Pest Identification & IPM Approach Go Farm Hawaii 2016

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Managing Pests to Sustain & Expand Hawaii's Diversified Agriculture Industry


What is a PEST?


Agricultural Crop Pests

- Plant or animal detrimental to humans or human concerns (agriculture or livestock production)
  - includes insects, animals and plant diseases that predate upon, or otherwise cause damage to plants

Source: Miriam-Webster dictionary

Pest Identification

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


In commercial;
farming...


Pests are endless


New diseases..
Taro Vein Chlorosis Virus

Bagrada Bug

Bagrada hilaris (Burmeister)

(Hemiptera: Pentatomidae)

Background

The bagrada bug, a serious economic pest of agricultural crops, was discovered in several areas of Maui Island in October and November, 2014. A small population was found attacking Chinese cabbage and tatsoi in a student garden at the University of Hawaii Maui College campus, Kahului. Shortly after, the bagrada bug was found in Makawao and Kula.

Figure 1. Adult bagrada bug

Description

This small stink bug has five immature life stages (Fig. 5B-E, Reed et al. 2013) before maturing into an adult (Fig. 1 & 5F). Adults are shield-shaped and can range in size from 3/16 to 1/4 inch; females are larger than males (Fig. 3 middle). Adults are black with orange and white markings. They are similar-looking to the harlequin bug, *Murgantia histrionica* (Fig. 2), but much smaller in size (Fig. 4). The bagrada bug may also be confused with ladybird/ladybug beetles, however, unlike beetles, stink bugs have piercing needle-like mouthparts which they use to insert into and feed on host plants. Females lay oval, cream-colored eggs, which mature to become more of an orange-red color, on the undersides of leaves, on stems, and in soil around plants (Reed & Perring 2012). Eggs laid in soil are camouflaged and very easily mistakenly transported to uninfested areas.

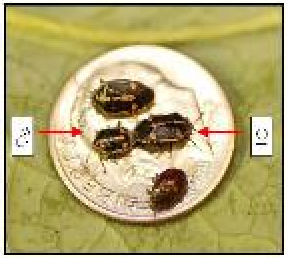

Figure 3. Male (top), female (middle) in comparison to the dime, and a mature nymph (bottom) of Bagrada bug on a dime. Photo by Surendra Dara.

Figure 2. Look-alike: the harlequin bug. Photo: Mike Quinn (http://creativecommons.org/licenses/by-nc/3.0/)

Hosts

Preferred hosts are cruciferous vegetable crops including broccoli, tatsoi, cabbages (head cabbage, Chinese cabbages, etc.), cauliflower, kale, radish, turnip, mustards, brussels sprouts, sweet alyssum, collards, and arugula. The bagrada bug can also feed on corn, cucumbers, okra, sugarcane, papaya, potato, cotton, figs and some legumes. In the absence of preferred host crops, this polyphagous pest will feed on a variety of weeds, also in the Brassicaceae plant

Figure 4. A bagrada bug sitting on a harlequin bug showing size difference. Photo by Surendra Dara.

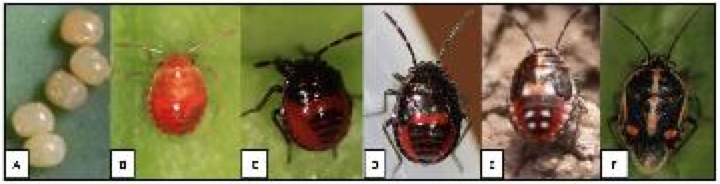

Figure 5. Life stages of the Bagrada bug. A) Barrel-shaped eggs. B-E) Different nymphal instars and F) adult. Younger nymphs only have black and orange coloration while the later instars and adults develop white markings as well. A & B photos by Eric Natwick and the rest by Surendra Dara.

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New Pest Advisory
No. 14-02 December 2014

oir for the population.

ng damage causes stippled, wilted leaves and
I or break. Fig. 6 shows early signs of damage
a bug, however, in heavy infestations (Fig. 7),
eliable. Feeding on apical meristems of cole
age) lead to multiple, unmarketable head
development at all (Fig. 9). Heavy feeding can
Natwick 2010, Reed et al. 2013).

been very expensive for *Brassica* crop growers
cticides, and the organic farmers have taken
cious control measures acceptable to organic

Figure 6. Damage to tatsoi showing stippling and early signs of wilting

a, India, and Asia (Howard 1906). In 2008, it
e first time in California, and now spread to
Arizona, New Mexico, and Texas (Reed et al.
d from Maui Island.

grada bug, please call:

Figure 7. Damage to collard greens

hy of Arizona), Surendra Dara and Eric Natwick
on of Agriculture and Natural Resources
heir photos with permission.

Figure 8. Damage to broccoli showing unharvestable, small (?) crowns. Photo: John Palumbo.

rada hilaris). Transvaal Agric J. 5: 168-173.

3 December 2014.

agrada bug (Hemiptera: Pentatomidae): A new invasive
[Online] Plant Health Progress doi:10.1094/PHP-2010-

s/pub/php/brief/2010/bagrada/> Accessed: 28

May. 2013. *Bagrada hilaris* (Hemiptera: Pentatomidae),

est Manage. 4(3): 1-7.

a bug: biology, host range and effects on cole crops.
ersity of California, Riverside. [Online] Available at:
-reed-sept-19-2012.pdf> (Accessed: 28 November 2014).

Figure 9. Damage to cauliflower [illegible] Photo: John Palumbo.

lant Pest Control Branch, Hawaii Department of Agriculture

Phone: (808) 973-9538
Web: http://hdoa.hawaii.gov/pi/ppc/

Prepared by: Janis N. Matsunaga
Issued: December 2014

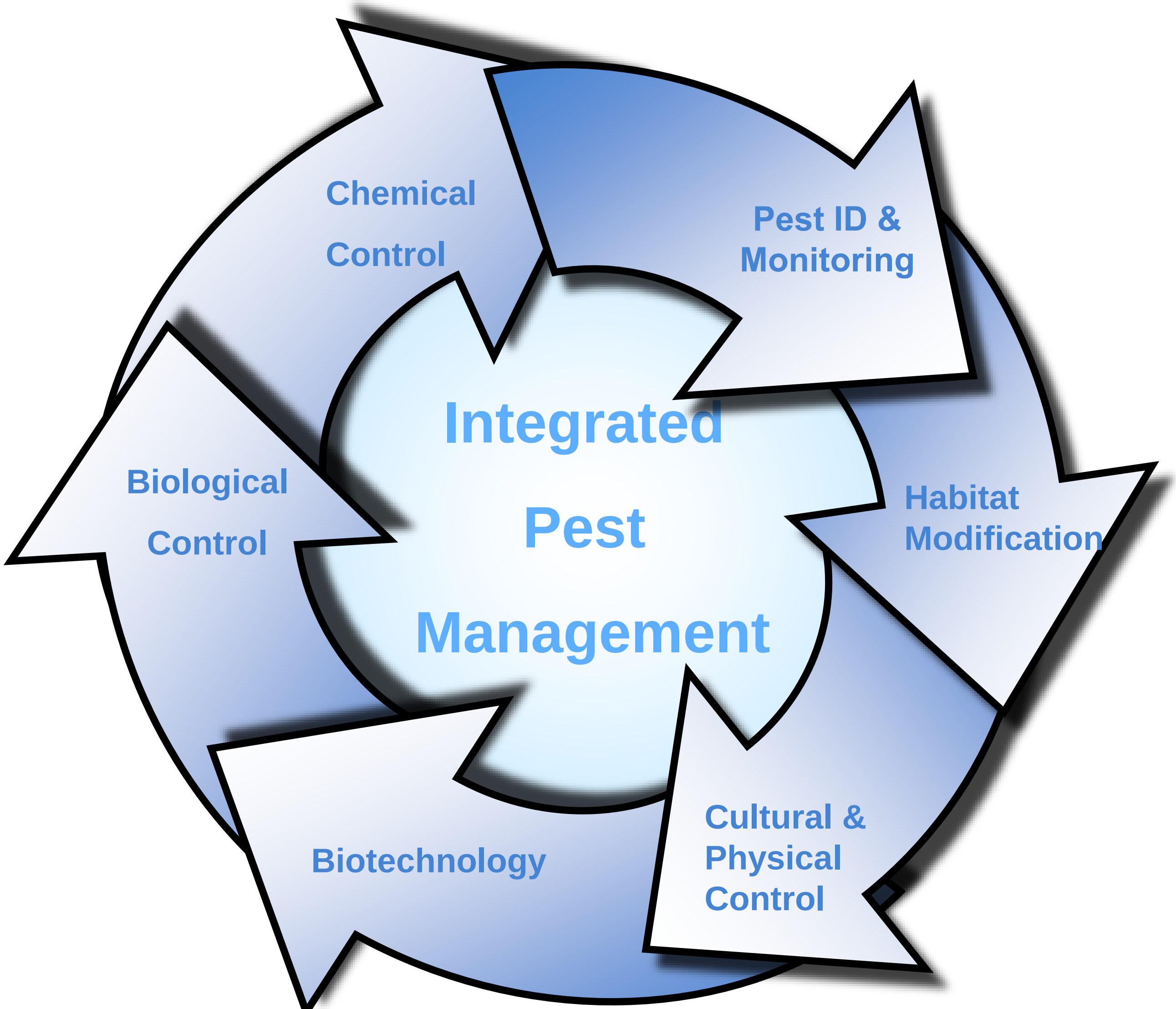

Banana Bract Mosaic Virus


Canna Yellow Mottle Virus

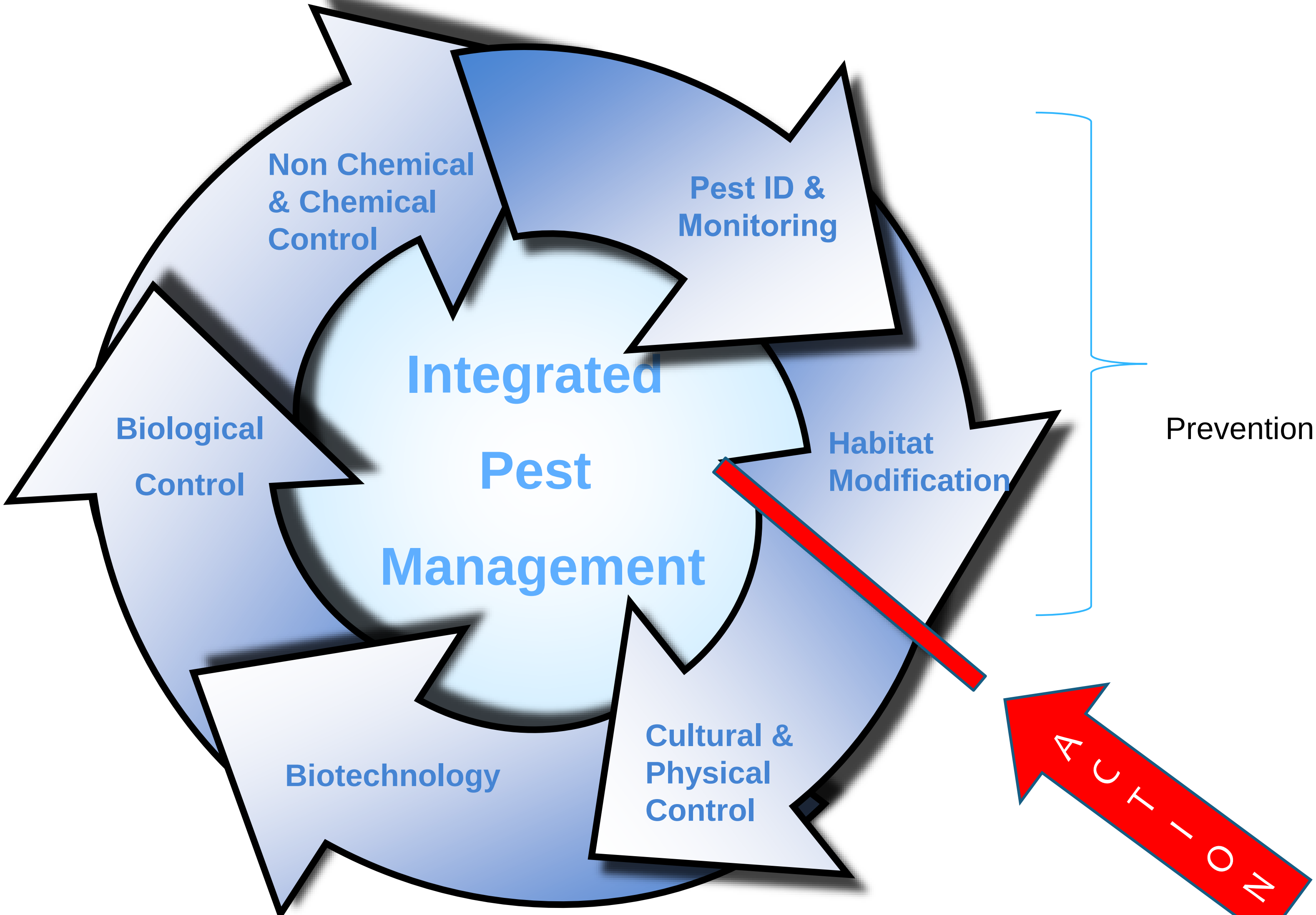
Industry Need: Integrated Pest Management Programs

