North Dakota State University
# CROP & PEST REPORT

NDSU EXTENSION

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## plant pathology

### EARLY SEASON SEEDLING DISEASES IN SOYBEANS AND WHY SEED TREATMENTS MATTER

Soybeans face a critical battle within the first few weeks of growth when cool, wet soils often favor the development of soilborne pathogens. Among the most common assailants are Pythium, Phytophthora, Fusarium, and Rhizoctonia. These organisms can prevent seedlings from emerging, stunting or death of early growth leading to poor stand establishment, and reduced yield potential (**Figs. 1 and 2**). Because commercial soybean varieties currently provide very little genetic resistance against most of these pathogens, with some exceptions for Phytophthora, managing seedling diseases depends heavily on strategic crop rotations, seed treatments, and field water management.

***Figure 1: Stunted soybean seedling with suspected infection by seedling pathogens. Symptoms include reddish lesions just below hypocotyl, rotten tap root, and no lateral root development.***

*Figure 2. A soybean field with pockets of dead plants due to infection by seedling diseases early in the season. Stunted plants can also be seen on the outer edges of this pocket most likely due to poor root development.*

One reason it is challenging to control these pathogens is their ability to survive on hosts other than soybeans. Rhizoctonia for instance can also infect sugar beets, while Pythium and Fusarium survive on crops such as small grains, corn, and dry beans. As a result, rotating into these crops may not reliably eliminate the soilborne inoculum. Further, soybean varieties with Phytophthora resistance genes such as Rps1a, Rps1c, or Rps1k have been shown to have reduced ability to control the development of disease because of an overuse of these tools leading to the Phytophthora populations adapting and overcoming them. These generally "broken" resistance genes no longer offer the level of protection they once did, leaving farmers with fewer defenses against this destructive pathogen. However, Rps3a and Rps6 have shown to be highly effective at preventing Phytophthora root rot from occurring.

Seed treatments provide a vital role in protecting soybeans against these early season seedling diseases. Most commercially available treatments target either Pythium and Phytophthora (oomycetes) or Fusarium and Rhizoctonia (true fungi). If only one type of chemistry is used, seedlings remain vulnerable to the group of pathogens not covered. Therefore, it is recommended that if planting into fields with a known history of reduced stands or seedling diseases, to have a full coverage seed treatment for protection against both oomycetes and true fungal pathogens. This strategy reduces stand losses, supports early vigor, and helps preserve yield potential. Although seed treatments do not eliminate the threat of infections, they often prove cost-effective by preventing widespread damping-off and weakening of young plants.

Water management also plays a crucial role in curbing early-season seedling diseases by limiting the prolonged saturation that favors infections by soilborne pathogens. Fields with adequate drainage not only allow seeds to germinate under less stressful conditions but also reduce the likelihood of fungal and oomycete growth around young roots. Further, avoiding planting immediately before heavy rains and addressing issues like compaction or standing water can significantly lower disease development. By minimizing excess soil moisture through installing drainage tiles, strategic tillage, and other practices, farmers can create conditions less favorable to pathogen infection, help seedling establishment, and lower the overall threat of yield losses.

Individuals who have observed seedling losses in their fields should consider scouting thoroughly and submitting samples to the NDSU diagnostic lab if they suspect any of these pathogens to understand which pathogens are causing problems.

***Further Resources***

For a comprehensive overview of control strategies and product efficacy, the North Dakota Field Crop Plant Disease Management Guide provides valuable information and can be found here. Additional info through the Crop Protection Network, including soybean seed treatment efficacy data can be found here. Also, the University of Wisconsin–Madison has created another useful document for examining what specific active ingredients are on your seed which can be found here.

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## CLS MANAGEMENT IN SUGARBEET: FUNGICIDES AND FUNGICIDE RESISTANCE

North Dakota State University and University of Minnesota Extension programs recently wrapped up the 2025 Sugarbeet Growers' Seminars. One of the topics discussed was fungicide selection and rotation for management of Cercospora leaf spot (CLS) in sugarbeet. This article outlines some best practices for control of CLS using fungicides and highlights some of the data supporting these recommendations.

