Welcome to the Summer Burst of AG 101.

You should be able to hear music – and can control the MP3 Player shown in your view.

Program will begin at 1:00 PM.

**Kristen Saacke Blunk**, Penn State Cooperative Extension, Moderating

**Today’s Program – Pest Management**

**Weeds, Insects, and Disease**
Last Week - Session VII
• Field, Forage & Grains – Crop production and identification

This Week - Session VIII
• Pest Management – weeds, insects, fungus, virus, disease

Next Week - Session IX
• Specialty Crops – Vegetables, fruits, greenhouse production
AG 101 Summer Burst

Session XI
- Wood Crops, Agroforestry, and Woodlot Management

Session XII
- Special Topics – whole landscape approaches, riparian systems, adaptive management

Summer Burst Farm Visits
Today’s Program –

Pest Management

Insects & Weeds

Ed Rajotte
Professor of Entomology and PM Coordinator
Penn State Entomology

John Tooker
Assistant Professor of Entomology and Extension Specialist
Penn State Entomology

Bill Curran
Professor of Weed Science
Penn State Crop and Soil Sciences
Integrated Pest Management: A brief Introduction

Ed Rajotte
Professor of Entomology
Components of Lecture

- History of Pest Management
- Define IPM
- Tactics and Goals of IPM
- IPM Decisions
- IPM Program Implementation
History

- Pre-pesticide era
  - Accepted large losses and contaminated food
  - Labor intensive control
    - Burning
    - Weeding
History

- Pesticide era
  - Late 1800s
  - Rapid adoption of ‘miraculous technology’
- Things started to go wrong
  - Non-target species impacts
    - Released secondary pests
    - Wildlife affected
  - Pest resistance to pesticides
  - Contamination of soil and water
  - Human health impacts
History
Rachel Carson
Environmental awareness 1960s
New laws, regulations, agencies
IPM born to address these issues
I - P - M

- Examine each term
- P = Pest
- What is a pest?
  - Any organism negatively affecting humans or their property
  - Insects, mites, fungi, virus, bacteria, weeds, mammals
Pest Environments

Where can you find pests?

Farms, forests, houses, schools, ..... anywhere!
Pest Attributes
Human construct
Situational
M = Management

- Suppress pests to tolerable limits
  - Economically tolerable
  - Aesthetically tolerable
  - Protect Human Health
- Prevention before remediation
I = Integrated

- Integrated across pest types
  - Usually threatened by more than one species
- Integrated Tactics
- Integrated Goals
Integrated Tactics

- **Biological** - organism against organism (predators, parasitoids, etc.)
- **Cultural** - pest habitat modification (cover crops, planting date, tillage, etc.)
- **Host plant resistance** - classical, transgenics, etc.
- **Mechanical** – barriers (screens, fans, etc.)
- **Legal** - quarantines, noxious weed list, port inspections, etc.
- **Chemical** - pesticides, pheromones, etc.
  - Only when necessary
  - Least toxic selection
- **Genetic** - sterilization

- Only when necessary

- Least toxic selection
Integrated Goals

- Economics
- Environment
- Social Welfare

Management Philosophy
- Conventional
- Sustainable
- Organic

All IPM decisions involve these goals
Six steps in IPM decision

- Pest Identification
  - Estimated 10 million species of insects
    - Worldwide, less than 2000 species are pests (<.02 %)
- Threat Assessment
  - Monitoring (scouting)
  - Damage Potential
- Tactic(s) selection
- Tactic application
- Evaluation of results
- Record keeping leading to planning
Decision Criteria

- Thresholds
  - Economic
  - Aesthetic
  - Public/Animal Health Guidelines
Economic Threshold

Above EIL, benefit > cost

Below EIL, cost > benefit

Pest population without control

Control
Decisions in Time and Space

- Short, medium and long timeframes
  - Week, season, years
- Small, medium and large management units
  - Field, farm, community
IPM Implementation

- Changing human behavior
- Tools
  - Regulation
    - Incentives
    - Disincentives
  - Marketplace
- Informed citizen and consumer
NRCS Connection