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

Components of IPM

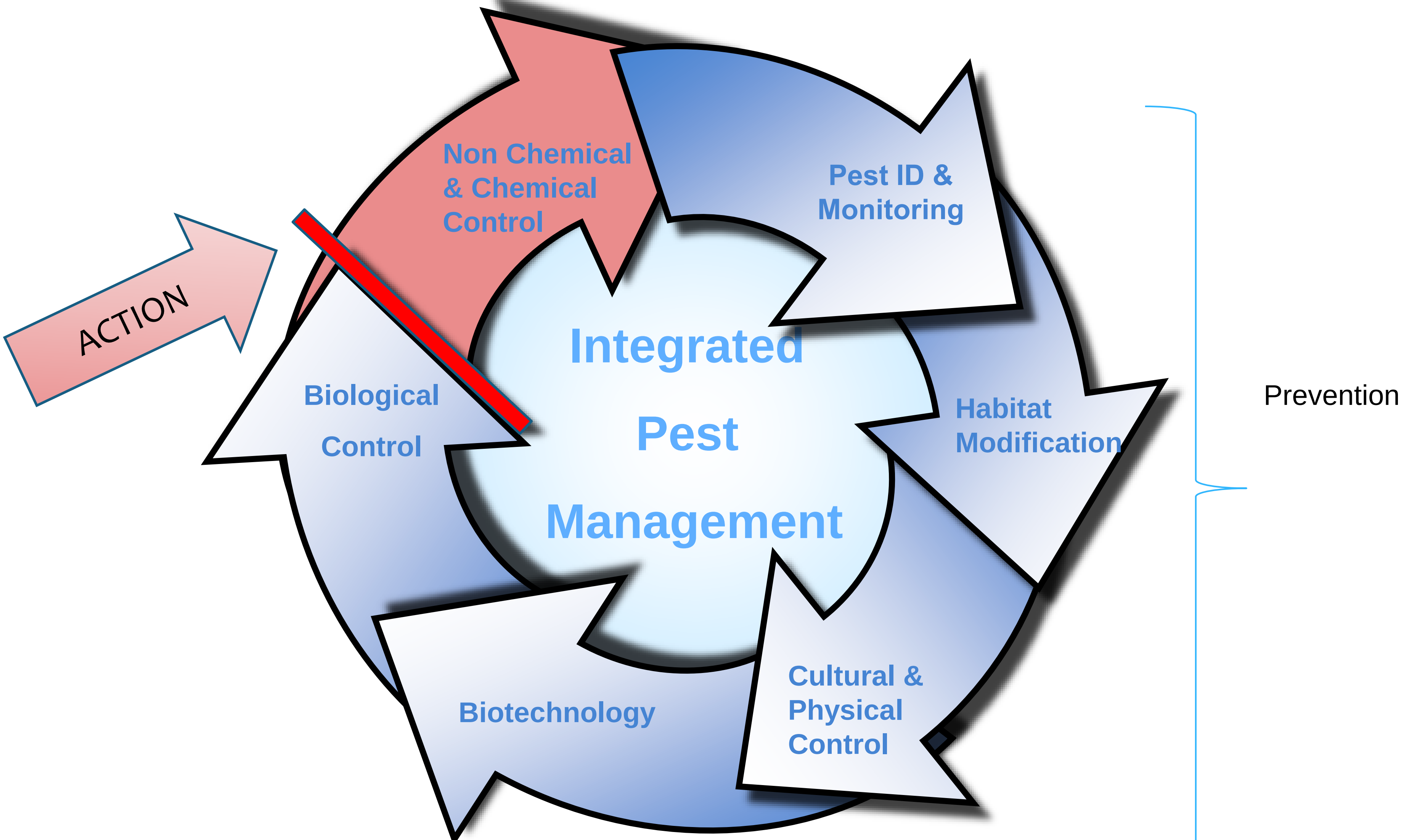


Components of Traditional Integrated Pest Management (IPM)



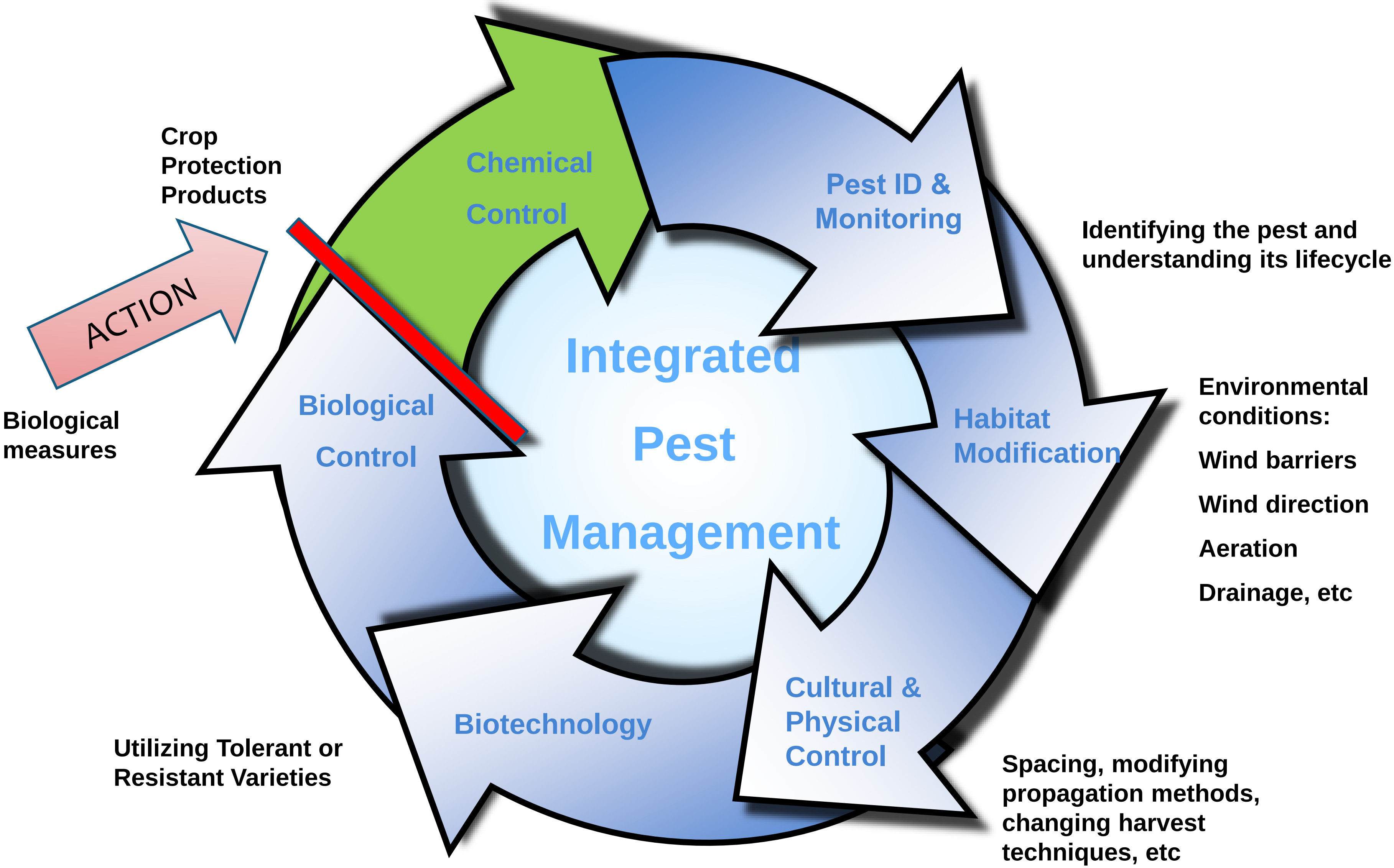
Sugano, 1997

Components of Modified Integrated Pest Management (IPM)

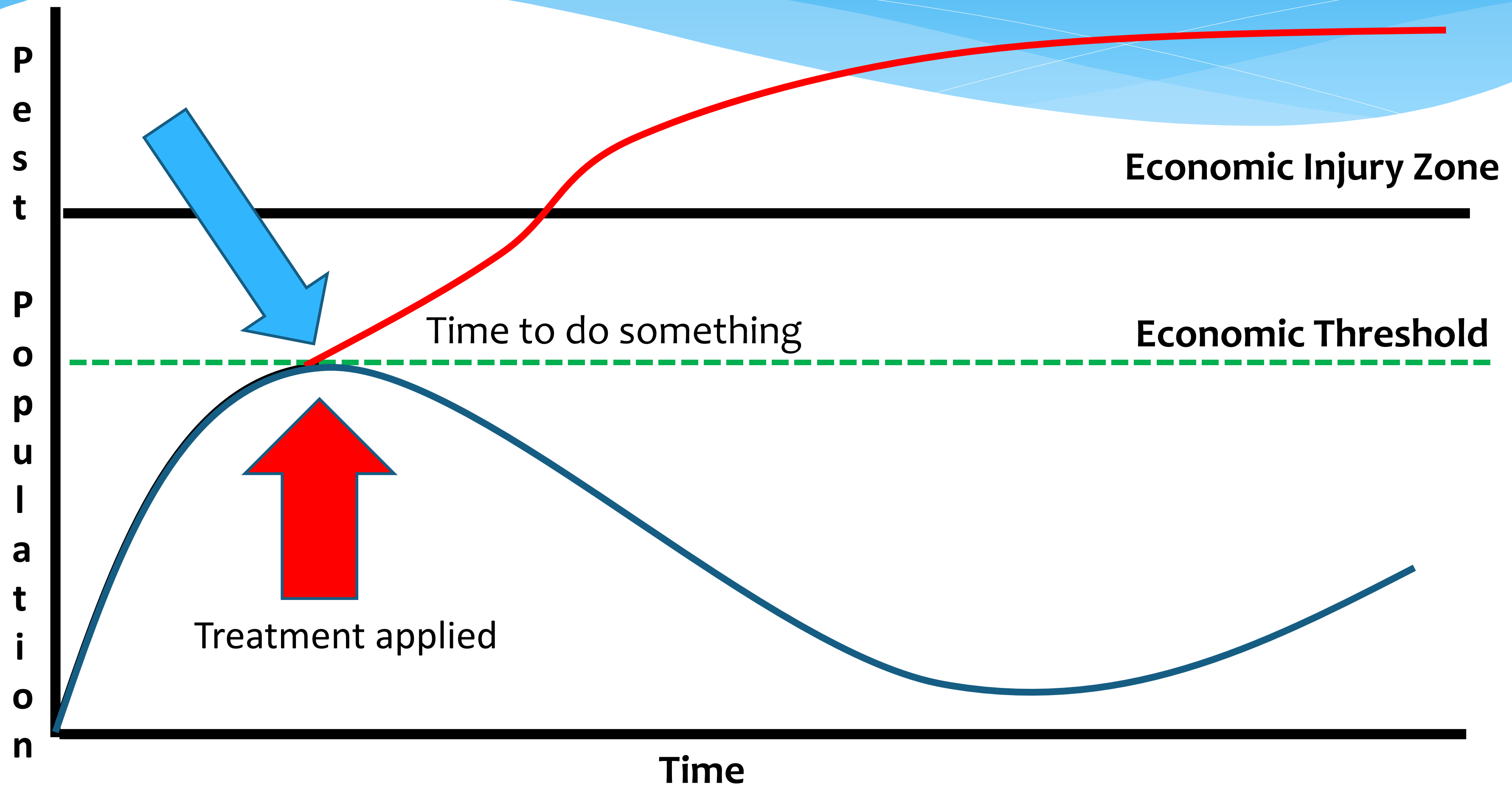


Sugano, 2015

Ex: Basil Integrated Pest Management

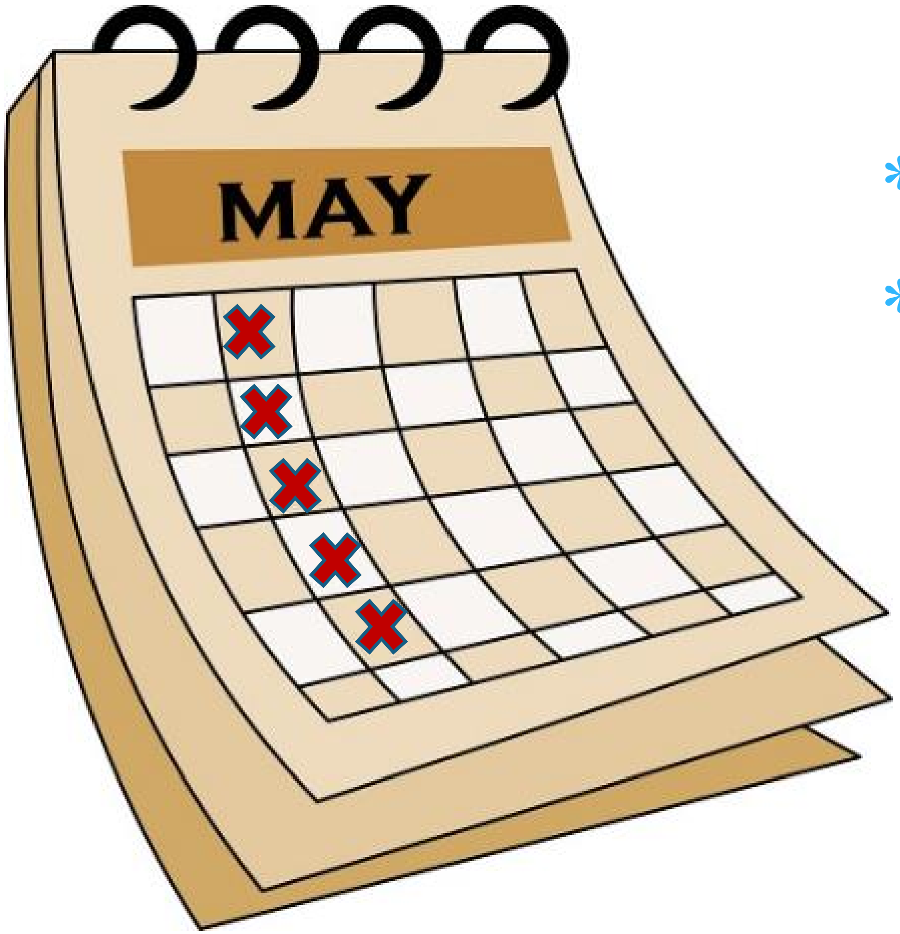


Implementation of Pest Management Treatments



Modified from the National Pesticide Applicator Certification - Core Manual

Vs. Calendar Based



- Routine applications
- Requires less
  - Skill
  - Decision making
  - Management

PROPER Pest Identification

- Proper identification
- Utilize correct pest control techniques for specified crop



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.

