UNIVERSITY OF ILLINOIS EXTENSION

PREPARING A NEW GENERATION
OF ILLINOIS FRUIT AND VEGETABLE FARMERS

INTEGRATED PEST MANAGEMENT

focusing on plant diseases, insects, and weeds

Rick Weinzierl

May, 2014

Illinois Migrant Council

new ILLINOIS fruit & vegetable FARMERS

Integrated Pest Management (IPM)

- An approach that uses a range of practices that limit losses to pests (insects, pathogens, weeds, vertebrates) while minimizing the environmental damage, human health risks, and dollar costs associated with pest suppression.
  - Tactics include biological control, cultural controls, pest-resistant varieties, regulatory programs … and pesticides where needed and in ways that minimize their adverse effects

Illinois Migrant Council

University of Illinois Extension

new ILLINOIS fruit & vegetable FARMERS

Objectives

- Today …
  - Consider farm plans that minimize the likelihood of severe pest outbreaks … a theme that's repeated for all kinds of "pests"
  - Understand the basics of disease cycles, monitoring, and management
  - Understand the basics of insect life cycles, monitoring, and management
  - Understand the basics of weed life cycles, monitoring, and management
  - Know how to identify key references on identification, monitoring, and management so that you can build a library of resources
    - Examples for sweet corn, tomatoes, and apples
- Your longer-term goals …
  - Develop plans for integrated pest management in your crops

Illinois Migrant Council

UNIVERSITY OF ILLINOIS EXTENSION

new ILLINOIS fruit & vegetable FARMERS

More on IPM …

- Previous presentations and discussions on …
  - Basics of fruit and vegetable production
  - Variety selection
  - Transplant production
  - Pruning
  - Soils and soil fertility
  - Irrigation
  - Pesticides

  … all of these included components related to integrated pest management, and future presentations and discussions will do so as well.

Illinois Migrant Council

University of Illinois Extension

new ILLINOIS fruit & vegetable FARMERS

IPM is part of a farm plan that minimizes the likelihood of severe losses to pests and optimizes yields and profits…

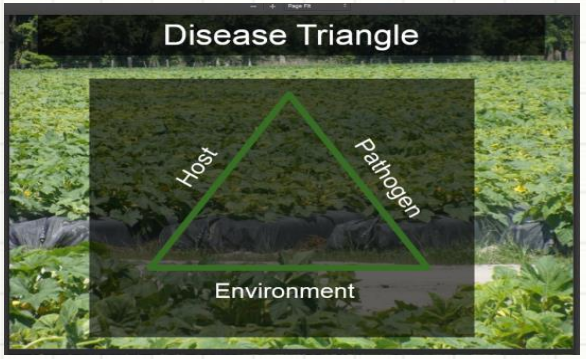
- Crop rotation
- Cover crops
- Appropriate tillage and soil management
- Diversification of plantings
- Well suited and disease-resistant cultivars
- Irrigation management
- Exclusion / avoidance
- Monitoring / record-keeping
- Direct control practices, including pesticides

Illinois Migrant Council

EXTENSION

new ILLINOIS fruit & vegetable FARMERS

Basic Concepts in Plant Pathology, by J.R. Hartman.
http://www.hort.purdue.edu/mg/pubs/DiagnosisBasicConcepts.pdf



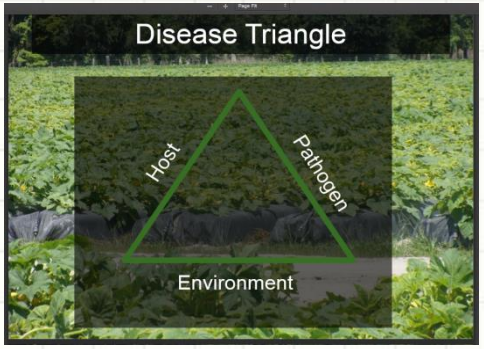
- Types of plant diseases
  - Abiotic noninfectious diseases
  - Infectious diseases
    - The disease triangle
      - Susceptible host plant, infective pathogen, and conducive environment
    - Diseases caused by fungi, bacteria, viruses, and nematodes
  - Disease symptoms and signs
  - Controlling diseases
    - Avoidance, exclusion, eradication, protection, resistance, and “therapy”

