What's Cropping Up?

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Corn Grain Hybrids for New York

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In choosing corn hybrids for grain production, the two most important considerations for any grower are maturity and yield potential. Maturity comes first, because it's of no use to have the most fantastic yield potential in the world if the grain will not be able to mature and dry down reasonably in the production environment available to it. Recent years have included a number of growing seasons with plenty of summer heat and nice warm fall weather with late frosts. Growers have been able to produce hybrids that are longer season than one might expect in many areas. Summer 2009 provides a reminder that it's not always going to be that way! With growing degree days running well behind over much of the state and weather during September and early October unknown, it's a good year to have planted some hybrids that are guaranteed to mature in the available growing season. For any season, it's a good strategy to choose a mix of longer season hybrids that will take good advantage of a year that happens to have a long, warm growing period and shorter season hybrids that are virtually guaranteed to mature and that can be planted in cooler microclimates or at later dates.

Beyond maturity, any grower wants to choose a hybrid with excellent yield potential as well. Yield potential is a function of the genetics of the hybrid and is clearly also affected by hybrid maturity. It's a simple relationship with maturity – the more heat and light a hybrid absorbs during active growth, the more photosynthate it has available to fill out grain on the ear. So if the growing season were unlimited, the later hybrids would always yield more because they have more time to capture and utilize the sun's energy in forming their grain. Growers need to focus on choosing those hybrids that have good

Table 1. Hybrids for early grain (1400–1900 growing degree days[1], 70–90 days relative maturity).

Hybrids in order of maturity

Brand or Source	Hybrid	Comparative Yield[2]	Comparative Standability[3]	Years in Tests	No. Tests
Cornell	M1821	90	7.8	1	3
Hyland	HL CVR44	102	8.1	1	3
Growmark FS	3968VT3	107	7.8	1	3
Hyland	HL R230	99	7.6	1	3
T A Seeds	TA290-19	97	7.5	1	3
T A Seeds	TA370-00	113	7.6	1	3
Dekalb	DKC38-89(VT3)	111	8.1	1	3
Hyland	HL CVR48	108	8.0	1	3
Doebler's	372XRR	104	8.3	1	3
Growmark FS	3989VT3	110	7.8	1	3
Croplan Genetics	294RR/BT	108	7.3	1	3
Growmark FS	4282VT3	107	7.8	1	3

[1]**Growing degree day** ratings for New York–adapted corn hybrids range from 1400 to 3000. Within the growing degree day range for this table, the hybrids listed first are earlier maturing and those listed last are later maturing.

[2]**Comparative yield ratings** are obtained in Cornell statewide tests from yields adjusted to an average of 100. A hybrid with a rating of 110 has performed 10 percent above average in trials where it was entered. Rating differences smaller than 5 percent are probably not statistically significant.

[3]**Comparative standability** is the comparative resistance to stalk lodging in Cornell tests on the basis of 1 to 9, with 1 indicating the lowest resistance and 9 the highest.

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genetic potential for grain yield within a maturity class that will fit their production areas.

Brand or Source	Hybrid	Comparative Yield[2]	Comparative Standability[3]	Years in Tests	No. Tests
Dyna-Gro	54V78	108	7.7	1	4
N K	N27B-CB/LL/RW	96	7.7	1	4
LICA	1898CB/LL	98	7.5	1	4
Growmark FS	4465VT3	106	8.0	1	4
Hyland	HL CVR54	96	7.7	1	4
Hyland	HL CVR64	99	8.0	1	4
T A Seeds	TA451-11	105	7.6	2	8
Growmark FS	4373VT3	99	7.9	2	8
Dekalb	DKC46-60(VT3)	101	8.1	2	8
Croplan Genetics	388TS	105	7.7	1	4
Doebler's	468RB	104	8.0	3	13
Dyna-Gro	55V18	104	7.9	2	8
Growmark FS	4861VT3	107	7.9	2	8
Garst	88C97CB/LL	106	7.6	1	4
Dekalb	DKC50-44(VT3)	112	8.0	1	4
LICA	9707BT/LL	94	7.4	1	4
Growmark FS	4819XRR	103	8.1	2	8
Croplan Genetics	421TS	108	8.0	2	8
Hyland	HL CVR72	104	8.0	1	4
Hyland	HL CVR74	113	7.8	1	4
T A Seeds	TA500-16	108	8.2	1	4
Doebler's	467BVR	103	7.9	1	4
Hyland	HL B49R	108	8.2	1	4
LICA	19C00	110	7.8	1	4
Growmark FS	5484VT3	107	8.0	1	4

Table 2. Hybrids for medium-early grain (1900–2400 growing degree days[1], 85–105 days relative maturity).

Hybrids in order of maturity

[1]**Growing degree day** ratings for New York–adapted corn hybrids range from 1400 to 3000. Within the growing degree day range for this table, the hybrids listed first are earlier maturing and those listed last are later maturing.

[2]**Comparative yield ratings** are obtained in Cornell statewide tests from yields adjusted to an average of 100. A hybrid with a rating of 110 has performed 10 percent above average in trials where it was entered. Rating differences smaller than 5 percent are probably not statistically significant.

[3]**Comparative standability** is the comparative resistance to stalk lodging in Cornell tests on the basis of 1 to 9, with 1 indicating the lowest resistance and 9 the highest.

