Growing Productivity with Innovative Research

DuPont Pioneer Agronomy Sciences

DuPont
Pioneer

CORN

Introduction

At DuPont Pioneer, we are engaged in a relentless pursuit of greater productivity, increasing the quantity and quality of agricultural production from a finite amount of resources. Corn productivity trends over the past century show a phenomenal track record of success that has been built on continuous genetic improvement. Today's corn products are very different from those of 100 or even 50 years ago, with tremendous advances in yield potential and characteristics such as stress and disease tolerance, as well as biotechnology traits to help protect yield and expand management options.

These dramatic improvements in corn genetic potential have been accompanied by equally dramatic improvements in crop management. Advances in areas such as soil fertility management and planting practices have maximized gains in productivity that improved genetics have made possible. At DuPont Pioneer, we recognize that meeting future demand for agricultural output requires integrating new technologies into management systems that allow their full potential to be realized.

This commitment to improving crop management is the foundation of the broad network of agronomic research and expertise that we have today. The DuPont Pioneer Agronomy Sciences team is comprised of an industry-leading network of agronomists and researchers across North America. The mission of this team is to help maximize grower productivity by delivering useful crop management information built on rigorous, innovative research. DuPont Pioneer Agronomy Sciences researchers conduct studies in growers' fields and at research sites across North America, including many research studies conducted in collaboration with university scientists.

This book is intended to serve as an introduction to DuPont Pioneer agronomic research, with examples of recent research results in several key areas of corn management. However, what follows is just a small sample of the vast array of crop management research and information available from your Pioneer Sales Professional and at www.pioneer.com. This extensive library of agronomic information and research-based insights, coupled with the local expertise of DuPont Pioneer agronomists and researchers, can serve as a valuable resource to help drive productivity in your operation.

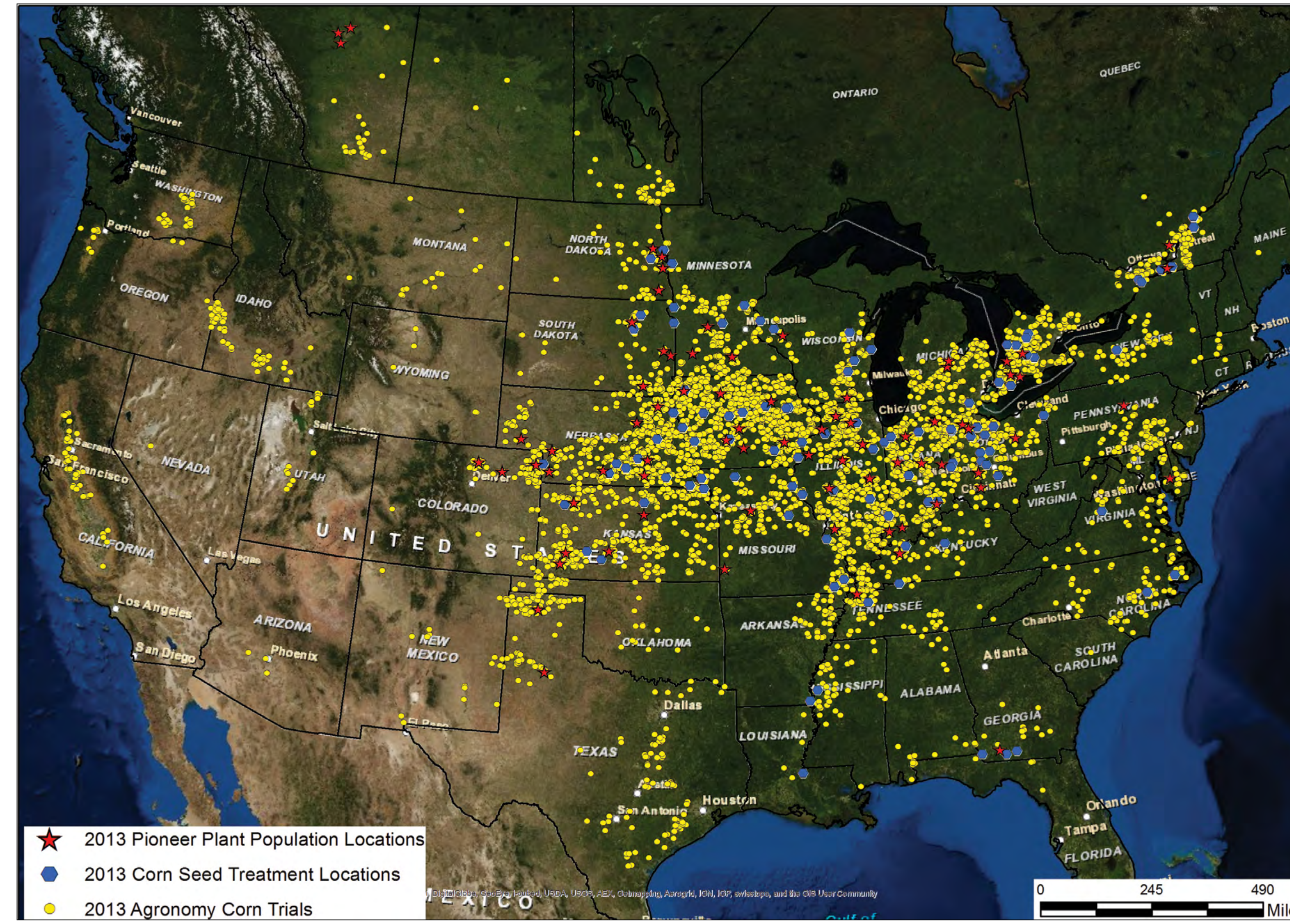
DuPont Pioneer Agronomy Sciences Team

Mark Jeschke and Rebecca Ahlers, Editors

DuPont Pioneer Agronomy Research Corn Management Topics:

- Hybrid Selection
- Planting Rate
- Planting Date
- Stand Establishment
- Row Spacing
- Nitrogen Management
- Cropping Sequence
- Residue Management
- Disease Management
- Insect Management

2013 Agronomy Sciences Testing - Corn



Collaborative Research

Collaborations with university researchers are a critical component of DuPont Pioneer's commitment to innovative crop management research. Many of the research studies included in this book were conducted as a part of the DuPont Pioneer Crop Management Research Awards (CMRA) Program. This program provides funds for agronomic and precision farming studies by university and USDA cooperators throughout North America. The awards extend for up to four years and address crop management information needs of Pioneer agronomists, sales professionals and customers.

