Efficacy of Fungicide Applications in the Control of Disease in Corn Production

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There is considerable interest and many marketing efforts for the use of fungicides in field corn production. With the increased price and demand for corn for ethanol production there has been increasing trend for the production corn following corn. With adoption of no-tillage practices the potential increasing the sources and magnitude of inocula for a number of diseases of corn is apparent. Most prominent of the pathogens associated with no-tillage production are *Cercospora zeae-maydis*, causal agent of gray leaf spot, and *Exserohilum turcicum*, causal agent of northern leaf blight, which are facultative saprophytes and survive in infested corn debris.

In Virginia, corn production gray leaf spot is a significant disease impacting corn production. Our tactic to reduce losses has been to avoid the use of susceptible hybrids in areas where the disease is likely to occur. Through hybrid evaluation for gray leaf spot resistance under heavy disease pressure we have been able to identify and recommend to our producers adapted hybrids that will perform well under these conditions and not likely require a fungicide application.

Considerable work has been done over the past twenty years in Virginia to evaluate fungicides for the control of gray leaf spot on susceptible, high yielding hybrids as means to support Federal registration and to demonstrate to corn growers that the use of adapted more resistant hybrids and yield economic returns without the use of fungicide application.

Examples of such evaluations are presented here:

Evaluation of foliar fungicides for the control of gray leaf spot of corn in Virginia, 2004.

Gray leaf spot (GLS) ratings, yield, harvest grain moisture, and lodging ratings were obtained for 19 fungicide treatments and a non-treated control on a known high yielding, susceptible hybrid, Pioneer Brand 3394, grown under heavy gray leaf spot disease pressure on the University's Whitethorne-Kentland Experimental Farm, Montgomery Co., VA. Prior to planting on a Hayter silt loam, pH 6.8, a fertilizer containing 200 lb N, 45 lb P, and 25 lb K per acre was broadcast. The experimental design was a randomized complete block replicated four times with plots consisting of four 25-ft rows spaced 30 in. apart and seeded at a rate of 25,000 seeds/A. The plots were no-tillage planted with an Almaco two-row cone planter on 6 May into a field continuously cropped to corn since 1986 and abundantly covered with corn debris naturally infested with *Cercospora zeae-maydis*, the causal agent of gray leaf spot. On 13 July. when lesions had developed from the base of plants to halfway to the ear leaf, the first applications of fungicides were made. At this time, 5% of plants were silking. Spray solutions were applied in a volume of 27 gal/A with a single Tee Jet@ 8004 flat fan nozzle at 40 psi. Second applications of some of the fungicides were made on 27 Jul, depending on protocol. Leaf blighting or GLS reaction was assessed five times and is reported as a disease severity index (0-5) read in 0.1 units. Plots were also rated for percentage stalks lodged just prior to harvest, grain moisture at harvest, bushel weight, and grain yield in bu/A adjusted to 15.5% moisture. Grain was harvested on 18 Oct with a Massey Ferguson 8XP-plot combine.

Moisture in the soil profile at planting and weather conditions for thirty days after planting provided conditions favorable for vigorous stand establishment. GLS lesions were first observed on the lower leaves of susceptible hybrids by mid-June. From late June through September, temperatures were mild to warm with abundant rainfall. These conditions were moderately favorable for disease development. GLS lesions had moved to the ear leaf and above on the non-treated control by 19 July, and to the top of the plants by 12 August. Significant differences in GLS ratings among treatments were apparent at all rating periods. At harvest, statistically significant differences among treatments occurred in grain yield, and grain moisture at harvest, but not bushel weights. All fungicide treatments provided statistically ($P \leq 0.05$) greater grain yields (37.0-74.3 bu/A) than the non-treated control. All fungicide applications, either single or multiple, provided statistically significant ($P \leq 0.05$) reduction in blighting at all rating dates over the non-treated control except for Headline 2.09EC at 6.13 fl. oz. applied once. All fungicide applications provided statistically ($P \leq 0.05$) increased 1000-kernel weights over the non-treated control (by 67.3-110.3 g). No phytotoxicity was observed for any fungicide treatment.

