

Cornell University
Cooperative Extension

*Soil and Crop Sciences Section
School of Integrative Plant Science
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FIELD CROP DEALER MEETING

November 12, 2014



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2014 FIELD CROP DEALER MEETING

DEPARTMENTS/SECTIONS OF:
Soil and Crop Sciences
Animal Science
Entomology
Plant Pathology and Plant-Microbe Biology
Plant Breeding and Genetics
and
the New York State IPM Program

CORNELL COOPERATIVE EXTENSION
IN COOPERATION WITH
NEW YORK STATE COLLEGE OF AGRICULTURE AND LIFE SCIENCES
CORNELL UNIVERSITY
ITHACA, NEW YORK 14853

AGENDA

TIME	TOPIC	SPEAKER
1:00 PM	INTRODUCTORY COMMENTS	
1:15 PM	<i>Western Bean Cutworm in NY: Update on Status and Implications of a new corn and dry bean pest</i>	Keith Waldron
1:45 pm	<i>New Developments in Field Crop Disease and Detection and Management</i>	Gary Bergstrom
2:15 pm	<i>Alfalfa Fields Revisited; Soil pH, sulfur, and cation exchange capacity</i>	Quirine Ketterings
2:45 pm	BREAK	
3:15 pm	<i>Neonics in groundwater, bee decline and BT-CRW resistance: The double whammy for corn production</i>	Elson Shields
3:45 pm	<i>What's the Status of Technologies Being Developed for Herbicide Resistance Management?</i>	Russ Hahn
4:15 pm	<i>Who put those genes in my food?? Facts and myths about genetically engineered crops</i>	Margaret Smith
4:45 pm	ADJOURN	

Western Bean Cutworm in NY: Status and Implications of a new corn and dry bean pest

Keith Waldron, Cornell University, NYS Integrated Pest Management Program
NYSAES, Geneva NY

Western bean cutworm (WBC) poses a risk to corn (field, sweet) and dry bean production. This insect, a native of western US High Plains states was unique to that area until the late 1990's. Since then its range has expanded eastward and was first detected in NY, PA and Quebec in 2009, CT in 2010 and MA, ME and VT in 2011.

WBC larvae feed on developing corn kernels, dry bean seeds and pods causing direct damage and leaving them vulnerable for potential infection by fungal pathogens. WBC moths prefer to lay their eggs on pre-tassel corn. Once the corn crop is in full tassel or beyond, they prefer to lay their eggs on dry beans and later planted corn. Soybeans are NOT a host.

Unlike other common corn ear infesting caterpillars such as European corn borer, corn earworm and fall armyworm multiple WBC larvae may infest the same ear of corn. An infestation averaging one WBC larva per plant can reduce corn yields by ~ 4 bushels / acre. In it's historical home range field corn losses as high as 40% have been documented. In dry beans, WBC larvae chew an entry hole into pods where they crawl in and feed on developing seeds. Larvae feed on pods during the evening and retreat to the soil during the day making them hard to scout. Eight to 10% losses due to damaged dry bean seeds have been estimated in Michigan. A 2% or greater dry bean cull ("pick") rate can downgrade market value.

Current Status in NY

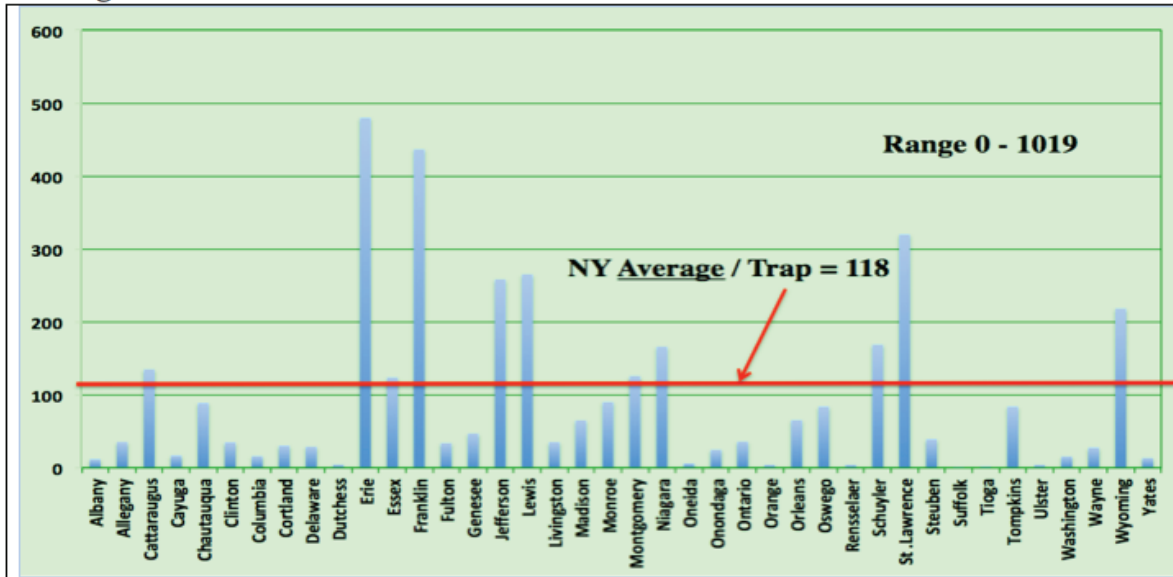
A statewide volunteer-based pheromone trap network has documented a near doubling of WBC numbers caught per trap every year since WBC trapping began in 2010 (Table 1). The pheromone attracts male WBC moths providing an indication of moth presence, identifies peak flight activity and helps refine timing of field monitoring. Midwest information suggests an accumulation ~ 100 WBC moths per trap should trigger monitoring corn for presence of WBC egg masses. Wisconsin & Ontario WBC field and sweet corn guidelines suggest inspecting 100 plants for egg masses. The treatment threshold is reached when 5% or more of inspected plants have an egg mass. If threshold levels are reached, insecticides for control should be applied when corn is 95% tasseled. Insecticide treatment is most effective on small exposed larvae, prior to their entering the ear. Monitoring WBC in dry beans is quite difficult. Trap data and an evaluation of adjacent corn fields for presence of WBC egg masses can provide a good basis for spray decisions. There are many insecticides labeled and registered for use in NY to control WBC in dry beans, field and sweet corn. Corn hybrids Cry1F (e.g. Herculex 1, Xtra, Optimum AcreMax1, SmartStax), or Vip 3A (Agrisure Viptera) are labeled for control of WBC.

