What's Cropping Up?

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IPM and Water Quality: Minimizing Pesticide Risk

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As this growing season approaches, many farmers are considering ways to maximize profitability and protect water quality. To help prevent or reduce the availability, release and transport of pesticides into water sources these farmers are using a variety of Integrated Pest Management (IPM) techniques.

IPM builds on an understanding of crop production and the biology of weeds, diseases, and insects, collectively known as pests. IPM encourages use of compatible crop production and crop protection tactics to keep pest populations below those causing economic injury while protecting against hazards to humans and the environment. These tactics include cultural, mechanical, biological, and chemical control options. Effective use of IPM techniques can affect water quality by minimizing or eliminating the need for chemical pest control. Use of IPM contributes to optimal crop health and improved net-profitability of crop production. Healthy crops, in addition to producing more harvestable product, use fertilizer more efficiently leaving less residual (especially nitrate) in the soil profile after harvest, are more competitive with weeds and less dependent on herbicides for weed control, and return more organic matter to the soil.

Eight examples of how IPM practices can help protect water quality by minimizing pesticide use follow.

Eight Pest Management Activities for Water Quality Protection:

Strive for Agronomic Success:

IPM is part of a sound crop management program. Careful planning helps protect water quality by identifying long and short term production practices which contribute to crop performance and help avoid pest problems. Many crop production practices such as proper site selection, seed bed preparation, nutrient balance and pH, planting depth, and other activies can greatly affect risk of pest damage, and are important factors in optimizing crop health and growing season success.

Hybrid and Variety Selection:

Crop varieties selected for their yield potential, adaptation to local conditions, and disease resistance help optimize net profit. These attributes also influence, among other factors, crop health affecting crop nutrient use efficiency, competitiveness with weeds and tolerance of insect pest damage. These factors contribute to water quality protection by minimizing the need for pesticide use and reducing the risk of unused nutrients, especially nitrates, being left in the soil profile.

Date of Planting:

Date of planting can influence several key field crop pest problems such as weed management in new alfalfa seedings. To minimize weed competition and eliminate herbicide use, alfalfa can be successfully established using small grains and small grain/field pea combinations as companion crops. Recent studies by Drs. Russ Hahn and Jerry Cherney have shown that planting alfalfa seedings with companion crops are moderately successful for weed control if planted prior to May 1, but generally unsuccessful after May 1. (See 1994 Cornell Recommends for Integrated Field Crop Management).

Crop Rotation:

Continuous corn fields may be at risk from corn rootworm (CRW) damage if last summers average number of CRW beetle per plant were greater than 1 western CRW beetle or two northern CRW beetles or if CRW induced lodg-

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ing was observed. Those fields scheduled for corn again this year after late planted corn the previous year are at high risk from CRW. Rotation out of high risk fields eliminates the need for using a corn rootworm insecticide. If the field must be replanted to corn, consider recent information from studies by Dr. Paula Davis indicating corn rootworm impacts are potentially greater for corn grown for silage than for grain. (See What's Cropping Up, February 1994).

Crop Monitoring:

Monitoring fields regularly for pests helps you to evaluate crop conditions and detect problems early. Timely field visits provide information to better meet real crop needs, avoid unnecessary crop losses and help eliminate unnecessary pesticide use. Crop monitoring, for example, can provide information to refine weed control programs, identify needs for disease resistant hybrids, or detect activities of a significant insect pest. Keeping records of field visit information also helps optimize management decisions by documenting problems for future reference.

Pesticide Application:

Crop monitoring may detect pest problems which warrant pesticide use. To protect water quality, apply pesticides using proper mixing, handling, storage, application and disposal practices. Some recommended practices include selecting pesticides that are registered for the specific pest(s); strictly following pesticide label instructions including personal safety and environmental precautions; preventing spills while mixing and loading; avoiding backsiphoning while filling sprayers; calibrating pesticide application equipment before use; mixing only that amount of pesticide needed; never rinsing pesticide application equipment near wellheads, ditches, streams or other water sources; and triple rinsing or pressure rinsing pesticide containers before disposal or recycling. If you cannot find the information you need consult your cooperative extension office, pesticide retailer, or product manufacturer.

