What's Cropping Up?

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Adapt-N Responds to Weather, Increases Grower Profits in 2013 Strip Trials

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Adapt-N is an on-line tool for weather-adjusted precision nitrogen management in corn that has been available to growers in the Northeast and several Midwestern states since 2010 (http://adapt-n.cals.cornell.edu). In 2013, with an uncharacteristically wet spring, the tool successfully adapted N recommendations to account for early-season N dynamics, and further demonstrated its ability to improve farmer profits.

Background

Nitrogen dynamics in corn production are strongly influenced by weather, particularly early-season precipitation. In Northeastern and Midwestern US climates, N mineralizes from soil organic matter earlier than a corn crop is able to take it up. In a dry or normal spring, most of such early-mineralized soil N remains available to a corn crop (Figure 1a), so that growers can reduce N inputs without yield loss as demonstrated in 2011-2012 (Moebius-Clune et al., 2013a).

However, many growers apply the bulk of their nitrogen inputs before or at corn planting. This means not only that they lose the opportunity to reduce inputs in-season after a dry spring, but that they face significant risk of profit loss due to wet weather. Significant N loss of both early-mineralized and early-applied soil N occur during wet spring weather (Figure 1b and c). N rates must then be adjusted in-season when these losses can be accounted for, in order to maintain corn yield potential.

Adapt-N provides such site-specific in-season N sidedress recommendations. It uses a well-calibrated computer model and information on soil and crop management, along with real-time, high-resolution weather data, to account for a location's conditions. It also provides insights on soil nitrogen status, gains and losses, and crop growth stage through simulation outputs.

The tool's accuracy and precision have been evaluated through on-farm trials and improved in response to performance and user feedback (Moebius-Clune et al., 2013a, 2013b, 2013c, 2012). The wet spring encountered in much of the Adapt-N user area in 2013 provided the first chance to test the tool for extreme wet conditions. A summary article for all three years of testing provides averages for 104 trials over 3 years of testing in NY and IA. In this article, we examine Adapt-N's performance in 2013 New York and Iowa strip trials, guided by the following questions:

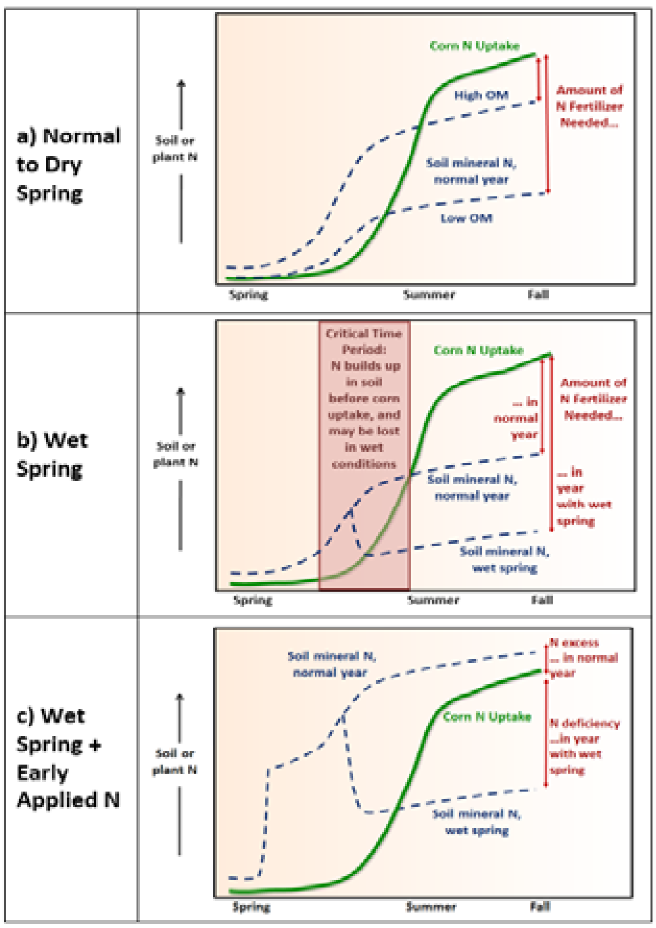

Figure 1. Early-season N dynamics in corn systems. a) N in organic matter (OM) begins mineralizing before corn is ready to take it up, and contributes significant amounts of nitrogen for crop uptake in normal to dry years. b) In a wet spring, early-mineralized N is easily lost during this critical time period, leading to later-season N shortages if not accounted for with additional sidedressed N. c) Applying N fertilizer or manure early increases the risk of large losses.

1. Do Adapt-N simulations of N losses in wet-spring conditions lead to weather-adaptive N recommendations that are agronomically and economically beneficial to farmers?

2. How do the model's recommendations affect environmental N losses in a wet season?

Table 2. Agronomic and economic assessment of model performance in 2013. Values are average differences resulting from Adapt-N use (Adapt-N minus Grower-N treatment), such that a negative number indicates a decrease due to Adapt-N, a positive number indicates an increase due to Adapt-N. Profit calculations assume $5.00/bu grain, $50/T silage, $0.50/lb N, and $8/ac operational savings if sidedress was avoided. Silage yields are reported as grain equivalent (1T silage = 8.14 bu grain)

2013 Trial Results					
Average Change due to Adapt-N use (Adapt-N - Grower-N)	NY grain	NY silage	All NY trials	All IA trials	Grand Mean for NY and IA
	n=8	n=3	n=11	n=9	n=20
Total N fertilizer applied (lb/ac)	23	13	20	-19	0
Yield (grain: bu/ac; silage: T/ac; combined: bu/ac grain equiv)	25	1	21	1	11
Profit ($/ac)	$112	$47	$94	$12	$53
Simulated N leaching loss (lb/ac)	3	-1	2	0	1
Simulated N total loss (lb/ac)	11	0	8	-9	0

Methods

We completed 20 replicated strip trials on commercial and research farms, 11 in New York and 9 in Iowa during the 2013 growing season. Trials were conducted in grain and silage corn, in varied tillage systems, with and without manure application, with previous crops of corn or soybean (Table 1). Most participants applied small amounts of starter or preplant N, with the majority of total grower rates applied at sidedress. Sidedress treatments involved at least two rates of nitrogen, a "Grower-N" rate based on current grower practice, and an "Adapt-N" rate based on a simulation run just prior to sidedressing. Growers in IA and NY implemented field-scale strips with 2 to 7 (usually 4) replications per treatment. In several trials (23-25, 27, 61, 62) treatment replicates were reported as composite harvest values due to time and equipment constraints.

