What's Cropping Up?

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Cover Crop Carbon and Nitrogen Content: Fall of 2010 Sampling

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Introduction

Cover crops have received increasing interest from farmers in recent years. The reasons vary from erosion control and nutrient uptake to improved soil quality, increasing organic matter and field trafficability. As fertilizer prices continue to increase and farms aim to reduce N loss to the environment, producers are asking about the N benefits of cover crops for silage corn systems. In the fall of 2010, with Federal Formula Funds, we sampled cover cropped fields in typical field crop/dairy or vegetable rotations to determine total carbon (C) and nitrogen (N) pools just prior to snowfall. We also calculated the C:N ratio of each sample because the ratio drives N release by cover crops over time (N dynamics); once the ratio exceeds 25-30, the microbes that break down the biomass will have to take up N from other sources as the plant material itself does not have enough N to break down the biomass. This temporarily immobilizes some portion of freely available inorganic N, and can cause competition for N with crops and short-term N deficiency. If the C:N ratio is higher than 25-30, the cover crop might not contribute at all to the N supply that season, though a trade-off likely exists between short-term fertility and long-term soil benefits of plant materials that are more resistant to decomposition. If farmers terminate their cover crops when the C:N ratio is below or around 25, the biomass can quickly be broken down and release N to the soil. Here we present the results of the fall 2010 measurements take at four western NY farms.

Materials and Methods

The biomass samples were harvested from four NY dairy or cash grain farms in western NY and included 14 species of cover crops: annual ryegrass (4 samples), annual ryegrass/crimson clover mix (4), crimson clover (4), forage turnips (17), oats (22), oats/rye mix (4), peas/oats mix (4), tillage radishes (46), sorghum sudangrass (8), and triticale (24). The samples were either from individual farm fields or from actual experiments (species comparisons, method of establishment comparison).

Depending on the biomass of the species and individual plant size, either one 10 sq. ft. or two 2.14 sq. ft. frames were placed over the sample at ground level. For oats, pea/oats mixture, annual ryegrass, sorghum sudangrass, and crimson clover, only above ground biomass was sampled. For turnips and radishes, both roots and above-ground biomass were sampled and analyzed separately. All the samples were sorted by species, plant part (root or shoot) and treatment, if the field was part of a trial. Each individual sample was analyzed for total C and N.

Results and Discussion

Cover crops seeded after small grain harvest

The C:N ratio of the summer seeded cover crops ranged from a low of 11 to a high of 32. Where roots and shoots were analyzed (radishes and turnips), the roots had a larger average C:N ratio than the shoots (25 versus 13 for radishes and 21 versus 16 for turnips) (Table 1).

Nutrient Management

Table 1: Total carbon (C) and nitrogen (N) pools of summer seeded cover crops (seeded after small grain or peas) in western NY in the fall of 2010 (November sampling).					
Location	Cover crop (single species/mix)	Plant part	total C	total N	C:N
			------- lbs/acre -------		
Branton Farm					
	Oats	**shoot**	**2869**	**145**	20
	Sorghum sudangrass	**shoot**	**1375**	**83**	17
	Annual ryegrass	**shoot**	**1562**	**75**	21
	Peas/oats/radish	**total in mix**	**2188**	**128**	
	Peas/oats/radish	root (radish)	659	31	22
	Peas/oats/radish	shoot (radish)	815	72	11
	Peas/oats/radish	shoot (peas/ oats)	714	25	29
	Tillage radish	**total**	**2246**	**104**	
	Tillage radish	root (radish)	1298	41	32
	Tillage radish	shoot (radish)	948	63	16
CY Farms	**Tillage radish**	**total**	**2503**	**172**	
	Tillage radish	root (radish)	1272	59	23
	Tillage radish	shoot (radish)	1231	113	12
Lightland Farm	**Tillage radish**	**total**	**2186**	**135**	
	Tillage radish	root (radish)	975	40	25
	Tillage radish	shoot (radish)	1211	95	13
	Radish/oats	total in mix	2170	**112**	
	Radish/oats	root (radish)	407	18	22
	Radish/oats	shoot (radish)	750	62	12
	Radish/oats	shoot (oats)	1013	32	32
	Turnip/oats	**total in mix**	**2185**	**126**	
	Turnip/oats	root (turnip)	57	4	14
	Turnip/oats	shoot (turnip)	910	78	12
	Turnip/oats	shoot (oats)	1218	44	28
	Oats	shoot	2825	**119**	24
	Forage turnip	**total**	**2096**	**110**	
	Forage turnip	root (turnip)	288	11	27
	Forage turnip	shoot (turnip)	1808	99	19
	A. Ryegrass/crimson clover	**shoot**	**1558**	**103**	15
	Crimson clover	**shoot**	**1094**	**84**	13
	Sorghum sudangrass	**shoot**	**882**	**66**	13

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Total C pool ranged from a low of 882 lbs C/acre for above ground biomass of sorghum sudangrass (unfertilized) to a high of 2825 and 2869 lbs C/acre for two pure stands of oats (two farms, above ground biomass). Total above ground N pool ranged from a low of 66 lbs N/acre for the sorghum sudangrass stand to a high of 172 lbs N/acre for the tillage radishes seeded after peas at CY Farms. For tillage radishes, roots contained on average, 51% of the total C and 34% of the total N with the remainder in the above ground biomass. At Branton Farms, oats had the greatest N uptake in the above ground biomass (145 lbs N/acre). At Lightland Farm, the oats and turnip and oats mixture showed the highest total N uptake in the above ground biomass (119 lbs N/acre for the oats and 122 lbs N/acre for the turnip and oats mixture). The tillage radishes had 30% of its total N uptake in the roots for an overall N uptake of 135 lbs N/acre. It is unknown how large the root C and N pools were for oats. It should be taken into account that with root sampling it is difficult to obtain all roots and that in some of the mixtures, we did not always obtain root biomass for all species so the actual percentage of root biomass and C and N pools is likely somewhat higher than we report here.

Cover crops seeded after corn silage harvest

The cover crops that were seeded after corn silage harvest showed C:N ratios with slightly higher values for roots than shoots as well (similar to the summer seeded cover crops) but considerably lower C and N pools (Table 2), reflecting a shorter growing season.

The total C pool ranged from 271 lbs C/acre and 21 lbs N/acre for an oats/rye mix to 372-434 lbs C/acre and 27-29 lbs N/acre for triticale, suggesting an average N uptake by fall seeded cover crops of 20-30 lbs N/acre (fall of 2010).

Table 2: Total carbon (C) and nitrogen (N) pools of fall seeded cover crops after corn silage harvest in western NY in the fall of 2010 (November sampling).