Every year, Cornell University invites seed companies to enter their corn hybrids in grain yield evaluation trials within each of three maturity classes: early (70 to 90 days relative maturity), medium-early (85 to 105 days relative maturity), and medium to late (100 to 120 days relative maturity). Within these groupings, hybrids are planted in three to five locations that are appropriate for their maturity. Trials are grown in farmer-cooperators' fields at about nine locations around the state, and also at one location on an experimental farm (Chazy in northern New York). Cooperators carry out land preparation, weed control, and side-dressing as appropriate. We plant the hybrids using a precision vacuum planter, collect data throughout the growing season, and harvest them by machine (except at Chazy where hybrids are hand harvested by Mike Davis and his crew – we thank them!). Each hybrid is evaluated in a two-row plot that is 17.5 feet long (plot size 1/500th acre), with three replications of each hybrid per location. Data are collected on final plant stand, stalk strength (a scale of 1 to 9 is used, where the stalks are pushed by hand, and resistance to pushing and breaking is rated as 9 if the stalks have strong resistance against breakage when pushed, or lower if they

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are weak and break easily), grain yield, and grain moisture at harvest.

Every year, we summarize the data over years for all hybrids that are included in that year's testing program. Many hybrids will be new to our testing program, so may have only one year worth of testing data. Others will have been tested in one or more previous years. You can always have more confidence in the data from those hybrids that have been tested in the most environments, because they have proven their performance over a greater range of different conditions. Because hybrid performance will vary from location to location and year to year, we report the data as percentage of the test average. In other words, a hybrid with a comparative yield of 110 had a yield that was 10% above the average of all the hybrids tested in the same locations. The tables below report our hybrid grain yield evaluation data: early maturity hybrids in Table 1, medium-early maturity hybrids in Table 2, and medium to late hybrids in Table 3.

Recall that you should compare hybrids only with others in the same table. Comparisons of ratings between tables are misleading because the different maturity groupings are tested in different locations. Early hybrids are tested at short-season locations, medium-early maturity hybrids at slightly longer season locations, and medium and late hybrids at sites with a moderate to long growing season. High-yielding hybrids in the early group would probably do poorly in medium or late tests and vice versa, because they are unadapted and inappropriate maturity for the sites where those tests are done.

In developing these tables, only those hybrids that performed above 90 percent of the test average and those that companies plan to offer for sale in New York in the coming cropping season are included. Not all hybrids are available in all regions of the state, however. For further help in selecting hybrids specifically suited to your needs, check with your Cornell Cooperative Extension educators and/or with seed company representatives. You can also find detailed results of each of our last four years of annual testing data at: http://plbrgen.cals.cornell.edu/cals/pbg/programs/departmental/corn/index.cfm

Table 3. Hybrids for medium and long season grain (2400–2900 growing degree days[1], 100–120 days relative maturity).

Hybrids in order of maturity

Brand or Source	Hybrid	Comparative Yield[2]	Comparative Standability[3]	Years in Tests	No. Tests
T A Seeds	TA510-19	104	7.5	1	4
Garst	87Y26GT	106	7.7	1	4
Dekalb	DKC52-59(VT3)	106	7.7	1	4
LICA	18B04	106	8.7	1	4
N K	N48G-CB/LL/RW	109	7.7	1	4
Dyna-Gro	54T42	102	7.8	1	4
Dyna-Gro	55V48	100	8.1	1	4
Dyna-Gro	55B49	100	8.2	2	7
T A Seeds	TA555-13V	107	8.2	1	4
LICA	18D04	101	7.9	1	4
T A Seeds	TA607-11	106	8.4	2	7
Dekalb	DKC62-29(VT3)	104	8.0	1	4
Doebler's	660BVR	108	8.2	1	4
Dekalb	DKC61-69(VT3)	114	7.8	1	4
Hyland	HL B337	110	7.7	3	11

[1]**Growing degree day** ratings for New York–adapted corn hybrids range from 1400 to 3000. Within the growing degree day range for this table, the hybrids listed first are earlier maturing and those listed last are later maturing.

[2]**Comparative yield ratings** are obtained in Cornell statewide tests from yields adjusted to an average of 100. A hybrid with a rating of 110 has performed 10 percent above average in trials where it was entered. Rating differences smaller than 5 percent are probably not statistically significant.

[3]**Comparative standability** is the comparative resistance to stalk lodging in Cornell tests on the basis of 1 to 9, with 1 indicating the lowest resistance and 9 the highest.

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Field-scale Studies Evaluating the Agronomics and Economics of Selecting Double and Triple-stacked Hybrids.

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Double and triple-stacked hybrids dominate the hybrid corn industry now so we conducted field-scale studies on four farms in New York in 2007 and 2008 to evaluate the agronomics and economics of the base genetics of a corn hybrid with double-stacked (Roundup Ready, and Bt trait for corn borer) hybrids in a corn-soybean rotation as well as triple-stacked (Roundup Ready, Bt trait for corn borer, and Bt trait for rootworm control) hybrids in continuous corn. The objective of the study was to determine if growers in New York would benefit from selecting stacked-hybrids because European corn borer is only an occasional pest in New York, western corn rootworm damage is not as severe in New York as in the Midwest USA, and Roundup Ready resistant weeds have not been observed in New York.

As indicated in a previous What's Cropping Up? article (Vol.19, No.3, p.3-5), a site x hybrid trait interaction for yield was observed in continuous corn but not in the corn-soybean rotation (Table 1). When average across the 2007 and 2008 growing season, the double-stacked hybrids compared with the base genetics yielded 5.7 % higher at the Jefferson Co. site and 3.6% higher (yields were rounded to the nearest bushel in Table 1) at the Onondaga Co. site in continuous corn where moderate stalk lodging occurred. In contrast, the double-stacked hybrids compared with the base genetics yielded similarly (about 0.9% lower at the Cayuga Co. and about 1.6% higher at the Livingston Co. sites) where minimal stalk lodging occurred. The results from this study indicate that the yield response to the Bt corn borer trait had significant spatial variability, which is consistent with other studies on the use of Bt corn. The addition of the Bt rootworm trait of the triple-stacked hybrids provided no additional yield advantage compared to the double-stacked hybrids in continuous corn when averaged across sites or at individual sites. Apparently, corn rootworm did not affect corn yields in second -year corn, which corroborates the recommendations to not use a Bt rootworm resistant hybrid until third-year corn in New York (What's Cropping Up?, Vol.18, No. 1, p.8-9).

