Cornell University
Cooperative Extension

Agronomy Fact Sheet Series **Fact Sheet 77**

Nitrogen for Corn; Management Options

Although fertility recommendations for corn can vary from state to state, most recognize that accurate yield records are essential to guide nitrogen (N) management decisions. Many farms are striving to refine N rates over time through adaptive management. In New York the first step is to define a field's expected yield (yield potential or YP). Here we define yield potential, describe the need for an adaptive management approach, and present the state accepted adaptive management options to address N needs for corn fields.

Yield Potential Estimates and N Guidelines

Cornell guidelines for N management of corn use the YP (bu/acre) multiplied by 1.2 to determine the expected net amount of N that must be taken up by the crop, with various N credits such as soil organic matter and sod contributions subtracted out (Agronomy Factsheet 35). Since some N will be lost, tied up by non-crop organisms or otherwise not available to the crop, the net N adjusted for various N credits is divided by an N uptake efficiency value (Agronomy Factsheet 4). For example, if adjusted net N needed is 100 lbs, and the N uptake efficiency is 65% (see Table 1 for examples), 100/0.65 = 155 lbs of N is the calculated amount to apply.

Yield Potential for New York Soils

The concept of using yield potential to determine N rates is based on the idea of fertilizing for the better crop years. In this way a theoretical average yield of the best 4 out of 5 crop years can be used to set a target N rate as a place to start. Each of the nearly 600 different soil types in New York has an estimated YP (see Table 1 for a subset). For soils that are very poorly, poorly, or somewhat poorly drained, the assigned yield potentials increase if artificial drainage is installed.

High performing soils (high YP) tend to have a greater capacity to supply soil N and to make use of fertilizer N or manure N than low YP soils (Table 2). As a result, a higher yield does not necessarily mean that more external N is needed to produce such yield. Lower yielding soils are often impacted by factors other than N supply (i.e. drainage, root restrictive soil layers, etc.) and tend to need the highest N applications. One thing is clear: a specific amount of N needs to get into the corn plant to support a given yield so there has to be enough N in the right place, time, and form to meet plant needs.

Table 1: Corn yield potentials from the Cornell soils database for a subset of New York soils*.

Soil Type	Drainage	SMG	Corn Yield Potential	
			UDr	Dr
			bu/acre	bu/acre
Kingsbury	S	1	95	110
Vergennes	M	1	115	120
Honeoye	W	2	140	140
Hamlin	W	2	155	155
Canandaigua	P	3	90	110
Tioga	W	3	140	140
Swanton	P	4	95	125
Madrid	W	4	135	135
Adams	W	5	95	95
Muck	V	6	NA	150

*SMG = soil management group. Drainage: V = very poorly drained, P = poorly drained, S = somewhat poorly drained, M = moderately well drained, W = well drained. UDr = undrained, Dr = artificially drained. For the complete Cornell University soil database see: http://nmsp.cals.cornell.edu/publications/tables/soils_database.pdf. To convert silage yields into grain estimates, assume that 1 ton silage (35% dry matter (DM) equals approximately 5.9 bushels of shelled corn (85% DM).

Table 2: The N uptake efficiencies, soil N supply, and YP for a subset of New York soils.

Soil Type	N uptake efficiency		Soil N supply		Corn Yield Potential	
	UDr	Dr	UDr	Dr	UDr	Dr
	%	%	lbs N/acre		bu/acre	
Kingsbury	60	65	65	75	95	110
Vergennes	70	70	75	75	115	120
Honeoye	75	75	75	75	140	140
Hamlin	75	75	80	80	155	155

Yield Potential Verifications

During the past ten years, the YPs for various soils have been re-tested through on-farm research projects conducted in coordination with the Nutrient Management Spear Program (NMSP). For most of the soil types tested so far, yield potentials are consistent with most recent actual yield data. However, for some

soils, conditions, and farms the actual yield was consistently higher, sometimes much higher, than the Cornell "typical" YP. Currently, producers and nutrient management planners can override the yield potentials provided in the Cornell University soil database if yield records are documented. Currently, there are two approaches to deriving N guidelines for corn for farms that are required to follow a nutrient management plan (e.g., per a public cost-share contract or CAFO regulation):

(1) Corn yield potential for the soil type as documented in the Cornell soil database and recommendations based on the corn N equation (Agronomy Factsheet 35);
(2) Actual corn yield measured over a 3-year period under current N guidelines (drought years excluded; N management as in approach 1).

Adaptive Management Approach

It must be realized that using YP as the basis for an N guideline is only a starting point; variations in management, soils, and many other factors will impact actual N needs. In addition, there is variability in the conversion from silage to grain yield among varieties, fields, growing seasons, and field management conditions. In addition, higher yielding fields do not necessarily need more external N to obtain such yields. It is therefore recommended to evaluate the need to make refinements over time.

In consultation with agency partners involved in nutrient management planning in New York, two new adaptive management techniques were added that support additional fertility from manure and/or fertilizer for specific fields. The new guidance states that application of N fertilizer and/or manure *for a specific corn field* shall be based on approaches 1 or 2 above *or* one of following two new adaptive management approaches:

(3) Findings of two years of on-farm replicated trials with a minimum of four replications and five N rates including a zero-N control treatment; or
(4) Yield measurements and the results of the corn stalk nitrate test (CSNT), and other tests such as the Illinois Soil Nitrogen Test (ISNT).

Approaches 3 and 4 are adaptive management approaches that allow producers to exceed current Cornell University N guidelines for corn (based on approach 1 and documented in Agronomy Factsheet 35). All four approaches are approved for use within the USDA-NRCS 590 Standard. Details for each of the approaches can be found in the Agronomy Factsheets 35 (N guidelines for corn), 71 (Measuring corn silage yield), 68 (On-farm research), and 78 (Adaptive management of N for corn).

Updating the Cornell Database

Where yield data can be collected over multiple years (approaches 2-4), farms are encouraged to share these data with the Nutrient Management Spear Program (NMSP) so the information can become part of a statewide dataset that will allow for adjustments in the Cornell yield potential database over time. Email qmk2@cornell.edu if interested in joining the corn yield potential evaluation project.

Concluding Remarks

Accurate yield records are essential to guide N fertilization decisions. The Cornell yield database and N equation offer a starting point, but farmers are encouraged to apply adaptive management approaches to fine-tune N management over time.

Additional Resources

- Cornell University soils database: http://nmsp.cals.cornell.edu/publications/tables/soils_database.pdf.
- Nutrient Management Spear Program Agronomy Fact Sheet Series: nmsp.cals.cornell.edu/index.html.
- USDA-NRCS New York State 590 Standard: ftp://ftp-fc.sc.egov.usda.gov/NY/eFOTG/Section_4/Practice_Standards/nyps590.pdf.

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.cals.cornell.edu

Quirine Ketterings and Karl Czymmek (Cornell), Greg Albrecht (NYSDAM), Dale Gates (NRCS). and Jacqueline Lendrum (NYSDEC)

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