RAULSTON, J. R., S. D. PAIR, F. A. PEDRAZA MARTINEZ, J. WESTBROOK, A. N. SPARKS, AND V. M. SANCHEZ VALDEZ. Ecological studies indicating the migration of *Heliothis zea, Spodoptera frugiperda,* and *Heliothis virescens* in northeastern Mexico and Texas. In Proc. XVII Int. Cong. Ent., Hamburg, Germany, August 1984. Springer-Verlag. pp. 204-220.

SAS. 1982. User's Guide. Statistical Analysis System Institute, Inc., Cary, NC.

SPARKS, A. N., AND E. R. MITCHELL. 1979. Economic thresholds of *Heliothis* species on corn. Southern Coop. Series Bull. 231: 51-56.

TANADA, Y., AND C. REINER. 1962. The use of pathogens in the control of the corn earworm, *Heliothis zea* (Boddie). J. Invertebr. Pathol. 4: 139-154.

WOLF, W. W., J. K. WESTBROOK, AND A. N. SPARKS. Relationship between radar entomological measurements and atmospheric structure in south Texas during March and April, 1982. *In* A. N. Sparks (Ed.). Long-Range Migration of Moths of Agronomic Importance to the United States and Canada: Specific Examples of Occurrence and Synoptic Weather Patterns Conducive to Migration. (ESA Symposium, 1982.) USDA Misc. Pub. (in press).

YOUNG, J. R., AND J. J. HAMM. 1966. Nuclear polyhedrosis viruses in control of corn earworm and fall armyworm in sweet corn. J. Econ. Ent. 59: 382-384.

GREENHOUSE AND FIELD EVALUATIONS OF GRANULAR SOIL INSECTICIDES FOR CONTROL OF SUGARCANE BEETLE, *EUTHEOLA RUGICEPS* (COLEOPTERA: SCARABAEIDAE) IN FIELD CORN

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ABSTRACT

Seven granular soil insecticides were tested in the greenhouse and field for control of adult *Eutheola rugiceps* (Lec.). Terbufos, isofenfos and phorate provided consistently good control. Chlorpyrifos, fensulfothion and ethoprop produced variable levels of control. Carbofuran was least effective of the insecticides tested.

RESUMEN

La efectividad de 7 insecticidas en granulos para la tierra, para el control del adulto *Eutheola rugiceps* (Lec.) fué examinada en vivieros y en el campo. Terbufos, isofenfos y phorate proveyeron consistentemente un buen control. Chlorpyrifos, fensulfothion y ethoprop producieron variables niveles de control. Carbofuran fué el menos efectivo de los insecticidos probados.

The sugarcane beetle, *Eutheola rugiceps* (Lec.), is an occasional pest of seedling corn in Louisiana. Adults damage corn by chewing into the subterranean portion of the plant, killing small seedlings and stunting large plants. In Louisiana beetle activity begins in late March and early April and peaks when corn is in the seedling stage.

Eutheola rugiceps has been a significant pest of corn in the south. Its life history, damage and cultural control in corn was described by Baerg (1942), and Phillips and Fox (1926). Chemical control of the beetle in corn was investigated by Henderson et al. (1958) and Eden (1954). With the exception of phorate, the insecticides they tested are no longer available to corn producers.

No insecticides are presently registered for the control of this beetle. Since farmers routinely apply a soil insecticide for the control of the southern corn rootworm, granular insecticides registered for this use were evaluated for effectiveness against the sugarcane beetle.

Methods

The first experiments were conducted in 1981 and 1982 in a greenhouse using 12-cm-diameter, 2-liter plastic pots filled with soil. Soil used was a silt-sand alluvial soil, obtained from the immediate bank of the Mississippi River. It was deposited during the annual spring rise of the river, several months prior to the experiments, and had no known prior exposure to insecticides.

The granular insecticides carbofuran 10G, chlorpyrifos 15G, ethoprop 10G, fensulfothion 15G, isofenfos 20G, phorate 15G, and terbufos 15G were valuated at the rates of 1.12, 1.68 and 2.24 kg AI/ha. Carbofuran at .56 kg AI/ha was also tested in 1981. Insecticides were applied by hand in a manner that approximated in-furrow and band applications in the field. The furrow applications were made across the pots at a depth of 3.5 cm and covered with soil. Banded applications were sprinkled on the soil surface and covered with 5 mm of soil. In 1982, insecticides were applied at the 1.12 and 2.24 kg a.i./ha rates in simulated bands only. Pots were watered immediately after application. In 1981 pots were watered again 9 days later and beetles introduced 10 days after insecticide application. In 1982 the second watering and beetle introduction were 6 and 9 days respectively after insecticide application. Four replications of each insecticide treatment were used.

