Bagrada bug: biology, host range and effects on cole crops

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Research Collaborations

- **UCR personnel – Tom Perring, Darcy Reed, Nilima Castle, Jocelyn Millar, Steve McElfresh, Satya Chinta**
- **Univ of Arizona – John Palumbo**
- **USDA-ARS Biological Control – Walker Jones**
- **Oklahoma State Univ – Monica Papes, Tom Royer**
- **New Mexico State Univ – Tessa Grasswitz, Scott Bundy**
- **Funding: USDA/NIFA – WR-IPM and Critical Issues**

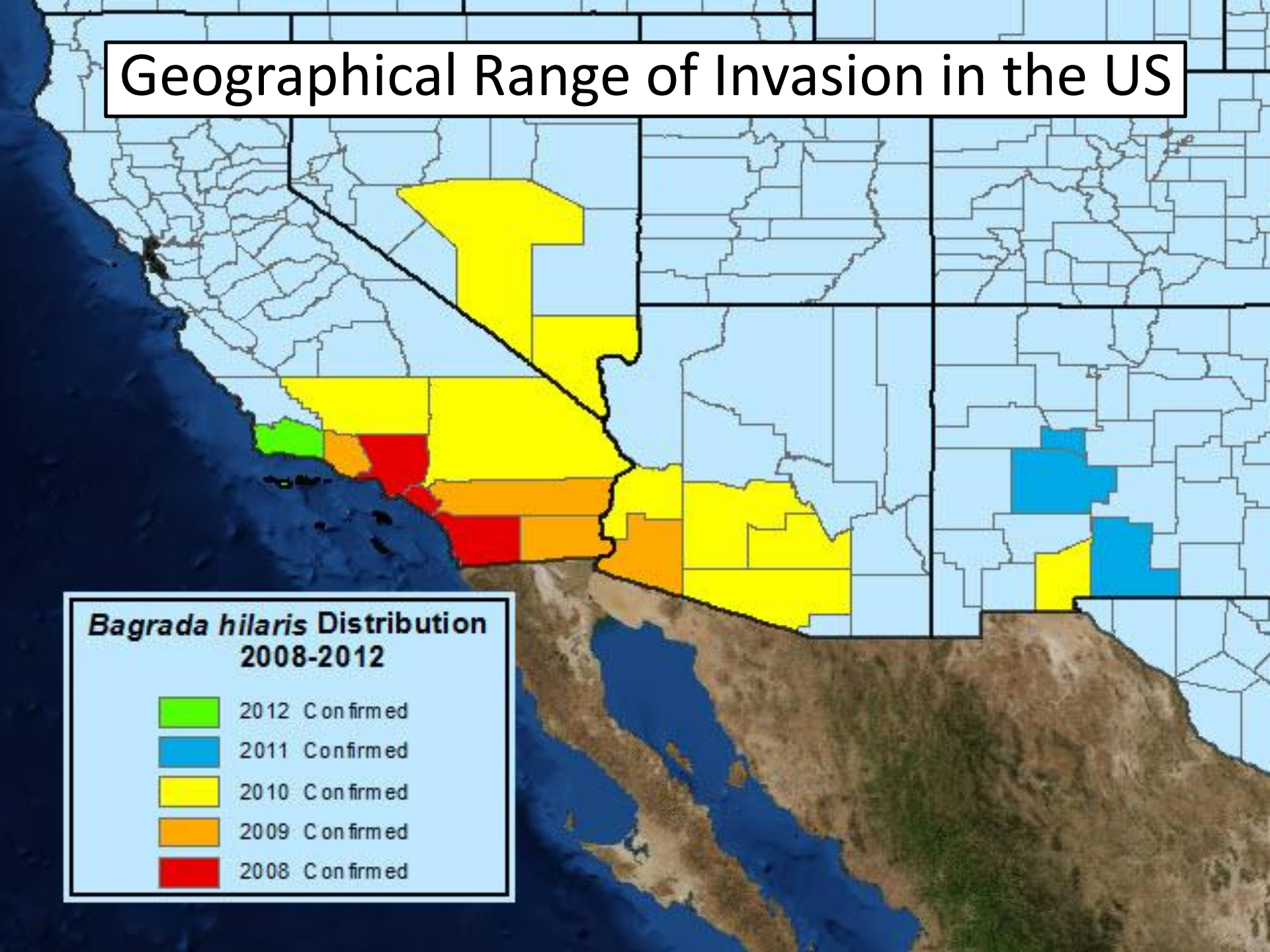
Research Areas

- Insect development – as affected by temperature, host plant
- Seasonal migration
- Monitoring, trapping, attractant pheromone
- Effects on plant development
- Pesticide testing and timing
- Biological Control
- Current / Projected Distribution

