What's Cropping Up?

A NEWSLETTER FOR NEW YORK FIELD CROPS & SOILS *VOLUME 20, NUMBER 4, NOVEMBER-DECEMBER, 2010*

Recommended Roundup Ready Soybean Varieties for New York

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New York farmers planted about 285,000 acres to soybeans in 2010 with a projected state record yield of 49 bushels/acre. Currently (early December of 2010), soybean prices exceed $12.00/ bushel. Ultimately, winter weather conditions in South America, crude oil prices over the next year, export demand to China, number of corn vs. soybean acres planted in the USA in 2011, and weather conditions in the Midwest in 2011 will determine 2011 prices. Selection of soybean varieties is one of the most important management practices determining soybean yields. Growers should gather as much information as possible on variety selection to optimize yields and profits, regardless of the 2011 selling price of soybeans.

The varieties in Table 1 are recommended varieties for central/western NY, based on tests in Cayuga (Aurora Research Farm) and Livingston Co. (Neenan Brothers Farm in Lima in 2010). The varieties in Table 2 are recommended varieties for Northern NY, based on tests in Jefferson Co. (Ron Robbins's farm in Sackets Harbor) and Clinton Co. (Minor Institute in Chazy). We recommend varieties that have average relative yields of more than 100% across the two sites in central/western or Northern NY (100% relative yield equals the mean yield of the test). **Recommended varieties, which have been tested more than one year, have performed well over different growing seasons in NY so more consideration should be given to those varieties. When looking at relative yields in Tables 1 and 2, only compare relative yields of varieties within a Maturity Group.**

CENTRAL/WESTERN NY
When averaged across the Group I tests at Aurora and Lima in 2010, SG1727 from Seedway had the highest average yield, despite being one of the older varieties in the test. Likewise, HS 199RR from GROWMARK FS, another

Table 1. Relative yields of recommended Group I and Group II Roundup Ready soybean varieties for Central/Western New York, based on tests in Cayuga and Livingston Co. over the last few years.

VARIETY	COMPANY/BRAND	RELATIVE YIELD (%)	YEARS IN TEST
		GROUP I VARIETIES	
HS 199RR	GROWMARK FS	108	7
AG1431	ASGROW	106	1
HS 19A02	GROWMARK FS	106	1
AG1730	ASGROW	106	1
TS1719R2	T.A. Seeds	105	1
SG1727	Seedway	104	5
AG1931	ASGROW	104	1
S13-A4	NK	102	1
		GROUP II VARIETIES	
2800R2	CHANNEL	110	1
HS 2766	GROWMARK FS	108	3
HS 20R80	GROWMARK FS	106	3
2903R2	CHANNEL	106	1
H27-R2	HUBNER	106	1
V278RR	Dyna-Gro	105	1
S24-J1	NK	104	4
3000R2	CHANNEL	104	1
S21-N6	NK	103	5
HS 23R55	HYLAND	103	1
2400R2	CHANNEL	102	1
2300R2	CHANNEL	101	1

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older variety, had the highest yield of all varieties at Lima, despite its 7th year in the test. Consequently, we continue to recommend these Group I varieties in NY (Table 1). GROWMARK FS also entered a new variety, HS 19A02, which had the highest yield in the Group I test at Aurora (and at Sackets Harbor and Chazy) in 2010. ASGROW entered three new varieties (AG1431, AG1730, and AG1931) in NY in 2010, all of which performed exceptionally well. The earliest variety, AG1431, had the second highest average yield across the Aurora and Lima sites, and was at ~14% moisture at Aurora on 20 September, which makes it an excellent variety preceding winter wheat. Another new Group I variety, S13-A4, an NK brand, also yielded above-average in the Group I tests and was at ~14% moisture at Aurora on 20 September making it another excellent variety preceding winter wheat. Another new Group I variety, TS1719R2, from T.A. Seeds, also yielded exceptionally well in 2010, especially at Lima.

When averaged across the Group II tests at Aurora and Lima in 2010, new varieties from Channel, Hubner, and Dyna-Gro and older varieties from GROWMARK FS had the five highest yields. The numerically highest recommended varieties (Table 1), 2800R2 from Channel and HS 2766 from GROWMARK FS, also had the highest average yields in 2010. The new varieties, 2903R2 from Channel, H27-10R2 from Hubner Seed, and V278RR from Dyna-Gro, followed closely behind. An older variety, HS 20R80 from GROWMARK FS, continued to yield well in 2010 (5th highest average yield), especially at the Aurora site. Two other older varieties, S21-N6 and S24-J1, yielded above-average in 2010 as did a newer variety from Hyland Seed, HS 23R55. Other new varieties that yielded above-average in 2010 include three Channel varieties, 3000R2, 2400R2, and 2300R2. At the Lima site, the 29 Group II varieties had a 4 bu/acre yield advantage when compared with the 19 Group I varieties (76 and 72 bu/acre, respectively).

Table 2. Relative yields of recommended Group I and Group II (only close to Lake Ontario) Roundup Ready soybean varieties for Northern New York, based on tests in Jefferson and Clinton Co. over the last 4 years.

VARIETY	COMPANY/BRAND	RELATIVE YIELD (%)	YEARS IN TEST
		GROUP I VARIETIES	
HS 19A02	GROWMARK FS	114	1
1901R2	CHANNEL	106	1
1400R2	CHANNEL	105	1
1700R2	CHANNEL	105	1
DB 1809RR	DOEBLER'S PA	104	1
TS1719R2	T.A. Seeds	103	1
36R19	Dyna-Gro	102	1
HS 199RR	GROWMARK FS	101	4
SG1727	Seedway	101	4
		GROUP II VARIETIES	
SG2205	Seedway	105	2

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The new variety, HS 19A02 from GROWMARK FS, which also performed well in the Group I tests in central/western NY, yielded 14% above-average across the two sites in Northern NY (Table 2). Other new Group I varieties that yielded well in Northern NY in 2010 include three from Channel, 1901R2, 1400R2, and 1700R2; DB1809RR from Doebler's PA; TS1719R2 from T.A. Seeds; and 36R19R2 from Dyna-Gro. The new variety, TS1719R2, also yielded above-average in the central/western NY Group I tests. The Channel varieties, 1901R2 and 1400R2, also yielded above-average at the Aurora site (but were not entered at the Lima site). Two older Group I varieties, SG1727 from Seedway and HS 199RR from GROWMARK FS, continued to yield above-average in Northern NY in 2010. Three new varieties from Asgrow that yielded above-average at Sackets Harbor (but were not entered at Chazy) include AG1431 (3rd highest yield), AG1730 (4th highest), and AG1931 (6th highest), very similar to their yield performances in central/western NY in 2010.

The only Group II variety that was entered at both sites in 2010 was SG 2205 from Seedway, which yielded 3rd highest in the Group II test at Sackets Harbor and 4th highest overall at Chazy. Other noteworthy Group II varieties at Sackets Harbor include TS2890R2 from T.A. Seeds, HS 2766 from GROWMARK FS, 2400gR2 from Channel, H25-10R2 from

Hubner, AG2031 and 2131 from Asgrow, 31RY20 from Dyna-Gro, TS2190R from T.A. Seeds, and HS 23R55 from Hyland. The Group II test yielded 65 bushels/acre and the Group I test yielded 60 bushels/acre at Sackets Harbor. Nevertheless, we only recommend that Group II varieties near the Lakes (Ontario and perhaps Champlain) in Northern NY, if planted in May, because the frost potential in September could prevent attainment of maturity of Group II varieties.

