Chapter 7

Planting Practices

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Many different planting practices are used by Arkansas soybean producers to get acceptable stands of soybean plants depending on grower preference, available equipment, soil texture, cropping system and, to some extent, planting date. Acceptable and consistent stands can be obtained with both conventional and no-till row planters and drills. In recent years many farmers have gotten rather consistent, and fairly uniform, stands with broadcast seeders. Current University of Arkansas research is being directed toward improving stand establishment in clay soils using broadcast and drill plantings on beds. Additional work has begun to evaluate the potential of aerial seeding. This chapter deals with some of the more important grower considerations when planting the Arkansas soybean crop.

Figure 7.1. Stand of Arkansas soybeans.

Planting Depth

Planting depth has an important influence on the number of seedling plants that emerge to a stand. The optimum depth in most soils is 1 to 1.5 inches. In clay soils it is important to place the seed about 0.5 inch into the wet soil or muck. The soybean seed needs to absorb up to 50 percent moisture by weight to germinate, so it should be planted in moisture. If adequate moisture is not available, the seed may only absorb enough moisture to swell and begin, but not complete, germination. Deep planting increases the risk of the soil crusting from heavy rains before the seedlings emerge. Shallow planting is particularly desirable when planting in early April while the soil is very cool and/or the potential for significant rainfall is great.

To obtain a satisfactory stand, most planters and properly designed drills can accomplish the task of placing the seed into moisture while firming the soil around the seed. However, some planter modification may be necessary to accommodate large amounts of residue and/or hard, dry soil conditions (including no-till). Coulters are often used to slice through the residue. Weights may be added to exert enough downward pressure to force the seed opener through the hard soil to place seed into moisture.

Seed Quality

Obtaining soybean seed of acceptable quality for planting is highly recommended. This will help ensure establishing an optimum stand of vigorously growing seedlings. Seed with a standard germination test of 80 percent or better generally result in adequate stands during the April and May plantings. As plantings are delayed into June and especially into July, the vigor of the seed becomes more important if marginal soil moisture and elevated soil temperatures occur. Seed that has less than 80 percent germination late in the planting season may produce poor stands especially if there are significant adverse conditions at planting due to low seed vigor. Seed vigor, as measured by the Accelerated Aging (AA) test, may be below 50 percent in late June and July. Growers who plant bin-run seed should obtain both the Standard Germination and the Accelerated Aging tests of all potential seedlots to determine if the seed is even suitable for planting (**see Chapter 4**).

Management Tips

1. Generally, seed placement should be **at least** 0.5 inch into the moist soil zone but should not greatly exceed 2 inches below the soil surface.
2. Downward pressure (sometimes up to 500 pounds per seed opener) may be required to place seed into moisture in hard, dry soil conditions.
3. Soil temperature should be at least 55˚F. **(See Chapter 2.)**

Soil Temperature

Although optimum soil temperature for soybean germination is around 95˚F, soybean seed will germinate between 37˚F and 109˚F (**see Chapter 2**). Growers can expect rather uniform stand establishment after soil temperatures reach or exceed 50˚F. In Arkansas, this typically occurs during the month of April.

Variety Selection

As indicated in **Chapters 3** and **16**, proper variety selection is crucial for profitable soybean production, and many tools such as Extension's *Soybean Update* and the computerized variety selection program *SOYVA* are available to assist growers.

Management Tips

1. Seed Quality – As discussed in **Chapter 4**, seed should have 80 percent or better germination and preferably with vigor (Accelerated Aging test) within 15 percent of the Standard Germination test. Seedlots with less than 80 percent germination in April will likely have very poor vigor in July.
2. Growers who plan to use bin-run seed should obtain a Standard Germination and Accelerated Aging (AA) test to determine if the seed is suitable for planting.

Seed Treatments

There are instances when the use of a fungicidal seed treatment is essential to obtain acceptable and vigorous stands. These instances include April plantings (cool, wet soils), late plantings (especially no-till doublecrop) and in fields that have a history of seedling disease problems. Where there is increased concern for serious seedling disease problems, growers are urged to treat seed with a systemic fungicide such as Apron, Allegiance or Apron XL to minimize Pythium and seeding Phytophthora root rot problems. Growers are encouraged to use products such as Vitavax 200, Vitavax M or Maxim, etc., to enhance the control of Rhizoctonia organisms. A more thorough discussion of seedling diseases and related control measures is available in **Chapter 11**.