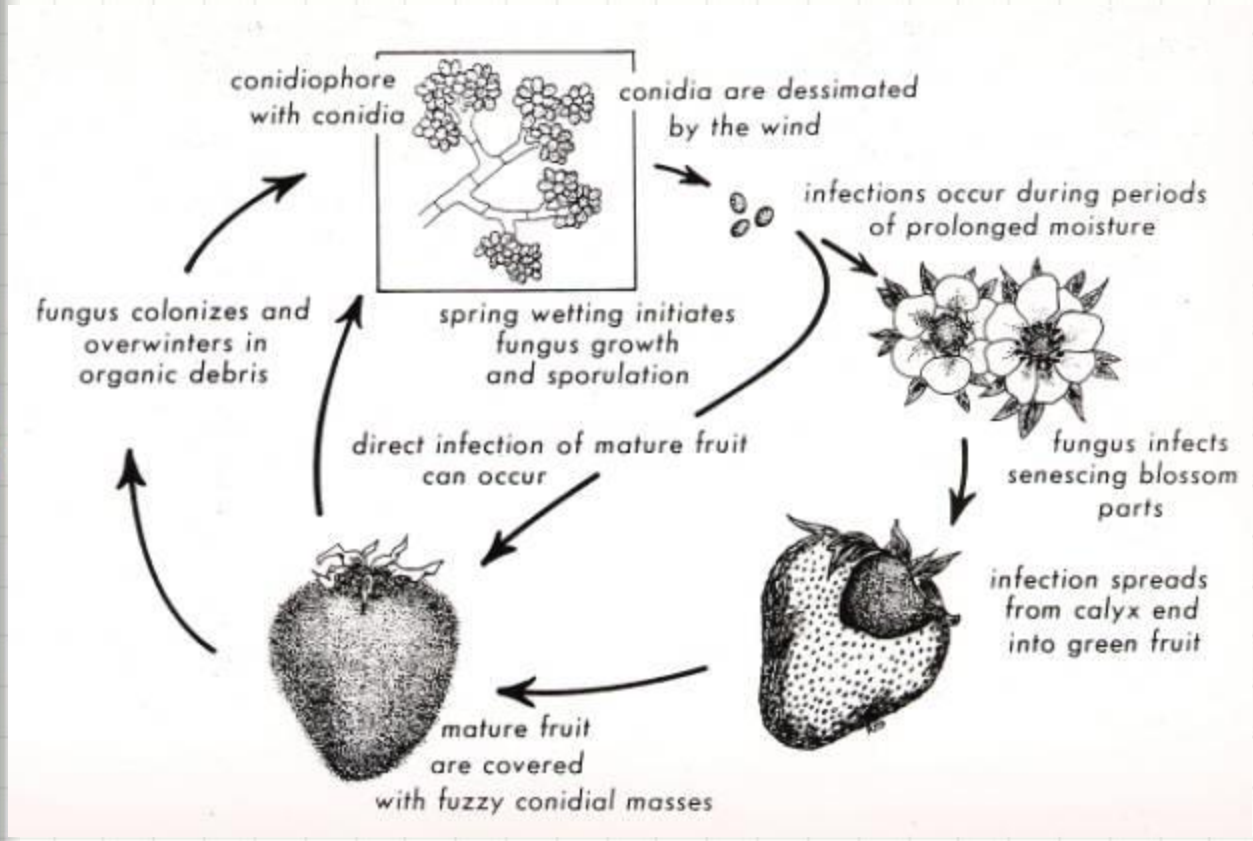
Illinois Migrant Council

UNIVERSITY OF ILLINOIS EXTENSION

new ILLINOIS fruit & vegetable FARMERS

Disease cycle: Gray mold (*Botrytis*) on strawberries





Illinois Migrant Council

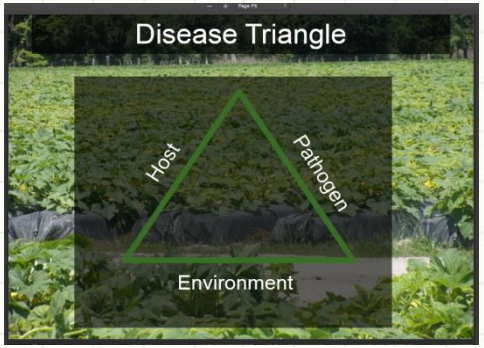
University of Illinois Extension

new Illinois fruit & vegetable FARMERS

Monocyclic versus polycyclic diseases

- Polycyclic = Compound interest … several infection cycles per season – gray mold, powdery mildew, brown rot in stone fruits
- Monocyclic = Simple interest … one infection cycle per season – soil-borne pathogen infections such as those caused by *Fusarium*, also peach leaf curl in peaches

Controlling plant diseases …



- Avoidance
  - By geographic area (climate), planting date, topography and drainage, disease-free planting stock, crop rotations
- Exclusion
  - By disease-free planting stock, quarantines, exclusion of insect vectors
- Eradication
  - (Or at least reduction in inoculum) By crop destruction, crop rotation, fumigation or other soil treatments
- Protection
  - By application of fungicides or bactericides, habitat modification (high tunnels), control of insect vectors
- Resistance
  - Usually not immunity, slowing disease progress can be adequate
- Therapy
  - Removal of diseased plant parts

