Effect of palm bunch ash and Neem (*Azardirachta indica* A. Juss) leaf powder on termite infestation in groundnut field in Owerri ultisol, South-eastern, Nigeria.

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Abstract: As one of the major pests of field crops, termites attack groundnut at all stages of its development especially during prolonged dry spell. Effect of palm bunch ash and neem (*Azardirachta indica* A. Juss) leaf powder on termite infestation in groundnut field in Owerri, Nigeria was investigated in this study. The field trial was carried out in 2016 at the Teaching and Research Farm of the Department of Crop Science and Technology, Federal University of Technology, Owerri, Nigeria. The experiment was laid out in a 3x3 Factorial fitted into a Randomized Complete Block Design (RCBD) with three replications. The treatments include three rates of palm bunch ash at 0.0 (control), 1.0 and 2.0tons/ha and three rates of neem leaf powder at 0.0(control), 1.0, 2.0tons/ha respectively. Data were collected on percentage emergence, termite incidence and termite severity. These were subjected to analysis of variance (ANOVA) and means were separated using least significant difference at 5% level of probability. Result shows that there were no significant ($P< 0.05$) differences in percentage emergence amongst treatment means due to palm bunch ash and neem leaf powder applications. Contrarily, palm bunch ash at 2.0tons/ha recorded least termite incidence especially at twelve weeks after planting (12WAP) with a value of 22.20% while control plot maintained highest values at 6WAP (48.70%) and 12WAP (48.30%) respectively. Also palm bunch ash at 2.0 tons/ha depressed termite severity more than other treatments especially at 2 and 4 WAP (0.56) respectively. Control plots on the other hand consistently maintained highest termite severity throughout the trial with highest value at 2 and 12WAP (1.56). Conclusively, palm bunch ash exhibited highest depressive action against termite on groundnut especially at higher application value of 2.0tons/ha, and so farmers could integrate it into termites control programme in Owerri, Imo state, Nigeria.

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1. Introduction

Groundnut (*Arachis hypogea* L.) is a legume which belongs to the family leguminoceae. It is an important crop grown for human consumption and livestock feed in Nigeria. Groundnut originated in South America, [1] (Hammons, 1994). It constitutes one of the major sources of foreign exchange as well as generating local income to farmers Nigeria. Groundnut is used for manufacturing cooking oil as well as making paste for the preparation of groundnut sauce in African communities. It can be eaten boiled, fried or roasted and its by-products can be used as animal feed. It is rich in protein and oil.

Several factors militate against successful groundnut production in Nigeria. These include: unreliable rains with recurrent drought, soil fertility status, lack of viable and improved seed, low inputs, pests and diseases etc. [1] (Hammons, 1994). Among these, pests and diseases tend to cause the greatest setbacks to groundnut production and which often discourage farmers from taking up its cultivation. Some of the notable diseases include: leaf spot disease (*Cercospora arachidicola*), groundnut rust (*Puccinia arachidis)*, Bacterial wilt, root knot nematodes, groundnut rosette virus etc. Insect pests attacking groundnut include: millipedes, blister beetle, white grub, wireworms, earthworm, termites etc.

Termites are social insects belonging to the order isopteran. They are one of the major pests of groundnut and occur in three forms (castes) namely: Reproductive's (which are the sexual forms and comprised the queen and her consort), the king, workers (builds and maintain the nest, and also responsible for all the foraging activities). The soldiers are specialized for defending the colony, and are usually sterile females. Termites attack and damage

wood, stored food, field crops such as yam, maize, cassava, groundnut etc, which result in significant yield losses [2] (Johnson *et al*., 1981).

