

What's Cropping Up?

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Field-Scale Studies Show Significant Year X Location X Seeding Depth Interactions for Plant Populations and Corn Yields

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It is generally recognized that the 2.0 planting depth is optimum for corn stand establishment and yield. Too shallow a planting depth (<1.5 inches) may result in drying out of the seed, if extended dry conditions occur before and after planting (especially in tilled seed beds), and increased lodging because of poor brace root development. Too deep a planting depth may delay emergence under cool soil conditions (especially in heavy clay soils), leading to increased pest incidence, soil crusting, and potentially poor stands.

We conducted field-scale (10 to 20 acres) studies in 2013 and 2014 with growers in Cayuga, Livingston, Orleans, and Seneca County to evaluate early plant populations and yield of corn planted at 1.0, 1.5, 2.0, and 2.5 inch depths. Planting dates differed across locations and growing seasons (May 14 and June 1 at Cayuga Co.; May 6 and May 29 at Livingston Co.; May 14 in both years at Orleans Co.; and May 7 and June 2 at Seneca Co. in 2013 and 2014, respectively). Because wet conditions delayed corn planting in 2014, growers at three locations had to shorten the maturity of their hybrids (P0533X at four sites in 2013; but P0216 at Orleans Co.; DKC50-84 at Seneca Co.; and P9690 at Cayuga Co. and Livingston Co. in 2014). Seeding rates also differed across locations (~38,000 kernels/acre in 2013 and 32,000 kernels/acre in 2014 at Cayuga Co.; ~37,000 kernels/acre at Livingston Co. in both years; ~34,000 kernels/acre at Orleans Co. in both years, and ~33,000 kernels/acre at Seneca Co. in both years). Silt loam soils predominated at the

Cayuga Co. site, clay loam soils at the Livingston Co. and Orleans Co. sites, and silty clay loam soils at the Seneca Co. site. The Cayuga Co. site (20-inch rows) was chisel-tilled, the Livingston Co. site (30-inch rows) was moldboard-plowed, the Orleans Co. site (30-inch rows) was disk-tilled, and the Seneca Co. site (15-inch rows) was no-tilled. Soybean was the preceding crop at all locations in 2013 and at Cayuga and Seneca Co. sites in 2014, but corn was the preceding crop at Livingston (same field) and Orleans Co. in 2014.

Corn plant populations responded to seeding depths at all locations in both years but the optimum depth varied across locations and years, including across years within locations (Table 1). Likewise, corn yields responded to seeding depths at all locations in both years (except for Cayuga Co. in 2013), but as with populations, the optimum depth varied across locations and years, including across years within locations (Table 2).

Plant populations did not have a year x seeding depth interaction at Cayuga County and showed quadratic responses to seeding depths in both years with maximum populations at the 1.5 to 2.0 inch seeding depths (Table 1). Yield, however, did show a year x seeding depth interaction. Yield did not show linear

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nor quadratic responses to seeding depth in 2013 at Cayuga Co. (although the 1.5 inch depth yielded significantly greater than the 2.0 inch depth), but did show a quadratic response in 2014 with maximum yield occurring at the 1.5 inch seeding depth. The 1.5 inch seeding depth resulted in close to maximum plant populations and yielded more than the 2.0 inch seeding depth (but similar to the 1.0 and 2.5 inch seeding depths) when planting in mid-May in 2013 or early June in 2014 on silt loam soils at this site.

Corn plant populations and grain yields had year x seeding depth interactions at Livingston Co. (mostly because of damage to corn at the 1.0 inch seeding depth in 2013). Corn plant populations showed a quadratic response to seeding depth in 2013 but a linear response in 2014. (Table 1). Plant populations and resulting yields were exceptionally low at the 1.0 inch seeding depth in 2013, presumably because heavy rains shortly after planting resulted in herbicide and/or fertilizer damage to corn planted at the 1.0 inch depth. Plant populations and grain yield showed linear responses to seeding depths in 2014 as the 2.5 inch depth had the greatest plant populations and grain yield. Extended dry conditions ensued shortly after planting at this site in 2014, which delayed and reduced emergence at the 1.0 inch and 1.5 inch depths. Clearly, the 2.5 inch seeding depth was optimum at

this moldboard-plowed clay loam site when planting in early May of 2013 or late May of 2014.

