Hail Damage

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A hailstorm can cause yield losses in soybean ranging from slight to total destruction of the crop. Extensive research has been conducted to predict the effects of hail damage on soybean yields accurately. Results from these studies are used by hail insurance companies to assess yield losses and determine adjustment payment made to clients.

Yield loss predictions are based on two factors: a) the growth stage at the time of damage and b) the degree of plant damage. Plant damage is classified as leaf defoliation, stand reduction, stem damage and pod damage**.**

Stand reduction is a measure of the number of plants killed by the storm. The pre-storm plant population is compared with the remaining stand seven to 10 days after the storm to determine the yield loss due to stand reduction.

To determine the pre-storm population, count the original number of plants (live plants and remnants of plants) in 10 feet of row. Repeat this step several times throughout the field to get a representative sample.

Now convert the average stand per 10 feet of row to plants per acre, using the following formula:

$$\frac{\text{(average number of plants in 10-foot row)}}{\text{(row spacing in inches)}} \times 52{,}250 = \text{number of plants per acre}$$

Using the same procedure, determine the remaining live plant population.

(stand before the storm – stand after the storm) = stand loss in plants

(stand loss in plants)/(stand before the storm/100) = percent stand loss

Percent yield loss of soybean as affected by the amount of stand reduction (all stand counts x 1,000 plants/acre).

Original stand (x 1,000)	Remaining stand (x 1,000)											
	120	110	100	90	80	70	60	50	40	30	20	10
	Percent yield loss[1]											
125	1	3	6	10	14	18	24	30	36	44	54	65
120	0	1	5	9	13	17	23	29	35	43	53	64
110	–	0	3	7	11	15	21	27	33	41	51	62
100	–	–	0	3	7	11	17	23	29	37	45	59
90	–	–	–	0	3	7	13	19	25	33	43	55
80	–	–	–	–	0	4	10	16	22	30	40	52
70	–	–	–	–	–	0	6	12	18	25	35	48
60	–	–	–	–	–	–	0	7	13	20	30	45
50	–	–	–	–	–	–	–	0	8	16	25	41
40	–	–	–	–	–	–	–	–	0	11	23	39

[1] Yield loss also will depend on the growth stage of the crop.

Defoliation is measured as a percentage of the leaf area destroyed by the storm. Leaf tissue that is green and still attached to the plant will continue to produce photosynthate and is **not** considered destroyed leaf area. Research has shown that leaf loss during vegetative stages has little effect on yield. Defoliation loss is measured only in the reproductive stages for indeterminate varieties.

Percent yield loss of indeterminate soybean varieties as affected by degree of defoliation.

	Defoliation (Percent leaf area destroyed)									
Stage	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
R1-2	0	2	3	5	6	7	9	12	16	23
R3	2	3	4	6	8	11	14	18	24	33
R4	3	5	7	9	12	16	22	30	39	56
R5	4	7	10	13	17	23	31	43	58	75
R6	1	6	9	11	14	18	23	31	41	53

These tables are intended only to provide general guidelines to soybean yield losses due to hail injury. The percentage of nodes cut off or broken were not included. Even though early season soybean defoliation appears to be very devastating, research has shown that soybean plants can recover and yield fairly well under good growing conditions. The pod-setting and pod-fill periods are very susceptible to severe injury. Hail adjusters usually

will defer final yield loss determinations until later in the season. These tables and guides are being revised and updated continually as research becomes available. Specific loss predictions should be left to trained hail adjusters.

Source: National Crop Insurance Association - Soybean Loss Instruction - Pub. No. 6302.

Frost Damage

Soybean plants are damaged easily by frost in the 28 to 32 F range. Temperatures of 28 F for any extended period of time can kill soybean plants (stems and leaves) completely. During the early seedling stage (VE to VC), soybean has some tolerance to temperatures of 29 to 30 F for short periods of time. If the seedlings have been somewhat hardened off by cool temperatures for several days, then temperatures as cool as 28 F can be tolerated. Once true leaves emerge, soybean plants become more susceptible to freezing temperatures below 32 F for any extended period of time. The unifoliolate leaf stage is slightly more frost tolerant than the first or second trifoliolate leaf stages.

