Granular Nematicides for Control of the Yam Nematode, Scutellonema bradys, and Relevant Residues in Raw Tubers

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Abstract: Four granular nematicides were evaluated for control of the yam nematode, *Scutellonema bradys* (Steiner & LeHew) Andrassy, on Guinea yam, *Dioscorea rotundata* Poir, under field conditions prevelant in the tropics. A single application of nematicides (sidedressing) at the rate of 2 kg ai/ha as postplanting treatment at the onset of the rainy season depressed numbers of *S. bradys* attacking yams during the growing season and significantly increased tuber yields over untreated. The efficacy, based on the regression coefficient values of evaluated nematicides, was in the order of miral, carbofuran, aldicarb, and oxamyl (b = −75.9, −75.5, −72.1, and −65.9, respectively). Yam tuber yields increased by 136.9, 90.6, 87.9, and 85.3% over untreated ($P = 0.05$) in aldicarb, carbofuran, oxamyl, and miral treated plots, respectively. Residues in raw tubers pretreated with aldicarb, carbofuran, or miral were negligible (from less than 0.02 to 0.3 ppm) and far below the established tolerance levels (1.0 and 1.3 ppm for aldicarb and carbofuran, respectively) of a related crop in the United States. This is the first report on residues of systemic pesticides in yams. *Key words: Scutellonema bradys,* granular nematicides, *Dioscorea rotundata,* sidedressing, postplanting treatment, residue in harvest tubers.

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Yams (*Dioscorea* spp.) are grown for their stem tubers throughout the wetter tropics (100–320 cm mean annual) where they provide a staple and preferred food for many people (10). Several nematodes, such as the yam, root-knot, and lesion nematodes, constitute an economic menace to yam cultivation (3,4). Infection by the yam nematode, *Scutellonema bradys* (Steiner & LeHew) Andrassy, causes heavy losses to yams in the field and predisposes tubers to dry and wet rot storage diseases that result in decreased edibility (2,9). The efficacy of several granular nematicides for the control of noxious nematodes attacking other tuber crops such as potatoes, sweet potatoes, carrots, and sugarbeets is well documented (1, 6,8,11,12,13,15). Oxamyl (methyl-N′, N′-dimethyl-N-[(methylcarbamoyl)oxy]-1-thiooxamimidate) alone or in combination with nitrogenous fertilizers has been shown to be effective in the field against *Meloidogyne javanica* (Treub) Chitwood and *Pratylenchus brachyurus* (Godfrey) Goodey infesting Guinea yam, *Dioscorea rotundata* Poir (7). The objectives of this study were to further evaluate granular nematicides for maximum nematode control and yield and to determine nematicide residues in harvested tubers.

MATERIALS AND METHODS

The Guinea yam tubers used for the experiment were collected from a field infested with *S. bradys*. Nematode infection was detected by placing 50 g peels/tuber into modified Baermann funnel (16) and inspecting for the presence of nematodes after 24 h. Infected tubers were cut into 200-g seed pieces and planted in 35-cm mounds set 1 m apart in a sandy loam (84% sand, 9.6% silt, 6.4% clay, 5.7 pH, 0.64% organic matter, and 210 μg Ca, 18 μg Mg, 36 μg Mn, 43 μg K, and 8 μg Na as exchangeable cation per gram soil). Test nematicides were incorporated into the mounds as a sidedressing 10 cm from the tubers 2 wk after planting. The nematicides were aldicarb (2-methyl-2-[methylthio] proionaldehyde O-[methylcarbamoyl]oxime), carbofuran (2, 3-dihydro-2, 2-dimethyl-7-benzofuranyl methycarbamate), miral (0-[5-chloro-1-[1-methylethyl]-1 H-1, 2, 4-trizol-3-yl] O,O-diethylphosphorothioate), and oxamyl (methyl-N′, N′-dimethyl-N-[(methylcarbamoyl]oxy]-1-thioxamidate) at the rate of 2 kg ai/ha. The experimental design was a randomized complete block with four 4-plant replica-

