Corn for Western Canada:
Expanding Crop Opportunities for Western Canadian Farmers
DuPont Pioneer was founded by Henry A. Wallace in 1926. It was the first company in the world to develop, produce and market hybrid seed corn. From the beginning, Pioneer Hi-Bred has maintained a commitment to improving farmer productivity and profitability.

Today Pioneer Hi-Bred is the world’s leading source of customized solutions for farmers, livestock producers and grain and oilseed producers. With headquarters in Des Moines, Iowa, Pioneer Hi-Bred provides access to advanced plant genetics in nearly 70 countries.

**DuPont Pioneer in Canada**

Established in 1946, Pioneer Hi-Bred is Canada’s premier seed company.

- **Sunflowers**
- **Winter wheat**
- **Sila-Bac® brand forage inoculants**

**Crop genetics research and product development**

At Pioneer Hi-Bred, our goal is to rapidly create seed products with ever-greater **total economic value**. Our product development focuses on increasing yield potential and overall product value while minimizing any potential losses and costs. Key to reaching this goal is the integration of traits deemed valuable by the marketplace into our collection of superior, proprietary germplasm.

Pioneer Hi-Bred is breaking new ground in every field of the seed business. Our customers have challenged us to dig deep for results that will meet the next decade’s toughest market and cropping challenges. And our researchers are delivering.

"Western Canada provides a great opportunity for us to grow corn acreage in Canada. With this in mind we are investing heavily in hybrid corn development which will be supported with a new corn research facility in Southern Alberta. DuPont Pioneer has extensive knowledge of corn agronomy and production which we will use to educate growers on how to produce the new crop and be with them every step of the way from seed to harvest."

**Greg Stokke, Business Director - Western Canada, DuPont Pioneer**
Depending on the end purpose of your corn crop, you must select an appropriate heat unit corn to achieve the desired maturity. A hybrid that you would choose for silage would not be one you select for grazing. The same can be true for silage to grain production.

When selecting corn hybrids for your local conditions, it is best to work with someone that understands the area. This is where your local Pioneer Hi-Bred sales representative can make a recommendation to help you select the appropriate hybrid for your needs.

**Grain production**

The corn production area of Western Canada is continuing to grow outside the traditional area of the Red River Valley in Manitoba. With the development of lower heat unit corn, and a developing ethanol market, the potential for grain corn production has expanded.

With our expanding network of local Pioneer Hi-Bred sales representatives, we are helping to push the boundaries of corn growing areas. Our sales rep network are continually setting up grain corn demonstration sites across what would be considered non-traditional corn growing areas. Ask your local Pioneer Hi-Bred sales representative about setting a trial up on your farm. For those that are interested, Pioneer Hi-Bred has an extensive agronomic support network to help ensure your success.

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**Corn Agronomy**

**What hybrid is right for my farm?**

Corn hybrid maturity ratings help growers compare and select hybrids, manage risk, and spread out their harvest period. However, since there is no industry standard for these ratings, comparing hybrid maturities between companies can be difficult and confusing.

By rating corn hybrids for silking, physiological maturity and harvest moisture, Pioneer provides the maturity information needed to accurately compare hybrid differences and help make sound hybrid decisions. These maturity ratings are called comparative relative maturity (CRM) ratings.

Pioneer CRM ratings are values to allow maturity comparisons between hybrids. However, they do not represent actual days from planting or emergence.

Pioneer also assigns corn heat unit (CHU) values to help position hybrids in the field. Corn heat units are a system of relatively ranking hybrids for their maturity as determined by the level of moisture a hybrid has at harvest.

Look at the corn heat unit rating of the hybrid and the physiological maturity for your area (see provided maps) to best determine whether a hybrid can be safely planted on your farm. Compare the ratings of a new or unfamiliar hybrid to one you are currently planting or one that is grown successfully in your area. Keep in mind that varied area climates or extreme conditions may alter some hybrid maturity comparisons.

It is important to select a hybrid with the appropriate maturity because a hard killing frost before physiological maturity will cause premature black layer, halt grain fill, and may result in chaffy kernels with poor grain quality and test weight. Frost damaged corn is usually slower drying and additional losses may result due to delayed harvest. Therefore, it is critical to select hybrids that can normally mature before the first average killing frost date in your area.

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**Corn Heat Units**

<table>
<thead>
<tr>
<th>Less than 1000</th>
<th>1000 to 1150</th>
<th>1150 to 1300</th>
<th>1300 to 1450</th>
<th>1450 to 1600</th>
<th>1600 to 1750</th>
<th>1750 to 1900</th>
<th>1900 to 2050</th>
<th>2050 to 2200</th>
<th>More than 2200</th>
</tr>
</thead>
</table>

**Physiological Maturity map**


**Physiological maturity map**

Corn Planting Considerations

Planting corn seed to a depth of 1 ½” – 2” is optimum. Planting too shallow inhibits nodal root development and can lead to lodging. It also risks greater exposure of the early stage of corn development to herbicide residue. Planting too shallow can effect both brace and crown root development, which are responsible for stabilizing young plants and help with 85% of water & nutrient uptake.