Late-season Frost Damage

Research information from Wisconsin has shown that all varieties tested had reduced yields when frost occurred at or before R6. Earlier-maturing varieties sustained economic yield losses from frost at more advanced growth stages than later-maturing varieties. The greatest yield losses occurred when frost occurred at stage R5. The number of beans per plant and reduced bean size contributed to overall yield loss. Maturity was hastened by some frost treatments and was not delayed in any of the trials studied.

Soybean seed on frost-damaged plants many mature and change color as early as or even earlier than nonfrosted soybean plants. The leaves tend to remain on the frost-damaged soybean plants. Seed moisture may be slightly higher and seed size usually is reduced as the soybeans dry and shrink. A frost will not hurt soybean yields if the soybean growth stage is beyond R7. A frost between R6 and R7 may or may not affect yield, depending on the temperature and duration of the freeze.

Beans that are still green and soft will shrivel. Stalks rapidly turn dark green to brown and will not recover. Beans in pods that have turned yellow will mature normally. Some green beans will turn yellow after 30 to 40 days of storage.

Growers and researchers through the years have tried to use color keys such as yellow soybean leaves, yellow pods and brown pods to estimate soybean

maturity and safety from frost. Generally these methods didn't work because of differences in varieties regarding symptoms of maturity. However, studies do show that "yellow" pods sprinkled with brown are the best clue of physiological maturity.

Open pods and check shrinking of beans and look for separation of beans from the white membrane inside the pod. This indicates the soybean plants are physiological mature and fairly safe from frost injury. Pods do not all mature evenly. Note that if one or two pods on any of the upper four nodes have turned brown and other pods are light yellow to tan, the soybean plants are fairly tolerant to a killing frost. In the event of a leaf-killing frost when pods are still light green or yellow, wait until the pods are mature in color before combining. The most significant effect of an early frost on soybean may be in the reduction in their value as a future source of seed.

Generally speaking, soybean fields planted to narrow row spacings (6 or 7 to 12 inches) may have slightly more tolerance to light frosts than soybean planted in wider rows (30 to 36 inches). The heavy plant canopy of the solid-seeded, closely drilled beans tends to hold the soil heat better and therefore protects the plants to some degree.

Estimating Soybean Yields

Soybean yield estimates are most accurate within three weeks of maturity but are still only estimates. Assume 2.3 beans per pod.

- Determine the number of feet of row needed to make 1/1,000 of an acre (table below).
- In the determined area, count the number of plants in 10 different randomly selected sample areas. Calculate the average.

  Avg. = _____ = A (plants/acre)

- Count the number of pods per plant on 10 randomly selected sample areas. Calculate the average.

  Avg. = _____ = B (pods/plant)

- Calculate pods/acre by multiplying plant population by pods/plant.

  A X B = _____ = C (pods/acre)

- Calculate seeds/acre by multiplying pods per acre by an estimate of 2.3 seeds/pod.

  2.3 X C = _____ = D (seeds/acre)

- Calculate pounds/acre by dividing seeds/acre by an estimate of 3,000 seeds/pound.

  D ÷ 3,000 = _____= E (lbs/acre)

- Estimate yield by dividing pounds/acre by 60 pounds/bu.

  E ÷ 60 = _____ = yield (bushels/acre)

Row length equal to 1/1,000 acre

Row width	Length of a single row equal to 1/1,000 of an acre
(inches)	
6	87′ 1″
7	74′ 8″
8	65′ 4″
10	52′ 3″
15	34′ 10″
20	26′ 2″
28	18′ 8″
30	17′ 5″
32	16′ 4″
36	14′ 6″
38	13′ 9″
40	13′ 1″