



**UH**  
MĀNOA

**Extension**

College of Tropical Agriculture and Human Resources

People, Place, Promise

# Pest Management for UH CTAHR Master Gardeners

J. Sugano, J. Uyeda, Steve Fukuda, Koon-Hui Wang & T. Radovich

University of Hawai'i at Mānoa  
College of Tropical Agriculture and Human Resources  
March 2017





# Master Gardeners at UH CTAHR

- Adults who love gardening, want to learn and to share their knowledge with others through volunteer educational services.
- Extension resource for expanded outreach into the community.
- Trained volunteers who help Extension meet the overwhelming demand for research based horticultural and gardening information to the public.





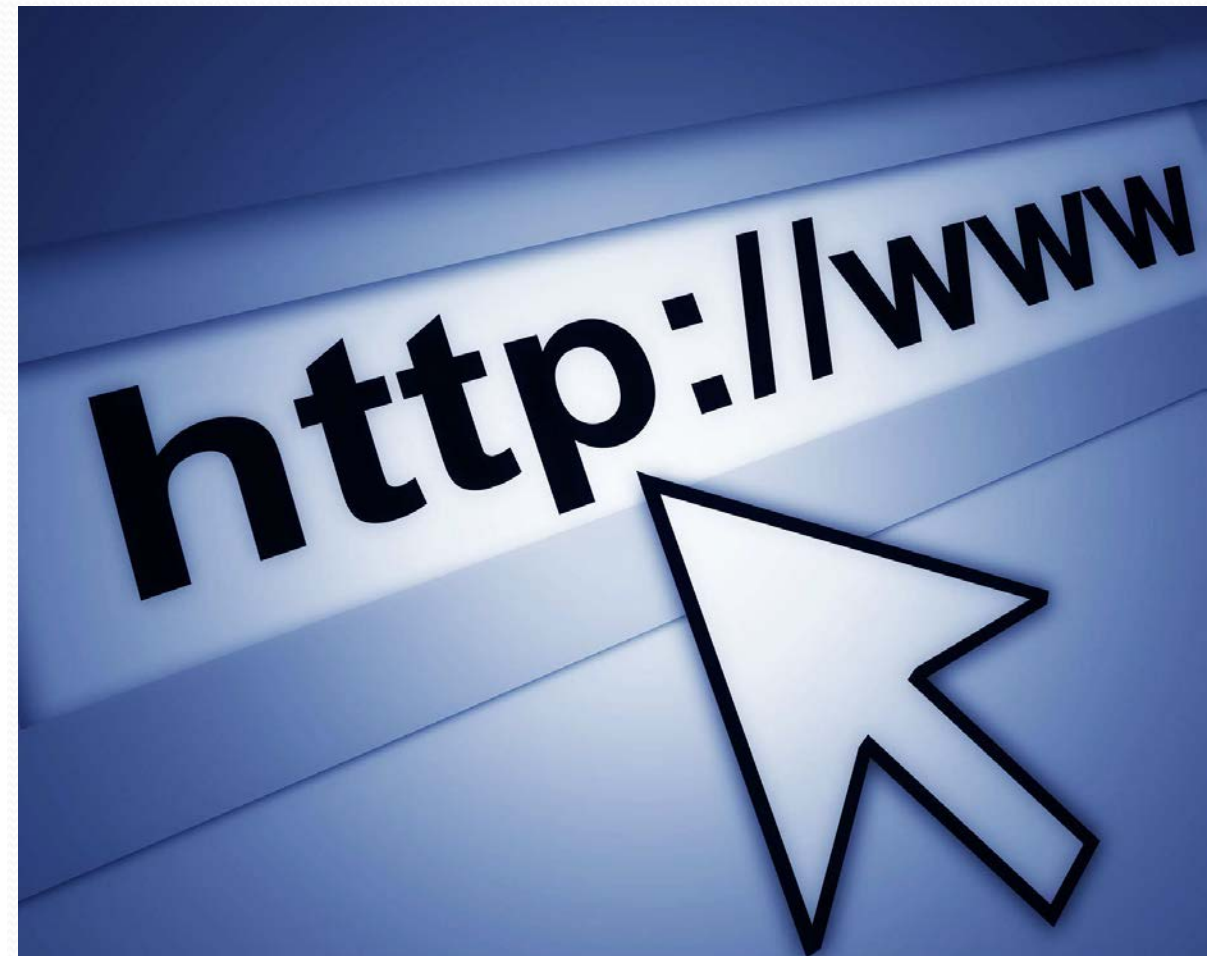
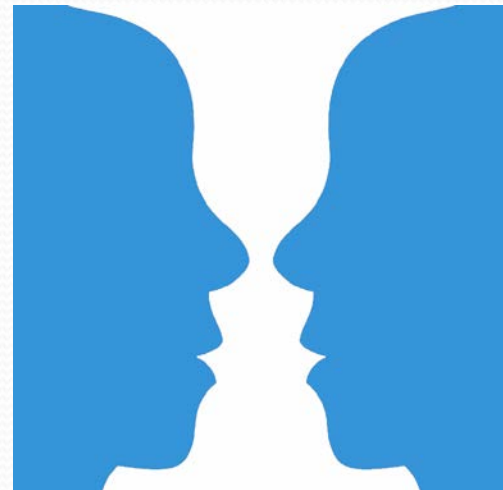


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# Increasing Demands for Information





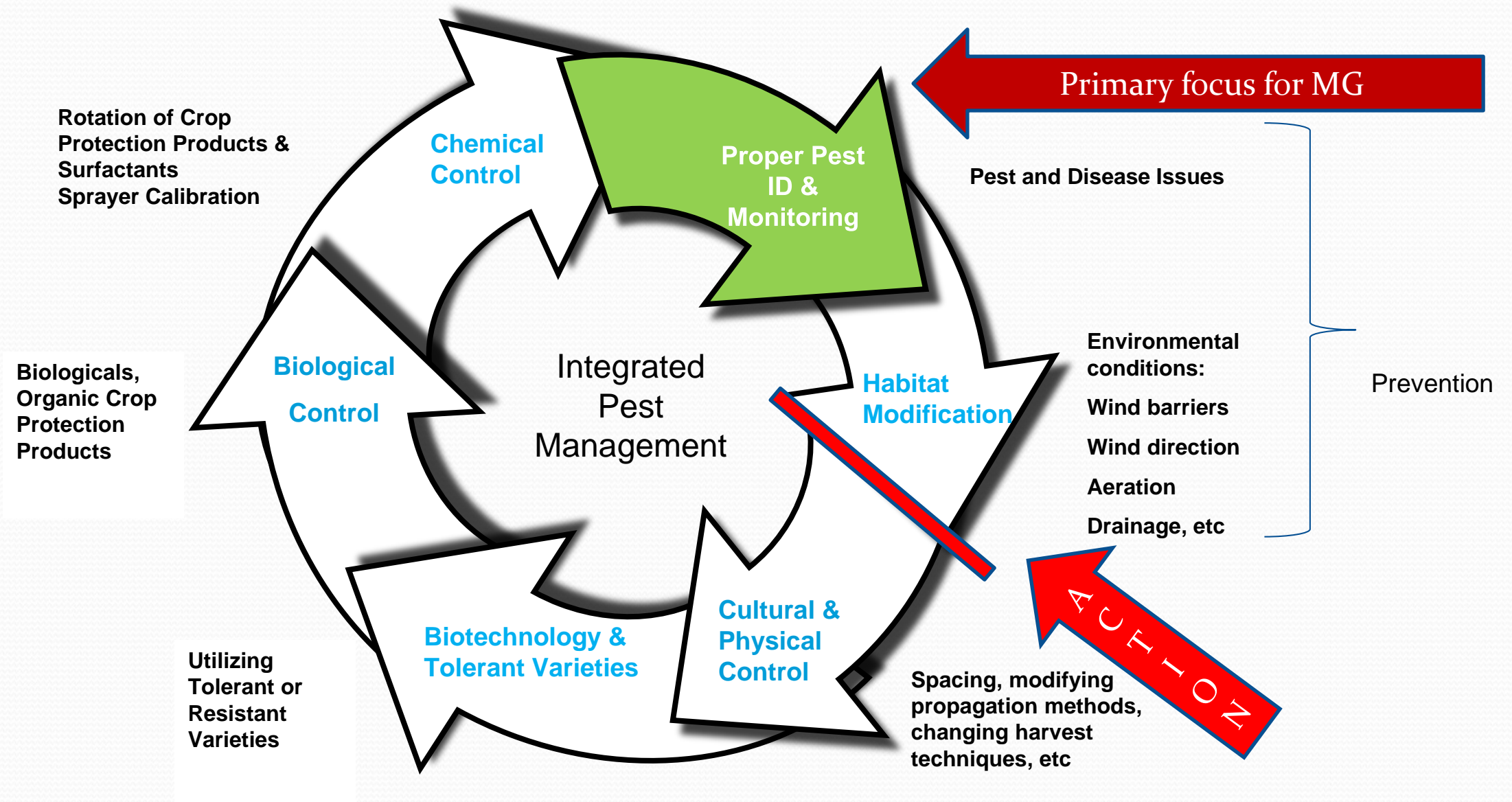


# Agricultural Crop Pests

- 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















# Chewing Pests:

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







# Sucking Pests

These pests 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  
 Provide IPM Project  
 Regents, University of California







# Thrips

Thrips have rasping and sucking mouthparts. Damage results in discoloration and scarring 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.







# Mites

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



Spider mites











# 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





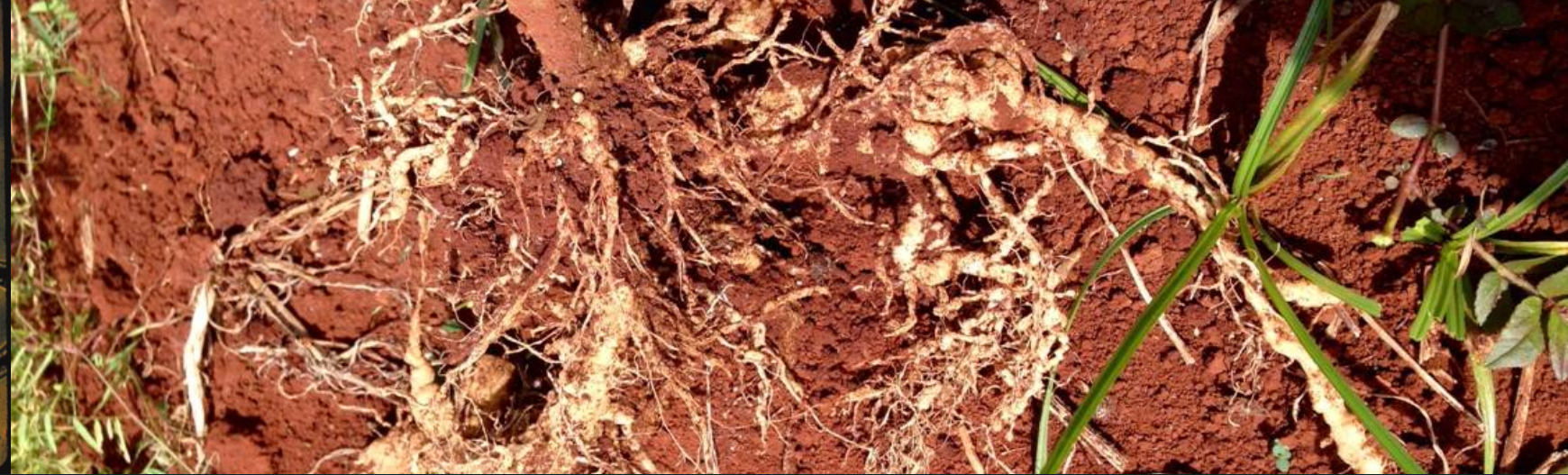


# Slugs and Snails

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

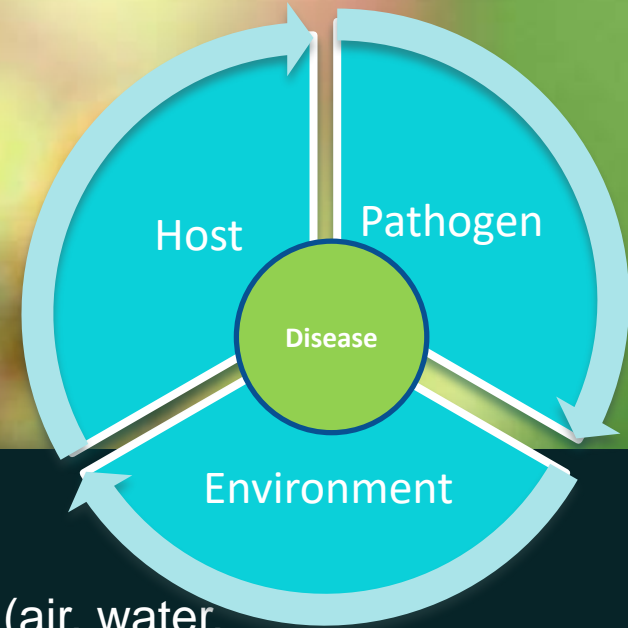
Roundworms that attack the root system of plants and impair water and nutrient uptake. Symptoms: stunting, poor plant growth, narrow and weak stems, foliar chlorosis, root rotting and galling, plant toppling and poor root development.