Although there was no significant site x hybrid trait for corn yield in the corn-soybean rotation (P=0.11), the double-stacked hybrids yielded about 4.7 % higher compared to the base genetics at the Jefferson Co. site averaged across the 2007 and 2008 growing seasons.

Table 1. Grain yield of corn hybrids with three genetic traits at four locations in New York in continuous corn and a corn-soybean rotation, when averaged across two hybrids and the 2007 and 2008 growing seasons.

Hybrid	Cayuga	Livingston	Jefferson	Onondaga	Mean
			CORN-CORN		
	--------	-----------	--bu acre^{-1}--	--------	---------
Base Genetics	172	196	140	175	
Double-Stacked††	171	199	**148**	**182**	
Triple-Stacked§	175	198	**147**	**181**	
			Contrasts		
Base vs. Double	NS†	NS	*	*	
Base vs. Triple	NS	NS	*	*	
Double vs. Triple	NS	NS	NS	NS	
			CORN-SOYBEAN		
Base Genetics	164	196	171	170	176
Double-Stacked	169	194	**178**	172	179
			Contrast		
Base vs. Double	NS	S	*	NS	NS

* Significant at the 0.05 level of probability.

† NS, not significant.

†† Has the Roundup Ready and corn borer resistant genetic traits.

§ Has the Roundup Ready, corn-borer and corn rootworm resistant genetic traits.

The yield advantage for double-stacked hybrids at the Jefferson Co. site is probably associated in part with lower stalk lodging. The double-stacked hybrids and base genetics, however, yielded similarly at the Onondaga Co. site where significant lodging differences were also observed between hybrid traits so other factors in addition to stalk lodging probably affected yield at both sites. The yield response for the double-stacked hybrids in continuous corn but not in the corn-soybean rotation at Onondaga Co. underscores the spatial variability in response to Bt hybrids for corn borer control.

Table 2. Grain moisture of corn hybrids at harvest with three genetic traits at four locations in New York in continuous corn and a corn-soybean rotation, when averaged across two hybrids and the 2007 and 2008 growing season.

Hybrid	Cayuga	Livingston	Jefferson	Onondaga	Mean
			CORN-CORN		
	--------	-----------	--%--	--------	---------
Base Genetics	22.9	21.7	20.3	28.2	23.2
Double-Stacked††	**25.9**	**23.2**	**21.1**	**29.5**	**24.9**
Triple-Stacked§	**25.5**	**22.9**	**21.1**	**29.1**	**24.6**
			Contrasts		
Base vs. Double	**	*	*	*	**
Base vs. Triple	**	*	*	*	**
Double vs. Triple	NS†	NS	NS	NS	NS
			CORN-SOYBEAN		
Base Genetics	24.1	21.2	21.5	28.8	22.3
Double-Stacked	**26.2**	**22.7**	**22.5**	**31.2**	**23.8**
			Contrast		
Base vs. Double	**	**	*	**	**

* Significant at the 0.05 level of probability.

** Significant at the 0.01 level of probability

† NS, not significant.

†† Hybrids have the glyphosate and corn borer-resistant genetic traits.

§ Hybrids have the glyphosate, corn-borer, and corn rootworm-resistant genetic traits.

When averaged across growing seasons and sites, grain moisture at harvest averaged about 1.5 percentage points greater in the double and triple-stacked hybrids compared with the base genetics, regardless of rotation (Table 2). Site x hybrid trait interactions were not observed for grain moisture in either rotation. Roundup Ready hybrids have not been reported to have higher grain moisture and the double and triple-stacked hybrids had similar grain moistures in this study. Consequently, the higher grain moisture of the stacked hybrids in this study is probably associated with the Bt trait for corn borer control, which has been observed at times in other regions of the USA and Canada. If higher grain moisture in hybrids with the Bt corn borer trait continue to occur, it could be an ongoing concern in New York for grain corn production, especially if energy prices remain high.

A site x hybrid trait interaction was observed in both rotations for partial returns (Table 3). When comparing variable costs of double-stacked hybrids vs. base genetics, the $12/acre reduction in herbicide costs ($18/acre for Roundup in the stacked-hybrids vs. $30/acre for preemergence herbicides in the base genetics) was mostly offset by the $13.20/acre increase in seed costs ($201/bag for base genetics at a seeding rate of 32,000 seeds/acre= 2.5 acres/bag or $80.40/acre vs. $234/bag for double-stacked hybrids or $93.60/acre). Consequently, the main determinants of profit were increased revenue, associated with any yield advantage (average market weighted corn price in NY was $5.05/bushel in 2007 and $4.29 in 2008 or $4.67/bushel), offset by increased drying costs ($.04/point/bushel of moisture) associated with higher grain moisture. At the Jefferson Co. site, the 7 to 8 bushel/acre yield advantage resulted in increased revenue in both rotations, which was not offset by increased drying costs. Consequently the Jefferson Co. grower realized an overall profit of about $25-35/acre for selecting double-stacked hybrids compared with the base genetics in both rotations. At the Onondaga Co. site, the 6 bushel/acre yield increase offset the increased drying costs resulting in a significant profit of about $18/acre for selecting

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the double-stacked hybrid in continuous corn. In the corn-soybean rotation, however, the 2 bushel/acre yield increase did not offset the increased drying costs in the corn-soybean rotation resulting in no economic advantage for selecting the double-stacked hybrid. The spatial variability of the yield response between fields on the farm at Onondaga Co. underscores the site-specificity of profitability for selecting a double-stacked hybrid in New York. Furthermore, the selection of a double-stacked hybrid compared with the base genetics resulted in a significant loss of profit at the Cayuga Co. site in continuous corn and at the Livingston Co. site in the corn-soybean rotation because increased drying costs were not offset by increased revenue from a yield increase. Growers in New York should carefully analyze expected yield increase, expected corn price for the crop, and expected drying costs before selecting hybrids with the Bt corn borer trait.

