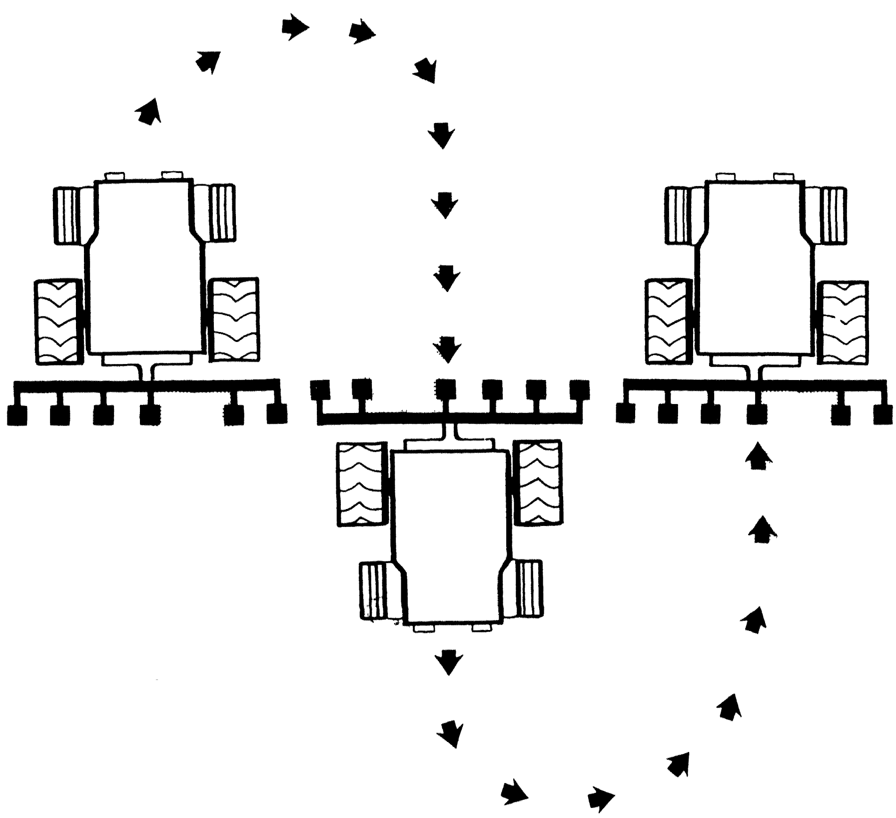
Research Bulletin 1151

Extension Bulletin 706
Agdex 141/22

# Skip Row Soybeans

Better Management for More Yield



OSU Cooperative Extension Service
The Ohio State University

**Skip Row Soybeans**
**Better Management for More Yield**

**Author**
**James Beuerlein**
Associate Professor, Agronomy
The Ohio State University and
Ohio Agricultural Research and
Development Center

The past 12 years have seen major changes in the importance of soybeans as a cash crop to Ohio's farmers. The crop once carried a reputation of low profit and nonresponse to management, and it was considered a secondary crop until the mid-1970s when pioneering research at the Ohio Agricultural Research and Development Center (OARDC) began to unravel some of the production mysteries held fast since the crop's introduction into the U.S. in the early 1900s.

Research has shown that early planting, narrow row, improved fertilization, better weed control and other management practices have greatly increased the yield potential over the past two decades. The yield response to earlier dates of planting has been up to 1/2 bushel per acre per day. Yield increases due to decreasing the row width range from 1/4 to 1/3 bushel per acre for each inch reduction in row width (Table 1). Since 1970, the average row width of the Ohio soybean crop has decreased from more than 30 inches to almost 20 inches, and the crop is planted two weeks earlier now than in 1970.

Table 1. Effect of planting date and row width on the yield of soybeans. Data taken from numerous studies conducted by OARDC agronomists from 1970 through 1981.

| Row Width (in.) | Planting Date May 1 | June 1 | July 1 | Avg. |
|---|---|---|---|---|
| | | (bu/Ac) | | |
| 30 | 50 | 37 | 22 | 36.3 |
| 15 | 55 | 45 | 33 | 44.3 |
| 7* | 58 | 48 | 37 | 47.7 |
| Avg. | 54.3 | 43.3 | 30.7 | |

* Seven-inch rows were planted with unit planters. Seven-inch-wide rows planted with grain drills usually produce yields 2 to 3 bushels per acre lower than those planted with unit planters.

The adoption of improved management techniques has enabled Ohio's soybean farmers to increase yields at a rapid pace. Some farm averages have increased over 20 bushel per acre during the past 10 years. The average state yield has increased 11 bushels per acre over the same period.

Some fields are producing yields approaching 70 bushel per acre, with some farm averages passing the 50 bushel per acre mark. Each year, researchers obtain plot yields of 70 to 80 bushel per acre. Some report yields of 90 to 100 bushel per acre for intensively managed research projects.

Good management is the key to high yields. No longer will changing one management practice or input affect higher yields. A balance of all cultural practices and inputs is necessary for maximum yields. Modern soybean production systems consist of early planting, narrow rows, good fertilization, selection of the best varieties, good weed control, well drained land capable of supplying sufficient water to the crop and other factors such as disease and insect control, crop rotation, and the reduction or elimination of any stress factor on the crop.

