STEWART'S WILT IN WISCONSIN CORN IN 1999 AND PROGNOSIS FOR 2000

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Introduction

Stewart reported a bacterial wilt disease of corn from New York in 1895 that caused considerable damage to sweet corn grown in Long Island ((Elliot, 1941). The epidemics and the severity of losses of 1932 and 1933 stimulated intensive studies on the disease that led to the development of resistant corn hybrids. Since the use of more resistant hybrids, the occurrence of the disease has been sporadic (Pepper, 1967).

Stewart's disease of corn is caused by the bacterium *Pantoea stewartii* (formerly *Erwinia stewartii*). Since its initial identification, it has been found in most corn-growing areas of the USA and in restricted regions elsewhere in the world. It often occurs in the south central Corn Belt eastward to the Atlantic coast. The last report of its occurrence in Wisconsin was in 1943. The disease was absent in Wisconsin for the last 57 years and reappeared in 1999, presumably because of the last two years of mild winters.

Stewart's Wilt in Wisconsin

Fig 1. Number of seed corn fields inspected in various counties in 1999.

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In 1999, for the first time in almost 57 years, Stewart's wilt was detected in seed corn production fields in southern Wisconsin. The Wisconsin Department of Agriculture Trade and Consumer Protection (WDATCP) inspected 124 seedcorn fields in 17 counties (Fig.1).

Diseased samples that were collected from Dane, Columbia, Iowa, Walworth, Rock, and Waukesha counties were sent to Agdia Testing Services for diagnosis. The test results were positive for *Pantoea stewartii*. The identification of the flea beetle samples was made at the UW Extension Diagnostic Lab. Symptomatic plants typical of Stewart's wilt also were observed in Dodge, Green and as far north as Fond du Lac counties (Fig. 2). In addition to seedcorn fields, Stewart's wilt was also detected in sweet corn fields in Dane, Columbia, and Rock counties.

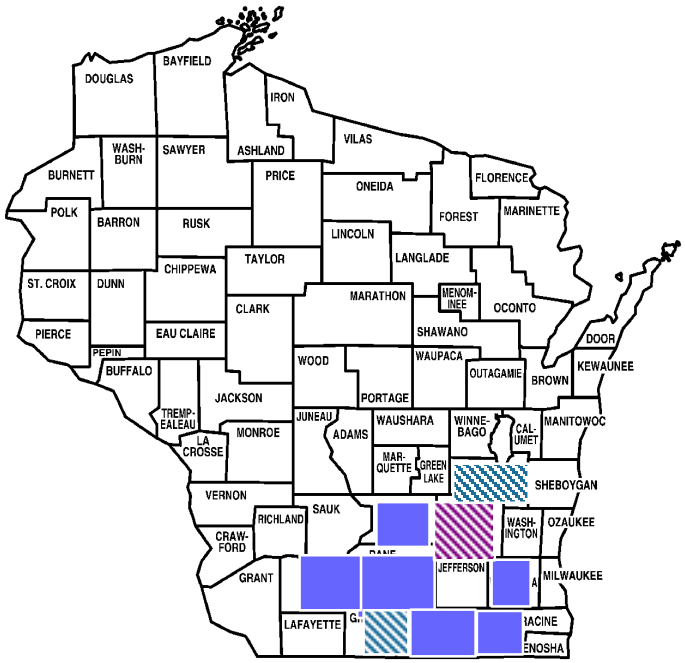

Fig. 2. Areas where Stewart's wilt was detected in 1999.
Confirmed Stewart wilt; Stewart's wilt symptoms present

Symptoms of Stewart's disease

Two phases of this disease have been described (White, 1999). The seedling phase causes pale green-gray, linear water-soaked lesions with irregularly wavy margins, stunting, and wilting leading to death of plants. Cavities may form in severely infected plants in the stalk pith near the soil line. Bacterial masses ooze from the cut end of infected stalks or leaves. Kernels from severely infected plants may harbor the bacterium, resulting in low levels of seed transmission. The seedling phase of this disease is more apparent in young plants of sweet corn and certain susceptible field corn inbreds.

The other phase is the leaf blight phase that can affect most dent corn inbreeds and hybrids after pollination. Lesions are gray-green to yellow-green and develop as streaks

on the leaves. These lesions are almost always are associated with the corn flea beetle feeding scars.

The corn flea beetles

The corn flea beetle (*Chaetocnema pulicaria*) is quite small (1/16 inch in length) and is an impressive leaper when disturbed, so the name is a good fit. The adult is a very small black beetle with enlarged hind legs. The beetle is the overwintering host and vector of *Pantoea stewartii*. Flea beetles overwinter as adults and are most likely a problem when corn plants are slowed in their development by cool spring weather. After mating, females lay eggs on plant leaves or in the ground near stems and roots. A second generation of adults appears in early August and feed until late in fall before hibernating in debris. The bacterium overwinters in the gut of the corn flea beetle. In spring Adult flea beetles overwintering in woods, ditches and fencerows move out into cornfields.

The bacterium overwinters almost exclusively in the digestive tracts of hibernating adults. The number of flea beetles emerging in spring from hibernation depends on the severity of winter temperatures. The ability of the beetle to survive mild winters is closely linked to the severity of the disease the next growing season. Such an association led to accurate forecasting of the severity of the disease based on winter temperatures. In areas where disease was severe the previous summer, approximately 20 percent of the surviving beetles in the spring are contaminated with the bacterium.

