

The Crop Profit Game

*An interactive satellite connection
to Ohio's farmers*

2004 Proceedings

Sponsored by:
Ohio State University Extension
Ohio Soybean Council
Ohio Corn Growers

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The Competitive Position of Ohio's Crop Industry

Topics:

Which America will produce soybeans?

Will Ohio compete?

Will crop rotations change?

Are your neighbor's production costs like yours?

Who will position themselves best for future market share?

Which America will Produce Soybeans?

2001 CORN Yields

USA 138 Bu.

S. Amer. 57 Bu.

2001 SOYBEANS

USA 39 Bu.

S. Amer. 39 Bu.

USDA 1998 Bean Costs per Bu.

	U.S.	Brazil	Argentina
Non-Land Costs	\$3.20	\$3.75	\$2.69
Transportation	<u>\$0.81</u>	<u>\$1.91</u>	<u>\$1.30</u>
Sub Total	\$4.01	\$5.66	\$3.99
Land Cost	<u>\$1.91</u>	<u>\$0.14</u>	<u>\$1.24</u>
Total	\$5.92	\$5.80	\$5.23

Misleading Conclusions about Competitiveness

Higher land rent or price often an *effect* of higher "competitiveness" as opposed to *causing* lower competitiveness.

Land value based upon expected returns- whether from grain market, government or investment returns

Brazil may or may not have an absolute advantage in soybeans...

But, opportunity costs lead to a comparative advantage for soybeans in Brazil and for corn in the U.S.

Long Run Production Implications

Continued soybean production in the U.S.

But, with increased incentive for **2 or 3 year continuous corn**—A relative shift away from soybeans toward corn

Competitive Corn Production-1999

W. Ohio		SW MN	
Yield	141 Bu.	Yield	155 Bu.
Value/Bu.	\$ 1.90	Value/Bu.	\$ 1.75
Seed	\$ 30.83	Seed	\$ 35.39
Fertilizer	\$ 54.20	Fertilizer	\$ 36.20
Chemical	\$ 27.41	Chemicals	\$ 25.32
Rent	\$ 91.44	Rent	\$ 88.81
Direct Exp.	\$ 1.73	Direct Exp/Bu	\$ 1.53
Total Exp.	\$ 2.04	Total Exp/Bu	\$ 1.90
Net/Ac.w/Govt.	\$ 45.64	Net/Ac. w/Govt.	\$ 18.41

Cost of Production for Corn & Soybeans-Is There Still a Difference?

23 Western Ohio Farms 2001

	Average	*Range
Return on assets	4%	0.5 to 7.4%
Return on equity	2.1%	-1.6 to 6.8%

*Range between 30th and 80th percentiles for farms
With a median gross cash farm income of \$237,923.

Conclusions

Ohio remains competitive for grain production

Precision farming is incomplete without the application of the same precision to farm financial records

Benchmarks should be known and comparisons made with top producers

Executive farm managers spend more time in analysis, not only at the end of the year

Lowest cost producers will prevail.....

The 2003 Growing Season, A Review

Dr. Jim Beuerlein
Department of Horticulture & Crop Science
The Ohio State University

The 2003 growing season was anything but normal for most producers. In spite of all the problems, we had an all-time record corn crop of 156 bushels per acre, an average to poor soybean crop with 40 bushels per acre, and our third best wheat crop ever, which was 66 bushels per acre. The growing season can be described as cool and wet, which is not at all what we envision as a good growing season. Figure 1 shows the average temperature for each month relative to the normal or long-term average temperatures. Figure 2 tells the rainfall story which ended up being too much of a good thing for most producers. The warm April temperatures and dry soil allowed us to plant 80 percent of the corn crop and 40 percent of the bean crop before May 5 for the first time ever. April was also very good to the wheat crop, which was more developed than normal by the end of April. Although we got off to great start in April, the rest of the season was one problem after another.

Figure 1: Average Daily Temperature for April – October, 2003

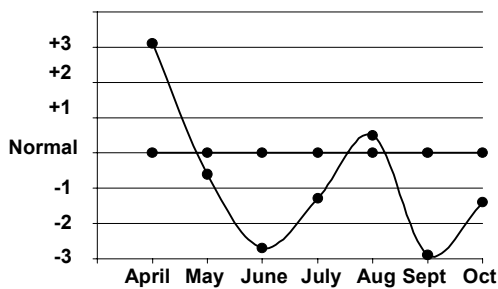
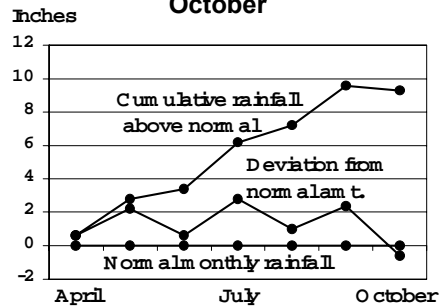


Figure 2: 2003 Rainfall, April – October



As seen in Figures 3 and 4, corn and soybean planters got an unwanted 3-week vacation due to rainfall starting around May 5. We finally planted about a half million acres of corn in late May and the first few days of June, and then quit for the year. It took all of June and a few days in July to finish planting our almost 5 million acre soybean crop. Corn and wheat seemed to enjoy the cool, wet weather of May and June, while beans were fighting root rot disease and trying to survive. Near the end of June we had a great wheat crop in the field although it was a week late due to the cool, wet, and cloudy weather. Just as we started harvest there were another two weeks of rainy weather (Figure 5) that lowered both grain quality and test weight and turned a near record crop into an average crop.

Figure 3: Progress of 2003 Corn Crop

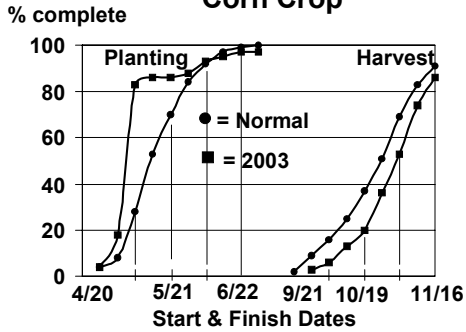


Figure 4: Progress of 2003 Soybean Crop

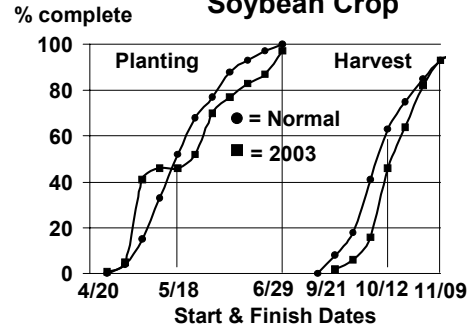
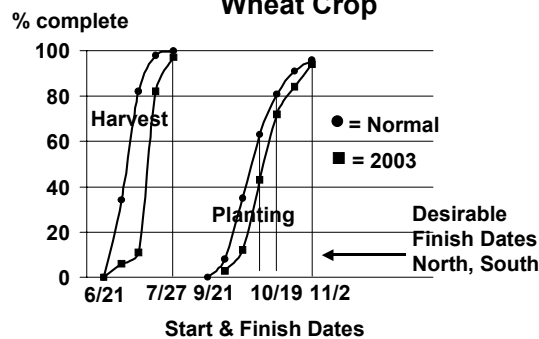


Figure 5: Progress of 2003 Wheat Crop



The cold September delayed both corn and soybean harvest about 10 days, which in turn delayed the planting of the 2004 wheat crop. Most corn and bean fields were harvested by the end of November. The weather for October and November was good for the late planted wheat crop, which entered December in good condition except for west central Ohio where lots of fields had to be planted in wetter than desirable conditions. Most wheat fields will be OK until next March, which is almost always the most stressful period for wheat.

Most producers are really glad to be finished with the 2003 growing season and hope 2004 will be less stressful and allow us to produce record yields of all three crops.

Soybean Insects

Ronald B. Hammond

Professor

OARDC

Soybean Aphids

Most of the concern, effort, and insecticide spraying in soybeans were directed towards soybean aphids, which were a significant problem in parts of Ohio in 2003. Aphids began showing up in late June, when we found fields with relatively large populations of aphids for that time of year. Following this, in July and August, aphids began being found in numbers exceeding threshold, throughout much of northern Ohio. In some fields, aphid populations exceeded 1000-2000 aphids per plant by late August. Insecticide treatments were applied in many counties to thousands of acres. Most reports from last summer suggested yield savings between 5 -15 bushel. At a price of \$7.50 per bushel, this is a savings of between \$37 and \$112 per acre.

We continue to use the following management guidelines and thresholds. Sampling should begin no later than R1 to early R2, or the flowering stages of soybean growth. Growers or scouts should sample 4-5 plants from 30 locations in the field and count the number of aphids on each plant. At this time, most aphids should be found on the upper 1-2 leaves of the plant. However, growers should also check a few whole plants to make sure they are locating most of the aphids. A count of 250-300 aphids per plant across the field suggests that soybean aphids are common and abundant, that there is an increasing population, and that treatment should be considered. Usually at this density, aphids will also be found on some of the stems and petioles.