Grain moisture did not differ between the triple and double-stacked hybrids so seed cost differences ($248/bag =$99.20/acre at 32,000 seeds/acre for triple-stacked) and revenue differences associated with yields were the main determinants in partial returns between these hybrid traits. The triple-stacked compared with the double-stacked hybrids had less negative partial return at the Cayuga Co. site but also less partial return than the double-stacked hybrid trait at the Jefferson Co. site. If corn rootworm has not been an historical problem in second-year corn on specific farms, the addition of the Bt corn rootworm trait to the base genetics or double-stacked hybrid could reduce profit because of the lack of yield increase coupled with increased seed costs.

Conslusion

Stacking the Bt corn borer and/or Bt rootworm traits with the Roundup Ready trait may not always be justified in New York as indicated by three of eight site-rotation comparisons

Table 3. Partial budget analyses for four farms in NY comparing the adoption of double and triple-stacked hybrids compared with the base genetics in continuous corn and adoption of a double-stacked hybrid compared with near-isolines in a corn-soybean rotation, based on additional corn grain yield and mean corn price in NY in 2007 and 2008 ($4.67 bu^{-1}) and added variable (operating) costs at 2009 dollars for seed, grain drying, and herbicide costs.

Hybrid	Cayuga	Livingston	Jefferson	Onondaga	Mean
			CORN-CORN		
	--------	-----------	--$ acre^{-1}--	--------	---------
Double[††] vs. Base Genetics	-28.70	0.24	35.99	18.47	
Triple [§] vs. Base Genetics	-11.84	-5.06	21.94	11.85	
Double vs. Triple-Stacked	-16.86	5.30	14.05	6.61	
			Contrasts		
Double vs. Base Genetics	**	NS[†]	**	*	
Triple vs. Base Genetics	*	NS	*	*	
Double vs. Triple-Stacked	*	NS	*	NS	
			CORN-SOYBEAN		
Double-Stacked vs. Base	8.68	-19.18	24.76	-8.49	
			Contrast		
Double-Stacked vs. Base	NS	*	**	NS	

* Significant at the 0.05 level of probability.

** Significant at the 0.01 level of probability

† NS, not significant.

†† Hybrids have the glyphosate and corn borer-resistant genetic traits.

§ Hybrids have the glyphosate, corn-borer, and corn rootworm-resistant genetic traits.

showing a profit but two site-rotation comparisons showing a profit loss. Growers who have not historically encountered corn rootworm damage in second-year corn fields should weigh the benefits of relatively inexpensive insurance against potential corn rootworm damage against increased seed costs for Bt corn with the rootworm trait. If the Bt trait for corn borer control compared with base genetics results in higher grain moisture at harvest, corn growers in New York should weigh the benefits of relatively inexpensive insurance against potential corn borer and stalk lodging problems against increased drying and seed costs, especially when energy costs are high. Other options for not incurring increased drying costs when selecting hybrids with the Bt corn borer trait is to plant hybrids that are 3-4 d shorter in RM or to select hybrids with the same RM but to delay harvest for an additional week. Both management options would result in similar drying costs to that of the base genetics but could reduce yields because of lower yield potential associated with the use of shorter-season hybrids or increased yield loss associated with weather or pest-related problems during the extended 1-week dry-down period. The results of these studies indicate that growers in New York should carefully match each hybrid trait to their specific fields and not buy Bt stacked hybrid traits indiscriminately because of their availability or for control of potential pest problems.

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Seeding Rates for Soft Red Winter Wheat?

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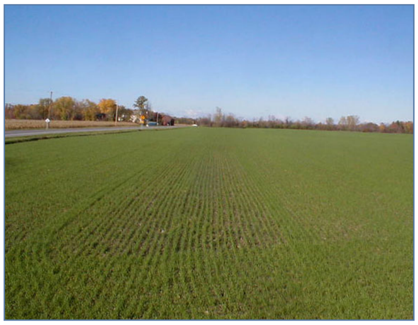

Soft white winter wheat represented over 80% of the New York wheat acreage in the mid-1990s. Over the last 15 years, however, soft red winter wheat now represents close to 80% of the New York acreage, primarily because of its greater tolerance to sprouting damage. We have conducted numerous studies on seeding rates on soft white winter wheat at timely (late September) and late (mid-October to early November) planting dates. Soft white winter wheat has a very broad optimum seeding rate range with optimum seeding rates generally about 1.5 to 2 bushels/acre for September planting dates and about 2.5 bushels/acre for mid-October to early November planting dates (Tables 1 and 2). Surprisingly, seeding rates of generally about 1.5 to 2 bushels/acre at both planting dates maximized straw yields of soft white winter wheat so growers who also harvest the straw should not increase seeding rates to increase straw yields, even at late planting dates (Tables 1 and 2). Soft red winter wheat now dominates the NY wheat acreage and recommended seeding rates from Pioneer and other states that grow soft red wheat is about 1.4 M seeds/acre, which usually translates into about 1.75 bu/acre, depending upon the number of seeds/lb of the variety.

We tested Pioneer 2555, a soft red wheat variety, along with Geneva wheat in 1989 and 1990 and found that indeed Pioneer 2555 over a 2-year period generally yielded best at 1.4 M seeds/acre for the September planting date but about 2.2 M seeds/acre for the mid-October planting date (Table 3). This translated into about 1.75 and 2.5 bu/acre seeding rates, respectively, or about the same general optimum seeding rate as Geneva, the soft white variety, for grain yield

Table 1. Grain yield and straw yield of Geneva soft white winter wheat for September-planted wheat (~9/20) and October-planted wheat (~10/15) at 1.5, 2.0, 2.5, and 3.0 bu/acre seeding rates at the Aurora Research Farm in 1989 and 1990.

