

What's Cropping Up?

A NEWSLETTER FOR NEW YORK FIELD CROPS & SOILS

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Fall harvest management is one of the factors affecting the ability of alfalfa to overwinter successfully. Other factors include the age of the stand, the winter hardiness and disease ratings of the cultivar, the length of cutting intervals throughout the season, soil pH, soil K level, soil drainage, and whether growth is left to catch snow. Once we have planted a stand of alfalfa or alfalfa-grass, the primary two persistence factors we can control are soil K level and fall cutting management.

Good Old Days

For a number of decades, the policy for alfalfa fall harvest was to insist on a no-cut fall rest period of 4-6 weeks before the first killing frost. This critical fall period allowed root reserves to be replenished and minimized the chances that cutting management would negatively impact overwintering. Adequate time to replenish root reserves was considered 10% bloom by some researchers, while others assumed that 8-10" of top growth in the fall assured maximum root reserve storage, prior to the first killing frost. It also left significant alfalfa residue to facilitate insulating snow catch.

What is a "Killing Frost"?

The temperature at which alfalfa essentially stops all growth is somewhere between 24 and 28° F. Sheaffer (MN) suggested the first killing frost was 28° F, Tesar (MI) considered it 26.6° F (-3° C), while Undersander (WI) considered a killing frost as 4 or more hours at 24° F. Other studies have used 25° F as the definition of first killing frost. This can greatly impact the date of "first killing frost". In Ithaca, NY for example, the latest "first killing frost" date for 30 years of weather data occurred Nov. 5 at 28° F vs. Dec. 10 at 25° F. When accumulating Growing Degree Days (GDD) until first killing frost, a low temperature such as 25° F is not reasonable, as all alfalfa varieties with appropriate winter hardiness ratings for the region would have gone dormant well before Dec. 10.

Alfalfa Fall Harvest Guidelines in NY – Should They Change?

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Fall Alfalfa Harvest Management, 1980's

During the 1980's, numerous studies in Canada and the northern USA investigated alfalfa fall harvest management. Research in southern Saskatchewan found that a third cut between Aug. 25 and Sep. 20 reduced spring yields, compared to an Oct. 1 cut. McKenzie et al. (1980) determined that

a second cut from Aug. to mid-Sep. consistently reduced future yields in central Alberta, but not in northern Alberta. In Minnesota, Marten (1980) concluded that a third harvest anytime in September would not reduce persistence, assuming it was a winter hardy variety on well-drained soils high in K, and there was consistent snow cover. In Michigan, Tesar (1981) also concluded that a third cut in September or early October was not harmful.

Tesar and Yager (1985) suggested that a third cut in September in the northern USA was not harmful as long as there was adequate time for replenishment of carbohydrate reserves between the second and third cuttings. Sheaffer et al. (1986) concluded that fall cutting does increase the risk of long-term stand loss, but that fall cutting will provide short-term higher yields and high quality. They also concluded that length of harvest interval and number of harvests during the growing season were as important as the final harvest date.

Root Reserves Assessed with GDD

The first attempt to quantify carbohydrate reserves between second and third cuttings of alfalfa based on GDD occurred in Canada. Research in Quebec by Belanger et al. showed that it may be acceptable to cut during the critical fall rest period in September, as long as there was an interval of approximately 500 GDD (base 5° C) between the fall harvest and the previous harvest. For forage crops in the USA, GDD are calculated using base₄₁, with heat units accumulated above a daily average of 41° F (5° C). These do not generate the same number of GDD units, 500 GDD base₅ C is equal to 900 GDD base₄₁ F.

Crop Management

Current NY Guidelines

The sum of the above research results caused NY fall alfalfa harvest recommendations to change about 20 years ago to "Allow a rest period of 6 to 7 weeks between the last two cuts". A similar recommendation in PA of "At least 45 days between the last two cuts" was also adopted. This recommendation has not changed in NY for the past 20

Table 1. Ithaca (central NY) vs. Watertown (northern NY), 30 years of weather data.

	Ithaca	Watertown
Range in 1 st 28°F frost date	Sep. 29 – Nov. 5	Sep. 20 – Oct.28
Average date of 1 st frost	Oct. 16	Oct. 7
Decline in GDD units/day from August 1 to Oct. 31 (GDD base ₅ C)		
Linear decline per day in GDD	-0.16	-0.16
Critical Rest Period before 1 st frost (500 GDD base ₅ C interval)		
30 year Range	6.3 to 9.0 weeks	5.3 to 8.2 weeks
Average Critical Rest Period	7.6 weeks	6.8 weeks
Average Rest Period between last two cuts (500 GDD base ₅ C interval)		
If last cut is on Sep. 1	4.6 weeks	5.0 weeks
If last cut is on Sep. 15	5.3 weeks	5.6 weeks
If last cut is on Sep. 30	6 weeks	6.3 weeks
If last cut is on Oct. 15	6.7 weeks	6.9 weeks
Rest Period to guarantee 500 GDD between last two cuts		
If last cut is on Sep. 1	5.1 weeks	5.3 weeks
If last cut is on Sep. 15	5.9 weeks	6.1 weeks
If last cut is on Sep. 30	6.6 weeks	7.0 weeks
If last cut is on Oct. 15	7.3 weeks	7.6 weeks

years. Keep in mind that any cutting management options during the critical fall rest period must involve healthy stands of better adapted winter hardy varieties with multiple pest resistance.

Application of the 500 GDD Criteria

A comparison of the Quebec 500 GDD base₅ C rest period can be made with the currently recommended "6-7 week rest period". By selecting the years with the least and most GDD accumulated during August and September, a range in days for the rest period can be calculated, based on a 500 GDD interval between the last two cuts (Fig. 1 & 2). If cutting on Sep. 1, the 500 GDD interval prior to Sep. 1 is about 5 weeks (Table 1). If cutting Sep. 30, the 500 GDD interval prior to Sep. 30 is 6 to 7 weeks. The rate of decline in GDD units per day in the fall is similar for central and northern NY (Fig. 3 & 4; Table 1).

All X- and Y-axis date combinations below the shaded

boxes in Fig. 1 and 2 identify the rest period interval that will result in 500 GDD before the September cut with high confidence. These date combinations resulted in 500 GDD for all 30 years of weather data. All X- and Y-axis date combinations above the shaded box in Fig. 1 and 2 will be very unlikely to accumulate 500 GDD, as this never happened in 30 years. For example, in Ithaca (Fig. 1) if alfalfa is cut on Aug. 2, it is Sept. 12 before you are out of the rest period shaded zone. Using the 500 GDD concept, our current 6-7 week rest period is appropriate for cutting at the end of September, but could be reduced to approximately a 5 week rest period if cutting Sep. 1. For rest periods based on GDD, the later it is in the season, the longer it will take to accumulate 500 GDD (Fig. 3 & 4).

Applying the 500 GDD Interval to the Critical Fall Rest Period before 1st Frost

It has been suggested to apply the Quebec research to the period preceding 1st frost, and help define a "no-cut" time interval prior to 1st frost. The assumptions are that we need 500 GDD (base₅ C) for alfalfa to build up root reserves. A second assumption is that it is safe to cut alfalfa if there are less than 200 GDD (base₅ C) remaining before the first killing frost, as there

would be insufficient regrowth to use up enough storage carbohydrates to negatively affect alfalfa persistence. We are presenting this system as an example, even though we were not able to find any evidence in the scientific literature concerning the 200 GDD assumption. A similar example of this concept can be found in Michigan literature (<http://www.agweather.geo.msu.edu/agwx/articles/article-09.html>), although GDD base₄₁ were used for this example incorrectly. Using the 500/200 GDD criteria, we can approximate the odds that fall mowing will not cause winter injury.