Table 1. Background information on 2013 on-farm strip trials implemented in NY and IA to compare current Grower N application rates with rates recommended by the Adapt-N tool.

State	Trial ID	Harvest	Manure	Prior crop
NY	7	grain	no	grain corn
NY	9	grain	no	soy
NY	12	grain	no	soy
NY	15	grain	no	soy
NY	18	grain	no	grain corn
NY	23	grain	no	soy
NY	24	grain	no	soy
NY	25	grain	no	soy
NY	5	silage	no	silage corn
NY	22	silage	2013	silage corn
NY	27	silage	2013	silage corn
IA	57	grain	2012	soy
IA	58	grain	2012	soy
IA	59	grain	2012	soy
IA	61	grain	no	soy
IA	62	grain	no	soy
IA	63	grain	no	soy
IA	64a	grain	no	soy
IA	65a	grain	no	soy
IA	65b	grain	no	soy

Yields were measured by weigh wagon, yield monitor, or in a few cases by representative sampling (two 20 ft x 2 row sections per strip). Partial profit differences between the Adapt-N recommended and Grower-N management practices were estimated through a per-acre partial profit calculation:

Profit=[Adapt-N yield – Grower-N yield] * crop price – [Adapt-N rate – Grower-N rate] * price of N + Sidedress operation savings/loss

Yields were used as measured, regardless of statistical significance, since the statistical power to detect treatment effects is inherently low for whole-field strip trials, but averaging across many trials provides good statistical power for assessing Adapt-N performance. Prices of $0.50/lb N, $5.00/bu grain, $50/T silage were used. (Prices varied across implementation areas, but generally were close to a 10:1 price ratio). Operational costs of sidedressing ($8/ac) were accounted for where only one of the treatments was sidedressed. Agronomic, economic, and simulated environmental outcomes of these trials were used to assess Adapt-N performance.

Results

Agronomic and economic comparisons between Grower-N and

Adapt-N treatments for each trial are provided for NY and IA trials in Figure 2, and as averages for agronomic, economic, and environmental performance in Table 2.

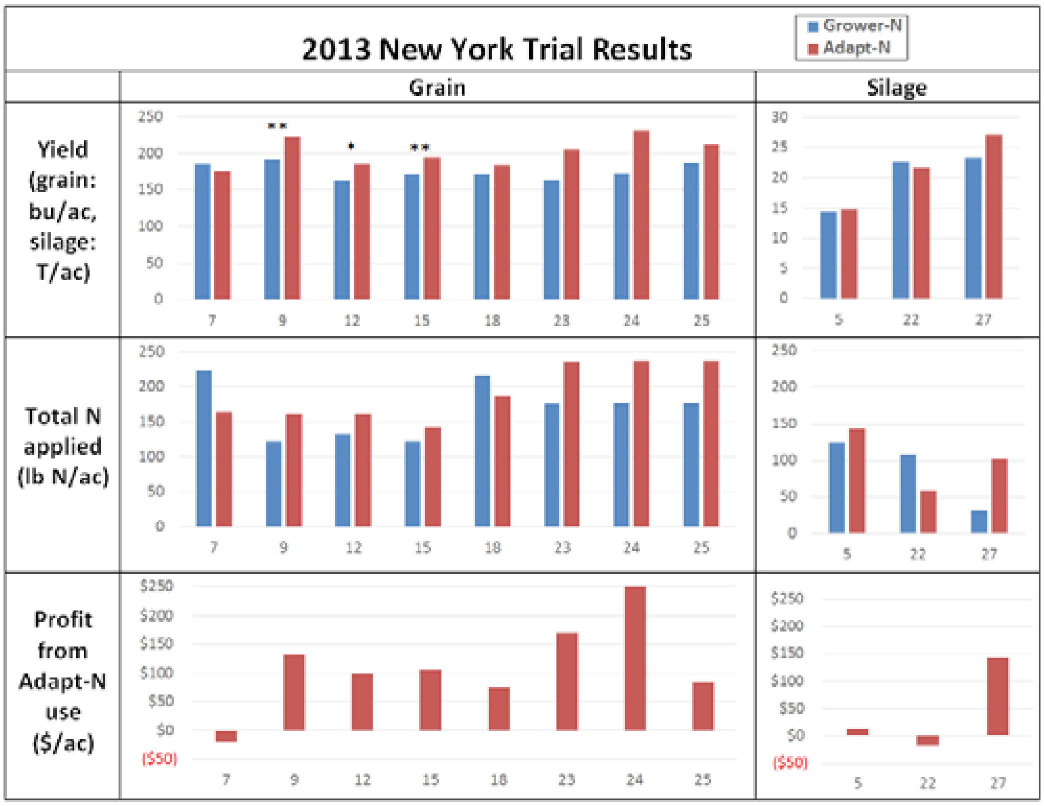

*Figure 2. Yield and fertilizer use from Grower-N vs. Adapt-N treatments in a) NY and b) IA trials. N rates represent total N in lbs/acre applied as inorganic fertilizer in 2013. Partial profit gain (positive) or loss (negative) from using the Adapt-N recommendation, relative to grower's current practices. (Yields statistically different at *p < 0.05 or **p < 0.01)*

