Managing Deficient Soybean Stands

University of Illinois at Urbana-Champaign
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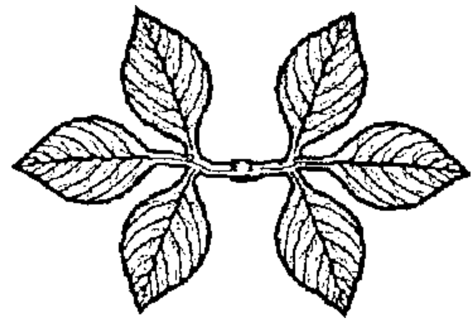
Part 1

Soybean Replanting Considerations for Maximizing Returns



Soybean producers whose crops suffer poor stand emergence may wonder whether or not replanting presents a viable economic alternative. Sometimes growers elect to replant deficient stands, but doing so can add considerable expense to their operations through the costs for seed, tillage operations, and perhaps even herbicides. The grower's economic risk is compounded by the possible loss in potential yield due to late seeding, which eventually leads to a reduction in net profit. Making the decision to either replant or stick with a somewhat deficient field is difficult. To that end, the information in this circular is intended to help growers decide which course of action will present them with the best economic return.

The Compensation Level of Soybeans Versus Replanting

One of the most important features of the soybean plant is its substantial ability to compensate for low plant populations. When deficient stands occur early in the growing season, soybeans growing next to the gaps in deficient stands can compensate for lost yield. When soybeans are planted next to a gap, they have more room to branch out, thus producing more seeds and pods than soybeans planted in full, crowded rows. Because of the soybean plant's ability to compensate in this way, irregular or uneven stands often yield surprisingly well.

Most of the soybeans grown in Illinois exhibit indeterminate growth habit, although a few varieties with a determinate growth habit have been introduced. Illinois field studies have shown that, when initial stands are planted in a timely fashion (at the beginning of the growing season when weather first permits), the soybean's growth habits do not affect the plant's ability to compensate for yield in deficient stands. However, when serious delays in planting occur, particularly into late June, determinate varieties adapted to the Midwest often appear less capable of filling in the soybean leaf canopy in typical 30-inch rows. Lack of full canopy development by the late flowering or early pod stages will limit a crop's potential yield.

Rarely does the yield potential of replanted soybeans equal that of soybeans planted at the beginning of the growing season. A two- or three-week delay in planting generally results in measurable reductions in yield. Further reductions can occur if replanting follows a delayed seeding date. If replanting is to be a profitable alternative, growers should replant as soon as possible in order to minimize the yield penalty (loss in yield) associated with delayed planting.

If a deficient soybean stand seems to result from a limited water supply, the grower should examine ungerminated seed at a number of locations throughout the field to determine whether or not the seed still exhibits the potential to germinate and grow. If the embryo color remains light yellow, the seed can probably still germinate and produce a healthy plant. Also, it is not uncommon for rain to bring about a second flush of germinating seed, thereby essentially completing a stand. If ungerminated seed still appear sound, then replanting may be neither wise nor profitable.

The warmer soil temperatures associated with later dates in the growing season generally enhance the rate of soybean emergence after replanting. However, low soil moisture at the time of replanting increases the risk of a second poor stand. If replanted soybeans fail to emerge adequately, the grower may be in a worse position than before.

Several research projects, in which random deficiencies in soybean stands have been purposely generated, provide data that support replanting decisions in fields that develop uneven stands in 30-inch rows. However, before replanting, the grower needs to determine both the percentage of total row occupied by gaps and the stand count in the remaining row sections. Both factors will influence the degree of compensation expected from a deficient stand and, ultimately, the yield. A comparison needs to be made between the expected yield and subsequent dollar return from a less than perfect stand, and the expected yield and return from a replanted crop. Too often a grower feels compelled to replant due to constraints stemming from the landlord, banker, or neighbors. Replanting decisions should be based solely upon the factors that help in identifying the best economic opportunities. Also, if the crop is insured against yield loss due to poor stands, the grower should have the field inspected by an insurance adjuster before deciding to replant.