CONCLUSION

Variety selection strongly influences yield and subsequent profit. Commercial varieties in the same maturity group have significant yield differences, lodging resistances, and harvest moistures. Consequently, soybean variety selection greatly impacts harvesting efficiency and profit so growers should consider all sources of information when selecting varieties. More detail of the 2010 New York State Soybean Variety Tests (as well as previous years) is posted on our Web site, www.fieldcrops.org.

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Recommended Corn Silage Hybrids for New York

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The increase in corn prices over the last few years has resulted in a higher percentage of corn silage in the dairy ration. Consequently, dairy producers must carefully select corn silage hybrids that have high yields as well as outstanding silage quality to maximize milk production from their herd. Cornell University evaluates 95-115 day corn silage hybrids at two locations in central/western NY and 80-100 day corn silage hybrids at two locations in Northern NY. We arrange the hybrids in the field into 5-day relative maturity (RM) groups (i.e. 95-100, 101-105 day hybrids, etc.) and harvest one or more RM groups at a particular site when the hybrids are in the 60-70% moisture range. We also take an initial 10,000-gram sample from each plot and then sub-sample to 700 grams to determine moisture and to run silage quality analyses on all four replications of each hybrid at each site.

MILK2006, a spreadsheet from the University of Wisconsin, calculates milk/ton, a silage quality index, derived from neutral detergent fiber (NDF), NDF digestibility (30 hr), crude protein, ash, and starch concentrations from the quality analyses. MILK2006 also calculates milk yield/acre of each hybrid by combining silage yield and milk/ton values. We recommend hybrids that have comparative milk yields of greater than 100 across the two sites (the average milk yield of each hybrid RM group is adjusted to 100 and hybrids within the RM group with above-average milk yields have values above 100). We list the comparative milk yields as well as comparative silage yields and milk/ton values for recommended hybrids in central/western (Table 1) and Northern NY (Table 2). **Hybrids within each table should only be compared within RM groups. Hybrids that have been tested more than 1 year should be given more weight because they have performed above-average in more environments.**

CENTRAL/WESTERN NY (TABLE 1)

95-100 day RM

The new hybrid, D39QN29, from Dyna-Gro, performed exceptionally well in 2010 with exceptionally high silage yields and an above-average milk/ton value (mostly because of above-average NDF digestibility). Other new hybrids that performed well include TMF2L533 from Mycogen (highest average silage yield in this RM); and TA 477-08 and TA 501-12 from T.A. Seeds. As in previous years, 1900F/RR/HT from LICA and HL STV50 from Hyland performed well.

101-105 day RM

The new hybrid release, N49J-3000GT, an NK brand, performed exceptionally well in 2010 with much-above average silage yield and an above-average milk/ton value (mostly because of above-average NDF digestibility). Also, 86T82-3000GT a Garst brand and MC530 from King's Agriseeds performed exceptionally well in NY for the second consecutive year. Hybrids that continued to perform much-above average for the third consecutive year included HL SR59 from Hyland Seed and 553GRB from Doebler's. Other new hybrid releases that performed well include P0125HR from Pioneer, 5667 GT3 from GROWMARK FS, and TA 545-20 from T.A. Seeds. Other hybrids that had above-average calculated milk yields in 2010 (in order) include DKC52-59 from DEKALB, 35F40 and 36V53 from Pioneer, HL B77R from Hyland, and TA 557-00F from T.A. Seeds.

106-110 day RM

New hybrid releases, P1011XR from Pioneer, DK58-83 from DEKALB, and 209-77VT3 from Channel, had much-above average calculated milk yields in 2010. Other new hybrid releases that performed well include 2114 LHX from Wolf River Valley, 85V88-3000GT a Garst brand, V4884HTXRNS from Dyna-Gro, and 210-61VT3 from Channel. Also, 1084L HX from LICA performed well for the second consecutive year as did DKC59-64 from DEKALB. The brown midrib hybrid, F2F622 from Mycogen, yielded reasonably well and had a much-above milk/ton value (because of its very high NDF digestibility) for the second consecutive year.

111-115 day RM

Two DEKALB hybrids, a new release, DKC63-84, and an older hybrid, DKC67-88, had much-above average calculated milk yield with DKC63-84 having a much above-average silage yield and above-average milk/ton value and DKC67-87 having the highest silage yields in 2010. New hybrid releases, V5294HTXRNS from Dyna-Gro and P1173HR from Pioneer, had above-average silage yields and above-average milk/ton values. Other new hybrids that performed well in 2010 include 214-14VT3P from Channel (above-average silage yield), 7000 GT from GROWMARK FS (above-average milk/ton value because of above-average NDF digestibility), and TA 657-13VP from T.A. Seeds. The older hybrid, DKC61-69 from DEKALB, also had above-average calculated milk yield in 2010 because of above-average silage yield.

Table 1. Recommended 95-115-day corn silage hybrids in New York based on tests in Cayuga Co. (Aurora Research Farm) and Livingston Co. (Sparta Farms, formally Southview Farms).

Brand/Co.	Hybrid	Comparative Silage Yield	Comparative Milk/Ton	Comp. Milk Yield	Years in Test
		-----------------------------%-----------------------			no.
		95-100 day Relative Maturity			
Dyna-Gro	39QN29	110	103	114	1
Mycogen	TMF2L533	113	97	110	1
T.A. Seeds	TA 477-08	104	102	105	1
LICA	1900/F/RR/HT	105	97	102	2
T.A. Seeds	TA501-12	103	98	101	1
Hyland	HL STV50	102	99	101	3
		101-105 day Relative Maturity			
NK	N49J-3000GT	110	101	111	1
Garst	86T82-3000GT	106	101	108	2
T.A. Seeds	TA557-00F	106	101	108	7
Master's Choice	530	106	100	107	2
Doebler's	552GR	103	102	105	3
Hyland	HL SR59	107	98	104	3
Pioneer	P0125HR	103	101	104	1
GROWMARK FS	5667 GT3	104	100	104	1
T.A. Seeds	TA 545-20	102	100	102	1
Pioneer	36V53	101	101	102	2
Hyland	HL B77R	105	97	102	1
DEKALB	DKC52-59	101	100	101	2
Pioneer	35F40	101	100	101	3
		106-110 day Relative Maturity			
Pioneer	P011XR	113	100	112	1
DEKALB	DKC58-83	108	101	109	1
Channel	209-77VT3	107	100	107	1
LICA	1084 LHX	107	98	107	2
Wolf River Valley	2114 LHX	107	97	104	1
Garst	85V88-3000GT	103	101	104	1
Dyna-Gro	V4884HTXRNS	102	101	103	1
DEKALB	DKC59-64	105	98	103	2
Channel	210-61VT3	103	98	101	1
Mycogen	F2F622	95	107	101	2
		111-115 day Relative Maturity			
DEKALB	DKC63-84	108	102	110	1
Dyna-Gro	V5294HTXRNS	105	103	108	1
DEKALB	DKC67-88	109	98	107	3
Pioneer	P1173HR	102	103	104	1
Channel	214-VT3P	103	100	102	1
GROWMARK FS	7000 GT3	100	102	102	1
T.A. Seeds	TA 657-13VP	101	102	102	1
DEKALB	DKC61-69	102	101	102	3

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80-85 day RM

The hybrid, TA290-11 from T.A. Seeds, has exceptionally high silage yields and an above-average milk/ton value. Despite being grouped with the 85-90 day hybrids in 2010, this 84-day hybrid had the 4th highest silage yield and calculated milk yield.