**Fungicide resistance versus tolerance**

The fungus that causes CLS, *Cercospora beticola*, may be resistant or tolerant to the active ingredients in available fungicides, based on DNA mutations present that confer or affect traits. A fungicide resistant strain would exhibit no reduction in growth rate despite appropriate application of a previously effective fungicide, and infection and disease symptoms would occur. However, a fungicide tolerant strain would exhibit a partial reduction in growth rate in the presence of that fungicide. In this case, fungicides may still be able to contribute towards disease control but with diminished efficacy. We might think of fungicide resistance (for example, to strobilurin fungicides) within *C. beticola* populations as using one switch: isolates are either resistant or not resistant. Other fungicide modes of action, namely the triazoles, may involve multiple "switches", where the level of tolerance depends on multiple genetic factors. This results in a situation of fungicide tolerance. Each fungicide application filters the existing *C. beticola* population: only resistant or tolerant individuals survive to start the next generations via spores that can germinate and successfully cause infection.

**Within each field, fungicide resistance is more complex than simple presence/absence**

Frequency of fungicide resistance on a field or regional base is not the same as fungicide resistance on the basis of individual *C. beticola* isolates. That is, in each field (local population) some individuals may be sensitive and some individuals may be sensitive to a given fungicide. Based on end-of-season testing of isolates collected in recent years, the percentage of individual CLS isolates resistant to a given fungicide varies from over 80% to as low as 15%, depending on the active ingredient/mode of action in question. So, even though fungicide resistance is present, anywhere from 20% to 85 of the pathogen population can still be controlled using these products. A spray program utilizing each mode of action can serve as four to six more "filters" to reduce the *C. beticola* population.

*Table 1. Although a large percentage of fields may have fungicide resistance present, only a fraction of Cercospora beticola isolates collected and assessed at the end of each growing season are resistant to a given fungicide. Data from Nathan Wyatt, USDA-ARS, Fargo,ND.*

| Fungicide mode of action | Resistance mutation | Percent of Resistance Individuals | | | |
|---|---|---|---|---|---|
| | | 2016 | 2017 | 2021 | 2023 |
| Strobilurin | G143A | 29% | 31% | 20% | 25% |
| Triazole (tetraconazole/prothioconazole) | E170 | 81% | 46% | 72% | 62% |
| Triazole (mefentrifluconazole/difenoconazole | L144F | 47% | 45% | 51% | 53% |
| Benzimidazole | E198A | 30% | 14% | 23% | 15% |
| Organotin | GST | 31% | 22% | 35% | 30% |

**Cercospora is unlikely to be resistant to multiple modes of action**

Carrying fungicide resistance mutations (examples in Table 1) often comes with some cost to the fungus. If no fungicide is present in the environment, sensitive individuals may grow or reproduce faster than individuals that carry these DNA mutations. Data from Dr. Wyatt's program at the USDA has assessed the tendency of *C. beticola* to be resistant to a second fungicide, given a particular resistance already present (Table 2). For example: cross resistance between tin and benzimidazoles occurs at relatively low frequencies. In other words, *C. beticola* individuals that are resistant to tin are likely to be sensitive to benzimidazoles fungicides. Similarly, *C. beticola* individuals resistant to tetraconazole are also likely to be sensitive to benzimidazoles. Together with the previous information (Table 1), this is why tank mixing multiple modes of action and rotating chemistries are effective managements strategies.

*Table 2. Correlation matrix between fungicide resistance traits that may be present in one C. beticola individual, based on isolates collected at the end of the growing seasons. Data from Nathan Wyatt, USDA-ARS, Fargo, ND.*

| Fungicide | Strobilurin | Benzimidazole | Triazole (tetraconazole) | Triazole (prothioconazole) | Triazole (difenoconazole) | Tin |
|---|---|---|---|---|---|---|
| Strobilurin | 1.00 | | | | | |
| Benzimidazole | 0.18 | 1.00 | | | | |
| Triazole (tetraconazole) | 0.69 | 0.33 | 1.00 | | | |
| Triazole (prothioconazole) | 0.53 | 0.41 | 0.92 | 1.00 | | |
| Triazole (difenoconazole) | 0.51 | 0.37 | 0.59 | 0.60 | 1.00 | |
| Tin | 0.40 | 0.21 | 0.48 | 0.54 | 0.43 | 1.00 |

Optimal CLS management is based on many such "filters" to reduce germination and infection of *C. beticola*, beginning with burying sugarbeet leaf residue, where the fungus survives the winter, and rotating to new fields for next year's crop. CLS-tolerant sugarbeet varieties are another tool to reduce the number of spores able to infect and cause disease. Combining these strategies with a sound fungicide program can greatly reduce the risk of CLS epidemics.