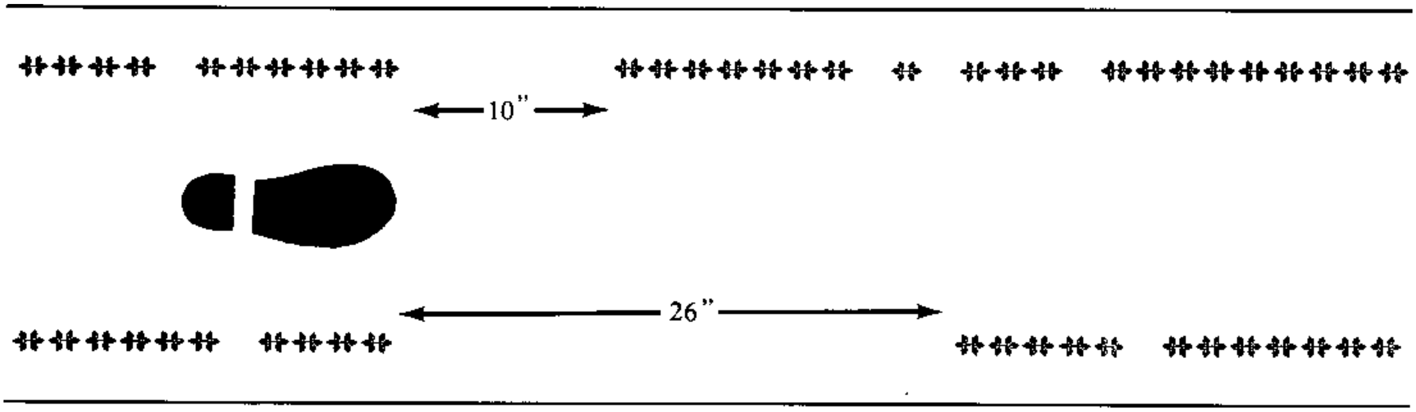


Figure 1. Observing gaps in a soybean stand by using the Boot-Toe Method. In this illustration, only the 26-inch gap would be recorded. ⁂ Each represents a seedling.

Evaluating Stand Deficiency and Plant Density

Evaluating irregular soybean stands is the single most important step to take before making a decision to replant. The level of stand deficiency will most often be the determining factor in a grower's decision whether or not to stick with the potential yield from a less than uniform full stand or to replant in the hope of increasing yield potential with an improved stand. The following **Tally Sheet** and sampling method have been devised for determining the levels of stand deficiency in 30-inch row soybeans.

The Tally Sheet

The tally sheet is used to record three types of information: data on the extent of stand deficiency, data on remaining uniform stand sections, and calculations for determining the average number of plants per foot of row in remaining row sections. A grower can use this information to calculate whether or not replanting presents a viable economic alternative. The use of the tally sheet will be explained in conjunction with recording data and figuring calculations.

Evaluating Stand Deficiency

Select a location representative of the stand deficiency and apply the **Boot-Toe Method** as described in this section. Be sure to have your tally sheet and a pencil with you.

1. Starting at the edge of the field and at a point between a pair of rows, walk at least 25 paces into the field. Be sure that you are well into the field and not in the turn rows at the field edge.

2. Walk five paces down the space between the rows and stop. You are at the location of the first of 50 observations that you need to make.

3. First, take your tally sheet and make a "hash mark" on the first blank line of the column headed **Number of observations**; this mark records your first observation. Eventually, you will have five hash marks on this line to designate the five observations you will make for the first pair of rows. (The number 1 to the left of the column designates this as the first set of paired rows.)

4. Next, note and record any gap 12 or more inches long that occurs *either to the left or the right of the toe of the boot with which you took the last pace.* Record this information in the same way on the first blank line of the column headed **Number of gaps**; make one hash mark for each gap. You have the possibility, then, of recording 2 hash marks for this observation and of recording up to 10 hash marks for this pair of rows. *Remember, you count only the gaps that are 12 or more inches in length.* Generally, gaps of less than 12 inches are fully compensated for by the remaining plants and are not considered a liability to potential yield. Figure 1 illustrates the type of gap to record when making an observation.