Good management is a system of compromises. Sometimes the optimization of one cultural practice makes optimization of other practices difficult. An example is the increased difficulty of obtaining good weed control with preemergence herbicides as the planting date becomes earlier. Changes in management practices also have a positive effect on other inputs. For example, reducing the row width of soybeans usually makes controlling weeds easier through successful competition of the crop with weeds.

Although there has been excellent improvement in soybean herbicides, one of the major problems with early planted soybeans is that application of postemergence herbicides is usually required in addition to preemergence herbicides. This means that tractors and spraying equipment move through the fields after crop emergence. If equipment is to avoid running down emerged plants, wide rows are necessary -- and wide rows reduce yields. The problem, therefore, is to maintain the flexibility to move equipment through fields of early planted soybeans in narrow rows without damaging or destroying plants.

This can be accomplished by using airplanes and helicopters for the application of post emergence herbicides. Aerial application has disadvantages to ground application in terms of complete coverage of the field, uniform application and availability of equipment. Aerial application however, also allows rapid coverage of large acreages and the ability to work when the soil is too wet for ground equipment.

## Skip Row Production

An alternative to aerial application or wide rows and low yields is the use of skip row production systems. This practice has been used throughout Europe for many years where intense management of the small grain crop necessitates several applications of pesticides and fertilizers during the growth of the crop. Skip row systems for soybeans consist of planting the field in narrow rows with repeating patterns of missing rows to allow wheel space for the postemergence application of pesticides with ground equipment. The particular skip row system depends on the size and type of equipment used on a particular farm. Systems can vary in row width, distance between a pair of skipped rows and the distance from one pair of skipped rows to the next. All three factors affect yield. Yield reductions due to skipped row vary from as little as a few pounds of yield per acre up to about 3 bushels per acre depending on the skip row system used. Following is a summary of research conducted on skip row soybean production in Ohio.

Skip row soybean research was initiated in 1977. Results are reported in Table 2, in which the effect on yield of several skip row

Table 2. Effect of three row spacings and four skip row patterns on the yield of three soybean varieties (Amcor, Wayne and Williams 79).

| Row Spacing or Skip Row System | Yield (bu/ac)* | | | |
|---|---|---|---|---|
| | Amcor | Wayne | Williams 79 | Average |
| 30 inch | 47.8 | 46.7 | 48.0 | 47.5 |
| 20 inch | 52.9 | 50.6 | 51.0 | 51.5 |
| 15 inch | 54.7 | 51.1 | 53.2 | 53.0 |
| 4-15 + 30-4** | 50.8 | 48.9 | 50.3 | 50.0 |
| 5-15 + 30-5 | 52.1 | 50.7 | 50.3 | 51.0 |
| 4-20 + 30-4 | 53.2 | 48.9 | 51.5 | 51.2 |
| 3-20 + 30-3 | 53.5 | 50.0 | 49.5 | 51.0 |
| Average | 52.3 | 49.6 | 50.5 | 50.8 |
| LSD .05 | | | | 2.3 |

* Average of eight year-locations.

** 4-15 + 30-4 indicates four rows 15 inches apart, bordered by a 30 inch skip, with four rows between the pairs of skipped rows.

systems was compared to the more common uniform row spacings. The skip row systems compared in this study consisted of three to five rows spaced 15 to 20 inches apart and bordered by skips 30 inches wide. Weed control was ideal throughout the four-year study, and no effect of weeds on the yield of any of the treatments was observed. Only a few of the many possible skip row systems were compared and they were not as efficient as some to be discussed.

The skip row systems in Table 2 are presented graphically in Fig. 1. The yield data in Table 2 are the average of three varieties (Amcor, Wayne and Williams 79) and eight year-locations. No significant "skip row system by variety" interactions were observed. The data indicate that as the uniform row spacing decreases from 30 to either 20 or 15 inches, yield increases by 4.0 and 5.5 bushels per acre, respectively. With this yield increase comes the loss of the ability to cultivate and apply postemergence pesticides without damaging the crop. At the least, cultivation is slowed and difficult and requires special equipment.

Selecting one of the skip row systems in Table 2 would increase yields by 2.5 to 3.7 bushels per acre over uniform 30 inch rows and would permit the application of postemergence pesticides without