Figure 7.2. Soybean germination and emergence.

Seed Inoculation

Specific nitrogen (N)-fixing bacteria (Bradyrhizobia) form the round nodules commonly seen on soybean roots. These bacteria are not native to Arkansas soils and are introduced by inoculating the seed. The bacteria take gaseous N from the atmosphere and fix it into compounds required by the soybean plant. The amount of N fixed by the bacteria can exceed 300 pounds per acre during the growing season. These nodules exist in a symbiotic (mutually beneficial) relationship within the soybean root system, obtaining food sources from the root and, in turn, fixing the considerable amount of nitrogen for the plant. Active nodules will have a

Management Tips

1. Inoculate soybean seed when soybeans will be grown on land that has not been planted to soybeans within the past five years or where previously grown soybean plants did not have adequate nodulation.

2. A seed treatment of the micronutrient Molybdenum (Mo) at the rate of 0.2-0.4 oz/A should be applied in acid soil to enable the N-fixing bacteria to function properly.

pinkish color when sliced open. After the bacteria are well-established in the soil, adequate populations will generally survive (even in the absence of soybean plants) for three or more years. Additional information related to this topic is presented in **Chapter 5**.

Planting Date

Soybean plants from most commercial varieties are sensitive to the photoperiod, or length of daylight (more specifically the number of hours of darkness). Thus, soybean plants can be especially affected by the planting date since it impacts the number of days to flowering, the amount of time available for vegetative plant growth and plant development, which all are necessary for good yields. Planting beyond the optimum date will cause yields to be reduced. Planting too early or too late can reduce yields because of poor stands due to excessively cold or hot soil temperatures or because day lengths are too short. Short day length may result in plants flowering early and having reduced vegetative growth.

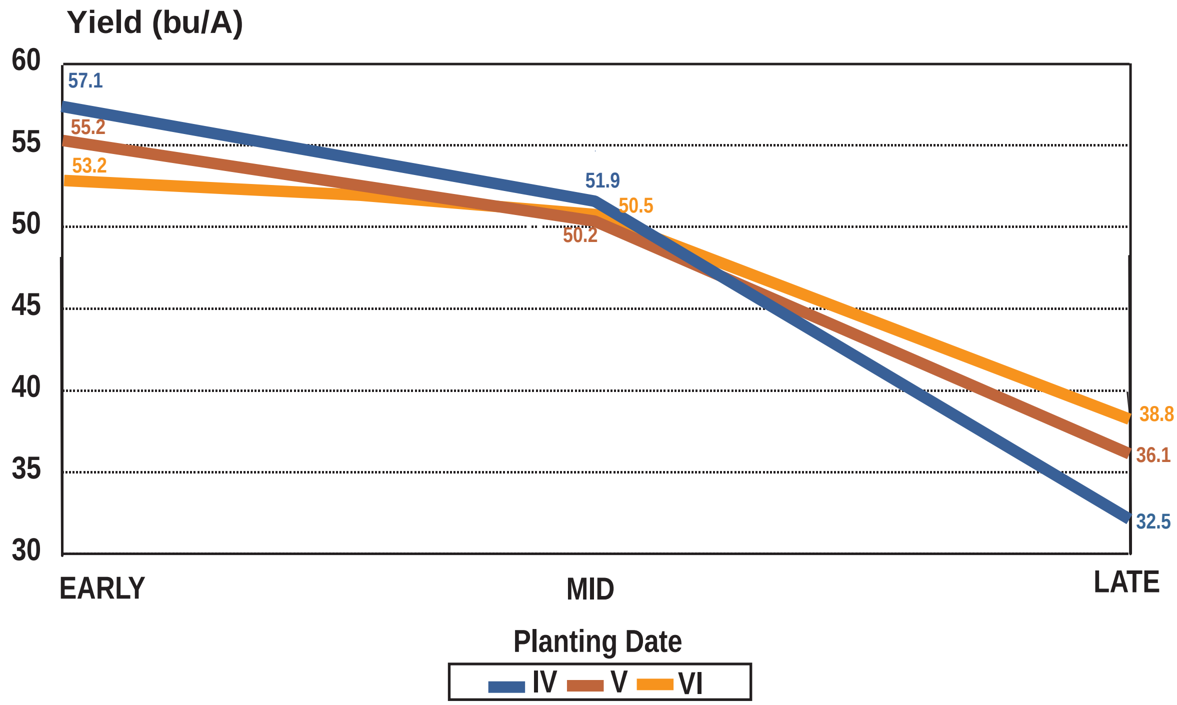
As described in **Chapter 2**, the response to day length determines whether a variety is early or late in maturity. The minimum number of hours of darkness required to induce flowering is the factor that separates the early from the late-maturing varieties. In the southern United States, most MG V and VI adapted varieties require at least 10 hours of darkness before flowering is initiated.

