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Insect Resistance Management when Planting Bt Corn Hybrids

Eileen Cullen, Extension Entomologist

Planning to plant Bt corn hybrids this spring? If so, growers and consultants are required by law to have an insect resistance management (IRM) plan in place. The IRM plan is implemented by planting refuge corn acres on each farm where a Bt corn hybrid is planted. Refuge corn acres are hybrids that do not contain the Bt insect trait used in the Bt planting. The refuge must be planted to 20-percent of the corn acreage on each farm, and there are specific configuration and distance requirements.

As a condition of registration of Bt crops, the US Environmental Protection Agency requires all farmers who use Bt crops to plant at least 20-percent of their corn acreage to a refuge. The aim of this strategy is to provide an ample supply of insects that remain susceptible to the Bt toxin. The non-Bt refuge will decrease the odds that a resistant insect can emerge from a Bt field and choose another resistant insect as a mate. By preventing the pairing of resistant genes, these refuges help ensure that susceptibility is passed on to offspring.

To implement EPA's IRM refuge requirement, the Bt corn registrants (e.g., Monsanto, Dow AgroSciences, Syngenta, and Pioneer Hi-Bred) enter into a contractual agreement with every farmer who buys *Bt* corn that obligates the farmer to plant the appropriate refuge. EPA also requires the Bt corn registrants to establish a compliance assurance monitoring program (CAP) to identify and address noncompliant farmers. If a farm is found to be out of compliance, a grower will receive a warning from the seed company. If the farm is out of compliance for a second year, the seed company will refuse to sell Bt corn to the grower. Field inspections may be performed by seed companies through the compliance assurance monitoring program. The purpose of the IRM refuge requirement is to maintain efficacy of Bt crops as an insect pest management tool by preventing or delaying development of insect resistance to these traits.

The remainder of this article serves as a primer for the 2007 season on Bt corn insect trait registrations and IRM refuge configurations. This article lists the IRM refuge requirements contained in the "grower agreement" (also called "stewardship agreement") signed by each grower at the time of purchase of Bt corn seed. Please consult the grower guide/product use guide from your seed company for full details.

***Lepidopteran Registrations* -** Registered Bt insect traits for field corn in 2007 include YieldGard® Corn Borer (Cry1Ab) and Herculex I® (Cry1F) for Lepidopteran control. Both traits protect corn against European corn borer, southwestern corn borer, sugarcane borer, and southern corn stalk borer; and provide corn earworm and fall armyworm suppression. Herculex I also includes western bean cutworm and black cutworm on its label.

- On each farm no more than 80-percent of the corn acres may be planted with a Bt Lepidopteran hybrid.
- 20-percent of total corn acres must be planted to a corn refuge that does not contain a Bt technology for control of any of these "caterpillar" pests.
- The refuge may be a separate field within ½-mile, but must be on the same farm and managed by the same grower. Within field refuge configuration options include a large block refuge, split planter to alternate four or more rows of non-Bt Lepidoptera corn, or plant the field perimeter four or more rows wide to meet the 20-percent refuge.
- The refuge corn can be treated with insecticide only when the level of pest pressure meets or exceeds economic threshold, and foliar Bt microbial sprays cannot be applied in the refuge.
- One type of Bt lepidopteran corn hybrid (e.g., YieldGard Corn Borer) cannot serve as a refuge for another group (e.g., Herculex I).

Corn Rootworm Registrations – Registered Bt insect traits for field corn in 2007 for northern, western, and Mexican corn rootworms include YieldGard® Rootworm and YieldGardVT® Rootworm (Cry3Bb1), Herculex® RW (Cry34Ab1/35Ab1) and Agrisure® RW (mCry3A).