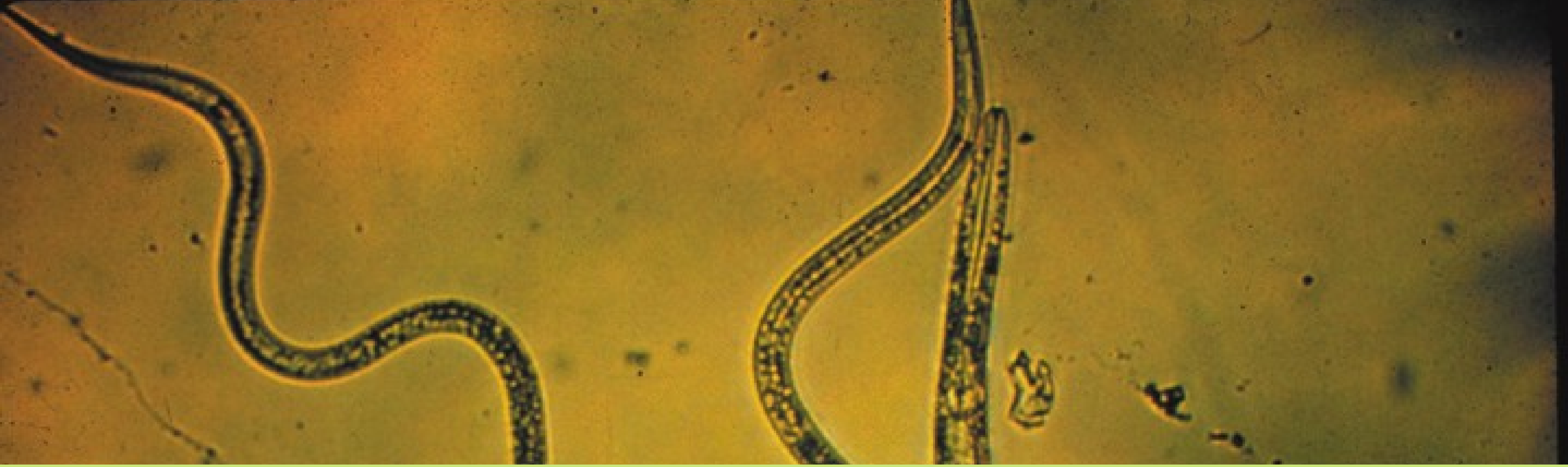
Photo credit: USDA ARS

Plant Hoppers

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

Slugs and Snails

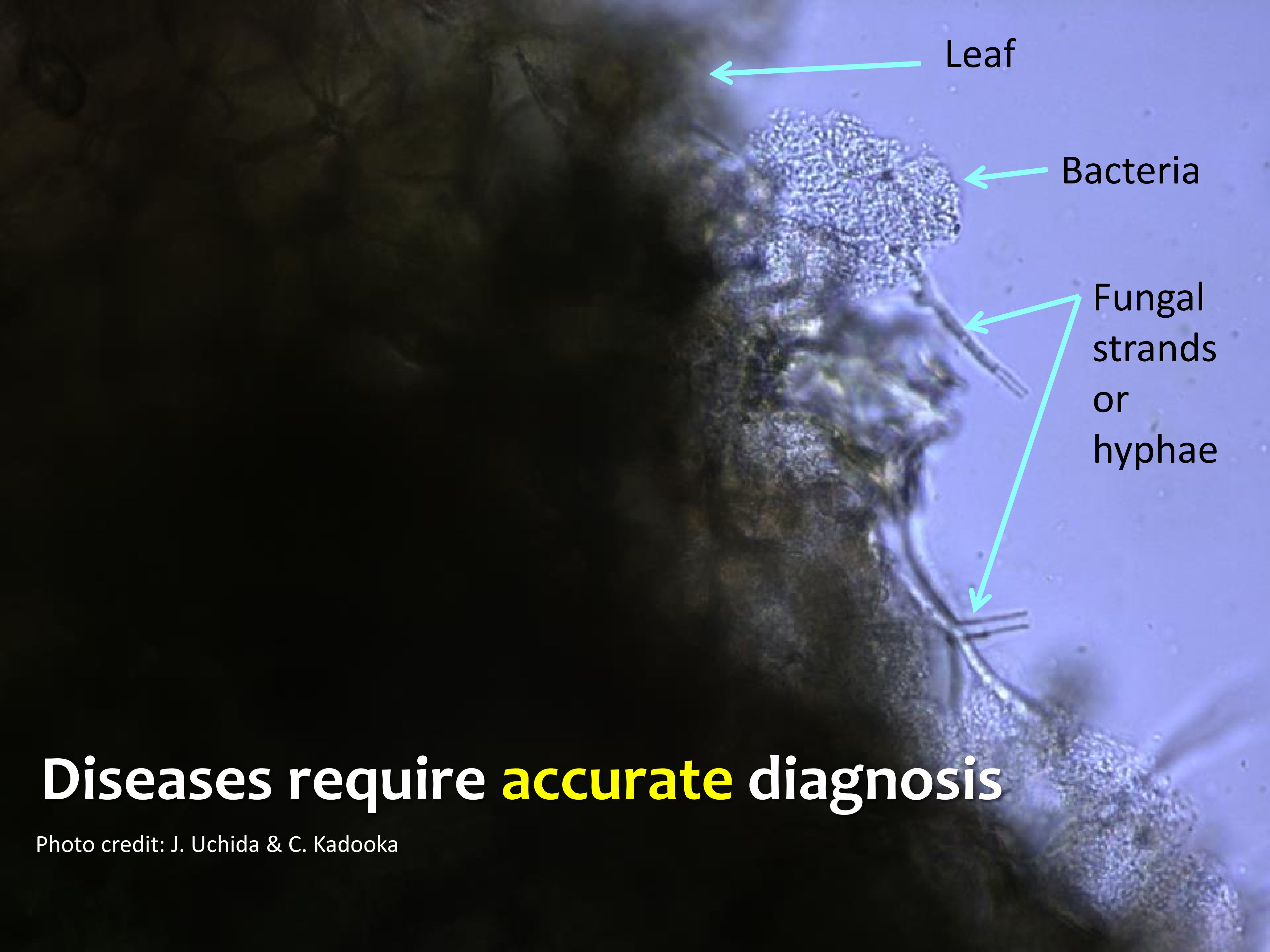
Slugs and snail are problem for low-growing vegetables. They are active in the evenings and are commonly associated with seedlings magically disappearing overnight.



Nematodes

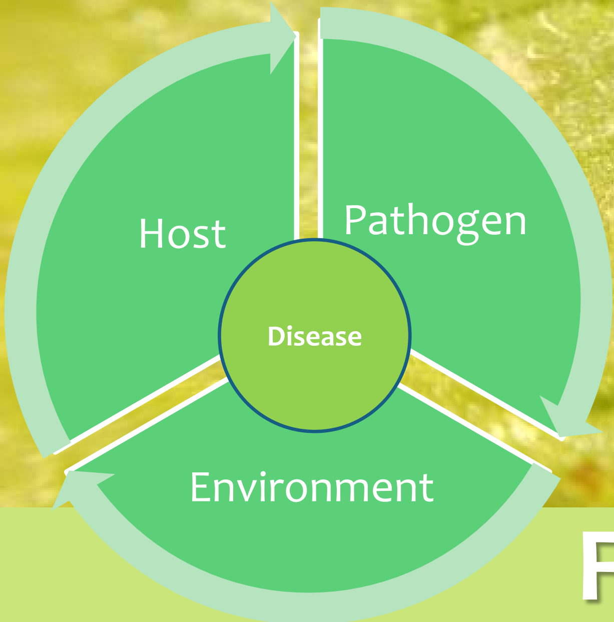
Roundworms that attack the root system of plants and impair water and nutrient uptake. Symptoms: stunting, poor plant growth, narrow and weak stems, foliar chlorosis, root rotting and galling, plant toppling and poor root development.

Photo credit: Dr. Scot Nelson & USDA



Diseases require **accurate** diagnosis

Photo credit: J. Uchida & C. Kadooka



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

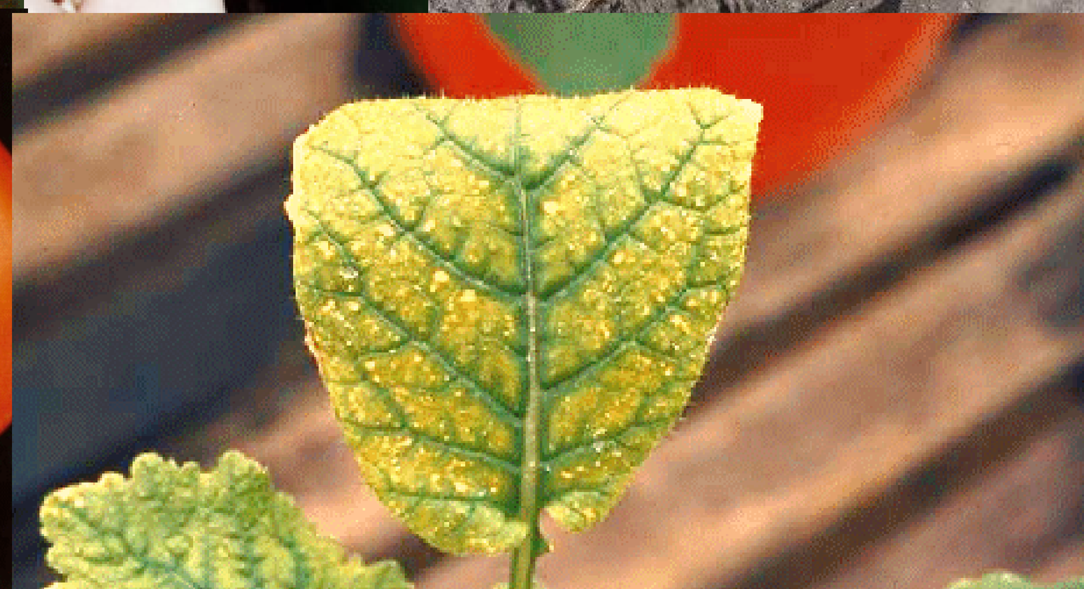
Weeds

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







Symptoms

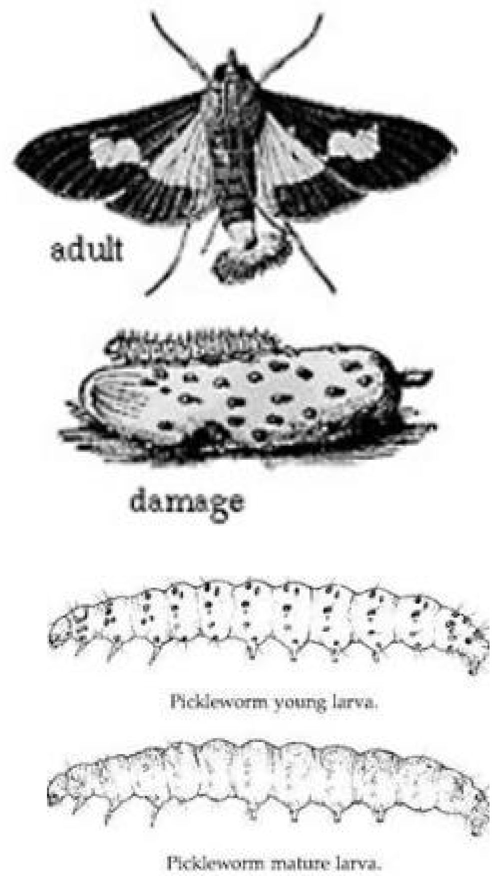
Identify, Understand…before CONTROL

Example: Pickleworm
Diaphania nitidalis

- Pest of squash, cucumber, cantaloupe, and pumpkin.
- Tunnel and feed on foliage, stems, and fruit
- Leave behind a distinctive hole and frass

Ex. Pickleworm Lifecycle *Diaphania nitidalis*

- Complete metamorphosis in 30 days
- **Eggs**: Laid in small clusters of individually on buds, flowers etc.
  - Each moth can lay 300-400 eggs
- **Larval Stage: Five instars**
  - Immature larvae, spotted and found in flower buds or stems
  - Older 5th Instar stage: Spots fade
- **Pupal Stage: (8-9 days)**
  - Pupate outside of fruit, on leaf surfaces at and the base of plants
- **Adult Stage**:
  - Adult moth that are active only at night



Source: HDOA, and University of Florida
Photo credit: http://pubs.ext.vt.edu, www.simplykitchengarden

IPM Control Strategy: Pickleworm

- **Monitoring:** Scouting flowers and stems
- **Physical Control:** Barriers, bagging (pollination)
- **Cultural Control:** Field sanitation, timely knock down, crop rotation, etc.
- **Biological control:** Encourage biological insects
- **Chemical Control:** Rotation of approved crop protection products such as, Success, Pyrethroids, Organophosphates, Bt, etc.

** NOTE, this pest attacks multiple crops. Please read and follow labels before utilizing any chemical listed. These products are just general recommendations.

Integrated Pest Management
Pest Identification: Common Pests

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

Chewing Pests

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

Ants

Ants are honeydew consumers and protect pests from natural enemies. Honey dew secretions promote sooty mold development. There are: sugar vs. fat loving ants.

Sucking Pests

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 and leaf hoppers.

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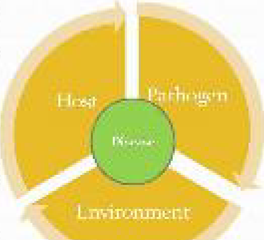
Integrated Pest Management
Pest Identification: Common Diseases

Plant diseases are the result of a physiological or morphological change in a plant that results in abnormal growth, appearance or development due to a pathogen. Pathogens are parasitic organisms that cause a disease. Pathogens include: fungi, bacteria, viruses, nematodes, phytoplasma.