Corn plant populations and grain yield had strong year x seeding depth interactions at Orleans Co. (Table 1), presumably because of very different weather conditions after planting. In 2013, an extended dry period occurred for a few days before planting and for 15 days after planting. This probably contributed to the quadratic plant population response to seeding depths (higher populations at the 2.0 and 2.5 inch depths compared to the shallower depths, which apparently dried out). Yield, however, showed a linear response to seeding depth with maximum yield occurring at the 2.5 inch depth in 2013. In 2014, a severe thunderstorm dropped almost 2 inches of rain immediately after the grower finished planting the study. The clay loam soil crusted significantly before and during corn emergence. Consequently, a negative linear response of plant populations to seeding depth was observed with low plant populations at the 2.0 and 2.5 inch seeding depths. Despite, the negative linear response of plant populations to seeding depths in 2014, yields did not differ among seeding depths. It is hard to determine what the optimum seeding depth should be when planting on this disk-tilled clay-loam soil in mid-May because disk-tilling contributed to drying and reduced emergence at the 1.0 and 1.5 inch planting depths in

2013, and heavy rains resulted in severe crusting and reduced emergence at the 2.0 and 2.5 inch seeding depths in 2014.

Corn plant populations had significant year x seeding depth interactions but grain yield did not have a year x seeding depth interaction at the Seneca Co. site (Table 1). Heavy rains shortly after planting resulted in soil crusting on this silty

Table 1. Early plant populations (V3-V4 stage) at four locations in NY during the 2013 and 2014 growing seasons.

DEPTH	LOCATION			
	CAYUGA	LIVING.	ORLEANS	SENECA
Inches	plants/acre			
	2013			
1.0	36,850	7,045	27,110	25,995
1.5	38,730	32,570	29,880	24,960
2.0	36,980	30,560	31,090	22,320
2.5	36,325	31,505	30,775	21,005
Linear	*	***	**	***
Quadratic	*	***	*	NS
	2014			
1.0	27,960	28,070	27,735	30,190
1.5	30,775	31,960	27,165	31,075
2.0	31,045	34,245	25,830	29,460
2.5	30,690	34,900	23,950	30,155
Linear	*	***	***	NS
Quadratic	*	NS	NS	*
*, **, *** Significant at the 0.05, 0.01, or 0.001 level, respectively. NS-non-significant				

clay soil in 2013, which resulted in a negative linear response of plant populations to seeding depths in 2013. Grain yields, however, showed a quadratic response to seeding depth with maximum yield observed between the 1.5 and 2.0 inch depth. In 2014, an extended dry period was observed at this location after the late planting, but plant populations showed a quadratic response to seeding depth with maximum populations at the 1.5 inch depth. Regression equations indicated that maximum yield occurred between the 1.5 and 2.0 inch seeding depth in 2014. The 1.0 and 1.5 inch seeding depths on this no-tilled silty clay site resulted in maximum plant populations, but regression equations indicated that the 1.5 inch to 2.0 inch seeding depth resulted in maximum yield when planting in early May of 2013 or early June of 2014.

CONCLUSION

Corn plant populations and grain yields had strong year x location x seeding depth interactions indicating that the “one size fits all” 2.0 inch seeding depth was not optimum across all years and sites. When torrential rains occurred shortly after planting, the 1.0 inch seeding depth had maximum plant populations on a no-till silty clay soil planted in early May of 2013, and on disk-tilled clay loam soil planted in mid-May of 2014. The 1.0 inch seeding depth, however, did not have maximum yield at these sites nor any sites in the study. **Consequently, the 1.0 inch seeding depth is probably too shallow a planting depth for corn in almost all situations.**

The 2.5 inch seeding depth had the lowest plant populations at the two sites mentioned above but had among the highest plant populations and the highest grain yields at the moldboard-plowed clay loam site in

Table 2. Corn yields at four seeding depths at four locations in NY during the 2013 and 2014 growing seasons.

DEPTH	LOCATION			
	CAYUGA	LIVING.	ORLEANS	SENECA
inches	plants/acre			
	2013			
1.0	207	96	156	183
1.5	214	169	159	188
2.0	200	176	160	186
2.5	211	198	172	177
Linear	NS	***	**	*
Quadratic	NS	**	NS	**
	2014			
1.0	204	181	173	135
1.5	209	173	172	140
2.0	206	189	171	142
2.5	202	202	170	132
Linear	NS	***	NS	NS
Quadratic	*	**	NS	*
*, **, *** Significant at the 0.05, 0.01, or 0.001 level, respectively. NS-non-significant				

both years and at the disk-tilled clay loam site in 2013. **Clearly, there is a place for the 2.5 inch seeding depth on some soils in some years.**

