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NITROGEN MANAGEMENT FOR CORN

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Nutrient management is quintessential for U.S. grain producers to maintain a competitive advantage in the world market place and at the same time a quality environment. Over the last 19 years, average annual Illinois corn prices have varied considerably, averaging $2.44 per bushel. Unfortunately, prices the last several years have been tending down (Fig.1) and based on the world grain supply, there is little hope that they will improve in the near future. The price paid for ammonia by U.S. farmers has been relatively constant over the last 20 years, with the exception of the 2001 crop year.

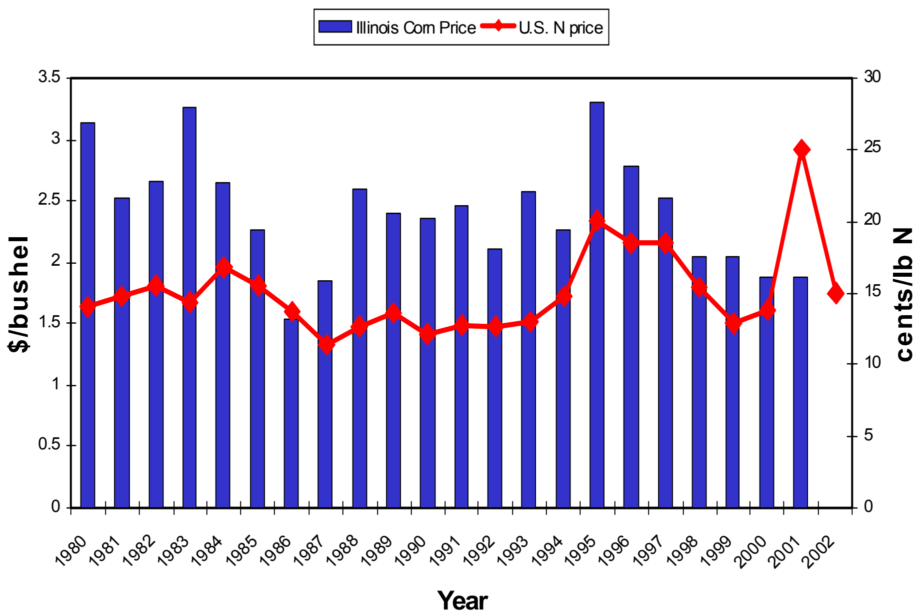

Fig. 1. Historical U.S. retail prices for anhydrous ammonia and the price farmers received for corn in Illinois

At the same time as economics are becoming tighter, pressure to improve nutrient management because of environment concerns are being stepped up by regulatory agencies. Recently, the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force reaffirmed the commitment to reduce N loss to the Mississippi River by 30%, with some suggesting that most of the gain will come from reduction in fertilizer use. While this is an amiable goal, the relationship between fertilizer sales and the size of the hypoxia zone is not strong (Fig. 2).

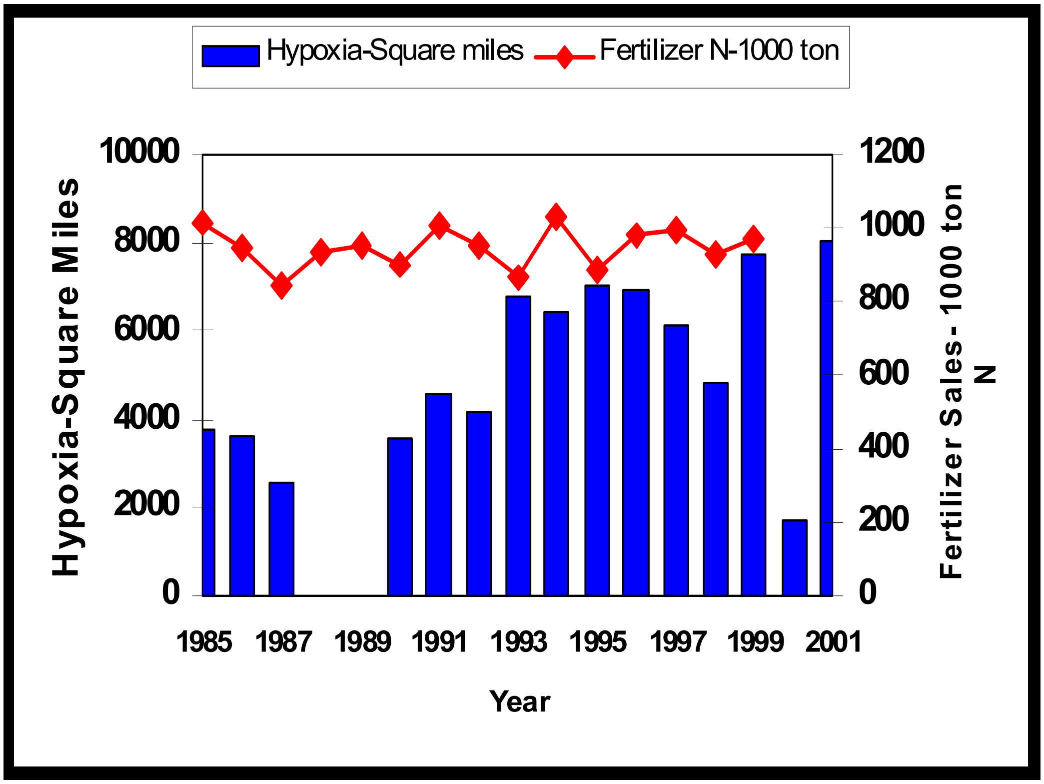

Fig. 2. Size of the hypoxia zone and Illinois nitrogen fertilizer sales. Hypoxia data provided by N.N. Rabalais, R.E. Turner, and W.J. Wiseman, Jr.

Do these regulatory activities and tight economics mean that nutrient use will be dramatically curtailed in the future? Not likely, but they do mean that we must use the best management practices that have been identified through research and practical experience.

Nitrogen Best Management Practices:

1. **Use the proper rate:** Most agronomists recognize that rate of application is one, if not the most important factor affecting N loss to the environment. Unfortunately, there is no system that will accurately predict the optimum rate for each field each year. Lack of an accurate prediction system is due in large part to climatic variability, which affects the optimum rate for any given year (Fig. 3). Years of low N need are often associated with poor growing conditions in that year or the year(s) before. In the example given in Fig. 3, 2 years (1985 and 90) had identical yields, but the amount of N needed to attain it was 50 pounds higher in 85 than 90. The 85 yield followed a good yield in 84, but the 90 yield followed 2 years of low yield. It is surmised that the residual N remaining in the field for the 90 crop year was adequate to give the same high yield as in 84, with much less N. In some fields, especially those that have a history of manure application, use of the nitrate test will help predict where lower N might be needed. Unfortunately, it does not always work. A new test is being developed at the University of Illinois that appears to predict those fields that will not respond to applied N (Fig. 4) and we are hoping that it will assist in identifying fields that need less than the recommended rate of application. Until such new tests are developed,

economic analysis of the data indicates that use of the current recommendation system will provide a higher rate of return than using the N rate that is needed to maximize yield in the best of growing years. Fortunately, recently collected data indicates that use of the recommended rate will minimize the potential for N loss through tile lines as compared to those fields that have a history of excessive use over time (Fig. 5).

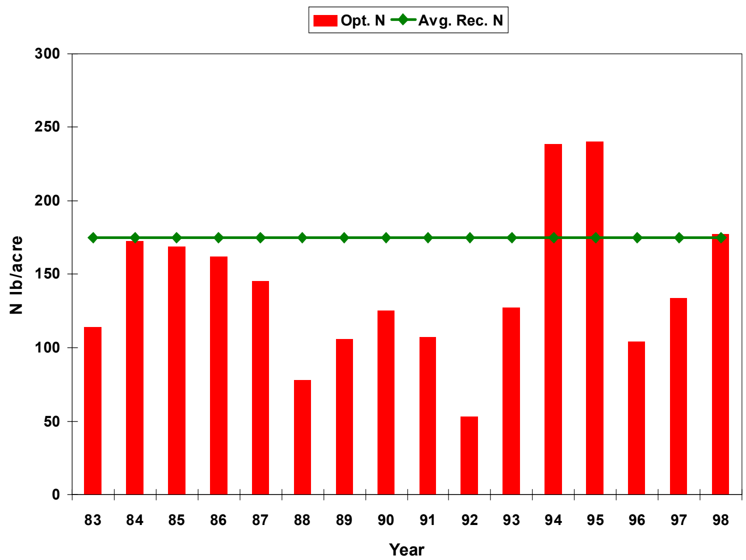

Fig. 3 Variation in optimum nitrogen need over time from a single location

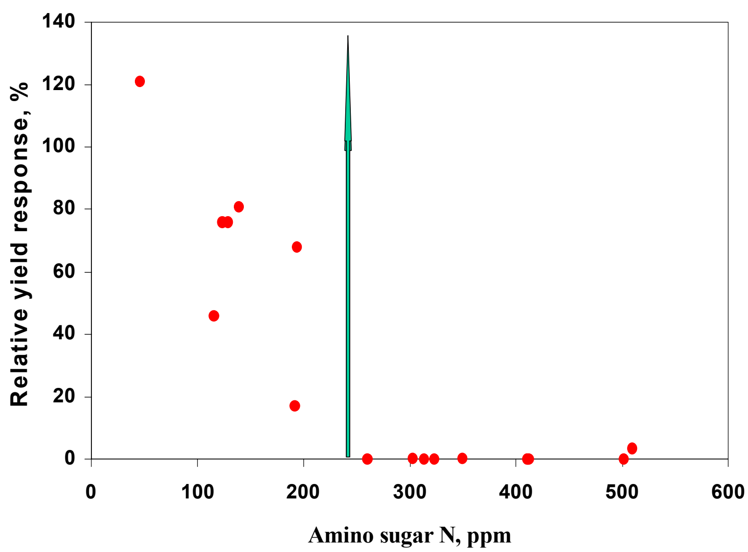

Fig. 4. Relationship between amino sugar N and relative yield

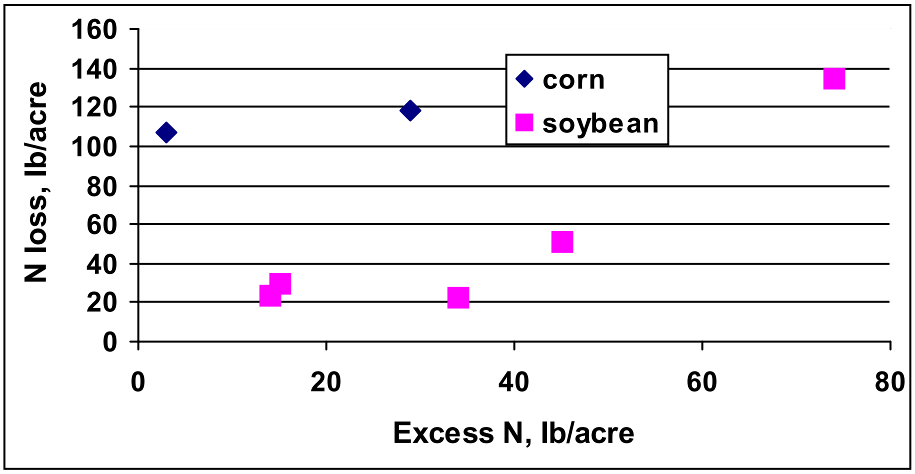

Fig. 5. Effect of excess N application (N rate above recommendation) on N loss in tile lines.

2. **Take credit for home-grown nitrogen:** Research has shown that corn after corn needs more N than corn after a legume. The suggested "credit" for soybean is 40 lb. N/acre. More recent data suggests that this is a conservative figure and may be closer to 50 lb. N/acre. If manure or sludge has been applied, obtain an accurate measure of the amount of N applied and reduce the rate accordingly.

