

The Effectiveness of Four Insecticides Applied at Planting for the Control of Termites on Maize in the Northern Guinea Savanna.

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ABSTRACT

The effectiveness of four insecticides: aldrin 2½% dust, pirimiphos ethyl (30% W.P), chlorpyrifos (10%g) and carbofuran 3g applied at planting to control termites on maize was evaluated in field trials at Samaru between 1980 and 1982. Aldrin treated-plots had lower termite population, reduced percentage plant lodging and termite attack on wooden baits than the other treatments. Carbofuran was effective against the termites for about eight weeks post treatment but also gave a good control of the stem borers. Aldrin and carbofuran—treated plots significantly out—yielded all other treatments. Although carbofuran appears to be a good alternative to aldrin because of the deleterious effect of the latter insecticide, the time and number of applications of carbofuran for effective control of termites on maize need to be further investigated.

INTRODUCTION

Termites are soil insects some of which live in small discrete chambers below the soil surface. Their cryptic habit makes it difficult to determine their presence and the extent of damage they cause to a variety of crops. The predominant termite pest species in Nigeria belongs to the sub-family Macrotermitinae commonly called "fungus-growing termites" because of their ability to cultivate, symbiotically, *Termitomyces* on their faecal deposits called fungus combs (Wood, 1976, Wood and Sands 1978).

Termites are polyphagous pests, unlike some insect pests which are specific to certain crops. Attack on crops is mostly seasonal, being related to either the planting period or the termites' seasonal foraging activity. Their populations are not normally subject to violent fluctuations resulting in outbreaks followed by several years of recession (Wood, 1977). In Nigeria, termite problems seem to be chronic rather than acute and damage to crops is rarely spectacular and usually involves a low to moderate loss.

However, maize (*Zea mays* L.) is highly susceptible to termite attack. In this crop an attack results in severe lodging and a yield loss of 8—10% in the sudan savanna of Nigeria (Ohiagu, 1979). Attack on maize occurs mainly through the subterranean root system, although direct attack on the aerial parts by some members of the Macrotermitinae—*Macrotermes subhyalinus* (Kambur) and *Odontotermes* spp have been reported (Ohiagu, 1979).

In cases of heavy infestation, as was observed in the sudan savanna where maize is grown marginally (Wood *et al*, 1977), the entire stem and cobs are consumed. Since termite's attack on the plant is insidious, the damage done is not always observable until it is too late to apply

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any control measure. The best control measure therefore, seems to be the use of soil applied insecticides. This paper reports the efficacy of four insecticides, applied to the soil at planting to control termite infestation on maize.

MATERIALS AND METHODS

The studies were carried out at the Institute for Agricultural Research, Ahmadu Bello University between 1980—82. The experimental lay-out was a randomised block design with five treatments replicated six times. Each plot measured 10m long x 5m wide with an interrow spacing of 75cm. There was a 5m buffer area between adjacent plots. A compound fertilizer mixture 20-10-10 (N.P.K.) was broadcast before ridging at the rate of 300kg/ha. Maize (var. TZB) was planted in the second week of June each year at the rate of 2 seeds/hole and later thinned to 1 plant/stand four weeks after planting.

Four insecticides; Aldrin 2½ dust, pirimiphos ethyl (Pirimicid) 30% WP, chlorpyrifos (Dursban) 10% granules and carbofuran (Furadan) 3% granules were applied at the rate of 1kg a.i./ha at planting in grooves made 2—3cm away from the planted seeds. Aldrin dust was applied by means of a perforated tin held close to the ground to avoid the dust being blown away by the wind. Pirimiphos ethyl was mixed thoroughly with some sifted subsoil and similarly applied.

The granular formulation of chlorpyrifos and carbofuran were applied with a granular applicator. The relative efficacy of the different insecticides was measured by the following parameters namely, (1) estimated termite population, (2) termite attack on wooden baits which measured the index of foraging termite population, (3) quantity of fungus combs, (4) percent lodged plants and damaged cobs and (5) grain yield, on treated and control plots.

Termite population estimate

The sampling procedure adopted and its efficiency had been described by (Wood *et al.* 1977). Soil cores (10cm diameter x 100cm deep) were taken with "Jarretti augurs" and the termites were extracted by hand sorting. Five cores were taken at random per plot on each sampling occasion, and each plot was sampled three times at monthly intervals during the growing season.

Index of foraging termite population

This was determined by baiting the various plots with 100 baits *Triplochytos sclerocylus* (Obèche) each measuring 18.2cm x 2.54cm x 2.54cm. Baits were placed on the soil surface in a 2m grid system and checked at seven day intervals for termite activity. The intensity of termite foraging activity was measured by the rate of discovery of the baits (% attack on baits). The duration of the potency of the applied insecticides was also determined by the baiting method.

