UH Extension
MĀNOA | College of Tropical Agriculture and Human Resources

# Field Screening for Basil Downy Mildew

Report from the Basil Swat Team:
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College of Tropical Agriculture and Human Resources
2016

# Basil Downy Mildew
## *Peronospora belbahrii*

* Symptoms started at the end of 2010
* Confirmed on 1/28/11 by the UH CTAHR Agricultural Diagnostic Service Center
* Transmitted by
  * Infected seeds
  * Movement of spores on leaves, seeds, etc.
  * Movement by wind
* Pathogen prefers
  * Cool weather
  * Rainy season
  * High humidity conditions

# ALIEN PEST ALERT!

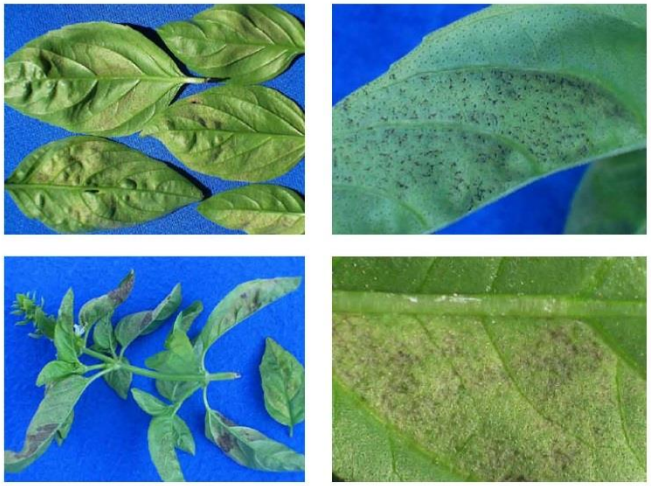
College of Tropical Agriculture and Human Resources
University of Hawai'i at Mānoa

Feb. 1, 2011

# Basil Downy Mildew

*Peronospora belbahrii*

On Friday, Jan. 28, the pathogen Basil Downy Mildew was identified as infecting basil at several farms in Wai'anae. It has not yet been found anywhere else in Hawai'i. Basil is a $6.8M crop in Hawai'i, sold within the Islands and exported to the Mainland and Canada. Leaves infected with downy mildew cannot be sold, and in some areas of the Mainland, growers have lost their entire crop to this disease and fast-spreading pathogen. It is important to first identify this downy mildew and then work quickly to eradicate or greatly reduce it to save present crops and prevent it from spreading.



*Clockwise from top left: yellowing of infected basil leaves; sporulation on undersides of leaves; sporulation as seen from top of leaves; black discoloration of dying leaves. Photographs are from the Cornell Vegetable MD Online, Dept of Plant Pathology, Ithaca, NY.*

## What Is It?

According to Cornell University's Plant Pathology department, Basil Downy Mildew, caused by *Peronospora belbahrii*, is a destructive pathogen characterized by clear to black sporulation, yellow leaf discoloration, and die-off of basil leaves. Since 2001, it has been found throughout Europe, Israel, New Zealand, Argentina, and some parts of Africa. It reached the mainland US and Canada in 2007 and greatly expanded the areas infested in 2008. In 2009, it was reported in California. This is the first instance of basil downy mildew identified in Hawai'i.

## What Causes It?

Downy mildews are spread by seeds that have been penetrated and infected by the pathogen and by spores on leaves, seeds, and other items. The numerous spores can also be dispersed great distances by the wind, making it especially contagious. Temperatures in Hawai'i are usually high enough that downy mildews are not a problem, but the recent cool weather and unusual rains in Wai'anae have created a favorable environment for this mildew. It may not be an ongoing problem in Wai'anae and other dry areas, but as long as the temperature remains low in the morning hours and there is high humidity or rain, the environment will continue to be ideal for this pathogen. If the pathogen spreads to wetter sites like Kahuku and Waialua on O'ahu or to sites on the neighbor islands, it may become an even greater problem.

## How Do I Know Whether My Plants Have It?

Plants infected with downy mildew have black lesions on the lower leaves and black or purple-gray mildew growing on the underside of the leaves. The leaves then turn yellow, particularly on the upper surface, and eventually become splotched with black or brown and



es may be mistaken
es o not have the spores
e not sure, you can
the Agricultural Diagnos-
ologist Dr. Janice Uchida

t?
fields. If downy mildew
ted leaves, including those
and burn them or bury
ot. Leaves should not be
npletely decomposed—
ending on how moist the

s, apply a fungicide to the
ne new growth. Fungi-
y mildew include Fungi-
ovate® AG. These prod-
wai'i. The two products
n (see Web site, below),
ot licensed for sale in
ne active ingredient as
e products are for com-
owners; an appropriate
ll under study. OxiDate®,
cation, does not have
refore should not be used.
le, is approved for use in
d to basil. Kaligreen®
re study is needed.
luding boxes, trucks,
, and anything else that
nitized. Plastics, cloth-
in 15% freshly prepared
h mixed with 85 parts of
r soap added for better
spray well with a 30%
h and 70 parts water); try
benches also, as well as
benches can be sprayed
0 parts bleach and 80
ld be discarded, as it is
will survive on boxes.
nay have host tissue
and should be cleaned
prayed with fungicide
ores are fragile and will
not last in soil for more than a few days to a week.