Location	Cover crop (single species/mix)	Plant part	total C	total N	C:N
			------- lbs/acre -------		
CY Farms	**Oats**	**shoot**	**367**	**25**	16
	Radish/oats	**total for mix**	**308**	**29**	
	Radish/oats	root (oats)	39	3	14
	Radish/oats	shoot (oats)	108	10	10
	Radish/oats	root (radish)	44	4	13
	Radish/oats	shoot (radish)	117	12	10
	Radish/oats	oats %	48	45	
	Radish/oats	radish %	52	55	
	Triticale-drilled	**total**	**434**	**29**	
	Triticale-drilled	root	84	3	25
	Triticale-drilled	shoot	350	26	13
	Triticale-airflow	**total**	**394**	**28**	
	Triticale-airflow	root	70	3	23
	Triticale-airflow	shoot	324	25	13
	Triticale	**total**	**372**	**27**	
	Triticale	root	82	4	21
	Triticale	shoot	290	23	13
	Oats/rye	**total**	**271**	**21**	
	Oats/rye	root	57	3	21
	Oats/rye	shoot	214	18	12

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The percentage of total C in the below ground biomass was considerably higher for the summer seeded cover crops (average of 47% of total C and 31% of total N in roots for summer seeded cover crops) than it was for the fall seeded cover crops where most of the C and N (73-82% of the total C pool and 76-90% of the total N pool) were in the above ground biomass.

Summary and Conclusions

Nitrogen uptake for summer seeded cover crops (after small grain harvest) was considerably higher than for fall seeded cover crop (after corn silage harvest) illustrating the importance of early seeding for fall N uptake. The actual N uptake and N benefits of overwintering cover crops might be considerably larger than suggested by the fall sampling and for those species spring growth should be taken into account. Such studies are currently ongoing for the plots at Van Slyke's, Branton Farm and Lightland Farm as well as at the Valatie Research Farm in eastern NY (wheat, triticale, rye). Weekly soil sampling is ongoing as well to determine N release to the soil for 6-8 weeks after turnover/kill of the cover crop.

Acknowledgments

This work is supported with Federal Formula Funds and a grant from the Environmental Protection Agency (EPA). For questions about the cover crop biomass and carbon and nitrogen content sampling contact Quirine M. Ketterings at 607-255-3061 or qmk2@cornell.edu, and/or visit the Cornell Nutrient Management Spear Program website at: http://nmsp.cals.cornell.edu/.

Seeding Rates Studies for Soft Red and White Winter Wheat Planted in September

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Crop Management

Wheat prices remain strong ($7.75/bushel in early-September of 2011) so wheat acreage has increased in NY as many growers no longer consider wheat exclusively as a rotation crop but more and more as an important cash crop. In addition, the wet spring of 2011 prevented some growers from planting their entire corn crop and most of the non-planted corn acres will be planted to wheat in September. We initiated a 3-year seeding rate study in 2008-2009 on two soft red winter wheat varieties (25R47 and 25R62) from Pioneer Hi-Bred to help growers determine the optimum seeding rate for soft red winter wheat planted in late September. Seeding rates evaluated included ~745,000, 1,030,000, 1,320,000, 1,510,000, and 1,875,000 seeds/acre, which corresponded to ~1.0, 1.4, 1.7, 2.0, and 2.5 bushels/acre, respectively. In addition, we included 25W36, a soft white wheat variety from Pioneer Hi-Bred, in the study. We applied Harmony Extra in the fall for weed control in two of the years and in all three years we applied approximately 70 lbs/N acre in April.

When averaged across the three growing seasons of the study, regression analyses indicated that 25R47 had maximum yield at ~1,320,000 seeds/acre, close to the seed company's recommended rate of 1,400,000 seeds/acre (Table 1). In contrast, 25R62 had a maximum yield at ~1,030,000 seeds/acre, about 400,000 seeds/acre less than the current recommended rate (Table 1). Furthermore, this variety did not respond to seeding rates in the last two years of this study. The data indicate that current soft red winter wheat varieties planted in late September in NY exclusively for grain should be seeded at somewhere between 1,000,000 and 1,300,000 seeds/acre.

Many growers in NY, however, also harvest wheat straw because of the strong demand by nearby dairy producers, which makes the wheat crop even more profitable. In contrast to grain yields, straw yields of 25R47 and 25R62, when averaged across the three growing seasons, had maximum yield at ~1,510,000 seeds/acre, mainly because of the more positive response to seeding rates in the last two growing seasons (Table 1). The price of wheat straw averaged about $150/ton in NY in July-August of 2011 so NY wheat growers should also pay particular attention to the response of straw yields to seeding rates.

Up until the last 10 years, soft white winter wheat varieties dominated NY wheat acreage and recommended seeding rates for a September planting date was ~2 bushels/acre. The

Table 1. Grain and straw yield of two Pioneer Hi-Bred soft red winter wheat varieties (25R47 and 25R62) planted in late September at seeding rates of around 0.75 1.0, 1.3, 1.5, and 1.9 million seeds/acre at the Aurora Research Farm in the 2008-09, 2009-10, and 2010-2011 growing seasons.

	25R47				25R62			
Seeding Rate	9/23/08	9/21/09	9/20/10	Avg.	9/23/08	9/21/09	9/20/10	Avg.
seeds/acre (bu/acre)	----------------Grain Yield (bu/acre)							-----------------
745,000 (~1.0)	**94**	80	82	85	95	**84**	**80**	86
1,030,000 (~1.4)	92	72	**88**	84	**105**	81	81	**89**
1,320,000 (~1.7)	95	**84**	88	**89**	105	79	82	89
1,510,000 (~2.0)	93	81	85	86	93	85	76	85
1,875,000 (~2.5)	98	76	85	86	102	83	73	86
	----------------Straw Yield (tons/Acre)							-----------------
745,000 (~1.0)	**2.6**	2.7	2.4	2.6	**2.1**	2.3	2.5	2.3
1,030,000 (~1.4)	2.2	2.8	2.8	2.6	2.1	2.5	2.5	2.4
1,320,000 (~1.7)	2.3	**2.9**	2.7	2.6	2.0	2.4	2.7	2.4
1,510,000 (~2.0)	2.4	2.9	**3.0**	**2.8**	2.2	**2.7**	**3.0**	**2.6**
1,875,000 (~2.5)	2.5	2.9	2.9	2.8	2.3	2.7	3.0	2.7

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latest soft white winter wheat variety from Pioneer Hi-Bred, 25W36, had maximum grain and straw yields at ~1,375,000 seeds/acre when averaged across the three growing seasons (Table 2). This corresponded to a seeding rate of about 1.8 bushel/acre, close to the recommended seeding rate. It is interesting to note that the soft white variety had a more consistent response to seeding rates across the three years than the two soft red varieties.

Conclusion

If NY wheat growers are marketing only the grain, seeding rates for soft red winter wheat varieties should range from ~1,000,000 to 1,300,000 seeds/acre if planting the crop in mid to late September. If soft red winter wheat producers also harvest and market the straw, seeding rates should be ~1,500,000 seeds/acre for a September-planted crop. In 2010-2011, we did observe increased lodging at seeding rates above 1,375,000 seeds/acre, which probably contributed to the yield decline at the higher seeding rates for grain yields in the soft red winter varieties (although straw yields continued to increase). A soft white winter variety, 25W36, had mostly consistent maximum grain and straw yields at ~1,375,000 seeds/acre (~1.8 bushel/acre) across growing seasons so higher seeding rates are not required for September-planted wheat. Although many NY wheat growers plant greater than these recommended seeding rates, yields are seldom increased. In addition, the risk of lodging and disease pressure increases at higher rates so growers should not pay a higher seed cost/acre to increase lodging and disease pressure.

Table 2. Grain yield and straw yield of a Pioneer soft white winter wheat variety (25W36) planted in September at seeding rates of around 0.75, 1.1, 1.4, 1.6, and 1.9 million seeds/acre at the Aurora Research Farm in 2008-09 and 2009-10, and 2010-2011 growing seasons.