Regulatory requirements

Stewart's bacterial wilt of corn is a plant disease that can act as a major trade barrier for U.S. seed corn producers who want to export seed to international markets. More than 100 countries have quarantine restrictions that prevent the importation of corn seed unless the seed is certified as Stewart's wilt free. Seed is often certified by a field inspection of the growing plants, but the current regulations (set by the importing country) have zero tolerance for Stewart's wilt. Finding even a single plant with a few leaf spots will cause the field to fail inspection. The producer's only options are then to wait until harvest and have the seed tested for bacteria or not to export the seed. This restriction was imposed because Stewart’s wilt is reported to be seed transmitted. The following is the phytosanitary requirements for countries/states regulating Stewart’s wilt:

1. Seed corn fields must be inspected during the growing season
2. When Stewart’s wilt is found in a field, an official seed sample grown in a specific field will be taken for laboratory testing.
    - If the result of the seed test is negative, a phytosanitary certificate may be issued based on the requirement of importing country or the state.
    - If the result on the other hand is positive, the permit to export the seed will be denied.

Prediction of Stewart’s disease

The system used to predict survival of the insect and risk of the disease is based on winter temperatures. An index referred to as Stevens-Boewe index is calculated by simply adding the mean monthly temperatures for December, January, and February

(Stevens,1934). When the average temperature for these three months added together exceeds 90 °F, environmental conditions favor survival of flea beetles and the risk of Stewart's disease is high. Mild winters favor the survival of flea beetles and increase the odds that Stewart's disease may be a problem (Table 1).

Table 1. The relationship between Stevens-Boewe Index (Dec, Jan, and Feb.) and disease severity. Early-season wilt will probably be:

Below 81 ^{o}F	Absent or nearly so
Between 81 – 90 ^{o}F	Light
Between 90 – 99 ^{o}F	Moderate
Above 99 ^{o}F	Severe

Table 2. Show the conditions that could have made it favorable for Stewart's wilt appearance in Wisconsin. The values represent the sum of the average temperature for the three months in Wisconsin during the winters of 1997-98 and 1998-1999. It is clear that some areas in Wisconsin were quite warm and had a moderate to severe potential for high flea beetle numbers.

Table 2. Stevens-Bow Indices for Wisconsin in 1998 and 1999

Districts	No. of Counties with stations	Cumulative mean temps. (^{o}F) Dec. Jan. & Feb.		No. of counties with > 90 ^{o}F	
		97-98	98-99	97-98	98-99
Southwest	13	84.7	90.3	1	8
South central	15	86.3	93.0	1	13
Southeast	15	91.6	96.2	10	15
West Central	13		83.7		1
Central	11		85.6		1
East Central	12		87.7		0

In the winter of 1997-98 there were ten counties that had average mean total Stevens-Boewe Indices greater than 90 ^{o}F and 15 counties in 1998-99 for the southeastern section of the state. In 1997-98 only one county each had greater than 90 ^{o}F in the southwest and south central. While in 1998-99 there were 8 and 13 counties with Stevens-Boewe Indices greater than 90 ^{o}F in the southwest and south central regions, respectively. This indicate that most of the southern section of the state was warmer in 1998-99 than the previous years. These conditions may have allowed for corn flea beetle survival and disease distribution in the southern tier counties of the state.

Scouting and assessment procedures

Examine newly emerged corn for the presence of the beetles and count the approximate number per plant. They will first appear around field edges as they move from grassy areas and other overwintering sites. Vigilant scouting for this small beetles for next

spring is critical, especially where inbreds and hybrids susceptible to Stewart's disease are grown. Disease severity greater than 40 % (i.e. a disease rating >6, which corresponds to systemic infection and stunting) could result in yield decrease of 17 % (Suparyono and Patacky, 1989). In field corn prior to stage V5 consider treatment if 50% of the plants have severe feeding injury and 5 or more beetles per plant are detected. In susceptible seed corn varieties, treat if 10% of the plants show severe injury with two or more beetle per plant. If corn variety is resistant to Stewart's wilt and stand loss has not occurred, extensive feeding due to flea beetle may be tolerated. If stand loss begins to occur and flea beetles are abundant, then a rescue treatment may be warranted (Eastern, 1996; Ratcliffe, and Gray,1999).

Prognosis for the year 2000

The level of disease severity of Stewart's wilt in the summer of 1999 ranged from light to severe in parts of southern Wisconsin. Since the conditions were good for the survival of flea beetles in the winters of 1997-98 and 1998-99 (Table 2) and if the winter of 1999-2000 continues to be mild, there is a likelihood of a high percentage of infected corn flea beetles vectoring the bacteria for next season's crop. This could result in a significant impact on the production and export of seed next summer. Growers in areas where Stewart's wilt was detected should consider the following control options. If susceptible varieties are planted early in the season, in areas where Stewart's wilt has been found, and where the severity index indicates a potential for a moderate to severe problem, systemic insecticides should be applied at planting. This may help control corn flea beetle, and thus prevent transmission of Stewart's wilt (Wedburg, UW-Ext. personal communication). Always consult the University of Extension and obtain an up to date information and recommendation on control.

Control

1. Grow well-adapted wilt-resistant seedcorn inbred and sweet corn varieties. Sweet corn hybrids with high levels of resistance to Stewart's wilt are available. There are however, very few early maturing hybrids with high levels of resistance to Stewart's wilt.

2. Plant disease-free seed. Seed that is intended for export must be produced in disease free areas. Therefore, no infected seed corn enters the trade.

3. If corn flea beetle populations are high early in the season, they can damage corn plants even in the absence of *P. stewartii*. You can control early-season Stewart's disease on susceptible corn by controlling the corn flea beetle with an approved foliar insecticide. It also helps reduce the spread and overall severity of Stewart's wilt.

4. Delayed or later plantings may have less flea beetle activity than early-season plantings.

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