In 2013, in contrast to previous years, Adapt-N rates were higher than Grower-chosen sidedress rates in 73% of NY trials, because the most extreme rainfall occurred primarily after corn planting, in June and early July, when large amounts of mineralized N and early applied N were vulnerable to losses. In Iowa, however, Adapt-N rates were higher than Grower-chosen rates in only 22% of trials, despite the wet spring, because the most extreme rainfall occurred in May and early June, followed by fairly dry conditions in some of the user area. At that time, relatively less of the potentially available N from organic matter had mineralized. The largest losses thus occurred where corn was planted early and preplant N fertilization was high (up to 110lb/ac, trial 63), prior to extreme rainfall. This was only the case in a small number of trials. Those who sidedressed the majority of their N in June were able to avoid the extreme losses. Averaging all 20 trials conducted in NY and IA in 2013, total fertilizer applied and environmental losses did not change, while yield increased by +11 bu/ac, and profits increased by $53/ac.

NY trials. Adapt-N recommended increased sidedress rates over the grower's normal practice in 8 out of 11 NY trials. The difference between Adapt-N recommendations and grower practice (A-G) averaged +20 lbN/ac (-60 to +70 lb N/ac). Yield increased on average by +21 bu/ac (-10 to +58 bu/ac; silage reported as grain equivalent: 1 T silage = 8.14 bu grain). In all cases where Adapt-N recommended a fertilizer increase, higher rates resulted in increased yields and profits. Overall, profits from Adapt-N recommendations increased in 9 out of 11 trials (82%), ranging from -$20 to +$252/ac with an average increase of $94/ac.

Despite significant fertilizer increases, simulated total losses of N over the season (through 12/31/2013) averaged only 8 lb N/ac higher in Adapt-N versus Grower strips (Table 2). Post sidedress losses occur if sidedress N is applied before the crop is large enough to prevent wet soil conditions through high transpiration rates, or if excess N remains at the end of the season. Most of the additional fertilizer recommended by Adapt-N was taken up by the crop after sidedressing, while N applications and losses were reduced in 3 of the trials. In two trials where profit losses did occur, we suspect that the combination of inadequately drained, compacted, poorly aggregated soils and heavy rains caused higher losses than simulated by the model.

Success stories from two growers in particular can be highlighted. Grower Arnold Richardson, working with Keith Severson of CCE Cayuga County, saw significant profit gains of over $100/ac on average from Adapt-N use this year (see Case Study in this volume [http://blogs.cornell.edu/whatscroppingup/?p=759]). Dave DeGolyer of Western NY Crop Management Association established several trials of rescue N applications in July with growers Donn and Chad Branton (23-25, Fig 2). The Brantons' standard N management places nearly all N fertilizer in a deep slot with stabilizer at planting. However, this year demonstrated that such fertilizer is vulnerable to losses during heavy rains despite stabilizer. Adapt-N indicated that more N was needed, even though enough would have been available in a normal year (Fig 1c). By sidedressing an additional 60 lb N/ac, the Brantons saw increases of 25, 42, and 58 bu/ac in three trials and profit gains of approximately $79, $164, and $246/ac due to avoided yield loss. The Brantons have decreased their preplant N applications this spring, and plan to use Adapt-N-informed sidedress rates provided by WNYCMA.

IA trials. Despite the wet spring, Adapt-N recommended fertilizer rate reductions from grower's normal practice in 7 out of 9 IA trials, in part because most participating IA growers were planning to apply the majority of their N at sidedress. The difference between Adapt-N recommendations and grower practice (A-G) ranged from -40 to +30 lbN/ac with an average change of -19 lb N/ac. Yield changes due to Adapt-N use ranged from -4 to +14 bu/ac with an average of +1 bu/ac. Profits increased on average by $12/ac, ranging from -$6 to +$57/ac, with increases due to Adapt-N in 3 trials, no change ($0 to $1/ac) in 3 trials, and decreases in 3 trials. Simulated total N losses over the season (through 12/31/2013) were lower in Adapt-N versus Grower strips (-9 lb N/ac on average). Similarly to NY results, small profit losses in a few trials with reductions in N rates are likely due to the extreme wet conditions for which the model had not yet been field tested. Improvements in model handling of drainage have been in progress for the 2014 version of Adapt-N. Overall, the fact that Adapt-N was able to decrease N inputs even after such a wet spring without significant yield loss in these 6 trials (-1 bu/ac on average) indicates that Adapt-N accounted for losses successfully, and can inform much more significant N input reductions in Iowa during more normal or dry years, as demonstrated by our 2011 and 2012 trials, when growers plan on sidedressing. It should also be noted that predominant practice of IA growers at this time is to apply N in the fall or spring prior to planting. Such growers would have seen results most like trial 63 in IA, and trials 23-25 in NY (Figure 2), where additional N was needed to make up for rain-induced losses, with increased profits above $50/ac likely.

