University of Hawaii at Manoa, College of Tropical Agriculture and Human Resources

Pest Identification and Sustainable Pest Management Strategies

J. Sugano, J. Uyeda, S. Fukuda, K. Wang, M. Kawate, C. Tamaru, B. Fox, and T. Radovich

College of Tropical Agriculture and Human Resources

University of Hawaii at Manoa

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Aquaponics


Pest Problems Still Exist

#1 Question…

What Can I Spray?

An Integrated Pest Management System

* Utilization of **all possible pest control methods** in a well organized and harmonious way to achieve long term pest control.




IPM stands for
Integrated
Pest
Management

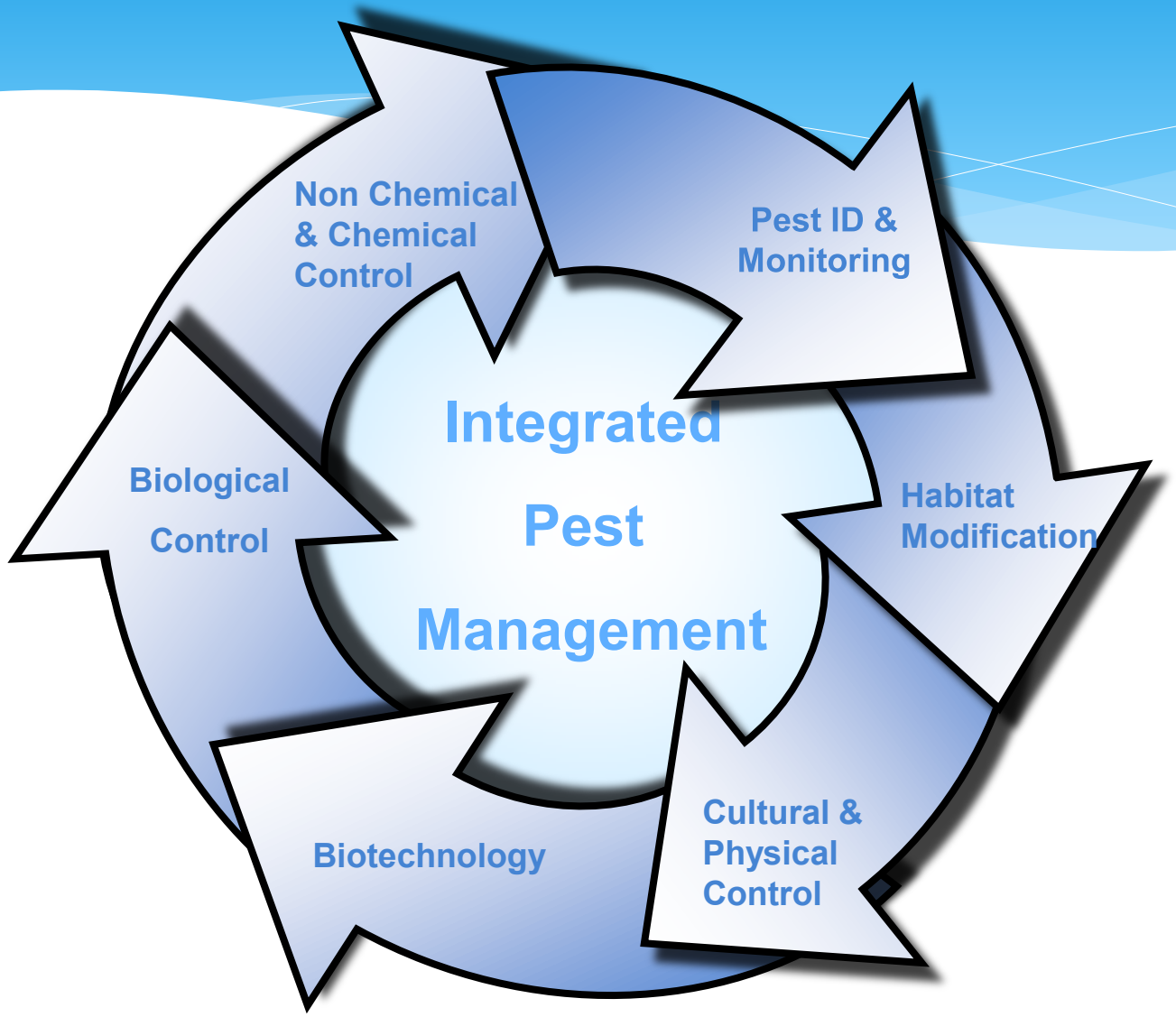
Integrated Pest Management in Aquaponics

The primary goal of IPM is to retain or improve production without negatively impacting the environment, human, & aquaculture safety.

Benefits of IPM

- ✓ Effective & flexible
- ✓ Potential cost savings
- ✓ Environmentally responsible
- ✓ Enhances food, worker and workplace safety
- ✓ **Informed decision making**
  - ✓ **Promotes use of economic thresholds**
  - ✓ **Utilizes the least hazardous control first**
  - ✓ **Chemicals applied on an 'as needed' basis (as last resort)**

Components of IPM



Pest Identification

* Proper identification and understanding the nature of the pest are the key steps in selecting the best pest management strategy.

