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CONDITIONED YIELD RESPONSE OF CORN HYBRIDS TO TILLAGE AND THE INSECTICIDES USED IN BREEDING PROGRAMS

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ABSTRACT

Researchers have reported differential and conflicting responses of corn (*Zea mays* L.) to insecticides. Our research was conducted to determine if tillage and corn genotypes cause the variation in response. Two experiments were conducted. In one 3-yr study no-tillage (NT) and conventional tillage (CT) were main plots and four insecticide treatments were split plots (2.2 kg a.i. Carbofuran ha^{-1} (CF 2.2), 1.1 kg a.i. Carbofuran ha^{-1} (CF 1.1), 2.2 kg a.i. Terbufos ha^{-1} (TF 2.2), and a untreated control (C). In the other study six hybrids were main plots with the same insecticides as split plots. Grain yield was measured at harvest. Treatments with CF 2.2 gave higher grain yield in NT, but TF 2.2 gave equal grain response in CT. When "Asgrow RX777" (developed using TF) was treated with TF 2.2, it averaged 32 q ha^{-1} more grain than the C. Also, "Dekalb XL71" (developed using CF) yield 28 q ha^{-1} more grain with CF 2.2 than with the C. These results suggested that a hybrid will respond better to the insecticide used during its breeding development.

INTRODUCTION

The Entomological Society of America (1987) have reported differential and conflicting responses of corn (*Zea mays* L.) to insecticides. There is evidence that environmental factors influence both the magnitude and expression of genetic resistance. Tingey and Singh (1980) claim 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. Furthermore, Burton (1979) and Henson et al (1984) emphasize that genotypes may react differently in different environments resulting in populations that were relatively stable in their original environment, being unstable and fluctuating greatly in the stress of a new environment.

The advantages and disadvantages of no-tillage (NT) on crop production have been reviewed by Phillips et al (1980). No-tillage induces major modifications in ecological conditions in fields, especially the conditions affecting soil fauna. These alterations may enhance, have no affect, or deter the biopotential of soil arthropods including agricultural pests. Musick (1975) anticipated insect infestations are more severe in NT systems and their control will be more difficult than in conventional tillage (CT) corn. However, All and Gallaher(1977) found infestations of lesser cornstalk borer (*Elasmopalpus lignosellus*) to be deterred in NT corn cropping systems. Pathogens affect the absorption of soil applied pesticides. Kunstman and Lichtenstein (1983) concluded that both root rot (*Giberella zeae* S.) and Leaf rust (*Puccinia sorghi* S.) affected the translocation of carbofuran from soils into the plant.

The method and timing of pesticide application determine the efficiency of application. Depew and Hooker (1987) claim 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. Felsot (1981) and Garder (1982) established that Carbofuran degradation in some soils is rapid, occasionally failing to provide adequate pest control. In a tillage-corn genotypes study 60 commercial hybrids were grown under NT and CT, no differential response of these hybrids to tillage system was found by Newhouse and Crosbie(1986).

Since high grain yield is likely the overriding objective of the corn breeder, and since emphasis is directed to higher grain yields for grain farmers to maintain an existence in farming, hybrid development is likely carried out under ideal conditions such as; fertility and pest control. These genotypes (cultivars) would be developed under relatively specifically altered environments. Furthermore, it is proposed that a hybrid developed for high grain yield under high fertility and ideal irrigation may not perform well in other environments of low fertility and/or non irrigation. Abbott (1925) hypothesized that if hybrids are developed using a specific pesticide (insecticide and/or nematicide) they may not perform the same if grown using another pesticide.

The objective of this research was to determine if tillage and corn genotype are the reasons why scientist, industry, and farmers disagree on yield response among pesticides.

MATERIALS AND METHODS

This research was conducted in north-central Florida from 1981 to 1983. Two sets of experiments were carried out on Hernando LFS (Typic Hapludalf) soil. In both cases, a randomized complete block design was used. The two sets of experiments were the following: tillage/pesticide, and genotype/pesticide.

Tillage/Pesticide Experiments

In this 3-year study (1981, 1982, 1983) the response of "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 were split plots (1.1 Kg a.i. Carbofuran ha^{-1} (CF 1.1) 2.2 Kg a.i. Carbofuran ha^{-1} (CF 2.2), 2.2 Kg a.i. Terbufos ha^{-1} (TF 2.2) and a untreated control (C)). Split plots were 10 feet (3.07 m) wide, and 30 feet (9.20 m) long. There were four rows 30 inches (0.75 m) 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. The corn hybrid Dekalb XL71 at 90,000 seed per hectare was planted from 27 February to 10 March each year. A Brown Harden in-row subsoil NT planter was used either where no prior land preparation had occurred or where the soil had been prepared conventionally with an off-set Harrow and Rototiller. The pesticide treatments were applied in 6 inch (0.15 m) 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 200 Kg ammonium nitrate (NO3), and 225 Kg KMAG ha^{-1}. Also, Ammonium nitrate was sidedressed at a rate of 168 Kg ha^{-1} when plants were 10 inches (0.25 m) tall. Weed control was done 10 days prior to planting with Paraquat plus X77 surfactant. When corn was about six inches (0.15 m) tall a post-broadcast application over the top was done with Atrazine. Atrazine at 2.2 Kg a.i. ha^{-1} and 2 L crop oil ha^{-1} was used in all experiments.