Table 1. NYS WBC pheromone trap network highlights 2010 – 2014

	2010	2011	2012	2013	2014
No. Counties	29	37	44	39	41
No. Traps	54	67	88	89	97
Avg. No. WBC / Location	13	23.3	42.4	66.1	116.9
Range in Totals	0 - 99	0 - 165	0 - 344	0 - 853	0 - 1019
Peak Flight	2-Aug	2-Aug	25-Jul	21-28-Jul	3-Aug

Although WBC trap catches have nearly doubled each year, there have been no reports to date of economic impacts. Higher WBC counts have occurred in northern and western NY counties (Figure 1). In 2013, 89 traps collected 5,917 moths, 83% of traps had less than 100 moths per trap, total catch per trap ranged from 0 to 853 moths per trap. In 2014, 97 traps collected 11,341 moths, 66% of traps caught less than 100 WBC, total catch per trap ranged from 0 to 1019 moths per trap. WBC larvae have been found feeding in sweet and field corn. In 2014 there were reports of WBC larvae on sweet corn at some farm stands resulting in rejection by consumers. Potential risk of WBC injury pre-disposing corn ears to infection by mycotoxin producing ear molds is a concern.

Figure 1. Average Number WBC Moths Per Trap By County Compared to NY State Average in 2014*



2015?

Weekly WBC pheromone trap survey will continue. WBC trap catches are expected to increase, but if so by how much and under what conditions? Field monitoring for WBC in 2015 is highly recommended - especially in areas that had high trap counts in 2014 and fields with sandy soil types that would allow easier burrowing and may affect overwintering survival. Watch for WBC trap count updates. Will there be any potential economic impacts?

Updates on WBC Activity – See:

NYS IPM Weekly Pest Report: <http://blogs.cornell.edu/ipmwpr/#>

NY Sweet Corn Pheromone Trap Network: <http://sweetcorn.nysipm.cornell.edu/>

Penn State “Pest Watch” – regional map of WBC trap catches over time: www.pestwatch.psu.edu/

Acknowledgements:

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11/04/14

NOTES

NEW DEVELOPMENTS IN FIELD CROP DISEASE DETECTION AND MANAGEMENT

Gary C. Bergstrom and Jaime A. Cummings

Section of Plant Pathology and Plant-Microbe Biology
School of Integrative Plant Science

The 2014 crop season followed one of the coldest and most persistent winters in the past decade. One consequence was reduced winter survival of perennial forage crops. Brown root rot (BRR) was a contributor to alfalfa stand loss in northern New York and even in areas such as the southern Finger Lakes Region where the disease has seldom been observed in the past. A new molecular assay (see Fig. 1) is now available from the Cornell Plant Disease Diagnostic Clinic for accurate and rapid detection of the BRR fungus. Cornell plant breeders are utilizing a BRR nursery in Clinton County to select alfalfa populations that persist and yield well through cold winters and in the presence of the fungus.

