

Soybean Replant

DECISIONS



SOYBEAN REPLANT DECISIONS *should be based on accurate stand count and interacting factors, including yield potential of the existing stand, planting date, maturity group, and the true cost of replanting. Unfortunately, producers tend to make replant decisions based on quick visual estimations that often underestimate the existing plant population. Seedlings are usually in an early-vegetative growth stage with only a few leaves when early stand counts are made. Narrow row widths exaggerate the impression of a low stand level because there are larger within-row spaces between plants.*

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Hail damaged soybeans.



Planting into a poor seedbed, use of poor quality seed, inaccurate planter adjustment, planting “too fast,” soil crusting, soil moisture extremes, and environment-induced plant injury—pesticide drift, insects or disease pathogens, frost, and hail—contribute to inadequate soybean stands.

Causes of Stand Reduction

MANY FACTORS CONTRIBUTE TO INADEQUATE soybean stands, including planting into a poor seedbed, use of poor quality seed, inaccurate planter adjustment, planting “too fast,” soil crusting, soil moisture extremes, and environment-induced plant injury (pesticide drift, insects or disease pathogens, frost, and hail). Taking steps to identify and correct the cause of a poor quality stand where possible prevents repeating the problem in a replanted stand.

In most situations, stand reduction occurs in two forms: not uniform across the field, or gaps within the row. Stand reductions are frequently patchy in their distribution. Examples of nonuniform stand reduction include poorly drained drowned-out areas, sandy areas with insufficient moisture,

compacted high-traffic field areas, and field boundaries injured by pesticide drift. Size and location of the poor stand area must be considered before replanting. Consider, for example, a drowned-out area of less than one acre isolated in the middle of a field. Time required to replant the area (and potential damage to the existing crop incurred as a result of driving equipment to the isolated area) may not be worth the return gained by replanting.

Gaps of less than 2 feet in diameter can be compensated for by adjacent soybean plants, which fill in the gaps by developing branches. These branches develop pods and seed that compensate for seed production lost by the reduced stand. Gaps greater than 2 feet in diameter usually contribute to reduced yield.

TABLE 1

Percentage of full-yield potential for soybeans, as influenced by plant density established and stand reduction 2 to 4 weeks after planting.

Stand reduction (%)	Plants per foot of row		
	8	6	4
	Percent of yield potential		
0 (full stand)	100	97	95
10	98	96	93
20	96	93	91
30	93	90	88
40	89	86	83
50	84	81	78
60	78	75	73

The reduction in stand was achieved by random placement of 12-inch gaps within 30-inch rows and the “plants/foot of row” were without gaps or skips.

Source: University of Illinois.

Relationship between Yield and Plant Stand

SEVERAL UNIVERSITY RESEARCH STUDIES have evaluated the yield potential of soybean stands. Results indicate that stand levels can vary widely without significant yield loss. A study conducted by University of Illinois researchers is summarized in Table 1.

Established stands of 8, 6, and 4 plants per foot in 30-inch rows equal approximately 140,000, 105,000, and 70,000 plants per acre (PPA), respectively. “Full stand” established populations ranging from 70,000 to 140,000 PPA differed in “full-yield potential” by only 5 percent. **These results suggest that soybeans compensate for low stands, producing yields that differ only slightly across a wide range of planted populations.** The data suggest that yield potential decreases by 2 to 6 percent for each 10 percent decrease in stand (up to 60 percent stand

reduction). Stands of 8 plants/foot had 2 to 3 percent greater yield than stands of 6 plants/foot, and stands of 6 plants/foot had 5 to 6 percent greater yield than stands of 4 plants/foot.

Differences in yield potential (Table 1) between 4 plants/foot established at planting versus 4 plants/foot resulting from 50 percent stand reduction emphasize the importance of both stand reduction timing and stand uniformity on yield potential. Researchers consider a stand of 8 plants/foot optimum (100 percent of yield potential).

Results from the University of Minnesota indicate that timing of stand reduction also is important. The study evaluated the effects of stand reduction at different growth stages on yield and is summarized in Table 2.