Photo credit: Dr. Scot Nelson, yardcare.com, & USDA







# Fungal Diseases

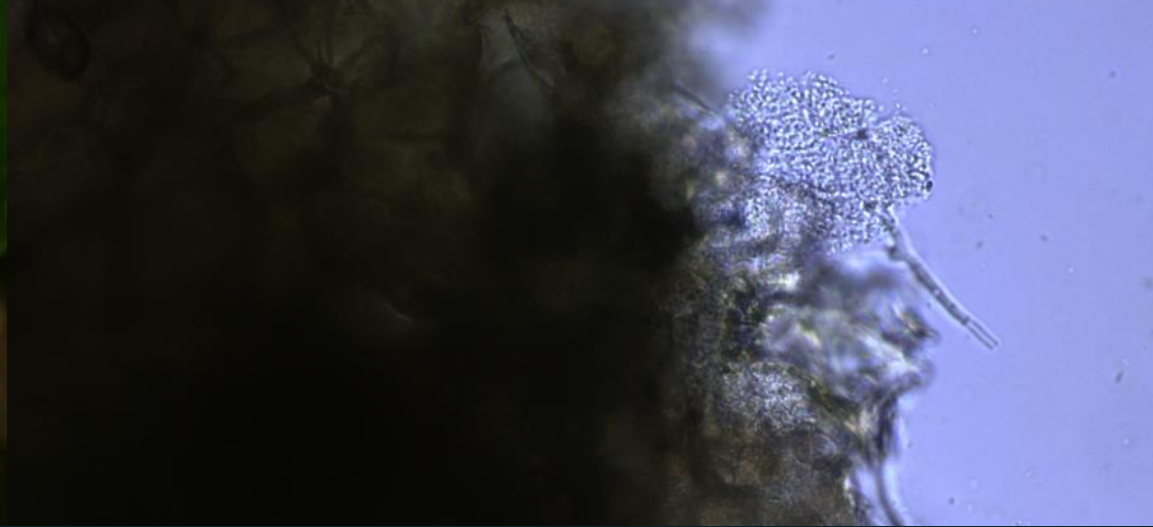
Fungal diseases are caused by fungal pathogens. Reproduce and disperse by spores (air, water, soil and via humans too). Common fungal pathogen include: powdery mildew, downy mildew, *Alternaria*, *Cercospora*, *Phytophthora*, etc.



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: *Xanthomonas*, *Pseudomonas*, *Erwinia*, etc.







# 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.







# Plant Hoppers

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







# 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).







New diseases..

Taro Vein Chlorosis Virus





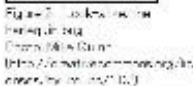
**Bagrada Bug**  
*Bagrada hilaris* (Burmeister)  
(Hemiptera: Pentatomidae)

## Background

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

### Description

This small stink bug has five immature life stages (Fig. 5B-E, Rees et al. 2013) before maturing into an adult (Fig. 1 & 5F). Adults are shield-shaped and can range in size from  $\frac{3}{16}$  to  $\frac{1}{4}$  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 boga bug may also be confused with acyrid/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 (Rees & Perring 2012). Eggs in soil are camouflaged and very easily mistakenly transported to uninfested areas.



## Hosts

Preferred hosts are cruciferous vegetable crops including broccoli, tarsoi, cabbages (head cabbages, 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

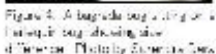


Figure 1: Adult beagles (n=2)



Figure 3. Pattern of egg-laying by male female in response to sex pheromone and a mixture of sex pheromone and 2-Ethylhexyl acetate. Photo by Shigeru Imai.

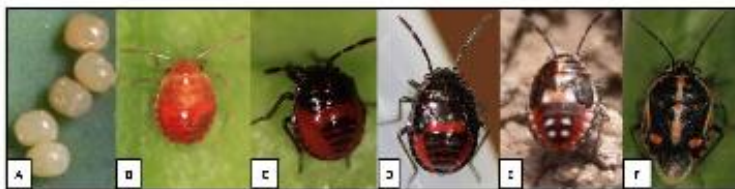


Figure 5. Life stages of *A. baumannii*. A: Same as above eggs. B: 2nd/3rd instar larvae in water, and C: adult. Young get nymphs or nymphs develop into adults in water while the water column and also develop while emerging on land. A: S. B: 1st instar. C: 2nd/3rd instar. D: 4th/5th instar. E: 6th/7th instar. F: 8th/9th instar. G: 10th/11th instar. H: 12th/13th instar. I: 14th/15th instar. J: 16th/17th instar. K: 18th/19th instar. L: 20th/21st instar. M: 22nd/23rd instar. N: 24th/25th instar. O: 26th/27th instar. P: 28th/29th instar. Q: 30th/31st instar. R: 32nd/33rd instar. S: 34th/35th instar. T: 36th/37th instar. U: 38th/39th instar. V: 40th/41st instar. W: 42nd/43rd instar. X: 44th/45th instar. Y: 46th/47th instar. Z: 48th/49th instar. AA: 50th/51st instar. AB: 52nd/53rd instar. AC: 54th/55th instar. AD: 56th/57th instar. AE: 58th/59th instar. AF: 60th/61st instar. AG: 62nd/63rd instar. AH: 64th/65th instar. AI: 66th/67th instar. AJ: 68th/69th instar. AK: 70th/71st instar. AL: 72nd/73rd instar. AM: 74th/75th instar. AN: 76th/77th instar. AO: 78th/79th instar. AP: 80th/81st instar. AQ: 82nd/83rd instar. AR: 84th/85th instar. AS: 86th/87th instar. AT: 88th/89th instar. AU: 90th/91st instar. AV: 92nd/93rd instar. AW: 94th/95th instar. AX: 96th/97th instar. AY: 98th/99th instar. AZ: 100th/101st instar. BA: 102nd/103rd instar. BB: 104th/105th instar. BC: 106th/107th instar. BD: 108th/109th instar. BE: 110th/111th instar. BF: 112th/113th instar. BG: 114th/115th instar. BH: 116th/117th instar. BI: 118th/119th instar. BJ: 120th/121st instar. BK: 122nd/123rd instar. BL: 124th/125th instar. BM: 126th/127th instar. BN: 128th/129th instar. BO: 130th/131st instar. BP: 132nd/133rd instar. BQ: 134th/135th instar. BR: 136th/137th instar. BS: 138th/139th instar. BT: 140th/141st instar. BU: 142nd/143rd instar. BV: 144th/145th instar. BW: 146th/147th instar. BX: 148th/149th instar. BY: 150th/151st instar. BZ: 152nd/153rd instar. CA: 154th/155th instar. CB: 156th/157th instar. CC: 158th/159th instar. CD: 160th/161st instar. CE: 162nd/163rd instar. CF: 164th/165th instar. CG: 166th/167th instar. CH: 168th/169th instar. CI: 170th/171st instar. CJ: 172nd/173rd instar. CK: 174th/175th instar. CL: 176th/177th instar. CM: 178th/179th instar. CN: 180th/181st instar. CO: 182nd/183rd instar. CP: 184th/185th instar. CQ: 186th/187th instar. CR: 188th/189th instar. CS: 190th/191st instar. CT: 192nd/193rd instar. CU: 194th/195th instar. CV: 196th/197th instar. CW: 198th/199th instar. CX: 200th/201st instar. CY: 202nd/203rd instar. CZ: 204th/205th instar. DA: 206th/207th instar. DB: 208th/209th instar. DC: 210th/211st instar. DD: 212th/213th instar. DE: 214th/215th instar. DF: 216th/217th instar. DG: 218th/219th instar. DH: 220th/221st instar. DI: 222nd/223rd instar. DJ: 224th/225th instar. DK: 226th/227th instar. DL: 228th/229th instar. DM: 230th/231st instar. DN: 232nd/233rd instar. DO: 234th/235th instar. DP: 236th/237th instar. 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IN: 484th/485th instar. IO: 486th/487th instar. IP: 488th/489th instar. IQ: 490th/491st instar. IR: 492nd/493rd instar. IS: 494th/495th instar. IT: 496th/497th instar. IU: 498th/499th instar. IV: 500th/501st instar. IW: 502nd/503rd instar. IX: 504th/505th instar. IY: 506th/507th instar. IZ: 508th/509th instar. JA: 510th/511st instar. JB: 512th/513th instar. JC: 514th/515th instar. JD: 516th/517th instar. JE: 518th/519th instar. JF: 520th/521st instar. JG: 522nd/523rd instar. JH: 524th/525th instar. JI: 526th/527th instar. JJ: 528th/529th instar. JK: 530th/531st instar. JL: 532nd/533rd instar. JO: 534th/535th instar. JP: 536th/537th instar. JQ: 538th/539th instar. JR: 540th/541st instar. JS: 542nd/543rd instar. JT: 544th/545th instar. JU: 546th/547th instar. JV



## 3/25/17: Bagrada Bug damage and insect found in Waimanalo





Banana Bract Mosaic Virus



Canna Yellow Mottle Virus





# Available Resources

- MG Extension Agents
- Statewide Extension Agents
- Past MG graduates
- Plant Doctor
- ADSC Diagnostic Lab
- Various online Resources

## The Plant Doctor



10 common plant diseases

Request a diagnosis

more

Please enter as much information as possible in the spaces below

Host plant name:

(one or more of the following: common name, scientific name, variety name)

Primary symptoms:

(e.g., yellowing, wilting, death, leaf spot, deformity, discoloration, stunting, etc.)

Plant setting:

(indoors, landscape, garden, nursery, farm, forest)

back

submit



What's New?

For Students

SOFT: Student Organic Farm Training

For New Farmers

Farm Income

Environmental Stewardship

Sustainable and Organic Production Methods

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Hānai'Ai Newsletter

## Hānai'Ai

The Food Provider ~ Septe

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

Plant Disease  
March 2012  
PD-81

## Tomato Spotted Wilt

Michael J. Melzer<sup>1</sup>, Savarni Tripathi<sup>2</sup>, Tracie Matsumoto<sup>2</sup>, Lisa Keith<sup>2</sup>, Jari Sugano<sup>1</sup>, Wayne B. Borth<sup>1</sup>, Ania Wiczeń<sup>3</sup>, Dennis Gonsalves<sup>2</sup>, and John S. Hu<sup>1</sup>  
<sup>1</sup>Department of Plant and Environmental Protection Sciences, <sup>2</sup>USDA-ARS Pacific Basin Agriculture Research Center, <sup>3</sup>Department of Tropical Plant and Soil Sciences

Tomato spotted wilt, caused by the virus *Tomato spotted wilt virus* (TSWV), is one of the most economically devastating diseases of tomato around the world. TSWV was first discovered in Australia in 1919 and has been present in Hawai'i since the 1920s. Tomato production losses of 75–100% from tomato spotted wilt have been reported in Hawai'i.