Ten beetles were placed in each pot and observed until they had burrowed into the soil. Pots were then covered with cardboard lids fitted with 3-mm mesh hardware cloth. Lids were weighted and pot bottoms covered with 4 layers of aluminum foil to prevent beetle escape. Pots were emptied, soil sifted, and living and dead beetles counted 5 and 6 days after introduction in 1981 and 1982 respectively. Greenhouse temperature during the experiments was 29 ± 2°C.

In the field chlorpyrifos 15G, ethoprop 10G, fensulfothion 15G, isofenfos 20G and terbufos 15G were evaluated. Carbofuran was consistently inferior in the greenhouse tests and was therefore not included in the field trial. Phorate was not field tested since it is not widely used by Louisiana corn producers. Insecticides were applied on May 13, 1983 as in-furrow and 20 cm wide band applications at 1.12 kg AI/ha using a two row John Deere model 71 planter. Banded insecticides other than ethoprop were applied over the open furrow, covered by the press wheel and further incorporated by drag chains. All ethoprop applications were made behind the press wheel and incorporated by drag chains. Pioneer Brand 3030 field corn was planted as the insecticides were applied.

A completely randomized block design was used with 3 replications. Each treatment consisted of a 2 × 2 × 2 m Saran screen cage placed over two treated rows and enclosing 9 corn plants. The cages were installed and 100 sugarcane beetles placed in each on May 27. Insecticides were evaluated on May 31 by sifting all the soil in the cage to a depth of 25 cm and counting the number of dead and live plants and dead and live beetles recovered.

TABLE 1. PERCENT MORTALITY OF SUGARCANE BEETLES IN A GREENHOUSE EVALUATION OF FOUR GRANULAR SOIL INSECTICIDES.

Insecticide and Formulation	Kg ai/hectare	Method of Application	% Mortality[1]
Isofenfos 20 G	1.12	Furrow	100.0 a
Isofenfos 20 G	1.12	Band	100.0 a
Isofenfos 20 G	2.24	Furrow	100.0 a
Isofenfos 20 G	1.68	Band	100.0 a
Terbufos 15 G	1.12	Furrow	100.0 a
Terbufos 15 G	1.12	Band	100.0 a
Terbufos 15 G	1.68	Band	100.0 a
Terbufos 15 G	2.24	Band	100.0 a
Phorate 15 G	1.12	Band	100.0 a
Phorate 15 G	2.24	Band	100.0 a
Isofenfos 20 G	1.68	Furrow	93.7 a
Terbufos 15 G	2.24	Furrow	93.7 a
Phorate 15 G	1.68	Band	93.7 a
Terbufos 15 G	1.68	Furrow	91.6 a
Isofenfos 20 G	2.24	Band	83.3 a
Carbofuran 10 G	2.24	Band	45.8 b
Carbofuran 10 G	1.68	Furrow	33.3 bc
Carbofuran 10 G	1.68	Band	31.2 bc
Carbofuran 10 G	2.24	Furrow	19.4 bcd
Carbofuran 10 G	1.12	Band	8.3 bcd
Carbofuran 10 G	0.56	Furrow	0.0 d
Carbofuran 10 G	1.12	Furrow	0.0 d
Carbofuran 10 G	0.56	Band	0.0 d
Check			0.0 d

[1]Means followed by the same letter do not differ significantly (P = 0.05) (DMRT).

The soil in the experimental area was a silt-sand recent alluvial soil with good drainage. Its last exposure to soil insecticides was two years earlier when a small plot test of carbofuran, isofenfos, phorate and terbufos was conducted. Fifteen cm of precipitation fell on the study area between planting and infestation. Temperature extremes at ground level within the cages during the infestation period were 35.6 and 15.6°C respectively.

Sugarcane beetles were collected one to two weeks prior to each experiment using black light traps. They were maintained in the laboratory in ten gallon aquaria half filled with silt-sand soil obtained from the immediate bank of the Mississippi River. Apple slices were fed to the beetles twice weekly.

Data were analyzed using analysis of variance and Duncan's multiple range test.

RESULTS AND DISCUSSION

Isofenos, phorate and terbufos produced the best results in the initial greenhouse test (Table 1). Carbofuran treatments were ineffective. In 1982, both rates of chlorpyrifos, fensulfothion, phorate and terbufos produced the best results and were statistically inseparable (Table 2). Ethoprop and isofenfos were less effective at the lower rate, and carbofuran was again ineffective at both high and low rates.

TABLE 2. PERCENT MORTALITY OF SUGARCANE BEETLES IN A GREENHOUSE EVALUATION OF SEVEN GRANULAR SOIL INSECTICIDES.