The 1.5 inch and 2.0 inch seeding depths resulted in maximum grain yields on the no-tilled silty clay site planted in early May of 2013 or early June of 2014. At the chisel-tilled silt loam soil, however, the 1.5 inch seeding depth yielded higher than the 2.0 inch seeding depth when planted in mid-May of 2013 and early June of 2014. **Consequently, the 2.0 inch seeding depth never solely resulted in the highest yield in any of our 8 site/year comparisons.**

Although yield differences among seeding depths were usually small, increasing the seeding depth from 2.0 to 2.5 inches at the no-tilled silty clay site decreased yield an average ~6%. In contrast, a decrease in the seeding depth from the 2.5 inch to 2.0 inch seeding depth at the moldboard-plowed clay loam site decreased yield an average ~9%. **The significant year x location x seeding depth interaction for grain yield indicates that corn growers in NY should adjust seeding depth to soil conditions (although it is difficult to predict ensuing soil conditions after planting, which can greatly influence the optimum seeding depth for plant populations and yields).**

Stalk Nitrate Test Results for New York Corn Fields from 2007 through 2014

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Since the introduction of the corn stalk nitrate test (CSNT) as an end-of-season evaluation tool for nitrogen (N) management in 2nd or higher year corn fields, the number of fields that have been tested for CSNT has been on the increase. The greatest benefit of this test is that it allows evaluation and fine-tuning of N management for each specific field. It does, however, require multiple years of testing to gain experience with on-farm interpretation. Corn stalk nitrate test results >2000 ppm indicate there was significantly more N available during the growing season than the crop needed.

The summary of CSNT results for the past eight years is shown in Table 1. In the 2013 and 2014 growing season, the CSNT testing results from the Nutrient Management Spear Program and Dairy One were summarized to obtain a distribution of CSNT categories in New York State. Quality control samples shared between the two laboratories in both years showed excellent consistency in reported data between the two laboratories. Data prior to 2013 reflect submissions

to Cornell University only. For 2014, this summary shows that about 36% of all tested fields were over the 2000 ppm range, while 27% were over 3000 ppm and 14% exceeded 5000 ppm. In contrast, 29% of the 2014 samples tested low in CSNT. For 2nd or higher year corn fields, low test results (less than 250 ppm) are likely to reflect a true N deficiency. Weed pressure, disease pressure, lack of moisture, lack of oxygen and other stress factors can impact the N status of the crop, so in some circumstances, additional N might not have been able to overcome the real reason for the low CSNTs (e.g. no amount of N fertilizer can make up for a drought).

As mentioned, the CSNT is most effective when used for multiple years on the same fields to determine how each responds to the way N is being managed. Crop history, manure history, other N inputs, soil type, and growing conditions all impact CSNT results, and crop management records that include these pieces of information can be used to evaluate CSNT results and determine where changes can be made.

Table 1. Distribution of CSNT values for New York State corn fields sampled in 2007-2014.

Corn stalk nitrate test category	2007	2008	2009	2010	2011	2012	2013	2014
	%	%	%	%	%	%	%	%
Low (<250 ppm)	12	19	30	24	21	20	35	29
Marginal (250-750 ppm)	13	12	14	17	19	17	16	16
Optimal (>750-2000 ppm)	26	22	21	19	24	22	20	19
Excess (>2000 ppm)	49	48	35	40	36	41	29	36
Excess (>3000 ppm)	34	36	22	28	24	29	20	27
Excess (>5000 ppm)	21	20	11	14	12	14	9	14
Total number	105	252	367	509	765	923	1473	1175
Maximum value (ppm)	14933	13069	11723	13966	16687	15671	13147	14659

Note: 2013 data included results from NMSP (924 samples) and Dairy One (549 samples); 2014 data included 521 samples from NMSP and 654 samples from Dairy One.

Planting a Full-Season Hybrid at the ~1.5 to 2.0 Inch Depth from ~May 15 to ~May 20 Resulted in Maximum Yield (but Higher Grain Moisture) on a Silt Loam Soil in the Finger Lakes Region



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The average corn planting date is considerably earlier now compared to 25 years ago, especially in the Midwest USA. In NY, planting is earlier than ever but still lags behind most upper Midwest states. Certainly, the soils in the upper Midwest States are as cold as New York in late April or early May. Consequently, the slower planting pace in New York must be attributed to either wetter soils; lack of readiness, especially for dairy producers; previous negative experiences by growers with April planting dates; or lack of belief that the newer hybrids with seed treatments can be planted into somewhat cold April soils.