The diagram to the right illustrates the three factors required for disease development: a host plant, casual pathogen and a favorable environmental conditions. Managing these factors can also help prevent and suppress disease populations.



Fungal Pathogens

Common plant disease composted of threadlike structures called hyphae. Reproduce and disperse by spores. Common fungal pathogen include: powdery mildew, downy mildew, *Alternaria*, *Cercospora*, *Phythophthora*, etc.

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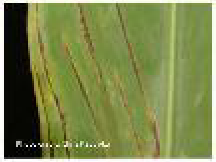
Bacterial Pathogens



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Phytoplasma

Phytoplasma is a bacteria which parasitizes on the phloem of plant tissue via an insect vector. Symptoms range from yellowing of plant tissue, cupping of leaves and even death of infected plants. Leafhoppers are often associated with vectoring of phytoplasmas like the Watercress Aster Yellow (WAY).

Example of a Plant Vector

Plant vectors are organisms that can transmit a pathogen such as a bacterium, virus, or phytoplasma into a plant.

EXAMPLES:
Banana aphid → Banana Bunchy Top Virus (BBTV)
Western flower thrips → Tomato Spotted Wilt Virus (TSWV)
Aster Yellow Leaf Hopper → Watercress Aster Yellow Phytoplasma
Onion thrips → Iris Yellow Spot Virus (IYSV)

Monitoring: Common Tools

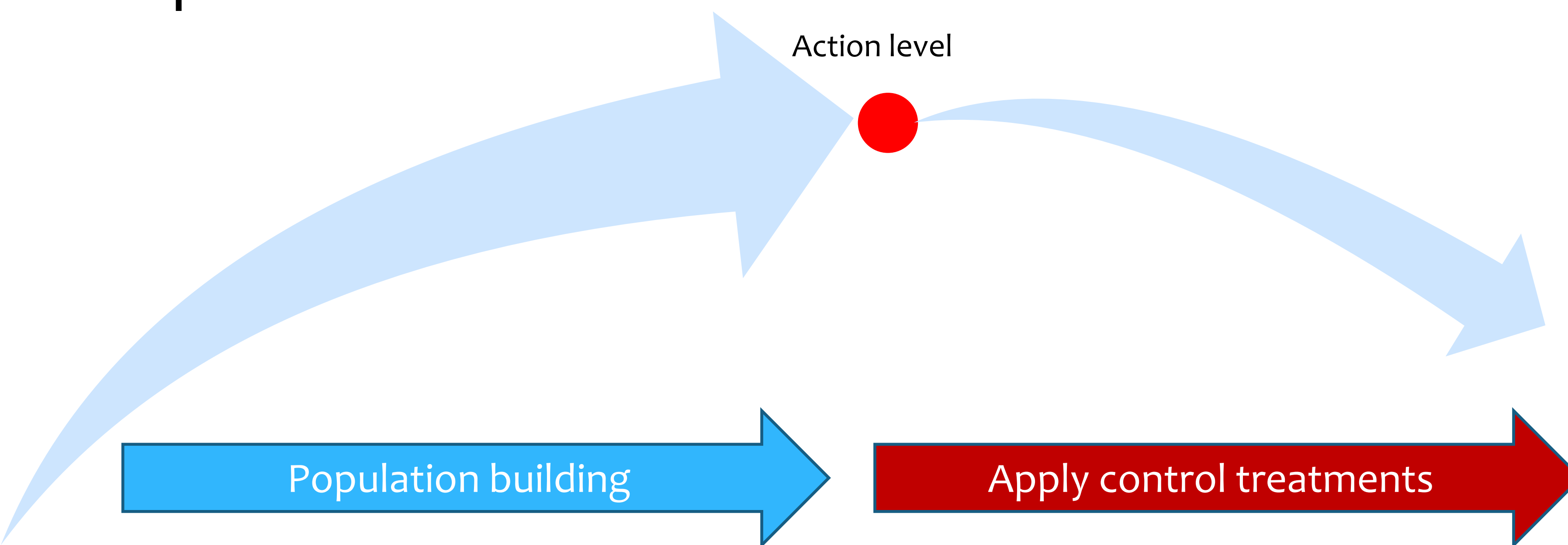
- Sticky traps
- Pheromone traps
- Light traps
- Sweep nets
- Field observations

Field Scouting

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

Pest Control in IPM Systems

- Treatments based on monitoring data
- Control measures are used after action threshold is surpassed



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

Control strategies are utilized and pest levels decrease over time

Apply control treatments

PREVENTATIVE TACTICS:

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

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.


Healthy Start


Fast Start

Clean Water & Media


Clean Start: Sanitation


Clean Seeds


High organic matt
Healthy Soils
Firm soil aggregates
Higher water holding capacity
Better drainage
Co2 retention
Less run off

Ex: Soil Amendments

Cultural Control / Habitat Modification

- Manipulation of cultural practices to disadvantage the pest
  - Eliminate breeding sites
  - Eliminate conditions favorable to pest build up
    - Removal of food or habitat sources
    - Reflective devices
    - Field sanitation
    - Buffer zone
    - Time of year
    - Etc.