	PLANTING DATE					
Seeding Rate	9/20/89	9/21/90	Avg.	10/14/89	10/17/90	Avg.
Bu/acre	Grain Yield (bu/acre)					
1.5	**75**	77	**76**	54	58	56
2.0	72	77	75	55	65	60
2.5	70	81	76	**58**	69	**64**
3.0	71	**85**	78	59	**72**	65
Mean			76			62
LSD 0.05†			6			
	Straw Yield (Tons/Acre)					
1.5	**2.0**	**1.5**	**1.8**	1.0	**1.1**	1.1
2.0	2.1	1.6	1.9	**1.6**	1.1	**1.3**
2.5	2.1	1.6	1.9	1.2	1.2	1.2
3.0	2.1	1.7	1.9	1.4	1.4	1.4
Mean			1.7			1.2
LSD 0.05†			.015			

†LSD 0.05 compares means between planting dates.

Table 2. Grain yield and straw yield of Caledonia soft white winter wheat for September-planted wheat and November-planted wheat at 1.0, 1.5, 2.0, 2.5, and 3.0 bu/acre seeding rates at the Aurora Research Farm in 2005 and 2006.

	PLANTING DATE					
Seeding Rate	9/14/05	9/27/06	Avg.	11/4/05	11/02/06	Avg.
Bu/acre	Grain Yield (bu/acre)					
1.0	52	54	53	42	44	43
1.5	59	59	59	44	52	48
2.0	**64**	**62**	**63**	**47**	50	49
2.5	60	61	60	47	**58**	**53**
3.0	60	62	61	49	52	50
Mean			59			48
LSD 0.05†				4.5		
	Straw Yield (Tons/Acre)					
1.0	2.2	0.8	1.5	1.5	0.5	1.0
1.5	**2.4**	**1.0**	**1.7**	**1.8**	0.7	**1.3**
2.0	2.5	1.0	1.8	1.6	0.7	1.2
2.5	2.4	1.2	1.8	1.6	**0.9**	1.2
3.0	2.4	1.1	1.8	1.8	0.8	1.3
Mean			1.7			1.2
LSD 0.05†				0.20		

†LSD 0.05 compares means between planting dates.

in those 2 years. Furthermore, the straw of Pioneer 2555 yielded best at 1.8 M seeds/acre (Table 3), about 2 bu/acre, at both planting dates, which was only a slightly higher optimum seeding rate for straw than Geneva for the mid-October planting date. Consequently, we did not discriminate in our seeding rate recommendations between soft white and soft red winter wheat varieties in NY because of similar responses of soft red and soft white winter wheat varieties (we also tested Susquehanna, another soft red variety that had the same response as Pioneer 2555). Because of the increased acreage of soft red winter wheat in NY in the 2000s, we initiated a study in the fall of 2008 to determine the optimum seeding rate response of two current soft red winter wheat varieties along with one soft white winter wheat variety from Pioneer Hi-Bred at a timely planting date (September 23).

Table 3. Grain yield and straw yield of Pioneer soft red winter wheat for September-planted wheat (~9/20) and October-planted wheat (~10/15) at seeding rates of around 1.4, 1.8, 2.2, and 2.6 million seeds/acre at the Aurora Research Farm in 1989 and 1990.

	PLANTING DATE					
Seeding Rate	9/20/89	9/21/90	Avg.	10/14/89	10/17/90	Avg.
Seeds/acre	---------------------Grain Yield (bu/acre)------------------------					
1,400,000	**77**	82	**80**	63	66	65
1,800,000	72	83	78	60	70	65
2,200,000	71	**86**	79	**70**	**73**	**71**
2,600,000	69	84	77	69	72	70
Mean			79			68
LSD 0.05†				7		
	-------------------Straw Yield (Tons/Acre)---------------------					
1,400,000	2.0	1.4	1.7	1.3	1.4	1.4
1,800,000	**2.2**	**1.6**	**1.9**	1.2	**1.6**	**1.4**
2,200,000	2.1	1.6	1.9	**1.5**	1.6	1.5
2,600,000	2.3	1.7	2.0	1.4	1.7	1.6
Mean			1.9			1.5
LSD 0.05†				0.20		

†LSD 0.05 compares means between planting dates.

Despite the exceptionally high wheat yields in 2009, both soft red winter wheat varieties showed a somewhat limited response to seeding rates. Regression analysis indicated that Pioneer 25R47 did not respond to the seeding rates in this study and had maximum grain and straw yields at 745,000 seeds/acre (or about 1 bu/acre). Likewise, regression analysis indicated that 25R62 had maximum grain yield at 1,140,000 seeds/acre (~1.4 bu/acre) but straw yields did not respond to the seeding rates in this study with maximum straw yield at 835,000 seeds/acre (~1 bu/acre). Perhaps 2008-2009 growing conditions were close to ideal for wheat yields (dry and warm April and most of May, and a cool wet June) negating the need for higher seeding rates in the 2008-2009 growing season. The soft white variety, 25W36, however, had maximum yields at 1,375,000 seeds/acre or 1.8 bu/acre, which is typical for soft white winter wheat varieties planted in September in New York.

Conclusion

Soft red winter wheat varieties showed a limited response to seeding rates in 2009, which again suggests that wheat has a very broad optimum seeding rate range. The 2009 growing season had atypically high yields so may not be the most representative year to draw

Crop Management

Table 4. Grain yield and straw yield of Pioneer 25R47 and 25R62, two soft red winter wheat varieties and Pioneer 25W36, a soft white wheat variety, planted on September 23, 2008 at the Aurora Research Farm at seeding rates of around 1.0, 1.4, 1.8 2.1, and 2.6 bushels/acre, which corresponded to different seeds/acre for each variety.

