Control of Stewart's Wilt in Sweet Corn with Seed Treatment Insecticides

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ABSTRACT

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Corn flea beetles, *Chaetocnema pulicaria*, vector *Erwinia stewartii* (synamorph *Pantoea stewartii*), which causes Stewart's bacterial wilt of corn (*Zea mays*). A seed treatment insecticide, imidacloprid, killed flea beetles and reduced the number of feeding wounds and Stewart's wilt symptoms per leaf in greenhouse studies. The objective of our research was to evaluate the ability of imidacloprid and thiamethoxam seed treatments to control Stewart's wilt on sweet corn hybrids under field conditions with naturally occurring populations of the corn flea beetle. Six field trials were planted at four locations in 1998. Eleven field trials were planted at nine locations in 1999. The treatment design was a factorial of sweet corn hybrids and seed treatments. Stewart's wilt incidence ranged from 0 to 54% in the 1998 trials. Incidence of Stewart's wilt in nontreated plots of the susceptible hybrid Jubilee ranged from 2% at the 8-leaf stage to 77% 1 week after mid-silk in the 1999 trials. Seed treatment insecticides reduced the incidence of Stewart's wilt by ≈50 to 85% relative to nontreated controls. The level of control was ≈75 to 85% in seven trials planted before 1 June 1999, when incidence of Stewart's wilt on nontreated Jubilee ranged from 4 to 71%. The level of control was ≈50 to 70% in the three trials planted after 1 July 1999, when incidence of Stewart's wilt on nontreated Jubilee ranged from 44 to 73%. Although comparisons varied, the level of control gained from seed treatment insecticides was similar to the next higher level of host resistance. Seed treatment insecticides appear to control Stewart's wilt during very early growth of corn plants, when foliar applications of insecticides are ineffective and the effectiveness of host resistance varies depending on the proximity of flea beetle feeding sites to the plant's growing point.

Corn flea beetles, *Chaetocnema pulicaria*, vector *Erwinia stewartii* (synamorph *Pantoea stewartii*), which causes Stewart's bacterial wilt of corn (*Zea mays*) (10,11). Flea beetles introduce *E. stewartii* into plant tissues that are wounded during feeding. Movement of *E. stewartii* in the vascular system of resistant plants is restricted to within a few centimeters of flea beetle feeding wounds. The bacterium may move systemically throughout the vascular system of susceptible plants.

The seedling wilt phase of Stewart's wilt can substantially reduce yield of susceptible or moderately susceptible sweet corn hybrids and dent corn inbreds (8–10,12). Yield is rarely affected when resistant or moderately resistant hybrids are infected after the 3- to 5-leaf or 5- to 7-leaf stages, respectively (9,12). When plants are infected prior to the 3-leaf stage (i.e., three fully open leaves with visible leaf collars), main stalks may be killed, causing tillers to grow profusely (8). Ears are not produced on these plants. Main stalk death probably results from movement of *E. stewartii* to the growing point, which may be only a few centimeters from infection sites during very early growth stages. Main stalk death occurs even in the most resistant sweet corn hybrids, although the incidence of main stalk death appears to decrease with increasing levels of resistance (8).

The growth stage at which resistance begins to effectively control Stewart's wilt by restricting the movement of *E. stewartii* is not known precisely. Resistance may not prevent systemic infection (i.e., movement of *E. stewartii* throughout the plant and occurrence of symptoms on new leaves) or main stalk death if flea beetles feed prior to the 2- or 3-leaf stage on tissues close to the growing point. In preliminary greenhouse trials, a high proportion of moderately resistant plants inoculated in the whorl at the 1- or 2-leaf stage became systemically infected (N. D. Freeman and J. K. Pataky, *unpublished*). Symptoms were restricted to within a few centimeters of inoculation wounds when moderately resistant and resistant plants were infected at later growth stages.

