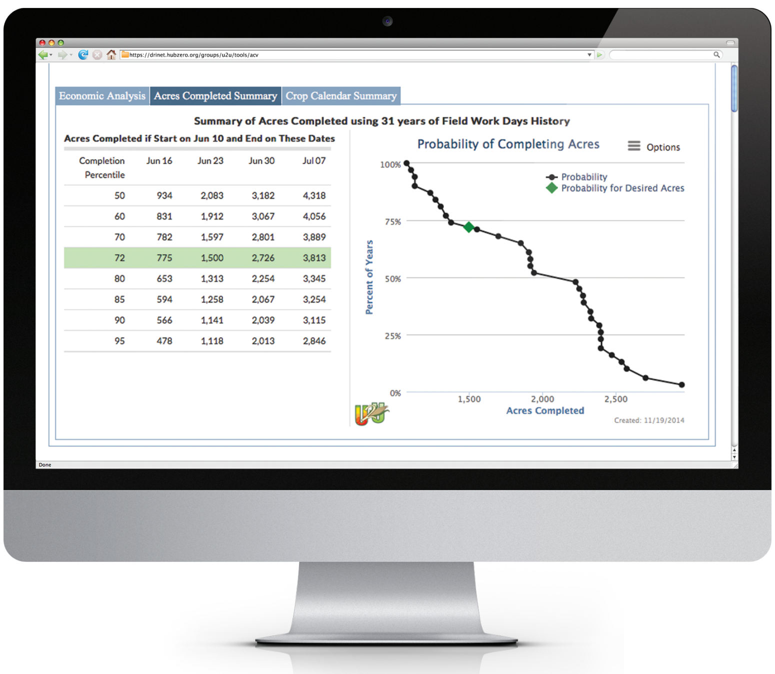
Corn Split N DST

Determine the feasibility and profitability of using post-planting nitrogen application for corn production.



SplitN.AgClimate4U.org

This product is designed to help farmers and farm advisors understand the risks and benefits of using post-planting nitrogen (N) application for corn production. The Corn Split N tool combines historical weather and fieldwork data with economic considerations to determine the feasibility and profitability of completing a second (split) N application within a user-specified time period.

This tool may help you with decisions that:

- **Increase corn yields**
- **Reduce nitrogen costs**
- **Reduce nitrogen losses to the environment**
- **Affect the likelihood of completing fieldwork tasks**

With the Corn Split N tool you can quantify the costs and benefits of post-planting nitrogen applications for your farming operation to help your bottom line and the environment.

Purdue University • Iowa State University • University of Illinois • University of Missouri • University of Wisconsin
University of Michigan • Michigan State University • South Dakota State University • University of Nebraska-Lincoln

Why Split Apply Nitrogen?

Farmers traditionally apply nitrogen to the soil in a single pass during either the fall or in the spring before planting. However, early nitrogen application can result in significant losses due to weather factors (e.g. warm, moist soils). Research has shown that a split application of nitrogen – one application in the fall or around the time of planting and a second application after planting when there is the greatest demand for N from the crop – can reduce total nitrogen use (savings to the farmer) and/or reduce nitrogen loss to the environment (savings to society).

There are some risks involved with a split nitrogen application strategy. Greater costs are incurred because two passes through the field are required. Additionally, the second application (if conducted using ground application equipment) may be hindered due to weather conditions. If soils are too wet during the time when a second application of nitrogen is needed, insufficient nitrogen may result in lower yields. **With the Corn Split N tool farmers now have a way of quantifying the costs and benefits of post-planting nitrogen applications.**