- Other types of sterilizing agent include the quaternary ammonium chloride compounds such as Physan 20™. Follow directions for use. These are not toxic to humans if used properly.
- Cornell University advises that certain species of basil are more susceptible to basil downy mildew than others: sweet basil (Ocimum basilicum) is the most susceptible, while Thai basil is slightly less susceptible and lemon basil cultivars are even less so. No symptoms were found in New Jersey on 'Spice,' 'Blue Spice,' and 'Blue Spice Fil.'
- Growing basil in environments that reduce leaf wetness and humidity will discourage disease. There should be enough space between the plants to allow air to circulate freely among them. For new fields, design a pattern with rows parallel to the prevailing wind direction and use drip irrigation. In fields that are densely planted, removal of some of the plants is recommended to increase air movement and canopy drying. If plants are grown in greenhouses, fans should be used to circulate the air, and plants should be spaced at greater distances.

## More Information

Cornell University's Extension Service has put out a useful fact sheet about basil downy mildew: http://vegetablemdonline.ppath.cornell.edu/NewsArticles/Basil-Downy.html#Report

More pictures of infected plants can be seen here: http://www.longislandhort.cornell.edu/vegpath/photos/downymildew_basil.htm

**Local contacts:**

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Maui: CTAHR extension agent, Robin Shimabuku
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Big Island: CTAHR research support, Brian Bushe
bushe@hawaii.edu, 808-969-8266

# AT RISK: Hawaii Basil Industry 6.2 Million Dollars (2011)

# November 2016

Confirmed by CTAHR Extension agents that BDM is widespread on Oahu, Maui, Molokai and Hawaii (Waimea and spreading)

Photo source: NASA. Image courtesy Jacques Descloitres, MODIS

# Downy Mildew Symptom, Upper Leaf Surface
# 露菌病葉面病症

Photo credit: J. Uchida & C. Kadooka

# Downy Mildew, Symptom Under Sides of Leaves
# 露菌病葉背病症

Photo credit: J. Uchida & C. Kadooka

# Downy Mildew Close-up-Under Side of Leaf
# 露菌病 葉背特寫 咖啡硬介殼蟲

Photo credit: J. Uchida & C. Kadooka

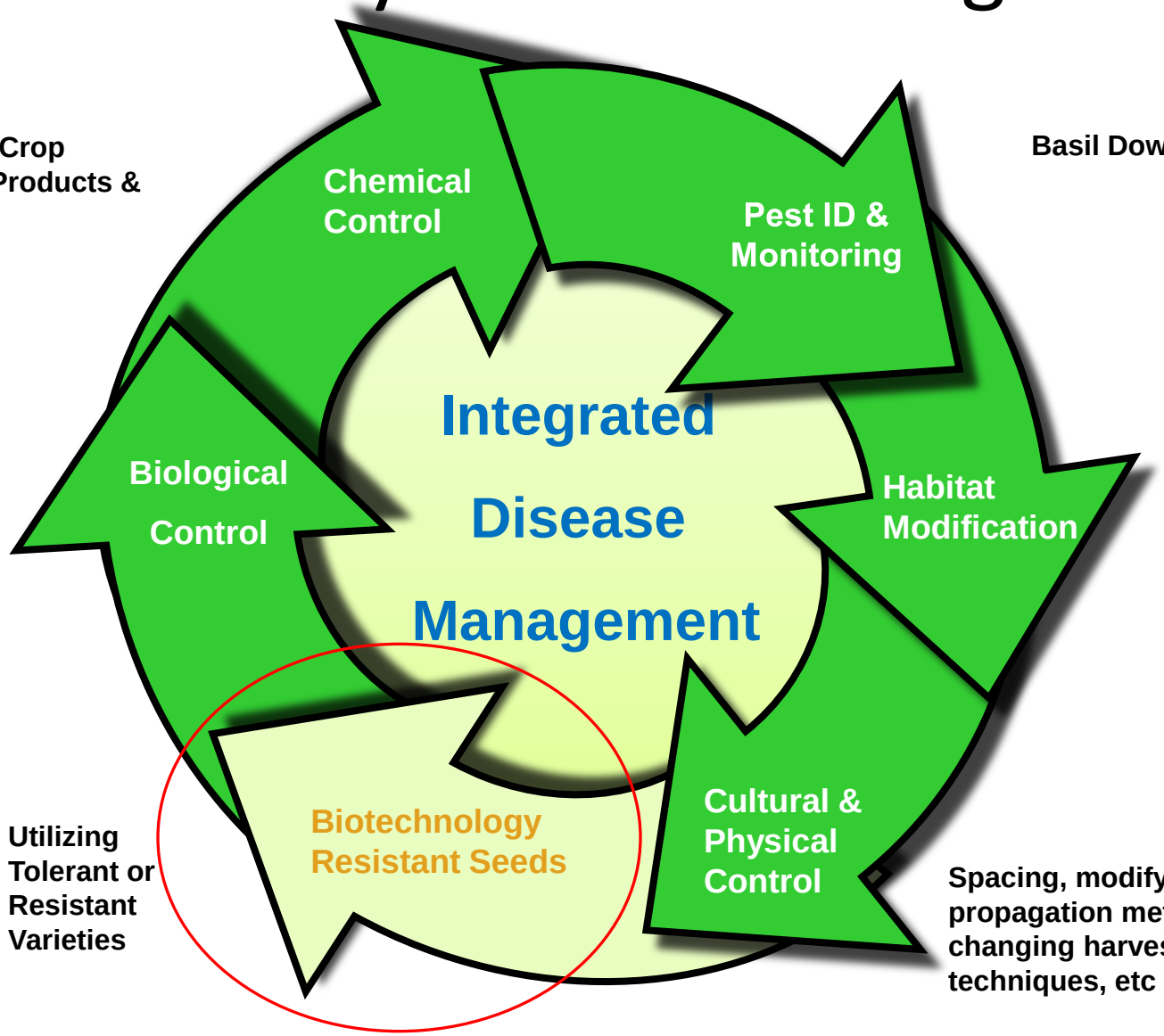

Photo credit: J. Uchida & C. Kadooka

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

# Basil: Ideal Housing for Fungi

# Perfect BDM Environment: Underside of Leaf

# Basil Downy Mildew Management




Rotation of Crop Protection Products & Surfactants

Basil Downy Mildew

Biologicals, Organic Crop Protection Products

Environmental conditions:

Wind barriers

Wind direction

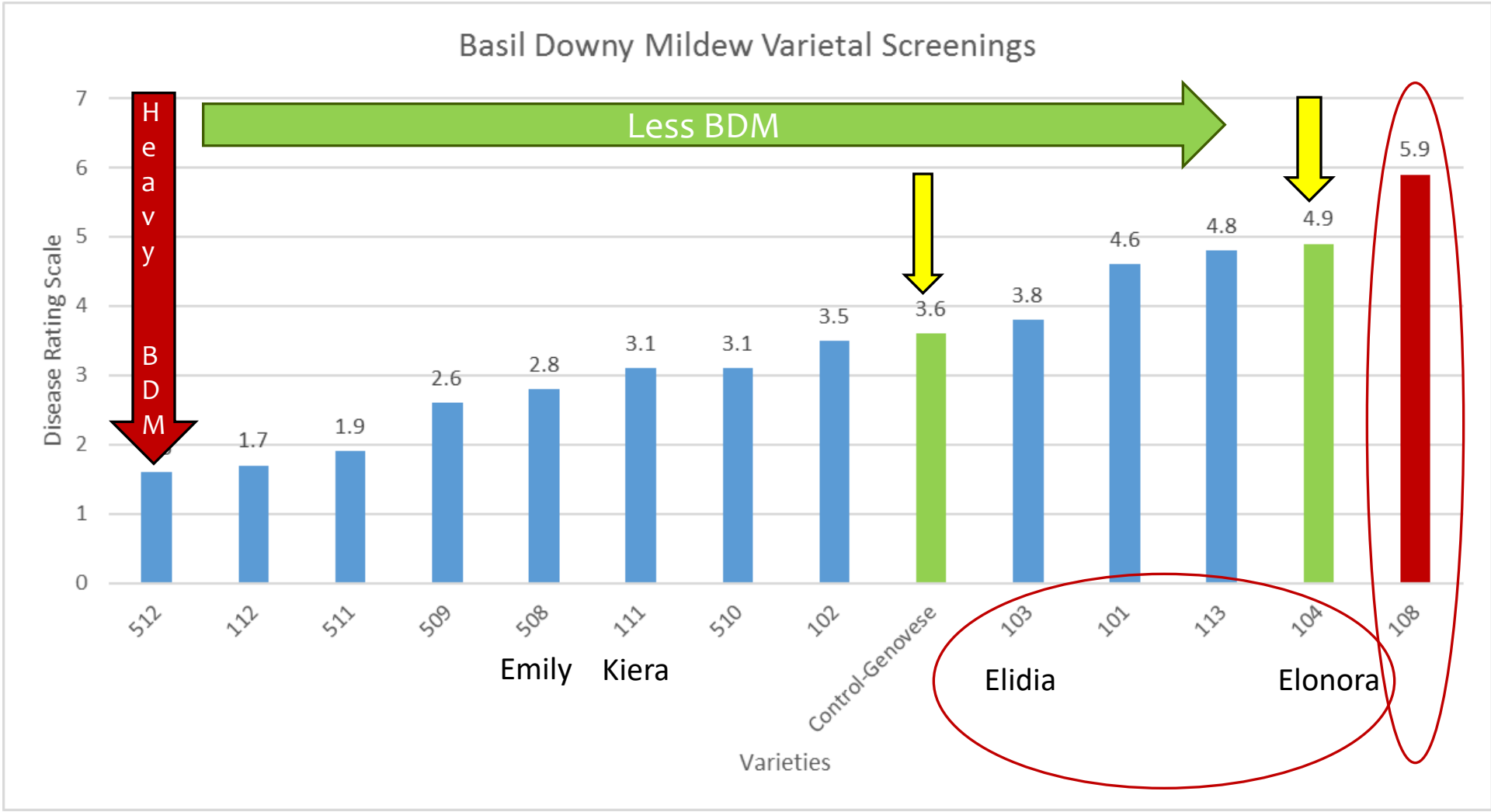
Aeration

Drainage, etc

Utilizing Tolerant or Resistant Varieties

Spacing, modifying propagation methods, changing harvest techniques, etc

Basil Downy Mildew Variety Field Trials (2015) Enza Zaden / Vitalis Organic Seeds