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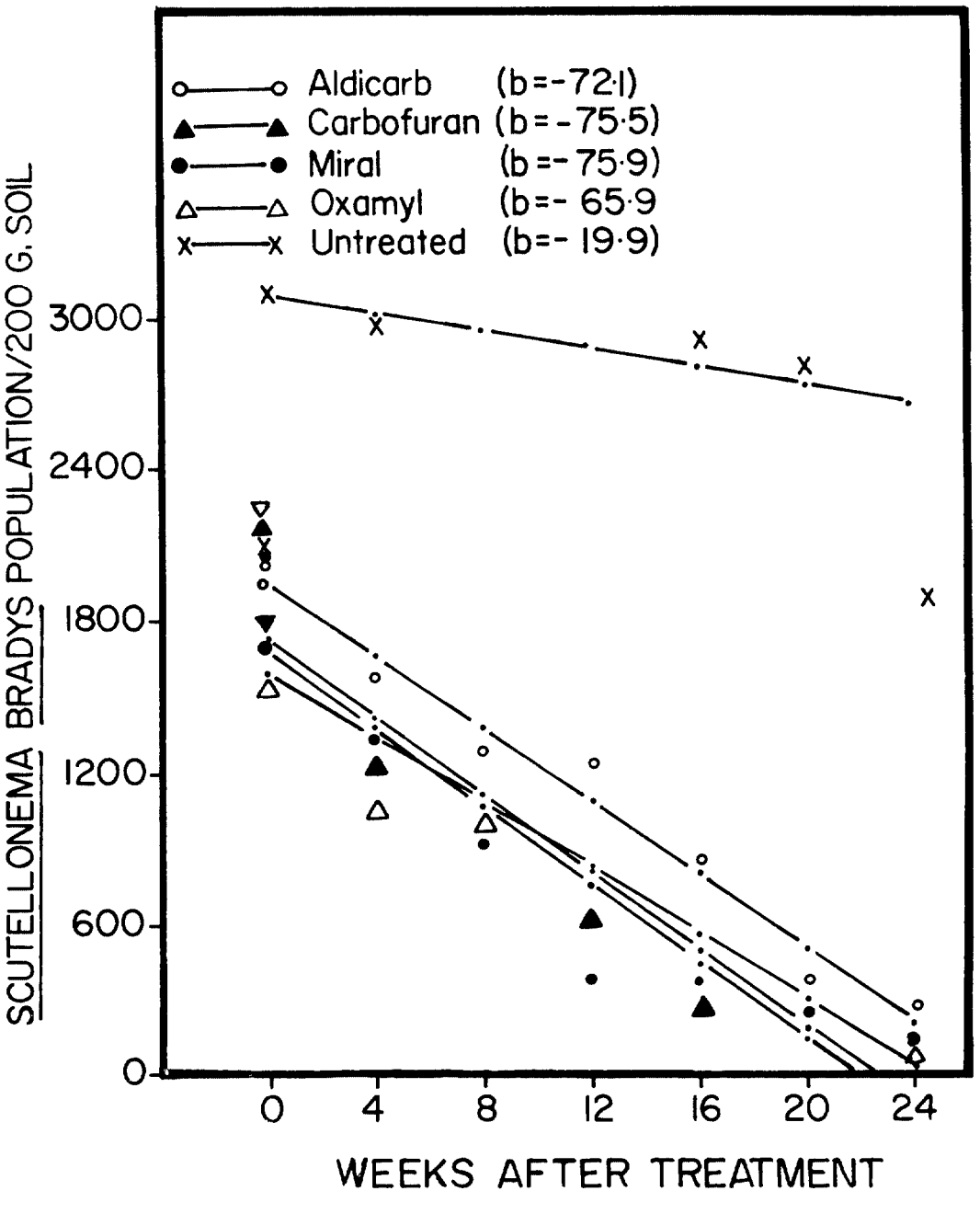

Fig. 1. Efficacy of granular nematicides in the control of *Scutellonema bradys* on Guinea yams, *Dioscorea rotundata,* under tropical field conditions. b's are the regression coefficient values of the linear relationship between nematode numbers and sampling intervals.