Historical Geographic Range:

- African origins (also India, Pakistan, SE Asia, parts of Italy)
- Outbreaks common, dependent on weather conditions and food availability
- Wide host plant range (mainly crucifers, but also grasses and grains, potatoes, some legumes…)

Geographical Range of Invasion in the US



Bagrada Bug

- *Bagrada hilaris* Burmeister
  - –Previously *B. cruciferarum* Kirkaldy
- Common names: Painted bug, Bagrada bug, Harlequin bug (Old World)

Harlequin Bug

IDENTIFICATION/RECOGNITION

Bagrada Bug

Life Stages

Female and Male Adult
Bagrada hilaris

Oviposition

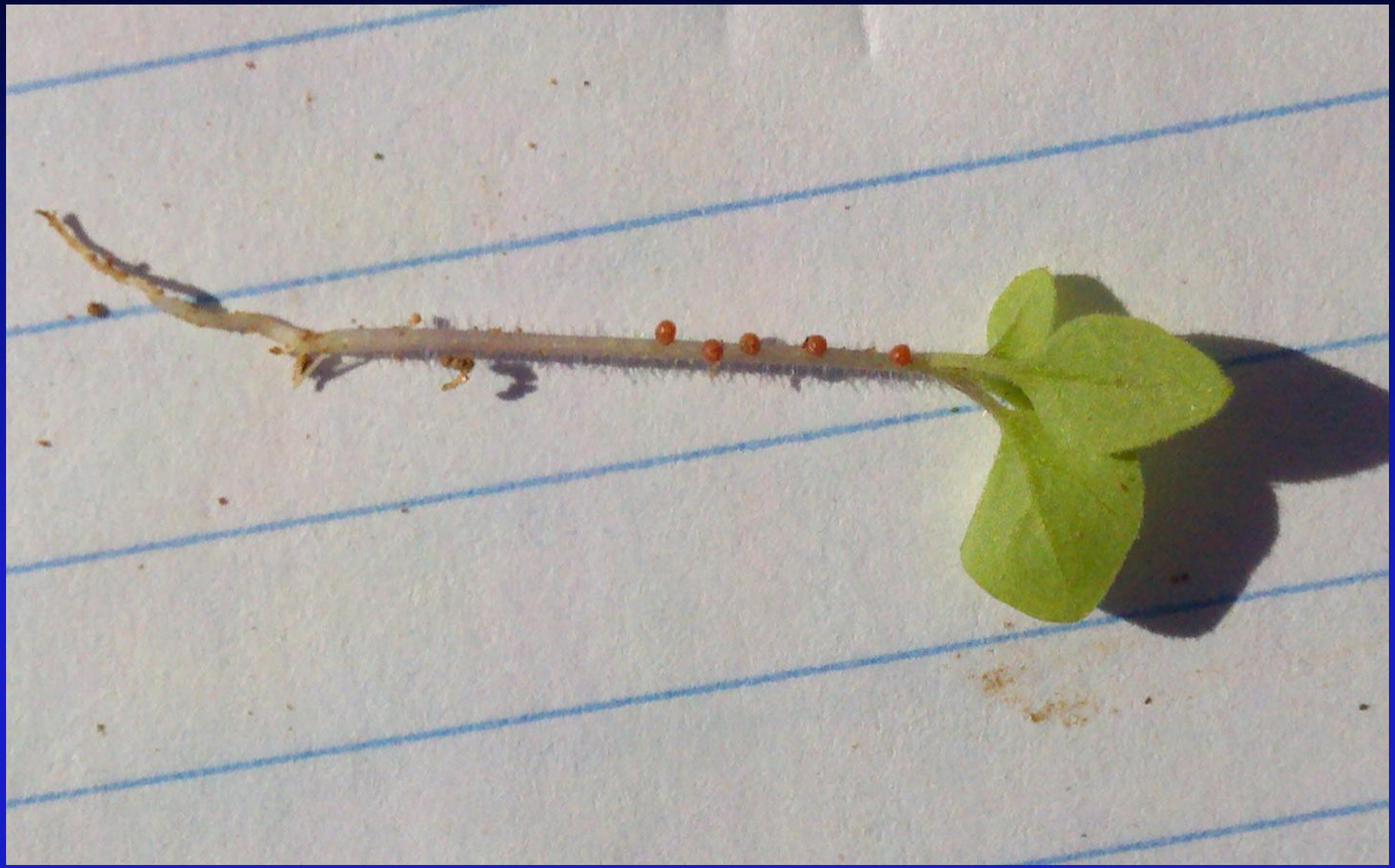
- ~3-4 days after adult emergence
- Females produce ~10 eggs/day
- Undersides of leaves, cracks & crevices, hairy stems of non-host plants