Timing of the insecticide application continues to be very important. Prior to flowering is too early to apply an insecticide. Other states have seen a rebound in aphid densities if an insecticide is applied this early because of the reproductive capabilities of the remaining aphids. However, detecting an early infestation at this time will alert growers to potential problems. Most applications should occur in July during flowering or immediately thereafter. However, observations suggest that sprays done in early to mid August will be beneficial when aphid populations reach levels 500 to 1000 per plant.

We continue to recommend that care be taken during flowering if bees are actively working a soybean field. Although bees are not usually associated with soybeans, problems could occur if hives are nearby. Soybean growers must notify nearby, registered, apiaries before spraying. Names and addresses of registered apiaries are available at the Ohio Department of Agriculture.

Although we initially thought that ground equipment would be the best option for control, observations have indicated that aerial application is doing an excellent job. A specific concern in narrow-row soybeans is driving down rows after the plant canopy has closed. Growers in areas of the state that experienced large aphid populations who use narrow rows might consider the use of skip-row systems. Studies have shown that the yield loss in skip-row systems is minimal compared to driving over rows.

Currently, there are numerous insecticides labeled for aphid control, including Warrior, Asana, Mustang Max, Lorsban, Furadan, and Penncap M. This past summer, a study was

conducted with some of these insecticides with treatments being applied at the R2 growth stage. Only Lorsban and Furadan gave what would be considered long-term control in terms of keeping aphid populations low. The pyrethroids such as Asana, Warrior, Mustang Max, and Baythroid, did not achieve the same level of reduction. However, ALL insecticides prevented significant yield reductions. While the yield in the check plots were 29.0 bushel, all treated plots were 32 bushel or higher. Comparing the untreated plot with the highest yield, there was a 7 bushel difference. At a soybean price of \$7.50, this would have been a loss of over \$50 per acre.

It remains to be seen if soybean aphids are again a problem in 2004. We will need to keep a close watch on the situation next summer.

Bean Leaf Beetle

Although the bean leaf beetle has caused problems to Ohio soybean growers since the 1980s, we have recently seen an increase in their populations. Knowing that numbers were larger than expected in the fall of 2002, we expected more bean leaf beetles in 2003, and indeed, we did. This was especially true in northwest Ohio. As expected, highest populations were evident in the earliest planted fields. Cool and wet weather during the second half of the summer, however, delayed and possibly reduced the emergence of the second generation population, and thus, a large second generation was not reported.

The bean leaf beetle has recently been receiving extra attention from growers who grow food grade soybeans and soybeans for seed. The concern is from the insect's ability to vector bean pod mottle virus. Infection with this virus, while causing yield reductions outright, also results in plants showing green stem syndrome and mottled seed. Green stem syndrome is characterized either by plants having stems that remain green while the pods mature normally, or by plants that remain totally green, retaining their green leaves, and having small and misshapen pods. The presence of these green-stemmed syndrome plants also makes harvesting more difficult because the combine often has problems cutting the plants and processing them through the machinery. The other major concern from bean pod mottle virus is seed coat mottling. Mottling of the seed is a quality issue, and can result in soybeans being marked down in price or even refused by buyers of food grade soybeans. Mottled seed is also a problem in the seed industry that demands clean and unblemished seed.

The only management tactic currently available is against the vector of the virus, the bean leaf beetle. Transmission of the virus can occur during two time periods. The first is during the soybean seedling stage by adult beetles that have over-wintered, while the second time period is in July by adult beetles of the first generation. Bean leaf beetle management begins by planting the crop late, because the over-wintered beetles will go to the earliest planted soybean fields. Late planting can often reduce the number of beetles that occur in the field. The other tactic, currently being recommended by a few states to our west and being researched in Ohio, is to control those two groups of beetles with a longer residual pyrethroids insecticide. First, an insecticide should be sprayed on the emerging soybeans after plants emerge and before they reach the V2 growth stage. Then, growers should treat a second time in July, when first generation beetles begin to appear, to control that generation. We hope to know in a few years if this management approach proves effective in reducing the overall incidence of bean pod mottle virus. It is unclear at this time if the potential for large bean leaf beetle populations is high next summer, but the situation warrants close observations.

For both the soybean aphid and the bean leaf beetle, as well as for other insects on soybeans and other crops, we recommend keeping abreast of the situation during each and every summer through the CORN newsletter.

Corn is King in 2003

The 2003 Growing Season in Review

*Dr. Peter Thomison
Extension Specialist
The Ohio State University*

One of the biggest (and most pleasant) surprises of the 2003 growing season were the record high corn yields produced in many parts of Ohio. In the November crop report, USDA estimated that Ohio corn yields will average 156 Bu/A in 2003, more than 6% greater than the previous record high of 147 Bu/A in 2000, and 77% greater than last year's dismal average yield of 88 Bu/A.

How did we obtain such high corn yields? At first glance, one might not think the weather conditions were entirely favorable for corn growth. While weather conditions, especially rainfall, varied considerably across Ohio, the 2003 growing season was characterized by cooler and much wetter than normal weather. During the 27-week period from early April to early October, in much of the state, temperatures averaged below normal in 17 weeks and rainfall was above normal in 15 weeks.

The following are some of the factors that influenced corn yields in 2003. Not surprisingly, many of these involve weather in some way.

1. **Timely planting:** 83 percent of the corn crop was planted by May 4. This was 34 days ahead of 2002 and 20 days ahead of the five-year average. Past OSU research indicates that planting in late April through early May usually results in the highest yields.
2. **Good seedbed conditions:** In the 2 to 3 weeks preceding planting, rainfall was near normal to below average; temps were generally warmer than normal. Dry soil conditions allowed timely field operations and minimized soil compaction.
3. **Favorable conditions for emergence and early growth:** Soil conditions for most plantings in April were excellent and promoted uniform emergence and good stands. Moderate temperatures and rainfall were favorable for growth until early May. According to USDA estimates, by May 18, 72% of corn plants had emerged. This was 24 days ahead of 2002 and 10 days ahead of the five-year average.

Some growers experienced problems with emergence in corn planted at the end of April and early May because excessive rainfall in mid May resulted in saturated soil conditions, which, along with cooler temperatures, inhibited seedling development and early growth. Such conditions were conducive for seedling diseases caused primarily by Pythium and Fusarium fungi, which led to stand loss and replanting in some cases. In localized areas of the state, ponding and flooding also killed or stunted corn, especially in poorly drained fields. However, cool soil temperatures prolonged corn survival in many fields subjected to flooding.

4. **Crop growth was not limited by a lack of soil moisture.** Rainfall was persistent throughout the growing season. Instead of turning hot and dry in June, as the weather often

has in recent years following a cool, wet May, soil moisture was adequate throughout the season because of frequent rains. Above normal rainfall was especially important during grain filling (the period from silking to physiological maturity or black layer formation).

5. **Cooler than average temperatures minimized stress.** During most of growing season, temperatures were below normal. Cool night temperatures reduced respiration losses during grain filling. Night temperatures in the 70s and 80s result in wasteful respiration and a lower amount of dry matter accumulation in the plant. In parts of the state where rainfall was spotty in late June/early July, moderate temperatures minimized moisture stress. Cooler than normal temperatures also reduced soil nitrogen losses that can occur under warm, saturated soil conditions through denitrification.
6. **No major harvest delays:** Most corn hybrids planted in April and May achieved maturity with fewer GDDs than are specified by the seed company maturity ratings. This helped minimize yields losses to an earlier than normal frost Oct. 2 and 3. Although crop maturation was slower than normal, grain moisture at harvest was lower than many growers expected. Stalk lodging was negligible for the most part and did not cause major harvest delays.
7. **No major disease or insect problems:** Although rains were persistent through the growing season, conditions favorable for disease - extended periods of high humidity and warm temperatures - were generally absent. Disease problems, including northern corn leaf blight, started showing up in some fields in late August and early September. Significant disease injury was limited to especially susceptible hybrids. European corn borer injury was also observed, but serious damage was not widespread.
8. **Good management practices:** The contribution of growers to the high yields of 2003 cannot be overlooked. The use of more effective and improved management practices involving nitrogen management, hybrid selection, crop establishment, and pest control also helped increase yields. Although the benefits of some of these cultural practices appeared to be limited last year, such practices set the stage for high yield potential under the favorable growing conditions of 2003.

2003 Update on Corn Insect Activity

*Bruce Easley
Research Associate
Ohio State University*

Status of First Year Corn Rootworm in Ohio

Personnel from Ohio State University Extension sampled for western corn rootworm adults (WCRA) in soybean fields for the sixth year in a row. The sampling was done using Pherocon[®] AM yellow sticky traps placed in more than 90 fields in 22 counties. Six traps were placed in the soybeans on metal posts at canopy height and located at least 100 feet from the field edge and evenly spaced in the field. The traps were placed in the field at the end of July and changed weekly for six weeks until the early part of September. Each week the old traps were removed from the posts, the WCRA were counted and recorded and new traps placed on the posts. After each trapping week, the number of beetles collected were summed and divided by the number of days the traps were in the field resulting in the average number of beetles collected per trap per day. Research indicates that catches in soybean of 5 or more beetles/trap/day **during any trapping week** indicates a potential problem with rootworm in the field the following year.