Specifically, termites attack groundnut at all stages of its development. However infestation during the early stages is less severe except during prolonged dry spells. At the early stages of the crop, they damage the crop by constructing foraging galleries in them. The root may be destroyed below the crown which leads to sudden wilt [3] (Mercer, 1978). As the plant matures, termites damage becomes more pronounced and appears in various forms. Most often, they invade the root system and hollow out the tap root. The holes so created are filled with soil [2] (Johnsons *et al*, 1981). Scarification of pods is by far the most common types of termite damage. This involves the removal of the soft corky layer between the fibrous veins. This type of damage is caused mainly by *Microtermes* spp [4] (Umeh, 1997). Scarification may not affect groundnut directly but promotes the rate of colonization by fungi such as *Aspergillus flavus* [5] (Umeh,1998) which produces the carcinogenic aflatoxin in groundnut [6] (Wightman and Wightman, 1994).

[7] Umeh (2002) stated that effective control measures applied against termites rely principally on the use of organo-chlorine insecticides such as aldrin, dieldrin, lindane etc. However, due to increase in environmental awareness demanding reduction in the use of commercial pesticides [8] (Hansen, 1987), non-chemical control of termites is attracting renewed interest worldwide. According to [9] Schmutterer (1990), one of the alternatives to usage of synthetic organic pesticides is to tap plant resources which have evolved diverse array of pesticides but safe pest control molecules.

Palm bunch ash constitute varying amount of calcium, phosphorus, potassium and magnesium, which affects the yield of crops positively [10] (Aya and Lucas, 1979). The presence of potassium in palm bunch ash protects groundnut plant as well as other crops from pest damage. Neem (*Azadirachta indica* A. Juss*)* has attracted global attention due to its strong and inherently safer insecticidal properties in the environment. Neem derivatives supply nutrients and also serve as an important source of biopesticide [11] (Chandrasekaran and Gunasekaran, 2007). The use of palm bunch ash and neem leaf powder to tackle termite problem in groundnut field has not been practiced by our local farmers. Therefore, the need to determine the effect of palm bunch ash and neem leaf powder on termites infestation in groundnut field in Owerri, Southeast, Nigeria, forms the objective of this study.

2. Materials and Methods

The experiment was conducted in 2016 at the Department of Crop Science and Technology, School of Agriculture and Agricultural Technology, Teaching and Research Farm, Federal University of Technology Owerri (FUTO). The University is located between Latitude 4^0 40` and $8^0$ 15` N and Longitude 6^o 40` and $8^0$ 15` E [12] (FDALR, 1985) in the humid tropics, characterized by wet and dry seasons. The two seasons are influenced by the effect of the humid maritime air mass with its South-westerly winds, while the wet or rainy season usually begins in mid-March and ends in November with a little dry spell (August Break) occurring in August. The dry season starts in mid November and terminates in mid March. The mean annual rainfall is about 2500 mm and is bimodal with peaks in July and September [13] (Nwosu and Adeniyi, 1980). Minimum and maximum mean annual temperatures are 22.5^oc and 31.9^oc respectively with relative humidity of about 82.6%. The experimental site lies within the lowland areas of South-Eastern Nigeria [14] (Ofomata, 1975) and is naturally infested with termites.

The experiment was laid out in a 3X3 factorial fitted into a Randomized Complete Block Design (RCBD) with three replications. The experiment was carried out in a piece of land that was left fallow for about one year ago. The experimental site was cleared manually using cutlasses and spades and the field marked out with the use of tape, pegs and ranging poles. The total field size measures 27 x 9m (243 m^2) corresponding to 0.024 ha, Plot size was 2 x 2m ($4m^2$) while the distance between plots and between blocks was 1m apart. Treatments were assigned to each block and plots via randomization using table of random numbers.

Treatments comprised Palm bunch ash at 0.0 (control), 1.0 and 2.0 tons/ ha respectively (Factor A) and Neem leaf powder at 0.0 (control), 1.0 and 2.0 tons/ha respectively (Factor B). These culminated into nine (9) treatments replicated three (3) times to give a total of 27treatments. The variety of groundnut used was erect type. The palm bunch (30Kg) was gathered and air dried for two (2) weeks, burnt in a drum and the ash produced, while the neem leaf (30 Kg) was also air dried for two (2) weeks and ground to a fine powder using mortar and pistol.