86-90 day RM

The new hybrid release, 87S9 from LICA, had an exceptionally high silage yield and calculated milk yield in 2010. Also, HL SR35 from Hyland Seed had much-above average calculated milk yield for the 4th consecutive year because of much above-average silage yield, as did the new hybrid release, MC 480, from King's Agriseeds. New hybrid releases, ST-9780 from Dairyland and HL B24R from Hyland Seed, had above-average milk yields with ST-9890 having an above-average milk/ton value and HL B24R having an above-average silage yield.

91-95 day RM

The hybrid, Hi.DF.-3195-Q from Dairyland, had an exceptionally high silage yield and calculated milk yield in 2010. Also, 946 LRR from LICA and 478SL from Doebler's performed exceptionally well for the fourth and second consecutive years, respectively. New hybrid releases that also performed well in 2010 include DS95RB from Croplan, DKC45-52 from DEKALB, TA451-19 from T.A. Seeds, and N34N-3000GT, an NK brand. The hybrid, TMF2L418 from Mycogen, also performed above-average in 2010.

96-100 day RM

New hybrid releases, 5288VT3 from GROWMARK FS, and 2702 L and 2596 LRR from Wolf River Valley, had much-above calculated milk yields in 2010. The hybrids, 5288VT3 and 2702 L had much-above silage yields; whereas 2596 LRR had an above-average silage yield and milk/ton value (because of high NDF digestibility).

Table 2. Recommended 80-100-day corn silage hybrids in Northern NY based on tests in St. Lawrence Co. (Greenwood Farms) and Jefferson Co. (Robbins Farm in 2010).

Brand	Hybrid	Comparative Silage Yield	Comparative Milk/Ton	Comp. Milk Yield	Years in Test
		----------	%	----------	no.
		80-85 day Relative Maturity			
T.A.Seeds	TA290-11	108	102	110	3
		86-90 day Relative Maturity			
LICA	87S9	115	99	114	1
Hyland	HL SR35	108	100	108	4
Master's Choice	480	105	101	107	1
Dairyland	ST-9789	100	102	102	1
Hyland	HL B24R	102	99	101	1
		91-95 day Relative Maturity			
Dairyland	Hi.DF.-3195-Q	117	98	114	1
LICA	946 LRR	109	101	110	5
Doebler's	478SL	109	99	108	2
Croplan	DS95RB	104	102	106	1
DEKALB	DKC45-52	106	98	104	1
T.A. Seeds	TA 451-19	102	101	103	1
NK	N34N-3000GT	105	98	103	1
Mycogen	TMF2L418	102	101	103	4
		96-100 day Relative Maturity			
GROWMARK FS	5288VT3	110	100	110	1
Wolf River Valley	2702 L	107	100	107	1
Wolf River Valley	2596 LRR	102	103	104	1

Conclusion

Hybrid selection is one of the most important management practices that affect corn silage yield and quality. Dairy producers must select the best adapted hybrid for their region to maximize high-quality corn silage in the ration, especially if the predicted lower milk prices coupled with higher grain materialize in 2011. We urge seed companies to enter their hybrids in our corn silage hybrid testing program so New York dairy producers can make informed decisions, based on tests under NY environmental conditions. You can access the detailed 2010 Corn Silage Hybrid Report at our Web site, www.fieldcrops.org.

Nitrogen balances for the New York Upper Susquehanna River Watershed: Implications for manure and fertilizer management

Nutrient Management

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Introduction

The Upper Susquehanna River Watershed (USW) encompasses the headwaters of the Susquehanna River (Figure 1) and thus the headwaters of the Chesapeake Bay. Recently, each state in the Chesapeake Bay Watershed was given a load allocation to meet for sediment, phosphorus (P) and nitrogen (N). A recent assessment of P balances of the USW showed a significant reduction from +13.8 to an estimated +1.5 lb P per acre between 1987 and 2006, indicating the USW is in P balance (see What's Cropping Up?, Sept-Oct 2008). In this article, we report on gross and cropland (net) N balances for those counties and parts of counties that lie within the USW, covering the U.S. Census of Agriculture (Census) years 1987, 1992, 1997, 2002 and 2007.

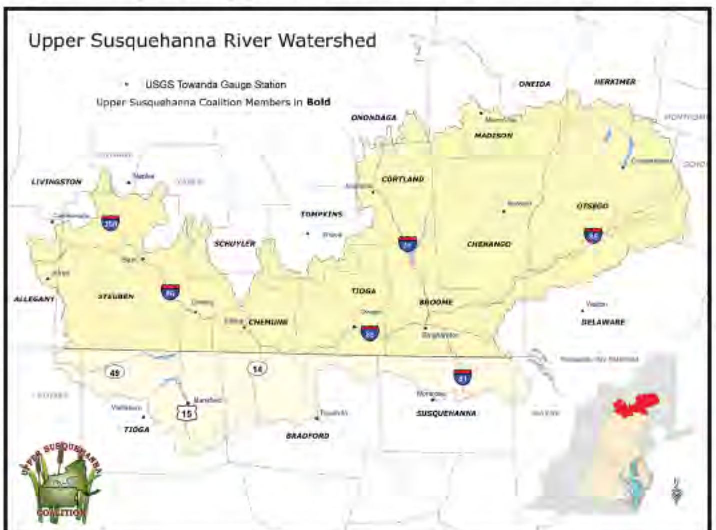

Figure 1: Upper Susquehanna River Watershed (Courtesy Chris Yearick, Upper Susquehanna Coalition).

How were the balances derived?

Gross N balances for non-legume cropland were determined as the difference between major N inputs (manure and fertilizer) and outputs (harvested crops). In excluding legume crops, it was assumed that legume N uptake was equal to legume N fixation and that legumes received no fertilizer N. Balances were derived for Census years 1987, 1992, 1997, 2002, and 2007. The Census supplied animal population data, crop yields and acreage, and cropland use at state and county levels. Gross N balances are calculated with manure N estimates as excreted. Net cropland N balances were derived assuming that 35% of total N excreted by dairy cattle is lost from manure to volatilization during housing and storage in systems typical of NY. Balances were calculated using acres of cropland within the watershed for each of the counties (derived from 2002 data obtained from the Chesapeake Bay Program). It was assumed that the percentage was the same in 2007 and is the same for all N balance components (e.g., manure N, fertilizer N, crop N, harvested acres cropland). Each county level N balance component was multiplied by the county's watershed cropland percentage to estimate the watershed balance for the county, and added together to derive the N balance for the New York State portion of the USW.

A word of caution

The N balances were developed to quantify gross and cropland net N released to the environment in excess of crop removal and to derive general trends in gross agricultural N balances over time. These balances are partial balances because of the inability to accurately determine all N inputs and outputs for cropland. They should not be equated to annual N losses; a higher N balance may indicate greater N loss potential, but actual N losses will depend on within-farm distribution of N, landscape patterns, soil resources and management, and climate or weather patterns.