Based on the potential treatment level of 5 beetles/trap/day during any trapping week, the trapping data from 2003 had the following results:

One field had an average > 3 beetles/trap/day, 3 fields had an average > 2 beetles/trap/day, 26 fields had an average > 1 beetle/trap/day and 61 fields had an average catch of less than 1 beetle/trap/day. None of the fields went over the threshold of 5 beetles/trap/day.

Based on these data, if any of these fields are planted to corn in 2004, a treatment (either insecticide or plant resistance) should not be needed for rootworm. These data do not mean that other fields in a county, that were not sampled, do not need treatment but it does give good information about the fields that were sampled and about the abundance of the beetles this year.

In addition to sampling with the sticky traps, OSU Entomologists sampled soybeans in 8 counties along the Ohio-Indiana border for WCRA the first week of August. Twenty sweeps in 5 places in 3 fields per county were taken and contents of the nets bagged and later counted in the lab. Sweep net samples do not tell us if a field has a high enough WCRA population to warrant treatment the next year, but they do tell us the relative abundance of the beetle population. The number of WCRA per 100 sweeps ranged from 0 to 25. This is the first year that we have swept for beetles so we cannot compare data from this year with prior years data but if we compare these sweep counts with data from Indiana and Illinois where they may sweep several hundred beetles in some of their problem counties, it does indicate how low our beetle populations were in soybeans this year.

A full report of the sticky trap sampling and sweep net sampling is available on the WEB at: <http://ipm.osu.edu/fycr/fycr.htm>.

Seed Treatment in Corn

There has been a lot of interest this past summer about the new seed treatment insecticides Cruiser and Poncho. Cruiser (thiamethoxam) was labeled on corn last fall and

Poncho (clothianidin) was labeled this past spring. The crops and insects they are labeled on depend on the amount of material applied to the seed. The crops and insects for the various seed treatments and rates are as follows:

1 – Cruiser 5FS @ low rate (0.125 to 0.8 mg ai/seed) is labeled on field, sweet, pop and seed corn and the insects chinch bug, cutworms (suppression), flea beetles, seedcorn maggot, southern corn leaf beetle, white grubs and wireworms.

2 – Cruiser 5FS @ high rate (1.25 mg ai/seed) is labeled on field corn only and in addition to the above insects also has billbugs, corn rootworms (light to moderate infestations) on the label.

3 – Poncho 250 @ low rate (0.25 mg ai/seed) is labeled on field, sweet and pop corn and the insects chinch bug, corn flea beetle, corn leaf aphid, cutworm (black), grape colaspis, seedcorn maggot, southern corn leaf beetle, southern green stink bug, white grubs (including European chafer larvae, May/June beetle larvae, Japanese beetle larvae), thrips and wireworms.

4 – Poncho 1250 @ high rate (1.25 mg ai/seed) is labeled on field, sweet and pop corn and in addition to the insects listed above also has corn rootworms (northern, western, southern and Mexican) and southern corn billbug on the label.

The question that is being asked at this time is whether or not the seed applied insecticides are needed and how well they will perform against some of the insects. We do not have information about how these seed treatments perform against many of these insects nor do we have some of these insects in Ohio. However, several trials were performed this past summer to evaluate the seed treatments against a couple of pests and to determine where, when and if the seed applied insecticides are needed.

Two trials were conducted to evaluate Cruiser and Poncho against seedcorn maggot (SCM). The plot area was in alfalfa, disked the latter part of April and left to lay for 2 weeks so that SCM adults would lay their eggs. In one trial, seed treated with 3 rates of Cruiser (0.125, 0.25 and 0.50 mg ai/seed) and a single rate of Gaucho was planted into the alfalfa plot area. The Cruiser treated seed resulted in significantly better stand and yield than the untreated check. The second SCM trial evaluated Poncho 250, the hopper box seed treatment Agrox Premiere, Gaucho and the granular soil insecticide Aztec 2.1G. All of the insecticide treatments resulted in significantly better stands and yield than the untreated check.

Another trial was conducted to determine whether corn planted at various times during the spring would benefit from the use of seed applied insecticides. The area, in soybeans in 2002, was sprayed with herbicides in the fall of 2002 to kill any winter annuals and did not have any known insect problems. Plantings were made on April 24, April 30 and May 22. The April 24 planting had the treatments of Cruiser @ 0.25 mg ai/seed, Gaucho @ 0.16 mg ai/seed and Poncho 250 @ 0.25 mg ai/seed. The April 30 and May 22 plantings contained Cruiser, Gaucho, Poncho and the hopper seed treatment Agrox Premiere. There were no significant differences in stand or yields with any of the treatments. Thus in this case there wasn't any benefit from using a seed treatment even though some of the plantings were made early in the season.

Two trials were established to evaluate Cruiser, Poncho and other insecticides and YieldGard Rootworm hybrids against corn rootworm larvae. Cruiser was applied at 1.25 mg ai/seed and Poncho was applied at 1.25 mg ai/seed. The corn rootworm populations were low in these 2 trials (2.8 and 2.6 root rating on a 1-6 scale in the untreated, 3 is considered economic) and all of the treatments had significantly lower root ratings than the untreated. However, there were no significant differences in yield between the treatments and the untreated. The seed treatments have done a good job in our trials against rootworm but the pressure has been low to

moderate. However other states indicate that the seed treatments may not hold up under heavy rootworm pressure.

Two trials were planted side by side into an area that had been in wheat in 2002 at the Northwestern Branch of OARDC near Hoytville, Ohio. Two different hybrids were planted in this trial. The treatments included Gaucho, Cruiser @ 0.25 mg ai/seed, Poncho 250, and Poncho 1250. Although there were no differences in stand in the two trials the Poncho 1250 had a significantly higher yield in one of the trials.

The bottom line is that we need to determine where the new seed applied insecticides fit into a farming operation. Each field needs to be looked at individually and a treatment regiment decided for that field. If a field has benefited with the use of a seed treatment in the past, then one should probably be used now. However, if a seed treatment has not been used in the past, a grower should ask is there a need to use them now? We do know that a field with a history of insects such as wireworms or fields that may have seedcorn maggot problems, will benefit from a seed treatment. Additionally, Cruiser and Poncho could also be used to control rootworm in Ohio because our rootworm pressure tends to be normally low to moderate even under long-term continuous corn. However, there are still a lot of questions about where and when to use these new seed treatment insecticides, and hopefully we will be able to answer these questions in the future.

Information from the above trials can be found on the WEB at:
<http://entomology.osu.edu/ag/reports.htm>

Managing Leaf Diseases of Wheat in Ohio: Recommendations for Foliar Fungicide Applications

Dr. Pat Lipps

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Dennis Mills

Department of Plant Pathology, The Ohio State University Extension

Foliar diseases significantly reduce yields of wheat in years when weather conditions favor their occurrence and spread. When diseases occur early in the season on susceptible varieties, yield losses can be as high as 25-30%. Powdery mildew and Stagonospora leaf blotch have about the same potential for yield loss, whereas leaf rust can limit yield to a greater extent at similar levels of leaf damage.

Predicted percentage yield loss to powdery mildew based on varietal susceptibility and disease level.

Varietal reaction	-----Detectable disease (1%) at head emergence-*-----		
	Flag leaf**	Leaf two	Leaf three
Susceptible	25%***	16%	6%
Mod. Susceptible	16%	10%	4%
Mod. Resistant	8%	5%	2%
Resistant	—	—	--

*1% disease = 2-3 powdery mildew lesions/leaf

**Flag leaf is the top leaf, leaf two is leaf below flag and leaf three is below leaf two

***Percentage of yield loss based on 6 varieties over 3 years.

Disease control strategies have been based primarily on use of resistant varieties, proper crop rotation and planting dates. In recent years, some producers have used higher seeding rates, earlier planting and higher rates of nitrogen, in an attempt to increase yields. Each of these factors has increased the amount of disease in wheat fields. Research has shown that early planting (prior to the Hessian Fly Safe Date) and higher seeding rates have not increased yields. Spring nitrogen application, at the recommended rates, has significantly improved the yield of wheat on a statewide basis. Additionally, many of the newer, higher yielding varieties are susceptible to one or more of the diseases present in Ohio. There are highly effective fungicides available for use on wheat, but the economics of wheat production has been the limiting factor affecting their use in recent years.

The most important factors affecting the use of fungicides on wheat are:

- 1) Varietal susceptibility
- 2) Level of disease in the field
- 3) Weather conditions and potential for disease spread
- 4) Yield potential of the field
- 5) The market price of wheat

Foliar fungicides are not recommended for all wheat fields. Fields with yield potentials less than 60 bu/A should not be considered for fungicide applications unless the producer knows that yield potential has been limited to this level by disease, rather than agronomic factors. In cases where good stands of wheat with high yield potential have received a well-timed application of fungicide, yield increases have ranged from 10 to 30%.

The level of disease in fields varies with weather conditions. Powdery mildew is important in mild seasons with high relative humidity. Stagonospora leaf blotch is common in years with 2 to 3 days of rain each week during May. Thus, the diseases that are important in fields this year may not be present next year. Monitoring fields for diseases and following weather reports in May and early June will help determine the need for fungicide applications.