3. **Take credit for "incidental" nitrogen:** Nitrogen is often applied as a part of another fertilizer treatment or as a part of another farming operation. For example, phosphorus is often applied as an ammoniated phosphate (nitrogen containing material), starter fertilizers almost always contain nitrogen, and many use UAN solutions to apply herbicides. The nitrogen in all of these materials needs to be credited toward the total N need for the crop.

4. **Apply nitrogen at the proper time for your soil type:** The closer the time N is applied to the time N is needed by the crop, the lower the potential for N loss. This is not to say that earlier applications should never be used as there is data to suggest that the difference due to time of application is minimal if done properly, at least as compared to rate of application. Delaying fall applications until soil temperatures are cool enough will reduce the rate of conversion of ammonium to nitrate (Fig. 6). Do not fall or winter apply urea for the following year corn crop.

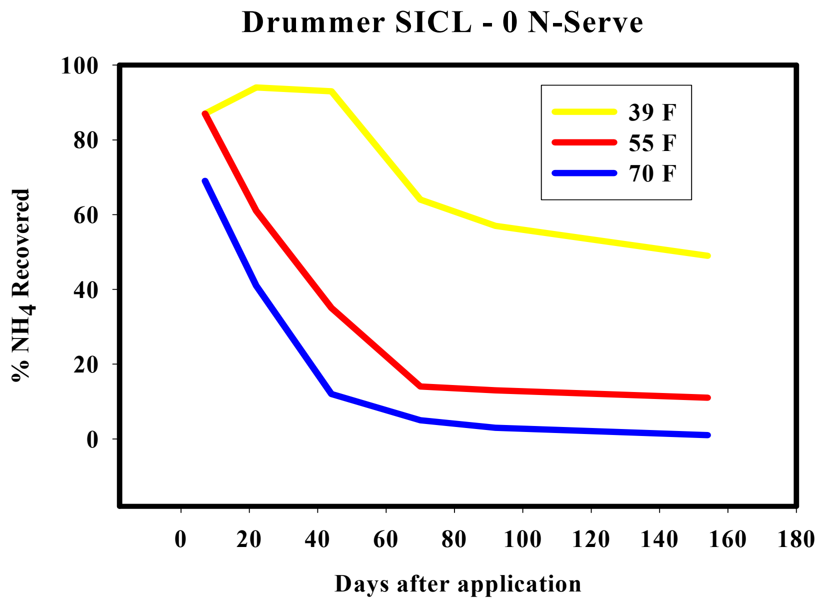

Fig. 6. Relationship between soil temperature and rate of ammonium disappearance (conversion to nitrate).

5. **Use nitrification inhibitors to reduce the rate of conversion of ammonium to nitrate:** Minnesota results have shown that use of a nitrification inhibitor with fall-applied nitrogen will reduce the amount of nitrogen lost in tile lines. Wisconsin and Illinois research has also shown that inhibitors reduce the potential for N loss.

6. **Use the appropriate method of application for the fertilizer product being used.** Incorporate urea-containing fertilizers soon after application or consider the use of a urease inhibitor. Inject nitrogen fertilizers that contain free ammonia (anhydrous ammonia and aqua ammonia).

OHIO AGRI-BUSINESS AND TMDLS: A PERFECT MATCH

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Introduction

Recently, at the national and state level, a lot of energy and emotion has been directed by industry, municipalities, private citizens and environmental interests to a section in the Federal Clean Water Act (CWA) that has been around since 1972. CWA section 303(d) embodies the total maximum daily load (TMDL) program. Under section 303(d), states are required to develop lists of waters that do not meet the water quality standards set for them, establish a priority ranking for the waters on the list based on the severity of the pollution and designated uses, and develop TMDLs for these waters. The TMDL program is aimed at assuring the attainment of water quality standards by requiring the establishment of loading targets and allocations. In essence, waters not meeting the CWA's basic goals deserve special attention and the TMDL program is the primary mechanism for doing that. Waters are to remain on the list until water quality standards have been met.

The purpose of this paper is to provide an overview of TMDL concepts, an update of national and Ohio activity regarding TMDLs followed by a discussion on how TMDL implementation will influence Ohio agri-businesses.

What are TMDLs?

A Total Maximum Daily Load or TMDL is defined by regulation as "the sum of the individual (waste load allocations) for point sources and (load allocations) for nonpoint sources and background." It is commonly referred to as a "calculation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards." The issue has been further complicated by recent proposed revisions to the TMDL rules to expand the definition of a TMDL to a "written quantitative plan and analysis for attaining and maintaining water quality standards in all seasons for a specific waterbody and pollutant."

Pictorially, the TMDL process can be viewed as a glass and four pitchers (see Figure 1.). Depending on the particular water in question and the pollutant being considered, the size of the glass can vary from large to small. The size of the glass is dictated by the assimilative capacity of the water body for the pollutant in question. It is also important to remember that the number of glasses per water body depends on the reasons why the waterbody is listed. Each glass represents one pollutant (sediment, nitrate, phosphorus, etc.). The four pitchers represent the sources of the pollutant load: point sources, nonpoint sources, background and margin of safety. In the ideal world, one can empty all four of the pitchers into the glass and it will not overflow. This situation indicates a waterbody that can accept and assimilate the total load of the pollutant and would be classified as "not impaired".

If on the other hand, the glass overflows, the pollutant load is too large and the waterbody would be classified as "impaired". The goal of the TMDL process is to identify which of the pitchers should be reduced so the glass does not overflow. The expanded definition for TMDLs would require a plan be developed to describe how the pitchers would be reduced, who is responsible and the time line for making it happen.

Why TMDLs Now?

The TMDL program has been around for almost thirty years as part of the 1972 federal Clean Water Act (CWA). Since the enactment of the CWA, the focus of state and national water quality management efforts has been directed at controlling point sources of pollution through the use of mandated technological improvements and restricted discharges required in permits issued under the National Pollutant Discharge Elimination System (NPDES). While many improvements have been made in the quality of the nation's surface waters, there is still much to do. US EPA's 1998 National Water Quality Inventory Report to Congress estimates 40% of the assessed surface waters were not clean enough to achieve the CWA goal of "fishable and swimmable".

With point source limitations in place, the focus has shifted to the virtually unregulated nonpoint sources of pollution such as agriculture, mining, forestry and urban runoff. In doing so, section 303(d) of the CWA has come into the limelight. Environmental interest groups started filing lawsuits against US EPA to force implementation of section 303(d). The citizen lawsuits were motivated by the belief that the TMDL process was a viable means to address nonpoint source pollution. US EPA has been involved in litigation relating to TMDLs in 39 states.

The numerous citizen lawsuits resulted in many inconsistent court orders. As a result, US EPA convened a committee under the Federal Advisory Committee Act (FACA) in 1996 to address the TMDL issue directly. The committee, composed of 20 individuals with diverse backgrounds, met for 18 months and issued a report that contained over 170 separate program and policy recommendations in 1998. The recommendations were used to guide the development of proposed changes to the TMDL regulations, which US EPA issued in draft in August 1999. The final rule was published on July 13, 2000.

The controversy continued as US EPA expressively stated that nonpoint sources of pollution are to be included in the TMDL process and mandated that schedules for TMDL development be established. Congress added a "rider" to an appropriations bill prohibiting US EPA from spending FY2000 and FY2001 money to implement the new rule. In addition, US EPA was directed to contract with the National Academy of Sciences (NAS) to analyze the scientific basis of the TMDL program. The NAS report was released on June 15, 2001 with the conclusion that the data and science available to the states are sufficient to follow an ambient-based approach to water quality management but the capacity for states to do so is inconsistent.

The release of the NAS report as well as numerous lawsuits led US EPA to delay the effective date of the revised July 2000 TMDL rule to April 30, 2003. During this time period, US EPA is conducting a series of public listening sessions to obtain stakeholder perspectives on key issues associated with the TMDL program and to give the agency time to review and revise the rule to achieve a workable program.

Ohio's Story

The quality of Ohio's surface waters has improved substantially over the past 10 – 15 years. The majority of this improvement is the result of improvements in the quality of municipal and industrial wastewater treatment discharges across Ohio.

Ohio is a water-rich state with over 61,500 total miles of streams. Approximately half of these (29,100 miles) are perennial, flowing year round. Through it's monitoring program, Ohio EPA has monitored 8,232 miles or 28.3 percent of the perennial streams. The 2000 Ohio Water Resource Inventory estimated that just over half (54.6%) of the monitored stream miles in Ohio are fully supporting their applicable aquatic life use designation (see Figure 2.). The good news is that more than one-half of Ohio's streams have populations of good or exceptional quality fish and macroinvertebrates. The bad news is that the other half do not.

By combining the biological and chemical monitoring data, the Ohio EPA is able to associate causes and sources of pollutants to the observed water quality impairments. Causes of impairment are the pollutants that actually damage or impair the aquatic life in a stream. Sources of impairment are the origin of the pollutant. In the 2000 Ohio Water Resource Inventory, the six leading causes of impairment of Ohio streams are habitat alteration, siltation, organic enrichment, nutrients, flow alteration and metals (see Figure 3.). The six leading sources of impairment are hydromodification, agriculture, point sources, mining, other and urban runoff (see Figure 4.).

The 1998 prioritized list of impaired waters was submitted to US EPA as required under section 303(d) and was approved in December 1998. The 1998 list indicates 881 of 5,000 (18%) waterbody segments are impaired or threatened. Two hundred seventy-six (276) of Ohio's 326 watersheds (85%) contain at least one listed waterbody segment.

Ohio EPA prepared a schedule to complete TMDLs for all impaired waters by the year 2013. Hampered by an economic downturn and a court order to spend more money on education, however, the state legislature reduced its financial support to Ohio EPA. The reduction in the funds prompted Ohio EPA to revisit the TMDL development schedule. Given the current level of available financial resources, the schedule has lengthened from 15 to 25 years. In an effort to "force the state legislature" to adequately support the TMDL program, a coalition of environmental organizations filed a lawsuit in US District Court in Columbus to force US EPA to mandate Ohio to develop and implement a shorter time frame to clean up its polluted waterways.

Impact to Ohio Agri-Business

Water quality monitoring data in Ohio indicates nonpoint source pollution (NPS) is the primary cause of stream impairment today. NPS pollution is, by definition, a by-product of how humans utilize the land resource. Agriculture is the largest land use in Ohio so it is no wonder many fingers point to agriculture as a culprit. As TMDLs are developed and implemented across Ohio to address NPS pollution, it is reasonable to believe that impacts will be felt throughout the agricultural industry.

Agricultural TMDLs will be developed primarily to address two pollutants - nutrients and sediment. These pollutants are two of the six leading causes of water quality impairment in Ohio that can be associated with agricultural land use. Controlling the off-site transport of these pollutants can be achieved through the voluntary incorporation of conservation tillage and/or conservation buffers or by the development and implementation of a nutrient management plan. Helping producers make management decisions such as these is the role that certified crop advisors, agronomists, extension educators and conservationists have been playing for many years. The question now is "How will the development and implementation of TMDLs change this role in the future?"

There is no reason to believe that TMDLs will change the way farmers and their consultants conduct business. The advice and assistance provided will continue to address the natural resource issues of the producer while keeping profitability in mind. What will change are the geographical locations where business relationships will be developed in the future. Producers located in watersheds where TMDLs are scheduled to be developed and implemented should be considered potential clients. Consultants should look at this as an opportunity to market their services. The implementation of NPS-based TMDLs will remain dependent upon the voluntary adoption of management measures leading to water quality improvement. Targeted technical expertise and assistance from certified crop advisors, agronomists, extension educators and conservationists would be needed to meet the established water quality goals.