- On each farm no more than 80-percent of the corn acres may be planted with a Bt corn rootworm hybrid.
- 20-percent of total corn acres must be planted to a corn refuge that does not contain a Bt technology for control of corn rootworms.
- The refuge must be planted within or directly next to each Bt corn rootworm field. The corn rootworm refuge cannot be separated by another field, it does not have the distance flexibility of the corn borer refuge.
- Within field refuge configuration options include a large block refuge, split planter to alternate four or more rows of non-Bt corn rootworm corn, or plant the field perimeter four or more rows wide to meet the 20-percent refuge.
- If the corn rootworm refuge is planted on rotated ground, then the Bt corn rootworm hybrid must also be planted on rotated ground.
- If the refuge is planted in continuous corn, then the Bt corn rootworm corn may be planted on either continuous or rotated ground.
- The corn rootworm refuge can be treated for control of corn rootworm larvae and other soil insect pests with soil-applied, seed-applied or foliar-applied insecticides.
- The corn rootworm refuge can be treated with a non-Bt foliar insecticide to control late season pests such as corn borer, however if adult corn rootworm (beetles) are present at this time, then the Bt corn rootworm hybrid field must be treated in a similar manner.

Stacked Lepidopteran + Corn Rootworm Registrations – Stacked Bt insect traits for field corn in 2007 include YieldGard® Plus and YieldGardVT® Plus (Cry1Ab + Cry3Bb1), Herculex® XTRA (Cry1F + Cry34Ab1/Cry35Ab1), and Agrisure® CB/RW (Cry1Ab + mCry3A).

Two different refuge planting options are allowed to meet the IRM requirements for stacked Bt insect trait corn hybrids. These options include a Common Refuge or Separate Refuge. For either refuge option below, if the refuge is planted on rotated ground, then the stacked Bt corn hybrid must also be planted on rotated ground. If the refuge is planted on continuous corn ground, then the stacked Bt corn hybrid may be planted on either continuous or rotated ground.

Common Refuge

- Plant one common refuge for both Lepidopteran insects and corn rootworms. The common refuge must be planted with corn hybrids that do not contain Bt technology for control of either rootworms or corn borers (non-Bt corn).
- The refuge area must represent at least 20-percent of the grower's corn acres (i.e, sum of stacked Bt corn and refuge acres).
- Refuge must be within or directly next to each stacked Bt corn hybrid field. It cannot be separated by another field, and does not have the distance flexibility of a corn borer only refuge.
- Refuge can be planted as a large block, split planter to alternate four or more rows of non-Bt corn, or plant the field perimeter four or more rows wide.
- The common refuge can be treated with a soil-applied, seed-applied, or foliar-applied insecticide to control rootworm larvae and other soil insect pests.
- The common refuge can also be treated with a non-Bt foliar insecticide for late season pests such as European corn borer, if pest pressure reaches economic threshold. However, if rootworm adults (beetles) are present at the time of foliar applications then the stacked Bt corn field must be treated in a similar manner.

Separate Refuge

- Plant a separate refuge for corn borers; and a separate refuge for corn rootworms.
- Corn Rootworm Refuge: 20-percent of total corn acres must be planted to a corn refuge that does not contain a Bt technology for control of corn

rootworms; but can be planted with Bt corn borer hybrids.

- The corn rootworm refuge must be planted within or directly next to each stacked Bt corn hybrid field (e.g., large block, split planter or perimeter strips four or more rows wide).
- The corn rootworm refuge can be managed for corn rootworm larvae and other soil insect pests using a soil-applied, seed-applied, or foliar-applied insecticide.
- The corn rootworm refuge can be treated with a non-Bt foliar insecticide for control of late season pests such as corn borers if pest pressure reaches economic threshold. However, if rootworm adults are present at that time, then the stacked Bt hybrid field must also be treated.
- Corn Borer Refuge: 20-percent of total corn acres must be planted to a refuge that does not contain Bt-Lepidopteran protection, and must be planted within ½-mile of the stacked Bt corn field.
- The corn borer refuge can be treated with a soil-applied or seed-applied insecticide for corn rootworm larval control or other soil insect pests.
- The corn borer refuge can be treated with a non-Bt foliar insecticide if economic thresholds for late season pests such as corn borer are met; the stacked Bt corn hybrid would NOT have to be treated in a similar manner under this option.