**Symptoms of Tomato Spotted Wilt**  
In tomato foliage, the first observable symptoms are small, chlorotic lesions on the leaflets that often have a darker green "halo." These chlorotic lesions may coalesce and become necrotic, giving the foliage a "bronzed" appearance (Fig. 1a). These necrotic regions spread to terminal shoots, causing them to "wilt." Tomato plants become severely stunted when infected at an early age (Fig. 1b). This effect is less dramatic when mature plants become infected (Fig. 1c). The most conspicuous symptoms of tomato spotted wilt are discolored blotches or concentric rings on the fruit of infected plants (Fig. 2a). These fruit symptoms can mimic those caused by *Pepper mottle virus* (PepMoV) (Fig. 2b). PepMoV, however, does not cause obvious foliar symptoms. Therefore, plants with symptoms on both foliage and fruit are likely to be infected by TSWV, while plants with symptoms only on the fruit are likely to be infected with PepMoV.

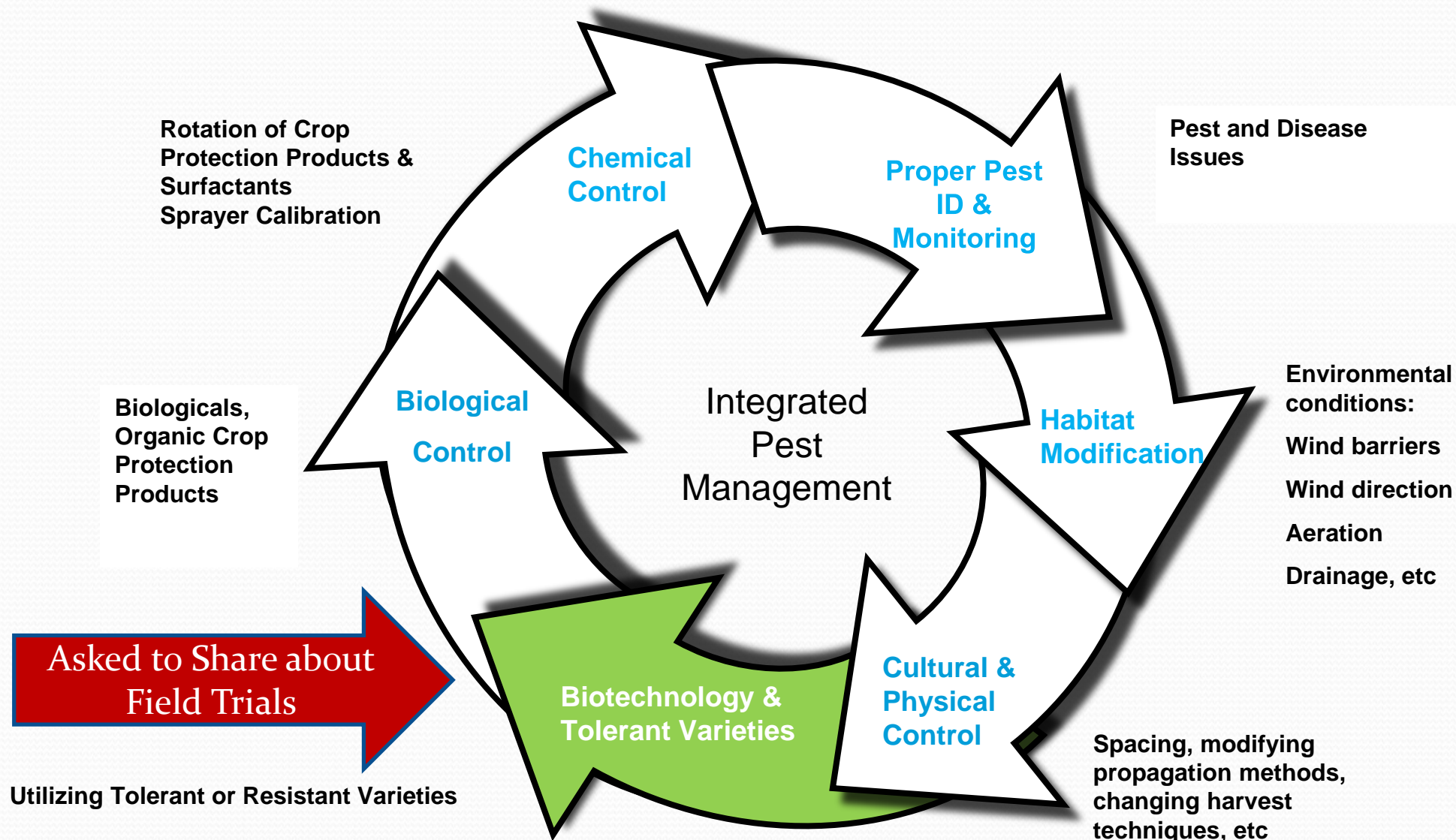


Figure 1. Symptoms of tomato spotted wilt. (a) Foliar chlorosis from TSWV infection results in a "bronzed" appearance (arrowheads) over time. (b) Plants infected with TSWV at a young age are severely stunted. (c) This stunting is less dramatic when mature plants are infected. Healthy plants are on the left and infected plants are circled on the right in (b) and (c).

### Spread of TSWV

TSWV is transmitted by several species of thrips, including common blossom thrips (*Frankliniella schultzei*), tobacco thrips (*F. fusca*), eastern flower thrips (*F. intonsa*), western flower thrips (*F. occidentalis*), Florida flower thrips (*F. bispinosa*), *F. gemina*, chili thrips (*Scirtothrips dorsalis*), light brown soybean thrips (*Thrips setosus*),









# Importance of Variety Screenings

- High influx of new pest and diseases annually
- Existing pest populations easily adapt
- Environmental conditions are changing
- New varieties being developed annually
- Utilizing varieties with natural tolerance to pests may help ease other pest management efforts



State of Hawaii  
DEPARTMENT OF AGRICULTURE

New Pest Advisory  
No. 14-02, December 2014

## 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 in October and November, 2014. A small population was found attacking Chinese cabbage and cassava in a student garden at the University of Hawaii Maui College campus, Kahului. Shortly after, the bagrada bug was found in Makawao and Kulua.



Figure 1. Adult bagrada bug.



Figure 2. Four bagrada bugs on a leaf. The bagrada bug is a serious pest of agricultural crops. It is a member of the family Pentatomidae (Hemiptera) and is known for its ability to feed on a wide range of plants.



Figure 3. Bagrada bugs on a leaf. The bagrada bug is a serious pest of agricultural crops. It is a member of the family Pentatomidae (Hemiptera) and is known for its ability to feed on a wide range of plants.