	GRAIN YIELD				STRAW YIELD			
Seeding Rate	9/23/08	9/21/09	9/20/10	Avg.	9/23/08	9/21/09	9/20/10	Avg.
seeds/acre (bu/acre)	-----------bu/acre-----------				---------tons/acre----------			
775,000 (~1.0)	89	74	65	76	2.2	2.4	2.5	2.4
1,075,000 (~1.4)	89	84	67	80	2.3	2.4	2.7	2.5
1,375,000 (~1.8)	**96**	**86**	**75**	**86**	**2.5**	**2.8**	2.7	**2.7**
1,575,000 (~2.1)	88	83	76	82	2.3	2.7	2.7	2.6
1,950,000 (~2.6)	96	82	77	85	2.4	2.7	**3.0**	2.7

Effect of Timing of Nitrogen Application on Corn Stalk Nitrate Test (CSNT) Results

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Nutrient Management

Introduction

In 2007, the late season Corn Stalk Nitrate Test (CSNT) was introduced to evaluate the adequacy of N supplied during the growing season. New York field trials indicated optimal N supply if the CSNT was between 250 and 2000 ppm, while less than 250 ppm suggested insufficient N, and over 2000 ppm was indicative of more N than the crop needed that season (http://nmsp.cals.cornell.edu/publications/factsheets/factsheet31.pdf). This test is one way growers can apply adaptive management techniques by using it to make site-specific adjustments in N fertility management for corn over time.

In 2010, a study was conducted at the Musgrave Research Farm (Aurora, NY) to evaluate the impact of the timing of N fertilization and timing of sampling on CSNT-N. This study addressed the questions: “Do timing of N application and timing of sampling impact CSNT-N”?

Table 1: Initial soil fertility at the Musgrave Research Farm, Aurora, NY. The soil type is predominantly Lima silt loam (SMG 2). M=Medium, H=High, VH=Very High and D=Deficient.							
Previous crop	pH	OM	P	K	Mg	Ca	ISNT
		%	-------------------- lbs/acre --------------------				ppm
Corn	7.9	1.9	10 (H)	140 (H)	545 (VH)	5380	156 (D)
Soybean	7.8	2.4	8 (M)	90 (M)	620 (VH)	8310	192 (D)

Methods

Two adjacent fields were chosen, one planted to corn in 2009, the other to soybeans. Soil samples were taken (0-8 inch depth) prior to fertilizer application (Table 1) and prior to N application at sidedress time (0-12 inch) (Table 2). Both fields exhibited very low Illinois Soil Nitrogen Test (ISNT) results indicating that the sites would respond to additional N.

Urea was applied on both fields on 5/6/10 at a rate of 150 lbs N/acre and incorporated with a chisel plow and a field cultivator. Both fields were planted on 5/10/10 with Dekalb DKC42-91 (32,000 seeds/acre). Corn was planted with a starter of 200 lbs/acre of 15-15-15. Four sidedress treatments (timing of application) were implemented in addition to a no-sidedress control; 150 lbs N/acre was sidedressed on 6/24/10, 7/1/10, 7/8/10 or 7/22/10 using urea. The sidedressed urea was surface applied using an EarthWay 1001-B Precision Garden Seeder with a fertilizer attachment and then lightly incorporated with a hoe. The high N rates were chosen to ensure sufficient N with the control treatment so we could evaluate the impact of amount and timing of excess N application on CSNT. Plots were 300 ft. long by 10 ft. wide. There were 2 repetitions in the former corn field and 3 in the former soy field. Weekly CSNT and whole plant moisture samples were taken from 8/19/10 until after grain harvest on 11/5/10. Plots were harvested on 11/2/10 using a Case IH 2144 combine with a yield monitor. Grain samples were taken and dried at 150^{o}F to determine moisture content.

Results and Discussion

Timing of application

The additional 150 lbs N/acre in sidedress N did not increase yield (Table 2). This lack of a yield increase with sidedress N and a CSNT of 1648 ppm (optimal) for the control plots indicate that the initial application of 150 lbs N/acre at planting plus the 30 lbs/acre starter application provided sufficient N at this location (Table 2).

The additional sidedress N applications on 6/24 increased CSNTs (averaged over all sampling times) from 1232 ppm to just over 2000 ppm. Applications on 7/8 and 7/22 did not increase CSNT as compared to the control, while the 7/1 application showed a lower CSNT than the control (Table 3).

In addition to 4.7 inches of rain from planting until 6/24, rain followed within 2 days of each N application date except 7/1. The rainfall totals for the week after

Table 2. Corn grain yield, plant population, PSNT (0-12 inch depth), and corn stalk nitrate test (CSNT; averaged over all sampling dates) (<250 ppm=deficient, 250-2000 ppm=Optimal, >2000 ppm=excess) as impacted by the timing of sidedress N application at the Musgrave Research Farm at Aurora, NY. The PSNT samples were taken 6/9-6/10, prior to the sidedress applications and reflect the broadcast N application at planting.				
N timing	Yield	Plant population	PSNT	CSNT
	bu/acre	plants/acre	ppm	ppm
Control	163 a	30,318 ab	43 a	1232 b
6/24/2010	163 a	29,795 ab	37 a	2002 a
7/1/2010	154 a	28,750 b	34 a	850 c
7/8/2010	161 a	30,492 ab	37 a	1350 b
7/22/2010	161 a	30,710 a	39 a	1331 b

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Table 3: Stalk nitrate concentration as influenced by timing and moisture content (MC). The same letter within a row implies no significant difference. Optimal silage harvest time was the last week of August.						
Week	Date	Corn stalk nitrate test				
		------------------------------ NO_3-N ppm----------------------------				
	Control	Control	6/24	7/1	7/8	7/22
1	8/19/2010	1477 ab	1807 a	1162 b	1491 ab	1387 ab
2	8/27/2010	1648 a	2216 a	1154 a	1903 a	1797 a
3	9/03/2010	1303 ab	2167 a	1007 b	1502 ab	1226 ab
4	9/10/2010	1302 a	1888 a	1116 a	1530 a	1385 a
5	9/17/2010	1248 ab	2569 a	644 b	1432 ab	1365 ab
6	9/24/2010	1024 b	1943 a	721 b	1403 ab	1177 ab
7	10/01/2010	1645 a	2197 a	799 a	1540 a	1171 a
8	10/08/2010	940 a	2120 a	1079 a	1364 a	1819 a
9	10/15/2010	986 ab	1972 a	714 b	1428 ab	1133 ab
10	10/22/2010	940 a	1490 a	564 a	1051 a	1151 a
11	11/02/2010	877 ab	2179 a	664 b	791 a	1077 a
12†	11/05/2010	1392 a	1471 a	573 a	763 a	1265 a
Average across dates		1232 b	2002 a	850 c	1350 b	1331 b
† Samples taken post grain harvest.						

sidedressing were 1.6, 1.6, and 2.1 inches for the 6/24, 7/8 and 7/22 applications, respectively. Rain following the 7/8 application was mostly from a single 1.6 inch event. The total monthly rainfall was above average for June, July and August.