References

USEPA. 2005. *Bacillus thuringiensis* Cry3Bb1 Protein and the Genetic Material Necessary for its Production (Vector ZMIR13L) in Event Mon 863 Corn & *Bacillus thuringiensis* Cry1Ab Delta-Endotoxin and the Genetic Material Necessary for its Production in Corn (006430, 006484) Fact Sheet. http://www.epa.gov/pesticides/biopesticides/ingredients/factsheets/factsheet_006430-006484.htm

YieldGard 2007 IRM Guide. http://www.monsanto.com/monsanto/us_ag/content/stewardship/irm/2007/yieldgard.pdf

Product Use Guides for Hybrids with Herculex® and YieldGard® Traits http://www.pioneer.com/web/site/portal/menuitem.6cc64f075e4174bc81127b05d10093a0/

Nitrogen Management for Corn following Corn

Larry Bundy, Dept. of Soil Science

High corn prices and increasing demand for corn grain for use in ethanol production have stimulated producer interest in producing high yields in corn following corn cropping systems. Using appropriate nitrogen (N) rates and management is critical for successful corn on corn production. Although high yields are the objective for most producers, it is important to recognize that desired yield or yield goal is not a good predictor of the optimum N rate in corn production. Effective N management includes selecting the N rate that will maximize economic return and using appropriate application methods and management techniques to minimize losses of applied N. Selecting the appropriate N rate is the most important N management decision because it has major effects on agronomic performance and risk of N loss to the environment.

The maximum return to N rate (MRTN) guidelines introduced in 2006, provide the starting point for the N rate decision. As shown in Table 1, MRTN rates for corn following corn depend on soil yield potential and the N:corn price ratio. Current prices place the N:corn price ratio near 0.10, and near-maximum agronomic yields are likely to occur at the 0.05 price ratio. For high yield potential soils at the 0.10 price ratio, the MRTN rate is 135 lb N/acre, and rates that will provide an economic return within $1/acre of the MRTN range from 120 to 155 lb N/acre. At any given N:corn price ratio, applying more N that the suggested rates is not likely to result in a profitable corn yield increase.

The range of rates shown for each price ratio in Table 1 indicates the range in which economic return to N will be within $1/acre of the MRTN rate. Depending on the production situation, growers may wish to select the higher or lower end of the range provided [See Extension publication Nutrient application guidelines for field, vegetable and fruit crops (A2809), page 31 for further information]. For example, the high end of the range should be selected if corn residue cover will be greater than 50% at planting. Adding N

Table 1. Suggested N application rates for corn following corn (grain) at different N:corn price ratios.

	N:Corn Price Ratio ($/lb N : $/bu)							
	0.05		0.10		0.15		0.20	
Soil	Rate H	Range I	Rate	Range	Rate	Range	Rate	Range
	-------------------------- lb N/acre (total to apply) ' --------------------------							
High/V. high yield poten-tial soils	165	135-190	135	120-155	120	100-135	105	90-120
Medium/Low yield poten-tial soils	120	100-140	105	90-120	95	85-110	90	80-100
Irrigated sands and loamy sands	215	200-230	205	190-220	195	180-210	190	175-200
Non-irrigated sands and loamy sands	120	100-140	105	90-120	95	85-110	90	80-100

H Rate is the N rate that provides the maximum return to N (MRTN).
I Range is the range of profitable N rates that provide an economic return to N within $1/acre of the MRTN.
' These rates are for total N applied including N in starter and N used in herbicide applications.

fertilizer to residue in no-till or other high residue systems for the purpose of promoting corn residue decomposition has been proven ineffective and often promotes N losses if a urea-containing fertilizer is used.

The MRTN rate guidelines must be adjusted for any non-fertilizer N sources such as manure applications, and second-year legume N credits that may be applicable. For second-year corn following a good or fair alfalfa stand, a credit of 50 lb N/acre should be taken. Appropriate legume and manure N credits are shown in A2809, page 60.

Once the MRTN rate has been selected and adjusted as described above, appropriate management strategies must be applied to control losses of available N (See A2809, page 38). These strategies include placement, timing, and N source variables. Where urea or urea-containing solutions (28 % UAN solution) are used as surface-applied N sources, growers should be aware of the risk of N loss through ammonia volatilization. Maximum losses of N as ammonia seldom exceed 25% of the applied N, but these losses can be great enough to influence yield. Inject or incorporate urea-containing fertilizers to minimize ammonia losses or consider using fertilizers that do not contain urea if N must be surface-applied. Preplant or sidedress times of N application can be used on medium-textured soils with good drainage. Sidedress or split sidedress N applications are preferred on poorly drained soils and are essential for coarse-textured sandy soils.