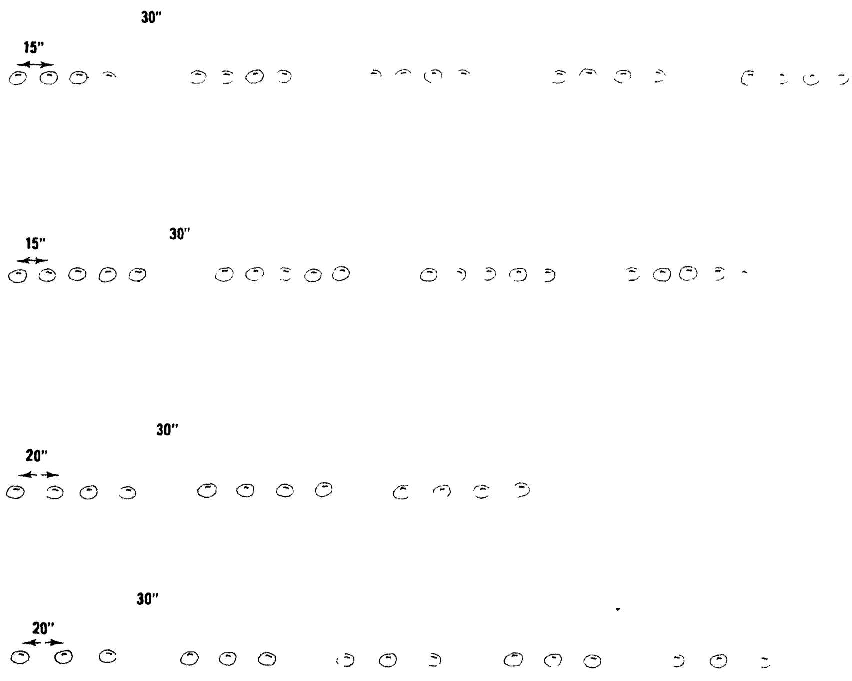



Fig. 1: Graphical description of the skip row patterns presented in Table 2.

running over the crop. The yield loss due to the skip row systems in Table 2 as compared to uniform 15 inch row spacings varied from 1.8 to 3.0 bushels per acre. However, these skip row systems contained a maximum number of skipped rows per acre and therefore gave a larger yield loss than would be expected from more efficient systems. As the number of skips per acre decreased, the efficiency and yield increased. The type of skip row pattern selected and its efficiency depend on the type and size of planting equipment available. Large planters and grain drills allow the development of high yield and highly efficient systems.

For maximum yields, seeding rates for skip row systems should be precise. The narrow rows should be seeded at the normal rate, such as five seeds per foot of row when rows are 15 inches apart. Rows next to the skip should be seeded at the rate recommended for rows the width of the skip. The higher seeding rate hastens the development of a leaf canopy over the skips and increases yield. Where seeding rates cannot be changed in rows next to a skip, the use of a branching type variety that grows tall will also be effective in increasing yield.

### Planter Adaptation

The row width used in skip row systems and the width of the skip can be any size. In this discussion, rows and skips are assumed to be 15 and 30 inches respectively except where grain drills are

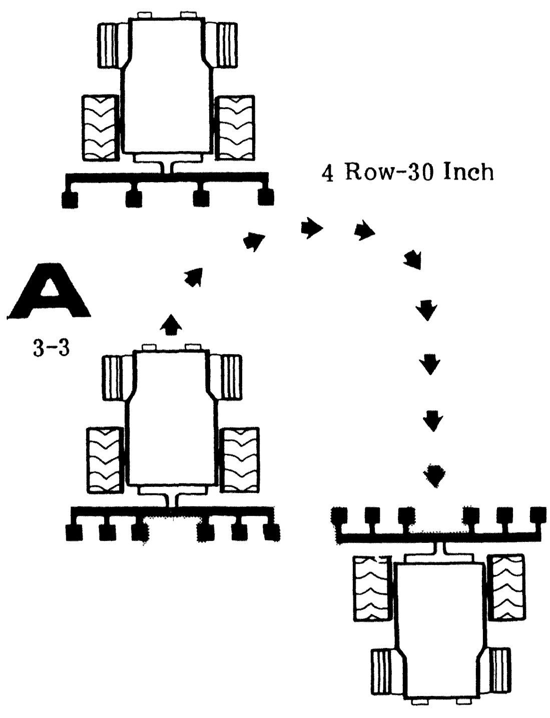



Fig. 2 (A-L): Modification of 4, 6, 8, 12, 16 and 24 row planters to plant skip row patterns.