Chewing Pest:

Feeding on the foliage, stems, fruit or roots.
Pests within this group include beetles, caterpillars, earwigs, leaf miners, etc.

Sucking Pest

These pest pierce plant's vascular tissue and withdraw plant sap. They cause plants to discolor, twist and distort. Pests within this group include aphids, whiteflies, mealy bugs, scales etc.

Photo Credit University of California, IPM Project ; Jari Sugano, Ming Yi Chou, Jensen Uyeda, Steve Fukuda, CTAHR Oahu County

Thrips

Thrips have rasping and sucking mouthparts. Damage results in discoloration and scaring of leaves, stems, fruit and flowers. They are also plant vectors which are organisms that can transmit a pathogen such as a bacterium, virus, or phytoplasma into a plant.

Photo credit: www.ent.uga.edu

Mites

Mites have rasping and sucking mouthparts. Damage results in a brown to russet discoloration of leaves, stems, fruit and flowers.

Photo credit: Dr. Ted Radovich Dr. Scot Nelson & Jari Sugano



Fruit Flies

There are 4 fruit flies in Hawaii: Oriental fruit fly, Melon fly, Mediterranean fruit fly, Malaysian fruit fly. Adult females sting fruits and vegetables resulting in blemishes.

Larvae tunnel within fruit.

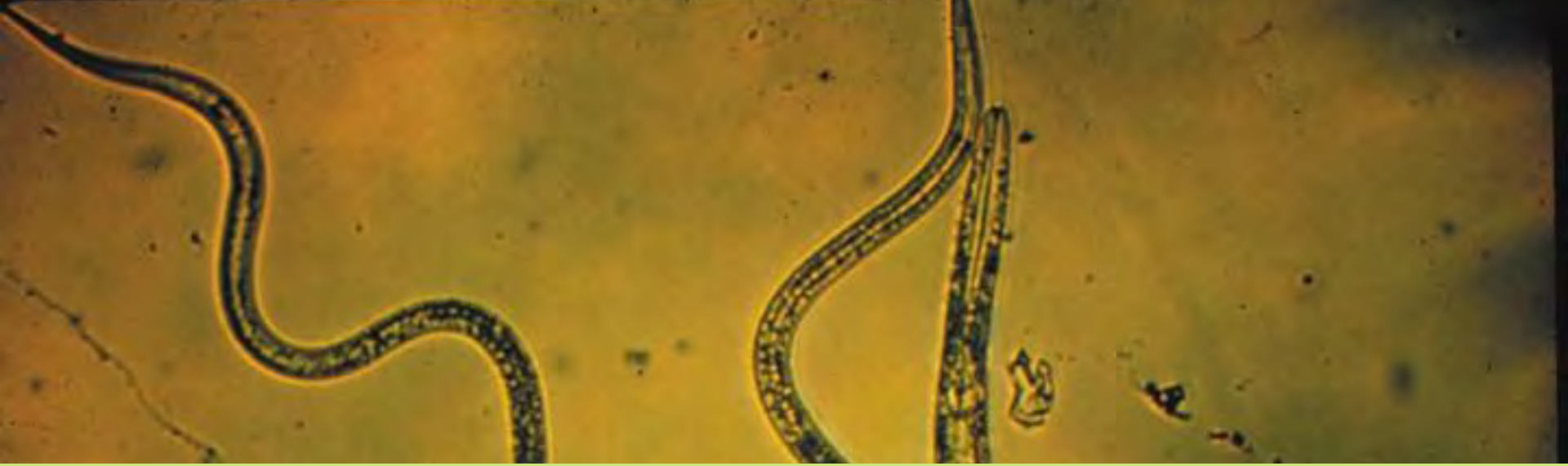

Photo credit: USDA ARS

Plant Hoppers

Plant hoppers damage leaves, stems, fruits, and flowers. They also serve as vectors for plant diseases, especially phytoplasmas.

Slugs and Snails

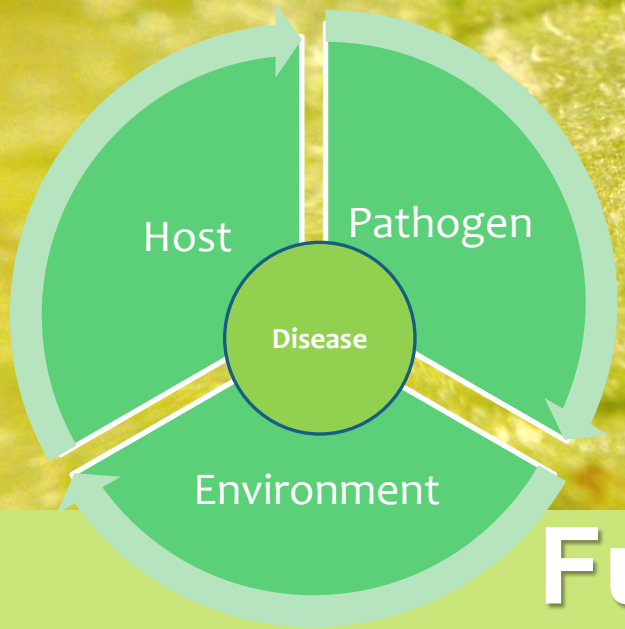
Slugs and snail are problem for low-growing vegetables. They are active in the evenings and are commonly associated with seedlings magically disappearing overnight.