Insecticides applied in-furrow at planting reduced flea beetle populations and controlled Stewart's wilt better than insecticides applied to foliage (1,4). A seed treatment insecticide, imidacloprid (Gaucho), killed flea beetles and reduced the number of feeding wounds and Stewart's wilt symptoms per leaf in greenhouse studies (7). If seed treatment insecticides kill flea beetles before *E. stewartii* is transmitted to plants,

Table 1. Locations (Illinois counties), planting dates, and data collection from seed treamtent insecticide trials in 1998 and 1999

Location	Date planted	Stewart's wilt rating: Date	Stewart's wilt rating: Growth stage[z]
1998			
Champaign	April 24	June 3	4- to 6-leaf
Madison	May 28		No disease
Mason	June 2		No disease
LaSalle	June 20	August 28	Early tassel
Mason	June 26		No disease
Champaign	June 30	July 20	3- to 5-leaf
1999			
Henderson, KY	April 23	June 7	5- to 6-leaf
Champaign	April 30	June 1	4- to 5-leaf
		June 23	7- to 9-leaf
Mason	May 1	June 15	6- to 8-leaf
Madison	May 2	June 9	6- to 7-leaf
		June 18	Early tassel
Shelby	May 4	June 10	6- to 7-leaf
		July 16	Mid-silk + 1 week
Douglas	May 17	July 18	Mid-silk
Fayette	May 20	June 29	6- to 7-leaf
		July 16	Early silk
Pope	May 21	June 29	7- to 9-leaf
Mason	July 5	August 17	Early silk
Champaign	July 6	August 11	Early tassel
LaSalle	July 9	August 25	Early silk

[z] Growth stage based on number of fully expanded leaves with visible leaf collars.

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incidence of Stewart's wilt and main stalk death could be reduced on resistant and susceptible hybrids.

The objective of this research was to evaluate the ability of seed-treatment insecticides to control Stewart's wilt on sweet corn hybrids under field conditions with naturally occurring populations of the corn flea beetle.

MATERIALS AND METHODS

Field trials were done in 1998 and 1999. The experiments differed slightly between years.

1998 trials. Six field trials were planted at four Illinois locations in 1998 (Table 1). The treatment design was a factorial of eight sweet corn hybrids and two seed treatments. Hybrid reactions to Stewart's wilt ranged from resistant (R), moderately resistant (MR), moderately susceptible (MS), to susceptible (S) and included Bonus (R), Terminator (R/MR), GH 2628 (R/MR), Crisp n Sweet 710 (MR), GH 2690 (MR/M), Rival (M/MS), Royal Sweet (MS), and Jubilee (S). Seeds were not treated (check) or were treated with imidacloprid (Gaucho 480FS) at a rate of 300 g a.i./100 kg of seed. The experimental design was a split-plot of a randomized complete block with four replicates. Hybrids were planted in main plots. Seed treatments were in subplots. Each experimental unit consisted of 4 rows, ≈3.2 m long, with ≈15 plants per row.

Plants per plot were counted ≈2 weeks after emergence. Plants with Stewart's wilt symptoms were counted, and severity of symptoms was rated on a scale of 1 to 9 (12) when plants were at the 4- to 6-leaf stage during the trials in Champaign County. Incidence of Stewart's wilt was calculated for each experimental unit as the percentage of plants infected. Incidence and severity were measured in the LaSalle County trial when plants were beginning to produce tassels. Incidence and severity were analyzed by analysis of variance (ANOVA).