The state's infant malting barley industry was also punched by the 'Polar Vortex' as many of the small number of winter malting barley fields succumbed to winterkill. Yet, several winter barley fields survived winter, yielded well, and produced good quality grain for malting. A survey of 27 malting barley fields (winter and spring types, multiple varieties) in 13 counties across the state produced a mixed bag of observations. Grain quality and mycotoxin levels were generally more favorable than what was produced in New York in 2013. Yet, 10 of these 27 grain lots had deoxynivalenol (DON) mycotoxin at levels above the 1.0 ppm cut-off for purchase by most malt houses. In addition to Fusarium head blight that results in DON toxin, malting barley in various locations was also affected by other head diseases (loose smut and ergot), foliar diseases (net blotch, spot blotch, scald, powdery mildew, leaf rust, bacterial blight, halo spot) and root diseases (snow mold, Fusarium root rot, Rhizoctonia root rot). Integrated management of barley health will require a combination of good crop rotation, selection of varieties with disease resistance, environmental adaptation and quality traits, and utilization of effective fungicides – especially timed at head emergence for suppression of Fusarium and mycotoxins.

Winter wheat diseases were of relatively limited concern in 2014, except for some hot spots in central and eastern New York, and few grain loads were rejected because of mycotoxin contamination. In experimental plots in Cayuga County, significant reductions in DON toxin were achieved with varieties moderately resistant to FHB and with triazole fungicides applied at flowering. FHB and DON were elevated in some of the limited acreage spring wheat crop in 2014.

Crown rust was more widespread and severe on spring oat than in several years. This is another disease where we may need to focus more attention on selecting varieties that are resistant to prevalent races of the rust fungus. Ergot was present at surprising frequency in a number of rye fields and at lower incidence in some triticale, barley, and wheat fields in 2014. Caution will be needed to utilize ergot-free seed and to avoid planting cereals into grass sods.

Northern leaf blight continued its trend of occurrence in every region in New York State, yet the overall severity was less than in the past two years. Vastly different intensities of blight, even in adjacent fields, were the reflection of the large role of hybrid genetics. By 2015, hopefully every corn grower will have received the message that corn planted in New York State (anywhere) should have at least moderate resistance to northern leaf blight. Good levels of resistance are now available in most maturity groups from most seed companies. Gray leaf spot occurred in the usual hot spot areas of the Southern Tier and Eastern New York, yet was not as severe as in past seasons.

Disease surveys of soybean were conducted with Cornell Cooperative Extension collaborators in 2013 (36 fields in 12 counties) and 2014 (64 fields in 15 counties) with support from the New York Soybean Check-off Program and the Northern New York Agricultural Development Program. Five new (for New York) and significant diseases were confirmed: charcoal rot, Fusarium wilt, sudden death syndrome, brown stem rot, and northern stem canker. Especially for the latter three, selection of resistant varieties will become of increasing importance in affected areas. The most destructive pathogen in other portions of the U.S., soybean cyst nematode (SCN), has not yet been confirmed in New York but a survey of soil from 2014 soybean fields is currently being conducted. The Cornell Plant Diagnostic Clinic is now offering SCN testing as a service to New York producers (see Fig. 2). The most widespread and damaging disease seen in 2014 was white mold in conjunction with cool, wet conditions through the flowering period. Where white mold occurred, growers should institute at least a two year rotation with corn or small grains before returning to soybean. It is becoming increasingly important for all New York soybean producers to avoid planting varieties that are highly susceptible. Efficacious fungicides are available, but they require precise timing, often multiple applications, and there is not a reliable system to predict economic return on fungicide investment.

Time will be reserved to discuss other diseases or issues observed by field crop professionals in 2014.

(Figures on following pages.)