Ex: Breeding Sites


Ex: Modify Environment

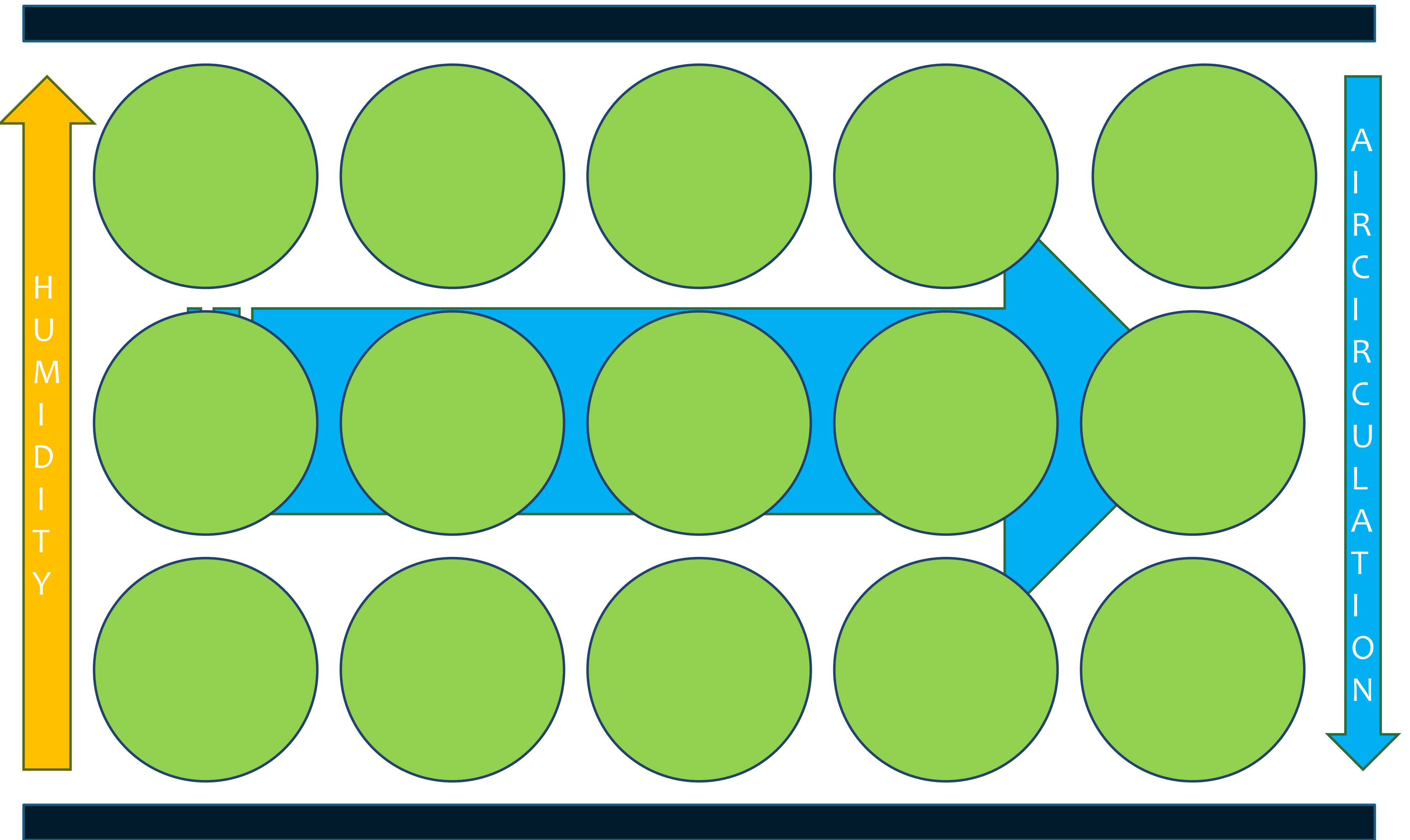

Ex: Reflective Mulches

Ex: Companion planting

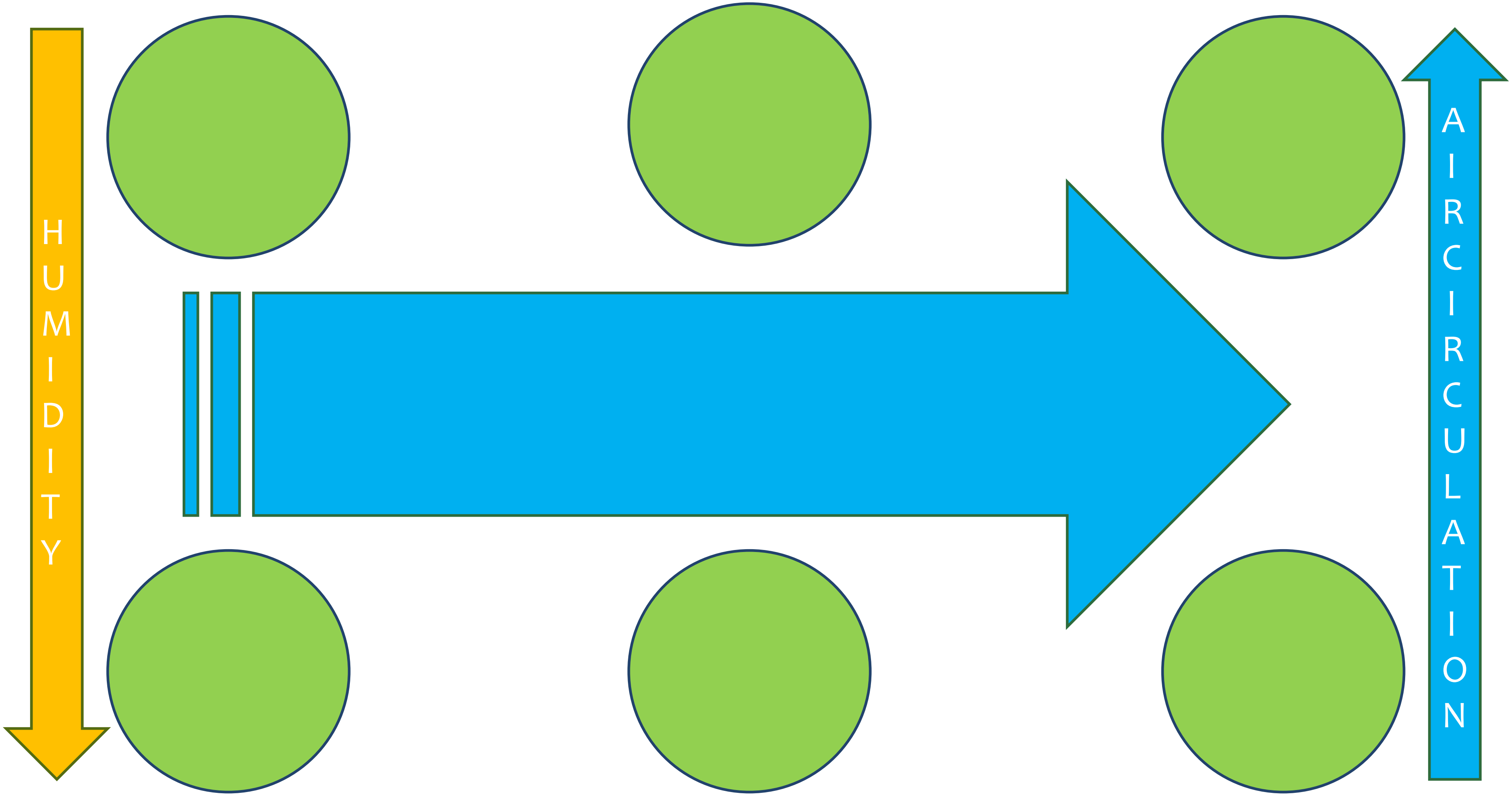
Ex: Trap Crops


Ex: Spacing

Evaluate Cultural Practices
High Intensity Plant Spacing



Changing Cultural Practices
Low Intensity Plant Spacing



Physical / Cultural Controls

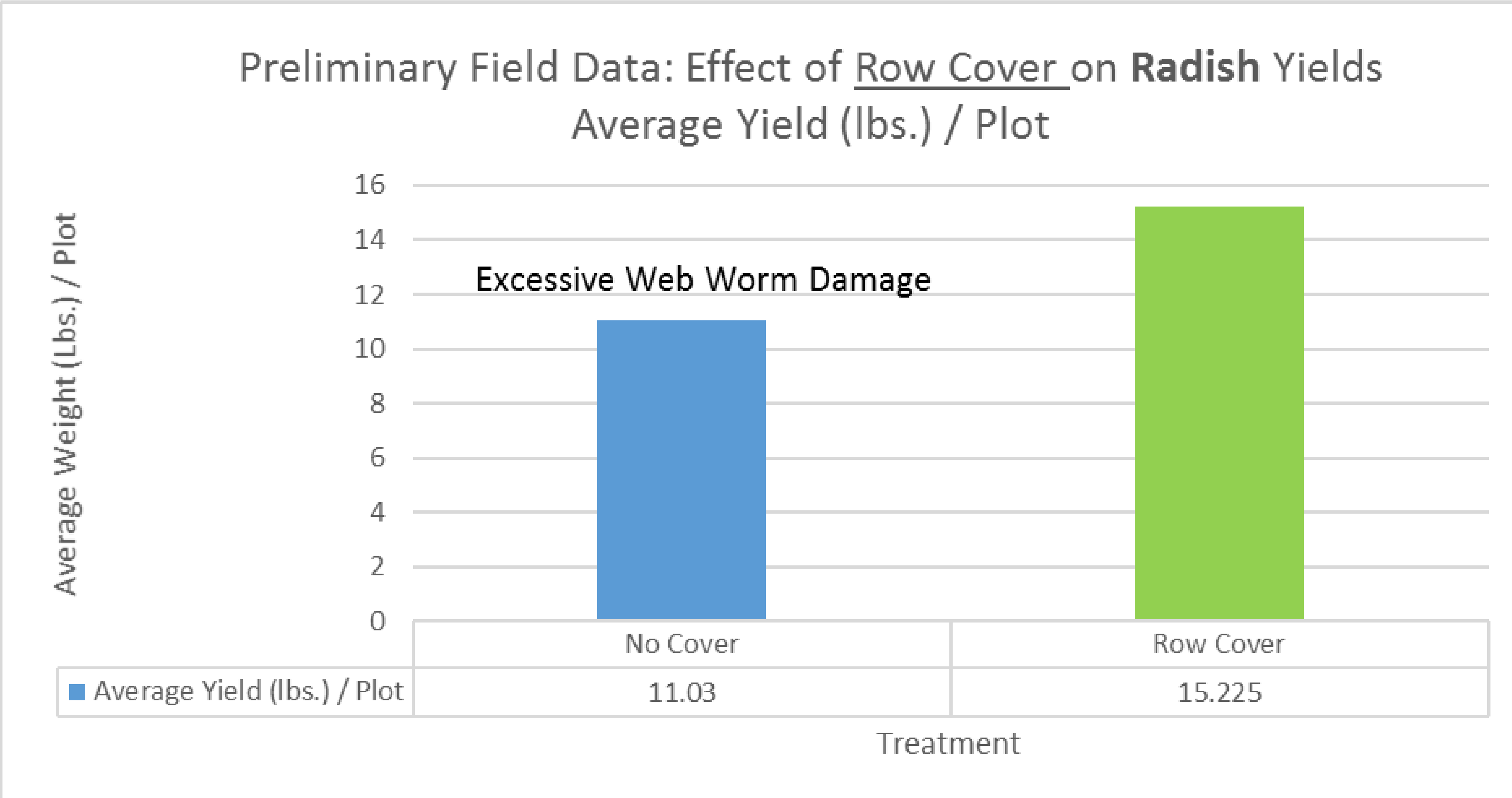
- Manipulation or installation of physical barriers to disadvantage the pest
  - Tillage
  - Crop rotation
  - Screens/ barriers
  - Spacing
  - Weed mat, mulch, etc.

Hoop House Systems

Bending pipes, door, frame, etc


EX: Physical Barriers

Evaluating Row Covers (2016)



Planted 4/12/16 Waimanalo Research Station. Harvested: 6/8/16 (re-worked field trial due to lack of bird pests)
Thinned rows of direct seeded daikon grown under (and without) row crop for germination period
Preliminary data selected from data rows within 3 plots of 8’ x 25’
More work is needed to understand the potential and drawbacks of row covers


Ex: Excessive Moisture


Ex: Birds:Transplanting vs direct seeding


Ex: Weed Management

Ex: weed management properties (also reflective, moisture, etc.)


Ex: Detrashing

Ex: Timely Crop Tillage


Ex: Mounding

Biological Controls

- The use natural predators, parasites, pathogens, etc. to control pests
- Encourage beneficial insects


Rather than cultivate biological agents,
we ATTRACT them

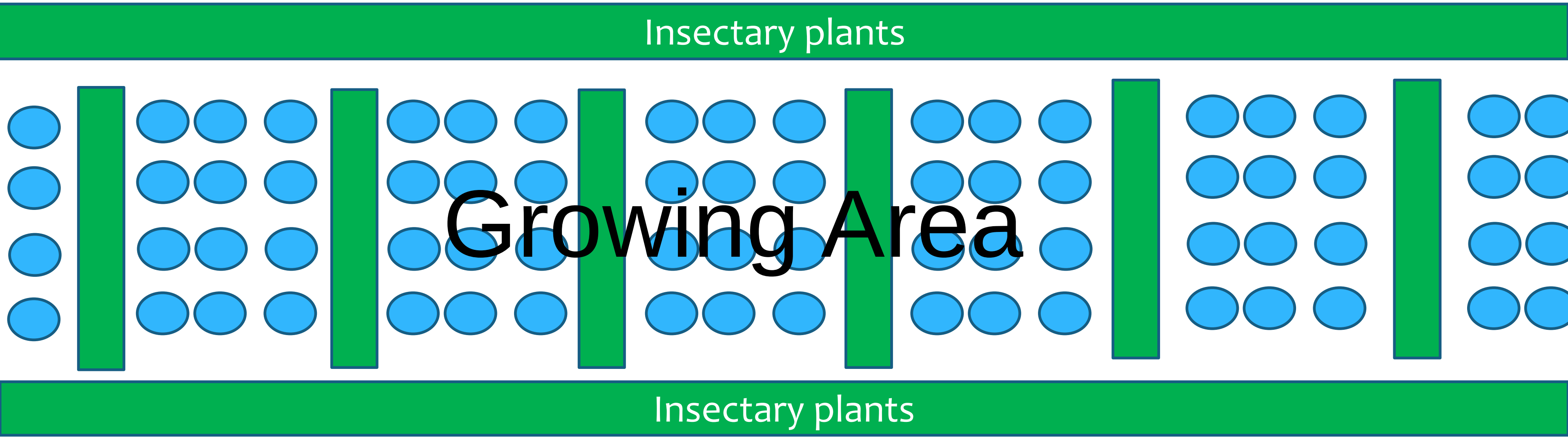
Ex. Catch and Release

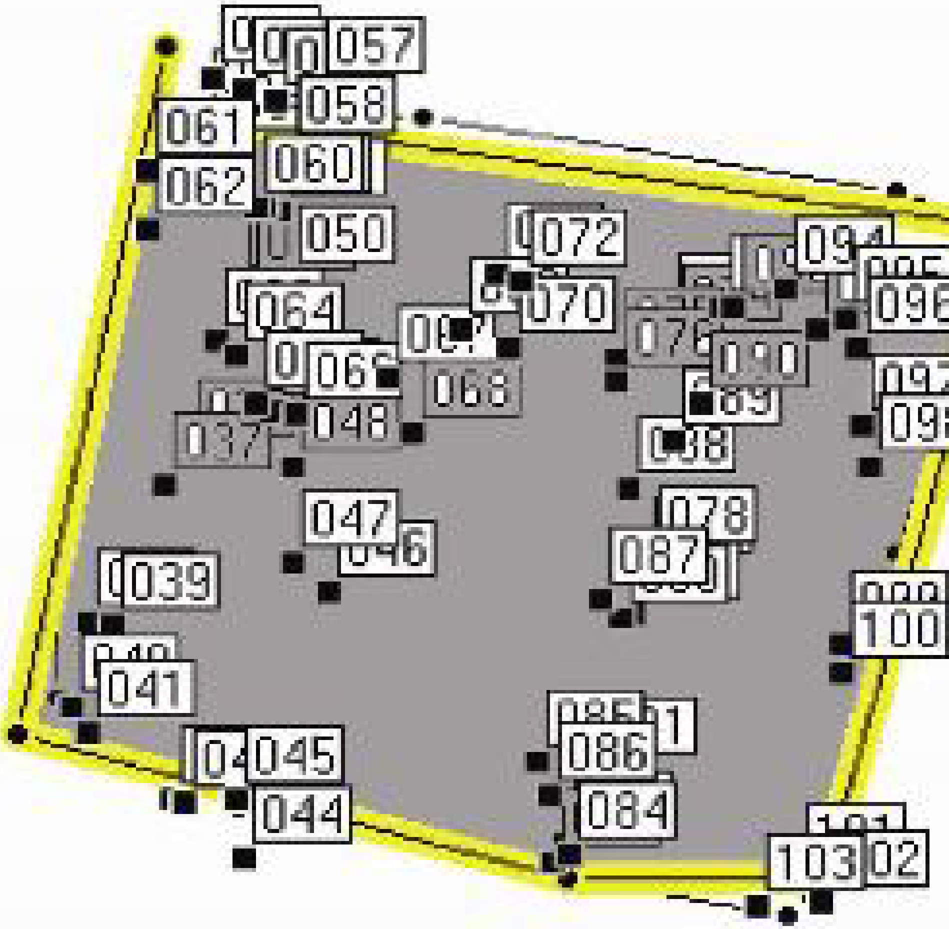

Ex. Catch and Release

Ex: Incorporating Companion Planting

Encourage Beneficial Insects: Palu (Bait) + Hukilau System

Modification of banker plant & push / pull systems





Ex. Eliminate Protectors

Photo source: http://en.wikipedia.org/wiki/File:Scale_and_sooty_mold_on_a_Eucalyptus_tree.jpg

Ants that produce formic acid are attracted to flower nectaries and to sap-feeding insects that secrete honeydew. They climb the plants to feed and, when startled, eject formic acid from their abdomens, causing blackened spots and trails.

Entire bunches may be damaged by

Startled and disturbed ants scatter over the banana fingers, spraying formic acid and leaving burnt, sunken trails.

Severe formic acid injury to a hand
Hawai'i caused by *Anoplolepis grac*

Affected bunches are left in the field and are not harvested.

De-flowering the fingers on a banana bunch by plucking them off and severing the male flowers (the hanging "bell") will remove the sweet flower nectaries that attract sugar-loving ants in the subfamily Formicinae.

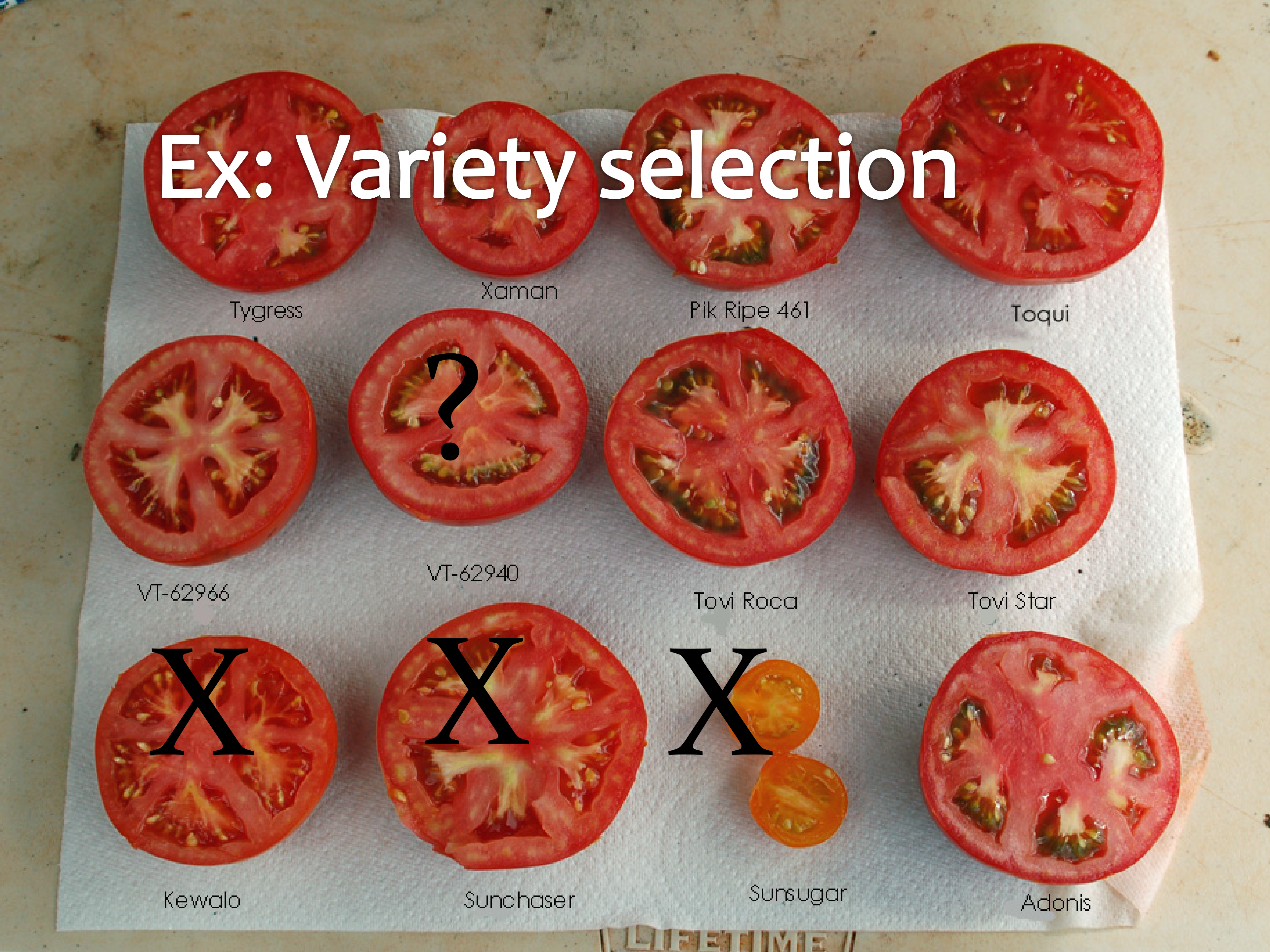
Fruits in bunches should be de-flowered to make them less attractive to foraging ants.