Corn requires 10ºC to germinate and emerge, however you should plant once your land is prepared and in planting condition. It is important to plant in early to mid May, if field conditions are suitable for proper germination and emergence. Achieving the maximum potential number of heat units is critical for the success of corn in Western Canada. Planting into cold soil does not increase the potential for more corn heat units, waiting as long as you can until soils warm up will ensure more even and faster germination & emergence.

The growing point of the corn plant remains below the surface until the sixth leaf appears. A slight frost prior to the emergence of the sixth leaf will lead to leaf loss but should not kill the plant.

Day length and night temperature are other factors to consider when choosing a corn hybrid. For example, a grower in Manning, Alberta can plant a 2450 CHU corn for grazing because of the extended daylight hours. While a grower in Saskatoon, Saskatchewan might achieve the same results.

Other considerations:
- Good seed to soil contact is essential, as the corn seeds require 1/3 of their kernel weight of moisture to germinate.
- Slower planting speeds produce more uniform seed placement.
- Pioneer® brand corn seed is available with one of two seed treatment options: treated with a fungicide only or treated with a fungicide + insecticide seed treatment for protection from pests to ensure the crop gets off to the best possible start.

Plant population
An initial target of 32,000 plants/acre is a good starting point. However, this may need to be adjusted depending on field conditions. For example, under dry conditions use lower target seeding rates to allow plants more access to available moisture.

Use the following table to check seeding rates:

<table>
<thead>
<tr>
<th>Kernels/Acre</th>
<th>15” row</th>
<th>20” row</th>
<th>30” row</th>
</tr>
</thead>
<tbody>
<tr>
<td>22,000</td>
<td>19.0</td>
<td>14.3</td>
<td>9.5</td>
</tr>
<tr>
<td>24,000</td>
<td>17.4</td>
<td>13.1</td>
<td>8.7</td>
</tr>
<tr>
<td>26,000</td>
<td>16.1</td>
<td>12.1</td>
<td>8.0</td>
</tr>
<tr>
<td>28,000</td>
<td>14.9</td>
<td>11.2</td>
<td>7.5</td>
</tr>
<tr>
<td>30,000</td>
<td>13.9</td>
<td>10.5</td>
<td>7.0</td>
</tr>
<tr>
<td>32,000</td>
<td>13.1</td>
<td>9.8</td>
<td>6.6</td>
</tr>
<tr>
<td>34,000</td>
<td>12.3</td>
<td>9.2</td>
<td>6.1</td>
</tr>
<tr>
<td>36,000</td>
<td>11.6</td>
<td>8.7</td>
<td>5.8</td>
</tr>
</tbody>
</table>

Weed control
Corn is planted in wide rows and its growth is slower at the early stages versus other crops. Thus, early weed control is very important. Row spacing between 15-30 inches has shown to increase yields due to the high potential to intercept more light and also to reduce weed competition within rows due to faster development of the crop canopy.

Timing of herbicide application is very important, both to minimize competition from weeds and to prevent injury to the corn plant.

Consult your local Crop Protection Guide for herbicide choices and recommendations. Be aware, corn hybrids have different levels of herbicide tolerance to different broadleaf herbicides. Your local Pioneer Hi-Bred sales representative can help you select the best herbicide options for the corn hybrids you are growing.

Philip Mansiere, Pioneer Hi-Bred sales representative, Meskanaw, Saskatchewan

“In order to maximize yield potential, it is extremely important to keep the early stage of corn development free of weeds.”

Timing of herbicide application is an important factor in the success of your corn crop.
Making High Quality Silage

Critical processes in making silage

- Agronomics of the hybrid
- Growing season management
- Moisture and maturity at harvest
- Chop length and degree of processing
- Integrity of pack
- Rate of fill
- Sizing of structure
- Inoculation
- Covering with plastic
- Rate of removal
- Technique of removal

Silage management considerations

The ideal moisture content for chopping hybrids for corn silage will vary depending on the storage device that you are using. Please refer to the chart below:

Optimal Moisture Content of Corn Silage for Specific Storage Devices

<table>
<thead>
<tr>
<th>Silo Structure</th>
<th>Recommended moisture content %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horizontal bunker silos</td>
<td>70 to 65</td>
</tr>
<tr>
<td>Bag silos</td>
<td>70 to 60</td>
</tr>
<tr>
<td>Upright concrete silo</td>
<td>65 to 60</td>
</tr>
<tr>
<td>Upright oxygen limiting</td>
<td>50 to 50</td>
</tr>
</tbody>
</table>

Moisture content decreases at an average rate of 0.5% per day Days between early dent and 50% kernel milk ~12 d; between 50% kernel milk and 0% milk (black layer) ~13 d.