Nematodes

Roundworms that attack the root system of plants and impair water and nutrient uptake. Symptoms: stunting, poor plant growth, narrow and weak stems, foliar chlorosis, root rotting and galling, plant toppling and poor root development.

Photo credit: Dr. Scot Nelson & USDA



Fungal Diseases

Fungal diseases are caused by fungal pathogens. Reproduce and disperse by spores (air, water, soil and via humans too). Common fungal pathogen include: powdery mildew, downy mildew, *Alternaria*, *Cercospora*, *Phythophthora*, etc.

Photo credit: Chris Kadooka

Bacterial Diseases

Bacterial pathogens reproduce quickly and cause damage by degrading cell walls produce toxins, alter hormones, clog xylem of plant tissue. They are spread primarily via rain, or splashing water (seed and soil as well). They often enter plant tissue through natural openings or injury sites. Examples include: *Xanthamonous*, *Pseudomonas*, *Erwinia*, etc.

Photo credit: Chris Kadooka

Viral Diseases

Viruses are caused by viral organisms which cause stunting, ,malformation, mosaic mottling symptoms, etc. They can only survive on living plant tissue. Once infected there is no cure. They are mainly transmitted by insect vectors, farm tools, etc. Common plant viruses include: Banana Bunch Top Virus, Tomato Spotted Wilt Virus, etc.

Photo credit. R. Shimabuku

Phytoplasma

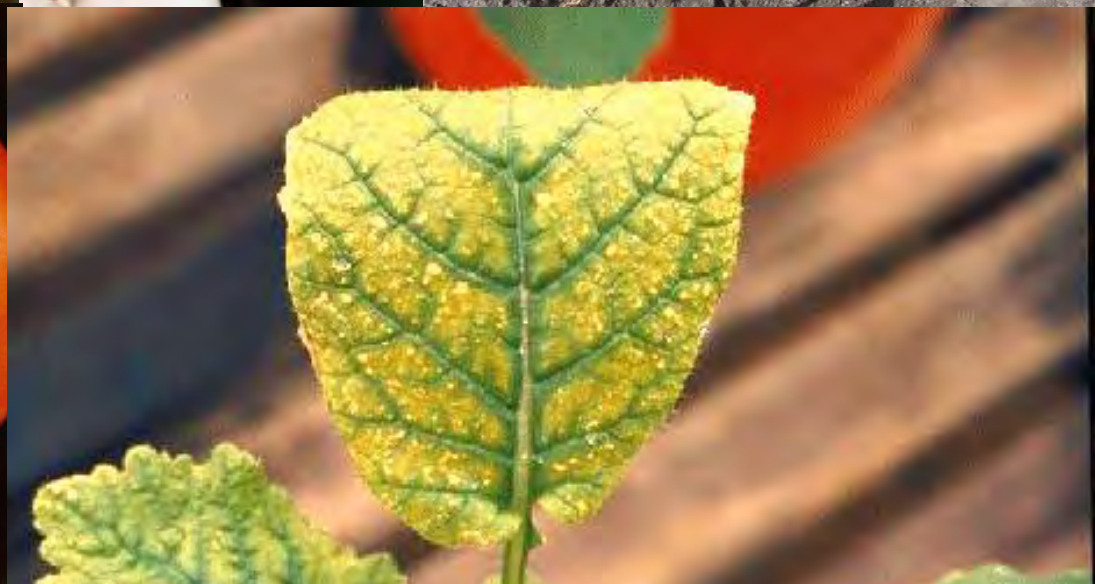
Phytoplasma are plant diseases that are caused by a bacteria which parasitizes on the phloem of plant tissue via a sucking type of insect vector. Symptoms range from yellowing of plant tissue, cupping of leaves, witches broom, stunting and even death of infected plants. Leafhoppers are often associated with vectoring of phytoplasmas like the Watercress Aster Yellow (WAY)

Photo credit. S. Fukuda

Weeds

Weeds (annuals, biennials, perennials, etc.) often outcompete plants for food, sunlight, etc. They are fast growing, prolific seed producers, etc. Some weeds may be alternative hosts for crop pests (insects and diseases).

Proper Pest Identification is Essential for Pest Control



Monitor: Why is monitoring Important?

* Assess pest population levels
* Determine pest activity
* Track changes over time
* Create field history