Fungus comb biomass, % lodged plants and maize yield

Fungus comb biomass was measured by digging pits, each measuring 1m x 1m x 1m. Fungus combs within the soil so removed were collected, dried and weighed. All lodged plants within each plot were examined and those lodged for reasons other than damage by

termites on the root system were not included on the record. Similarly, the number of damaged cobs on the ground was counted and recorded. Yield was determined by harvesting the cobs on the three centre rows of each plot. The cobs were dried, threshed and the grain weighed. Data from the various treatments were subjected to the analysis of variance.

RESULTS AND DISCUSSION

Data on attack of wooden baits, termite population and fungus comb biomass in the different plots are given in Table 1. Aldrin-treated plots had significantly ($P < 0.05$) lower level of attack on baits than all others.

Mean percentage attack on chlorpyrifos, pirimiphos ethyl and carbofuran treated plots did not differ significantly from each other but was lower than that recorded on control plots. Termite population was lower in the insecticide-treated plots than in the control plots. Aldrin plots had a significantly ($P < 0.05$) lower termite population than all other treatments. There was a non significant positive correlation ($r = 0.059$) between level of attack on baits and termite population in the different treatments.

Fungus comb biomass was higher on the control plots than on any of the insecticide treated plots. This indicates that the various insecticides effectively disrupted the foraging activity of the termites, and thereby resulted in low fungus comb accumulation within their nests.

Table 1. Effect of four insecticides on termite population, foraging and fungus comb biomass

Treatment	* Mean attack on wooden baits	Mean No of termites/m ²	Mean wt (g) of fungus combs
Aldrin (2½% dust)	5.54a	34d	3.54g
Pirimicid (30% WP)	25.40b	78e	5.15g
Dursban (10% G)	23.60b	65e	5.33g
Furadan (3% G)	24.30b	70e	4.96g
Control	39.10c	154f	12.84h

Means followed by the same letter are not significantly different at the 5% level by Duncan's multiple range test.

*Mean of a 3-year record

The duration of the effectiveness of the insecticides on treated wood is shown in (Fig 1). Aldrin was consistently effective throughout the period of the experiment, owing to its residual properties in the soil. Attack on wooden baits was less than 10% throughout the 112 days for which the experiment lasted. Carbofuran-treated plot, on the other hand, showed a low percentage attack (15-20%) up to 56 days of exposure of baits. The rate of discovery of baits (% attack) consequently rose sharply from 22—34% between 56—112 days after application. It would, therefore, appear that carbofuran applied at planting in the soil, is effective in suppressing termite damage for a period of approximately 7-8 weeks and thereafter its effectiveness becomes considerably reduced (Fig. 1). Attack on the maize root system is known to commence between 10—12 weeks after planting and intensifies as the crop matures (Wood, Johnson and Ohiagu, 1980). Therefore, the timing of application of carbofuran would appear to be an important factor in its effectiveness as a termite control agent. In the chlorpyrifos and pirimiphos ethly treated plots, initial attack was relatively

high (19—21%) between 0—56 days after baits exposure. Subsequent attack was not significantly different from the initial 23.5%—25% for Pirimiphos ethyl and 23.5%—28.0% for chlorpyriphos respectively. These two insecticides, although less effective than carbofuran initially, appeared to have remained effective for 3-4 months in the soil and thereby maintained a consistently low termite population throughout the period.

Fungus comb biomass and the percentage attack on baits, both indices of foraging termite population, have been used by other workers for predicting termite damage on crops (Wood *et al* 1977).