Split Nitrogen Timing and Application Methods

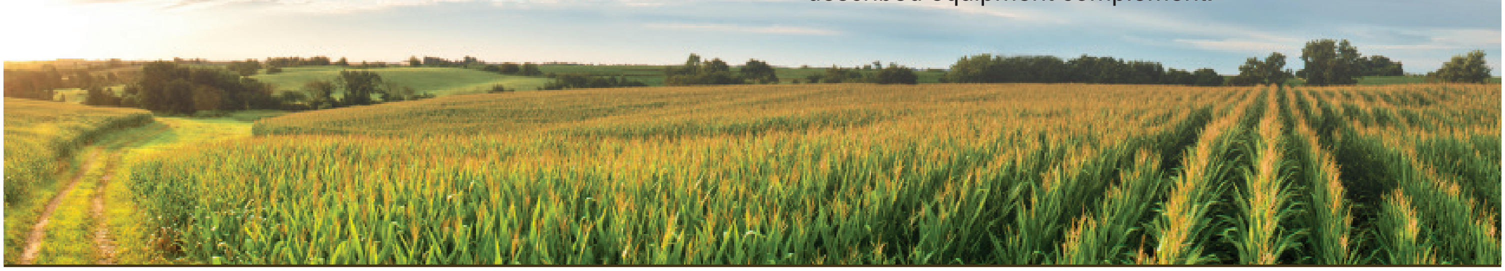
University recommendations suggest applying N by V6 if you do not use a starter N. If starter N is used, the post-planting application is determined by height of the corn plant and equipment used. For typical surface application equipment, application by V8 is recommended. Some surface application equipment may be able to apply N until V10. Split nitrogen application can also be conducted using aerial application. The Corn Split N tool is intended for use with surface application equipment.

Nitrogen management of corn includes many factors, one of which is the timing of application. Recommended application times vary depending on the climate and soil conditions of your location. This tool is designed to assist farmers with planned sidedressing of nitrogen.

Planned split N applications are different than rescue N applications. Rescue N is for the purpose of remedying a known problem of insufficient N in growing plants. It may occur early enough for surface application of N or so late that aerial application is the only option. Planned split N applications are done with the intention of supplying sufficient N without waiting for the crop to express a need. By that time it may be losing yield.

The Corn Split N tool helps farmers investigate the implications of planning a post-planting sidedressing of N. Research indicates that split N applications have several potential benefits. First, the total amount of N needed for optimal yield may be lessened. Fertilizer savings are most likely to be experienced where the risk of N loss is high. Second, increased yield may occur. Research results differ on whether or not yields can be increased. In some years, split N applications increase yields and in others it does not.

If a farmer plans to apply nitrogen post-planting and is unable to accomplish this due to weather or equipment problems, there is a good chance that yields will suffer. This tool estimates how often that will occur given your described equipment complement.



Assumptions and Data Sources

The Corn Split N tool combines historical weather data, historical fieldwork data (observed and simulated), and economics to determine the riskiness associated with post-planting nitrogen applications for your location.

Corn Growth Estimates

Corn height is an important factor in determining the probability of successful post-planting nitrogen application since your equipment must be able to travel through growing corn without damaging it. The Corn Split N tool provides estimates of corn development stages based on your location, your selected planting date, and the accumulated corn growing degree days (GDD) for the year.

This tool uses daily gridded* growing degree days (GDD), calculated using the 86/50 method, as a proxy for corn height. GDD are based on data from the Applied Climate Information System (ACIS). The relationship between accumulated GDD and plant growth comes from recommendations found in ISU publication PMR 1009 entitled “Corn Growth and Development.” Corn emergence in the Corn Split N tool is assumed to occur at 105 GDD post planting.

GDD accumulations and associated corn growth beyond the current day are estimated based on the 30-year (1981-2010) average GDD accumulation for your location.

Historical Field Work Data

The Corn Split N tool uses historical observations (1981-last year) and model simulations of days suitable for field work (FWD) to estimate the probability of being able to fertilize corn during the user-defined application period. FWD are simply the estimated number of days per week that are suitable for conducting in-field activities.

Observed FWD data are reported weekly by the USDA National Agriculture Statistics Service (NASS) throughout the growing season (roughly Mar/Apr - Oct/Nov) for each Crop Reporting District (CRD) in the following Corn Belt states: IA, IL, IN, KS, MO.

In Michigan, Minnesota, Nebraska, North Dakota, Ohio, South Dakota and Wisconsin the FWD data reported by NASS are only available at the state-wide level (i.e. one weekly value represents conditions for the entire state). The Split N tool requires more localized FWD data. Therefore, the weekly FWD values for these seven states within the Split N tool are estimated weekly values, not historical observations. The estimates are derived from the statistical relationship between historic weather data and the area-weighted soil drainage class for each CRD in the states where weekly FWD data are available. The empirical equation used to generate these estimates is available at https://mygeohub.org/groups/u2u/aboutsplitn#Data.