Key

Planter

Air units off

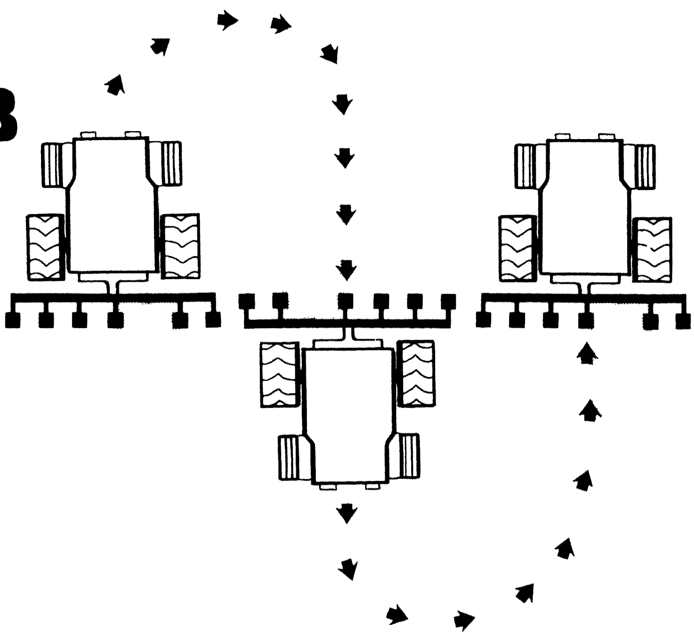
Skip row

mentioned. A planter designed to plant six 30 inch rows can be adapted to plant a wide variety of skip row patterns. The addition of three planter units, one between the two units on each end and one between the two center units, would result in a pattern of three 15 inch rows between a pair of 30 inch skips (3-6) and six rows between two pairs of skips (Fig. 2D). The addition of four units to the planter would result in a pattern of 4-16 (Fig. 2E). The four added units are placed between the five units on the left end of the planter, and the second unit from the right is moved out (right) 15 inches to create a 30-inch space with two units to its right.

Where air planters are used, such as those available from Allis-Chalmers Machinery Company, two units can be prevented from seeding by turning off the fan that services the units. With the addition of five units to a six row, 30-inch air planter, and with two units turned off every third pass across the field, a highly efficient system (3-28) is produced (Fig. 2F). These skip row systems (Fig. 2D-F) would produce yields of 51.6, 52.5 and 52.7 bushel per acre, respectively, as compared to a yield of 47.5 and 53.0 bushels per acre for uniform 30- and 15-inch rows, respectively (Table 2). For these three patterns the row markers are moved in 15 inches to reduce the guess middles to 15 inches. The yield difference between 15-and 30-inch rows was 5.5 bushel per acre (Table 2). Because Fig. 2D shows that 75 percent of the potential 15-inch rows were planted, yield for that system would be 75 percent of 5.5 bushels added to the yield of 30-inch rows or 51.6 bushel per acre (.75 x 5.5 + 47.5 = 51.6).