Hybrid Selection

Hybrid selection is crucial to establishing productive stands and achieving high yields. Hybrids have specific strengths that could make one a top-performing choice for a certain environment but a lower performer in a different environment. Selecting a diverse lineup of locally adapted hybrids that vary in maturity and agronomic strengths can help growers lower their risk of crop loss. Hybrids should be considered/selected for the following key traits: maturity, yield, drought tolerance, standability, pest resistance, drydown, grain quality and harvestability.

Hybrid drought tolerance can be a major factor in determining yield in water-limited conditions. Pioneer® brand Optimum® AQUAmax™ hybrids help growers minimize risk and maximize their productivity under drought stress. DuPont Pioneer researchers evaluated the performance of Optimum AQUAmax hybrids in 289 on-farm grower trials over three years in western regions of the Corn Belt. At an increased seeding rate, the Optimum AQUAmax hybrids out-yielded the grower-selected hybrid and seeding rate in 221 of the 289 environments. The average yield advantage was 9.2 bu/acre.

Figure 1. Ears of an Optimum AQUAmax hybrid (left) and a hybrid of similar maturity but with lower drought tolerance (right) produced under significant drought stress at Johnston, Iowa, in 2012.

DuPont Pioneer **stress emergence and high-residue suitability ratings** give guidance to growers selecting hybrids for early planting and reduced-tillage systems. Every year, DuPont Pioneer conducts extensive emergence trials under a wide range of stressful environments and soil types, including early-planted and reduced-tillage fields. Based on data from stressful locations as well as lab assays that mimic extreme cold stress, each hybrid is assigned a stress emergence score. This score helps characterize hybrids for their genetic potential to establish stands under stress conditions (Figure 2).

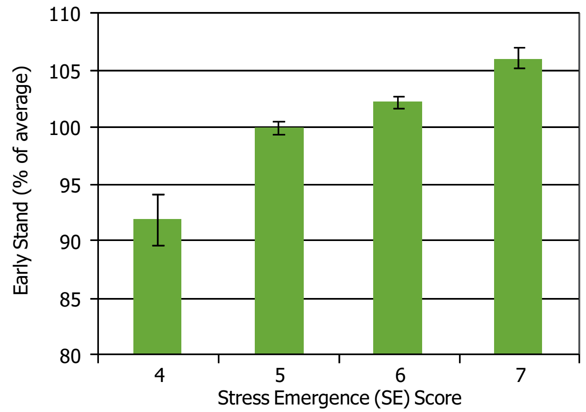


Figure 2. Relationship between early stand and stress emergence scores in stressful, high-residue locations in a two-year study.

Disease resistance is another important consideration when selecting hybrids. Pioneer® brand hybrids are rated on a scale of 1 to 9 for their level of resistance to major foliar diseases: 1-3 = susceptible, 4-5 = moderately susceptible, 6-7 = resistant, 8-9 = highly resistant. High-residue environments can be associated with greater disease pressure, making hybrid resistance more critical. The survival of diseases in corn residue can lead to earlier infection and higher disease incidence and severity in the subsequent corn crop. Extensive DuPont Pioneer research has consistently shown the importance of hybrid disease resistance in disease management (Figure 3).

Figure 3. Two hybrids showing vastly different levels of foliar disease symptoms in a trial near Macomb, Illinois, in 2009.

Finally, hybrid selection can be improved by **matching a hybrid with the expected growing environment.** Pioneer EnClass® Soils is a new tool that optimizes product selection based on a hybrid's response to a field's soil/water characteristics. Because hybrids and varieties differ in their tolerance to high or low water availability and drainage, it's important to take soil moisture and water-holding characteristics into account.

In 2012, DuPont Pioneer conducted research trials to examine how hybrids respond to various plant populations in soils with different levels of water availability using the Pioneer EnClass Soils system.

Results from this study showed that the hybrid yield responses varied substantially among the Pioneer EnClass Soils categories—potentially wet, well drained and wet/dry (Figure 4).

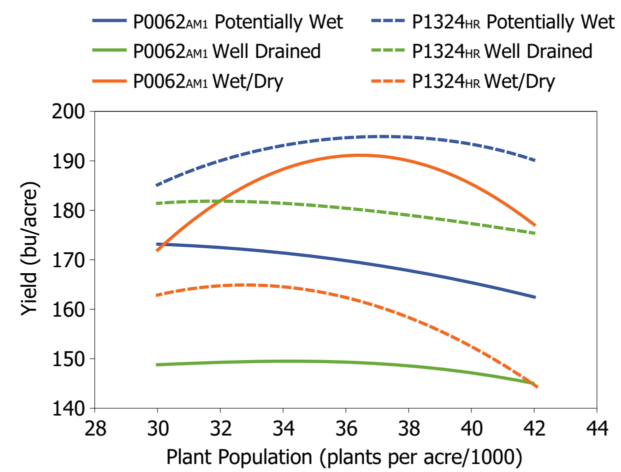


Figure 4. Response of Pioneer® brand products P0062AM1™ (AM1, LL, RR2) and P1324HR (HX1, LL, RR2) to population and Pioneer EnClass Soils categories across 27 and 31 locations, respectively.

Planting Rate

Increased seeding rates are closely associated with increased corn yields and allow hybrids to reach their full genetic potential. Average grower seeding rates have increased from 23,000 seeds/acre in 1985 to over 30,000 seeds/acre today. During that same time period, average yields have increased from about 105 to 160 bu/acre (Figure 1).

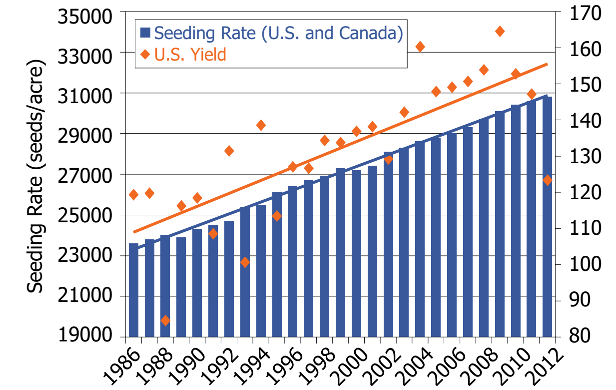


Figure 1. Average corn seeding rates reported by growers in the U.S. and Canada (DuPont Pioneer Brand Concentration Survey, 2012) and average U.S. corn yields (USDA/NASS).

Higher plant density causes increased competition between plants. When resources for moisture, light and nutrients are limited, interplant competition can lower yields. Through breeding, hybrids have been developed to be better suited for higher densities. For instance, hybrids now have more upright leaves to capture needed sunlight with less space, and root systems are more efficient with moisture uptake.

Every year DuPont Pioneer performs extensive plant population trials to determine optimum seeding rates, which can vary by hybrid and growing environment.