Oviposition

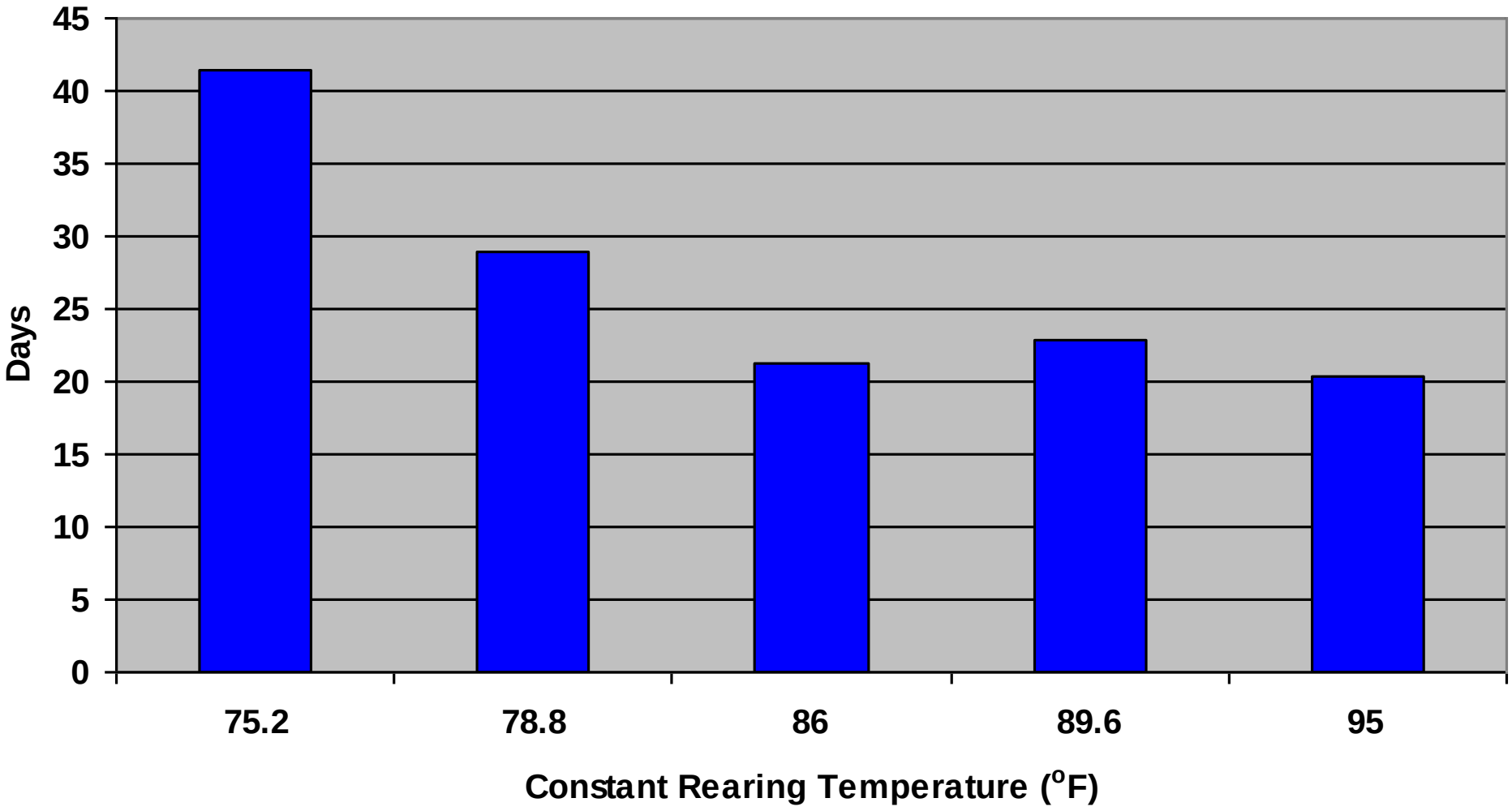
- ~3-4 days after emergence
- Females produce ~10 eggs/day
- Undersides of leaves, cracks & crevices, hairy stems
- Go from adult reproductive quiescence to young feeding nymphs in ~12-14 days.
- Eggs often laid on non-biological structures, e.g. row cover, shade cover

