Corn Yield Response to Tillage, Hybrids, and Insecticides

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Abstract

Researchers have reported conflicting responwof corn *(Zea mays* L.) to insecticides. This research was conducted to relate insecticides, tillage and corn genotypes to these conflicting responses. Two sets of experiments were conducted. A 3-yr study compared no-tillage (NT) and conventional tillage (CT) (main plots) and four insecticide treatments (split plots) [2.0 lb a.i. Carhofuran A' (CF 2.0), 1.0 lb a.i. Carhofuran a^{-1} (CF 1.0). 2.0 lb a.i. Terhufos A' (TF 2.0), and a untreated control (C)]. A 2-yr study compared six hybrids (main plots) with the previous insecticide treatments (split plots). Grain yield and plant height were measured at harvest. Treatments with CF 2.0 gave higher grain yield in NT, hut TF 2.0 gave equal grain response in CT. Asgrow RX777 yielded 51 bu A^{-1} more grain when treated with TF 2.0 than the C. DeKalb XL71 yielded 45 bu A^{-1} more grain with CF 2.0 than with the C. Since TF and CF were used in the breeding management programs for Asgrow RX777 and DeKalb XL 71, respectively, these interactions suggested that a hybrid would respond better, under farm production conditions, to the insecticide used in it's breeding development management program than an alternative pesticide.

Introduction

Researchers have reported differential and conflicting responses of corn *(Zea mays* L.) to insecticides (5). Environmental factors such as tillage practices, influence both the magnitude and expression of genetic resistance. Other cultural factors such as soil fertility, soil moisture, pesticides, and plant growth regulators affect yield and nutritional quality of host plant tissue appearing to be particularly important in the induction of resistance (13). Genotype populations that were relatively stable in their original environment may become unstable and fluctuate greatly in the stress of a new environment (3, 8).

No-tillage (NT) induces major modifications in ecological conditions in fields, especially the conditions affecting soil fauna (Phillips et al (11). These alterations may enhance, have no affect, or deter the biopotential of soil arthropods. It is generally anticipated that insect infestations will be more severe in NT systems and that insect control will be more difficult than in conventional tillage (CT) corn (9). However, infestations of lesser cornstalk borer *(Elasmopalpus lignosellus* Zeller) were deterred in NT corn cropping systems (2). Both root rot *(Giberellazeae* S.) and Leaf rust *(Piccinia sorghi* S.) affected the absorption and translocation of carbofuran from soils into the plant (12).

The method and timing of pesticide application determine the efficiency of application. Terbufos gave excellent season-long control of greenbugs *(Schizaphis graminum* R.) and increased grain yield when injected into soil. Equivalent rates applied in a band on the soil surface gave poor control (4). Carbofuran used to control northern rootworm *(Diabrotica longicornis* Say) degraded rapidly in some soils, occasionally failing in other soils (6,7). A tillage-corn genotypes study with 60 hybrids showed no differential response of these hybrids to tillage (NT vs CT) (10).

Hybrid selection is usually related to high yield and may be carried out under high fertility, irrigation, and good pest control. It is suggested that hybrids selected in this manner may not perform well in other environments (low fertility, nonirrgation, and other pesticides) (1)

The objectives of this research were to relate insecticides to tillage and corn genotypes, and to better understand the reported conflicting responses of corn to insecticides.

Materials and Methods

This research was conducted in the north-central Florida region on Hernando LFS (Typic Hapludalf) soil. A randomized complete block design was used.

Tillage/Pesticide Study

In this 3-yr study (1981, 1982, 1983) the response of

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DeKalb XL71 corn hybrid to insecticides under two tillage management conditions was evaluated. No-tillage plus in-row subsoil versus CT plus in-row subsoil were whole plots with four replications and three insecticide treatments and a control as the split plots [1.0 lb a.i. Carbofuran A^{-1} (CF 1.0) 2.09 lb a.i. Carbofuran A^{1} (CF 2.0), 2.0 lb a.i. Terbufos $^{-1}$ (TF 2.0) and a untreated control (C)]. Split plots were 10 feet wide, and 30 feet long. There were four rows 30 in. apart. Plots were kept under monocrop corn for 6-yr, 3-yr prior to the implementation of the pesticide treatments, and during the 3-yr experiment. DeKalb XL71 was planted at 36,400 seed A^{-1} 27 Feb. 1981, 8 Mar. I982 and 10 Mar. 1981. A Brown Harden in-row subsoil NT planter was used in NT and CT (prepared with an off-set Harrow And Rototiller). The pesticide treatments were applied in 6 in. bands over the row at planting. Complete fertilizer including N, P, K, S, Mg, Fe, Cu, B, Zn and Mn was broadcast prior to planting based on soil test and plant need. Preplant broadcast fertilization include 180 lb ammonium nitrate (NO_3), and 200 lb KMAG A^{-1}. Also, Ammonium nitrate was sidedressed at a rate of 150 lb A^{1} when plants were 10 in. tall. Weed control was done 10 days prior to planting with Paraquat plus X77 surfactant. When corn was about 6 in. tall a post-broadcast application over the top was done with Atrazine (2.0 lb a.i. A^{-1} and 1 quart crop oil A^{-1}).

Collected data consisted of plant height at the soft dough state of grain formation, and corn grain yield at harvest. Statistical analyses were performed using split plot ANOVA on a TRS-80 model III microcomputer. Means were tested at the 0.05 probability level.

Genotype/Pesticide Experiments

A three-location study with six commercial hybrids was evaluated for yield as affected by pesticide treatment during 1982 and 1983. Locations were in Alachua county, FL in 1982 and in Levy county, FL in 1983. The three locations had similar cropping histories, of continuous double cropped NT corn followed by soybean (*Glycine max* L.).