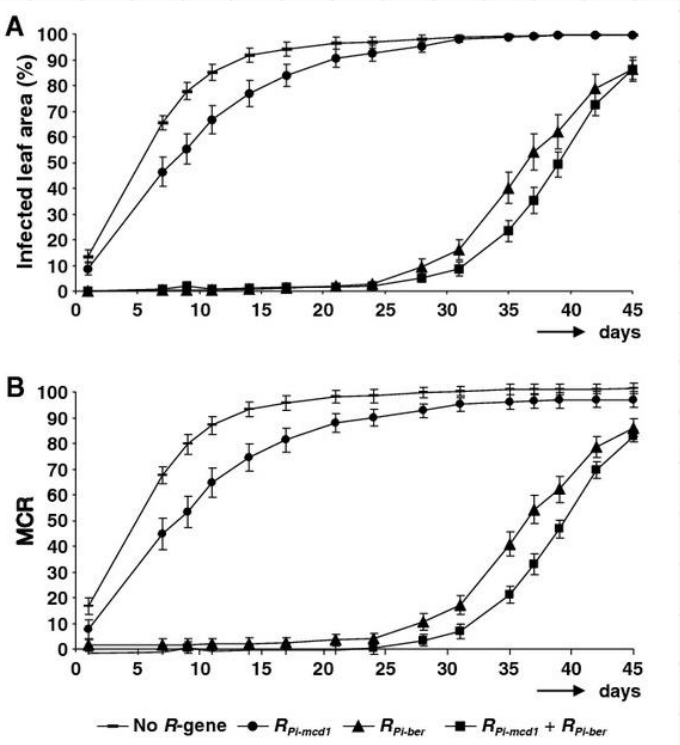
Illinois Migrant Council

UNIVERSITY OF ILLINOIS EXTENSION

new ILLINOIS fruit & vegetable FARMERS

Using resistant varieties slows disease progression

- Late blight disease progress curve showing the proportion of leaf area infected across 45 days post infection (dpi) of the four groups of pyramiding population RH03-424; without R_{pi}-genes, with $R_{Pi\text{-}mcd1}$ present, with $R_{Pi\text{-}ber}$ present, and containing both R_{pi}-genes $R_{Pi\text{-}mcd1} + R_{Pi\text{-}ber}$. Error bars indicate the standard error of the mean. **a** Uncorrected disease progress using values as observed in the field. **b** Disease progress values using maturity corrected resistance (MCR) values. From: **The effect of pyramiding Phytophthora infestans resistance genes R Pi-mcd1 and R Pi-ber in potato** , by Tan, M. Y. Adillah; Hutten, Ronald C. B.; Visser, Richard G. F.; Eck, Herman J. Theoretical and Applied Genetics **Vol.** 121 **Issue** 1.



Illinois Migrant Council

University of Illinois Extension

new Illinois fruit & vegetable FARMERS

Examples of plant disease resources

- ***Cornell's Vegetable MD*** online site focusing on plant diseases http://vegetablemdonline.ppath.cornell.edu/
- ***Midwest Small Fruit Pest Management Handbook***
  - http://pested.osu.edu/documents/CommStudy/2b%20Midwest%20Small%20Fruit%20Pest%20Mgmt..pdf
- ***Midwest Tree Fruit Pest Management Handbook***
  - http://www2.ca.uky.edu/agc/pubs/id/id93/id93.htm
- Tomato diseases
  - http://www.extension.iastate.edu/publications/pm1266.pdf
  - http://aggie-horticulture.tamu.edu/vegetable/tomato-problem-solver/

Illinois Migrant Council

UNIVERSITY OF ILLINOIS EXTENSION

new ILLINOIS fruit & vegetable FARMERS

- The University of Illinois Plant Clinic
  - http://web.extension.illinois.edu/plantclinic/

Background information on insect pest management

- ***Introduction to Applied Entomology***
  - http://cpsc270.cropsci.illinois.edu/syllabus/ … early topics cover biology / identification; later topics cover insect pest management; lab 10 (http://cpsc270.cropsci.illinois.edu/syllabus/lab10.pdf) covers fruit and vegetable insect management
- **Garden Insects of North America.** W. Cranshaw. ISBN: 9780691095615. 672 pp. 1,400+ color photos.
  - An excellent general reference with lots of illustrations.

Illinois Migrant Council

University of Illinois Extension

new ILLINOIS fruit & vegetable FARMERS

Things to know about insect pests and their natural enemies

- Insect life cycles
  - Univoltine (1 generation per year) versus multivoltine (2 or more generations per year)
  - Complete versus gradual metamorphosis
  - Chewing versus piercing/sucking mouthparts
  - Structure of legs and wings
- Phenology
  - Relationship between development and degree-days
- Direct versus indirect pests
  - Direct pests feed on the part of the crop we harvest – especially important for fruits and vegetables because of cosmetic standards. Indirect pests feed on "supporting" plant tissues (often but not always roots and stems)
- Secondary pests
  - Insects or mites that are usually controlled by natural enemies, they build up to become pests after control actions kill their natural enemies