- Create crop-specific practice descriptions
- Work with NRCS to develop guidelines and contractual language for EQIP, AMA, CSP, etc.
- Educate NRCS personnel about practices and practice evaluation.
More information

- Pennsylvania IPM Program
  - [http://paipm.cas.psu.edu](http://paipm.cas.psu.edu)
- Pest Problem Solver
  - Livestock Pest Problem Solver - Veterinary problems, Poultry, Dairy Cattle, Horses, etc.
- NRCS EQIP/AMA IPM guidelines
  - [http://extension.psu.edu/ipm/resources/nrcs](http://extension.psu.edu/ipm/resources/nrcs)
AG101:
Management of Insect Pests in Field and Forage Crops

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Integrated Pest Management (IPM)

Goal = Reduce pest populations to less than damaging numbers

- Knowledge intensive approach
  - Host / pest biology
  - Multiple tactics in addition to chemical control
  - Economic thresholds
  - Monitoring of pest/beneficial populations

- Scouting guides decisions
Scouting

Best way to detect a pest problem / evaluate natural enemies

• Get into field and look
  • Specific sampling protocols
  • Informed decisions
  • Accurate time management tactic
PA Field Crops & Insects

Dominant Crops in PA

- **Corn**
- **Alfalfa**
- **Soybeans**
- **Wheat**
- **Oats**

Each crop species has its own suite of insect pests
Alfalfa

Perennial crop

• 4-7 yrs of productivity
• Cut ~3 times per year
• Can harbor good populations of natural enemies
• Resistant varieties

Most important insect pests

• Alfalfa weevil
• Potato leafhopper
  • Neither is in every year in every field

Scouting is the key
Pin-Hole Damage Caused by Alfalfa Weevil Larva

Alfalfa Weevil Larva
Alfalfa Weevil

• Injury occurs primarily on the 1st crop of the year
• Yield impact declines as alfalfa height increases
  • 1 larvae/stem on 12” alfalfa = 0.4 tons/acre loss
  • 1 larvae/stem on 16” alfalfa = 0.1 tons/acre loss
• Concentrate scouting on early growth stages (< 12” tall)
  • Check fields early, often
• Once alfalfa reaches 16” or more in height, early cutting is often best control option
Control decisions depend on:

1. Alfalfa height
2. Value of the hay
3. Insecticide treatment cost
4. Number of larvae per stem
Three parasitic wasps attack weevil larvae:

*Bathyplectes curculionis*, *B. anurus*, and *Microctonus colesi*

- Introduced by USDA to control alfalfa weevil
- Overuse of insecticides can disrupt control they provide
Potato Leafhopper on Alfalfa
Migrates up from the southern states on storm fronts
Life cycle (eggs to adults) takes about 3 weeks
3 or 4 generations during the summer
Activity usually peaks in July and declines in mid August.
Potato Leafhopper on Alfalfa

- Rarely a problem on the first crop, tends to infest second crop
- Heavy infestations stunt growth, reduced yield (current, subsequent crops)
- Populations worse when it is hot and dry
  - Damp weather favors fungal pathogens
- Control options:
  1) Grow resistant varieties; 2) early harvest; 3) insecticides
After first cutting, scout weekly, use thresholds

- Treatments must be applied before yellowing begins
- If yellowing appears, harvest immediately; this conserves beneficial organisms
- Harvest early if >60% bud stage or > 28 days since last cutting
‘Drivers’ of corn IPM

European corn borer

Corn rootworm
‘Drivers’ of corn IPM

European corn borer  Control now rarely involves IPM

Corn rootworm  Easily controlled in PA via crop rotation
European Corn Borer Damage

- Larvae can bore into any area on the corn plant
  - Frass found around outside of entrance holes
- Damage to the whorl or stalk is sign of ECB activity
- Stalk feeding interrupts nutrient flow, can break stalk
European Corn Borer

- U.S. losses estimated as high as $1 billion
- In 2001 losses in northeast estimated at $35 million
European Corn Borer Control

- Control used to be challenging
  - Minimize number of overwintering sites – tillage
  - Monitor populations with pheromone traps / black lights
  - Spray when adults active