Approximate probabilities of either accumulating over 500 GDD (base₅ C) or accumulating less than 200 GDD (base₅ C), with long-term weather data (30 consecutive years) can be calculated if alfalfa is cut on a particular date in the fall at a particular site (Fig. 5 & 6). Four dates can be determined to approximate 0 and 100% chances of either more than 500 GDD after fall cutting, or less than 200 GDD

Crop Management

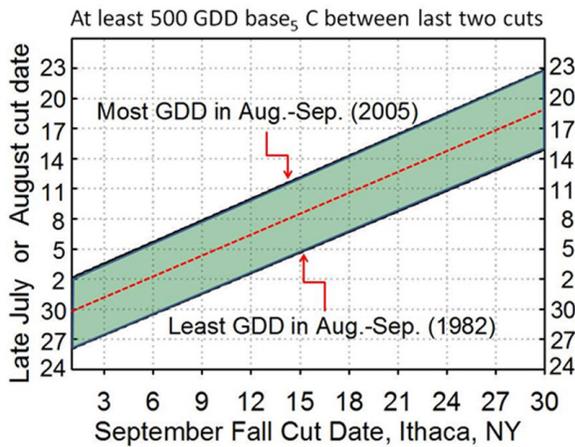


Figure 1: Range in rest period between September cut and previous cut to accumulate 500 GDD base₅ C (or 900 GDD base₄₁ F) for Ithaca, NY. Based on 1982-2011 weather data.

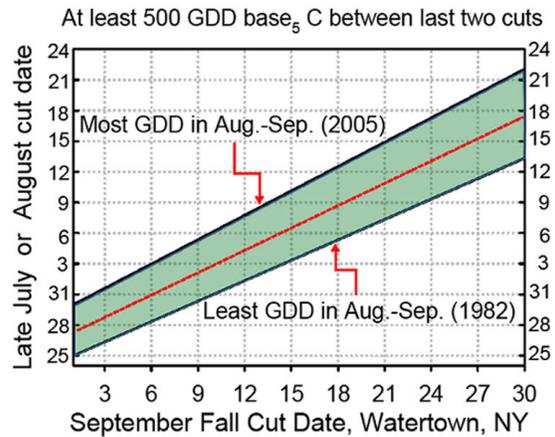


Figure 2: Range in rest period between September cut and previous cut to accumulate 500 GDD base₅ C (or 900 GDD base₄₁ F) for Watertown, NY. Based on 1982-2011 weather data.

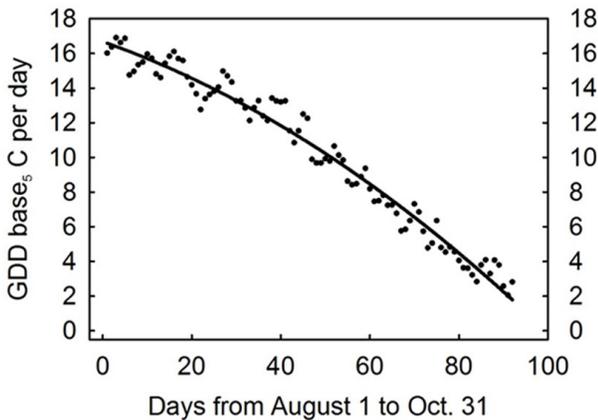


Figure 3 (left): Accumulation of GDD units (base₅ C) per day between August and October for Ithaca, NY. Averages of 1982-2011 GDD weather data.

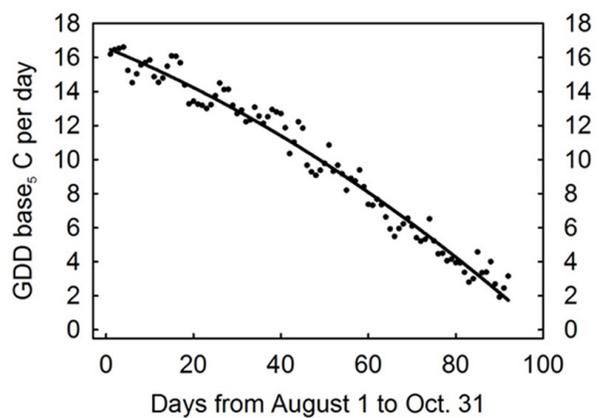


Figure 4: Accumulation of GDD units (base₅ C) per day between August and October for Watertown, NY. Averages of 1982-2011 GDD weather data.

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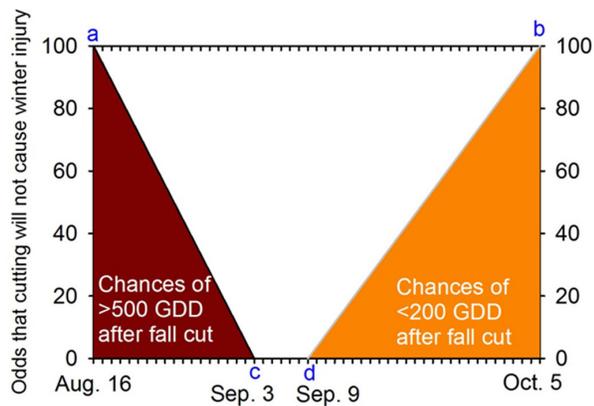


Figure 5: Approximate chances that fall cutting will not cause winter injury to alfalfa in Ithaca, NY. Based on 1982-2011 weather data and GDD base5 C (500 and 200 equivalent to 900 and 360 GDD base41 F). This is based on killing frost dates considered as the first 28o F temperature.

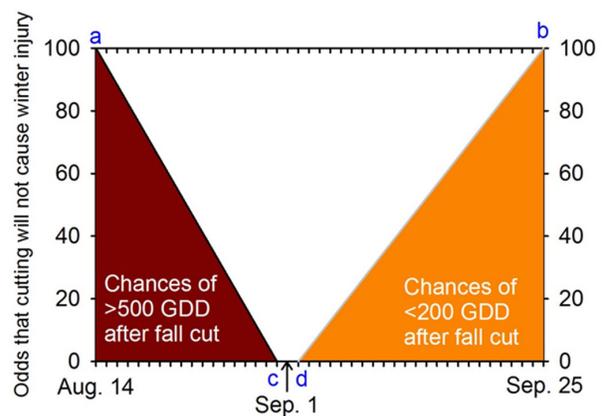


Figure 6: Approximate chances that fall cutting will not cause winter injury to alfalfa in Watertown, NY. Based on 1982-2011 weather data and GDD base5 C (500 and 200 equivalent to 900 and 360 GDD base41 F). This is based on killing frost dates considered as the first 28o F temperature.

after fall cutting. For this exercise, we are assuming that the first occurrence of 28° F is a “killing frost”. A killing frost in Watertown occurs on average 9 days earlier than in Ithaca (Table 1).

Four dates, (a,b,c,d, Fig. 5 & 6) are identified by calculating the following:

- Year with earliest killing frost date: subtract 500 GDD base₅ C (from Sep. 20, 1993).
- Year with latest killing frost date: subtract 200 GDD base₅ C (from Oct. 28, 2001).
- Year with latest killing frost date: subtract 500 GDD base₅ C (from Oct. 28, 2001).
- Year with earliest killing frost date: subtract 200 GDD base₅ C (from Sep. 20, 1993).

For long term weather data, these dates correspond to:

- Latest calendar date resulting in >500 GDD base₅ C after fall cutting.
- Earliest calendar date resulting in <200 GDD base₅ C after fall cutting.
- Earliest calendar date resulting in <500 GDD base₅ C after fall cutting.
- Latest calendar date resulting in >200 GDD base₅ C after fall cutting.

To simplify the display, we then assume a linear relationship between 0% and 100% chances that fall cutting will not cause winter injury. Statistical probabilities could be

calculated individually for each day, but the results would not provide clear guidelines. The rate of GDD accumulation into the fall gradually decreases and is not perfectly linear (Fig. 3 & 4), but for practical purposes a linear display suffices. Cutting on Aug. 31, Sep. 1, or Sep. 2, the odds of either accumulating >500 GDD or accumulating <200 GDD in Watertown, NY are approximately zero. Using this system, the date that would maximize the chances of winter injury due to cutting is Sep. 1 in Watertown, and Sep. 6 in Ithaca.