NOTES

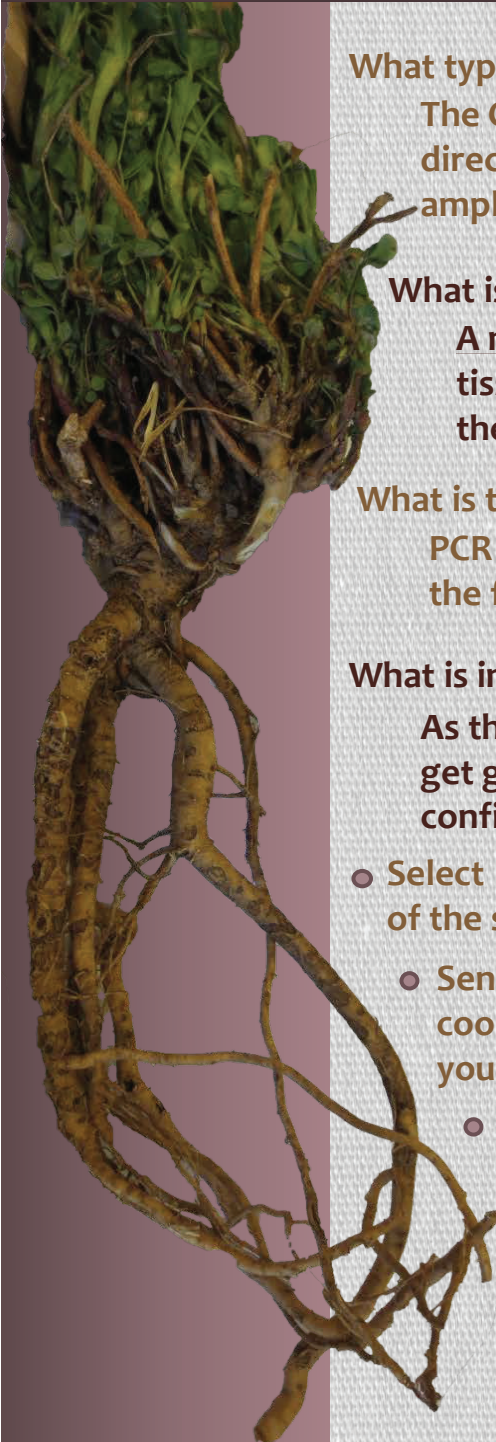


Cornell University
Department of Plant Pathology
and Plant-Microbe Biology

Brown Root Rot of Alfalfa

Suspect Sample Submission Guidelines

The Cornell University, Plant Disease Diagnostic Clinic (CU-PDDC) now offers a more sensitive molecular test for the Brown Root Rot pathogen, *Phoma sclerotioides*.



What type of testing is available for the brown root rot pathogen?

The Clinic offers two types of testing, 1) PCR analysis that directly uses suspect, infected plant tissue in a DNA amplification procedure and 2) plant tissue culture

What is the benefit of this new, more sensitive test?

A much faster result... the PCR uses symptomatic plant tissue. The culturing method may take months to produce the structures needed for identification

What is the fee for testing?

PCR only is \$60 & PCR with culturing is \$80 for residents of NY, the fee for out of state samples is an additional \$20 for each

What is included in the ideal sample submission?

As they say with computer data, if you put garbage in... you get garbage out. Submitting a quality sample will give you confident, accurate answers!

- Select and collect a few whole plants expressing various stages of the symptoms but not dead material
- Send your samples quickly and when possible, ship in a cooler with ice packs so it arrives to us looking like what you collected in the field
- If unsure, contact us... we are here to help you get the answers you need, as quickly as possible!

Go to the CU-PDDC website, www.plantclinic.cornell.edu for our sample submission form and more instructions. The Clinic's mailing address is 329 Plant Science Bldg., Ithaca, NY 14853, email: slj2@cornell.edu



Plant Disease
Diagnostic Clinic





Is the Soybean Cyst Nematode in your field?



Check out this distribution map and consider where it may spread next...

What does this mean to you?

If you grow soybeans...Test, Don't Guess!

Check your fields now! Nematode infestations can be present for years before symptoms cause you alarm. Early detections increase your ability to manage newly introduced pests and pathogens.

How should you "test" your fields?

Send samples to the Plant Disease Diagnostic Clinic

Guidelines for collecting and submitting samples to the Cornell University, Plant Disease Diagnostic Clinic (CU-PDDC) are available at our website: <http://plantclinic.cornell.edu> and if you have additional questions, we are only a phone call away...607-255-7850.

Why choose the CU-PDDC?

Because we know nematodes...and can name them!

Our team has over 40 years experience identifying the agriculturally important plant parasitic nematodes. We can distinguish between harmful and beneficial nematodes and our Clinic is one of the first in the country to pursue and receive NPDN STAR-D laboratory accreditation.

Five things you need to know...

1. soil cores from an area as large as 10 acres can represent one sample,
2. cores are collected in a pail, mixed well and subsampled preparing for submission,
3. only ship a 1-2 pint size subsample of your collected cores,
4. keep samples cool and ship quickly...NEVER leave in a hot car for any period of time,
5. this very labor intensive diagnosis is only \$50/sample for New York State residents (\$75 for those from outside the boundaries of New York State).

Note: for more specific information, please go to our website or call us at the contact information above.

Photo Credits: soybean seeds, <http://www.sproutstoyou.com.au>; yellow, brown, and golden cysts, Greg Tyika, <http://www.ipm.iastate.edu>; nematode and cream colored cyst, <http://bondisc.missouri.edu>; soybean field, <http://tamutimes.tamu.edu>

**Neonics in the groundwater, Bee decline and CRW resistance to BT-corn:
A double whammy for corn production.**

Elson Shields, Entomology, Cornell University, Ithaca

The neonicotinoid class of insecticides is currently the most widely applied class of insecticides in the world. This class of insecticide is chemically similar to nicotine and is currently registered in 120 different countries around the world. The relative safety to applicators, mammals in general, and birds while being toxic to insects is a major contributing factor to its widespread use on a wide range of crops and animals.

Neonics have been linked to honey bee decline. Sub-lethal doses have been reported to cause disorientation in the exposed bee, causing them to become lost and not returning to the hive. The mode of exposure appears to be insecticide contamination of flowers which are visited by honey bees for pollen and nectar. Honey bees are exposed either by direct contact when visiting flowers or through contaminated pollen carried back to the hive. Contaminated pollen is also fed to developing honey bee larvae and has a negative impact on those larvae. While there are many possible scenarios regarding the mechanism of flower contamination by the neonics across the wide array of crops treated, a very compelling case has been documented in corn. All corn seed is treated with a low rate of neonics to protect the germinating plant from secondary corn pests like seed corn maggot and wireworm. Research from Purdue University has documented that early flowering plants surrounding corn fields are contaminated with neonic contaminated dust when corn planters are used which rely on vacuum to pick up and hold the seeds (air planters). These early blooms are heavily visited by honey bees since they are the first flowering plants after a long winter.