Aim to chop silage at approximately the 1/3 to 2/3 milk line. Milk line describes the hard starchy in a kernel. It may be the most widely used indicator for determining when to harvest corn for silage. One advantage of the kernel milk line is that it indicates the rate at which the crop is drying down.

Harvesting at a favourable milk line ensures proper ensiling, and delivers excellent feed quality with maximum stable energy content. If the moisture level is too high when the hybrid is chopped, it results in higher sugar content which is not stable in the bunk and can lead to increased seepage. While chopping silage when the hybrids are too dry will result in corn kernels passing through the animal undigested.

The fermentation process

<table>
<thead>
<tr>
<th>Phase I</th>
<th>Phase II</th>
<th>Phase III</th>
<th>Phase IV</th>
<th>Phase V</th>
<th>Phase VI</th>
</tr>
</thead>
<tbody>
<tr>
<td>90°F</td>
<td>65°F</td>
<td>84°F</td>
<td>84°F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>60 to 65%</td>
<td>5.0</td>
<td>4.0</td>
<td>7.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Harvesting can typically begin once the corn has reached 30-32% moisture. Results of other harvest methods can range from 70% grain to almost 90% grain. HMEC will yield 12-20% more dry matter per acre at harvest than HMSC.

Modern self-propelled harvesters equipped with snapper heads and “kernel processing” units typically harvest HMEC which is 80% grain. HMEC has a tendency to trap more air, has a higher chance of mould and mycotoxin contamination, and separates more when fed. The snaplage form of HMEC will be even more prone to mould and mycotoxins and separation because of additional trash components.

Corn can be harvested wet and stored as high moisture corn. The recommended moisture level for harvesting, storing, and feeding HMSC and HMEC is between 26-32%. Harvesting too early will reduce dry matter yields and can result in extensive fermentation causing energy losses during storage. Harvesting too late will also reduce dry matter yields and make packing difficult.

High Moisture Ear Corn (HMEC) vs. High Moisture Silage Corn (HMSC)

Technically, HMSC contains corn grain only while HMEC contains grain, cob, husk and various amounts of trash composed of stalks, leaves and tassels. A variation of HMEC known as “snaplage” contains additional stalk, leaves and tassel plant parts. The percent grain in HMEC varies greatly with harvest method, hybrid, and moisture content.

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Nutritional Comparisons

<p>| Source: 2001 Dairy NRC, Michigan State Spartan, Pioneer tech service samples |</p>
<table>
<thead>
<tr>
<th>%DM</th>
<th>CP%</th>
<th>ADF%</th>
<th>NDF%</th>
<th>NE%</th>
<th>PAF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry Corn</td>
<td>88</td>
<td>9.4</td>
<td>3.4</td>
<td>9.5</td>
<td>0.92</td>
</tr>
<tr>
<td>HMSC-ground</td>
<td>72</td>
<td>9.2</td>
<td>3.6</td>
<td>10.3</td>
<td>0.92</td>
</tr>
<tr>
<td>HMSC-rolled</td>
<td>72</td>
<td>9.2</td>
<td>3.6</td>
<td>10.2</td>
<td>0.92</td>
</tr>
<tr>
<td>HMEC</td>
<td>67</td>
<td>8.4</td>
<td>9.4</td>
<td>21</td>
<td>0.89</td>
</tr>
<tr>
<td>Snaplage</td>
<td>67</td>
<td>8.4</td>
<td>11</td>
<td>36</td>
<td>0.72</td>
</tr>
</tbody>
</table>

Adapted from McCullough *Temperature dependent on ambient. Ensiling temperature generally is 150 higher than ambient.

Source: 2001 Dairy NRC, Michigan State Spartan, Pioneer tech service samples

Brent Jordan, Pioneer Hi-Bred sales representative, Ponoka, Alberta

"Milk line is a good indicator to determine when you are getting close to the time to start chopping silage. But more accurately, you should actually chop up some representative plants from the field and use a Koster tester to dry down the sample to precisely determine the moisture percentage before you start making silage."

Brent Jordan, Pioneer Hi-Bred sales representative, Ponoka, Alberta
Sila-Bac® brand forage inoculants

Sila-Bac® brand inoculants from Pioneer contain patented strains of lactic acid-producing bacteria designed to help improve silage quality in several ways:

- Speed up and improve fermentation, retaining valuable nutrients and reducing dry matter loss
- Improve nutritive value of starch and fibre
- Improve protein quality by reducing ammonia production
- Extend bunklife by reducing spoilage by yeast and moulds

Inoculants pay

Our newest generation Sila-Bac® brand inoculants contain a combination of unique proprietary strains of bacteria, including Lactobacillus buchneri. L. buchneri is a heterofermentative bacterium that produces acetic and propionic acids, which substantially decrease the growth of the yeasts and moulds responsible for silage heating and spoilage.

