SOYBEAN PRODUCTION SYSTEMS

Plant Populations and Seeding Rates for Soybeans

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Seed is one of the most expensive input costs for soybean growers, so it's important for growers to plant the right amount of seed to minimize input costs and increase profitability. Seeding rate, plant population, and row spacing are tied together. If the population is too high, plants compete with each other and often lodge. If the population is too low, a producer is wasting growing space and lowering yield.

This publication examines the relationship between soybean seeding rate and plant population, describes how to determine the right seeding rates for optimal plant populations, and recommends seeding rates and plant populations for various crop row widths.

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Seeding rate, plant population, and row spacing are closely related. As row spacing increases, the optimal number of plants per acre decreases.

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Physiological Response to Plant Population

High plant populations can have some advantages: canopy closure is quicker, light interception is greater, and weed competition is lower. However, yield does not always increase as plant population increases. As the number of plants per acre increases, each plant captures less light, which limits each plant's growth. High plant populations also increase competition for nutrients and water, may promote lodging, and add to seed costs.

Soybean plants are adaptable. When plant populations are low, individual soybean plants increase their leaf areas — which allows each plant to capture more sunlight — and produce more branches — which allows each plant to produce more pods. This characteristic (called plasticity) means that low soybean plant populations can offer competitive yields.

Determining Optimum Seeding Rate

Many factors influence plant population and seeding rate, including row spacing, seed placement and planter calibration, and the seed's germination rate.

Purdue Extension recommends row spacing between 7.5 and 15 inches for maximum soybean yield. Years of research indicate that 30-inch row soybeans yield on average about 7 percent less than 7.5- or 15-inch row soybeans (Hanna et al., 2007; Oplinger and Philbrook, 1992). The advantages of planting soybean in 15- or 30-inch rows are uniform seed placement, more uniform emergence, and decreased seeding rates, which means lower seed costs (Table 1).

A common practice among growers who reduce their seeding rates is to select a bush-type soybean. Our research indicates that there is no yield difference between erect and bushy soybeans planted in 7.5-inch rows even at low stand populations (about 50,000 plants per acre).

Seed placement is another important factor. Seeds should be planted between 0.75 and 1.5 inches deep, depending on soil type and tillage. Seeds can be planted shallower in heavy soils, such as high-clay soils. Uniform seed placement promotes uniform emergence, which is better than staggered emergence that can result in plant-to-plant competition. Growers should always follow their drill or planter instructions to make sure they are correctly calibrated and functioning properly to meter seed at desired rates and establish a uniform stand. For more information, see Purdue Extension publication ABE-126-W, *Grain Drill Metering Systems and the Need for Calibration*, www.ces.purdue.edu/extmedia/ABE/ABE-126-W.pdf.

The seed itself also plays a role in determining seeding rate. Growers must consider the percent of pure seed a bag contains, the germination percentage, the percent of live seed emergence, and the desired plant population. Remember, seed companies test germination rates under ideal temperature and moisture conditions, so (depending on the situation) growers may plant 10 to 15 percent more soybean seeds than called for by the germination rate.

To calculate a seeding rate, use the following equation:

$$\frac{\text{Desired Plant Population}}{\text{Percent Germination x Percent Pure Seed x Percent Live Seed Emergence}} = \text{Seeding Rate}$$

Growers can use this equation with any unit — acre, square yard, square foot — as long as the same unit is used in both seeding rate and desired plant population.

For example, let's say a grower wants to establish a stand of 170,000 plants per acre using a 7.5-inch row drill. The seed tag indicates that the seed has a 92 percent germination rate and is 98 percent pure live seed. Assuming a 10 percent loss in germination due to a clay soil that crusts, what seeding rate will achieve the goal stand?

$$\frac{\text{170,000 plants per acre (Desired Plant Population)}}{\begin{array}{c}\text{0.92 (Percent Germination) x 0.98 (Percent Pure Seed) x}\\\text{0.90 (Percent Live Seed Emergence)}\end{array}} = \begin{array}{l}\text{209,505 seeds per acre}\\\text{(Seeding Rate)}\end{array}$$

When deciding the amount of soybean to seed, growers may need to consider other conditions on a field-to-field basis. These conditions include the type, texture, and moisture of the soil; weather patterns; pathogen and insect pressure; previous tillage practices; crop rotation; planter settings; planting dates; and seed treatments. Biotic and abiotic stresses in the field can reduce germination rates compared to rates measured in seed-testing labs.

Current Practices

Currently, Indiana growers plant approximately (Conley, S.P. and J.B. Santini, 2007):

- 197,000 seeds per acre in rows spaced 10 inches or less
- 178,000 seeds per acre in rows spaced 11 to 20 inches
- 154,000 seeds per acre in rows spaced 21 inches or more

Based on its research, Purdue Extension recommends seeding rates of (assuming 90 percent germination and 90 percent emergence):

- 210,025 seeds per acre for rows spaced 7 inches
- 163,350 seeds per acre for rows spaced 11 to 20 inches
- 130,675 seeds per acre for rows spaced 21 inches or more (see Table 1)

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Today, 67 percent of Indiana growers plant soybean one to three weeks earlier than they did 10 years ago. This earlier planting can reduce stands in cold or wet years. In these situations using a fungicide seed treatment may prove beneficial.

To maximize yields in most environments growers should have no less than 100,000 uniformly standing plants per acre in 7.5- and 15-inch rows and no less than 80,000 uniformly standing plants per acre in 30-inch rows.

Table 1. Recommended Seeding Rates and Plant Populations at Different Row Widths

Row Width (inches)	Required Seeding Rate at 90% Germination and 90% Emergence (seeds/foot)	Recommended Seeding Rate at 90% Germination and 90% Emergence (seeds/acre)	Recommended Plant Population (plants/foot)	Recommended Plant Population (plants/acre)
30	7.4	130,675	6.0	104,540
20	6.2	163,350	5.0	130,680
18	5.6	163,350	4.5	130,680
16	5.0	163,350	4.0	130,680
14	4.3	163,350	3.5	130,680
12	3.7	163,350	3.0	130,680
10	3.4	179,688	2.8	143,750
8	3.1	204,188	2.5	163,350
7	2.8	210,025	2.2	168,020
6	2.5	217,800	2.0	174,240

To maximize yield and reduce input costs, soybean growers need to pay attention to plant populations and seeding rates. These recommendations present the optimal seeding rates and plant populations for Indiana growers and following them may reduce input costs and improve profitability.

References

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NEW 11/07