Water quality monitoring efforts associated with the federal Clean Water Act have identified few incidents of crop protectant products being detected in Ohio's surface waters. Pesticides are number 22 on the ordered list of causes of water quality impairment in the 2000 Ohio EPA 305(b) report. On the other hand, monitoring activities conducted by public drinking water purveyors under the federal Safe Drinking Water Act has revealed occasional incidents where crop protectant products have been detection at levels approaching established concentrations of concern. For Ohio's agri-businesses, the largest challenges and greatest opportunities, which lie ahead, fall under the topic of crop protectant products.

Ohio EPA and the public drinking water purveyors will be developing source water assessment and protection (SWAP) plans for each of the over 5,800 public water systems. As these plans are developed and implemented, the advice that certified crop advisors, agronomists, extension educators and conservationists provide to their clients may have to be adjusted. When working with clients in the delineated source water area, recommendations for alternative crop protection products, seed types and management practices will have to be considered and made to be consistent with the SWAP document.

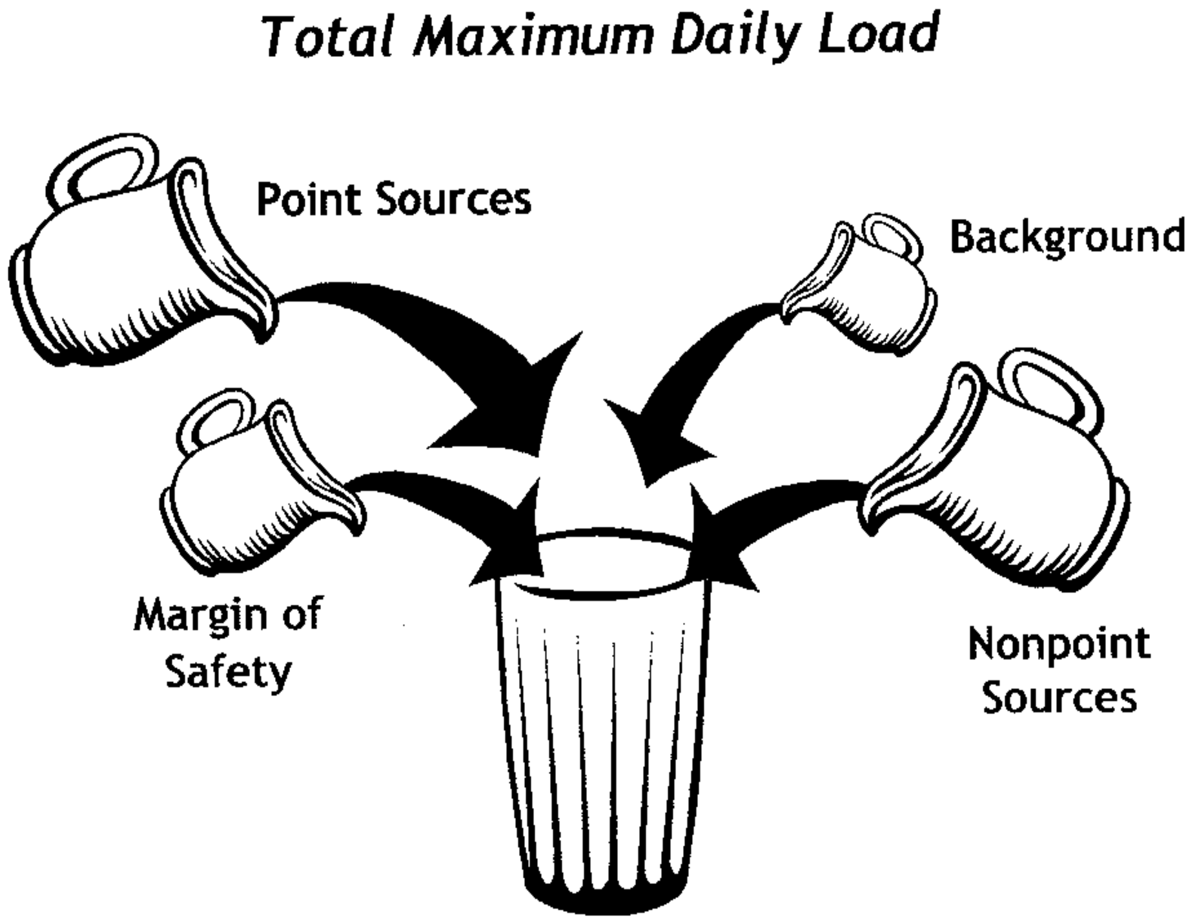

Figure 1. Pictorial representation of a Total Maximum Daily Load.

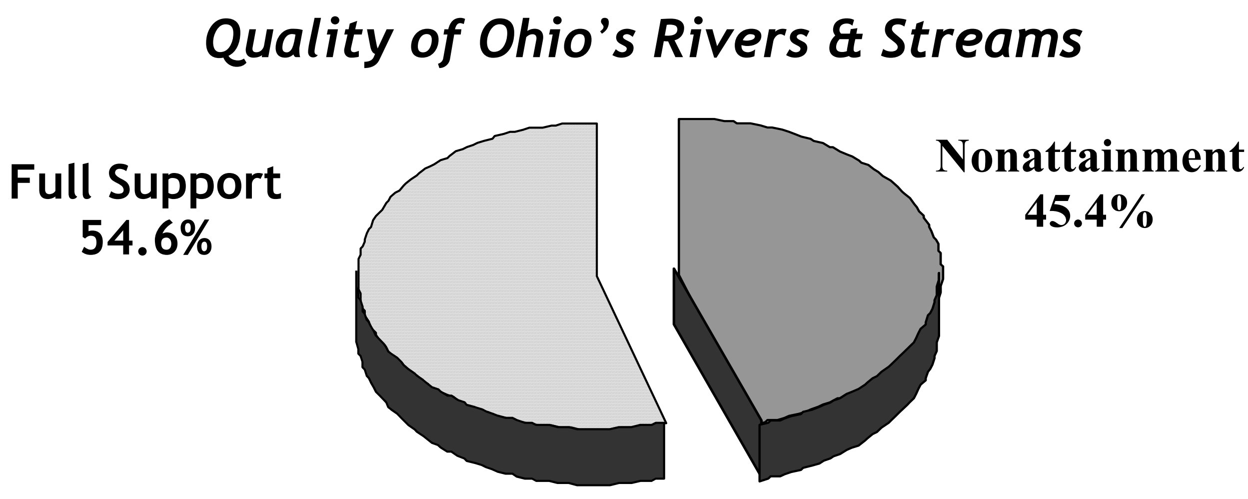

Figure 2. Aquatic life use attainment status of Ohio's rivers and streams (Ohio EPA 2000 305(b) report).

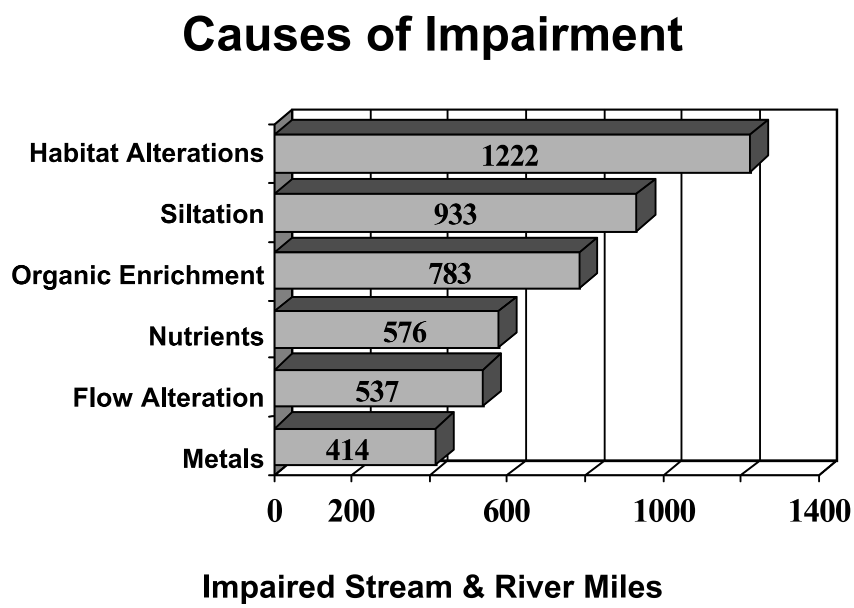

Figure 3. Six leading causes of water quality impairment (Ohio EPA 2000 305(b) Report).

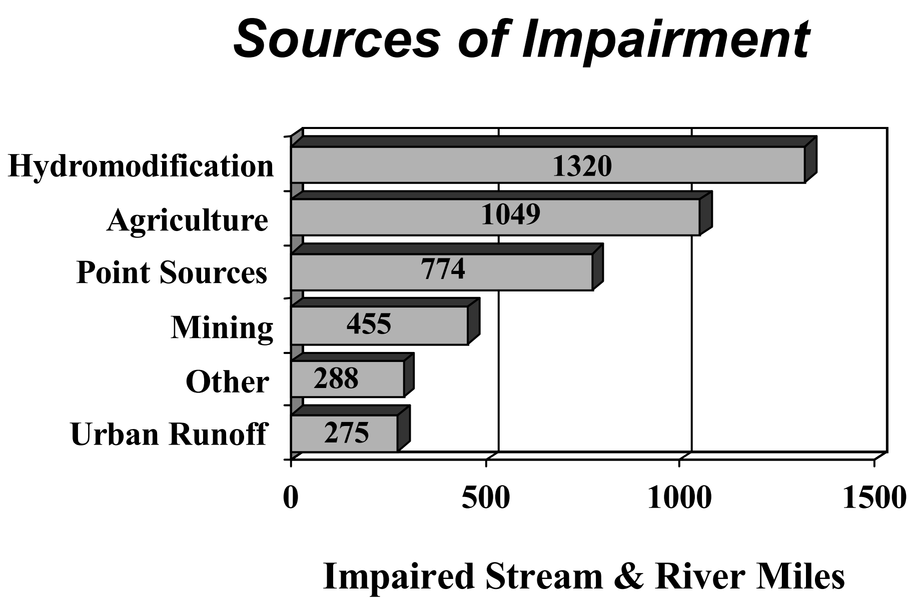

Figure 4. Six leading sources of water quality impairment (Ohio EPA 2000 305(b) Report).

THE EFFECT OF TIME OF DAY ON HERBICIDE ACTIVITY - OSU RESEARCH IN 2001

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We have received occasional questions over the years about the possible effects of dew and time of day on herbicide activity on weeds and crops. Interest in this topic seems to have increased recently as herbicide applicators attempt to minimize spray drift and use postemergence herbicide programs on a greater percentage of their crops. New technology in tractor and applicator guidance systems allows accurate application of herbicides even during nighttime hours, but there have been concerns about herbicide activity in the dark. Research in this area has been lacking, making it difficult to answer questions. We conducted several studies in the summer of 2001 to determine the effect of time of day on herbicide activity. Although inconsistent across weeds, herbicides, and locations, we observed a definite effect of time of day on activity in some studies, providing a basis by which to make some general recommendations.

Research methods

We conducted two studies in Roundup Ready soybeans and two studies in wheat stubble in the summer of 2001. The soybean studies were conducted at OARDC Western and Northwest Branches. Flexstar (1.3 pts), FirstRate (0.3 oz), and Roundup UltraMax (20 oz) were applied postemergence at weed sizes of approximately 4 to 6 and 9 to 12 inches at the following times: 0600, 0900, 1200, 1500, 1800, 2100, and 2400 hours (2400 at Western Branch only). Herbicides were applied with the appropriate adjuvants in a spray volume of 20 gpa using flat fan nozzles. Weeds at Western Branch included giant and common ragweed, smooth pigweed, Pennsylvania smartweed, velvetleaf, and common lambsquarters. Weeds at Northwest Branch included common ragweed and seedling dandelion.