Monitoring: Common Tools

* Sticky traps
* Pheromone traps
* Light traps
* Sweep nets
* Observations

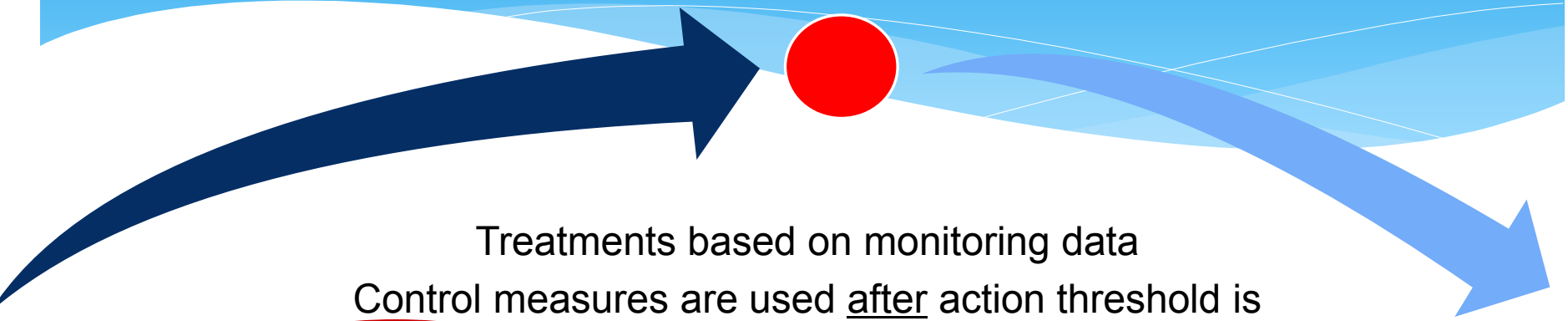
What to Look For

* Pest population
* Level of infestation
* Plant location
* Natural enemies
* Time of year
* Contributing conditions
* Environmental conditions

Action Thresholds

Established levels that a pest population must reach before implementing pest control treatments.

Action level



Treatments based on monitoring data

Control measures are used after action threshold is surpassed

Pest levels are increasing, but within economic threshold

Monitor Pest populations
Implement Prevention Methods

PREVENTATIVE TACTICS:

- Habitat Modification
- Physical Measures
- Cultural Measures
- Biotechnology
- Enhance Natural Enemies

Control strategies are utilized and pest levels decrease over time

Apply control treatments

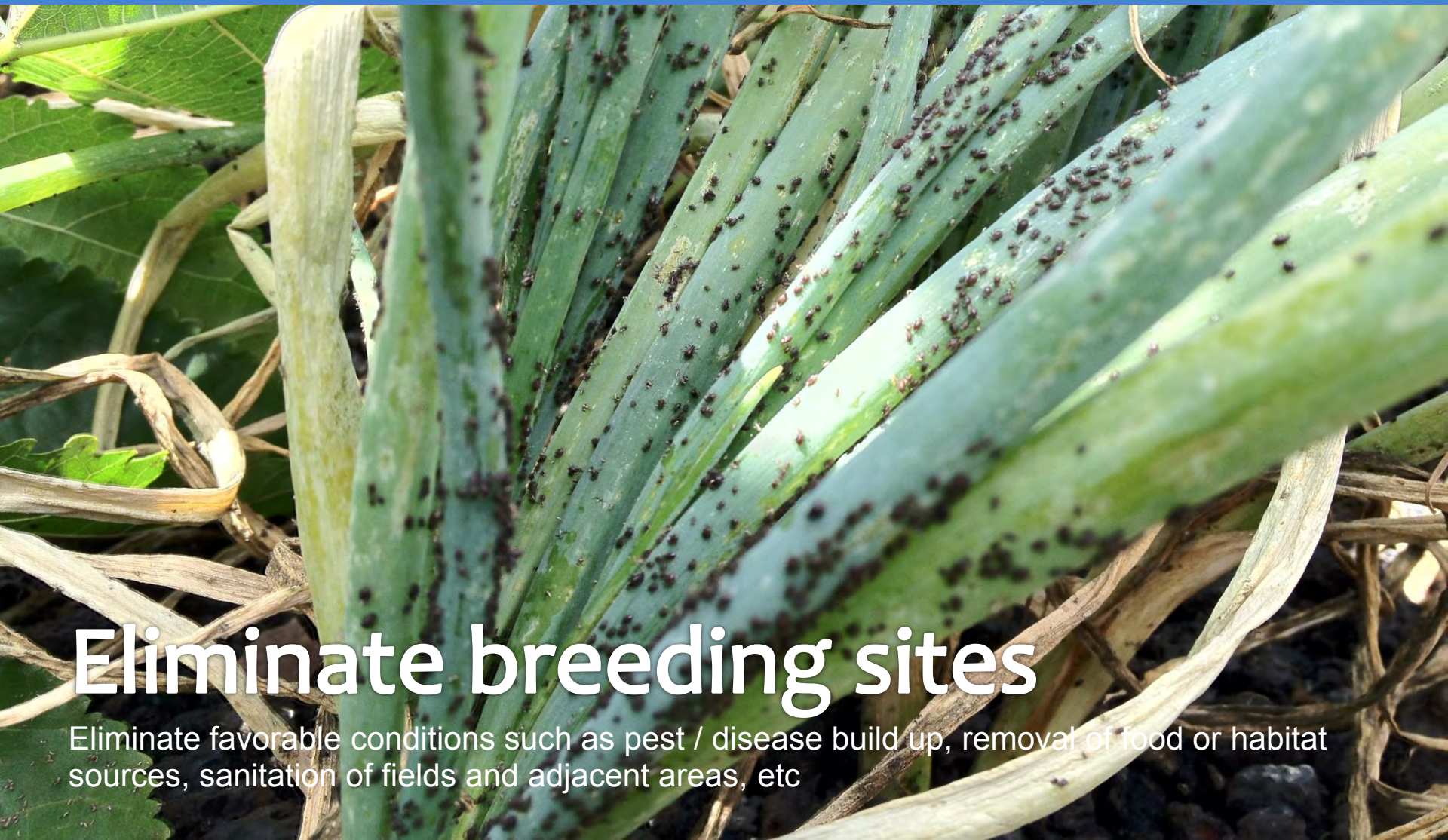
CONTROL STRATEGIES

- Releases Bio-control agents
- Implement Non-Chemical Control
- Chemical Control (as last resort)

Prevention Strategies

Prevention is an important strategy in avoiding and keeping a pest populations below economic threshold levels.