- Pest for which transgenic Bt corn was developed

- Transgenic, insect-resistant varieties (Bt) are now widely used
  - Cost-effective for areas with large populations
    - Bt varieties kill 99.9% of ECB larvae
  - Non-Bt Refuge is required
    - Reduces risk of resistance development
    - Refuge: 5-20% of Bt acreage has to be in non-Bt seed
Bt corn varieties

Plant contains a toxic protein (gene was isolated from *Bacillus thuringiensis* [Bt])

**Bt mode of action**

1. Bt Gene is inserted into crop
2. Crop is infected by European corn borer
3. Pest dies when feeding on any plant part
4. (Image of caterpillar and plant)
Bt corn varieties

• Engineered to be insect resistant

• *Bacillus thuringiensis* (Bt) - naturally occurring soil bacterium
  
  • Produce crystaline proteins (insecticidal endotoxins; *cry* genes)
  
  & vegetative insecticidal proteins (*vip* genes)
    
    • Toxin damages the gut lining, leading to gut paralysis
    
    • Inserted into plants
    
    • Very specific (some caterpillar species or rootworm larvae)

• Bt is considered safe to people and wildlife
Bt corn varieties

Non-Bt refuge is required by law (5-20% of acreage)
Bt corn lines

- Effective insect management tools
- 2009: 63% of corn in US was genetically modified

http://www.ers.usda.gov/data/biotechcrops/

Data for each crop category include varieties with both HT and Bt (stacked) traits. Sources: 1996-1999 data are from Fernandez-Cornejo and McBride (2002). Data for 2000-09 are available in tables 1-3.
Bt corn: Progression of Development

Started as Bt gene vs. European corn borer
- Some activity against a few other caterpillars
- Offered Bt gene against corn rootworm
- Then both types of Bt in one variety
- Then Multiple modes of action
- Now some varieties have six genes vs insects

**Agrisure Viptera™ 3111 Trait Stack: Multi-Pest Control**

- Breakthrough control of the multi-pest complex
- First VIP in corn
- New tool for resistance management
- High-performance triple stack
- Proven control of corn borer, corn rootworm
- Tolerance to both glufosinate and glyphosate herbicides

**Multi-pest control of:**
- European corn borer
- Corn earworm
- Northern corn rootworm
- Western corn rootworm
- Black cutworm
- Western bean cutworm
- Fall armyworm
- Dingy cutworm
- Mexican corn rootworm
- Southwestern corn borer
- Southern cornstalk borer
- Common stalk borer
- Beet armyworm
- Sugarcane borer
Data from USDA/NASS:
http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1002
Seed prices are in the April reports each year.
IPM usually not involved in current corn production:

- Bt varieties are deployed with little regard of pest population
- Many growers use Bt varieties as a form of ‘insurance.’

Need to remember:

Bt varieties: protect against some, not all, pest damage

- No protection from:
  - Slugs, wireworm, seedcorn maggot, true armyworm

To combat these other mostly early season pests:

- Most seed comes seed-applied insecticide
  - Systemic neonicotinoids that protect seedling for ~45 d
  - Also deployed with little regard for pest population
Brown marmorated stink bug

Images from Steve Jacobs
Brown marmorated stink bug

Native to China, Japan, Korea

- Occasional pest of fruit, soy, homes

Discovered near Allentown (1998)

High populations first reported in 2001
Brown marmorated stink bug

Images from Steve Jacobs & Gerald Brust, UKY, UDel
Brown marmorated stink bug:

- Feeds on hundreds of plant species
- Already disrupting effective IPM programs in tree fruit
- Large populations in corn & soybean (nursery crops?)
- If populations continue to grow, this pest could require 1000s of acres of crops to be sprayed with insecticides

Promises to change pest management in a wide range of crops
Integrated Pest Management in Field Crops

- Requires knowledge of local populations
- Scouting is key
  - Works well for alfalfa
- Technology is allowing corn growers to avoid IPM
- IPM can still provide insight
  - Are Bt varieties necessary if pest populations drop?
  - Can growers save money by planting non-Bt varieties?
  - IPM will help guide approach to new pests
AG 101 – Weed Management