Reducing soybean plant density at the VC and V3 stages resulted in

similar yield responses, except that VC stand reduction to 50,000 PPA produced yields higher than the same population at V3. Yield responses to stand reductions at the V6 stage of development were lower than VC and V3 when the plant densities were less than 100,000 PPA. Yield compensation by the remaining plants was less at the V6 stage when the populations were less than 100,000 PPA. Soybean stands of 75,000 PPA with 1-foot gaps produced similar yields to those with uniform stands at the same population. However, 2-foot gaps in the row at the same population resulted in a greater yield reduction. These studies indicate that soybean stands may be reduced early in the growing season without significant yield loss. **Stand reduction occurring during late vegetative stages may result in greater yield loss.**

TABLE 2

Effect of plant density at three stages of development on soybean yield.

Plant density	Thinning stage		
	VC ^a	V3	V6
Plants/acre	Bushels/acre ^b		
150,000 (no thinning)	45.1	45.5	45.3
125,000	44.8	46.0	45.0
100,000	45.1	48.1	44.0
75,000	44.2	44.7	41.4
50,000	41.6	38.5	33.3
1-ft gaps ^c (75,000)	43.6	43.8	40.2
2-ft gaps (75,000)	41.5	41.3	38.8

^a VC, cotyledon stage; V3, third node stage; and V6, sixth node stage.

^b LSD (0.05) = 2.1 bushels/acre difference between any two means.

^c 1- and 2-foot within row gaps were applied 2–4 weeks after planting

Source: University of Minnesota.



Wait several days after soybeans have emerged or are damaged by hail, chemicals, or other causes and count only live plants when determining stand levels.

Estimating Plant Stands

UNDERSTANDING HOW TO ACCURATELY estimate soybean plant population is an important component of replant decisions. Wait several days after soybeans have emerged or are damaged by hail, chemicals, or other causes and count only live plants when determining stand levels. If the plants are damaged by hail or chemicals, healthy soybean plants should start regrowth within a few days after being damaged. Loss of soybean leaf tissue is less serious than stem damage and will have little effect on yield, provided some leaf tissue

remains on the plant. Soybean plants severed below the cotyledons by hail or mechanical damage have no potential for regrowth and should be considered dead. Bruised plants may not survive damage, depending on the severity of the bruise and the presence of disease organisms. Monitor weather conditions closely for several days after stands are damaged. A period of sunny, warm weather should allow a greater percentage of damaged plants to recover and survive. A prolonged period of cool, damp conditions after

Evaluating soybean population.



Hula-hoop use for stand counts.



TABLE 3

Plant density for common row widths based on the average number of plants/foot of row.

Plants/foot of row	Plants per acre						
	Row width (inches)						
	38	36	30	20	15	10	7
1	13,800	14,500	17,400	26,100	34,800	52,300	74,700
2	27,500	29,000	34,800	52,300	69,700	104,500	149,300
3	41,300	43,600	52,300	78,400	104,500	156,800	224,000
4	55,000	58,100	69,700	104,500	139,400	209,100	298,700
5	68,800	72,600	87,100	130,700	174,200	261,400	373,400
6	82,500	87,100	104,500	156,800	209,100	313,600	
7	96,300	101,600	122,000	183,000	243,900		
8	110,000	116,200	139,400	209,100	278,800		
9	123,800	130,700	156,800	235,200	313,600		
10	137,600	145,200	174,200	261,400			
11	151,300	159,700	191,700	287,500			
12	165,100	174,200	209,100	313,600			
13	178,800	188,800	226,500				
14	192,600	203,300	243,900				
15	206,300	217,800	261,400				

plants are damaged, however, restricts plant regrowth and allows disease organisms to thrive. If hail has caused the stand reduction, a trained hail-adjusting professional should be consulted for accurate yield loss estimates.

When estimating the number of plants remaining in a reduced stand, randomly sample several areas of the field. Within-row gaps should be included in random samples for stand counts. Do not restrict plant stand estimates to only the best- or worst-appearing areas. Make at least 10 random stand counts in areas where the stand is reasonably uniform. With

a tape measure, mark off the appropriate row length representing $\frac{1}{1000}$ th of an acre for the desired row width. Record the average stand counts as plants per foot of row.