Prevention: Habitat Modification



Eliminate breeding sites

Eliminate favorable conditions such as pest / disease build up, removal of food or habitat sources, sanitation of fields and adjacent areas, etc

Manipulate the Habitat: Drainage

Prevention: Physical Measures

* Installation of physical barriers or devices to disadvantage the pest
  * Screens
  * Barriers
  * Sprinkler systems
  * Wires


Screens


Hoop Houses


Screened Areas


Copper Wires


Reflective Mulches

Prevention: Cultural Modifications

* Manipulation of cultural practices to disadvantage the pest
  * Crop rotation
  * Fallow periods
  * Crop spacing
  * Companion planting
  * Crop selection
  * Aeration
  * Worms-nutrition


Clean Start: Sanitation


Spacing

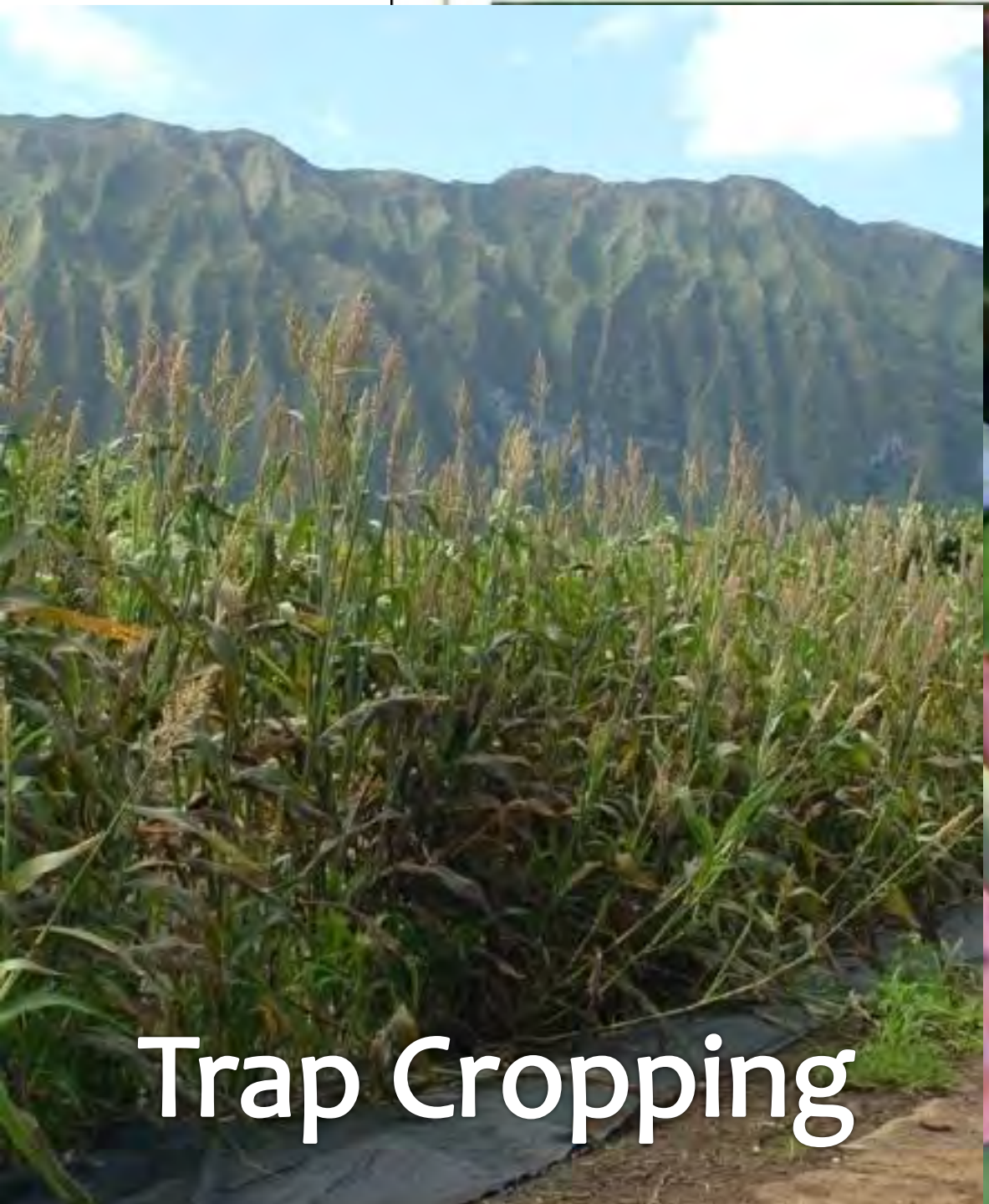

Companion planting


Woms

Deterrent: Overhead Irrigation

http://goingtoseed.files.wordpress.com


Crop Selection



Trap Cropping


Crop Selection: Color

Prevention: Biotechnology