1999 trials. Eleven field trials were planted at eight locations in Illinois and one in Kentucky in 1999 (Table 1). The treatment design was a factorial of four sweet corn hybrids and four seed treatments. Hybrids differed in reaction to Stewart's wilt and included Bonus (R), GH 2628 (R/MR), Royal Sweet (MS), and Jubilee (S). Seeds were not treated (check) or were treated with Gaucho 480FS at a rate of 250 g a.i./100 kg of seed, with thiamethoxam (Adage) at a rate of 250 g a.i./100 kg of seed, or with an experimental compound (results not presented). The experimental design was a split-plot of a randomized complete block with six replicates. Seed treatments were in main plots. Hybrids were planted in subplots. Each experimental unit consisted of six rows. Row lengths differed among trials depending on field space constraints and varied from ≈6.4 to 9.5 m, with ≈30 to 45 plants per row. Plants per plot were counted ≈2 weeks after emergence. Plants with Stewart's wilt symptoms were counted at different growth stages in different trials (Table 1). Incidence was calculated for each experimental unit as the percentage of plants infected and was analyzed by ANOVA. Treatments were compared using Waller-Duncan Bayesian LSD values (k = 100). When Stewart's wilt incidence in nontreated plots was 4% or higher, the level of control for all insecticide treatments was calculated as a percentage of the incidence in nontreated plots according to the formula: percent level of control = [1 – (incidence in insecticide treated plots/incidence in nontreated plots)] × 100.

RESULTS

1998 trials. Little or no natural infection occurred in trials in Madison and Mason counties. Stewart's wilt incidence ranged from 0 to 54% in trials in Champaign and LaSalle counties (Table 2).

Incidence and severity of Stewart's wilt on hybrids grown from Gaucho-treated seed were lower than or not different from incidence and severity on plants grown from nontreated seed (Table 2). For the early trial in Champaign County, the interaction of hybrids and seed treatments was significant, and Stewart's wilt incidence was compared between seed treatments within hybrids (Tables 2 and 3). Stewart's wilt incidence was 8 and 4% for two susceptible hybrids, Jubilee and Royal Sweet, respectively, grown from Gaucho-treated seed, which was significantly less than 25 and 14% incidence, respectively, for these two hybrids grown from nontreated seed (Table 2). In the late trial in Champaign County, the main of effect of treatments was compared because interactions were not significant (Table 3). Mean incidence was 7% for sweet corn grown from Gaucho-

Table 2. Incidence and severity of Stewart's wilt on sweet corn hybrids grown from nontreated or imidacloprid (Gaucho)-treated seed in 1998

	Champaign Co., IL			LaSalle Co., IL	
	April 24 planting	June 30 planting		June 20 planting	
Treatment	Incidence (%)[x]	Incidence (%)	Severity[y]	Incidence (%)	Severity
Main effect means					
Gaucho-treated	5	7*[z]	2.5*	10	4.5
Nontreated	8	23*	3.1*	12	5.3
Susceptible to moderate hybrids					
Jubilee, Gaucho-treated	8*	7	2.8	37	4.5*
Jubilee, nontreated	25*	54	4.3	26	7.0*
Royal Sweet, Gaucho-treated	4*	9	2.8	6	4.5*
Royal Sweet, nontreated	14*	25	3.8	15	7.5*
Rival, Gaucho-treated	4	8	3.2	9	4.3*
Rival, nontreated	6	25	3.6	12	6.0*
Moderate to resistant hybrids					
GH 2690, Gaucho-treated	6	9	2.7	16	6.8
GH 2690, nontreated	4	19	2.8	14	6.3
Crisp n Sweet 710, Gaucho	3	12	2.1	5	5.0
Crisp n Sweet 710, nontreated	10	24	3.8	4	3.8
GH 2628, Gaucho-treated	3	5	1.8	8	5.3
GH 2628, nontreated	0	14	1.6	9	4.5
Terminator, Gaucho-treated	2	5	2.0	1	3.0
Terminator, nontreated	8	5	2.3	5	3.0
Bonus, Gaucho-treated	6	3	2.0	3	2.5
Bonus, nontreated	2	5	2.5	8	3.0