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

108 (segregated), but smaller leaves. 111 highest yielding

# 2016 Basil Downy Mildew Field Screenings

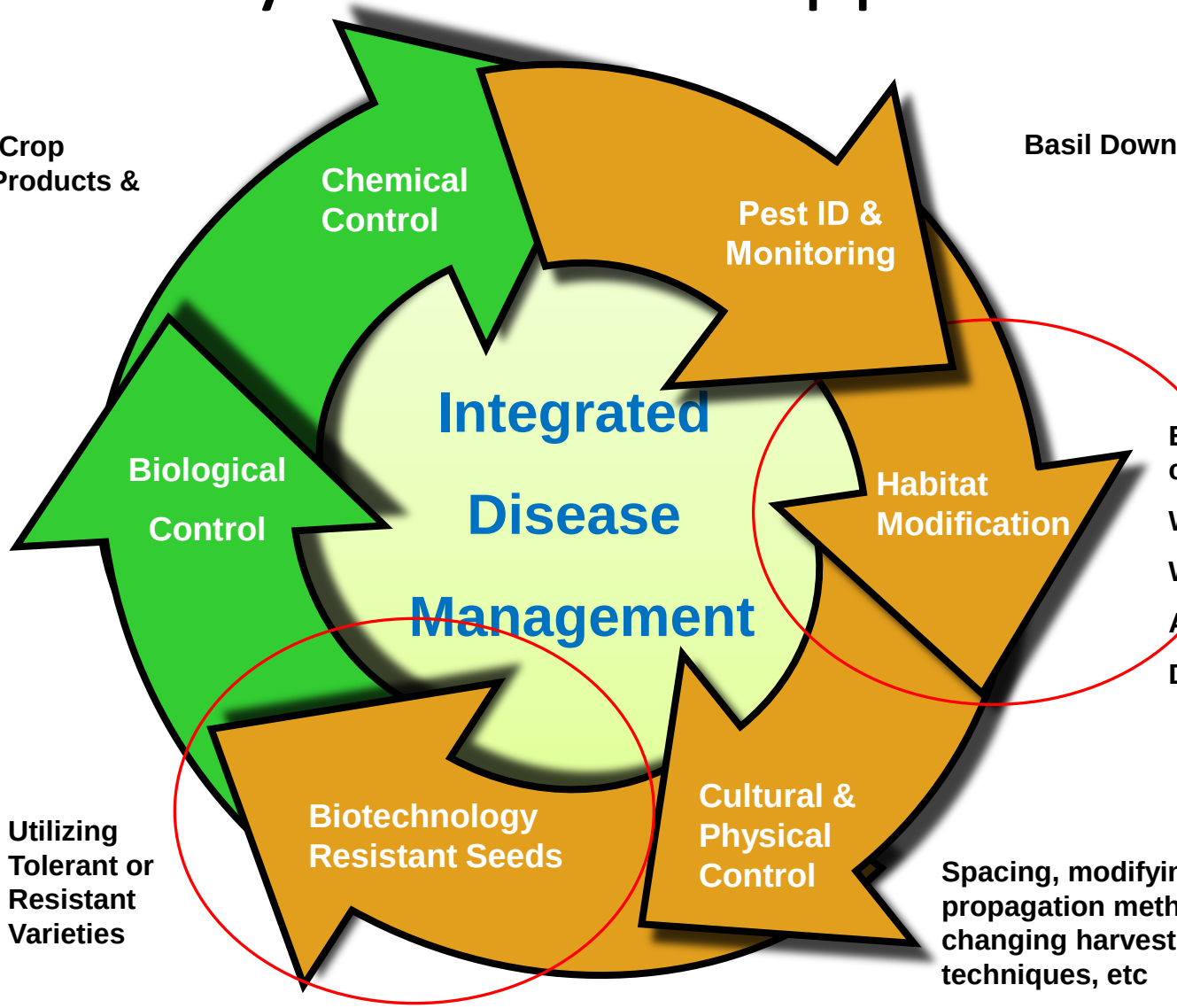
| | | |
|---|---|---|
| Genovese (Control) | 108 | 111 |
| 114 (2016) | Genovese (Control) | 508 (Emily) |
| 104 (Elonora) | 115 (2016) | Genovese (Control) |

Planted 8/23/16
10 plants / row
As of 11/7/16: BDM is not significant to take data

# Desired Crop Traits

* High BDM tolerance
* Large leaves
* Few flowers
* High yielding
* Uniform color
* Upright growth
* Sweet basil flavor