Planting was done on beds in April, 2016. The groundnut was planted at the rate of two (2) seeds per hole with a planting distance of 30cm x 15cm giving a plant population of 222,222.22 stands/ha. Different treatments were applied at the rates specified above at planting. Plots without any application served as control.

After germination, emergence and subsequent development of the plant, weeding was carried out at four weeks and 6 weeks after planting (WAP) by hoeing and afterwards rouging were carried out

continually until harvest.

Termite incidence was determined by counting and recording the number of groundnut plants with evidence of termite attack per treatment per plot at two weeks intervals and the value was determined by dividing the total number of termite infested plants/plot by the total number of plants per plot and multiplied by 100. That is;

$$\text{Termite incidence (\%)} = \frac{\text{Number of plant infested per plot}}{\text{Total number of plant per plot}} \times 100$$

Termite severity was also determined at two weeks intervals. This was estimated using the visual observation and scoring method according to [15] Ferd and Herwitt (1980) as thus:

Severity estimate (%)	Scale	Interpretation
0	0	No infestation
1-20	1	Slight infestation
21-40	2	Moderate infestation
41-60	3	Extensive infestation
61-80	4	Very extensive infestation
81-100	5	Plants moderately infested

Emergence count was determined by counting the total number of plants that emerged one Week after planting and divided by the total number of plants per plot and multiplied by 100. That is;

$$\text{Emergence count (\%)} = \frac{\text{Number of emerged plants}}{\text{Total number of plant per plot}} \times 100$$

All data collected were subjected to analysis of variance (ANOVA) according to the procedure for a factorial experiment laid in a Randomized Complete Block Design (RCBD) as outlined by [16] Steel and Torrie (1980). Test for significant differences among treatment means were performed using the least significant difference (LSD) at 5% level of probability.

3. Results and Discussion

Table 1 shows the effect of palm bunch ash and neem leaf powder on groundnut percentage emergence count, the analysis of variance result shows that there was no significant ($p>0.05$) differences in percentage emergence. However, neem leaf powder at 1.0 tons/ha and control (interaction) maintained the highest percentage emergence (96.70 %.). This probably shows that groundnut emergence may not really depend on treatment applied rather on the prevailing environmental condition of the experimental area. On the other hand, there were significant ($P<0.05$) differences on termite incidence due to effect of palm bunch ash and neem leaf powder amongst treatment means throughout the trial. From the table palm bunch ash at 2.0 tons/ha recorded the least termite incidence especially at 12 WAP (22.20%) while the control maintained the highest termite incidence (48.30).

However, there were no significant differences among treatment means due to treatment interaction except at 12WAP where palm bunch ash at 2.0 tons/ha and neem leaf at 2.0 tons/ha recorded the least mean termite incidence (21.70%) while control also recorded the highest (74.30%) termite incidence (Table 2). Termites were found feeding and climbing on the stem of growing groundnut evidenced by the presence of termite gallery deposits found on the base of the plant. (plate1).

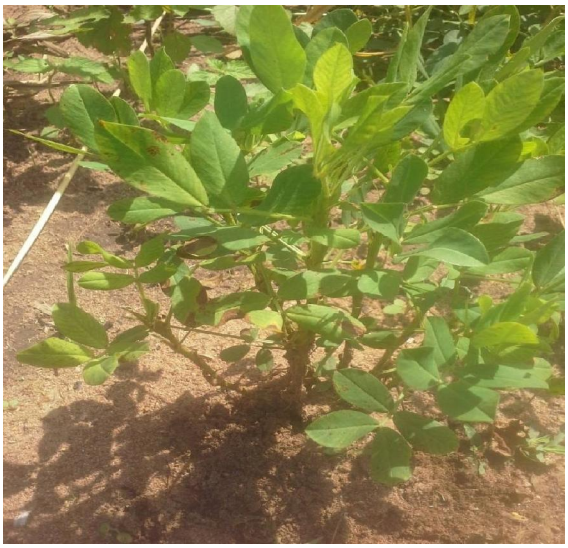

Plate 1: Evidence of termite attack

The high suppressive action on termite incidence witnessed with higher application rates of palm bunch ash and neem leaf powder shows that there is a direct relationship between termite infestation and treatment application. This further suggests that the amount of toxicant (active ingredients) available to effectively achieve the much needed termite repellency on

groundnut lie to a reasonable extent on the quantity of either palm bunch ash or neem leaf powder applied.