Eggs of Stink Bugs

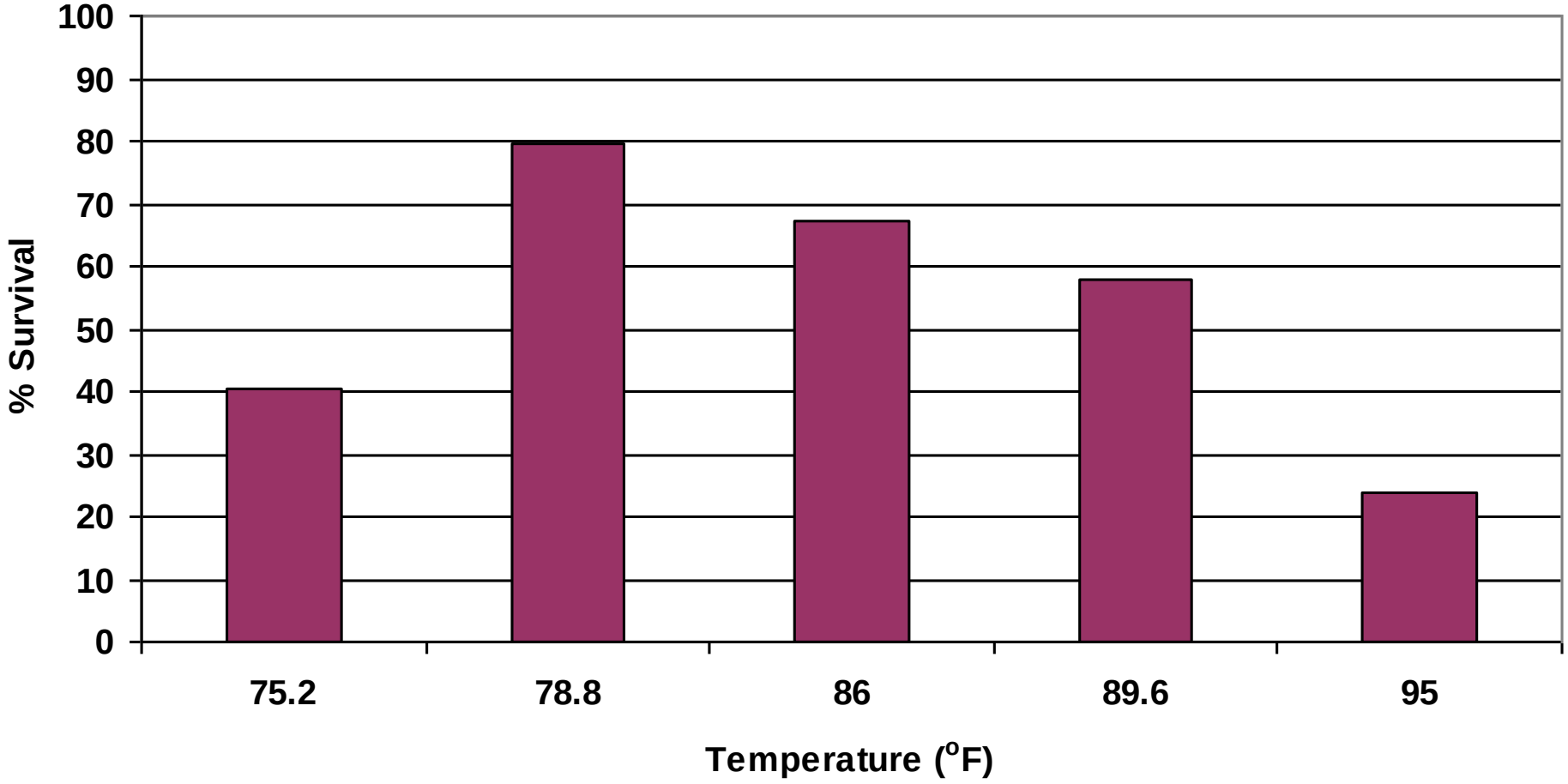
Eggs on weed seedling 14d PID



Total Development Time of *Bagrada hilaris*



Survivorship to Adulthood of *Bagrada hilaris* Reared at Constant Temperatures



Seasonal Activities

What are these bugs doing and where are they doing it?