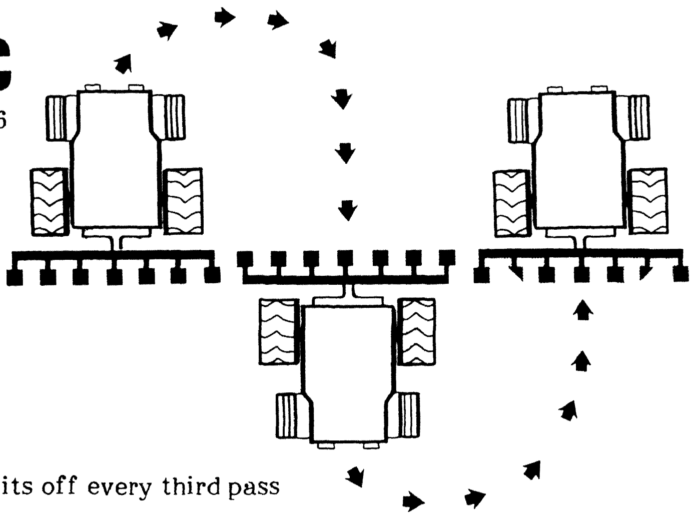
**B**

4-8



**C**

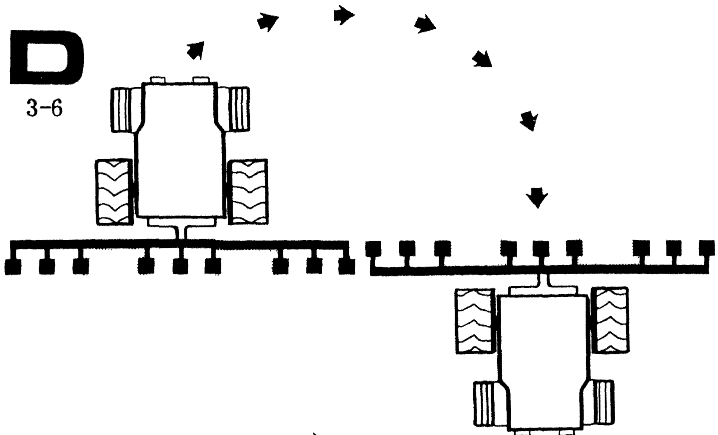
3-16



Air units off every third pass

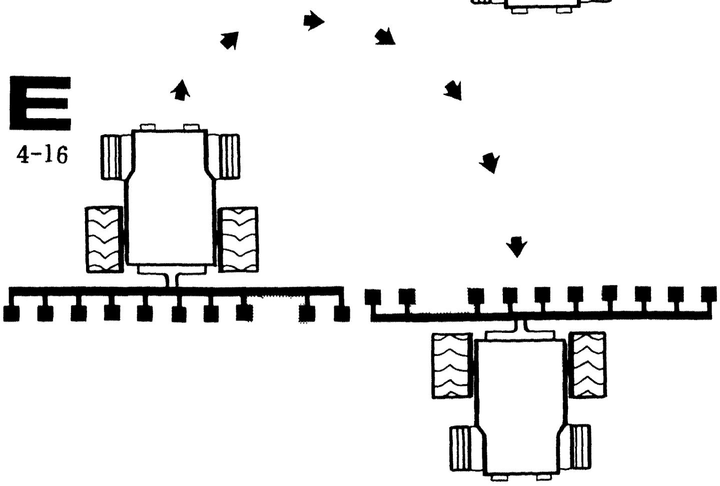
**D**

3-6



**E**

4-16



## Economics of Skip Rows

If the three units added to the six row planter (Fig. 2D) cost $3,000, and the yield increase of 4.1 bushels per acre was sold for $6 per bushel, then 122 acres of skip row production would pay for the added planter units. The number of acres needed to pay for either four or five added units as used in Figs. 2E and 2F would be 133 and 161, respectively. Therefore, the investment in additional planter units can be recaptured rapidly. Some of the many possible skip row systems suitable for 4, 8, 12, 16 and 24 row planters are also shown in Figure 2.

When pesticides are applied to the growing crop using skip row systems, it is important that the width of sprayer boom match the width of the skip row pattern (Table 3). For most patterns, there are two or more widths of spray booms capable of matching the skip row pattern. When this match is made, the possibility of sprayer skips and overlaps is eliminated. This is an important advantage for skip row patterns because skipped areas result in strips of poor weed

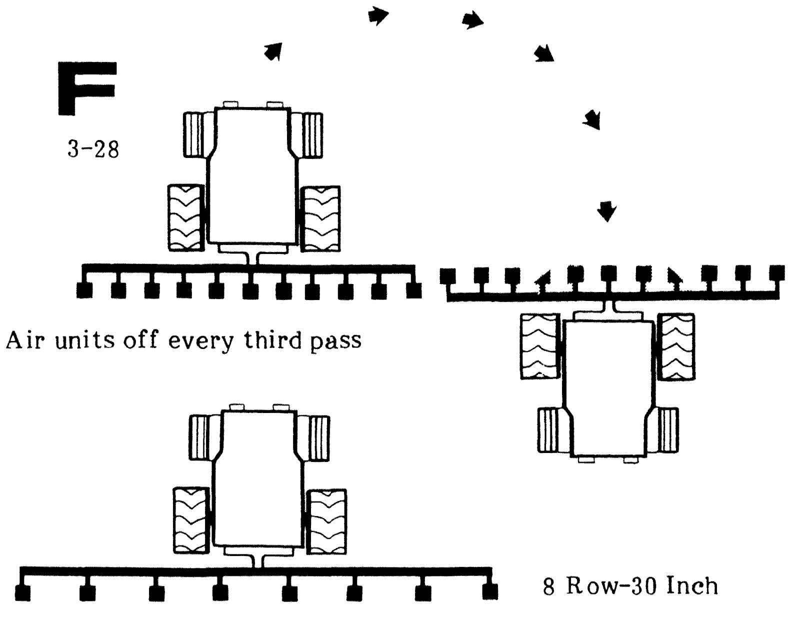
Table 3. The yield increase over 30-inch rows, efficiency, acres needed to pay for added units and sprayer width associated with the skip row patterns described in Fig. 2.

| ›attern | Yield Increase (bu/ac) | Efficiency* | Acres needed to Pay for Units | Sprayer Width (feet) |
|---|---|---|---|---|
| A | 4.1 | 75 | 82 | 30,35,40,45 |
| B | 4.4 | 80 | 76 | 17.5,35,52.5 |
| C | 5.0 | 90 | 100 | 26.25,52.5 |
| D | 4.1 | 75 | 122 | 30,35,40,45 |
| E | 5.0 | 91 | 133 | 27.5,55.0 |
| F | 5.2 | 94 | 161 | 41.25 |
| G | 4.8 | 87 | 174 | 37.5 |
| H | 5.1 | 93 | 196 | 37.5 |
| I | 5.1 | 93 | 229 | 37.5 |
| J | 5.0 | 91 | 300 | 28.75,57.5 |
| K | 5.3 | 96 | 315 | 28.75,57.5 |
| L | 5.3 | 96 | 346 | 28.75,57.5 |
| M** | 5.2 | 94 | 425 | 38.75 |
| N** | 5.3 | 96 | 660 | 58.75 |

* Percent of area planted in 15-inch rows.
**Similar to Fig. 2L for 16 and 24 row patterns