The wheat stubble studies were conducted on a producer's fields in Delaware County. Roundup UltraMax (26 and 52 oz) and Roundup UltraMax plus 2,4-D ester (26 oz plus 16 oz) were applied in early August to weeds that were approximately 10 to 20 inches tall at 0600, 1400, and 2100 hours. Herbicides were applied with ammonium sulfate in a spray volume of 20 gpa using flat fan nozzles. The weed population at one site consisted of common lambsquarters and common ragweed, while the other site had giant ragweed, smooth pigweed, and giant foxtail.

Results

We observed a significant effect of time of day on herbicide activity in both soybean studies and one wheat stubble study, though not for all herbicides or weeds. In general, weed control between 0900 and 1800 hours was similar and not affected by the time of application, while control was reduced at 0600, 2100, and 2400 hours. This effect was observed for Roundup UltraMax and Flexstar, but not FirstRate or 2,4-D. The effect was most evident in giant ragweed, which is not surprising, since it can be a difficult weed to control under any conditions. Time of day did not affect control of annual grasses. In the soybean studies, the rates used were inadequate for consistent control of weeds larger than 4 to 6 inches, so results on 9 to 12 inch weeds were variable and are not generally discussed here, though they tended to support results on smaller weeds. There was also a trend for greater soybean injury with Flexstar between 1200 and 1800 hours, compared to other times of the day. In the wheat stubble study, the effect of time of day could not be overcome by increasing the rate of Roundup UltraMax, but could be overcome with the addition of 2,4-D. By study, we observed the following:

Northwest Branch – Control of 4 to 6 inch common ragweed with Roundup UltraMax was significantly reduced at 2100 hours. Control of 9 to 12 inch common ragweed with Flexstar was reduced at 0600 and 0900 hours.

Western Branch – Control of common and giant ragweed (all sizes) with Roundup UltraMax was reduced at 0600, 2100, and 2400 hours. A similar trend occurred for velvetleaf, pigweed, and Pennsylvania smartweed, for which control was reduced at 0600 and/or 2400 hours, depending upon size. Control of giant ragweed with Flexstar was reduced at 0600, 2100, and 2400 hours, while control of common ragweed was reduced at 0600 and 2400 hours. Control of velvetleaf and Pennsylvania smartweed with Flexstar was reduced at 2400 hours, and there was no effect of time on control of pigweed or lambsquarters.

Wheat stubble I – There was no effect of time on control of common lambsquarters or common ragweed with Roundup UltraMax.

Wheat stubble II – Control of giant ragweed and pigweed was reduced at 0600 and 2100 hours with Roundup UltraMax, compared to 1400 hours. Control with a mixture of Roundup UltraMax plus 2,4-D was not affected by time of day.

Why does time of day affect herbicide activity in plants?

We can only speculate as to the cause of reduced herbicide activity in the early morning and evening. The absence or presence of dew could have an effect, although dew was not present in the morning in every experiment. We also did not typically observe dew at 2100 hours when activity was often reduced. Some possible consequences of applying when a heavy dew is present: 1) drops of dew falling from leaves could carry herbicide with them; 2) dew could in effect increase the volume of water in which the herbicide is diluted on the leaf surface, reducing the effective concentration of adjuvants and the activity of some systemic herbicides that are most effective in low water volumes; and 3) dew could delay evaporation and prolong the time herbicide is suspended in water, which would possibly allow time for additional herbicide penetration into the leaf. Our best guess at this point is that changes in the weeds' physiological processes at night could be responsible for reduced herbicide effectiveness. Plant processes are on a 24-hour cycle (diurnal rhythm), and it is possible that reduced transport of herbicide or some other point in the herbicide mode of action is affected by time of day. As we have said for years in regard to plant stress and weed control, herbicides are most active in actively growing plants. Apparently, this statement applies to time of day as well.

Recommendations

While it is evident from these studies that time of day can affect herbicide activity, the effect appears to vary with herbicide, weed species and size, and environmental conditions. As a general rule, herbicides should be applied between the hours of approximately 9 am and 6 pm to maximize herbicide activity and weed control. Unfortunately, this time period often represents the windiest part of the day when spray particle drift is most likely. To minimize drift, applicators may therefore have to wait for a calmer day to apply herbicides, or apply in early morning or evening when winds are calmer even if herbicide activity is reduced. Use of drift-reducing agents and low-drift nozzles may allow for more flexibility in application, and should be considered when herbicides are applied between 0900 and 1800 hours to minimize drift.

Managing Winter Annual Weeds and Dandelion in Corn and Soybeans

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Populations of winter annual weeds seem to have been at an all time high over the past several years. Weeds such as common chickweed, henbit, purple deadnettle, and marestail (horseweed) have increased to the point that they require changes in herbicide management in some fields. Several factors may have caused the increase in winter annual weeds. Most winter annuals emerge in the fall, and the warm weather in late fall during the past several years has resulted in higher populations. No-tillage tends to promote winter annual populations, since there is no tillage in fall to disrupt their emergence. However, winter annuals can emerge after an early fall tillage, and have been a problem in tilled as well as no-till fields. Early soybean harvest in 1999 and 2000 allowed earlier than typical fall tillage in some fields, providing a window after tillage for winter annual emergence. Another factor may be the switch from preplant/preemergence herbicide programs (Squadron, Canopy etc) to Roundup Ready and other postemergence programs, since we have observed winter annual weed problems showing up more often following postemergence programs. If so, this may indicate that the preplant herbicides are either: 1) preventing seed production by these weeds in the spring, or 2) persisting into the fall at rates that are high enough to reduce winter annual emergence. Continued problems with winter annuals may warrant reconsideration of the utility of total postemergence programs.

The life cycle of winter annual weeds

Chickweed, deadnettle, and most other winter annual weeds emerge primarily in the late summer or fall, although some emergence can occur in the spring. Marestail and common chickweed can follow a winter annual or summer annual life cycle, and have the potential to emerge over most of the year depending upon environmental conditions. Winter annuals survive the winter with little or no further growth, resume growth in late-winter or early spring, and flower and go to seed in late-spring or early summer. Consequently, the major negative effect of most winter annuals occurs at the time of crop establishment. Marestail does not flower until late summer, and directly competes with crop growth along with foxtail, ragweeds, and other summer annuals. We have occasionally observed completion of the winter annual life cycle within a shorter period of time. For example, when chickweed gets an early start in late summer, it may set seed by late fall or early winter. One characteristic of winter annuals that allows populations to increase over a short time period is the lack of after-ripening needed for seed viability. While seed from many weed species requires a year or more of after-ripening in the soil in order to germinate, seed from winter annuals is often ready to germinate as it leaves the plant.

Problems caused by dense populations of winter annul weeds

- Prevent soil from drying in spring
- Prevent soil from warming up quickly in spring
- interfere with spring tillage and crop establishment
- harbor insects that cause problems with crop establishment and early-season growth
- some serve as host for soybean cyst nematode

- longer-lived winter annuals such as marestail interfere with crop growth through much of the growing season and interfere with harvest.

Purple deadnettle and soybean cyst nematode

OSU research has shown that some winter annuals can serve as hosts for soybean cyst nematode. In Ohio, the primary potential host appears to be purple deadnettle. OSU research indicates a possibility that deadnettle emerging in late summer could serve as an alternate host for cyst nematode when the soybeans senesce, allowing completion of another nematode life cycle and increasing their populations. We are therefore suggesting that in fields where cyst nematode is a known problem, deadnettle should be controlled by late September or within 30 days of deadnettle emergence to interrupt the nematode life cycle. Have fields tested for the amount of soybean cyst nematode if you are unsure whether it is a problem.

Strategies for fields where winter annuals are a problem

Since the major problems with chickweed and deadnettle often are the slow soil drying and interference with crop planting and tillage, the primary goal of winter annual management should be to allow maximum time for weed death and dessication. This may be accomplished with fall or early spring herbicide applications or tillage. Applications too soon before planting may not kill plants rapidly enough, especially during periods of cold weather. Control can be achieved with tillage or herbicides, although herbicides will be the method of control in no-till fields. Some advantages and disadvantages of the various management strategies:

- tillage in fall or early spring – controls most winter annuals, but soil may be too wet for tillage at these times
- herbicide treatment between mid-October and early December - most consistent control of emerged plants but can miss spring-emerging weeds unless herbicide with residual activity is used
- herbicide treatment in March – control of emerged plants more erratic than fall treatments – larger plants and cold weather may prevent rapid plant death and dessication needed to prevent problems with planting

Are all fields candidates for fall herbicide programs?

Winter annual populations vary greatly among no-till fields, and some fields have few winter annuals at this point. We do not see a great advantage to fall applications in these fields. Any type of program that has been consistently effective in prior years, including application of herbicides at planting for burndown, can still be used. Since there appears to be a general trend for increasing winter annual populations, however, these fields should be scouted each fall to ensure that populations are not increasing. Preventing seed production in low populations of winter annuals will minimize the risk of future problems.

Overview of OSU research on winter annuals

OSU weed scientists conducted field research in the fall and spring of 1999/2000 and 2000/2001 to determine the effectiveness of various herbicide treatments for control of common chickweed and purple deadnettle. We had field studies at three locations each year – east of Chillicothe, Amanda, and South Charleston. Our research was much more extensive in 2000/2001, with regard to the number of herbicides and rates included. Fall herbicide treatments were applied in mid- to late-November both years, and spring treatments were applied in late March. Results of these studies are summarized below and tables showing all of the data are available at the OSU Weed Science website – http://www.oardc.ohio-state.edu/weedworkshop/. We included 2,4-D ester (1 pint/A) with most treatments. Treatments containing glyphosate were applied with ammonium sulfate. All other treatments were applied with crop oil concentrate. Overall, fall treatments provided much more consistent control of chickweed and deadnettle than spring treatments. Among soybean herbicides, few treatments provided more than 80% control of both weeds in March, but a number provided better than 90% control when applied in November. Most of the chickweed and deadnettle (95% or greater) emerged prior to November treatments, but we did observe a few deadnettle emerging in the spring where treatments without residual activity were applied.

Fall herbicide treatments for soybeans providing an average of at least 90% control of chickweed and deadnettle in OSU research:

- Canopy XL (2.5 to 4.5 oz/A) + Express (0.2 oz/A) + 2,4-D ester (1 pt/A)
- Classic (1 oz/A) + Express (0.2 oz/A) + 2,4-D ester (1 pt/A)
- Canopy SP (6.5 oz/A) + 2,4-D ester (1 pt/A)
- Glyphosate (0.75 lb ae/A = 26 oz of Roundup Ultra Max or 32 oz of Touchdown, Glyphomax, others)
- 2,4-D ester (1 pt/A) + Glyphosate (0.38 lb ae/A = 13 oz of Roundup Ultra Max or 16 oz of Touchdown, Glyphomax, others)
- Canopy SP (2.6 oz/A) + Sencor (4 oz/A) + 2,4-D ester (1 pt/A)
- Backdraft (4 pts/A) + 2,4-D ester (1 pt/A)
- Extreme (3 pts/A) + 2,4-D ester (1 pt/A)
- Sencor (4 oz/A) + glyphosate (0.56 lb ae/A - 20 oz of Roundup Ultra Max or 24 oz of Touchdown, Glyphomax, others)
- Sencor (4 oz/A) + Gramoxone (1 qt/A) + 2,4-D ester (1 pt/A)

Fall herbicide treatments for soybeans providing an average of 80 to 90% control of chickweed and deadnettle in OSU research:

- Sencor (8 oz/A) + 2,4-D ester (1 pint/A)
- Backdraft (3 pts/A) + 2,4-D ester (1 pint/A)

Spring herbicide treatments for soybeans providing an average of 80 to 92% control of chickweed and deadnettle in OSU research:

- Sencor (8 oz/A) + 2,4-D ester (1 pint/A)
- Canopy XL (2.5 or 4.5 oz/A) + Express (0.1 to 0.2 oz/A) + 2,4-D ester (1 pt/A)
- Classic (1 oz/A) + Express (0.1 to 0.2 oz/A) + 2,4-D ester (1 pt/A)

Fall herbicide treatments for corn providing an average of at least 90% control of chickweed and deadnettle in OSU research (Note: simazine + 2,4-D ester is effective on most winter annuals but is weak on deadnettle):

- Basis (0.5 oz/A) + 2,4-D ester (1 pt/A)
- Express (0.33 oz/A) + simazine (1 lb ai/A) + 2,4-D ester (1 pt/A)
- Simazine (1 lb ai/A) + Sencor (4 oz/A) + 2,4-D ester (1 pt/A)

Spring herbicide treatments for corn providing an average of at least 90% control of chickweed and deadnettle in OSU research (glyphosate and Gramoxone were not included in corn trial, but we assume results would be similar to soybean study):

- Atrazine (1.5 lb ai/A) + 2,4-D ester (1 pt/A)
- Aim (0.3 oz/A) + atrazine (1.5 lb ai/A)
- Balance Pro (2.2 oz/A) + atrazine (1.5 lb ai/A) + 2,4-D ester (1 pt/A)
- Balance Pro (3.8 oz/A) + atrazine (1.5 lb ai/A)
- Callisto (3 oz/A) + atrazine (0.3 lb ai/A)

Some suggestions for use of 2,4-D ester

We included 2,4-D ester in most treatments because it is economical and helps control dandelion, marestail, and mustards. 2,4-D is generally not effective for control of chickweed or deadnettle, but can have some activity on these weeds. Where dandelion is target weed, use a 2,4-D rate of 1 quart/A unless it is combined with Canopy XL or glyphosate, in which case a rate of 1 pint/A may be adequate.

Fall herbicide options for dandelion

Dandelion control in the spring has been variable and extremely slow with many herbicide treatments, especially when the dandelions are well established. Fall is an excellent time to apply herbicides for dandelion control. We suggest applying by early November when control of dandelion is a goal. Herbicide options include:

- 2,4-D ester (1 qt/A)
- Glyphosate (0.75 lb ae/A = 26 oz of Roundup Ultra Max or 32 oz of Touchdown, Glyphomax, others)
- 2,4-D ester (1 pt/A) + glyphosate (0.56 lb ae/A = 20 oz of Roundup Ultra Max or 24 oz of Touchdown, Glyphomax, others)
- Canopy XL (2.5 to 4.5 oz/A) + Express (0.2 oz/A) + 2,4-D ester (1 pt/A)
- 2,4-D ester (1 pt/A) + Backdraft (4 pts/A)

Fall herbicide options for marestail (horseweed)

Marestail can emerge throughout much of the year, but the majority emerges in the fall. Most of these treatments will be effective in fall or early spring. Closer to the time of soybean planting, larger marestail may require more aggressive herbicide mixtures. Treatments containing Sencor, Valor, Python, or Canopy XL will provide residual control of marestail, but we have insufficient information on the length of residual control. Fall herbicide options include:

- 2,4-D ester (1 pt/A)
- Glyphosate (0.56 lb ae/A = 20 oz of Roundup Ultra Max or 24 oz of Touchdown, Glyphomax, others)
- 2,4-D ester (1 pt/A) + Glyphosate (0.38 lb ae/A = 13 oz of Roundup Ultra Max or 16 oz of Touchdown, Glyphomax, others)
- Backdraft (4 pts/A)
- 2,4-D ester (1 pt/A) + Backdraft (3 pts/A)
- 2,4-D ester (1 pt/A) plus Sencor or Valor
- 2,4-D ester (1 pt/A) plus Python or Canopy XL (* as long as the fields do not have ALS-resistant marestail)

Suggestions on adjuvants

- All treatments containing glyphosate should include ammonium sulfate, and some glyphosate products also require the addition of nonionic surfactant.
- All treatments not containing glyphosate should generally include crop oil concentrate at the rate of 1% v/v or 1 quart per acre (when applying in a spray volume of less than 15 gallons/A). Some labels specify the use of 28% nitrogen solution or ammonium sulfate also.

Application timing

Data from OSU field studies shows that application in the fall from about mid-October to early December can provide effective control of winter annuals. Herbicides should be applied by early November for control of dandelion and Canada thistle. Where winter annual populations are dense in the spring, applications should be made by late March to allow time for weed dessication. Marestail becomes more difficult to control as it increases in size, so fall or early spring applications are more effective than applications at planting. Glyphosate is more inconsistent in the spring for control of marestail.

Need for a burndown application at planting

Use of herbicides in the fall does not necessarily eliminate the need for an application of burndown herbicides at planting the following spring. This will be affected by the nature of the weed populations in the field, date of planting, and type of herbicides used in the fall. While a fall application may control most of the winter annual weeds, some summer annual weeds start to emerge in early spring. Early-emerging weeds can include ragweeds, smartweed, atriplex, and lambsquarters. When herbicides with residual activity (Backdraft, Canopy XL, Sencor, Python) are applied in the fall, they should provide at least some control of these weeds into the following spring. Fall treatments without residual (glyphosate, paraquat, 2,4-D) provide no control of spring-emerging weeds. Based on our experience in conventional and Roundup Ready soybeans, we suggest the following:

- In conventional or STS soybeans, burndown herbicides should be applied before or at the time of planting if any vegetation is evident in the field (even if weeds are very small).
- In Roundup Ready soybeans, one postemergence application during the growing season is not likely to be adequate except in fields where weed populations are low and giant ragweed is not present. In fields where the summer annual weeds are small and infrequent at the time of planting, the first application of glyphosate can be delayed until after soybeans emerge and followed by a second postemergence application several weeks later. In fields where weeds are large and numerous at the time of planting, application of glyphosate or glyphosate plus 2,4-D ester before or at planting is probably still the best strategy.

2001 UPDATE ON FIELD CROP INSECT ACTIVITY

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YieldGard Bt Corn and Corn Borer Activity in Ohio:

The 2001 growing season represented the fifth year of replicated trials comparing YieldGard Bt corn hybrids to equivalent isolines (without the Bt trait) at the OARDC Western and Northwestern Branch Stations. During the first four years, corn borer infestation levels at the Western Branch Station had been moderate to low and average yields of non-Bt isolines were equal to that of the YieldGard Bt-corn yields. Corn borer injury at the Western Branch station and Northwestern Branch station in 2001 remained low at 0.7 and 0.5 cavities per plant respectively. Yield data are forthcoming.

In addition to the trials at the Western and Northwestern branch stations, a replicated trial was conducted at the Van Wert Farm Focus site and non-replicated comparisons of YieldGard Bt-corn hybrids and their equivalent isolines were conducted at on-farm sites in seven Ohio counties (Allen, Crawford, Darke, Fairfield, Fayette, Highland and Licking Counties) with the cooperation of OSUE agents and grower cooperators. Corn borer infestations of non-Bt isolines in the on-farm trials ranged from 0.37 to 1.97 cavities per plant. Yield data are forthcoming from these sites.

Status of First Year Corn Rootworm in Ohio

Ohio State University Extension personnel continued to monitor for First Year Corn Rootworm (FYCR) beetles in soybeans in 2001. This is the 4th year that monitoring has occurred. The data presented in Table 1 represents collections of adult western corn rootworm (WCR) beetles on Pherocon AM yellow sticky traps from sixty-nine soybean fields in 17 counties. Most of the soybean fields were adjacent to first year corn fields. The data represent the average number of WCR collected from four traps changed on a biweekly schedule from mid-July to late August. An average catch of one to two WCR per trap per day would be regarded as relatively high catch in Ohio. County WCR averages of 0.5 or above indicate a potential for FYCR problems at some sites within the area monitored. WCR averages near 0.2 indicate a presence of FYCR, but most of the sites are expected to have minimal risk of a FYCR problem.

Beetle numbers remain low in all areas sampled. There was only 1 field above 0.5 beetles/trap/day and approximately 75% of the fields had beetle counts < 0.20 beetles/trap/day. Counts were lower in all of the counties sample in 2001.

Table 1: Trap collections of Western Corn Rootworm in Ohio Soybeans, 1998 to 2001.

Ohio Counties by Position from Indiana State Line	1998 Survey No. Sites	1998 Survey WCR/Trap per Day	1999 Survey No. Sites	1999 Survey WCR/Trap per Day	2000 Survey No. Sites	2000 Survey WCR/Trap per Day	2001 Survey No. Sites	2001 Survey WCR/Trap per Day
1st Tier - Adjacent to Indiana State Line								
Williams	14	0.49	14	0.24	1	0.26	0	n.a.
Defiance	21	0.59	12	0.30	4	0.14	4	0.10
Paulding	5	0.26	7	0.30	7	0.11	4	0.08
Van Wert	14	0.55	20	0.44	13	0.28	10	0.20
Mercer	8	0.16	9	0.35	5	0.26	4	0.25
Darke	39	0.15	23	0.34	8	0.29	8	0.22
Preble	7	0.10	6	0.12	2	0.12	0	n.a.
Butler	7	0.07	3	0.03	3	0.10	3	0.02
1st Tier County Averages:		0.30		0.26		0.20		0.15
2nd Tier of Counties from Indiana State Line								
Fulton	12	0.21	12	0.14	7	0.16	5	0.03
Henry	16	0.26	10	0.62	14	0.26	4	0.15
Putnam	14	0.08	13	0.17	11	0.11	4	0.12
Allen	12	0.05	9	0.22	7	0.25	4	0.17
Auglaize	8	0.07	9	0.20	5	0.17	0	n.a.
Shelby	18	0.10	9	0.19	0	n.a.		
Miami	7	0.03	5	0.04	1	0.17	0	n.a.
2nd Tier County Averages:		0.11		0.23		0.19		0.12
3rd Tier of Counties from Indiana State Line								
Wood	12	0.05	11	0.08	7	0.09	3	0.06
Hancock	16	0.08	6	0.04	1	0.15	0	n.a.
Champaign	10	0.07	11	0.18	5	0.27	4	0.15
Clark	10	0.01	10	0.05	1	0.22	1	0.01
3rd Tier County Averages:		0.05		0.09		0.18		0.07
Central Ohio Counties Reporting 3 Years or More of Data								
Sandusky	15	0.04	19	0.05	8	0.05	4	0.14
Seneca	13	0.04	17	0.04	9	0.04	0	n.a.
Wyandot	6	0.02	4	0.05	2	0.04	0	n.a.
Erie	9	0.03	7	0.10	3	0.02	0	n.a.
Crawford	13	0.02	8	0.03	6	0.05	3	0.03
Morrow	5	0.04	5	0.05	2	0.04	3	0.01
Madison	12	0.02	8	0.04	1	0.10	1	0.02
Licking	4	0.02	5	0.01	4	0.06	0	n.a.
Fairfield	23	0.01	10	0.04	2	0.09	0	n.a.
Central Ohio Averages:		0.03		0.04		0.06		0.02

New Bt-Corn Trait Registered in U.S.

A newly registered Bt Corn trait, Herculex 1, was approved for sale in the U.S. this year. The new trait was developed in a collaboration between Dow AgroSciences and its affiliate company, Mycogen Seeds, and Pioneer Hi-Bred International, Inc. At the time of this writing, the corn had not been approved for sale in Canada and overseas markets, such as Japan. This Bt corn uses the Bt protein Cry1F to give protection from certain lepidoptera insect pests such as European corn borer (ECB) and southwestern corn borer. Other pests, black cutworm and fall armyworm, are also listed as being controlled by this new trait.

