IOWA STATE UNIVERSITY
Extension and Outreach

Understanding Soybean Plant Population Recommendations for Iowa

Concerns over rapidly escalating seed prices have caused farmers, agronomists, and seed suppliers to revisit the soybean plant population-soybean yield relationship. Historically, seeding rates for soybean have ranged from 180,000 to 240,000 seeds per acre. Today, many universities report 100,000 to 140,000 uniformly spaced plants per acre at harvest are optimal to achieve high yields. Soybean planted at optimum plant populations may not achieve maximum yield but is likely to result in a higher return per acre when seed cost is considered.


Image: Greg Tylka

Research conducted over several years at Iowa State University by De Bruin and Pedersen (5) concluded that soybean plant populations of more than 100,000 plants per acre at harvest did not result in significant increases in yield. They conducted studies between 2003 and 2006 that compared a wide range of seeding rates. Production of maximum yields required seeding rates of 175,000 to nearly 225,000 seed per acre. However, to obtain approximately 95 percent of maximum yield only 75,000 to 125,000 seed per acre was needed. Optimum planting rates were field specific and were on the lower end of the range for more highly productive environments.

Soybean plants compensate for lower plant populations by increased branching, increased pod number, and increased seed size. Cox and Cherney (4) found that soybean produced twenty percent more branches per plant at lower seeding rates. At higher plant populations, yield per plant is decreased because of intra-row competition that can cause lower plant establishment (5), less branching (4), fewer pods per plant, fewer seeds per plant (3), and increased lodging (9).

The results of De Bruin and Pedersen (5) support much earlier research in Iowa by Weber and coworkers (16). They compared plant populations that ranged from less than 50,000 to over 200,000 plants per acre and reported that yield of soybean was not increased beyond a plant population of 64,000 plants per acre.

Similarly, several studies conducted in surrounding states found maximum soybean yields were achieved with plant populations ranging from 101,000 to 142,000 plants per acre (1,6,7). Elmore (7) evaluated seeding rates of 45,000 to 330,000 seeds per acre in trials in Nebraska. He reported 140,000 seeds per acre either maximized yield or had yields nearly equal to the highest yield. Trials conducted at the University of Minnesota also showed a seeding rate of 140,000 seeds per acre provided optimal yield in southern soybean growing areas of the state. Naeve (11) reported that seeding rates of 50,000 to 150,000 seeds per acre had been evaluated at five locations and no significant yield differences were found among the 75,000 to 150,000 seeds per acre planting rates.

ADDITIONAL CONSIDERATIONS

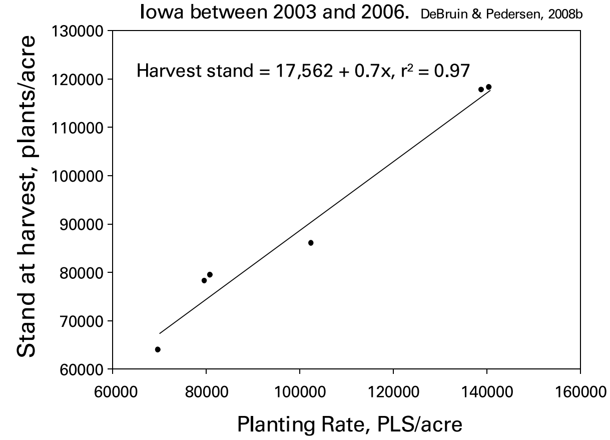
Determining the optimum plant population is one management practice that can improve soybean yield. However, there are many factors that influence yield including environment. Management practices and environment alone and in combination with each other can influence yield and change the profitability of producing soybean in Iowa. Implementing a management plan that includes optimum seeding rate and science-based best management practices will position the crop to achieve high yield within the limitations of the growing environment.

De Bruin and Pedersen (5) reported a strong linear relationship (*r*=.97) (Figure 1) between seeding rate and crop density at harvest. The difference between harvest population and seeding rate will depend upon several factors including seed quality, soil conditions after planting, temperature, moisture, soil crusting, and the use of seed applied fungicides and insecticides (14).

They evaluated seeding rates in low- and high-yielding environments and concluded that low-yield locations required greater harvest populations than higher yield-potential locations, presumably because plants growing in lower-yielding environments are under more biotic and abiotic stress. Similarly, Naeve (10) reported that soybeans planted in high pH areas prone to iron deficiency chlorosis may benefit from higher seeding rates.

New technologies or inputs such as seed applied fungicides and insecticides are becoming more popular and may enable producers to use lower seeding rates than when planting untreated seed. Iowa State University plant pathologist X.B. Yang (17) reported that seed treatments can protect seeds from infections by soilborne fungi and the treatments can be beneficial when the risk of damping-off is high. Fields with heavy soil and no-till can have a relatively high incidence of damping-off in the absence of seed fungicide treatment. He concluded that fields that had the disease in the past have a high probability of repeat infections.

Figure 1. Soybean planting rate influence on plant stand at harvest for six locations in Iowa between 2003 and 2006. DeBruin & Pedersen, 2008b



Weeds compete with soybean for sunlight. Using seeding rates higher than the optimum seeding rate can improve soybean competitiveness with weeds due to more rapid canopy development (8, 13). More rapid closure of the soybean canopy also can be obtained with a reduction in row spacing (12,13,15), and selection of varieties with traits that favor rapid canopy development (2). However, Guillermo and coworkers (8) reported that weed density was not consistently affected by soybean population but that weed biomass present at soybean harvest was inversely related to soybean population.

CONCLUSIONS

Research conducted over a number of years at Iowa State University found that soybean stands beyond 100,000 to 125,000 plants per acre at harvest typically do not result in yield increases great enough to be economically important when the added seed cost is considered. Because soybean compensates well when grown at lower plant populations, fewer seeds are needed to achieve optimum yields.

Because there are a large number of factors that influence yield on a field-by-field basis evaluate a number of seeding rates in large-scale strips to determine the optimal seeding rate and optimal yield at which you are comfortable. Commodity grain prices and seed costs also greatly influence what is accepted as 'optimal' seeding rates and yield for each production system. Re-evaluate seeding rates regularly and adjust 'optimal' levels as necessary.

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