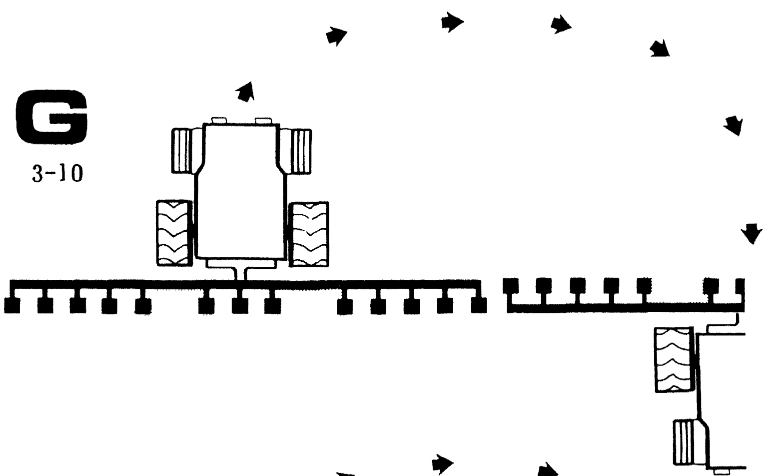
**F**

3-28



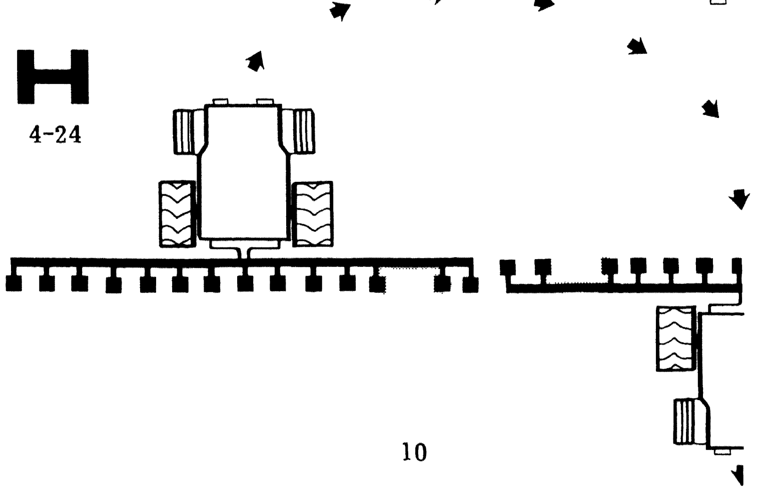

**G**

3-10



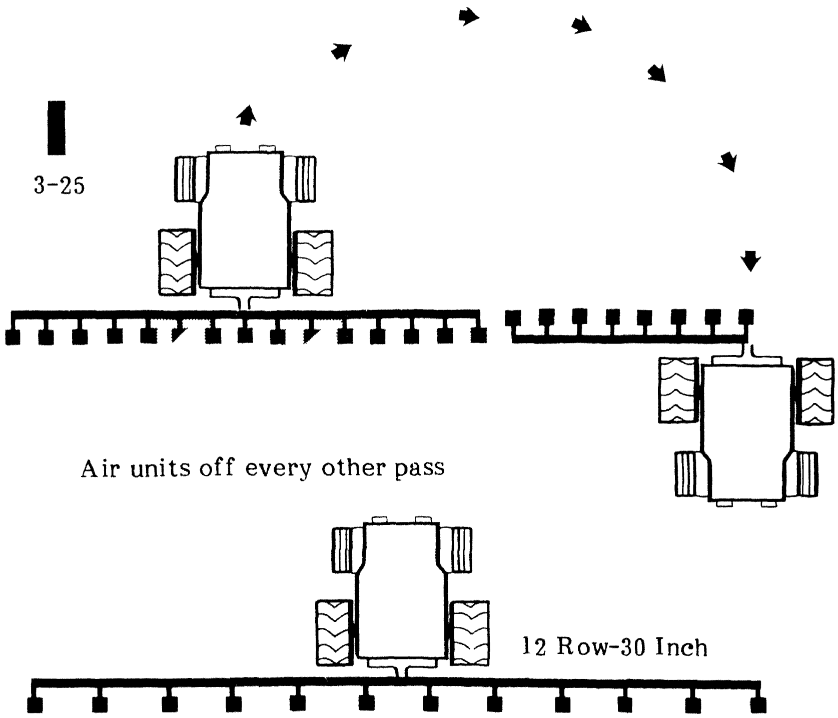
**H**

4-24



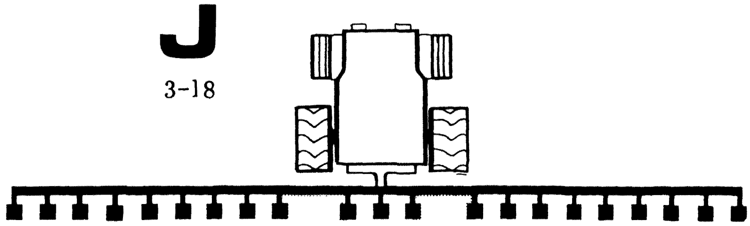
**I**

3-25



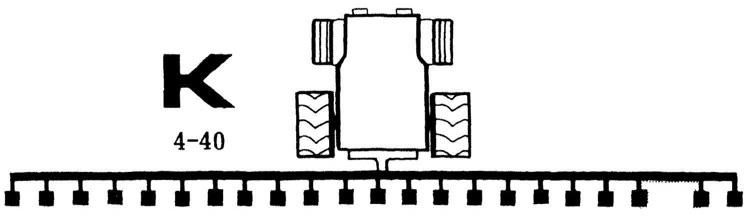

**J**

3-18



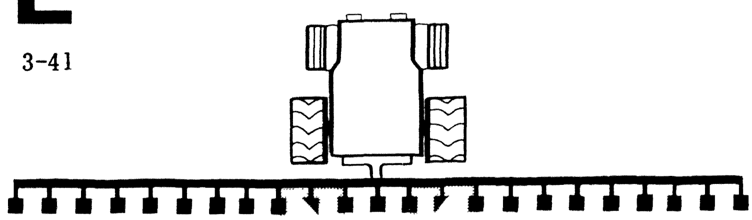
**K**

4-40



L

3-41



Air units off every other pass

control, while overlaps may cause severe crop damage and a loss of yield as well as a potentially serious weed problem if competition from the crop is reduced.