Trials at the Western Branch the past two years investigated the efficacy of Herculex 1 against ECB (artificial infestation) and cutworm (artificial infestations). Results from the cutworm trials were inconclusive because the cutworm populations did not reach damaging levels in the trials. The ECB trials in 2000 and 2001 resulted in excellent control by the Herculex 1 trait. The Bt corn average 0 and 0.08 cavities per plant in 2000 and 2001 while the non-Bt isolines average 1.3 and 3.35 cavities per plant in 2000 and 2001.

Slug Management

Slug populations in late summer and early fall of 2000 were very large, an indication of possible economic problems in the spring of 2001. Although individual fields throughout Ohio did have slug infestations that required treatment, widespread problems did not occur. Slugs caused problems on both corn and soybean, although replanting of significant soybean acreage did not happen as in the previous year. Fall sampling in 2001 suggest that slugs survived the summer in moderate to high numbers. Trap catches from fields with known slug populations are averaging around 7-10 slugs, ranging from 2-3 slugs to around 20 slugs per trap. These numbers suggest that slug populations could be high next year.

A new molluscicide, Trail's End LG was tested for slug control in 2001. Three rates of this new bait were tested against the standard, Deadline MPs at 10 lb/acre. Results indicate that Trail's End LG was able to reduce the number of slugs per corn plant at its two highest rates, 7.5 and 10.0 lb per acre, similar to Deadline MPs (Table 1). Observations on subsequent plant injury following treatment showed that no further feeding occurred at the two higher rates of Trail's End LG or with Deadline MPs. The population of slugs was not sufficient to cause yield loss, and thus, yield data were not collected. This new bait should be available in the state in the coming year.

Table 2. Slug counts from molluscicide efficacy trial in corn

Treatment/ formulation	Rate amt form/acre	No. GGS/corn plan Field 1 3 DAT	No. GGS/corn plan Field 1 7 DAT	No. GGS/corn plan Field 2 3 DAT
Untreated check	--	1.5a	2.2a	2.1a
Trail’s End LG 3.5%	5.0 lb	0.4b	1.6a	0.8b
Trail’s End LG 3.5%	7.5 lb	0.3b	0.9b	0.3c
Trail’s End LG 3.5%	10.0 lb	0.2b	0.7b	0.3c
Deadline MPs 4%	10.0 lb	0.2b	0.7b	0.1c

Means in a column followed by the same letter are not significantly different (LSD, P = 0.05).

Seedcorn Maggot

This soil pest continues to be a concern in situations where a green cover, such as a cover crop or an alfalfa stand, is incorporated into the soil prior to planting. Significant stand reductions have been observed in both corn and soybean. Of note, studies in the 1980s showed that seedcorn maggot populations are not significantly increased under no-till situations. The greatest increase in their numbers occurs when a green cover is incorporated.

The primary management tactic against seedcorn maggot is the use of a seed treatment. A study was conducted in soybean using Kernal Guard Supreme and Isotox, two seed treatments labeled for the crop, along with Agrox Premiere and Gaucho, neither of which are labeled (albeit they are labeled on corn). An alfalfa field was plowed on 2 May and disked on 3 and 8 May. Planting occurred on 9 May. Seedcorn maggot traps that were used to determine the relative size of the population averaged 136 adults per trap, considered a large number. All the seed treatments had better stands than the check, or non-treated areas (Table 3). However, Agrox Premiere and Gaucho, the materials not labeled for soybean, had the best stands. The treatments having the greatest plant stands also had the highest yields, although all seed treatments gave an improvement. It should be noted that the rate for Isotox, although the recommended rate for most soybean uses, is not the rate suggested for seedcorn maggot control on corn.

Table 3. Soybean plant stands and yield from seed treatment study against SCM

Treatment/ formulation	Rate oz/100 lb seed	Plants/ ft	Plants/ acre	Yield bu/acre
Agrox Premiere*	3.6	7.7a	134,369	48.4a
Gaucho*	2.0	6.4b	111,938	45.0a
Gaucho*	1.0	5.5bc	95,282	43.0bc
Isotox	2.0	5.2c	89,506	40.7c
Kernal Guard Supreme	3.0	4.9c	85,369	40.2c
Check	--	3.7d	65,115	35.8d
Check	--	3.7d	64,680	34.4d

Means in a column followed by the same letter are not significantly different (LSD, P = 0.05).
* not labeled on soybean

Twospotted Spider Mites on Soybeans

Numerous areas of Ohio, especially in the more northern counties, experienced significant drought conditions. Many fields received little rainfall during June and July. The result of this severe drought was the outbreak of the twospotted spider mite. As in many outbreak years where an early drought occurs, mite buildups began both on the edges and within the field. We continue to recommend two insecticide/miticides for mite control, Lorsban and dimethoate. These are the only two materials that will give a grower adequate control. While Warrior is labeled for suppression only, we believe that the former two materials are better choices.

Soybean Aphid

Soybean aphids became a significant problem in parts of Ohio in 2001. Very large populations were observed in the more northern areas of Ohio, especially in the counties surrounding Lake Erie. Many fields had populations of thousands of aphids per plant, with aphids being extremely heavy on the upper leafs and on the stems and petioles. It is not clear at this time why aphid populations were so heavy in these counties, falling off as you got farther away. By the time you got to central and southern Ohio, aphid numbers were quite low. However, aphids were found in all soybean growing counties in the state, and by the end of summer were probably in all soybean fields. We conducted a survey for the aphid in 2001, and Figure 1 illustrates the relative populations that were found. Why populations were heaviest in the north is unclear. Temperature differences is the most likely reason, although its ability to overwinter on buckthorn is another possibility.

We observed the overall population development of the aphids in Ohio throughout the summer. Aphids entered soybean fields in later spring/early summer, producing a number of unwinged generations (Figure 2). Significant population build up occurred during July. There were reports of plant yellowing associated with aphid infestations. However, this appeared to be limited, and is felt to be associated with potassium deficiency. Most aphid-infested fields remained green. Additionally, much of the aphid problem co-existed with the drought situation in northern Ohio. Thus, numerous fields in these areas had stunted plants. However, it is hard to determine whether smaller plants were a result of the aphids or lack of rain. It should be noted that soybean in most fields in these areas were smaller, whether they had aphids or not, and that corn fields under similar water stress also had shorter plants. Areas of the state with sufficient rainfall having significant aphid populations had normal size plants.

In early August, the aphid population went through a generation that produced winged forms, occurring because of crowded conditions. Based on observations in other states in 2000, these winged forms and their subsequent dispersal were anticipated. Many of the fields having large populations saw an immediate drop in population size. While still numerous, aphid numbers were only a fraction of what they had been.

During the remainder of the summer, aphid populations grew in some fields and leveled off in others. Sooty mold, which is a blackish mold, was observed in many fields on the lower leaves. This mold grows on the honeydew that aphids secrete and is another symptom of aphid infestations.

Currently, we have little information on the impact of the aphid and this sooty mold on soybean yield. Information coming this fall indicates that yields are indeed being reduced. In a number of strip trials conducted in Ohio and other Midwest states, yield losses ranging from 2 to

8 bu per acre are being reported. Little is known about the thresholds needed for treatment, a situation common to all states having the aphid. It is still too new of a pest to know exactly when or when not to treat. A question is whether aphid populations will build up next year and/or occur

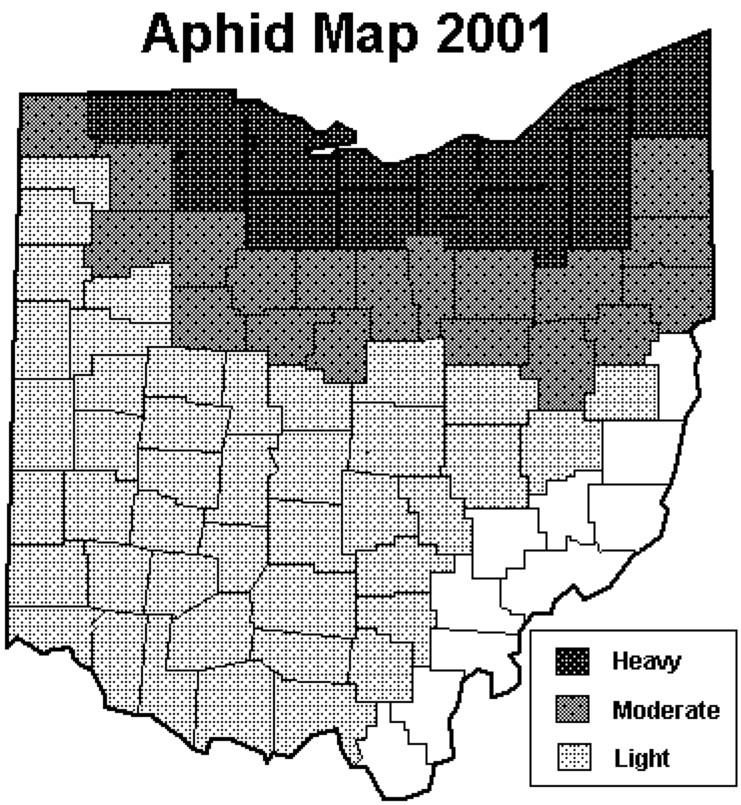

Figure 1. Relative presence of aphids in Ohio in 2001.

in different locations. Many Midwestern states that had large populations in 2000 did not have problems in 2001. Through discussion this winter, we hope to obtain more useful information for the 2002 growing season.

The potential for aphid problems necessitates keeping a close watch on what occurs during the coming year. We will be conducting insecticide trials, although our interest will also include when best to apply needed materials. Because of the dispersal that occurs in early August, we will need to know how early prior to that happening do we need to treat. Although we did not conduct insecticide trials in Ohio in 2001, information from states that had the problem in 2000 suggests many materials will adequately control the aphid. There are currently a few insecticide with the aphid on their label, including Furadan, Lorsban, and Warrior. We expect to see numerous additional materials labeled for the aphid in 2002. It is our thought that successful control will depend more on the application technique (spray volume and pressure, canopy penetration, timing, etc.) than the specific insecticide and the rates. Researchers also hope to determine whether beneficial insects can play an important role in aphid management. Aphid-infested soybean fields had large numbers of adult and larvae lady beetles, and their impact needs to be studied.

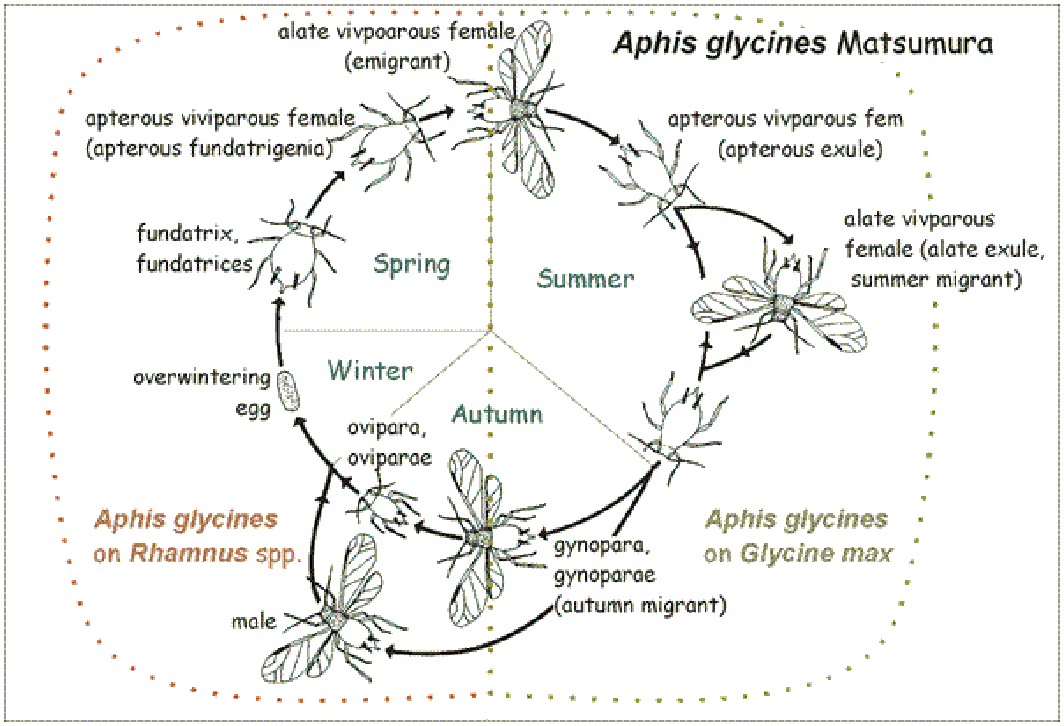

Figure 2. Life cycle of soybean aphid.