The length of row needed to represent $\frac{1}{1000}$ th of an acre varies by soybean row width as follows:

- 38-inch row width = 13 feet, 9 inches
- 36-inch row width = 14 feet, 6 inches
- 30-inch row width = 17 feet, 5 inches
- 20-inch row width = 26 feet, 2 inches
- 15-inch row width = 34 feet, 10 inches
- 10-inch row width = 52 feet, 3 inches
- 7-inch row width = 74 feet, 9 inches

Use Table 3 to determine the field's estimated plant density. Plant density also can be estimated by counting plants per square yard or plants inside a circle of a known area. The hula-hoop method can be used to rapidly count plants, especially in narrow row widths. Toss or roll the hoop into the area to be counted and allow it to fall at random, then count plants inside the circle. Average at least 10 samples for a reliable estimate of plant density. Table 4 provides information to determine plants per acre if plant counts are based on plants per square yard (9 ft^2) or plants inside a circle.

TABLE 4

Plant density per square yard and circle measurements based on number of plants counted per square yard or circle.

Plants counted	Square yard	Plants per acre								
		Circle measurements (inside diameter in inches)								
		38	37	36	35	34	33	32	31	30
10	48,000	55,000	58,000	62,000	65,000	69,000	73,000	78,000	83,000	89,000
12	58,000	66,000	70,000	74,000	78,000	83,000	88,000	94,000	100,000	107,000
14	68,000	77,000	82,000	86,000	91,000	97,000	103,000	109,000	116,000	124,000
16	77,000	89,000	93,000	99,000	104,000	110,000	117,000	125,000	133,000	142,000
18	87,000	100,000	105,000	111,000	117,000	125,000	133,000	140,000	150,000	160,000
20	97,000	111,000	117,000	123,000	130,000	138,000	147,000	156,000	166,000	178,000
22	106,000	122,000	128,000	136,000	143,000	152,000	161,000	172,000	183,000	196,000
24	116,000	133,000	140,000	148,000	157,000	166,000	176,000	187,000	200,000	213,000
26	126,000	144,000	152,000	160,000	170,000	179,000	191,000	203,000	216,000	231,000
28	136,000	155,000	163,000	173,000	183,000	193,000	205,000	218,000	233,000	249,000
30	145,000	166,000	175,000	185,000	196,000	207,000	220,000	234,000	250,000	266,000
32	155,000	177,000	187,000	197,000	209,000	221,000	235,000	250,000	266,000	284,000
34	165,000	188,000	199,000	209,000	222,000	235,000	250,000	265,000	283,000	302,000
36	174,000	199,000	210,000	222,000	235,000	249,000	264,000	281,000	300,000	
38	184,000	210,000	222,000	234,000	248,000	263,000	279,000	297,000		
40	193,000	221,000	234,000	247,000	261,000	277,000	294,000			
42	203,000	232,000	245,000	259,000	274,000	290,000				
44	213,000	243,000	257,000	271,000	287,000	304,000				
46	223,000	255,000	269,000	284,000	300,000					
48	232,000	266,000	280,000	296,000						
50	242,000	277,000	292,000							
52	252,000	288,000	304,000							
54	261,000	299,000								

Example: 24 plants counted inside a 34-inch circle = 166,000 plants/acre.

Replant Decisions

Yield results suggest that planting dates through mid-May provide the best chance of attaining maximum soybean yield potential. Delaying planting until early June (or later), resulted in consistent, significant loss of soybean yield potential at all locations.

PRODUCERS EVALUATING A REDUCED soybean stand may be tempted to replant directly into the stand and thicken existing stand levels. This “quick fix” is not recommended. Replanting into the existing stand results in nonuniform plant sizes causing uneven competition for light, moisture, and nutrients. Smaller plants suffer due to the competition from larger adjacent plants and may actually act as weeds competing with larger plants.