Illinois Migrant Council

UNIVERSITY OF ILLINOIS EXTENSION

new ILLINOIS fruit & vegetable FARMERS

References and resources on vegetable insects

- Fact sheets on vegetable insects
  - http://ento.psu.edu/extension/vegetables/fact-sheets
  - http://www.vegedge.umn.edu/vegpest/pests.htm
- Vegetable Insect Management
  - http://store.meistermedia.com/vegetable-insect-management-w-bonus-cd-rom/

Illinois Migrant Council

UNIVERSITY OF ILLINOIS EXTENSION

new ILLINOIS fruit & vegetable FARMERS

References and resources for fruit insects

- Field Guide for Identification of Pest Insects, Diseases, and Beneficial Organisms in Minnesota Apple Orchards
  - http://www.mda.state.mn.us/plants/pestmanagement/ipm/apple-guide.aspx
- Tree Fruit Field Guide to Insect, Mite, and Disease Pests and Natural Enemies of Eastern North America. ISBN: 1-933395-02-8. Order at:
  - http://palspublishing.cals.cornell.edu/nra_order.taf?_function=detail&pr_id=158&_UserReference=4983462C15D28A6C4A201F4B
- Epstein et al. Pocket Guides for IPM scouting in Apples and in Stone Fruits.
  - Order at http://msue.anr.msu.edu/resources/scouting_guides_for_fruit or view online at http://web2.msue.msu.edu/Bulletins/Bulletin/PDF/Historical/finished_pubs/e2720/e2720-2004.PDF and at http://www.oakgov.com/msu/Documents/publications/e2840_ipm_scoutingin_stonefruits.pdf
- Midwest Small Fruit Pest Management Handbook
  - http://pested.osu.edu/documents/CommStudy/2b%20Midwest%20Small%20Fruit%20Pest%20Mgmt..pdf
- Midwest Tree Fruit Pest Management Handbook
  - http://www.ca.uky.edu/agc/pubs/id/id93/id93.htm

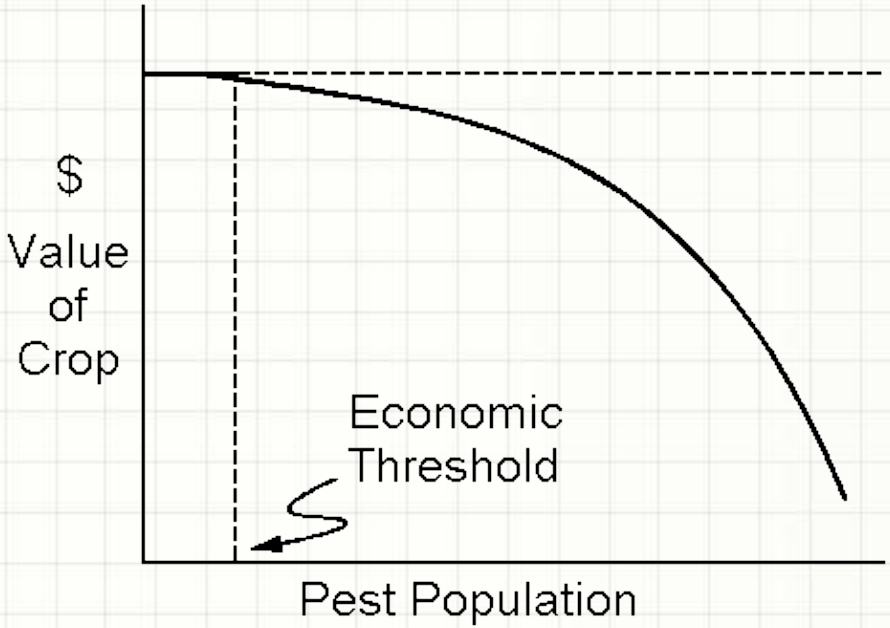
Illinois Migrant Council

UNIVERSITY OF ILLINOIS EXTENSION

new ILLINOIS fruit & vegetable FARMERS

Economic thresholds and insect pest management

- Thresholds: Pest density at which control actions should be taken to prevent crop losses that exceed the cost of control
  - Can be complicated by environmental consequences and the ability to monitor pest densities before control steps need to begin



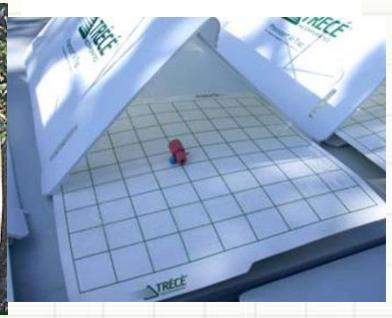
Illinois Migrant Council

University of Illinois Extension

new ILLINOIS fruit & vegetable FARMERS

Monitoring Insects and Mites

- Primary tools
  - Hand lens
  - Beating tray
  - Pheromone traps
  - Sweep net
- Sources of Equipment and Supplies
  - Great Lakes IPM, 10220 E Church Rd., Vestaburg, MI 48891
  - 989-268-5693 or 800-235-0285 … http://www.greatlakesipm.com/