*Gridded data are derived from nearby weather observation stations, which allows data to be available for the entire region at about a 2.5 mile resolution.

Assumptions and Data Sources cont.

Yield Penalties and Benefits

Corn plants require adequate nitrogen for optimal growth. In the event that plant-available nitrogen is limited, there could be an associated yield reduction. Conversely, a "rescue" application of nitrogen could result in a yield increase. The Corn Split N tool allows you to customize yield (bu/acre) penalties and benefits to account for these situations since they will vary by location and time of year.

The default values used for Yield Benefit and Reduced N are based on data reported in the literature. They do not take into account the range of values that could be used. You are encouraged to seek information from university extension or crop consultants on what values should be used for your particular soil and climatic conditions.

A variety of factors contribute to yield penalties associated with inadequate nitrogen availability, and nitrogen rate trials and data availability varies by location. The Corn Split N tool uses a number of data sources, including Extension publications and direct consultation with local Extension specialists, to provide the best available default yield penalty information.

Yield penalties for Illinois, Indiana, Iowa, Michigan, Minnesota, Ohio, and Wisconsin are based on the "Percent of Maximum Yield" information contained in the online Corn N Rate Calculator (http://extension.agron.iastate.edu/soilfertility/nrate.aspx) that was jointly developed by agronomy and fertility extension specialists from across the Corn Belt region (J. Camberato, S. Culman, D. Kaiser, C. Laboski, E. Nafziger, J. Sawyer and K. Steiner. Corn Nitrogen Rate Calculator, 2013)

Kansas, Missouri, Nebraska, North Dakota and South Dakota are not included in the Corn N Rate Calculator. Expert recommendations from local Extension specialists were used to develop default yield penalties for these locations. Full details are available online in the About Split N page (https://mygeohub.org/groups/u2u/aboutsplitn).

Nitrogen Price, Corn Price, and Sidedress Cost Inputs

Corn and nitrogen prices and sidedressing costs will have a direct impact on the profitability of split nitrogen applications. Default values for price and cost are provided in the Corn Split N tool, but these should be adjusted based on local conditions. Any change in corn yield is best priced using your local market price. Reduction in fertilizer use would need to take into account both the type of fertilizer used and the local price of that fertilizer. The default values in this tool were appropriate for a particular time and assumed a particular type of N fertilizer. Corn Split N users are encouraged to adjust this information to make it realistic of their situation.

For simplicity, we have assumed that the cost of sidedressing N is a custom rate, or a flat rate per acre. This is appropriate since most sidedressing will be done by a custom operator such as your input supplier. The default value is appropriate for illustrative purposes, but the user is encouraged to call potential sidedress application businesses to discern their price and availability for applying post-planting N on your fields.

Corn Split N Scenario

Reducing Nitrogen Loss

Some farmers use post-planting nitrogen applications to reduce nitrogen fertilizer loss. Nitrogen loss via leaching is problematic on well-drained, sandy soils, whereas poorly drained soils tend to lose nitrogen via the process of denitrification during times of soil saturation.

The Corn Split N tool can help farmers analyze the feasibility and economic outcome of reducing nitrogen loss via post-planting applications. The concept is that less total fertilizer would be applied to the corn crop because less is expected to be lost. There is no expectation that yield would be increased over supplying all of the fertilizer prior to planting – only that the quantity of fertilizer loss is reduced; and, therefore, the total quantity of fertilizer purchased is reduced. Typically, to accomplish this objective, a reduced rate or starter fertilizer rate of nitrogen would be applied in the fall or around the time of planting. A post-planting application would later be applied to the growing crop to supply all its needs. The risk of this management approach is that yields could suffer if poor weather conditions prohibit post-planting nitrogen application.