The flowers shown here may attract sweet-loving ants that may produce formic acid secretions when disturbed. This "bell" should be severed from the bunch.

Biotechnology

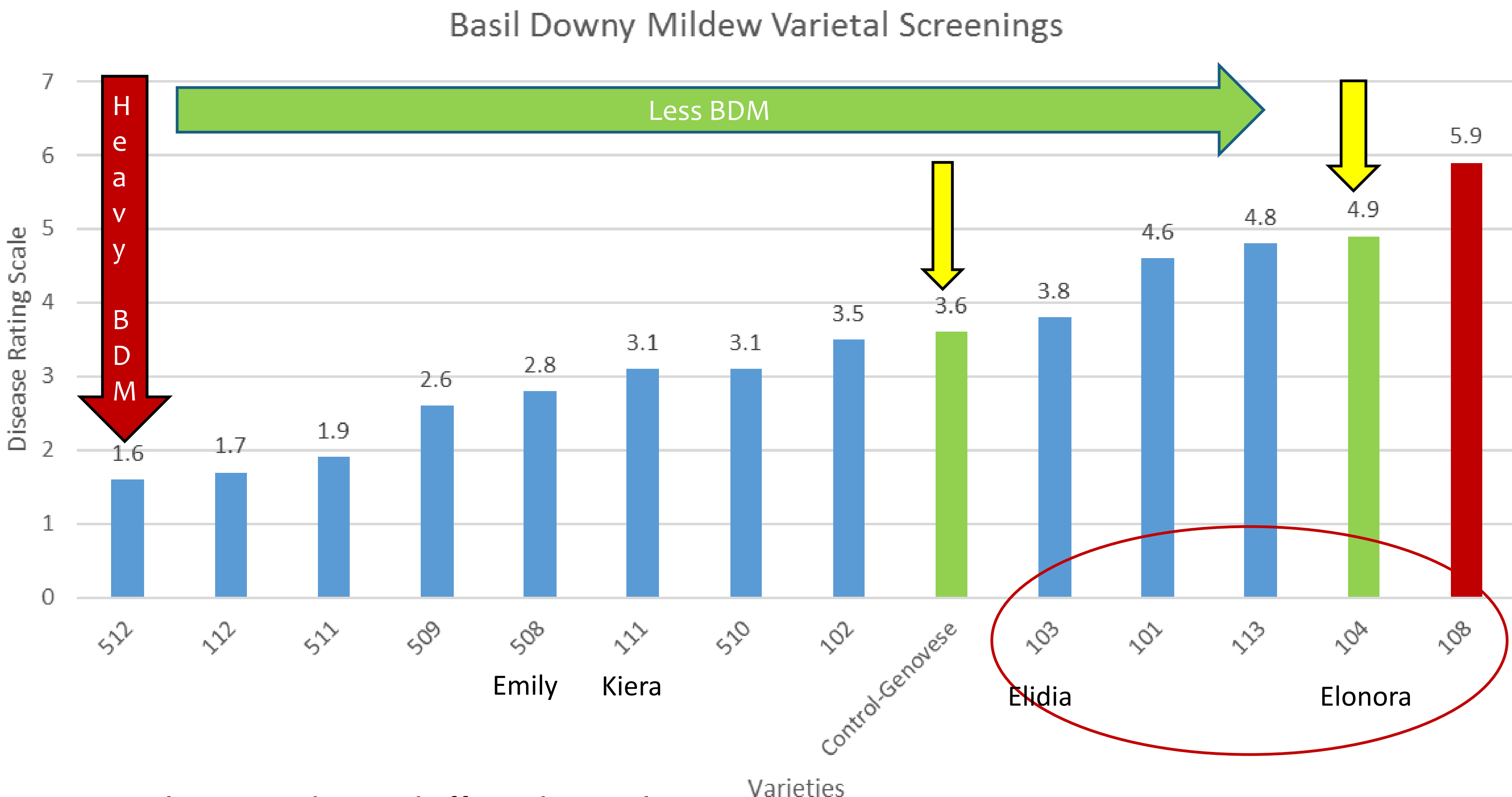
- Application of scientific techniques to modify and improve plants, insects and pathogens
  - Selective breeding
  - Pest resistance
  - Resistant root stock
  - Etc.

Ex: Variety selection



Ex: Variety selection
Tygress
Xaman
Pik Ripe 461
Toqui
VT-62966
?
VT-62940
Tovi Roca
Tovi Star
X
Kewalo
X
Sunchaser
X
Sunsugar
Adonis
LIFETIME

Ex: Crop Selection

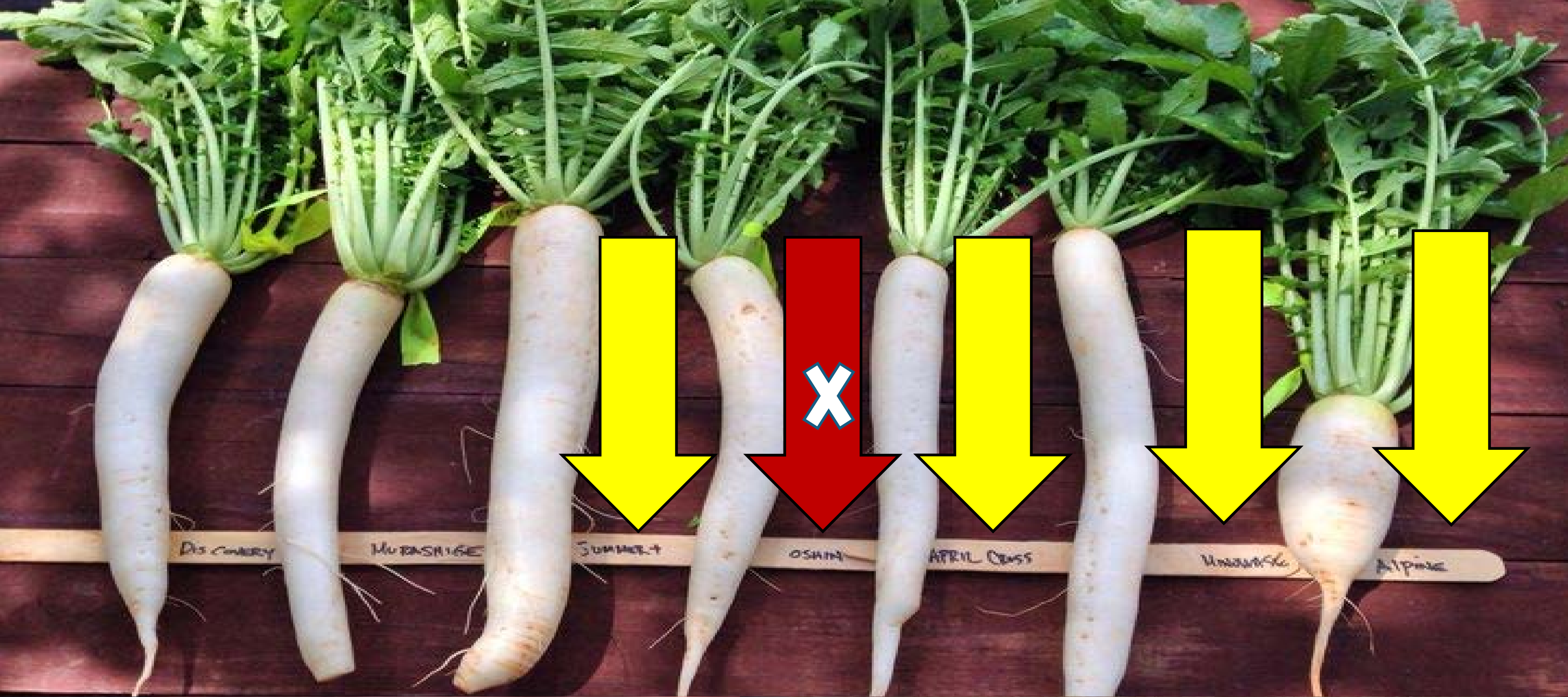


Disease scale: 1=very diseased affected to 9=absent

108 (segregated) and 111 highest yielding

Turnip Mosaic Virus (2014)

14 varieties screened


X
DISCOVERY
MURASHIGE
APRIL CROSS
Alpine

Ex: Grafting

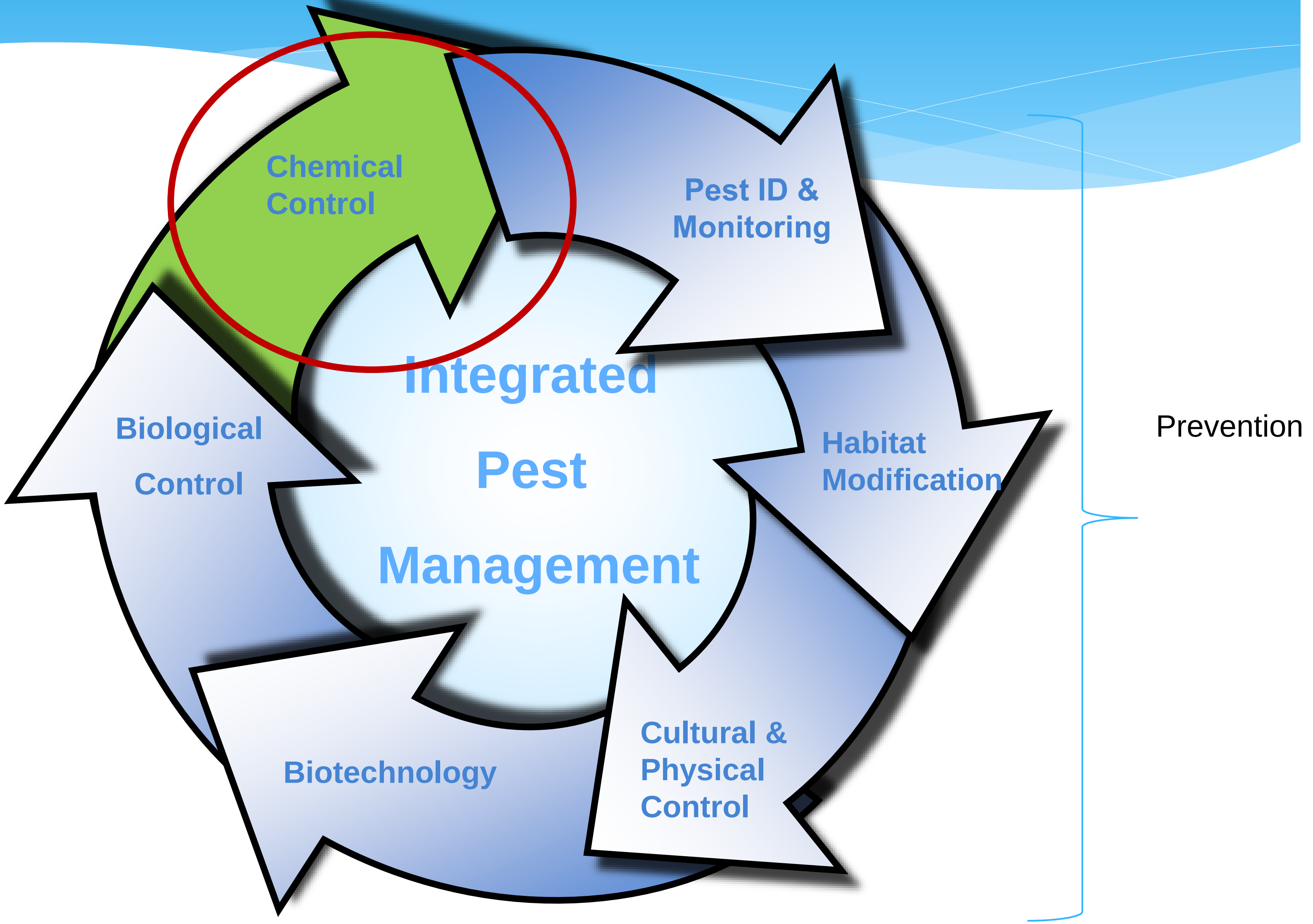

Ex: Veg Grafting

Ex: Post Harvest Quarantine

Other Non- Chemical Control

- Hot water system
- Ozone
- Etc.

