

Soybean Seeding Rate in Illinois



Soybean seed has become more costly in recent years due to advances in biotechnology, higher-yielding germplasm, and a variety of available seed treatments. These advances have enabled lower soybean seeding rates than those of a few decades ago. Yet seed remains a major expense at about 35% of soybean direct production costs under current practices. Optimizing seeding rate is therefore an important strategy for improving profitability.

Seeding Rate and Plant Population

Seeding rate is the number of seeds planted per acre, while plant population, or stand, refers to the number of plants per acre that successfully establish. The goal is to settle on the number of plants needed to maximize sunlight interception and yield potential, then to choose seeding rates to get to this stand. Because we cannot precisely predict the percentage of planted seeds that will produce healthy plants, and soybeans show a fairly wide range of stands needed to produce the highest yields, choosing a seeding rate always involves some guesswork.

Soybean exhibits high levels of phenotypic plasticity relative to other crops, allowing plants to adjust their growth and yield components (e.g., number of pods and seeds per plant) through branching in response to different plant population levels. Crop researchers found that fields with 80,000 plants per acre can look and yield similarly to those with 125,000 plants per acre, provided stands and spacing between plants are uniform, such that sunlight interception is high during seed fill.

Other crops, such as corn, also exhibit phenotypic plasticity, but their ability to compensate for lower population densities is more limited, making yield loss at lower stands more predictable. As a result of soybean's greater plasticity, combined with prior experience of anticipated percent germination and establishment, soybean producers in the U.S. Upper Midwest report using a wide range of seeding rates, from 100,000 or less to 180,000 or more seeds per acre. Given the wide yield plateau or the range of stand over which yield does not change, most stands are likely in this range, even though many fields probably have more plants than needed for maximum return to seed.

Yield Response and Economic Optimum

Figure 1 illustrates soybean yield response to plant population in trials conducted at the University of Illinois Urbana-Champaign. Typically, soybean yield increases with plant population until it plateaus and stops increasing despite additional plants per acre. In some cases, particularly under severe stress such as drought or disease pressure (e.g., white mold), increasing plant population beyond the point of maximum yield can lower yield. In the examples shown in Figure 1, soybean yield followed a “quadratic-plus-plateau” or leveling off with no decrease up to the highest stand in the trial response in 2017 and 2018, but in 2016, yield at the highest stand (~160,000 plants per acre) was lower than the yield at 110,000 plants per acre.

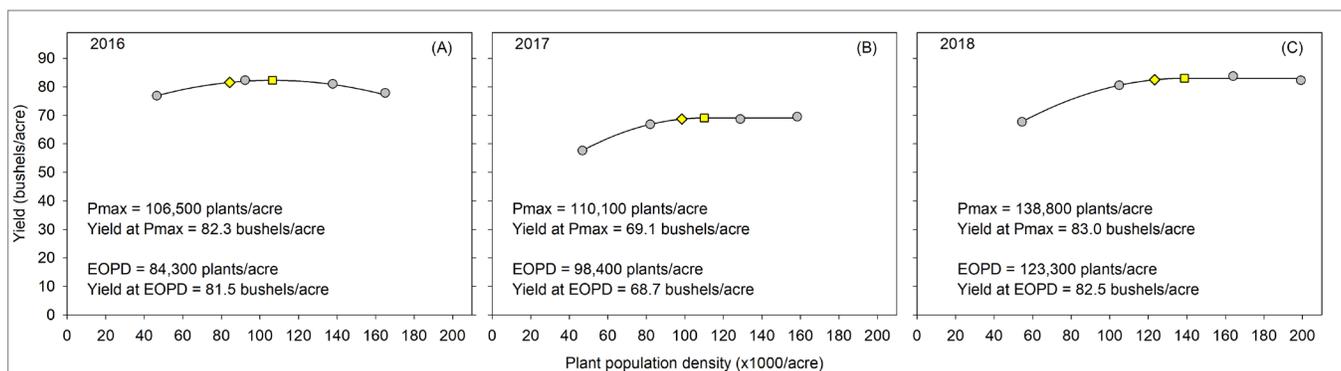
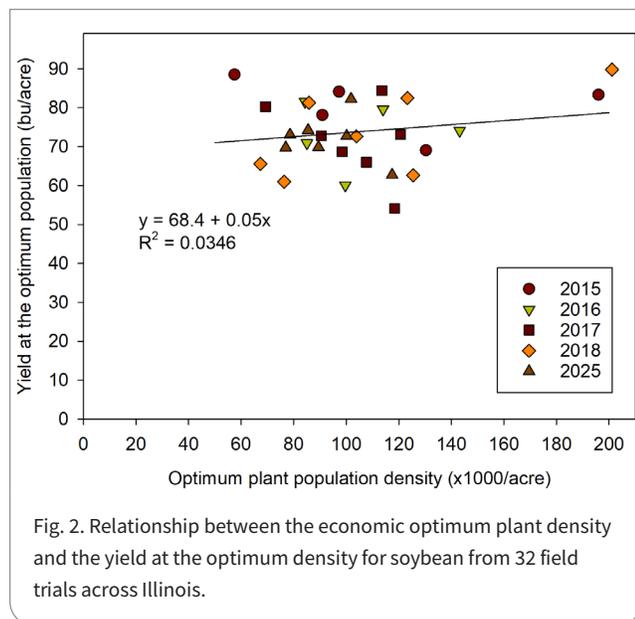


Fig. 1. Soybean yield response to plant population density at trials conducted in Urbana, IL. The yellow square and triangle indicate the agronomic maximum (Pmax) and the economic optimum plant density. The EOPD was estimated using \$10.50 per bushel and \$0.70 per thousand seeds.

