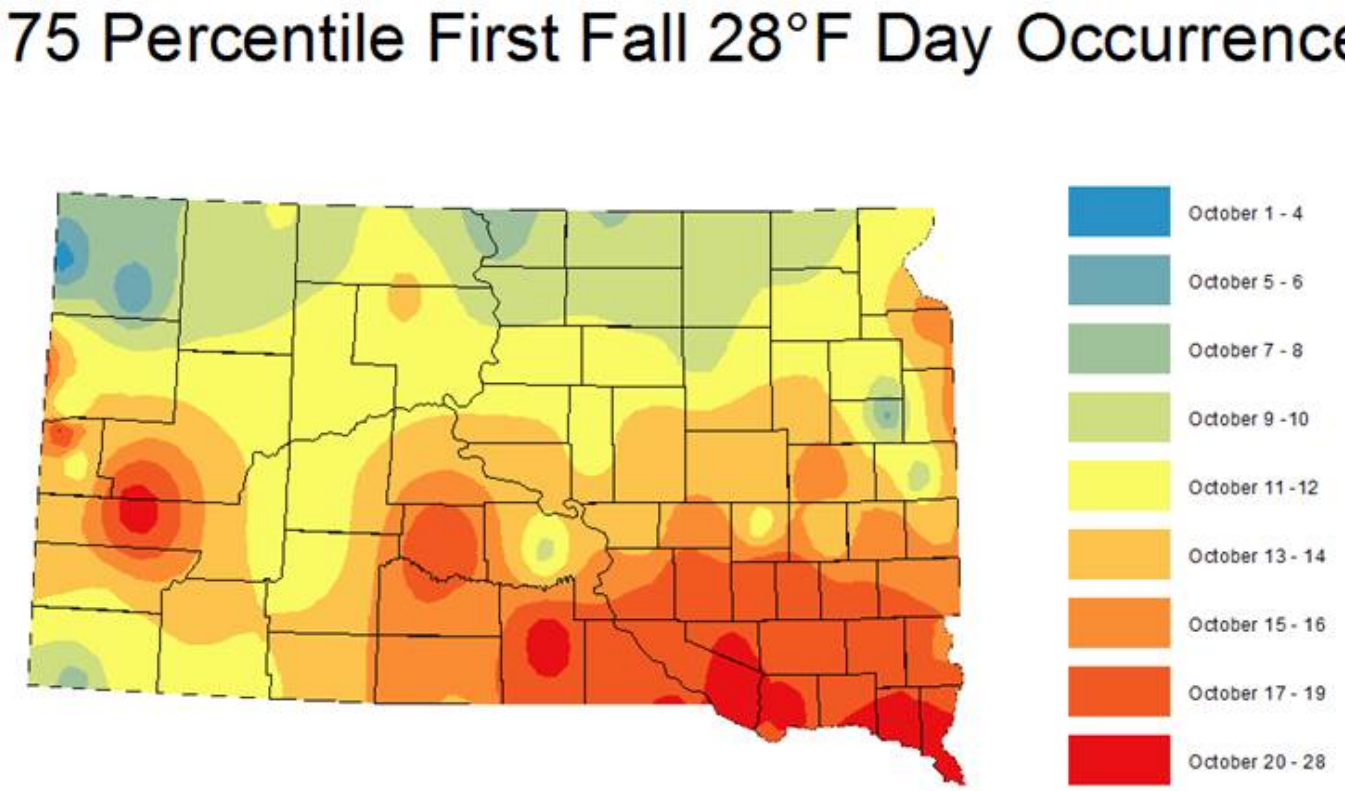
GDU and soil temperature updates as of October 20th

Location	Average Soil Temperature	GDU's Accumulated*
Baltic	56	2801
Britton	53	2711
Cottonwood	59	2782
Faulkton	53	2827
Parkston	59	3060
Pierre	61	3057
South Shore	NA	2483
White Lake	NA	3008

Soil temperatures and GDU accumulation from SDSU's Climate website: climate.sdstate.edu

Our soil temperatures are above 50°F consistently across the state, meaning that it is still too early to apply nitrogen (see more information below). We had accumulated approximately 2400-3000 GDU's across the state when a killing frost covered most of the state on the morning of October 16th. Hopefully nobody was worried about their corn reaching black layer as most of it should have reached physiological maturity sometime over the past month. On the topic of a killing frost (28°>), how late was this year compared to normal?



Map created at climate.sdstate.edu

According the above map, approximately 75% of the time we receive a killing frost earlier than this year (with the exception of the far SE corner of South Dakota which is more close to normal). This helped the corn finish maturing, while it presented some challenges with soybeans (green stem syndrome). We have experienced a warm fall thus far.

Why do fall agronomy applications depend upon the soil temperature?