[x] Incidence of plants with symptoms of systemic Stewart's wilt infection or main stalk death.
[y] Severity (1 to 9 scale) of symptoms of Stewart's wilt infection.
[z] Paired means (treated versus nontreated) followed by an asterisk are significantly different (P < 0.05) from each other. Main effect means were compared in the late trial in Champaign County when the hybrid–seed treatment interaction was not significant. Seed treatments were compared within hybrids when the interaction was significant in the early trial in Champaign County and in the LaSalle County trial.

treated seed, which was significantly less than 23% incidence for plants grown from nontreated seed. Severity also was lower on plants grown from Gaucho-treated seed than on plants grown from nontreated seed in the late trial in Champaign County (Table 2). In the late trial in LaSalle County, severity was compared between treatments within hybrids due to a significant interaction (Table 3). For all three susceptible hybrids, severity was less for plants grown from Gaucho-treated seed than for plants grown from nontreated seed. Incidence differed among hybrids in the late trial in LaSalle County but not between seed treatments.

Coefficients of variation (CV) for Stewart's wilt incidence were exceptionally high (greater than 100%) in all trials (Table 3). This variation probably was due to the relatively low incidence of Stewart's wilt in these trials and too few plants per experimental unit for count data (i.e., each infected plant per experimental unit was ≈2% incidence).

1999 trials. Incidence of Stewart's wilt in nontreated plots of susceptible hybrid Jubilee ranged from 2% at the 8-leaf stage in the trial in Pope County to 77% 1 week after mid-silk in the trial in Shelby County (Table 4). The range of Stewart's wilt incidence in nontreated plots of the other hybrids was <0.1 to 47% for Royal Sweet, <0.1 to 16% for GH 2628, and 0 to 4% for Bonus (Tables 4 and 5). The hybrid–seed treatment interaction was significant in each ANOVA of Stewart's wilt incidence, so seed treatments were compared within hybrids. CVs for Stewart's wilt incidence ranged from 21 to 119%. CVs were below 50% in trials where incidence in nontreated Jubilee was higher than 30%. CVs were between 50 and 80% in trials where incidence in nontreated Jubilee was between 8 and 30%.

Incidence of Stewart's wilt on Jubilee was significantly lower for plants grown from insecticide-treated seed than for plants grown from nontreated seed, except for plants rated at 1 week past the mid-silk growth stage in the trial in Shelby County (Table 4). Relative to the incidence of Stewart's wilt in nontreated plots of Jubilee, seed treatment insecticides provided ≈50 to 85% control. The level of control was ≈75 to 85% in seven trials planted before June 1, when incidence of Stewart's wilt on nontreated Jubilee ranged from 4 to 71%. The level of control was ≈50 to 70% in the three trials planted after July 1, when Stewart's wilt incidence on nontreated Jubilee ranged from 44 to 73%.

In plots of Royal Sweet, insecticide seed treatments provided ≈50 to 80% control relative to Stewart's wilt incidence in nontreated plots (Table 4). The level of control was ≈70 to 80% in five trials planted before June 1, when incidence of Stewart's wilt on Royal Sweet ranged from 4 to 24%. In the three trials planted after July 1, when incidence of Stewart's wilt on Royal Sweet ranged from 17 to 47%, the level of control ranged from ≈50 to 80%. Incidence of Stewart's wilt was 4% or higher in nontreated plots of GH 2628 in three trials and in nontreated plots of Bonus in two trials (Table 5). The level of control provided by insecticide seed treatments ranged from ≈50 to 80% for these five comparisons. When incidence of Stewart's wilt was between 1 and 4% in nontreated GH 2628 and Bonus, incidence was never higher than 1% in insecticide-treated plots, except when GH 2628 was rated at 1 week past the mid-silk growth stage in the trial in Shelby County. The level of control for Gaucho and Adage seed treatments was similar (Tables 4 and 5).