Mustang Labeled on Alfalfa & Corn

Mustang 1.5 EW, Zeta-cypermethrin, has received label for use on alfalfa and corn. Mustang is labeled on alfalfa for all of our common alfalfa insect problems including alfalfa weevil, potato leafhopper, meadow spittlebug and aphids. It has a 3 day waiting period before harvest on alfalfa. Mustang is also labeled on field corn for all of the common pests including cutworms, flea beetles, armyworms and others. Check the label for all of the pests labeled on field corn. Mustang is a Restricted Use Pesticide with a Warning on the label.

We have tested Mustang in our alfalfa trials for the past several years for both alfalfa weevil and potato leafhopper. The results from alfalfa weevil trials in 2000 with Mustang and other labeled compounds are shown in Table 4. The results from potato leafhopper trials with Mustang and other labeled compounds in 2000 are shown in Table 5.

Table 4. Evaluation of Foliar Insecticide Treatments for Alfalfa Weevil Control in Alfalfa, Western Branch Station, OARDC, 2000

Treatment	Rate (ounces/Acre)	AW Larvae/Stem (14 DAT)	Yield (Ton Dry Matter/Acre)
Baythroid 2E	1.6	0.50 a	1.96 a
Baythroid 2E	2.8	0.25 a	1.80 a
Furadan 4F	16	0.00 a	2.06 a
Mustang 1.5EW	3.2	0.50 a	1.87 a

Treatment	Rate (ounces/Acre)	AW Larvae/Stem (14 DAT)	Yield (Ton Dry Matter/Acre)
Pounce 3.2EC	6	2.00 b	1.80 a
Warrior T	2.56	0.00 a	1.94 a
Warrior T	3.84	0.00 a	1.99 a
Untreated Check		17.25 c	1.23 b

Means in a column followed by the same letter are not significantly different at P = 0.05
DAT = Days after treatment

Table 5. Evaluation of Foliar Insecticide Treatments for Potato Leafhopper Control in Alfalfa, Western Branch Station, OARDC, 2000

Treatment	Rate (ounces/Acre)	PLH/10 Sweeps (20 DAT)	Yield (Ton Dry Matter/Acre)
Baythroid 2E	1.0	5.75 a	1.46 ab
Mustang 1.5EW	3.2	8.50 a	1.39 ab
Pounce 3.2EC	6	11.25 a	1.57 a
Warrior T	1.92	11.25 a	1.58 a
Warrior T	2.56	8.75 a	1.49 a
Untreated Check		37.75 b	1.29 b

Means in a column followed by the same letter are not significantly different at P = 0.05
DAT = Days after treatment

Mustang performed as well as the other commonly used insecticides when it came to both alfalfa weevil and potato leafhopper control.

Potato Leafhopper Management on Alfalfa with Insecticides

Potato leafhopper (PLH) continues to be a problem on alfalfa most years. It migrates into Ohio from the south and is mainly a problem on 2nd and 3rd cuttings. Even though there are a number of PLH resistant alfalfas on the market, we continue to evaluate chemicals (registered & un-registered) for efficacy against PLH.

A trial was conducted at the OARDC Western Branch Station in 2001 to evaluate 6 insecticide products (Baythroid 2, F0570 0.8EW (not labeled to date), Lorsban 4E, Pounce 3.2EC, Warrior T (@ 2 rates) and XR-225 (not labeled to date)) applied as rescue treatments to second cutting alfalfa when PLH activity was 3 to 4 adults per sweep on 10 inch plants.

All treatments provided effective control of control of potato leafhoppers. Some yellowing however did occur in the Lorsban and Pounce plots 3 weeks after treatment. Average yield of treated alfalfa was 1.96 tons per acre. Average yield of untreated alfalfa was 1.53 tons per acre. Thus treating with an insecticide resulted in a yield difference of 0.43 tons per acre.

Potato Leafhopper Resistant Alfalfa

We continued to examine glandular-hair, potato leafhopper resistant alfalfa varieties and experimental lines obtained from seed companies in replicated plots throughout Ohio. Depending on the location, either adults, nymphs, or both are sampled using either pan sweeps or sweep nets. Table 6 presents representative data from 2 dates in the test at Wooster, OH, showing insect data collected in 5 sweeps. The susceptible varieties, 5454SC and WL324SC, always tend to have relatively large populations, while the experimental lines have the lowest. We will continue to monitor the relative resistance levels of these lines as they become available.

Table 6. Number of adult potato leafhoppers in 5 sweeps in variety trials at Wooster, OH, in 2001.

	Adult PLH/5 sweeps	
Variety/Line	17 July	23 July
5454SC	19.8a	32.5a
Ameriguard	12.8b	14.5b
WL324SC	11.3 b	30.5a
DK131HG	9.5bc	14.5b
TMF4355L	9.5bc	15.0b
Cimarron	8.5bcd	30.3a
4R37	8.3bcd	13.3bc
ZH9820H	8.0bcd	10.8bc
6310	7.8bcd	13.0bc
FQ302HR	7.8bcd	27.3a
LH4	7.0bcd	9.5bc
4M30	6.5bcd	11.0bc
4M16	4.8cd	5.3c
ZH9841H	4.8cd	14.0b
PLH40	4.5cd	10.8bc
ZH9840H	4.0cd	7.5bc
ZH9844H	3.0d	7.5bc
54H69	2.8d	10.3bc
4M32	2.8d	5.3c

Armyworm Problems in Wheat

The common armyworm (CAW) is a migrant that moves into Ohio in April and begins laying eggs on host plants including grasses, small grains, etc. In most years, CAW is only a problem on corn that has been no-tilled into a grass cover crop or into a field with perennial grasses such as orchardgrass and not a problem on wheat. In the case of corn, CAW moths lay eggs grasses that hatch into small worms that feed on the grass until it is killed by herbicides at which time they move over and feed on the corn. In 2001 CAW was an important pest on a large scale on wheat for the first time since the early 80's. This armyworm problem was reported throughout the Midwest and even extended to the eastern U.S. The moths laid eggs on the small wheat plants and the worms began feeding on the leaves.

Reported populations varied in wheat fields from 1 or 2 worms per row foot to 12 to 15 worms per foot of row. Defoliation by the worms ranged from only slight feeding damage to almost 100% of the leaf surface missing. There are a number of natural enemies (diseases, parasitic wasps, parasitic flies) that help keep CAW larva in check and may be the reason some fields did not have any problems from CAW.

Starter Fertilizer for Corn: Do You Need It?

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Application of fertilizer at planting (starter fertilizer) was a common practice through much of the 1950's and early 60's. However, in the 70's as farm size got larger and planters went from 4-row to 16-row or bigger, this practice nearly disappeared. In the 90's and now in the early part of the new century, there is a resurgence of interest in this practice.

This renewed interest in starter came about in large part with the observation that growth of no-till corn was often reduced in comparison to conventional tilled corn. Many questioned whether fertility management could overcome a part of that problem. As a result, two separate, but related experiments were conducted at four locations to evaluate the response of no-till corn to: 1) primary N applications of anhydrous ammonia preplant, UAN broadcast preplant, and ammonia sidedressed at V6; 2) factorial combinations of N, P, and K banded 2 inches below and 2 inches beside the seed (2x2); seed-placed fertilizers with various N, P, and K rates and sources; and 4)dribbling fertilizer on the soil surface near the seed furrow.

Results of those experiments showed the following:

1. Broadcast application of UAN was not consistently as effective as injected anhydrous ammonia, particularly on warmer soils receiving less than 1 inch of rainfall within five days after application (Table 1).

Table 1. Effect of primary N source on grain yield averaged over 3 years and 4 locations.

	Location				
Primary N Source	A	B	C	D	Average
	Yield, bu/acre				
Ammonia-Preplant	141	131	140	155	142
UAN-Preplant	141	128	124	139	133
Ammonia-Sidedress	138	123	132	156	137

2. Inclusion of both N and P (25-30-0) in a 2x2 starter increased early season plant growth and corn yield, even when initial soil P and K tests were high. About 2/3 of the increase could be attributed to N (Table 2).

Table 2. Effect of 2x2 banded starter fertilizer on grain yield averaged over 3 years and 4 locations.

Starter			Location				
N	P_20_5	K_20	A	B	C	D	Avg.
	lb/acre				Yield, bu/acre		
0	0	0	131	119	128	146	131
25	0	0	141	123	139	150	138
25	30	0	147	129	139	155	143
25	30	20	146	137	133	160	144

3. Seed placed fertilizers increased early growth and yield, but not as much as did banded starters. Liquid fertilizers with lower salt indices did not slow emergence (Table 3).

Table 3. Effect of fertilizer placement on yield.

Fertilizer placement	Yield, bu/acre
None	122
Seed placed	128
2X2 band	136

4. Dribbling fertilizers on the soil surface near the seed furrow resulted in higher average yields than with no starter, but yield increases were not as high or as consistent as the banded fertilizer (Table 4).

Table 4. Comparison between UAN dribble on surface over row and fertilizer placed 2 inches below and to the side of the seed.

	Location			
Fertilizer Placement	A	B	C	Avg.
	Yield, bu/acre			
None	130	122	120	124
2x2 band	150	138	131	140
UAN surface over row	137	129	126	131

After observing the consistent response to 2x2 banded starter fertilizer in no-till systems, we decided to evaluate the impact of starter under reduced tillage (chisel plow) systems that leave more residue than intensive tillage, but less residue than no-till. Experiments were conducted for 2 years at 5 locations to evaluate the impact of 1) starter (2x2 banded) fertilizer containing combinations of N, P, and K; 2) starter N placement; and 3) addition of S and Zn with the starter treatments.

Results of those studies showed the following:

1. Starter fertilizer consistently increased early growth of corn in the reduced tillage system, but grain yields were not consistently increased. Grain yields were increased in 2 of the 10 site years by 6 of 8 banded fertilizer treatments that contained N (Table 5).

Table 5. Effect of fertilizer placement on corn grain yield at 2 responding sites and the average for 8 non-responding sites.

				Location		
N	P_2O_5	K_2O	Placement	A	B	Avg. non-responding
	lb/acre				Yield, bu/acre	
0	0	0	2X2	145	164	162
12.5	0	0	2X2	153	164	166
25	0	0	2X2	163	181	165

N	P_2O_5	K_2O	Placement	Location A	Location B	Location Avg. non-responding
	lb/acre				Yield, bu/acre	
0	30	0	2X2	152	169	160
12.5	30	0	2X2	154	173	163
25	30	0	2X2	171	178	170
0	0	20	2X2	150	162	163
12.5	0	20	2X2	164	182	164
25	0	20	2X2	164	183	165
0	30	20	2X2	158	166	165
12.5	30	20	2X2	171	176	168
25	30	20	2X2	171	186	167
12.5	0	20	surface	151	168	159
25	0	20	surface	162	171	158
			Lsd_{10}	15	17	

2. When starter fertilizers containing N and P increased grain yields, adding S, Zn, or ACA did not further increase yields (Table 6), nor did these additives consistently increase plant weight.