Collected data consisted of grain yield (GY) at the soft dough stage of grain formation. Statistical analyses were performed using split plot ANOVA on a TRS-80 model III microcomputer. Means were tested using Duncan's new multiple range test at the 0.05 probability level.

Genotype/Pesticide Experiments

In this three-location study six commercial hybrids were evaluated for yield as affected by pesticide treatment. This genotype/pesticide experiment was conducted during 1982 and 1983, having different locations. The 1982 experiment was in Alachua county, FL and the two 1983 experiments (1983A, 1983B) were in Levy county, FL. The three locations had similar cropping histories, of continuous double cropped NT corn followed by soybean *(Glycine max* L.) for 1 yr in the case of the 1982 location, and for the last 4 yr in both 1983 locations.

The hybrids evaluated were the following; Asgrow RX777(A), Dekalb XL 71(D), Funks G4507A(F), Coker 19(C), Pioneer Brand 3320(P), and Gold Kist 748(G). Hybrids were whole plots with 4 replications. The same insecticides and rates used in the tillage/pesticide study were split plots. The same plot size and cultural practices used in the tillage/pesticide experiment were used in this experiment, such as planting technique, weed control, and fertilization rate. Data collection, and statistical analysis were handled in the same manner.

RESULTS AND DISCUSSION

Tillage/Pesticide Experiments

The average of 3-yr data showed interactions between tillage and pesticide treatments for grain yield (Table 1). The highest GY was given under NT conditions by CF 2.2 which was different from the others at the 0.05 probability level. It was followed by the other two pesticide treatments, which did not differ in yield response to pesticides. All pesticide treatments gave higher GY than the Control (Table 1).

Under CT conditions there was no difference (0.05 prob. level) among pesticide treatments. However, both pesticides and rates were better than the Control (Table 1). Among the pesticide treatments, CF 2.2 gave the highest grain yield under NT conditions. The opposite occurred with CF 1.1, having greater grain yield under CT conditions. But TF 2.2 did not show any differences between tillage treatments. For the C, NT grain yield was higher than CT.

Genotype/Pesticide Experiments

Interactions were shown between genotype and pesticide treatments under NT conditions for grain yield (Table 2). Asgrow RX777 attained the highest grain yield (105 qq ha^{-1}) using TF 2.0. All hybrids obtained highest grain yield with CF 2.0. Coker 19 responded egually to the two CF rates (Table 2). Grain yields were compared across hybrids within an individual pesticide treatment (Table 2) and for CF 2.0 Dekalb XL 71 and Gold Kist 748 gave the highest grain yield. However when CF 1.0 was used Pioneer 3320 and Gold Kist 748 gave the highest grain yield.

CONCLUSIONS

Tillage treatments were different for the hybrid Dekalb XL71 only when the highest CF rate (2.2 Kg a.i. ha^{-1}) was used, being in favor of NT. This may have been due to the Growth regulator effects attributed to CF. The three insecticide treatments gave equal grain yield in CT. The results showed that it is not appropriate to use recommendations from research conducted in one type of tillage and expect the same response in another tillage environment. Research is needed in both NT and CT in order to make proper recommendations to growers.

These data indicate that hybrids do not respond equally to pesticides and this genotype/pesticide relationship is likely the major reason why scientists disagree from one location to another. Strong evidence was found that commercial corn breeders are selecting for a pesticide when it is used during the development of the hybrid. This appears to be the case of Asgrow 777 which gave the highest yield when TF 2.2 was used. Terbufos was used throughout its breeding program. All other hybrids were developed using CF in their breeding program. In order to make valid recommendations on pesticide use by growers, recommended pesticides may need to be tested on all recommended hybrids in order to match up the proper pesticide, rate of pesticide, and hybrid for maximum response of each hybrid and maximum benefits from the use of pesticides.

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

		Tillage			
Pesticide	Rate	No	Yes	Average	
	Kg a.i. ha-[1]	q ha-[1]			
Carbofuran	2.2	118 a	109 a	*	114
Carbofuran	1.1	100 b	108 a	*	104
Terfubos	2.2	102 b	104 a	NS	103
Control	0.0	92 c	81 b	*	87
Average		103	100		

a, b, c, = within columns among pesticides, values not followed by the same letter are significantly differente at the 0.05 level of probability. * = different at the .05 P in rows between tillage. NS = nonsignificant

Tablele 2 Corn hybrid grain yield response to pesticides in notillage management (three location average)

Hybrid	Insecticide Treatment				
	Carbofuran (CF)		Terbufos(TF	Control	Average
	————————————		q ha^{-1}	————————————	
A	97 v	92 w	105 u	73 vw	92
	b	c	a	d	
D	103 u	92 w	90 v	75 vw	90
	a	b	b	c	
C	92 w	95 vw	93 v	75 vw	89
	a	a	a	b	
G	104 u	98 uv	84 w	77 v	91
	a	b	c	d	
F	90 w	83 x	79 w	69 w	80
	a	b	c	d	
P	98 v	101 u	89 v	91 u	77
	a	a	b	b	
Average	97	94	90	77	

Insecticide rates expressed as Kg a.i. ha^{-1}. A= Asgrow RX777, D = Dekalb XL71, C = Coker 19, G = Gold kist GK748, F = Funks G4507, P = Pioneer brand 3320.
a,b,c= within rows of pesticides, values not followed by the same letter are significantly different at the 0.05 level of probabilyty;
u,v,w,x = within columns, values not followed by the same letter are significantly different at the 0.05 level of probability.

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