There is some uncertainty about the adequacy of N fertilizer supplies if demand is greatly increased by an expansion of corn acreage. If supplies of N are limited, the following considerations can be used to prioritize N use.

- Apply some N to all potentially responsive acreage.
- Fully credit N from legumes and manure.
- Incorporate or inject manure to conserve N.
- Reduce or eliminate N applications in cropping situations that need little or no fertilizer N such as corn following alfalfa and heavily manured fields.
- Use diagnostic tests, such as soil nitrate tests, to identify N fertilizer needs.
- Manage N to avoid losses.

Phosphorus and Potassium Management for Corn Grain

Carrie Laboski, Dept. of Soil Science

With increased interested in corn grain production this year, it is important to consider phosphorus (P) and potassium (K) management as well as nitrogen (N). It is necessary to use a current (within the last 4 years) soil test to guide P and K fertilization decisions. Even if the crop rotation on the soil test report is not the one that you are using for 2007, the soil test levels are still useful. Table 1 provides the soil test P and K levels that are considered optimum and excessively high for corn grain production.

Table 1. Soil test P and K interpretation categories.

Soil Group*	Soil Test P		Soil Test K	
	Optimum	Excessively High	Optimum	Excessively High
	ppm			
A	11-15	>25	81-100	>140
B	16-20	>30	91-110	>150
C	16-20	>30	71-100	>140
D	13-18	>28	101-130	>160
E	23-32	>42	66-90	>130
O	23-32	>42	66-90	>130

*Each soil in Wisconsin has been assigned a soil group. See Table 4.1 in UWEX Publication A2809 for details.

When soil test levels are in the optimum range, nutrient recommendations are equal to the amount of phosphate (P_2O_5) or potash (K_2O) removed in the grain at harvest. At excessively high soil test levels, no fertilizer is recommended. The P and K nutrient application guidelines for corn grain are provided in Tables 2 and 3.

Table 2. Phosphorus application rate guidelines for corn grain.

Yield level	Soil test interpretation category				
	Very low	Low	Optimum	High	Excess. High
bu/a	lb P_2O_5/a to apply*				
71-90	65	55	30	15	0
91-110	75	65	40	20	0
111-130	80	70	45	25	0
131-150	90	80	55	30	0
151-170	95	85	60	30	0
171-190	105	95	70	35	0
191-220	110	100	75	40	0

* Total amount of P_2O_5 to apply including starter fertilizer

Table 3. Potassium application rate guidelines for corn grain.

Yield level	Soil test interpretation category				
	Very low	low	Optimum	High	Excess. High
bu/a	lb K_2O/a to apply*				
71-90	70	55	25	15	0
91-110	75	60	30	15	0
111-130	80	65	35	20	0
131-150	85	70	40	20	0
151-170	90	75	45	25	0
171-190	95	80	50	25	0
191-220	105	90	60	30	0

* Total amount of K_2O to apply including starter fertilizer.

Crop removal rates of P and K for corn grain are different than for other crops. Table 4 provides a comparison of the amount of P and K removed in the harvest portion of the crop for corn grain, corn silage, soybean, and alfalfa. If converting corn silage or alfalfa acres to corn grain, much less P and K will be removed by corn grain. This could impact nutrient management plans with regard to the amount of P that could be applied to a field based on crop removal rates for the rotation and subsequent changes in soil test P levels.

Table 4. Crop removal of P_2O_5 and K_2O for selected crops and yield levels.

Crop	Yield level	P_2O_5	K_2O
		lb/a nutrient removed	
Corn, grain	180 bu/a	70	50
Corn, silage	28 T/a (65% moist.)	110	250
Soybean	65 bu/a	50	85
Alfalfa	7 T/a (dry matter)	90	420

The amount of potash fertilizer sold in Wisconsin over the past four years has been decreasing as reported by the Department of Agriculture, Trade, and Consumer Protection. Over the same time period, potash deficiencies and lower soil test K levels have been observed. While corn grain may have lower K requirements than some other crops, it is still important to ensure adequate K is supplied to the crop to achieve maximum economic yield.