Comparing the Systems

Compare Fig. 4 (interval to 1st frost) to Fig. 2 (interval between last two cuts). If alfalfa was mowed on July 25, and then mowed again on Sep. 1 in Watertown, the chances of winter injury due to cutting are near zero for Fig. 2 (with 500 GDD accumulated between the last two cuts all 30 years). So under one system (Fig. 4), Sep. 1 would be the worst date to cut alfalfa in Watertown, while under the other system (Fig. 2), Sep. 1 can be a very safe date to cut alfalfa.

It is possible that both systems are reasonable. Allowing a 500 GDD interval before a Sep. 1 cut would make a Sep. 1 cut relatively safe. On the other hand, not allowing 500 GDD before a Sep. 1 cut might make this the worst possible time to cut an alfalfa stand. Keep in mind that winter damage to alfalfa is an accumulation of insults. A weakened stand will be considerably more susceptible to

damage from intensive harvest management, as well as mowing during the critical fall rest period.

Reasons to be more Conservative in NY vs. the Midwest

There are several issues more specific to the Northeast/ New England, which will likely have an impact on the chances of fall cutting affecting long-term alfalfa persistence. The basic requirement for any cutting of alfalfa during the critical fall period is that near ideal conditions exist. That is, you have a healthy, very winter hardy variety with high soil K, good soil drainage, and good snow cover over the winter. Good soil drainage in NY is often not the case, and consistent snow cover is never guaranteed. In northern NY there is also the possibility of alfalfa snout beetle and/or brown root rot damage, which could greatly affect the consequences of cutting during the fall period.

Reasons to be less Conservative in NY vs. the Midwest

Another NY-specific issue is that of species mixtures. Most alfalfa in the Midwest is sown in pure stands, over 85% of alfalfa sown in NY is in mixture with perennial grasses. For mixed stands with alfalfa, growers may be somewhat less risk averse than with pure stands, when it comes to the chances that fall cutting will result in shortened persistence of the alfalfa component. Loosing alfalfa more quickly from a mixed stand is not quite as catastrophic as loosing alfalfa in a pure stand. With the availability of Round-up Ready alfalfa, the frequency of pure alfalfa stands in the Midwest is likely to increase. Because NY has few prime alfalfa soils, it is less likely that RR-alfalfa will greatly increase the proportion of pure alfalfa stands in NY.

Conclusions

Our historical understanding of alfalfa root reserves provides evidence for maintaining a Critical Fall Rest Period for alfalfa. Applying the 500 GDD criteria to the Critical Fall Rest Period, however, results in an average rest period before 1st killing frost exceeding 7 weeks. Past research data provide evidence that a sufficient rest interval between the last two cuts allows us to take the last cut during the critical rest period. There does not appear to be evidence to change our basic logic for fall harvest of alfalfa. Some fine tuning of the rest interval between the last two cuts can be made using Fig. 1 and 2. The above suggestions are for healthy stands. If a stand is not healthy, a more conservative harvest management may increase the chances of stand survival.

Crop Management

Corn Emergence When Planting in April a Few Days Before a Snow Storm

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March 2012 was the warmest March on record across much of the USA (13 degrees above normal for most of NY). Surprisingly, a couple of growers in NY planted limited corn acreage during the week of March 19th when daytime temperatures averaged about 75 degrees. Farmer testimony indicated satisfactory emergence for the March-planted corn. Many other growers, however, elected to wait until the next warm spell, which occurred during the week of April 15th when daytime temperatures averaged about 70 degrees. Farmer testimonies, however, were somewhat mixed for the corn planted during this week with some replanting reported, especially in poorly drained areas of a field. We planted two studies that week: our corn silage hybrid trial with 82 entries on April 20th at the Aurora Research Farm in Cayuga County and a 10-acre seeding

Table 1. Weather conditions at the Aurora Research Farm and the Auburn airport from April 15-April 30th in 2012. Emboldened date indicates the weather conditions on the day of planting for studies discussed in this article.

CLIMOD product: Daily Data for a Month Creation Time: 06/13/2012 10:31 EDT
Month: April 2012-Aurora

Day	Max Temp	Min Temp	Precipitation	Snowfall	Snow Depth
15	66	34	0.00	0.0	0
16	69	52	0.06	0.0	0
17	88	47	0.00	0.0	0
18	56	31	0.00	0.0	0
19	55	32	0.00	0.0	0
20	73	45	0.00	0.0	0
21	78	37	0.00	0.0	0
22	54	35	0.60	0.0	0
23	41	31	0.86	5.0	5
24	36	31	0.20	0.0	1
25	45	35	0.01	0.0	0
26	49	34	0.00	0.0	0
27	64	32	0.19	0.0	0
28	42	26	0.00	0.0	0
29	48	26	0.00	0.0	0
30	53	29	0.00	0.0	0

CLIMOD product: Daily Data for a Month Creation Time: 06/13/2012 10:39 EDT
Month: April 2012-Auburn

Day	Max Temp	Min Temp	Precipitation	Snowfall	Snow Depth
15	61	38	Tr	0.0	0
16	64	53	0.03	0.0	0
17	89	48	0.02	0.0	0
18	56	29	0.00	0.0	0
19	57	29	0.00	0.0	0
20	74	42	0.00	0.0	0
21	76	48	0.00	0.0	0
22	49	37	0.53	0.0	0
23	42	32	0.82	3.4	3
24	39	32	0.42	Tr	0
25	47	34	0.04	Tr	0
26	47	30	0.03	Tr	0
27	62	32	0.18	0.2	0
28	41	24	0.02	0.0	0
29	50	24	0.00	0.0	0
30	53	26	0.00	0.0	0

Table 2. Stand establishment rates of 82 hybrids from 12 seed companies planted on April 20th, 2012, 2 days before a 5-inch snow storm.

SEED COMPANY/BRAND	STAND ESTABLISHMENT-%	ENTRIES-No.
DEKALB	84.0	14
T.A. SEEDS	85.2	12
DOEBLER'S	84.5	10
HEALTHY HERD GEN.	83.8	7
PIONEER	86.5	6
CHANNEL BIO	86.6	6
DAIRYLAND	87.2	5
MYCOGEN	84.2	5
DYNA-GRO	87.2	5
GROWMARK FS	88.2	4
SYNGENTA	88.8	4
HUBNER	84.8	4

rate study on April 18th just northwest of Auburn in Cayuga County.

Weather conditions (daily weather is recorded the morning after at 8:00 AM so the April 20th data at Aurora is recorded as April 21st data when the high temperature was 78) for the first 10 days after planting at Aurora changed drastically (Table 1). At Aurora, the high temperature the day after planting was 54 and then only 2 days above 50 degrees were recorded over the next 8 days (64 on April 26th, reported as April 27th data, and 53 on April 29th, reported as April 30th data). More importantly, only 24 hours after planting, Aurora received a cold 0.6 inches of rain followed by 0.86 inches of precipitation in the form of a 5-inch snow storm 48 hours after planting. Another 0.20 inches of precipitation occurred the following day, 72 days after planting, when the high temperature was only 36 degrees. Also, note that low temperatures dipped down to 26 degrees for two nights about a week after planting. Obviously, weather conditions were conducive for imbibitional chilling damage during the initiation of the emergence process, cold stress during the emergence process, and drowning out of corn seeds shortly after planting in poorly-drained areas of a field.

When averaged across the 82 hybrids entered in the study,

Crop Management

Table 3. Plant populations at the fifth leaf stage (V5) of a DEKALB and a Pioneer hybrid at four seeding rates in a field-scale study planted on April, 18th, 2012 a few miles northwest of Auburn, NY in Cayuga County.

SEEDING RATE	DKC49-94	9807HR
kernels/acre	-----plants/acre-----	
27,000	23,890	22,082
32,000	27,161	26,716
37,000	32,638	31,728
42,000	36,300	34,530

the stand establishment rate (number of established plants in 2 rows of the 20 foot plot length at the V4 stage/86 seeds in each seed packet planted) averaged 85.4% (Table 2). Stand establishment averaged from about 84 to about 89% for the 12 seed companies that entered hybrids. Of the 82 hybrids entered in the study, only six hybrids had stand establishment rates of less than 80% on this drained Lima silt loam soil. Obviously, most modern hybrids can withstand the rigors of cold and wet weather conditions, even 5 inches of snow, shortly after planting (Fig.1 and 2).