Research shows that hybrids with different maturities often have different population optimums. Early maturity hybrids usually require higher populations than later maturity hybrids (Figure 2).

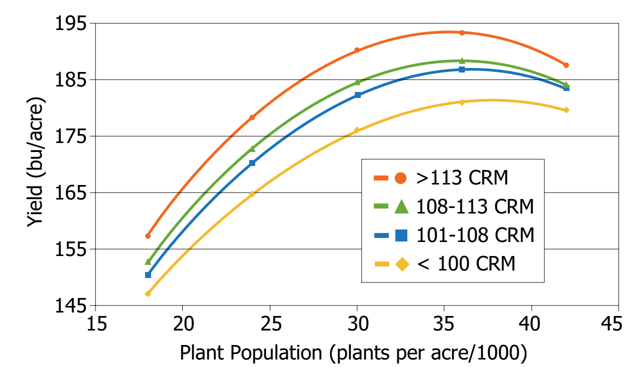


Figure 2. Yield response to plant population from four maturity (CRM) ranges over four years.

Optimum populations also vary by yield; more productive soils can accommodate more plants and produce higher yields. DuPont Pioneer research trials indicate that corn seeding rates generating the most income range from 33,000 seeds/acre to over 38,000 seeds/acre. Corresponding yields are 130 to 160 bu/acre and 220 to 250 bu/acre (Figure 3).

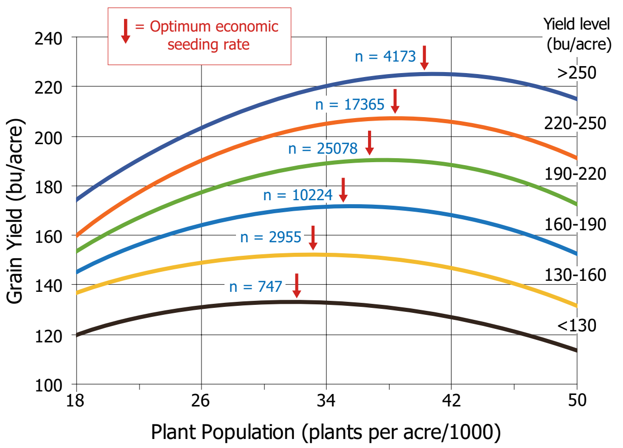


Figure 3. Yield response to plant population by location yield level over a six-year period (n = # of observations within a yield range).

Advances in variable rate seeding (VRS) technology allow a greater degree of precision in selecting the optimum seeding rates for different hybrids and soils. To implement VRS, growers are encouraged to define crop management zones in a field by using long-term yield maps.

DuPont Pioneer offers growers an online planting rate calculator that provides recommendations based on a selected hybrid, grain price, seed cost and yield level. It can be found at: https://www.pioneer.com/home/site/us/agronomy/tools/planting-rate-calculator/

Planting Date

Planting a full-season hybrid as early as possible generally helps maximize corn yield by allowing the crop to utilize more of the growing season.

For over 18 years, DuPont Pioneer has conducted planting date research at numerous locations to show how optimum planting dates vary in different parts of the Corn Belt. For instance, planting in early April provided growers in the central Corn Belt with the greatest profitability, whereas in the northern Corn Belt, planting in early May showed the greatest profitably (Figure 1).

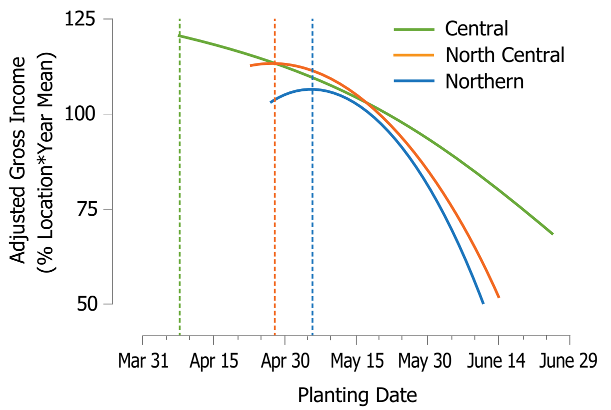


Figure 1. Adjusted gross income responses to planting dates in the central, north central and northern Corn Belt over 18 years.

Soil Temperature

Corn stands may be reduced when average soil temperatures are below 50°F. To help growers manage this risk, DuPont Pioneer provides stress emergence (SE) scores for its North American hybrids. Choosing hybrids with higher SE scores (and reduced genetic vulnerability) can help reduce stand loss due to cool soil temperatures.

A DuPont Pioneer study on SE showed that hybrids with higher SE had better stand establishment than those with lower SE in cold soils. (Figure 2).

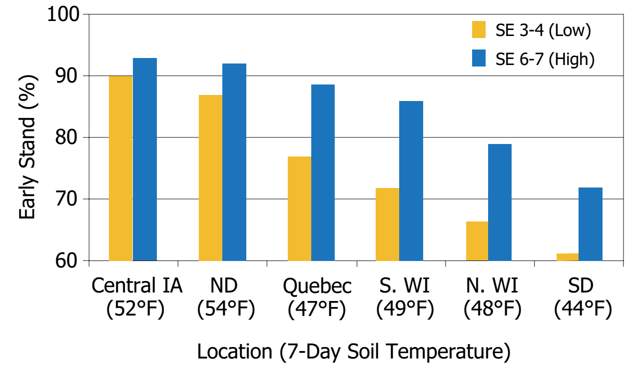


Figure 2. Average stand establishment for high and low SE hybrids in six emergence locations. Locations are sorted from least stressful (left) to most stressful (right) based on average early stand.

Planting early to maximize yield often means planting into a stressful environment, such as cold, wet soils or planting just before a cold spell. These environments can then result in sub-optimal conditions for germination.

Timing of Cold Stress

If corn is planted prior to a cold rain or snow, the seed may sit in cold, saturated soils, which imposes stress emergence and decreases stand establishment.

DuPont Pioneer research has shown that the first 24 hours after planting are critical for successful stand establishment. Cold stress within this period can greatly reduce germination, whereas cold stress that begins more than 24 hours after planting will likely be much less detrimental (Figure 3).