tions of each treatment including untreated controls. The field was left to grow from early April (the onset of the wet season) to late October without supplemental irrigation. Nematode populations were determined (16) from 200-g composited soil samples taken from each mound at 4-wk intervals. Tuber yield was determined at harvest, and toxic residues within tubers from treated mounds were determined by the Huntingdon Research Centre in England (17,18) and Ciba-Geigy Residue Laboratory in Switzerland (5). Tuber yield data were submitted to analysis of variance and Duncan's multiple-range test; nematode populations assays were submitted to linear regression analysis and b values determined (14).

RESULTS

Populations of *S. bradys* were substantially less in nematicide treated soils than in untreated soil ($P = 0.05$). The efficacy, based on the regression coefficient values of evaluated nematicides, was in the order of miral, carbofuran, aldicarb, and oxamyl (Fig. 1). At the end of the trial (24 wk after treatment), nematode populations dropped to 125, 130, 250, and 270/200 g soil treated with miral, carbofuran, oxamyl, and aldicarb, respectively. This represented decreases from the control of 85.6, 86.6, 93.1, and 93.3% for aldicarb, oxamyl, carbofuran, and miral, respectively. In untreated soil, *S. bradys* increased from 2,015/200 g soil at the start of the trial in April to 3,432/200 g soil during July, and declined to 1,870 in October. The population increase correlated with the rainy season, and the population decrease corresponded to the dry season. Plots received 178.1, 205.4, 133.8, 290.6, 184.8, 259.4, and 156.4 mm of water in April, May, June, July, August, September, and October 1979, respectively.

In the field, plants from soil treated with aldicarb and carbofuran were larger and appeared greener and healthier than plants from soil treated with other nematicides or left untreated. Yam yields were significantly ($P = 0.05$) increased by all chemicals (Table 1). The residual concentrations of aldicarb, carbofuran, and miral in tubers from treated soil are given in Table 2.

Table 1. Effect of nematicide treatments on yield of Guinea yams (*Dioscorea rotundata*).

Treatment	Yam yield (tons/ha)
Untreated	33.9 a
Aldicarb	80.3 d
Carbofuran	64.6 c
Miral	62.8 b
Oxamyl	63.7 b

*Applied postplant at 2 kg ai/ha. Means followed by dissimilar letters are significantly different according to Duncan's multiple-range test ($P = 0.05$).

DISCUSSION

Our results show that Guinea yam responds favorably to treatments with granular nematicides for control of the yam nematode. A single postplant sidedressing treatment with aldicarb, carbofuran, oxamyl, or miral at 2 kg ai/ha effectively controlled *S. bradys* during the growing season and significantly increased yields without toxic deposits in raw harvested tubers. The high yield increases in plots treated with nematicides indicate the need for an effective chemical control to minimize the economic losses caused by this nematode.

The potential for accumulation of toxic residues from the application of systemic pesticides to root tuber crops must be considered in a control program. Chemical treatment on these crops must be timed appropriately to provide efficient nematode control and food tubers safe for human consumption. We report the first case of resi-

Table 2. Determination of residual concentrations of nematicides in yam tubers.

Nematicide	Concentration
Aldicarb*†	<0.02
Carbofuran*	0.05-0.3
3-hydroxy carbofuran*	0.05-0.06
Isazophos miral‡	0.02

*Data supplied the Huntingdon Research Centre, Huntingdon, England.

†Total combined amounts of the parent pesticide aldicarb and its cholinesterase-inhibiting metabolites aldicarb sulfoxide and aldicarb sulfone.

‡Data supplied by Ciba-Geigy Ltd., Residue Laboratory, Basel, Switzerland.

due analysis on yams. Data reveal that a single sidedressing treatment at the rate of 2 kg ai/ha 2 wk after planting increased yields substantially without appreciable accumulation of toxic residues in raw tubers. Accumulated toxic residues were far below the established tolerance levels (1.0 and 1.3 ppm for aldicarb and carbofuran, respectively) of a related crop (potatoes) in the United States.

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