Treatment in fl. oz. product/A and timing[z]		GLS Severity Index (0-5)[y] 12 Aug	24 Aug	Grain[x] %H_2O 18 Oct	Bu wt[w] in lb 18 Oct	1000 K[v] in g 8 Nov	Yield[u] Bu/A 18 Oct
Non-treated	---	2.70	4.05	21.9	56.1	261.0	115.5
Headline 2.09EC 6.13 . . . + Induce 0.6% v/v	1	2.50	2.70	23.2	57.2	330.0	156.2
Headline 2.09EC 6.13 . . . + Induce 0.6% v/v	2	2.43	2.40	23.5	57.0	337.3	163.0
Quadris 2.08SC 9.2	1	2.30	2.30	23.5	57.4	346.8	168.3
Quadris 2.08SC 9.2	2	2.28	2.23	24.0	57.1	366.5	184.9
Quilt 1.66EC 14.0	1	2.28	2.35	24.2	57.4	339.3	156.2
Quilt 1.66EC 14.0	2	2.23	2.13	24.2	56.8	371.3	189.8
Stratego 250E 10.0	1	2.40	2.33	23.3	57.5	328.3	154.8
Stratego 250E 10.0	2	2.45	2.25	23.6	57.5	350.8	170.9
Headline 2.09EC 9.2 . . . . + Induce 0.6% v/v	1	2.33	2.30	23.5	56.3	353.5	152.5
LSD ($P \leq 0.05$)	=	0.25	0.35	1.2	1.2	37.4	24.4
Standard Deviation	=	0.17	0.24	0.8	0.8	25.6	16.8
Coefficient of Variation	=	7.27	.70	3.38	1.43	7.56	10.4

[z]Treatment and timing: Fungicide(s) applied in fl. oz. product/A. Timing of applications was as follows: 1 = a single application (12 July) at 5% silking; and 2 = an application at 5% silking (13 July) followed by a second application 14 days later (26 July).
[y]GLS Disease Severity Index: 0 = no gray leaf spot lesions; 1 = trace of lesions below ear, none above; 2 = many lesions below ear, trace above; 3 = severe lesion development below ear, all leaves above with lesions; 4 = all leaves with severe lesion development, but green tissue still visible; 5 = all leaves dry and dead.
[x]Grain moisture at harvest expressed in percentage.
[w]Bushel weight in pounds at a standard 15.5% grain moisture.
[v]1000-Kernel weight in grams.
[u]Yield in bushels per acre at a standard 15.5% grain moisture.

Evaluation of foliar fungicides for the control of gray leaf spot of corn in Virginia, 2005.

Gray leaf spot (GLS) ratings, yield, harvest grain moisture, and lodging ratings were obtained for 16 fungicide treatments and a non-treated control on a known high yielding, susceptible hybrid, Pioneer Brand 3394, grown under heavy gray leaf spot disease pressure on the University's Whitethorne-Kentland Experimental Farm, Montgomery Co., VA. Prior to planting on a Hayter silt loam, pH 6.8, a fertilizer containing 200 lb N, 45 lb P, and 25 lb K per acre was broadcast. The experimental design was a randomized complete block replicated four times with plots consisting of four 25-ft rows spaced 30 in. apart and seeded at a rate of 25,000 seeds/A. The plots were no-tillage planted with an Almaco two-row cone planter on 9 May into a field continuously cropped to corn since 1986 and abundantly covered with corn debris naturally infested with *Cercospora* *zeae-maydis* (Czm), the causal agent of gray leaf spot. On 13 July, when lesions had developed from the base of plants to halfway to the ear leaf, the first applications of fungicides were made. At this time 5% of plants were silking. Spray solutions were applied in a volume of 27 gal/A with a single Tee Jet@ 8004 flat fan nozzle at 40 psi. Second applications of some of the fungicides were made on 27 July, depending on protocol. Leaf blighting or GLS reaction was assessed two times and is reported as a disease severity index (0-5) read in 0.1 units and as percentage leaf area blighted. Plots were also rated for percentage stalks lodged just prior to harvest, grain moisture at harvest, bushel weight, and grain yield in bu/A adjusted to 15.5% moisture. Grain was harvested on 17 October with a Massey Ferguson 8XP-plot combine.

Moisture in the soil profile at planting and weather conditions for thirty days after planting provided conditions favorable for vigorous stand establishment. GLS lesions were first observed on the lower leaves of susceptible hybrids by mid-June. From late June through September, temperatures were mild to warm with abundant rainfall. These conditions were moderately favorable for disease development. GLS lesions had moved to the ear leaf and above on the non-treated control by 21 July, and to the top of the plants by 12 August. Significant differences in GLS ratings among treatments were apparent at all rating periods. At harvest, statistically significant differences among treatments occurred in grain yield, grain moisture at harvest, and bushel weights. All fungicide treatments, but Caramba 90SC at 9.5 and 17.0 fl. oz. product/A applied twice, provided statistically ($P \leq 0.05$) greater grain yields (18.9-50.6 bu/A) over the non-treated control. All fungicide applications, either once or twice, provided statistically significant ($P \leq 0.05$) over the non-treated control except Caramba 90SC at 17.0 fl. oz./A applied twice once. All but five fungicide applications provided statistically ($P \leq 0.05$) increased bushel weights over the non-treated control (by 1.1 – 2.3 lbs). No phytotoxicity was observed for any fungicide treatment.