Benefits and Strengths:

- Helps during feed-out, reduces heating thus increasing bunklife.
- Excellent nutrient retention, reduces spoilage.
- Combination products containing L. buchneri require significant testing to insure that the homo- and hetero-fermentative organisms work in a concerted fashion.

Bunker at left features silage treated with an inoculant containing L. buchneri. The infrared photo (below) shows cool silage (blue areas) with slight warming on the top caused by the penetration of sunlight (yellow areas). The infrared image of the untreated bunker, right, shows evidence of substantial heating (yellow to red areas), not only on the top but also around the perimeters. This indicates conditions are ripe for the breakdown of nutrients and deterioration of silage quality.

Pioneer Appli-Pro® SLV (Super Low Volume) Inoculant Applicator System

Designed and developed by Pioneer Inoculant Research, the Appli-Pro SLV uses air from a compressor and a small amount of water to deliver the inoculant solution. The total amount of liquid applied is 10 ml/ton, so each 2.5-litre inoculant bottle treats 250 tons of chopped forage. It’s simple to use. All you need to do is add water to the bottles of inoculant, shake the bottle to put the product in solution and screw the bottles to the applicator. Each applicator holds two bottles.

Advantages of the Appli-Pro® SLV System

- Treats up to 500 tons before needing to refill.
- Saves time! Less stopping and reloading of both water and inoculant.
- Eliminates mixing of inoculant material in large water tank.
- More accurate, more precise application with the unique injection system.
- Less waste, improved quality control because you can remove and refrigerate the mixed inoculant bottle at end of the day. Completion-Pac bottles are available for finishing fields.
- Unique back-flush system reduces waste, makes system cleaning easy.
- 12-month full manufacturer’s warranty on parts and labour.

“By starting to use inoculants, large feedlots and dairies have seen significant improvements in silage quality.”

Nicole Rasmussen, Area Agronomist, DuPont Pioneer, Taber, AB
Grazing Corn Cost Comparison

Grazing Corn versus Barley

Cost Estimates - 2008

<table>
<thead>
<tr>
<th>Operating Costs</th>
<th>Barley Swathed</th>
<th>Corn Swathed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seed</td>
<td>14.00</td>
<td>80.00</td>
</tr>
<tr>
<td>Fertilizer (applied)</td>
<td>47.00 (50N + 20P)</td>
<td>80.00 (80N + 40P)</td>
</tr>
<tr>
<td>Chemical &amp; Application</td>
<td>19.50</td>
<td>14.00</td>
</tr>
<tr>
<td>Labour (cropping &amp; feeding)</td>
<td>20.00</td>
<td>20.00</td>
</tr>
<tr>
<td>Seeding</td>
<td>20.00</td>
<td>20.00</td>
</tr>
<tr>
<td>Cultivate/Disc</td>
<td>12.00</td>
<td>12.00</td>
</tr>
<tr>
<td>Land</td>
<td>35.00</td>
<td>35.00</td>
</tr>
<tr>
<td>Swathing</td>
<td>20.00</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>187.50</td>
<td>261.00</td>
</tr>
</tbody>
</table>

Cost Predictions - 2008

<table>
<thead>
<tr>
<th>Measures</th>
<th>Barley (seeded June 20th)</th>
<th>Corn (seeded May 10th)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Projected Yield</td>
<td>2.7 ton DM</td>
<td>4.2 ton DM</td>
</tr>
<tr>
<td>Estimated Cow days per acre based on 3.5% BW consumption for 1000 lb animal</td>
<td>154 cow days per acre</td>
<td>240 cow days per acre</td>
</tr>
<tr>
<td>$ per cow/day</td>
<td>$ 1.22/day</td>
<td>$ 1.09/day</td>
</tr>
</tbody>
</table>

Nutritional considerations

- Whole plant corn for grazing is a very high quality feedsource that will meet the nutritional requirements of the pregnant beef cow.
- The best way to manage grazing corn and increase utilization is to move animals through paddocks every 2-3 days.
- If the corn becomes too mature, this can be managed through supplementation of hay. Corn should freeze and thus be grazed at the R5 stage (half milk line) for optimal utilization and stalk cleanup, as well as to minimize risk of digestive upset.
- Silaging a potentially mature crop may provide a better return on your investments.
- Select the right maturity for your local area. Your Pioneer Hi-Bred sales representative can help.

One option may be to feed a little high quality alfalfa/grass hay every 2-3 days. This will improve crude protein level in the diet and allow for better animal utilization of less digestible stalks at the back end of the grazing period.

Feed a highly palatable, complete, 2:1 winter mineral (with salt). Ensure proper water sources and windbreaks are provided.

Be prepared to supplement if there is a cold snap. Cows forced to clean up stalks during extremely cold periods can impact cow performance. Feed high quality hay or range pellets in the evening. Move into a new paddock if you can.

Other Management Considerations

Make sure to have a proper adaptation period during entry of corn fields. Monitor naive cows and ensure proper adaptation period is allowed - possibly provide supplementation until cows are accustomed to grazing corn.

