Bulletin 671
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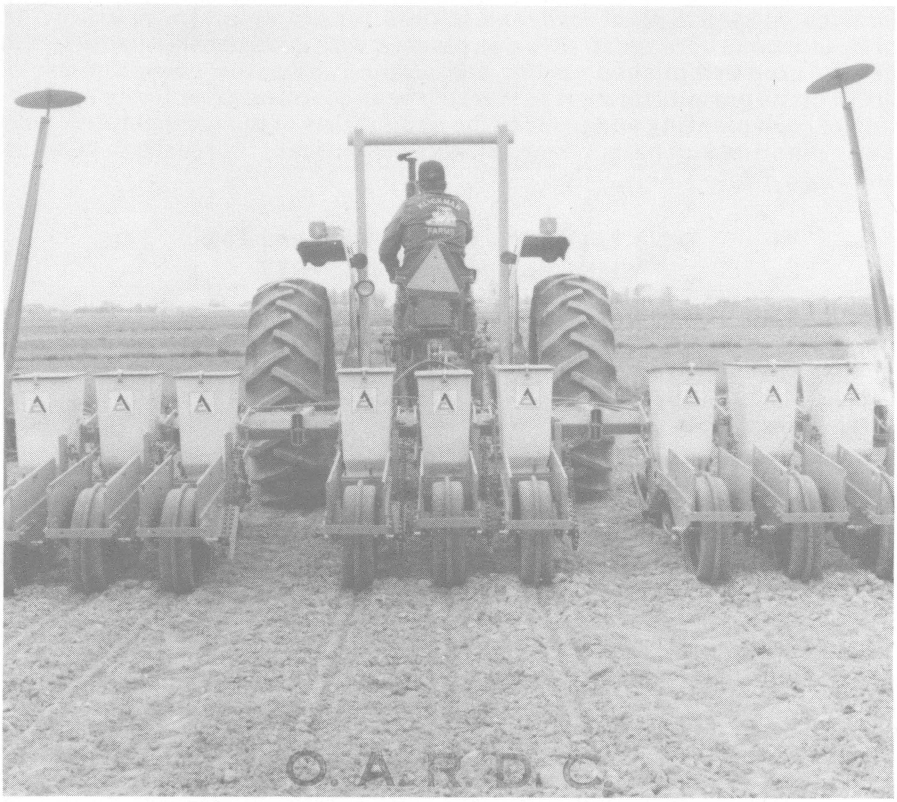
Narrow Row Soybeans
Alternative Systems



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Soybean acreage in the U.S. increased by almost 50 percent during the 1970's. During the same time in some Midwest states such as Ohio, acreage increased by 65 percent.

There has been a general trend to earlier planting and narrower rows in the Midwest. Ohio farmers planted two weeks earlier in 1980 than in 1970 and their average row width was reduced from 31 inches in 1970 to just over 23 inches in 1980.

Increased acreages of soybeans, earlier planting and the use of narrower rows have forced farmers to make extensive modifications in the equipment used to plant soybeans. In Ohio, for example, almost 40 percent of the soybean acreage in 1979 was planted with grain drills in an effort to get the crop established earlier and planted in narrow rows. The use of grain drills permits farmers to start soybean planting prior to the completion of corn planting and prior to the availability of the corn planter. Both early planting and narrow rows produce significant increases in yield, as shown in Table 1.

Table 1: Effect of Planting Date and Row Widths on Yield, 1974 — 1977

Row Width	Date of Planting		
	May 10	May 25	June 10
		Bushels Per Acre	
15	51.3	44.7	36.3
30	47.4	41.2	32.3
Difference	3.9	3.5	4.0

L.S.D. .05 = 1.6

The data in Table 1 are from a research study containing 54 production systems and were conducted seven times from 1974 to 1977. All plots were planted with unit planters mounted on a tool bar. Treatments included three planting dates, two row widths, three seeding rates and three varieties.