Seeding Rate	Grain Yield	Straw Yield
Seeds/acre (bu/acre)	------bu/acre---	-----tons/acre------
	Pioneer 25R47	
745,000 (~1.0)	**94**	**2.6**
1,030,000 (~1.4)	92	2.2
1,320,000 (~1.8)	95	2.3
1,510,000 (~2.1)	93	2.4
1,875,000 (~2.6)	98	2.5
	Pioneer 25R62	
835,000 (~1.0)	95	**2.1**
1,160,000 (~1.4)	**105**	2.1
1,485,000 (~1.8)	105	2.0
1,700,000 (~2.1)	93	2.2
2,105,000 (~2.6)	102	2.3
	Pioneer 25W36	
775,000 (~1.0)	89	2.2
1,075,000 (~1.4)	89	2.3
1,375,000 (~1.8)	**96**	**2.5**
1,575,000 (~2.1)	88	2.3
1,950,000 (~2.6)	96	2.4

conclusions from. We will continue this study for 2 more growing seasons, although seeding rates in many of our studies have had less impact on wheat yields than variety selection, planting dates, and N management. Nevertheless, the cost of wheat seed has increased in recent years so despite the apparent broad optimum seeding rate range growers should strive to optimize seeding rates for economic reasons as well as for yield responses.

Laudis Registered for Annual Broadleaf and Grass Control in Corn

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Weed Management

Laudis, a herbicide for annual broadleaf and grass weed control, was recently approved by the Department of Environmental Conservation for use on field and sweet corn in NY State. The active ingredient in Laudis, tembotrione, has the same site of action as mesotrione and topramezone, the active ingredients in Callisto and Impact respectively. These Group 27 herbicides inhibit 4-HPPD, an enzyme critical to synthesis of plant pigments. When these herbicides inhibit this enzyme, susceptible weeds turn white and this bleaching (see photo) is followed by tissue necrosis and death.

Bleaching symptoms associated with 4-HPPD herbicide application.

Label Details

Laudis, like Impact, is registered for postemergence (POST) use only. On the other hand, Callisto and its' associated products can be applied either preemergence (PRE) or POST. Laudis is a 3.5 lb/gal suspension concentrate with a normal use rate of 3 fl oz/A. It can be applied from corn emergence up to the V7 and V8 stages of growth for sweet corn and field corn respectively. Applications should be made in a minimum of 10 gal/A of water and must include a methylated seed oil (MSO) and a nitrogen fertilizer source such as urea ammonium nitrate (UAN) or ammonium sulfate (AMS). Like Callisto and Impact, Laudis has good to excellent activity against many summer annual broadleaf weeds such as velvetleaf, pigweed, common ragweed, common lambsquarters, and wild mustard. It also controls barnyardgrass, large crabgrass, and giant and yellow foxtail. Laudis does not control fall panicum and provides only partial control of green foxtail.

While Laudis and these other 4-HPPD inhibitors have great value for annual broadleaf weed control, their activity against selected annual grasses should not be ignored. Emerged annual grasses are not well controlled with traditional PRE herbicides and choices for their burndown and control are limited in conventional (non GMO) corn. Along with Steadfast (now Steadfast Q), these herbicides have proven valuable for annual grass burndown in conventional corn. Glyphosate and Ignite 280 SL are used for burndown

Table 1. Giant foxtail burndown and control 3 and 6 weeks after treatment (WAT) respectively, and corn yields following POST applications of full or half rates of residual combinations with burndown herbicides at Aurora, NY in 2008.

Herbicides*	Rate Amt/A	% Burndown 3 WAT	% Control 6 WAT	Yield Bu/A
Residual**	Full Rate	49	27	194
+ Laudis	3 fl oz	97	97	204
+ Impact	0.73 fl oz	100	100	209
+ Steadfast	0.75 oz	99	100	200
Residual**	Half Rate	-	-	-
+ Laudis	3 fl oz	99	97	220
+ Impact	0.73 fl oz	99	99	219
+ Steadfast	0.75 oz	98	100	219
LSD (0.05)		8	10	31

*Applied with 1% (v//v) MSO and 2.5% (v/v) 28% UAN.

**Average of Dual II Magnum + AAtrex and Prowl H2O + AAtrex treatments.

Weed Management

Table 2. Large crabgrass burndown and control 1 and 6 weeks after treatment (WAT), and corn yields following postemergence applications of full or half rate residual combinations with burndown herbicides at Valatie, NY in 2008.				
Herbicides*	Rate Amt/A	% Burndown 1 WAT	% Control 6 WAT	Yield Bu/A
Residual**	Full Rate	55	23	132
+ Laudis	3 fl oz	98	99	144
+ Impact	0.73 fl oz	97	95	138
+ Callisto	3 fl oz	97	99	147
+ Steadfast	0.75 oz	71	83	143
Residual**	Half Rate	-	-	-
+ Laudis	3 fl oz	97	97	141
+ Impact	0.73 fl oz	95	87	143
+ Callisto	3 fl oz	97	95	143
+ Steadfast	0.75 oz	73	83	137
LSD (0.05)		10	15	14

*Applied with 1% (v//v) MSO and 2.5% (v/v) 28% UAN.

** Average of Dual II Magnum + AAtrex and Prowl H2O + AAtrex treatments.

in glyphosate-resistant (Roundup Ready) and Liberty Link corn respectively.

Research Conducted

Experiments were conducted in 2008 to evaluate Laudis and other herbicides for their ability to burndown emerged giant foxtail and large crabgrass in conventional corn. Laudis was compared with Impact and Steadfast for giant foxtail burndown, and with these herbicides as well as with Callisto for large crabgrass burndown. These burndown herbicides were applied with full and half rates of residual herbicide combinations to determine whether half rates of the residuals would provide season-long control. Residual combinations used were Dual II Magnum plus AAtrex and Prowl H2O plus AAtrex. All of these POST treatments, including those with residual combinations only, were applied with 1% (v/v) MSO and 2.5% (v/v) of 28% UAN in 20 gal/A of water.

