



2001 Research Trials Report

February 2002

Research Overview

Landec Ag, a division of Landec Corporation, conducted the 2001 Intellicoat® Early Plant™ Corn testing program to demonstrate that its Intellicoat Early Plant polymer coating could protect hybrid seed corn that was planted two to four weeks earlier than normal planting dates, and achieve better stand counts and yields than uncoated seeds that were also planted early. The trials also included comparisons with uncoated seeds that were planted during normal planting dates. The program included numerous farmer field trials in varied environments, as well as replicated research trials by universities and other trial cooperators who followed standardized protocols.

The research showed that the Intellicoat coated seeds met expectations with higher stands than the uncoated seeds planted early. Intellicoat seed coatings provided higher plant populations and more uniform emergence, and achieved higher yields when compared to uncoated seeds planted earlier than normal planting dates. The coated seeds planted early also provided slightly higher yields than uncoated seeds planted during normal planting dates.

Background of Intellicoat Technology

Landec Ag has developed three Intellicoat coating applications currently in commercial use—



- Early Plant Corn, which allow farmers to plant coated hybrid seed corn up to four weeks prior to their normal planting date;
- Pollinator Plus™ male inbred delay coatings for seed production is used commercially in seed production by more than 30 of the nation's top seed companies; and
- Relay™ Intercropping system, which involves interplanting Intellicoat coated soybeans between rows of wheat prior to jointing, allowing for successful double-cropping in areas considered too far north for the practice. Landec Ag marks its third year of commercial testing of the system in 2002.

Corn farmers have long recognized the importance of timely planting in establishing a uniform stand and achieving maximum yield potential. Landec Ag has developed Intellicoat Early Plant, a new seed-coating technology that can expand the planting window of corn two to four weeks ahead of normal planting dates with minimal risk of chilling injury to the seed. This technology enables corn farmers to achieve improved stand counts with more uniform emergence, even under harsh, early conditions. In addition, it also helps farmers spread their workload for better labor efficiency during the peak planting season.

Intellicoat Early Plant technology works by effectively controlling seed germination in cold, early spring soils. The coating protects the seed as long as the soil temperatures are low by restricting the amount of water entering the seed. Once the soil temperature warms, the coating undergoes a physical change, allowing water to permeate into the seed, promoting good germination.

EPH 2001 Research Program

In the spring of 2001, Landec Ag conducted farmer trials and replicated research trials to test its Intellicoat Early Plant Corn seed coatings. Farmer trials involved 152 farmers in 21 states on about 3,000 acres. Replicated research trials took place in nine locations across the Corn Belt states of Indiana, Minnesota, Missouri, Ohio and South Dakota (Figure 1). The trial participants planted one or more of six Fielder's Choice seed corn hybrids of different maturities and characteristics matched to their specific geography. The hybrids differed in their ratings for cold vigor and emergence.