The hybrids evaluated were the following; Asgrow RX777, DeKalb XL 71, Funks G4507A, Coker 19, Pioneer 3320, and Gold Kist 748. Hybrids were whole plots with 4 replications. The same insecticides and rates used in the tillage/pesticide study were split plots with the same plot size and cultural practices. Data collection, and statistical analyses were handled in the same manner.

Results and Discussion

Tillage/Pesticide Study

Interactions between tillage and pesticide treatments were shown for grain yield, and plant height (Tables I, and 2). Grain yield for NT, CF 2.0 was significantly greater than other treatments at the 0.05 probability level. All pesticide treatments gave higher grain yield than the Control (Table I).

There were no difference among pesticide treatments with CT. No-tillage grain yield was greater than CT for CF 1.0. Terbufos 2.0 did not show any differences between tillage treatments. With no pesticide NT grain yield was higher than CT.

The tallest plants occurred under NT condition at the highest rate of CF 2.0. The CF 1.0, TF 2.0, and C did not differ in NT (Table 2). Under CT both CF 2.0 and CF 10 gave the tallest plants. The TF 2.0 treatment had shorter plants than the Carbofuran treatments. The C had the shortest plants in CT. Among the pesticide treatments, tillage treatments were different only for the highest rate of Carbofuran, and was in favor of NT (Table 2).

Table 1. Corn graln yield response to tillage and pesticides (three year average).

		Tillage[3]		
Pesticide	Rate	NT	CT	Avg
	lb a.i. A^{1}		bu A^{-1}	
Carbofuran	2.0	188 a	173 a *	181
Carbofuran	1.0	159 b	172 a *	166
Terbufos	2.0	162 b	165 a NS	164
Control	0.0	146 c	129 b *	138
Avg		164	160	

a,b,c, = within columns among pesticides.
* = different at .05 P in rows between tillage.
NS = nonsignificant.
[3] NT = No-tillage, CT= Conventional Tillage.

Table 2. Corn plant height response to tillage and pesticides (two year average).

		Tillage		
Pesticide	Rate	NT	CT	Avg
	lb a.i. A^{-1}		feet	
Carbofuran	2.0	8.7 a	8.3 a *	8.5
Carbofuran	1.0	8.1 b	8.3 a NS	8.2
Terbufos	2.0	8.1 b	8.0 b NS	8.0
Control	0.0	7.9 b	7.7 c NS	7.8
Avg		8.2	8.1	

a,b,c, = within columns among pesticides.
* = different at .05 P in rows between tillage.
NS = nonsignificant.

Genotype/Pesticide Study

Interactions were shown between genotype and pesticide treatments under NT conditions for both grain yield and plant height (Tables 3, and 4). Asgrow RX777 attained the highest grain yield (167 bu A^{-1}) using TF 2.0. All hybrids obtained highest grain yield with CF 2.0. Coker 19 responded equally to TF and CF. Pioneer 3320 responded equally to the two CF rates (Table 3). Grain yields were compared across hybrids within an individual pesticide treatment (Table 3) and showed that for CF 2.0 DeKalb XL71 and Gold Kist 748 gave the highest grain yield. However when CF I.0 was used Pioneer 3320 and Gold Kist 748 gave the highest grain yield. Terbufos seemed to favor Asgrow RX777 grain yield over the others. When the hybrids were placed in a untreated environment Pioneer 3320 gave the greatest grain yield.

In general the tallest plants occurred with CF 2.0 (8.4 feet). The exception was DeKalb XL71 with the tallest plants from TF 2.0 (8.I feet). The C gave the shortest plants. The plant height response among hybrids within an individual

Table 3. Corn hybrid grain yield in relation to pesticides across tillage treatment and locations.

	Insecticide Treatment[1]				
	Carbofuran		Terbufos	Control	Avg
Rate	2.0	1.0	2.0	0.0	
Hybrid	.....	.....	bu A^{-1}	.....	.....
Asgrow RX777	154 v b	146 w c	167 u a	116 vw d	146
DeKalb xL71	164u a	146 w b	143 v b	119 vw c	143
Coker 19	146 w a	151 vw a	148 v a	119 vw b	141
Gold Kist 748	165u a	156uv b	134 w c	122 v d	144
Funks G4507A	143 w a	132 x b	126 w c	110 w d	128
Pioneer 3320	156 v a	161u a	142 v b	145u b	151
Avg	155	149	143	122	

[1]Insecticide rates expressed as lb a.i. A1. 'a,b,c = within rows of pesticides, and u,v,w,x = within columns, values not followed by the same letter are significantly different at the 0.05 level of probability.

Table 4. Corn hybrid plant height in relation to pesticides across tillage treatment and location.

	Insecticide Treatment[1]				
	Carbofuran		Terbufos	Control	Avg
Rate	0.0	1.0	2.0	0.0	
Hybrid	.....	.....	feet	.....	.....
Asgrow RX777	8.2 v a	7.7 y c	7.9 w b	7.1 w d	7.7
DeKalb XL71	7.9 w b	7.8 x c	8.1 u a	7.7 uv c	7.9
Coker 19	8.2 v a	7.5 z c	7.7 x b	6.9 x d	7.6
Gold Kist 748	8.4 u a	8.2 u b	8.0 vw c	7.8 u d	8.1
Funks G4507A	8.0 w a	7.9 w a	7.6 y b	7.1 w b	7.7
Pioneer 3320	8.3 u a	8.1 v b	7.8 x c	7.7 v d	8.0
Avg	8.2	7.9	7.9	7.4	

pesticide treatment is shown in table 4. This comparison showed that CF rates gave the tallest plants for Gold Kist 748. DeKalb XL71 plant height was increased by TF 2.0. Gold Kist 748 and DeKalb XL71 were also the tallest plants when placed in a untreated environment (C).

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