Aggregations

Early Fall

August - April

March-May

Sudan grass Corn, Sorghum Small Grains

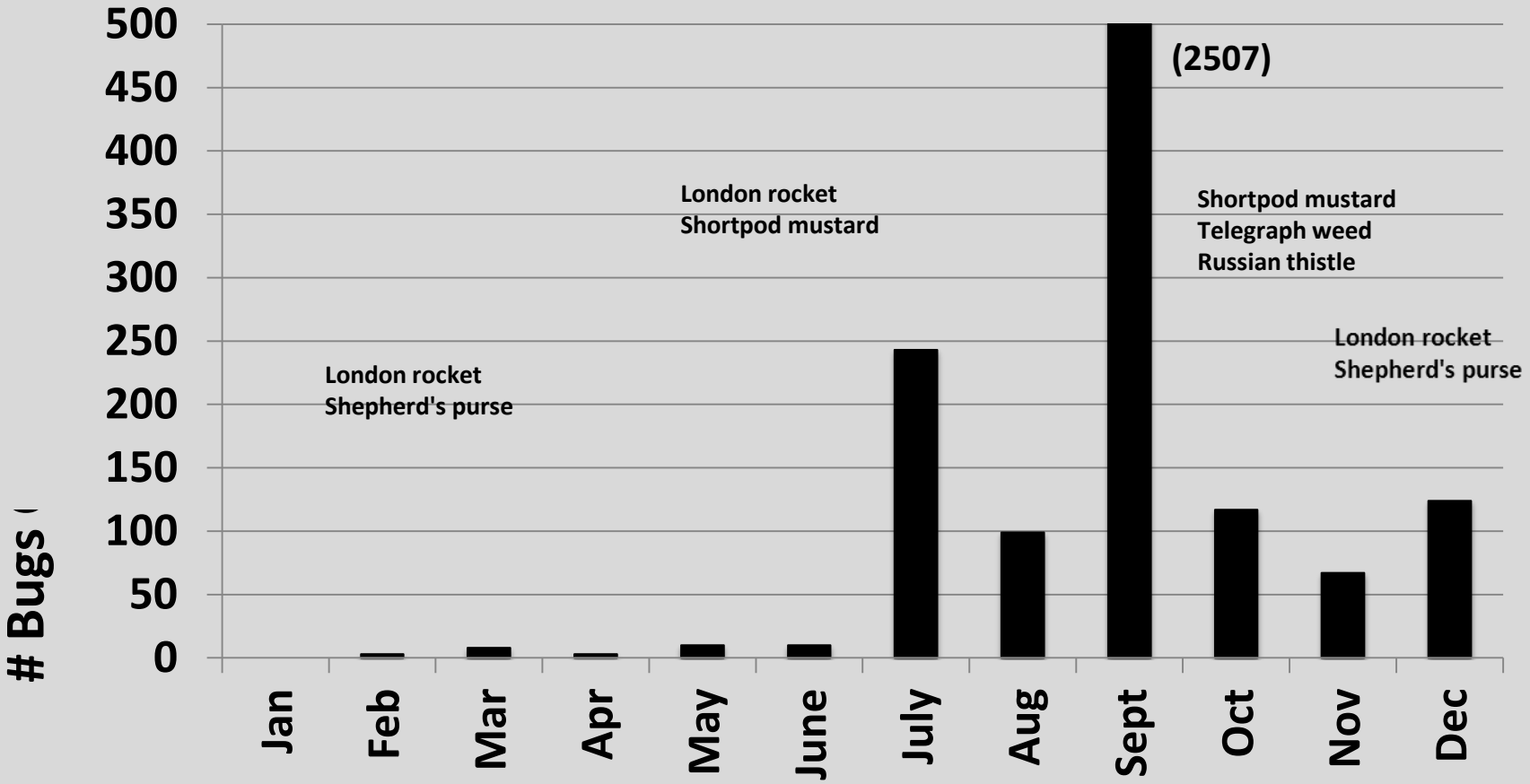
Weeds Cotton Bermuda grass