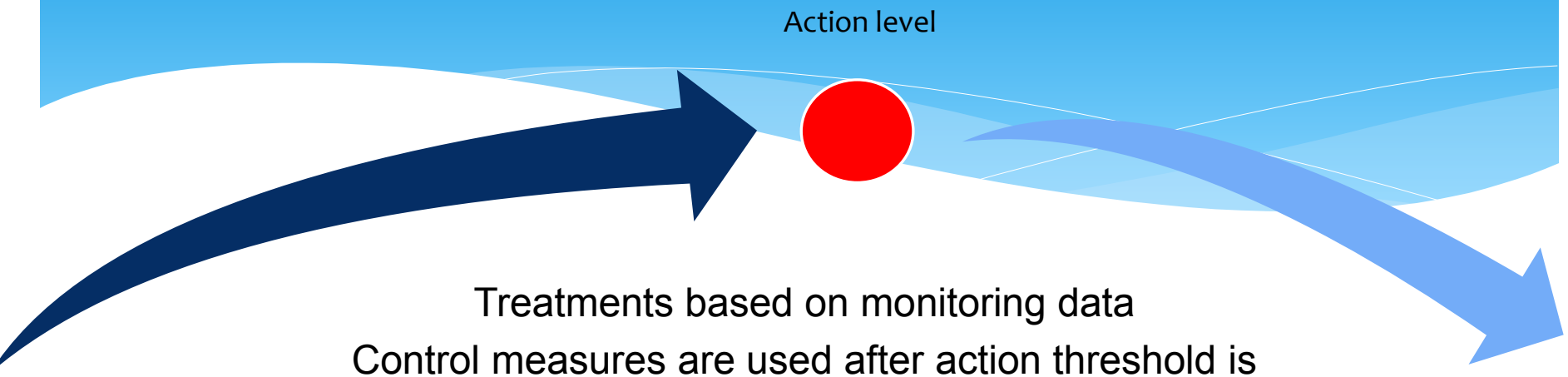
* Application of scientific techniques to modify and improve plants, insects and pathogens
* Selective breeding (hybridization)

Hybridization

Variety selection


Environmental conditions

Action Thresholds SURPASSES



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IPM Control Strategies

Least toxic approach first

Worker
Aquaculture
Food
Environment

Control: Biological Strategies

The use natural predators, parasites, pathogens, etc. to control pests

Example: ladybugs, predatory insects

Non Chemical Control Strategies: Hot Water Treatments

PESTICIDE APPLICATIONS:
Crop Protection Chemical Control

Control: Chemical Applications

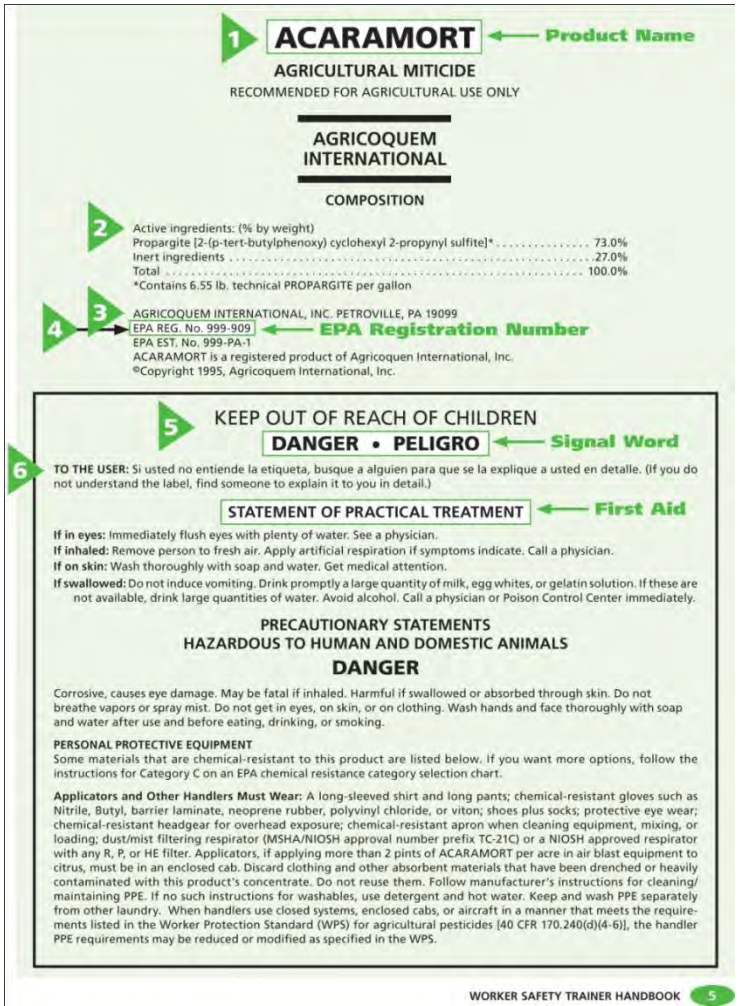
- Typically considered <u>after</u> other control methods
- Low toxicity chemicals are considered first
- Selective vs. broad spectrum chemicals
- Rotated with other chemicals (resistance)

What is a pesticide?