Bill Curran
Professor of Weed Science
Crop and Soil Sciences
2011
What is a weed

• A plant out of place
• A plant growing where it’s not wanted
• A plant whose virtues have not yet been discovered
• Plants that are competitive, persistent, pernicious, and interfere negatively with human activity
Weeds

- Most fields contain many different species – (10 - 20)
- Produce large numbers of seeds (2000 - >100,000)
- Produce viable seeds under adverse conditions
- Seeds exhibit periods of dormancy
- Seeds buried in the soil can remain viable for years
- Seeds survive adversity – freezing, drought, fire, animal digestion, etc.
- Seeds can be difficult to detect in or remove from crop seed
- Some seeds and fruits have adaptations that aid in dispersal
Managing Weeds

• The first step in managing a weed problem is proper identification
Weed ID resources

Lots of websites
• www.weeds.psu.edu

Print
• Weeds of the Northeast
• Newcomb’s Wildflower Guide
• Many others

Purchasing information for selected weed ID resources

Weeds of the Northeast (~$30)
• Barnes and Noble
• Amazon.com
• Cornell University Press, cupress-sales@cornell.edu or by calling 607-277-2211

Newcomb’s Wildflower Guide (~$15)
• Barnes and Noble
• Amazon.com
Life history

• Annual

• Biennial

• Perennial
Problem Weeds of the Northeast

• Annual Broadleaves
  – Lambsquarters
  – Velvetleaf
  – Burcucumber
  – Ragweed
  – Horseweed (marestail)

• Annual Grasses
  – Foxtails
    • Giant and yellow
  – Crabgrass
    • Large and smooth
  – Shattercane

• Biennials
  – Burdock
  – Wild carrot
  – Bull and Musk thistle
  – Garlic mustard

• Perennials
  – Dandelion
  – Pokeweed
  – Canada thistle
  – Multiflora rose
  – Johnsongrass
  – Yellow nutsedge
Annual weeds
Common lambsquarters
(*Chenopodium album*)

- Summer annual
- Native to Eurasia
- Reproduces by seed
  - 72,000 seeds/plant
  - Seeds can remain viable for many years in the soil
- Emerges from mid-April to mid-June
- Common in all tillage systems
Common chickweed

(Stellaria media)

- Winter annual
- Native to Europe
- Reproduces by seed
  - 3,000 - 5,000 seeds/plant
- Emerges from late-August to spring
- Common in winter annual crops, perennial forages, and no-till tillage systems
Biennial weeds
Common burdock
(*Arctium minus – sunflower family*)

- Biennial
- Native to Eurasia
- Key features
  - Large, wavy, heart shaped leaves
  - White hairs on stems and leaves
  - Branched stems
  - Burs have purple flowers and hooks
    - Inspiration for Velcro
  - Forms rosette
Perennial weeds
Perennial structures

- Stolons
- Rhizomes
- Budding roots
- Bulbs
- Tubers
Canada thistle

*(Cirsium arvense—sunflower family)*

- Native of Europe
- Aggressive, creeping perennial
  - Reproduces by seeds and extensive root system
  - Deep rhizomes below 2 feet can escape tillage
- Wavy, spiny, hairless leaves; pink flowers
  - 2-4 feet tall plant
  - No spines on stalk
- Troublesome in cultivated crops (esp. reduced tillage systems), pastures, roadsides
Factors influencing weed management in PA

• Diverse agriculture – many crops
• Annuals often mixed with perennials
• Corn grown in the same field for 3-4 years
• More Roundup Ready crops being grown
• Increased adoption of no-till and cover crops
• Manure a blessing and a curse
What’s this mean?