Ensure full rumen entry to limit digestive upset and acidosis risk.

Manage and monitor herd closely. Electric fencing is very important as you are preparing your operation for grazing corn. Consider running a dual wire fence (wire return) – where the top wire is hot while the lower wire acts as the ground. Make sure your fence is well-grounded.

Sometimes you may have to put several rods along the fence in order to obtain a good ground.

Traditional feeding methods with prepared feeds and rations cost between $1.60 - $2.50 per cow per day. These costs may vary depending on the size of the operation.

Electric fencing will take some time to plan and set up. It’s a good idea to run a second paddock next to your current one. This holds animals to a smaller area in case they break out. It also makes moving them easier. Consider getting your paddocks ready just before the ground freezes up.

- Don’t put all eggs in one basket - have a backup feed source.
- Electric fencing is a good option for managing the herd. Make sure your fence is well-grounded.
- Plan in conjunction with other feed sources.
- Ensure fresh clean water is provided as well as additional windbreaks if necessary.
Goss’s wilt in Corn

Goss’s wilt is a bacterial disease that is more prevalent in Nebraska but in recent years has moved east across the Corn Belt. It has been confirmed in upper mid-west corn belts, which includes Manitoba. In heavily infected fields, this disease can cause devastating damage with corn yield losses approaching 50 percent. Goss’s wilt can be most severe the year following a Goss's wilt infection because of the increased amount of bacterium in the residue. Increased levels have started to be observed in some corn growing regions of Manitoba. Symptoms of Goss’s wilt may be confused with other foliar diseases, so proper identification is important. Suspicious samples should be sent to a laboratory for diagnosis.

Facts

- Disease is caused by a bacterial pathogen.
- Overwinters in infected residue of corn and several grasses.
- Depending on conditions, may cause only minor problems or devastating damage with grain yield losses approaching 50%.

Development of Goss’s wilt

- Disease has been found in parts of Manitoba, the Dakotas, Minnesota, Wisconsin, Nebraska, Colorado, Iowa, Illinois and Indiana.
- Plant wounding from wind, sandblasting and especially hail provide openings for bacteria.
- Insects are not known to be a factor in spread or development of this disease.
- Wet weather and high humidity encourage disease development.

Management tips

Genetic resistance

- Primary management method.
- DuPont Pioneer researchers inoculate, screen and rate hybrids for resistance.
- Hybrids are also rated under natural infestations in affected states.
- DuPont Pioneer screens material and breeds hybrids with genetic resistance to this disease at our Carman, MB research centre.
- See your local Pioneer Hi-Bred sales representative for help in selecting appropriate hybrids for your field.

Reduce corn residue

- Disease can become problematic in corn on corn, high-residue fields.
- Crop rotation is effective in reducing residue.
- Tillage encourages residue breakdown.
- Control grassy weeds that are hosts for the bacteria such as green foxtail and barnyard grass, and others.

Prevention/Avoidance

- Harvest and till affected fields last and clean equipment to avoid spreading the pathogen to uninfected fields.
- Fungicide application is NOT effective, as this is a bacterial disease.

Goss’s wilt lesions may expand to eventually encompass entire corn leaf.
The DuPont Pioneer Goss’s wilt advantage

DuPont Pioneer currently conducts an industry leading corn hybrid screening program to select hybrids that are resistant to Goss’s wilt. This will help growers in Manitoba to best manage this devastating disease and to prevent the spread of Goss’s wilt to other areas. Contact your local Pioneer Hi-Bred sales representative for more information on testing corn for Goss’s wilt infections. DuPont Pioneer researchers select corn hybrids for resistance to Goss’s wilt. Corn hybrids are rated against known susceptible and resistant hybrids using Pioneer Hi-Bred’s rating system

(1 = susceptible, 9 = resistant).

<table>
<thead>
<tr>
<th>Pioneer® brand Product</th>
<th>Technology Segment</th>
<th>Goss’s Wilt Ratings*</th>
</tr>
</thead>
<tbody>
<tr>
<td>P7213R</td>
<td>RR2</td>
<td>3</td>
</tr>
<tr>
<td>39F44</td>
<td>RR2</td>
<td>3</td>
</tr>
<tr>
<td>P7410HR</td>
<td>HR1, LL, RR2</td>
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</tr>
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<td>P7443R</td>
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</tr>
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<td>P7632AM**</td>
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<tr>
<td>P8906R</td>
<td>RR2</td>
<td>4</td>
</tr>
<tr>
<td>P8906AM**</td>
<td>AM1, RR2</td>
<td>4</td>
</tr>
</tbody>
</table>

Distinguishing features of Goss’s wilt lesions

FRECKLES – dark green to black water soaked spots, often near lesion edges
SHINY EXUDATE – bacteria ooze on the leaf surface and may appear shiny after drying