When soil test P or K levels are in the high range or lower, applying some (or all) of the required nutrients is starter fertilizer is a good practice. The most consistent responses to starter fertilizer in no-till or high residue situations have been seen when complete (N-P-K) starter fertilizers are applied in a 2- by 2-inch placement relative to the seed. If using pop-up (with seed) starter fertilizers, the N+K_2O in the fertilizer can not exceed 10 lb/a. Application rates typically used with pop-up starter fertilizer may not maximize yield. On high P testing soils, corn yield is often maximized with a 2- by 2-inch side placed starter at rates of about 10-20-20 (N-P_2O_5-K_2O). Additionally, late planted corn can benefit from a complete starter fertilizer when grown on high testing soils because the early season growth is accelerated resulting in quicker attainment of maturity.

If phosphate and/or potash fertilizer supplies become limited, then it may be necessary to prioritize which fields should have fertilizer applied. Below is a list of things to consider when prioritizing fertilizer applications:

- Soil test to determine P and K needs
- Fully credit P and K in manures
- Apply P and/or K first to lowest testing fields
- Apply some P and/or K to all fields likely to respond (soil test level optimum or lower)
- Apply banded P and K to increase efficiency
- Defer P and/or K applications on soils testing high or above

For additional information on P, K, and starter fertilizer see UWEX Publication A2809 Nutrient application guidelines for field, vegetable, and fruit crops in Wisconsin. This publication and other soil fertility information can be found on the Soil Science Extension website: http://www.soils.wisc.edu/extension/

Tillage Management Considerations for Continuous Corn Production in Wisconsin

Dick Wolkowski, Extension Soil Scientist

It is estimated that ethanol production will consume about 30% of the US corn crop by 2010. This phenomenon is encouraging favorable grain prices and dramatically increasing corn acreage. A consequence of long-term continuous corn production could be the adoption of more aggressive tillage to manage large amounts of crop residue. This could potentially lead to decreased soil quality and increased soil loss. Research has shown that moldboard and chisel systems reduce aggregate stability. Coupled with the lower surface crop residue resulting from tillage the affected soils are prone to more erosion than no-till or other low disturbance systems. Soil degradation and increased soil erosion would be a poor trade-off for fuel independence. Therefore, producers must carefully consider tillage options when growing corn on corn.

There are few long-term Wisconsin studies that examine tillage management in continuous corn. One example is a study that this author has overseen since 1997 that has included fall chisel, fall strip-till, and no-till in continuous corn and corn/soybean rotations, along with several fertilizer placement treatments. Data for the main effect of tillage in the continuous corn portion are shown in Table 1. The no-till system did not employ any in-row residue management. Yield was not measured in 2000. Of the nine years that these tillage treatments have been in place significant yield differences were observed in three seasons, each time in favor of the chisel system. Averaged over the nine years grain yield was five and nine percent lower for strip-till and no-till, respectively. A detailed analysis is required to determine the overall profitability between tillage systems, however more soil loss could be anticipated for the chisel system, especially if stalks were shredded prior to tillage and an aggressive chisel implement were used.

Table 1. Tillage effect on corn grain yield in continuous corn, Arlington, Wis. 1997 -2006.

	Tillage				
Year	Chisel	Strip-till	No-till	Pr>F	LSD
	------------------------- bu/a --------------------------------				
1997	190	178	176	0.37	--
1998	161	160	164	0.85	--
1999	147	135	147	0.34	--
2001	189	182	151	<0.01	11
2002	181	175	174	0.41	--
2003	161	157	149	0.26	--
2004	187	178	159	<0.01	17
2005	182	187	176	0.19	--
2006	210	181	166	<0.01	15
Average	179	170	162	--	--

Soil loss can be predicted using RUSLE 2, components of which run within the Snap-Plus nutrient management program. A simulation of the soil loss for six common Wisconsin soils was conducted over a four year continuous corn rotation for an eight percent slope of 150 ft. in length. Table 2 shows the soil loss estimates for these six soils. As expected there is variation in soil loss between soils, but in all cases the moldboard system exceeded allowable soil loss. Using a chisel system substantially reduced soil loss, but depending on the soil the loss may still be relatively high. No-till generated very little soil loss, but some producers may not be able to produce sustainable crop yields using strict no-till and will likely opt for some form of tillage, which could include strip-tillage or other methods of in-row residue management.