Specific information on important diseases and overall disease control strategies can be obtained at Ohio State University Extension offices or on the Ohio Field Crop Disease web site at <http://www.oardc.ohio-state.edu/ohiofieldcropdisease>.

Steps for effective use of foliar fungicides to control diseases on wheat.

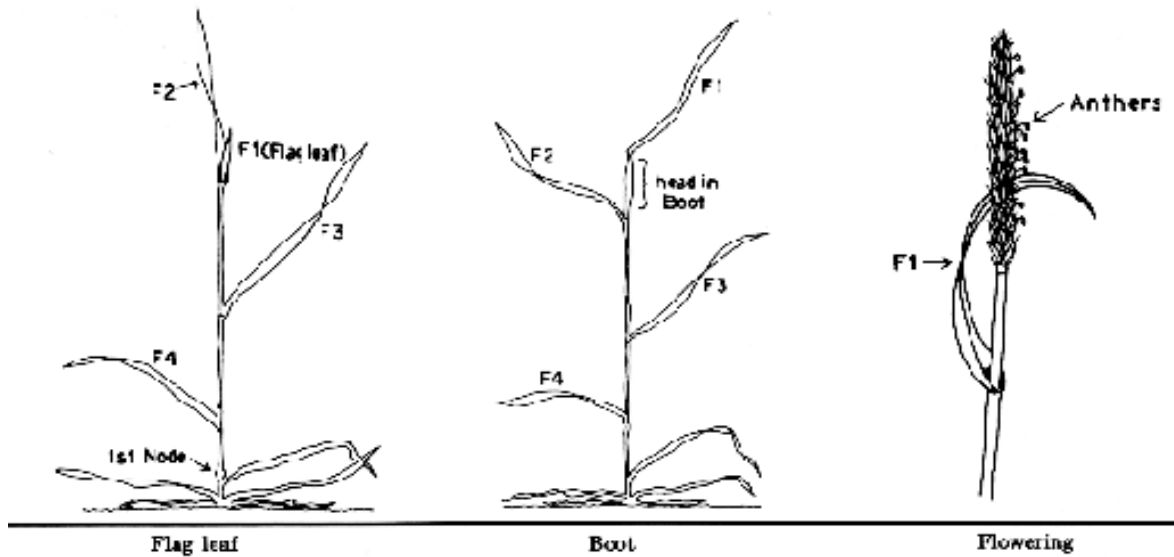
1) Target susceptible varieties: Fields planted to susceptible varieties are to be targeted for disease scouting and possible fungicide applications. Disease pressure on any particular variety varies according to location, local weather, and management practices. Some locations are prone to high disease pressure. Growers in these areas should be particularly aware of yield loss potential. Wooster OH, is a location with consistent pressure from powdery mildew and Stagonospora leaf blotch. Over the ten-year period from 1991 to 2000, the average yield response to fungicide application on susceptible varieties has been 10.4 Bu/A. Updated information on wheat variety reactions to disease can be obtained on the Ohio Field Crop Disease web site at http://www.oardc.ohio_state.edu/ohiofieldcropdisease/wheat/Wheatreactions01.htm.

2) Accurately identify diseases: Know symptoms of powdery mildew, Stagonospora leaf blotch and leaf rust. Growers should become familiar with symptoms of the common diseases affecting wheat in Ohio. Correct diagnosis and scouting are important steps in identifying the yield limiting diseases on your farm. Help in diagnosis can be obtained from OSU Extension or other crop consultants. OSU Extension Agronomic Crop Disease Fact Sheets provide descriptions and pictures of the common diseases in the state. These Fact Sheets can be found on OSU's website Ohioline at http://www.ag.ohio_state.edu/~ohioline/ac_fact/index.html and Ohio Field Crop Disease web site at <http://www.oardc.ohio-state.edu/ohiofieldcropdisease>.

3) Scouting fields for disease is essential to determine the need for fungicide applications. This involves checking the level of disease on 30-50 individual tillers randomly selected throughout the field. Fields should be scouted for powdery mildew at flag leaf emergence and boot stage (Feekes growth stage 8 and 10, respectively) and scout for Stagonospora leaf blotch and leaf rust at boot stage and after full head emergence.

The upper two leaves on tillers and the glumes on heads contribute most to grain fill. Thus, it is important to keep these upper plant parts free of disease to avoid yield loss. Disease thresholds are one percent of leaf area affected on the leaf below the flag leaf up to boot stage (Feekes growth stage 8 through 10), and one percent leaf area affected on the flag leaf between head emergence to the end of flowering (growth stage 10.1 to 11). When these disease levels are present, a fungicide should be applied as soon as possible to protect leaf tissue before more

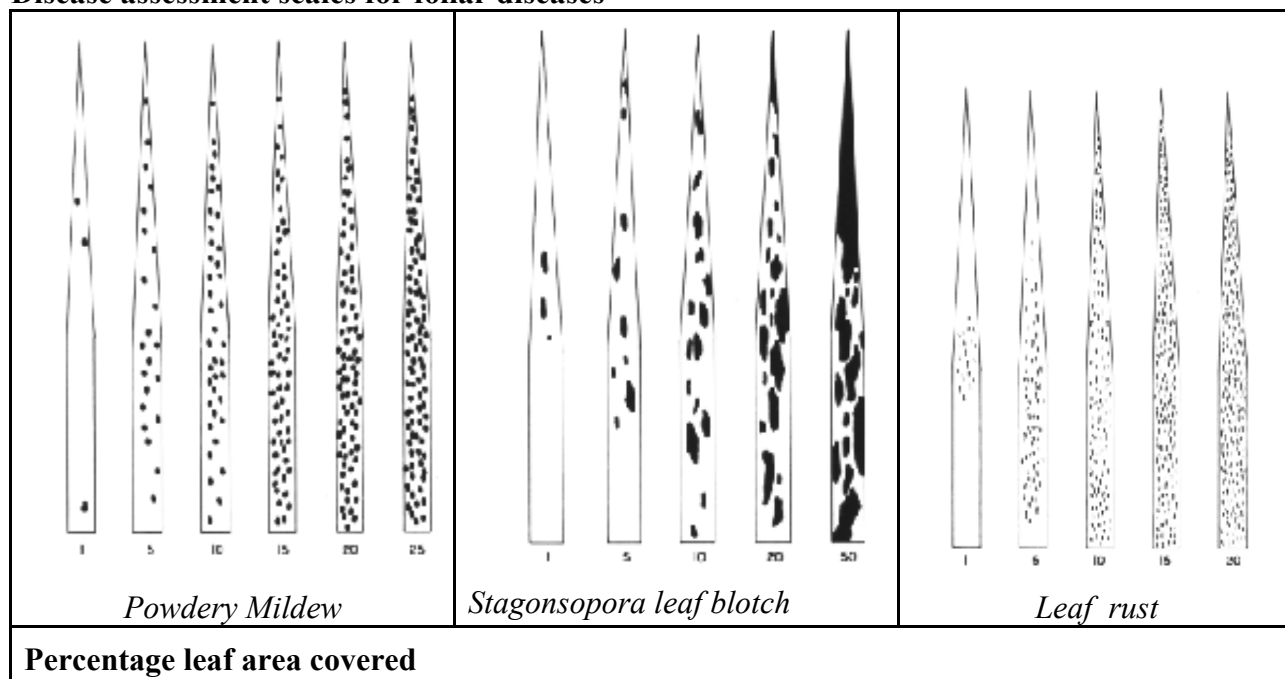
becomes infected . One percent leaf area affected roughly translates to 5-10 leaf rust pustules, 2-3 powdery mildew pustules or 1-2 *Stagonospora nodorum* blotches.



Scout wheat for disease at Feekes wheat growth stages 8, 10 and 10.5

Growth stage	Flag leaf emergence	Boot	Flowering
Feekes scale	8	10	10.5.1
Zadoks scale	37	45	60
Time of year	Late April to early May	Early May to mid-May	Late May to early June

Disease assessment scales for foliar diseases



Wheat disease thresholds for fungicide applications

Wheat growth stage	Disease	Leaf*	Disease level**
Flag leaf emergence (GS8) to Boot (GS10)	Powdery mildew	2	2-3 lesions
Flag leaf emergence (GS8) to Boot (GS10)	Stagonospora leaf blotch	2	1-2 lesions
Head emergence (GS10.1) to end of flowering (GS10.5.4)	Stagonospora leaf blotch	2	1-2 lesions
Head emergence (GS10.1) to end of flowering (GS10.5.4)	Leaf rust	1(flag)	5-10 pustules

* Leaf number counted from top leaf (Flag leaf = leaf 1) down on the tiller.

**Disease level based on average of 30-50 tillers randomly collected throughout field.

4) Fungicides: There are several different fungicides available for use on wheat. If powdery mildew is the target disease then Tilt or PropiMax should be applied. Use 20 gal water/A with ground equipment and 5 gal water/A if applying by airplane. Using less water will lower effectiveness. Current prices for 4 oz. of Tilt or PropiMax range from \$9.00 to \$11.00/A, not including application costs. Quadris, Stratego, and Headline are recently labeled materials with good effectiveness against Stagonospora leaf blotch and leaf rust. Their cost is higher than Tilt or PropiMax.

Efficacy of fungicides for wheat disease control based on application at threshold level.