Objectives of the 2001 EPH Trials

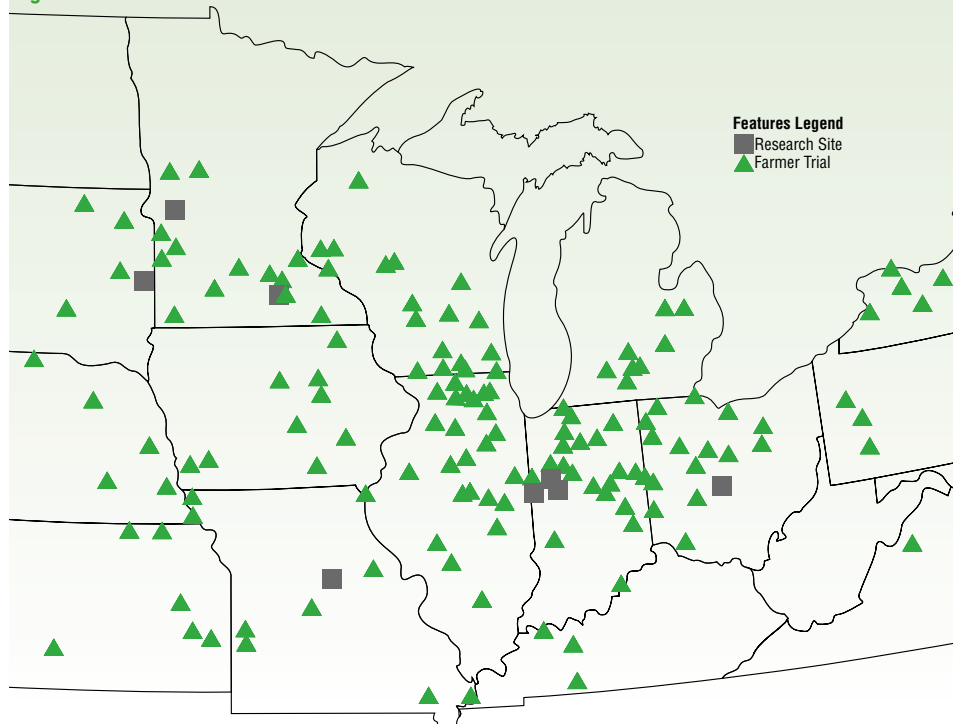
Farmer Trials

- To test the performance of Intellicoat coated seeds in real life situations in varied geographies and environmental conditions so that the benefits of the coating can be quantified.

Research Trials

- To test the performance of Intellicoat coated seeds in replicated trials on several planting dates to study the effect of coating on emergence and yield.
- To understand the effects of cold stress on emergence percentage and uniformity of emergence.

Figure 1 Farmer and Research Trials Locations



Farmer Trials Research Results

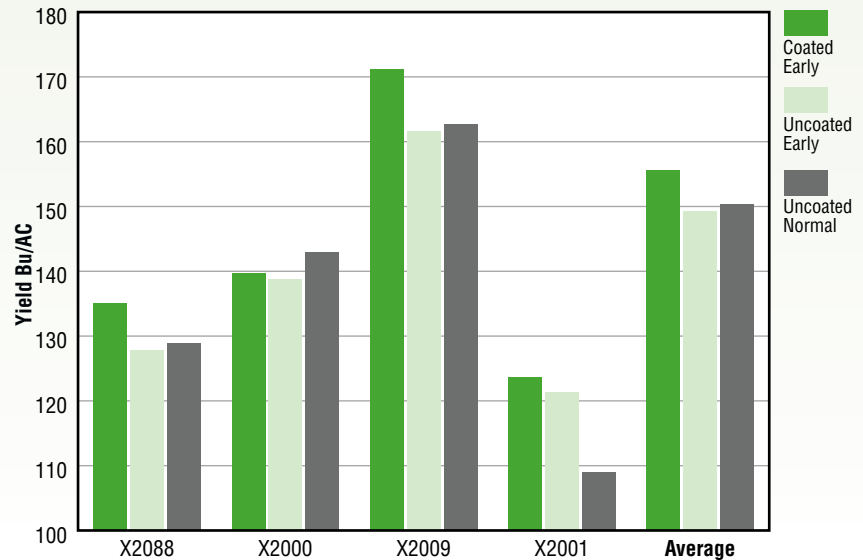
Farmers planted as early as the field conditions allowed them to plant. Early planting of coated and uncoated seeds in the farmer trials ranged from March 25 to April 25. Most farmers also planted the same variety of uncoated seed at their normal planting time as a control for comparison.

Trial data from farmers were collected and analyzed statistically. The data were divided into three groups to make the comparisons meaningful. They are illustrated in the following graphs.

- Thirty-three locations reported yield data comparisons for coated seeds planted early, uncoated planted early and uncoated planted during normal planting schedules (*Figure 2*).
- Sixty-eight locations reported two sets of yield data—coated seeds and uncoated seeds, both planted early (*Figure 3*).
- Fifty-six locations reported yield data for coated seeds planted early and uncoated seeds planted during normal planting dates (*Figure 4*).

The data shown in *Figure 2* illustrate the yield data for 33 cooperators who reported data from all three plantings. The average yield from coated seeds planted early was more than 6 Bu/acre greater than the average yield of the uncoated seeds planted early and more than 5 Bu/acre greater than the average yield of the uncoated seeds planted during normal planting dates. The coated seeds also gave higher yields for four hybrid varieties in comparison to

Figure 2 Comparison of yields in 33 farm locations of Early Plant Hybrid coated seeds planted early, uncoated seeds planted early and uncoated seeds planted during normal planting dates.



Hybrid X2007 is not included in Figure 2 because farmers reported minimal yield data with all three comparisons.

Figure 3 Comparison of yields in 68 farm locations of Early Plant Hybrid coated seeds and uncoated seeds, both planted early.