Neonics have been detected in ground water and surface water. Initially, the first detection was reported in the central sands potato production area of Wisconsin. Higher insecticide doses of a water soluble insecticide used at planting with potatoes, sandy soils, and a water table 30-50 ft away preloaded the system for this detection in ground water. However, neonics have also been reported in nine different Iowa streams where the only source appears to be corn production and a strong link to seed treatments.

Discussions of neonic bans are increasing with current bans in parts of Europe and the proposal of a neonic ban in Minnesota. The loss of neonic seed treatments for corn and soybeans will open these crops up to attack from secondary insects, resulting in more stand establishment losses. The widespread usage of neonic seed treatments has allowed us to forget about these pests which in the past required the addition of a planter box treatment prior to planting. A ban will also remove one of our CRW management tools (high rate on seed) and may be critical as CRW resistance BT-corn continues to spread.

The increasing incidences of control failures with BT-CRW corn across the northeast will also be discussed. In addition, there are some new concepts of biological control to reduce the resistant CRW being researched.

NOTES

What's the Status of Technologies Being Developed for Herbicide Resistance Management?

Russell R. Hahn
Soil and Crop Sciences

The number of herbicide resistant weed biotypes has increased from 404 to 437 in the past 11 months. A summary of resistant biotypes for various herbicide site-of-action groups is shown in Table 1. There have been 33 new cases of ALS (acetolactate synthase) inhibitor resistance (Group 2 herbicides) and 12 new cases of glyphosate (EPSP inhibitor) resistance (Group 9 herbicides) around the World. Along with these newly documented cases of herbicide resistance, there continues to be much media attention to this problem, especially related to glyphosate-resistant weeds.

Table 1. A summary of resistant weeds by site-of-action herbicide group as of November 1, 2014 is shown below with information from <http://www.weedscience.org>

Herbicide Group	Group #	Example Herbicide(s)	Total
ALS inhibitors	2	Resolve Q	145
Triazine	5	Atrazine	72
ACCase inhibitors	1	Fusilade DX	46
Synthetic Auxin	4	2,4-D	31
Glycine	9	Roundup, Touchdown, etc.	31
Bipyridilium	22	Gramoxone SL 2.0	31
Ureas and Amides	7	Lorox	25
Dinitroaniline, etc.	3	Prowl	12
Thiocarbamate, etc.	8	Eptam 7E	9
PPO inhibitors	14	Sharpen	6
Chloroacetamide, etc.	15	Dual II Magnum	4
Nitriles and others	6	Buctril	4
Glutamine synthesis inhibitors	10	Liberty 280 SL	2
HPPD inhibitors	27	Callisto	2
Others	-	-	17
Total Herbicide Resistant Biotypes			437

WSSA Takes Action

In response to the growing concern about herbicide resistance, the Weed Science Society of America (WSSA) sponsored a national scientific summit on this topic on September 10, 2014 in Washington D.C. This summit built on the insights and perspectives developed at a similar event in 2012. Dr. David Shaw, a past president of WSSA and Chair of the WSSA Herbicide Resistance Education Committee said “We want everyone to walk away with a clear understanding of specific actions they can take to help minimize the devastating impact of herbicide resistance on agricultural productivity”. In Addition, WSSA issued a new fact sheet to address the media attention/hysteria about herbicide resistance on October 8, 2014. The fact sheet discusses the truth behind two common misconceptions about “superweeds”. According to WSSA, the first misconception is that “superweeds” are the product of rampant gene transfer from genetically modified crops creating herbicide resistant weeds. The second misconception is that “superweeds” have supercharged abilities to muscle out competing plants in new and more aggressive ways”. The WSSA fact sheet is posted online at <http://wssa.net/weed/wssa-fact-sheets>.

Glyphosate-Resistant Weeds

While ALS inhibitor-resistant weeds account for one-third of the documented cases, glyphosate-resistant (GR) weeds get more attention because of the connection to the vast acreages of GR crops and because of the rapid spread of GR Palmer amaranth across the U.S. A summary of GR weeds in the U.S. is shown in Table 2.

Table 2. Documented cases of glyphosate resistance in the U.S. as of November 1, 2014.

