Can Manure Replace the Need for Starter Nitrogen Fertilizer?

2009, 2010 and 2011 Results

December 8, 2011

Campus team:
Quirine Ketterings, Greg Godwin, Sheryl Swink, Karl Czymmek, Eun Hong and Joseph Foster

Collaborators:
Carl Albers, Stephen Canner, Paul Cerosaletti, Aaron Gabriel, Mike Hunter, Joe Lawrence, and Alex Wright (Cornell Cooperative Extension); Peter Barney (Barney Agronomic Services); Brian Boerman (Agricultural Consulting Services); Tom Kilcer (Advanced Agricultural Services); Eric Young (W.H. Miner Institute); and participating farmers

Contact:
Quirine Ketterings
Nutrient Management Spear Program (http://nmsp.cals.cornell.edu)
Department of Animal Science
323 Morrison Hall, Cornell University
qmk2@cornell.edu or 607 255 3061

Can Manure Replace the Need for Starter Nitrogen Fertilizer?

Project Leader:

Quirine M. Ketterings, Associate Professor
Nutrient Management Spear Program (NMSP)
Dept. of Animal Science, Cornell University

Collaborators:

Cornell University:
Greg Godwin, NMSP Research Support Specialist
Sheryl Swink, Research Aide
Joseph Foster and Eun Hong, Cobleskill Interns
Karl Czymmek, PRODAIRY

Cornell Cooperative Extension:
Alex Wright (CCE of Albany and Rensselaer Counties)
Paul Cerosaletti (CCE of Delaware County)
Mike Hunter (CCE of Jefferson County)
Joe Lawrence (CCE of Lewis County)
Stephen Canner (CCE of St. Lawrence County)
Carl Albers (CCE of Steuben County)
Aaron Gabriel (CCE of Washington County)

W.H. Miner Institute (Clinton County):
Eric Young, agronomist

Consultants:
Tom Kilcer, Advanced Ag Systems
Brian Boerman, Agricultural Consulting Services
Pete Barney, Barney Agronomic Services

Funding:

Federal Formula Funds and Northern New York Agricultural Development Program (NNYADP).

Background

Initial studies at a Western NY dairy farm suggested that for corn fields with a recent manure history, starter nitrogen (N) fertilizer could be eliminated without a penalty in yield or forage quality. Eliminating starter N on corn fields with a manure history has the potential to save NY dairy producers both time and money. Seeing the results of the 3 trials conducted in Western NY in 2007–2008, we initiated a 3-yr statewide project to test the need for starter N fertilizer across NY soil types and growing conditions, starting in 2009. The objectives of this study were to assess differences in yield and forage quality between corn receiving starter N fertilizer and corn that receives none on fields with varying manure history. In this report, we summarize the data generated these past three years (28 trials). In total, 21 of these trials generated useable data.

Materials and Methods

In 2009, seven trials were completed, including three trials at commercial farms and four at the Aurora Research Farm (sites 1 through 7). In 2010, starter N response trials were established at ten commercial farm locations, including the W.H. Miner Institute, and at the Aurora Research Farm where the starter N trial was superimposed on an existing experiment on manure application methods that included four different manure histories (sites 8-21). In 2011, seven more trials were completed (sites 23, 25, 27, 28, 31, 34 and 35); seven additional sites were either not planted due to challenging spring conditions, or lost due to flooding of fields in the spring and/or the fall. The field history data and initial soil fertility data are shown in Tables 1 and 2, respectively. Monthly temperature and rainfall are shown in Table 3. Phosphorus (P) and magnesium (Mg) were high at all of the sites with the exception of site 31, which was classified as medium in soil test P (Table 2). Potassium (K) was high in all but two of the sites (site 20 tested low and 19 tested medium). Eight of the 28 sites tested optimal in Illinois Soil Nitrogen Test-N (ISNT-N; an indicator of soil N supply potential), meaning that they were predicted to have enough readily mineralizable soil organic N to make them nonresponsive to additional fertilizer N, given favorable soil mineralization conditions. Farm sites 4–7 and 9–12 (the plots at the Aurora Research Farm), sites 8, 15, 16, and 28 showed potential for a response to N application according to the ISNT results (deficient), while the remaining eight sites were classified as marginal in ISNT. The Aurora plots that were sidedressed received 120 lbs N/acre. Similarly, sites 15, 20, 21, 25, 34, and 35 were sidedressed (Table 1).

The corn trials were conducted using 30-inch rows (except for site 35 which was twin-rows) and replicated four (sites 13–21, 23–35), five (site 8), or six (sites 4–7 and 9–12) times. Plots were 4 to 16 rows wide (depending on planter and chopper width) and 100 to >2000-ft long. At each location, plots receiving 30 lbs of starter N per acre at the onset of the trial were compared to those receiving none. Plots were sampled for presidedress nitrate test (PSNT), ISNT-N, end-of-season Corn Stalk Nitrate Test (CSNT), end-of-season soil nitrate test (0–12 inches; 2009, 2010 only), corn yield, and forage quality if harvested for silage. The various soil tests were taken at sidedress (all years) and harvest time (2009, 2010).

Results

In 2009, site 1 had planter problems resulting in significant differences in stand density (Table 4). The yields were not significantly different and the larger variability was most likely a result of the planter malfunctioning. When population density was taken into account, the yield differences were non-existent (results not shown). At site 2, there was no significant difference between the with and without starter treatments, but saturated soil conditions prevented the harvest and collection of yield data from two of the four plots that received no starter, reducing the statistical power of the comparison. Results of both sites 1 and 2 were compromised by factors other than the starter N treatments and should be treated with caution. At site 3, elimination of the starter did not impact yield either. Sites 4, 5, 6, and 7 were all located at the Aurora Research Farm on somewhat poorly drained soils. The wet spring caused drainage problems that impacted yield and caused irregular stands in all of the treatments (Table 4). Of these four sites, site 5 was the only location where a statistically significant yield response was measured. At this site, 8,000 gallons of manure had been spring-applied and chisel-incorporated for the past five years (no manure history prior to the first applications in 2005). Although similar trends of higher yield in the starter plots were seen for site 6 (no manure) and site 7 where 8,000 gallons/acre of manure had been surface-applied and not incorporated, the means were not statistically different. At site 4, which received 8,000 gallons/acre of manure via an aerator, there were no significant differences in yield.

In 2010, the only locations that showed a yield increase with starter N application were the plots at the Aurora Research Farm with a limited manure history, and the plots in Jefferson County (site 18) where the stand density was less than 25,000 plants/acre and yields were very low due to excessive bird damage (Table 4). At site 17, challenges at harvest time resulted in loss of plots and an exceptionally large least significant difference (LSD). Results of both sites 17 and 18 are compromised by factors other than the starter N treatments and should be treated with caution. At all other sites, the use of starter N did not result in a significant yield response, despite visual differences in early growth stages at some locations.

In 2011, at two locations (sites 27, 31), starter N use resulted in a yield increase of 3.3 and 4.0 ton/acre, respectively (table 4). However, stands were very irregular at site 27 where deer damage had impacted the plots resulting in a stand population difference of more than 3500 plants/acre. At site 34, results suggest a yield decline with starter N application. Given large within-field variability due to weed pressure, compaction issues, and moisture issues during the 2011 growing season as well as the loss of one of the plots at harvest time, we cannot draw further conclusions for this site. At site 28 stand variability caused the 3.2 ton/acre difference in average yield between plots with and without starter N to not be significant (very variable site). Results of sites 27, 28 and 34 were compromised by factors other than the starter N treatments and should be treated with caution. Sites 23, 25, and 35—which had consistent stands—did not show a yield increase with starter N.

There were 20 silage trials in the dataset and 8 grain trials (Table 5). Of the silage trials, two locations showed a significant increase in crude protein with starter N addition (sites 3 and 21) while at one site, crude protein declined with starter N addition (site 25). Soluble protein increased at two locations, although the difference was very small (an increase of 0.3 and 0.1% in soluble protein at sites 3 and 16, respectively) and decreased at two sites (sites 18, the location with heavy bird damage, and site 25). The difference at location 18 could have resulted from disparities in bird damage. Only one site showed a change in NDF (decrease, site 21). At two sites, NDF digestibility increased with starter N addition (sites 2 and 23) while at two additional sites, NDF digestibility decreased with starter N addition (sites 31 and 35). Lignin and starch were not impacted at any of the 20 silage trials. Elimination of starter N did not result in significant differences in milk per acre estimates at 19 of 20 locations. At one site, starter N use decreased estimated milk per ton of silage from 3447 to 3355 lbs/ton. There was no significant difference in milk per ton with starter addition at any of the sites. Milk per acre estimates were impacted at three of the 20 trials (increase at sites 27 and 31, decrease at site 34). All three trials were 2011 trials, where the change in milk per acre estimate reflected a change in yield between plots with or without starter N addition. As mentioned before, there is uncertainty about the treatments at site 24, so results for this location cannot be relied on.