Table 2. Estimated soil loss for four years of continuous corn using three tillage systems on six Wisconsin soils.

	Tillage			Allowable
Soil	Moldboard	Chisel	No-till	Soil Loss (T)
	----------------------tons/acre/year ------------------------			
Plano	6.3	2.8	0.1	5
Fayette	10.4	4.6	0.2	5
Norden	9.2	4.1	0.2	3
Kewaunee	4.1	1.8	0.1	3
Loyal	5.4	2.4	0.1	5
Hochheim	6.4	2.9	0.1	5

Slope = 8%; Slope length = 150 ft.

Producers and their consultants need to balance the aggressiveness of the selected tillage system with its effect on soil quality and soil loss. A return to clean tillage systems will not be sustainable and will likely result in soil loss values exceeding “T”. While the increase in biofuel crop production is offering opportunities to producers care must be taken to avoid “back-sliding” into practices that in the long term will reduce productivity and impact water quality.

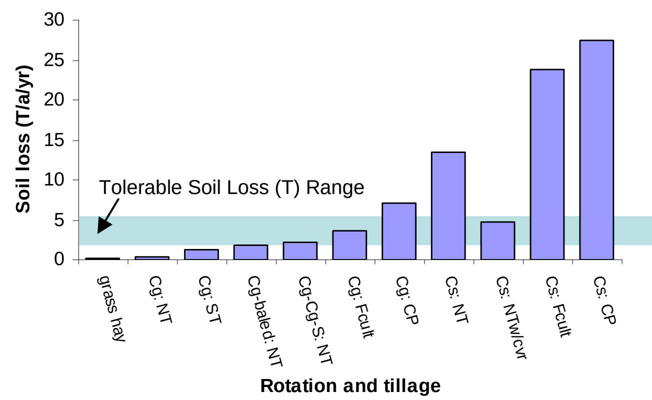
Converting CRP Land to Corn: Impacts and Meditation

Laura Ward Good, Dept. of Soil Science

Currently in Wisconsin there are more than 600,000 acres enrolled in the USDA’s Conservation Reserve Program (CRP). The contracts for approximately 44 percent may expire in 2007 and 2008. Given current rising demand for corn, it is likely that at least a portion of these acres will go into a corn-based row crop rotation. If these highly erodible lands are converted to corn, will this lead to disastrous soil loss? Are there ways to manage corn on former CRP lands that will keep the soil quality and conservation gains from the Conservation Reserve Program from being totally lost?

To answer these questions, I used Snap-Plus software to evaluate soil loss with different corn rotation and tillage combinations on eleven representative steep (soil mapping unit D) fields from counties with significant CRP acreages (Table 1). Estimated soil loss for established perennial grass hay is compared with ten different corn rotation and tillage combinations in Table 2 and Figure 1.

Figure 1. Average estimated rotational erosion for example CRP fields by rotation and tillage.



Estimated soil loss for grass hay was minimal for all sites (0.1 ton per acre). Soil loss for the corn rotations ranged from two to hundreds of times greater than for grass hay. No-till and strip-tilled corn for grain, however, had estimated soil loss values below the Natural Resource Conservation Service (NRCS) standard for tolerable soil loss (T, shown in Table 1) at all sites. Most of the fields could not meet T with even a one-pass tillage system (Cg: Fcult) and none could meet T if corn silage was grown without a cover crop. Fields with gentler slopes are expected to lose less soil under the same

Table 1. Location and site characteristics of fields used for soil loss estimations.