no culture





# SCREEN: Replicated Webworm Trial (2016)







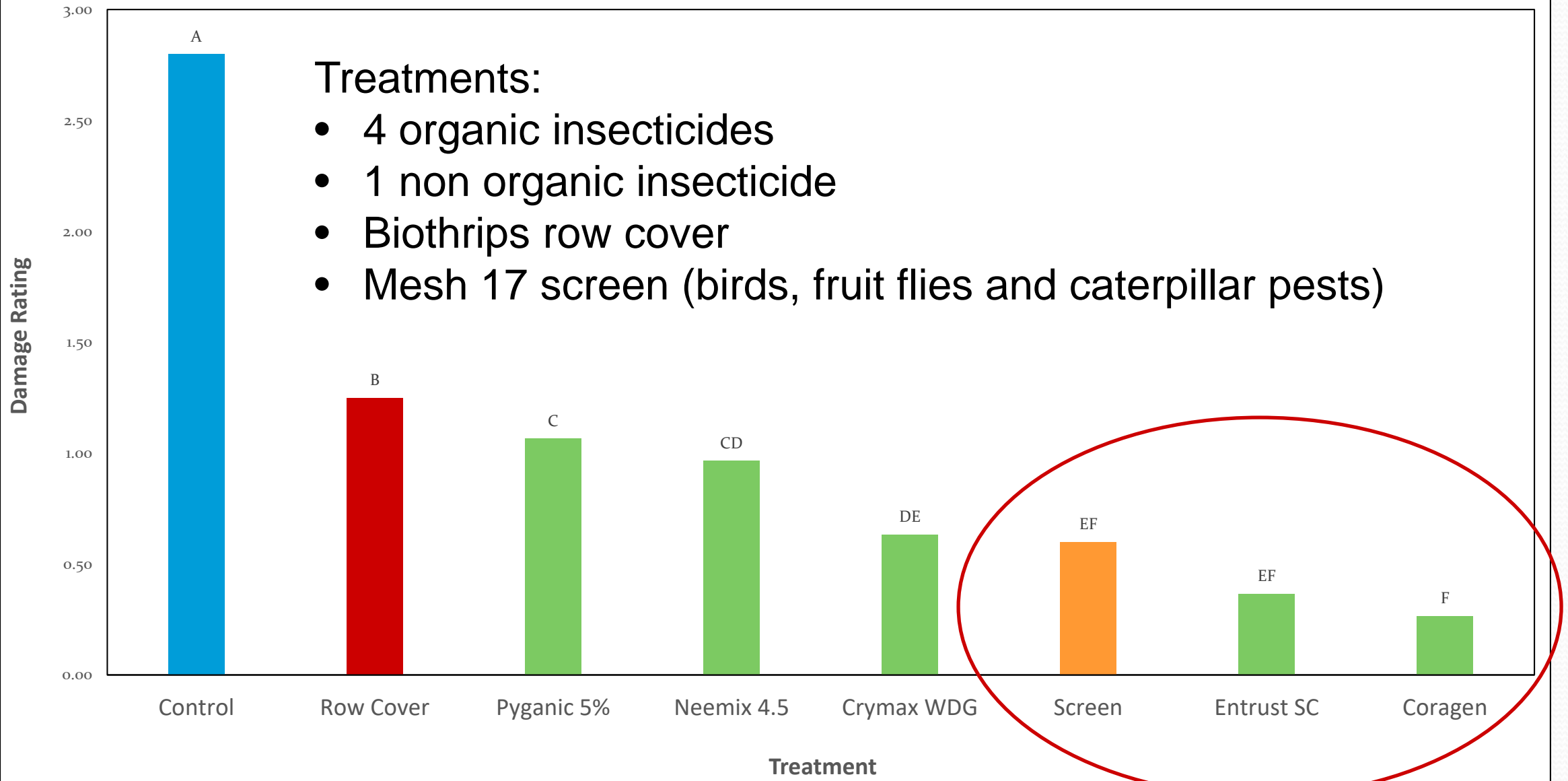




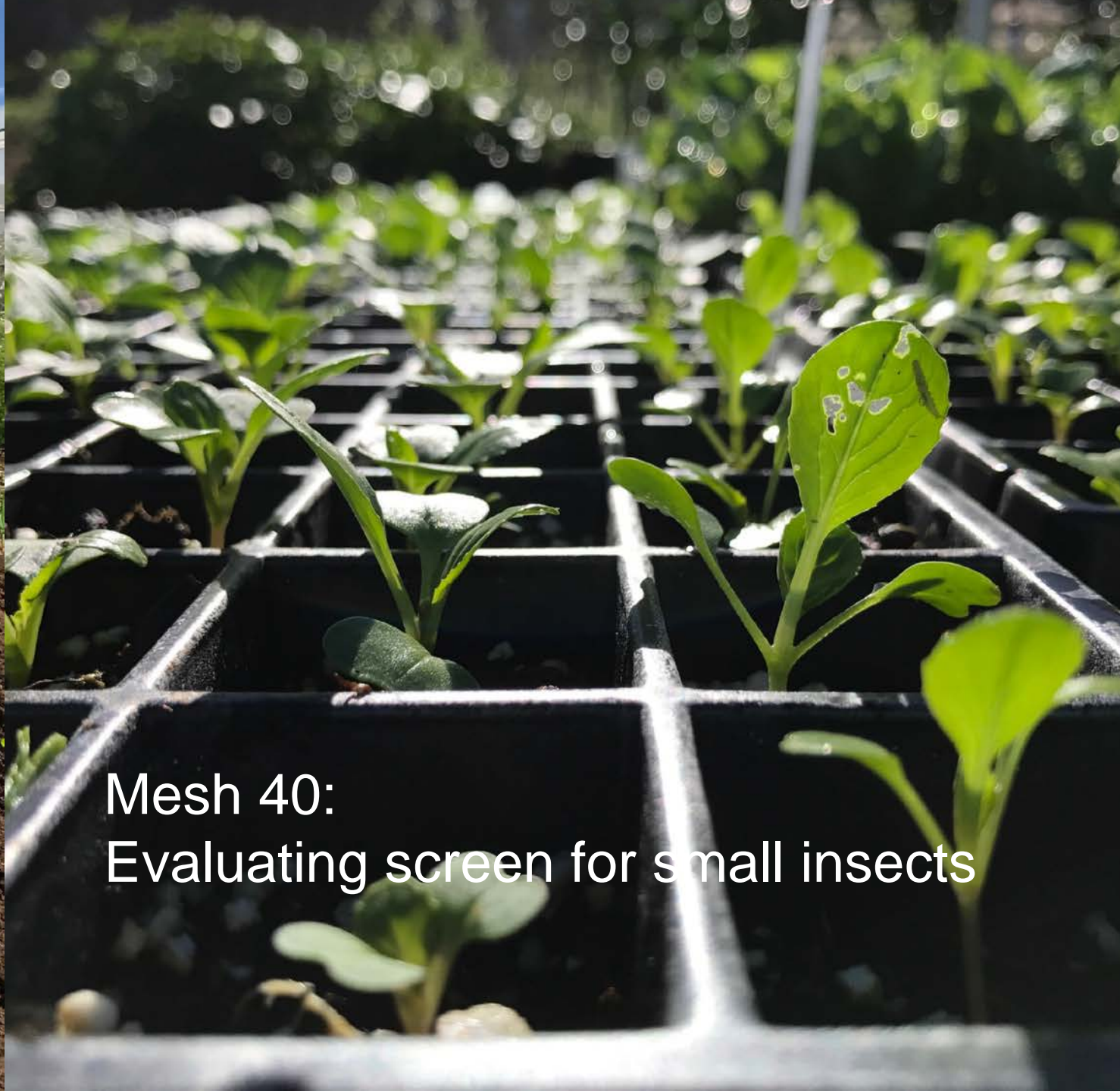


# Cabbage Webworm: Organic Insecticide Trial

## Average Damage/Plant







Mesh 40:  
Evaluating screen for small insects





# Tomato Yellow Leaf Curl Virus

- Devastating disease of tomato first detected in 2009
- Vectors are the silver leaf (*Bemisia tabaci*) and the sweet potato whitefly (*Bemisia argentifolii*)
- UH CTAHR screened several dozen varieties for TYLCV tolerance in replicated field trials from 2009-2016







# Tomato Yellow Leaf Curl Virus

Stunted due to shortened internodes



Interveinal discoloring

Photo credit: M. Melzer



Chlorotic (yellowing)

Photo credit: M. Melzer



Leaflets curl or cup upwards









## Summary: UH Field Trials from 2009-2016 (with Melzer, Kaufman, Tateno, & Wright, etc.)

- Varieties exist with tolerance to TYLCV strains on Oahu based on tissue blot test:
  - Beef Steak Type (12):
    - Adonis, PIK Ripe 461, Pamela, Sacramento, VT-62940, VT-62966, Tovi Star, Tovi Roca, VT-62966, Yaqui, Xaman (Roma) and Tygress
  - Specialty Type (7):
    - Grape: 72618, Rona, Komohana
    - Cherry: Felicity, Hathor, Sarina

### Online Publications:

<http://www.ctahr.hawaii.edu/oc/freepubs/pdf/PD-70.pdf>

<http://www.ctahr.hawaii.edu/oc/freepubs/pdf/PD-78.pdf>

<http://www.ctahr.hawaii.edu/sustainag/news/articles/V12-Uyeda-OrgTomato.pdf>

<http://www.ctahr.hawaii.edu/sustainag/news/articles/V22-Tateno-tomato.pdf>

[http://www.ctahr.hawaii.edu/e-notes/downloads/Field\\_day\\_handout\\_last\\_version.pdf](http://www.ctahr.hawaii.edu/e-notes/downloads/Field_day_handout_last_version.pdf)





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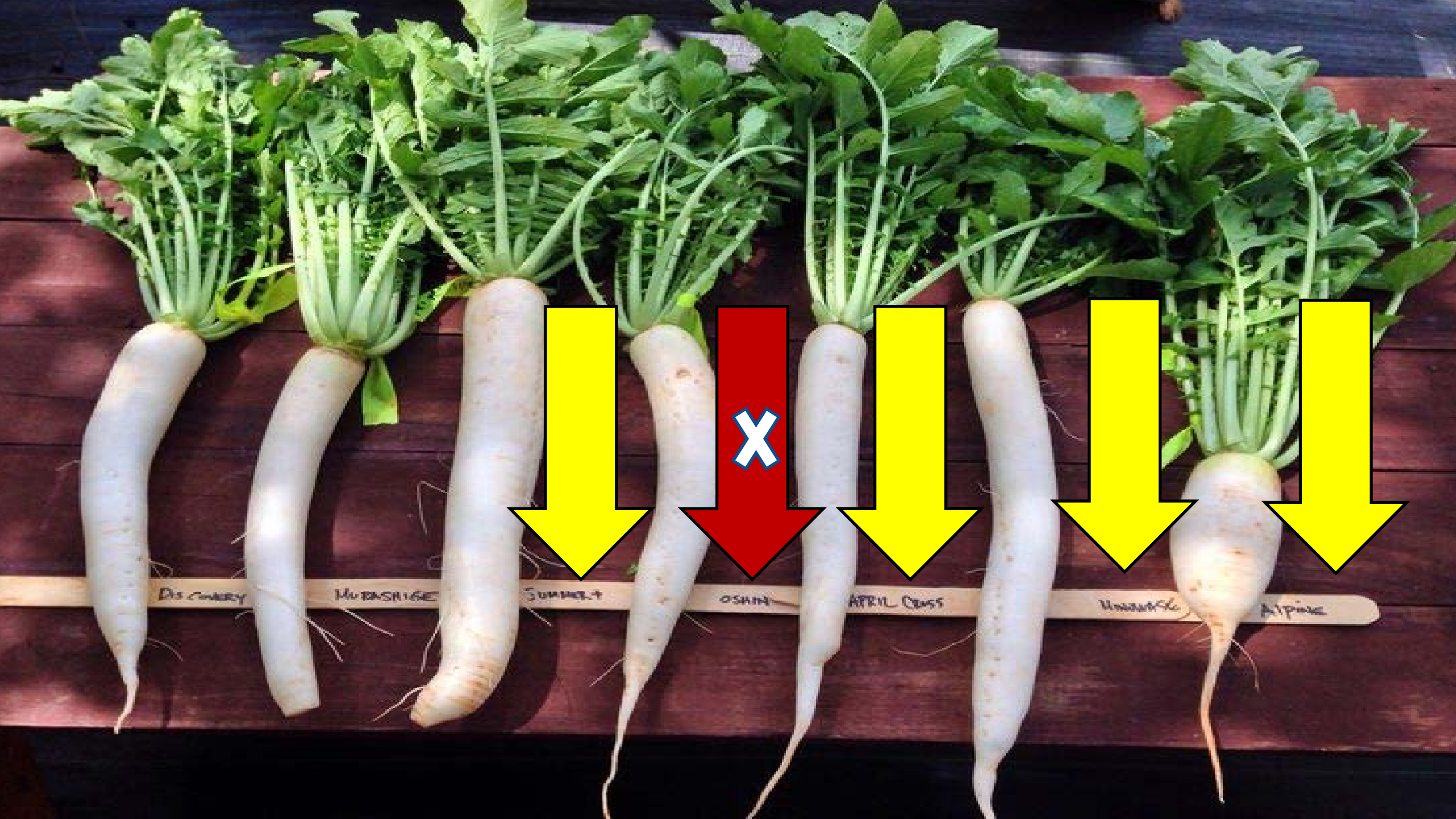
# Turnip Mosaic Virus (2014)

14 varieties screened



Aphid transmitted





Dix CHERRY

MIDNIGHT

SUMMIT

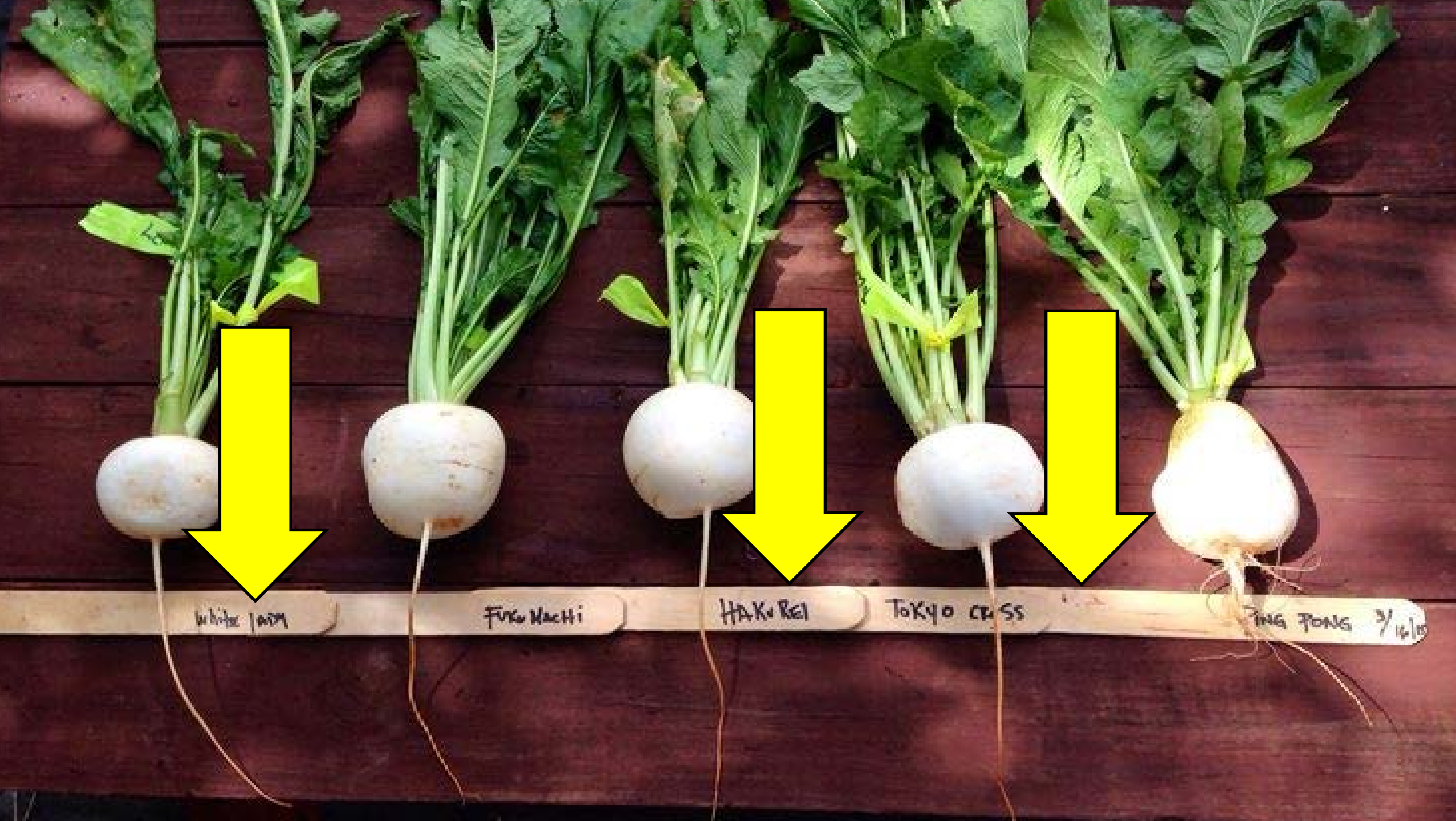
OSHIN

APRIL CROSS

MIDNIGHT

ALPINE





White 1/2 in

Fuku Natchi

HAKU REI

Tokyo Cross

PING PONG 3/16 in





# UH Field Trials (2014-2015)

- Promising Daikon Varieties
  - Alpine, Minowase, Summer Cross, April Cross, Bravo, Bora King (2016)
- Promising Turnip Varieties:
  - Tokyo Cross, Hakurei, White Lady