Sites 6 and 11 (the only deficient ISNT sites without a manure history) illustrate that starter N will be needed under some conditions even if sidedress N is applied. This scenario applies to cash grain operations without manure histories. Under those conditions, the best management practice is to use starter N (20-30 lbs N/acre) and sidedress to meet crop N needs. ***Omission of starter N is not recommended for fields without a manure history (deficient ISNT-N)***.

Sites that were classified as optimal in ISNT included sites 2, 18, 27 (sites to be excluded from the summary due to external conditions impacting stands and yields), and sites 19–25 (5 sites). None of these five sites showed a yield response or a quality response to starter N addition. ***We conclude that if the ISNT is classified as optimal, manure can be used to replace starter N.***

Manured sites that were sidedressed (15, 20, 21, 25, 28, 35) all had CSNTs that were optimal or excessive (site 34 was sidedressed as well, but due to large variability and loss of a plot at this site we cannot draw any conclusions here). Starter N use did not increase yield or forage quality at any of these locations. Optimal or excessive CSNTs at each of these six locations suggest sidedress N rates could have been eliminated or reduced at these locations. ***These results suggest that starter N can be omitted for sites even if the ISNT is deficient or marginal, as long as sufficient N from manure and other sources (rotations, soil N, sidedress N) is available***.

Sites that had a manure history but were classified as deficient in N based on the CSNT included sites 2, 4, 5, 7, 9, 10, 12, 18, and 27 (9 sites). Site 2 had weed control and harvest challenges (too wet) and lost plots in 2009, whereas variability between replications at sites 18 and 27 was very large due to bird and deer damage, respectively. Of the remaining sites (all Aurora Research Farm sites with some but limited manure application history), sites 5, 9, 12 showed higher yields when starter N had been applied than where corn was planted without a starter, with similar trends at sites 4, 7, and 10. The ISNT for each of these Aurora Research Farm locations was classified as deficient, suggesting additional N was needed (sites 2, 18 and 27 were sufficient in ISNT, but again at each of these locations there were other factors impacting stands and yield). ***These results indicate that a response to starter N is likely if soil N is deficient and additional N applied is insufficient***—and no other limiting conditions occur (weed issues, bird damage, or saturated conditions during planting and/or harvest).

The tool available to determine whether or not the overall N addition was sufficient is the CSNT. The yield results at sites 11 and 31 and the trend observed at site 28 (all locations with an average CSNT between 250 and 750 ppm plus a significant yield difference) suggest that ***a new interpretation should be added for 2nd or higher year corn: "Marginal" (250-750 ppm), where a response to starter N could be expected in wet years***.

Summary

Elimination of starter N did not result in a yield or quality penalty for sites with a recent manure history that tested optimal in ISNT-N and had CSNTs>750 ppm; results reflected a lack of a yield or quality response under such conditions of sufficient or excess N. Sites with no or limited manure history (e.g., Aurora Research Farm) tended to be responsive to starter N addition. At sites where the ISNT was deficient and CSNTs were deficient as well, starter N use did increase yield. The 3-year study suggests a new twist to the ISNT: on fields where manure is applied, no starter or sidedress N is required when soil N supply potential is high as measured by the ISNT. Fields without a manure history (past and current year) and deficient soil N supply potential require starter N addition for optimal yield. Where soil N supply alone is insufficient to meet crop N needs (ISNT=deficient), manure could replace the need for starter N, but sufficient N will need to be supplied one way or another; use the CSNT to adjust rates over time. The data suggest that a new interpretation should be added: "Marginal" (250–750 ppm), where a response to starter N could be expected in challenging years.

Main Conclusions

- Use starter N (and sidedress N) for fields with no manure history (deficient ISNT-N) and no current-year applications.
- If the ISNT-N is classified as optimal, manure can be used to replace starter N without a loss in yield or quality of the corn silage.
- Starter N can be omitted for sites even if the ISNT is deficient or marginal, as long as sufficient N from manure and other sources (cover crops, soil N, sidedress N) is available.
- A response to starter N is likely if ISNT-N is deficient and additional N applied is also insufficient.
- A new interpretation should be added for the CSNT for 2nd or higher year corn: "Marginal" (250–750 ppm), where a response to starter N could be expected in some years. It is recommended that farms strive for CSNTs between 750 and 2000 ppm, using 8-inch stalks taken between 6 and 14 inches above the ground.

Acknowledgments: The project was funded with federal formula funds.

Table 1: Soil series, cropping history, planting and harvest dates, and manure history for seven starter N trials in NY.

Site	County	Soil Series	Soil Series Description	Cropping History	Planting Date	Harvest Date	Manure History* (gallons/acre)			Sidedress N*
							2009/10/11	2008/09/10	2007/08/09	2009/10/11
1	Rensselaer	Pittstown-Nassau	Coarse-loamy, mixed, active, mesic Aquic Dystrudepts; Loamy-skeletal, mixed, active, mesic Lithic Dystrudepts	Alfalfa (2006) Corn (2007) Corn (2008)	11 May 2009	8 September 2009	8,000 Aerator Spring	8,000 Aerator Spring	8,000 Spring	No
2	Lewis	Farmington	Loamy, mixed, active, mesic Lithic Eutrudepts	Alfalfa (2006) Alfalfa (2007) Alfalfa (2008)	8 June 2009	16 October 2009	None	None	None	No
3	Washington	Hoosic	Sandy-skeletal, mixed, mesic Typic Dystrudepts	Corn (2006) Corn (2007) Corn (2008)	5 May 2009	24 September 2009	6,000 Incorpor-ated Spring	None	10,000 Surface Spring	No
4	Cayuga	Lima	Fine-loamy, mixed, active, mesic Oxyaquic Hapludalfs	Corn (2006) Corn (2007) Corn (2008)	12 May 2009	13 November 2009	8,000 Aerator Spring	8,000 Aerator Spring	9,500 Aerator Spring	No
5	Cayuga	Lima	Fine-loamy, mixed, active, mesic Oxyaquic Hapludalfs	Corn (2006) Corn (2007) Corn (2008)	12 May 2009	13 November 2009	8,000 Chisel Spring	8,000 Chisel Spring	9,500 Chisel Spring	No
6	Cayuga	Lima	Fine-loamy, mixed, active, mesic Oxyaquic Hapludalfs	Corn (2006) Corn (2007) Corn (2008)	12 May 2009	13 November 2009	None	None	None	Yes
7	Cayuga	Lima	Fine-loamy, mixed, active, mesic Oxyaquic Hapludalfs	Corn (2006) Corn (2007) Corn (2008)	12 May 2009	13 November 2009	8,000 Surface Spring	8,000 Surface Spring	9,500 Surface Spring	No
8	Steuben	Howard	Loamy-skeletal, mixed, mesic Glossoboric Hapludalfs	Alfalfa-Grass (2007) Corn (2008) Corn (2009)	7 May 2010	26 August 2010	5,000 Chisel Spring	5,000 Chisel Spring	5,000 Chisel Spring	No