Year	Weeds	# of States
1998	Rigid ryegrass	1
2000	Horseweed aka Marestalk	24
2004	Italian ryegrass	7
2004	Common ragweed	15
2004	Giant ragweed	12
2005	Palmer amaranth	24
2005	Tall waterhemp	15
2007	Kochia	7
2007	Hairy fleabane	1
2007	Johnsongrass	3
2008	Junglerice	1
2010	Goosegrass	2
2010	Annual bluegrass	3
2012	Spiny amaranth	1

Although there are no documented cases of GR weeds in NY, there are reasons to believe that there are isolated GR weed populations in the state. Several years ago, there was a situation in western NY where a grower noticed giant ragweed in a soybean field on newly purchased land that had not been controlled with a normal glyphosate application. It turned out that the previous landowner had purchased a combine from Ohio where there have been documented cases of GR giant ragweed. Seed from the surviving giant ragweed were grown in the greenhouse and treated at 3 or 6 inches in height with from 22 to 88 fl oz/A of Roundup PowerMax. Some of the 3- and 6-inch giant ragweed survived up to 88 fl oz/A of Roundup PowerMax. There have also been reports of horseweed that is not controlled with normal glyphosate applications. Several states in the Midwest believe that GR Palmer amaranth was introduced on contaminated cotton seed imported for dairy rations. This was cause for alarm last summer when an unfamiliar pigweed was not controlled with a normal glyphosate application in Wayne County. It is now believed that the strange pigweed was tall waterhemp (*Amaranthus tuberculatus*). According to Anna Stalter, Associate Curator and Extension Botanist of the L. H. Bailey Hortorium Herbarium, tall waterhemp is considered native throughout NY, having spread from the Midwest. There are 17 specimens of tall waterhemp from NY in the herbarium collection dating from 1891 near Fort Ann in Washington County to 2005 near DeKalb in St Lawrence County. None are from west of Cayuga and Tompkins. On the other hand, Stalter says Palmer amaranth (*Amaranthus palmeri*) is not native in NY. However, there are two Palmer amaranth specimens from NY in the herbarium collection. One was from Corona on Long Island in 1936 and the other from Albany in 1949.

Herbicide Resistance Management

Effective herbicide resistance management, to avoid or control herbicide resistant weed populations, involves engagement of all involved in weed management decisions. Primary responsibility falls on the grower or crop consultant who must scout fields to determine if weed control practices are working and to identify and determine the reason(s) for weed escapes. Key elements of an effective grower/crop consultant weed management

plan includes some or all of the following practices;

- 1) Crop rotation and the use of hybrids/varieties with different genetic traits for herbicide resistance.
- 2) Cultivation of row crops to control escaped weeds.
- 3) Rotate or use herbicides with different sites-of-action over the course of the crop rotation.
- 4) Use tank mixes/premixes or sequential herbicide applications with different sites-of-action.

Chemical and seed companies, which are often one and the same, provide information and products that reinforce management practices for those who are on the front lines in this battle. Among these are: 1) including site-of-action group numbers on all herbicide containers, 2) developing and marketing premixes of herbicides with different sites-of-action, and 3) developing and marketing crops with multiple types of herbicide resistance/tolerance. It is this last item that is receiving much attention in this battle against herbicide resistant weeds. There are examples of crops with multiple types of herbicide resistance in the marketplace. Most everyone is familiar with SmartStax corn hybrids with resistance to glyphosate (Roundup etc.) and glufosinate (Liberty 280 SL) as well genetic traits for resistance to insects. In addition there are recently deregulated herbicide resistant crops with new combinations of herbicide resistance/tolerance traits and others under development.

Enlist Weed Control System

USDA deregulated Dow AgroSciences' new corn and soybean genetic traits on September 17, 2014 in the U.S. These traits include Enlist corn, Enlist soybeans, and Enlist E3 soybeans. Enlist corn is resistant to glyphosate (Group 9), glufosinate (Liberty 280 SL) which is a Group 10 herbicide, and postemergence "fop" grass herbicides such as Assure II (quizalofop) and Fusilade DX (fluazifop) which are Group 2 herbicides. Enlist corn is not resistant to the other postemergence "dim" grass herbicides such as Poast Plus (sethoxydim) and Select Max (clethodim) which are also Group 2 herbicides. In addition, Enlist corn will have robust tolerance to 2,4-D (Group 4). Enlist soybeans and Enlist 3E soybeans will be resistant to glyphosate, 2,4-D, and glufosinate (Liberty 280 SL). These genetic traits were developed in conjunction with development of a new 2,4-D choline salt formulation that has very low volatility and other formulation improvements compared with amine and ester formulations of 2,4-D. This new 2,4-D formulation, with Colex D Technology, will be premixed with glyphosate for postemergence use on Enlist crops and marketed as Enlist Duo. Enlist Duo was registered for use by the EPA on October 15, 2014. This technology has been approved for six Midwestern states in 2015 and an additional ten states will likely be approved by the end of the year.

Roundup Ready Extend Crop System

It's expected that USDA will deregulate Monsanto's Roundup Ready 2 Xtend soybeans in 2015 with commercial launch in 2016. Meanwhile, China has agreed to consider Monsanto's request for allowing imports, and as you know, this is an important consideration. Roundup Ready 2 Xtend soybeans have resistance to glyphosate, a group 9 herbicide and to dicamba, a group 4 herbicide. These Monsanto genetic traits will be used in conjunction with new herbicide products, Roundup Xtend, a premix of glyphosate and dicamba, and a dicamba only herbicide XtendiMax. The dicamba in these Monsanto products will be the diglycolamine (DGA) formulation, the same formulation that's in Clarity. However these new products will have components that will make them less volatile than Clarity. BASF will introduce Engenia, a new dicamba formulation with less volatility than the DGA formulations, which can be tank mixed with any glyphosate product. Other dicamba formulations will not be labeled for use on Roundup Ready 2 Xtend soybeans.