At the field-scale study where soil conditions are more variable, we counted the number of established corn plants at the V5 stage along the entire length of one row (~800 feet) at each seeding rate for the two hybrids (9807HR from Pioneer and DKC49-94 from DEKALB) evaluated in this study. When averaged across hybrids and seeding rates, stand establishment rate averaged 84.6%. Stand establishment varied from about 83 to 87% between hybrids and from about 84 to 87% across seeding rates (Table 2). This site did experience two warm days (highs of 74 and 76, Table 1) 2 days after planting so conditions were not quite as harsh. On the other hand, low temperatures dipped down to 24 degrees for two nights and 26 degrees another night about 10 days after planting. In addition, this site received about 4 inches of snow a few days after planting. So the 84% stand establishment rate on this production field was quite satisfactory given the conditions. I will add that in a 50 by 100 foot low spot in the third replication of the study no corn emerged (not accounted for in the data because it was a seeding rate study) so certainly the excessively wet conditions after planting had a major impact on stand establishment rates.

So, what does the stand establishment data from 2012 tell us? First, most if not all modern hybrids have excellent cold tolerance and perhaps tolerance to imbibitional chilling (an elusive phenomenon that I am not sure that I have ever observed). On the other hand, modern hybrids have limited tolerance to flooded soil conditions shortly after planting as observed in the field-scale study. So obviously, soil drainage conditions should be a major factor when considering early planting dates (an early planting date lengthens the time that corn is in the vulnerable period to flooded soil conditions, from planting to about the V5 stage). Another factor to consider is planting depth. We only plant at about a 1.5 inch depth in April, especially when cool and wet conditions are forecasted for the immediate future. Many growers mentioned that their planting depth was at the 2-inch soil



Figure 1 (top): Fig.1. Aurora corn silage hybrid trial on May 11th, 2012, planted on April 20th. Figure 2 (bottom): Counting emerged corn plants at the V4 stage in the Aurora corn silage hybrid trial on May 31, 2012.

Crop Management

depth when planting the week of April 15th, which may have contributed to poor stand establishment reported by some farmers in some poorly drained areas of a field or on heavy soils.

What happens if soil conditions are dry in mid-April next year and soil conditions are once again ideal for planting? I will again recommend to begin planting any time after April 10-15, provided your location does not experience late spring killing frosts (< 28 degrees after May 15th or so) and your soils are well-drained and do not readily flood. In other words, I recommend to plant fields with good drainage that are not in frost pockets any time after April 10-15th at a soil depth of about 1.5-1.75 inches. I wouldn't plant much deeper in April unless you are looking for moisture.

Phosphorus Saturation versus the New York P Index? Impact on Manure and Fertilizer Management in New York State

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Nutrient Management

Introduction

Phosphorus enrichment of surface waters leading to algal blooms and other issues related to eutrophication continues to be an issue in a number of locations. Runoff from agricultural fields can contribute to P runoff and management tools and policies have been developed to manage runoff risk. In 1999, New York (NY) introduced its first Concentrated Animal Feeding Operation (CAFO) Permit. This was followed by release of the NY Phosphorus Index (NY-P Index; USEPA, 1999; Czymmek et al., 2003) and establishment of a statewide on-farm research partnership in 2001. State policy requires implementation of the Natural Resources Conservation Service (NRCS)-NY 590 nutrient management standard on all farms with a CAFO Permit as well as animal feeding operations (AFOs) receiving state or federal cost share funds for manure storage and other related practices. Since 2001, the NY-P Index has been a required element of the NY 590 nutrient management standard.

In May of 2009 President Obama signed an Executive Order to intensify efforts to protect and restore the Chesapeake Bay and its watershed. This Order resulted from the belief that there had not been sufficient progress in restoring the health of the Bay and its watershed in the past 25 years. As a result of the Order, USEPA published *Guidance for Federal Land Management in the Chesapeake Bay Watershed* ("Guidance document") on May 12, 2010. This document states that managing P

through state-based P runoff indices is flawed and results in over-application of P to cropland. In the Guidance document, USEPA replaced the P index approach with a Psat approach based on a 20% Psat cutoff for manure or fertilizer application (USEPA, 2010) (Figure 1). While only applicable on federal lands at this point, it is viewed by some as a potential precursor to more widespread implementation on private lands.

During the review period for the Guidance document, USEPA received input from numerous organizations, including academic members of SERA-17. This group consists of research scientists, policy makers, extension personnel, and educators with the mission to develop and promote innovative solutions to minimize P losses from agriculture by supporting: (1) information exchange between research, extension, and regulatory communities; (2) recommendations for P management and research; and (3) initiatives that address P loss in agriculture (<http://www.sera17.ext.vt.edu/>). The SERA-17 scientists questioned the validity of the use of a Psat based cutoff for land application of manure and/or fertilizer, raised concerns that the Psat approach does not consider landscape position (a critical component of P loss), and pointed out that various Psat methodologies provide significantly different results. Despite these comments, USEPA published the 20% Psat cutoff in the Guidance document (http://www.epa.gov/owow/keep/NPS/chesbay502/pdf/chesbay_responsetocomments.pdf):

Guidance for Federal Land Management in the Chesapeake Bay Watershed by USEPA:

Base P application on P saturation in soils as follows:

- If the soil P saturation percentage is above 20 percent, do not apply manure or commercial fertilizer that contains P to cropland, grazing or pasture land.
- When soil P saturation percentage allows for application (i.e. < 20%), apply up to an N-based rate.
- Also, implement a soil P monitoring plan to ensure that soil P levels are staying steady over time.
- If soil P saturation percentage is increasing, adjust manure applications to P based rate and use commercial N fertilizer to make up the difference; if levels exceed 20 percent P saturation, no longer apply P.

Figure 1. Guidance for Federal Land Management in the Chesapeake Bay Watershed: 1.2.2 Implementation Measures for Agriculture in the Chesapeake Bay Watershed to Control Nonpoint Source Nutrient and Sediment Pollution, USEPA.

"EPA recognizes that Psat is an important feature that could improve the usability of the P index in long term nutrient management planning, particularly where P leaching is the primary environmental concern. EPA does not recommend any one methodology for determining Psat. We understand that the methods used to determine Psat are depended upon the chemical features of the extracts and do not provide conversion factors between the methods mentioned. EPA understands that the method of P analysis should always be clearly described in any presentation of Psat or soil test P. Also, while Psat and soil P are correlated, by determining the P application based on P-Sat, EPA's recommendation will still allow application beyond realistic yield goals in areas where Psat is lower than 20 percent; soil P is a more conservative estimate for P applications."

Nutrient Management

The implementation of the Psat cutoff for P application to federal land, and the potential for implementation of a similar cutoff for all agricultural land, motivated a project to compare the impact of use of a Psat approach on P fertilizer and manure application cutoffs as compared to our current NY P index approach. Specifically, our goal was to evaluate if a Mehlich-3 derived Psat ($P/[Fe+Al]$) could be converted to a particular Cornell Morgan P and if so, determine the potential 20% Psat cutoff for manure application.

What Did We Do?

In total, 91 soil samples were tested for Cornell Morgan (Morgan, 1941) and Mehlich-3 (Mehlich, 1984) extractable P, Fe, Al, and Ca. The Psat was determined as $P/[Fe+Al]*100$ (molar ratios) according to Kleinman et al. (2002). As mentioned, there are different methods for estimating Psat. The ratio of Mehlich-3 extractable P over Fe+Al was selected as a most likely candidate for implementation, because it is a commonly available agronomic test, despite evidence that this method (1) is unsuitable for calcareous soils found in parts of NYS, and (2) requires soil specific calibrations. Samples were collected from New York farms identified in conjunction with Agricultural Consulting Services, Inc. (ACS). Samples were air-dried and ground to pass a 2 mm sieve prior to laboratory analysis. Regression analyses were performed to determine if Morgan data could be correlated to Psat and if so, at what Cornell Morgan soil test level a Mehlich-3 derived P saturation of 20% was obtained.