DISCUSSION

Seed treatment insecticides reduced the incidence of Stewart's wilt due to infection

Table 3. Probability of exceeding the *F* value in analysis of variance of data from seed treatment insecticide trials in 1998

	Champaign Co., IL			LaSalle Co., IL	
	April 24 planting	June 30 planting		June 20 planting	
Source of variation	Incidence (%)	Incidence (%)	Severity	Incidence (%)	Severity
Hybrid	***[y]	ns[z]	0.03	***	***
Seed treatment	0.12	***	0.06	ns	0.05
Hybrid–seed treatment interaction	0.01	ns	ns	ns	0.06
Coefficient of variation (%)	100	116	43	116	32

[y] *** indicates significant source of variation, $P < 0.01$.
[z] ns indicates nonsignificant source of variation, $P > 0.20$.

Table 4. Incidence of Stewart's wilt on Jubilee (susceptible) and Royal Sweet (moderately susceptible) corn grown from nontreated or insecticide-treated seed in 1999

		Jubilee				Royal Sweet			
		Incidence (%)[x]			Level of	Incidence (%)			Level of
Trial	Growth stage[w]	Nontreated	Adage	Gaucho	control (%)[y]	Nontreated	Adage	Gaucho	control (%)
Henderson, KY	3-leaf	31*[z]	4	4	86	14*	3	2	78
Champaign, IL (Apr. 30)	4-leaf	8*	1	1	86	4*	1	2	69
	8-leaf	36*	5	7	84	9*	2	4	77
Mason, IL (Jun. 1)	7-leaf	4*	2	<1	76	3*	1	1	
Madison, IL	6-leaf	58*	10	9	84	17*	3	5	81
	Tassel	71*	15	17	79	24*	5	7	78
Shelby, IL	6-leaf	15*	4	3	77	5*	1	1	74
	Mid-silk + 1 week	77	63	70	18	19*	6	6	68
Douglas, IL	Mid-silk	6*	1	1	88	2	nd	nd	
Fayette, IL	6-leaf	18*	3	4	86	8*	2	2	79
	Early silk	17*	2	4	87	6*	1	1	81
Pope, IL	8-leaf stage	2*	<0.1	0		<0.1	0	0	
Mason, IL (Jul. 5)	Early silk	44*	16	15	68	17*	5	3	80
Champaign, IL (Jul. 6)	Tassel	62*	32	39	48	22*	13	12	48
LaSalle, IL	Early silk	73*	33	45	50	47*	23	26	53

[w] Growth stage at which Stewart's wilt was rated was based on the number of leaves with visible leaf collars.
[x] Incidence of plants with symptoms of systemic Stewart's wilt infection or main stalk death.
[y] Level of control as a percentage of the nontreated mean was calculated from the mean of all insecticide seed treatments when incidence in nontreated plots was ≥4%. Percent control = [1 – (incidence in seed treatment plots/incidence in nontreated plots)] × 100.
[z] Nontreated means followed by an asterisk are significantly different ($P < 0.05$) than means for Adage- and Gaucho-treated means. nd indicates mean not determined.

by *E. stewartii* vectored by corn flea beetles. Apparently, flea beetles were killed by seed treatment insecticides before plants were infected with *E. stewartii*. Because of their systemic mode of action, these compounds are present in new leaf tissue in the whorl, where flea beetles frequently feed. In the 11 trials conducted in 1999, incidence of systemic infection or main stalk death of Jubilee, Royal Sweet, GH 2628, and Bonus grown from insecticide-treated seed was ≈50 to 15% of that for plants grown from nontreated seed. These results confirm the results from 1998 that incidence and severity of Stewart's wilt on Jubilee, Royal Sweet, Rival, GH 2690, Crisp n Sweet 710, GH 2628, Terminator, and Bonus grown from Gaucho-treated seed was lower than or not different from plants grown from nontreated seed. These results also corroborate the observations of Munkvold et al. (7) that seed treated with imidacloprid at 3 or 6 g a.i./kg of seed reduced flea beetle feeding and symptoms of Stewart's wilt on greenhouse-grown plants.