HPPD Tolerant Soybeans

Bayer CropScience is developing Balance GT soybeans that will convey tolerance to the HPPD inhibiting herbicide Balance (isoxaflutole), a Group 27 herbicide, and to the EPSP synthase inhibitor glyphosate, a Group 9 herbicide. Bayer will have a herbicide product, Balance Bean (isoxaflutole), to use in conjunction with Balance GT soybeans. Balance herbicides are not registered for use in NY State. While USDA has deregulated the Bayer trait for HPPD tolerance in the U.S., these HPPD tolerant soybeans will not likely be commercialized until 2017

or 2018. It's expected that the HPPD and glyphosate resistance traits will eventually be stacked with glufosinate (Liberty 280 SL) resistance. In addition, Bayer and Syngenta are co-developing a different event for HPPD resistance known as MGI (mesotrione, glufosinate, and isoxaflutole) which would convey tolerance to the HPPD inhibitors Callisto and Balance Bean, and to the glutamine synthase inhibitor Liberty 280 SL, a Group 10 herbicide.

NOTES

Who put those genes in my food??
Facts and myths about genetically engineered crops

Margaret Smith
Plant Breeding and Genetics
School of Integrative Plant Science, Cornell University

Field Crop Dealer Meetings, 12 November 2014

Genetically engineered organisms (or what many call GMOs – genetically modified organisms) have hit the headlines recently. There have been splashes about new genetically engineered (GE) crop types, proposed labeling legislation, and even shocking photos claiming to show animals harmed by consuming GE crop feeds. What are these crops, how are they produced, and what scientific information do we have regarding the concerns raised about them? This presentation will try to answer these questions.

Genetic engineering is a new tool for breeding improved crops. Now that science has allowed us to understand the genes that control inheritance, it is possible to identify the genetic code in an organism that causes it to produce a particular product. For example, the bacterium *Bacillus thuringiensis* (long sold as a bacterial insecticide under names like “Dipel” and “Thuricide”) can infect and kill certain caterpillar- and beetle-type insects. Researchers found the gene in this bacterium that codes for the protein that is transformed into a toxin inside an insect gut. They cut this gene (called the Bt gene) out of the bacterial genetic material and inserted it into crops like corn and cotton to make them insect resistant. That is how genetically engineered Bt corn and Bt cotton were produced. For each insect, a slightly different variant of the bacterial Bt gene is used based on which one is most effective against each insect species. In corn, for example, there is a Bt-corn borer gene that is slightly different from the Bt-corn rootworm gene. Both of these genes are built into many commercially-available GE corn varieties.

A similar process was used to create GE plants that are able to tolerate being sprayed with herbicides that are normally toxic to plants. These include genes for resistance to glyphosate and glufosinate (both originally found in naturally-occurring soil bacteria). Herbicide resistance from these genes (particularly glyphosate resistance) has been built into many GE crops, including soybean, corn, cotton, canola, alfalfa, and sugarbeet. Recently, GE crops with resistance to isoxaflutole (2, 4-D) have also been developed and are in the queue for commercialization approval.

Virus resistant GE plants (papaya, green and yellow summer squash) have been created using the gene that codes for a virus’s coat protein. This process parallels the way vaccinations work for human diseases. The disease-causing genetic material of the virus is left out, but the coat protein gene, when inserted into and expressed by the plant, causes the plant to be immune to infection by the virus.

So how does genetic engineering differ from “traditional” plant breeding? (“Traditional” plant breeding means the kind of selection and breeding practiced by early farmers and by plant breeders, exclusively so through the 1980s and continuing on to this day – cross pollinating different parent plants and finding offspring from those crosses that are superior.) The GE crop varieties cultivated commercially today were created by moving individual genes between organisms that could not naturally cross pollinate (like a soybean and a bacterium). For many years, plant breeders have made crosses between crops and their wild and weedy relatives to transfer genes for traits like pest resistance to the domesticated crops, so this process is not entirely new. However, traditional plant breeders are limited to transferring genes between organisms that are so closely related that they can be sexually crossed. A second difference is that in making sexual crosses, all the genes present in each of the parents are mixed together in the offspring, and those can include desired genes and any others that come along with them. Genetic engineering introduces only one or a few genes and genetic sequences needed for their identi-

cation and expression. In that way, GE approaches may be described as more precise than traditional breeding. Lastly, the ability to identify and manipulate individual genes has led to the legal right to patent genes, so most GE traits are patented and their use is legally constrained by the patent holder.