The standard recommendation for planting determinate varieties in Arkansas is between April 25 to June 30. Planting before this date as early as April 1 in southern and April 15 in northern Arkansas can be accomplished when planting the early maturing indeterminate MG IV varieties. Slow emergence and growth often occur with this early planting date, but the potential for an early harvest (August or early September) and the possible avoidance of summer drought during seed filling often result in improved grain yields (both irrigated and non-irrigated). This early planting of MG III and IV varieties is commonly referred to as the Early Soybean Production System (ESPS) and is further discussed in **Chapter 16**. For a more thorough discussion pertaining to determinate and indeterminate growth types, see **Chapter 2**.

Planting during the conventional time period (mid-May to early June) usually provides for rapid seed germination and emergence. Although plants will grow taller and are more apt to shade the middles sooner, maximum yields appear to occur at a slightly earlier planting date (Figure 7.3). These recent research findings indicate that varieties of different MGs react somewhat differently to planting date, with MG IV and V performing well in earlier plantings while MG VI varieties tend to perform better in the later planting dates. This apparent maturity group by planting date interaction has significant implications to the economic viability associated with the soybean production systems in Arkansas (**see Chapter 16**).

Earlier research findings suggest that planting after June 15 results in a 1 to 2 percent yield loss per day, with the yield loss potential increasing to 2 to 3 percent per day after July 1 under moisture-limiting conditions. Some of the yield loss associated with late planting can be minimized by changes in variety, variety growth habits, herbicide selection, increasing the plant population and decreasing the row spacing to 20 inches or less. Plantings after July 15 are not recommended due to a greatly shortened growing season although some late MG IV and MG V varieties usually have enough time to produce mature seed before a fall frost if emerged by August 1. Plant height and grain yields will be greatly reduced in the July plantings.

Figure 7.3. Effect of Planting Date on Irrigated Soybean Yield by Maturity Group, Pine Tree Experiment Station – 1995-98



Early – Comprises planting dates between April 25 and May 6.
Mid – Comprises planting dates between May 25 and June 5.
Late – Comprises planting dates between July 1 and July 10.

Seeding Rate and Plant Population

Soybean plant populations (number of plants per acre) can vary often without seriously impacting grain yield. Thick plant populations in ideal growing conditions may result in plants that are more subject to lodging, while thin plant stands may result in plants that set pods close to the ground making harvest more difficult.

Generally, it is not wise nor cost effective to greatly vary from the Extension-recommended seeding rates. The data in Table 7.1 were obtained from studies on Starks Farm in Miller County by Ashlock, et al., on a deep alluvial silt loam soil. This data indicated that under non-irrigated conditions there were relatively small differences in the soybean grain yield at seeding rates varying from 60,000 (approximately 30 lbs of seed/A) up to 240,000 plants/A (120 lbs of seed/A). However, more recent research on sharkey clay soil in Northeast Arkansas by Vories, et al., suggested that an increased seeding rate may be advisable in field environments that typically result in reduced plant development (canopy width and height). Although further work is needed in this area for other soils and environments, it appears the seeding rates listed in Tables 7.2 and 7.3 are sufficient for most fields. Optimum seeding rates should result in growers obtaining stands of recommended

Table 7.1. Effect of Plant Population on Soybean Yield (Bu/A), Averaged Over Four Varieties and Three Row Spacings, Starks Farm, 1994-96

Seeding Rate (#/A)	1994	1995	1996	Average
60,000 (30)	51.1	20.8	47.2	39.7
120,000 (60)	51.7	20.7	51.2	41.2
180,000 (90)	53.9	19.9	51.9	41.9
240,000 (120)	53.4	18.8	50.3	40.8
LSD (.05) =	2.6	1.2	3.3	