Based on these principles, the following practices can help to maximize control of CLS using fungicidesR

1. **Always tank mix multiple modes of action**
2. **Use full rates for each product**
3. **Rotate active ingredients used in CLS spray applications**

For more details about this and other topics discussed at the 2025 Sugarbeet Growers' Seminars, please see "Presentations" under the tab "Resources" on the Sugarbeet Research and Education Board website, www.sbreb.org.

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plant science

**SOYBEAN PLANTING CONSIDERATIONS**

As spring approaches, planting is at the forefront of our minds. This critical stage sets the foundation for the growing season, and early decisions can significantly impact the final yield. While achieving a uniform stand is less crucial in soybeans compared to other crops, we still strive for consistent and uniform emergence to maximize yield potential. In general, earlier planting dates are associated with higher yield potential. To put this into perspective, delaying planting from May 1 to May 31 can result in a yield loss of approximately 0.3 bushels per acre per day. However, this assumes that soil conditions are suitable for planting—adequate moisture, soil temperatures around 50°F, and a favorable weather forecast.

Soil temperatures below 50°F can prolong emergence, increasing the risk of soil-borne diseases, especially in wet conditions. Therefore, monitoring soil temperatures and moisture levels is essential before planting.

Another key consideration is the last frost date in the spring, which helps manage early-season risks (Figure 1). Additionally, selecting an appropriate maturity group is crucial to ensure the crop reaches full maturity before the first frost in the fall. When soybeans are planted between mid-May and the end of May, opting for a variety that matures 0.1 (one-tenth) later than usual may boost yield potential by approximately 0.7 bushels per acre. However, if planting is delayed into June, switching to an earlier-maturing variety is recommended to ensure the crop reaches maturity before the season ends.

By carefully considering these factors—planting date, soil conditions, temperature, and variety selection—farmers can optimize their soybean yields and set the stage for a successful growing season.