Giant Foxtail Results

POST applications of full and half rates of the residual combinations were made with Laudis, Impact, or Steadfast to 6-inch giant foxtail in corn that was planted May 21, 2008 near Aurora, NY. Burndown and control ratings were made 3 and 6 weeks after treatment (WAT) respectively, and grain corn yields measured. Giant foxtail burndown and control averaged 49 and 27% 3 and 6 WAT respectively when full rates of the two residual combinations were applied without a burndown herbicide (Table 1). When full or half rates of these residual combinations were applied with Laudis, Impact, or Steadfast, giant foxtail burndown and control was at least 97%. In addition, there were no differences in the average corn yields between the full (204 bu/A) and half rates (219 bu/A) of the residual combinations with these burndown herbicides.

Large Crabgrass Results

Early POST applications of the full and half-rate residual combinations were made with Laudis, Impact, Callisto, or Steadfast to 1.25-inch large crabgrass in corn that was planted April 25, 2008 at Valatie, NY. Burndown and control ratings were made 1 and 6 WAT respectively, and grain corn yields measured. Large crabgrass burndown and control

Table 3. Effectiveness of selected postemergence herbicides for annual grass burndown and control in conventional corn.						
Herbicides	**Barnyard-grass**	**Large Crabgrass**	**Giant Foxtail**	**Green Foxtail**	**Yellow Foxtail**	**Fall Panicum**
Laudis	Good	Good	Good	Fair	Good	None
Impact	Good	Good	Good	Fair	Fair	Fair
Callisto	None	Good	None	None	None	None
Steadfast	Good	Fair	Good	Good	Fair	Good

averaged 55 and 23% 1 and 6 WAT respectively when full rates of the residual combinations were applied without a burndown herbicide (Table 2). When the full or half rates of the residual combinations were applied with Laudis, Impact, or Callisto, large crabgrass burndown was at least 95% 1 WAT. Control 6 WAT with these treatments was at least 87% and there were no significant differences among them. Crabgrass burndown and control averaged only 72 and 83% 1 and 6 WAT respectively when Steadfast was used for burndown but there was no difference between the full and half rates of residuals with Steadfast. Grain corn yield averaged 144 and 141 bu/A when burndown herbicides were applied with full and half rates of residual herbicides respectively.

Conclusions and Comments

These results reinforce the importance of including a burndown herbicide with residual herbicides after annual grasses have emerged, and show that half rates of residual combinations perform as well as full rates when used with burndown herbicides. Although these results show that Laudis and the other products work well with giant foxtail and large crabgrass, corn growers should be reminded that effectiveness of these herbicides varies with different annual grasses. A quick look at the relative effectiveness of these products for common annual grasses in Table 3 shows that no one product is best for all grasses. Correct grass identification is the key to selecting the best burndown herbicide for emerged annual grasses in conventional corn.

Nutrient Management

Nitrogen Fertilizers for Field Crops: Agronomy Factsheet # 44

John Weiss, Tom Bruulsema, Mike Hunter, Karl Czymmek, Joe Lawrence, Quirine Ketterings, Cornell University

Introduction

With the increased cost of nitrogen (N) fertilizer and concerns about the adverse environmental impacts of N losses, there is great interest in fine-tuning N fertilizer management. The goal is to match application source, rate, timing and method to supplement on-farm sources of N (e.g., manure, soil organic N, sod, legume cover crops) to meet crop needs and achieve optimum levels of N use efficiency. Optimum N fertilizer management requires an understanding of the different N fertilizers. In this fact sheet we will discuss the basic properties of major N fertilizer sources.

Urea

Urea is a highly soluble, dry material. Its N becomes plant-available when converted to ammonium (NH4+) and then nitrate (NO3-). Urea can be used as a starter, broadcast or topdress application and can be used in fertilizer mixes (dry or liquid). Advantages of urea are its high N content (45 to 46%), relatively low cost per lb of N, and rapid conversion to plant-available N. If urea is surface applied and not incorporated (either by rain or tillage), N losses to the air (as ammonia) can approach 40% of the applied N. In addition, a rapid pH increase after application caused by hydrolysis of urea can result in ammonia release that can damage seedlings if the urea is applied too close to the seed. If urea is used as a band-applied starter, the planter should be carefully checked to ensure placement is not closer than 2 inches beside and below the seed, and be calibrated to apply no more than 60 lbs urea per acre (30 lbs of actual N from urea). Conversion of ammonium to nitrate results in the formation of hydrogen ions (H+), so, like most N ertilizers, repeated urea applications will cause a reduction in soil pH over time.

Urea Ammonium Nitrate

Urea ammonium nitrate (UAN) is a soluble, readily available N source with 28-32% N prepared by mixing of ammonium nitrate and urea. It is primarily used as a non-pressurized liquid fertilizer and is for many the preferred source of N for sidedressing of row crops. UAN can be broadcast or placed in the starter band. If broadcast, UAN should be incorporated into the soil as the urea portion is subject to volatilization. However, because of its lower % of N in urea and ammonium form, volatilization losses per pound of N from UAN will be lower than for urea. Banding with drop nozzles has been found to minimize volatilization losses. The benefits of this product are its uniformity, ease of storage, handling and application. Like urea, UAN will lower the pH because of conversion of ammonium to nitrate and subsequent release of H+.