Insecticide and Formulation	kg ai/hectare	$\bar{X}$ % dead beetles[1]
Phorate 15 G	1.12	100.0 a
Phorate 15 G	2.24	97.5 ab
Isofenfos 20 G	2.24	97.5 ab
Terbufos 15 G	2.24	97.5 ab
Terbufos 15G	1.12	95.0 ab
Fensulfothion 20 G	2.24	92.5 abc
Chlorpyrifos 15 G	1.12	85.0 abc
Chlorpyrifos 15 G	2.24	85.0 abc
Fensulfothion 15 G	1.12	82.5 abc
Ethoprop 10 G	2.24	77.5 bc
Isofenfos 20 G	1.12	72.5 c
Ethoprop 10 G	1.12	52.5 d
Carbofuran 10 G	2.24	27.5 e
Carbofuran 10 G	1.12	17.5 ef
Check		00.0 f

[1]Means followed by the same letter do not differ significantly (P = 0.05) DMRT.

TABLE 3. PERCENT MORTALITY OF SUGARCANE BEETLES AND CORN PLANTS IN A FIELD EVALUATION OF FIVE GRANULAR SOIL INSECTICIDES AT 1.12 KG AI/HA IN FIELD CORN.

Insecticide and Formulation	Placement Method	$\bar{X}$ % Dead[1] Beetles	$\bar{X}$ % Dead Plants	Total Beetles Recovered
Terbufos 15 G	Band	86.8 a	51.9 a	138
Terbufos 15 G	Furrow	84.1 a	68.8 ab	134
Chlorpyrifos 15 G	Band	83.6 a	56.6 a	128
Isofenfos 20 G	Band	80.7 a	77.8 ab	144
Fensulfothion 15 G	Band	66.0 a	77.8 ab	117
Ethoprop 15 G	Band	20.0 b	96.3 b	55
Check		9.7 b	88.9 b	83

[1]Means followed by the same letter do not differ significantly (P = 0.05) DMRT.

In the field, terbufos, chlorpyrifos, isofenfos and fensulfothion were most effective (Table 3). Ethoprop was ineffective possibly due to its application as a band on top of the covered seed furrow allowing greater exposure to weather.

The percent of plants killed corresponded inversely to the effectiveness of the insecticide treatments with exception of the furrow application of terbufos. A possible explanation for the greater number of dead plants in this treatment could be the beetles' habit of burrowing just below the soil surface when feeding on corn. They would not be deep enough to directly contact the insecticide and therefore would be able to inflict more damage before being killed. In all treatments, all plants not counted as dead were damaged by the beetles. This was attributed to the large number of beetles used per cage in the experiment.

All the insecticides tested are registered for use on corn at or above the 1.12 kg AI/ha rate. In Louisiana, carbofuran has been the most frequently used insecticide for soil insect control in corn, terbufos and fensulfothion are also used. Based on the greenhouse experiments, growers should not expect sugarcane beetle control if carbofuran is used at planting. Isofenfos is no longer available for use on corn, therefore terbufos, fensulfothion or chlorpyrifos would be preferable if the sugarcane beetle is a recurrent problem.

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REFERENCES CITED

BAERG, W. J. 1942. Rough-headed corn stalk beetle. Arkansas Agric. Exp. St. Bull. 415.

EDEN, W. G. 1954. Control of the sugarcane beetle in corn. J. Econ. Entomol. 47: 1155-1156.

HENDERSON, C. A., J. W. INGRAM, AND W. A. DOUGLAS. 1958. J. Econ. Entomol. 51: 631-633.

PHILLIPS, W. J., AND HENRY FOX. 1926. The rough-headed corn stalk beetle in the southern states and its control. U.S. Dept. Agric. Farmers Bull. 875.

BIBLIOGRAPHY OF IMPORTED FIRE ANTS AND THEIR CONTROL: SECOND SUPPLEMENT

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The red and black imported fire ants (IFA), *Solenopsis invicta* Buren and *S. richteri* Forel, now occupy more than 52 million ha in the southern United States. The literature on these controversial pests was collected in a bibliography (46) in 1978 and a supplement (370) in 1982. Since the first supplement was compiled, the flow of literature on IFA has increased to such an extent that a second supplement is warranted.

The primary source of citations for this supplement was the Agricultural Research Service Current Awareness Literature Service provided by the Lending Division, National Agricultural Library. This service is a computerized search of Biological Abstracts, Biological Abstracts/RRM, Chemical Abstracts, AGRICOLA (USDA's National Agricultural Library file), and the Commonwealth Agricultural Bureaux. Current Contents/Agricultural, Food, and Veterinary Sciences and Dissertation Abstracts were