5. Take 10 more paces, stop, and again record any 12-inch or longer gaps you find to your left or right. Then move on, stopping every 10 paces until you have recorded your observations a total of five times for this pair of rows. Do not continue farther down the space between the rows.

6. Next, moving either to the left or right, cross nine or a greater odd number of rows and stop. Then begin your observations as before, until you have recorded the same type of information five times for this second pair of rows.

Your information will go on the next set of lines on your tally sheet, in the space provided for recording the second pair of rows. Repeat the observation process until you have recorded the gaps for 10 pairs of rows.

7. After you have recorded your data on the 10 pairs of rows, add the total number of gaps you recorded, and write this figure at the bottom of the **Number of gaps** column. This number will be your estimate for the percent of stand deficiency in your soybean crop. One series of observations (50 stops, 2 observations per stop) provides an accurate estimate of your crop's stand deficiency, provided the area you sampled was representative of the field as a whole. If you feel the area is not representative, you can add to the information gathered by repeating the observation process in other areas of the field that exhibit stand deficiencies. Then take an average of the total number of gaps for each series of observations.

After collecting the data on stand deficiency, the next step is to determine the density of plants per foot of row in the uniform sections of the field. This information will be used along with that on stand deficiency to determine the percent of full yield potential in your field and, ultimately, whether or not replanting will be of economic benefit.

Evaluating Plant Density

Return to the same area of the field that you used for the last sampling. Use the following procedure to collect your data on plant density. Be sure to bring your tally sheet and a pencil.

1. Identify at random 10 row sections that appear to have a full or fairly uniform plant stand.

2. For each row section, count the number of plants you find in a single 3-foot section of that row.

3. Record the number of plants from that 3-foot section on one of the blank lines under **Plants per 3 foot of row** on your tally sheet. Repeat this procedure for each of the 10 sections.

4. After recording your 10 plant counts, add the 10 lines and divide that total by 30 to determine the average number of plants per foot of row. Record this figure on the blank line in the section of your tally sheet entitled **Plants per foot of row.**

Predicting the Relative Yield Potential

Table 1 provides you with a means for predicting the relative yield potential of your field. The table provides values for stand deficiency and for plant density in remaining row sections. You can compare these values against the estimates for stand deficiency and plant density that you recorded on your tally sheet. The left column of Table 1 (**Percentage of stand reduction**) lists percentages of stand reduction from **0** (a full stand without gaps) up to **60 percent** (only 40 percent of the stand remaining). The three values under **Plants per foot of row** represent the average number of plants, (**8, 6,** or **4**) found in a remaining row section of a stand-deficient field. Values within the table represent estimated percentages of full or average yield potential you might expect for various combinations of stand reductions and remaining plant densities within a row. The following example will show you how to use this table to predict the relative yield potential of a soybean crop that has a stand deficiency problem.

Suppose that your percentage of stand deficiency is 34 percent. You will want to compare your percentage with the one most closely approximating it in the table under the column headed **Percentage of stand reduction**. Since that number is 30, you will read to the right across the line of the table on which 30 appears. Thus, you will be able to determine the yield potential of your field according to the average number of plants you have per foot of row, after taking into account your crop's percentage of stand deficiency. But let's return to our example to see your specific calculation.

Things seldom come out in even numbers, so let's imagine that your plant count averages 7 plants per foot of row. If you read straight across to the right, the next number is **93** (or 93 percent). If you read directly above to the top of the column, you will find that 93 percent is the relative yield potential of your field if you average 8 plants per foot of row. This estimate is slightly to the high side of what your estimate would be, but it is still fairly close. To establish the range for determining your estimate, read to the right of the number **93** and you will find the number **90** (or 90 percent), the estimated percentage of yield potential if you average 6 plants per foot of row in full-growing stands. Obviously, this number is slightly to the low side, but now you have a range of 90 to 93 percent within which you can estimate the yield potential of your own crop.

Table 1. *Percentage of Full Yield Potential for Soybean Fields with Deficient Stands*

Percentage of stand reduction	Plants per foot of row[a]		
	8	6	4
	percentage of full yield potential		
0	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

[a]Plants per foot of row in sections without gaps.