Site	County	Soil Series	Soil Series Description	Cropping History	Planting Date	Harvest Date	Manure History* (gallons/acre)			Sidedress N*
							2009/10/11	2008/09/10	2007/08/09	2009/10/11
9	Cayuga	Lima	Fine-loamy, mixed, active, mesic Oxyaquic Hapludalfs	Corn (2007) Corn (2008) Corn (2009)	11 May 2010	31 August 2010	8,000 Aerator Spring	8,000 Aerator Spring	8,000 Aerator Spring	No
10	Cayuga	Lima	Fine-loamy, mixed, active, mesic Oxyaquic Hapludalfs	Corn (2007) Corn (2008) Corn (2009)	11 May 2010	31 August 2010	8,000 Chisel Spring	8,000 Chisel Spring	8,000 Chisel Spring	No
11	Cayuga	Lima	Fine-loamy, mixed, active, mesic Oxyaquic Hapludalfs	Corn (2007) Corn (2008) Corn (2009)	11 May 2010	31 August 2010	None	None	None	Yes
12	Cayuga	Lima	Fine-loamy, mixed, active, mesic Oxyaquic Hapludalfs	Corn (2007) Corn (2008) Corn (2009)	11 May 2010	31 August 2010	8,000 Surface Spring	8,000 Surface Spring	8,000 Surface Spring	No
13	Albany	Angola	Fine-loamy, mixed, mesic Aeric Ochraqualfs	Sod (2007) Corn (2008) Corn (2009)	27 May 2010	7 September 2010		10,000 Incorpor-ated	4,000 Incorpor-ated	No
14	Rensselaer	Occum-Barbour	Coarse-loamy/coarse-loamy over sandy or sandy skeletal, mesic Fluventic Dystrochrept	Sod (2007) Corn (2008) Corn (2009)	10 May 2010	7 September 2010	8,000 Surface Spring	9,000 Surface Spring	9,000 Surface Spring	No
15	Columbia	Occum	Coarse-loamy, mixed, mesic Fluventic Dystrochrepts	Corn (2007) Corn (2008) Corn (2009)	11 May 2010	8 September 2010	4,000 Chisel Spring	20 t/ac	20 t/ac	Yes
16	Washington	Vergennes	Very fine, illitic, mesic Glossaquic Haplaudalfs	Corn (2007) Corn (2008) Corn (2009)	28 May 2010	15 September 2010	11,000 Oct 2009 2,200 Spring Disc>5d	12,000 Disc>5d	10,00 Disc>5d	No
17	Lewis	Croghan	Sandy, mixed, frigid Aquic Haplorthods	Corn (2007) Corn (2008) Corn (2009)	17 May 2010	16 September 2010	6,000 Chisel Spring	6,000 Chisel Spring	6,000 Chisel Spring	No

Site	County	Soil Series	Soil Series Description	Cropping History	Planting Date	Harvest Date	Manure History* (gallons/acre)			Sidedress N*
							2009/10/11	2008/09/10	2007/08/09	2009/10/11
18	Jefferson	Vergennes	Very fine, illitic, mesic Glossaquic Haplaudalfs	Corn (2007) Corn (2008) Corn (2009)	22 May 2010	20 September 2010	10 t/ac Surface Spring	10 t/ac Surface Oct 08-Apr 09	10 t/ac Surface Oct 07-Apr 08	No
19	St. Lawrence	Swanton	Coarse-loamy over clayey, mixed, nonacid, frigid Aeric Haplaquepts	Alfalfa-Grass (2007) Alfalfa-Grass (2008) Corn (2009)	4 May 2010	24 September 2010	11,440 Injection Spring	None	7,378 Surface Aug 2008	No
20	St. Lawrence	Malone	Coarse=loamy, mixed, nonacid, frigid Aeric Haplaquepts	Sod (2007) Sod (2008) Corn (2009)	29 May 2010	23 September 2010	1,900 Chisel Spring	2,000 Chisel Spring	6,000 Surface June-Sep	Yes
21	Clinton	Malone	Coarse-loamy, mixed, nonacid, frigid Aeric Epiaquepts	Corn (2007) Corn (2008) Corn (2009)	10 May 2010	17 September 2010	17 t/ac Surface Dec 2009	16,000 Surface Nov 2008	5 t/ac Surface Oct 2007	Yes
23	Steuben	Howard	Loamy-skeletal, mixed, active, mesic Glossic Hapludalfs	Corn (2008) Corn (2009) Corn (2010)	12 May 2011	23 September 2011	25 t/ac Surface Jan 2011	25 t/ac Surface Jan 2010	25 t/ac Surface Jan 2009	No
25	St. Lawrence	Hogansburg	Coarse-loamy, mixed, semiactive, frigid Aquic Eutrudepts	Corn (2008) Corn (2009) Corn (2010)	13 May 2011	21 September 2011	11,145 Injection May 1	14,620 Injection Spring	6,285 Surface Summer	Yes
27	Delaware	Wellsboro	Coarse-loamy, mixed, active, mesic Typic Fragiudepts	Clover/Grass 2008 Corn (2009) Corn (2010)	10 June 2011	3 October 2011	5,200 Surface +3 t/ac May	5,200 Surface May	5,200 Surface May	No
28	Washington	Oakville	Mixed, mesic Typic Udipsamments (loamy sand)	Corn (2008) Corn (2009) Corn (2010)	3 June 2011	7 October 2011	30 t/ac Chisel 4-5 days May	20 t/ac Chisel 4-5 days April	20 t/ac Chisel 4-5 days June	No

Site	County	Soil Series	Soil Series Description	Cropping History	Planting Date	Harvest Date	Manure History* (gallons/acre)			Sidedress N*
							2009/10/11	2008/09/10	2007/08/09	2009/10/11
31	Lewis	Croghan	Sandy, mixed, frigid Aquic Haplorthods	Corn (2008) Corn (2009) Corn (2010)	25 May 2011	3 October 2011	6,000 Chisel 1day May	6,000 Chisel 1day May	6,000 Chisel 1day May	No
34	Clinton	Hogansburg	Coarse-loamy, mixed, semiactive, frigid Aquic Eutrudepts	Corn (2008) Corn (2009) Corn (2010)	7 June 2011	7 October 2011	None	25,000 Chisel > 5 days October	16,000 Chisel > 5 days October	Yes
35	Tompkins	Hudson	Fine, illitic, mesic Glossaquic Hapludalfs	Corn (2008) Corn (2009) Corn (2010)	14 May 2011	26 September 2011	6,700 October 7,400 April Injected	8,600 Surface October	10,600 Injected October/ April	Yes

*First year in header for manure and sidedress applications applies to 2009 trials (Sites 1–7), the second year applies to 2010 trials (Sites 8–21). The third year applies to 2011 trials.

Table 2. Initial soil fertility status (0–8 inch depth) for each of the 21 sites included in a starter N project. All soils were analyzed for pH, organic matter (OM) by loss-on-ignition, Morgan extractable P, K, Mg, Ca, Al, Mn, Zn, and Illinois Soil Nitrogen Test (ISNT, O=optimal, M=Marginal, D=deficient). Trials at Sites 1-7 were conducted in 2009, at Sites 8–21 in 2010, and at all others in 2011.

Site	pH	OM	P		K		Mg		Ca	Al	Mn	Zn	--------ISNT--------		
		%	---------- lbs/acres ----------										ppm	ratio	
1	6.6	4.2	12	High	245	Very High	367	Very High	3174	26	41	1.0	302	0.99	M
2	7.2	6.0	40	Very High	133	High	336	Very High	12414	27	44	1.9	449	1.35	O
3	6.4	4.9	94	Very High	960	Very High	426	Very High	3563	30	34	5.7	336	1.05	M
4	7.8	3.5	28	High	215	Very High	741	Very High	5941	11	27	1.3	264	0.92	D
5	7.8	3.3	28	High	210	Very High	696	Very High	5666	12	28	1.1	252	0.89	D
6	7.7	3.1	15	High	127	High	661	Very High	5271	11	26	0.8	224	0.81	D
7	7.8	3.3	31	High	224	Very High	705	Very High	5611	10	29	1.2	252	0.89	D
8	6.1	3.3	10	High	198	High	444	Very High	2138	33	19	0.5	235	0.83	D
9	7.7	3.7	31	High	268	Very High	685	Very High	5611	9	39	1.2	257	0.87	D
10	7.7	3.5	29	High	244	Very High	667	Very High	5751	9	39	1.1	248	0.86	D
11	7.7	3.3	17	High	116	High	623	Very High	5476	9	36	0.6	230	0.82	D
12	7.7	3.5	34	High	263	Very High	686	Very High	5892	9	38	1.1	245	0.85	D
13	6.6	3.5	71	Very High	334	Very High	323	Very High	4428	18	22	1.4	290	1.01	M
14	6.9	4.0	35	High	609	Very High	423	Very High	3736	28	33	3.1	315	1.05	M
15	6.4	2.8	80	Very High	777	Very High	383	Very High	2981	20	53	3.4	216	0.81	D
16	7.0	4.1	25	High	244	Very High	584	Very High	5348	35	39	1.4	247	0.81	D
17	6.8	4.5	11	High	373	Very High	349	Very High	3849	135	5	3.1	327	1.05	M
18	5.5	5.3	11	High	323	Very High	993	Very High	4915	86	52	5.3	372	1.14	S
19	7.0	4.2	16	High	149	Medium	923	Very High	5231	16	25	1.7	334	1.09	O
20	7.0	4.1	16	High	64	Low	624	Very High	4596	19	22	1.0	344	1.13	O
21	6.9	4.3	50	Very High	576	Very High	549	Very High	3434	24	25	3.7	344	1.12	O
23	6.8	5.3	163	Very High	1566	Very High	733	Very High	3380	22	32	3.9	439	1.35	O
25	6.7	4.1	12	High	213	Very High	512	Very High	3701	16	45	2.2	356	1.17	O
27	5.7	4.7	32	High	361	Very High	471	Very High	2293	36	92	4.2	389	1.23	O
28	7.0	2.3	74	Very High	343	Very High	272	Very High	2392	19	27	3.9	171	0.69	D