Example Situation:

You're a farmer in Story County, IA, who planted 1500 acres of corn beginning May 1. You're planning to apply additional nitrogen between June 4 (when you expect all planting will be completed) and June 22 (before reaching V8). You estimate that 30 fewer pounds of nitrogen fertilizer would be applied using a split application approach than if all had been applied prior to planting. You put down an initial 50 lbs of nitrogen last fall. However, if the fertilizer is not applied by June 22, your crop consultant said to expect a 27 lb/acre yield loss on those acres not receiving the post-planting application of nitrogen.

The Economic Analysis indicates that post-planting nitrogen application would be possible on all 1500 acres in 30 of the last 34 years, or 88% of the time. The net benefit of this approach, after accounting for additional costs of the second nitrogen application and savings from your reduced nitrogen use, would result in a **net savings of $2,000 each year**.

In the worst year of the last 34 years, only 920 of the 1500 acres planted to corn received post-planting nitrogen. In this case, the money saved from unused nitrogen was outweighed by yield losses on the 580 unfertilized acres. The net economic result is that, in this one year, you would lose $59,000.

The Breakeven calculation indicates that in 30 of the last 34 years, or 88% of the time, post-planting nitrogen application would have provided economic returns at least equal to the economic costs. As long more than 1479 of the 1500 acres received the post-planting application of nitrogen, the benefit would exceed the cost.

The worst case scenario gives an upper bound on the number of acres a farmer desiring to test split N applications should commit to this management style. If a farmer is confident that the machinery will be available during the necessary time, they can conduct a relatively risk free trial of split N fertilization on the worst case scenario number of acres (920 acres in this example).

Corn Split N Scenario

Saving Nitrogen and Increasing Yield on Sandy Soils

Retaining nitrogen in sandy soils is often problematic. Nitrogen loss is so common that in some years, yield suffers because more nitrogen was lost prior to planting than was anticipated. Thus, there is great potential for increasing yields and reducing overall nitrogen use on sandy soils by adopting post-planting nitrogen application.

Typically, to realize both reduced nitrogen application and increased yield, a reduced rate of nitrogen would be applied in the fall or around the time of planting. A post-planting application would later be applied to the growing crop to supply all of its needs. The risk of this management approach is that yields could suffer if poor weather conditions prohibit post-planting nitrogen application.

Example Situation:

You're a farmer in Marshall County, KS, who started planted 1500 acres of corn beginning April 30. You're planning to apply additional nitrogen between May 29 and June 13 (before reaching V8). You estimate that 40 fewer pounds of nitrogen fertilizer would be applied using a split application approach than if all had been applied prior to planting, and a yield benefit of 5 bu/acre is anticipated. You did not apply any nitrogen to your fields last fall or before spring planting, and your crop consultant said if fertilizer is not applied by June 13 you can expect a 52 bu/acre yield loss on those acres not receiving the post-planting nitrogen application.

The Economic Analysis indicates that post-planting nitrogen application would be possible on all 1500 acres in at least 27 of the last 36 years. The net benefit of this approach, after accounting for additional costs of the second nitrogen application, yield gains, and savings from your reduced nitrogen use, would result in a **net savings of $44,000 each year**.

In the worst year of the last 36 years, only 262 of the 1500 acres planted to corn received post-planting nitrogen. In this case, the yield losses on the 1238 unfertilized acres outweighed the yield gains and nitrogen savings. The net economic result is that, in this one year, you would lose $255,000.

The Breakeven calculation indicates that in 30 of the last 36, or 83% of the time, post-planting nitrogen application would have provided economic returns at least equal to the economic costs. As long more than 1317 of the 1500 acres received the post-planting application of nitrogen, the benefit would exceed the cost.

