



Agronomic Spotlight

Soybean Nitrogen Credit for Corn Production

Nitrogen Stewardship

Accounting for available nitrogen (N) is very important for environmental stewardship and nutrient management. Being a good steward helps keep N available for crop use and out of navigable waters. Implementation of the 4Rs best management practices for N (Right Source, Right Rate, Right Time, and Right Place) can help optimize fertility efficiency.¹ Nitrogen stewardship begins by accounting for residual N from previous crops. In much of the corn-growing area, corn and soybean crops are rotated annually.

Nitrogen Produced by Root Nodules

Soybean plants have the ability to produce N through N-fixation, a process that occurs in root nodules (Figure 1). Healthy soils for soybean production contain rhizobia bacteria that begin to invade soybean roots shortly after seed germination and multiply within the cortex cells of the roots.² Small nodules are usually visible 1 week after the rhizobial invasion and are easily seen within 2 to 3 weeks after planting. Nodule interior colors are white to gray when young and pink to red when actively fixing N. Nitrogen fixation begins around the V2 to V3 plant growth stages when atmospheric N₂ is absorbed by the nodules and the N-fixing rhizobia bacteria within the nodules change the N₂ to plant usable ammonia (NH₃). Fixation is maximized around the R5 to R6 growth stages. Several hundred nodules can develop, perish, and be replenished during the life of a soybean plant. At maturity, most nodules are no longer active because the developing seeds have priority for photosynthetic nourishment.² To produce 1 bushel of soybean grain, 5 lb of N from the soil and fixation is required. On average, 58% of the N is attributable to fixation.³ The removed grain from a field that averages 40 bu/acre contains an average N concentration of 6.34% or 3.8 lb of N/bu (152 lbs total).³

Source of the Nitrogen Credit?

The N credit associated with a prior soybean crop is largely from the reduced immobilization of soil N associated



Figure 1. Nodules on soybean roots.

with the quick decomposition of the soybean plant residue compared to the massive amounts of corn or sorghum crop residue.⁴ As mentioned, the production of 1 bushel of soybean grain requires large amounts of N; therefore, ammonia-N produced by the nodules is unlikely to provide residual N for the next corn crop. Compared to corn and grain sorghum residue, soybean residue has a lower carbon to nitrogen (C:N) ratio, which allows for faster decomposition and release of the N utilized for decomposition. Potential corn fields covered with soybean residue warm up and dry quicker in the spring in comparison to fields covered with corn or sorghum residue, which is favorable for microbial nitrate production from soil organic matter.⁵ Residual N, regardless of it being manufactured within the nodules or provided by rotation can vary depending on the soil type, growing conditions, by

geography, and other factors. University of Nebraska recommendations for corn following a soybean crop indicate a credit of 45 lb of N/acre should be considered for non-sandy soils and 25 lb of N/acre for sandy soils unless the previous soybean crop yielded less than 30 bu/acre.⁴ However, within recent years, the Iowa State University Nitrogen Rate Calculator has become a recognized standard for N guidelines. Recommended N rates within the calculator account for N credits from previous legume crops (Table 1) and can be accessed at <http://extension.agron.iastate.edu/soilfertility/nrate.aspx>.

Table 1. Nitrogen rate guidelines for Iowa based on the cost of nitrogen and the commodity price of corn.⁶

Price	Corn Following Soybean		Corn Following Corn	
Ratio*	Rate [#]	Range**	Rate*	Range**
\$/lb:\$/bu	lb N/acre			
0.05	145	130 - 164	205	188 - 226
0.10	124	111 - 140	181	165 - 196
0.15	110	98 - 123	158	145 - 174
0.20	97	86 - 109	145	131 - 156

*Price/lb of N divided by the expected corn price. Values calculated using \$3.50/bu and varying N price to achieve the different price ratios. [#]Rate is the lb/N/acre that provides the Maximum Return to N (MRTN). All rates are based on results from the Corn Nitrogen Rate Calculator as of October 16, 2007. **Range is the range of profitable N rates that provides similar economic return to N (within \$1.00/acre of the MRTN).

Sources

¹4R Nutrient Stewardship. The Fertilizer Institute. ²Flynn, R. and Idowu, J. 2015. Nitrogen fixation by legumes. Guide A-129. New Mexico State University. ³Ruark, M. 2009. Nitrogen and soybeans. 2009 Area Soil, Water, and Nutrient Management Meetings. University of Wisconsin. <http://www.soils.wisc.edu>. ⁴Zoubek, G. and Nygren, A. 2008. Giving proper nitrogen credit for legumes in corn and milo rotations. CROPWATCH. University of Nebraska. <http://www.cropwatch.unl.edu/giving-proper-credit-legumes-corn-and-milo-rotations>. ⁵Castellano, M., Archontoulis, S., Cordova, C., Dietzel, R., and Licht, M. (Iowa State University) 2015. Fixing the soybean nitrogen credit. Advance. A publication of the Iowa Soybean Association Research Programs. On-Farm Network. Iowa Soybean Association. ⁶Sawyer, J. 2007. Don't double dip soybean. Integrated Crop Management. IC-498(25). Iowa State University. www.ipm.iastate.edu/ipm/icm/2007/11-12/nrates.html. Web sources verified 4/21/16. Doc ID: 160405113549

For additional agronomic information, please contact your local seed representative.

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