Site	pH	OM	P		K		Mg		Ca	Al	Mn	Zn	--------ISNT--------		
		%	--- lbs/acres						---				ppm	ratio	
31	6.2	5.2	6	Medium	262	High	314	Very High	2216	142	6	3.6	314	0.97	M
34	7.0	4.3	69	Very High	465	Very High	612	Very High	3880	15	15	3.6	298	0.97	M
35	7.4	4.1	79	Very High	468	Very High	548	Very High	5466	11	57	2.9	324	1.07	M

Table 3. Monthly precipitation in total inches and temperature in degrees F for seven sites (four fields) where starter N trials were conducted in NY in 2009, fourteen sites (ten fields) where NY starter N trials were conducted in 2010, and seven sites (seven fields) where NY starter N trials were conducted in 2011. Data for sites 4–7 and 9–12 were obtained from an on-site weather station and for the other sites from weather stations in close proximity (data for all sites taken from the Northeast Regional Climate Center CLIMOD database in 2009, 2010, 2011*). The average monthly temperature is derived from calculated daily averages. The 30-year** average is from 1979 through 2008 for research sites 1–7, 1980 through 2009 for 2010 sites (8–21), and 1981 through 2010 for 2011 sites (23–35).

Month		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Site 1 Rensselaer Co.													
Rainfall	2009	2.51	1.27	3.26	1.59	4.79	4.63	5.67	5.99	2.18	5.05	2.34	2.64
	30-year	2.73	2.11	3.04	3.44	3.91	4.28	4.49	4.08	3.66	3.65	3.50	2.89
Temperature	2009	14.4	24.4	32.8	46.9	55.4	63.2	66.5	68.0	57.5	45.6	41.0	24.5
	30-year	23.1	25.5	34.7	47.9	59.2	68.3	73.2	71.7	63.4	51.1	41.0	29.7
Site 2 Lewis Co.													
Rainfall	2009	2.63	2.05	2.50	1.87	5.62	2.37	5.82	4.48	2.18	3.67	1.58	4.34
	30-year	3.43	2.42	2.78	3.22	3.25	3.28	3.44	3.70	4.09	4.11	4.00	3.57
Temperature	2009	10.7	20.2	29.8	43.7	53.4	60.8	64.7	66.6	56.2	44.3	39.6	20.7
	30-year	16.9	18.5	28.2	42.2	54.1	63.0	67.4	65.8	57.7	46.3	35.7	23.6
Site 3 Washington Co.													
Rainfall	2009	2.72	1.63	2.54	1.59	3.73	3.88	8.18	3.16	1.96	5.32	3.25	3.96
	30-year	3.19	2.44	3.05	3.23	3.66	3.84	4.20	4.14	3.78	3.67	3.48	3.11
Temperature	2009	15.5	25.1	36.3	50.3	60.0	66.4	70.2	72.5	61.3	48.8	44.4	26.5
	30-year	21.0	23.1	33.6	47.1	59.3	68.2	72.8	70.8	62.2	50.6	39.5	27.4
Site 4-7 Cayuga Co.													
Rainfall	2009	—	0.44	3.38	1.89	3.77	4.75	2.43	3.64	2.61	3.32	1.42	1.63
	30-year	2.05	1.75	2.51	3.31	3.01	3.75	3.44	3.12	4.20	3.29	3.26	2.37
Temperature	2009	18.9	28.6	35.2	48.0	58.1	64.5	67.6	70.6	61.0	47.5	43.2	27.5
	30-year	24.3	25.3	33.3	45.8	57.0	66.5	70.8	69.4	62.3	50.7	40.7	30.0
Site 8 Steuben Co.													
Rainfall	2010	2.43	1.91	2.40	1.39	3.95	3.99	3.24	2.93	1.22	6.83	1.5	—
	30-year	1.66	1.49	2.20	2.79	2.80	3.71	3.29	3.00	3.42	2.53	2.72	2.49
Temperature	2010	22.5	24.9	37.2	48.9	59.2	67.3	72.0	69.4	61.0	49.3	38.4	—
	30-year	22.7	24.3	31.5	44.3	54.6	63.7	68.1	66.4	59.5	48.1	38.2	27.7

Month		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sites 9-12 Cayuga Co.													
Rainfall	2010	1.38	1.90	1.95	1.97	2.22	5.24	4.26	5.83	2.57	5.84	2.36	—
	30-year	1.87	1.73	2.57	3.28	3.05	3.80	3.50	3.05	4.13	3.25	3.22	2.31
Temperature	2010	22.8	24.2	38.4	51.0	60.8	67.2	72.5	70.1	62.0	50.4	40.0	—
	30-year	24.4	26.2	33.5	46.2	57.1	66.6	70.8	69.6	62.4	50.7	40.7	29.9
Site 13 Albany													
Rainfall	2010	1.75	3.99	2.69	1.25	1.88	4.69	2.88	1.69	3.44	7.10	3.53	—
	30-year	2.54	2.09	3.26	3.22	3.58	3.80	4.11	3.62	3.26	3.52	3.27	2.87
Temperature	2010	24.4	28.0	41.7	51.9	61.2	67.6	74.9	72.0	64.6	50.3	39.6	—
	30-year	22.8	25.9	34.8	47.6	58.2	67.0	71.6	70.0	61.8	49.7	39.8	28.4
Site 14 Rensselaer Co.													
Rainfall	2010	1.66	4.78	2.49	1.77	3.29	5.40	2.94	1.81	0.96	9.43	—	—
	30-year	2.23	1.93	2.98	3.26	3.74	4.17	4.55	4.09	3.32	3.64	3.09	2.55
Temperature	2010	25.5	27.8	42.0	52.6	-	68.9	76.5	72.4	66.8	51.4	40.4	—
	30-year	23.2	25.9	34.6	48.0	59.2	68.3	73.2	71.7	63.4	51.1	40.8	29.5
Site 15 Columbia Co.													
Rainfall	2010	2.37*	4.29*	5.00*	1.54*	2.04	2.83	2.50	1.88	1.19	7.42	—	—
	30-year	2.05	1.91	2.82	3.74	4.04	4.60	4.34	4.25	3.97	4.11	3.27	2.52
Temperature	2010	26.6*	30.3*	43.9*	53.8*	64.5*	68.7	76.6*	70.9	64.5	49.7	—	—
	30-year	22.5	26.2	34.1	46.5	57.6	66.2	70.6	69.6	61.6	49.7	39.9	28.3
Sites 16 Washington Co.													
Rainfall	2010	2.04	2.83	3.74	2.09	2.62	4.42	5.34	2.92	2.13	9.25	2.92	2.51
	30-year	3.01	2.52	2.99	3.22	3.67	3.89	4.46	4.16	3.72	3.72	3.55	3.22
Temperature	2010	24.3	27.8	41.2	53.2	63.2	69.2	76.0	72.5	65.1	51.6	39.6	26.4
	30-year	2.09	24.1	33.8	47.4	59.1	68.2	72.6	70.8	62.4	50.6	39.6	27.4
Site 17 Lewis Co.													
Rainfall	2010	2.73	1.73	1.50	1.06	2.21	6.26	4.12	6.09	2.35	8.80	2.30	2.81
	30-year	3.16	2.49	2.73	3.23	3.34	3.35	3.63	3.70	3.96	4.15	3.92	3.64
Temperature	2010	18.0	19.9	36.2	47.2	56.9	63.7	69.6	66.4	59.2	46.6	35.0	21.3
	30-year	16.7	19.1	28.1	42.4	53.8	62.9	67.2	65.8	57.7	46.2	35.6	23.3