After the producer determines 1) the cause of soybean stand loss, 2) the uniformity and estimated plants per acre of the remaining stand, and 3) the yield potential of the remaining stand, he or she can make an informed soybean replant decision. Current and forecasted weather conditions, estimated date of replanting, the real costs of replanting, yield potential of a replanted field, and opportunity cost of time spent replanting, also need to be considered. Real costs include input

costs (e.g., seed, fuel, pesticides), equipment depreciation, interest on a loan to replant, risk of yield loss due to early fall frost damage on late-planted soybeans, and labor costs. **Economically, a soybean stand of 73,000 (or more) healthy, uniformly spaced plants per acre in early June or later is probably worth keeping,** according to research results from the University of Minnesota and the University of Illinois.

If a reduced stand is saved, weed control must be a greater priority. Reduced soybean stands allow additional light to reach the soil surface and more weeds to compete with the soybean plants. Monitor the field closely and use appropriate management practices to minimize the impact of weed competition on yield.

If the decision is made to replant, consider planting the crop in intermediate (10–20 inches) or narrow (less than 10 inches) row widths, and use a

TABLE 5

Effect of planting date on soybean yield in Iowa (1995 to 1997).

Planting date	Northern Iowa	Central Iowa	Southern Iowa
	Relative yield (percent of potential yield)		
Late April	100*	96*	98*
Early May	96*	100*	100*
Mid-May	99*	96*	98*
Early June	81	93	89
Mid-June	61	59	82
Early July	33	45	47

* Not statistically different from 100 percent.

seeding rate 10–20 percent higher than normal. These management strategies are recommended because late-planted soybeans remain shorter and have fewer pods and seeds per plant than earlier-planted soybeans of the same variety. Late-planted wide-row (30 inches or more) soybeans probably will not close the canopy between the rows, allowing sunlight to reach the soil surface. Failure to achieve canopy closure limits photosynthesis and promotes weed growth and competition. **Use of narrower rows and slightly higher seeding rates increase plant growth efficiency of late-planted soybeans, resulting in more pods per acre and reduced weed competition.**

Consider Date of Planting

Soybean planting date studies provide useful yield loss potential information. Studies at Iowa State University evaluated dates of planting at five locations (two in northern Iowa, one in central Iowa, and two in southern Iowa) from 1995 to 1997. Results are summarized in Table 5.

TABLE 6

Interaction between planting date and maturity group on physiological maturity date, days from VE to R8, and relative yield for soybeans grown in Iowa, 1997.

Planting dates	Maturity group								
	2.2			2.5			2.9		
	Date ^a	Days ^b	Relative ^c	Date	Days	Relative	Date	Days	Relative
	Yield (%)			Yield (%)			Yield (%)		
Late April	9/30	137~	100	9/17	132	100	9/25	131	100
Mid-May	10/3	134	96	9/21	118	91	9/25	126	88
Early June	10/5	116	91	9/26	107	72	10/1	111	75
Late June	10/14	108	67	10/2	99	61	10/6	103	54
Early/mid-July	10/14	104	61	10/15	95	38	10/15	99	40

^a Harvest date (month/day).

^b Days between growth stages VE to R8.

^c Relative yield = percent of potential yield for the average of six varieties.

Yield results suggest that planting dates through mid-May provide the best chance of attaining maximum soybean yield potential. Soybeans planted from late April through mid-May yielded similarly at all locations. Two conclusions can be drawn from these results: 1) soybeans respond favorably to early-planting dates (i.e., if soil conditions are fit for planting and weather is favorable for early soybean growth), and 2) the potential risk of stand-reducing late-spring frost is offset by the opportunity to capture maximum soybean yield potential, particularly if early-season growing conditions are favorable.

Planting dates from late April through mid-May produced similar yields. **Delaying planting until early June (or later), however, resulted in consistent, significant loss of soybean yield potential at all locations.** Yield loss potential was most obvious in northern Iowa, where soybeans planted in early June yielded nearly 20 percent less than those planted in late April. Further planting delays until mid-June

resulted in yield losses of 40 percent or more in northern and central Iowa. These results suggest that producers replanting in early July should expect to capture only 33 to 50 percent of the yield potential available when planting before mid-May.