What Did We Find?

Across all soil samples, a P saturation of 20% corresponded to a Cornell Morgan P of 86 lbs/acre (Figure 2). This Cornell Morgan value was somewhat higher than the 56 lbs P/acre (Cornell Morgan test) reported for 59 soil samples from the Delaware River Watershed in 1999 (Kleinman et al., 1999; assuming that Psat based on Mehlich-3 equals 0.7 times Psat derived from the oxalate extraction according to Kleinman and Sharpley, 2002), and similar to the 80 lbs P/acre (Maine Modified Morgan test) for 106 soil samples submitted to the Maine Soil Testing Service (Ohno et al., 2007). The New York data also show a wide range in soil test P equivalents; for example, of the 7 soils with a Psat of 20%, corresponding Cornell Morgan P levels ranged from 56 to 172 lbs P/acre with a median value of 71 lbs P/acre. Similarly, soils with a Cornell

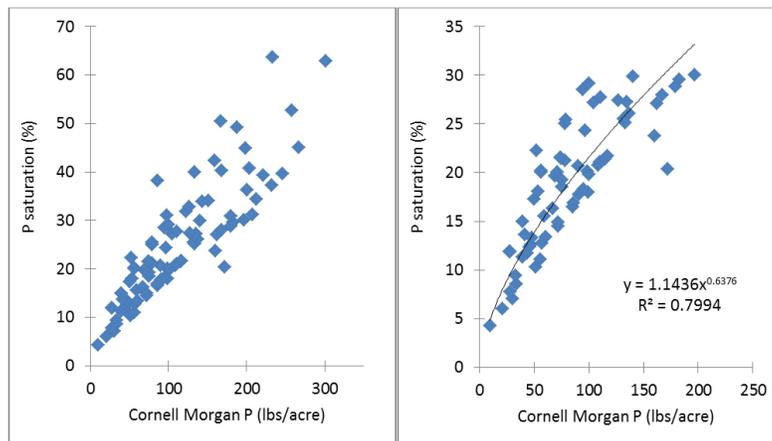


Figure 2: Relationship between the Cornell Morgan P test and P saturation derived from Mehlich-3 data ($P/(Fe+Al)$ in molar ratio).

Morgan P of 75-85 lbs/acre corresponded to a Psat ranging anywhere from 16 to 38%.

Implications

The implementation of a Psat cutoff of 20% for manure application instead of the NY-P Index will not impact manure application to high risk fields with a Cornell Morgan soil test of 80 lbs/acre or more, as the current P Index will not allow manure application to those fields as the NY-PI score will be 100 or more if the the transport factor is 1.0. Given that a very low percentage of NY fields test greater than 80 lbs P/acre (about 5%), implementation of a Psat in NY will have minimal effect on manure application practices. However, it could adversely impact farms with fields with very high soil test P but low transport risk. Such Psat based policy purports to address manure disposal (i.e. application beyond what would be most optimal for P resource management) but will increase the use of purchased fertilizer as it does not account for fertilizer value of N and K in the manure. Further, we do not believe implementing the Psat cutoff in NY offers real environmental benefit because as a chemical test alone, it fails to account for key, field specific risk considerations of landscape position and relationship of the field to surface waters.

Conclusions

Implementation of a Psat approach will cause restrictions on P application for very high P fields with a low NY-PI transport risk. On average, across all soils in the study, a Psat of 20% corresponded to a Morgan soil test P level of 86 lbs/acre, just above the current cutoff for P application for fields with a high transport risk. This means that implementation of a Psat approach would eliminate manure

Nutrient Management

and fertilizer application to fields with a Cornell Morgan P of 86 lbs/acre, *independent* of the risk of transport of this soil test P to surface or groundwater. We do not recommend the application of the Psat approach in NY as it will increase costs for some farms while unlikely to offering corresponding environmental benefit.

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Acknowledgments

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New York P Index Survey: What Caused Impressive Improvements in the NYS P Balance?

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Introduction

The New York Phosphorus Index (NY-PI) was introduced in 2001. Since then, phosphorus (P) fertilizer sales (farm use) declined from 36,506 tons of P₂O₅ in 2001 (19.5 lbs P₂O₅/acre) to 18,610 tons P₂O₅ in 2009 (10.2 lbs P₂O₅/acre). In 2011, we surveyed Certified Nutrient Management Plan (CMNP) developers certified through the New York State Agricultural Environmental Management (AEM) program to evaluate their perceptions of the drivers for this change in P use. All 24 planners responded to the survey allowing us to document: (1) farms and acres covered by CNMPs and changes in management practices and soil test levels; and (2) planner perceptions of the drivers of these changes since the introduction of the NY-PI in 2001. The survey contained questions related to (1) farms and acres for which CNMPs were developed in 2010; (2) time and effort needed to do a NY-PI assessment for a field; (3) impact of NY-PI field assessment on changes in manure and/or fertilizer practices; and (4)

changes in soil test P levels after 2001 when the NY-PI was introduced. In addition, planners were asked what they would tell policy makers about why farmers made changes and what policies and programs are needed to continue progress. The 24 CNMP planners consisted of 18 from the private sector, 5 from Soil and Water Conservation Districts (SWCD) and one from Cornell Cooperative Extension based in the New York City Watershed. One of the SWCD planners works with a private sector planner and their joint response is included in the private sector planner category.

Results and Discussion

Farm Sizes

The private sector planners were responsible for CNMPs covering 88% of all CNMP cropland and 76% of all farms with a CNMP (Table 1). Although private sector planners also planned most of the new plans in 2010 (74% of all acres, 62% of all farms), 22% of all acres newly planned in 2010 were farms in the NYC Watershed. The SWCDs planned less than 10% of all farmland and farms.

Table 1: Percent of all acres and farms under nutrient management planning in 2010 in New York planned by Soil and Water Conservation Districts (5 planners), Cornell Cooperative Extension (1 planner, New York City Watershed), and private sector planners (18 planners).

Planner affiliation	All farms		New plans in 2010		Plan updates in 2010	
	Area-basis	Farm-basis	Area-basis	Farm-basis	Area-basis	Farm-basis
-----%-----						
Soil and Water Conservation District	7	6	4	4	7	6
Cornell Cooperative Extension (NYC Watershed)	5	18	22	33	4	15
Private sector	88	76	74	62	89	79

Table 2: Total acres and number of farms as well as farm size for farms with certified nutrient management plans in 2010 planned by Soil and Water Conservation Districts (SWCD, 5 planners), Cornell Cooperative Extension (CCE, 1 planner, working in the New York City (NYC) Watershed), and private sector planners (18 planners).

Planners	All planners	SWCD planners	CCE planner (NYC-Watershed)	Private sector planners
All 2010 plans				
Total acres	756,032	54,063	40,000	661,969
Total farms	923	52	170	701
Acres/farm	819	1,040	235	944
New plans				
Total acres	67,434	2,816	15,000	49,618
Total farms	180	8	60	112
Acres/farm	375	352	250	443
Plan updates				
Total acres	688,598	51,247	25,000	612,351
Total farms	743	44	110	589
Acres/farm	927	1,165	227	1,040

The private sector and the SWCD planners worked primarily with CAFO-farms (200 cows or more) with average farm size exceeding 800 acres/farm. The planner from the NYC Watershed worked primarily with smaller operations (<200 acres/farm and 50-80 cows per farm) (Table 2). About 1/3rd of all the farms that CNMPs were developed for in 2010 did not meet the minimum size requirements to be qualified as a medium or large CAFO but were in state or federal programs that required a CNMP. Most of the farms in the NYC Watershed are included in this category. For both private sector planners and SWCD planners, new plans developed in 2010 tended to be for smaller farms (Table 2), consistent with the 100% compliance for CAFO farms in NY and expansion of CNMP planning to smaller farms involved in federal or state programs.