• Diverse agriculture helps curb potential weed problems – compared to monoculture or even two-crop system
• Growing the same crop in the same field for several years promotes the potential for weed problems – herbicide resistance
• Using the same herbicide(s) repeatedly selects for herbicide resistant weeds – glyphosate and RR crops
• No-till eliminates a very powerful weed management tool and increases herbicide use.
• Adding manure ensures plenty of annual weed seeds back into the system
Weed management tactics

• **Chemical**
  – Herbicides

• **Mechanical**
  – Primary and secondary tillage
  – Cultivation
  – Hand weeding
  – Thermal weed control

• **Biological**
  – Insects
  – Diseases

• **Cultural**
  – Crop rotation
  – Rotational tillage
  – Cover crops - dead mulches and green manures
  – Cover crops - living mulches
  – Planting date
  – Crop residue management
  – Irrigation and drainage
  – Planting arrangement and density
  – Crop cultivar selection
  – Intercropping
  – Fertilization
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PA Herbicide Use
(source: USDA-NASS)

• Corn – 92% treated in 2004
  − 87% atrazine
  − 59% metolachlor
  − 53% pendimethalin
• Soybean – 99% treated in 1999
  − 81% glyphosate (1999)
• Snap beans – 95% treated in 2004
• Sweet corn – 93% treated in 2004
• Potatoes – 96% treated in 2003
• Pumpkins – 84% treated in 2004
• Wheat – 21% treated in 2000
# Common corn herbicides

**Soil applied**

- Bicep
- Cinch ATZ
- Degree Xtra
- Guardsman Max
- Harness Xtra
- Keystone
- Generics
- Lumax
- Lexar
- Balance Flexx
- Radius *(non-atrazine premix)*
- Corvus *(non-atrazine premix)*
- Hornet
- Prequel
- Prowl
- SureStart/TripleFlex *(non-atrazine premix)*
- Sharpen/Verdict *(non-atrazine premix)*

**Post**

- Atrazine
- Callisto
- Distinct/Status
- Glyphosate
- Halex GT *(non-atrazine premix)*
- Impact
- Laudis/Capreno
- Ignite
- NorthStar
- Option
- Resolve
- Resolve Q
- Spirit
- Steadfast (Q)/Accent (Q)
- Yukon

> 100 products labeled for corn
Herbicides – practical benefits

• Facilitate no-till
• Allow earlier establishment
• Reduce time and energy
• Provide consistency/rescue
• Reduce the need for crop diversity/rotation - specialize
• Cost effective
Nicosulfuron control of shattercane in corn

Glyphosate control of volunteer corn in RR corn
Negative consequences of herbicides

• Herbicides are pesticides with inherent dangers
• Air and water pollution
• Human and other non-target exposure
• Requires energy inputs to produce and use
• Indirect effects - litigation, residue testing, waste disposal, etc.
• Cost effective?
Where to find herbicide use information?

• Manufacturer’s label
• University performance guides – Cooperative extension
• Private sector publications
• Experts – public and private
• Manufacturer’s marketing brochures
The **Penn State Agronomy Guide**

- 2011-12 version recently printed
- Contains information in two sections:
  - **Crop and soil management**
    - Soil and soil fertility management
    - Specific agronomic info on commodities
      - Corn, sorghum, soybean, small grains, forages
    - Storing seed and grain
    - Cover crops
    - Farm budgets
    - Organic crop production
  - **Pest Management**
    - Weed, insect, disease management in each of the commodity areas

http://agguide.agronomy.psu.edu/
## Comparison of POST grass herbicides – PSU Agronomy Guide

<table>
<thead>
<tr>
<th>Species</th>
<th>Accent</th>
<th>Basis Gold</th>
<th>Steadfast</th>
<th>Option</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crabgrass</td>
<td>7</td>
<td>7+</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>F. panicum</td>
<td>9</td>
<td>9</td>
<td>9</td>
<td>8+</td>
</tr>
<tr>
<td>Gi. foxtail</td>
<td>9</td>
<td>9</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>Yel. foxtail</td>
<td>9</td>
<td>8</td>
<td>9</td>
<td>7+</td>
</tr>
<tr>
<td>Shattercane</td>
<td>9</td>
<td>9</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>J-grass (rhizome)</td>
<td>8+</td>
<td>7</td>
<td>8+</td>
<td>8+</td>
</tr>
<tr>
<td>Wirestem muhly</td>
<td>7</td>
<td>6</td>
<td>6+</td>
<td>7</td>
</tr>
<tr>
<td>Y. nutsedge</td>
<td>6</td>
<td>6+</td>
<td>6</td>
<td>7+</td>
</tr>
</tbody>
</table>