Several studies involving row width have been conducted in Ohio in recent years. These studies indicate that for soybeans planted the first half of May there is a 14 bushel per acre yield increase as row widths are narrowed from 40 inches to 7 inches (Fig. 1). This is about 0.4 bushel increase per inch of row. The curve in Figure 1 is a composite of the effects of row width on grain yield accumulated from many studies conducted over a period of 10 years. It shows the general trend of how reducing the row width increases yield.

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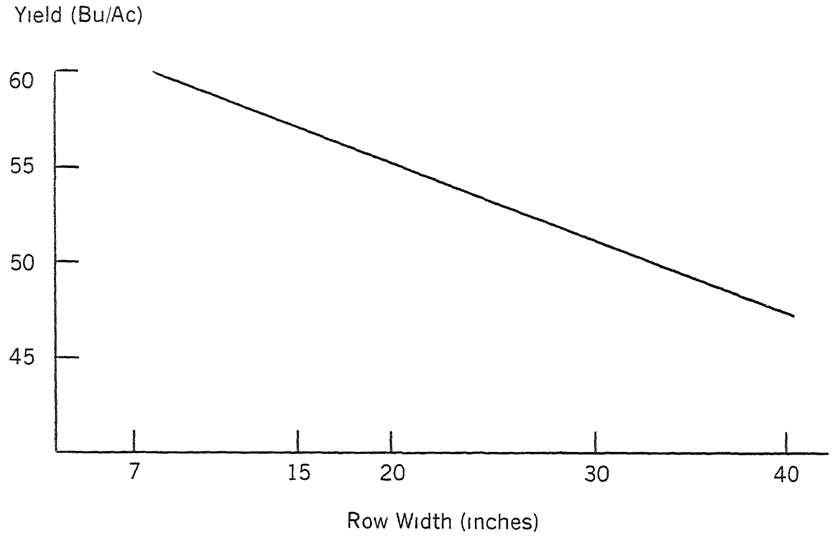
Fig. 1: Effect of row width on soybean yields for several studies conducted in 1970-80



Research studies showing this response to row width were conducted on highly productive soil where production practices were near optimum and yields were high. In environments where the production potential is low such as in dry growing seasons or low productivity soils, the percent yield increase due to narrow rows would probably be different than that indicated in Figure 1. In low yield environments, a canopy develops slowly and the middles of wide rows are not filled in completely until late in the growing season. The use of narrow rows in this situation results in the development of a complete canopy earlier in the season with yield increases being the usual result. In near ideal conditions where plants grow rapidly and a complete canopy develops very early, even for wide rows, the yield increase is likely to be less than that indicated in Figure 1.

Unit Planter vs. Grain Drill

A number of studies have been conducted throughout the Midwest comparing seed plate planters to fluted feed grain drills in an effort to evaluate their relative ability to establish a vigorous soybean crop. In many of these studies, the row width for the planter and drill were not the same. Therefore, it is impossible to know whether yield differences were due to the planting tool or to the row width effect.

Although most producers cannot see a yield difference of 3 to 5 bushels per acre in standing soybeans, many of them have told us that since they changed from 30-inch-wide rows to solid seeded, 7-inch rows, their yields have not changed. All other things being equal, research into the effect of row spacing on grain yield indicates that yields should have increased by about 6 to 9 bushels per acre. Other producers have reported yield increases but felt that the better yields may have been partially due to a more ideal growing season.

Because of the increased interest and use of grain drills in Ohio, a study was initiated in 1977 to compare the unit planter and grain drill at 4 row widths (7, 14, 21 and 28 inches) and 3 seeding rates (100,000, 150,000 and

200,000 seed drop per acre). With all possible combinations of factors the study involved 24 treatments with 4 replications and was conducted 6 times from 1977 to 1979.

Prior to planting, certified Williams soybeans were sized so that all seed were between 16/64 and 18/64 inch in size. In these seed lots, there were about 2,500 seed per pound. Both the planter and drill were carefully calibrated to give precise and accurate seeding rates. Twenty-four-cell seed plates were selected for the planter that would hold exactly two seeds per cell and then the proper combination of sprockets was selected to give the desired seeding rate.