Where skips or overlaps 3 feet wide are left with each pass of a 30-foot-wide sprayer and yields reduced by half due to weeds or stunted plants in the skip, the yield loss per acre would be 2.25 bushels per acre worth $13.50. The yield loss due to the use of a skip row system compared to continuous 15 inch rows be only 1/2 bushel per acre worth $3. Thus, skip row systems are advantageous where sprayer skips or overlaps are likely.

**Splitting the Middles**

Symmetric skip row patterns are difficult to produce when doubling back with to split the middles. However, where air planters are used, it is easy to produce a wide range of skip row patterns by installing an electrical switch in the tractor that will disengage the fan on two units. For example, when using a four row air planter with 30-inch spacings and splitting the middles on the return pass of each round, disengaging the second and fourth unit from the left end of the planter on every third return pass would produce a skip row pattern of 3-19, which is similar to the pattern shown in "J" of Fig. 2.

Table 4 shows some of the skip row patterns possible by splitting the middles with different size air planters. Table 5 gives the expected yield increase, efficiency, income per hour while splitting the middles and sprayer sizes associated with the skip row patterns in Table 4. Fig. 3 shows a graphic description of how a skip row pattern is produced when splitting the middles with a planter having four air units spaced 30 inches apart and when two of the units are prevented from planting on every third return pass. This technique can be used with any size planter.

When splitting the middles, it is important that each row middle is the same width. This is easily accomplished by setting the hitch

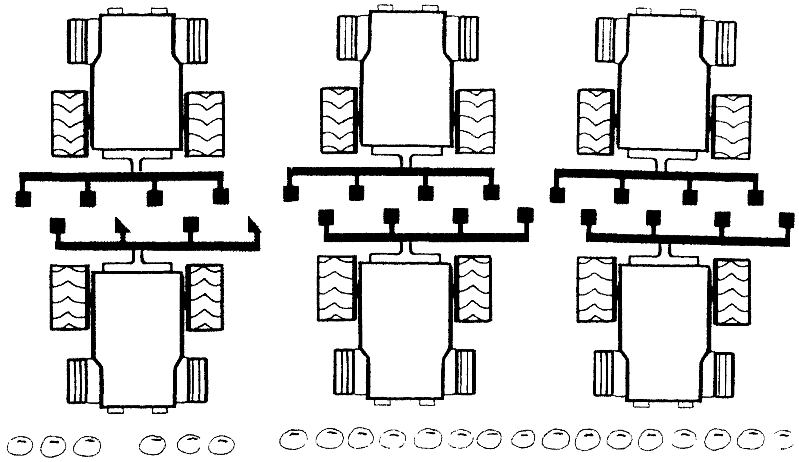


Fig. 3: How to use a 4-30 air planter to produce skip rows while splitting the middles.

Table 4. Skip row patterns when splitting the middles with air planters. Rows are 15 inches with a pair of 30 inch skips separated by three rows. A 3-19 pattern is diagrammed in Fig. 3.

| Planter Size | Return Pass on Which Air Units Are Defunct | Skip Row Patterns* | Pattern |
|---|---|---|---|
| 4 row 30 inch | every other | 3-11 | 1 |
| | every third | 3-19 | 2 |
| | every fourth | 3-27 | 3 |
| | every fifth | 3-35 | 4 |
| | every sixth | 3-43 | 5 |
| 6 row 30 inch | every other | 3-19 | 6 |
| | every third | 3-31 | 7 |
| | every fourth | 3-43 | 8 |
| 8 row 30 inch | every other | 3-27 | 9 |
| | every third | 3-43 | 10 |
| 12 row 30 inch | every pass | 3-19 | 11 |
| | every other | 3-43 | 12 |
| 16 row 30 inch | every pass | 3-27 | 13 |
| 24 row 30 inch | every pass | 3-43 | 14 |

* First number indicates the number of rows between the two skipped rows. Second number indicates the number of rows between each pair of skipped rows.

point of the tractor drawbar 7.5 inches off center and holding in that position while planting. Driving on the same tracks for the return trip will produce a uniform set of 15-inch-wide rows. The row marker should be moved 7.5 inches in the opposite direction of the drawbar and the next round marked on the first pass.