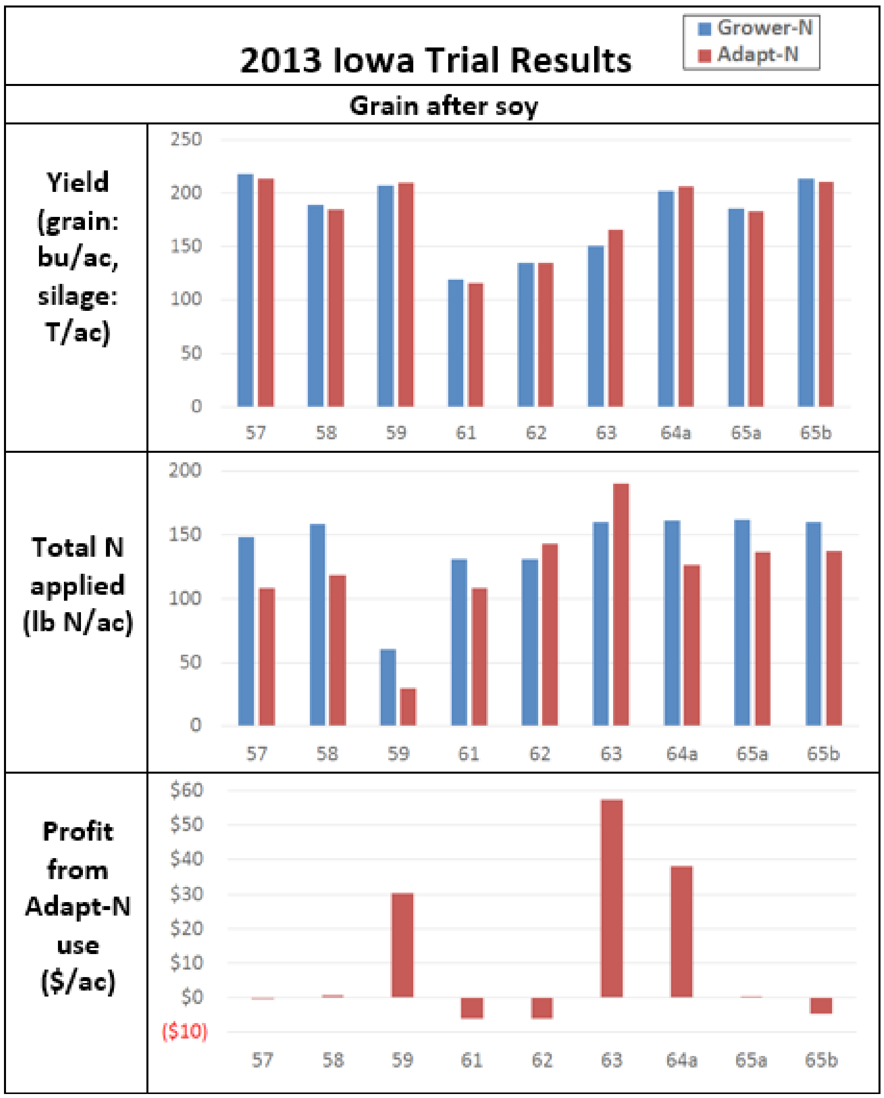

Figure 2b.

Conclusions

2013 on-farm testing in NY and IA further demonstrated the monetary and environmental value of using Adapt-N's weather-adjusted recommendations.

Key Take Home Points:

- Environmental losses due to Adapt-N recommendations in 20 trials, on average, did not increase over grower practice in the wet 2013 season.
- Yields increased by 11 bu/ac on average (21 bu/ac in NY, 1 bu/ac in IA).
- Profits increased by $53/ac ($94/ac in NY, $12/ac in IA).
- In 75% of trials Adapt-N increased or maintained profits compared to grower practice. The model's ability to handle the impacts of poor drainage has been further improved for 2014.
- 2013 results demonstrate the value of site-specific, adaptive recommendations provided by Adapt-N. The tool's site-specific recommendations successfully identified opportunities for N input reductions where possible, and N input increases where agronomically necessary to maintain yield potential following a wet spring.
- Results, especially in IA, conservatively estimate possible profit gains in a wet year, because most collaborating growers sidedress the majority of their N. Profit were highest when compared to more common grower practices of large or total preplant applications.
- This third year of on-farm testing further confirms the significant advantages growers have when they apply the majority of their N at sidedress time, when economically optimum N rates can be better estimated.

For more information: An in-depth 2014 training webinar on Adapt-N, manual, and further information are available at http://adapt-n.cals.cornell.edu/. The Adapt-N tool can be used from any device with internet access, and as of the 2014 sidedress season is offered through a public-private partnership between Cornell University and Agronomic Technology Corporation for a fee ($1-3/ac, depending on area covered). Users can sign up for an account at http://www.adapt-n.com/products/, and can elect to receive email and/or cell phone alerts providing daily updates on N recommendations and soil N and water status for each management unit being simulated in Adapt-N.

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Crop Management

Do Modern Corn Hybrids Still Exhibit Imbibitional Chilling Injury?

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Imbibitional chilling injury to corn **purportedly** occurs when recently planted corn seed imbibes water at temperatures less than 41oF (although some say 50oF) during the first 48 hours after planting. We have planted corn a few times over the last 30 years when temperatures have been in the 40s or upper 30s, even with a little snow falling. Sure, final stands have not been perfect when planting under these conditions, but on almost all occasions, final stands have been satisfactory. So I must pose the question, as once again we have encountered poor conditions shortly after planting in April of 2014, and have had not perfect, but certainly satisfactory corn stands. **Do modern hybrids still exhibit imbibitional chilling injury under field conditions?**

Emergence of corn hybrids planted on April 14th after encountering cold rain and snow 21 to 30 hours after planting.

We planted two corn hybrids at our recommended seeding rate of ~32,000 kernels/acre at five seeding depths on April 14, April 21, May 7, May 20, and May 31 **on a well-drained soil** at the Aurora Research Farm in Cayuga Co. We have not had time to conduct statistical analyses on the data nor have we taken early plant population counts on the May 20 and May 31 planting dates yet. We do have days to emergence for the April 14, April 21, May 7, and May 20 planting dates and early plant populations for the first three planting dates. When averaged across the two hybrids and five planting depths, corn emergence occurred about 27 days after planting for the April 14 planting date, about 21 days after planting for the April 21 planting date, and about 7 days after planting for the May 7 planting date (Table 1). When averaged across hybrids and planting depths, early plant populations averaged about 27,000 plants/acre for both April planting dates, an average emergence rate of about 85% (Table 2). In contrast, early plant populations averaged about 28,500 plants/acre for the May 7 planting date, an average emergence rate of about 90%. Clearly, the May 7 planting date resulted in better stand establishment, but were the April planting dates that unsatisfactory, given the conditions in the first 48 hours after planting corn?