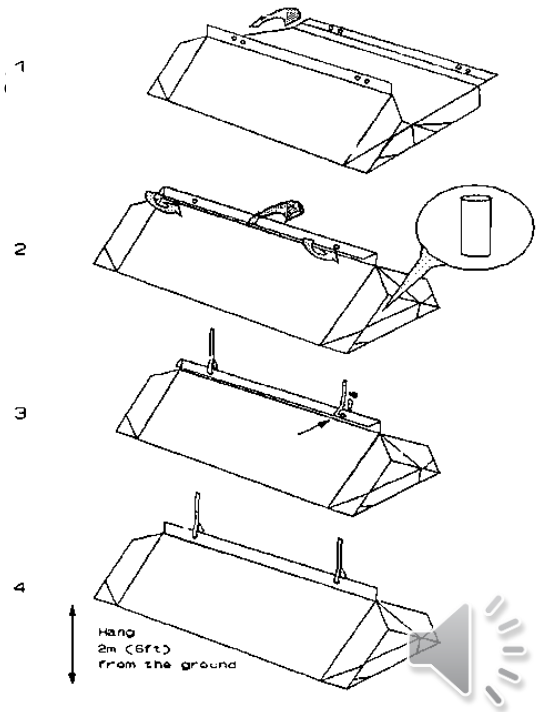
Illinois Migrant Council

UNIVERSITY OF ILLINOIS EXTENSION

new ILLINOIS fruit & vegetable FARMERS

Pheromone traps

- Using pheromone traps (and other insect traps)
  - A summary of insect trapping guidelines for tree fruit insects (for monitoring populations to determine the need for and timing of sprays) is provided at http://ipm.illinois.edu/ifvn/contents.php?id=40#fruit
  - Color … orange or white for most moths (red sphere for apple maggot)
  - Type … large delta trap for most moths
  - Lures … differ for each species; do not combine in single trap
  - Record keeping



Beneficial insects

- See:
  - Natural Enemy Field Guide … http://www.ncipmc.org/glvwg/pdfs/NaturalEnemiesFlyer-FINAL.pdf
  - Identifying and Enhancing Natural Enemies in Vegetable Crops … http://www.youtube.com/watch?v=r1EYCevAgnY
  - Alternatives in Insect Management: Biological and Biorational Approaches … http://www.aces.uiuc.edu/vista/abstracts/aaltinsec.html
  - An IPM Scouting Guide for Natural Enemies of Vegetable Pests … http://www2.ca.uky.edu/agc/pubs/ent/ent67/ent67.pdf
  - Plants that Attract Beneficial Insects … http://nac.unl.edu/bufferguidelines/guidelines/5_protection/2.html
  - Attracting Beneficial Insects with Native Flowering Plants … http://migarden.msu.edu/uploads/files/e2973.pdf

Illinois Migrant Council

UNIVERSITY OF ILLINOIS EXTENSION

new ILLINOIS fruit & vegetable FARMERS

Controlling insects… (using the same categories of practices listed for plant disease control)

- Avoidance
  - By geographic area (climate), planting date, insect-free planting stock, crop rotations
- Exclusion
  - By insect-free planting stock, quarantines, row covers, screening
- Population reduction
  - By crop destruction, crop rotation, fumigation or other soil treatments
- Protection
  - By application of insecticides and miticides
- Resistance
  - Usually not immunity, slowing population growth can be adequate; fewer examples of insect resistance than plant disease resistance in fruit and vegetable crops … thrips resistance in cabbage and onions; Bt sweet corn
- Therapy
  - Systemic insecticides (emerald ash borer)

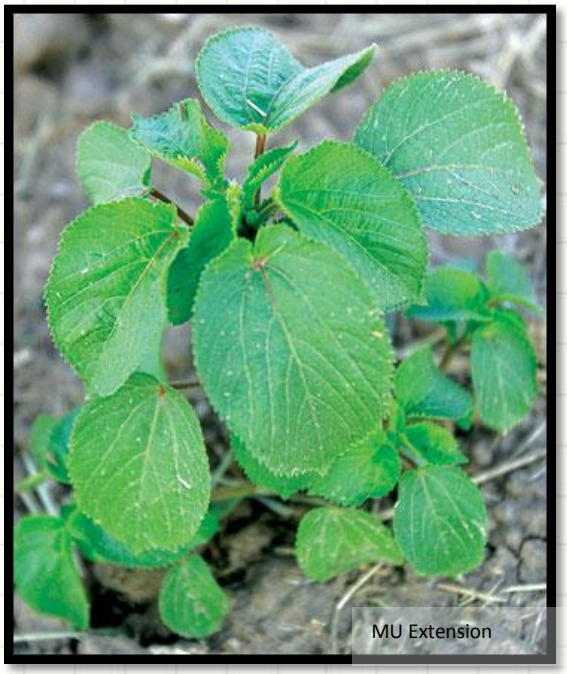
Weed Management

- Important considerations
  - Broad taxonomic categories
  - Life cycles and time of control
  - Identification
  - Cultural control practices
  - Mechanical control practices
  - Herbicides … chemical control