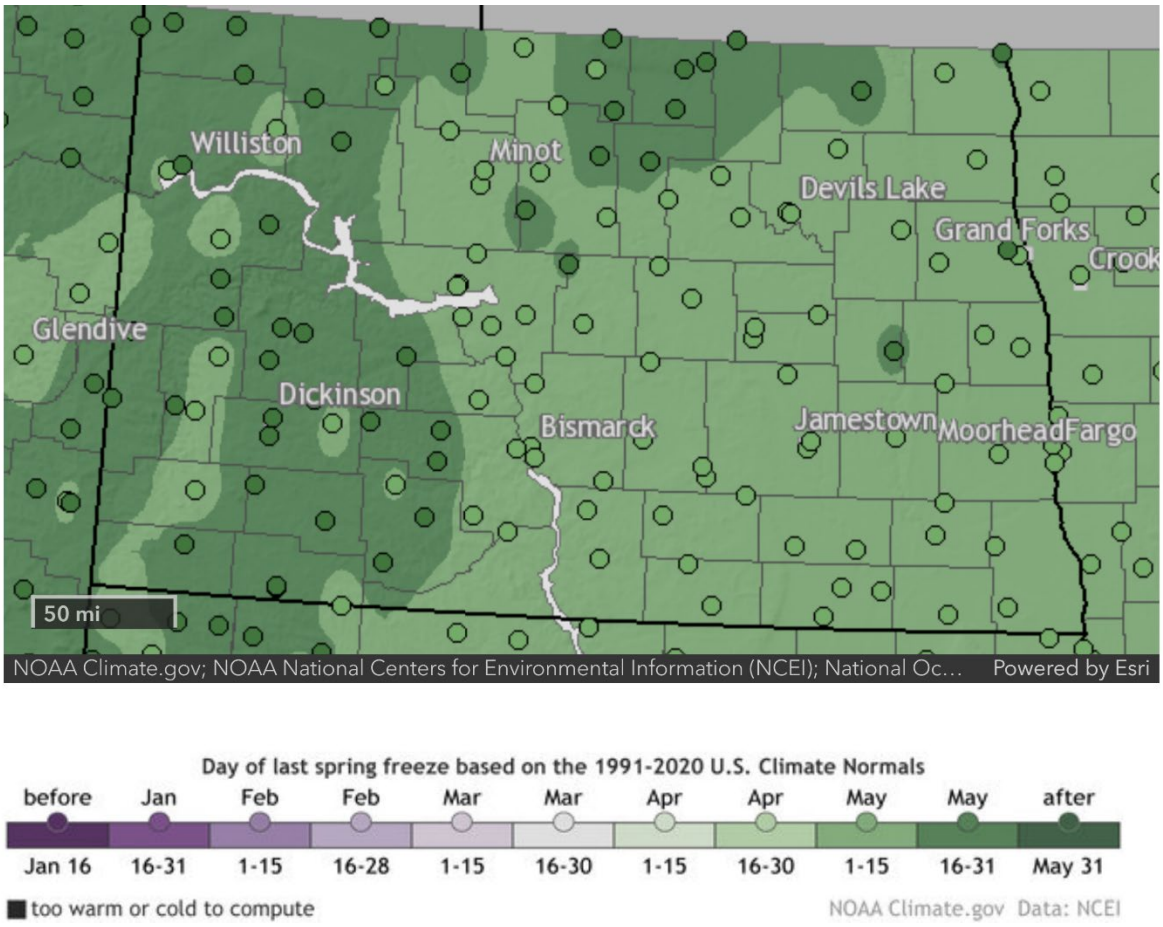


***Figure 1: Map showing the average date past which the chances that the temperature will remain above freezing for the rest of the season are higher than the chances of return to freezing temperatures. Data from NOAA***

**More information on planting can be found here:**
Early Soybean Planting Considerations | NDSU Agriculture
North Dakota Soybean Production Field Guide 2023 (A1172)

**To access the NOAA weather interactive map to see the last frost day closer to your field use this link:**
Interactive map: average date of last spring freeze across the United States | NOAA Climate.gov

Ana Carcedo
Broadleaf Crop Agronomist

**LINKS FOR 2024 NDSU SMALL GRAIN AND CORN VARIETY TRIAL RESULTS**

It is hard to believe that most of February is behind us and March 2025 is just around the corner! I've enjoyed traveling around the state and speaking with people this winter and hearing your thoughts on the 2024 crop and your questions about the up-coming growing season. If you did not get a chance to pick up a printed copy of any of the NDSU small grain or corn hybrid variety trial guides, please find links to the pdf versions of these publications below.

2024 NDSU Corn Hybrid Test Results
2024 NDSU Hard Red Spring Wheat Variety Trial Results
2024 NDSU Durum Wheat Variety Trial Results
2024 NDSU Barley-Oat-Rye Variety Trial Results

I've enjoyed the warmer temperatures the past few days and am eager for spring to arrive. Best wishes to all the producers reading this with hauling grain, calving, and getting equipment ready for the 2025 season. Please feel free to reach out to me if you have any questions I can assist you with.

Clair Keene
Extension Agronomist Small Grains and Corn

soils

**MANAGING FERTILITY TO MAXIMIZE PROFITS**

Over the past month, fertilizer prices have increased sharply across the board, with urea and potash leading the charge in price increases. While wholesale prices of potash are still slightly lower than this time last year, this may not be the case for long with the risk of tariffs on this Canadian product. Given the forecasted high input costs and the lingering risk of drought in some parts of the state, a common question this year has been "where can I cut back?" While reducing fertilizer applications can save some money in some crops, the removed soil nutrients will still need to be replaced to support long-term productivity. "Mining" the soil for nutrients, especially P and K, this year (or for the past few years, which may be the case) only increases the amount of fertilizer which needs to be applied down the road—robbing Peter to pay Paul. Fortunately, there are a few strategies in fertility management which will allow for a reduction in inputs, by increasing efficiency, while still supporting profitability and not unduly reducing soil test levels.