Month		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Site 18 Jefferson Co.													
Rainfall	2010	2.00	1.10	1.59	1.10	1.86	6.06	3.54	2.48	6.68	4.46	3.20	—
	30-year	2.63	2.22	2.35	2.99	3.02	2.76	2.69	3.13	3.67	3.66	3.77	3.14
Temperature	2010	20.4	20.0	37.3	48.7	58.4	64.1	71.2	69.4	61.4	48.4	38.2	—
	30-year	19.3	21.1	30.2	43.7	54.6	63.3	68.5	67.0	59.4	48.2	38.1	26.0
Sites 19-20 St. Lawrence Co.													
Rainfall	2010	1.53	0.83	1.12	1.99	1.60	6.66	0.11	4.10	4.51	8.54	2.23	2.48
	30-year	2.10	1.81	2.13	2.90	3.06	3.26	3.86	3.67	4.18	3.86	3.37	2.51
Temperature	2010	19.1	21.0	36.5	48.8	59.2	64.4	—	68.4	—	46.9	36.9	21.4
	30-year	15.7	18.5	28.5	43.1	54.9	64.0	68.6	66.8	58.7	46.8	36.4	23.2
Site 21 Clinton Co.													
Rainfall	2010	0.32	0.65	3.02	2.96	0.89	4.95	1.85	6.45	—	—	—	—
	30-year*	1.37	1.01	0.99	2.30	3.00	3.46	3.56	3.81	3.23	3.04	2.42	0.61
Temperature	2010	23.3	26.3	40.0	51.2	61.1	66.4	74.2	70.4	61.8	47.5	36.8	22.7
	30-year	17.7	20.2	30.1	44.7	56.3	65.1	69.7	68.0	59.8	47.9	37.0	24.7
Site 23 Steuben Co.													
Rainfall	2011	1.33	3.79	3.91	7.05	6.28	3.24	0.67	5.17	4.98	—	—	—
	30-year	2.05	1.73	2.53	3.08	3.20	4.28	4.00	3.59	3.69	3.13	2.91	2.34
Temperature	2011	19.9	22.2	29.6	44.3	57.5	65.1	71.1	66.5	62.1	49.6	—	—
	30-year	21.9	23.6	31.4	43.8	53.9	63.8	67.1	66.8	59.7	47.2	38.3	26.1
Site 25 St. Lawrence Co.													
Rainfall	2011	0.76	—	4.19	6.08	—	3.08	4.39	5.64	—	—	—	—
	30-year	2.12	1.82	2.08	2.83	3.09	3.40	3.72	3.70	4.17	4.06	3.30	2.50
Temperature	2011	16.6	—	29.2	45.0	—	65.8	70.9	68.1	—	—	—	—
	30-year	15.8	18.8	28.8	43.2	55.1	64.2	68.6	66.8	58.8	46.9	36.5	23.5
Site 27 Delaware Co.													
Rainfall	2011	—	4.6	5.35	7.24	5.68	8.62	5.26	12.47	10.60	—	—	—
	30-year	3.23	2.58	3.58	3.91	4.27	4.56	4.57	3.71	4.31	4.24	3.85	3.45
Temperature	2011	—	22.1	31.7	45.6	57.9	64.6	70.4	66.7	63.2	—	—	—
	30-year	20.8	23.4	31.6	43.7	53.9	62.7	66.8	65.7	58.3	47.1	37.7	26.6

Month		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Site 28 Washington Co.													
Rainfall	2011[1]	2.63	3.67	5.39	4.68	4.81	6.04	3.19	9.45	8.94	—	—	—
	30-year	3.27	2.59	3.46	3.61	4.14	4.35	4.40	4.21	3.59	3.97	3.79	3.59
Temperature	2011	21.3	23.8	34.4	49.2	61.8	68.1	74.7	71.0	65.9	—	—	—
	30-year	21.8	25.2	34.7	48.0	58.7	67.5	71.6	69.9	62.0	50.1	39.6	27.9
Site 31 Lewis Co.													
Rainfall	2011	1.20	3.24	5.54	6.70	6.70	3.46	1.25	5.92	4.22	—	—	—
	30-year	3.17	2.52	2.64	3.07	3.35	3.43	3.55	3.87	3.92	4.23	3.89	3.65
Temperature	2011	15.4	16.9	27.1	43.1	57.5	64.3	69.7	66.6	60.8	50.5	—	—
	30-year	16.6	19.3	28.3	42.5	53.9	63.0	67.3	65.7	57.7	46.3	35.8	23.5
Site 34 Clinton Co.													
Rainfall	2011[2]	—	—	—	4.52	—	1.14	0.77	9.58	—	—	—	—
	30-year	1.33	0.97	1.14	2.30	2.93	3.60	3.50	3.90	3.23	3.06	2.42	0.61
Temperature	2011	17.2	16.9	26.9	45.7	61.2	66.0	73.0	—	—	—	—	—
	30-year	17.8	20.5	30.5	44.9	56.5	65.3	69.9	68.1	59.9	48.1	37.2	24.9
Site 35 Tompkins Co.													
Rainfall	2011	1.32	3.70	3.64	7.42	6.18	2.59	1.99	4.63	10.46	—	—	—
	30-year	2.06	1.98	2.68	3.28	3.19	3.98	3.75	3.57	3.64	3.41	3.16	2.39
Temperature	2011	20.2	22.2	31.1	45.8	58.5	66.1	71.9	67.5	61.3	52.4	—	—
	30-year	22.9	24.8	32.4	44.8	55.5	64.8	68.9	67.6	60.2	48.8	39.4	28.6

* Data for 2011 have not yet been submitted for some months to CLIMOD or is still subject to further quality control so may change.

**This is an approximate 30-year average for rainfall for some of the months at a few of the weather stations as data was not collected every month all years. Temperature data was only available for the most recent 11 years (2000 through 2010) at the station for Site 23.

[1] Only Aug and Sep rainfall data available for Sta. 307484; data for other months taken from Sta. RDLN6, Round Lake 1 SE.

[2] From Sta. 301402 Chazy Miner – no 2011 precipitation data available for Chazy Sta. 301401.

Table 4. Stand density, percent moisture content at harvest, and yield as influenced by application of 30 lbs of starter N fertilizer/acre at planting in 2009 (Sites 1–7), 2010 (Sites 8–21), and 2011 (Sites 23–35). Grey background highlights results at sites where starter N addition increased the yield with a P value of 0.05 (95% certainty level). Corn yield is in ton/acre at 35% DM for silage (sites 1–3, 8, 13–35) or bushel/acre at 85% DM (sites 4–7, 9–12).

Site	Treatment	Stand density	Moisture	Corn yield		Field notes
		plants/acre	%	tons/acre	bushels/acre	
1 Kilcer	Starter	15,685 b	68.4 a	17.9 a	—	Stand density problems (planter malfunctioning)
	No Starter	23,192 a	69.4 a	21.3 a	—	
	p-value	0.0011	0.2775	0.0610	—	
2 Lawrence	Starter	28,000 a	64.6 a	17.0 a	—	Wet harvest conditions resulted in the loss of two of the plots, both no-starter plots
	No Starter	29,250 a	60.3 a	15.3 a	—	
	p-value	0.3308	0.1318	0.4805	—	
3 Gabriel	Starter	25,134 a	67.3 a	25.4 a	—	
	No Starter	25,014 a	65.6 a	24.9 a	—	
	p-value	0.7788	0.1090	0.6786	—	
4 Aurora Aerway	Starter	28,579	18.2 a	—	112.3 a	Manure was surface applied (spring) and aerator-incorporated at 8,000–9,000 gallons/acre (5 past years).
	No Starter	28,579	17.4 a	—	108.5 a	
	p-value	n/a*	0.2159	—	0.6054	
5 Aurora Chisel	Starter	29,513	18.3 a	—	118.7 a	Manure was surface applied (spring) and chisel plow-incorporated at 8,000–9,000 gallons/acre (5 past years).
	No Starter	29,513	17.6 a	—	105.0 b	
	p-value	n/a*	0.3944	—	0.0290	
6 Aurora Inorganic	Starter	29,394	18.1 a	—	143.7 a	No manure history. Sidedressed
	No Starter	29,394	19.0 a	—	126.3 a	
	p-value	n/a*	0.3115	—	0.0632	
7 Aurora Surface	Starter	28,885	18.5 a	—	103.0 a	Manure was surface applied (spring) at 8,000–9,000 gallons/acre (5 past years).
	No Starter	28,885	18.2 a	—	91.2 a	
	p-value	n/a*	0.5255	—	0.1162	
8 Albers	Starter	25,706 a	67.1 a	19.2 a	—	
	No Starter	25,626 a	67.0 a	20.0 a	—	
	p-value	0.9267	0.9266	0.5051	—	