Fungicide	Rate/A	Powdery mildew*	Stagonospora leaf blotch**	Leaf rust**	Head scab***
Tilt	4 fl. oz.	Excellent	Good	Excellent	Poor
PropiMax	4 fl. oz.	Excellent	Good	Excellent	Poor
Quadris	6.2-10.8 fl. oz.	Fair	Good	Excellent	Poor
Stratego	10.0 fl. oz.	Fair	Good	Excellent	Poor
Headline	9.0 fl. oz.	Fair	Good	Excellent	Poor

* Powdery mildew efficacy based on application at flag leaf emergence (growth stage 8)

**Stagonospora and leaf rust control based on application at head emergence (growth stage 10.1)

***Head scab control based on application at beginning flowering (growth stage 10.5.1)

5) Factors affecting the response to fungicide application: Fungicides are a tool that need to be used appropriately to achieve the desired result. Fungicides do not improve yield of a crop, but they do help reduce losses caused by certain diseases. They do not control all diseases. They are used to manage a few specific, but common leaf diseases. Fungicide treatment is not profitable when:

- resistant or moderately resistant varieties are treated
- fungicide application was applied after flowering
- fungicide application was applied after the flag leaf was severely diseased
- fungicide rate was cut
- not enough water was applied with the fungicide to achieve adequate coverage

It is generally not profitable to apply a fungicide to wheat when the grain price is less than \$2.25/bu because it will take a 10% yield response just to pay for the fungicide plus application (10% of 70 Bu/A = 7 bushel; 7 bushel x \$2.25 = \$15.75/A fungicide plus application cost).

It is better to apply a fungicide a little too early than too late.

2003 Fungicide Label Restrictions and Usage Recommendations on Wheat

Tilt 3.6 EC (Propiconazole), Syngenta Crop Protection, Inc.

- 1) Tilt can be applied by ground, air and chemigation.
- 2) National label restricts application to before and during growth stage 8 (flag leaf emergence), but Ohio 24c label extends application timing to Feekes growth stage 10.5 (pre flower).
- 3) Do not apply more than 4 fl. oz. of Tilt per acre per season.
- 4) Do not apply within 40 days of harvest.
- 5) Do not graze or feed livestock treated wheat forage or cut the green crop for hay or silage.
- 6) After harvest, the straw may be used for bedding or feed.

PropiMax 3.6 EC (Propiconazole), Dow AgroSciences, LLC.

- 1) PropiMax can be applied by ground, air or chemigation.

- 2) National label restricts application to before and during growth stage 8 (flag leaf emergence), but Ohio 24c label extends application timing to Feekes growth stage 10.5 (pre flower).
- 3) Do not apply more than 4 fl. oz. of PropiMax per acre per season.
- 4) Do not apply within 40 days of harvest.
- 5) Do not graze or feed livestock treated wheat forage or cut the green crop for hay or silage.
- 6) After harvest, the straw may be used for bedding or feed.

Quadris Flowable Fungicide 2.08 F (Azoxystrobin), Syngenta Crop Protection, Inc.

1. Do not make more than two applications of Quadris or other strobilurin fungicides per acre per year.
2. Apply between Feekes growth stage 6 and 10.5, DO NOT apply later than 10.5.
3. Applications may be made by air, ground or chemigation.
4. Add a crop oil concentrate (1.0%, v/v) to optimize efficacy.
5. Do not harvest treated wheat for forage.
6. Do not apply more than 12.32 oz product per acre per season.
7. Do not apply within 14 days of harvest for hay.
8. Do not apply within 45 days of harvest for grain and straw.

Stratego Fungicide (propiconazol 11.4%, trifloxystrobin 11.4%) Bayer Corp. Crop Protection

1. Stratego can be applied by ground and by air, not by chemigation.
2. Do not apply more than 10 fl oz/A per season.
3. National label limits application of Stratego to before Feekes growth stage 8 (ligule of last leaf emerged), but Ohio 24c label extends application timing to Feekes growth stage 10.5 (pre flower).
4. Do not apply Stratego within 40 days of harvest.
5. Grazing restrictions: 1 application (total of 10 oz./A) do not graze treated area within 30 days after application, and do not harvest for forage within 30 days after application or for hay within 45 days after application.
6. Rotation restrictions: soybeans have a 105 day plant-back interval after application.

Headline Fungicide 2.09 EC (Pyraclostrobin) BASF

1. Headline can be applied by ground, air and chemigation.
2. Apply no later than the end of flowering, Feekes growth stage 10.5.3.
3. Do not make more than 2 applications per season.
4. Do not apply more than 18 oz. per season.
5. Do not harvest wheat hay within 14 days of last application.
6. May be combined with the lowest rate of an adjuvant to enhance disease control.
7. No rotation restriction for crops on Headline label, all other crops can be planted 14 days after last application.

Reaction of winter wheat varieties to various diseases in Ohio.

Brand	Cultivar	Powdery mildew	Leaf rust	Stagonospora leaf blotch	Stagonospora glume blotch	Head scab	Wheat spindle streak mosaic
AGI	201	MR					
	525	R		MS		MS	
	535	S		S	S	MS	
	538	MR					
AGRA	GR962	MS	S	MS	S	MS	
	Honey	R	S	MR	R	MS	
	Valor	R		MS		MR	
Agripro	Gibson	S		S		MS	
	Foster	MS	MS	MS	S		
	Patton	S		S	MS	MR	
Beck	107	S		S	MS		
	108	S		S	S	MS	
	110	S					
Certified	Bravo	S		S	S	MS	
Public Certified	Dynasty	S	S	MS	MS	S	R
	Freedom	MR	R	MS	MS	MR	MR
	Hopewell	MR	S	MR	MR	MS	R
	Patterson	S	R	S	S	S	MR
	Roane	MR		MS	MR	MS	
NK (Syngenta)	Coker 9474	MS		S	MS	MS	S
	Coker 9663	MR		MR	MR	MS	
Pioneer	25R18	S	MR	MR		MR	
	25R26	MS	R	MS	MS	MS	R
	25R37	MS				S	
	25R44	S				S	
	25R47	MR				MS	
	25R49	S				S	
	25R78	S				S	
	25W60	MS				S	
Rupp	RS909	MS		MS	S	MS	
	RS931	MR					
Steyer	Bernard	S		MS	S	MS	
	Bouillon	S		MS	MR	MS	
	Wonderly	S		S	MS	MS	
Thompson	TS3060	MR					
	TS4020	S	MR	MS	MS	MS	S
	TS6020	S		S		MS	
	TS8040	S		S	MS	MS	
Wellman	W-101	R		MS	R	MS	S
	W-115	MR		MS		MS	
	W-130	MR					
	W-150	MR					
	W-9830	S		S	MS	MS	
	W-9910	S		MS	MR	MS	
	W-9920	S		S	MS	MS	
W-9940	MS		MS	S	MS		

R = resistant; MR = moderately resistant; MS = moderately susceptible; S = susceptible

Reactions scored during 2000-2003.

Obtain new information each year due to expected changes in reactions over time.

Weed Management Issues: Dandelion, Marestail, and Lambsquarters

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The Dandelion Problem

Dandelion has been present in no-tillage and minimum fields for years, but more recently has become extremely problematic in corn, soybean and wheat production across much of Ohio. OSU weed scientists have conducted a number of studies on dandelion over the past several years. In this research, we have focused not only on the immediate results of fall or spring herbicide applications, but also their effect on the dandelion population up to one year after application. A primary conclusion of this research - although there are several effective fall and spring treatments, reducing the dandelion population and preventing re-establishment requires use of appropriate herbicide programs for several years. Established dandelions have the capability to regrow in the late spring or summer following a fall or spring herbicide treatment, and an effective post-emergence treatment is required for control of this regrowth. In addition, dandelion seed is viable as it leaves the seed-head, and this seed is the source of seedling dandelions that emerge in spring and late summer/early fall. Herbicide programs for dandelion need to target these seedling dandelions in addition to the more established plants.

We believe changes in herbicide programs in the late 1990's and early 2000's have been partly responsible for the increase in dandelion. The adoption of Roundup Ready soybeans allowed producers to deemphasize the use of a preplant burndown application and the use of 2,4-D ester, and replace it with an at or after planting application of glyphosate only. Research we conducted in 2003 showed that a combination of glyphosate plus 2,4-D ester is more consistently effective for control of dandelion in the spring, compared to glyphosate alone. This change in burndown treatments was accompanied by a decrease in the use of preplant herbicides with residual (CanopyXL, Scepter, etc), because there was a perception that residual herbicides were not needed in the Roundup Ready system. Since much of the seedling dandelion emerges in late April into May, it is possible that residual herbicides applied in April can control seedling dandelion, and help keep populations in check. Our current tillage practices tend to promote increased dandelion populations, since dandelion establishes well in no-tillage, and minimum tillage tools currently in use by many producers prior to corn planting will not adequately control established dandelions.