Table 1. Days to emergence, averaged across two corn hybrids, planted on five dates and at five depths at the Aurora Research Farm in Cayuga Co. in 2014.

DEPTH	PLANTING DATE				
	4/14	4/21	5/7	5/20	5/31
INCHES	DAYS TO EMERGENCE				
1.0	26	20	7	7.75	?
1.5	26.5	20	7	8	?
2.0	26.75	20.5	7	8	?
2.5	27	21	7.5	9	?
3.0	27.25	22	8	8.75	?

Table 3 indicates that temperatures were in the 70s during the afternoon of April 14. **Temperatures, however, dropped into the upper 30s, 21 hours later, accompanied by a cold rain for three hours (8:00-11:00), followed by an accumulating snow for the next few hours (12:00-16:00) on 4/15. Temperatures then dipped down into the lower 20s (a low of 21.7!) during the evening of 4/15 and remained in the 20s throughout the day of 4/16.**

Climatic conditions were not as inhospitable after the April 21 planting date but Table 4 **indicates that 36 hours (4/22, 3:00) after planting corn, temperatures were in the upper 30s accompanied by a cold rain. Temperatures remained in the upper 30s throughout the day of 4/23.**

Table 2. Early plant populations, averaged across two corn hybrids, planted on five dates and at five depths ata seeding rate of ~32,000 plants/acre at the Aurora Research Farm in Cayuga Co. in 2014

DEPTH	PLANTING DATE				
	4/14	4/21	5/7	5/20	5/31
INCHES	PLANTS/ACRE				
1.0	26,500	26,833	28,500	?	?
1.5	**27,800**	27,000	27,750	?	?
2.0	27,315	**28,250**	**29,500**	?	?
2.5	26,750	27,000	28,500	?	?
3.0	27,000	26,250	28,200	?	?

Both April planting dates thus had temperatures below 41 degrees in the first 48 hours after planting, accompanied by a cold rain and even snow. The field was plowed and harrowed so soil temperatures closely tracked air temperatures, especially in the top 2 inches. Yet, emergence rates averaged 85% for the April planting dates compared with 90% emergence for the May 7 planted corn, which encountered almost ideal conditions in the first 48 hours after planting(temperature range of 52 to 81oF). Was the 5% lower emergence rate for the April planting dates due to imbibitional chilling injury? And if imbibitional chilling reduced emergence by 5%, should it be cause for alarm? Or should we just continue to recommend that growers assume an 85% emergence rate for April-planted corn and a 90% emergence rate for May-planted corn in NY?

One criticism of inferring that modern hybrids may no longer exhibit imbibitional chilling injury, based on data from this study, is that we examined only two hybrids. In 2012, we planted our corn silage hybrid trial with 82 entries on April 20 at the Aurora Research Farm in Cayuga Co. when the high temperature was 78 oF on the day of planting. **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 during the next 24 hours after planting (Table 5). Obviously, weather conditions were conducive for imbibitional chilling damage during the initiation of the emergence process in the 2012 study.**

Table 5. Weather conditions at the Aurora Research Farm from April 14-April 29 in 2012. Emboldened date indicates the wather conditions on the day of planting.

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
14	66	34	0.00	0.0	0
15	69	52	0.06	0.0	0
16	88	47	0.00	0.0	0
17	56	31	0.00	0.0	0
18	55	32	0.00	0.0	0
19	73	45	0.00	0.0	0
20	**78**	**37**	**0.00**	**0.0**	**0**
21	54	35	0.60	0.0	0
22	41	31	0.86	5.0	5
23	36	31	0.20	0.0	1
24	45	35	0.01	0.0	0
25	49	34	0.00	0.0	0
26	64	32	0.19	0.0	0
27	42	26	0.00	0.0	0
28	48	26	0.00	0.0	0
29	53	29	0.00	0.0	0

When averaged across the 82 hybrids entered in the study, early stand establishment averaged 85.4% (Table 6). Stand establishment averaged from about 84 to about 89% for the hybrids from the 12 seed companies. 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.

So, I must once again pose the question. **Do modern hybrids still exhibit imbibitional chilling injury under field conditions?** Based on the circumstantial data from the 2012 and 2014 studies, I would say maybe not. If modern hybrids do exhibit imbibitional chilling injury, the timing of the adverse conditions would have to be so unique and so time-dependent in the first 48 hours after planting that it may not be worth worrying about. **Keep in mind that these studies were conducted on well-drained soils.** If we had planted corn on poorly drained soils and encountered such weather conditions after planting, corn emergence would have been much lower. But it probably would have been associated

Table 3. Hourly temperature and hourly precipitation during the 48 hours after planting two corn hybrids at five planting depths on April 14 at the Aurora Research Farm (read the table from the bottom to the top to track temperature and precipitation during the first 48 hours after planting).