The drill was calibrated by jacking the drive wheel off the ground so it could be turned at the speed to be used in the field. A micrometer was used to measure the flute opening that would give the desired seeding rates. The drill was equipped with depth bands and press wheels so that proper seeding depth and good seed-soil contact were accomplished. The seed bed was prepared adequately to permit both the drill and planter to perform optimally. A cultimulcher was used on the last tillage operation to firm the seedbed ahead of the drill for better depth control.

For the drill, the different row spacings were accomplished by blocking off the appropriate seed tubes. Planter units were spaced appropriately on the tool bar to produce the 3 wide-row widths. The 7-inch row spacing was accomplished by splitting the middles of 14-inch-wide rows. The adjustments made on the drill for seeding depth and distribution were, undoubtedly, more precise than a farm operator would perform.

The interaction of planting tools and row width is shown in Table 2. Yield losses of 7.4 bushels and 4.6 bushels occurred for the planter and drill respectively as row widths were increased from 7 to 28 inches.

Table 2: Interaction Effects of Planting Tools and Row Width on Grain Yields

	Planting Tool		
Width (in.)	Unit Planter	Grain Drill	Difference
7	55.8	52.2	3.6
14	51.3	50.8	0.5
21	49.7	48.3	1.4
28	48.4	47.6	0.8
Ave.	51.3	49.7	1.6

L.S.D. .05 = 1.5

Yield differences between the drill and planter were greatest for the 7-inch rows. As row widths narrowed and the spacing between seeds in the row increased, the drill proved to be less satisfactory than the planter. Plant populations for the planter and drill at a particular row width and seeding rate were comparable but the plants were spaced much more uniformly in plots seeded with the planter. In numerous other studies having narrow rows (7 to 14 inches), we have observed that uniform spacing in the row is critical. We have observed a consistent pattern of increasing yields when plant spacing in the row is more uniform, regardless of seeding rate and to some extent the row width. This leads us to believe that uniform plant spacing in 7 inch rows is much more critical than we formerly believed.

Table 3 shows that there was no interaction of planting tools and seeding rate. Yields resulting from drill-planted plots were 1.6 bushels per acre less than plots established with the unit planter, when averaged across row widths and seeding rates.

Table 3: Effects of Planting Tools and Seeding Rates on Soybean Yields

Seeding Rate (1000)	Planting Tool Unit Planter	Grain Drill	Average
	Bushels per acre		
100	50.8	49.3	50.1
150	51.6	50.4	51.0
200	51.5	49.5	50.5

The data in Table 4 indicate that there was no interaction between row width and seeding rate. Further, a seeding rate of 150,000 seeds per acre appeared to be adequate for maximum yields.

Table 4: Interaction Effect of Row Width and Seeding Rate on Grain Yield

Row Width	Seeding Rate (1000 seeds/ac) 100	150	200
	Bushels per acre		
7	53.9	54.4	53.8
14	51.0	51.6	50.5
21	48.3	49.4	49.1
28	47.0	48.5	48.5
Ave.	50.1	51.0	50.5

We have observed that in addition to the poor distribution of seed in narrow rows, many grain drills plant some seed too deep and still others too shallow. This causes emergence problems for deeply placed seed and potential herbicide damage for seed placed too near the soil surface. This is particularly true in field conditions when planting across soil types with different structure and texture characteristics. The fluted feed metering mechanism will not uniformly meter out one seed every six inches in 7-inch rows, which is the optimum spacing. In summary, this study indicates that planter units on a tool bar were more satisfactory for planting soybeans in narrow rows than was a grain drill.

When wider row widths (14, 21, 28 inch) are used, the fluted feed grain drill spaced seed more uniformly but was never comparable to the uniformity of spacing accomplished with the planter units. Likewise, when narrow rows were used, the fluted feed mechanism did extensive damage to large seed. This damage to large seed was shown in a study where seed were collected as they were metered out by the drill.