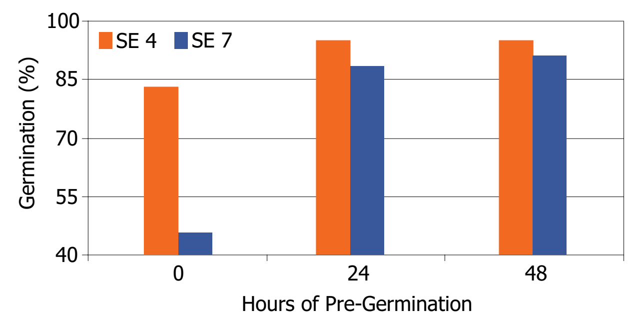
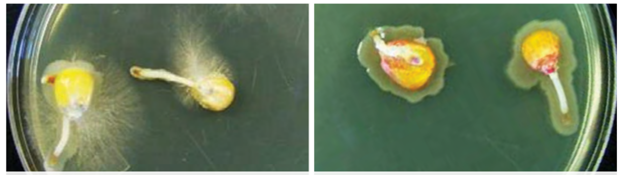


Figure 3. Germination of two hybrids with stress emergence scores of 4 (below average) and 7 (above average) following imbibitional chilling induced by melting ice. Ice was applied immediately after planting (0 hours), 24 hours later or 48 hours after pre-germination in warm conditions.

Stand Establishment

Planting corn early to maximize yield potential often means that germinating and emerging seedlings are exposed to significant stress. Soil temperatures at planting are typically well below the optimal temperature for corn emergence, which is around 85°F. High-residue environments can be particularly stressful; soils are cooler and wetter under corn residue, which slows emergence and increases the vulnerability of seeds and seedlings to diseases and insects. Seed treatments are an important tool to help protect seedlings and promote stand establishment and early vigor for increased yields.



Untreated seeds (left) compared to seeds treated with Poncho® 1250 + VOTiVO® and fungicide (right), which display a protective zone around seeds and developing roots.

Pioneer Premium Seed Treatment (PPST) 250 is standard on all Pioneer® brand corn hybrids. PPST 250 seed treatment includes fungicide, insecticide and biological components. The exclusive biological seed treatment product in PPST 250 contains selected living microorganisms, their exudates and other bio-active compounds. Seed corn treated with the biological seed treatment has shown enhanced performance in early growth and yield.

Results from 52 on-farm strip trials showed that PPST 250 had an average yield advantage of 2.9 bu/acre over seeds treated with only the fungicide (FST) and insecticide (IST) components (Figure 1).

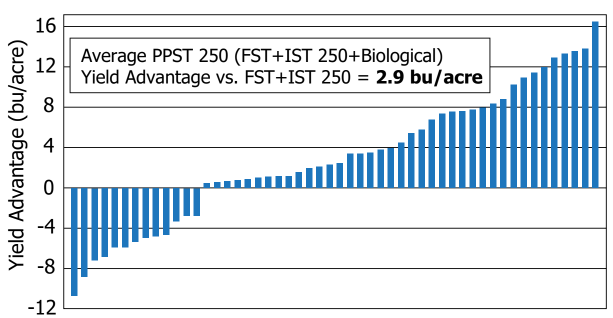


Figure 1. Average PPST 250 (FST+IST 250+Biological) yield advantage vs. FST+IST 250 across 52 on-farm locations.

Corn from seed treated with Poncho 1250 + VOTiVO (left) compared to IST 250 (right) in a field with needle nematodes near Muscatine, Iowa, 2011.

DuPont Pioneer customers can also choose Poncho® 1250 + VOTiVO® seed treatments on selected Pioneer® brand corn hybrids where nematode or enhanced insect protection is needed. According to Bayer, this seed treatment controls over 10 species of nematodes through a biological mode of action that protects corn seedlings and roots.

DuPont Pioneer conducted a three-year study evaluating the performance of Poncho® 1250 + VOTiVO® seed treatment vs. an insecticide seed treatment (IST 250).

When averaged across the three year study, results showed that the Poncho 1250 + VOTiVO treatment yielded 2.6 bu/acre more than the IST 250 check (Figure 2).

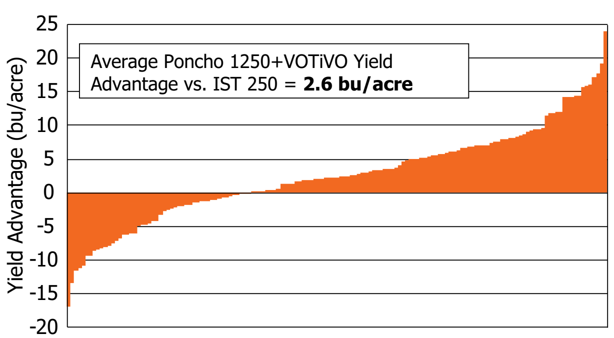


Figure 2. Average Poncho 1250+VOTiVO yield advantage vs. IST 250 across 147 on-farm locations over three years. (Both treatments included a standard FST.)

Row Spacing

Ever since the replacement of horse-drawn machinery allowed corn rows to be less than 40 inches apart, growers and researchers have looked to narrower row spacing as a way to increase corn yields. Today, the vast majority of U.S. corn acres are grown in 30-inch rows with narrow rows being defined as any spacing less than 30 inches.

Plants in narrow rows are more equally spaced within and across rows. Researchers are studying whether more equidistant plant spacing will consistently increase corn yields and if certain growing environments are better suited for narrow rows.

DuPont Pioneer has conducted numerous narrow-row and twin-row studies throughout the Corn Belt to evaluate the effects of narrow rows on corn yields.

The most consistent positive responses were found in Minnesota and the Dakotas where the average yield advantage in narrow rows was 3.9% (Figure 1). Most other states had mixed results. In Iowa and Illinois, the narrow-row advantage averaged 2% across all the locations tested.

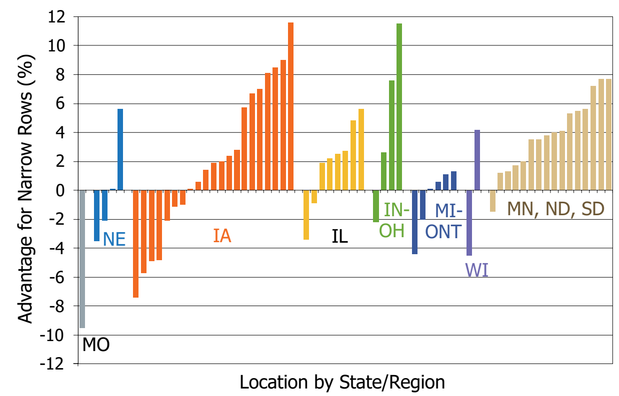


Figure 1. Narrow-row yield responses by state/region. Data from DuPont Pioneer Agronomy Sciences studies in the U.S. and Canada over 15 years.

A two-year DuPont Pioneer/University of Minnesota study also showed a yield advantage with 22-inch rows compared to 30-inch rows in northern Minnesota. Results indicated that narrow rows were advantageous at higher seeding rates. When plant population was increased from 33,000 to 38,500 plants/acre, yield increased by 4% in 22-inch rows (Figure 2).