Banding of Herbicides and Cultivation:

A weed control program that bands herbicide over the row at planting with subsequent timely cultivation(s) can reduce the per acre use of preemergence herbicides by 60% and almost totally eliminate the need for postemergence herbicides.

Soil: Pesticide Interactions:

When deciding on pesticides, consider efficacy, appropriateness, and the potential risk of materials leaching or running-off fields. Some important soil properties which affect pesticide movement are texture, permeability and organic matter. A number of pesticide chemical properties also affect potential risk of leaching or surface runoff. Among the most important are pesticide degradation rates, soil adsorption, water solubility, and volatility. Using these factors, the Soil Conservation Service (SCS) has developed a guide which evaluates the potential risk a specific pesticide may pose to ground or surface waters if used on a given soil. This locally adapted information is available through most county SCS or Cooperative Extension offices. Keep in mind that application rate and many additional factors can affect pesticide movement including field slope, soil moisture, weather conditions, and others.

Summary:

Water quality protection is every farmer's responsibility. Some ways IPM methods can help you protect water quality have been presented. To learn more about these methods and IPM contact your local Cornell Cooperative Extension office. Additional sources of Water Quality Protection information: Pesticide Management for Water Quality: Principles and Practices, Cornell Cooperative Extension, SCAS, Extension Series No. 1; 50 Ways Farmers Can Protect Their Groundwater, CES, Univ. of IL, (217) 333-4780; Alliance for a Clean Rural Environment (ACRE) (800) 545-5410; Farm-A-Syst: Farmstead Assessment System, CE, Univ. of WI, (608) 262-0024.

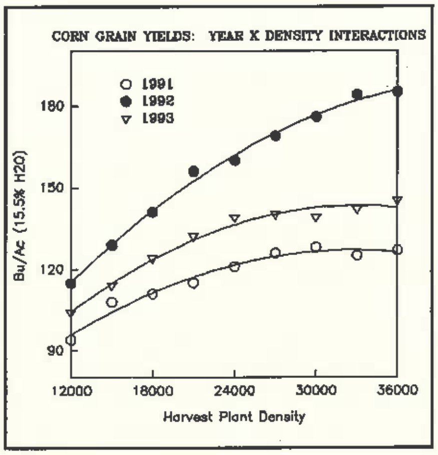
Grain Corn Populations: High But Not Too High

CROP MANAGEMENT

Bill Cox
Soil, Crop and Atmospheric Sciences

We recently evaluated silage and grain yield responses of seven hybrids at nine harvest plant densities on a well-drained Honeoye silt loam soil in central New York. We reported in a previous issue of What's Cropping Up? (Vol. 3, No. 6) that modern corn hybrids require a harvest plant density of about 30,000 plants/acre to produce maximum economic silage yields in most years on well to moderately well drained soils in New York. For dry-shelled grain corn production, we recommend harvest plant densities of 26,000 to 28,000 plants/acre on these same soils (Table 1).

When water is not limiting and significant lodging does not occur, such as in 1992, maximum economic grain yields can occur at harvest plant densities as high as 36,000 plants/acre (Fig. 1). In dry years, such as in 1991 or 1993, maximum economic grain yields occur at much lower harvest plant densities, 29,000 plants/acre (Fig. 1). In the dry years, some hybrids continued to produce maximum economic yields at harvest plant densities of 30,000 plants/acre or greater. In contrast, some hybrids



attained maximum economic grain yields at harvest plant densities of 26,000 plants/acre or less. Because of the strong interaction of some hybrids with growing conditions, we recommend in the 1994 edition of Cornell Recommends For Integrated Field Crop Management to plant at 30,000 plants/acre on well to moderately well drained soils to obtain a harvest plant density of 26,000 to 28,000 plants/acre (Table 1).