What did we find?

In 2007, gross N inputs in the USW were estimated at 10.5 and 33.0 million lb of N for fertilizer and manure, respectively (Table 1). Non-legume crops removed 32.5 million lb of N, resulting in a 2007 gross N balance of +11.0 million lb or +29 lb N per acre non-legume cropland. This is a little over half of the NY statewide N balance (+55 lb per acre). On a per acre non-legume cropland basis, fertilizer N use in the USW was very low (28 lb N per acre) compared to 54 lb N per acre for NY state, while total N excreted in manure was similar to the state average (86 and 90 lb N per acre, respectively). Animal units (AU) per acre cropland was the same (0.43 AU) as for the state.

Gross N balances for counties with >20% of their cropland within the watershed ranged from -5 lb to +61 lb N per acre. Only Onondaga and Ontario counties had higher N balances (+98 and +111 lb N per acre, respectively); however, both counties have very little cropland in the watershed (8.4% and

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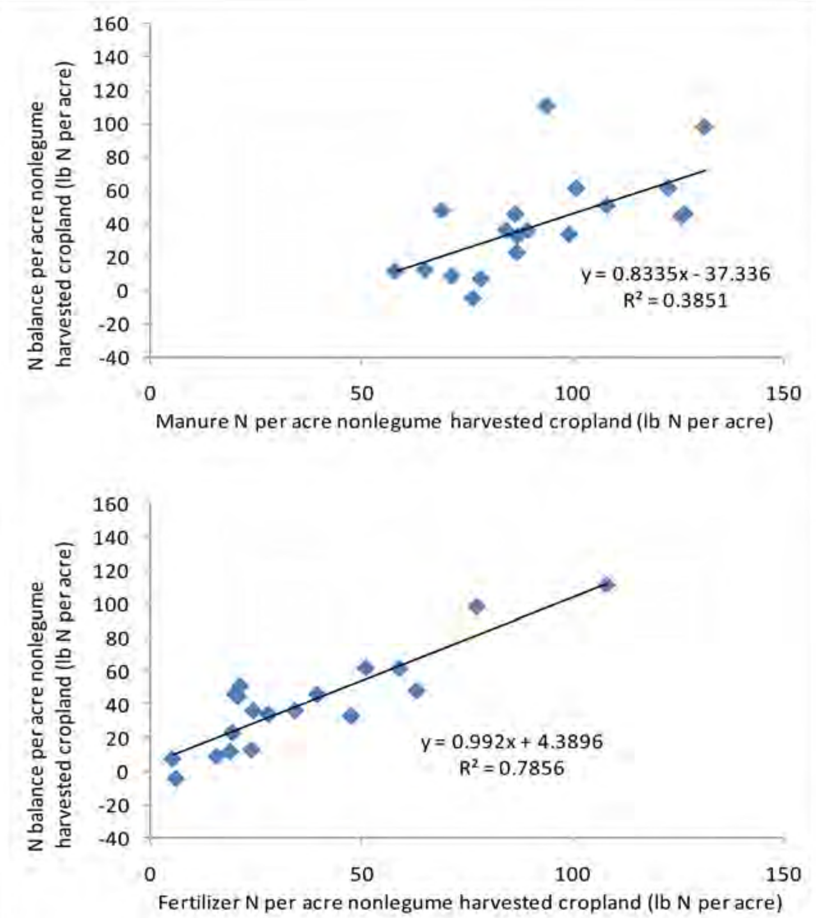

Figure 2: Relationship between gross nitrogen (N) balance per acre non-legume cropland and (1) total manure N excreted per acre non-legume harvested cropland, and (2), N fertilizer use (lb N sold for farm use per acre non-legume harvested cropland) for 19 NY counties in the upper Susquehanna River watershed (2007 data).

0.1%, respectively).

Fertilizer N use explained 79% of the N balance on a per acre basis across the 19 counties in the watershed whereas manure N explained 38% of the gross N balance on a per acre non-legume cropland basis (Figure 2).

Since 1987, the N balance of the NY portion of the USW decreased by two- thirds, from +93 lb N per acre in 1987 to +29 lb N per acre in 2007. This is significantly greater than the 50% decrease that has occurred statewide (from +112 to +55 lb N per acre) in the same time period. As can be seen in Figure 3, this reduction is due to a steady decline in manure N produced (reflecting a decline in animal units in the watershed) and a 50% reduction in fertilizer N use between 1987 and 1997. Crop N removal has remained fairly stable over the same time period (Figure 3).

Potential Impact of Improved Herd Nutrition on N Balances

A number of dairy herds in NY have made reductions in ration N levels in the last few years. As an example, N excretion can be reduced from 328 lb N per cow per year to 247 lb N per cow per year by lowering ration crude protein from 18.3 to 14.2%. This lowers daily N excreted in the manure from 0.90 to 0.68 lbs/cow per day. These calculations are for a cow producing 65 lbs of milk per day. Application of improved diet management and the above reduction in N excretion to all upper Susquehanna watershed herds in the 2007 N balance equation results in a 49% reduction from the current 2007 N balance of +11.1 million lb (+5,528 tons), and a reduction of the gross N balance from +29 lb N per acre to +14 lb N per acre (Figure 3). Lower CP diets for dairy cattle have also been shown to reduce the portion of total N that is excreted in urine as compared to feces, significantly reducing volatile N losses in the form of ammonia and nitrous oxide from stored manure. The shift to a greater proportion of total N excreted as fecal N versus urinary N can reduce N loss per unit N applied (i.e., increase N uptake efficiency of manure N), especially important if direct incorporation of manure is not feasible. However, it will increase the need for additional N sources to meet crop needs.

Post Excretion N Losses and Cropland N Balance

Assuming 35% of total N excreted by dairy cattle is lost to volatilization in the barn and manure storage in systems typical of NY, only 21.7 million lb (10,837 tons) of the total N in the 2007 NY upper Susquehanna River watershed manure could potentially be land-applied, resulting in a cropland N balance on a per unit cropland basis of −0.8 lb N per acre, as

Table 1: Nitrogen balances for New York State, the NY Upper Susquehanna River Watershed, and the portions of counties in the watershed.

