Field Nitrogen Balances for Corn Silage

Introduction

A field nutrient balance is an end-of-season evaluation tool defined as the difference between nutrients accessible for crop uptake (nutrient supply), and nutrients removed with forage harvest (nutrient uptake). A large positive balance (excess) signals inefficient use of inputs (including fertilizer and manure), elevated risk of nutrient loss to the environment and/or accumulation in soil over time. Tracking field balances, especially for nitrogen (Figure 1) can help inform if a change in field nutrient management can be considered without negatively impacting crop yield or quality. This factsheet explains the steps involved in deriving field nitrogen (N) balances for corn silage.

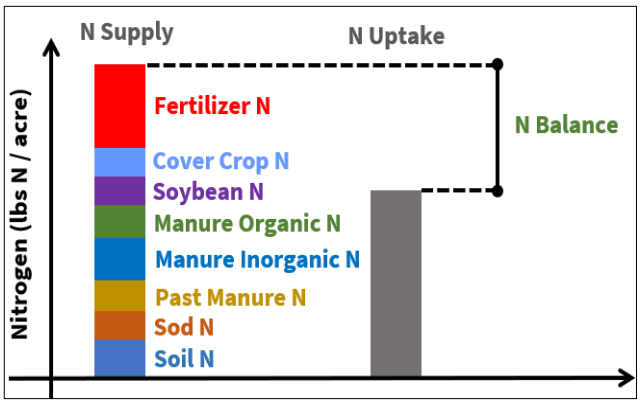

Figure 1. Field-level nitrogen (N) balances can be estimated as the different between N supply and N uptake.

Available versus total N balances

The way manure is managed (application method and timing) impacts the amount of plant-available N we can expect from a specific manure application. More informed decisions can be made when both the total amount of N and N availability are evaluated. Thus, it is important to derive two types of field N balances: (1) available N balance; and (2) total N balance. The total N balance of a given crop year considers the total amount of N applied with manure, independent of timing (e.g. fall or spring) or method of application (surface applied versus incorporated or injected). The available N balance takes into account only the portion of N in the manure that is considered plant available in the year for which the balance is derived (Figure 2).

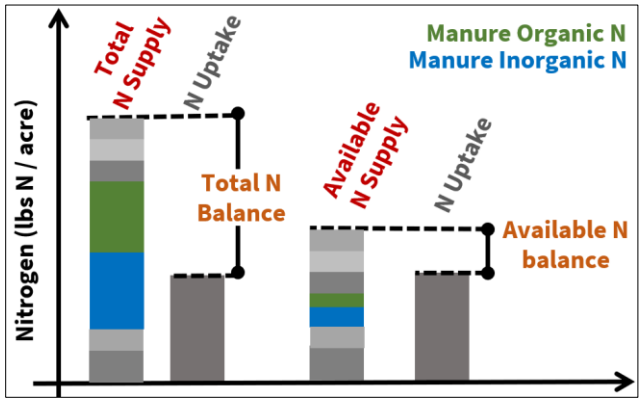

Figure 2. Total and available nitrogen (N) balances differ on the portion of manure-N considered.

Determining N balances

There are three main steps in determining total and available N balances for a corn silage field.

Step 1: Estimate N uptake per acre

Corn varieties can differ in the amount of N per ton of silage. If reliable forage sample results are available for the field, use the crude protein content listed on the forage report and the following equation to derive the amount of N (lbs N) in a ton of silage (at 35% dry matter):

*N per ton=(%CP/100/6.25)*2000*0.35*

If field specific data are not available, assume 8.6 lbs N/ton of corn silage (at 35% DM) for short-season hybrids (≤95 days-to-maturity [DTM]) and 8.2 lbs N/ton of corn silage (35% DM) for long-season hybrids (≥96 DTM). If hybrid relative maturity information is not available, an average of 8.4 lbs N/ton of corn silage (35% DM) can be used.

Once the total amount of N per ton of silage is determined, multiply this number and the yield per acre (also at 35% DM) to obtain N uptake per acre for the field.

*N uptake per acre=yield (ton/acre)*N/ton*

Step 2: Estimate N supply

To determine N supply, sum the contributions of the following N sources.

N_{Soil}

Soil organic matter can supply 40 to 80 lbs of N/acre annually. The soil's N supplying capacity (N_{soil} in lbs N/acre) is a function of soil type and tile drainage. Estimates of soil N supply can be found in Appendix Table 2 of the Nitrogen Guidelines for Field Crops in New York.

N_{Sod}

Alfalfa, grass, and mixed alfalfa/grass stands will release N into the soil once they are terminated prior to seeding of corn. The amount of N expected from a terminated sod varies depending on the percentage of legume in the stand and the number of years that have passed since termination of the stand (Table 1).

Table 1. Expected nitrogen (N) credit from terminated sods.

Legume in sod	Available N		
	Year 1	Year 2	Year 3
%	---------- lbs N / acre ----------		
0	83	18	8
1-25	110	24	10
26-50	138	30	13
>50	165	36	15

$N_{Soybeans}$

Corn that follows soybean in a rotation will require less external N than continuous corn. A representative estimate of soybean N credits for corn for N balance assessments is 30 lbs N/acre.

$N_{CoverCrop}$

Cover crops can also supply N to the crop that follows. The amount of biomass, its N content, and its C:N ratio (maturity) can greatly influence N dynamics in the soil after termination. A representative estimate of cover crop N credits for corn for use in field N balances is 30 lbs N/acre. This assumes spring termination of a fall-planted, timely seeded, overwintering cereal grain cover crop such as cereal rye, winter wheat, or triticale.

$N_{ManureInorganic}$, $N_{ManureOrganic}$, $N_{ResidualManure}$

When estimating N supply for total N balances, total organic and inorganic N contributions from manure can be determined by multiplying field-level manure application rates with total N content as listed on the manure analysis. For available N balances, N contributions need to consider when and how manure was applied using Tables 2 and 3. Residual N credits are derived from Table 2 as well.

Table 2. Estimated manure organic nitrogen (N) availability.

Source	Release rate for organic N (%)			
	% DM	Present year	Last year	2 yr ago
Cows	<18	35	12	5
Cows	>18	25	12	5
Poultry	All	55	12	5
Swine	<18	35	12	5
Swine	>18	25	12	5
Horses	<18	30	12	5
Horses	>18	25	12	5
Sheep	<18	35	12	5
Sheep	>18	25	12	5

Table 3. Estimated inorganic nitrogen (N) availability.

Manure application method	Inorganic-N utilized by the crop (%)
Injected (growing season)	100
Incorporated within 1 day	65
Incorporated within 2 days	53
Incorporated within 3 days	41
Incorporated within 4 days	29
Incorporated within 5 days	17
No incorporation/Fall injection	0

$N_{Fertilizer}$

Nitrogen contributions from fertilizer are determined by multiplying the application rate and the N content of the material.

Step 3: Estimate available and total N balances

The final field N balances are derived by subtracting N uptake from N supply.

In Summary

Field N balances are end-of-season evaluations to help optimize field N management. Deriving field balances requires assessment of N supply and N uptake using easily obtainable records.

Additional Resources

- Cornell NMSP Agronomy Fact Sheet Series. http://nmsp.cals.cornell.edu/guidelines/factsheets.html.

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 discharge levels from agricultural land.

For more information

Cornell University Cooperative Extension

Nutrient Management Spear Program
http://nmsp.cals.cornell.edu

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2022