

Additional Resources

Spring frost damage

- **Spring Frost Damage to Early-Planted Corn**, Jeff Coulter, University of Minnesota (<http://blog.lib.umn.edu/efans/cropnews/2010/05/spring-frost-damage-to-early-p.html>)
- **The Corn Growers Field Guide for Evaluating Crop Damage and Replant Options**, Dale Hicks and Seth Naeve, University of Minnesota (<http://www.soybeans.umn.edu/pdfs/CornGuide.pdf>)
- **Assessing Frost Damage to Young Corn**, R.L. Nielsen, Purdue University (<http://www.agry.purdue.edu/ext/corn/news/articles.98//p&c9818.html>)
- **Corn Stand Evaluations**, Jeff Coulter, University of Minnesota (<http://blog.lib.umn.edu/efans/cropnews/2010/05/corn-stand-evaluations-1.html>)

Glyphosate resistant weeds

- **Glyphosate, Weeds and Crops: Several publications**, (consortium of 16 universities) (<http://www.glyphosateweeds crops.org>)
- **Glyphosate-Resistant Weeds Confirmed in Minnesota**, Jeff Gunsolas, University of Minnesota (<http://www.extension.umn.edu/cropnews/2008/08MNCN10.html>)

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What's inside?

- Evaluating frost damage in early stage corn
- Scouting for glyphosate (ex. Roundup) resistant weeds



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Focus on Ag

Dear Ag Producer,

The miserable weather last week slowed recovery of early-stage corn that was injured by frost on May 9. The first article in this edition is a refresher on evaluating frost damage in young corn.

I've also included some information on looking for Roundup® (glyphosate) resistant weeds. Glyphosate resistance is difficult to identify, because it can look like poor performance from a number of different factors (poor timing, poor coverage, etc). You'll find a checklist in the article and some tips on what to look for in problem areas to sort out performance issues from resistance. If you suspect glyphosate resistance in any of your fields, I'd be interested in hearing from you.

In Minnesota, two glyphosate resistant weeds have been identified, giant ragweed and tall waterhemp, in nine confirmed and six suspected locations. The closest documented cases to us are in McLeod and Sibley counties where resistant giant ragweed and waterhemp have been found. To delay or prevent resistance from developing, weed scientists recommend using an integrated approach that does not rely on a single herbicide or single mode of action for weed control.

Finally, if you are an irrigator and interested in knowing how much nitrate-N you apply through your water during the growing season, I'd like to hear from you. My hope is to follow a couple of irrigation wells over the season to see if concentrations change and get a picture of the total nitrate applied.

Here's wishing you a safe and successful spring!

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Evaluating frost damage in early stage corn

Last week's cold, wet weather added stress to young corn plants that were injured by frost on May 9. Since cool temperatures slow both recovery and deterioration, it takes several days to see the extent of the damage. The warm weather forecast for this week should make it possible to evaluate frost damage and stands.

Figure 1 shows a corn plant with significant frost damage to the emerged leaves. While the corn looks terrible in this photo, chances are very good that this early stage corn will completely recover.

Recovery of frost damaged plants depends on whether or not the growing point was damaged. Since the growing point of the corn plant is below the soil surface and generally protected until the 5th or 6th leaf stage, frost that occurs during earlier leaf stages typically will not kill the plant.

You can inspect the growing point by digging up a corn plant and splitting the stem vertically. Look for the growing point at the tip of the pyramid-shaped tissue below the rolled up leaves (Figure 2). If it is firm and yellowish-white, the growing point is healthy and the plants should recover. Plants killed by a frost will have growing points that are soft and brown or grayish in color.

A recovering corn plant in Figure 3 is showing new leaf tissue 60 hours after the frost. Corn that was injured in the May 9 frost will most likely be showing signs of recovery like this. If frost did kill the first couple of leaves, keep that in mind when you're staging corn for postemergence herbicide applications.



Figure 3. Young corn plant recovering 60 hours after frost damage. Photo courtesy of R. Nielsen, Purdue University.

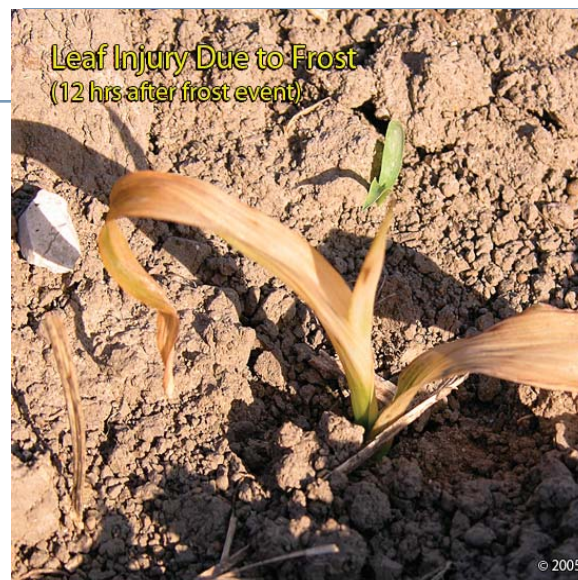


Figure 1. Leaf injury on young corn plants 12 hours after frost. Photo courtesy of R. Nielsen, Purdue University.