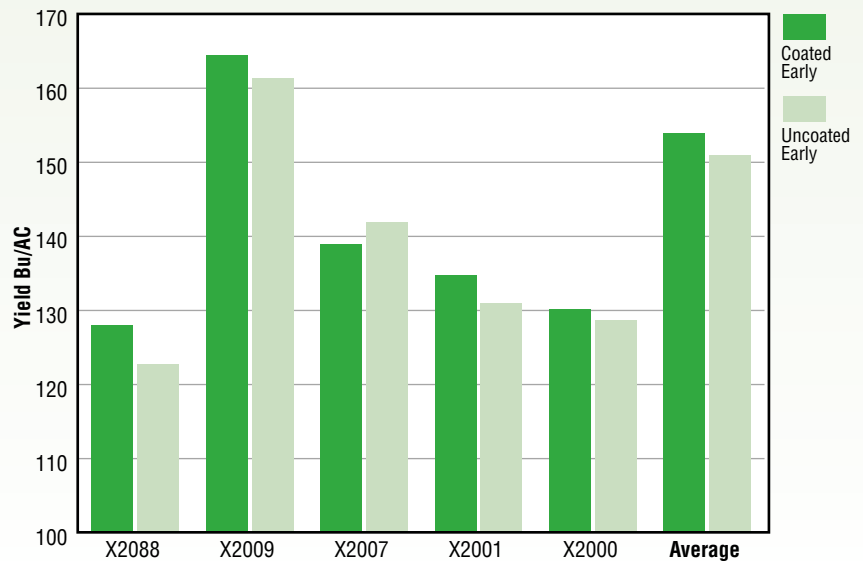
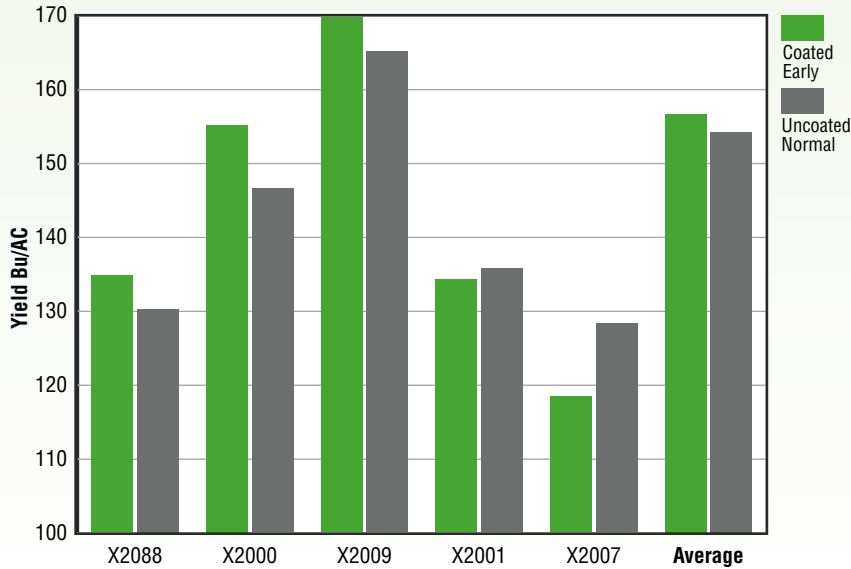


Figure 4 Comparison of yields in 56 farm locations of Early Plant Hybrid coated seeds planted early and uncoated seeds planted during normal planting dates.



yields of uncoated seeds planted early, and higher yields on three of the four hybrid varieties in comparison to uncoated seeds planted during normal planting dates. The coated seeds provided higher yields when planted early compared to both uncoated seeds planted early and uncoated seeds planted at the normal time.

The data shown in *Figure 3* illustrate the yield data for 68 locations that reported data on Intellicoat® Early Plant™ coated seeds versus uncoated seeds. The coated seeds had a 2.6 Bu/acre advantage over the uncoated seeds. Of the 68 locations, 73 percent reported yields equal to or greater than the uncoated seeds.

The data shown in *Figure 4* illustrate that, in the 56 locations where Intellicoat Early Plant coated seeds were planted early compared to uncoated seeds planted during

normal planting dates, the average yield from coated seeds was 2.5 Bu/acre greater than the yield of uncoated seeds. Of the 56 locations, 64 percent had coated seed yields equal to or greater than the yields of uncoated seeds planted during normal planting dates.

Farmer Trials Results Summary

Most of the cooperators reported high stand counts with good stand uniformity. They rated the handling and plantability of the Intellicoat coated seeds as good. When farmers planted the coated seeds into warm soils during normal planting dates, the coated seeds emerged within a few days of the uncoated seeds. This confirmed that the temperature switch property of the Intellicoat polymer worked as designed.

Research Trials

University and contract researchers at nine locations conducted research trials across five major Corn Belt states. They conformed to standard protocols that required frequent observations during emergence. The data from these trials were used to determine emergence profiles that compared the emergence percentage and yield of coated seeds to uncoated seeds across locations.