Many of our fall agronomy applications depend upon the soil temperatures being below 50°F, why is this so important? The short answer is that soil bacteria and microorganisms remain active at temperatures above 50°F. Here are a few

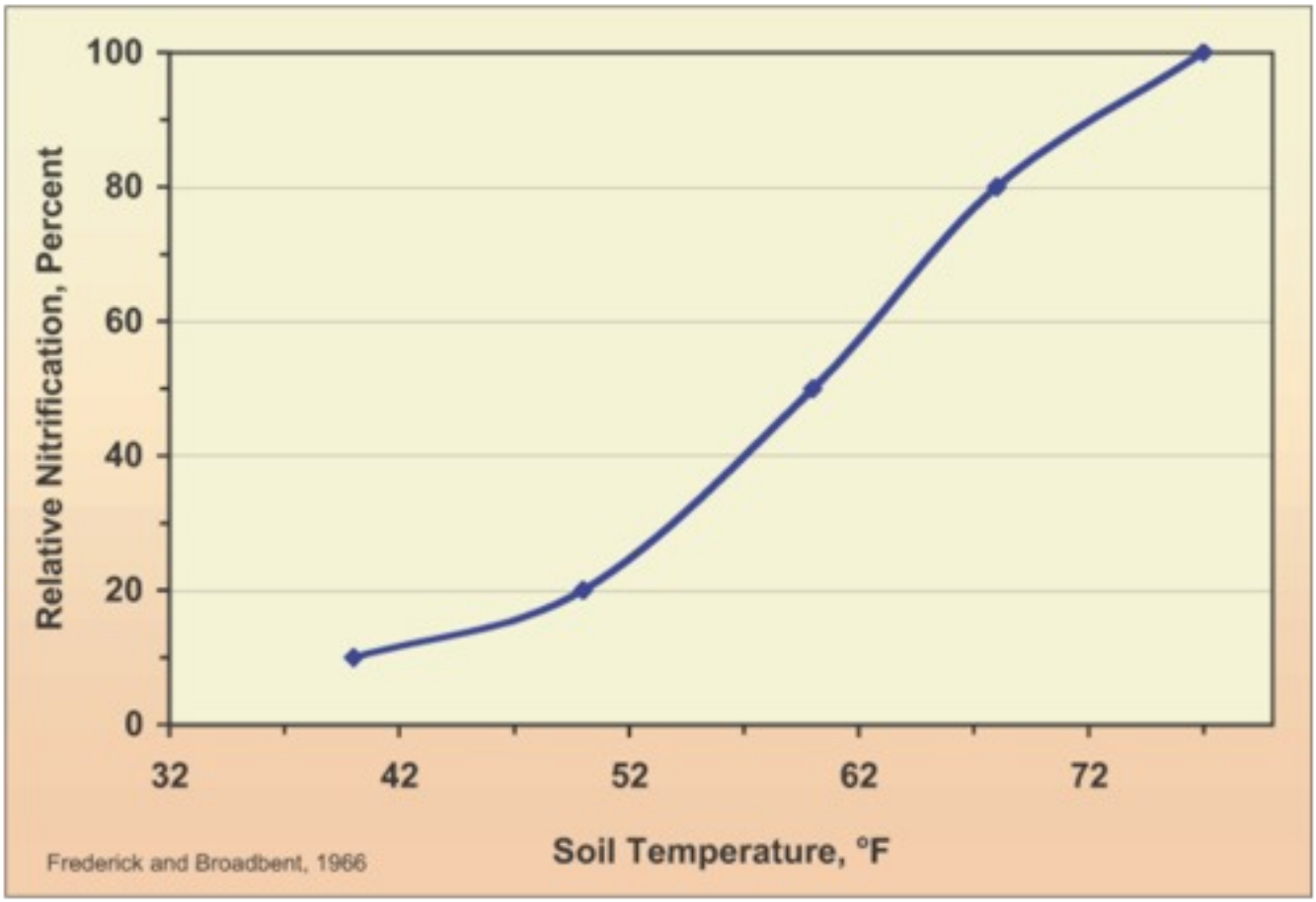
common questions around fall nitrogen applications and how they relate to weather. Much of the data presented below is adapted from an article written by John Sawyer (Iowa State University). The link to this article is found below.

Is moisture important when making nitrogen applications?

The short answer is yes. When nitrogen fertilizers containing ammonia (example: anhydrous ammonia) are applied to the soil, it is in the form NH3+. It 'steals' a hydrogen ion from a water molecule to stabilize itself in the soil as ammonium (NH4+, we will refer to ammonium nitrogen from here forward). If soils are too dry at the time of application, anhydrous ammonia will escape as a gas out of the soil through volatilization, and it the soil is too wet the soil cannot seal behind the injection knives and the anhydrous ammonia will escape this way.