Yields are increased by 4.8 to 5.3 bushels per acre over 30 inch rows when splitting the middles (Table 5). This technique requires no additional investment in equipment and will generate an income of $115 to $763 per hour while splitting middles depending on the size of planter. Although the number of acres planted per day is reduced and the planting of some acreage is delayed, the yield increase from the narrow rows will be twice as great as the yield loss due to delayed planting. For example, assuming 400 acres are to be planted with a four row planter at the rate of 40 acres per day, the yield loss due to delayed planting caused by splitting the middles would be 1,000 bushels. With a yield increase of five bushels per acre over 400 acres from splitting the middles, a net gain in total production of 1,000 bushels worth $6,000 or an increase of $15 per acre in income is

Table 5. The yield increase over 30 inch rows, efficiency, income per hour produced while splitting middles and sprayer sizes associated with the skip row patterns described in Table 4.

| Pattern | Yield Increase (bu/ac) | Efficiency | Income per Hour* Produced While Splitting Middles ($) | Sprayer Widths (feet) |
|---|---|---|---|---|
| 1 | 4.8 | 87 | 115 | 20,40,60 |
| 2 | 5.0 | 91 | 120 | 30,60 |
| 3 | 5.2 | 94 | 125 | 40 |
| 4 | 5.2 | 94 | 127 | 50 |
| 5 | 5.3 | 96 | 127 | 60 |
| 6 | 5.0 | 91 | 180 | 30,60 |
| 7 | 5.2 | 94 | 187 | 45 |
| 8 | 5.3 | 96 | 191 | 60 |
| 9 | 5.2 | 94 | 250 | 40 |
| 10 | 5.3 | 96 | 254 | 60 |
| 11 | 5.0 | 91 | 300 | 30,60 |
| 12 | 5.3 | 96 | 318 | 60 |
| 13 | 5.2 | 94 | 499 | 40 |
| 14 | 5.3 | 96 | 763 | 60 |

* Assume 2 acres per hour for each 5 feet of planter width, and soybeans worth $6 per bushel.

obtained. At a planting rate of four acres per hour, the operator would be producing extra grain worth $120 for each hour he spent splitting the middles and producing a skip row pattern (Table 5). Because available hours are at a premium at planting time, a larger planter would compensate for the loss in acreage planted per hour due to splitting the middles. If an eight row planter cost $10,000 more than a four row planter, the extra yield from 334 acres of narrow row soybeans would pay for the difference in the cost of the two planters, and the actual number of hours needed to plant a given acreage would not change. In other words, a four row planter could plant 334 acres in 67 hours without splitting the middles, and an eight row planter would plant that same acreage in the same amount of time while splitting the middles. The difference in the price of the two planters would be paid with the yield increase from that same acreage.

## Grain Drills and Skip Rows

Research studies comparing the use of grain drills and unit planters for narrow rows have shown that 15-inch-wide rows planted with unit planters produce yields similar to those produced by grain drills planting 7-inch-wide rows. The use of planters for narrow row soybeans may reduce the amount of tillage required to produce a satisfactory seed bed. However, skip row systems can be produced with grain drills as well as planters, but the flexibility to produce a wide range of patterns is limited. When the fourth, fifth and sixth row from either end of a 24-hole 7-inch drill is prevented from planting, a skip row pattern (6-36) is produced. In view of a yield difference of 5.5 bushels per acre between 7 and 30 inch rows, the yield increase for this system would be 4.8 bushels per acre and there would be no additional expenditures for equipment. The width of a sprayer that would match this system must be either 28 or 56 feet. When using a grain drill to establish skip rows, it is advisable to use markers on the drill so the width of guess rows can be kept constant.

## Summary

Skip rows prevent sprayer overlap and skips when applying postemergence pesticides. Skip rows eliminate the need to count rows to determine where the next pass with the sprayer should be. This is especially convenient where large sprayers or narrow rows are in use. Skip rows also encourage the application of postemergence pesticides when required and give additional yield as a result of better crop management.

Skip rows permit easier harvest of the crop, especially when lodging occurs. When the end of the header is in a skipped row, there is less rubbing and bumping of adjacent rows, which reduces grain shatter. Finally, skip row systems are easy to develop and use.

With skip row systems, yields are increased by up to 5.3 bushels per acre over the yield obtained from 30-inch rows, and the cost of any additional equipment needed to produce skip rows is recaptured rapidly. Although little or no damage is done to small soybeans by tire traffic, there is reluctance to run over an emerged crop. Skip rows permit the application of needed pesticides to soybeans in narrow rows without running over rows of plants.

Skip rows give great flexibility with respect to row width, distance between the two skipped rows and distance between the pairs of skipped rows. In this publication, consideration of 15-inch rows and 30-inch skips for planters and 7-inch rows with 28-inch skips for grain drills has been emphasized. However, any row spacing and skip size is satisfactory as long as it will accommodate the available equipment.

In conclusion, skip rows are another useful soybean management practice available to farmers. In Ohio, yields have been increased up to 5.3 bushels per acre over 30-inch rows when skip row systems are used. If used properly, additional equipment required for skip row production can be repaid with fewer than three days of planting. Considering the advantages of skip row production, this management practice is a viable option for many soybean producers.



Issued in furtherance of Cooperative Extension work, Acts of May 8 and June 30, 1914 in cooperation with the U.S. Department of Agriculture, George R. Gist, Acting Director of Cooperative Extension Service, The Ohio State University.