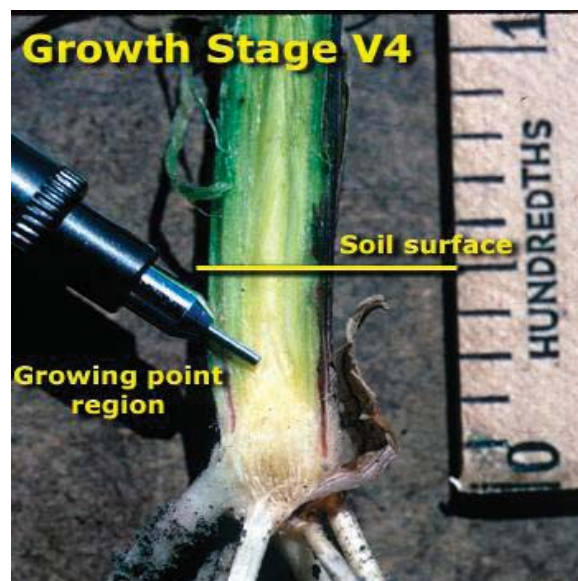


Figure 2. Growing point of V4 corn. Photo courtesy of R. Nielsen, Purdue University.

Potential yield impact

Researchers in Wisconsin concluded that frost occurring early in development has relatively little impact on yield (before third leaf-collar stage). In their study, they simulated a hard frost by completely defoliating but not killing all of the two leaf-collar stage corn plants. They found that yields were reduced by 8 percent, less than the expected impact from a delayed replanting. For information on stand loss and replanting decisions from frost or hail damage at later stage corn, see the links in Additional Resources.

Herbicide resistant weeds are not new in Minnesota. The first case, an atrazine resistant lambsquarters, was identified in 1982. Since then, 14 different types of herbicide resistance have been documented in the state impacting thousands of acres in corn, soybeans, sugarbeets and wheat. Glyphosate resistant giant ragweed and waterhemp are the most recent additions to this list.

Glyphosate resistance

Glyphosate (Roundup and others) resistance in weeds is difficult to confirm, because low-level resistance can look like poor control from any number of factors: improper application rate or timing, poor spray coverage, weed stress, unfavorable weather, etc. At low-levels of resistance, significant injury in the weed population does occur at the labeled rate and small plants can be killed. Contrast this with herbicide groups (ex. triazines) where a high level of resistance has been documented. In these situations, labeled rates generally cause only minimal injury to the resistant weed population and they can, in fact, survive applications at 10 times the labeled rate.

Scouting for resistance: a checklist

Since glyphosate resistance is difficult to identify, first rule out other factors that might have affected herbicide performance. Scout fields 10 to 14 days after application to look for "escapes." If you find surviving plants, can other factors explain the poor control?

- Was the proper rate of glyphosate applied at the correct time?
- Was the spray coverage complete?
- Were the weeds stressed, making them less able to absorb herbicide? (drought, cold, etc.)
- Did it rain before the glyphosate was completely absorbed?
- Did the weeds emerge after the application?
- Is the weed naturally tolerant to glyphosate? (yellow nutsedge, morningglories, wild buckwheat)

If these factors or a naturally tolerant species can't explain the surviving plants, ask the following questions:

- Has glyphosate been used frequently in the past or has resistance been confirmed in the region?

Scouting for glyphosate resistant weeds

- Did glyphosate fail in the same area of the field in the previous year?
- Did only **one species** escape control? If other weeds listed on the product label were controlled, then the glyphosate worked and resistance may be possible. Typically, only one species will show resistance in any one field. If other weed species were not controlled, then consider something other than resistance, such as the factors listed above.
- Does glyphosate typically control the weed that "escaped?"
- Is there a continuum of response to the glyphosate (Figure 4)? There should be dead plants, both of the suspected resistant weed and other species listed on the product label. There should also be a range of injury symptoms in the surviving plants and may include the following:
 - Stunting (seen on the far left in Figure 4)
 - Yellow and white areas on the plant
 - Plants where the main stem was killed and there is subsequent branching
 - Plants that appear normal (seen on far right in Figure 4)

If most of these conditions exist, then glyphosate resistance may be possible. Control the surviving weeds with an herbicide with a different mode of action; Don't attempt to control them with another application of glyphosate. A very useful (short) video on scouting for resistance, developed by Dr. Jeff Stachler at North Dakota State University, can be found at www.ag.ndsu.edu/glyphosateresistance.



Figure 4. Continuum of response to glyphosate in resistant population 3 weeks after application: Dead and stunted plants to healthy plants. Photo taken by Jeff Stachler, NDSU/U of M