User Guide

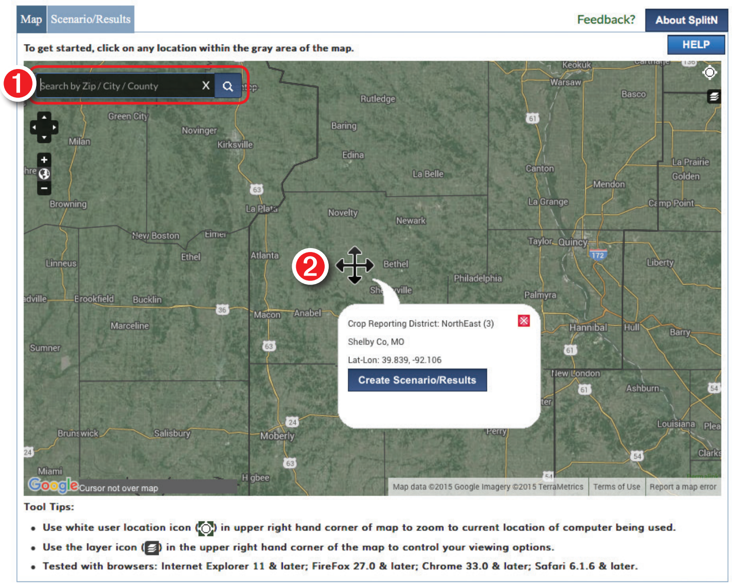
Follow these simple instructions to get started with the Corn Split N tool. Click the blue (?) button on any page for step-by-step instructions on using the tool. For additional background information on this product, click on the blue **About SplitN** button on the upper corner of the tool.

Location Selection Overview

To start, select your location of interest. This can be done in several ways:

1. Type in a ZIP code, city name, or county name into the search bar and the map will zoom to the center of that location.
2. Zoom in and manually drag the map to your area of interest, and then click on the map.

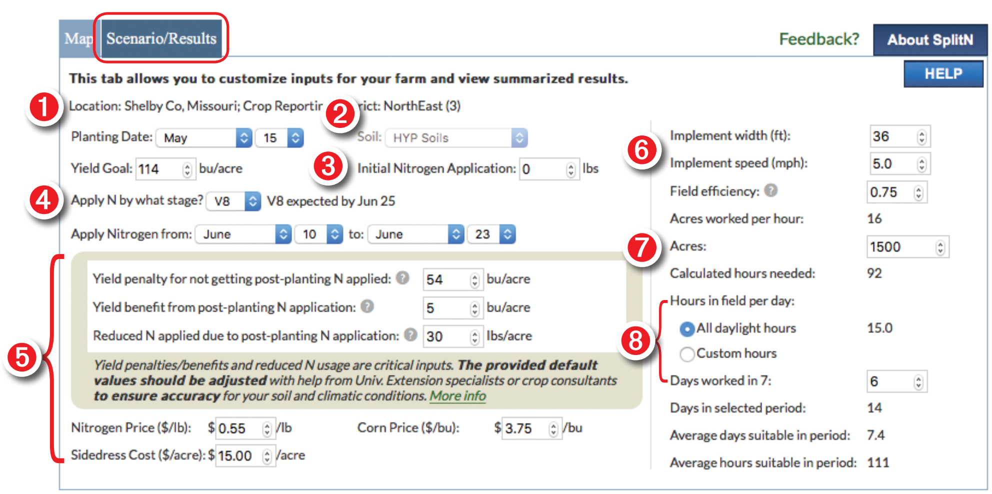
Once your area of interest has been located, click on the **Create Scenario/Results** button.



Scenario Overview

The top half of the Scenario/Results tab allows you to customize inputs based on your farming operation. Although default values are provided, it is important to adjust the inputs for more accurate results.

1. Provide dates for when your corn was planted and when nitrogen applications are scheduled to start/end.
2. Yield penalty data for Wisconsin, Nebraska, and Indiana will require additional information about soil type.
3. Enter the amount of nitrogen that was applied to the field before planting.
4. Specify by what corn growth stage (V stage) nitrogen must be applied.
5. Provide estimates for yield penalties and benefits, anticipated reduction in nitrogen use, nitrogen and corn prices, and sidedress costs.



6. Specify machinery implement details.
7. Input the number of acres for which you are planning a post-planting nitrogen application.
8. Estimate how many days you will work per week and how many hours you will work per day.

Results Overview

The bottom half of the Scenario/Results tab lets you view results of the Corn Split N Economic Analysis, Acres Completed Summary, and the Crop Calendar Summary.

Economic Analysis

❶ The **Input Acres Completed** scenario provides estimates based on the assumption that all desired acres will successfully receive a post-planting nitrogen application. The results show the expected economic net benefit and the number of years in which this scenario would occur.

❷ The **Average** scenario shows how many acres can typically be expected to successfully receive a post-planting nitrogen application and the associated economic returns.