7=65-75%; 8=75-85%; 9=85-95%
Agronomy Guide Comments

Part 2, Section 2 © Corn Pest Management

**Table 2.2-10. Preplant or preemergence herbicides for conventional, min-, or no-till corn (continued).**

<table>
<thead>
<tr>
<th>Herbicide</th>
<th>Application</th>
<th>Product/A</th>
<th>lb ai/A</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hornet 78.5WG (flumetsulam + clopyralid)</td>
<td>Preplant or preemergence</td>
<td>3–5 oz</td>
<td>0.13–0.21</td>
<td>Hornet is a mixture of flumetsulam (Python) + clopyralid (Stinger). The addition of clopyralid improves ragweed control and may help with Canada thistle. The medium soil texture rate is 5 oz/A. Hornet WDG may be used at 3 oz/A in combination with an atrazine/pre-grass herbicide premix. Apply at soil-applied rates to corn up to spike stage before weed emergence. Plant corn at least 1.5 inches deep, do use where soil pH is greater than 7.8, where organic matter is less than 1.5%, or when extended cool, not wet conditions exist. Apply all soil insecticides in a T-band or a band to avoid serious crop injury. Do not use if Counter insecticide was applied. See Table 2.2-17 for recrop restrictions. To prevent herbicide resistance, avoid repeated annual applications of soil-persistent ALS herbicides. See “Herbicide Resistance Management” in Part 2, Section 1 for more information. <em>(Water quality advisory)</em></td>
</tr>
<tr>
<td>Lexar 3.7SC (s-metolachlor + mesotrione + atrazine) or Lumax 3.95SC (s-metolachlor + mesotrione + atrazine) or Camix 3.67SC (s-metolachlor + mesotrione)</td>
<td>Preplant or preemergence</td>
<td>3.0–3.5 qt</td>
<td>2.78–3.24</td>
<td>Lexar and Lumax are mixtures of s-metolachlor (Dual II Magnum), mesotrione (Callisto), and atrazine. The typical use rates in all tillage systems are 3 qt/A Lexar and 2.5 qt/A Lumax. Lexar may be applied broadcast on up to 12-inch-tall corn and Lumax may be applied broadcast on up to 5-inch-tall corn, but prior to annual grass emergence. Do not apply more than 3.5 qt/A Lexar or 3 qt/A Lumax per growing season. Do not apply Callisto following Lexar, Lumax, or Camix during the same season. Do not apply Lexar or Lumax early post if the corn was treated with Counter insecticide. Do not tank mix Lexar or Lumax with organophosphate (OP) or carbamate insecticides and apply as a foliar post application. Do not make a foliar post application of any OP or carbamate insecticide within 7 days before or 7 days after a Lexar or Lumax application or severe corn injury may occur. Corn, soybeans, small grains, and sorghum may be planted the spring following Lexar or Lumax application. Camix is similar to Lumax, but contains no atrazine. The typical use rate is 2 qt/A. <em>(Restricted-use pesticide and water quality advisory)</em></td>
</tr>
</tbody>
</table>
Weed management tactics

- Chemical
  - Herbicides

- Mechanical
  - Primary and secondary tillage
  - Cultivation
  - Hand weeding
  - Thermal weed control

- Biological
  - Insects
  - Diseases

- Cultural
  - Crop rotation
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  - Cover crops - dead mulches and green manures
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Cultural Weed Control

• Crop rotation
  – disrupts pest and present alternatives

• Crop competition
  – variety selection
  – planting date
  – seeding rate
  – row spacing
  – soil fertility
  – smother crops

• Good farming practices
  – timely tillage
  – drainage
  – traffic control
“A healthy crop is my most important weed management tool”