Table 6. Effect of the addition of sulfur and zinc to starter fertilizers on corn grain yield.

2x2 Starter N	2x2 Starter P_2O_5	K_2O	Sulfur	Zinc	Yield
		lb/acre			bu/acre
0	0	0	0	0	161
25	30	0	0	0	168
25	30	0	10	0	167
25	30	0	0	.25	166
25	30	0	10	.25	166

Bottom line:

No-till corn frequently benefits from the use of a 2x2 starter that contains N and P. Most of the response comes from the N, but there is an additional benefit for including some P, even on high testing soils. Inclusion of K in the starter is not of benefit if the soil test is high and/or if a broadcast application of K has been used that year. Seed placed fertilizer provides a less consistent yield increase than does a 2x2 placement and depending on salt content and rate of application a much higher risk of seedling injury.

Reduced till corn seldom responded to starter fertilizer (2x2 placement) when soil test levels were at the optimum for P and K. Application of neither sulfur nor zinc provided a significant yield increase on reduced till corn.

THE YEAR-IN-REVIEW AND A PEEK TO THE FUTURE

Wesley Haun
Regional Agronomist, Agriliance

Crop production in 2001 was challenged by several adverse situations. Some areas of the state were more or less affected than others. Crop yield response varied from region to region with variations in weather conditions. The northwest area had 1.6 inches above normal rainfall and there was 4.28 inches below normal rainfall in the northeast.

Corn and soybean establishment problems were wide spread. Most areas of the state experienced almost ideal planting conditions in last two weeks of April. High percentage of both crops was planted in this time frame. Then the weather changed to cool and moist conditions for approximately 12-18 days. Soybeans that emerged these 2.5 weeks had significant amount of uneven emergence due to damping off and Pythium. Those fields planted with an appropriate fungicide protected seed responded with much more even emergence, increased vegetative growth, and greater yields.

Phosphorus (P) and zinc (Zn) deficiencies were very prominent in corn during and following these stressful growing conditions. Oftentimes, these deficiencies were the result of reduced root growth; therefore, the root system was not able to take-up sufficient P or Zn. Following the cool and moist days in mid-May, corn reflected other distress signals. Many farmers got the crop planted, but no herbicides were applied due to the wet conditions. Once the fields dried sufficiently, the planned pre-emerge herbicides were applied as post-emerge. Although, the corn had not exceeded the maximum height permitted on corresponding labels, the plants were more mature than exhibited by its vegetative growth. Therefore, several cornfields were damaged from these treatments.

Many inquires were received concerning yellow soybeans. There were several areas within fields that exhibited typical manganese (Mn) deficiency. Generally, this was a moisture driven situation where the soybean roots could not explore significant soil volume due to wet conditions and unable to take-up sufficient Mn.

Weather conditions contributed significantly to crop responses from several post-emerge herbicides. Many situations could have been minimized with sufficient tank cleaning when changing crops. Some compounds present greater potential than others for crop injury from contaminated tanks. Plant growth regulator and sulfonylurea herbicides are the most difficult to remove from spray tanks and they can result in greater crop response at very low dosage. As little as 0.0001 lb./acre of dicamba can cause injury to soybeans. There is a large selection of tank cleaning compounds available. The key factor is matching the appropriate tank-cleaning agent with the targeted compound to be removed. This critical information is located on the pesticide label.

A common discussion topic in soybean production this year was the soybean aphid. It was predominate across the northern half of the state. Since this was a new insect to Ohio and the Corn Belt, management decisions were difficult as no research data existed to support economic injury levels (EIL) and economic threshold (ET). Researchers in the industry and universities throughout the Midwest have been supporting each other in gathering and sharing information about the soybean aphid. This collaboration will contribute to more effective aphid management in the very near future.

Late season corn stalk strength deteriorated very rapidly with some hybrids. Several factors contributed to this situation:

- Wet soil conditions early in the growing season
- Lack of root development
- Nitrogen deficiency
- Nitrogen cannibalization in stalk
- European corn borer
- Stalk rot
- High winds in October
- Genetics

Each year is a learning opportunity that provides a gradual progression of knowledge accumulation called experience. Hopefully, we can apply that experience to advise our farmer customers in minimizing adverse effects from the factors that we have control which will reduce the impact from the factors which we have no control.

THE YEAR-IN-REVIEW
SOUTHERN OHIO

Harold Watters, CCA

To give the year end results of our labors is easy and enjoyable. Yields were excellent for both corn and soybeans for southern Ohio. We probably have not had soybean yields this good for 20 years, and this is the best corn crop in 10 or more years. How we got these yields does take some explaining, and I am not sure I know all the reasons.

Planting

Crop planting started early for Ohio, with some corn out of the ground by mid April. We were nearly finished planting corn by May 1, and everyone knows that early planted corn yields well. Soybean planting was also early, with a majority in the ground and up before the 15th of May. Those last few beans planted just before the 15th had to be replanted.

The rain and the cold

From mid May to mid June nothing was accomplished except for watching the rain, and you had to wear a coat while doing it. For some folks, corn that was 12 inches plus tall seemed to go backwards. Soybeans "sat" for a month and did not add any new leaves. During this period we lost nitrogen and also the latest planted soybeans. No root system developed, there was little need. Slugs ate some soybeans. Slowly developing canopies allowed weeds to develop.

The hot and the dry

It seems that we next went from one extreme to the other. By the 10th of June we started to dry out, but then we went another month with little or no rain. Temperatures were above 90 for days, and we had some corn roll due to the lack of an adequate root system to take up moisture. In southeast Ohio this hot, dry period lasted through July and into August.

Normal or better

July and August for most of us was near perfect; we had good rains, temperatures actually were mild, and we made great yields. A lot of the ills that we saw in the wet May-June period disappeared. Corn evened up, soybeans grew tall and were green again. This period may have covered up most of the ills, but there were still some gremlins in our corn fields.

Soybean aphids did make an appearance in southern Ohio, but yields seemed unaffected. SCN appeared not to affect us, but soybean acres were up some so surely we increased SCN populations. And PRR, which always has a great affect on Ohio soybeans, was minor except in replant fields. The dry planting period in late April and early May helped the soybean crop establish a healthy root system, that got us through.

Some of the nitrogen losses in May and June started showing up as fired corn, and also had an effect on stalk quality. Anthracnose, diplodia, giberella, GLS even NCLB started showing up in corn. It seems that the leaf diseases didn't reduce yield much, but they took their toll on the stalks.

Harvest

As we approached harvest, those thoughts of yield helping rains turned to thoughts of "when will it stop so I can harvest?". Soybean harvest was slow due to frequent rains and at one point we were more than two weeks behind normal. And a slow soybean harvest delayed corn harvest.

A delayed harvest was the last thing corn stalks needed. Already weak, due to a poor root system, disease and nutrient deficiencies and high yields, corn started falling down. What should have been remembered as one of the best years on the farm will be remembered as a year of lodged corn.

A Peek at Next Year

Stay the course, do what we know from history works well in Ohio. Don't change practices based on 2001. Do become a better manager and this includes scouting, especially when disaster is always just around the corner.

STRIP-TILL OPTIONS TO IMPROVE CORN MANAGEMENT

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Fall strip tillage can be considered as an alternative to intensive tillage systems when farmers are reluctant to initiate or continue with a "pure" no-till system. Only 21% of Indiana's corn acreage was no-till planted in 2000 despite the fact that 60% of the soybean acreage was no-till planted (Clean Water Indiana Survey). Thus farmers are most likely to use full-width tillage systems for corn after no-till soybeans in rotation; this practice will not leave sufficient residue cover for erosion protection during the corn year. Although strip tillage has been one of the fastest growing tillage systems in the last 3 years, its precise usage is difficult to quantify since drive-by surveys after corn planting can't visually distinguish between pure no-till and fall strip tillage.

System Description

Fall strip tillage is an in-row soil loosening system where the interrow areas are undisturbed and retain residue cover. Row crops like corn can be planted into the loosened areas in spring (often without a specifically designed no-till planter). Ideally, the fall zone-tilled strips will leave a mound (berm) approximately 3" to 4" high in the fall that, with overwinter events, may subside to just 1" to 2" high in spring. A wide assortment of strip tillage implements have been designed; they range from just coulters alone, to shanks plus berming disks, and to combinations of the above with the addition of residue clearing devices. The tools have had an operating depth range of 4" to 18", and the shanks (where present) have resembled modified anhydrous knives or (in some cases) deep ripping-type shanks. The most common implements employ a mole knife operating to a depth of about 8-9 inches, but there is no universal acceptance on what the ideal implement configuration and operation is for the range of soil and residue conditions farmers encounter.

Soil Benefits

The raised berm, plus the loosening and residue disturbance, associated with fall strip tillage improves soil drying rate and warming in spring compared to regular no-till rows. Research experience in Indiana thus far indicates that the improved soil conditions with fall strip tillage may allow for 2 to 3 days earlier planting in comparison to no-till. After planting, the main advantages associated with strip tillage relative to no-till, included warmer soil temperatures (2" depth) and looser soil (i.e. less resistance to seedling root extension) from near the surface to the depth of loosening achieved in fall. The potential benefits of soil temperature gains with strip tillage in the period after planting will be more evident in cool and dry springs than in warm and wet springs.

Corn Benefits

Fall strip tillage resulted in corn emergence about 1 to 2 days earlier than no-till, earlier silk emergence, and drier grain at harvest than no-till in results of experiments conducted to date (when the planting date was the same for all tillage systems). Corn doesn't always develop significantly faster with strip tillage, nor will it have a consistent yield gain relative to no-till. However, in the majority of experiments conducted with fall strip tillage in the northern Corn Belt, corn yields with fall strip tillage have been similar to those with conventional tillage (whether based on chisel plowing or moldboard plowing). Corn yield gains with fall strip tillage over no-till are most likely to occur when no-till yields are significantly lower than conventional-till yields. Potential advantages of fall strip-tillage relative to no-till may be more apparent when (a) farmers can take advantage of a 2 to 3 day earlier planting date, and (b) there are more early season stresses to corn after planting.

Fertilizer Placement

Strip tillage systems afford a unique opportunity for deep banding of nutrients in the intended row zone. Deep banding of relatively immobile nutrients like P and K may be a particular advantage with medium testing soils, and where there is significant stratification of these nutrients as well as the potential for dry soil conditions in June and July (where fewer shallow roots may impede P and K uptake). In addition, the additional cost of strip-till, relative to no-till, is easier to justify when farmers complete both nutrient application and row-zone tillage in the same pass. Numerous custom fertilizer applicators are already offering their customers a combination service in the fall. However, farmers should be careful to avoid N losses when the nutrient application package also includes anhydrous ammonia. The customary management principles of monitoring soil temperatures, adding nitrification inhibitors and fertilizing for realistic yield goals are all essential to practice in those soils and areas of Indiana where fall N application is a reasonable option. In addition, the banding of P and K in the row zone may accentuate (relative to broadcast fertilization) the horizontal stratification of K that takes place when soil exchangeable K concentrations increase in corn row areas. Subsequent no-till, narrow-row soybeans after fall strip tillage may require careful attention to K fertilization to obtain optimum yields and seed quality. Research on optimum fertilizer placement strategies with strip tillage is currently underway in several states.

Future of Strip Tillage

As more strip tillage tools become available, new questions will be raised about the merits of (a) alternate depths of in-row loosening, (b) alternate shank and disk (or coulter) designs, (c) nutrient banding strategies, and (d) cost effectiveness of strip tillage operations within the context of expanding farm size, low commodity prices, and higher tractor HP requirements than in the no-till system. Still, the fall strip tillage system should see major expansions in the corn acreage that is presently in a rotational tillage or even continuous no-till system. Furthermore, researchers at Purdue University hope to work with both farm and manufacturing communities to improve the viability of this option on erosion-prone soils.

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