The lack of rainfall the week after N sidedressing on 7/1 might have caused some N volatilization loss explaining lower CSNTs than for 6/24, 7/8, and 7/22 but volatilization losses would not explain why the CSNT of corn that was sidedressed 7/1 was lower than for plots that did not receive any sidedress N application at all. Therefore, it is more likely that the plots that were sidedressed on 7/1 already had lower available N levels at PSNT time than the control (reflected in the PSNT values). The lack of an increase in CSNT with sidedressing late in the season more likely reflects a lack of excess N uptake later in the season (relocation of N

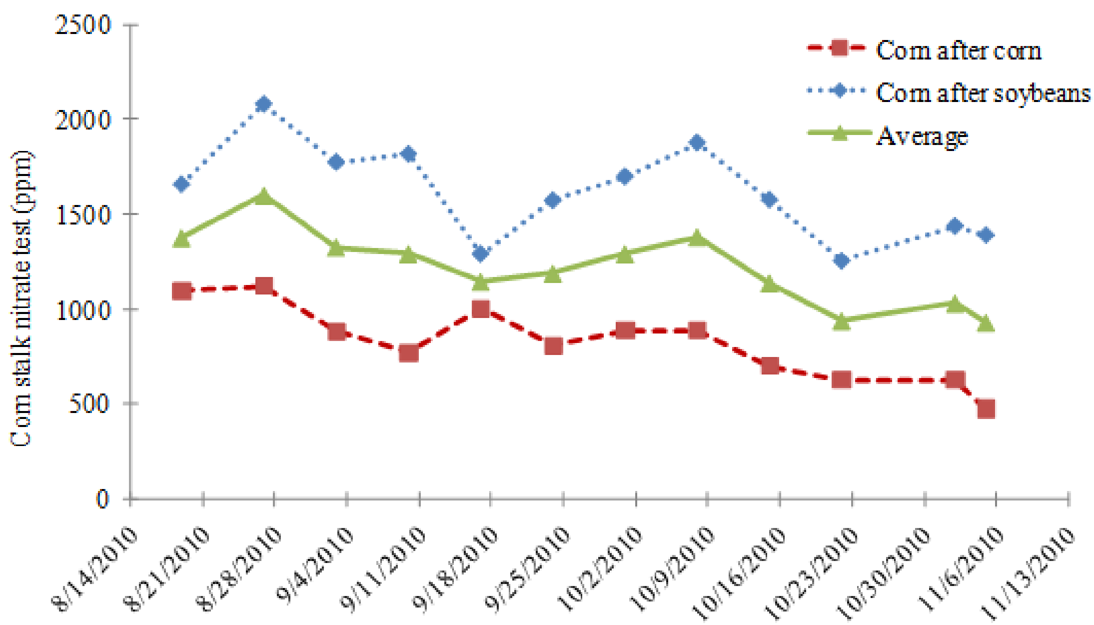

Figure 1: Corn stalk nitrate test as impacted by date of sampling.

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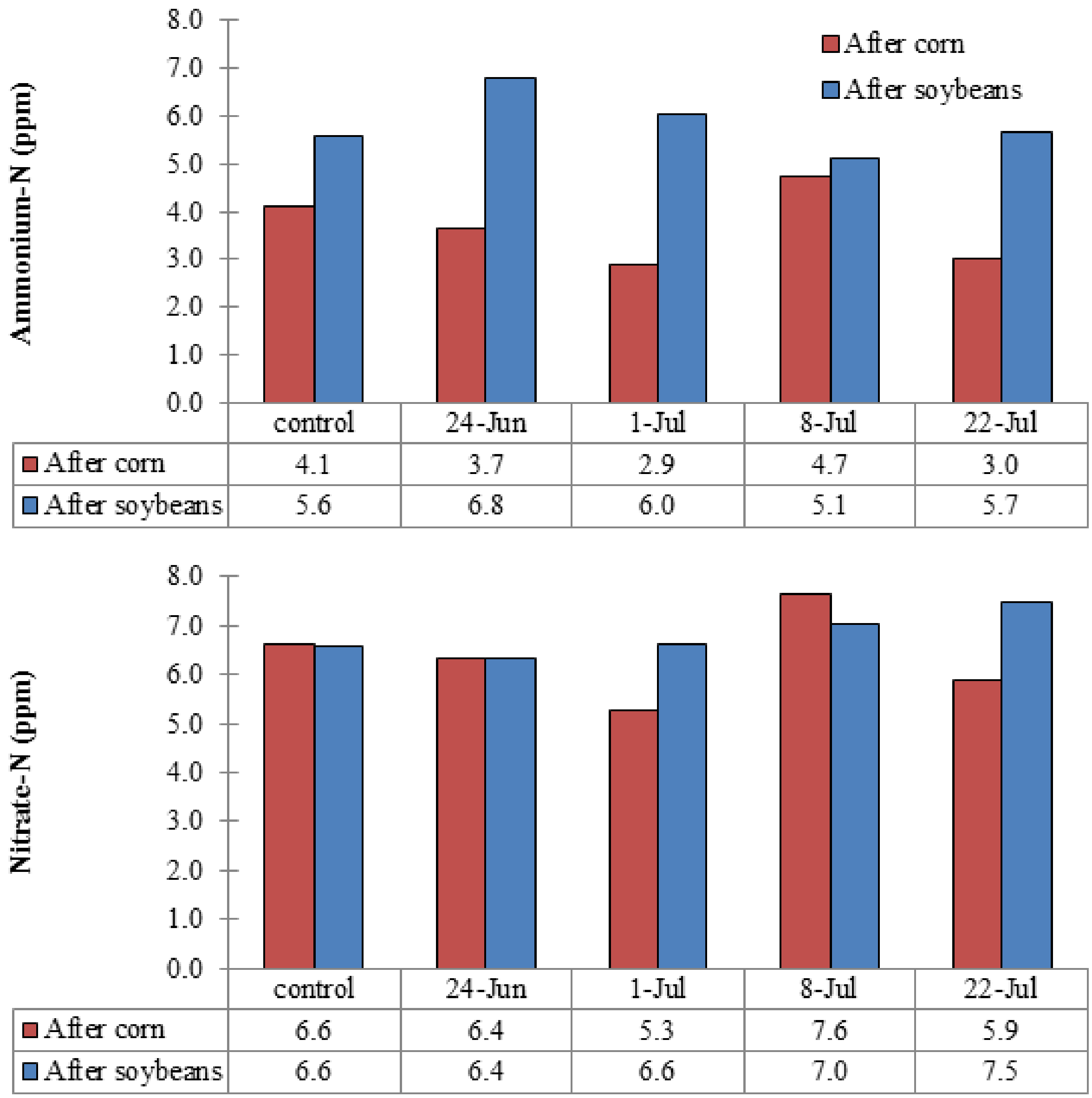

Figure 2: Ammonium-N and nitrate-N in April of 2011.

already in the plant rather than additional uptake) and suggests that available N during the rapid growth portion of the corn growing season might determine CSNTs. This hypothesis needs to be tested using a diversity of fields and field histories.

Timing of sampling

Across all treatments, CSNT results did show a significant decline with samples taken after mid-October when whole plant moisture contents were less than 35% (Figure 1). This decline was more consistent for corn after corn than for corn after soybean. The change in CSNT was, averaged over all treatments, not large enough to impact the interpretations of the CSNT results.

