NO-TILLAGE SWEET CORN HYBRID RESPONSE TO CARBOFURAN (FURADAN 4 F)

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INTRODUCTION

Sweet corn (*Zea mays* L.) is an economically important crop for Florida. The hot-humid climate in Florida provides an environment for off-season sweet corn production at a time when most of the U.S. is too cold for corn growth. This same environment also is favorable for large populations of insect pests, which can reduce yield and quality. Past studies have shown that the use of the insecticides Counter (terbufos) and Furadan (carbofuran), at planting of field corn, can significantly increase yield (Gallaher, 1983, 1986a,b; Gallaher and Baldwin, 1985; Espaillat and Gallaher, 1989). All of the above research in the 1980's was with the use of Furadan 15G. This granular formulation was widely used at the time but became restricted and largely unavailable and was replaced with a non-granular formulation. The granular product had the advantage of ease of application and incorporation in the seed furrow or row and was easily activated around the seed zone. The liquid product, Furadan 4F available for use at present in Florida, is thought to require more sophisticated equipment in order to obtain good activation in the seed furrow-zone.

In these earlier studies with field corn, we found that Furadan performed better than Counter under no-tillage management, but the two products were equally effective in conventional tillage systems. Another discovery was that field corn hybrids responded more favorably to the insecticide that had been used in the hybrid breeding program. It was not unusual to obtain 40 to 50 bu/acre yield increases from the use of insecticides applied in the row at planting time (Espaillat and Gallaher, 1989). These materials also show activity as nematicides (Norton et al., 1978). After the loss of the granular formulation of Furadan in Florida, sales of this product were significantly reduced.

The objectives of this investigation were to determine 1) the yield differences among five sweet corn hybrids under no-till management, 2) the effectiveness of the use of Furadan 4F formulation sprayed in a band over the corn row at planting and 3) effects on plant-parasitic nematode populations.

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MATERIALS AND METHODS

The split-plot experiment was conducted on a Arredondo fine sand on the University of Florida, Green Acres Agronomy Field Laboratory in 1997. Main plots were five sweet corn hybrids ('XPH 3084'; 'VXT 5 Forever'; 'VNE 2 Endeavor'; 'VNT 5 Punchline'; 'XPH 3105'), planted at 28,000 plants/acre, in four-row plots, 2.5 ft wide and 20 ft long. The two subplots were with the application of carbofuran (formulated as Furadan 4F) at 1.0 lb ai/acre (the labeled rate) versus a control without application of carbofuran.

The experimental site was planted to a cover crop of 'Tift Blue" lupin (*Lupinus angustifoilus* L.) in the fall of 1996. On 17 April 1997, the sweet corn was planted directly into the standing lupin with a Brown-Harden In-Row Subsoil (Strip-till) no-tillage planter, using John Deere Flexie 71 planter units. On 21 April 1997, 1.8 quarts Bicep II (mixture of atrazine and metolachlor)/acre plus 2 quarts Roundup (glyphosate)/acre were broadcast over the experiment. On 22 April 1997, the subplot Furadan treatments were imposed by spraying the 1.0 lb ai/acre treatment in a 6-in. band over the row. The Furadan was mixed with water at a delivery rate of 30 gallon liquid/acre. The experiment was irrigated within a few hours after application of Furadan with 1/3 acre-in. of water to move the Furadan into the seed zone. On 6 May, 55 lb N/acre was applied as ammonium nitrate. On 13 May 480 lb 13 (N) - 5 (P_2O_5) - 29 (K_2O) - 1 (Mg) - 2.5 (S)/acre was broadcast over the experiment. An additional 50 lb N/acre as ammonium nitrate was applied 4 June. Supplemental weed control was by hooded sprayer, post-direct application of 1.5 pints Gramoxone Extra (paraquat), with non ionic surfactant added at the rate of 1 pint/100 gallon water. Gramoxone Extra was sprayed in 30 gallon water/acre. Supplemental gun irrigation water was applied six times at approximately 1 acre-in. each time during the growing season.

The two center rows were harvested for fresh ear and stalk weight on 30 June. Subsamples were taken to determine dry matter yield. Soil samples for nematode analysis were collected over each replication and combined at planting time. Additional samples were collected 18 July from all plots. Each nematode sample consisted of six cores of soil (1 in. diameter and 8 in. deep) collected in a systematic pattern and then combined into a plastic bag for transport. In the laboratory, a 100-cm^3 soil subsample was removed for nematode extraction using a modified sieving and centrifugation procedure (Jenkins, 1964). Extracted nematodes were identified and counted under an inverted microscope. All data were analyzed by an analysis of variance for a split-plot design, followed by mean separation by F test or Duncan's multiple-range test as appropriate.

RESULTS AND DISCUSSION

All sweet corn hybrids responded to application of Furadan (Table 1). Averaged over all hybrids, fresh ear weight was 25% greater from the application of Furadan compared to the control. This same statistic for fresh stalk weight was a 35% yield increase from application of Furadan. Fresh ear yield appeared to be greatest for XPH 3084, which was equal to VNE 2 Endeavor. Lowest yields were obtained by XPH 3105. Average fresh ear yield for VNE 2 was almost 40% greater than that of XPH 3105, and with the application of Furadan the difference was even greater (almost 45%) (Table 1).