Figure 2. DuPont Pioneer and University of Minnesota study showing yield responses to 22-inch and 30-inch rows with increased plant populations.

Twin-row planting is another row configuration that has gained interest as a way to increase plant-to-plant spacing and avoid some of the difficulties and costs of switching to narrow rows.

DuPont Pioneer conducted research studies at several Midwest locations, comparing yield in twin and 30-inch rows at plant populations of 36,000, 42,000 and 48,000 plants/acre. These studies did not show a yield advantage for planting twin rows over 30-inch rows at any population (Figure 3).

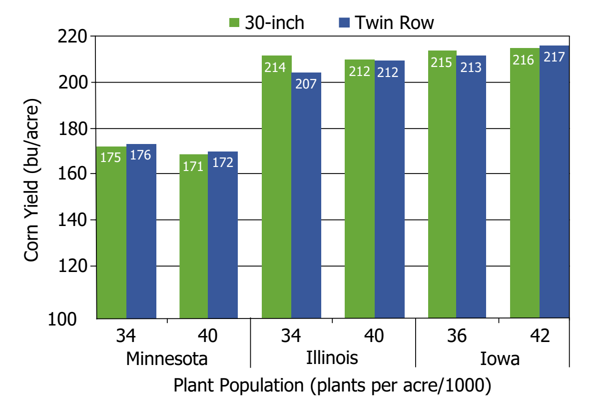


Figure 3. Corn yield in 30-inch rows and twin rows by plant populations included in DuPont Pioneer studies conducted in Minnesota, Illinois and Iowa.

Nitrogen Management

Nitrogen (N) is typically the most yield-limiting nutrient and one of the largest input costs for corn production. DuPont Pioneer is aggressively working to develop hybrids that increase yield through improved nitrogen-use efficiency. Researchers are applying transgenic, molecular and conventional breeding methods to enhance nitrogen utilization within the plant. Additionally, Pioneer continues to conduct extensive research on improved nitrogen application and management.

In multiple Midwest locations over the past eight years, studies have been conducted to compare how cropping sequences and hybrids affect yield under a range of N fertility levels.

Previous research has shown that current hybrids seldom differ in their response to nitrogen. Recent studies confirmed this by showing that products of comparable maturity had similar yield responses over a range of N rates (Figure 1).

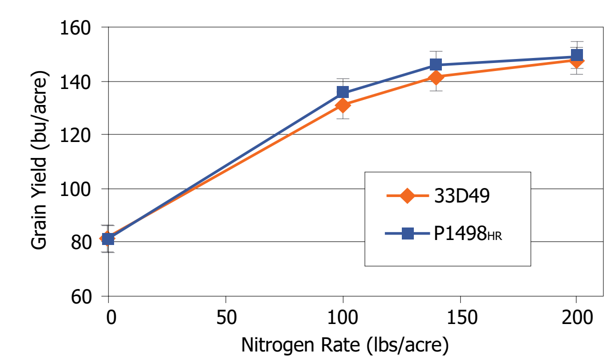


Figure 1. Yield response of 33D49 (HX1, LL, RR2) and P1498HR (HX1, LL, RR2) to N rate in continuous corn during 2012.

Results also showed a 35% yield advantage associated with rotation. The average yield for continuous corn was 135 bu/acre while corn in rotation yielded 183 bu/acre. Reducing N rates resulted in a much more substantial yield decrease in continuous corn than in rotated corn. In fact, rotated corn with no applied N yielded more than continuous corn that was applied with 70% of the optimum N rate (Figure 2).

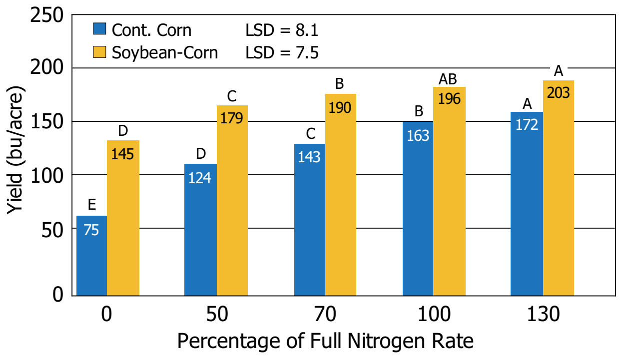


Figure 2. Influence of N rate on yield in continuous corn and corn-soybean rotation, averaged over four years.

One strategy that can help improve the efficiency of N management is utilizing crop canopy sensors. This approach uses indirect assessments of leaf chlorophyll content (leaf greenness) from active canopy sensor reflectance measurements to estimate the N content of plants. Basing N application rates on sensor reading allows N to be applied in the needed places and amounts.

When comparing sensor data, it is important to consider cropping histories, growth stages and/or hybrids, as these can affect sensor readings. Sensor readings between adequately fertilized hybrids have been known to vary widely due to differences in color, canopy architecture and inherent leaf structure.

To better understand and evaluate the role crop canopy sensors may play with N management, DuPont Pioneer has conducted on-farm studies and collaborative research with university scientists. Results have shown the potential for substantial economic benefits and increased N efficiency by utilizing crop sensors to determine the actual N needed compared to traditional N management strategies (Table 1).

Table 1. Two-year study about total N applied, yield, income and partial factor productivity (PFP) for preplant vs. preplant + sensor-based sidedress N programs at eight trial locations.

N Program	Hybrid	Total N[1]	Yield	Income[2]	PFP[3]
		lbs/acre	bu/acre	$/acre	bu/lb N
Preplant	A	233	209	1136	.91
	B	233	212	1153	.93
Sensor Based Split App	A	155	207	1166	1.54
	B	156	209	1179	1.48

[1]Total N = pre-plant or early vegetative sideress N + sensor N
[2]Income = (Yield x $6/bu) – (Total N x $0.50/lb N)
[3]PFP = Yield/Total N

Cropping Sequence

Rotating corn with other crops, particularly soybeans, has long been the overwhelming choice of farmers in the U.S. and Canada. Rotation with soybeans can reduce nitrogen fertilizer requirements, decrease disease and insect pressure, and allow growers to alternate herbicides.

Even when all limiting factors appear to have been adequately supplied in a continuous corn system, numerous studies have documented corn yield reductions when corn follows corn rather than soybeans. In recent years, however, the economic advantages of growing corn have prompted many growers to increase the proportion of corn acres in their operations.

A three-year DuPont Pioneer/University of Illinois study compared continuous corn (CC), corn-soybean (CS) and corn-corn-soybean rotations (CCS) at several locations, representing a range of productivity levels.