Nutrient Management

Time Required for NY-PI

The time needed to complete an NY-PI assessment for a field varied from 10 to 90 min, mostly dependent on whether the assessment was for a new field (and included determination of dominant slope and flow distance to streams), or if the assessment was an update from a previous year. Averaged across all planner responses, 40 min per field was needed, although 50% of all planners indicated assessments could be done within 30 min. About 40% estimated they needed 30-60 min per field, while 10% said more than 1 hour per field was needed. These differences might reflect differences in field topography (complex slopes, multiple flow paths etc.).

Fields Impacted by NY-PI

The planners estimated that management of 17% of acres under nutrient management planning was altered because of an initially very high or high NY-PI score. As a result of NY-PI implementation, manure was reallocated to fields that would otherwise not have received manure (as indicated by 77% of the planners). The most frequent changes made in manure management were changes in timing and rate (86% of the planners ranked timing and rate as the top two changes made). Changes in method of application were less common (ranked in the top two by 13% of the planners only). According to 65% of the planners, the introduction of the NY-PI resulted in an increase in both acres per farm and amount of exported manure. Forty three percent of the planners indicated that NY-PI based planning decreased the average soil test P levels over time and 48% said the percentage of fields classified as very high in soil test P decreased. The introduction of the NY-PI did not change cow numbers per farm or poultry litter use over time, according to 57% and 78% the planners, respectively.

Soil Test P Trends

Only 5% of the fields represented in the assessment tested above 80 lbs/acre Morgan extractable P, the level at which the NY-PI exceeds 100 if the transport risk from the field is high, and slightly less than ten times the agronomic critical level for most crops. Of the total cropland area, 4% could not receive manure under NY regulations because the NY-PI already exceeded 100 without the manure application.

Perceptions of Drivers

The two most important drivers for the changes in fertilizer use

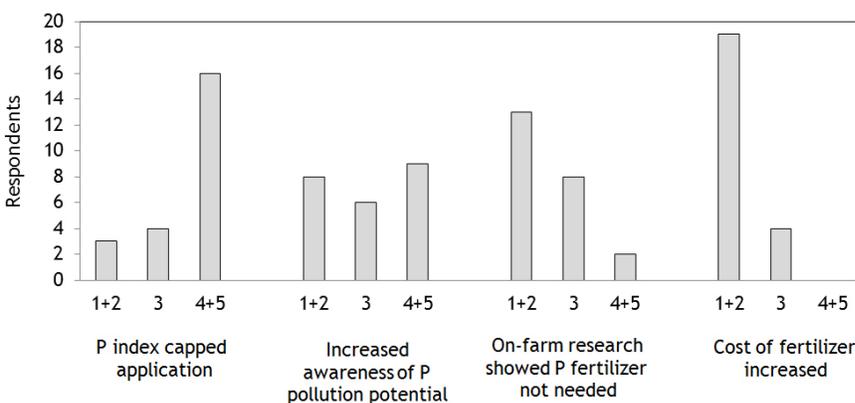


Figure 1: Planner perceptions of the drivers of the drastic reduction in P fertilizer sales for on-farm use in New York. Planners were asked to rank the drivers from 1-5 with 1-2 considered important, while 4-5 was not an important contributor to the change over time. Cost of fertilizer and on-farm research were identified as the most important drivers (23 respondents).

observed by NY planners were the price of fertilizer and the on-farm research partnership that showed that no additional starter P was needed if the soil test was classified as high or very high in P (Figure 1).

The reply related to fertilizer sales is most likely reflecting recent memory of the peak in fertilizer prices in 2008, as actual fertilizer sales decreased over time, prior to the 2008 price spike. Other reasons included greater use of soil testing for fertilizer use decisions, the expansion of manure application options in the state, awareness of the link between animal numbers and acres needed to apply the manure generated by the animals, improvements in herd nutrition, and the onset of a regulatory environment. One planner pointed out the importance of involving stakeholders when addressing environmental concerns:

“The history of collaboration and trust between the public, academic, and private sector stakeholders in New York State has led to a track record of efficient problem solving. Involve stakeholders in the process and hold them accountable to create real solution.”

Policy Message

Some planners pointed to improvements made in NY, the farms' investment in protection of the environment, and the role of the NY-PI in achieving such improvements. Others pointed to the need for partnership, science-based guidelines, and funding for applied research and planner and farmer training:

Nutrient Management

“The bottom line for the success that we have seen in NYS is because of the “systems” approach taken by the state and not just focusing on one problem area. Not only was phosphorus looked at, but, nitrogen and now potassium research is ongoing. On-farm research is one of the major “keys” to have “real data” from a true farm field setting with actual weather and field conditions with specified goals being measured. This approach has proven to be successful within all farming regions of NYS.”

“Another “key” to the success in NYS is that ALL agencies have collectively worked together in providing funding for research, data collection and analysis, training and educational programs for certified CNMP planners and farmers along with assistance for implementation of all needed conservation practices. Funding at the state and federal levels is the life blood for continued success that NYS has experienced thus far.”

The role of qualified professionals was stressed by several of the planners:

“The support of a skilled and knowledgeable planner using good information and effective tools applying the right strategies in the right places at the right times has been critical in helping NY farmers achieve reduced environmental impact. The P-Index applied by trained Nutrient Management Planners helps farms implement practices that are both environmentally effective and economically feasible.”

Also pointed out were the needs for farm-specific solutions and flexibility to address the challenges in nutrient management:

“Farmers need to know why changes are required, but they need flexibility to manage with day to day changes. Economics will continue to be major driver.”

In addition, the need for research and improvement of tools for management in general was pointed out in the planner responses:

“We need to continue to use science based technology such as the P index, N index, etc. rather than using broad restrictions to nutrient management planning (i.e. no winter spreading)”

“Keep supporting our farms with research and training programs.”

Planners referred to benefits of the collaborative approach to P management among dairy farms in NY for other industries, and/or called for action by other sectors of agriculture:

“The system is working!! Good research coupled with effective communication and on-farm planning has brought incredible benefits to New York agriculture. It goes beyond livestock agriculture. I know of several successful landscape businesses that never apply any P fertilizer to lawns anymore.”

Enforcement of regulations was identified as a key component as well in achieving improvements at the farm level:

“I think however that the biggest driver of changes in terms of nutrient management, amount of manure applied and reduction of overall P applications is due to the fact that the DEC is enforcing the CNMP. We have been doing CNMPs in NY since [...], most (and maybe all) of our medium and large CAFO clients have been inspected several times, and as the competence of the inspectors increase, and the inspections became more thorough, the attitude of the farmers was to look for the recommendations and to make sure that they actually applied what was there. [...].”

Others indicated the need for continued support for planners, training, and on-farm research:

“With the success that has been obtained in NYS, I would recommend continuing the current programs that are in place with more funding devoted to enhancing our farm producers viability, farmers know their farms and fields better than anyone else, including government officials, but they continually need assistance with improving production and lessening environmental risk through state and federal programs so new technology and implementation practices or best management practices can be adopted in a timely and financially stable manner.”

Conclusions

The key ingredients for success identified by the CNMP planners were: (1) statewide awareness of environmental issues driven by both regulations and extension programming/training; (2) development and implementation of science-based and practical tools (like the NY-PI) that allow for farm-specific solutions to the challenges; (3) demonstrated need for or benefits of alternative management practices (i.e. an on-farm research partnership that addresses relevant questions and on-farm research that results in credible answers); (4) accountability; (5) state enforcement of regulations; and (6) the presence of economically feasible solutions. The

Nutrient Management

success story of NY reflects a recognition of the need for change by both farmers and farm advisors, an interest in exploring management alternatives while looking for win-win approaches (e.g. reduced fertilizer use, re-evaluation of dairy rations, etc.), and a willingness by farmers and farm advisors to contribute to on-farm research that generated reliable data and believable results (with as the foundation a trust-based farmer-advisor-researcher relationship). We conclude that the NY-PI contributed to the successful reduction in P use in NY by being acceptable to farmers and farm advisors as a risk assessment tool, by being directionally correct (it made sense) and by allowing farms to design farm-specific solutions. The story of NY shows that change can be obtained via policy, incentives, measuring and monitoring.