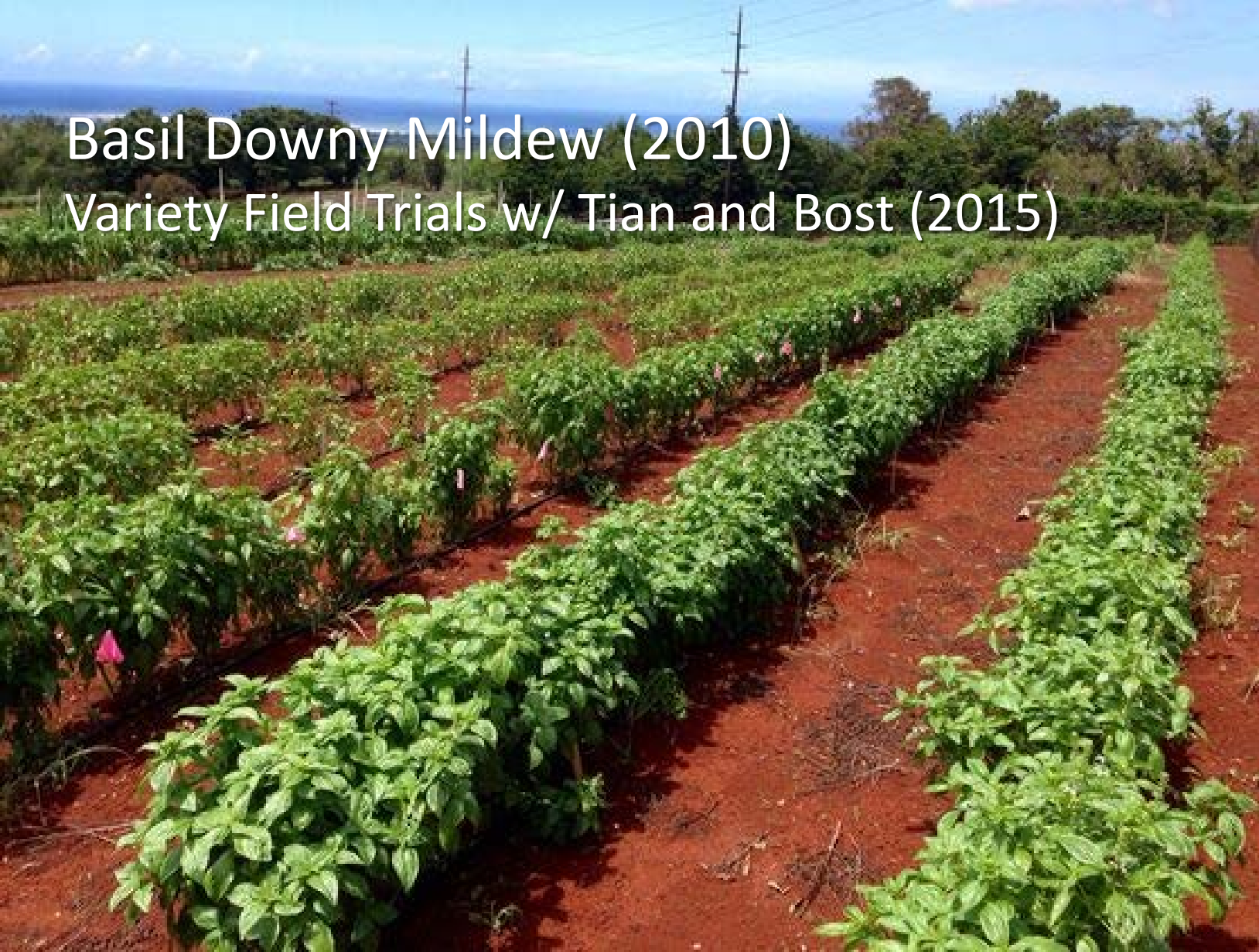


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# Basil Downy Mildew (2010) Variety Field Trials w/ Tian and Bost (2015)







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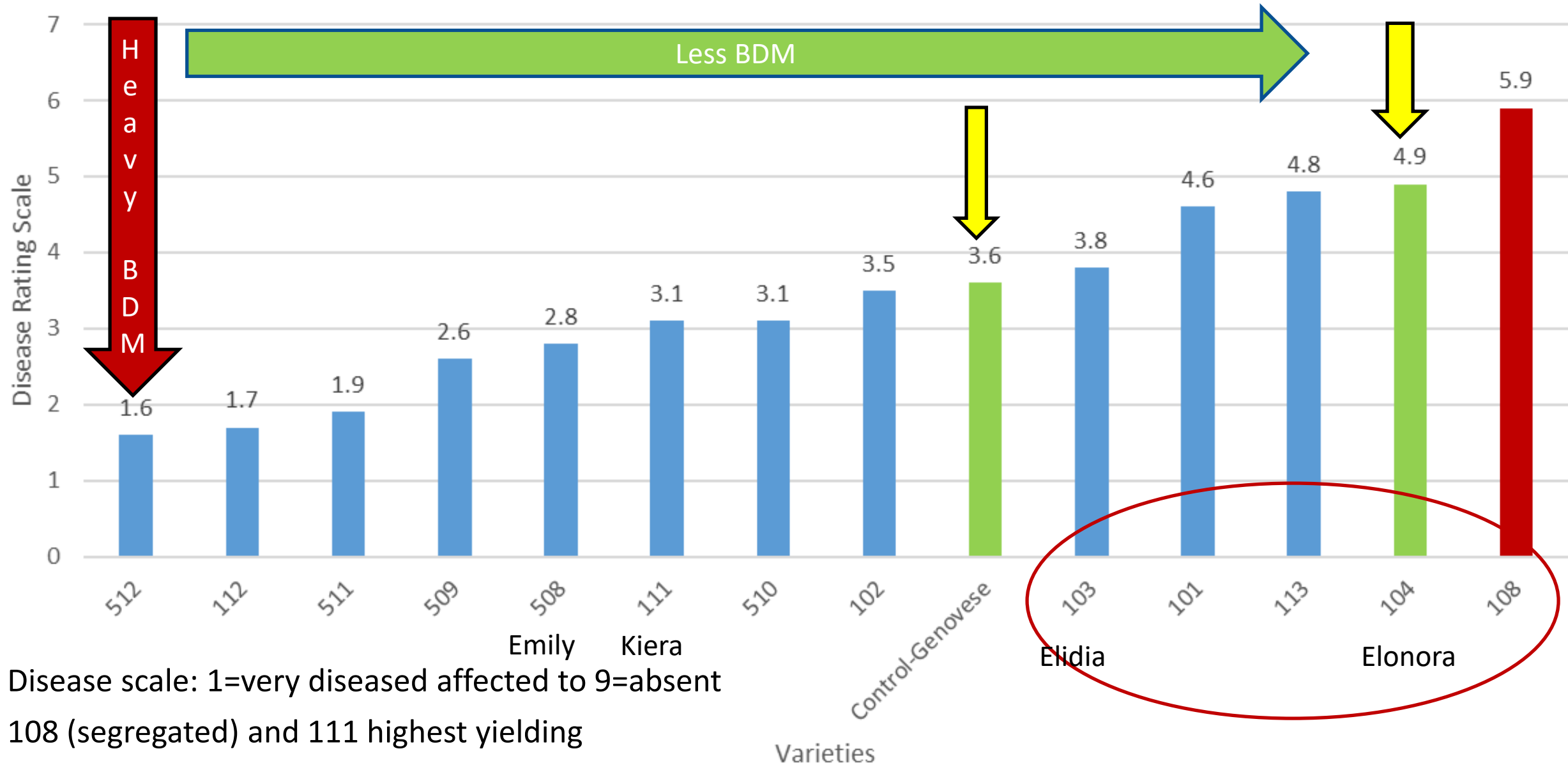
# Basil Downy Mildew Screenings (2015)

14 Varieties



Photo credit: J. Uchida & C. Kadooka









# Persian Cucumber (2014)

- Screened 12 varieties of Persian cucumbers
- Based on preliminary data:
  - Jawell, Unistars, Alexander, GVA 608, GVA 609, GVA 606

Online Publication:

<http://www.ctahr.hawaii.edu/sustainag/news/articles/V20-SuganoEtAl-PersianCuke.pdf>





## QUICK &amp; APPLIED AGRICULTURAL TRIAL

**Persian Cucumber (Beit Alpha) Variety Screening 2014***J. Sugano, J. Uyeda, S. Fukuda, S. Migita and K.-H. Wang**University of Hawai'i at Mānoa, College of Tropical Agriculture and Human Resources*

The economic success of food crop producers relies on the growers' ability to adapt farming principles and practices to integrate the latest technology and research developments. Oahu CES establishes critical on-farm field experiments in conjunction with edible crop growers to tackle priority crop production issues that strive to improve productivity and profitability. We understand that time is critical in this industry and any crop production managerial decisions must reflect time and cost efficiency. Therefore, please find below a summary of a recent field trial evaluating different varieties of Persian cucumbers due to increased interest and popularity in the market place.

A cucumber field trial was conducted under screenhouse culture at the Poamoho Research Station in Waialua, Oahu. Seeds were solicited and secured from De Ruiter, Golden Valley, Hazera and Johnny's Select Seed Company. A total of 12 varieties/hybrids were evaluated in this study.

The cucumbers were drip irrigated, planted on January 27, 2014 and harvest began on March 27, 2014. Harvest was conducted every other day. Harvest was terminated on May 2, 2014 (after 5 weeks of harvest). Plants were trellised using "T"-posts and cucumber netting. The organic fertilizer, Sustane 4-6-4 fertilizer was applied at the rate of 300 lbs. per acre on March 12 and 26, 2014. A supplemental application of a complete fertilizer (16-16-16) was applied at the rate of 150 lbs. per acre. One application of an organic insecticide was utilized to maintain thrips populations below economic threshold levels.

Due to the limited space under the screen house, the trial was not replicated. The screen house was the limiting factor in the number of plants / treatment as it provided a physical, non chemical barrier against fruit fly and pickleworm pests. Varieties were planted in 20 feet plots (21 plants maximum). Production data is presented based on yield per plant values.

Fruit from the selected varieties in the trial had a dark green color, crisp and pleasant fresh cucumber taste based on testimonials. Overall, Jawell and Unistars were early yielders compared to the remaining varieties. Unistars had short dark green, glossy fruits compared to others in the trial. In summary, Jawell, Unistars, Alexander, and GVA hybrids stood out among the varieties based on its horticultural characteristics and production data.