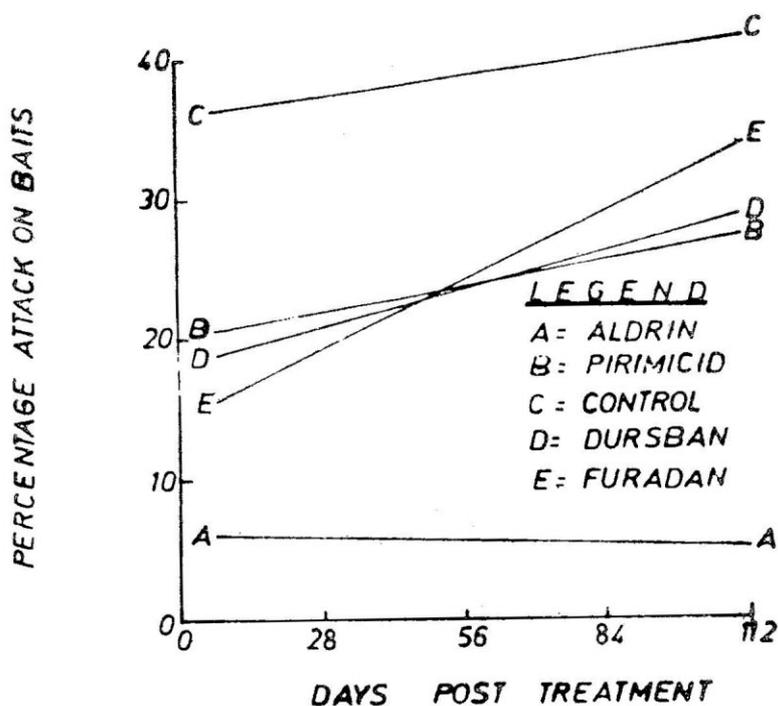


Figure 1: The rate of recovery of baits and duration (days of the efficacy of the different insecticides).

Table 2 shows the analysis of the other parameters used in assessing the efficacy of the insecticides. Plant population varied from 183—207 plants/plot. The highest percentage lodging 27.1—46.8 was recorded in the second year of the experiment (Table 2). The combined data for the three years showed less lodging in the aldrin treated plots (3%) than in the carbofuran (14.0%), chlorpyriphos (18.2%) and pirimiphos ethyl (21.3%) treated plots. Most of the lodging recorded on the plots was caused by members of the termitinae, especially *Microtermes* spp. Other termite species identified included *Microtermes semeathmami* (Fuller) and *Ancistrotermes cavithorax* (Sjostedt). The cobs on lodged plants were in contact with the soil and were damaged by termites, ants, rodents and termites. The extent of damage by these agents is influenced by rainfall and the time lag between lodging and harvesting of the crop. The number of cobs on the ground damaged by

Chemical control of termites on maize.

termite was significantly ($P < 0.05$) lower in aldrin and carbofuran treated plots than in the other plots. Damaged cobs may cause a reduction in yield. Ohiagu (1979) reported that termite damage on cobs caused a 7.6% and 4.3% loss of grain yield in Dambatta (Kano State) and Gusau (Sokoto State) respectively. Grain yield in the various treatments for the different years is shown in Table 2. The yield from carbofuran (4002kg/ha) and aldrin treated (3904kg/ha) plots were significantly ($P < 0.05$) higher than those from the other plots. There was no significant difference in yield between chlorpyrifos (3385kg/ha) and pirimiphos ethyl (3449kg/ha) treated plots. Higher grain yields were obtained from the various treatments in the 1981/82 growing season than in the preceding years. The high yield figures obtained from carbofuran treated plots in spite of its low persistence in the soil, could be attributed to other factors. These include its systemic nature and its ability to give initial protection against termite to the young crop, and its excellent control of stem borers, especially *Busseola fusca* (Fuller) an important pest of maize in this locality.

Because of its short lived effect in soil, the timing and frequency of application of carbofuran to control termites on maize needs to be further investigated. The long residual properties of aldrin would appear to be ideal for the effective control of termite which attack maize later in the growing season. However, its persistence and other properties considered deleterious to human health make it less preferable than carbofuran. Pirimiphos ethyl and chlorpyrifos were not effective since yields from plots where they were used did not differ significantly from the control plots (Table 2). Chlorpyrifos has, in addition, been shown to be phytotoxic to young maize seedlings at higher concentrations (Ohiagu, 1981).

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Table 2. Treatment means of different parameters used in assessing the effectiveness of four insecticides for termite control on maize

Year	Insecticides	Mean No. of plants per treatment	Mean % Lodging	% Damaged cobs	Mean Yield (kg/ha)
1980	Aldrin	250a	3.0de	0e	3115bcd
	Furadan	210bc	7.0de	1de	2873cd
	Dursban	221b	10.0cde	8a	2585cd
	Primiphos ethyl	202bcd	11.8cd	6ab	2256d
	Control	201bcd	16.1c	7ab	1745d
1981	Aldrin	177ef	3.9de	0e	3653abcd
	Furadan	189de	27.1b	4bcd	3256bcd
	Dursban	162f	38.8a	8a	2602cd
	Primiphos ethyl	160f	46.8a	6ab	2623cd
	Control	163f	41.2a	5abc	2361d
1982	Aldrin	193cde	1.7e	0e	4943abc
	Furadan	195cde	7.9dce	0e	5878a
	Dursban	189de	5.7de	0e	4969abc
	Primiphos ethyl	188de	5.3de	0e	5468ab
	Control	186de	9.4cde	2e	4853abc
SE		7.11	3.10	1.09	178.0
MSD (.05)		20	8.8	3	503
CV%		9.0	47.5	89.2	12.3
Grand Mean		192	16.7	3	3545

Means followed by same letters are not significantly different at the 5% level by Duncans multiple range test.

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