In the case of urea, it is important to note the soil condition if making a surface application. If the soil is wet, urea can volatilize faster than if soil conditions were dry. It is best to make a surface application of urea within a day or two of forecasted precipitation (rain or snow). Nitrogen stabilizers such as Agrotain can help reduce nitrogen losses when surface applying urea, but they should not substitute for proper timing based upon forecasted precipitation.

Why do I need to wait until 50°F or cooler to apply nitrogen?



Adapted from Fredereick and Broadbent, 1966, source: Iowa State University

Ammonium nitrogen (NH4+) is positively charged, and attaches to negatively charged soil particles which reduces risk of loss from leaching. Nitrate nitrogen (NO3-) is negatively charged and cannot attach to soils, thus increasing potential for leaching risk. Nitrification is the process by which ammonium is converted to nitrate nitrogen. This process is influenced by soil bacteria (examples: nitrosomonas and nitrobacter). Soil bacteria activity increases at soil temperatures of 50°F or higher (see above). As soils get warmer, more fertilizer applied as ammonium nitrogen converts to nitrate, and thus has more potential to leach through the profile.

How fast does ammonium convert to nitrate nitrogen?

The simple answer is it depends upon your soil temperature:

Temperature Sequence	% Nitrification
Continuous at 80°F for 24 days	100
12 Days at 80°F-12 days at 40°F	96
8 Days at 80°F-8 days at 60°F-8 days at 40°F	74
12 Days at 40°F-12 days at 80°F	62
Continuous at 60°F for 24 days	59
8 Days at 60°F-8 days at 80°F-8 days at 40°F	56
8 Days at 40°F-8 days at 60°F-8 days at 80°F	45
Continuous at 40°F for 24 days	29

Adapted from Chandra P., 1962. Source: Iowa State University.

The above research used ammonium sulfate fertilizer and held soils at constant temperatures of 80°, 60°, and 40° (or a combination of the three) for 24 days and measured the amount of nitrogen in the nitrate forms. When soils are warm (80°<) 100% of the ammonium nitrogen applied converts to nitrate in 24 days, and when soils are cool (40°>) 29% of ammonium nitrogen converts to nitrate. Our soils right now in South Dakota are around 60°, so in 24 days we would see 59% of that ammonium nitrogen convert to nitrate.
To put this into fertilizer terms: if we apply 200 lbs of anhydrous ammonia, we would be applying 164 lbs of ammonium nitrogen per acre. If our soils are 60°for the next 24 days (they will probably get cooler), 96 pounds of N would convert to nitrate. Whereas if we would wait until soils are 40° (probably also unrealistic because we wouldn't wait this long), only 47 pounds of ammonium N would convert to nitrate. Our soils will more than likely cool down in the next couple of weeks, but if we applied nitrogen fertilizer today, based upon the above research we could interpret at least 5-10 more pounds of ammonium N convert to nitrate versus if we would wait until soil temperatures drop below 50°.

Where does fall applied urea fit into this Conversation?

Urea is a prilled dry fertilizer product containing 46% nitrogen. Urea needs to be incorporated with tillage, or receive an adequate rain (.25-.5 in) following application. If rain is not received following application, the urea cannot stabilize itself and the nitrogen will be lost through volatilization. It is recommended to apply urea in the spring to reduce losses from leaching, however if a fall application of urea is planned, incorporation with tillage along with a nitrogen stabilizer with a proven track record such as Instinct II (Nitrapyrin) or Agrotain (NBPT) should be used to minimize losses from leaching or volatilization.

What to tell farmers if they want to apply nitrogen this fall?

Spring applications of nitrogen should be favored whenever possible. If making fall nitrogen applications it all comes down to soil temperature, form of nitrogen, and soil type. If nitrogen applications are made yet this fall, ensuring that the soil temperature is consistently below 50°F, proper incorporation with good soil conditions (not be too wet or dry), and using a nitrogen stabilizer will all help ensure maximum value out of the fertilizer investment (see information below). Stay away from light/sandy soil if possible to reduce the risk of leaching. Another option is to consider split application of nitrogen. Use a reduced rate this fall and substitute the remaining amount with an in-season sidedress nitrogen application next summer to reduce the risk of the nitrogen deficiency during next year's growing season.

		Sample Date		
		Dec. 8	Apr. 2	May 3
Application	Nitrapyrin	% NH_4-N Remaining		
Nov. 7 (>50°F)	No	39	19	3
	Yes	63	28	17
Nov. 18 (<50°F)	No	40	33	7
	Yes	57	58	26

Adapted from Sawyer, J.E. 1984. Nitrification of ammonium nitrogen as affected by the time of application location, temperature, and nitrification inhibitors. M.S. Thesis, Univ. of Illinois, Urbana, IL.