* Chemical used to prevent, destroy, or repel pests

USDA EPA

The Label is the Law



1 **ACARAMORT** ← Product Name

AGRICULTURAL MITICIDE

RECOMMENDED FOR AGRICULTURAL USE ONLY

AGRICOQUEM INTERNATIONAL

COMPOSITION

2 Active ingredients: (% by weight)
Propargite [2-(p-tert-butylphenoxy) cyclohexyl 2-propynyl sulfite]* 73.0%
Inert ingredients 27.0%
Total 100.0%
*Contains 6.55 lb. technical PROPARGITE per gallon

3 AGRICOQUEM INTERNATIONAL, INC. PETROVILLE, PA 19099

4 EPA REG. No. 999-909 ← EPA Registration Number

EPA EST. No. 999-PA-1

ACARAMORT is a registered product of Agricoquen International, Inc.

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5 KEEP OUT OF REACH OF CHILDREN

DANGER • PELIGRO ← Signal Word

6 **TO THE USER:** Si usted no entiende la etiqueta, busque a alguien para que se la explique a usted en detalle. (If you do not understand the label, find someone to explain it to you in detail.)

STATEMENT OF PRACTICAL TREATMENT ← First Aid

If in eyes: Immediately flush eyes with plenty of water. See a physician.
If inhaled: Remove person to fresh air. Apply artificial respiration if symptoms indicate. Call a physician.
If on skin: Wash thoroughly with soap and water. Get medical attention.
If swallowed: Do not induce vomiting. Drink promptly a large quantity of milk, egg whites, or gelatin solution. If these are not available, drink large quantities of water. Avoid alcohol. Call a physician or Poison Control Center immediately.

PRECAUTIONARY STATEMENTS
HAZARDOUS TO HUMAN AND DOMESTIC ANIMALS

DANGER

Corrosive, causes eye damage. May be fatal if inhaled. Harmful if swallowed or absorbed through skin. Do not breathe vapors or spray mist. Do not get in eyes, on skin, or on clothing. Wash hands and face thoroughly with soap and water after use and before eating, drinking, or smoking.

PERSONAL PROTECTIVE EQUIPMENT
Some materials that are chemical-resistant to this product are listed below. If you want more options, follow the instructions for Category C on an EPA chemical resistance category selection chart.

Applicators and Other Handlers Must Wear: A long-sleeved shirt and long pants; chemical-resistant gloves such as Nitrile, Butyl, barrier laminate, neoprene rubber, polyvinyl chloride, or viton; shoes plus socks; protective eye wear; chemical-resistant headgear for overhead exposure; chemical-resistant apron when cleaning equipment, mixing, or loading; dust/mist filtering respirator (MSHA/NIOSH approval number prefix TC-21C) or a NIOSH approved respirator with any R, P, or HE filter. Applicators, if applying more than 2 pints of ACARAMORT per acre in air blast equipment to citrus, must be in an enclosed cab. Discard clothing and other absorbent materials that have been drenched or heavily contaminated with this product's concentrate. Do not reuse them. Follow manufacturer's instructions for cleaning/maintaining PPE. If no such instructions for washables, use detergent and hot water. Keep and wash PPE separately from other laundry. When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides [40 CFR 170.240(d)(4-6)], the handler PPE requirements may be reduced or modified as specified in the WPS.

WORKER SAFETY TRAINER HANDBOOK 5

- Read and follow the label
- Calculate the treatment area
- Calibrate your equipment

Pesticide Laws in Regards to Aquaponics

* Pesticides in aquaculture /hydroponic systems are allowed:
  * Label language does not prohibit it
  * Crop is listed on the label

Environmental Hazard Statement

* If there is a reference that the pesticide is harmful to fish, then be aware of consequences if used.

ENVIRONMENTAL HAZARDS
This product is hazardous to fish and aquatic invertebrates.
For Terrestrial Uses: Do not apply directly to water, or to areas where surface water is present, or to intertidal areas below the mean high water mark. Do not contaminate water when disposing of equipment washwater or rinsate.

