Goss’s Wilt of Corn

Goss’s wilt (Clavibacter michiganensis subsp. nebraskensis) is a bacterial disease usually associated with corn fields in Nebraska and Colorado. In 2010, damage from this disease was notable not only in those states, but also in states to the north and east, including the Dakotas, Minnesota, Iowa, Wisconsin, Illinois and Indiana. The disease has even extended into some Manitoba, Canada corn production areas.

Plant pathologists have reported increased Goss’s wilt and corn damage in many midwestern and northwestern states over the last few years. Higher levels of corn residue from corn-after-corn production and reduced tillage are likely contributing factors in the spread of the Goss’s wilt.

However, the prevalence of hail events and storms has a large impact on the severity of infection and yield loss in a given growing season. When plants sustain abrasion injuries from hail or wind, Goss’s wilt bacteria can infect the leaves through the damaged plant tissues.

Disease Development

Goss’s wilt overwinters in infected corn residue, and that of other host plants, including green foxtail, barnyardgrass and shattercane. From this infected residue, Goss’s wilt bacteria enter corn plants through wounds caused by hail, heavy rain, wind or mechanical damage, and may even enter the leaves through the stomates. Rain splash is the usual means of transfer from residue to growing corn plants, but Goss’s wilt can also survive in irrigation water during the growing season. Plants may be infected at any stage of development.

Wet weather and high relative humidity tend to encourage development of Goss’s wilt. This is because leaf wetness is required for infection to occur, and the bacteria also spread most readily in humid weather. Goss’s wilt tends to be more severe in fields with high levels of corn residue.

Disease Symptoms

Early leaf symptoms are oblong or elongated lesions of water-soaked, grayish-green tissue that progress to long dead streaks with wavy, irregular margins (Figure 1a). These streaks extend along the leaf veins, which suggests a bacterial infection. One of the most characteristic symptoms of Goss’s wilt is leaf “freckles” that develop within the streaks (Figure 1a and 1b). In addition, a sticky exudate forms in the streaks, which dries to form a glistening residue, or varnish, within the lesion (Figure 1c). As lesions enlarge and coalesce, they form large areas of necrotic tissue on the leaves and eventually, entire leaves may wilt and dry up (Figure 1).

Plants may also be infected systemically by Goss’s wilt, especially in the seedling stage. These plants have discolored vascular tissue, with a slimy bacterial exudate in the stalk. Plants are commonly stunted and wilt and die as if drought stressed.

Goss’s wilt symptoms can be confused with those of another bacterial disease, Stewart’s wilt. Laboratory tests can easily distinguish them, but careful field examination can separate the diseases as well. In general, development of Goss’s wilt is most common after a hailstorm or sandblasting, whereas Stewart’s wilt epidemics occur when populations of flea beetles are high.

Figure 1. Goss’s wilt symptoms on corn leaves.

Therefore, Stewart’s wilt is accompanied by obvious flea beetle feeding scars on leaves. Table 1 lists other distinctions between these two diseases.

Table 1. Comparison of important features of two bacterial wilts of corn: Stewart’s wilt and Goss’s wilt.

<table>
<thead>
<tr>
<th>Symptoms</th>
<th>Stewart’s Wilt</th>
<th>Goss’s Wilt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infection of corn</td>
<td>Flea beetle</td>
<td>Hail storm</td>
</tr>
<tr>
<td>Long irregular lesions</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Leaf freckle symptoms</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Varnish-like exudate</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Crown cavity symptoms</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Vascular discoloration</td>
<td>Yellow</td>
<td>Orange</td>
</tr>
</tbody>
</table>

*B Adapated from University of Nebraska

Bacterial soft rot can often occur in the same field with Goss’s wilt, and can sometimes be confused with systemic Goss’s infection. Bacterial soft rot can be caused by a number of bacterial species, but is most often associated with Erwinia chrysanthemi pv. zea. Other Erwinia and Pseudomonas species have also been identified as soft rot causal agents. These bacteria survive in plant residue and infect through physical wounds in the corn plant. Rain splash due to strong thunderstorms and sprinkler irrigation are associated with severe levels of infestation.