Emergence Research Data

The following graphs illustrate representative emergence profiles of coated and uncoated seeds at different planting dates. *Figures 5 and 6* show a typical response of the coating in preventing chilling injury to the seed before emergence. Note that seed vigor affects the emergence of the uncoated seeds (difference in the uncoated control in *Figures 5 and 6*). The bar chart in *Figure 7* illustrates the differences in emergence of six hybrid varieties—both coated and uncoated.

The data in *Figure 5* illustrate a representative emergence profile of an Intellicoat® Early Plant™ coated seed with high seedling vigor. A cold spell from April 13 to 16 stressed the seeds and affected the emergence of the uncoated seed. The coated seed, however, provided a higher, more uniform stand.

The data shown in *Figure 6* illustrate the effect the Intellicoat Early Plant technology has on seeds with low seedling vigor. Low vigor of the seed variety and a harsh early planting environment contributed to very low germination of the uncoated seed. The coated seed, however, was protected, and resulted in a higher stand count.

Figure 5 Emergence profile of X2000. Planted April 4, 2001, in West Lebanon, Indiana.

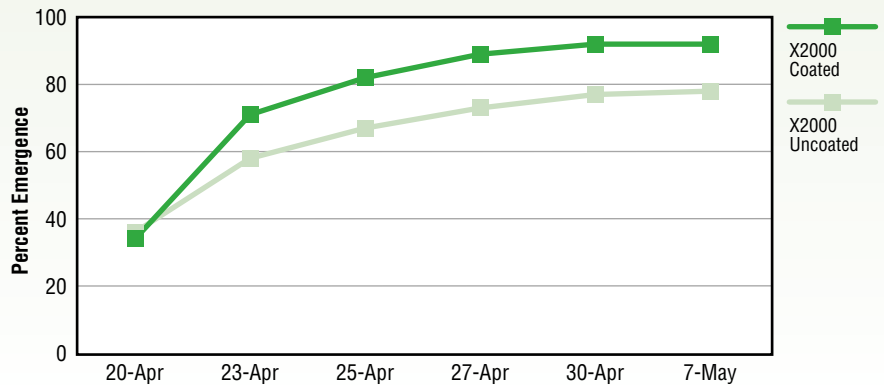


Figure 6 Emergence profile of a low vigor seed. Planted April 4, 2001, in West Lebanon, Indiana.

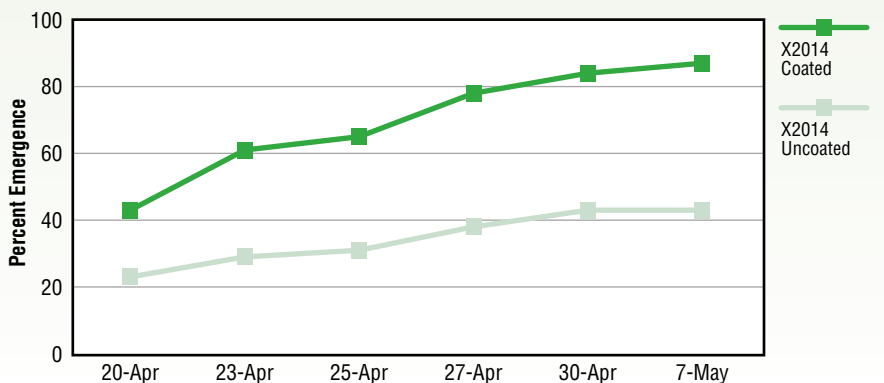
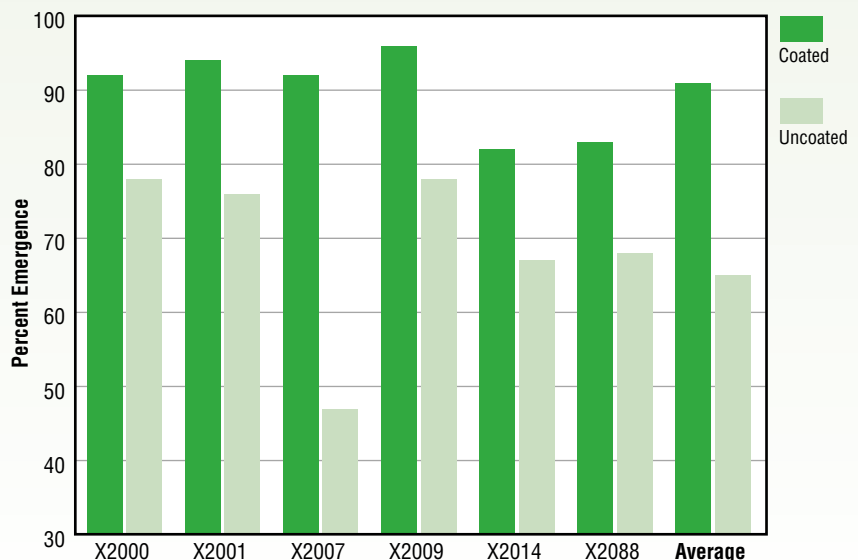


Figure 7 Comparison of emergence of coated seeds and uncoated seeds across six hybrid varieties. Planted April 4, 2001, in West Lebanon, Indiana.