Date/Time	Temp (F)	Rain (inches)
4/16/2014 12:00	**28.3**	**0**
4/16/2014 11:00	**27.1**	0.01
4/16/2014 10:00	**26.0**	**0**
4/16/2014 9:00	**23.8**	**0**
4/16/2014 8:00	**22.9**	**0**
4/16/2014 7:00	**22.5**	**0**
4/16/2014 6:00	**22.0**	**0**
4/16/2014 5:00	**21.7**	**0**
4/16/2014 4:00	**22.0**	**0**
4/16/2014 3:00	**23.1**	**0**
4/16/2014 2:00	**24.5**	**0**
4/16/2014 1:00	**24.7**	**0**
4/16/2014 0:00	**24.8**	**0**
4/15/2014 23:00	**26.1**	**0**
4/15/2014 22:00	**27.8**	**0**
4/15/2014 21:00	**28.9**	**0**
4/15/2014 20:00	**29.5**	**0**
4/15/2014 19:00	**29.8**	**0**
4/15/2014 18:00	**31.2**	**0**
4/15/2014 17:00	**31.6**	**0**
4/15/2014 16:00	**30.8**	**0.01**
4/15/2014 15:00	**31.0**	**0.01**
4/15/2014 14:00	**32.0**	**0.01**
4/15/2014 13:00	**33.6**	**0.05**
4/15/2014 12:00	**35.7**	**0.13**
4/15/2014 11:00	**36.4**	**0.16**
4/15/2014 10:00	**37.1**	**0.17**
4/15/2014 9:00	**38.0**	**0.22**
4/15/2014 8:00	58.6	0
4/15/2014 7:00	60.7	0
4/15/2014 6:00	60.4	0
4/15/2014 5:00	60.6	0
4/15/2014 4:00	59.9	0
4/15/2014 3:00	60.0	0
4/15/2014 2:00	59.9	0
4/15/2014 1:00	60.0	0.02
4/15/2014 0:00	63.1	0
4/14/2014 23:00	63.4	0
4/14/2014 22:00	63.4	0
4/14/2014 21:00	63.7	0
4/14/2014 20:00	63.1	0.01
4/14/2014 19:00	60.1	0.3
4/14/2014 18:00	71.4	0
4/14/2014 17:00	74.3	0
4/14/2014 16:00	76.6	0
4/14/2014 15:00	75.2	0
4/14/2014 14:00	72.9	0
4/14/2014 13:00	**72.2**	**0**

with flooding damage and not with imbibitional chilling injury.

What happens if soil conditions are conducive for a mid-April planting date next year but very cool wet weather (even snow) is forecast for the next few days? I will continue to plant corn any time after April 10-15, provided **soil conditions are dry, the location does not experience late spring killing frosts (< 28 degrees after May 15 or so) and the soils are well-drained and do not readily flood.** I would adjust my seeding rate to account for only 85% emergence and plant at a soil depth of 1.5-2.00 inches. Let's hope that most corn growers in NY get that opportunity next year and don't have to go through another spring like this year!!!!

Table 6. 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	EMERGENCE-%	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

DATE/TIME	TEMP (F)	RAIN (INCHES)
4/23/2014 14:00	37.7	0.00
4/23/2014 13:00	37.8	0.00
4/23/2014 12:00	37.2	0.00
4/23/2014 11:00	**37.8**	**0.01**
4/23/2014 10:00	**38.2**	**0.07**
4/23/2014 9:00	**39.4**	**0.07**
4/23/2014 8:00	**39.4**	**0.08**
4/23/2014 7:00	**38.3**	**0.06**
4/23/2014 6:00	**38.2**	**0.04**
4/23/2014 5:00	**39.7**	**0.07**
4/23/2014 4:00	**39.9**	**0.03**
4/23/2014 3:00	**40.3**	**0.01**
4/23/2014 2:00	42.3	0.00
4/23/2014 1:00	43.3	0.00
4/23/2014 0:00	43.4	0.00
4/22/2014 23:00	43.8	0.00
4/22/2014 22:00	45.3	0.01
4/22/2014 21:00	48.5	0.00
4/22/2014 20:00	51.2	0.00
4/22/2014 19:00	52.4	0.00
4/22/2014 18:00	56.3	0.00
4/22/2014 17:00	58.7	0.00
4/22/2014 16:00	61.3	0.00
4/22/2014 15:00	59.2	0.00
4/22/2014 14:00	56.6	0.16
4/22/2014 13:00	56.1	0.04
4/22/2014 12:00	56.4	0.03
4/22/2014 11:00	57.9	0.01
4/22/2014 10:00	57.4	0.00
4/22/2014 9:00	56.8	0.01
4/22/2014 8:00	56.8	0.00
4/22/2014 7:00	57.5	0.00
4/22/2014 6:00	59.2	0.00
4/22/2014 5:00	59.9	0.00
4/22/2014 4:00	60.4	0.00
4/22/2014 3:00	60.5	0.00
4/22/2014 2:00	61.3	0.00
4/22/2014 1:00	61.5	0.00
4/22/2014 0:00	59.5	0.00
4/21/2014 23:00	64.5	0.00
4/21/2014 22:00	65.2	0.00
4/21/2014 21:00	65.7	0.00
4/21/2014 20:00	68.2	0.00
4/21/2014 19:00	71.4	0.00
4/21/2014 18:00	72.5	0.00
4/21/2014 17:00	72.1	0.00
4/21/2014 16:00	72.5	0.00
4/21/2014 15:00	**71**	**0.00**

Table 4. Hourly temperature and hourly precipitation during the 48 hours after planting two corn hybrids at five planting depths on April 21 at the Aurora Research Farm (read the table from the bottom to the top to track temperature and precipitation during the first 48 hours after planting).

Nutrient Management

New York Farm Delves Deeper with Adapt-N

Margaret Ball, Bianca Moebius-Clune, Harold van Es, Jeff Melkonian, Department of Crop and Soil Sciences, Keith Severson, Cayuga County Cooperative Extension, Cornell University

Arnold Richardson has had his eye on Adapt-N since 2009, when the tool for weather-adapted sidedress nitrogen recommendations first became available. Of a self-described "competitive nature," the Red Creek, NY farmer is constantly seeking and testing new strategies that can improve his farm system and boost yields and profits. After several years of watching the development of Adapt-N and its success in early on-farm trials, Richardson conducted strip trials of the Cornell nitrogen management tool in three fields in 2013.

The Richardson Farm crew (left to right): Arnold, Eric, and Ryan Richardson and Nick Humphrey.

All three trials increased his yield and profit, and of course, got him thinking about what improvements to make next.

Richardson and sons grow grain corn and soybean on 1000 acres near the border of Cayuga and Wayne counties. The mix of rich river bottom loams and stony clay drumlins in their fields requires flexibility and ingenuity in management. The team has significantly changed management practices since inheriting the farm several decades ago. They switched from continuous corn to a corn-soybean rotation, which gave an immediate 20 bu/ac yield bump on corn, says Arnold. They've also experimented with various primary tillage tools, switching from moldboard to chisel plow in 1983, then testing strip till, aerator, and most recently "vertical tillage" tools over several years to see what works best in their system. Most recently, the farm's experiments have included increased seeding rates and a review of their nitrogen management practices.