• Timing of planting
  – Soil should be warm so that crop jumps out

• Variety selection
  – Crops with larger leaf area may compete better

• Crop population and row spacing
  – Close canopy as quick as possible

• Fertility management
  – Feed the soil, not the weed
Mechanical and Physical Weed Control

• Tillage
• Mowing
• Excavation
Tillage Systems and Weeds

• Type of tillage determines effect
• Annual tillage does little to reduced seedbank
• Plowing encourages larger seeded annuals (velvetleaf, cocklebur, burcucumber, etc.)
• No-till encourages small seeded annuals (foxtail, pigweed, lambsquarters)
• No-till encourages perennials
Weeds of no-till

• Small seeded annuals – need little seed to soil contact – chickweed, mustard, foxtail, panicum, lambsquarters, etc.
• Biennials – two year lifecycle with minimal soil disturbance – burdock, wild carrot, poison hemlock, etc.
• Perennials - live more than two years – dandelion, Canada thistle, quackgrass, etc.
Current challenges to no-till weed management in grain production

• Problem weeds
  – Herbicide resistant and tolerant biotypes
  – Certain perennials

• Lack of new herbicide modes of action
  – How to not overuse Roundup Ready

• Identifying long-term continuous no-till systems that are sustainable

• Discovering useful new technologies/practices that can improve no-till systems
Weed management tactics

- **Chemical**
  - Herbicides

- **Mechanical**
  - Primary and secondary tillage
  - Cultivation
  - Hand weeding
  - Thermal weed control

- **Biological**
  - Insects
  - Diseases

- **Cultural**
  - Crop rotation
  - Rotational tillage
  - Cover crops - dead mulches and green manures
  - Cover crops - living mulches
  - Planting date
  - Crop residue management
  - Irrigation and drainage
  - Planting arrangement and density
  - Crop cultivar selection
  - Intercropping
  - Fertilization
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Biocontrol of weeds

• **Classical** — Using a non-native control agent (usually an insect) to reduce an invasive weed.

• **Inundative** — Mass rearing of a microorganism that is released at high numbers to control native or invasive weeds. Very host specific.

• **Conservation** — Managing a system to increase the population(s) of natural weed suppressing organism(s). Multi-species control.

• **Grazing** — Using large herbivores to reduce weed populations. Non-selective control.
Pseudomonas sp. on Canada thistle

Pig and pigweed
Manage weeds throughout the year, not just as germinating seeds and seedlings – throughout their lifecycle – **it’s more than just herbicides**

- Seed decay
- Seed predation
- Seed aging
- Loss of seed dormancy
- Fatal germination
- Allelopathy
- Stale seedbed
- Mulches and cover crops
- Soil applied herbicides

- Physical control
- Post herbicides
- Crop competition
- Hand weeding
- Herbivory
- Seed removal
- Mowing
- Sanitation
Other Resources

• Pennsylvania IPM Program
  http://paipm.cas.psu.edu
  – Pest Problem Solver

• Livestock Pest Problem Solver - Veterinary problems, Poultry, Dairy Cattle, Horses, etc.

• NRCS EQIP/AMA IPM guidelines
  – http://extension.psu.edu/ipm/resources/nrcs
Other Resources

• Penn State Agronomy Guide  http://extension.psu.edu/agronomy-guide
• Upcoming events/trainings
  – Sustainable Cropping Systems Research Tour – Jun 22 at Rock Springs, PA  http://cropsoil.psu.edu/research/cropping-systems
Q&A on Pest Management

- Recording of this session will be posted in the “AG DIALOGUE” box, along with a pdf of today’s powerpoint AFTER the live session at http://breeze.psu.edu/AG101

- Registered participants will receive post program/pre-program assessment survey following each live session. To register – visit http://guest.cvent.com/e/d/vdq1f
NEXT on AG 101: Specialty Crops
How Pennsylvania grows fruits and vegetables: orchards, fields, greenhouses, high tunnels.

- June 23—1:00 to 2:30 PM at http://breeze.psu.edu/AG101
  - SPEAKERS: Dr. Ed Rajotte, Dr. John Tooker, and Dr. Bill Curran
- Register for AG101 at http://guest.cvent.com/d/vdqt1f