Most growers plant their corn at the “one size fits all” depth of 2-inches. Early-planted corn (~mid-April), however, can take 3 to 4 weeks to get out of the ground and a shallower planting depth may be beneficial for April planting dates. When planting is delayed until late May, as in 2011 and 2014, growers in NY wonder if they should switch to an earlier maturing hybrid. We conducted small-plot research at the Aurora Research Farm in 2013 and 2014 to answer three questions concerning corn planting: 1) Can corn be safely planted in early to late April on well-drained soils in NY without risk of poor stands and subsequent yield loss, 2) when should grain growers switch from a full-season to a shorter season hybrid, if planting is delayed, and 3) is the 2-inch seeding depth optimum from early April through late May planting dates?

We planted 103-day (203-44STXRIB from Channel) relative maturity (RM) and a 96-day (DKC46-20VT3P RIB from DeKalb) RM hybrids on ~April 10, ~April 20, ~May 6, ~May 19, and ~May 30 at 1.0, 1.5, 2.0, 2.5, and 3.0 inch seeding depths at a rate of 31,800 seeds/acre in 2013 and 2014. We determined stand establishment at ~ the 4th leaf stage (V4), about 3-6 weeks after planting, depending upon planting date. We harvested all plots on October 27th in 2013 and on November 5th in 2014.

Table 1. Plant populations of corn at the 4th leaf stage (V4) at five planting dates and five seeding depths, when averaged across two hybrids, in 2013 and in 2014.

DEPTH	PLANTING DATE				
	~4/10	~4/20	~5/6	~5/19	~5/30
inches	plants/acre				
	2013				
1.0	26,750	28,875	27,750	29,185	24,685
1.5	27,065	28,185	27,685	28,000	28,750
2.0	24,560	28,250	28,435	28,000	29,310
2.5	24,500	28,620	28,625	27,375	28,060
3.0	21,440	27,560	28,435	26,685	27,185
Linear	***	NS	NS	NS	*
Quadratic	NS	NS	NS	NS	**
	2014				
1.0	26,185	25,875	29,000	25,685	27,865
1.5	26,685	26,685	27,935	24,935	28,375
2.0	26,500	27,375	28,625	28,560	29,435
2.5	27,310	27,125	28,875	27,500	27,810
3.0	26,560	25,935	28,875	27,935	27,750
Linear	NS	NS	NS	*	NS
Quadratic	NS	NS	NS	*	NS

*, **, *** Significant at the 0.05, 0.01, or 0.001 level, respectively. NS-non-significant

Plant populations had a significant year x planting date x seeding depth interaction (Table 1). On most planting dates in both years, seeding depth did not affect plant populations (Table 1). In 2013, however, plant populations at the early April planting date had a negative linear response to seeding depths (~27,000 plants/acre at the 1.0 and 1.5 inch planting depths, ~24,500 plants/acre at the 2.0 and 2.5 inch planting depths, and only 21,500 plants/acre at the 3.0 inch depth). Presumably, the deeper-planted corn struggled to emerge because of cool conditions, accompanied by some soil crusting. Plant populations at the late May planting date in 2013, however, had a quadratic response (fewer than 25,000 plants/acre at the 1.0 inch planting depth, ~28,000-29,000 plants/acre from the 1.5 to 2.5 inch depths, before decreasing to ~27,000 plants/acre at the 3.0 inch depth). Presumably, soil conditions dried out in the top 1-inch depth resulting in poor emergence. Likewise, in 2014, there was an extended dry period shortly before and after planting on May 19th resulting in fewer than 26,000 plants/acre at the 1.0 and 1.5 inch seeding depths. Nevertheless, the 1.5 and 2.0 inch planting depths resulted in the most consistent stand establishment across all planting

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Table 2. Yield of corn at five planting dates and five seeding depths, when averaged across two years (2014 and 2014) and two hybrids (DKC46-20 VT3P-RIB and 203-44STXRIB).

DEPTH	PLANTING DATE					Mean
	~4/10	~4/20	~5/6	~5/19	~5/30	
inches	bushels/acre					
	2013					
1.0	202	214	213	221	207	211
1.5	211	217	218	224	217	218
2.0	205	215	219	230	219	218
2.5	203	211	212	221	215	212
3.0	189	209	224	229	211	212
	202	213	217	224	213	
Depth						
Linear	*	NS	NS	NS	NS	NS
Quadratic	**	NS	NS	NS	NS	NS
PL. Date						
Linear ***						
Quad ***						
*, **, *** Significant at the 0.05, 0.01, or 0.001 level, respectively. NS-non-significant.						

dates in both years of this study.