Weed classification: by broad taxonomic groupings

Grass

Broadleaf



Sedge

Illinois Migrant Council

University of Illinois Extension

new ILLINOIS fruit & vegetable FARMERS

Weed classification by life cycle

- Annuals – complete life cycle in one “season”
  - Summer annuals (waterhemp, giant foxtail)
  - Winter annuals (henbit, chickweed)

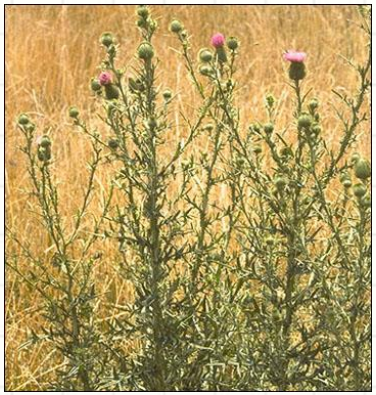



Illinois Migrant Council

UNIVERSITY OF ILLINOIS EXTENSION

new ILLINOIS fruit & vegetable FARMERS

- Biennial – complete life cycle in two growing seasons
  - Wild carrot, bull thistle, common mullein



Illinois Migrant Council

University of Illinois Extension

new ILLINOIS fruit & vegetable FARMERS

- Perennial – live for two or more years
  - Dandelion, pokeweed, johnsongrass, wild garlic

Illinois Migrant Council

UNIVERSITY OF ILLINOIS EXTENSION

new ILLINOIS fruit & vegetable FARMERS

Weed identification

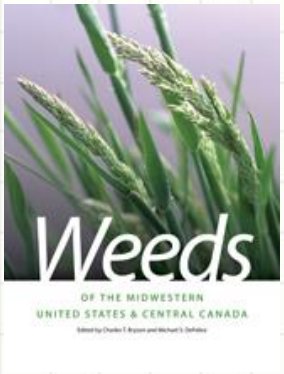
- The key to a successful weed management program.
  - Many herbicides only control certain weeds
  - Also important in mechanical or cultural methods
- The more similar the crop and weed the more difficult it is to control
  - It is much easier to control a grass weed in a broadleaf crop than a grass crop

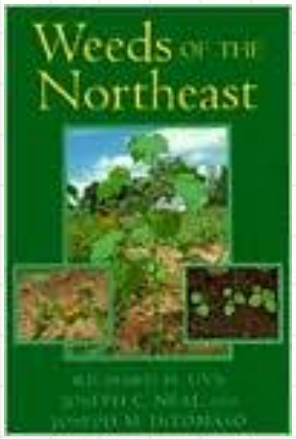
Illinois Migrant Council

University of Illinois Extension

new ILLINOIS fruit & vegetable FARMERS

Weed identification resources





- University of Missouri Weed ID
  - http://weedid.missouri.edu/
- USDA Plants Database
  - http://plants.usda.gov/java/
- Practical Weed Science for the Field Scout
  - http://extension.missouri.edu/p/ipm1007
- Weeds of the Northeast (book)
  - Uva, Neil, and DiTomaso
- Weeds of the Midwestern United States and Central Canada (book)
  - Bryson and DeFelice

Illinois Migrant Council

UNIVERSITY OF ILLINOIS EXTENSION

new ILLINOIS fruit & vegetable FARMERS

Cultural control practices for weeds

- Planting date
- Seeding rate/row spacing
- Cover crops
- Fertility
- Irrigation management
- Crop rotation
- Plant vigorously growing cultivars
- Mulching (Organic or Inorganic)

Mechanical control practices for weeds

- Cultivation/Tillage
  - Preplant tillage
  - Row cultivation after planting and emergence
- Hoeing/hand pulling
- Mowing
- Fallow
- Flaming/Burning
- Heat (steaming, solarization) – good for controlling / reducing weed seed bank population

Illinois Migrant Council

University of Illinois Extension

new ILLINOIS fruit & vegetable FARMERS

Herbicides for chemical control

- Many herbicides on the market but only a limited number are labeled for many specialty crops
- Why???
  - Due to the diversity of specialty crops
  - Specialty crops are a smaller market share compared with agronomic crops.