The data shown in *Figure 7* illustrate that, even though significant varietal differences in seedling vigor existed among the hybrids tested, all of the coated hybrids produced high stands in an early-plant environment. In comparison, the uncoated seeds produced weaker stands overall and uncoated low-vigor hybrids produced significantly lower stands in comparison to coated seeds.

Yield Research Data

The data shown in *Figure 8* illustrate the yield comparisons by state from university and contract research plots. Indiana and Minnesota have data for two separate early planting periods to illustrate the coating's performance under different planting times. Average yields reported for the coated seeds in these trials were higher than yields for the uncoated seeds.

Research Trials Results Summary

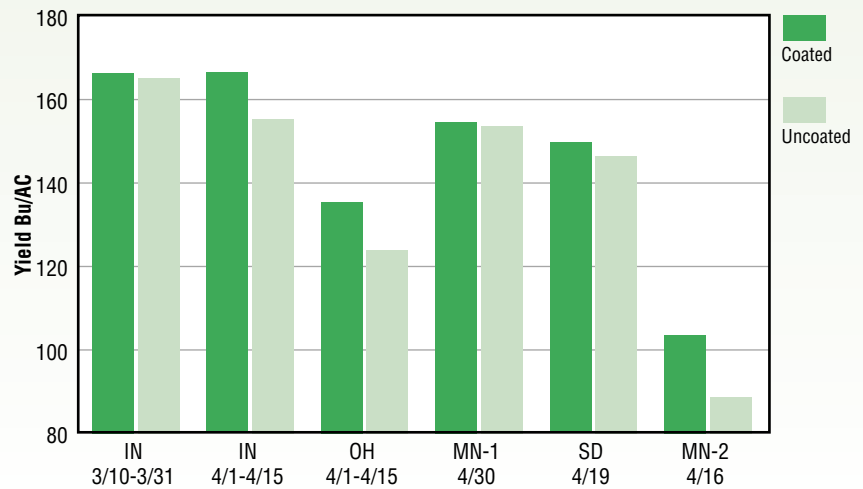
When the seeds were subjected to cold stress in the soil, coated seeds produced significantly higher stands and yields.

The performance of the coated seeds met expectations in these trials, with no differences between the coated and the uncoated seeds when soil conditions were ideal.

On average, coated seeds had higher yields than uncoated seeds on all planting dates.

The stand counts of all the hybrid varieties used in the trials were significantly higher for the coated seeds than the uncoated seeds. All other stand counts were statistically the same across the three locations.

Figure 8 Yield comparison by state and planting date



Conclusion

Landec Ag

conducted the 2001 Intellicoat Early Plant trials program to field-test the performance of its Intellicoat Early Plant seed-coating technology on hybrid seed corn at early and normal planting dates and under varied environmental conditions. The program involved numerous farmer field trials and university and contract research trials that replicated field conditions and followed standardized protocols.

During planting in early April, trial participants experienced unseasonably warm weather, with some areas within the Corn Belt states reaching 80°F. Later in the month, rains were followed by snow and cold temperatures.

The combined data reported by farmers and researchers demonstrated that Intellicoat Early Plant coated seeds planted earlier than normal planting dates performed with 4 percent higher stand than the uncoated seeds that were also planted early. Coated seeds planted early provided higher plant populations and more uniform emergence and achieved better yields in comparison to uncoated seeds planted early. The early-planted, Intellicoat coated seeds also provided slightly higher yields than uncoated seeds that were planted during normal planting dates. The trials confirmed that the Intellicoat polymer's temperature switch property is effective under varied environmental conditions.

The Intellicoat Early Plant technology enables corn farmers to achieve improved stand counts with more uniform emergence, even under harsh, early conditions, with acceptable seed handling and plantability. It also helps farmers distribute their workload for better labor efficiency and achieve maximum yield potential.

Landec Ag will expand its Intellicoat Early Plant testing program in the spring of 2002 to include approximately 500 farmers on approximately 18,000 acres. Also in 2002, eight seed companies will test Intellicoat Early Plant seed corn in research plots and commercial trials.





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