The preceding example shows you how to reach a fairly accurate estimate for your crop's yield potential by using the information from your tally sheet and from the table. But remember that the numbers in the table are used to calculate the percentage of full yield potential for a field that was **planted on time** but that suffers stand deficiency to some degree. Also, the yield potential calculated from this table will be realized **only** if the plants remaining in the field are healthy and kept free of weeds.

Comparing Reduced Yield with Yield Obtained from Replanting

Determining the percentage of full yield for a deficient stand will not provide you with all the necessary information for making a replanting decision. A figure for *average base yield* must be determined so that you can ultimately compare the yield from a somewhat deficient crop with that from a crop with replanted soybeans. This comparison will allow you to determine whether or not replanting will increase yield and thus, profitability. The average base yield differs from grower to grower but is simple to calculate. The average base yield will be the number that represents the yield a grower believes can be achieved from a particular field for the variety of soybean grown there and under the management system (including the original planting date) used for that field. The figure for average base yield will represent an average level of production for the field when a full stand of soybeans is achieved.

After estimating your average base yield, multiply that number by the percentage of full yield expected from a reduced stand (the percentage you took from Table 1). Multiplying these two numbers will give you the estimated yield potential in bushels per acre for your field. For example, if your field has a 30 percent stand deficiency with 6 plants per foot of row in the remaining sections, your estimate for full yield potential is 90 percent. If your average base yield is to be 50 bushels per acre, then the estimated yield potential for your field is 45 bushels per acre. Of course, this estimate is based on the assumption that weeds can be controlled in those areas lacking soybean plants.

Next, multiply the figure for average base yield by the percentage of full yield that can be expected from replanting. The following percentages of full yield can be anticipated after replanting, depending upon the average number of plants per foot of row that you achieved from the replant:

8 plants...........89 percent
6 plants...........86 percent
4 plants...........83 percent

To return to our preceding example, if the percentage of full yield you expect after replanting is 89 percent (8 plants per foot of row) and you multiply your average base yield of 50 bushels per acre by that percentage, then the estimated yield potential after replanting is 44.5 bushels per acre. Again, the estimated percentages of full yield for 8, 6, and 4 plants per foot of row after replanting are based on the assumption that a uniform stand will be achieved through replanting. Also note that the plant density within each row will also influence the potential yield.

Finally, compare the potential yield in bushels per acre from the deficient stand with that expected from replanting: in our preceding example, 45 bushels per acre compared with 44.5 bushels per acre. The difference by which the yield from replanting is greater (if any) than that from the deficient stand will represent the gain associated with replanting. However, even if replanting seems to offer you more harvestable beans, other factors you need to consider may not make replanting the most economical option.

Evaluating Returns from Replanting

Once you have calculated a figure that represents a gain in yield (if any) associated with replanting, you need to compare the market value of this yield increase with the costs of replanting. Generally, replanting costs will include those for seed, fuel, equipment, labor, and interest on investment. If the dollar value of your increased yield will more than pay for these costs, you may decide that replanting provides an economic benefit to your crop returns. However, if only 30 to 40 percent of your stand consists of gaps, you will most likely find no justification for replanting.

Whatever your decision, two other factors you should weigh in conjunction with replanting are weed control in stand gaps and disease problems in the remaining plants. Gaps provide a favorable environment where weeds can flourish and thus reduce the potential yield if you decide to stick with a less than desirable stand. On the other hand, replanting often requires a chemical weed control program as well. If seeding disease problems cause gaps to occur, there is a fair chance of your remaining plants being either infected or at least stressed for the remainder of the growing season. If the remaining plants in an irregular stand are diseased, replanting may be justified. At present, researchers have not yet been able to forecast the effects posed by the additional stress of disease on already irregular stands. But it is a safe assumption that soybeans will only be able to compensate for yield in irregular stands if the majority of the remaining plants are disease free.