There are also similarities between traditional plant breeding and GE approaches. Both depend on variation or changes in the genetic sequence to create crops that are more useful in agriculture. Both approaches aim to modify crops to better meet human needs. Finally, it is not new that private companies seek a return on their investments in plant breeding research. With traditional plant breeding, they were able to do that through plant variety protection laws and through marketing hybrid varieties that require annual seed purchases. With genetic engineering, the option of patenting genes has provided another avenue for the private sector to seek a return on their investment. Thus, although genetic engineering is a distinct new tool for plant breeding, it shares some of the same fundamental elements as traditional plant breeding: genetic variation as the basis, improving crops to better meet human needs as the goal, and mechanisms to ensure a return on private sector research investments.

Concerns about GE crop varieties include how widely used they are, where and how extensively they enter our food system, their food and feed safety, their environmental impacts, whether they should be labeled in food products, how they play into consolidation of agricultural industries and profits, and whether the technology used to produce them is “right” to do. Some of these are scientific questions, but some are not. No amount of scientific study will tell us how much consolidation in an industry is too much, or whether a technology is “right” or “wrong” to use. Those are societal value judgments that are implemented through government policy-making. Science can help us understand the prevalence, impacts, and safety of GE crop varieties, but it can only help to inform the debate on concerns that are not fundamentally scientific in nature.

U.S. Department of Agriculture data shows that for field corn, cotton, and soybean, 90% or more of U.S. acreage is planted to GE varieties. Clearly there has been widespread acceptance and use of GE varieties for these three crops. GE sugar beets are reportedly planted on 95% of U.S. sugar beet acreage and GE papaya on 75% of Hawaii’s papaya acreage, although these figures could not be fully confirmed. GE sweet corn is grown, but acreage data is hard to come by. Beyond these few cases, there are only a handful of other crops for which GE varieties are grown commercially (canola, alfalfa, green and yellow summer squash), and U.S. acreages for these are limited.

Adoption of GE varieties of corn, cotton, and soybean has led to environmental benefits, according to a study by the National Research Council of the U.S. National Academy of Sciences. These include reduced insecticide use in corn and cotton, a slight increase in herbicide use but a major shift from more environmentally damaging herbicides to one that is considered less damaging (glyphosate), and increased use of reduced tillage. Some concerns loom as well, including evolution of glyphosate resistance in a growing number of weed species and potential Bt resistance in corn rootworms. Careful stewardship of GE pest management tools is essential, just as for other pest management tactics. GE resistance is not a silver bullet that can be used widely and repeatedly without raising concerns about resistant pests. That is an integrated pest management lesson that we have long known but need to remember!

When people ask whether they are consuming foods that are produced from GE crop varieties, the answer is clearly “yes.” Estimates are that 60% to 70% of processed, packaged grocery store foods probably contain one or more ingredients that were derived from a GE crop variety. Products made directly from field corn and soybeans would be the most obvious. However, there are many refined products and ingredients derived from corn, soybean, sugar beet, and cotton that are found in packaged and processed foods – so many, in fact, that it is difficult to pick up a random packaged product from a grocery store shelf and not find an ingredient from one of these crops in it. Since most U.S. acreage of these crops is planted to GE varieties, the 60% to 70% estimate for presence in packaged, processed foods seems plausible.

These figures can create concern about food and feed safety. However, after hundreds of studies comparing commercialized GE varieties and corresponding non-GE varieties, no credible scientific evidence of food or feed safety concerns has emerged. This does not suggest that all future products will be safe, but rather reflects the success of U.S. regulatory efforts to date. Clearly we must continue to evaluate new products and consider them on a case-by-case basis.

The prevalence of ingredients derived from GE crop varieties in our food supply has motivated some to call for labeling of all foods with GE-derived ingredients. The FDA has authority to label foods or feeds if their nutritional quality is altered or they present a potential food safety concern. With no evidence suggesting any difference in nutritional quality or safety between commercialized GE varieties and non-GE varieties, it is not clear what authority FDA would have to mandate labeling. Many of the ingredients from GE crop varieties that make their way into our foods are highly refined products – things like corn syrup, corn oil, cottonseed oil, soy lecithin, and even more highly purified compounds like niacin. These ingredients are chemically purified through the refining process, and thus do not contain any of the novel genetic material or protein resulting from genetic engineering. Corn syrup, for example, is just molecules of sugar and water – corn syrup from a GE variety is chemically identical to that from a non-GE variety. So most of the ways that ingredients from GE crop varieties get into our foods are via ingredients that will be no different than the same ingredient from a non-GE variety. To put a “GE ingredients” label on such products would say nothing about the actual contents of the package – only something about the process by which it was produced. Some want to know about that process. Others view such labels as equivalent to a skull and crossbones on a perfectly safe product. Given the contentious nature of the labeling debate and the many angles from which it can be viewed, the controversy seems unlikely to end soon!

NOTES

2014 FIELD CROP DEALER MEETING

held in collaboration with the NYSABA Annual Meeting

November 12, 2014

Holiday Inn Liverpool/Syracuse

441 Electronics Pkwy, Liverpool, NY 13088