The DuPont Pioneer Goss’s wilt advantage

Pioneer Hi-Bred has been screening and breeding for Goss’s wilt resistance for decades in the western U.S. Once this bacterial disease spread into the northern corn belt over the last few years, Canadian researchers were able to leverage the vast experience and knowledge available within Pioneer Hi-Bred to diagnose, characterize, and select resistant early maturity genetics. This work will lead to improved Goss’s wilt resistance in the corn hybrids sold in Western Canada.
Maximized yields and simplified refuge compliance

DuPont Pioneer is committed to delivering integrated refuge products that provide growers with increased flexibility and convenience for insect resistance management (IRM). Pioneer® brand Optimum® AcreMax® and Herculex® products bring multiple modes of action for insect protection to help increase overall farm yields by reducing refuge and extend the durability of important traits.

### Technology Segments

<table>
<thead>
<tr>
<th>Technology Segment</th>
<th>Corn Technology Traits</th>
<th>Insect Resistance Levels</th>
<th>Herbicide Resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>RR2</td>
<td>Roundup Ready® Corn 2</td>
<td>E</td>
<td></td>
</tr>
<tr>
<td>LL</td>
<td>LibertyLink®</td>
<td>E</td>
<td></td>
</tr>
<tr>
<td>HXX, LL</td>
<td>Herculex®, LibertyLink (Corn Borer)</td>
<td>E M V E V E</td>
<td>E E</td>
</tr>
<tr>
<td>HXX, LL, RR2</td>
<td>Herculex®, LibertyLink, Roundup Ready Corn 2 (Corn Borer)</td>
<td>E M V E V E E E E</td>
<td>E E</td>
</tr>
<tr>
<td>AM™</td>
<td>Optimum®, AcreMax®, LibertyLink, Roundup Ready Corn 2, YieldGard® Corn Borer (Corn Borer)</td>
<td>E M V E V E E E E</td>
<td>E E</td>
</tr>
<tr>
<td>AMXT</td>
<td>Optimum AcreMax XTreme, LibertyLink, Roundup Ready Corn 2, (Corn Borer/Rootworm)</td>
<td>E M V E V E E E E</td>
<td>E E</td>
</tr>
<tr>
<td>HXII, LL, RR2</td>
<td>Herculex® XTRA, LibertyLink, Roundup Ready Corn 2 (Corn Borer/Rootworm)</td>
<td>E M V E V E E E E</td>
<td>E E</td>
</tr>
<tr>
<td>YGCB</td>
<td>YieldGard® Corn Borer</td>
<td>E M G</td>
<td></td>
</tr>
<tr>
<td>YGCB, RR2</td>
<td>YieldGard Corn Borer, Roundup Ready Corn 2</td>
<td>E M G</td>
<td>E</td>
</tr>
</tbody>
</table>

### Refuge Examples

- **Herculex® I (HX1)**
  - YieldGard® Corn Borer (YGCB) x Herculex® I (HX1) x herbicide tolerant refuge (LL, RR2) (AM, LL, RR2)
  - European Corn Borer
  - Corn Earworm
  - Western Bean Cutworm
  - Fall Armyworm
  - Black Cutworm
- **Herculex® XTRA (HXX)**
  - YieldGard® Corn Borer (YGCB) + herbicide tolerant refuge (LL, RR2) (AMXT, LL, RR2)
  - European Corn Borer
  - Corn Earworm
  - Western Bean Cutworm
  - Fall Armyworm
  - Black Cutworm
  - Southern Corn Rootworm
  - Northern Corn Rootworm
- **Herculex® I (HX1)**
  - YieldGard® Corn Borer (YGCB) + herbicide tolerant refuge (LL, RR2) (AMXT, LL, RR2)
  - European Corn Borer
  - Corn Earworm
  - Western Bean Cutworm
  - Fall Armyworm
  - Black Cutworm
  - Herculex® XTRA (HXX)
  - LibertyLink®
  - Roundup Ready Corn 2
  - YieldGard® Corn Borer
  - LibertyLink®
  - Roundup Ready Corn 2
  - YieldGard® Corn Borer

### Pests Controlled

- **Black Cutworm**
- **Fall Armyworm**
- **Corn Earworm**
- **European Corn Borer**
- **Northern Corn Rootworm**
- **Western Corn Rootworm**
- **Western Bean Cutworm**
- **Black Cutworm**
- **Southern Corn Rootworm**
- **Northern Corn Rootworm**

### Benefits

- Above-ground protection from corn, bean, western bean cutworm and black cutworm
- Ultimate simplicity
- Technology preservation
- Simplifies refuge
- Reduced refuge, maximum yields
- Technology preservation
- Proven performance
- Multiple modes of insect protection

### Refuge

- 20% refuge up to 1/4 mile or 400m away
- Integrated refuge, no separate refuge required
- Integrated refuge, no separate refuge required