Fall herbicide application – an effective tool for control of dandelion

Fall herbicide treatments are an effective tool for control of established dandelions, and are more consistently effective than spring burndown treatments for reducing dandelion populations. In OSU research, we have been able to achieve near complete control of even relatively high dandelion populations with several fall herbicide treatments. However, the effectiveness of control and reduction in the dandelion population will be dependent upon the size of the dandelion plants (or their roots), population density, and location. In low to moderate

population densities, herbicide treatments may control all or most of the dandelion present, but this level of control may not be possible where dandelion population densities are extremely high. The most effective reduction in the dandelion population will occur when fall applications are followed with a postemergence herbicide treatment in the next year's crop. In OSU research, control of dandelion has generally been more difficult in northwestern Ohio compared to western Ohio. The ranking of herbicide treatments with regard to their effectiveness is similar between sites, but they are more variable in northwestern Ohio. Therefore, it appears that following spring or fall treatments with a postemergence herbicide treatment will be even more important as one moves farther north in Ohio.

Some suggestions and observations on fall herbicide treatments for dandelion control follow. Glyphosate rates are listed as pounds of acid equivalent per acre – 0.75 lb is the equivalent of 22 oz of WeatherMax or 32 oz of most other glyphosate products.

- Across all of the dandelion studies we have conducted in fields where soybeans will be planted, the most consistently effective dandelion control resulted from application of: glyphosate (0.75 lb ae); a mixture of glyphosate (0.38 or 0.56 lb ae) plus 2,4-D (0.5 lb); or a mixture of Canopy XL (≥ 2.5 oz), Express (0.1 to 0.2 oz), plus 2,4-D (0.5 lb). The Canopy XL treatment does have the advantage of controlling seedling dandelions the following spring (and low rates of Canopy XL are sometimes recommended with fall glyphosate treatments for this reason).
- Where corn will be planted the following spring, effective dandelion treatments include the following: glyphosate (0.75 lb ae); a mixture of glyphosate (0.38 or 0.56 lb ae) plus 2,4-D (0.5 lb); Basis (0.5 oz) plus 2,4-D (1.0 lb), or simazine (1 lb) plus 2,4-D (1.0 lb). In one OSU study, the Basis/2,4-D treatment was more effective than the others listed here.
- Application of 2,4-D alone (1.0 lb) is a low cost treatment for control of dandelions, but can result in 10 to 20% less control compared to the treatments listed previously. In fields where dandelions and other winter annuals are the primary target of a fall herbicide treatment (but chickweed is not a problem), 2,4-D is an effective and inexpensive treatment.
- Treatments containing glyphosate should be applied with ammonium sulfate (and surfactant if required by the glyphosate label). Adding additional surfactant to inexpensive glyphosate formulations or when using high spray volumes may improve weed control with products that are “loaded” with surfactant. Treatments that do not contain glyphosate should generally be applied with crop oil concentrate.
- Sencor can reduce the effectiveness of glyphosate and/or 2,4-D applied in the fall. In OSU research, Valor has reduced the effectiveness of 2,4-D, but does not appear to reduce the effectiveness of glyphosate/2,4-D combinations.
- We do not have enough information to define exactly when in the fall herbicides should be applied for dandelion control, but anywhere between about late September and mid November can be effective. If possible, wait until after a light frost to apply herbicides, but try to apply when dandelions are still mostly green and actively growing (before a hard freeze causes plants to become mostly purple). We view fall herbicide treatments as the most effective tool for control of established dandelions, and an application too early or too late that results in slightly reduced dandelion control is probably still worth the cost and effort.

Control of dandelion in spring – timing and herbicide selection are important. It is possible to effectively control dandelions with preplant herbicide treatments in spring, but control can vary greatly among herbicides. In addition, control with even the most effective

treatments appears to vary with dandelion growth stage and environmental conditions. As with fall applications, following preplant treatments with an effective postemergence treatment ensures that any regrowth of the dandelions is controlled. We conducted spring studies in corn and soybeans in 2003, and these will continue into 2004.

In a study conducted at OARDC Western and Northwest Branches, we applied glyphosate (0.75 lb), 2,4-D (1.0 lb), or the combination of both at 10-day intervals from April 1 to May 20 to determine the effect of timing of spring application on dandelion control. A summary of this research:

- At Northwest Branch, control in late June averaged over all three herbicide treatments ranged from 93 to 94% for applications on May 9 or 19, but did not exceed 65% for earlier applications. The effectiveness of glyphosate applied alone was extremely variable. For example, glyphosate applied on April 9 controlled 82% of the dandelion, but this decreased to 30% for April 19 application, and then to 7% for April 29 application before rebounding to 98% for the May 9 application. The combination of 2,4-D plus glyphosate was more effective than either herbicide applied alone, and still controlled 73 to 100% of the dandelion on the dates when control with glyphosate alone was 30% or less. When averaged over all of the spring timings at this site, 2,4-D provided 44% control, glyphosate, 59% control, and glyphosate plus 2,4-D, 85% control of dandelion.
- At Western Branch, control in late June averaged over herbicides ranged from 86 to 94% for all timings except April 1, when it averaged 64%. As at Northwest Branch, glyphosate plus 2,4-D was more consistently effective than either herbicide applied alone. When averaged over spring timings at this site, 2,4-D provided 73% control, glyphosate, 88% control, and glyphosate plus 2,4-D, 94% control of dandelion. In other studies, we applied preplant herbicides in no-till corn and soybeans in late April, followed by a postemergence treatment (Distinct in corn and glyphosate in Roundup Ready soybeans), and evaluated dandelion control at various times throughout the season. We also measured dandelion populations at the time of crop harvest. We included a number of commonly applied preplant treatments in both crops. Corn herbicides were more effective at Western Branch than at Northwest Branch. A summary of this research:

- Mesotrione + atrazine (Lumax) was the most effective preplant corn herbicide treatment, controlling 87 to 97% of the dandelion in late May across both locations. The addition of 2,4-D ester to this treatment improved mid and late-season control of dandelion, and resulted in greater reduction in dandelion population at Northwest Branch.
- Balance + atrazine + 2,4-D, atrazine + glyphosate, and atrazine + glyphosate + 2,4-D controlled 83 to 93% of the dandelion in late May at Western Branch, but not more than 73% at Northwest Branch. Curtail (2 pts) + atrazine, applied only at Western Branch, was not as effective as these treatments within a month or more after application, but reduced the dandelion population as well as any other treatment.
- We applied a number of preplant soybean treatments at Western Branch, including glyphosate, glyphosate + 2,4-D, and combinations of these with CanopyXL, Valor, and Sencor. While these treatments were applied on a 38-degree day, they were generally effective. Any treatment that contained glyphosate or glyphosate + 2,4-D controlled 88 to 100% of the dandelion by late May, and this control was improved with the postemergence glyphosate treatment. Mixtures of Gramoxone plus CanopyXL also provided this level of control. Including Aim with glyphosate did not improve control, and control within a month after application was actually reduced to less than 80% in one treatment that contained Aim.

- The most effective corn and soybean treatments reduced dandelion populations by up to 95 and 100%, respectively, as measured at the time of crop harvest.

Glyphosate resistance in marestail

The current intensive use of glyphosate in Roundup Ready crops has resulted in the development of glyphosate-resistant marestail populations in Ohio. In greenhouse research in the spring of 2003, we confirmed glyphosate resistance in a number of marestail populations from southwest Ohio. At that time, resistance appeared to be confined to southwest Ohio and to fields that were primarily continuous Roundup Ready soybeans, where glyphosate was the only herbicide used in most of these fields over a several year period. However, our assumption was that glyphosate resistance would eventually be found in soybean fields in other parts of Ohio, and also in Roundup Ready soybean fields that were in a rotation with corn and/or wheat. In the fall of 2003, we collected marestail seed from fields as far north as State Route 36 where glyphosate resistance was suspected, including fields in most counties in the southwestern quarter of Ohio. We are in the process of screening these populations for glyphosate resistance in the greenhouse, and preliminary results indicate that a number of them are resistant. Corn has been in the crop rotation in many of these fields, although some have had multiple years of Roundup Ready soybeans between the corn years. A common practice in almost all of the suspect soybean fields is that glyphosate was the only herbicide used during the year of soybean production. The spread of glyphosate-resistant marestail is not surprising, given the intensive use of glyphosate, the prevalence of glyphosate-resistant marestail in other parts of the country, and the wind-borne nature of marestail seed. In Roundup Ready fields where glyphosate is the only herbicide used, the issue is probably more one of “when” glyphosate resistance occurs in marestail versus “whether” it occurs. We know that many marestail populations in Ohio are ALS-resistant, and an additional concern is the possible occurrence of glyphosate and ALS resistant in the same population. This type of multiple resistance could greatly limit options for control of marestail, especially in when it is more than about 6 inches tall.

In spite of the apparent spread of glyphosate-resistant marestail, certain practices appear to slow its development and help keep the population of resistant plants in a field low. These practices include:

- Crop rotation. Include corn and/or wheat in the rotation so that soybeans are not planted two years in a row. Avoid sequential years of Roundup Ready crops.
- Avoid use of only glyphosate in Roundup Ready crops.
- Use of multiple herbicide sites of action within and across years. Some examples: mixing 2,4-D ester with glyphosate in fall and spring burndown treatments; in corn, preemergence application of an atrazine premix product prior to postemergence glyphosate application; in soybeans, mixture of glyphosate plus FirstRate/Amplify in postemergence treatments.
- Use a fall herbicide treatment to control marestail that emerge in late summer and fall (see next section).
- Include an herbicide with residual activity on marestail in fall and early spring burndown treatments to reduce the population of spring-emerging marestail.
- Apply spring burndown treatments when marestail are less than 2 inches tall, which will maximize the activity of 2,4-D and other herbicides.