Although grain yield had no planting date x seeding depth interaction ($P=0.06$), the early April planting date did show a quadratic response to seeding depth with the 1.5 inch depth yielding 211 bushels/acre compared to only 189 bushels/acre for the 3.0 inch seeding depth (Table 2). On all the other planting dates, however, grain yield did not respond to seeding depth. Apparently, corn with its hygroscopic kernel can emerge adequately from a shallow depth in dry soil conditions, and with its coleoptile (seed leaf, first to emerge through the soil) can emerge adequately through crusted soils.

Grain yield showed a quadratic response to planting dates with the regression equation indicating that maximum yield occurred sometime between May 15 and May 20 (Table 2). This was somewhat later than expected. We expected that maximum yields would occur sometime between April 20 and May 20, especially because plant populations showed a quadratic response to planting dates with the numerically highest populations at the May 6 planting date (~28,525 plants/acre compared with 27,450 plants/acre for April 20 and 27,385 plants/acre for the May 19 planting date, averaged across

years, hybrids, and planting depths). Consequently, it is not clear why maximum yield occurred from ~ May 15-20 rather than the ~May 5- 20 planting date range.

The 103 day hybrid yielded ~5% higher (220 bushels/acre) than the 96-day hybrid (209 bushels/acre), when averaged across years, planting dates, and seeding depths. Surprisingly, there was no hybrid x planting date interaction, which indicates that the longer-season hybrid will yield more than the shorter-season hybrid when planted from early April through late May in the Finger Lakes Region of NY. On the May 19th planting date, however, grain yield averaged only 3% greater (228 bushels/acre for the 103-day compared to

221 bushels/acre for 96-day hybrid) with significantly higher grain moisture (23.5 vs. 19.3%, respectively). On the May 30th planting date, grain yield averaged ~4% greater (218 bushels/acre for the 103-day compared with 210 bushels/acre for the 96 day hybrid) but with much higher grain moisture (29.8% vs. 23.5% moisture, respectively). Given the much greater drying costs or much greater delay in harvest for the 103 day hybrid to dry down when planted in late May, NY growers should probably consider switching from a full-season to a medium-season hybrid shortly after May 20.

CONCLUSION

The reluctance of many corn growers in NY to plant corn in April may serve them well as indicated by maximum yields occurring sometime between May 15 and May 20 in this study. Growers, however, cannot plant their corn crop between May 15 and May 20 each year so the question remains “how early should growers begin to plant corn NY”? Although yields were 5% lower at the April 20 planting date (213 bushels/acre) vs. the May 19 planting date (224 bushels/acre), plant populations were similar and grain moistures were lower (17.5% vs. 21.4%, respectively). Consequently,

relative profit would be essentially the same (assuming \$4.00/bushel corn and \$0.04/point of moisture drying costs) between these two planting dates. If growers are reluctant to start as early as late April, certainly the first week of May is an excellent time given the higher plant populations (28,525 plants/acre) compared with the May 19 planting date (27,385 plants/acre), lower grain moisture (18.7% vs. 21.4%, respectively), albeit 3% lower yields (217 bushels/acre vs. 224 bushels/acre). Nevertheless, relative profit would be similar for the two planting dates, given the assumptions of \$4.00 corn and \$0.04/bushel/point drying costs.

Regardless, if growers begin planting in late April or early May, corn growers in NY should probably plant full-season hybrids until around May 20 because of the yield advantage (6.3% on April 20, 5.4% on May 6, and 3.0% on May 20). Grain moisture differences, however, widen at each successive planting date (17.9 vs. 17.1% for April 20, 19.8% vs. 17.7% for May 6, and 23.5% vs. 19.3% grain moisture for May 19, respectively) so beyond May 20 the higher grain drying costs would offset the yield advantage or require a delay in harvest, which could lead to more in-field losses of the full-season hybrid before harvest. Consequently, a switch to shorter-season hybrids after May 20 is probably the most economical and risk-averse management strategy.

Planting at the 1.5 inch to 2.0 inch depths consistently resulted in the highest plant populations and grain yields among seeding depths across all planting dates. The 2.0 inch planting depth had less than 80% emergence (~25,000 plants/acre) only on the April 10 planting date in 2013 and the 1.5 inch planting depth had less than 80% emergence only on the May 19 planting date in 2014. Planting depth did not affect yield, however, (except for the April 10 planting date) but the 1.5 to 2.0 inch depth looks optimum across most planting dates in this study. Keep in mind that this study was conducted on a well-drained silt loam soil in the Finger Lakes Region and does not apply to poorly drained clay soils or regions of the state where late spring frosts or early fall frosts occur.