### Refuge Examples

- **Herculex® I (HX1)**
- **Herculex® XTRA (HXX)**
- **Optimum AcreMax XTreme**
- **YieldGard Corn Borer (YGCB)**
- **Roundup Ready Corn 2 (RR2)**
- **LibertyLink**
- **Roundup Ready Corn 2 (RR2)**
- **YieldGard® Corn Borer**
- **Optimum AcreMax®, LibertyLink, Roundup Ready Corn 2, YieldGard® Corn Borer**
- **Optimum AcreMax XTreme, LibertyLink, Roundup Ready Corn 2, (Corn Borer/Rootworm)**
- **Herculex® XTRA, LibertyLink, Roundup Ready Corn 2 (Corn Borer/Rootworm)**
- **Herculex® Corn Borer, Roundup Ready Corn 2**
How a corn plant develops: Growth and development through the vegetative stages

All corn follows a similar pattern of development with variations based on hybrids, seasons, planting dates and locations. This illustration shows the key phases of corn development through the vegetative (V) stages.

<table>
<thead>
<tr>
<th>Stage</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Germination and emergence (VE)</strong></td>
<td>Once planted, corn seeds absorb water from the soil and begin to grow. VE (emergence) comes when the coleoptile (spike) pushes through the soil surface. Corn plants can emerge within five days in ideal heat and moisture conditions. But under cool and wet – or even under very dry conditions – they can take more than two weeks to emerge. The growing point (stem apex) is 1 to 1.5 inches below the surface. The seminal root system is growing from the seed. The seminal roots do much of the early work, but growth slows after VE as nodal roots begin to grow.</td>
</tr>
<tr>
<td><strong>V3 Stage</strong></td>
<td>At V3, the growing point is still below the surface. The stalk (stem) hasn’t elongated much. Root hairs are growing from the nodal roots as seminal roots cease growing. All leaves and ear shoots the plant will ever produce form from V3 to about V5. A tiny tassel forms at the tip of the growing point. Above-ground plant height typically is about 8 inches.</td>
</tr>
<tr>
<td><strong>V6 Stage</strong></td>
<td>The growing point and tassel rise above the soil surface at about the V6 stage. The stalk begins to elongate. The nodal root system grows from the three to four lowest stalk nodes. Some ear shoots or tillers are visible. Tiller (or sucker) development depends on the specific hybrid, plant density, fertility and other conditions.</td>
</tr>
<tr>
<td><strong>V9 Stage</strong></td>
<td>Dissection of a V9 plant shows many ear shoots (potential ears). These develop from every above-ground node except the last six to eight nodes below the tassel. Lower ear shoots grow fast at first, but only the upper one or two develop a harvestable ear. The tassel begins to develop rapidly. Stalks lengthen as the internodes grow. By V10, the time between new leaf stages shortens to about every two to three days.</td>
</tr>
<tr>
<td><strong>V12 Stage</strong></td>
<td>The number of ovules (potential kernels) on each ear and the size of the ear are determined at the V12 stage. The number of kernels per row isn’t determined until about a week before silking, at about V17. The top ear shoot is still smaller than the lower ear shoots, but many of the upper ears are close to the same size.</td>
</tr>
<tr>
<td><strong>V15 Stage</strong></td>
<td>This is the start of the most crucial period for determining grain yield. Upper ear shoot development overshadows lower ear shoot development. Every one to two days, a new leaf stage occurs. Silks begin to grow from the upper ears. By V17, the tips of upper ear shoots may be visible atop the leaf sheaths. The tip of the tassel also may be visible.</td>
</tr>
<tr>
<td><strong>V18 Stage</strong></td>
<td>Silks from the basal ear ovules elongate first. Silks from the ear tip ovules follow. This illustration represents about eight to nine days of reproductive organ development. Brace roots (aerial nodal roots) grow from the nodes above the soil surface to help support the plant and take in water and nutrients during the reproductive stages.</td>
</tr>
<tr>
<td><strong>VT Stage</strong></td>
<td>The VT stage arrives when the last branch of the tassel is completely visible. VT begins about two to three days before silk emergence. The plant is nearly at its full height. Pollen shed begins, lasting one to two weeks. The time between VT and R1 can fluctuate considerably depending on the hybrid and the environment.</td>
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</table>
How a corn plant develops: Reproduction through maturity

R1 stage: Silking
The R1 stage begins when silk is visible outside the husks. Pollination occurs when these moist silks catch falling pollen grains. Pollen takes about 24 hours to move down the silk to the ovule where fertilization occurs. The ovule becomes a kernel. Generally, all silks on an ear are pollinated in two to three days. The silks grow 1.0 to 1.5 inches each day until fertilized. The R1 kernel is almost engulfed in cob materials and is white on the outside. The inner material is clear with little fluid present.