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# Heat Tolerance Field Trials

Romaine (29), red and green (30+) leaf lettuce



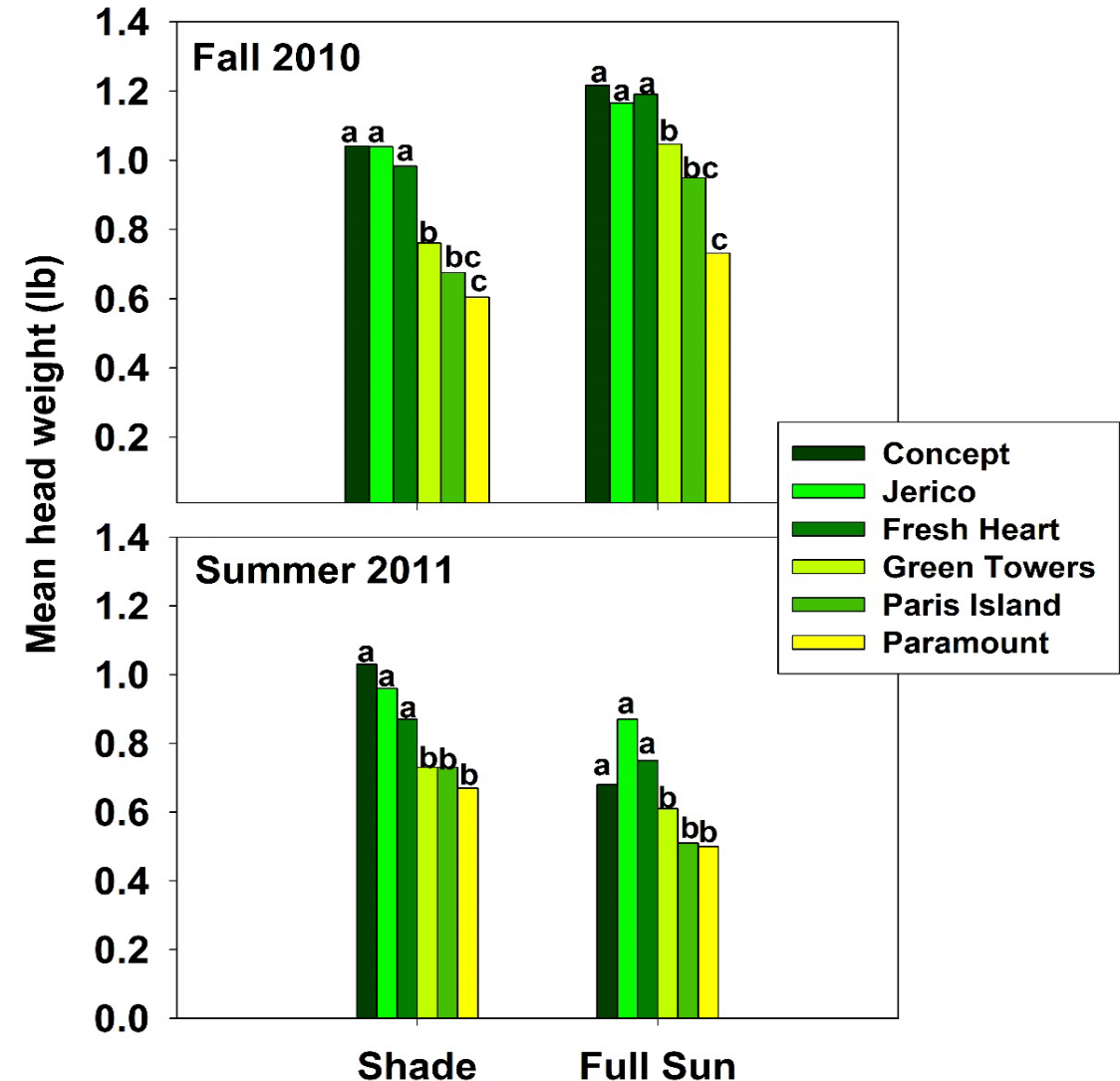




# Evaluated Shade (2010)

Field trials w/ Migita, Valenzuela & Goo

- 6 top producing Romaine varieties
- 30% shade Fall and Summer
- 4 replications with shade and full sun
- Results suggest shade is only needed in the summer months for Romaine production at low elevation sites on Oahu







# Evaluated 29 Romaine Varieties (2014)

- Jerico remains top producer, but color unacceptable
- Jerico, Valmaine, Ridgeline had the highest yields
- Caesar and Wildcat were promising for processors- small core
- Spretnak, Claremont were baby romaine types

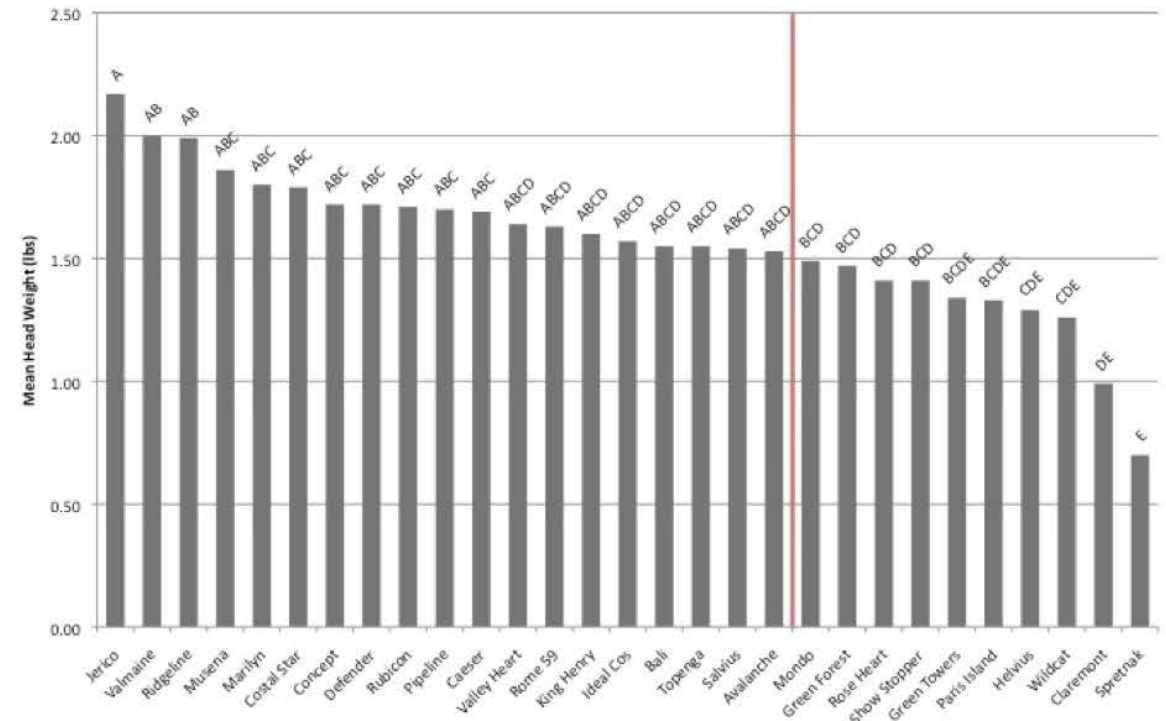


Figure 3: Mean head weight per variety of Romaine lettuce planted November 2013 and harvested January 2014 at the Poamoho Research Station. Letters represent mean separation using Tukeys HSD. Means with the same letter are not significantly different. The varieties to the left of the red line show potential for commercial production, while the varieties on the right may not be adequate, based on yield.





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# Yield, Color, Core, etc.



Jerico

Ridgeline







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# Everyone Manoa Lettuce

Field trials w/Nagata, Teves, Shingaki, & Shimabuku

Tip Burn







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# 30 Box Red & Green Lettuce Variety Trials

Quick response to aquaponic and leafy green growers' request for heat tolerant varieties







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# Evaluating Varieties with Putative Heat Tolerance

Red-Cherokee, Rouxai, Pomegranate Crunch (baby romaine), Multi red, Cannatrix, Salanovas, Roxy, Fossey, Red Sail, etc.

Green-Anuenue, Nancy, Adriana, Spretnak (baby romaine), Dragoon (baby romaine), Tropicana, Nevada, Kiribati, Concept, Gecko, Panisse, Rex, etc.







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# 2015: Heat and Diamond Back Moth (DBM) Tolerance

Head Cabbage (23) and Chinese Cabbage (13) & Broccoli (4)