Sampling of the 0-8 inch soil layer in April of 2011, illustrated no carryover of the previous year's urea applications but higher ammonium-N levels where soybean preceded the 2010 corn crop rather than corn (Figure 2).

Conclusion

Timing of N application did not impact yield or CSNT in this experiment; yields in control plots were comparable to those that received the extra N, independent of timing of application. Thus, the initial broadcast and starter N applications were adequate. The CSNT trends over time indicate a decline in values for samples taken after mid-October when whole plant moisture content was below 35%. Sidedressing on 6/24 increased CSNTs reflecting the extra N beyond what was needed for the corn. The CSNTs were similar to or lower than the control on any of the other sidedress timings.

Acknowledgements/Information

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Variability of Corn Stalk Nitrate Test Results as Impacted by Variety (BMR versus Conventional)

Nutrient Management

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Introduction

The late season corn stalk nitrate test (CSNT) is an excellent "post-season" evaluation tool for nitrogen (N) management. It allows for field-by-field fine-tuning of N rate over time (a component of "adaptive nitrogen management"). Field work in New York suggested optimum economic yields were achieved when the CSNT value was between 250-2,000 ppm. If the CSNT exceeded 2,000 ppm, yields were no higher, but the corn likely had access to more N than needed (http://nmsp.cals.cornell.edu/publications/factsheets/factsheet31.pdf). These are fields where a reduction in N application might be possible without impacting yield. Values less than 250 ppm suggested N was deficient (unless the field was first year corn after sod). As CSNTs reflect the growing conditions for the season and there is within field variability that adds to uncertainty in the numbers, we recommend monitoring fields for CSNT for 2-3 years if values are less than 5,000 ppm before deciding on changes in N management. However, if CSNTs exceed 5,000 ppm, N reductions can be made the next year.

Observations from the 2009 growing season CSNT database suggested that a higher percentage of brown midrib (BMR) corn varieties test above the optimum range for CSNT; 37% of conventional corn field samples had CSNTs exceeding 2000 ppm, versus 62% for BMR corn. As samples were collected randomly across numerous fields, we could not conclude whether the data reflected differences in field or fertility management or inherent differences between BMR and non-BMR corn. In fall 2010, we sampled variety trials for CSNTs to answer the question: "Is there a difference in CSNT of BMR and non-BMR corn when grown on the same field?"

Materials and Methods

Variety trials were sampled at ten different locations throughout New York State, including one location with 19 varieties, two with 18, one each with 15, 14, and 10, and two each with 6 and 4 varieties. Varieties differed among sites. At one site, the variety trial included conventional corn only (Site C). All other sites differed in the number of BMR varieties in the dataset from 50% of the varieties that were sampled to 20% of the varieties. At one location, there were two replications per variety (Site B) while for all other trials; conventional single treatment strip plots were used. To obtain a reliable estimate of CSNT for each variety, four composite samples of 6 stalks each were taken about 50 yards apart along the length of the plots at all locations except location C. This does not result in true replicates but allows for generation of a more reliable estimate for each of the varieties in the strip. Stalk samples were taken just prior to harvest, using the standard protocol for sampling (6 and 14 inches above the ground, processed for nitrate-N). Yield data were collected by the farms and seed companies (one value per variety within a Site).

For the statistical analyses, each Site was considered a single replication of two treatments (BMR versus non-BMR corn). In this assessment, site C was not included, as this location did not include BMR corn varieties. A means comparison was done across the remaining 9 locations using PROC MIXED with variety as fixed effect and Site as random effect. We also evaluated if yield impacted the CSNT levels. Two sets of analyses were done: one with all nine locations included, and one without Site A included. The latter assessment was done as this was the only location where the average CSNT exceeded 5,000 ppm.

Results

Yield and CSNT data for each of the individual sites showed considerable variability among varieties within the same field and among locations. In this study, CSNTs ranged from 53 ppm to a little over 12,000 ppm (Figure 1).

The variability in CSNT among BMR varieties in a trial was comparable to the variability in CSNT for conventional varieties. At one location, the field average CSNT (across all varieties) exceeded 5,000 ppm (Site A). At five locations, the average CSNT was less than 2,000 ppm while at three sites CSNTs exceeded 2000 ppm but were less than 5,000 ppm (Table 1).

A direct comparison of means across the 9 locations with both BMR and non-BMR corn showed a trend towards higher values for BMR corn (P=0.14). Because some variability in CSNT for fields with CSNTs exceeding 5,000 ppm would not impact the final recommendations for the field, we conducted the same analyses without Site A included. This analysis showed that in the desirable agronomic range, the CSNT of BMR corn is significantly greater than for non-BMR corn when grown on the same field.

These findings raise questions about the cause of the higher CSNT values for BMR corn when grown on the same field. In this study, on average, the average yield of the BMR varieties was somewhat lower than for the non-BMR varieties. Both types of corn had similar access to N during the year, so the higher CSNTs for BMR corn could reflect lower yield and/or maybe truly reflect that the corn had access to more N than it needed that season. On the other hand, it is also possible that higher numbers for BMR corn reflect greater N uptake efficiency or accumulation (higher whole plant crude protein and/or accumulation in the lower portion of the stalk) without requiring less (or more) N for optimum yield. We cannot answer these questions without field trials that evaluate CSNTs at the optimum economic N rate for BMR corn versus non-BMR corn grown on the same field and with the same field fertility management. However, our dataset allows for a tentative assessment of the relationship between yield and CSNT