Work Sheet

Stand reduction estimate using **Boot-Toe Method** ____________%

Base yield for field (bu/A)____________

1. Percent full yield expected (read from Table 1 after using Boot-Toe Method) __________%
2. Estimate of deficient stand yield potential (base yield for field x line 1) _________bu
3. Projected return from crop harvested (estimated market price x line 2) $____________
4. Weed control cost associated with a poor stand $____________
5. Return per acre if no replanting is done (line 3 minus line 4)[a] $____________

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6. Replanting percentage of full yield (for 8, 6, or 4 plants per foot of row) __________%
7. Estimate of replanted yield potential (base yield x line 6) ________bu/A
8. Yield x estimated market price $____________
9. Cost of replanting (seed, herbicide, etc.) $____________
10. Returns from replanted field (line 8 minus line 9)[a] $____________

[a]Compare the value in line 5 with the value in line 10 to determine the returns expected from keeping a poor stand versus replanting one.

Summary

Be sure to observe the following points when deciding whether or not to replant soybeans if deficient stands occur.

1. Evaluate the level of stand deficiency by using the **Boot-Toe Method** of stand evaluation.

2. Estimate the potential yield for your field, taking into account the level of stand deficiency.

3. Estimate the yield potential from replanting.

4. Compare the yield potential of your field with its existing gaps against that of a replanted field which you assume will emerge well enough to give you a full stand.

5. Compare the economic returns of your two alternatives (keeping the somewhat deficient crop or replanting). Use the accompanying **Work Sheet** to record your estimates.

6. Check your insurance policy on crop damage before proceeding with replanting.

Tally Sheet

Number of paired rows (total of 10 pairs)	**Number of observations** (5 needed)	**Number of gaps** (maximum of 10 on each line)
1	____________	____________
2	____________	____________
3	____________	____________
4	____________	____________
5	____________	____________
6	____________	____________
7	____________	____________
8	____________	____________
9	____________	____________
10	____________	____________
Total = percent stand deficiency (total of all gaps)		____________

Plants per 3 foot of row
(for each of 10 sections)

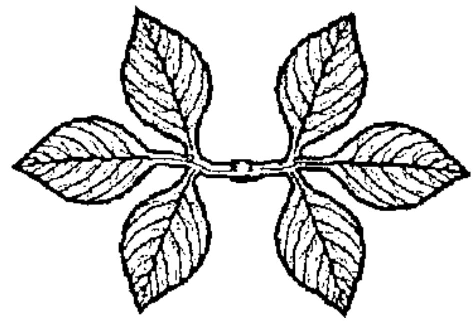
1. ____________	6. ____________
2. ____________	7. ____________
3. ____________	8. ____________
4. ____________	9. ____________
5. ____________	10. ____________

Plants per foot of row
(sum of preceding plant counts divided by 30) ____________

The authors express their appreciation to the soybean producers of Illinois for their support of the research presented in Part 1 of this circular. Funds made available by the Illinois Soybean Program Operating Board (Soybean Checkoff Program) made possible the applied field research.

Part 2

Patching or Repair of Deficient Soybean Stands



Efforts to "patch" or "repair" poorly emerged soybeans are sometimes carried out by producers having what they consider to be inadequate stands of soybeans. These efforts typically involve planting an additional row alongside each of the original poorly emerged rows. The additional row is sometimes referred to as an "offset row." Figure 2 depicts such original and offset rows in a field where the original planting did not result in stands considered satisfactory. The merits of planting offset rows, in an effort to repair or improve yield potential in a deficient soybean plant stand, will be discussed in this part of the circular.

Research has been done to identify benefits associated with using offset rows to improve a deficient soybean stand. Data were gathered from a two-year study conducted at three locations in Illinois. It is believed that the results of these experiments are typical of what producers in Illinois can expect if they use offset rows to repair or patch soybean stands considered deficient. Producers can use these typical results, as indicated in this part of the circular, in making management decisions about the repairing or patching of their stands.

Planting Offset Rows

Several factors must be considered in the planting of offset rows. First, to accomplish this planting, the planter must be shifted to the side 6 to 8 inches from its normal position. If this is not done, the wheels of the tractor will travel over the top of existing soybean plants, or at least come dangerously close to them. Shifting of the planter to the side is usually accomplished with a modification or adjustment of the hitch to the tractor. A second factor is the seeding rate. Because offset rows are planted to supplement existing stands, producers typically use reduced seeding rates. Finally, to maximize benefits to yield associated with offset rows, planting needs to be done as soon as possible following a determination that deficient stands exist.