2007	Percent of county cropland in watershed (%)	Gross N balance (lbs)	Gross N balance (lb/acre)	Manure N (lb)	Fertilizer N (lb)	Crops N (lb)	Harvested cropland (no legumes) (acres)	Acres fertilized	Acres manured
New York State		140,688,580	55	230,161,268	138,473,514	227,946,201	2,550,472	2,161,648	1,094,796
NY Upper Susquehanna River Watershed		11,055,584	29	33,023,745	10,541,406	32,509,567	382,641	233,994	180,377
Allegany	8.4	34,955	9	291,504	63,874	320,423	4,074	2,006	1,608
Broome	86.9	165,371	7	1,859,163	121,169	1,814,961	23,709	12,017	12,069
Chemung	86.5	190,071	11	961,132	311,649	1,082,711	16,548	9,058	6,134
Chenango	99.9	1,850,055	34	5,451,385	1,532,381	5,133,712	54,864	31,880	28,628
Cortland	88.9	1,302,236	46	3,613,411	569,563	2,880,738	28,520	21,085	18,868
Delaware	32.9	536,294	36	1,341,076	364,100	1,168,882	14,991	5,734	8,208
Herkimer	22.2	370,134	44	1,053,130	172,268	855,264	8,347	5,649	5,390
Livingston	1.3	41,763	33	111,584	60,867	130,688	1,281	1,508	407
Madison	38.6	1,307,539	61	2,614,567	1,085,634	2,392,662	21,273	18,804	13,751
Oneida	6.3	215,300	61	356,010	207,704	348,414	3,521	3,149	1,896
Onondaga	8.4	446,849	98	599,917	353,033	506,101	4,565	5,199	2,217
Ontario	0.1	4,807	111	4,086	4,697	3,977	43	54	16
Otsego	95.7	1,595,302	36	3,738,322	1,514,431	3,657,452	44,307	24,983	25,163
Schoharie	5.6	82,573	48	119,723	109,004	146,153	1,728	821	646
Schuyler	22.5	-25,338	-5	404,773	31,708	461,818	5,287	2,411	1,308
Steuben	88.0	1,426,688	12	7,518,761	2,751,786	8,843,859	115,394	69,325	36,822
Tioga	100.0	1,406,304	46	2,676,079	1,221,932	2,491,707	30,899	17,335	15,716
Tompkins	5.2	50,277	23	192,869	42,909	185,501	2,218	1,791	1,038

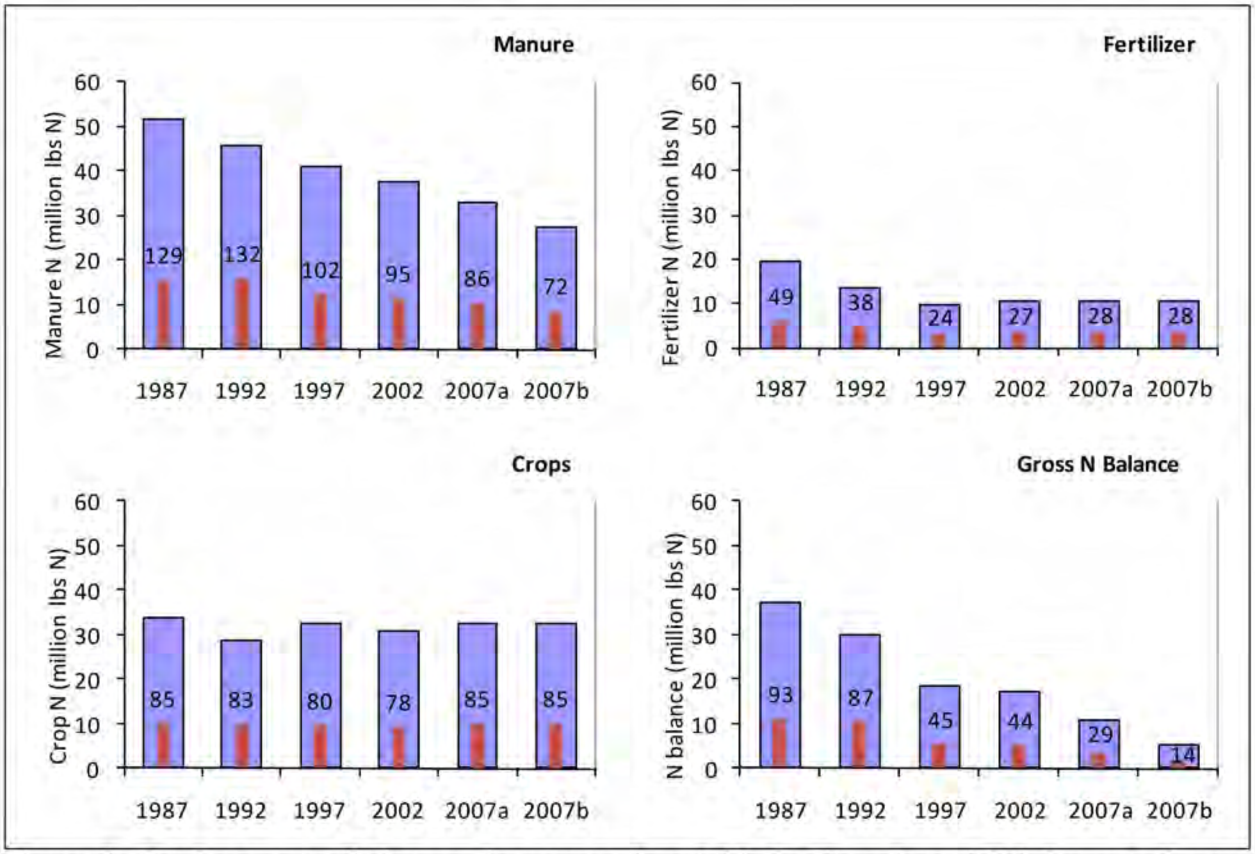

Figure 3: Total amount of nitrogen in manure (top left), fertilizer (top right), harvested crops (bottom left), and the upper Susquehanna River watershed gross N balance (bottom right). The 1987-2007a N balances assume an N excretion of 328 lb N per cow per year. Improved herd nutrition (excretion of 247 lb N per cow per year) was taken into account in the assessment of 2007b. Interior bars and numbers indicate the pounds of N per acre of non-legume cropland for inputs and the N balance for each year.

compared to the gross N balance of +29 lb per acre. This adjustment in manure N available for land application resulted in negative cropland total N balances in seven of the watershed counties, ranging from −0.6 lb N per acre in Chenango County to −31 lb N per acre in Schuyler County. A reduction in total manure N by 40%, reflecting a maximum N use efficiency of 60% for spring-applied, incorporated manure, further lowered the N balance for the USW from −0.8 lb N per acre to −23 lb N per acre. For a more realistic scenario in which manure is surface-applied without incorporation and the fertilizer use efficiency is 75%, this balance became −50 lb N per acre. This negative N balance indicates the need for best management practices that increase N use efficiency of manure and fertilizer and/or add N from other sources.

Conclusions

Nitrogen balances in terms of crop production can shift dramatically depending upon dairy rations, and management of N sources, especially manure and ammonia volatilization. Best management practices that reduce N loss in the barn and storage, increase manure and fertilizer N uptake efficiency, and/or reduce N needs (through N supply from other sources such as cover crops, shorter rotations, greater reliance on legumes) will be essential in order to balance N and P for the long-term sustainability of NY agriculture.

For Further Information

Questions about this project? Contact: Quirine M. Ketterings at 607-255-3061 or qmk2@cornell.edu, and/or visit the Nutrient Management Spear Program website at: http://nmsp.cals.cornell.edu/.

A LOOK AHEAD AT HERBICIDE RESISTANCE MANAGEMENT STRATEGIES

Weed Management

Russell R. Hahn, Department of Crop and Soil Sciences, Cornell University

Herbicide resistant weed populations are an ongoing concern for growers. They are also a concern for companies that develop/market herbicides and genetic traits that make crops resistant to certain herbicides. Growers have a responsibility to use practices that delay or prevent development of herbicide-resistant weed populations. While chemical and seed companies develop products that may contribute to this effort, it is the end users or growers who determine how these products/technologies are used. Ultimately, it is these use patterns that determine the number and distribution of herbicide-resistant weeds, and how long the value of new technologies is preserved. A previous article discussed the scope of herbicide-resistant weeds around the World and of glyphosate-resistant weeds in the U.S. To follow up on that discussion, a review of resistance management strategies for growers seems appropriate. In addition, we'll take a look at current and future industry efforts that may facilitate these efforts.