Nutrient Management

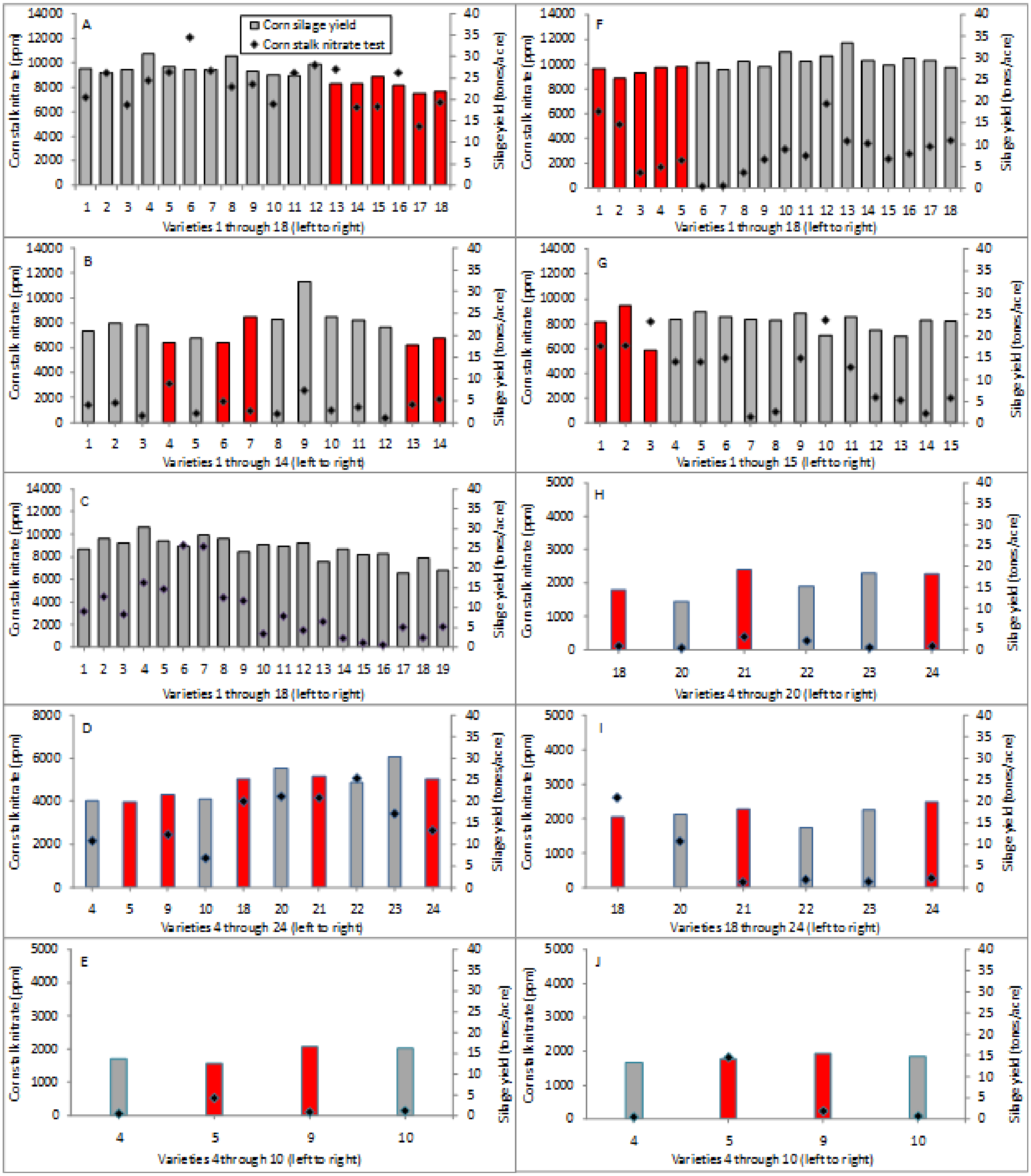

Figure 1: Corn stalk nitrate test (CSNT) results for corn silage grown as part of variety trials conducted at ten different locations (Sites A through J). Varieties differed per site. The varieties in red are BMR varieties; all others are conventional corn varieties (i.e. non-BMR).

Table 1: Means comparison of corn stalk nitrate test (CSNT) for conventional, non-brown midrib (BMR) corn varieties and BMR corn varieties grown in corn variety trials across 9 farm sites.			
	--------------CSNT (ppm) --------------		
Site	**NonBMR**	**BMR**	**Interpretation difference?**
A	8,633	7,438	No
B	3,261	4,285	No
D	66	1,026	Yes
E	99	320	Yes
F	3,421	6,844	No
G	135	211	No
H	755	815	No
I	2,784	3,300	No
J	1,108	2,046	Yes
Average all sites	**2,251 a**	**2,921 a**	**P=0.14**
Average without Site A	**1,454 b**	**2,356 a**	**P=0.05**

(limited number of Sites). Figure 2 shows this relationship between yield and CSNT for BMR corn (red squares) and for non-BMR corn (grey triangles). Using a polynomial to plateau model, this figure gives us some confidence that the optimum CSNT range for BMR corn is not difference from the optimum range for non-BMR corn although N response trials should be conducted to test this hypothesis; in this study both BMR and non-BMR corn showed no increase in yield with CSNTs is excess of 3,000 ppm.

Conclusions

The results of this study reaffirm that when the N needs of the corn are met, CSNTs will increase without an accompanying increase in yield. For fields with CSNTs<5000 ppm, BMR varieties tend to be higher in CSNT than non-BMR varieties but this initial assessment also illustrates no difference between BMR and non-BMR corn in the CSNT value beyond which a yield response is unlikely. The most useful aspect of the CSNT is its ability to identify fields with great potential for

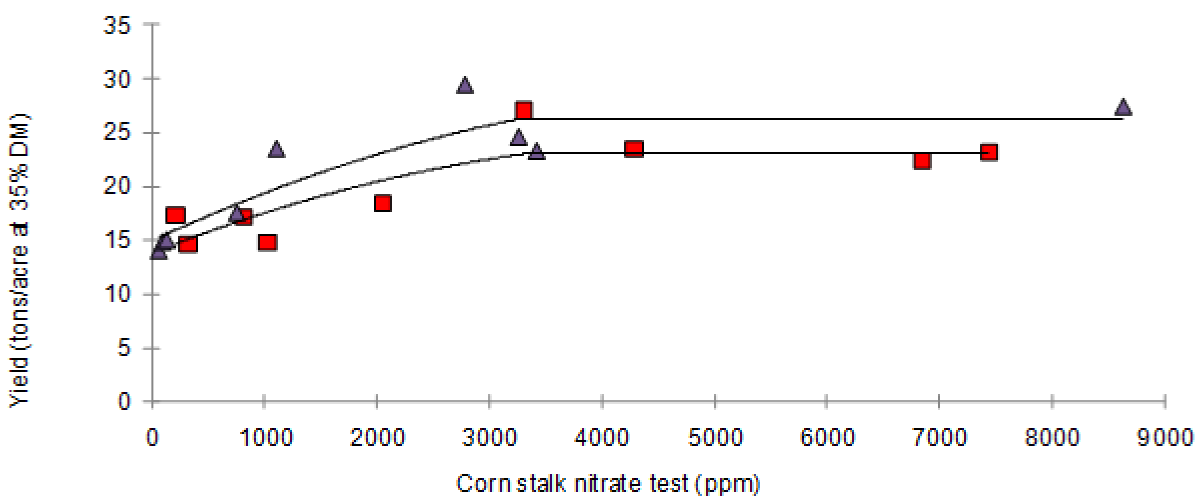

Figure 2: Relationship (polynomial to plateau models) between corn stalk nitrate test results and corn silage yields for brown midrib corn (BMR, red squares) and non-BMR corn (grey triangles). Data were averages of BMR corn varieties and non-BMR varieties sampled in nine un-replicated corn variety trials in western and central New York (Table 1).

savings in N fertilizer. Independent of corn variety and type, for fields with CSNTs >5000 ppm, N rates can be reduced. For fields with a CSNT between 2000 and 5000 ppm, there could be an opportunity for saving in N fertilizer but it is recommended to sample these fields multiple years prior to making any management changes.

Acknowledgments and For Further Information

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Flowering Time Applications of Triazole Fungicides Reduce Vomitoxin Levels in Wheat

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Disease Management

Vomitoxin (also known as deoxynivalenol or DON) is a toxin produced in wheat grain by the fungus *Fusarium graminearum.* This fungus infects wheat heads and causes the disease we know as Fusarium head blight (FHB). Even wheat heads without visible symptoms of FHB during the grain filling period can yield grain with significant levels of DON. Ingestion of DON at milligrams of toxin per kilogram (i.e., parts per million) of dietary intake can cause severe gastro-intestinal problems, including vomiting, in humans, dogs, cats, swine and other animals with simple stomachs. Ruminants and poultry are less sensitive to low amounts of DON. The United States Food and Drug Administration guidelines specify that wheat food products for human consumption should contain less than one part per million (ppm) of DON. To achieve this standard, flour mills routinely test every truckload of wheat for DON and in general only purchase wheat containing less than 2 ppm of

Table 1. Vomitoxin contamination level (parts per million) in winter wheat produced at the Musgrave Research Farm in Aurora, NY in replicated experimental plots sprayed at flowering (Feekes stage 10.5.1) with triazole fungicide or not treated. Triazole treatments were Caramba SL (13.5 fl. oz. per acre, contains metconazole) and Prosaro SC (6.5 fl. oz. per acre, contains prothioconazole and tebuconazole) applied according to product labels.