Farmers with Diverse Nitrogen Management Practices Find Value in the Adapt-N Tool in Iowa

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Shannon Gomes, owner of Cedar Basin Crop Consulting, provides services for 25 farmers in Northeast Iowa. Gomes, with his 28 years of consulting experience and a Master's degree from Iowa State University, has extensive knowledge of Iowa soils and a particular interest in precision management. He emphasizes a scientific approach in his work, advising clients and helping them run trials to assess the many available tools and products on their farms.

Gomes has long been searching for a better way to monitor nitrogen (N) availability and provide precise N recommendations. He's tried "all the different nitrogen management tools," with varying results, but has never been satisfied. When he stumbled upon [Adapt-N](#) in 2009, he found what he had been looking for: a real-time, location-specific adaptive N recommendation model that accounts for weather, management practices, and field variability. Since then, Gomes' expertise and enthusiasm have been essential in field-testing Adapt-N over three seasons and introducing the tool to Iowa. He now models all his clients' corn acres in Adapt-N, using it as both a starting point for his N recommendations, and a teaching tool for understanding complex N dynamics. We spoke with Gomes, his colleague Frank Moore, and two farmer clients—Nick Meier and Ken Humpal—to learn how they are using Adapt-N.

The Farmers

Nick Meier

Nick farms 1200 acres on a corn-soy rotation for grain and seed production. Typical of most farmers in Iowa, he used to apply all his nitrogen in the fall, but now puts on half (80 lb/ac) in the fall, another 30 lb/ac with pre-emergence herbicide, and the remainder (about 50 lb/ac) as an early sidedress application around the V2 stage. Adapt-N simulations of each field, run by Gomes, allow Nick to adjust this final sidedress application based on the spring's weather conditions and other field-specific factors.

Nick has completed three Adapt-N field trials. In 2012, Adapt-N recommended that he skip sidedressing altogether. There was no yield penalty, and he saved \$34/ac on fertilizer and operational costs. Though

waiting until sidedress sometimes makes Nick nervous, he appreciates the reduced risk of losses, and is still pushing his N applications later, as much as his comfort level will allow. In 2013, the tool warned that much of the fall-applied N had been lost to rain, and Nick should adjust his sidedress rate upward by 30 lb/ac. The higher rate yielded 14 more bu/ac and +\$57/ac profit.

Ken Humpal

Ken raises dairy and beef cattle, corn (grain and silage), soy, and alfalfa on 1700 acres. Like Nick Meier, he used to apply all nitrogen in the fall, but now puts about 50% of the season's N on as spring pre-plant (anhydrous ammonia) and the rest as sidedress. On sandier ground, he'll skip the pre-plant altogether and wait for sidedress, because leaching risks are higher.

Ken used late spring soil nitrate tests (LSNT or PSNT) in the past to determine N rates, adjusting for alfalfa and soybean credits. Now, Ken uses Adapt-N recommendations for all his acres, with minor adjustments. The tool helps account for variation in his fields due to OM content (3-5%), previous crop (corn, soy, alfalfa, or cereal rye cover crop), manure history, and soil type influences. It also helps him track the retention or loss of nitrogen from manure applications, for purposes of nutrient management planning and regulation compliance. Ken completed one Adapt-N field trial in 2011. In this instance, the tool recommended he apply 30 lb N/ac above his usual practice, and the higher rate was justified by a 6 bu/ac higher yield and +\$13/ac profit.

Frank Moore

Frank is a consultant colleague of Gomes and a farmer himself. He grows corn and soy on 2000 acres, and develops nutrient management plans for his clients through Three Rivers Ag Consulting. Unlike many Iowa farmers, Frank does not apply N in the fall or at planting but rather applies only 30 lb N/ac with pre-emergence herbicide. The rest of the season's N is added at sidedress, using Adapt-N-recommended rates. His sidedressing equipment can be driven in corn up to about 18" tall without damaging it, even at this stage. It takes Frank about 5 days to sidedress 1000 acres

of corn, but he's never been rained out. Sidedressing does cost slightly more for the extra trip, Frank says, but it is worth the minimized risk of N losses, and the ability to reduce total N applied in dry years.