However the presence of ash in burnt palm bunch released a repellent substance that probably scared the attacking termite away from the growing groundnut plants. Also, the reasonable quantity of neem derivatives obtained from the neem leaf powder equally released an appreciable amount of termicide which prevented the foraging termites from gaining access to the plants. This corroborates the views of [17] Logan *et al*. (1990) that the presence of some termicidal repellent in palm bunch ash and some biodegraded metabolites in neem leaf powder tend to prevent termite access to plant, reduce termite numbers in a variety of plants and also reduce susceptibility or increase resistance of the plant themselves.

Table 3 shows that there were significant ($P<0.05$) differences amongst treatment means on termite severity due to palm bunch ash throughout the trials, while no significant differences existed due to neem leaf powder application at 12 WAP, there were significant differences from 2 to 10 WAP. From the result, palm bunch ash at 2.0 tons/ha exhibited least termite severity as well as neem leaf powder at 2.0 tons/ha even up to zero level at 2 WAP, While control recorded the highest (2.00) severity.

The reduction of termite severity due to application of neem leaf powder could probably be attributed to the fact that its metabolites (biodegraded by- product) and associated chemical constituents (ingredient) are capable of repelling termites. This supports the view of [18] (Umeh and Ivbijaro, 1998) who reported that extracts of neem tree are efficacious against termite on cassava-maize intercrop and other crops. Apart from repellency achieved with application of palm bunch ash which enhanced reduction of termite severity, palm bunch ash tend to play significant role in improving the quality of seed coat via hardening the pod. This often acts as barrier to pod burrowing termites which often create holes into the groundnut pods through their feeding activities. This supports the claims of [10] (Aya and Lucas 1979) that palm bunch ash contains vital mineral constituent (calcium, phosphorus, potassium and magnesium), which are vital ingredients to groundnut during shell formation at nodulation and/or pegging via thickening of the pods which are hitherto prone to termite attack and damage. This also go a long way in reducing the number of empty shells at harvest as well as protecting groundnut plant and other crop from pest attack.

At harvest, palm bunch ash, neem leaf powder and interactions differed significantly ($p<0.05$) on termite incidence, termite severity and number of perforated pods/stand (Table 4). Palm bunch ash at 2.0 tons/ha recorded least termite incidence and severity on harvested groundnut pods as well as on the average number of perforated pods/stand. While control showed highest values in all cases. This was also applicable to plots where neem leaf powder was applied particularly at the rate of 2.0 tons/ha. Treatment interaction also showed that palm bunch ash at 2.0 tons/ha and neem leaf powder at 2.0tons/ ha maintained the least mean value of termite incidence (18.33%), termite severity (1.00) and average number of perforated pods/stand (13.33), while control recorded the highest mean value of termite incidence (48.67%), termite severity (3.00) and number of perforated pods/stand (40.33). Plate 2 captured a collection of some groundnut pods damaged (perforated) by pod boring termites.

Plate2: Evidence of perforated pods

This result also shows that the higher the rate of palm bunch ash and neem leaf powder, the lower termite incidence and severity on harvested groundnut pods. This also corroborates the fact that the presence of some termicidal repellent ingredients in palm bunch ash and neem leaf powder are capable of preventing and/or reducing termite access to groundnut pods probably due to the hardiness of the pods (shell) as a result of calcium deposit on them. This therefore resulted to increased reduction in susceptibility or increased resistance of plant themselves to termite attack. [17] (Logan *et al.,* 1990).

