SDSU Extension

iGrow Soybean

BEST MANAGEMENT PRACTICES

Chapter 51:
Assessing Spring Frost and Hail Damage

Nathan Mueller
Robert Hall
Kyle Gustafson

Spring frost and hail (Fig. 51.1) can result in partial to total destruction of a soybean crop early in the growing season. Agronomists, producers, and insurance agents need accurate estimates of these spring damages to make good recommendations on the decision to replant. The purpose of this chapter is to provide information and general rules of thumb (Table 51.1) for managing spring frost injury and hail damage.

Figure 51.1. Hail-damaged soybeans. (Left photo: http://www.extension.iastate.edu/CropNews/2008/0531PallePedersen.htm; Right photo: http://www.sciencephoto.com/image/15178/530wm/B2650152-Hail_damaged_soybean_plants-SPL.jpg)

Table 51.1. Rules of thumb for managing spring frost and hail damage.

1. Contact your insurance agent and follow directions to maintain insurance coverage on your soybean field.
2. Assess damage three to five days after the event
3. Determine economic ramification of the event.
4. Determine if the field should be replanted or left alone.
    a. Yields can decrease from ¼ to ½ bushel per acre per day from planting May 28 to June 14, respectively in South Dakota.
    b. A thin and uneven soybean stand in May and June has a great potential to compensate, resulting in little yield loss.
    c. If the average surviving soybean plant population is 75,000 or more after June 10, leave it alone even if one-foot gaps exist in the row.

When to scout and assess damage

All crop producers agree that assessing crop damage is a very emotional experience. If you assess damage too soon after a spring frost or hail event, you run the risk of under- or over-estimating damage. Damage to soybean plants should be assessed three to five days after the event to minimize rash decisions to replant, allow time for potential crop recovery, and schedule a field visit with your insurance agent. However, it is appropriate to scout fields after a spring frost or hail event in your area to generate a list of fields to revisit in three to five days.

Assessing spring frost injury

Soybean fields should be scouted for potential spring frost damage when temperatures are near 32°F and below for several hours since temperatures across the landscape are uneven. Low-lying areas may have experienced cooler temperatures than neighboring areas of higher elevation. In general, a 28°F air temperature or below for several hours is considered a severe low temperature event causing significant damage in soybean. The growing point(s) or bud(s) are above the ground in soybean, unlike corn early in the season. For this reason, assessing aboveground growth in soybean is a good indicator of potential recovery.

Generally, after a moderate frost, new buds could appear in about three to five days if temperatures increase enough to spur growth. If the seedlings are totally black below the cotyledons, the frost most likely killed the plant and there is no chance for recovery. If cool temperatures persist then you have two choices. First, you can go ahead and make a pre-mature decision that may or may not be to your advantage; or second, you can wait until temperatures rise to the point that plants will begin to recover (new growth or no growth). Remember, you are relying on the plants to show you that they have the potential to recover from injury.

Often the most vivid symptoms of freeze injury in soybean immediately following the frost or a few days later are the appearance of the leaves. Generally, water-soaked areas will appear on the leaves. These spots will turn brown in a few days if the frost event was moderate. In cases where the leaves appear black and/or are disintegrating, then the frost was severe. Even though the appearance of the leaves following a spring frost or freezing event may result in leaf defoliation, defoliation itself is not the most important factor. The primary goal in the assessment is to determine the number of plants with new buds that can recover. To make this assessment:

- Determine if a live plant has bud(s) available for regrowth.
- Determine the amount of live soybean plants per acre using guidelines in "Determining plant population after spring frost or hail."

The terminal growing point or bud (apical meristem) is a region of actively dividing cells located at the tip of the main stem (see Chapter 3). The terminal bud, along with the axillary buds located in the axil between the main stem and each leaf stem, all have the potential for regrowth if they are intact. The two cotyledons, the two unifoliolate leaves, and all the trifoliolate leaves have an axillary bud.