Organic Insecticide Trials with Implications for Aquaponics

Crop needs to be listed on the label

Crop	Target Diseases	Use Rate fl. oz. product/A (lbs. a.i./A)	Remarks
Herbs & Spices (except black pepper) Allspice; Angelica; Anise (seed); Anise, star; Annatto; Balm; Basil; Borage; Burnet; Camomile; Caper (buds); Caraway; Caraway, black; Cardamon; Cassia (buds); Catnip; Celery seed; Chervil (dried); Chive; Chive, Chinese; Cinnamon; Clary; Clove (buds); Coriander (cilantro or Chinese parsley) (leaf); Coriander (seed); Costmary; Culantro (leaf and seed); Cumin; Curry (leaf); Dill (seed); Dillweed; Fennel, common; Fennel, Florence (seed); Fenugreek; Grains of paradise; Horehound; Hyssop; Juniper (berry); Lavender; Lemongrass; Lovage (leaf and seed); Mace; Marigold; Marjoram; Mustard (seed), Nasturtium; Nutmeg; Parsley (dried); Pennyroyal; Pepper, white; Poppy seed; Rosemary; Rue; Saffron; Sage; Savory, summer and winter; Sweet bay; Tansy; Tarragon; Thyme; Vanilla; Wintergreen; Woodruff; Wormwood	Corynespora blight (*Corynespora cassiicola*) Dill blight (*Cercosporidium punctum*) Phoma blight (*Passalora puncta*)	6.0-15.5 (0.10-0.25)	Quadris applications should begin at the onset of disease development and continue throughout the season on a 7 day schedule, following the resistance management guidelines. Applications may be made by ground only. An adjuvant may be added at specified rates. Use a minimum of 30 gallons of water per acre. Do not apply more than two sequential applications of Quadris or other Group 11 fungicides before alternation with a fungicide that is not in Group 11.

Specific Use Restrictions:
1) Do not apply more than 92.3 fl. oz. of product/A/season.
2) Do not apply more than 1.5 lbs. a.i./A per season of azoxystrobin-containing products.
3) May be applied the day of harvest (0 day PHI).

* Make sure your crop is listed on label

Maximum Number of Applications

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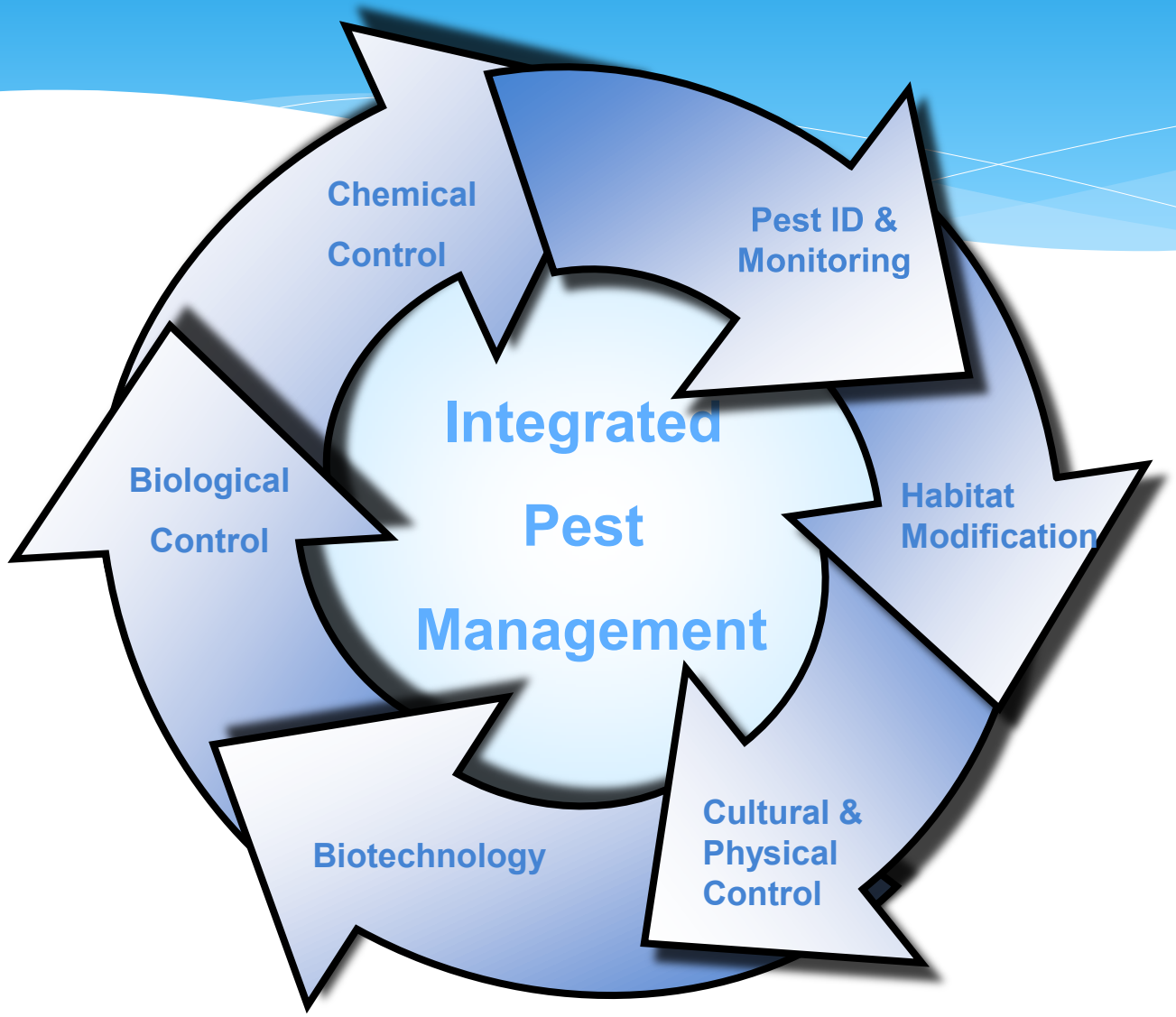
* Do not apply more product than listed on label

Components of IPM



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