Year and experiment:	Variety >	Caledonia (SWW)	Jensen (SWW)	Richland (SWW)	Pioneer 25R47 (SRW)	Freedom (SRW)	Truman (SRW)
	Fungicide:						
2007 A	none	0.0	0.0	-	-	0.0	0.0
	Prosaro	0.0	0.0	-	-	0.0	0.0
2007 B	none	0.4	0.0	-	-	0.0	0.0
	Prosaro	0.1	0.0	-	-	0.0	0.0
2008 A	none	0.2	0.0	-	-	0.2	0.2
	Prosaro	0.1	0.0	-	-	0.1	0.2
2008 B	none	0.7	0.4	-	-	0.2	0.2
	Prosaro	0.1	0.2	-	-	0.2	0.1
2009 A	none	-	3.1	1.1	1.6	-	2.3
	Prosaro	-	1.3	1.6	1.2	-	0.7
2009 B	none	-	48.8	22.8	20.4	-	13.5
	Prosaro	-	26.4	19.5	10.1	-	12.6
2010 A	none	-	12.1	5.5	3.5	-	1.1
	Prosaro	-	2.0	1.4	0.5	-	0.2
	Caramba	-	4.2	2.0	0.8	-	0.3
2010 B	none	-	8.9	3.8	3.3	-	1.6
	Prosaro	-	2.7	1.7	0.6	-	0.3
	Caramba	-	3.8	1.9	0.8	-	0.5

Disease Management

DON. Development of FHB and contamination of grain by DON are very common in the humid production environments of the Northeast, but they are also highly variable from year to year and between locations/environments within a year (illustrated by data in Table 1). The level of DON in wheat grain is affected by many cropping and environmental factors, most notably by the persistence of surface moisture on heads from rainfall and dew during the period from flowering through soft dough stages of kernel development and by the inherent susceptibility of the wheat variety.

No wheat variety currently grown in our region has a high level of resistance to FHB and DON accumulation, so additional control measures such as triazole fungicides are needed for integrated management when conditions favor disease and toxin. We have been evaluating registered triazole fungicides applied to wheat at the initiation of flowering (Feekes growth stage 10.5.1) for their effectiveness in reducing vomitoxin contamination to acceptable levels under a range of environmental conditions and with different varieties of wheat (Table 1). Two currently registered triazole products, Caramba SL (13.5 fl. oz. per acre, contains metconazole) and Prosaro SC (6.5 fl. oz. per acre, contains prothioconazole and tebuconazole) have shown excellent utility in lowering the levels of DON in grain.

Experience in New York and elsewhere suggests that these triazole fungicides are most effective when applied to a wheat variety, such as Truman, with a moderate level of resistance to both FHB and vomitoxin accumulation. Available designations of variety reaction to FHB (based primarily on disease symptoms) do not always fully reflect the potential for toxin contamination. Progress has been made in reducing the acreage of varieties such as Caledonia that are highly susceptible to disease and with very high potential for DON contamination. Many of our top-yielding varieties are at least moderately susceptible to FHB and toxin accumulation. A goal for the future is to produce high yielding varieties with increased resistance at the level of Truman or better. We are continuing our integrated management experiments with varieties and triazole fungicides and are awaiting DON data from our 2011 integrated experiments involving the red winter wheat varieties Otsego, Pioneer 25R47, SW 80, and Truman. Follow www.fieldcrops.org for updated results.

Caramba or Prosaro applied at flowering also protect flag leaves against leaf rust, leaf blotches, and powdery mildew during critical early grain filling stages. In summary, these materials are the current fungicides of choice for application at flowering for protecting wheat against foliar and head diseases while reducing the risk of vomitoxin contamination in grain.

Reduced Rates of Residual Herbicides Prevent Dandelion Establishment in Zone-Tillage Corn and Soybeans

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Weed Management

Concerns about energy costs, and about soil health and conservation have led to increased acreages of zone/no-tillage corn and soybeans in NY State. This shift in tillage practices can affect the types of weeds in a field. While winter annual, biennial, and simple perennial weeds do not survive primary and secondary tillage associated with conventional tillage systems, these weeds can become a problem in zone/no-tillage cropping systems. Because they live for many years, simple perennials like dandelions are among the most problematic.

Dandelions are considered simple perennials because they spread by seed only, unlike many perennials that spread both vegetatively and by seed. Perennial forages, most commonly legume/grass mixtures, are a common component of NY dairy farm rotations and are often infested with dandelions. Dandelions produce abundant seed and each seed has a tuft of hairs that facilitate wind dispersal to adjacent fields. While dandelions have always been a problem with continuous zone/no-tillage row crop production, this problem has increased with the widespread popularity of glyphosate resistant (GR) corn and soybeans. In the U.S., about 94 and 72% of soybean and field corn acreage respectively was planted to GR varieties/hybrids in 2011. All too often, glyphosate, a non-residual herbicide, is used alone on these GR crops. While glyphosate will control seedling dandelions, much of the dandelion germination and establishment occurs after early season glyphosate applications. Glyphosate is much less effective controlling established dandelions in subsequent growing seasons. Residual herbicides that would prevent dandelion establishment are not always used in these GR crops, especially in GR soybeans.

Perennial forages serve as a source of dandelion seed for adjacent zone-tillage fields.

Rotation Experiment Established

A corn/soybean rotation experiment was established near Aurora, NY in 2010 to document the value of residual herbicides in preventing dandelion encroachment into zone-tillage fields, and to determine whether this can be accomplished with reduced rates of residual herbicides. The field was plowed in the fall 2009 to eliminate established dandelions. In this multi-year experiment, five crop rotations serve as main plots of corn or soybeans (12 rows by 300 ft.) as shown in Table 1. Sub-plots (12 rows by 75 ft.) within crops are treated with glyphosate alone or in combination with one-half, two-thirds, or full labeled rates of residual herbicides. Corn sub-plots were treated early postemergence (EPO) with 22 fl oz/A Roundup PowerMax (Roundup) alone or tank-mixed with 1.25, 1.66, or 2.5 qt/A of Lumax for residual activity. Soybean main plots were split into two six-row strips so two residual programs could be compared. In one program, soybean sub-plots received no residual or were treated with preemergence (PRE) applications of Canopy at 1.125, 1.5, or 2.25 oz/A. All sub-plots in this program received mid-postemergence (MPO) applications of 22 fl oz/A of Roundup. In the other program, soybean sub-plots received no residual or were treated with PRE applications of Enlite at 1.4, 1.87, or 2.8 oz/A. In this program, sub-plots received MPO applications of 22 fl oz/A of Roundup alone or tank-mixed with Synchrony XP at 0.19, 0.25, or 0.375 oz/A.