The above table shows the amount of ammonium nitrogen remaining in the soil from two different nitrogen timings (early- when soil temperatures are warm, and late- when soil temperatures have cooled), as well as with and without a nitrogen stabilizer (Nitrapyrin- Instinct II/N-Serve). Higher numbers are better, meaning more nitrogen remains in the ammonium form. Applications made in cool soils (<50°F) coupled with a nitrogen stabilizer increased the amount of ammonium nitrogen remaining in the soil throughout the winter and into the growing season.

Links:

http://www.ipm.iastate.edu/ipm/icm/2001/10-22-2001/why50.html
http://www.montana.edu/cpa/news/wwwpb-archives/ag/baudr131.html

What about fall residual herbicide applications?

Many areas of the state have been struggling with adequate weed control over the past season. Waterhemp, kochia, and marestail just to name a few. A fall herbicide application that provides residual activity is an option to consider if you have the following problems:

1.) **Perennial or biennial weed control problems (example: Canada thistle, field bindweed, marestail)**
2.) **Acres with a high number of weed seeds in the seed bank (example: fields with high amounts of waterhemp, ragweed, or marestail).**
3.) **No-till acres where mechanical weed control is not an option.**
4.) **Acres that are consistently wet in the spring and have difficulty getting across the field in a timely matter.**
5.) **Acres that have only had one or two modes of action in the past and herbicide diversity is required.**
6.) **Any combination of the above scenarios.**

There are a couple of terms that get used with fall herbicide applications.

1.) **The first is known as a 'fall burndown' application. This usually consists of 2,4-D/dicamba/glyphosate to 'burn-down' and eliminate weeds after the growing season is complete. Usually it is assumed that any residual from these products will no longer be present by planting time next season (an example would be applying LV-6/Cornerstone (glyphosate) following wheat harvest).**
2.) **The second is a fall residual herbicide application. This herbicide application is done to provide a residual herbicide for next season's crop. It is applied AFTER the soil temperature drops below 50° F as biological activity slows when the soil cools down (same principle as nitrogen applications above), but BEFORE the soil freezes.**

Some herbicides have both foliar and residual characteristics. Examples include Valor/Rowel, Dimetric, and Sharpen. Your herbicide selection should be based upon activity on the weeds you want to control, and should fit with your crop rotation. The table below provides a nice overview of several herbicides labeled for fall residual applications.

	Rotational Interval			
Herbicide	Application Rate	Contact Activity?	Corn	Soybeans
Autumn	Up to .3 oz	Yes	30 Days	90 Days
Valor SX/Rowel	2-4 oz	Yes	30 Days*	Anytime*
Dimetric	4-12 oz	Yes	Anytime**	Anytime
Prowl H2O	2-3 pt	No	NA***	Anytime
Zidua	2-3 oz	No	Anytime	Anytime
Sharpen	2-4 oz	Yes	Anytime	1.5 months****

***Valor SX rotational intervals are based upon rate. Higher rates (2 oz+) have longer rotational intervals.**

****At rates above 5.3 ounces per acre Dimetric, corn has a 4 month rotational interval.**

*****Refer to Prowl H2O label for specific crop rotation interval with corn**

******Soybeans have a 1.5 month rotational restriction at the 2 oz/ac rate, 2-3 months at the 3 oz rate, and 4 months at the 4 oz/acre rate**

Some key points with fall residual herbicide applications include:

1.) This application does not provide season long weed control, it is meant to provide additional modes of action and potentially help control winter annual/biennial weeds (spring residual herbicides are still be necessary to provide additional weed control), and post herbicides will be necessary to provide weed control in-season.

2.) Again, fall residual herbicide applications should not replace spring residual herbicide programs. They should work in tandem together, with specific regard to fields with high weed pressure.

3.) Warm and dry winters can reduce the amount of residual activity the following spring.

4.) If chemicals will be incorporated, do not make deep tillage applications following a fall herbicide application (follow specific herbicide labels).

5.) Do not apply residual herbicides until soil temperatures are consistently 50° or less at 2" depth, and before soils freeze to allow incorporation from precipitation.

6.) If you want a contact/burndown, be sure to follow the herbicide's adjuvant recommendations (examples: SuperB (COC) and/or Class Act NG (AMS)) to provide additional foliar activity. If the herbicide does not have contact activity, include a herbicide that does such as 2,4-D, glyphosate, or Sterling Blue (dicamba). Follow specific label instructions.

7.) Always read and follow labeled rates and application instructions.

Links:

https://ag.purdue.edu/btny/weedscience/Documents/Startingnextyearnow.pdf

http://corn.osu.edu/newsletters/2010/2010-30/fall-herbicide-treatments-2013-focus-on-marestail-management