Consider Soybean Maturity Group

In planting date studies, Iowa State University researchers evaluated six varieties with a range of maturity groups (MG) adapted for each testing location. Varieties ranged in MG from 1.4 to 2.5 planted at northern Iowa sites, 1.9 to 3.2 in central Iowa, and 2.2 to 4.1 in southern Iowa. Varieties tested at each location represent MG extremes of early and late maturity to answer producer questions about switching to earlier MG varieties with planting delays. Conclusions about the yield response interaction of MG with planting date follow:

- In northern Iowa, the highest yields were most consistently produced using full-season (2.5 MG) varieties planted from late April to late June.
- All varieties yielded similarly on planting dates through late June in central Iowa; however, very full-season varieties (3.2 MG) may not mature before frost occurs in the fall when planting is delayed until early July.
- In southern Iowa, full-season varieties tended to yield best on planting dates through early July. However, when planting was delayed until mid-July, varieties ranging in maturity from 2.2 to 2.9 yielded highest.

Producers should plant their original soybean variety selection unless planting is delayed beyond late June in northern and central Iowa and beyond early July in southern Iowa.

Producers are frequently concerned about late maturity of full-season varieties planted in mid-June or later. Soybean yield potential and seed quality may be negatively affected if frost damages the soybean crop before the plants reach the R7 (beginning maturity) developmental stage. Data concerning planting date's effect on maturity date, days from emergence to maturity, and relative yield potential of three varieties are summarized in Table 6. The varieties profiled in Table 6 are representative of the MG designation and were evaluated in the region of Iowa where that MG is considered a full-season variety (i.e., MG 2.2 was evaluated in northern Iowa, MG 2.5 in central Iowa, and MG 3.2 in southern Iowa). Late-April planting resulted in 1) longest VE to R8 (emergence date to full-maturity date) period, 2) earliest maturity dates, and 3) greatest relative yield for all three varieties. The VE to R8 period was reduced by 33 (MG 2.2),

37 (MG 2.5), and 32 (MG 3.2) days when planting was delayed from late April until July. Late April-planted soybeans required 20–25 days to emerge, whereas those planted in July emerged within 3–8 days of planting. Days between VE and R1 (beginning flower) stages varied for each variety, with longer VE-R1 periods associated with earlier planting dates. Similarly, earlier planting dates were associated with longer reproductive growth periods (R1 to R8) for all varieties. **The positive yield response of soybeans to early planting dates is due to extended vegetative and reproductive growth periods. An 8 to 10 week difference in planting date is reduced to a 2 to 4 week difference in physiological maturity.** Day length and temperature are environmental factors responsible for this compression in the growing season associated with delayed planting. Varieties of the same maturity group may not respond the same in different environments.

Summary

IF PRODUCERS CAN ACCURATELY ESTIMATE a surviving stand they must evaluate the economics of replanting. Consider the yield potential of late-planted soybeans, along with costs associated with late planting. Final stands of at least 73,000 PPA consistently yielded more than 90 percent of optimum. Soybeans planted after mid-June probably have few options for replanting, but the producer can estimate the yield potential of the crop by determining the surviving stand and use the tables in this bulletin. Soybeans compensate for low stands and produce yields that differ only slightly across a wide range of populations. A soybean stand with the potential to yield 90 percent or more of optimum should be saved and not replanted because the costs associated with replanting probably are greater than the return from replanting.

The important issues for the producer to consider are 1) yield of the surviving stand versus yield of a replanted stand, and 2) cost of replanting versus losses resulting from surviving stand. If the decision is made to replant, consider planting the crop in intermediate- or narrow-row widths. Changing the variety to an earlier maturity may not be necessary unless the planting date is delayed until late June or early July. Soybeans planted in mid-June or later flower sooner than normal and do not develop to the same height as soybeans of the same variety planted earlier. Shorter plants may not close the canopy as rapidly as normal, and plants may not be able to use the available radiation and moisture efficiently to maximize yield.

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