Treatment in fl oz product/A and timing[z]		GLS Severity Index (0-5)[y]		GLS Blighted Percentage Area[x]		Grain[w] %H_2O	Bu wt[u] in lb	Yield[t] Bu/A
		12 Aug	2 Sep	12 Aug	2 Sep	17 Oct	17 Oct	17 Oct
Non-treated	---	3.00	4.85	35.0	96.0	21.4	57.1	94.5
Caramba 90SC 9.5	2	2.40	4.45	16.5	86.0	21.6	57.8	109.8
Caramba 90SC 13.5	2	2.30	4.53	13.5	88.0	21.8	57.9	113.4
Caramba 90SC 17.0	2	2.28	4.40	13.0	85.0	22.1	58.2	107.0
Caramba 90SC 6.14 + Headline 250EC 3.56	2	2.20	4.08	10.0	76.8	23.2	59.0	137.5
Caramba 90SC 9.05 + Headline 250EC 5.35	2	2.18	3.73	10.3	60.5	24.2	59.4	130.4
Headline 250EC 6.2	2	2.23	3.80	10.8	65.0	23.3	58.7	145.1
Quilt 200SC 13.68	2	2.25	4.18	12.0	78.0	23.0	58.6	141.1
Headline 250EC 6.2 + Induce 0.6% v/v	1	2.18	3.58	10.3	55.0	24.1	58.9	141.6
Headline 250EC 6.2 + Induce 0.6% v/v	2	2.13	3.63	9.3	57.3	24.1	58.8	141.9
Quadris 2.08SC 9.2	1	2.28	4.30	12.3	82.0	22.0	57.6	119.6
Quadris 2.08SC 9.2	2	2.23	3.98	10.8	72.5	23.5	59.0	142.8
Quilt 1.66EC 14.0	1	2.20	4.30	10.0	82.3	21.7	57.5	115.9
Quilt 1.66EC 14.0	2	2.13	3.65	9.3	58.8	23.7	59.2	136.0
Stratego 250EC 10.0	1	2.28	4.38	12.3	84.0	21.5	57.5	118.2
Stratego 250EC 10.0	2	2.18	3.70	9.8	61.3	23.6	59.4	135.3
Headline 250EC 9.2	1	2.20	4.15	10.5	77.3	22.3	58.1	116.1
LSD ($P \leq 0.05$)	=	0.14	0.26	4.1	9.8	0.9	1.0	16.0
Standard Deviation	=	0.10	0.18	2.9	6.9	0.6	0.7	11.2
Coefficient of Variation	=	4.32	4.37	22.5	9.2	2.8	1.2	8.9

[z]Treatment and timing: Fungicide(s) applied in fl. oz. product/A. Timing of applications was as follows: 1 = a single application (12 July) at 5% silking; and 2 = an application at 5% silking (13 July) followed by a second application 14 days later (27 July).
[y]GLS Disease Severity Index: 0 = no gray leaf spot lesions; 1 = trace of lesions below ear, none above; 2 = many lesions below ear, trace above; 3 = severe lesion development below ear, all leaves above with lesions; 4 = all leaves with severe lesion development, but green tissue still visible; 5 = all leaves dry and dead.
[x]Percentage leaf area of entire plant blighted by Czm (0-100%)
[w]Grain moisture at harvest expressed in percentage.
[u]Bushel weight in pounds at a standard 15.5% grain moisture.
[t]Yield in bushels per acre at a standard 15.5% grain moisture.

Results from 2006 and 2007 will also be presented.

There has been much marketing of the use of strobilurin fungicides on corn in the absence of disease. In 2007, Dr. Steve Rideout and I got funding from the Virginia Corn Board to conduct a series of experiments to evaluate this practice.

In 2007 a trial was conducted using Headline, Quadris, Quilt, Statego, and Tilt applied in the apparent absence of disease at two timings. There was no statistically significant increase in yield and no economic benefit from any application.