Nitrogen is usually at the top of the list as the critical fertilizer input for most N-demanding crops, and rightfully so since it is usually the moist limiting crop nutrient. However, remembering Liebig's law of the minimum—yield is proportional to the amount of the most limiting nutrient, whichever nutrient it may be. We must pay close attention to fields with very low soil test P and K levels and potential S deficiency conditions, if applications of these nutrients are reduced too much, no amount of N will compensate for the decreased productivity. This year, soil nitrate-N testing will be critical for making sound N management decisions, given potentially low productivity last year, residual levels might be higher than typical in some areas. Taking advantage of residual N is a good way to reduce inputs. The best way to make economically sound decisions regarding N management will be to use the NDSU-Extension N guidelines, which are specifically created to maximize profitability. While the outdated yield goal N recommendations attempted to maximize yield, they did so without regard for diminishing returns as the crop reaches maximum yield, meaning it takes more N to grow each bushel

of grain the closer you are to maximum yield (in addition to reaching a point where the additional bushels will cost more to grow than they will sell for). Recommendations made using economic optimum N rates (EONR) will maximize net return by only recommending N be applied until it no longer shows a benefit to profit, regardless of crop maximum yield (Figure 1).

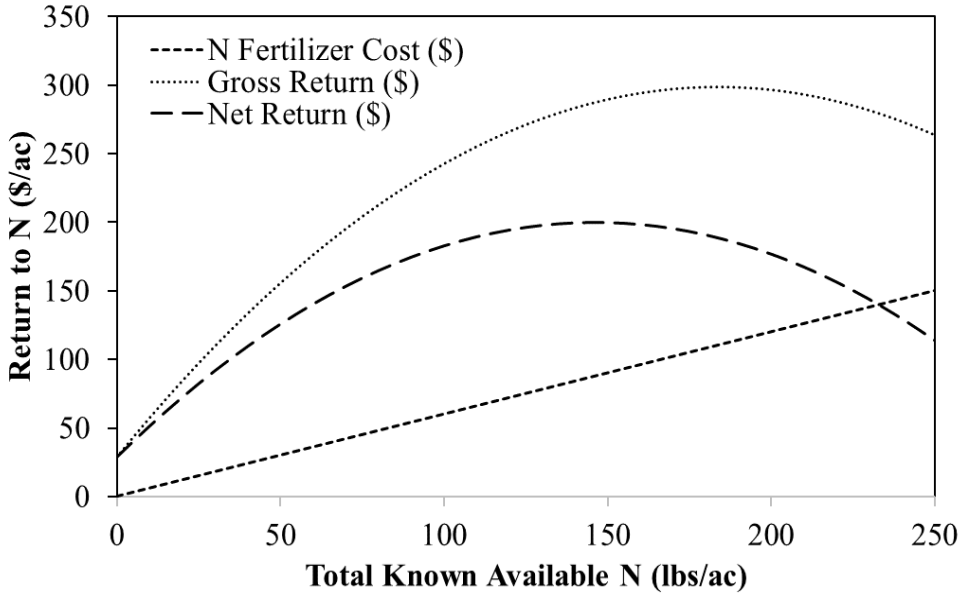


***Figure 1. Based on ND research and a barley price of $5 per bushel and N costs of $0.60/lb N, while maximum yield could be reached with approximately 190 lb N/ac, maximum profitability is attained at 133 lb N/ac. Gross return equals bushels of barley multiplied by the grain price, note beyond 190 lb/N ac gross returns decrease due to lodging from excess N. Net return is the gross return minus the cost of N fertilizer inputs.***

Shifting mindsets away from producing the highest yield to maximizing economic returns will serve producers well this year. Overall N inputs can be reduced by using EONR and the crop will be produced near the point of maximum net return—positive economics in a tight year! Currently, NDSU-Extension has economic N recommendations for corn, wheat/durum, sunflower, and barley and can be found either in the North Dakota Fertilizer Recommendation Tables or by using the online North Dakota Crop Nitrogen Recommendation Calculators.

With high P prices for the last few years, there have been many producers cutting back on application rates, which for many crops likely did not have a great impact on productivity if soil test levels were high. With continued P removal and decreasing soil test levels, it is critical to apply P in low soil testing fields. The best way to maximize P use efficiency is to band fertilizer close to or with the seed to facilitate better uptake. In North Dakota, corn and small grains have consistently shown positive responses to banded P (when applied at seed-safe level, of course, Fertilizer Application With Small-grain Seed at Planting). Additionally, for small grains if P is banded, recommended P rates can be reduced by approximately 30% without impacting yield compared to broadcast rates.