Location (County)	Field Slope	Field Slope Length	Soil Map Symbol	Soil Name	Surface Texture	Tol. Soil Loss (T)
	%	*ft*				*T/acre/yr*
St. Croix	16	100	AmD2	Amery	loam	5
Pierce	16	100	167D2	Derinda	silt loam	3
Iowa	14	150	DhD2	Dodgeville	silt loam	4
Grant	12	150	DuD2	Dubuque	silty clay loam	3
Dane	16	100	DuD2	Dunbarton	silt loam	2
Eau Claire	16	85	EmD2	Elkmound	loam	2
Trempealeau	16	150	GaD2	Gale	silt loam	3
Dunn	16	100	275D2	Hayriver	fine sandy loam	3
Fond du Lac	16	100	HmD2	Hochheim	loam	5
Rock	16	100	KdD	Kidder	sandy loam	5
Richland	16	100	254D2	Norden	silt loam	3

Table 2. Average, maximum and minimum estimated soil loss for example CRP fields by rotation and tillage in tons per acre per year.

	grass hay	Cg: NT	Cg: ST	Cg-baled: NT	Cg-Cg-S: NT	Cg: Fcult	Cg: CP	Cs: NT	Cs w/cvr: NT	Cs: Fcult	Cs: CP
Avg.	0.1	0.5	1.3	1.9	2.3	3.7	7	13	4.7	24	28
Max	0.1	0.8	2.3	3.2	3.5	5.7	11	20	6.5	37	44
Min	0.1	0.2	0.4	0.7	1.0	1.7	3	8	2.8	13	15

Abbreviations: Cg = Corn for grain, Cg-baled = Corn for grain with half stalks baled, S= Soybeans, Cs = Corn silage, Cs w/cvr = Corn silage followed by a small grain cover crop, NT= No-till, ST=Strip-till, CP= Chisel plow, Fcult = Field cultivation

rotations, but when the Snap-Plus analysis was run with the same soils with "C" slopes (averaging 9%), soil losses were still well above T for the corn silage rotations.

Snap-Plus also contains a field runoff phosphorus (P) loss indicator, the P Index, and a soil quality indicator, the Soil Conditioning Index (SCI). P Index trends closely mirrored those for soil loss, as most of the runoff phosphorus lost from these fields (in the absence of unincorporated fertilizer and manure P applications) is expected to be attached to eroded sediment. The SCI is a comparatively new index used by the NRCS to indicate the effect of a management system on soil organic matter. It takes into account crop biomass additions and removals, field operations, and erosion. If the calculated SCI value is positive, organic matter will be increasing with the rotation, and the reverse is true if the SCI is negative. Grass hay had the highest SCI values, followed by no-till and strip-till corn for grain, indicating that corn for grain systems with minimal tillage and residue removal will lead to continued accumulation of soil organic matter in a field, but not at the same rate as for CRP. Chisel-plowed and corn silage rotations without a cover crop had negative SCI values – these rotations will deplete existing soil organic matter.

Converting CRP from permanent grass lands to corn will certainly increase sediment and phosphorus loads in runoff from these areas. However, implementing management practices that minimize tillage and retain a significant amount of crop residue on the surface will reduce adverse impacts to soil and water resources. Harvesting the entire corn plant, as is done for corn silage, will lead to soil losses that are orders of magnitude higher than tolerable soil loss.

Snap-Plus is public domain software designed for use by growers, agronomists and other agricultural professionals in Wisconsin. It can be obtained from this website: http://www.snapplus.net

It includes the RUSLE2 soil loss calculation software. The field level information it requires is readily available to growers. With it, growers can assess potential sediment and phosphorus losses resulting from management changes on their own land and alternative practices to minimize those losses.

Weed Management in Continuous Corn

Chris Boerboom, Ext. Weed Scientist

Recent discussions on increasing corn acreage have raised concerns about how continuous corn production will affect various management practices, including pest management. While continuous corn may affect insect and disease management, I believe the effect on weed management will be relatively minor. Because corn is not a "host" of weeds like corn is a host of disease or insects, corn will not cause specific weed species to increase just because it is planted. Rather, weeds may increase because other practices used in corn production allow weed shifts or increased weed populations.

Let's look at how continuous corn would compare to a corn-soybean rotation and see where such differences might exist.