Maui and Oahu

w/ Migita, Shingaki, Shimabuku & Bost



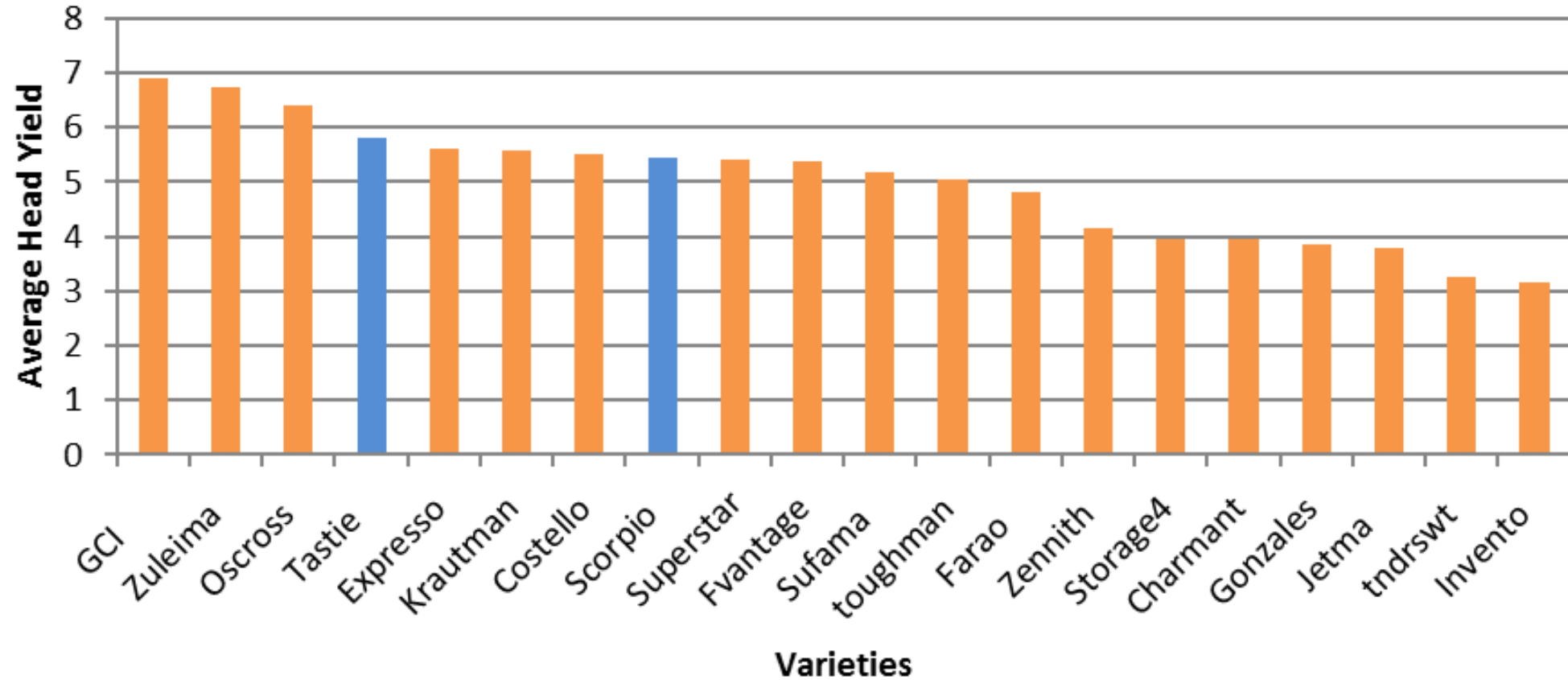


# Head Cabbage: Kula Research Station

Seeded March 10, transplanted April 21, harvest started June 8, 2015



Former Industry standards

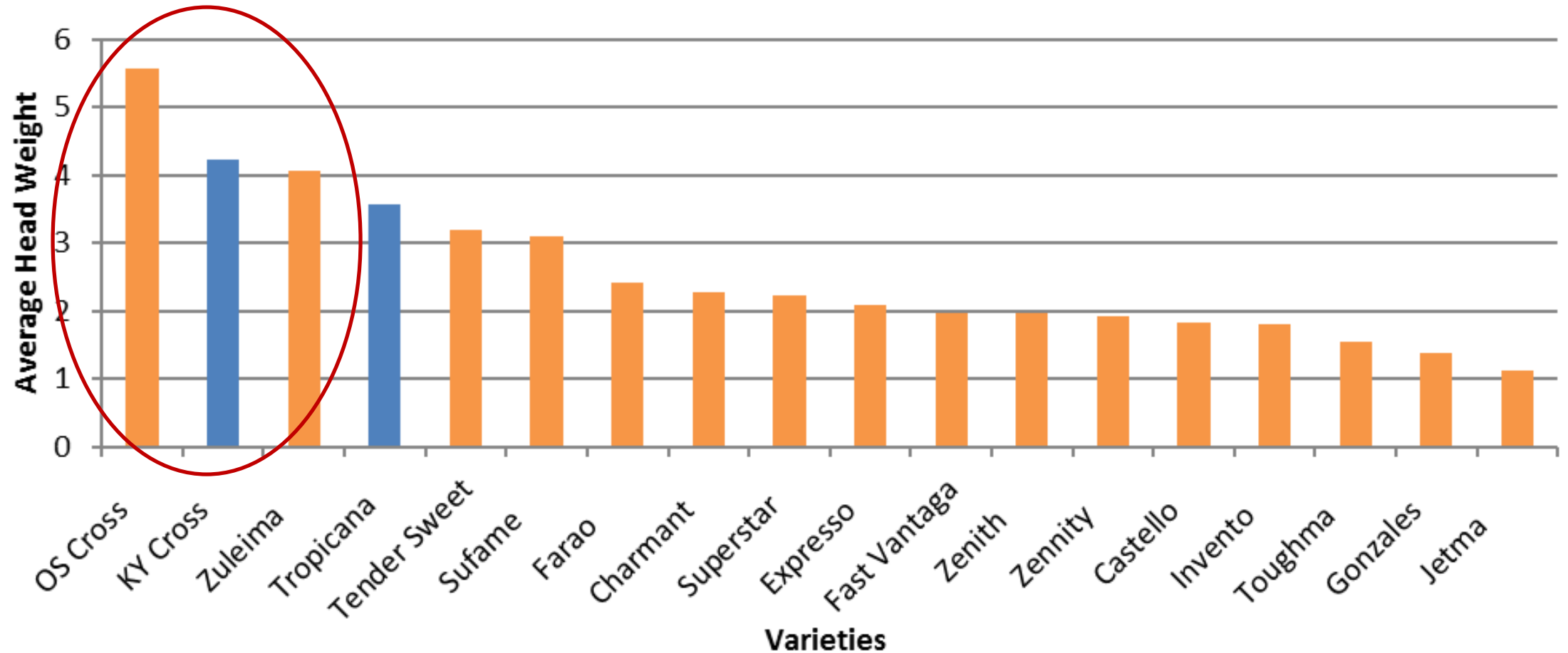


Approximately 40-70 heads of each head cabbage variety were grown in replication in Kula, Maui. The average weight per head was calculated based on a random selection of twelve heads per replication. There were three replications (36 heads)/ variety.



# Head Cabbage Trial: Poamoho Research Station

Harvest started: June 3, 2016



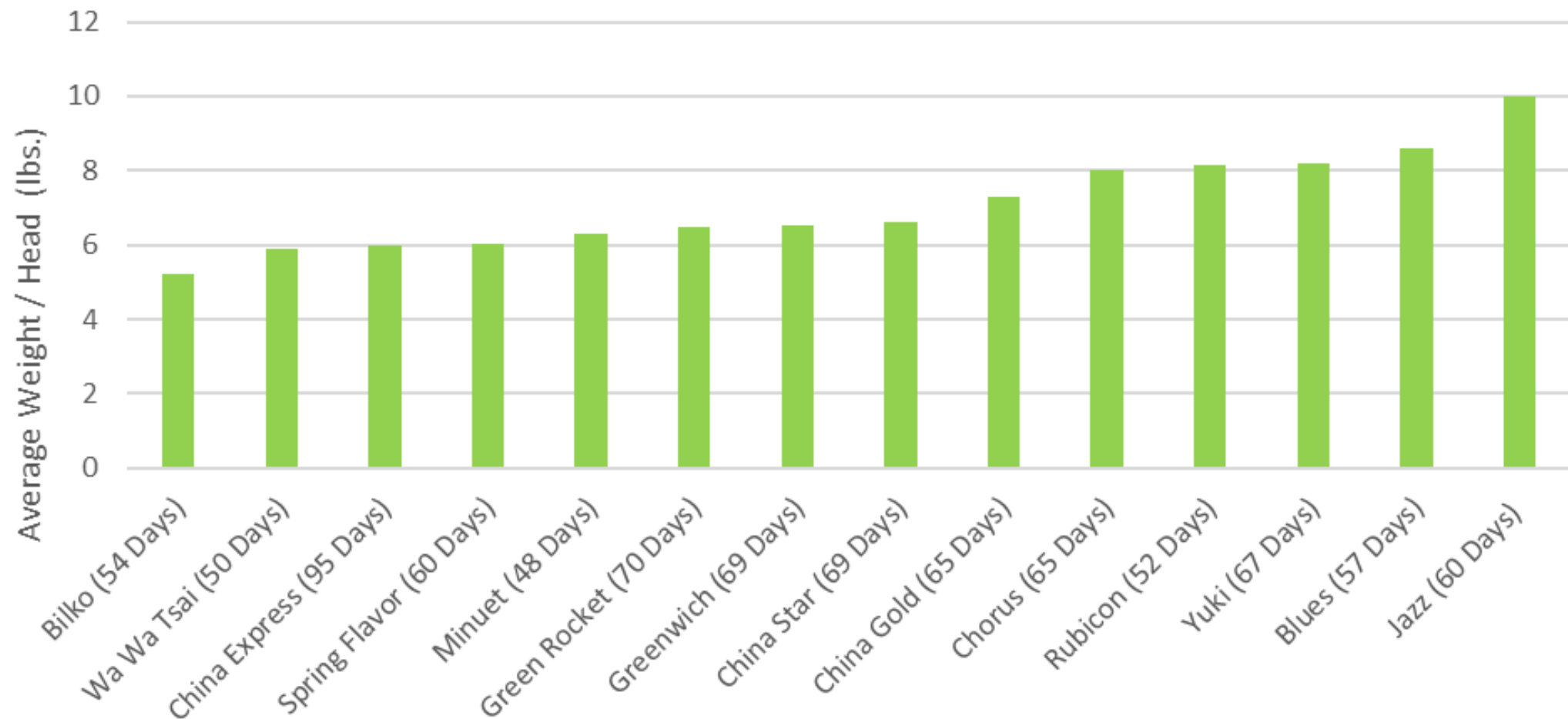
Eighteen varieties of head cabbage were transplanted in a randomized complete block planting design at the Poamoho Experiment Station with the assistance of Research Station Manager, Susan Migita and staff. The intent of these field trials are to evaluate yield and the horticultural characteristics of head cabbage cultivars at low elevation sites (<1,000 feet). Tropicana yields well but seeds are hard to find.



# Chinese Cabbage Variety Trial

## Kula Agricultural Park

Seeded: January 12, transplanted March 13, harvests starts April 6, 2015



(Based on an average of 20 heads / variety with the exception of China Express)





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# 2015: Statewide Hybrid Eggplant Variety Trial

(w/Migita, Takeda, Shingaki, Shimabuku, & Motomura)