Harvest plant densities did not significantly affect test weight or grain moisture in our study. Harvest plant densities above 28,000 plants/acre, however, increased lodging, especially in more susceptible hybrids. Most dry-shelled corn producers in New York harvest dry-shelled corn in mid to late-November, 6 to 8 weeks after physiological maturity. With the potential for high winds, heavy rain, snow storms, and thus increased lodging risk during this 6 to 8 week period, harvest plant densities for dry-shelled corn should not exceed 28,000 plants/acre in New York. High-moisture corn producers, who harvest at 30% moisture, do not experience as high a lodging risk so may wish to follow plant population recommendations for silage production.

Table 1. 1994 Corn Grain Plant Population Recommendations.

SOIL CONDITIONS	PLANTING RATE (90% EMERGENCE)	HARVEST POPULATION
Deep well-drained soils with high water-holding capacity	~30000	26000-28000†
Well to moderately well drained silt loams to clay loams	~30000	26,000-28000
Sandy loams or somewhat poorly drained loams to clay loams	~27750	24000-26000
Gravelly or shallow loams to clay loams	~23350	20000-22000

† Hybrids that respond to plant populations should be at the high end of the range.

WEED CONTROL

Pre- and Postemergence Soybean Herbicides Compared

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Soybean acreage in New York is approaching 60,000 acres annually. As a result, there has been increased interest in the selection and use of postemergence soybean herbicides. Most questions concern the use of postemergence herbicides for control of velvetleaf, common ragweed, and common lambsquarters that escape preemergence herbicide applications. There are also questions about total postemergence herbicide programs.

As with preemergence herbicides, accurate weed identification is basic to the success or failure of postemergence herbicide applications. Performance of postemergence herbicides is also affected by the size/age of the weeds and by the growing conditions before and after application. As a rule, postemergence herbicides are most effective when weeds are small and actively growing. Adverse environmental conditions, such as hot, dry weather before spraying, harden the weeds and make most postemergence applications less effective than when applied during warm, moist growing conditions. In addition, rainfall shortly after application may reduce effectiveness of postemergence herbicides.

Preemergence vs Postemergence

Field experiments at the Musgrave Research Farm near Aurora in 1992 and 1993 compared standard preemergence herbicides with postemergence soybean herbicides for control of velvetleaf, common ragweed, and common lambsquarters. Soybeans (Funk's G-3197) were planted on June 10, 1992 and on June 7, 1993 in 30-inch rows. Herbicides were applied in 25 gpa of water using 80015 flat fan spray tips. All treatments (including the check) received preemergence applications of 2 pt/A of Dual for annual grass control. Lorox DF at 2 lb/A or Sencor DF at 1 lb/A were applied preemergence in tank mixtures with the Dual. Postemergence applications of Basagran, Reflex, Cobra, or Pinnacle were applied at the rates shown in the accompanying tables on July 7, 1992 and July 4, 1993 when soybeans were in the two to three trifoliolate leaf stage. Basagran was applied with crop-oil concentrate (COC) at 1 qt/A while the other postemergence herbicides were applied with nonionic surfactant (NIS) at 0.25 pt/A for Cobra and Pinnacle and at 0.5 pt/A for Reflex.

Velvetleaf Control

There were no significant differences in velvetleaf (ABUTH) control among the pre-and postemergence broadleaf herbicide treatments in 1992, however all provided better velvetleaf control than the 8% obtained with the check (Table 1). Velvetleaf control ratings for the Lorox and Sencor treatments were 89 and 91% respectively. Postemergence herbicides provided from 81 to 95% control with Pinnacle and Basagran respectively. Velvetleaf control in 1993 was more variable than in 1992 (Table 2). In 1993, the preemergence applications of Lorox and Sencor controlled 73 and 94% of the velvetleaf respectively. This difference in control can probably be attributed to the limited rainfall following

Table 1. Soybean injury, annual broadleaf weed control, and soybean yields with pre- and postemergence herbicides in 1992.