The economic optimum plant density takes into account the ratio of the price of seed to the value of a bushel of soybeans, thereby maximizing return on seed investment. The EOPD is achieved when the last increment of seed increases yield just enough to offset its cost. Unless the seed has no cost, the EOPD is always lower than the population that maximizes yield (Pmax), as seen in Figure 1.

Figure 2 shows the relationship between EOPD and the yield at the EOPD from 32 trials conducted in Illinois between 2015 and 2025. There was essentially no correlation between EOPD and yield at the EOPD, which ranged from 54 to 90 bushels per acre. In addition, soybean yield responses to population were highly variable: the two highest yields in the study came at 70,000 plants per acre (93 bushels per acre) at a site in 2015, and at 200,000 plants per acre (92 bushels per acre) at another site in 2018. Across trials, the Pmax exceeded EOPD by an average of 38,600 plants per acre, but yield at the EOPD was only 1.3 bushels per acre less than the maximum yield. Note that the cost of this number of seeds is about the same as the value of the 1.3 bushels of yield not realized when the seeding rate is optimized.



Determining Seeding Rate

Table 1 provides estimated EOPD values for a range of soybean prices and seed costs, based on the average of the response curves across 32 field trials. Higher soybean seed quality and better seed treatments have improved emergence in recent years, but stands can still be reduced by poor conditions after planting, especially wet soils. Using 85% as the default for stand establishment is often reasonable, although this percentage should be adjusted downward, and the seeding rate increased, if planting into poor conditions or if standard (warm) germination is less than 90%. Factors such as excessive or insufficient soil moisture, suboptimal temperature, improper planting depth, soil crusting, insect damage, or disease can all lower seed germination and emergence.

For example, at a seed bag cost of \$90 per 140,000 units and a soybean price of \$11 per bushel, the EOPD is about 110,100 plants per acre. To calculate seeding rates from these values, divide by the expected percent establishment. For instance, 110,100 plants per acre divided by 85% establishment equals about 129,500 seeds per acre. Many companies sell 140,000 soybean seeds as a unit, and in this case, planting a unit or slightly less than a unit per acre should produce enough plants to maximize return to seed.

Replanting

Despite best efforts, conditions, especially heavy rainfall after planting, can lower stands in all or parts of fields to levels that will result in low or no yields. Such fields usually require a decision about replanting. Counting emerged plants can help inform this decision, but in practical terms, most of these fields have spots where there are no plants, and many plants that manage to emerge may not thrive. Crop insurance and seed company policy on replant seed are also factors. If replanting is needed, most research has shown that repair planting, or planting additional seeds into the existing stand, is often cost-effective. If the field is a mixture of lowered stands and places with no stand, seeding rates close to those used for the first planting make sense. If the no-stand areas are scattered in the field, then adjusting the rate depending on the existing stand might make sense.

Seed cost per 140k unit	\$9.00 per bushel	\$10.00 per bushel	\$11.00 per bushel	\$12.00 per bushel	\$13.00 per bushel	\$14.00 per bushel
\$50	122,100	124,600	126,600	128,400	129,800	131,100
\$60	117,000	120,000	122,500	124,600	126,300	127,800
\$70	111,900	115,500	118,100	120,800	122,800	124,600
\$80	106,900	110,900	114,200	117,000	119,300	121,300
\$90	101,800	106,400	110,100	113,200	115,800	118,100
\$100	96,800	101,800	106,000	109,400	112,300	114,800

Table 1. Economic optimum plant density for combinations of market soybean price per bushel and seed cost per 140,000 seed unit.

Note: To calculate seeding rates from the values in this table, divide by the expected percent establishment. For instance, 115,000 plants per acre divided by 85% establishment equals approximately 135,300 seeds per acre.

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References

Mourtzinis, S., J. I. Ratallino Edreira, P. Grassini, A. C. Roth, S. N. Casteel, et al. (2018). Sifting and winnowing: Analysis of farmer field data for soybean in the US North-Central region. *Field Crops Res*, 221. <https://doi.org/10.1016/j.fcr.2018.02.024>.

Nafziger, E. (2009). Soybean. [Illinois Agronomy Handbook](#).

Paulson, N., G. Schnitkey, B. Zwilling, and C. Zulauf. "Revised 2025 Crop Budgets." farmdoc daily (15):9, Department of Agricultural and Consumer Economics, University of Illinois Urbana-Champaign, January 14, 2025.

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