Conclusion and recommendation

The experiment revealed that there was no significant effect on emergence percent in groundnut field due to application of palm bunch ash and neem leaf powder. However, palm bunch ash at 2.0tons/ha and neem leaf powder at 2.0tons/ha consistently suppressed termite incidence and severity than other treatments. The suppressive ability of palm bunch ash and neem leaf powder to termite incidence and severity increased with increase in rate of application.

Farmers in Owerri, Imo State should avail themselves the opportunity of harnessing the much available palm bunch in this agro-ecological zone as an integral part of termite control measure on groundnut. This may serve as an alternative to most chemical termicides which are not only out of the reach of our local farmers in terms of cost but also are scarcely available.

Table 1: Effect of palm bunch ash and neem leaf powder on Percentage (%) Emergence

Treatment (tons/ha)	Percentage (%) Emergence
PBA at 0.0 tons/ha Control	88.90
PBA at 1.0 tons/ha	89.40
PBA at 2.0 tons/ha	77.20
LSD (0.05)	**NS**
NLP 0.0 tons/ha Control	83.90
NLP 1.0 tons/ha	90.00
NLP 2.0 tons/ha	81.70
LSD (0.05)	**NS**
PBA 0.0ton/ha + NLP 0.0ton/ha	95.00
PBA 0.0ton/ha + NLP 1.0ton/ha	96.700
PBA 0.0ton/ha + NLP 2.0ton/ha	75.00
PBA 1.0ton/ha + NLP 0.0ton/ha	90.00
PBA 1.0ton/ha + NLP 1.0ton/ha	93.30
PBA 1.0ton/ha + NLP 2.0ton/ha	85.00
PBA 2.0ton/ha + NLP 0.0ton/ha	66.70
PBA 2.0ton/ha + NLP 1.0ton/ha	80.00
PBA 2.0ton/ha + NLP 2.0ton/ha	85.00
LSD (0.05)	**NS**

Keys: PBA = Palm bunch ash. NLP = Neem leaf powder.

Table 2: Effect of Palm Bunch Ash and Neem Leaf on Termite Incidence (%)

Treatment	2WAP	4WAP	6WAP	8WAP	10WAP	12WAP
PBA at 0.0 tons/ha Control	40.40	37.33	48.70	38.33	40.56	48.30
PBA at 1.0 tons/ha	34.60	32.56	33.10	34.56	36.11	35.80
PBA at 2.0 tons/ha	28.90	30.67	25.80	31.33	30.89	22.20
LSD (0.05)	**6.43**	**4.663**	**8.29**	**4.817**	**3.953**	**12.99**
NLP 0.0 tons/ha Control	49.30	37.00	42.10	38.11	39.11	45.00
NLP 1.0 tons/ha	32.20	32.56	34.00	34.89	35.22	34.10
NLP 2.0 tons/ha	29.40	31.00	31.4	31.22	33.22	27.20
LSD (0.05)	**6.43**	**4.663**	**8.29**	**4.817**	**3.953**	**12.99**
PBA 0.0ton/ha + NLP 0.0ton/ha	49.30	42.67	64.30	43.33	45.67	74.30
PBA 0.0ton/ha + NLP 1.0ton/ha	36.70	33.33	42.30	38.00	38.00	44.00
PBA 0.0ton/ha + NLP 2.0ton/ha	35.30	36.00	39.30	33.00	38.00	26.70
PBA 1.0ton/ha + NLP 0.0ton/ha	41.00	34.33	32.00	35.00	40.00	37.30
PBA 1.0ton/ha + NLP 1.0ton/ha	31.30	31.67	34.70	37.67	34.67	36.70
PBA 1.0ton/ha + NLP 2.0ton/ha	31.30	31.67	32.70	32.00	33.67	33.30
PBA 2.0ton/ha + NLP 0.0ton/ha	36.30	36.00	30.00	36.67	31.67	23.30
PBA 2.0ton/ha + NLP 1.0ton/ha	28.70	31.67	25.00	28.00	33.00	21.70
PBA 2.0ton/ha + NLP 2.0ton/ha	21.70	25.33	22.30	29.00	28.00	21.70
LSD (0.05)	**NS**	**NS**	**NS**	**NS**	**NS**	**22.50**

Keys: PBA= Palm bunch ash. NLP= Neem Leaf Powder.