Yield Loss

Goss’s wilt limits yield by reducing green leaf area and causing premature death in corn plants (Figure 2). Timing of the infection has a critical role in the disease’s influence on grain yield. Early infections lead to the greatest yield reductions, whereas late infections may have little yield influence. Yield reductions of 50 percent have been documented when susceptible
hybrids were infected early in the growing season. Other agro-
nomic issues such as stalk lodging may result from fields that
have prematurely died from Goss’s wilt. This can result in fur-
ther reductions in yield (harvest losses) and quality.

Figure 2. Goss’s wilt lesions may expand to eventually encompass
entire corn leaf.

Disease Management

No rescue measures are available to control Goss’s wilt, so
preventing or avoiding infection are crucial. Where the disease
is already present in a field, growers can minimize damage by
reducing corn residue and using resistant hybrids.

Prevention/Avoidance

Goss’s wilt may be transmitted from field to field by equip-
ment and weather that move infected residue. Harvest and
tillage equipment, balers, and wind can all transfer infected
residue and soil to previously uninfested fields. To help avoid
spreading the pathogen in this way, harvest and till infected
fields last and clean equipment of crop residue.

Reducing Corn Residue

Crop rotation and tillage, when practical, can be used to re-
duce the amount of corn residue remaining on the soil surface
to infect the new crop. Crop rotation to a non-host crop such as
soybeans, dry beans or alfalfa allows for an additional year of
corn residue decomposition between corn crops. Deep tillage is
especially effective at incorporating and burying infected resi-
due. However, these practices only reduce but do not prevent
disease occurrence. Goss’s wilt has occurred on fields that are
first-year corn and in fields that were plowed.

Resistant Hybrids

Because useful levels of resistance to Goss’s wilt have
been identified in certain parent lines and hybrids, hybrid resis-
tance is becoming the primary method for disease management
of Goss’s wilt.

Pioneer researchers screen hybrids for resistance to
Goss’s wilt at sites with reliable annual disease pressure. In ad-
dition to screening under natural infestations, researchers also
hand-inoculate inbreds and hybrids with Goss’s wilt bacteria
and evaluate for disease symptoms. With the recent outbreaks
of Goss’s wilt, new samples of Goss’s wilt bacterium have been
collected and incorporated into the screening program to ad-
dress potential strain shifts. Hybrids are rated against known
susceptible and resistant hybrids using Pioneer’s 1 to 9 rating
system (1=susceptible, 9=resistant).

On-farm strip trials provide an additional resource for data
collection if the disease occurs. The primary maturity range for
Goss’s screening is from 90 CRM to 110 CRM. However, due to the
recent increase in Goss’s incidence in Manitoba, Kansas
and the Texas Panhandle, Goss’s screenings have been ex-
panded. Pioneer now offers a wide genetic range of hybrids
with very good to excellent resistance within a hybrid maturity
range of 75 to 118 days.

Pioneer will continue using all available plant breeding
technologies to improve hybrids for Goss’s wilt resistance.
This includes screening parent lines and hybrids in areas with
severe natural infection, as well as use of molecular markers
to identify more resistant types prior to field screening. These
steps are designed to accelerate hybrid improvement for resis-
tance to Goss’s wilt bacterial disease.

Notes
### Positioning Pioneer® brand Hybrids in Goss’s Wilt Areas

(S = Suitable to grow hybrid with this rating)