Ornamentals Alfalfa Citrus

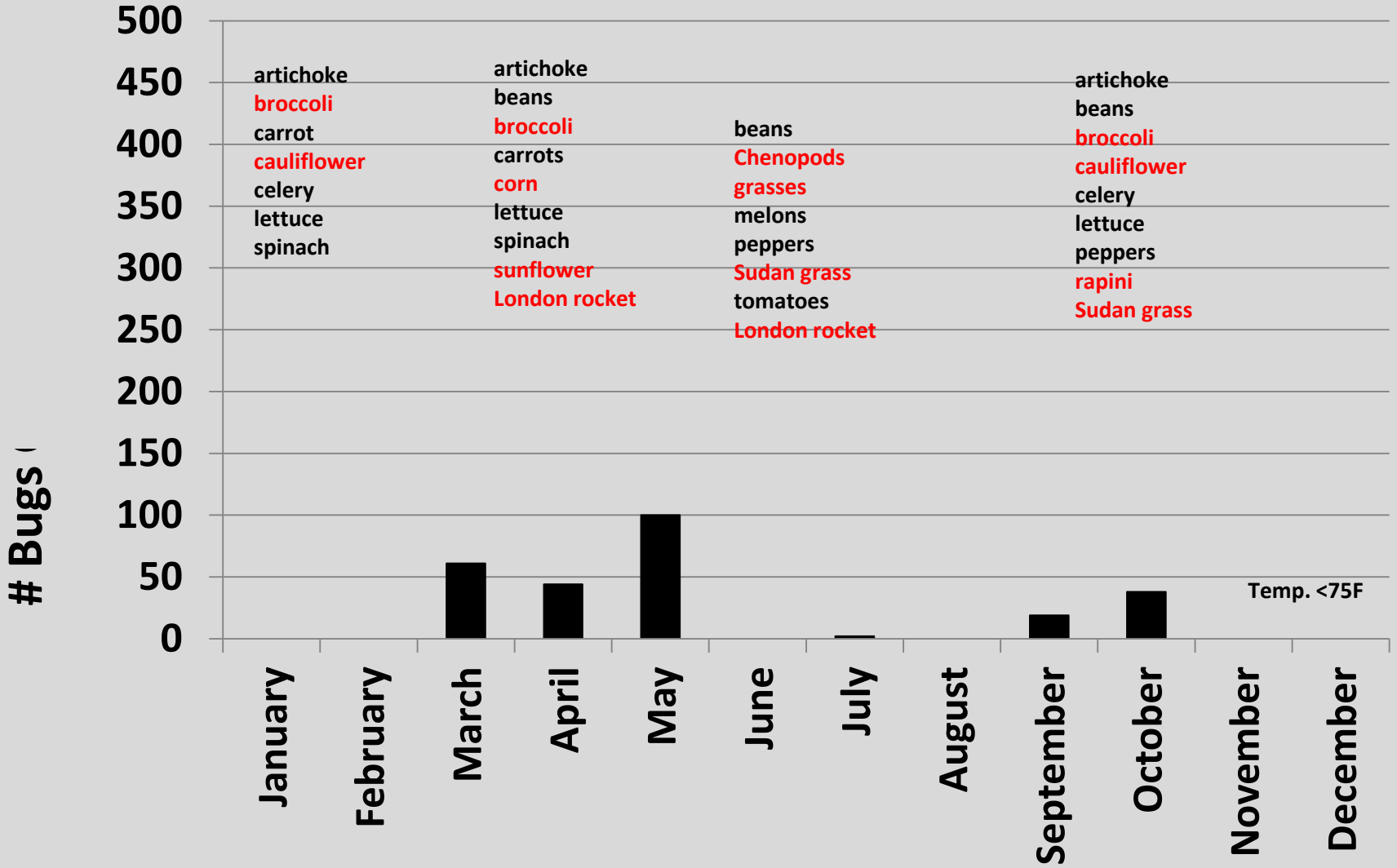
???

May-August

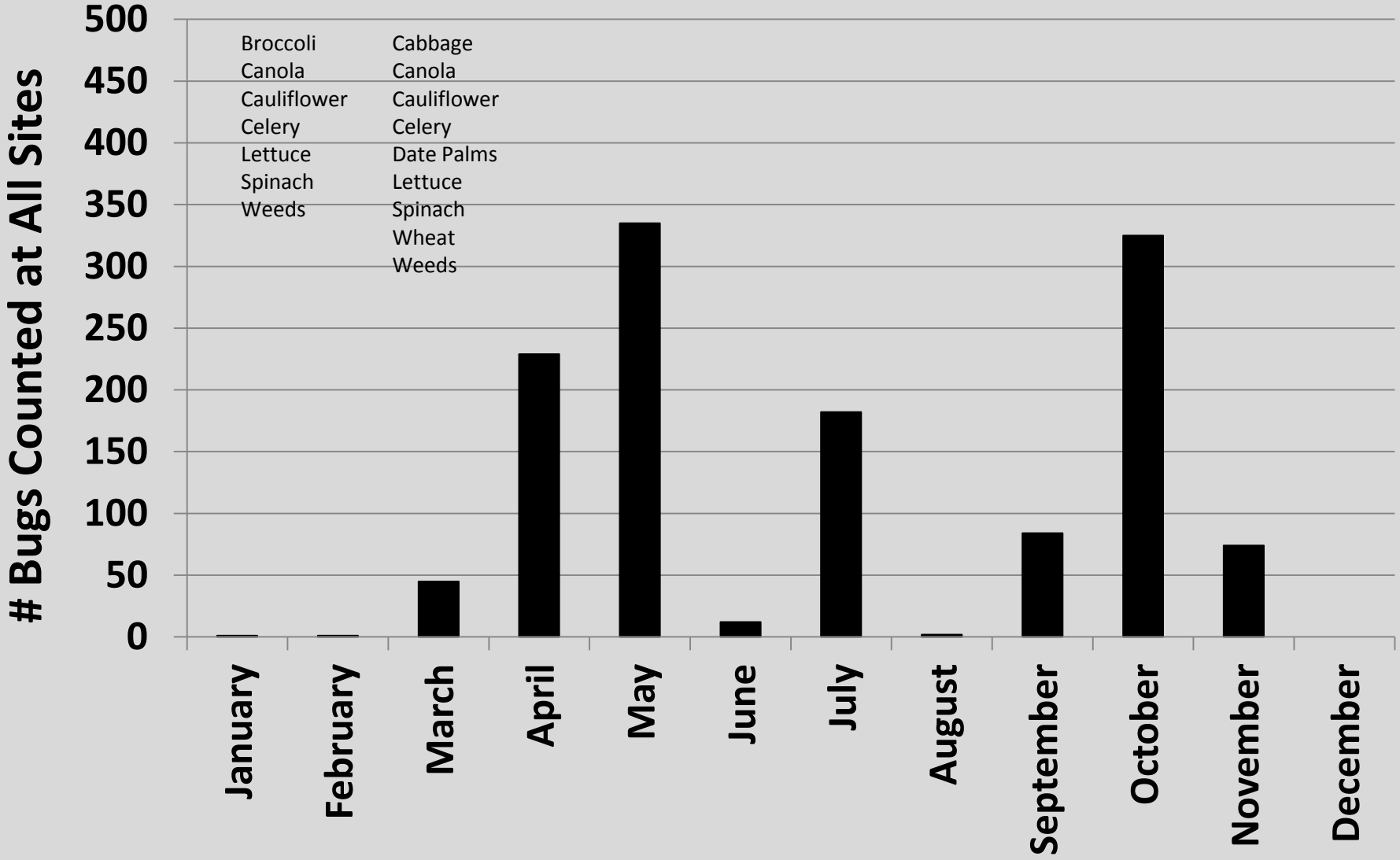
2011 Field Activity in Riverside, CA of *Bagrada hilaris*