Averaged across all sites and years, the yield penalty for CC compared to CS was 17 bu/acre, or about 9%. In contrast, the yield loss for second-year corn in the CCS rotation was only 10 bu/acre, or 5%. The three rotations' yields differed only slightly across environments, despite the wide range of productivity levels characterizing the six experimental locations (Figure 1).

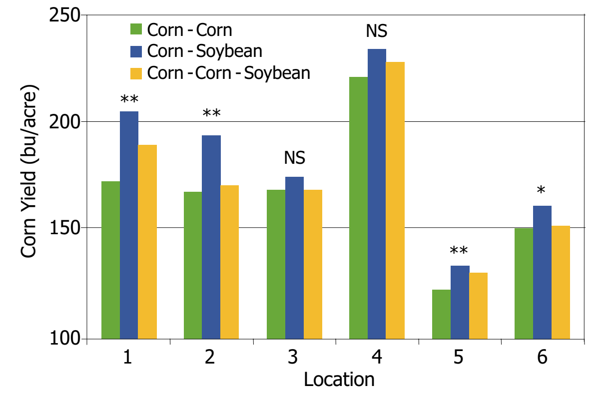


Figure 1. Corn yields obtained at six Illinois locations over a two-year period using three corn and soybean rotations. (*, **, NS = Significant at 10% and 5% level and not significant, respectively.)

Effectively managing corn residue can contribute to successful corn-after-corn production. A corn crop produces more than twice the residue of a soybean crop. Tillage and partial stover harvest are potential management options to reduce excess residue. Effective residue management often improves stand establishment and yield.

Corn-after-corn residue allows pathogens to survive, which causes leaf diseases, stalk rots, ear rots and seedling diseases to increase. This disease pressure may be managed by selecting hybrids with high genetic disease resistance and using foliar fungicides.

Nitrogen (N) has a huge impact in corn-after-corn production. Because N is immobilized by corn residue, avoid surface nitrogen applications. Instead, band N seven to eight inches deep, and consider using a starter fertilizer with N.

In addition, corn-after-corn depletes the soil of phosphorus (P) more quickly and potassium (K) more slowly than corn rotated with soybean. Banding P and K or using starter fertilizers can help manage these macronutrients successfully.

Hybrid selection is an important component of successful corn-on-corn production. Growers should always be sure to select hybrids that have:

- Proven performance under diverse environments and possible stresses.
- Above average drought tolerance. (Root mass may be reduced in corn-on-corn production, which limits water uptake similar to drought conditions).
- Maturities that match corn planting date and seasonal growing degree units. (Cooler soils and slower emergence caused by high levels of corn residue should be taken into account.)

Residue Management

As corn yields have increased, the amount of corn residue remaining after harvest has also increased. Managing the increasing amounts of corn residue, especially for continuous corn cropping systems, has increased the interest in harvesting a portion of corn stover. The developing cellulosic ethanol markets and increasing livestock feed costs have also contributed to this growing interest.

While some residue needs to be retained in the field to protect soil from erosion and sustain soil organic matter, removing excess residue has the potential to benefit the subsequent crop. Benefits may include improved stand establishment and early growth, reduced nitrogen immobilization, and lower disease pressure.

DuPont Pioneer is researching the effects of corn residue removal. One example is a four-year DuPont Pioneer/ University of Missouri study comparing several residue management practices in no-till continuous corn production. Results showed that removing some of the excess corn residue from a high-residue environment can provide a substantial yield advantage (Figure 1).

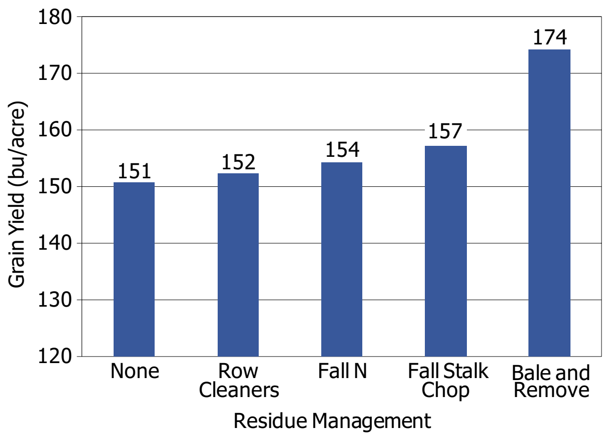


Figure 1. Effects of residue management on yield for no-till continuous corn. Shown are averages of a four-year field study in central Missouri.

Another DuPont Pioneer study showed that a partial stover harvest improved the subsequent corn crop's emergence rate 7 to 10 days after planting at six of eight central Iowa locations (Figure 2).

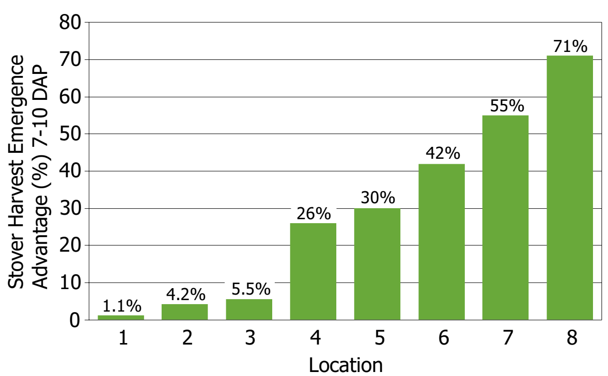


Figure 2. Effect of partial stover harvest on corn emergence 7 to 10 days after planting (DAP).

This study also looked at how partial stover harvest impacted yield on the subsequent crop. At seven of eight locations, corn yield increased (Figure 3). The yield increases were likely due to the improved stand establishment and availability of soil nitrogen during vegetative growth.

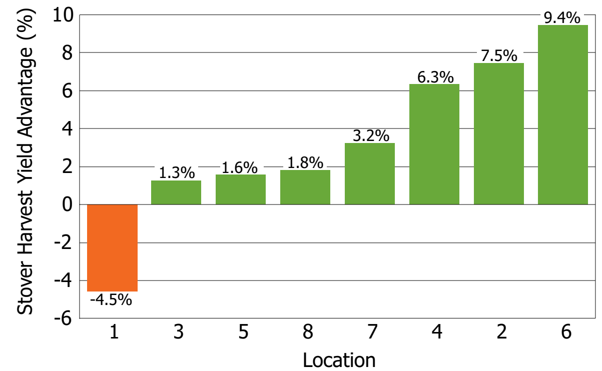


Figure 3. Corn yield response to a partial stover harvest the preceding fall.

Disease Management

Proper disease management is critical to preserving corn yields. If not properly managed, diseases can be a major yield-limiting factor.