Acknowledgments

For questions about these results contact Quirine Ketterings at 607-255-3061 or qmk2@cornell.edu, and/or

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Corn Stalk Nitrate Test: Low Accuracy in 2011 Strip Trials

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For over fifteen years, the corn stalk nitrate test (CSNT; Binford et al., 1992; Blackmer & Mallarino, 1996) has been promoted as a tool to determine whether a corn crop received deficient, adequate, or excessive nitrogen (N) amounts during a growing season. In recent years, the test has been strongly promoted as part of the adaptive N management approach, and its adoption has increased geographically beyond Iowa where it was initially developed. Little attention has been given to whether the test is sufficiently precise for field-level N management.

The Test

The basic concept of the CSNT is that the nitrate-N concentration of the lower corn stalk at the end of the season is indicative of whether sufficient N was applied to the corn crop, as plants suffering from N deficiency remove more N from the lower stalk than those with adequate or excess N supply. Universities and grower associations generally suggest the following interpretations of the test:

- Low (less than 250 ppm nitrate-N, in some states 450 or 750): high probability that the crop was N deficient.
- Optimal (generally between 250 and 2000 ppm nitrate-N, in some states also including a “marginal” range when below 750): high probability that yields were not limited by N, and no apparent excess.
- Excessive (>2000 ppm nitrate-N): high probability that N uptake exceeded plant requirement and that N was applied at excessive rates.

The CSNT is promoted as a tool that provides a *post-mortem* evaluation, but concerns have emerged about its utility to growers. All reported data on the CSNT in journal articles and fact sheets show that yield adequacy is often observed with CSNT values in the “low” range, which raises doubts about whether the test is a powerful indicator of N *deficiency*. Indeed, a recent Iowa report based on a large data set of N rate trials (Sawyer, 2010) indicated that 15% of CSNT values in the “low” range were false positives, while of cases with field-verified N deficits, 30% of CSNT results were false negatives. A recent Maryland study involving 10 experiments (Forrestal et al., 2012) found about a third of “low” CSNT values to be false positives for deficiencies.

Arguably, the primary value of the CSNT is related to determining *excessive* N rates, because N deficiencies can also be determined from leaf yellowing during the growing season. Recent New York research reports suggest that fields with high excessive N applications may still show low

or optimum CSNT values ([What's Cropping Up? Vol. 21 No. 3](#)) and that site differences affect CSNT values more than excess or deficient fertilizer rates (Katsvairo et al., 2003). The above-mentioned Iowa report (Sawyer, 2010) indicated that 33% of cases with field-verified excess N applications were not identified through the test, i.e., one third were false negatives for excess N. Moreover, the Maryland study (Forrestal et al., 2012) found as much as half the CSNT results to be false negatives for excess N. These results challenge the notion that the CSNT is an effective tool for adaptive nitrogen management in corn production.

Methods

As part of an *Adapt-N* beta testing effort (<http://adapt-n.cals.cornell.edu/>), we conducted 35 replicated strip trials on commercial and research farms throughout New York (17 trials) and Iowa (18 trials) in 2011. They involved two rates of N (a conventional “Grower” rate and an “Adapt-N” rate), which resulted in field-scale strips with N rate differences ranging from 15 to 140 lbs/ac. Trials had 3 to 8 replications for each treatment (except for 2 of the trials, NY8 and NY9, with only single strip yield measures, but replicated CSNT values). Trials were distributed across both states under a wide range of weather conditions, and involved grain and silage corn, with and without manure application, and rotations of corn after corn, corn after soybean, and corn after a clover cover crop (Table 1). New York yield results were reported in a recent *What's Cropping Up?* article ([Vol.22 No.2](#)).

To allow for comparison across all trials, silage yield values were converted to grain equivalents (8.14 bu grain per ton silage, calculated by using a harvest index of 0.55). The yield results from a majority of the trials showed unambiguous over-fertilization associated with the higher N rate (same yields for both rates). In these cases, the amount of “effective excess N applied” was set to the N rate difference between treatments (Table 1). In some cases the low rate provided insufficient N (reduced yields), and the optimum N level appeared to be between the high and low rates. In these cases, the amount of excess N applied was estimated by subtracting a conservative 1.25 lb N from the N rate difference between the treatments per bushel of yield lost due to the lower rate.

Fifteen corn stalk sections, sampled from each replicate strip, were dried, ground, and analyzed for nitrate content, according to published protocols. Means for each treatment are presented in Table 1. The utility of the CSNT was then assessed by evaluating the relationship between N rates, test values, and yield losses, and determining whether it

Nutrient Management

Table 1. Assessment of CSNT performance, based on strip trial results involving two fertilizer rates. CSNT values less than 250 (low) are presumed to indicate N deficiencies and values greater than 2000 (high) are presumed to indicate excess N.

Field Trial	Harvest	Manure	After soy	Low-High fertilizer N rate difference (lb/ac)	Effective yield difference (bu/ac equiv) ^a	Effective excess N applied for High rate (lb/ac) ^b	CSNT for Low N treatment	CSNT for High N treatment	CSNT correct for diagnosing demonstrated deficiency?	CSNT correct for diagnosing demonstrated excess?
NY3	grain	no	yes	-82	-22 ***	54	424	6250	NO	YES ^c
NY4	grain	no	no	-140	0	140	784	1776		NO ^c
NY5	silage	yes	no	-15	0	15	6893	6364		YES
NY6	grain	yes	no	-30	0	30	156	169		NO
NY7	silage	yes	no	-50	-4	45	279	1357	NO?	NO
NY8	grain	no	no	-43	0	43	465	829		NO
NY9	grain	no	no	-66	0	66	109	469		NO
NY11	grain	no	no	-31	-3	27	757	953	NO?	NO
NY12	grain	no	clover cc	-40	-29 ***	3	102	39	YES	NO? ^c
NY18	grain	no	yes	-115	-7	106	172	747	YES	NO
NY21	silage	yes	no	-43	-3	39	917	1233	NO?	NO
NY22	grain	no	yes	-123	-13 **	107	98	2054	YES	YES
NY24	grain	no	no	-52	-12 **	37	153	1103	YES	NO
NY25	silage	no	no	-34	0	34	47	65		NO
NY26	silage	no	no	-21	0	21	192	208		NO
NY27	grain	no	no	-75	0	75	1	71		NO
NY28	grain	no	no	-75	0	75	1	1		NO
IA1	grain	no	yes	-50	-6	42	2650	4830	NO?	YES
IA4	grain	yes	yes	-30	-6 ***	23	848	429	NO	NO
IA5	grain	no	no	-30	0	30	36	1450		NO
IA6	grain	no	yes	-18	-5	11	2070	3000	NO?	YES
IA8	grain	yes	yes	-50	-15	32	498	102	NO?	NO
IA9	grain	no	yes	-45	-4	40	277	392	NO?	NO
IA10	grain	yes	no	-40	-8	30	258	180	NO?	NO
IA11	grain	yes	yes	-50	-4 *	44	113	1410	YES	NO
IA12	grain	no	no	-55	-17 ***	34	99	102	YES	NO
IA13	grain	yes	yes	-35	0	35	3170	6590		YES
IA15	grain	no	yes	-41	0	41	1270	1685		NO
IA18	grain	yes	yes	-60	-3	57	1049	1345	NO?	NO
IA19	grain	no	yes	-60	-6	52	293	2530	NO?	YES
IA20	grain	no	yes	-60	-6	52	476	2727	NO?	YES
IA21	grain	yes	yes	-20	-9 **	9	431	466	NO	NO
IA22	grain	yes	yes	-20	-15 **	1	917	1134	NO	
IA23	grain	no	no	-30	-2 **	28	1763	2325	NO?	YES
IA24	grain	no	no	-75	-41 ***	23	197	1595	YES	NO

^a To facilitate comparisons between trials, grain equivalents for silage were calculated as 8.14 bu grain/T silage, by using a harvest index of 0.55. Yield differences were significant at $\alpha=0.10$ (*), 0.05 (**), and 0.01 (***), respectively.