Managing marestail I: the importance of residual control

Marestail is rampant throughout much of Ohio. Among all of the winter weeds we deal with, marestail can be the most difficult to make a single herbicide recommendation for due to its biology and ability to develop herbicide resistance. Marestail can emerge throughout most of the year. Peak times of emergence seem to be: 1) late summer into early fall; and 2) April into early May. However, when wet, cool conditions extend into late spring, we have observed considerable emergence into June. Plants that are larger than the rosette stage in fall do not survive the winter, but most fields with a history of marestail problems will be infested with plenty of very small plants in late fall. These plants can overwinter and are likely to reach the “bolt” or stem elongation stage earlier next spring, compared to those that emerge in the spring (marestail becomes more difficult to control after the stem elongates). An herbicide application in late fall will easily control small, emerged marestail plants, and our research indicates that 0.5 lb of 2,4-D ester is adequate for this purpose. Most of the commonly used fall herbicide treatments targeted for winter annuals and dandelions will control emerged marestail. While control of emerged marestail in fall is beneficial, we know that we can expect another round of marestail emergence in the spring. So, the real questions about use of residual herbicides for marestail control are whether application in fall or spring is more likely to prevent marestail emergence through early June, and which herbicides are most effective.

In a study we conducted over the past three years, we applied various herbicides in the fall and early spring to determine the length of residual control of marestail. Neither of our study sites contained glyphosate-resistant marestail, but the 2001/2002 site had areas of ALS-resistant plants. In the 2001/2002 study, most fall treatments were providing at least 90% marestail control in early May. However, differences among fall treatments were clearly evident by early June. Perhaps the clearest indicator of these differences was the measurement of marestail population densities, which in early June were as follows for fall applications (in # plants per square yard): 2,4-D – 73; Canopy XL (5.8 oz) – 78; glyphosate – 61; Valor (2.5 oz) – 55; Python (1 oz) – 47; FirstRate (0.6 oz) – 44; Authority (6.4 oz) – 17; Scepter (2.1 oz) – 13; Sencor (8 oz) – 13. In contrast, application of Canopy XL, Valor, Sencor, FirstRate, or Authority in early April resulted in 5 or fewer marestail plants per square yard by early June.

In the 2002/2003 study, where the marestail plants were less numerous and the population was not ALS-resistant, fall-applied herbicides were more effective than in the previous year’s study. Marestail population densities in early June were as follows for fall applications (in # plants per square yard): 2,4-D - 24; glyphosate – 16; Sencor – 12; Scepter – 12; Python – 8; Authority – 4; Canopy XL – 0; Valor – 0; FirstRate – 0. Early-April application of herbicides resulted in complete control of marestail through early June for all treatments except Python, for which a population of 4 plants per square yard was observed.

A primary conclusion from this study was that a number of herbicides could provide “season-long” marestail control (through early June) when applied in early April, but this was more difficult to accomplish when they were applied in the fall. The residual control from fall treatments will depend somewhat on how numerous the spring-emerging marestail are, and how late they emerge. In populations where most of the marestail have emerged by early May and the populations are not extremely high, fall applications can provide acceptable control of marestail through early June. Conversely, fall applications will be less effective where considerable numbers of marestail emerge after early May. We believe that the “ideal” marestail control program may be early-April application of 2,4-D plus one of the more effective residual

herbicides listed above. However, a fall application with residual activity can greatly reduce spring populations of marestalk and reduce the risk of developing glyphosate resistance.

Managing marestalk II: the importance of an effective burndown treatment

In no-till soybean fields where marestalk is not controlled with herbicides in fall or early spring, marestalk plants can bolt (i.e. stem elongates) and become difficult to control by early May. Use of an effective burndown treatment is essential, because plants that are not completely controlled will regrow and be less susceptible to later herbicide applications. The presence of glyphosate or ALS resistance in some marestalk populations, results in fewer effective burndown options, especially when plants become larger than 4 to 6 inches tall. One key to effective control of emerged marestalk is treatment when plants are less than 2 inches tall, because the activity of 2,4-D and other herbicides is maximized on small plants. OSU weed scientists conducted a number of studies in 2002 and 2003 to determine effective treatments for control of marestalk that were 4 to 6 inches tall. This corresponded to application in early to mid May. Marestalk at the 2002 research site were ALS-resistant in areas, and were glyphosate-resistant at two out of three research sites in 2003. At the other 2003 site, marestalk were sensitive to glyphosate and ALS inhibitors. Some results of this research (from evaluations taken 30 days after treatment):

- Glyphosate is still an extremely important tool for control of emerged marestalk. In the populations that were not glyphosate-resistant, glyphosate applied alone at 0.75 lbs acid equivalent controlled 90 to 100% of the marestalk. In all studies, including glyphosate-resistant sites, this rate of glyphosate controlled 100% of the marestalk when mixed with 0.5 lb ai/A of 2,4-D ester. Where marestalk were glyphosate-resistant, the addition of 2,4-D ester to glyphosate improved control from 68 to 97%. We suspect this combination would be less effective on resistant marestalk plants more than 4 to 6 inches tall, due to reduced effectiveness of 2,4-D and greater expression of glyphosate resistance with increasing plant size.
- CanopyXL (3.5 oz) plus 2,4-D ester controlled 98% of the marestalk at glyphosate-resistant sites, but only 63 to 88% of the marestalk at other sites. A combination of CanopyXL plus glyphosate, or CanopyXL plus glyphosate plus 2,4-D ester controlled 100% of the marestalk at all sites. FirstRate/Amplify was not included in this study, but provided control similar to CanopyXL in another study.
- Sencor (8 oz) had activity on emerged marestalk, but control was more variable across sites compared to CanopyXL. The combination of Sencor plus glyphosate plus 2,4-D ester controlled 97 to 100% of the marestalk at all sites, while Sencor plus glyphosate controlled 87 to 100% of the marestalk. When combined with either 2,4-D ester or paraquat, Sencor controlled greater than 90% of the marestalk at three sites, but less than 70% at the fourth site. A combination of Sencor plus paraquat plus 2,4-D ester controlled 100% of the marestalk at three sites, and 83% at the fourth site.
- Valor did not appear to have activity on emerged marestalk in this research. While not statistically significant, the combination of Valor plus glyphosate appeared to slightly reduce marestalk control, compared to glyphosate applied alone.

What's the deal with lambsquarters and glyphosate?

We have received numerous complaints over the past two years about poor control of lambsquarters with postemergence glyphosate applications in Roundup Ready soybeans. Historically, lambsquarters is a weed that can exhibit more tolerance to glyphosate than many other summer annual weeds, and tolerance is influenced by size or age of the plants. In greenhouse research last winter, we studied the response of a number of lambsquarters populations to glyphosate. Several of these populations were from fields where the lambsquarters appeared to be somewhat tolerant of postemergence glyphosate applications in 2002. We observed a range of tolerance to glyphosate in the greenhouse, although all of the populations were much less tolerant than the glyphosate-resistant marestail that is becoming more common in Ohio.

We conducted field research in Roundup Ready soybeans at four sites in 2003. Lambsquarters populations at two of these sites (within a mile of each other) were among the most tolerant in the greenhouse research, while the other two had no history of tolerance or problems with lambsquarters control. We applied a range of glyphosate rates, 0.38 to 7.5 lbs/A, to three sizes of lambsquarters, 1-2 inch, 4-6 inch, and 10-12 inch. Regardless of rate, glyphosate controlled essentially all of the lambsquarters at all sites when plants were less than 6 inches tall. The 10-12 inch lambsquarters plants were generally more difficult to control, but were effectively controlled at two sites, one of which had exhibited some tolerance in the greenhouse. At the other site where tolerance in the greenhouse had been observed, there was an area within the study where control of 10-12 inch lambsquarters was reduced. In this area of more tolerant plants, the 7.5 lb rate did not completely kill all of the lambsquarters, but the lambsquarters never regrew and did not produce seed. However, plants surviving the 0.75 lb rate in this area did recover somewhat and produced seed. At the fourth site, with no history of tolerance, we also observed a few plants surviving the 7.5 lb rate, but these plants also never recovered sufficiently to produce seed. So, what's it all mean? We interpret these results as follows:

- There appears to be variability among lambsquarters populations in their response to glyphosate, but in the field, differences in tolerance are expressed primarily in large plants.
- Even in populations without increased tolerance to glyphosate, large plants can be difficult to control under field conditions.
- Plants less than 6 inches tall appear to be effectively controlled by glyphosate, even in populations with increased tolerance.
- Environmental conditions probably affect the response of lambsquarters to glyphosate, but are more likely to affect control of large plants compared to small ones.