Illinois Migrant Council

UNIVERSITY OF ILLINOIS EXTENSION

new ILLINOIS fruit & vegetable FARMERS

Models and forecasting systems

- Degree-day (phenology) models for insects
  - http://ipm.illinois.edu/degreedays/
- Disease forecasting models for …
  - Stewart's wilt of sweet corn
  - Potato late blight
  - Apple scab, fireblight, and sooty blotch and flyspeck of apples
  - Early blight, Septoria, and Anthracnose of tomato (TOMcast)

Especially important if sprays must be applied before any signs of infection or infestation are present

UNIVERSITY OF ILLINOIS EXTENSION

new ILLINOIS fruit & vegetable FARMERS

Newsletters

- Illinois Fruit and Vegetable News
  - http://ipm.illinois.edu/ifvn/
- Facts for Fancy Fruit (Indiana)
  - http://www.hort.purdue.edu/fff/fff.shtml
- Vegetable Crops Hotline (Indiana)
  - http://www.btny.purdue.edu/pubs/vegcrop/index2013.html
- VegNet (Ohio)
  - http://vegnet.osu.edu/newsletter

UNIVERSITY OF ILLINOIS EXTENSION

new ILLINOIS fruit & vegetable FARMERS

Archived webinars

- University of Illinois Small Farms webinars …
  - http://web.extension.illinois.edu/hkmw/cat88_3926.html
  - Topics include …
    - 3 webinars on insect, disease, and weed management in organic vegetable production
    - 3 webinars on small orchard management … overall management, insect management, disease management
    - 2 webinars on the basics of fruit insect management and common vegetable insects
    - Many more topics of interest for small- to medium-scale farmers

Illinois Migrant Council

UNIVERSITY OF ILLINOIS EXTENSION

new ILLINOIS fruit & vegetable FARMERS

Examples of IPM Guides

- *An IPM Scouting Guide for Common Problems of Sweet Corn in Kentucky*
  - http://www2.ca.uky.edu/agc/pubs/id/id184/id184.pdf
- For tomatoes and peppers … *An IPM Scouting Guide for Common Pests of Solanaceous Crops in Kentucky*
  - http://www2.ca.uky.edu/agc/pubs/id/id172/id172.pdf
- *University of Kentucky Apple IPM*
  - http://www.uky.edu/Ag/IPM/appleipm/appleipm/ap-man.php
- *Identifying and Managing Cucurbit Pests*
  - Order for $11.00 from https://pubsplus.illinois.edu/C1392.html

Examples of scouting forms

- **Pumpkins**
  - http://www.pestmanagement.rutgers.edu/ipm/Vegetable/Scoutforms/PumpkinScoutingForm.pdf
- **Tomatoes**
  - http://www.pestmanagement.rutgers.edu/ipm/vegetable/Scoutforms/Tomato%20form.pdf
- **Cole crops**
  - http://www.pestmanagement.rutgers.edu/ipm/Vegetable/Scoutforms/Cole%20Crop%20Scouting%20Form.pdf
- **Peppers**
  - http://www.pestmanagement.rutgers.edu/ipm/Vegetable/Scoutforms/Pepper%20form.pdf

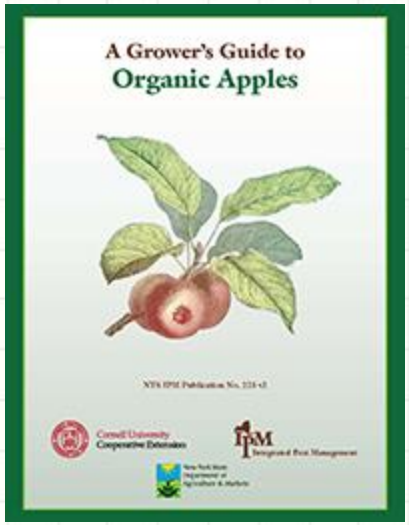
Illinois Migrant Council

UNIVERSITY OF ILLINOIS EXTENSION

new ILLINOIS fruit & vegetable FARMERS

How do you know what to spray against what pest in a given crop?

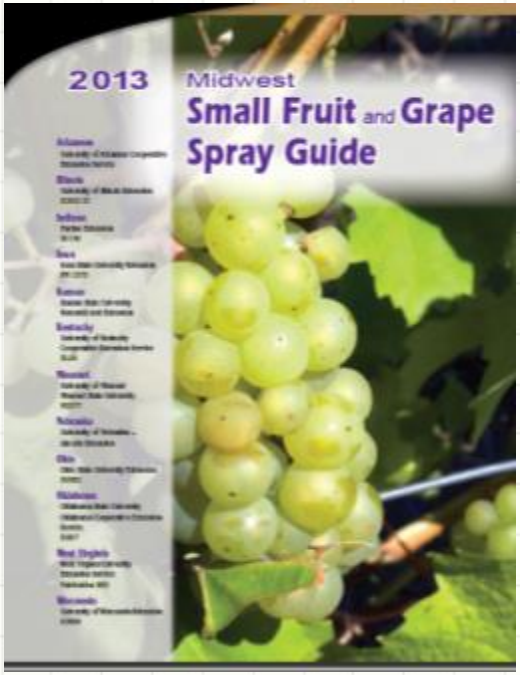
- Midwest Tree Fruit Spray Guide
  - http://www.extension.iastate.edu/Publications/PM1282.pdf
- Cornell Production Guide for Organic Apples
  - http://nysipm.cornell.edu/nysipm/organic_guide/fruit_org_guide.asp