Herbicides *	Amt/ Acre	How App.	% Injury	% Control** ABUTH	AMBEL	CHEAL	Yield Bu/A
Lorox DF	2.00 lb	PRE	0	89	--	99	32
Sencor DF	1.00 lb	PPE	0	91	--	99	34
Basagran + COC	1.50 pt	PO	6	95	--	93	35
Reflex + NIS	1.25 pt	PO	14	91	--	96	37
Cobra + NIS	0.78 pt	PO	29	95	--	65	35
Pinnacle + NIS	0.25 oz	PO	9	81	--	99	32
Check	--	--	0	8	--	0	31
LSD (0.05)			3	14	--	9	5

* All treatments, including the check, received 2 pt/A Dual preemergence.
**ABUTH - velvetleaf, AMBEL - ragweed, and CHEAL - lambsquarters.

application and the difference in water solubilities of Lorox and Sencor. The largest rainfall event during the first 2 weeks following application was 0.37 inches and the total was 0.91 inches. Water solubility is 75 ppmw (parts per million weight) for Lorox and 1220 ppmw for Sencor. The only postemergence application that provided acceptable velvetleaf control was the 0.25 oz/A application of Pinnacle with 83% control. This level of control was not significantly different from that obtained with the preemergence herbicides but was better than that obtained with the other postemergence treatments. Velvetleaf control was 47% with Basagran while Reflex and Cobra only controlled 23 and 27% respectively.

Ragweed and Lambsquarter

Common ragweed (AMBEL) population was not adequate for control ratings in 1992, however, a moderate infestation in 1993 demonstrated the strengths and weaknesses of the herbicides used (Table 2). Both Lorox and Sencor provided excellent (95-100%) ragweed control as did the postemergence applications of Reflex and Cobra with 99% control. Basagran provided fair (76%) ragweed control while Pinnacle, which is weak on ragweed, provided only 19% control. Moderate infestations of common lambsquarters (CHEAL) were controlled both years with all treatments except Cobra, which provided only about 65% control.

Soybean Injury and Yields

All postemergence herbicides caused noticeable injury when evaluated one week after postemergence treatments were applied. Injury ratings ranged from 6% with Basagran to 29% with Cobra in 1992 (Table 1) and from 9% with Basagran to 19% with Cobra in 1993 (Table 2). Soybean yields were not reduced as a result of this injury.

There were only small differences in soybean yields among the pre- and postemergence herbicide treatments in 1992 when precipitation was 5.93 inches above normal in July. In fact, the only treatment that yielded more than the check was the treatment of 1.25 pt/A of Reflex (Table 1). In 1993, there was no difference in yield between the preemergence applications of Lorox and Sencor with 27 and 31 bu/A respectively (Table 2). However, with precipitation 1.11 inches below normal in July, the reduced level of annual broadleaf weed control with all postemergence treatments resulted in lower soybean yields than with the preemergence application of Sencor.

These results show that the preemergence herbicides Lorox and Sencor each control a broader spectrum of annual broadleaf weeds than any of the postemergence herbicides. Although both pre- and postemergence herbicides can be adversely affected by weather, the preemergence herbicides provided more consistent control form year to year than the postemergence herbicides.

Table 2. Soybean injury, annual broadleaf weed control, and soybean yields with pre- and postemergence herbicides in 1993

Herbicides *	Amt/ Acre	How App.	% Injury	% Control** ABUTH	AMBEL	CHEAL	Yield Bu/A
Lorox DF	2.00 lb	PRE	0	73	95	100	27
Sencor DF	1.00 lb	PRE	0	94	100	100	31
Basagran + COC	2.00 pt	PO	9	47	76	97	25
Reflex + NIS	1.25 pt	PO	10	23	99	87	21
Cobra + NIS	0.78 pt	PO	19	27	99	66	18
Pinnacle + NIS	0.25 oz	PO	10	83	19	100	22
Check	--	--	0	3	37	80	15
LSD (0.05)			4	20	23	13	5

* All treatments, including the check, received 2 pt/A Dual preemergence.
**ABUTH - velvetleaf; AMBEL - ragweed; and CHEAL - lambsquarters

CROP MANAGEMENT

Cover Crops in Corn Reduce Residual Soil Nitrates

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Even with appropriate fertilization practices, nitrates may remain in the soil after corn harvest. Actively growing cover crops can take up these residual nitrates before they leach to ground water. Field studies were conducted to compare cover crop species and seeding dates for effectiveness in recovering residual soil nitrates. The experiments were established at the Soil Conservation Service Plant Materials Center in Big Flats (1991 and 1992) and at the Musgrave Research Farm (1992) in Aurora.