Table 7.2. Soybean Seeding Rate Recommendations for Indeterminate MG III and IV Varieties Anticipating a Final Plant Population of 130,000 Plants Per Acre[1]			
Row Spacing	**Recommended Seeding Rate (Seed Per Row Foot)**	**Desired Plants Per Row Foot**	**Row Width Factor[2]**
36-38	12.8	9.2	14.13
28-30	10.0	7.2	18.02
25-27	9.0	6.5	20.10
22-24	7.9	5.7	22.73
19-21	6.9	5.0	26.14
16-18	5.8	4.2	30.75
13-15	4.8	3.5	37.34
10-12	3.8	2.7	47.52
7-9	2.8	2.0	65.34
Suggestions for Broadcast Plantings	**Planted Seed Per Square Foot**	**Desired Plants Per Square Foot**	**Square Foot Factor**
Broadcast[3]	5.0	3.0	43.56

[1]The assumption is made that the seedlot has germination of 80 percent and that 90 percent of the viable seed will survive.
[2]The "row width factor" is the length of row at the various row spacings or planting patterns required to represent 1,000th of an acre.
[3]An assumption is made that 60 percent of planted seed will emerge to a plant stand with broadcast seedings.

Table 7.3. Suggested Soybean Seeding Rates for Determinate Varieties of Maturity Groups V, VI and VII for Both Irrigated and Dryland (Non-Irrigated) Production Resulting in an Approximate Final Stand of 100,000 and 80,000 Plants Per Acre, Respectively[1]					
Row Spacing	**Recommended Seed Rate (Seed/Row Foot)**		**Desired Plants Per Row Foot**		**Row Width Factor[2]**
	Irrigated 100,000	**Dryland 80,000**	**Irrigated 100,000**	**Dryland 80,000**	
37-39	10.1	8.1	7.3	5.8	13.75
34-36	9.3	7.4	6.7	5.4	14.93
31-33	8.5	6.8	6.1	4.9	16.34
28-30	7.7	6.2	5.5	4.4	18.02
25-27	6.9	5.5	5.0	4.0	20.10
22-24	6.1	4.9	4.4	3.5	22.73
19-21	5.3	4.3	3.8	3.1	26.14
16-18	4.5	3.6	3.3	2.6	30.75
13-15	3.7	3.0	2.7	2.1	37.31
10-12	2.9	2.3	2.1	1.7	47.52
7-9	2.1	1.7	1.5	1.2	65.34
Suggestions for Broadcast Plantings	**Planted Seed Per Square Foot**		**Desired Plants Per Square Foot**		**Square Foot Factor**
Broadcast[3]	3.8	3.1	2.3	1.8	43.56

[1]The assumption is made that the seedlot has germination of 80 percent and that 90 percent of the viable seed will survive.
[2]The "row width factor" is the length of row at the various row spacings or planting patterns required to represent 1,000th of an acre.
[3]For broadcast seeding only 60 percent of the planted seed are expected to germinate.

plant populations which do not significantly jeopardize yield, do not contribute to excessive lodging and result in the setting of the lower pods high enough on the plant to facilitate an efficient harvest.

Determining Actual Seeding Rate

Seed vary in size according to varieties and the year grown; therefore, the number of seed per row foot is a better guide for calibrating the planter than using pounds of seed per acre. Although there are numerous ways to calibrate a planter, one method is to determine the actual seeding rate by counting the number of seed in 10 feet of row and dividing by 10 to obtain an estimate of the average number of seed per row foot. (This should be done at least three or four times to obtain an average number of seed per row foot.) Planter units should also be checked for consistency when changing varieties or when the seedlot changes within a variety. Planting too many or too few seed per acre can be costly in terms of yield, lodging, seed cost and harvest efficiency. Travel speed and field roughness may also affect planting rate.

Determining Planting Seed Requirements

To find out the approximate amount of seed required to plant a specified acreage, a grower needs to determine:

1. The seeding rate in number of seed per row foot,
2. The row spacing,
3. The germination and seed size (the number of seed per pound), and
4. The acreage to be planted. Shown below in Equations 1 and 2 is a method that can be used to determine seed requirements using Tables 7.2 and 7.3.