Illinois Migrant Council

University of Illinois Extension

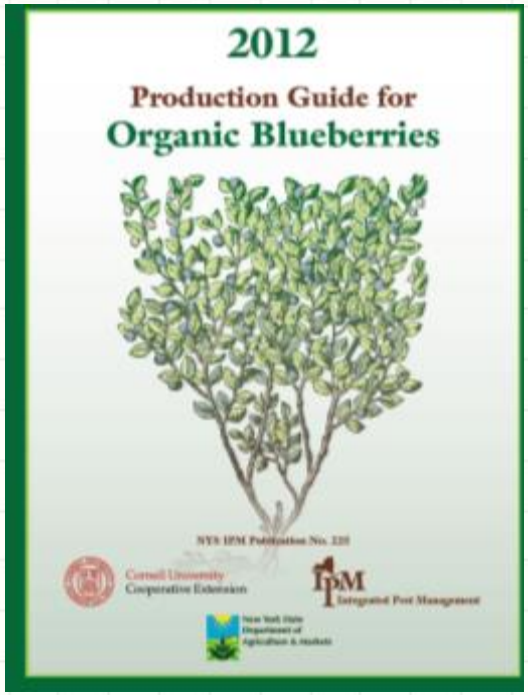
new ILLINOIS fruit & vegetable FARMERS



Spray Guides for Small Fruits

- Midwest Small Fruit and Grape Spray Guide:

https://ag.purdue.edu/hla/Hort/documents/ID-169-2013.pdf



- Cornell Organic Production Guides (blueberries, grapes, strawberries)

http://nysipm.cornell.edu/organic_guide/

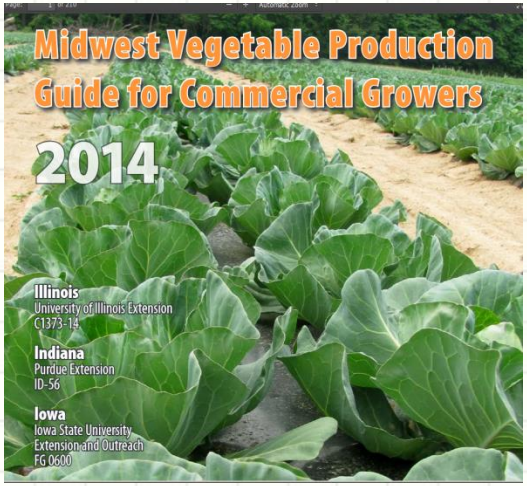
Illinois Migrant Council

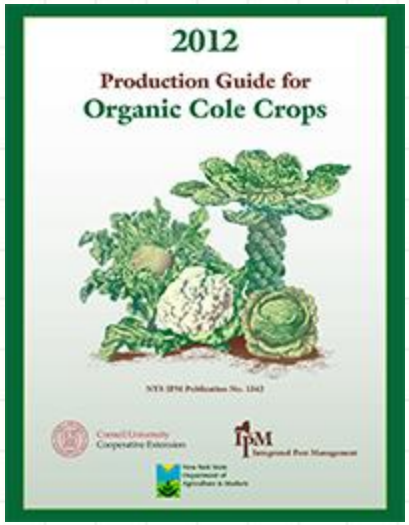
UNIVERSITY OF ILLINOIS EXTENSION

new ILLINOIS fruit & vegetable FARMERS

For Vegetables …

- Midwest Vegetable Production Guide
  - http://www.btny.purdue.edu/pubs/id/id-56/ID-56.pdf
- Cornell's Organic Production Guides for Vegetables
  - http://nysipm.cornell.edu/nysipm/organic_guide/veg_org_guide.asp





Illinois Migrant Council

UNIVERSITY OF ILLINOIS EXTENSION

new ILLINOIS fruit & vegetable FARMERS

To summarize …

- This presentation has provided some general information to help you …
  - Consider farm plans that minimize the likelihood of severe pest outbreaks … a theme that's repeated for all kinds of "pests"
  - Understand the basics of disease cycles, monitoring, and management
  - Understand the basics of insect life cycles, monitoring, and management
  - Understand the basics of weed life cycles, monitoring, and management
  - Identify key references on identification, monitoring, and management so that you can build a library of resources
    - Examples for sweet corn, tomatoes, and apples
- Upcoming presentations and discussions will address specifics of weed, plant disease, insect, and wildlife management in fruit and vegetable production so that you can begin to develop plans for integrated pest management in your crops

Illinois Migrant Council

UNIVERSITY OF ILLINOIS EXTENSION

new ILLINOIS fruit & vegetable FARMERS

To reach us …

Contacts	Contact information
Rick Weinzierl	weinzier@illinois.edu
Nathan Johanning	njohann@illinois.edu

Illinois Migrant Council

University of Illinois Extension

new ILLINOIS fruit & vegetable FARMERS