Soil K levels in North Dakota have been declining over the last decade for a variety of reasons and some fields have fallen well below the critical soil test levels of 150-200 ppm K (see the October 10, 2024 Crop and Pest Report for more information). In field with less-than-optimum K levels, it likely is not economical or feasible to build up the soil test in the short-term, so it is critical to fertilize for crop removal, at a minimum. As with nitrogen, corn K recommendation are based on economic returns and can be found by using the North Dakota Corn Potassium Recommendation Calculator.

Using economic N rates and increasing efficiency through the use of N extenders and additives are ways to reduce N rates in this year of high fertilizer prices, while still attaining maximum crop profitability. Banding P fertilizers with corn, small grains, and canola is a good tool to reduce P fertilizer rate compared to broadcast applications. All in all, focusing on the 4Rs of nutrient management (right source, rate, time, and place of fertilizer) will be the best option for maximizing profits and ensuring all applied nutrients are used as effectively as possible.

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**AROUND THE STATE**

**SOUTH-CENTRAL/SOUTHEAST ND**

Farmers, Agronomists, and myself have been busy attending and organizing meetings in January and February. I have attended, organized, and spoken at some great meetings this winter. Lot's of great information necessary for the 2025 growing season has been presented with more meetings yet to come in March.

Farmers and Agronomists are putting together seed, fertilizer, and pesticide programs for the 2025 growing season. When purchasing herbicide pre-mixtures, please be aware of the concentrations of each active ingredient in the purchased pre-mixture and make sure you calculate how much of each active ingredient will be applied based upon the product rate you choose. Then consult the 2025 North Dakota Weed Control Guide and weed control research data presented this winter to determine if each active ingredient is being applied at a rate to provide the most effective weed control. Two sources of winter time weed control presentations you may view include the Getting It Right Crop Production Webinars and the Advanced Crop Advisers Workshop.

As for weather across the region, of the 27 NDAWN stations in this region reporting the approximate maximum depth of frost, Oakes and Zeeland only have a maximum frost dept of 12 inches in the southern part of the region while Wing has soil frozen to a depth of 59 inches with an average frost depth across the region of 29 inches. Soil temperatures are already above 32 degrees Fahrenheit at the two-inch depth at Oakes and Skogmo! From January 1, 2025 through February 24, 2025 the average four-inch bare soil temperature ranged from 16 degrees Fahrenheit at Wing to 29 degrees Fahrenheit at Hillsboro and Zeeland with an average across the region of 24 degrees Fahrenheit.

Soil moisture readings at NDAWN stations during the winter are somewhat suspect and once soil temperatures are 32 degrees Fahrenheit and lower, soil moisture content is NOT VALID. Only 19 NDAWN stations in the region currently have soils at 33 degrees or higher at some soil depth to trust soil moisture values. Based upon this information soil moisture depth is not looking great at the moment. Marion has the lowest soil moisture content at 14% at the 39-inch soil depth with Cooperstown having the greatest soil moisture content at 49% at the 39-inch soil depth. The average soil moisture content at these locations in the region is only 32%. Oakes has the greatest soil moisture content of 45% at the highest soil depth of 20 inches.

From January 1, 2025 through February 24, 2025, the total liquid equivalent for this time period for this region ranged from 0.41 inch at Skogmo to 0.98 inch at Livona with an average for the region of 0.68 inch. Based upon the majority of NDAWN stations in this region, only Emmons County NDAWN stations received greater than 0.94 inch of liquid

equivalent during this time period! Only six NDAWN stations currently report snow depths ranging from -2 at Oakes to 5.7 inches at Carrington with an average of only 0.7 inch due to two negative snow depth sites.

From January 1, 2025 through February 24, 2025, the average high air temperature for this region ranged from 13 degrees Fahrenheit at Bremen, Carrington, Harvey, Hurdsfield, McHenry, and Wing to 19 degrees Fahrenheit at Oakes with an average of 15 degrees Fahrenheit across the region. The average low air temperature for this region for this period ranged from -7 degrees Fahrenheit at Pickardville to -1 degree Fahrenheit at Edgeley with an average of -4 degrees Fahrenheit across the region.

Very little precipitation is forecasted for the month of March at this time for most of the region.

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