The Richardsons have long taken a weather-conscious approach to nitrogen management decisions, applying most N as sidedress to better match the timing of crop uptake. "That's the best time," says Arnold. "The corn is making big decisions about its future at the 5 – 8 collar stage. We try to help it make good decisions… We've got to keep the corn happy all the way through." They follow a general rule of 1 lb N per 1 bushel expected yield, adjusting for N use efficiency and soybean credits, for an average of around 150 lb N per acre per year over the whole farm. Understanding that weather influences N dynamics, the Richardsons even split their N into earlier and later sidedress applications on sandier fields, to minimize the risk of leaching losses with rain. They ran a few Adapt-N simulations in previous years, usually coming up with recommendations that were lower than or similar to their own rates. However, they had not adjusted their total N rates based on weather until they tested Adapt-N in the field last year.

Keith Severson of Cayuga County Cooperative Extension guided the Richardsons in establishing three Adapt-N strip trials in 2013. The trials were conducted in corn grain following soybean, on Williamson and Ontario silt loams with 2.6% to 3.8% organic matter. All trials received 22 lb N/ac in starter, following the farm's normal practice. The third trial also received an extra 50 lb N/ac in May, because Richardson wanted to test a practice more similar to that of his neighbors, who apply more of their nitrogen early. Two treatments, replicated four times, were implemented in late June to compare Adapt-N-recommended and Grower-chosen sidedress rates. Due to the unusually wet spring, N leaching and denitrification losses (simulated by

Table 1. Yield and profit increases with Adapt-N recommended rates.

Richardson Farm 2013 Trial Results								
Trial ID	Total N applied (lb/ac)			Yield (bu/ac)			Profit ($/ac)**	p ***
	Adapt-N	Grower	A - G*	Adapt-N	Grower	A - G*	A - G*	
9	162	122	+ 40	222	192	+ 30	+ $122	0.007
12	162	132	+ 30	185	162	+ 23	+ $91	0.05
15	142	122	+ 20	194	171	+ 23	+ $99	0.0001

** Difference of Adapt-N minus Grower. Positive number shows increased N applied due to Adapt-N*
*** Profit calculation using farm's actual prices ($0.75/lb N and $5.00/bu corn)*
**** p values below 0.05 are statistically significant (real) yield differences*

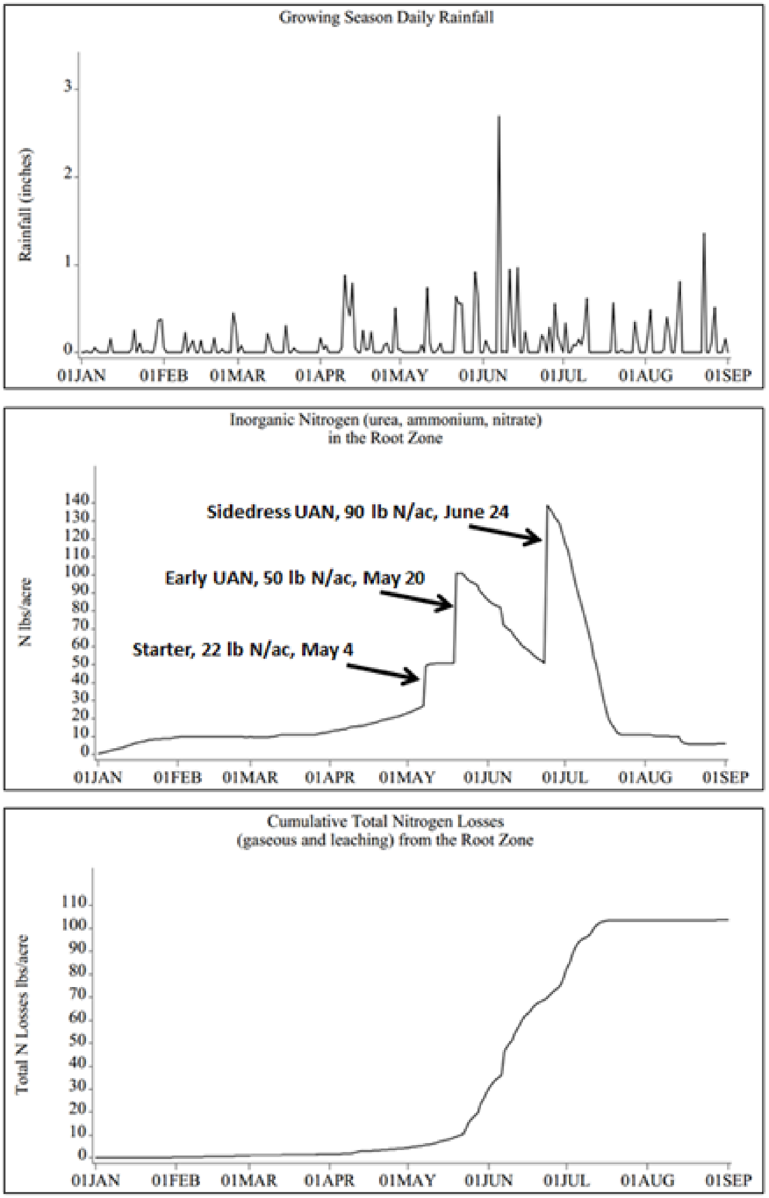

Figure 1. Graphic output from Adapt-N, showing rainfall, root-zone inorganic nitrogen, and cumulative N losses in one of Richardson's trials. The large early-season losses are typical of a wet spring.