Corn (DKC 4272) and soybeans (AG 2130) were planted May 17 and 25, 2010 respectively. Corn sub-plots in Rotations 1, 2 and 4 received EPO herbicide applications described above on June 15 when corn was 7 inches tall. PRE Canopy and Enlite applications were made May 27 on soybeans in Rotation 3. Finally, Roundup was applied alone (to PRE Canopy sub-plots), and either alone or tank-mixed with Synchrony XP (to PRE Enlite sub-plots) MPO on June 25 in Rotation 3 when

Table 1. Crop rotations for zone-tillage dandelion experiment near Aurora, NY.

Rotation #	2010	2011	2012	2013	Residual Regime
1	Corn	Corn	Corn	Corn	With residual herbicides
2	Corn	Soybeans	Corn	Soybeans	Residual herbicides in both
3	Soybeans	Corn	Soybeans	Corn	Residual herbicides in both
4	Corn	Soybeans	Corn	Soybeans	Residual herbicides in corn only
5	Soybeans	Corn	Soybeans	Corn	Residual herbicides in corn only

Weed Management

Table 2. Dandelion counts May 2, 2011 following Roundup alone or tank-mixes of Roundup plus residual herbicides in a corn/soybean rotation experiment near Aurora, NY in 2010.			
Crops and Herbicides	Rate Amt/A	When Applied	Dandelion/ 1,000 sq. ft.
Corn			
Roundup PM	22 fl oz	EPO	181
+ Lumax	1.25 qt	EPO	3
+ Lumax	1.66 qt	EPO	2
+ Lumax	2.5 qt	EPO	2
Soybeans – Canopy followed by Roundup Program			
Roundup PM	22 fl oz	MPO	75
Canopy*	1.125 oz	PRE	3
Canopy*	1.5 oz	PRE	2
Canopy*	2.25 oz	PRE	2
*Followed by 22 fl oz/A of Roundup PM MPO			
Soybeans – Enlite followed by Synchrony XP plus Roundup Program			
Roundup PM	22 fl oz	MPO	85
Enlite fb Synchrony XP*	1.4 oz 0.19 oz	PRE MPO	3
Enlite fb Synchrony XP*	1.87 oz 0.25 oz	PRE MPO	0
Enlite fb Synchrony XP*	2.8 oz 0.375 oz	PRE MPO	2
*Applied with 22 fl oz/A of Roundup PM			

soybeans were 6 inches tall. Soybeans in Rotation 5 received a MPO application of Roundup only.

Results and Discussion

On May 2, 2011, dandelions were counted in an area 7.5 ft. (between rows two and five of each six-row sub-plot) by 75 ft. Dandelion counts for the six corn sub-plots for each treatment from Rotations 1, 2, and 4 were averaged for each replication since all received the same herbicide treatment in year 1. The number of dandelions in corn sub-plots with EPO Roundup only was 181/1,000 sq. ft. (Table 2). Tank mixing 1.25, 1.66, or 2.5 qt/A of Lumax with the EPO Roundup application resulted in 3, 2, and 2 dandelions/1,000 sq. ft. respectively the spring following application. As can be seen in Table 2, there were no differences in dandelion counts between the two residual soybean programs. The average number of dandelions in soybean plots with MPO Roundup only in Rotations 3 and 5 was 80/1,000 sq. ft., while there was an average of 3, 1, and 2 dandelions/1,000 sq. ft. for the one-half, two-thirds, and full rates of the two residual soybean programs. While there was a big difference in dandelion counts between corn and soybean treatments that received Roundup only and those treatments that received Roundup plus residual herbicides, there was no differences among the one-half, two-thirds, and full rates of the residual programs (Table 2). Even the lowest rate (one-half of label rate) was effective in preventing dandelion establishment after one year of zone-tillage corn or soybeans.

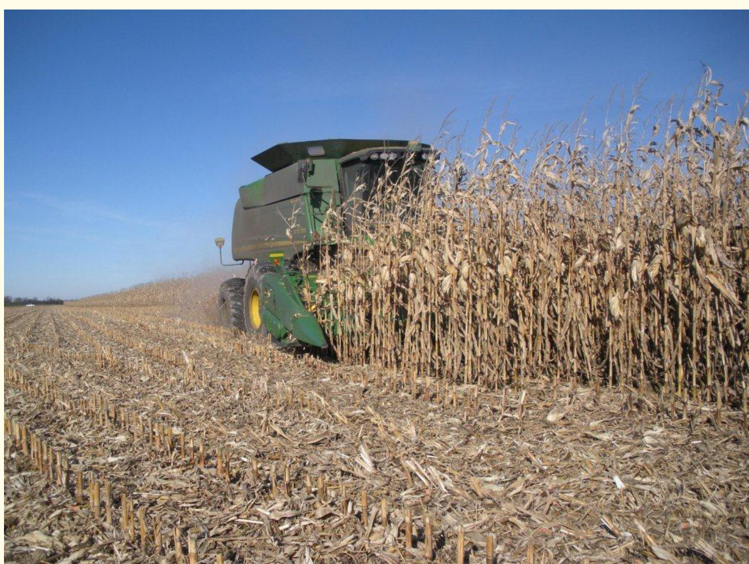
Of interest was the fact that there were more dandelions (181/1,000 sq. ft.) following EPO Roundup only in corn than following MPO Roundup only application in soybeans (80/1,000 sq. ft.) the previous year. This difference may be due to the 10 day difference between the EPO and MPO Roundup applications in corn and soybeans. It's also possible that differences in canopy development and the amount of shading between the two crops could explain this difference.

These initial results demonstrate the value of residual corn and soybean herbicides in preventing dandelion encroachment in zone-tillage systems. They also show that half-rate residual corn and soybean herbicide programs used in combination with Roundup were as effective as full labeled rates of these residual programs. Subsequent years of this study will show whether these trends continue over time and whether there is a difference between rotations that include residual herbicides in both crops and those that include residual herbicides in corn but not in soybeans.

Cornell Cooperative Extension's 2011 FIELD CROP DEALER MEETING November 21st

SAVE THE DATE!

- Mark your calendar for this one day event.
- Choose the location that is most convenient for you.
- Live meeting at Jordan Hall at the NYSAES in Geneva with interactive real-time broadcasts of this meeting to CCE Offices across NYS including Albany, Cayuga, Cattaraugus, Clinton, Genesee, Jefferson and Oneida counties.
- DEC and CCA credits will be offered.



Pre-registration for this meeting is **required**. This all day event will run from 10am to 3pm with participant check-in starting at 9am. Cost of attendance is $10 payable on the day of the meeting. Lunch will be available at all sites for an additional cost. The Cornell Guide for Integrated Field Crop Management will also be available for purchase at all sites.

For more information or to pre-register, please contact Mary McKellar at 607-255-2177 or mem40@cornell.edu.

Calendar of Events

Oct. 12-14, 2011	**APS Northeastern Division Meeting, New Brunswick, NJ**
Oct. 16-19, 2011	**ASA-CSSA-SSSA International Annual Meetings, San Antonio, TX**
Nov. 21, 2011	**Field Crop Dealer Meeting, Geneva, NY**
Nov. 29 - Dec. 1	**Northeast Region Certified Crop Adviser Training, Syracuse, NY**
Dec. 1, 2011	**Cornell Seed Conference, Geneva, NY**
Dec. 4-6, 2011	**National Fusarium Head Blight Forum, St. Louis, Missouri**
Dec. 12-14, 2011	**Field Crops Rust Symposium, San Antonio, TX**

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