❸ The **Worst Case** scenario provides the economic returns for the year with the fewest acres receiving a post-planting nitrogen application. This scenario would represent the maximum losses that could be expected in a year where weather conditions limit your ability to fertilize.

❹ **Best/Max Case** calculates the maximum number of acres that could theoretically receive a post-planting nitrogen application based on the provided inputs and historical weather data.

❺ **Breakeven** shows the number of acres requiring successful post-planting nitrogen application in order for economic returns to equal the economic costs.

Economic Analysis | Acres Completed Summary | Crop Calendar Summary

Economic Analysis using 38 years of Field Work Days History

Scenarios	Acres	Units/acre	Dollars/unit	Total Dollars
❶ **Input Acres Completed** (completed 1500 acres post-planting N application 27 years of 38 years, or 71% of years)				
Additional cost of post-planting fertilizer application	1500	1	$15.00	$(23,000)
Yield loss due to unfertilized acres	0	54	$4.50	$0
Yield gain due to post-planting fertilization	1500	5	$4.50	$34,000
Nitrogen saved (lb) due to post-planting fertilization	1500	30	$0.55	$25,000
Net Benefit of Post-planting N application on 1500 acres				**$36,000**
❷ **Average Acres Completed** (completed an average of 1500 acres post-planting N application 27 years of 38 years, or 71% of years)				
Additional cost of post-planting fertilizer application	1500	1	$15.00	$(23,000)
Yield loss due to unfertilized acres	0	54	$4.50	$0
Yield gain due to post-planting fertilization	1500	5	$4.50	$34,000
Nitrogen saved (lb) due to post-planting fertilization	1500	30	$0.55	$25,000
Average Net Benefit of Post-planting N application on 1500 acres				**$36,000**
❸ **Worst Case** (At least 375 acres of post-planting N application completed in all years)				
Additional cost of post-planting fertilizer application	375	1	$15.00	$(6,000)
Yield loss due to unfertilized acres	1125	54	$4.50	$(273,000)
Yield gain due to post-planting fertilization	375	5	$4.50	$8,000
Nitrogen saved (lb) due to post-planting fertilization	1500	30	$0.55	$25,000
Worst Case Net Benefit of Post-planting N application on 1500 acres				**$(246,000)**
❹ **Best/Max Case** (could have completed up to 2702 acres 1 year(s) of 38 years, or 3% of years)				
Up to 2702 acres of post-planting N application completed	2702			
❺ **Breakeven Number of Acres** (Post-planting N revenue equal costs in 30 years of 38 years, or 79% of years)				
Number of acres (out of 1500 acres) requiring post-planting N application to breakeven	1356			

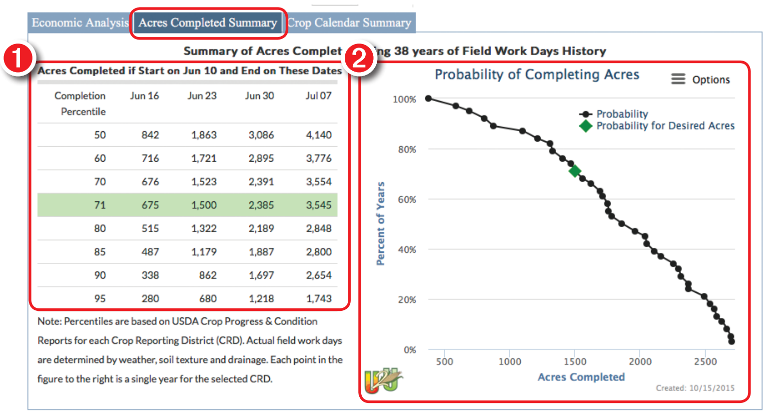
Note: This information is educational and should not be the sole source of information used to make a management decision.

Total Dollars are rounded to nearest thousand.

USER TIP: The results will automatically update as inputs are adjusted.

Acres Completed Summary

The Acres Completed Summary shows the probability of completing post-planting nitrogen application on your desired number of acres within your specified application window.