Site	Treatment	Stand density	Moisture	Corn yield		Field notes
		plants/acre	%	tons/acre	bushels/acre	
9 Aurora Aerway	Starter No Starter p-value	27,885 a 24,640 b 0.0101	16.6 b 17.2 a 0.0145	— — —	150.0 a 138.2 b 0.0064	Manure was surface applied (spring) and aerator-incorporated at 8,000–9,000 gallons/acre (5 past years).
10 Aurora Chisel	Starter No Starter p-value	29,124 a 27,863 a 0.1098	16.6 a 16.9 a 0.3149	— — —	160.3 a 151.2 a 0.0711	Manure was surface applied (spring) and chisel plow-incorporated at 8,000–9,000 gallons/acre (5 past years).
11 Aurora Inorganic	Starter No Starter p-value	27,576 a 24,107 b 0.0038	16.9 b 17.3 a 0.0087	— — —	172.7 a 146.5 b 0.0008	No manure history. Sidedressed
12 Aurora Surface	Starter No Starter p-value	27,683 a 26,208 a 0.2216	16.7 a 17.0 a 0.2555	— — —	140.8 a 125.3 b 0.0264	Manure was surface applied (spring) at 8,000–9,000 gallons/acre (5 past years).
13 Wright	Starter No Starter p-value	32,390 a 31,097 a 0.3307	65.0 a 65.8 a 0.4549	19.1 a 20.0 a 0.6344	— — —	
14 Wright	Starter No Starter p-value	37,952 a 37,952 a 0.9993	59.6 a 57.9 a 0.1317	21.2 a 20.6 a 0.7581	— — —	
15 Kilcer	Starter No Starter p-value	37,897 a 37,571 a 0.8544	60.1 a 61.2 a 0.4431	24.7 a 24.9 a 0.9412	— — —	
16 Gabriel	Starter No Starter p-value	29,442 a 29,186 a 0.6865	68.3 a 67.7 a 0.3081	18.0 a 19.1 a 0.3882	— — —	
17 Lawrence	Starter No Starter p-value	35,014 a 32,700 a 0.1253	64.9 a 68.0 a 0.3971	20.3 a 16.7 a 0.1661	— — —	Could not harvest all four replications due to wet field conditions.
18 Hunter	Starter No Starter p-value	24,067 a 24,557 a 0.5694	66.5 a 67.4 a 0.1262	15.4 a 12.8 b 0.0288	— — —	Bird damage all across the field.

Site	Treatment	Stand density	Moisture	Corn yield		Field notes
		plants/acre	%	tons/acre	bushels/acre	
19	Starter	30,492 a	49.8 a	30.3 a	—	
Barney	No Starter	30,982 a	50.1 a	29.5 a	—	
	p-value	0.2220	0.8041	0.6737	—	
20	Starter	30,546 a	67.9 a	20.0 a	—	
Canner	No Starter	33,106 a	66.5 a	21.1 a	—	
	p-value	0.1062	0.1176	0.2035	.	
21	Starter	31,908 a	67.9 a	23.8 a	—	
Young	No Starter	31,581 a	68.9 a	23.6 a	—	
	p-value	0.7154	0.3655	0.7932	—	
23	Starter	31,309 b	65.3 a	22.8 a	—	
Albers	No Starter	32,289 a	65.9 a	24.1 a	—	
	p-value	0.04267	0.3589	0.5816	—	
25	Starter	33,051 a	49.4 a	25.1 a	—	
Barney	No Starter	32,997 a	58.7 a	24.5 a	—	
	p-value	0.8924	0.1793	0.5652	.	
27**	Starter	31,200 a	69.3 a	17.0 a	—	Deer damage to field, large replication
Cerosaletti	No Starter	27,606 a	70.1 a	13.7 b	—	to replication differences.
	p-value	0.1587	0.0926	0.0096	—	
28	Starter	34,249 a	60.9 a	21.0 a	—	
Gabriel	No Starter	32,398 b	62.0 a	17.8 a	—	Very variable
	p-value	0.0322	0.1170	0.2096	—	
31	Starter	31,690 a	58.5 a	21.2 a	—	
Lawrence	No Starter	31,255 a	58.9 a	17.2 b	—	
	p-value	0.8645	0.4241	0.0260	—	
34	Starter	29,053 a	65.8 a	15.9 b	—	Large within-field variability due to
Young	No Starter	28,042 a	63.9 b	18.0 a	—	weed pressure, compaction/moisture
	p-value	0.1204	0.0005	0.0052	—	excess, and loss of a plot at harvest time
35	Starter	31,336 a	59.0 a	17.5 a	—	
Boerman	No Starter	31,363 a	59.5 a	17.0 a	—	
	p-value	0.9802	0.4529	0.5410	—	

*Only one stand density (mean of reps) available for combined starter/no starter at this site, no statistical analysis possible.

** Corn yield analyses adjusted for stand density (72% of yield explained by differences in population density)

Table 5. Crude protein, soluble protein, neutral detergent fiber (NDF), digestible NDF (dNDF), lignin, and starch as influenced by an application of 30 lbs of starter N fertilizer per acre at planting in trials conducted in 2009 (Sites 1–7), 2010 (Sites 8–21), and 2011 (Sites 23–35). Grey background highlights results at sites where starter N addition increased the yield with a P value of 0.05 (95% certainty level).

Site	Treatment	Crude protein	Soluble protein	NDF	dNDF	Lignin	Starch
		--------------------% of dry matter-------------------			% NDF	-----------% of dry matter----------	
1	Starter	7.7 a	1.9 a	42.1 a	66.8 a	3.0 a	32.9 a
Kilcer	No Starter	7.5 a	2.0 a	42.5 a	65.7 a	3.1 a	31.3 a
	p-value	0.5065	0.4743	0.3597	0.1525	0.3866	0.3754
2	Starter	7.9 a	1.6 a	49.1 a	67.8 a	2.7 a	31.6
Lawrence	No Starter	7.7 a	1.5 a	49.6 a	66.6 b	2.8 a	
	p-value	0.2450	0.4081	0.2724	0.0277	0.1881	n/a
3	Starter	8.3 a	2.4 a	42.2 a	65.2 a	3.2 a	33.6 a
Gabriel	No Starter	7.3 b	2.1 b	42.5 a	64.1 a	3.0 a	34.7 a
	p-value	0.0257	0.0052	0.7806	0.4981	0.2534	0.4894
8	Starter	8.0 a	1.6 a	46.4 a	67.6 a	3.5 a	29.3 a
Albers	No Starter	7.9 a	1.6 a	43.8 a	66.5 a	3.3 a	31.4 a
	p-value	0.7215	0.6791	0.2383	0.2583	0.1378	0.2361
13	Starter	7.8 a	1.8 a	40.5 a	69.8 a	2.8 a	34.6 a
Wright	No Starter	7.9 a	2.0 a	39.6 a	67.3 a	2.7 a	35.6 a
	p-value	0.7291	0.5415	0.5974	0.0551	0.8233	0.1598
14	Starter	7.8 a	2.1 a	40.0 a	64.3 a	3.1 a	40.4 a
Wright	No Starter	7.7 a	2.2 a	41.1 a	64.7 a	3.1 a	38.6 a
	p-value	0.8925	0.8315	0.4998	0.7609	0.7477	0.4181
15	Starter	8.3 a	2.2 a	47.0 a	61.2 a	3.6 a	28.7 a
Kilcer	No Starter	8.3 a	2.4 a	46.1 a	60.6 a	3.5 a	30.0 a
	p-value	0.9425	0.5509	0.6867	0.7248	0.3833	0.5343
16	Starter	8.3 a	2.0 a	39.3 a	70.2 a	2.8 a	34.5 a
Gabriel	No Starter	7.8 a	1.9 b	37.5 a	70.2 a	2.7 a	37.2 a
	p-value	0.1261	0.0408	0.2170	0.9890	0.1060	0.1150
17	Starter	7.8 a	2.3 a	41.2 a	66.3 a	3.0 a	35.7 a
Lawrence	No Starter	8.7 a	2.6 a	40.9 a	66.3 a	3.2 a	34.8 a
	p-value	0.3142	0.1367	0.9193	0.9812	0.2585	0.7993