Before Adapt-N, Frank applied all N with his pre-emergence herbicide. This system "works about 3 out of 5 years", he says, but not when you have excessive rain. Using Adapt-N hasn't greatly changed Moore's N rates overall, but it has helped him shift more N from spring to sidedress, and adjust for weather. He applied less than normal across his farm in 2012, and more in the wet season of 2013. In addition, Frank completed six trials of Adapt-N on his fields and on average, Adapt-N reduced N rates by 22 lb/ac resulting in insignificant yield and profit changes. Frank says the biggest savings from his N program have come in extreme circumstances. In 2013, when spring weather prevented planting in many fields, Moore estimates he saved \$35,000 by avoiding putting N on early!

Using Adapt-N

"When you compare [Adapt-N] to other tools... nothing even comes close," says Gomes, "and I've used all of them!" In a normal weather year, Gomes and his farmers observe that Adapt-N recommends N rates similar to what they would use otherwise. However, the tool is particularly useful in accounting for contrasting weather scenarios. For instance, in the very dry 2012 versus the very wet 2013 springs, Adapt-N helped Gomes "stay ahead of the curve" – recognizing and correcting N shortage in a field before the crop showed signs of deficiency. Adapt-N has allowed growers to reduce N applications by 29 lb/ac on average with no yield penalty, resulting in average savings of \$17/ac.

The tool is convenient—it achieves field- and sub-field-level precision without the large sampling effort associated with in-season field-measurements. Before using Adapt-N, Gomes based N recommendations on

PSNT samples from a few thousand acres per year. Although many samples can be taken, it's hard to be sure they are representative. When it rained after sampling, he had to go out and re-sample, or assume that test results were no longer useful. Gomes and Ken Humpal agree they can now monitor soil N availability through Adapt-N – its previous-day high resolution precipitation data gives the closest thing to real-time N measurements, and doesn't require in-season waiting on the results of lab tests. "I think [Adapt-N] is the thing!" Ken says. Within 24 hours of a rainfall event "you know what you've got out there."

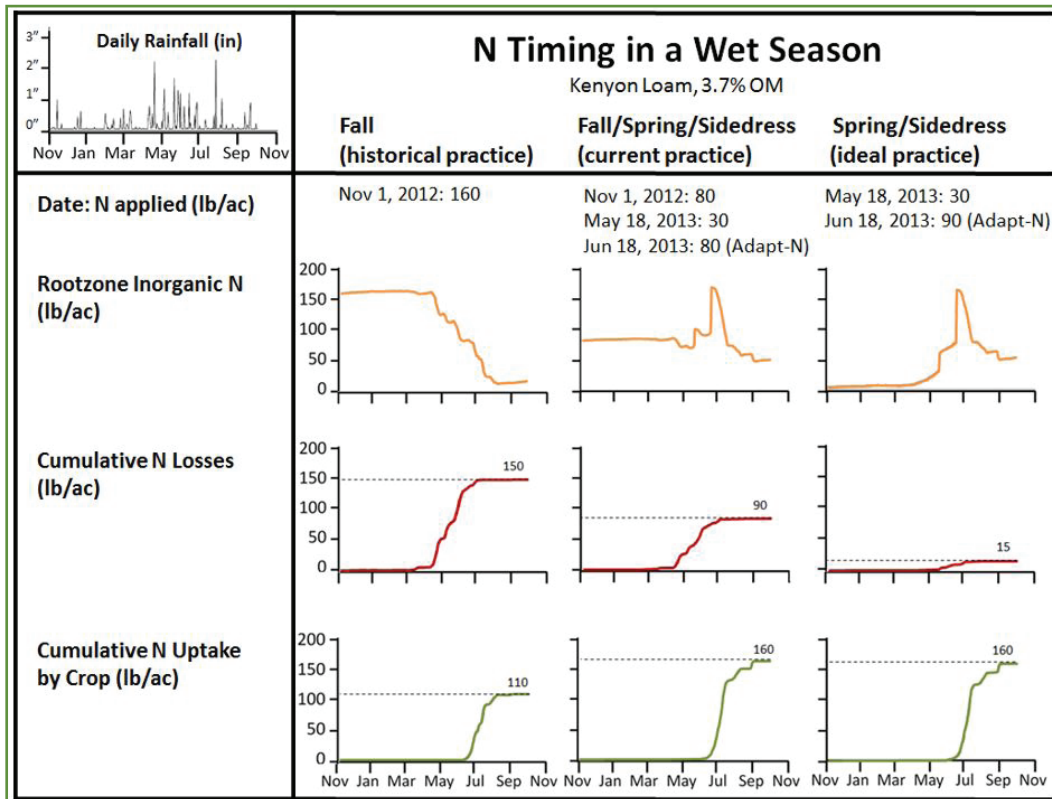


Figure 1. Adapt-N "what-if" simulation of three N timing practices (fall only; fall/spring/sidedress; and spring/sidedress) in a wet season. Adapt-N recommendations in this simulation would have minimize N losses and required less total N for an equivalent yield.