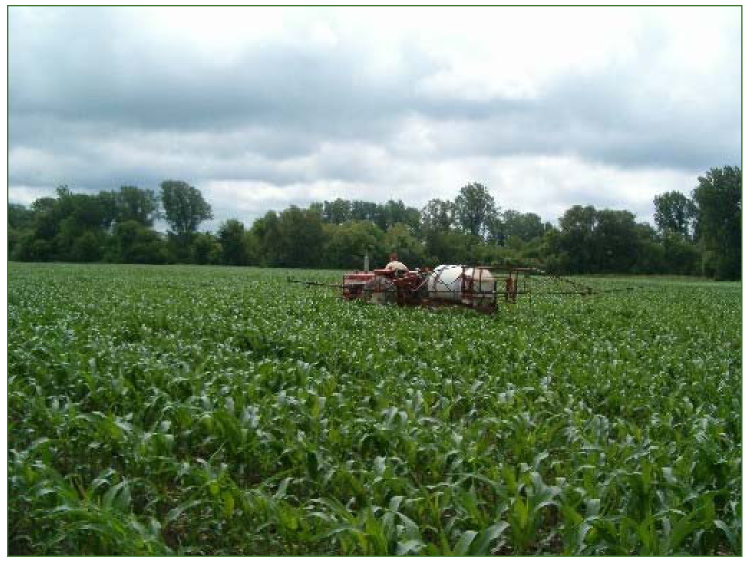

Figure 1: Urea ammonium nitrate in liquid form is a commonly used fertilizer to sidedress corn.

Ammonium Sulfate

Ammonium sulfate is a soluble, readily available source of N and sulfur (S). Dry forms contain 21% N and 24% S, while liquid forms have an analysis of 8-0-0-9. Ammonium sulfate can either be broadcast or applied in the starter band. In high P and K fertility situations, many NY producers use ammonium sulfate alone in the starter band. Ammonium sulfate is well-suited as a topdress application as it has a lower N volatilization risk than surface-applied urea. Also, where S is needed, ammonium sulfate is a good source of S. The drawbacks to using ammonium sulfate include a relatively high salt index and greater acidification potential per unit N applied than other ammonium-containing N sources, higher cost per lb of N, and relative low N content, requiring more frequent refilling of hoppers.

Nutreint Management

Anhydrous Ammonia
Anhydrous ammonia has the highest percentage of N of all fertilizers (82% N) and tends to be the cheapest N source (cost per unit N). It is a high-pressure liquid that can be deep-banded before, at or after seeding provided that there is no direct seed contact. Anhydrous ammonia must be injected 6 to 8 inches deep into moist and friable soil to limit ammonia loss (liquid ammonia converts to gas when no longer under pressure). It must be stored under high pressure, which requires specially designed, well-maintained equipment and facilities should be well-protected for safety reasons. During application, personal protective equipment (gloves and goggles) should be used.

Ammonium Nitrate
Ammonium nitrate is an odorless salt with 33 to 34% N. It can be surface-applied or incorporated into the soil. It contains both ammonium and nitrate resulting in reduced volatilization risk as compared to urea, and the nitrate provides a directly available N source. Since it contains ammonium, this fertilizer also lowers the pH of the soil.

Potassium Nitrate
Potassium nitrate, also known as saltpeter or nitric acid, is considered a specialty fertilizer. It is a colorless transparent crystal or white powder with 14% N and 46% potassium (K). Potassium nitrate does not lower the soil pH.

Mono-Ammonium Phosphate
Mono-ammonium phosphate (MAP) contains readily available sources of N (11%), P (52%) and S (1.5%). MAP is a dry granular material that is applied alone or often blended with other materials such as potash. It can be broadcast, band-applied or placed in the seed furrow. MAP can lower the soil pH but is an excellent starter fertilizer.

Di-Ammonium Phosphate
Di-ammonium phosphate (DAP) is dry fertilizer that contains readily available sources of N (18%) and P (46%). Formation of free ammonia produced after mixing of DAP with soil can cause seedling injury as described for urea. To prevent such injury using DAP, it is recommended to limit band-applications to (1) 65 lbs per acre of DAP, or (2) 30 pounds of urea N plus N from DAP.

Chilean Nitrate
Chilean nitrate can be used in conventional and organic cropping systems (permitted for use by USDA/NOP in 2003). It contains 16% of a readily plant-available form of nitrate-N and sodium. It is available in a dry, flowable prill form.

Enhanced-Efficiency Nitrogen Sources
Enhanced efficiency N sources are designed to reduce losses of N due to leaching, denitrification and/or volatilization. For more information on these enhanced-efficiency fertilizers see Agronomy Fact Sheet #45.

Concluding Remarks
Applying the right source of N fertilizer at the right rate, time, and place is critical to proper N management. For the best results, apply N only when needed, calibrate application equipment to ensure proper placement, and adjust source, rate and timing to meet N needs and avoid seed or seedling injury.

Additional Resources
Nutrient Management Spear Program Agronomy Fact Sheet Series. http://nmsp.css.cornell.edu.

Disclaimer

For more information

Cornell University
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Nutrient Management Spear Program
http://nmsp.css.cornell.edu
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2009

Calendar of Events

Oct. 27, 2009	**Field Crop Dealer Meeting, The Century House, 997 New Loudon Road, Latham, NY**
Oct. 28, 2009	**Field Crop Dealer Meeting, Holiday Inn Utica, 177 Burrstone Road, New Hartford, NY**
Oct. 29, 2009	**Field Crop Dealer Meeting, Batavia Party House, 5762 E. Main Road, Stafford, NY**
Oct. 30, 2009	**Field Crop Dealer Meeting, Auburn Holiday Inn, 75 North Street, Auburn, NY**
Nov. 1-5, 2009	**ASA-CSSA-SSSA International Annual Meetings, Pittsburgh, PA**
Dec. 8-10, 2009	**Northeast Region Certified Crop Adviser Training, Holiday Inn, Waterloo, 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, Animal Science, 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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