# Backyard Grower Approach

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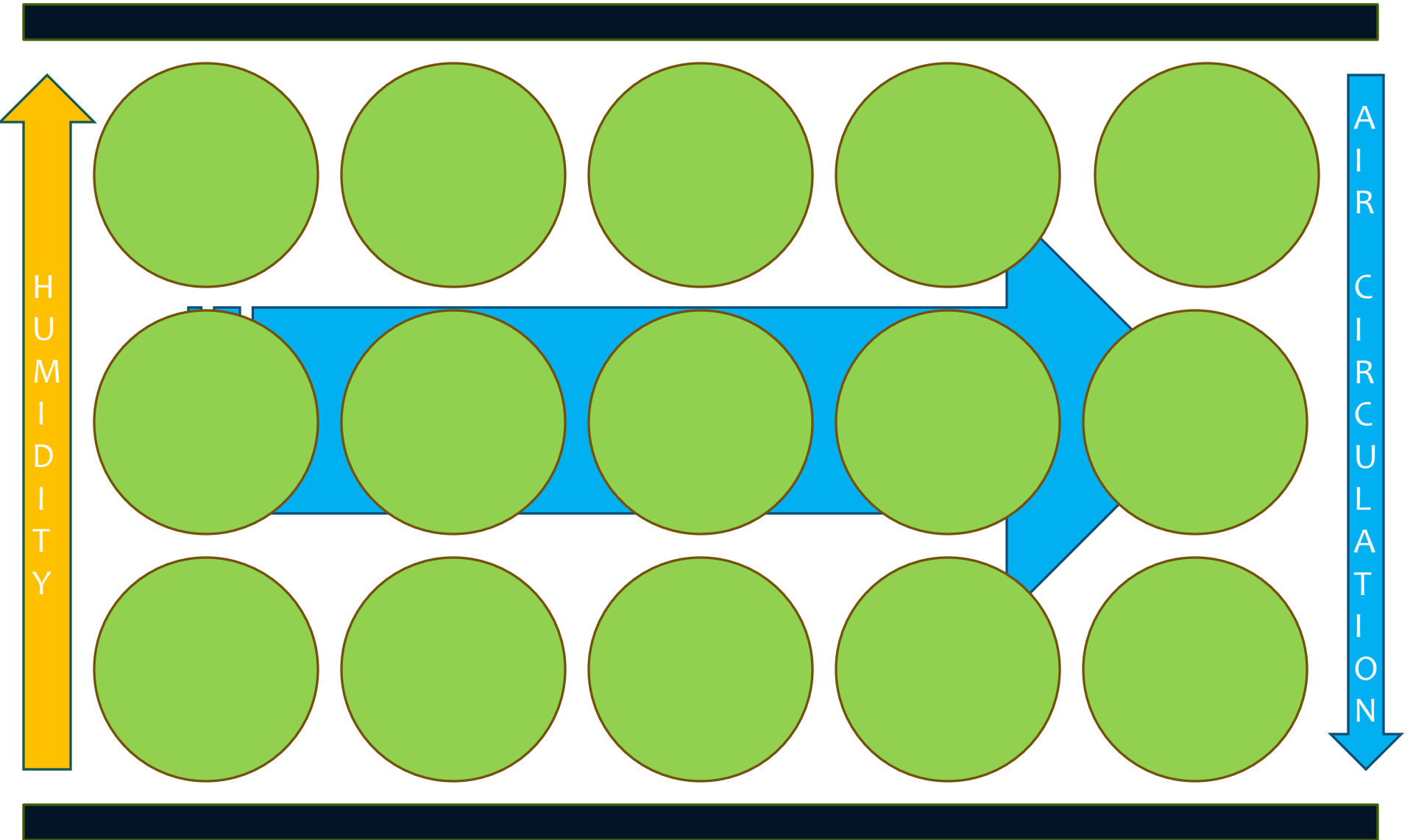
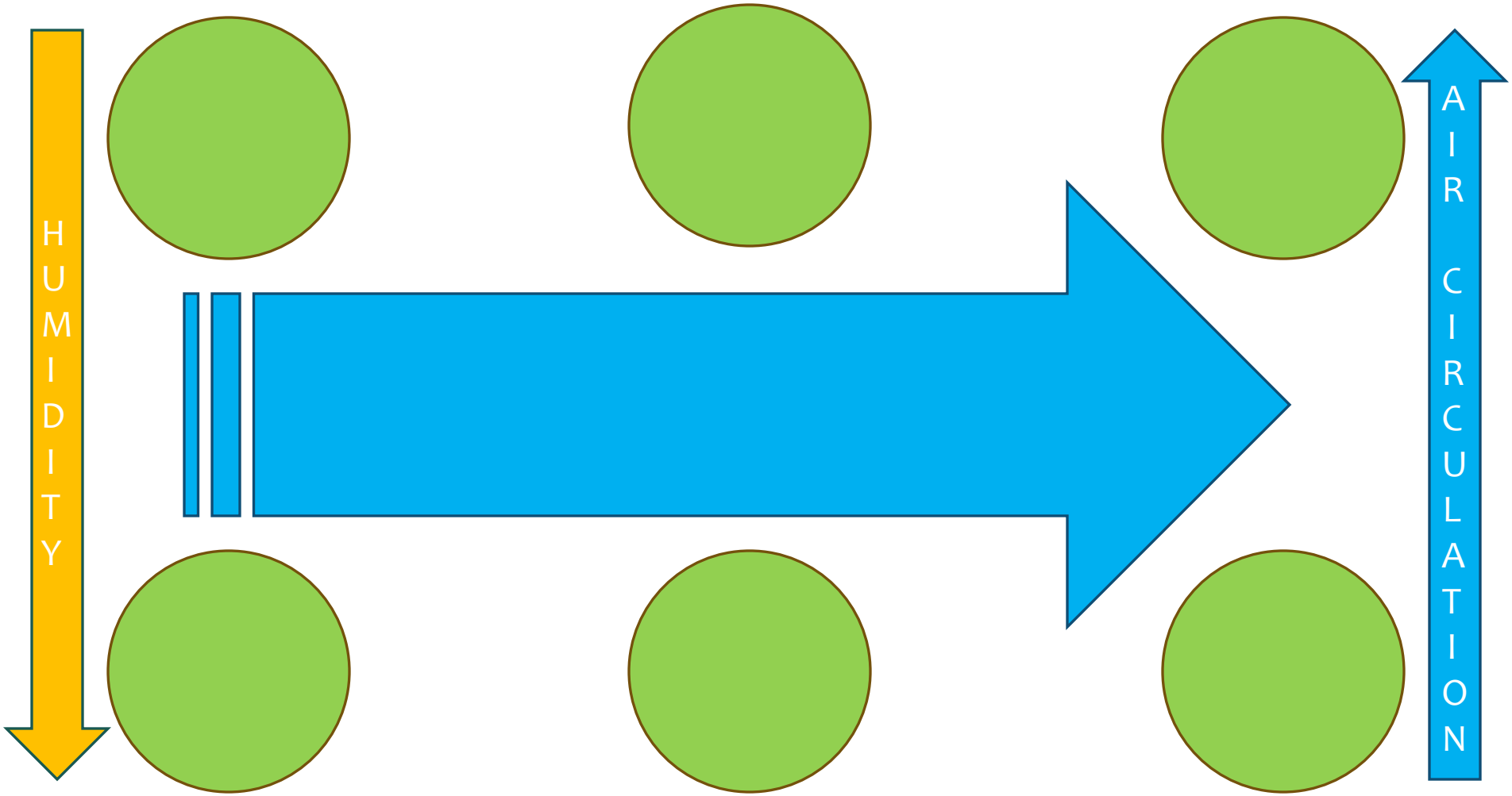
# Alternative Methods to Manage Disease