Site	Treatment	Crude protein	Soluble protein	NDF	dNDF	Lignin	Starch
		--------------------% of dry matter-------------------			% NDF	-----------% of dry matter----------	
18 Hunter	Starter	6.1 a	1.5 b	49.1 a	66.1 a	3.7 a	25.8 a
	No Starter	6.3 a	1.8 a	46.4 a	68.7 a	3.2 a	27.7 a
	p-value	0.3701	0.0236	0.1173	0.0586	0.1003	0.3141
19 Barney	Starter	8.1 a	1.7 a	36.4 a	74.8 a	2.4 a	43.6 a
	No Starter	8.1 a	1.8 a	34.2 a	72.1 a	2.4 a	46.1 a
	p-value	0.8729	0.3061	0.4575	0.0681	1.0000	0.4852
20 Canner	Starter	7.9 a	2.1 a	46.1 a	64.6 a	3.5 a	30.8 a
	No Starter	7.6 a	2.0 a	46.0 a	63.1 a	3.3 a	31.7 a
	p-value	0.6044	0.1351	0.9788	0.6316	0.2688	0.8375
21 Young	Starter	9.2 a	2.5 a	35.9 b	77.5 a	2.4 a	37.9 a
	No Starter	8.9 b	2.5 a	39.6 a	77.0 a	2.5 a	34.1 a
	p-value	0.0227	0.2679	0.0484	0.7064	0.2508	0.0537
23 Albers	Starter	8.8 a	2.4 a	41.3 a	63.8 a	3.2 a	31.7 a
	No Starter	9.0 a	2.4 a	41.3 a	62.5 b	3.3 a	31.4 a
	p-value	0.2191	0.6065	0.9623	0.0316	0.5288	0.8459
25 Barney	Starter	7.7 b	1.9 b	40.1 a	56.7 a	3.2 a	39.8 a
	No Starter	8.0 a	2.0 a	38.8 a	58.2 a	3.1 a	40.9 a
	p-value	0.0240	0.0267	0.3231	0.3398	0.2586	0.3640
27 Cerosaletti	Starter	6.6 a	1.7 a	40.9 a	64.7 a	3.0 a	36.2 a
	No Starter	6.7 a	1.7 a	41.0 a	67.3 a	3.2 a	32.8 a
	p-value	0.7413	0.7530	0.2521	0.1319	0.3014	0.1161
28 Gabriel	Starter	6.7 a	1.9 a	44.6 a	62.3 a	3.3 a	35.1 a
	No Starter	6.8 a	2.0 a	42.7 a	62.8 a	3.1 a	36.6 a
	p-value	0.2783	0.1294	0.3849	0.6598	0.5288	0.5169
31 Lawrence	Starter	6.3 a	1.3 a	42.6 a	60.8 b	3.1 a	38.0 a
	No Starter	5.8 a	1.1 a	44.4 a	63.2 a	2.9 a	36.2 a
	p-value	0.1056	0.1539	0.3730	0.0248	0.1363	0.3181
34 Young	Starter	8.0 a	2.2 a	37.6 a	75.6 a	2.2 a	38.5 a
	No Starter	8.2 a	2.2 a	37.2 a	76.4 a	2.2 a	39.2 a
	p-value	0.4944	0.7708	0.7225	0.2805	0.9866	0.6622

Site	Treatment	Crude protein	Soluble protein	NDF	dNDF	Lignin	Starch
		--------------------% of dry matter-------------------			% NDF	-----------% of dry matter----------	
35	Starter	9.1 a	2.2 a	41.4 a	79.5 b	2.3 a	34.9 a
Boerman	No Starter	8.9 a	2.2 a	41.6 a	80.6 a	2.3 a	34.8 a
	p-value	0.4765	0.6892	0.8313	0.0206	0.8649	0.9572

Table 6. Milk production estimate for each corn silage site (University of Wisconsin Corn Silage Evaluation System, Milk 2006), as influenced by an application of 30 lbs of starter N fertilizer per acre at planting in trials conducted in 2009 (Sites 1–7), 2010 (Sites 8–21), and 2011 (Sites 23–35). Grey background highlights results at sites where starter N addition increased the yield with a P value of 0.05 (95% certainty level).

Site	Treatment	Milk per ton	Milk per acre	Field notes
		lb/ton DM	lb/acre	
1	Starter	3438 a	21,519 a	Stand density problems (planter malfunctioning).
Kilcer	No Starter	3360 a	25,105 a	
	p-value	0.2933	0.1242	
2	Starter	3362 a	19,960 a	Wet harvest conditions resulted in the loss of two of the plots, both no-starter plots
Lawrence	No Starter	3291 a	17,784 a	
	p-value	0.0644	0.4440	
3	Starter	3465 a	30,831 a	
Gabriel	No Starter	3417 a	29,840 a	
	p-value	0.4554	0.5671	
8	Starter	3432 a	23,096 a	
Albers	No Starter	3508 a	24,609 a	
	p-value	0.2176	0.3460	
13	Starter	3563 a	23,777 a	
Wright	No Starter	3565 a	25,015 a	
	p-value	0.9544	0.6384	
14	Starter	3579 a	26,538 a	
Wright	No Starter	3516 a	25,402 a	
	p-value	0.2356	0.6119	
15	Starter	3355 a	28,974 a	
Kilcer	No Starter	3345 a	29,321 a	
	p-value	0.5906	0.9067	
16	Starter	3596 a	22,631 a	
Gabriel	No Starter	3664 a	24,545 a	
	p-value	0.1958	0.2837	
17	Starter	3549 a	25,165 a	Could not harvest all four replications due to wet field conditions.
Lawrence	No Starter	3533 a	20,534 a	
	p-value	0.8430	0.1579	

Site	Treatment	Milk per ton	Milk per acre	Field notes
		lb/ton DM	lb/acre	
18	Starter	3154 a	17,007 a	Bird damage all across the field. Low stand density.
Hunter	No Starter	3277 a	14,661 a	
	p-value	0.1885	0.0932	
19	Starter	3695 a	39,234 a	
Barney	No Starter	3724 a	38,477 a	
	p-value	0.8002	0.7968	
20	Starter	3423 a	23,969 a	
Canner	No Starter	3392 a	25,041 a	
	p-value	0.7829	0.4604	
21	Starter	3706 a	30,930 a	
Young	No Starter	3560 a	29,453 a	
	p-value	0.0511	0.2569	
23	Starter	3369 a	26,836 a	
Albers	No Starter	3316 a	28,064 a	
	p-value	0.2319	0.7092	
25	Starter	3366 b	29,527 a	
Barney	No Starter	3447 a	29,604 a	
	p-value	0.0280	0.9459	
27	Starter	3350 a	21,003 a	Deer damage to field, large replication to replication differences.
Cerosaletti	No Starter	3339 a	14,991 b	
	p-value	0.8970	0.0255	
28	Starter	3270 a	22,944 a	Very variable
Gabriel	No Starter	3321 a	19,402 a	
	p-value	0.6041	0.1610	
31	Starter	3298 a	24,416 a	
Lawrence	No Starter	3276 a	19,690 b	
	p-value	0.7392	0.0355	
34	Starter	3493 a	19,465 b	Large within-field variability due to weed pressure, compaction/moisture excess, and loss of a plot at harvest time
Young	No Starter	3507 a	22,047 a	
	p-value	0.6606	0.0014	

Site	Treatment	Milk per ton	Milk per acre	Field notes
		lb/ton DM	lb/acre	
35	Starter	3337 a	20,434 a	
Boerman	No Starter	3369 a	20,085 a	
	p-value	0.5364	0.6796	

Table 7. Soil nitrate (NO_3^-) (0–8 and 0–12 inch depths), and Corn Stalk Nitrate Test (CSNT) as influenced by the amount of banded N fertilizer at planting (0 versus 30 lbs N/acre) in trials conducted in 2009 (Sites 1–7), 2010 (Sites 8–21), and 2011 (Sites 23–35). In 2011 NO_3^- determined only for 0–12 inch depth samples taken at sidedress time.