<table>
<thead>
<tr>
<th>Field Situation</th>
<th>Previous Crop</th>
<th>Goss’s Wilt History</th>
<th>Goss’s Wilt Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>Corn Following Crop Other Than Corn</td>
<td>Rotational Crop</td>
<td>No</td>
<td>S</td>
</tr>
<tr>
<td>Corn Following Crop Other Than Corn</td>
<td>Rotational Crop</td>
<td>2 yrs. previous</td>
<td>S</td>
</tr>
<tr>
<td>Corn Following Corn</td>
<td>Corn-Unknown Goss’s Wilt Resistance</td>
<td>No</td>
<td>S</td>
</tr>
<tr>
<td>Clean Tillage - Very Little Residue</td>
<td>Corn</td>
<td>Previous year</td>
<td>S</td>
</tr>
<tr>
<td>Minimum Tillage - Existing Surface Residue</td>
<td>Corn</td>
<td>Previous year</td>
<td>S</td>
</tr>
<tr>
<td>Corn Following Corn</td>
<td>Corn Unknown Score</td>
<td>Previous year</td>
<td>S</td>
</tr>
<tr>
<td>Corn Following Corn</td>
<td>Pioneer hybrid with a Goss’s Wilt score of 5 or lower</td>
<td>Previous year</td>
<td>S</td>
</tr>
<tr>
<td>Corn Following Corn</td>
<td>Pioneer hybrid with a Goss’s Wilt score of 7 or higher</td>
<td>Previous year</td>
<td>S</td>
</tr>
<tr>
<td>Corn Following Corn</td>
<td>Corn</td>
<td>2 yrs. previous, previous year</td>
<td>S</td>
</tr>
<tr>
<td>Corn Following Corn</td>
<td>Susceptible Competitor Hybrid</td>
<td>Previous year</td>
<td>S</td>
</tr>
<tr>
<td>Corn Following Corn</td>
<td>Corn</td>
<td>Unknown</td>
<td>S</td>
</tr>
</tbody>
</table>

### ADDITIONAL CONSIDERATIONS

#### Irrigation Type
Overhead irrigation vs. gravity irrigation. Overhead irrigation simulates a rain event and rain splash with every irrigation, consequently, increasing the possibility for Goss’s Wilt.

#### Soil Type
Sandy soils are prone to blowing sand and sand blasting; potentially increasing the likelihood of early-season infection.

#### Cultural Practices
Cultural practices that cause injury to the plant may increase the risk of Goss’s Wilt infection.

#### Hybrid Rotation
This is a recommended practice that prevents placing susceptible genetics on the same field year after year.

#### Border Fields
If bordering fields have a history of Goss’s Wilt, then consideration should be given to planting hybrids with at least a “6” score.

Hybrid Suitability Ratings and position statements are based upon analysis of hybrid agronomic characteristics and field observations of Pioneer agronomists and research scientists. Suitability ratings are not based upon research in these environments. Since not all combinations of environmental factors can be observed and rated, hybrid response to these environments can be variable. Characteristics such as disease tolerance, relative maturity, early growth and plant height can make a hybrid well suited in one region and poorly suited in another region. Please use these ratings as suggestions only. Pioneer makes no warranty regarding the environmental suitability of hybrids as stated in this guide.

### DISEASE PRECAUTION:
Grower should balance hybrid yield potential, hybrid maturity and cultural practice selection against their anticipated risk of a specific disease and need for resistance. In high disease risk conditions, consider planting hybrids with at least moderate resistance ratings of 4 or higher to help reduce risk. When susceptible hybrids with disease ratings of 1 to 3 are planted in conditions of high disease pressure, the grower assumes a higher level of risk. If conditions are severe, even hybrids rated as resistant can be adversely affected. Independent of yield reduction, diseases can predispose plants to secondary diseases such as stalk rots. This requires individual field and hybrid monitoring for stalk stability and timely harvest when warranted.

### IMPORTANT:
Ratings based on comparison with other Pioneer hybrids, not competitive hybrids. Ratings are assigned from research and data over a wide range of both climate and soil types, based on average performance across area of adaptation under normal conditions. Extreme conditions may adversely affect performance. Contact your local Pioneer sales professional for specific product information in your area.

### DISEASE & PEST RATINGS:
8-9 Highly Resistant; 6-7 Resistant; 4-5 Moderately Resistant; 1-3 Susceptible.; Blank=Insufficient Data. Scores based upon period-of-years testing. Refer to www.pioneer.com/growingpoint or FIS for the latest and complete listing of traits and scores for each Pioneer corn hybrid.