201 X N



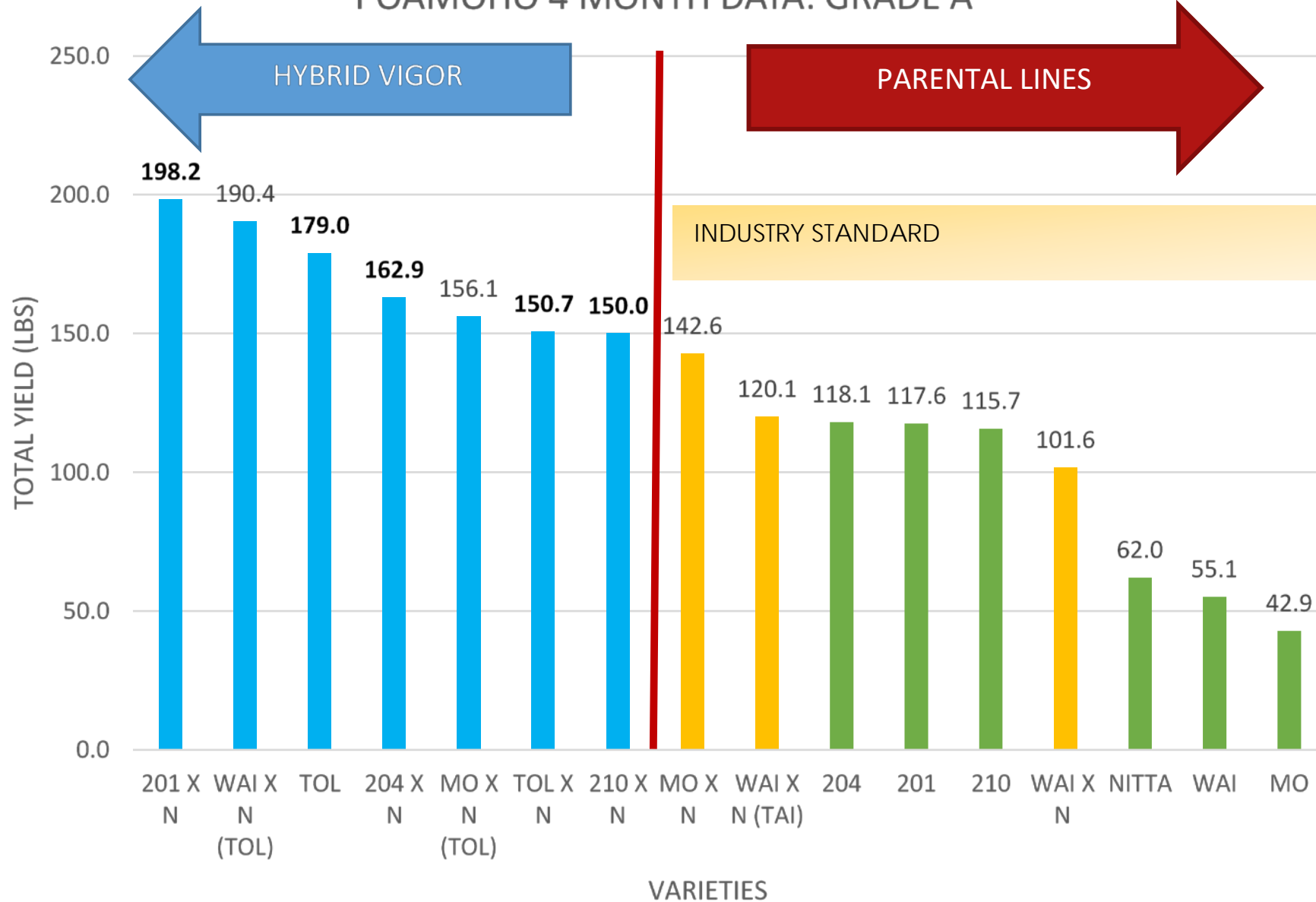
TOL X N



204 X N



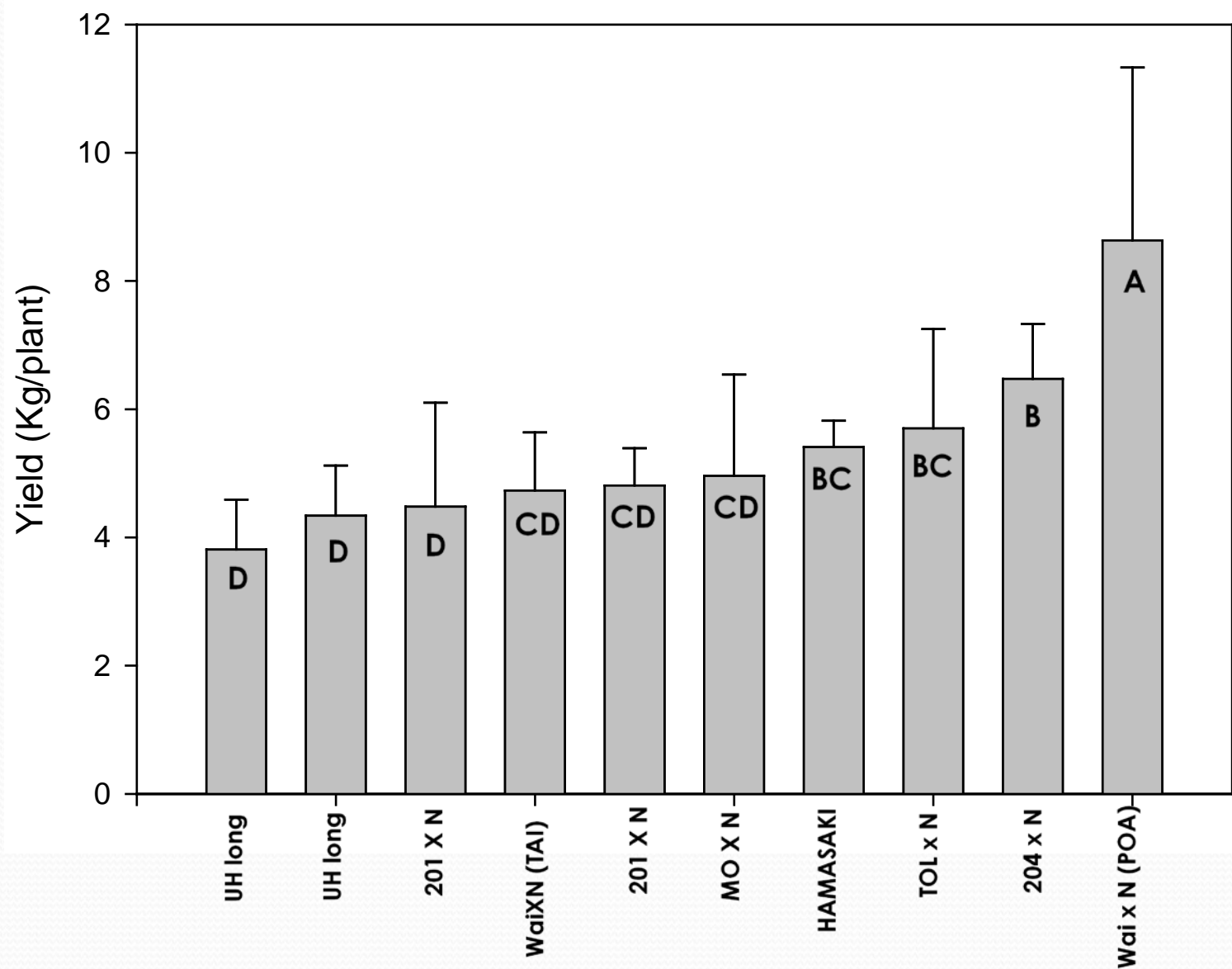
# POAMOHO 4 MONTH DATA: GRADE A



Oahu, Maui, & Hawaii (7 sites). Molokai (2015)



## Waimanalo Research Station (Organic Culture) Data: June-August 2014



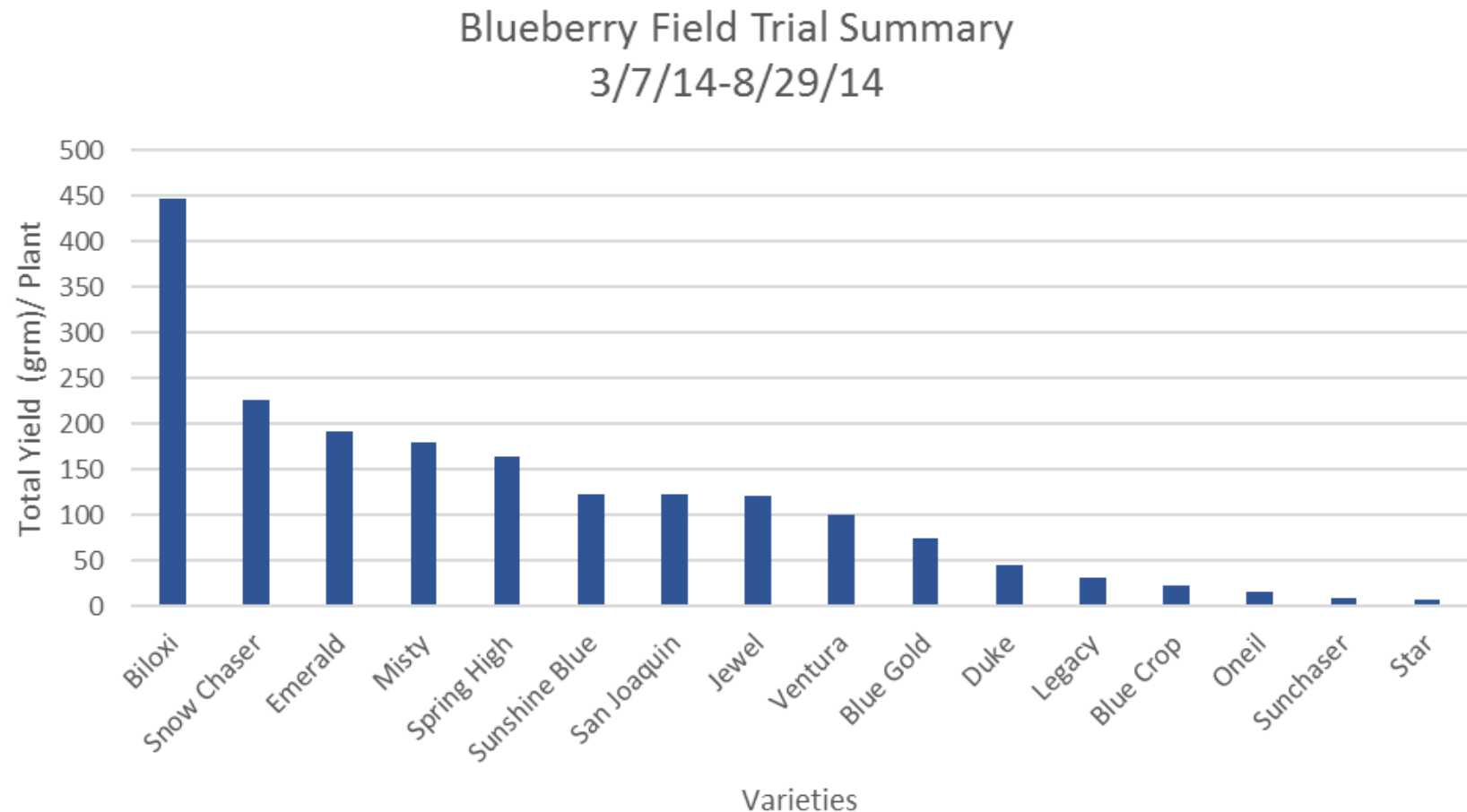
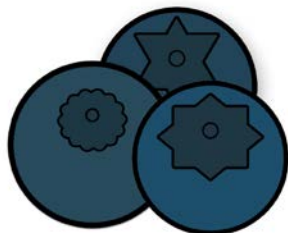




# New Crop Evaluations

Field trials with Migita, Nakamoto, Hamasaki, Kawabata(s) & Whitmore Ag Development

- 16 varieties evaluated
- Yield and brix data collected
- Grown under a plastic covering (rust) and netting (birds)
- Project ended in September 2014 due to tropical storm











2016: Kale Variety Trial



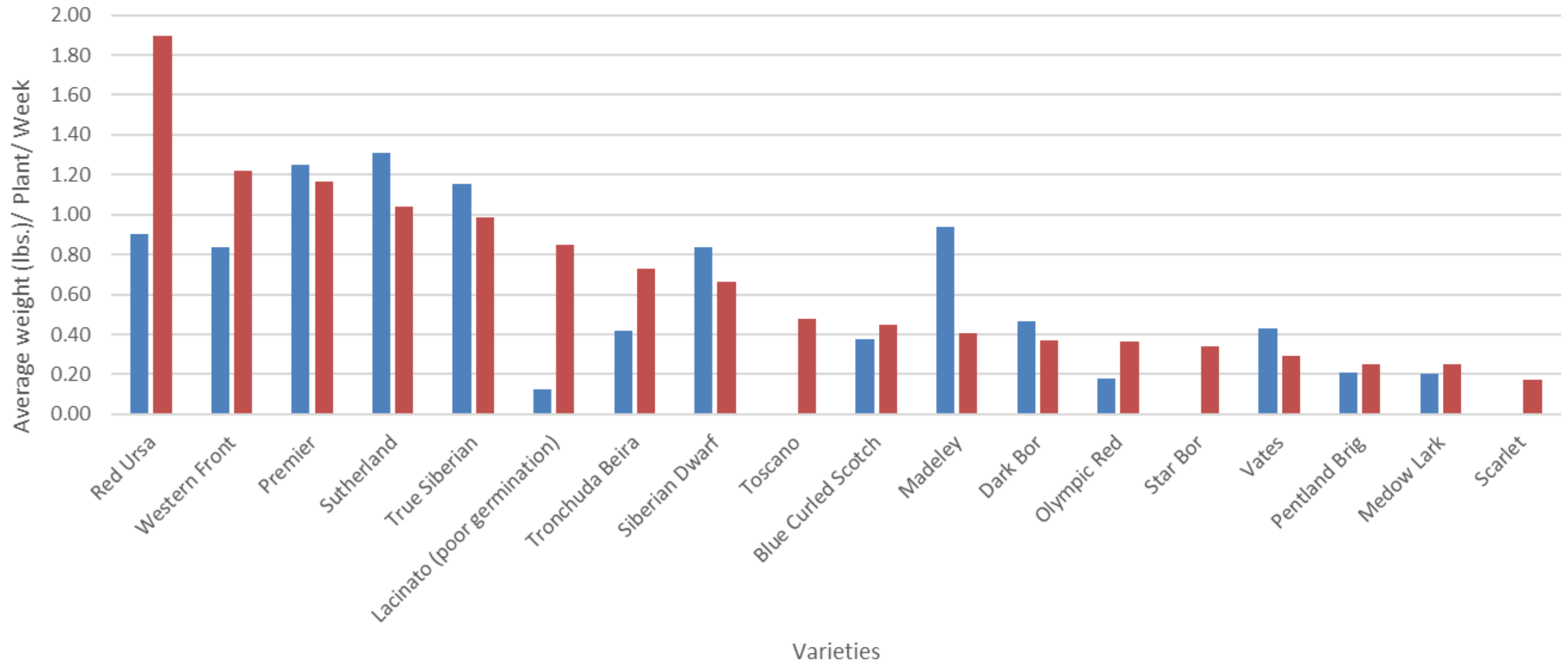


## 2016: DBM & Caterpillars: Kale (18)





## Overall Kale Production: Inside vs Outside Screen

[illegible]





# Suitability

- Each location varies
- Screen recommended varieties in your respective areas
- Stay current with seed companies and their offerings
  - Hawaii's market share is small, varieties can be discontinued without notice
- Utilizing varieties with tolerance to pests and disease is just way to manage pest in an IPM system







# For More Information

Jari S.K. Sugano

University of Hawaii at Manoa

College of Tropical Agriculture and Human Resources

Department of Plant and Environmental Protection Sciences

Wahiawa Extension Office

[suganoj@ctahr.hawaii.edu](mailto:suganoj@ctahr.hawaii.edu)

622-4185



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