Chemical Controls are often used last in IPM Systems and 'as needed'



Crop Protection Chemical

Definition of a Pesticide

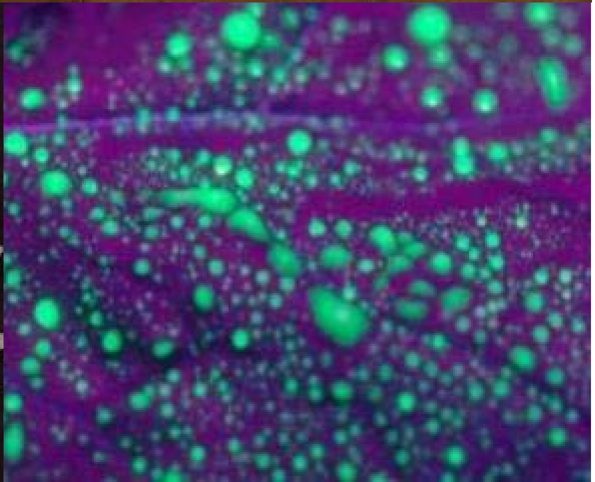
Chemical used to prevent, destroy, or repel pests

USDA EPA

Chemical Control

- Typically considered after other control methods
- Responsible use of crop protection chemicals (pesticides)
- Treatments based on monitoring data
- Applied after action threshold is surpassed

Chemical Control-Reminders

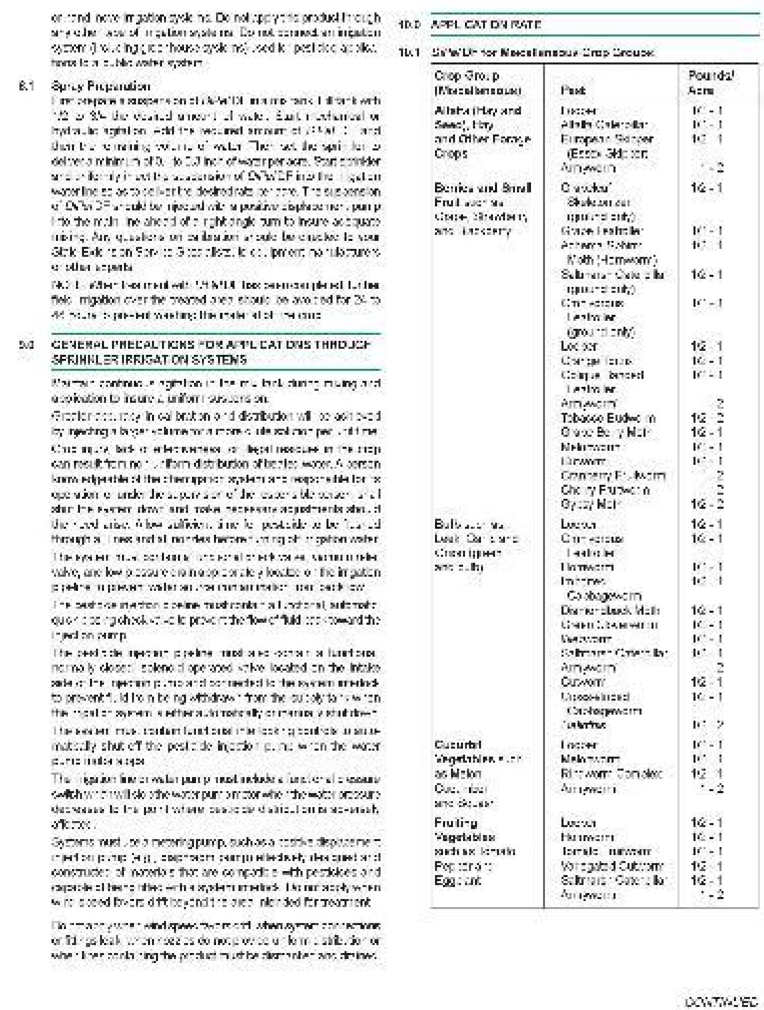


- ✓ Chemical selection
- ✓ Accuracy
  - ✓ Calibration
- ✓ Rotation
  - ✓ Resistance
- ✓ Coverage
  - ✓ Efficacy

Read and Follow Label

Knowing how much product is applied to your crop is essential to maximize efficacy

- Under-applying chemical products can result in poor pest control, as well as increased production cost and financial losses.
- Over-application of chemical products can lead to human health, legal, environmental, and pest-resistance issues.



Match Pest & Mode of Action

***Bacillus thuringiensis* (Bt)**
Derived from a bacterium which is selectively toxic to many moth and larvae. When ingested, Bt produces an endotoxin in the insects gut which is toxic to the insect. Examples: Dipel (o), Crymax, XenTari (o)

Copper products
Controls blights, mildew, anthracnose, but commonly associated with bacteria control. Example: Basic Copper 53 (o), Nucop 50DF (o), Champ WG (o)

Diatomaceous earth:
Naturally occurring substance comprised of the fossilized remains of diatoms. Insects such as roaches, ants, silverfish, fleas, etc. come in contact with this powder and die from desiccation.

Horticultural Oils:
Cover, wet, and suffocate, over wintering eggs, nymphs and adults. Effective on scale insects. Examples: Volck oil, JMS Stylet-oil (o), Biocover

Insecticidal Soaps:
Potassium Salts of Fatty Acids typically disrupt membranes of soft body pests leading to rapid death by evaporation.
Example: Mpede (o)

Neem Oil/ Azadirachtin: (IGR) ** many labels say it is toxic to fish
Disrupts insects' hormonal balance so they die before they molt, suppresses some insects' desire to feed, and it also repels. It has fungicidal properties as well. Examples: Trilogy (o), Neemix (o), Debug Turbo (o), Molt-X (o)

Natural / Essential Oils:
Pepper, citrus, clove, mint, oils. Caution as oils can burn. Herbicide properties. Examples: Ecotec (o)

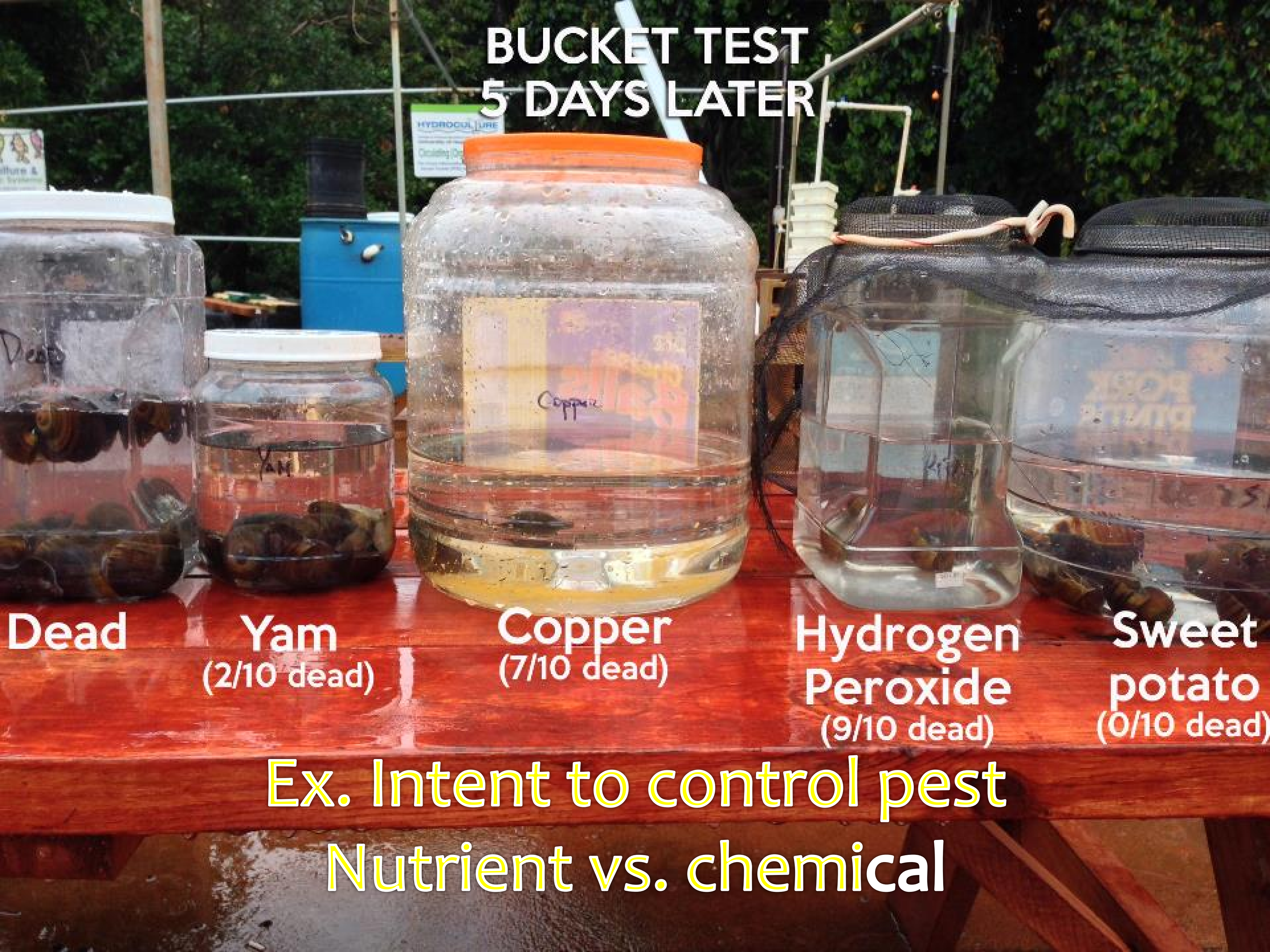
Potassium Bicarbonate
Used as a contact fungicide mainly for powdery mildew in organic farming systems. Examples: Armicarb (o), Kaligreen (o), Milstop (o)

Pyrethrin:
Derived from the blossoms of the pyrethrum flower, a chrysanthemum (contact). Breaks down in the environment quickly. Example: Pyganic (o)

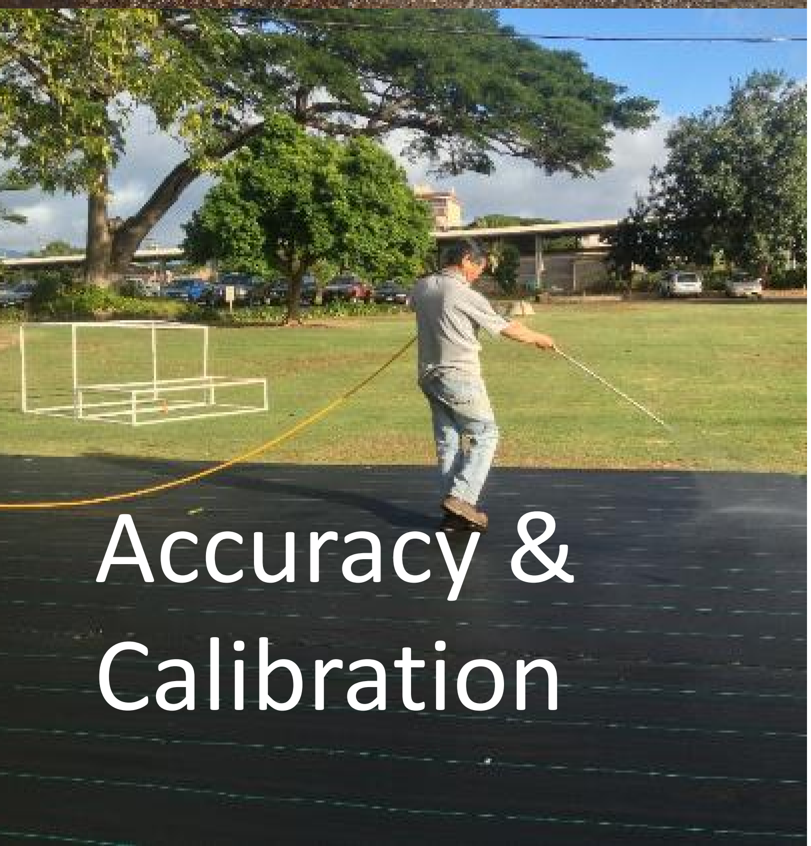
Spinosad
Derived from a bacteria in the soil. Kills by contact and ingestion. (Nerve and stomach poison). Examples: Entrust (o), Radiant, GF-120 NF (o)

Sulfur
Inhibits the attack of healthy plants by fungus disease by creating an environment that is not conducive to disease growth. Also effective on selected mites. Examples: Sulfur DF (o), Kumulus DF (o)

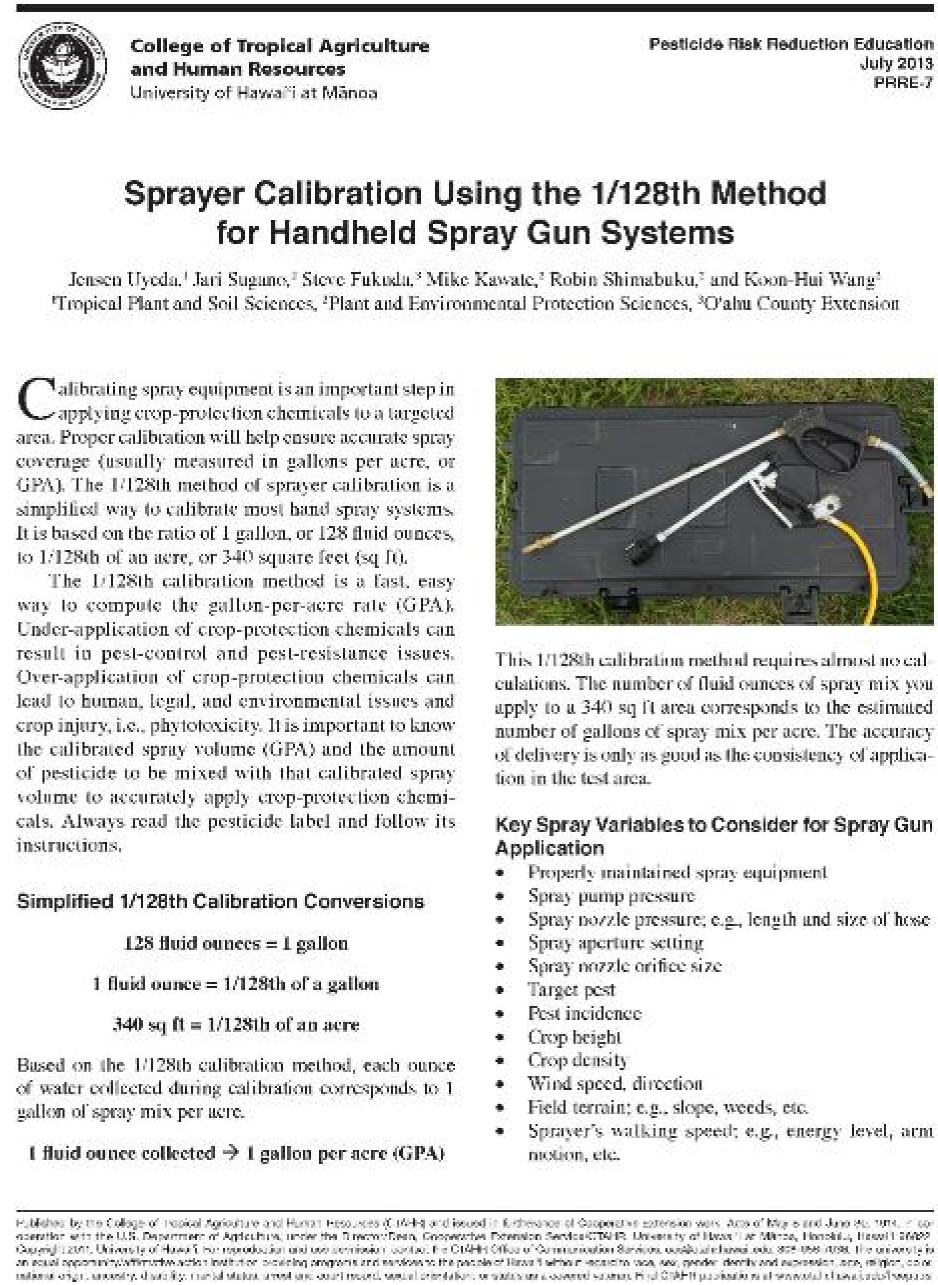
NOTE: (o) Refers to products approved for organic production by the Organic Material Review Institute (OMRI).