The first line of defense for managing corn diseases is genetic resistance. DuPont Pioneer rates its hybrids for resistance relative to known susceptible and resistant hybrids using a 1 to 9 rating system (1 = susceptible, 9 = resistant). These scores are made available to customers to aid in hybrid selection.

Figure 1. Northern corn leaf blight lesions on leaves of two hybrids with differing levels of genetic resistance in Johnston, IA, 2010.

Foliar fungicides are an important management option for fungal diseases. Over the course of five years, DuPont Pioneer researchers conducted 587 on-farm fungicide trials comparing yield of untreated corn to corn treated with a foliar fungicide between tasseling and brown silk. Across these trials, the average yield response to fungicide application was an increase of 6.7 bu/acre (Figure 2).

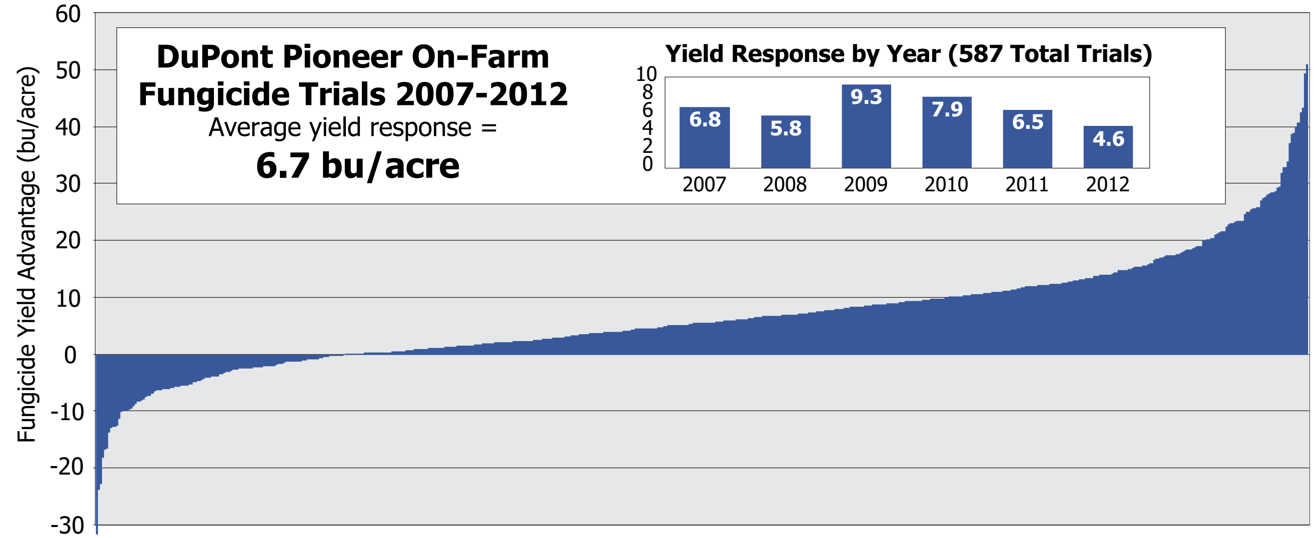


Figure 2. Corn yield response to foliar fungicide application in 587 DuPont Pioneer on-farm trials (2007 to 2011).

One of the most important factors in determining the value of a foliar fungicide application is disease pressure. For example, in a 2009 DuPont Pioneer small-plot research trial, yield response to a fungicide application was impacted by common rust. Across locations where common rust was prevalent, yield averaged 11.4 bu/acre whereas locations where common rust was less prevalent yield averaged 3.9 bu/acre (Figure 3).

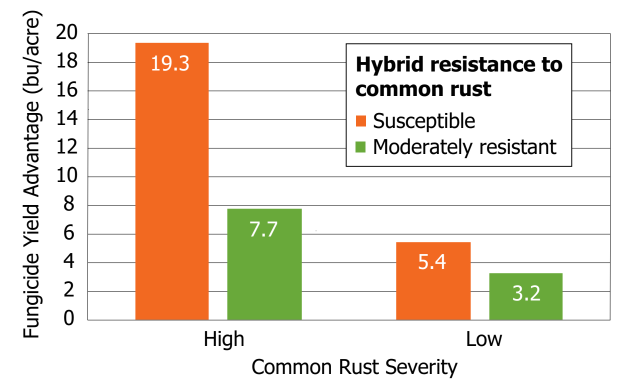


Figure 3. Average fungicide yield response of hybrids with low resistance (3 rating) and moderate resistance (4-6 rating) to common rust in DuPont Pioneer small-plot trials.

Disease pressure is generally lower under drought conditions because common foliar diseases favor moisture and humidity to spread and develop.

When comparing foliar fungicide trials conducted in Iowa and Missouri in 2011 and 2012 (both abnormally dry years) to trials done in prior years, drought conditions were shown to reduce the average yield response to foliar fungicide application (Figure 4).

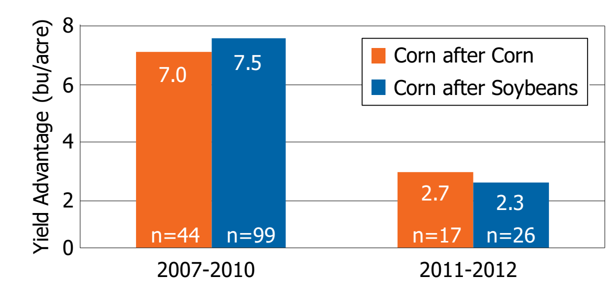


Figure 4. Comparison of average corn yield responses to foliar fungicides in on-farm trials conducted in Iowa and Missouri from 2007-2010 and 2011-2012.

Insect Management

Corn rootworm is an extremely destructive corn pest. Recent university research indicates that for every root node lost to feeding, farmers can expect a 15% yield loss.

DuPont Pioneer researchers have conducted a series of experiments related to enhanced corn rootworm control. Experiments varied from adult population management to novel forms of biological control. Researchers also tested Optimum® AcreMax® 1 Insect Protection (AM1) products (an integrated in-the-bag refuge solution) with and without insecticide. These products consist 90% of a Pioneer® brand corn hybrid with Herculex® XTRA Insect Protection and 10% of a Pioneer® brand corn hybrid with the Herculex® 1 trait only, which serves as the integrated rootworm refuge.

In 2012, on-farm research trials were established to evaluate AM1 products with and without insecticide treatments. Root evaluations were made on all treatments when the average node injury scale (NIS) score was equal to or greater than 0.75 in a check plot with no corn rootworm protection. Eight locations were evaluated for corn rootworm injury.

The AM1 product and combinations of AM1 products and insecticides had less root pruning by rootworm larvae compared to the check (Figure 1).