Six treatments were compared. Red clover (Trifolium pratense L.), perennial ryegrass (Lolium perenne L.) and rape (Brassica napus L.) were interseeded into corn at cultivation time; cereal rye (Secale cereale L.) and rape were seeded after corn silage harvest. Each treatment received two N rates: the Cornell Recommendation and two times that rate. Data presented here represent the mean of the two N rates.

Cover crops were sampled in the fall and spring for biomass accumulation. Soil samples were taken at several dates in the fall and once in the spring and were analyzed for total inorganic nitrogen. Fall-seeded rape never successfully established at either site so it has not been included in the following discussion. Red clover, although it was frequently successful, had no impact on soil nitrate levels and it likewise is not discussed.

Dry Matter Accumulation

The summer-seeded species, ryegrass and rape, usually accumulated more biomass by late fall than rye seeded after silage harvest (Table 1). By the following spring, however, rye frequently yielded more than either rape or ryegrass. Comparing the two summer-seeded species, ryegrass performed more consistently than rape.

Soil Nitrate Levels

When the cover crops accumulated significant biomass, they were quite effective in reducing soil nitrate levels, compared to plots with no cover crops (Figures 1 through 3). Fall soil nitrate levels were much lower in plots seeded to ryegrass at Big Flats in 1991 and 1992, compared to the no cover treatment. In both years at this site, ryegrass had accumulated 500 to 900 lbs/A dry matter by early December.

Rye was not as effective in recovering nitrates in the fall when it had produced little biomass, but by spring, after it had grown substantially, nitrate levels were lower in this treatment than in the no-cover treatment in two out of three site years. Summer-seeded rape did not perform consistently but it greatly reduced nitrate levels in Fall 1992 at Big Flats when it produced about 2000 lbs/A dry matter by early December.

Conclusions

We conclude from this study that cover crops can reduce soil nitrate levels but their effectiveness is directly related to the amount of dry matter produced. Summer-seeded species which establish well are most successful in reducing nitrate levels in the fall. Rye seeded after silage harvest will accumulate most of its biomass in the spring and reduces soil nitrate levels at that time compared to soil with no cover crop.

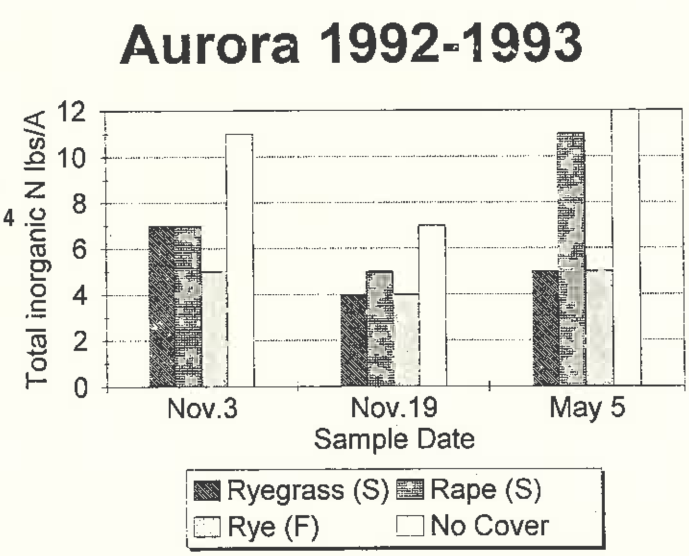
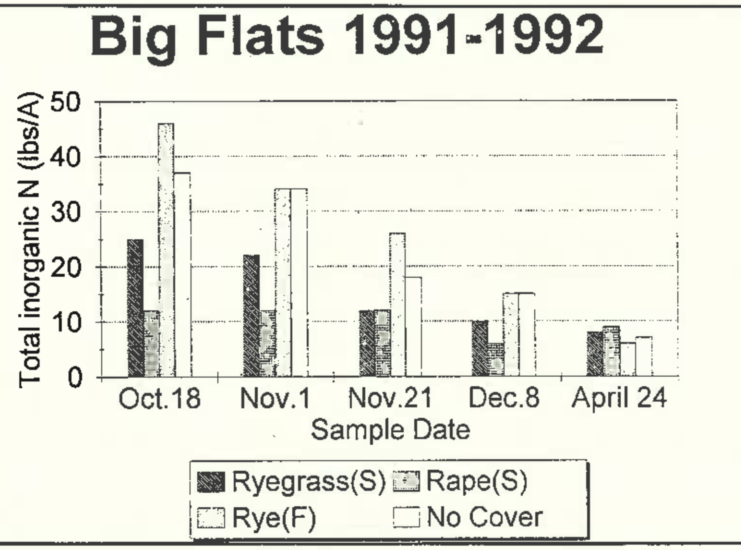