BUCKET TEST
5 DAYS LATER
Dead
Yam
(2/10 dead)
Copper
(7/10 dead)
Hydrogen
Peroxide
(9/10 dead)
Sweet
potato
(0/10 dead)
Ex. Intent to control pest
Nutrient vs. chemical


with fruity raspberry jam
Allergies
Contains egg, gluten and milk
May contain traces of nuts



Accuracy & Calibration



College of Tropical Agriculture and Human Resources
University of Hawai'i at Mānoa

Pesticide Risk Reduction Education
July 2013
PRRE-7

Sprayer Calibration Using the 1/128th Method for Handheld Spray Gun Systems

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Calibrating spray equipment is an important step in applying crop-protection chemicals to a targeted area. Proper calibration will help ensure accurate spray coverage (usually measured in gallons per acre, or GPA). The 1/128th method of sprayer calibration is a simplified way to calibrate most hand spray systems. It is based on the ratio of 1 gallon, or 128 fluid ounces, to 1/128th of an acre, or 340 square feet (sq ft).

The 1/128th calibration method is a fast, easy way to compute the gallon-per-acre rate (GPA). Under-application of crop-protection chemicals can result in pest-control and pest-resistance issues. Over-application of crop-protection chemicals can lead to human, legal, and environmental issues and crop injury, i.e., phytotoxicity. It is important to know the calibrated spray volume (GPA) and the amount of pesticide to be mixed with that calibrated spray volume to accurately apply crop-protection chemicals. Always read the pesticide label and follow its instructions.

Simplified 1/128th Calibration Conversions

128 fluid ounces = 1 gallon

1 fluid ounce = 1/128th of a gallon

340 sq ft = 1/128th of an acre

Based on the 1/128th calibration method, each ounce of water collected during calibration corresponds to 1 gallon of spray mix per acre.

1 fluid ounce collected → 1 gallon per acre (GPA)

This 1/128th calibration method requires almost no calculations. The number of fluid ounces of spray mix you apply to a 340 sq ft area corresponds to the estimated number of gallons of spray mix per acre. The accuracy of delivery is only as good as the consistency of application in the test area.

Key Spray Variables to Consider for Spray Gun Application

- Properly maintained spray equipment
- Spray pump pressure
- Spray nozzle pressure; e.g., length and size of hose
- Spray aperture setting
- Spray nozzle orifice size
- Target pest
- Pest incidence
- Crop height
- Crop density
- Wind speed, direction
- Field terrain; e.g., slope, weeds, etc.
- Sprayer's walking speed; e.g., energy level, arm motion, etc.

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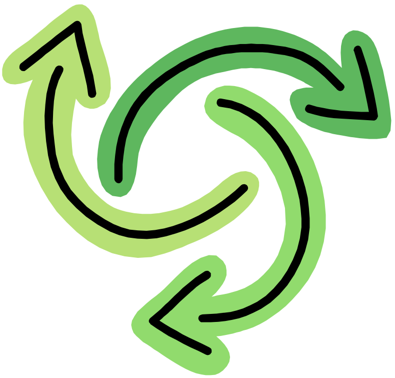
Ex. Accurate Applications


Ex. Chemical Treatments
Organic or Conventional Products

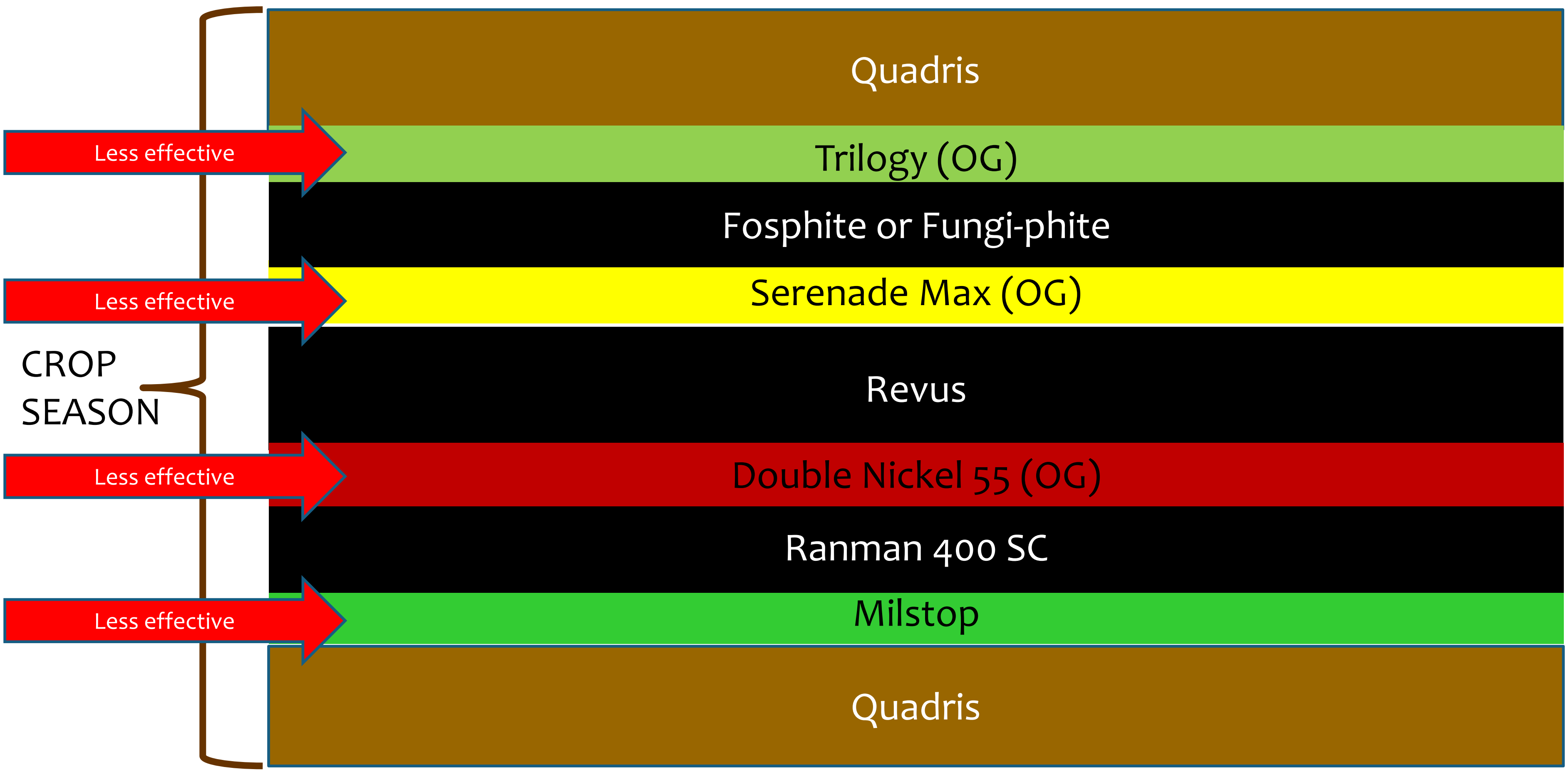
Rotate to Minimize Resistance:



- Always rotate between chemical classes
- Never use the same chemical for an extended period of time

Resistance Issues: “Fungicides not working”

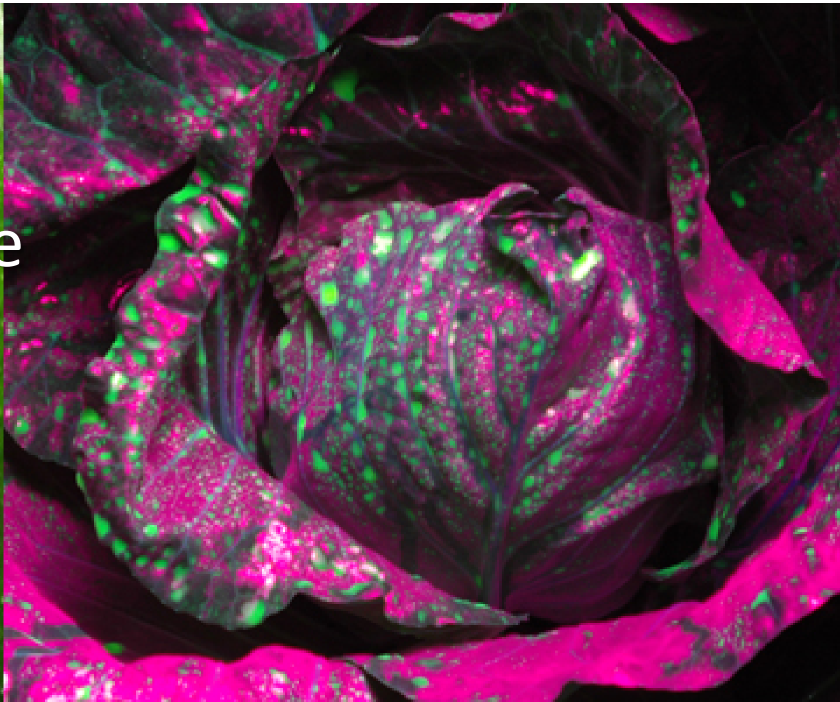
Stay within Maximum Application Limits
Limited Product Sandwich Effect / Season




Resistance Issues

Use of Spreader or Spreader-Sticker

* Increase good spray coverage and heighten product efficacy
* Maximize coverage area
* Be careful of phyto-toxicity issues




Al
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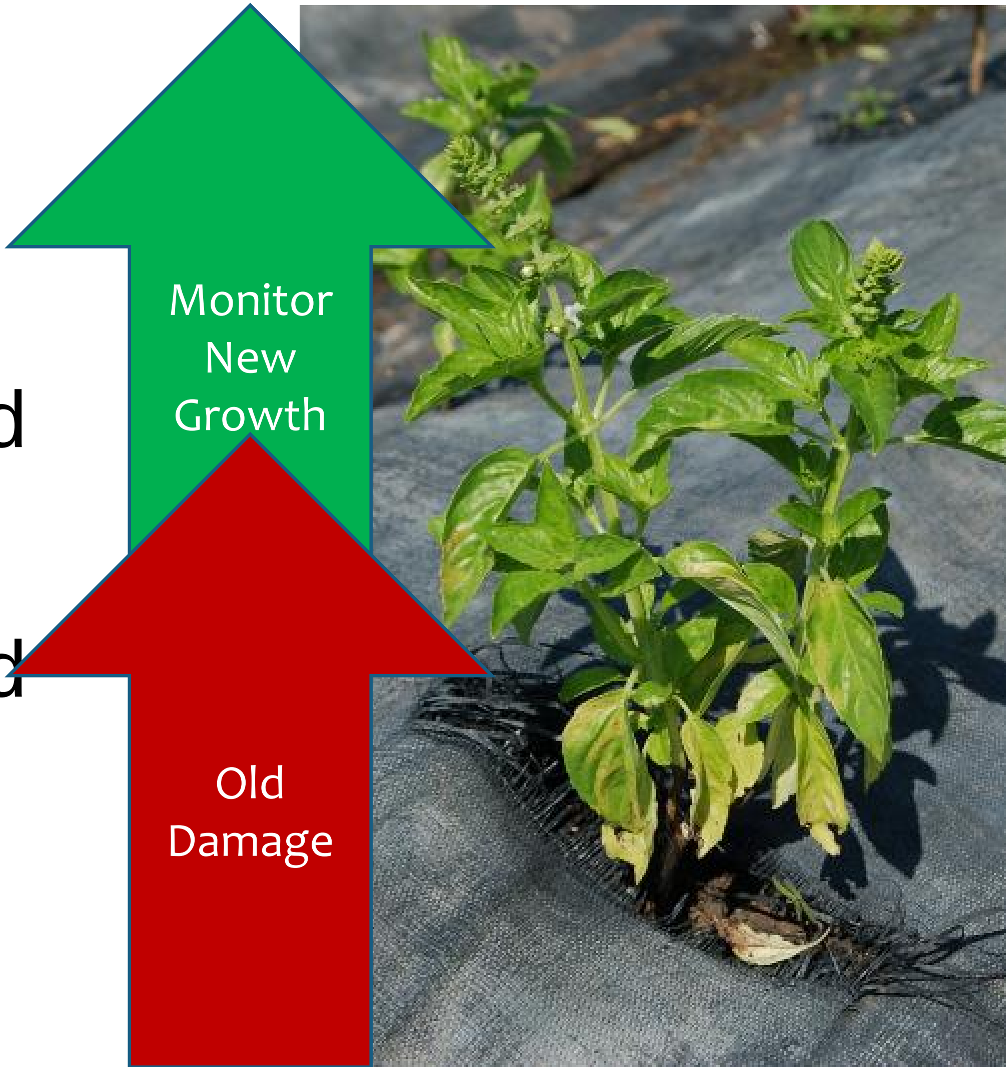
Run Off

* Source: http://bloominthyme.com/tag/organ

Target Your Sprays

Monitor for Damage = Damage

- **<u>CAN NOT</u>** undo old damage
  - Protect new leaves
  - Evaluate effectiveness based on **NEW** leaves
  - Do **NOT** assess effectiveness based on older parts of the plant




Monitor
& Protect
New
Growth
Last
Harvest

Same Approach for Organic IPM

For More information

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