In contrast to what one might expect, Furadan did not reduce nematode numbers as measured 18 July. In fact, root-knot nematode numbers were over 90% greater in plots receiving Furadan compared to the control plots (Table 2). However, of the two highest fresh ear yielding hybrids, VNE 2 Endeavor, had significantly lower root-knot nematode counts compared to XPH 3084.

Our data show that sweet corn hybrid selection is critical if yield is a major factor under consideration (Table 1). With yield increases as much as or more than 35% from the application of Furadan, it is obvious that this is one management input that requires consideration by growers, under conditions of this experiment. These sweet corn yield responses to application of Furadan are similar to those found for field corn hybrids (Gallaher and Baldwin, 1985; Gallaher, 1983, 1986a,b; Espaillat and Gallaher, 1989). No information was available regarding type of pesticide used in the breeding and development of the sweet corn hybrids used in this study. It is also evident that Furadan impacted insects or other pests in these sweet corn hybrids other than the four nematodes measured in this investigation. It appears that application of Furadan resulted in an environment that stimulated better plant growth, which in turn resulted in the healthier plants being able to tolerate larger populations of root-knot nematodes. This has been observed and reported for other crops and cropping systems (McSorley and Gallaher, 1997).

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Table 1. No-till sweet corn yield for five hybrids at two rates of carbofuran (Furadan 4F).

	Carbofuran rate		
Hybrid	1 lb ai[1]	0 lb ai	Average
	----- Fresh ear weight, ton/acre -----		
XPH 3084	5.37	4.33	4.85 a
VNT 5 Forever	4.38	3.86	4.12 b
VNE 2 Endeavor	5.01	3.70	4.36 ab
VNT 5 Punchline	3.57	2.77	3.17 c
XPH 3105	3.47	2.85	3.16 c
Average	4.36	3.50 *	
	---Fresh stalk weight, ton/acre---		
XPH 3084	8.02	7.23	7.63 a
VNT 5 Forever	7.33	5.06	6.20 b
VNE 2 Endeavor	6.56	4.52	5.54 b
VNT 5 Punchline	6.18	4.04	5.11 b
XPH 3105	3.34	2.48	2.91 c
Average	6.29	4.67 *	
	-------Dry ear weight, ton/acre-------		
XPH 3084	0.93 c	0.81 a NS	0.87
VNT 5 Forever	1.32 b	0.81 a *	1.07
VNE 2 Endeavor	1.61 a	0.92 a *	1.27
VNT 5 Punchline	1.14 bc	0.74 a *	0.94
XPH 3105	1.04 c	0.68 a *	0.86
Average	1.21	0.80	
	------Dry stalk weight, ton/acre------		
XPH 3084	1.86	1.87	1.86 a
VNT 5 Forever	1.89	1.26	1.58 ab
VNE 2 Endeavor	1.64	1.32	1.48 b
VNT 5 Punchline	1.79	1.11	1.45 b
XPH 3105	1.00	0.69	0.84 c
Average	1.64	1.25 *	

Data are averages of five replications. Main effect averages in columns (a,b) not followed by the same letter are different (P = 0.05), according to Duncan's multiple-range test. Sub-effect carbofuran with * or NS for differences at P = 0.05 or not different at P = 0.05, respectively, according to F test, except for the interaction for dry ear weight, in which case LSD was used (LSD = 0.23).

[1]Carbofuran was formulated as Furadan 4F.

Table 2. Effect of carbofuran (Furadan 4F) treatment and sweet corn hybrid on population levels of plant-parasitic nematodes.

	Nematodes per 100 cm^3 soil			
		18 July		
Hybrid	1 April[1]	+ carbofuran[2]	- carbofuran	Average
	Ring nematodes, *Criconemella* spp			
XPH 3084		123	138	130 a
VNT 5 Forever		154	182	168 a
VNE 2 Endeavor		170	195	183 a
VNT 5 Punchline		122	100	111 a
XPH 3105		214	192	203 a
Average	128	157	161 NS	
	Root-knot nematodes, *Meloidogyne incognita*			
XPH 3084		322	130	226 a
VNT 5 Forever		250	123	186 ab
VNE 2 Endeavor		95	39	67 b
VNT 5 Punchline		55	61	58 b
XPH 3105		59	51	55 b
Average	14	156	81 *	
	Stubby-root nematodes, *Paratrichodorus minor*			
XPH 3084		5	2	3 a
VNT 5 Forever		4	7	5 a
VNE 2 Endeavor		9	5	7 a
VNT 5 Punchline		2	6	4 a
XPH 3105		5	2	3 a
Average	9	5	5 NS	
	Lesion nematodes, *Pratylenchus* spp			
XPH 3084		35	36	35 a
VNT 5 Forever		43	39	41 a
VNE 2 Endeavor		22	49	36 a
VNT 5 Punchline		53	57	55 a
XPH 3105		26	37	31 a
Average	10	5	5 NS	

Data are means of five replications. Main effect averages in columns (a,b) not followed by the same letter are different (P = 0.10), according to Duncan's multiple-range test. Sub-effect carbofuran with * or NS for differences at P = 0.10 or not different at P = 0.10, respectively, according to F test. No interactions were significant at P = 0.10.

[1]Data from 21 April pooled across all treatments; average of five replications.

[2]Carbofuran (Furadan 4F) treatments: + = 1.0 lb ai/acre; - = untreated control.