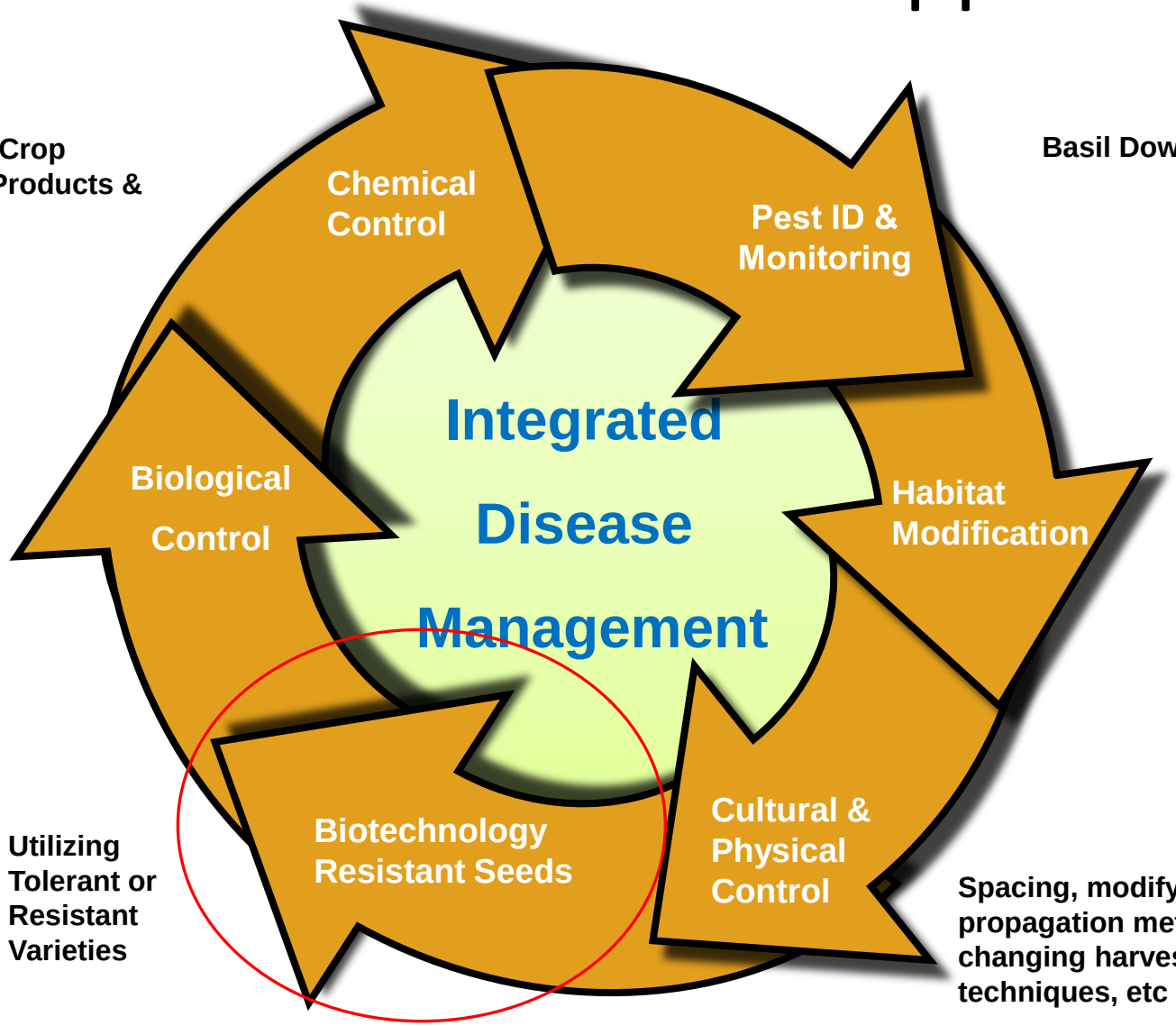
## High Intensity Plant Spacing



# Changing Cultural Practices
# Low Intensity Plant Spacing



# Commercial Producer Approach




Rotation of Crop Protection Products & Surfactants

Basil Downy Mildew

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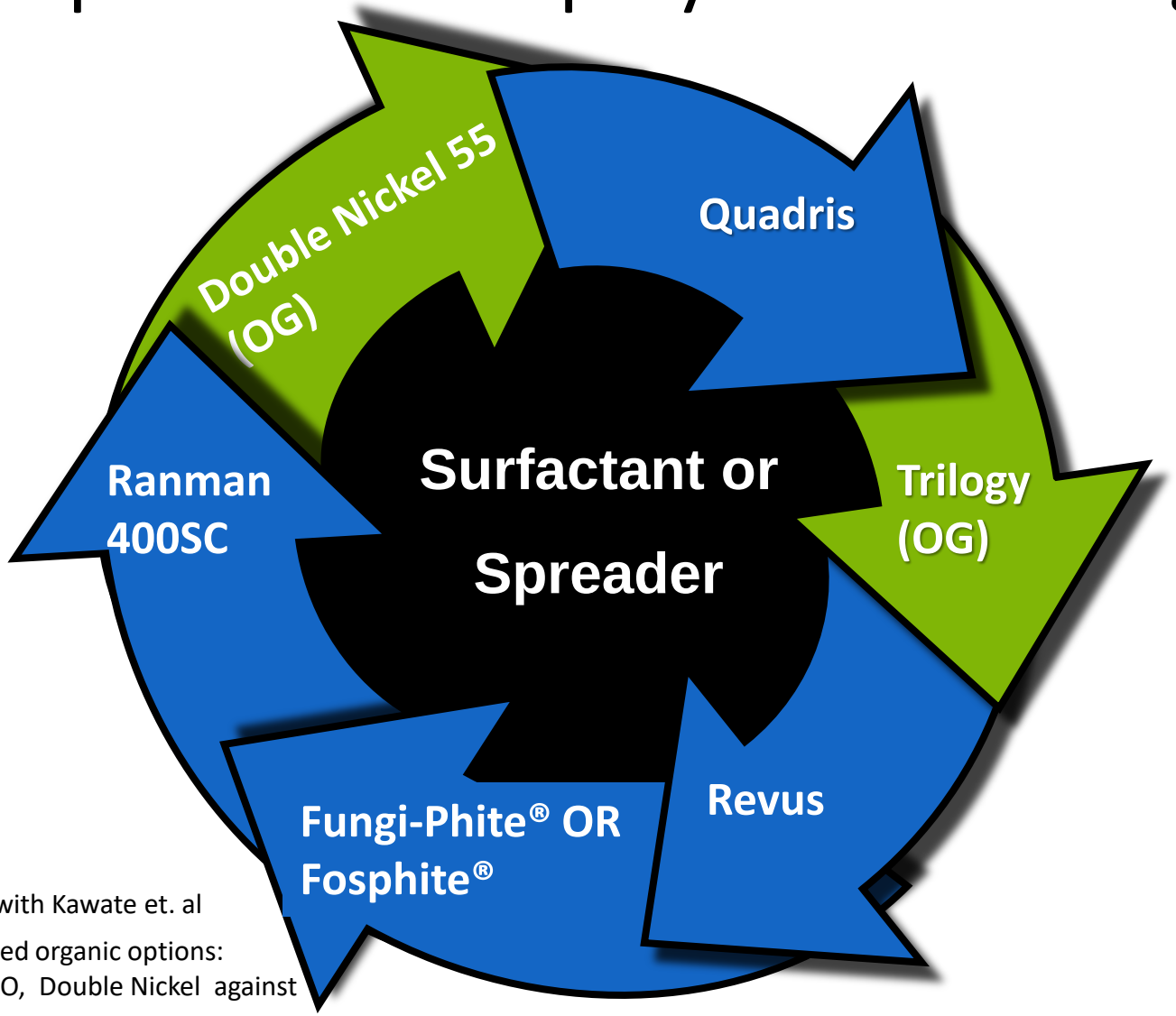