If the seedling was at the V1 stage (one trifoliolate leaf), the seedling would have a terminal bud plus axillary buds at the cotyledons, unifoliolate leaves, and the one trifoliolate leaf for a total of one terminal bud; and five axillary buds for a grand total of six buds available for regrowth (Chapter 3). Growing points are critical because they create all of the plant's leaves, buds and stems, and terminate in the uppermost trifoliolate leaf and its associated buds and pods. Therefore, if there is no terminal or any axillary buds, the plant has no means of recovering. Only one bud (terminal or axillary) is needed for regrowth and recovery.

Assessing spring hail damage

Hail damage can occur almost anytime during the growing season. However, hail damage in May and June needs to be critically evaluated to determine if replanting is an economically viable option. Hail causes defoliation and stem bruising/breakage. The amount of yield loss is dependent on growth stage, amount of damage, and surviving plant population.

The ability of soybean to recover from hail is similar to its ability to recover following frost injury. Again, when assessing damage, use the guidelines listed under spring frost injury. In many cases, the leaves may be stripped from the plant and recovery is possible if buds exist. Plants cut off below the cotyledons have no means of regrowth. If damaged plants are completely defoliated but have a stem, you still must look for axillary buds. Look for scars where the leaf stems were attached before the hail. If you can find the scars where the cotyledons were attached, you should find an axillary bud immediately above each of the two scars where the cotyledons were attached. If they are present, the plant has the potential to recover.

Determining plant population after spring frost or hail

Two ways to determine plant populations are 1) row width method (easier with 15-inch or wider rows) and, 2) the Hula Hoop® method (easier in drilled rows).

In the row width method, count the number of live plants (based on the discussion above on assessing frost injury and hail damage) in an area equivalent to 1/1000th of an acre in at least five locations and determine the average. It is always best to randomly select locations to get a good average. This length of row is dependent on the row spacing (Table 51.2). The population is the number of plants within that distance times 1,000. If the rows spacing is not listed, use the equation: Row length = (43,560 ÷ Row width in feet ÷ 1000).

Table 51.2. Row width method. When using this method, determine the plant population by counting the number of live plants in 1/1000 of an acre. The row length is dependent on the row width.

Row Width (inches)	Row Length Needed to represent 1/1,000th of an acre
30	17 feet, 5 inches
20	26 feet, 2 inches
15	34 feet, 10 inches

Plant populations can also be determined using the Hula Hoop® method. To use this method:

1. Randomly toss the hoop (any circular object similar to a Hula Hoop®) in at least five locations.
2. Count the plants within each of the five hoop counts, total them, and divide by five to obtain an average count.
3. Multiply the average hoop count by the multiplier factor listed in Table 51.3. For example, if the inside hoop diameter is 36 inches, multiply your average hoop count by 6,165 to obtain your estimate.
4. If the inside diameter of your hope is not listed, use the equation:
   - ▹ Multiplier factor = 43,560 ÷ (0.785 × diameter × diameter ÷ 144). The plants/acre is the counted number of plants in a hoop times the multiplier factor.
   - ▹ Small hoop diameters are less preferred (less than 18 inches).

Table 51.3. The Hula Hoop® method uses the inside diameter of a hoop and a multiplier factor for calculating the number of plants in an acre.

Diameter of Hoop (inches)	Multiplier Factor
18	24,662
24	13,872
30	8,878
36	6,165

Managing poor soybean stands with offset or patch planting

In most situations, the soybean plant has a large capacity to fill in low to moderate damage (Pepper, 1997; Whigham et al., 2000). Random loss of soybean plants across a field from hail damage is less worrisome if more than 75,000 live plants per acre still exist. Research in Minnesota showed no yield decrease even if one-foot gaps existed in the row with a soybean stand of 75,000 plants per acre compared to a full stand (150,000 plants/acre) prior to the V4 growth stage (Hicks et al., 1990).

Hick et al. (1990) found that even two-foot gaps in the row with a stand of 75,000 plants per acres decreased yield by only four bushels/acre prior to the V4 growth stage. However, frost damage may have impacted low-lying areas within a field, where a decision to replant these portions is clear. Unfortunately, the decision to replant a soybean field is not always very clear. Before replanting, consider the size and extent of the damage. Information on replanting options is provided in Table 51.4.