Although seed treatment insecticides reduced Stewart's wilt by ≈50 to 85% in our trials, they did not control Stewart's wilt as effectively as resistance. While comparisons vary, the level of control provided by seed treatment insecticides was similar to the next higher level of host resistance to Stewart's wilt. For example, in the trial in Madison County, incidence of Stewart's wilt at the 6-leaf stage was 58% for Jubilee grown from nontreated seed. Stewart's wilt incidence was 17% for a moderately susceptible hybrid, Royal Sweet, grown from nontreated seed, which was only slightly higher than 10% incidence for the insecticide-treated susceptible hybrid, Jubilee. Similarly, Stewart's wilt incidence was about the same for the insecticide-treated, moderately susceptible hybrid and a nontreated resistant to moderately resistant hybrid, i.e., incidence was 3 or 4% for Royal Sweet grown from Gaucho- or Adage-treated seed and 4% for GH2628 grown from nontreated seed. Incidence was 1 and 2% for GH 2628 grown from treated seed and Bonus, a resistant hybrid, grown from nontreated seed, respectively.

The seed treatment insecticides evaluated in these trials may have additional benefits beyond controlling Stewart's wilt if they decrease the incidence of other insect-vectored diseases of sweet corn, such as maize dwarf mosaic (MDM) and barley yellow dwarf (BYD). Imidacloprid seed treatments incapacitated *Rhopalosiphum padi*, the aphid vector of the PAV strain of *Barley yellow dwarf virus* (BYDV) and decreased the incidence of BYD in wheat and oat by 50% or more (2,3). Recently, the RMV strain of BYDV has been prevalent in sweet corn grown late in the season in the Midwestern United States (5,6).

Imidacloprid and thiamethoxam seed treatments appear to control Stewart's wilt during the very early growth of corn plants, when applications of conventional, foliar insecticides are ineffective and the effectiveness of host resistance varies depending on the proximity of flea beetle feeding sites to the plant's growing point. These treatments should reduce severe, early infection that can be prevalent even in moderately resistant sweet corn hybrids if flea beetles are abundant (8). These treatments also may reduce the incidence of leaf infections that are restricted in size on resistant hybrids; however, we did not assess this type of infection in these trials because it has little or no effect on sweet corn yield. Additional trials and commercial use of seed treatment insecticides will provide data from which to determine if and how levels of resistance and seed treatment insecticides can be integrated to best control Stewart's wilt and if other insect vectored diseases of sweet corn, such as MDM and BYD, also can be controlled with these treatments. Further information on the associations between the size of flea beetle populations, incidence of systemic Stewart's wilt, and effects of Stewart's wilt on sweet corn yield may help determine the conditions under which seed treatment insecticides are economically beneficial.

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LITERATURE CITED

1. Ayers, J. E., MacNab, A. A., Tetrault, R. C., and Yocum, J. O. 1979. The influence of selected insecticides on yield and the incidence of Stewart's wilt in sweet corn. Plant Dis. Rep. 63:634-638.
2. Gourmet, C., Hewings, A. D., Kolb, F. L., and Smyth, C. A. 1996. Effect of imidacloprid on nonflight movement of *Rhopalosiphum padi* and the subsequent spread of barley yellow dwarf virus. Plant Dis. 78:1098-1101.
3. Gourmet, C., Kolb, F. L., Smyth, C. A., and Pedersen, W. L. 1996. Use of imidacloprid insecticide to control barley yellow dwarf virus (BYDV) in oat and wheat. Plant Dis. 80:136-141.
4. Heichel, G. H., Sands, D. C., and Kring, J. B. 1977. Seasonal patterns and reduction by carbofuran of Stewart's bacterial wilt of sweet corn. Plant Dis. Rep. 61:149-153.
5. Itnyre, R. L., D'Arcy, C. J., Pataky, J. K., and Pedersen, W. L. 1999. Symptomatology of bar-