Fig. 1. Inorganic nitrogen in the plow layer (0-9 in.) under 4 cover crop treatments. S=summer seeded. F=fall seeded.



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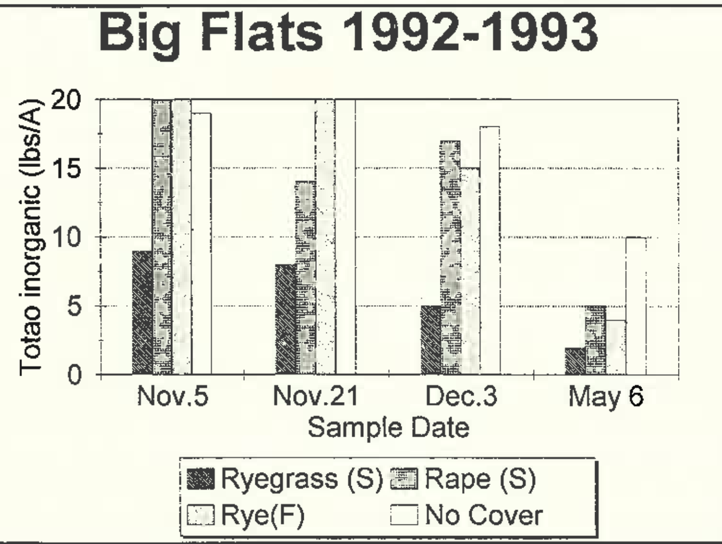

Fig. 3. Inorganic nitrogen in the plow layer (0-9 in) under four cover crop treatments. S=summer seeded. F=fall seeded.

Table 1. Fall and spring dry matter production from covercrops seeded into corn at cultivation and after silage harvest. New York 1991-1993.

		Aurora		Big Flats			
		1992 - 1993		1991 - 1992		1992 - 1993	
	Seeding	Fall	Spring	Fall	Spring	Fall	Spring
Species	Date	--- lbs/A ---		------------ lbs/A ------------			
Ryegrass	Summer	386	857	527	980	942	1142
Rape	Summer	234	249	1862	1297	448	70
Cereal Rye	Fall	258	1667	261	1528	62	712

Calendar of Events

June 2	**Small Grain Management Field Day, Aurora Research Farm**
July 10-13	**Northeast Branch American Society of Agronomy meetings, MacDonald College, Canada**
August 5	**Certified Crop Adviser (CCA) Exam, New York State Grange, Cortland, NY.**
Nov. 13-18	**American Society of Agronomy Meetings, Seattle, Washington.**

What's Cropping Up? is a bimonthly newsletter distributed by the Department of Soil, Crop and Atmospheric Sciences 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: Soil, Crop and Atmospheric Sciences, Plant Breeding, Plant Pathology, and Entomology. **To subscribe, send a check for $8.00 along with the form at the right.**

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