Seed were collected from different seeding rate settings and at different ground speeds. The collected seed samples were then analyzed with several tests for seed quality. The amount of damage was much less in wider rows or when small seed were used in the grain drills with the fluted feed mechanism.

It's reasonable to expect greater yield differences between the unit planter and grain drill in favor of the unit planter under field conditions than was measured in this research conducted under carefully controlled conditions. To improve the operation of the grain drill and make it more nearly comparable to the corn planter as a seeding tool for soybeans, a number of adjustments should be considered.

1. Tractor wheel tracks should be removed ahead of the drill. This can be accomplished with a cultimulcher, springtooth harrow or similar tool. A leveling-firming tool between the tractor and drill will firm the seedbed and enable a more uniform planting depth when changing from one soil type to another or when planting through cloddy areas. Uniform depth placement can also be further improved if double disk openers are equipped with depth bands. When depth bands are used, maximum down-pressure should be applied to assure adequate depth of placement in hard spots and where cloddy conditions exist. Rubber surfaced depth bands or gauge wheels will prevent soil buildup in wet conditions. The drill should always be equipped with press wheels capable of exerting enough down-pressure to develop good seed-soil contact, which helps ensure rapid emergence. Drills with single disk openers should never be used to seed soybeans, because of the lack of uniform depth placement of seed.

2. Adjust the metering mechanism to drop 2 viable seed per foot in 7-inch rows or 4 viable seed per foot in 14-inch rows. Generally, less seed damage occurs with 14-inch rows. Using a wider gate opening and slower rotation of the flute usually will give better distribution of seed in the row. Always calibrate drills on the basis of seed per foot of row and never on the basis of pounds of seed per acre, because seed size and the number of seed per pound is highly variable.

3. Large seed **should be avoided** whenever possible because seed damage increases as the size of the seed increases. Use seed lots having at least 2,400 seed per pound and increase the seeding rate to compensate for the seed damaged by the fluted feed mechanism. Other seeding rate adjustments are:
   a) Increase 10 percent for a poor seedbed.
   b) Increase 10 percent for thin line or very early maturing varieties.
   c) Increase 20 percent when planting is delayed until early June.
   d) Increase 50 percent for dwarf varieties.

Adjusted Seeding Rates should never exceed 180,000 viable seed per acre, except for the dwarf varieties, which should be seeded at a rate of 200,000 to 250,000 viable seed per acre.

Most planting equipment performs optimally under ideal planting conditions. In the previous data it was shown that plots established with the plate planter produced higher yields than those planted with the fluted feed grain drill, even though planting conditions were ideal. In the less than ideal planting conditions that exist on most farms, we would expect a greater difference in the quality of performance of the two tools. Because the plate planter is capable of more uniform and accurate depth placement and more uniform spacing of seed in the row, we feel farmers can obtain higher yields from narrow row soybeans planted with a plate planter than with a fluted feed grain drill. Following are some suggested ways of obtaining narrow soybean rows with currently available corn planters.

Planter Modifications

Row widths of 10 to 20 inches can be accomplished by splitting the middles of wide rows produced by wide-row corn planters. Splitting the middles of 30-inch rows to produce 15-inch rows can produce an income of $180 to $540 per hour, depending on the planter size. Table 5 indicates the acres planted per hour and extra bushels of yield produced per hour when splitting the middles of 30-inch rows. The data in Table 5 were generated with the assumption of 4 mph planting speed, 85 percent field efficiency and a yield increase of 6 bushels per acre with soybeans worth $7.50 per bushel. If the yield increase was only half that used in Table 5, splitting middles would still be a very profitable practice, even though it does require the use of extra time during the planting season when time is a precious and expensive input.

Table 5: Economics of Generating 15-Inch Rows by Splitting the Middles of Wide Rows

Planter Size	Acres Planted / Hour	Bushels Prod. / Hour	Income ($) / Hour
4 Row	4	24	180
6 Row	6	36	270
8 Row	8	48	360
12 Row	12	72	540

Another alternative is the addition of extra units to an existing planter, as shown in Table 6. In this approach, the cost of new units can be regained by growing only 50 to 183 acres of narrow row soybeans, depending on the size of the planter. After the initial cost is recaptured, each acre should generate about $45 additional income.