Offset Rows and Weed Control Options

When an additional row of soybeans is established beside the originally planted but poorly emerged row, mechanical cultivation for weed control will likely be eliminated. Thus, offset row planting will necessitate a modification in weed control strategies. If post emergence herbicides are used, application with ground equipment can only be done if the tractor used has sufficiently narrow tires.

Crop Maturity Considerations

Soybeans in originally planted rows with deficient stands get a "head start" on offset rows planted at a later date. Assuming the same variety is used to plant offset rows as was used in the original planting, there will in most cases be a difference in maturity of 7 to 10 days between the two plantings. Depending on the weather after the plants in the originally planted rows reach maturity, these plants can begin to shatter seed before harvest-ready conditions are reached in the offset row planting.

Growers may decide to change varieties when planting offset rows, using an earlier maturing variety in an attempt to make the time of maturity coincide for the two plantings. The use of an earlier maturing variety for offset rows, however, will most likely diminish the yield potential of the second planting. This is because the period of vegetative growth prior to flowering will be of shorter duration in soybean plants that reach maturity earlier, and a shorter vegetative growth period will lessen the competitive ability and potential of the plants in the offset rows. Because the originally planted rows have a head start over offset rows, the variety selected for planting the offset rows needs to have as much of a competitive ability as possible. Therefore, it is not suggested that the variety of soybeans used to plant offset rows be any earlier in maturity than that used for the initial planting.

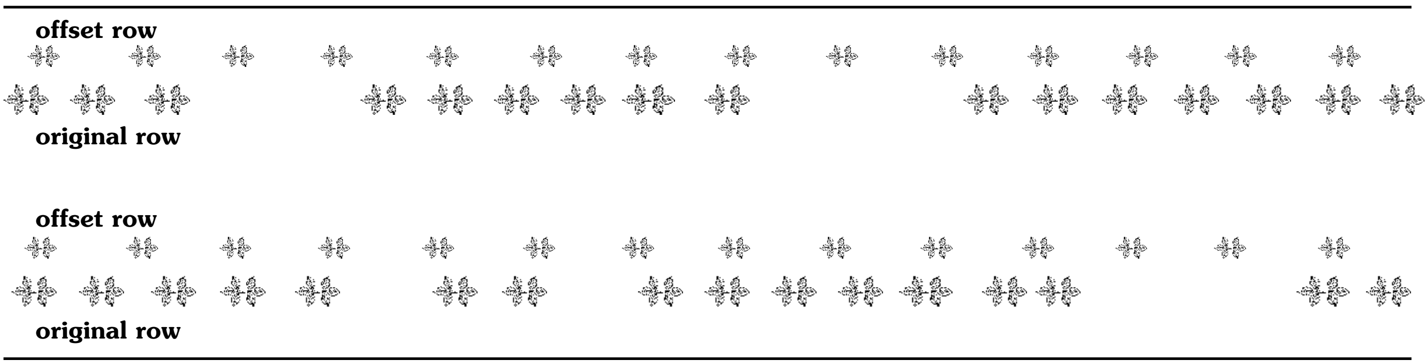


Figure 2. Original rows in an unsatisfactory soybean stand, and later planted offset rows. Each represents a seedling.

Lodging in Offset Rows

Lodging of plants in the offset rows is likely to occur. Offset rows experience pressure from the shade cast by the initially planted rows, except in areas where the original planting resulted in no plant establishment. Even though the originally planted rows are not considered to have adequate stands, they will generally exert some shade pressure on offset rows—often resulting in shorter plants with weaker stems. Plants in offset rows with reduced stem length and strength will contribute little to yield and will be prone to lodging. The benefit of having the offset row present is then diminished.