Grower Practices and Responsibilities

Growers must recognize that repeated use of the same cropping practices, like choice of crop(s), tillage systems, etc., will favor certain weeds. Likewise, repeated use of herbicides with the same site of action may result in herbicide-resistant weed populations. Due to genetic variability, there may be a few weeds in a native population that are resistant to a particular type of herbicide. With repeated use of the same herbicide(s), these surviving weeds are the only ones that reproduce. Over time, this results in a shift to a population that is dominated by the resistant weed biotype.

Cultivation can play a role in preventing weed population shifts by controlling the resistant survivors before they reproduce. Crop rotation can also play an important role in delaying development of herbicide-resistant weed populations. Before the introduction of genetically engineered herbicide-resistant crops, crop rotation often forced changes in herbicide use. Now, if growers are using glyphosate-resistant (GR) corn and GR soybeans, and are relying heavily on glyphosate alone for weed control in both, crop rotation doesn't really contribute to resistance management. It's the change in herbicides that is the key element. The most important resistance management practices for growers are to rotate the types or genetics of their crops, to rotate herbicides with different sites of action, and to use herbicide combinations or sequential applications with herbicides with different sites of action. To work, this means that more than one of the herbicides used in rotation or combination must control a particular weed. Growers must know how different herbicides work to rotate herbicides most effectively. A herbicide site of action classification system has been approved by the Weed Science Society of America (1). In this system, a group number is given to all herbicides with the same site of action. These group numbers are included in the *Cornell Guide for Integrated Field Crop Management* and are found on many herbicide labels. This site of action information can assist growers in using a variety of different types of herbicides in their resistance management plans.

Industry Strategies

Industry strategies to facilitate resistance management focus on educational efforts, on the development of herbicide premix products that include herbicides with more than one site of action, and on development of crop varieties that have resistance to multiple types of herbicides that they would not normally tolerate.

While herbicide premixes with more than one site of action have been in the market for many years (Bicep), there are several new products that have been developed specifically for use on GR crops. Perhaps the best known of these is a GR corn herbicide, Halex GT. Table 1 shows it's a mixture of glyphosate, a Group 9 herbicide that inhibits an enzyme (EPSP synthase) essential for amino acid synthesis; metolachlor (Dual), a Group 15 herbicide that inhibits long-chain fatty acid synthesis; and mesotrione (Callisto), a Group 27 herbicide that inhibits an enzyme (4-HPPD) that is essential for pigment formation. Two other premixes, Extreme and Flexstar GT are for use in GR soybeans. Extreme combines glyphosate with imazethapyr (Pursuit), a Group 2 herbicide that inhibits an enzyme (ALS or acetolactate synthase) which is essential for amino acid synthesis. Flexstar GT teams glyphosate with fomesafen (Reflex), a Group 14 herbicide that acts as a cell membrane disrupter.

Crops with Multiple Resistance

Crops with resistance to more than one herbicide site of action are not new. However, the intentional development and marketing of varieties that are resistant to herbicides they would not normally tolerate is relatively new. Corn hybrids have been available for several years that are resistant to

Weed Management

Table 1. Herbicide premixes with multiple sites of action for use on glyphosate-resistant crops				
Products	**GR Crops**	**Components**	**Group #**	**Company**
Halex GT	Corn	Glyphosate	9	Syngenta
		Dual	15	
		Callisto	27	
Extreme	Soybeans	Glyphosate	9	BASF
		Pursuit	2	
Flexstar GT	Soybeans	Glyphosate	9	Syngenta
		Reflex	14	

both glyphosate, a Group 9 herbicide, and to glufosinate (Ignite 280), a Group 10 herbicide. Group 10 herbicides cause ammonia accumulation that destroys plant cells and directly inhibits photosynthesis. SmartStax corn hybrids, with these two types of herbicide resistance along with six types of insect resistance, are an example (Table 2). SmartStax hybrids, developed by Monsanto in cooperation with Dow AgroSciences, were introduced in 2010. There are other hybrids that are resistant to both glyphosate and glufosinate herbicides.

On the drawing board are DHT (Dow AgroSciences Herbicide Tolerance) traits for both corn and soybeans. As shown in Table 2, DHT crops will have enhanced tolerance to 2, 4-D, a Group 4 growth regulator or synthetic auxin. This trait will be stacked with glyphosate resistance, and no doubt with insect resistance traits in corn. These DHT hybrids/varieties are being developed with Pioneer and could be introduced as soon as 2013 (corn) and 2015 (soybeans). New 2,4-D formulations, with low spray drift potential and little volatility, are being developed and will have to be used with these DHT varieties. In addition, the use of air induction spray nozzles will be recommended to further reduce the risk of off-site movement of spray particles. Monsanto and BASF are collaborating on soybean varieties that will combine resistance to glyphosate and to dicamba (Clarity, Banvel, etc.), another Group 4 herbicide. Like Dow, Monsanto and BASF are working to develop dicamba formulations that are less volatile than those currently available. These dicamba-resistant soybeans could be available in 2014. Finally, Optimum GAT (glyphosate and ALS tolerant) corn and soybeans are being developed by DuPont/Pioneer. These Optimum GAT hybrids/varieties combine glyphosate resistance with enhanced tolerance to Group 2 herbicides that inhibit ALS (acetolactate synthase). Optimum GAT technology is targeted for introduction in 2015 at the earliest.

With both the premix herbicide products and with the multiple resistance hybrids/varieties, the idea is to use more than one herbicide site of action to control an individual weed species. The theory is that if one site of action doesn't control the weed, the other one will. Although this concept will help manage existing resistant weed populations and delay development of new ones, it is not guaranteed to work. There are weed populations that have developed resistance to more than one site of action. For example, there are isolated populations of five weeds in the U.S. that are resistant to both glyphosate and ALS inhibitor herbicides. This multiple resistance has occurred with two pigweeds, Palmer amaranth and tall waterhemp, both common and giant ragweed, and horseweed.

Growers must recognize that weed resistance to many sites of action is common, that resistance is manageable, and that most herbicides and genetic traits retain their value despite resistant weeds. Growers must also recognize that the battle against weed population shifts and against the development of resistant weed populations is ongoing. This battle requires an integrated approach to weed management that involves vigilant scouting for weeds that are not being controlled with current practices/herbicides. It also requires that growers use different control tactics over time, including the use of rotations with different crop genetics and the use of herbicides with different sites of action.

Table 2. Current and future crops with multiple types of genetically engineered herbicide resistance are shown in the table.					
Product	**Crop(s)**	**Resistance**	**Group #**	**Companies**	**Date***
SmartStax	Corn	Glyphosate	9	Monsanto	2010
		Ignite 280	10		
DHT	Corn	Glyphosate	9	Dow	2013
	Soybeans	2, 4-D	4	(Partners – Pioneer and other companies)	2015
??	Soybeans	Glyphosate	9	Monsanto	2014+
		Dicamba	4	BASF	
Optimum GAT	Corn	Glyphosate	9	DuPont/Pioneer	2015+
	Soybeans	ALS Inhibitors	2		2015+
*All dates after 2010 are proposed product launch dates.					