^b Where no yield loss was found ($p > 0.7$ or measured yield gain), effective yield difference was set to zero, and effective excess N was set to the fertilizer applied in excess of the lower N rate. Where yield was lost or there is a chance greater than 40% ($p < 0.6$) that yield was lost, effective yield difference was set equal to the measured yield loss, and, by accounting for a conservative 1.25lb N per bu corn, the effective excess N was adjusted downward.

^c Cells color coded in green mark correctly identified and certain deficiencies or excesses. Cells color coded in red signify excess of 30lb of N or greater not diagnosed as excess by the CSNT. "NO?" indicates that demonstrated deficiency or excess was possible, but not certain.

Nutrient Management

accurately diagnosed field-demonstrated deficient or excessive N levels.

Results

Figure 1 shows the relationship between yield loss and CSNT results (the critical 250 and 2000 ppm levels are indicated on the graph). This pattern is similar to those in the original publications, but our data also indicate that:

- While yield losses are strongly associated with low CSNT values, the reverse does not hold: Low stalk nitrate levels do not necessarily imply yield losses.
- Adequate N rates (no yield losses) can result in a wide range of CSNT values. I.e., the power of the test to detect adequate or excess N rates is limited because low CSNT values may be observed when yield losses did not occur.
- Conversely, high CSNT values correctly imply a high probability of excess N rates.

In most trials, but not all, CSNT values for the upper N rates were higher than for the lower ones, indicating that the test shows some sensitivity to N levels (Table 1). However, in only 8 out of 35 trials (6 of them from Iowa) did the CSNT for the upper rate fall into a higher category than the CSNT for the lower rate.

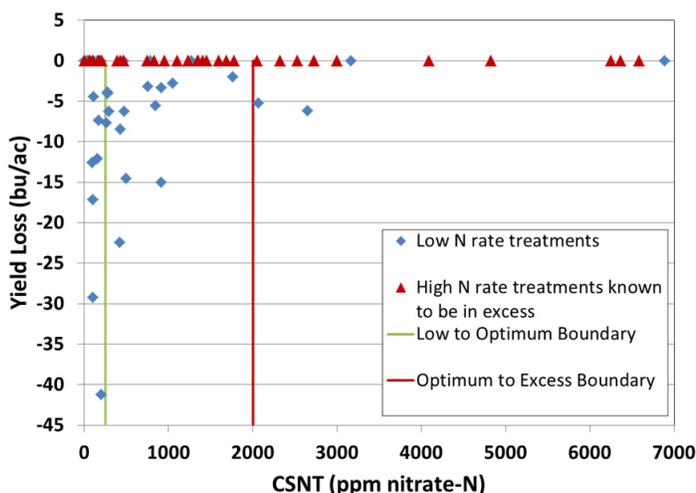


Figure 1. Yield losses (bu/ac) and CSNT values (ppm) from the lower N rate treatments in all trials, and for the higher N rate treatments in those trials where excess was unambiguous (implying no yield gain with further added N).

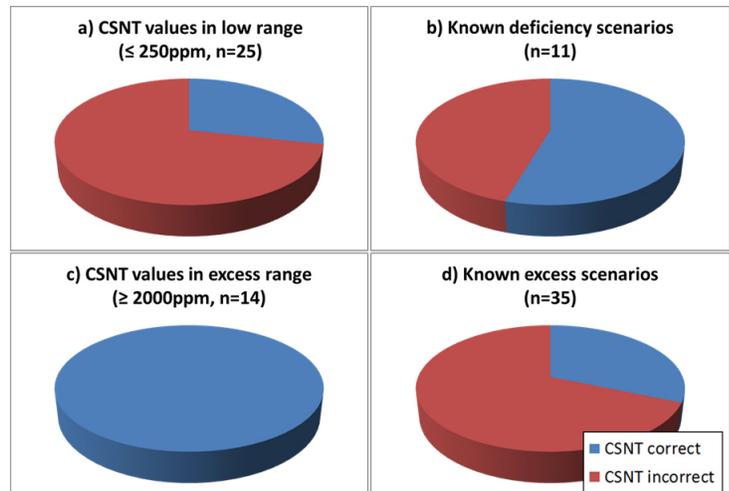


Figure 2. Proportion of CSNT values that correctly or incorrectly identified field-demonstrated deficiency or excess status of the number of a) CSNT values measured in the low range, b) known deficiency scenarios, c) CSNT values measured in the excessive range, and d) known excess scenarios.

N Deficient Cases: An evaluation of the power of the CSNT to detect N deficiencies is presented in Table 1 and Figure 2. Of all CSNT values in the “low” range (25 instances), 60% were measured when N rates were in fact known to be adequate or even excessive (i.e., more than half were false positives of deficiency; Fig 2a). For only six of these trials, yield reductions were statistically significant and the CSNT correctly supported the results (highlighted in green in Table 1). Of the 11 trials where significant yield losses were measured with the lower N rate (and deficiencies occurred), the CSNT identified six (54%) correctly in the “low” range (Fig 2b), while CSNT results for the remaining 46% of trials were false negatives for deficiency.

N Excess Cases: Instances with excessive CSNT values (>2000 ppm) were in fact known to have excess N or there was no evidence to the contrary (Table 1, Fig 2c). Therefore, the test was 100% accurate when showing excessive CSNT values, similar to Sawyer’s (2010) results. However, the opposite was not the case. We found that in only 11 of 35 cases (31%, 24% of those in NY) where unambiguous surplus N applications occurred, the CSNT correctly identified excess N levels (CSNT>2000 ppm, Fig. 2d). Conversely, for 24 of these 35 cases (69% overall;

Nutrient Management

76% for those in NY) the CSNT erroneously diagnosed non-excessive levels (i.e., more than two-thirds were false negatives). Many of these could be considered serious misdiagnoses (highlighted in red, excess of 30 lb N or more). This includes Trial NY4 where at least 140 lbs N/ac excess were applied, Trial NY18 with an excess of at least 106 lb N/ac, and Trial NY27 and NY28 where at least 75 lbs N/ac excess were applied. In the latter case, the CSNT values suggested deficiency when in fact N was applied in considerable excess.

Conclusions

We used 35 strip trials to make an assessment of the utility of the CSNT for corn nitrogen management on a field-by-field basis. We conclude from this year's data and other published work that the test has limited ability to support management decisions. The primary question is whether the test can effectively detect excessive N applications. The answer appears to be "no". Over two-thirds of the cases with substantially over-fertilized crops (up to 140 lbs/ac) did not show CSNT values in the excessive range (>2000 ppm), i.e., a majority of those cases were false negatives. Since the test's primary need is related to determining excessive N rates, the test appears to perform weakly in serving its main purpose. A second issue is whether the CSNT precisely determines N deficiencies. In this case the problem is with high rates of false positives, i.e., low CSNT values while N rates were in fact adequate or even excessive.

An additional concern is that end-of-season evaluations of the current growing season have limited value for the predictability of N needs in future growing seasons. Research has demonstrated (summarized by van Es et al., 2007) that weather conditions during the early growing season greatly affect N losses and are a critical factor in determining optimum N rates. This implies that an interpretation of CSNT values requires an evaluation of the complex growing conditions of the past season, and that test results from one growing season have limited value for predicting N needs for the next year when the weather may be very different.

Overall, we conclude from previous research reports and our own 35 strip trials that the CSNT is not an effective tool for use in field-specific adaptive N management, especially in the Northeast. We suggest that users of the test recognize the test's inherent weaknesses, and we recommend caution with the adoption of the CSNT for field-level adaptive N management.

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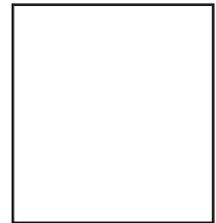
Calendar of Events

Nov. 27-29, 2012 | NRCCA Training, Syracuse, NY
December 12, 2012 | Field Crop Dealer Meeting, Syracuse, NY

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