# Applied Field Trials Generated CTAHR Recommendations

# Ex.Crop Protection Spray Rotation Program




Based on field trials with Kawate et. al

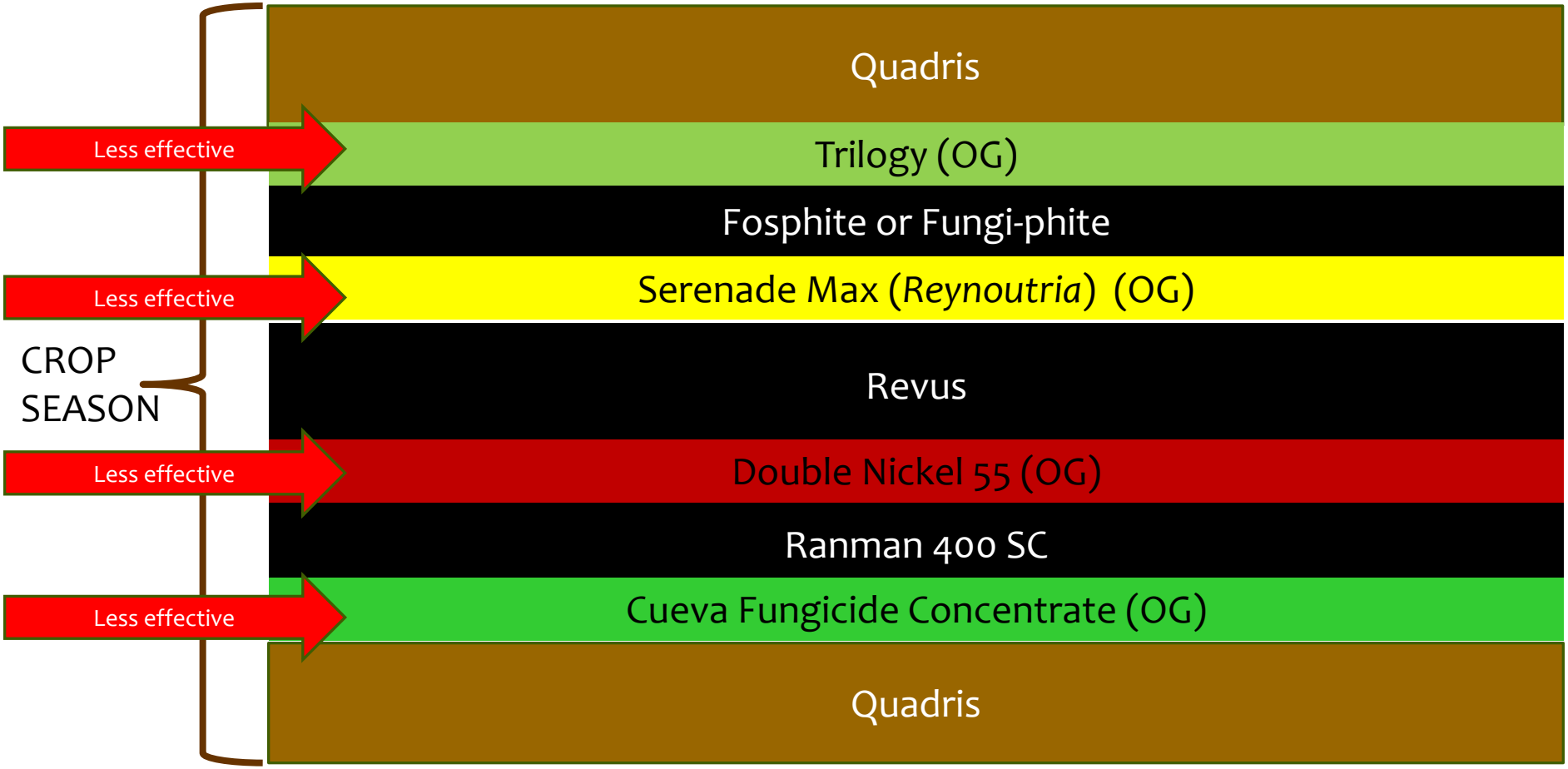
2016: CTAHR evaluated organic options: Actinovate, Camelot O, Double Nickel against Revus