Suggestions for managing glyphosate applications in Roundup Ready crops to avoid problems with lambsquarters control include the following:

- apply glyphosate when lambsquarters are less than 6 inches tall if possible. Increase glyphosate rates if plants are larger than 6 inches tall.
- Apply a preemergence herbicide that provides residual control of lambsquarters prior to or at the time of soybean planting. Most preemergence soybean herbicides control lambsquarters, with the exceptions of alachlor, Dual II, Outlook, and low rates of Domain, Boundary, and Axiom. In areas of triazine-resistant lambsquarters, Sencor, Domain, Boundary, and Axiom will not provide adequate control regardless of rate.

Precision Agriculture Technologies: Can It Lower Cost of Production?

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Introduction

The use of precision agriculture technologies has taken crop management to a new level. Rather than farming a field as a “whole” treatment it creates the ability to micro-manage specific sections of fields for given applications and provide the ability to evaluate changes over time.

It has also provided opportunities for more efficient equipment navigation processes involved with chemical spraying, controlled traffic and tillage, and accurate fertilizer placement.

These technologies have also provided a system of documenting and tracking identity preserved products, GMOs and traceability issues when dealing with food safety.

Economics of Precision Agriculture

But more importantly, the question we need to answer "Is precision farming profitable?": This is one of the questions we most frequently receive from farmers. It is also very difficult to answer.

Precision farming is more likely to be profitable if the practice results in greater yields, improved quality, or more efficient use of resources. Some precision farming practices may also allow increased farm size. For instance, precision guidance systems can allow faster work or work in low light conditions. The bottom line: Precision farming profitability is site-specific. It depends on farm conditions, the systems adopted, and the skill of the manager. Now let's talk about precision farming adoption.

In a March 2003 survey of Ohio farmers, we asked which of 18 precision farming technologies they use on their farms. Geo-referenced soil sampling has been adopted by about 15 percent of Ohio farmers. Variable rate application of lime, potassium and phosphorus fertilizers ranged from 13 to 14 percent. In fifth position was the yield monitor at about 12 percent adoption.

Two other components deserve note. The satellite global positioning system is an essential tool of precision farming. GPS adoption now stands at only 7.6 percent. A new but rapidly growing use of GPS involves precision guidance. About 5.2 percent of farmers say they are using these

systems, up from essentially zero in 1999.

We asked farmers to consider the 18 precision farming components and to identify three that were most important for their farming application. Forty-one percent indicated that geo-referenced soil sampling was one of the three most important components on their farm. This was followed by VRT lime applications, the combine yield monitor, VRT application of phosphorus and potassium fertilizers, and, finally, precision guidance.

Let's look at a few precision agriculture technologies to see how they may be best incorporated into your operation.

Global Positioning Systems

Global Positioning System (GPS) receivers are the basis for all precision agriculture applications. GPS accuracy and stability determine the effectiveness and reliability of a GPS receiver to perform desired applications.

The GPS receivers can be classified based on accuracy and performance into low, middle, and high classes. For general mapping such as field boundaries, line mapping, soil sampling, yield mapping and scouting, the low performance GPS receivers will provide good location positions for less than \$400.00.

The middle and high performance GPS receivers will provide more stability and greater accuracy along with the option of a higher output rate which is needed for guidance applications. Most of the middle and high performance GPS receivers have less than 3 feet accuracy. The middle and high performance GPS receivers range in cost between \$800 to \$8000, depending upon specifications and differential source.

The most accurate GPS receiver in agriculture is Real-Time Kinematic GPS. This GPS has 1 inch accuracy and can be used in all precision applications, but is predominately used in auto-steering guidance systems. The cost of RTK GPS is about \$40,000. The cost may seem prohibitive, but the benefits derived from RTK GPS may offset a lot of the costs.

Soil Sampling and Mapping

Soil variability is a major factor influencing crop performance within farm fields. Soil sampling can provide needed information but can also be a major expense.

Three major sampling approaches are commonly used: whole field sampling, grid sampling, and zone sampling. Whole-field sampling involves a single composite sample combining individual samples from 20 to 30 points in a field.

Where there are areas of markedly different crop response, a grid or zone sampling approach is warranted. Grid samples are usually taken on a regular pattern located using GPS and be converted easily to GIS maps. Typically, a grid density of at least one site per acre is recommended. However, grid schemes may be wasteful where the manager already understands

some of the soil distribution patterns. Typically, grid samples consist of composites (often 10 to 15 samples), located within a defined distance of the grid center (point sampling). Alternatively, grid values can be assessed from composites taken to represent each entire grid cell (cell sampling).

Where yield variability may be closely related to known conditions such as soil moisture storage, soil type or topography, zone sampling, which partitions the field into homogeneous units, may be recommended. Soil or topographic units, or units derived from yield maps or remote sensing may provide a basis for delineating management zones. By sampling known zones where attributes are expected to be relatively uniform, the number of soil samples required for management decisions may be reduced significantly.

Variable Rate Technologies (VRT)

Variable rate technologies (VRT) provide the ability to vary crop inputs across the field. These inputs include: seeding, lime, nitrogen, phosphorus, potassium, micronutrients, herbicides, fungicides, and insecticides. A majority of variability in fields occur from soil characteristics, topography and past management practices.

The decision to use VRT exists when there is evidence of field variability. To make varied input recommendations, supporting data can be used from yield monitors, aerial photography, field scouting, electrical conductivity, soils and fertility, or combinations thereof. Most VRT systems produce a record of what was applied in the field. This is also beneficial as it helps further document actual application amounts, errors or defects with equipment, and potential misapplications resulting in crop damage.

Yield Monitoring and Mapping

Using a yield monitor goes along ways to understanding field productivity levels in your field. When equipped with GPS, a yield monitor is a system of electronic components and sensors that measures and records grain mass flow, moisture, area covered, and specific location.

When calibrated properly, yield monitors can produce plus or minus 3% accuracy. Calibrate your yield monitor at least once a year for different crops and varieties that vary from typical seed size and percent moisture. Use certified scales or calibrated weigh wagons when calibrating loads.

A yield map does not tell you why variability exists rather than differences in yield found in the field. Visual interpretations of yield maps along with other field notations including soils, fertility, drainage, and weather obtained need to be considered when making exact determinations of variability.

Identifying and managing for drainage has been the most sought out benefit found when using a yield monitor. However, for some fields it may take several years of yield data and other sources of data to rule out why yield levels change in the field, particularly due to soil fertility, rainfall patterns, cropping activities, and pest infestations.

Guidance Systems

Guidance systems are helping farmers accurately place crop inputs and increase efficiencies across all acres. This relatively new and popular technology can be classified by two general categories, guidance steering aids and auto-steering guidance systems.

The guidance steering aids guide the operator through the field in a series of parallel and curved lines and can be used instead of visual marking systems such as row or foam markers.

These systems need an operator steering the vehicle at all times and can be accurate up to 20 inches. Since the systems perform similarly in accuracy, factors to consider are portability and mounting. A typical guidance steering aid will cost between \$3,000 to \$10,000.

The auto-steering guidance systems have the capability to steer a machine across the field. At the end of the field, the driver must steer the machine to the next pass where the auto-steering system will steer itself as directed.

The auto steering guidance systems can use two different GPS receivers for location position, DGPS or RTK-GPS. The auto-steering guidance systems with a DGPS receiver have accuracies between 4 to 20 inches depending on the differential source. Using a DGPS receiver with auto-steer, the driver may experience the vehicle drifting from pass to pass over an extended period of time. The cost for a DGPS auto steering system is about \$20,000. Using a RTK GPS receiver, the auto-steering guidance system is accurate to 1 inch. The cost for an auto-steering system is about \$45,000.

Sensor Technologies

Soil Electrical Conductivity and the Veris Soil EC Mapping System

One of the new technologies in Precision Ag is Veris's coulter implement used to measure soil electro conductivity or EC. Two coulters apply a voltage while the remaining four detect the drop in voltage at 0-1 and 0-3 feet depths.

The output is coupled with GPS coordinates to create an EC map. EC changes are often related to soil texture. Clay soil will have a high EC and sandy soil will have a low EC. It is best to interpret EC maps along with other information if available, such as soil maps and yield data.

EC boundary maps can be helpful in defining management zones for soil testing and VRT guidance as well as locating wet spots and root restrictive areas.

Remote Sensing

The use of aerial and satellite imagery, also referred to as remote sensing can identify differences within a field. It has been used to identify land surface features, determine field and water boundaries, conservation planning, and some soils identification.

Near-infrared imagery can be used to depict differences in the field that the human eye is unable to see. This further explains crop health, plant emergence issues, insect infestations, and other crop devastation issues. It is important to distinguish differences in the image with field scouting observations.

Imagery taken of bare soil after water drains through the field can even indicate tile lines, and identify surface drainage issues.

Summary

The decision to use precision agriculture technologies can only be valued to your operation when it leads to a profitable and productive management decision or validates other management practices. The influence of variability on crop production and the current management practices need to be understood before making appropriate field recommendations. This requires good data collection and interpretation of the field characteristics. This can be achieved from various precision agriculture technologies that you have learned about here.

For More Information

For more information about precision agriculture technologies visit our web site at:
<http://precisionag.osu.edu>

Need to find a Precision Agriculture Service Provider? Visit the Ohio Precision Agriculture Product and Service Resources Locator at <http://precisionag.osu.edu/parl>.