1. Time of planting. Certain weed species may be more successful in early or late planted crops. However, the time difference between corn and soybean planting is minimal and both are currently planted in early spring. The increased time to plant additional corn acres will basically extend into the time that was used to plant soybeans. The net effect seems to be negligible.

2. Canopy development. Narrow row soybeans can create a more complete canopy (i.e. greater shade) than corn. This could affect the survival of late emerging weeds. For instance, more dandelions might establish in no-till corn than in no-till soybeans even if early season control was the same. The canopy of soybeans in 30-inch rows might create shade that is more similar to a full corn canopy. In either case, I don't envision that any canopy differences would lead to a weed shift. Any differences in weed density should be manageable if they occur.

3. Herbicide use. Certain advantages might exist with continuous corn as compared to a corn soybean rotation. Specifically, corn herbicide carryover should never be a concern when corn is the following crop. Increased corn acres could also lessen the risk for corn herbicide drift onto soybeans if these fields are now planted to corn. On the negative side, more acres may need to be sprayed in the same short time period. If corn acres are being sprayed postemergence, this time period is short and it's critical to remove weed competition. Of course, preemergence herbicides in the corn program would lessen this concern.

4. No-till systems. No-tilling corn in to soybean residue is relatively easy. However, no-tilling corn into corn stalks may require more row cleaning to move residue. This would be a concern if a residual herbicide was applied preplant. If aggressive row cleaners are used, they may move the preplant herbicide out of the corn row and lead to poor control. A solution to this situation would be to apply the same residual herbicide as a preemergence application after planting.

5. Herbicide resistant weeds. If we look back in history, continuous corn fields led to herbicide resistant weeds in some cases because the same herbicides were used year after year. Could that happen again? It certainly could. However, it could also happen with a corn-soybean rotation if both crops are glyphosate resistant and glyphosate is the primary herbicide being used in both crops. We still recommend that herbicide diversity should be maintained whether continuous corn or a corn-soybean rotation.

Overall, I don't see where continuous corn will present any special weed management problems or where continuous corn differs greatly from a corn-soybean rotation. Both crops are summer annuals and weeds really don't care if they are growing in one crop versus the other.

Valor XLT Labeled on Soybean

Chris Boerboom, Ext. Weed Scientist

Valor XLT is a premix of Valor (30% flumioxazin) and Classic (10.3% chlorimuron) by Valent which is labeled for broadleaf weed control and suppression of annual grasses. The main label does not include mention of use in Wisconsin, but a supplement label is available from Valent (not on CDMS) that allows use of the lowest labeled rate of 2.5 oz/a in southern Wisconsin. Applications can only be made south of I-90 between LaCrosse and Madison and south of I-94 between Madison and Milwaukee. The 2.5 oz/a rate is equivalent to 1.5 oz/a Valor and 1 oz/a Classic. The restriction to southern Wisconsin is to avoid potential Classic carryover to corn. Valor XLT can be applied as a burndown treatment before planting or preemergence within 3 days after soybean planting. Applications to cracking or emerged soybeans will cause damage. Some of the weeds labeled for control include horseweed, lambsquarters, common ragweed, nightshade, pigweeds, velvetleaf, and suppression of foxtails, crabgrasses, giant ragweed, and waterhemp. If used in a burndown treatment, tank mixing with glyphosate or 2,4-D is still recommended. At this rate, Valor XLT will provide early residual weed control, but a postemergence application of glyphosate should still be made in glyphosate-resistant soybean for full season weed management.

Generic Herbicide List?

Chris Boerboom, Ext. Weed Scientist

I was recently asked if I had a list of generic or post-patent corn and soybean herbicides. While I would like to maintain such a list, it is a difficult task considering the number of new trade names that are continually entering the market. Although I don't have a list, I would recommend the Department of Agriculture, Trade, and Consumer Protection web site of "Pesticide Database Searches" at http://www.kellysolutions.com/wi/

The first database option listed is a Pesticide Registration Search. For example, if you want to know the other products that contain the active ingredient in Select. Click on "Search by active ingredient" and enter clethodim. When "clethodim" is returned, click on it and you will get a list of Wisconsin registered products with clethodim, including Select, Trigger, Envoy, Arrow, etc. This is a handy web site to have bookmarked for future use. ■