1. Mallory-Smith, C. A. and E. J. Retzinger. 2003. Revised classification of herbicides by sites of action for weed resistance management strategies. Weed Technol. 17:605-619.

Where Do the Fungal Spores Come From That Cause Fusarium Head Blight of Wheat?

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Disease Management

As part of a national research project to determine the relative importance of within-field cereal crop debris as a source of spores of *Gibberella zeae* (*Fusarium graminearum*) for Fusarium head blight and contamination of grain by deoxynivalenol (DON) toxin, microplot experiments were set up in 15 commercial wheat fields in New York from 2008-2010 (Fig. 1). Each of these fields was planted to winter wheat following harvest of a non-susceptible (to *Gibberella*) crop, e.g. soybean, dry bean, or pea, and without visible debris of corn or wheat. At wheat green-up in April, microplots consisting of circular hardware cloth cages of 33 in. diameter were placed in the wheat fields and separated by 100 ft in each direction (Fig. 2). Half of these microplots received no added material (Fig. 3A) while the other half received overwintered corn stubble (Fig. 3B) collected from an equivalent ground area in a nearby field of corn debris following grain harvest the previous fall. The wheat crops developed normally and the heads emerged above each cage in May. At the soft dough stage of grain development in June, heads above each microplot were rated for the occurrence of typical symptoms of Fusarium head blight (Fig. 4), i.e., premature bleaching and pink-orange discoloration. Just prior to field harvest by cooperating growers, wheat heads were hand-harvested above each microplot. A subsample of heads from each microplot was surfaced-disinfected with dilute bleach, rinsed, and cultured on a selective agar medium in the laboratory to determine if a head was infected by *Gibberella zeae*. Another subsample of heads from each microplot was threshed and the grain assayed for contamination by DON.

Figure 1. Distribution of Fusarium head blight microplot experiments in 15 winter wheat fields in New York during 2008-2010.

Figure 2. Microplot experiment in a Waterloo, NY wheat field that followed harvest of dry bean.

The results of these 15 field experiments are shown in Figure 5. Significant levels of head blight symptoms appeared at soft dough stage only in two fields (Aurora and Bath) in 2009. Yet DON toxin was detected in grain from

Figure 3. Microplots containing no added residue (A) or overwintered corn residue (B).

Disease Management

Figure 4. Fusarium head blight symptoms on wheat at soft dough stage in late June.

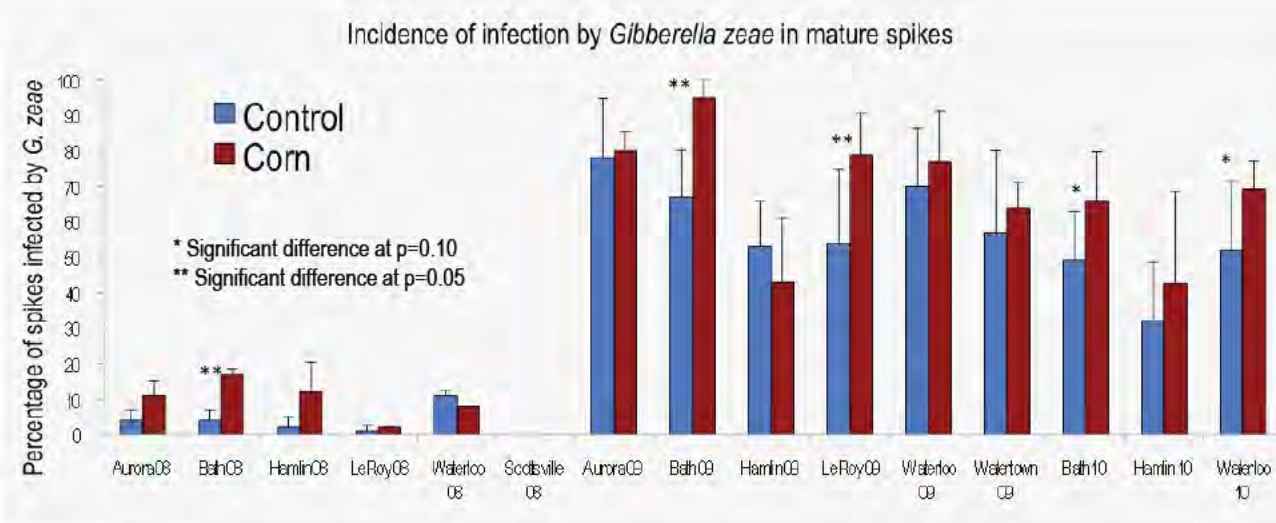
each of the 15 fields, suggesting that symptoms in June are not a sufficient predictor of DON in harvested grain. This is likely due, in part, to post-flowering infections that don't result in visible symptoms or grain shriveling, but can result in toxin accumulation in grain. The data on *Gibberella* recovery from mature heads support this mechanism. In 2009 and 2010, seasons with intermittent rain events through the grain-filling period, a majority of wheat heads was infected with *Gibberella* by harvest. In 2008, a season with persistent dryness through grain-filling, there was relatively little infection of mature heads.

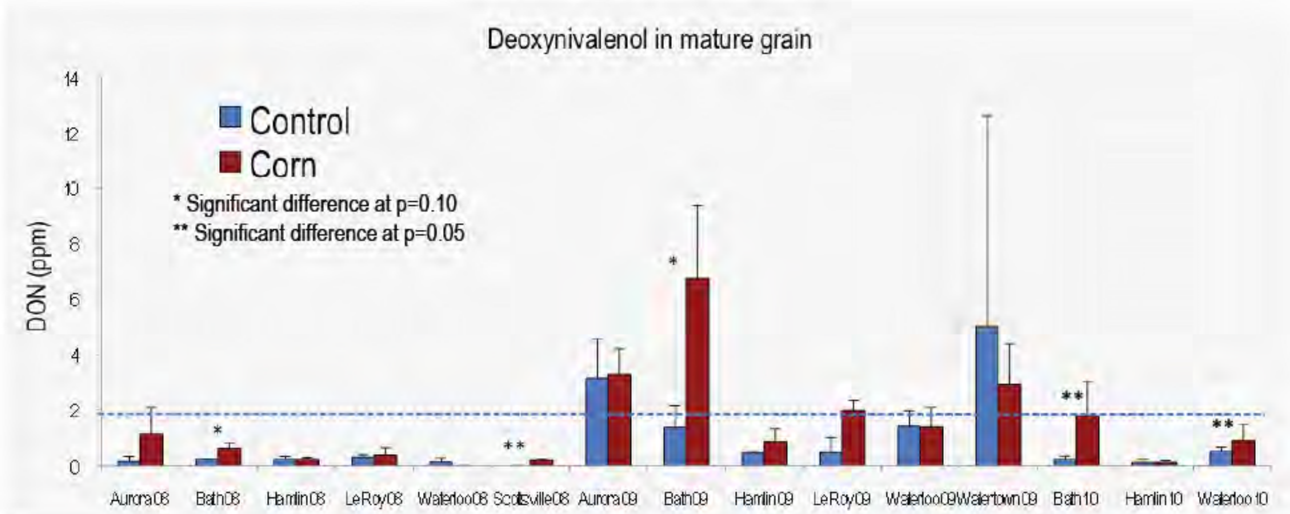
So what effects did natural corn residues within a wheat field have on localized infection, symptoms, and DON contamination? Data in Figure 5 suggest that spores in the air above each wheat field played a greater role in head infection and toxin accumulation than did spores coming from within-microplot corn debris. Yet there is evidence that within-field corn debris also played an important role. In five of the 15 wheat fields, there was significantly more head infection in wheat from corn debris-containing microplots. And in five fields, there were significantly higher levels of DON in grain from corn-debris containing microplots. Planting wheat after a non-host crop like soybean or following tillage of infected wheat or corn residues may reduce the local spore levels to some extent. Our results provide strong evidence that in a year with favorable environment for disease there are enough spores in the air to result in an epidemic and toxin accumulation in a wheat field that is free of cereal debris. However, exposure of wheat plants to spores from within-field corn debris is an additional risk factor in some years and situations, especially when weather conditions are only moderately favorable for disease.

