



“Soybean N Credits”

Introduction

Soybean acreage has more than doubled in New York State over the last 10 years. In response to high fertilizer prices, growers with soybean-corn rotations are asking about possible nitrogen (N) fertilizer savings for corn after soybean. We reviewed the scientific literature on soybean N fertilizer replacement values and potential causes of differences in N needs for corn after soybean as compared to corn after corn. In this agronomy fact sheet, our findings are summarized and Cornell guidelines are listed.



Figure 1: The optimum N rate for corn after soybean is often lower than for corn after corn. The difference is called the N fertilizer replacement value of soybean for corn.

Terminology

The term “soybean N credit” has been applied to the estimated N savings when corn follows soybean as compared to continuous corn. This term is confusing as N savings for corn after legumes are not necessarily due to N release of the previous crop alone. Two types of rotation effects are identified in the literature:

- *N rotation effects*
 - Effects that can be compensated for with an application of fertilizer N.
- *Non-N rotation effects*
 - Effects for which an application of fertilizer N is unable to compensate such as:
 - Soybean interruption of pest cycles.
 - Enhanced corn root functioning in the year after soybean (possibly due to soybean root exudates or changes in mycorrhizal fungi communities).
 - Changes in physical soil properties and moisture availability as a result of the year of soybean production.

To avoid confusion, we will use the more general term “N fertilizer replacement value” (NFRV) when talking about differences in optimum N rates for corn after soybean as compared to corn after corn, and use the term “soybean N credits” for direct references to N release from soybean residue.

Findings

- Nitrogen fixation by soybean is often *not* a major factor in the overall N fertilizer replacement effect of soybean on corn in a soybean-corn rotation.
- Soybean residue decomposes more rapidly than corn residue. This leads to more rapid immobilization and also N mineralization resulting in an earlier N release peak than would be seen for corn after corn.
- Non-N rotation effects can and usually have a positive impact on yield beyond what an

extra N addition to corn after corn can achieve.

- Several management factors can impact the N fertilizer replacement value of soybean for corn in a rotation, but additional research is needed in the following areas before adjustments can be recommended:
 - Soil type and properties:
 - Some studies show higher N savings on medium textured soils with low organic matter (OM) than on sandy or heavy clay soils with higher OM.
 - Tillage systems:
 - Some studies show higher N savings in tilled than in reduced-till systems.
- There is no consistent link between previous year soybean yield and nitrogen fertilizer replacement value.
- The beneficial effects of soybean in the rotation last one year only.

N Guidelines for Corn after Soybean

Based on this literature summary and limited research in New York State, we conclude that for corn grown after soybeans in New York State, the optimum economic N rate can be lowered by 20-30 lbs N/acre as compared to corn after corn.

Table 1: Adjustment in Land Grant University recommended rate of nitrogen for corn after soybean versus corn after corn.

Location	N replacement value (lbs N/acre)
<i>Northeast</i>	
Connecticut	No soybean production
Maine	0
Massachusetts	0
New Hampshire	30
New Jersey	15
New York	20-30
Vermont	30
<i>Mid-Atlantic</i>	
Delaware	0.5 lb N/bu soybean yield
Maryland	15-40
Pennsylvania	1 lb N/bu soybean yield
Virginia	0.5 lb N/bu soybean yield*
West Virginia	0.5 lb N/bu soybean yield*
<i>Canada</i>	
Ontario	27

*If yields are unknown, a N fertilizer replacement value of 20 lbs/acre is recommended.

This adjustment should be applied for one year only and is very much in line with recommendations from other land grant universities in the Northeast and Mid Atlantic States and Ontario, Canada (Table 1). To derive N guidelines for corn after soybean, determine N guidelines for corn without soybean or grass/alfalfa sod history (see nmsp.css.cornell.edu/nutrient_guidelines/) and subtract 20-30 lbs N/acre from the recommended N rate for corn after corn.

Cornell University

Nitrogen Fertilizer Replacement Value of Soybean for Corn

"Soybean N credits"

The optimum economic N rate for corn after soybean can be lowered by 20-30 lbs N/acre. This adjustment should be applied only for the first year of corn following soybean.

Additional Resources:

- Cornell Guide for Integrated Field Crop Management: <http://www.fieldcrops.org>.
- Cornell Nutrient Guidelines for Field Crops: http://nmsp.css.cornell.edu/nutrient_guidelines.
- Cornell University Agronomy Fact Sheets #2 (Nitrogen Basics – The Nitrogen Cycle), #3 (Pre-sidedress Nitrate Test), #4 (Nitrogen Credits from Manure), and #21 (Nitrogen needs for first year corn). <http://nmsp.css.cornell.edu/publications/factsheets.asp>.

Disclaimer:

This fact sheet reflects the current (and past) authors' best effort to interpret a complex body of scientific research, and to translate this into practical management options. Following the guidance provided in this fact sheet does not assure compliance with any applicable law, rule, regulation or standard, or the achievement of particular discharge levels from agricultural land.

For more information



Cornell University
Cooperative Extension

Nutrient Management Spear Program
<http://nmsp.css.cornell.edu>

Quirine Ketterings, Sheryl Swink, Bill Cox, Karl Czymmek

2007