The model provides graphs

Learning through Adapt-N “What-If” Scenario Testing

Adapt-N can simulate “what-if” scenarios, comparing season-long effects of N application timing and other management practices. Figure 1 shows three Adapt-N simulations run retrospectively on Nick Meier’s 2013 trial field in eastern Iowa. The soil is Kenyon loam, 3.7% OM, with no manure history, and 2012 crop was soybean. If Nick had applied all N in fall (his historical practice, and that of the majority of farmers in his region), large spring losses would have limited crop N uptake and yield (left column). Nick’s current practice, splitting N between fall, spring, and sidedress (middle), reduced losses and increased crop N uptake relative to the fall-applied scenario. If he had applied nitrogen only in the spring and at sidedress (right), N losses would have been further reduced, and less total fertilizer would have been needed for an equivalent yield. Crop nitrogen that’s not provided by fertilizer comes from the mineralization of soil organic matter.

of available soil N, N uptake and losses, rainfall, temperature, and other factors that are extremely useful as teaching tools, understanding recommendations, and for scenario testing through retrospective runs. For example, from the wet season of 2013 we can see Adapt-N’s “what-if” N timing simulations comparing standard management, Nick Meier’s actual management, and the Adapt-N recommendation (Figure 1; sidebox). This can help a farmer re-examine previous N management programs, and consider the effects of new programs before actually putting them into practice. “The most powerful part of the interface is the graphs,” says Gomes. “You can sit down with a farmer and show them what’s really happening.”

Future Directions

Gomes is proud that he has persuaded most of his clients to move away from fall N application—a project he’s been working on for quite a while. Now that he uses Adapt-N for recommendations on all client acres, he is able to offer even more incentive to plan on sidedressing, using more precise rates adjusted in season.

Shifting toward sidedress is not without its concerns. Nick and Ken worry about getting rained out and missing the critical window to fertilize, or damaging young corn. Ken remains confident however that sidedressing risks and costs are justified by the additional savings he found during three years of field trials. “I’m excited about Adapt-N,” he says “it’s just a matter of fitting it into the system...” Frank Moore has found great benefit in sidedressing, and risks of rain-

out or damage to corn have not caused him problems in his many years using this system. As high-clearance equipment, RTK/GPS, and variable rate technology are becoming more common among growers and custom applicators, the incentives for sidedressing are starting to clearly outweigh the challenges.

What is on Shannon Gomes’ mind for the future? He is strongly interested in soil health testing and helping his clients improve their soil management. Soil health and nitrogen management are closely connected (Figure 2), and Gomes is looking at cover crop and tillage system impacts on soil health and nitrogen dynamics. This way, his farmers can reap the benefits from improved soil health through increased yields and higher N availability, as estimated by Adapt-N.



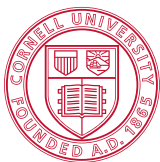
Figure 2. Weather and soil health properties interact to influence soil N dynamics. Such field-scale differences influence physical and biological factors that drive N mineralization and losses as shown in the aerial view of Ken Humpal’s farm.

Cornell FIELD CROPS



Calendar of Events

Feb. 9-12	Weed Science Society of America Annual Meeting , Lexington, KY
Feb. 10	New York Certified Organic Meeting , Geneva, NY
Feb. 11	Shop Meeting: discussion of GPS on Farms , Verona, NY
Feb. 12	Corn Day , Little Falls, NY
Feb. 13	Corn Day , Sherburne, NY
Feb. 17	Cover Crops Questions/Answer Session , Oriskany, NY
Feb. 17	19th Annual North Country Crop Congress , Chazy, NY
Feb. 18	19th Annual North Country Crop Congress , Lowville, NY
Feb. 27 & 30	NNY Agricultural Development Program Annual Meetings , Chazy, NY & Watertown, NY
Mar. 4	NOFA-NY Dairy & Field Crop Conference , Liverpool, NY
Mar. 17	Madison Field Crops Meeting , Cazenovia, NY



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What's Cropping Up? is a bimonthly electronic newsletter distributed by the Soil and Crop Sciences Section 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/Sections at Cornell University: Soil and Crop 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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