Planter Row Spacing

Earlier Arkansas research conducted by Caviness, et al., with a determinate MG VI variety suggested a grain yield increase when row widths are reduced from wide rows (38 to 40 inches) to narrow rows (20 inches or less). Additional research

Equation 1

$$\frac{\text{Seeds Per Foot x Row Width Factor x 1,000}}{\text{Variety Seed Size}} = \text{Lbs of Seed/Acre by Variety}$$

Equation 2

$$\frac{\text{Lbs of Seed/Acre x No. of Acres Planted/Variety}}{\text{Lbs of Seed/Bag}} = \text{No. of Bags/Variety}$$

Example

A grower plans to plant and irrigate 100 acres of Hutcheson (with 3,400 seed per pound) on a 20-inch row spacing. The seed had 80 percent germination, so the recommended seeding rate is 5.3 seeds per row foot. Using Equations 1 and 2 and Tables 7.1 or 7.2, we calculate that approximately 82 bags are required to plant the 100-acre field:

Equation 1

$$\frac{5.3 \times 26.14 \times 1{,}000}{3{,}400} = \text{40.75 lbs/A of the variety with 80 percent germination and a seed size of 3,400 seed per pound}$$

Equation 2

$$\frac{\text{40.75 lbs/A x 100 A}}{\text{50 Lbs. of Seed/Bag}} = \text{81.5 (no. of 50-lb bags required for 100 acres)}^{1}$$

[1]If for some reason seed with seed germination is less than 80 percent, the seeding rate would need to be increased accordingly.

Table 7.4. Effect of Row Spacings on Soybean Grain Yield (Bu/A), Averaged Over Four Varieties and Seeding Rates, Starks Farm, Miller County, 1994-96				
Row Spacing (Inches)	1994	1995	1996	Average
10	54.8	19.4	50.2	41.5
20	55.2	19.5	48.3	41.0
30	47.9	21.4	52.0	40.4
LSD .05 =	2.6	2.1	2.9	

(Table 7.4) suggests that row spacings of less than 30 inches may result in a significant yield increase, but this yield increase is not always consistent over years and/or environments. A yield increase due to planting MG V and VI (determinate) varieties in narrow row spacing is more likely to occur when one or more of these conditions exists: (1) planting before May 15; (2) planting after June 15; or (3) the field environment is such that soybean plants do not obtain canopy closure with current row spacing by flowering (R2). This reduced plant growth is often associated with flat clayey and/or droughty soils. Additional research findings suggest increases in grain yield often result from row spacings of less than 30 inches in the Early Soybean Production System (ESPS) (**see Chapter 16**).

Planting Systems

Fields are becoming larger as a result of fewer producers farming larger tracts of ground. The need exists to develop faster planting systems while retaining the basics of good seed placement into moist soil at recommended seeding rates. Some of the newer planting systems include airflow and other broadcast seeding systems (spreader trucks, etc.). Many growers are using no-till and/or conventional drills in lieu of the more conventional row planters in an attempt to reduce labor and their equipment inventory as well as take advantage of potential yield increases often associated with the more narrow row spacing.

Current University of Arkansas soybean research includes efforts toward improving stand establishment in environments with poor surface drainage, including using beds with both conventional planters and drills. As the data in Table 7.5 indicate, many different planting systems can result in acceptable grain yields if adequate, uniform plant stands are obtained. This previously unpublished research conducted by Huitink, et al., suggests that getting a good stand is more important than how it is obtained. The magnitude of the grain yield confirms that timely management after stand establishment is essential for good yields.

Table 7.5. Effect of Different Planting Systems on Conventional Planted Hutcheson Grain Yields (Bu/A) in Stuttgart Silt Loam at the Pine Tree Experiment Station, 1994-96				
Planting System	1994 (May 27)	1995 (June 2)	1996 (June 6)	Average
Drill (7.5 inch)	59.2	57.0	59.4	59.5
30-inch w/o cultivation	52.7	52.7	67.0	57.5
30-inch with cultivation	53.0	53.3	68.1	58.1
Simulated airflow	57.0	55.7	64.1	58.9
Simulated broadcast	55.9	50.1	72.5	59.5
LSD .05 =	4.6	3.6	10.5	