# Evaluation of Organic Fungicides

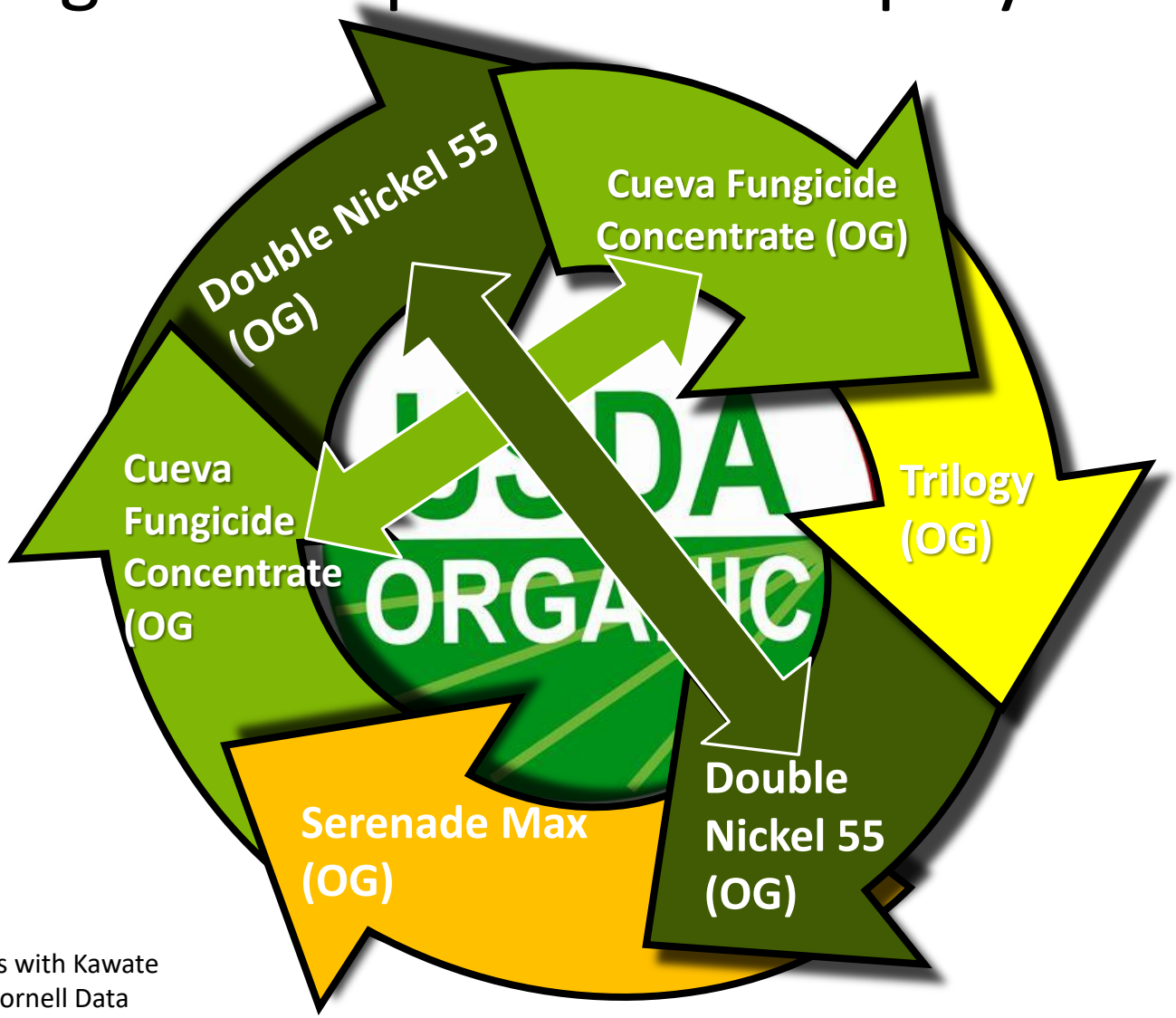
* 2016: CTAHR evaluated organic options:
  * Actinovate, Camelot O and Double Nickel
  * Double Nickel and Camelot O were promising
  * Camelot O not allowed for field use
  * Cueva Fungicide Concentrate (OG) would be a replacement option
* 2010 Cornell University evaluated:
  * Companion, Sonata, Sporatec, Organicide (without copper), Actinovate, Regalia and Oxidate were found to have more BDM than the untreated control
  * The organic pesticide least effective on BDM was Oxidate

Source: http://ir4.rutgers.edu/Fooduse/PerfData/3337.pdf

# Limited Product Sandwich Effect (non-organic) (Max a.i./crop season)



# Ex. Organic Crop Protection Spray Rotation

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Planted 8/23/16
10 plants / row


*New Basil Fungus:*
*Stemphylium*
April 2013

# Summary

* Commercial, large scale organic production of basil is highly difficult due to the lack of effective products for basil downy mildew
* Best chance of success would be to include:
  * Transition away from the *Genovese* variety in high risk areas
  * Selection and use of tolerant varieties (Elonora, Elidia, etc.)
  * Changes in cultural practices to promote better air movement
  * Proper chemical rotation with effective organic fungicides
  * Targeted sprays to susceptible (under side of leaf) areas
  * Use of a surfactant

# For More Information

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