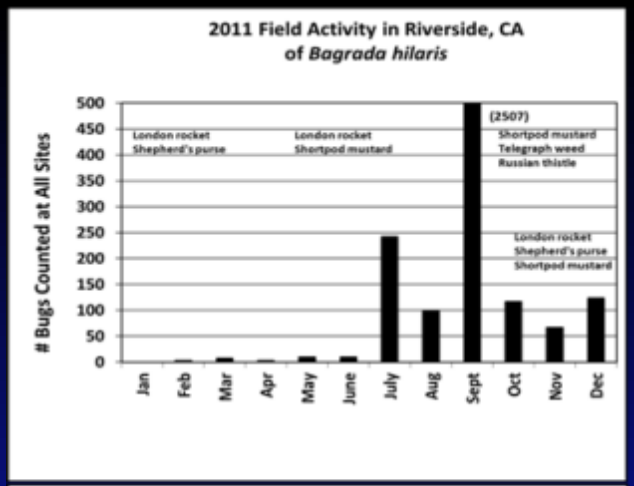
2011 Field Activity in Coachella Valley, CA of *Bagrada hilaris*

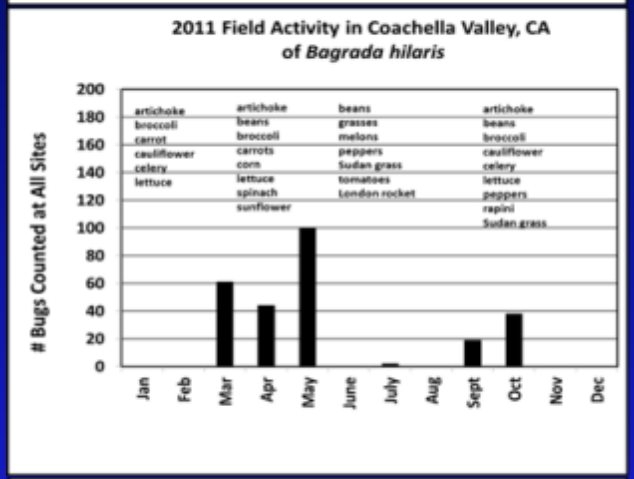


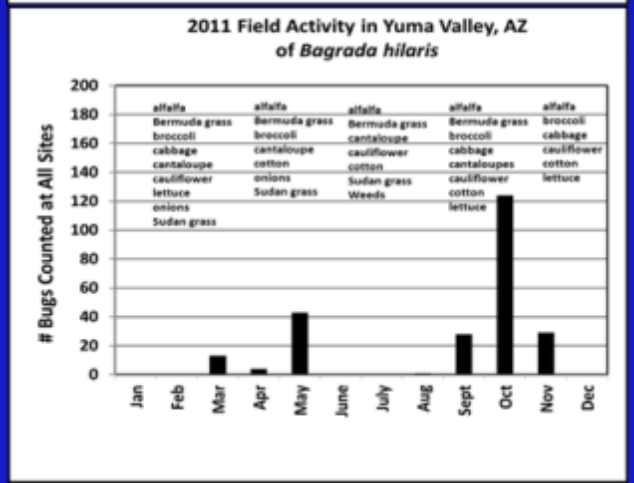
2011 Field Activity in Yuma, AZ of *Bagrada hilaris*