Table 5. Incidence of Stewart's wilt on GH 2628 (resistant to moderately resistant) and Bonus (resistant) corn grown from nontreated or insecticide-treated seed in 1999

		GH 2628				Bonus			
		Incidence (%)[x]			Level of control (%)[y]	Incidence (%)			Level of control (%)
Trial	Growth stage[w]	Nontreated	Adage	Gaucho		Nontreated	Adage	Gaucho	
Henderson, KY	3-leaf	3*[z]	<1	<1		2*	<1	<1	
Champaign, IL (Apr. 30)	4-leaf	1	<1	<1		1	<1	<1	
	8-leaf	3*	1	1		1	<1	<1	
Mason, IL (Jun. 1)	7-leaf	1*	<0.1	0		nd	nd	nd	
Madison, IL	6-leaf	4*	1	1	79	2*	1	<1	
	Tassel	nd	nd	nd		nd	nd	nd	
Shelby, IL	6-leaf	2	<1	<1		<1	<1	<1	
	Mid-silk + 1 week	3	1	2		1	<1	1	
Douglas, IL	Mid-silk	<1	nd	nd		<1	nd	nd	
Fayette, IL	6-leaf	3*	<1	1		<1	<1	<1	
	Early silk	2*	0	<1		<1	<0.1	0	
Pope, IL	8-leaf stage	<0.1	nd	nd		0	nd	nd	
Mason, IL (Jul. 5)	Early silk	nd	nd	nd		nd	nd	nd	
Champaign, IL (Jul. 6)	Tassel	10*	5	5	50	4*	2	2	59
LaSalle, IL	Early silk	16*	9	7	49	4*	1	1	74

[w] Growth stage at which Stewart's wilt was rated was based on the number of leaves with visible leaf collars.
[x] Incidence of plants with symptoms of systemic Stewart's wilt infection or main stalk death.
[y] Level of control as a percentage of the nontreated mean was calculated from the mean of all insecticide seed treatments when incidence in nontreated plots was ≥4%. Percent control = [1 – (incidence in seed treatment plots/incidence in nontreated plots)] × 100.
[z] Nontreated means followed by an asterisk are significantly different (P <0.05) than means for Adage- and Gaucho-treated means. nd indicates mean not determined.

ley yellow dwarf virus-RMV infection in sweet corn. Plant Dis. 83:781.
6. Itnyre, R. L. C., D'Arcy, C. J., Pedersen, W. L., and Sweets, L. E. 1999. Reaction of sweet corn to inoculation with barley yellow dwarf virus RMV-IL. Plant Dis. 83:566-568.
7. Munkvold, G. P., McGee, D. C., and Iles, A. 1996. Effects of imidacloprid seed treatment of corn on foliar feeding and *Erwinia stewartii* transmission by the corn flea beetle. Plant Dis. 80:747-749.
8. Pataky, J. K., du Toit, L. J., Kunkel, T. E., and Schmitt, R. A. 1995. Severe Stewart's wilt in central Illinois on sweet corn hybrids moderately resistant to *Erwinia stewartii*. Plant Dis. 79:104.
9. Pataky, J. K., Suparyono, Hawk, J. A., Gardiner, M. L., and Pauly, M. H. 1990. Associations between Stewart's wilts ratings and maturity of sweet corn hybrids. Plant Dis. 74:792-796.
10. Pepper, E. H. 1967. Stewart's bacterial wilt of corn. Am. Phytopathol. Soc. Mono. No. 4.
11. Poos, F. W., and Elliott, C. 1936. Certain insect vectors of *Aplanobacter stewartii*. J. Agric. Res. 52:585-608.
12. Suparyono, and Pataky, J. K. 1989. Influence of host resistance and growth stage at the time of inoculation on Stewart's wilt and Goss's wilt development and sweet corn hybrid yield. Plant Dis. 73:339-345.