Table 3: Effect of Palm Bunch Ash and Neem Leaf on Termite Severity

Treatment	2WAP	4WAP	6WAP	8WAP	10WAP	12WAP
PBA at 0.0 tons/ha Control	1.56	1.00	1.33	1.33	1.44	1.56
PBA at 1.0 tons/ha	0.67	0.78	1.00	1.00	1.00	1.22
PBA at 2.0 tons/ha	0.56	0.56	0.78	0.78	0.89	0.78
LSD (0.05)	**0.44**	**0.33**	**0.40**	**0.40**	**0.29**	**0.42**
NLP 0.0 tons/ha Control	1.44	0.78	1.33	1.33	1.33	1.33
NLP 1.0 tons/ha	0.78	1.00	1.00	1.00	1.00	1.22
NLP 2.0 tons/ha	0.56	0.56	0.78	0.78	1.00	1.00
LSD (0.05)	**0.44**	**0.33**	**0.40**	**0.40**	**0.29**	**ns**
PBA 0.0ton/ha + NLP 0.0ton/ha	2.67	1.00	2.00	2.00	2.00	2.00
PBA 0.0ton/ha + NLP 1.0ton/ha	1.00	1.00	1.00	1.00	1.00	1.33
PBA 0.0ton/ha + NLP 2.0ton/ha	0.67	1.00	1.00	1.00	1.33	1.33
PBA 1.0ton/ha + NLP 0.0ton/ha	0.67	0.67	1.00	1.00	1.00	1.00
PBA 1.0ton/ha + NLP 1.0ton/ha	1.00	1.00	1.00	1.00	1.00	1.33
PBA 1.0ton/ha + NLP 2.0ton/ha	0.67	0.67	1.00	1.00	1.00	1.33
PBA 2.0ton/ha + NLP 0.0ton/ha	0.00	0.67	1.00	1.00	1.00	1.00
PBA 2.0ton/ha + NLP 1.0ton/ha	0.75	1.00	1.00	1.00	1.00	1.00
PBA 2.0ton/ha + NLP 2.0ton/ha	0.00	0.00	0.33	0.67	0.67	0.33
LSD (0.05)	**NS**	**NS**	**NS**	**0.49**	**0.49**	**NS**

Keys: PBA= Palm bunch ash. NLP= Neem leaf powder.

Table 4: Effectof Palm Bunch Ashand Neem Leaf Powderon Termite Incidence, Severity and Number of Perforated pods/stand.

Treatment	Incidence (%)	Severity	No. of perforated pods/stand
PBA at 0.0 tons/ha Control	34.78	2.22	28.71
PBA at 1.0 tons/ha	27.00	1.78	20.12
PBA at 2.0 tons/ha	24.56	1.44	21.63
LSD (0.05)	**4.92**	**0.30**	**3.88**
NLP 0.0 tons/ha Control	35.78	2.22	31.78
NLP 1.0 tons/ha	26.67	1.67	20.83
NLP 2.0 tons/ha	23.89	1.56	17.86
LSD (0.05)	**4.92**	**0.30**	**3.88**
PBA 0.0ton/ha + NLP 0.0ton/ha	48.67	3.00	40.33
PBA 0.0ton/ha + NLP 1.0ton/ha	27.33	1.67	24.10
PBA 0.0ton/ha + NLP 2.0ton/ha	28.33	2.00	21.70
PBA 1.0ton/ha + NLP 0.0ton/ha	30.67	2.00	22.67
PBA 1.0ton/ha + NLP 1.0ton/ha	35.33	1.67	19.07
PBA 1.0ton/ha + NLP 2.0ton/ha	25.00	1.67	18.63
PBA 2.0ton/ha + NLP 0.0ton/ha	28.00	1.67	32.33
PBA 2.0ton/ha + NLP 1.0ton/ha	27.33	1.67	19.33
PBA 2.0ton/ha + NLP 2.0ton/ha	18.33	1.00	13.23
LSD (0.05)	**8.52**	**0.53**	**6.73**

Keys: PBA= Palm bunch ash. NLP= Neem leaf powder.