Most of the newer planters have units that can accommodate a 15-inch row spacing. For these planters it is very simple and easy to place an additional unit between original units; therefore, it is not necessary to move the original units. The extra units can then be locked up or chained up when planting corn and do not have to be removed from the planter once they have been added. This practice enables a farmer to use the same planter for both corn and soybeans, thus reducing fixed costs. One serious disadvantage to this approach is when the planter is needed for both crops at the same time. That disadvantage can be partially overcome by having a larger planter than would normally be needed.

Table 6: Economic Advantage of Adding Units to a 30-Inch Planter to Generate 15-Inch Wide Rows

Planter Size	No. Units Added	Total Cost ($)*	Acres Needed To Pay for New Units+
4	3	2250	50
6	5	3750	83
8	7	5250	116
12	11	8250	183

* Per Unit Cost is $750.00
\+ Based on a yield increase of 6.0 bushels per acre and Soybeans = $7.50 per bushel.

By using narrow rows, a farmer has abandoned any chance of cultivation and must have a knowledge of weeds in the field and know which herbicides will provide satisfactory control of them. The increasing availability and use of post emergence herbicides necessitates the use of large equipment in fields several weeks after the crop has emerged. The use of a skip-row planting pattern will enable the use of large equipment for the application of herbicides, fertilizers and insecticides through most of the growing season without damaging soybeans planted in narrow rows. Skip-row systems usually consist of sets of 3 to 5 rows 15 to 20 inches apart and bordered by a 30-inch wide middle to accommodate tractor tires.

Skip-row patterns usually produce yields comparable to uniform 15-inch or 20-inch rows. Table 7 gives the yields of several skip-row patterns.

Table 7: Effect of Skip-Row Planting Patterns on the Yield of Williams Soybeans in 1979 at 2 locations

Planting Patterns	Yield (Bu/A)
30-inch rows	46.7
20-inch rows	50.9
3 20-inch rows and 30-inch skip	50.7
4 20-inch rows and 30-inch skip	47.6
15 inch rows	50.5
4 15-inch rows and 30-inch skip	49.6
5 15-inch rows and 30-inch skip	49.8

L.S.D. .05 = 2.1

For maximum yields, seeding rates in skip-row systems should be precise. Those rows next to the wide skip should be seeded at the rate recommended for row widths of that size. Example: On a skip-row pattern of 5, 15-inch rows and a 30 inch skip, the 3 center rows of the 5 row set should be seeded at the rate recommended for 15-inch rows, while the 2 rows next to the 30-inch skip should be seeded at the rate recommended for 30-inch rows.

If cultivation is not anticipated, rows narrower than 20 inches are acceptable. Rows narrower than 20 inches are usually difficult to cultivate, even when skip-row patterns are used. When using a skip-row system, the planter and cultivator should be capable for accommodating the same number of rows and width of working area. Sprayer widths should be some multiple of the planter width to prevent excessive overlap or skips.

The yield and economic advantages of reducing the row width of soybeans has been thoroughly established. Any producer using wide rows should ask himself why he uses them, and if wide rows are really necessary. If the reason is for cultivation to control weeds, then he should investigate the potential use of post emergence herbicides. Or, he could plant the field to corn for two years and reduce the weed pressure by doing a good job of weed control in the corn crop. If a soil crust is a problem, then leaving a mulch on the surface will partially eliminate that problem. Fifteen and 20-inch rows can be cultivated if a skip-row pattern is used. If the reason for wide rows is that farmer has no drill and the corn planter must be used to plant soybeans, then we suggest he split the middles or buy extra units to reduce the row width, because both are very advantageous from a profit point of view. If soybeans are worth $7.50 per bushel, then reducing the row width by 10 inches increases the income per acre by $30.

Realistically, can anyone afford to grow soybeans in wide rows? With today's herbicides, technology and equipment available to producers, the answer must be an emphatic NO.