		Sidedress			Harvest			
Site	Treatment	Nitrate-N 0–8 inches lbs/acre	PSNT 0–12 inches ppm		Nitrate-N 0–8 inches lbs/acre	Nitrate-N 0–12 inches ppm	CSNT ppm	
1 Kilcer	Starter	58 b	28 b	Sufficient	11 a	6 a	827 a	Optimal
	No Starter	72 a	31 a	Sufficient	7 a	5 a	871 a	Optimal
	p-value	0.0153	0.0454		0.4120	0.6058	0.9449	
2 Lawrence	Starter	25 a	12 a	Deficient	31 a	16 a	155 a	Deficient
	No Starter	28 a	13 a	Deficient	33 a	17 a	58 a	Deficient
	p-value	0.4162	0.6871		0.5367	0.3101	0.3776	
3 Gabriel	Starter	60 a	34 a	Sufficient	63 a	27 a	5,154 a	Excess
	No Starter	52 a	30 a	Sufficient	47 a	27 a	5,017 a	Excess
	p-value	0.2289	0.1449		0.2497	1.0000	0.9264	
4 Aurora	Starter	11 b	7 a	Deficient	23 b	5 a	94 a	Deficient
	No Starter	17 a	8 a	Deficient	27 a	7 a	90 a	Deficient
	p-value	0.0344	0.4560		0.0032	0.3789	0.6206	
5 Aurora Chisel	Starter	18 a	12 a	Deficient	22 b	6 a	94 a	Deficient
	No Starter	21 a	9 a	Deficient	28 a	7 a	105 a	Deficient
	p-value	0.3483	0.0643		0.0202	0.3675	0.4889	
6 Aurora Inorganic	Starter	4 b	6 a	Deficient	16 a	4 a	160 a	Deficient
	No Starter	11 a	4 a	Deficient	18 a	5 a	208 a	Deficient
	p-value	0.0253	0.1103		0.0609	0.5770	0.4849	
7 Aurora Surface	Starter	14 a	9 a	Deficient	20 a	5 a	104 a	Deficient
	No Starter	14 a	7 b	Deficient	25 a	6 a	94 a	Deficient
	p-value	0.8759	0.0411		0.0519	0.5737	0.4782	
8 Albers	Starter	84 a	28 a	Sufficient	13 a	7 a	1,661 a	Optimal
	No Starter	79 a	27 a	Sufficient	10 a	5 b	463 b	Optimal
	p-value	0.7019	0.8693		0.0399	0.0474	0.0065	

		Sidedress			Harvest			
Site	Treatment	Nitrate-N 0–8 inches lbs/acre	PSNT 0–12 inches ppm		Nitrate-N 0–8 inches lbs/acre	Nitrate-N 0–12 inches ppm	CSNT ppm	
9	Starter	67 a	28 a	Sufficient	21 a	8 a	182 a	Deficient
Aurora	No Starter	74 a	28 a	Sufficient	20 a	9 a	99 a	Deficient
Aerway	p-value	0.2544	0.9460		0.6830	0.1106	0.3246	
10	Starter	63 a	31 a	Sufficient	22 a	9 a	80 a	Deficient
Aurora	No Starter	67 a	26 a	Sufficient	21 a	8 a	89 a	Deficient
Chisel	p-value	0.3820	0.0969		0.7320	0.2769	0.1107	
11	Starter	36 a	14 a	Deficient	18 a	8 a	827 a	Optimal
Aurora	No Starter	36 a	13 a	Deficient	18 a	7 a	669 a	Optimal
Inorganic	p-value	0.8270	0.2009		1.0000	0.3138	0.6087	
12	Starter	57 a	24 a	Borderline	21 a	8 a	129 a	Deficient
Aurora	No Starter	64 a	25 a	Sufficient	22 a	8 a	83 a	Deficient
Surface	p-value	0.1477	0.4425		0.3548	0.8090	0.2565	
13	Starter	96 a	31 a	Sufficient	20 a	10 a	1,225 a	Optimal
Wright	No Starter	76 a	33 a	Sufficient	24 a	9 a	818 a	Optimal
	p-value	0.2135	0.4282		0.6543	0.8791	0.7017	
14	Starter	124 a	55 a	Sufficient	42 a	18 a	10,135 a	Excess
Wright	No Starter	117 a	53 a	Sufficient	25 b	11 a	9,164 a	Excess
	p-value	0.7003	0.5382		0.0273	0.1265	0.3067	
15	Starter	130 a	52 a	Sufficient	158 a	44 a	7,838 a	Excess
Kilcer	No Starter	142 a	45 a	Sufficient	131 a	53 a	5,938 a	Excess
	p-value	0.7059	0.3637		0.1915	0.0566	0.2632	
16	Starter	66 a	33 a	Sufficient	40 a	33 a	2,552 a	Excess
Gabriel	No Starter	66 a	31 a	Sufficient	31 a	25 a	1,174 a	Optimal
	p-value	1.0000	0.8301		0.2038	0.2728	0.0963	
17	Starter	60 a	28 a	Sufficient	26 a	13 a	5,486 a	Excess
Lawrence	No Starter	54 a	26 a	Sufficient	25 a	14 a	2,556 a	Excess
	p-value	0.4754	0.6835		0.9667	0.3794	0.2275	

		Sidedress			Harvest			
Site	Treatment	Nitrate-N 0–8 inches lbs/acre	PSNT 0–12 inches ppm		Nitrate-N 0–8 inches lbs/acre	Nitrate-N 0–12 inches ppm	CSNT ppm	
18 Hunter	Starter	61 a	30 a	Sufficient	16 a	6 a	42 a	Deficient
	No Starter	61 a	27 a	Sufficient	13 a	6 a	61 a	Deficient
	p-value	0.8660	0.5026		0.2454	1.0000	0.0648	
19 Barney	Starter	80 a	29 a	Sufficient	30 a	14 a	4,817 a	Excess
	No Starter	81 a	33 a	Sufficient	32 a	16 a	4,164 a	Excess
	p-value	0.9320	0.5285		0.1895	0.0577	0.3765	
20 Canner	Starter	54 a	25 a	Sufficient	38 a	16 a	4,484 a	Excess
	No Starter	57 a	27 a	Sufficient	38 a	16 a	4,599 a	Excess
	p-value	0.5149	0.6124		0.9474	0.9189	0.9385	
21 Young	Starter	42 a	24 a	Borderline	67 a	24 a	9,326 a	Excess
	No Starter	50 a	23 a	Borderline	90 a	33 a	10,051 a	Excess
	p-value	0.3155	0.6856		0.5205	0.3723	0.6809	
23 Albers	Starter		48 a	Sufficient			3,449 a	Excess
	No Starter	—	44 a	Sufficient	—	—	5,872 a	Excess
	p-value		0.6172				0.1412	
25 Barney	Starter		20 a	Deficient			2,970 a	Excess
	No Starter	—	21 a	Borderline	—	—	1,353 b	Optimal
	p-value		0.6301				0.0211	
27 Cerosaletti	Starter		14 a	Deficient			434 a	Optimal
	No Starter	—	11 a	Deficient	—	—	72 a	Deficient
	p-value		0.2691				0.3376	
28 Gabriel	Starter		9 a	Deficient			724 a	Optimal
	No Starter	—	7 a	Deficient	—	—	590 a	Optimal
	p-value		0.3835				0.8224	
31 Lawrence	Starter		19 a	Deficient			704 a	Optimal
	No Starter	—	20 a	Deficient	—	—	762 a	Optimal
	p-value		0.6376				0.9397	

		Sidedress		Harvest		
Site	Treatment	Nitrate-N 0–8 inches lbs/acre	PSNT 0–12 inches ppm	Nitrate-N 0–8 inches lbs/acre	Nitrate-N 0–12 inches ppm	CSNT ppm
34	Starter					446 a Optimal
Young	No Starter	—	Not sampled	—	—	1812 a Optimal
	p-value					0.0717
35	Starter		21 a Borderline			2,129 a Excess
Boerman	No Starter	—	19 a Deficient	—	—	1,308 a Optimal
	p-value		0.1170			0.2910