Levels of DON were consistently higher in corn debris-containing microplots in the three experiments in Bath, in a valley environment more isolated from large acreages of corn than the other test locations. In two of the three experiments at Bath, grain from the corn debris-containing microplots had DON levels near or exceeding the USDA food safety guideline of 2 parts per million of DON for un-milled grain, whereas grain from the control plots had DON levels well below the threshold. Spores from within-field corn debris might be more important for wheat infection in regional environments with limited corn acreage, but this remains to be tested. Research is planned for 2011 in agricultural scale wheat plots, with and without corn debris, to better define the relative contribution of within-field corn debris to DON contamination of wheat grain.

For information on the integrated management of Fusarium head blight, consult the Scab Smart Extension Website (www.scabsmart.org).

Acknowledgements: This information is based upon research supported in part by Cornell University Hatch Project NYC153433 and by the U.S. Department of Agriculture under agreement No. 59-070-4-093. This is a cooperative project with the U.S. Wheat & Barley Scab Initiative. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the authors and do not necessarily reflect the view of the U.S. Department of Agriculture. We thank Carl Albers, Mike Hunter, and Mike Stanyard of Cornell Cooperative Extension for initial contact with wheat growers; Dale Cotterill and Paul Stachowski for wheat management at Cornell's Musgrave Research Farm; and the Branton, Gracey, Greenwell, Lott, Stokoe, and Weaver families for graciously allowing us to conduct research in their wheat fields.





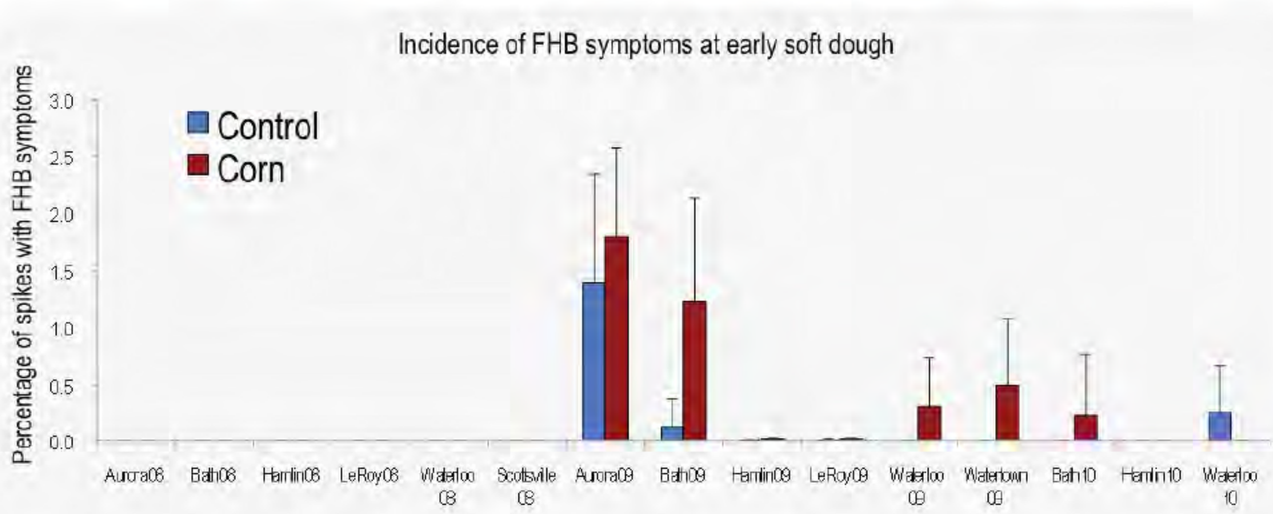
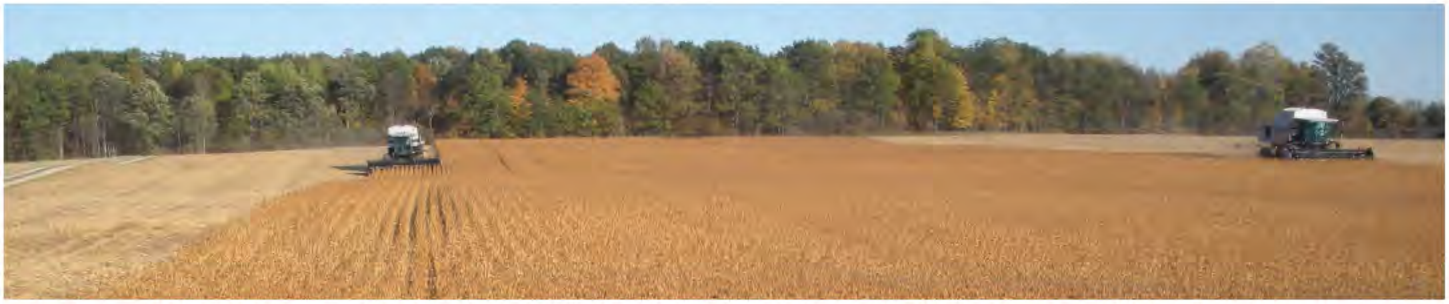


Figure 5. Fusarium head blight symptoms at soft dough stage (bottom), level of deoxynivalenol (DON) toxin in harvested grain (middle), and infection of mature heads by the Fusarium head blight pathogen in corn debris-containing and no-debris microplots in 15 winter wheat fields in New York.



Calendar of Events

Jan. 6, 2011	**NYS Agricultural Society Annual Forum, Syracuse, NY**
Jan. 26, 2011	**NY Corn and Soybean Expo, Holliday Inn, Liverpool, NY**
March 23, 2011	**Adaptive N Management and Soil Health Management Workshops, Ithaca, NY**

What's Cropping Up? is a bimonthly newsletter distributed by the Crop and Soil Sciences Department at Cornell University. The purpose of the newsletter is to provide timely information on field crop production and environmental issues as it relates to New York agriculture. Articles are regularly contributed by the following Departments at Cornell University: Crop and Soil Sciences, Plant Breeding, Plant Pathology, and Entomology. **To get on the mailing list, send your name and address to Larissa Smith, 237 Emerson Hall, Cornell University, Ithaca, NY 14853 or lls14@cornell.edu.**

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