5
	Sub Total	21	

Discussion

Description of types of damages

Soybean is associated with numerous kinds of insects. These insects belong to different orders. In the course of this study, insect pests that belong to the *Coleoptera*, *Lepidoptera, Hemiptera, Orthoptera* and *Diptera* are the major orders which had insect pests. Soybean insect pests can be classified into Foliage feeders, Pod feeders and Stem feeders. The types of herbivores that feed on soybean-based on their

feeding guild are; Defoliators, Phloem feeders, Seed and Pod feeders and Stem borers and Root feeders. The foliage feeders were practically present throughout the growing seasons.

These insects typically have biting and chewing mouthparts that either remove the leaf area or destroy the leaf structure. The *Coleoptera* (beetles), and Lepidoptera (moths and butterflies) orders were most significant. Their nature of damage ranges from eating foliage to making holes in the leaves. *Cerotoma trifurcate* and *Podagrica fuscicornis* which were very prominent, created rounded holes in the leaves. *Psueudoplusia includens* created large holes in the leaves and others with similar characteristics are caterpillars and beetles. The Grasshoppers (*Orthoptera*) are occasional visitors that strip plants of their leaves, but damage is often not alarming.

Table 4. Effects of neem leaf cold extracts on yield parameters of soybean at early planting in Asaba.

Treatment	Plant height (cm) at harvest	Pods No yield/plant	Seeds No per pod	Undamaged seeds No	Damaged seeds No	100 (g) seed weight	Seed yield t/ha
O (untreated)	41.28a	57.56a	2a	100.50a	12.90a	12.70ba	1.4ba
5% NLCE	41.28a	43.06a	2a	64.39a	10.97b	11.00bc	1.1b
10% NLCE	37.22a	59.67a	2a	103.67a	11.97ba	12.30bac	1.9a
15% NLCE	43.77a	54.44a	2a	80.56a	11.69ba	11.70bc	1.4ba
20% NLCE	47.83a	52.17a	2a	73.67a	12.03ba	12.00bac	1.4ba

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

Seed and Pod feeders of soybean are mainly of the order *Hemiptera* and pests of the orders *Coleoptera* and *Lepidoptera*. They suck the juice from immature soybean seeds and cause pod drop and yield loss. It was observed that the *Hemipterans*, *Acrosternum hilare* and *Euschistus serves* were prominent at this stage. This is in line with the findings of Kogan (1987). Loss from stem feeding (Stem Feeders) insects was relatively low and hardly noticeable. It was noticed that damaged plants were severely stunted.

Effects of neem leaf cold extract on soybean

A phyto-chemical azadarachtin is found in Neem extracts, it is an antifeedant, and its derivatives are reported to have efficacy over 200 insect species (Acharya 2017). According to Amadioha (2000), the advantages and prospects of using extracts of plant origin for pest and diseases management has been emphasized.Earlier studies show how azadarachtin affects insect pests feeding, reproduction and growth pattern. (Emosairue and Ukeh, 1996). Results from percentage prevalence tables showed how the different concentrations of Neem Leaf Cold Extracts controlled insect pests of the crop. Direct killing of pests was not seen. Insects avoided treated plots as concentration levels were increased which is in line with earlier studies that revealed how most insects stay off neem treated crops due to antinutritional factors present (Jakai and Oyediran; 1991; Jakai; 1993; Emosairue and Ukeh; 1996 and Mordue and Nisbet; 2000).

Table 5. Effects of neem leaf cold extracts on yield parameters of soybean at late planting in Asaba.

Treatment	Plant height (cm) at harvest	Pods No yield/plant	Seeds per pod No	Undamaged seeds No	Damaged seeds No	100 (g) seed weight	Seed yield t/ha
O (untreated)	33.89a	36.83a	2a	62.28a	11.77ba	11.67ba	1.2ba
5% CNE	34.83a	23.39a	2a	39.33a	10.37bc	10.33b	0.7b
10% CNE	32.78a	41.44a	2a	77.22a	11.23bac	11.67ba	1.4a
15% CNE	35.33a	35.94a	2a	59.83a	10.97bac	11.33ba	1.1ba
20% CNE	36.67a	29.69a	2a	49.17a	11.30bac	11.33ba	1.0

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

Comparison between both planting seasons showed that Insect pest infestation was higher at late planting. 183 insects were collected against only 166 that were collected in the early season. Insects found in the control plots rose from 51 in the early season to 66 in the late season. Higher concentrations of Neem Cold Extracts were also observed to have had more effect in controlling soybean pests. *Cerotoma trifurcarte* and *Colaspis brunnea* were more prominent at late planting, having 20 insects (30.3% prevalence) and 17 insects (25.8% prevalence) respectively in the control plot. *Antarcarsia gemmatalis* which replaced *Hypena scabra* in the late season as a major insect also showed the least prominence.

Conclusion

The study recommends that farmers should be encouraged to go into Soybean farming in Asaba as pest infestation is not as predominant as that of other crops like cowpea, and yield from this study were comparable in quality with those produced from other parts of Nigeria. It also establishes that at early planting of July 2021, 13 insect species from 5 orders and 8 families were identified and 9 insect species from 4 orders and 4 families were identified at late planting of October 2021 in Asaba, Delta State. Pest infestation was higher at late planting of October than in early-season planting of July. Neem Leaf Cold Extract concentrations had efficacy in controlling the most prevalent insect pest associated with soybean in Asaba.

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