In some situations, yield losses resulting from poor plant stands can be reduced by offset seeding or patching the problem areas. Patching the problem areas might involve seeding an additional row next to the emerged row. To conduct offset planting, the planter must be shifted from its normal position. One problem with this approach is that original and offset rows will be at different growth stages. Other problems to be considered in offset seeding include different soybean stages and offset rows during chemical application as well as variable stands and grain moisture levels at harvest. Yield advantages are higher when the original row has a gapped pattern rather than a uniform pattern (Pepper, 1987).

Final planting dates

The final planting date for full insurance coverage is June 10 in South Dakota with delayed planting coverage until July 5 (Chapter 46). Consider reducing the maturity rating by 0.5 from normal if replanting occurs in mid-June and at most by 1.0 if replanting in early July to minimize the risk of frost damage during seed fill (Table 51.5). When considering late planting or replanting, it is important to check the level of insurance coverage available with your agent. Numerous factors must be considered when considering replanting including the cost of additional operations/field passes, labor, and decrease in yield potential with later planting dates. In general, soybeans have a large capacity to compensate for thin and uneven stands.

Table 51.4. Information to consider when assessing replanting.

1. Count the surviving plants (new buds or growth) and determine the population per acre.
2. Estimate the yield without replanting. (Hicks et al. 1990, Klein and Shapiro, 2011; Robertson and Conley, 2007)
   a. A "surviving seedling" should contain one or more buds (terminal or axillary) that will enable the seedling to recover, resume growth, and produce a yield. In addition, a surviving seedling should also be able to be bent over until it touches the soil surface without breaking. If it breaks, it would most likely not have the strength to support the plant during pod filling.
   b. Soybeans have a large capacity to compensate for thin and uneven stands, especially when damage occurs during the vegetative growth stages in May and June. If the average surviving soybean plant population is 75,000 or more after June 10, leave it alone even if one-foot gaps exist in the row.
3. Estimate the yield with replanting.
   a. Yields can decrease from ¼ to ½ bushel per acre per day from May 28 to June 14, respectively in South Dakota or a total of eight bushels per acre average decrease in yield from planting on May 12 compared to June 14. (Data from 1986-2002 in Beresford, SD; Berg et al., 2002).
4. Consider reducing the maturity group of the soybean planted by 0.5 in mid-June to as much as 1.0 by early July compared to a full-season variety adapted to your area (Fig. 6.1 in Chapter 6). Data in Table 51.5 can be used to assess the change in the number of days to reach maturity with a change in planting date and maturity group.
5. Consider using narrow rows when seeding late in the season.

Table 51.5. The influence of a change in soybean maturity group rating and reseeding date on the number of days required to reach maturity. (Modified from Syngenta, 2011)

Days Between Planting Dates	Change in the Maturity Rating of the Planted Variety		
	0.0	0.5	1.0
	Change in Days Needed to Reach Maturity		
0	0	-5	-10
5	2	-3	-8
10	4	-1	-6
15	6	1	-4
20	8	3	-2
25	10	5	0
30	12	7	2
35	14	9	4
40	16	11	6
45	18	13	8
50	20	15	10
55	22	17	12
60	24	19	14

Problem 51.1. An example for using the replant tool shown in Table 51.5.

Problem: A severe hail storm on June 10 resulted in an average surviving stand of 20,000 plants/acre in a field orginally seeded on May 15 with a maturity group (MG) rating 2.0 soybean variety. What maturity rating should be used when replanting?

Answer: There are 30 days between May 15 and June 14 (four days taken to assess damage). The same soybean variety (MG 2.0) replanted 30 days later on June 14 will mature an estimated 12 days later than when originally seeded on May 15 (under the column zero change in maturity rating and 30 days between planting dates). If the MG rating of the replanted variety is reduced by 0.5 to a MG rating 1.5, it is expected that these soybeans will mature only 7 days later than the MG 2.0 soybeans seeded on May 15.

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