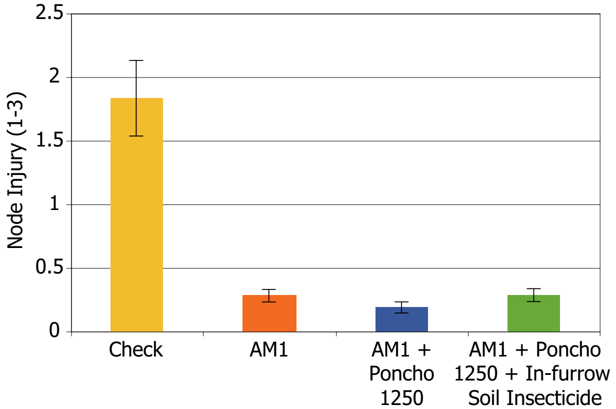


Figure 1. NIS scores for 2012 CRW DuPont Pioneer Agronomy Research Trials. Eight on-farm locations in TX, KS and NE.

Yield benefits associated with AM1 products and AM1 + insecticide combinations in the eight on-farm locations are shown in Figure 2. Yield advantages associated with these treatments ranged from an average of 26 to 29 bu/acre more than the check (Figure 2).

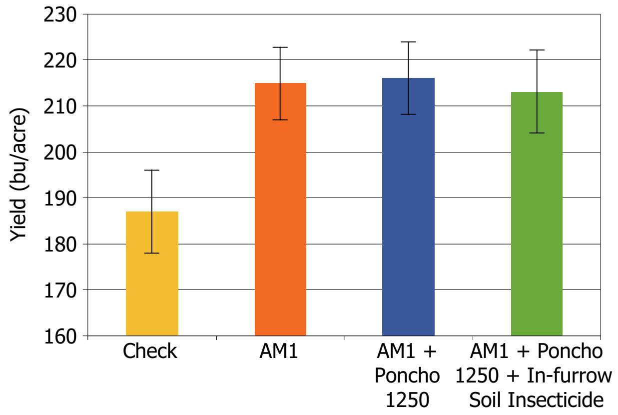


Figure 2. Corn yield for 2012 CRW DuPont Pioneer Agronomy Research Trials. Eight on-farm locations in TX, KS and NE.

DuPont Pioneer research has also focused on above-ground insect management. In 2012, a study evaluated DuPont™ Prevathon® insecticide for control of corn earworm and other insect pests on refuge and Optimum® Intrasect® hybrids.

Results from this study showed that Prevathon improved standability of the refuge hybrid to a level similar to standability of an untreated Optimum Intrasect hybrid (Figure 3).

Figure 3. Refuge hybrid without (left) and with (right) a foliar application of Prevathon in a trial near Wynne, AR, in 2012.

Agronomy Resources, Tools & Apps

Pioneer.com/Pioneer mobile

Growers can access extensive crop management resources at www.pioneer.com or take the resources with them using Pioneer mobile. They allow growers to have agronomy information at their fingertips. Some of the resources available include the following:

Field Troubleshooting Aids

- Videos
- Insects
- Diseases
- Environments

Current Research Trials

- By Locality

Field Tools

- Planting Rate
- Plantability
- GDU/Precipitation
- Growth Stage
- Yield Estimation
- Replant (NEW)

Pioneer® Field360™ Tools

Keep your fields at your fingertips and capture important information with this GPS powered field documentation tool.

- Pinpoints your field location via satellite imagery and records notes or photos on the spot.
- Instantly organize your crop scouting information by location to save or share.

Pioneer® Field360™ Notes

Conveniently packages the agronomy expertise from DuPont Pioneer into one app that provides field-level insights and real-time data.

- Input a location, start date and CRM one time and easily navigate between the enhanced agronomy tools.
- Track multiple field scenarios, view precipitation forecasts /daily precipitation, and calculate GDUs and key crop stages.

Send the results to other members of your operation through email-including screenshots of graphs, estimated growth stage and links to pioneer.com.

Pioneer® Field360™ Plantability

This planter settings calculator gives you precise planter settings for corn and sunflower seeds of all sizes and shapes.

- Select planter type and scan /type in a seed batch ID directly from Pioneer® seed packaging to view specific planter setting recommendations.
- See suggested plate or disc size, pressure or vacuum setting speed, and the singular setting, as well as the predicted seed drop for each batch and planter combination.

Pioneer Planting Rate Estimator

Allows user to examine historical yield response curves to help estimate an optimum planting rate for Pioneer® Brand Corn Products.

Product performance in water-limited environments is variable and depends on many factors such as the severity and timing of moisture deficiency, heat stress, soil type, management practices and environmental stress as well as disease and pest pressures. All hybrids may exhibit reduced yield under water and heat stress. Individual results may vary.

AM1 - Contains the Optimum® AcreMax® 1 Insect Protection System with an integrated corn rootworm refuge solution includes HXX, LL, RR2. Optimum AcreMax 1 products contain the LibertyLink® gene and can be sprayed with Liberty® herbicide. The required corn borer refuge can be planted up to half a mile away.

YGCB, HX1, LL, RR2 - Optimum® Intrasect® contains the Herculex® I gene and the YieldGard® Corn Borer gene for resistance to corn borer.

HX1 - Contains the Herculex® 1 Insect Protection gene which provides protection against European corn borer, southwestern corn borer, black cutworm, fall armyworm, western bean cutworm, lesser corn stalk borer, southern corn stalk borer, and sugarcane borer; and suppresses corn earworm.

HXX - Herculex® XTRA contains the Herculex 1 and Herculex RW genes.

Herculex® Insect Protection technology by Dow AgroSciences and Pioneer Hi-Bred. Herculex® and the HX logo are registered trademarks of Dow AgroSciences LLC.

YGCB – The YieldGard® Corn Borer gene offers a high level of resistance to European corn borer, southwestern corn borer and southern cornstalk borer; moderate resistance to corn earworm and common stalk borer; and above average resistance to fall armyworm.

LL - Contains the LibertyLink® gene for resistance to Liberty® herbicide. Liberty®, LibertyLink® and the Water Droplet Design are trademarks of Bayer.

Seed corn treated with Poncho® 1250 Insecticide. Poncho® and VOTiVO® are registered trademarks of Bayer.

RR2 – Contains the Roudup Ready® Corn 2 gene that provides crop safety for over-the-top applications of labeled glyphosate herbicides when applied according to label directions. Roundup Ready® is a registered trademark used under license from Monsanto Company.

All products are trademarks of their manufacturers.

The DuPont Oval Logo, DuPont™, and Prevathon® are a registered trademarks of DuPont.