R2 stage: Blister (10-14 days after silking)
R2 kernels are white on the outside and resemble a blister. The endosperm and its now-abundant inner fluid are clear. The embryo is still developing, but it now contains a developing miniature corn plant. Much of the kernel has grown out from the surrounding cob materials. The cob is close to full size. Silks are darkening and beginning to dry out. Starch has just begun to accumulate in the watery endosperm. Kernels are beginning to accumulate dry matter. Seed-fill is beginning.

R3 stage: Milk (18-22 days after silking)
The R3 kernel is yellow outside, while the inner fluid is now milky white due to accumulating starch. The embryo is growing rapidly. Most of the R3 kernel has grown out from the surrounding cob. Silks are brown and dry or becoming dry.

R4 stage: Dough (24-28 days after silking)
Continued starch accumulation in the endosperm causes the inner fluid to thicken to a pasty consistency. Usually four embryonic leaves have formed as the embryo has grown dramatically from the R3 stage. The shelled cob is a light red to pink. Toward the middle of R4, the embryo will stretch across more than half of the width of the kernel side. Just before R5, kernels along the length of the ear begin to dent or dry. The fifth (last) embryonic leaf and the lateral seminal roots have formed. If this seed is planted, these five embryonic leaves will appear the following season after germination and VE.

R5 stage: Dent (35-42 days after silking)
At R5, all or nearly all kernels are denting or denting. The shelled cob is dark red. The kernels are drying down from the top, where a small hard layer of starch is forming. This starch layer appears shortly after denting as a line across the back of the kernel (the non-embryo side). With maturity, the hard starch layer and line will advance toward the cob. Accumulated starch is hard above the line but still soft below the line.

R6 stage: Physiological maturity (55-65 days after silking)
By the R6 stage, kernels have attained their maximum dry weight or dry matter accumulation. The hard starch layer has advanced completely to the cob. A black or brown abscission layer forms, moving progressively from the tip ear kernels to the basal kernels of the ear. It’s a good indication of physiological maturity and signals the end of kernel growth. The husks and many leaves are no longer green, although the stalk may be.
Match Hybrid Maturity to Available CHUs

In Western Canada, especially in areas new to growing corn, it is very important that the maturity of your selected hybrid matches the available growing period. Growers should make hybrid selections that correspond to the corn heat unit (CHU) rating of their local area. The CHU rating of a hybrid is the number of CHUs required to achieve physiological maturity. The good news is that new early maturity corn hybrids from Pioneer Hi-Bred are very early – giving growers in non-traditional corn growing areas the opportunity to grow a successful corn crop. For example, the CHUs rating of our earliest hybrids are 2100 CHUs – this would match the average CHU ratings for Saskatoon or Edmonton.

Using the cob to determine crop stage, quality and yield potential

One way to track the corn plant’s development from reproduction through maturity is to establish the silking date (time of flowering) and then add:

- **Corn silage** – add 45 to 50 days to reach silage quality (approximately 65% moisture).
- **Grain corn** – add 55 to 60 days to reach grain quality.

**Silking / Tasseling**

<table>
<thead>
<tr>
<th></th>
<th>% of Maximum Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grain</td>
<td>0%</td>
</tr>
<tr>
<td>Whole Plant</td>
<td>50-55%</td>
</tr>
</tbody>
</table>

**Blister**

+13-14 days after silking

<table>
<thead>
<tr>
<th></th>
<th>% of Maximum Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grain</td>
<td>0-10%</td>
</tr>
<tr>
<td>Whole Plant</td>
<td>55-60%</td>
</tr>
</tbody>
</table>

Whole plant moisture = 80-85%

**Milk**

+7-8 days after blister stage

<table>
<thead>
<tr>
<th></th>
<th>% of Maximum Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grain</td>
<td>30-50%</td>
</tr>
<tr>
<td>Whole Plant</td>
<td>65-70%</td>
</tr>
</tbody>
</table>

Whole plant moisture = 75-80%

**Dough**

+5-6 days after milk stage

<table>
<thead>
<tr>
<th></th>
<th>% of Maximum Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grain</td>
<td>60-75%</td>
</tr>
<tr>
<td>Whole Plant</td>
<td>75-80%</td>
</tr>
</tbody>
</table>

Whole plant moisture = 70-75%

**Dent**

+13-14 days after dough stage

<table>
<thead>
<tr>
<th></th>
<th>% of Maximum Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grain</td>
<td>60-75%</td>
</tr>
<tr>
<td>Whole Plant</td>
<td>75-80%</td>
</tr>
</tbody>
</table>

Whole plant moisture = 70-75%

**1/2 Kernal Milk Line**

+7-8 days after dent stage

<table>
<thead>
<tr>
<th></th>
<th>% of Maximum Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grain</td>
<td>80-95%</td>
</tr>
<tr>
<td>Whole Plant</td>
<td>100%</td>
</tr>
</tbody>
</table>

Whole plant moisture = 65-70%
Backed by industry-leading agronomy support and expertise, this dedicated team is committed to helping you grow a successful crop under your local conditions.

Give them a call today!