References

1. Hammons, R.O. (1994). The origin and history of groundnut. In J. Smartt (ed), the groundnut crop, A scientist Basis for improvement. New York: Chapam and Hall.
2. Johnson K.A., Lamb R. A. and Wood T.G. (1981). Termite damage and crop loss studies in Nigeria survey of damage to groundnut. Trop. Pest manage. 27, 325-342.
3. Mercer P. C. (1978).Pest and disease of groundnut in Malawi. 11. Disorders of pods, kernels, and seedlings. Oleagineux 33, 119-122.
4. Umeh V.C (1997). Aspect of scio-ecological studies of groundnut soils pests: Farmers perceptive. International Arachis Newsletter 17, 42-43.

5. Umeh V.C (1998). Soil pests of groundnut in West Africa case study of Mali Burkina faso. Niger and Nigeria; pp. 50-52. In international newsletter No 18 (Edited by F. Waliyar and V.C Umeh).
6. Wightman J.A and Wightman A. S (1994). An insect agronomic and sociological survey of fields in southern Africa. Ecosyst. Environ, 51, 311-331.
7. Umeh, V. C. (2002). The need for an integrated management programme for termites in West Africa. Occasional publication of the Entomological Society of Nigeria9th-13th October 2000. Nigeria Institute for oil palm research (NIFOR) Benin city, Nigeria. Pp. 71-76.
8. Hansen, M. (1987). Escape from the pesticidal treadmill, alternatives to pesticides in Developing countries. Newyork, Institute for consumer policy. Pp. 185.
9. Schmutterrer, H. (1990). Properties and potential of natural insecticides from the neemtree, *Azadirachta indica*. Annual Review, *Entomology*. 109: 390-400.
10. Aya, F.O and Lucas, E.O (1979). A critical Assessment of cover crop policy in oil palm. Plantation in Earp., DAS Newll. W. (ed), Nigeria International development in oil palm proceeding of the Malaysian international Agricultural oil palm conference, 1979.
11. Chandrasekaran, B. and Gunasekaran, K. (2007). Neem derivatives in organic Agriculture. Proceedings of the world neem conference held in Coimbatore, India 2007. Pp. 10-20.
12. FDALR (Federal Department of Agricultural L and Resources) (1985). The reconnaissance soil survey of Imo State (2: 250). Soils report. Pp. 133.
13. Nwosu, A.C. and Adeniyi, E.O. (1980). Imo State: A survey of resources for development. NISER Ibadan. Pp. 310.
14. Ofomata, G.E.K (1975). Landforms regions. In: Ofomata G.E.K (ed.) Nigeria in map. Eastern State Ethiope publishing House Benin city.31-33.
15. Ferd, J.E. and Herwit, D. (1980). In: Band, D.A. (ed.) Vicia Faba Feeding values Processing and viruses. The Hague Martinus Nihoff. Pp. 125-130.
16. Steel, R. G. D. and Torrie, J. H. (1980), Principles and Procedures of Statistics: A Biometrical Approach, Second Edition, New York McGraw-Hill. Pp.633.
17. Logan, J.M.W., R.H. Cowieand T.G wood, (1990). Termite (isoptera) control in Agriculture and Forestry by non-chemical method: A review. Bull. Entomol. Res:309-330.
18. Umeh V.C and Ivbijaro M.F (1998). Termite abundance and damage in traditional maize cassava intercrops in South Western Nigeria Insect Sci. Applic 17, 315- 321.

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