Adapt-N) were high. Adapt-N thus recommended sidedress rates 20, 30, and 40 lb/N higher than Richardson's chosen rates. Yields increased significantly with the higher N rates in all three trials, with gains of 23 to 30 bu/ac. At Richardson's actual prices ($0.75/lb N and $5.00/bu corn), this translates to profit gains of $91/ac to $122/ac from the use of Adapt-N. Total yields in the trial strips ranged from 162 to 222 bu/ac. As well as implementing the trials, Richardson also followed Adapt-N recommendations on the rest of the farm's acres, "which resulted in a larger N bill than originally planned, but with a pleasing result yield wise," he says. One Adapt-N trial plot earned the farm fourth place in the Finger Lakes section of New York State Corn and Soybean Growers' Association 2013 Yield Contest, at 232 bu/ac.

Richardson's experience was typical of Adapt-N trials in New York last season. In 8 out of 11 NY 2013 trials, Adapt-N increased N rates over grower practice. Across all trials, growers saw their yields increase by an average of 21 bu/ac with Adapt-N rates 20 lb/ac higher than grower-chosen rates, resulting in profit gains of $94/ac (10:1 price ratio, silage reported as grain equivalent). Adapt-N was able to adjust N rates upward by using site-specific high resolution climate data to simulate the year's unusually wet spring conditions, and the resulting large leaching and denitrification losses of early-applied fertilizer and early-mineralized organic N. By contrast, in the more normal springs of 2011-2012, Adapt-N simulations were able to correctly identify higher N availability from the same sources. In 56 trials in these years, New York growers gained $31/ac on average by cutting back on 66 lb/ac of unnecessary N applications.

While yield and profit gains are a convincing incentive for the Richardsons to continue to use Adapt-N, the value of Adapt-N runs deeper than just financial on the Richardson farm. Arnold and sons were struck by the tool's graphs of soil N availability and rainfall, which clearly showed the farm's weather-related early N losses. Arnold has also "gotten into these what-if scenarios quite a bit," regularly using his Adapt-N account to play with different management schemes and retrospective simulations. The biggest lesson in Arnold's eyes, however, has come from three Cornell Soil Health Test samples that the Richardsons submitted as part of their Adapt-N trials. The farm's chemical analysis scores were perfect due to years of careful soil test-based management, but new biological and physical measures like aggregate stability, subsurface hardness, and active carbon ranked lower on the test's scales. "I look at these reds and yellows and think, this is our next project," said Arnold, indicating his scores for biological and physical measures of soil health. "To help get me to the next level, I've got to pay attention."

Weed Management

Weed Seedling Identification Workshop Held

Deb Grantham, Department of Crop and Soil Sciences, Cornell University

Professor Antonio DiTommaso, Cornell Department of Crop and Soil Sciences, in cooperation with the Cornell Cooperative Extension Invasive Species Statewide Program, held a one-day hands-on workshop on weed seedling identification for PRISM partners. Scott Morris, Kathy Howard, and Courtney Stokes, Department of Crop and Soil Sciences, assisted with the workshop. The workshop was held on the Cornell campus on Thursday, May 8 from 9 am – 4 pm. Live seedlings, seeds, mature plants, and photos were used in this very interactive event that included some lecture and presentation, a before and after weed ID "quiz", hands on seeds, seedlings, and mature plants in the Muenscher greenhouses to view, and a walk in the new weed garden. Weeds, or invasive species, included both agricultural and natural area weeds. General weed management approaches were discussed during the presentations.

Prof. Toni DiTommaso, Dept. of Crop and Soil Sciences, showing his enthusiasm to Marilyn Wyman, Issue Leader, CCE Columbia/Greene.

Courtney Stokes, grad student, Dept. of Crop and Soil Sciences, discussing invasive species with participants.

Nineteen participants came from around NYS, representing 5 of the 8 PRISMs (Partnerships for Regional Invasive Species Management). PRISMs, established by the NYS Department of Environmental Conservation, coordinate invasive species management functions in the 8 PRISM regions throughout the state.

The CCE ISP is a statewide program funded by the NYS Environmental Protection Fund through the NYS Department of Environmental Conservation. The program, established in 2010, provides assistance to the PRISMs, including education for PRISM members and their audiences, on-line resources, and connections to Cornell faculty and CCE Associations. The NY Invasive Species Clearinghouse (www.nyis.info) is a partnering CCE and NY Sea Grant program that provides on-line resources. The NYS Invasive Species Research Institute, housed in the Cornell Department of Natural Resources, is the third partner in the CCE system supporting PRISMs with the most effective and up to date control of invasive species in NYS.

Kathy Howard, Dept. of Crop and Soil Sciences, discussing grasses with participants.

An invasive species is a species that is non-native to the ecosystem under consideration and whose introduction causes or is likely to cause economic or environmental harm or harm to human health (National Invasive Species Management Plan – 2001 (http://www.invasivespecies.gov/main_nav/mn_NISC_ManagementPlan.html)).

Calendar of Events

June 24	Seed Growers Field Day, NYSIP Foundation Seed Barn, Ithaca, NY
July 16	Weed Science Field Day, H.C. Thompson Research Farm, Freeville, NY & Musgrave Research Farm
July 17	Aurora Farm Field Day, Musgrave Research Farm, Aurora, NY
Aug. 12-15	Soil Health Train the Trainer Workshop, Ithaca, NY
Aug. 19	Soil Health Field Day, Le Roy, NY

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What's Cropping Up? is a bimonthly electronic newsletter distributed by the Crop and Soil Sciences Department at Cornell University. The purpose of the newsletter is to provide timely information on field crop production and environmental issues as it relates to New York agriculture. Articles are regularly contributed by the following Departments at Cornell University: Crop and Soil Sciences, Plant Breeding, Plant Pathology, and Entomology. **To get on the email list, send your name and address to Jenn Thomas-Murphy, 237 Emerson Hall, Cornell University, Ithaca, NY 14853 or jnt3@cornell.edu.**

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