Yield Enhancement by Offset Rows

The basic reason producers would plant offset rows is a belief that yield and profits can be enhanced. Research has indicated yield benefits associated with planting offset rows tend to be much smaller than most growers imagine or expect, and from an economic standpoint, do not warrant the additional effort and expense. In situations where significant yield enhancement is achieved through offset row planting, the original plant stand is typically so deficient that replanting, rather than offset row planting, is the wiser choice of options. Considering the difficulties generated by offset row planting in regard to maturity, lodging, and weed control, yield enhancement potential must be considerable before growers will truly benefit from planting offset rows.

The increase in yield that may be achieved with offset row planting depends on the extent of the stand reduction and the pattern of remaining plants. The degree to which the original planting did not emerge (percent stand loss) is a primary factor determining whether yield can be enhanced by offset rows. If little reduction in yield potential results from stand reductions, then little can be gained by planting offset rows. The saying "If it ain't broke, don't try to fix it" applies to soybean stands.

The pattern of plants which becomes established as a result of the original planting is also relevant to any benefit derived from planting offset rows. Data presented in Table 2 illustrate how the degree of stand reduction and the distribution of plants remaining will affect the yield potential of soybeans.

The data in Table 2 suggest that uniform reductions in stand do little to reduce yield potential. Even when 66 percent of the stand was removed, less than 10 percent of the yield potential was lost if reductions in the stand were uniform in pattern.

Table 2. *Percentage of Full Yield and Offset Row Benefit from Soybean Fields with Stand Reductions, 1986-87*

	33% stand reduction		**66% stand reduction**	
Location	**Uniform pattern**	**Gapped pattern**	**Uniform pattern**	**Gapped pattern**
Monmouth				
Without OSR[a]	96	93	91	71
With OSR	98	95	90	83
OSR benefit	+2	+2	-1	+12
Urbana				
Without OSR	96	95	92	77
With OSR	95	98	93	90
OSR benefit	-1	+3	+1	+13
Carbondale				
Without OSR	100	97	96	64
With OSR	9	93	100	86
OSR benefit	-4	-4	+4	+22

[a]OSR = offset row

Reduction in stands equivalent to 66 percent, but occurring in a gapped pattern, do generate reductions in yield potential which most growers would consider to be significant (23 to 36 percent lost yield potential). Raising the yield potential in deficient soybean stands to a level nearer that of a full stand may be possible with the planting of offset rows. However, growers must be willing to accept the costs and various problems associated with offset rows. The total costs, yield potentials, and complications of totally replanting need to be compared to those associated with offset rows. The total replant may be a better option than trying to patch or repair a badly deficient stand.

The data presented in Table 2 also reflect soybean yield level as a percent of that obtained from a normal full stand when offset rows are added to deficient stands. The benefit to adding the offset row is minimal or nonexistent when stand reductions are uniform in pattern. The minor gains in yield potential from adding offset rows would typically not justify the expense or aggravation generated by such plantings.

When stand reductions were uniform, at either the 33 or 66 percent stand reduction level, increases in yield associated with adding offset rows were minimal at best. In four instances, adding the offset rows resulted in a slightly lower yield. Although yield reduction in these cases was minimal, the reductions nevertheless indicate the unpredictable effect which offset rows can have on stands with virtually a full yield potential to begin with. If stands have the capacity for near full yield, plants established in an offset row may act more like weeds than productive plants.

The greatest enhancement in yield resulted from offset row planting when stands were greatly reduced (66 percent) and when the remaining plants were distributed in a gapped pattern. Yield enhancement from offset rows under such circumstances could be viewed as significant. Realistically, however, producers will not keep a plant stand that is 66 percent deficient with remaining plants in a gapped pattern. Such plant stands would not be tolerated by farmers who have the option to replant.

Summary

If less than perfect soybean stands emerge in a field, they should first be evaluated to determine if reasonable compensation for yield can be expected from surviving plants. Experimental results suggest that surprisingly good yield potential can develop from less than perfect stands.

If stands are extremely poor, a situation in which offset rows might measurably enhance yield, growers are inclined to consider the stand unacceptable—resulting in replanting rather than patching of the stand. The replanting option, while having a reduced yield potential due to late planting, will not create the problems related to cultivation and uneven maturity that will be the case with offset rows. Patching or repair of soybean stands with offset rows simply doesn't appear to be a viable alternative. Growers are almost always advised not to choose this option.

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