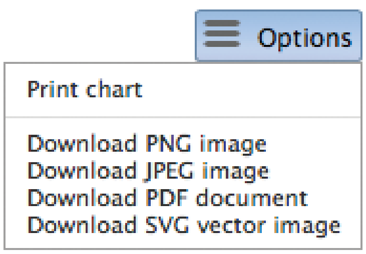


Completion Percentile	Jun 16	Jun 23	Jun 30	Jul 07
50	842	1,863	3,086	4,140
60	716	1,721	2,895	3,776
70	676	1,523	2,391	3,554
71	675	1,500	2,385	3,545
80	515	1,322	2,189	2,848
85	487	1,179	1,887	2,800
90	338	862	1,697	2,654
95	280	680	1,218	1,743

Note: Percentiles are based on USDA Crop Progress & Condition Reports for each Crop Reporting District (CRD). Actual field work days are determined by weather, soil texture and drainage. Each point in the figure to the right is a single year for the selected CRD.

❶ The table on the left shows the estimated number of acres receiving post-planting nitrogen for the period designated, plus one week prior and up to two weeks after the user-specified end date. The row shaded green represents, historically, the percentage of time that the desired number of acres received a post-planting nitrogen application by user-specified the end date.

❷ The chart on the right is a graphical representation of the probability of completing post-planting nitrogen application for your desired number of acres in the user-specified time period. The Chart Options button can be used to download or print this chart.



Crop Calendar Summary

The Crop Calendar Summary provides estimated dates for reaching various corn development stages based on the planting date and the accumulated corn growing degree days (GDD) for the year. GDD beyond the current day are estimated based on the 30 year average for that location.

Economic Analysis | Acres Completed Summary | Crop Calendar Summary

Crop Calendar Summary

Corn Stage	Estimated GDD to reach Stage	Estimated Date of Stage	Occurs within this range for all years (1981 - 2014)
V2	273	Jun 04	May 28 - Jun 08
V4	441	Jun 11	Jun 03 - Jun 16
V6	609	Jun 18	Jun 10 - Jun 24
V8	777	Jun 25	Jun 17 - Jul 02
V10	945	Jul 02	Jun 24 - Jul 08

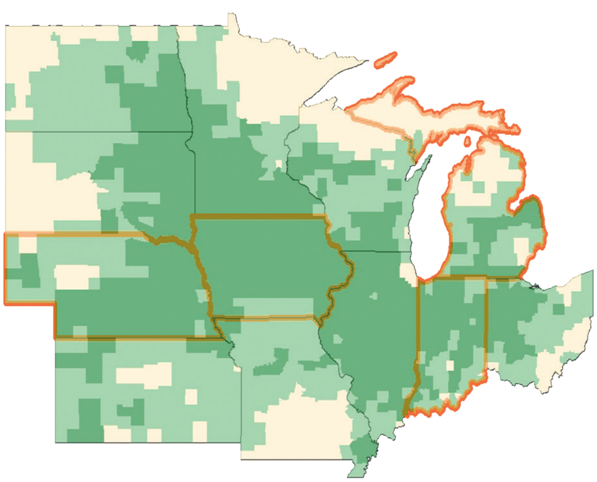
Note: post-planting application using ground vehicles for application should be completed by V10.

About Useful to Usable (U2U)

U2U is an integrated research and extension project, funded by the USDA, to improve farm resilience and profitability in the North Central U.S. by transforming existing climate data into usable products for the agricultural community. Our goal is to help producers make better long-term plans for what, when and where to plant and how to manage crops for maximum yields and minimum environmental impact.

The U2U team includes climatologists, agronomists, social scientists and computer specialists who have come together to create tools to aid in farming decisions. Partners include Purdue University, Iowa State University, Michigan State University, South Dakota State University, University of Illinois, University of Michigan, University of Missouri, University of Nebraska, University of Wisconsin, the High Plains Regional Climate Center, the Midwestern Regional Climate Center, and the National Drought Mitigation Center.

U2U Study Region



Pilot States

Major Corn Growing Area

Minor Corn Growing Area

Crop data from National Agricultural Statistics Service (NASS) U.S. 2007 Census of Agriculture

Major corn areas harvested over 60,000 acres of corn

Minor corn areas more than 5,000 acres of corn

Map created by Adam Reimer

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