Seasonal Movement







Population Dynamics

April – August: Shortpod Mustard

Crop Hosts Tested

Arugula, Bell pepper, Broccoli, Cabbage, Cantaloupe, Cauliflower, Cilantro, Collards, Corn, Cowpea, Cucumber, Delta Pine cotton, Fungicide-treated cotton, Fava bean, India mustard, Italian squash, Kale, Lettuce, Smooth leaf cotton, Snap bean, Lima bean, Soybean, Sudan grass, Spinach, Sunflower, Tomato

Not a host	Marginal host	Preferred host

Weed Hosts Tested

Birdsfoot trefoil, Shortpod mustard, Black nightshade, Goosefoot, Groundsel, London rocket, Shepherd's purse, Sowthistle, Sweet alyssum, Tree tobacco, Vetch, Wild gourd

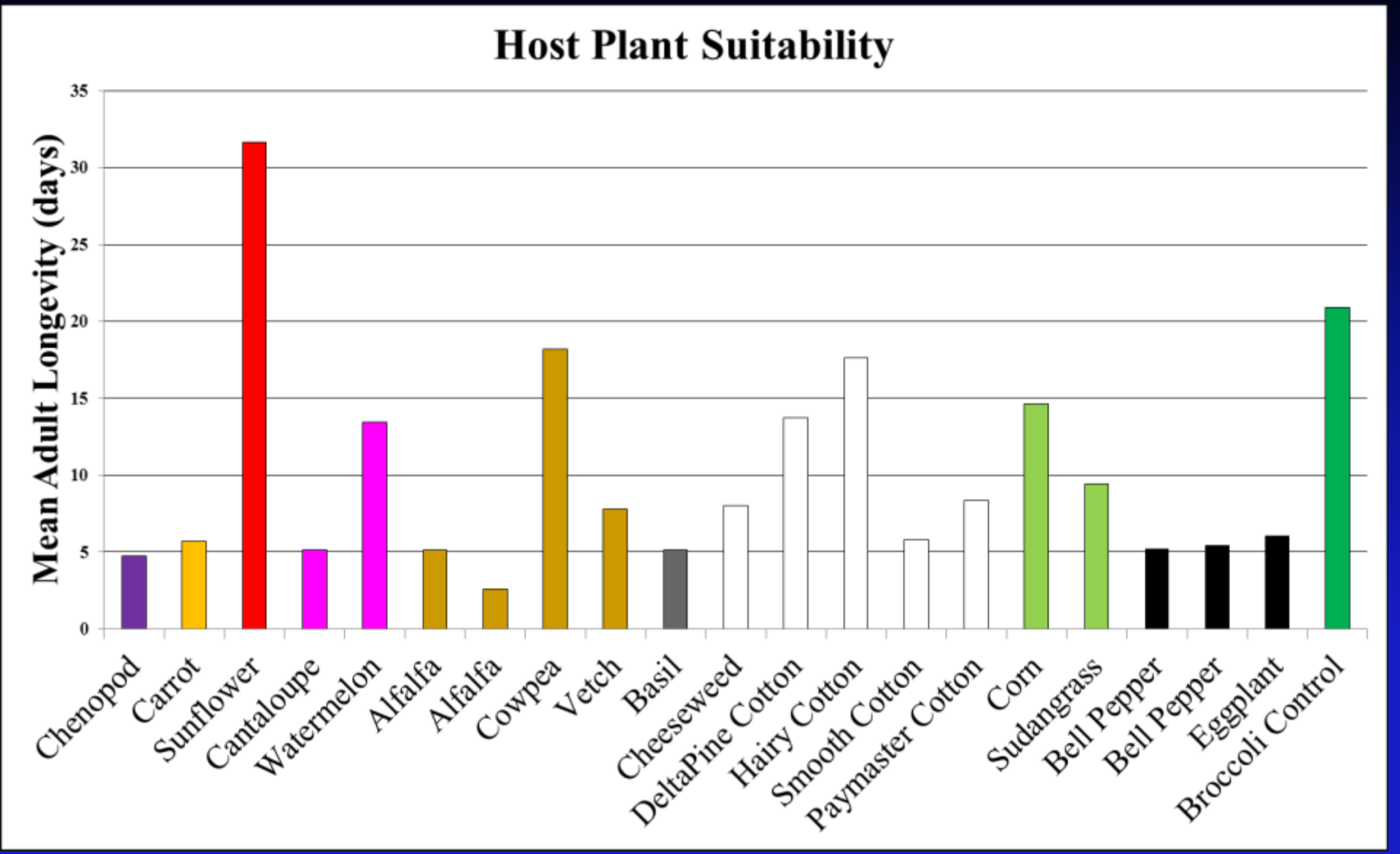
Not a host	Marginal host	Preferred host

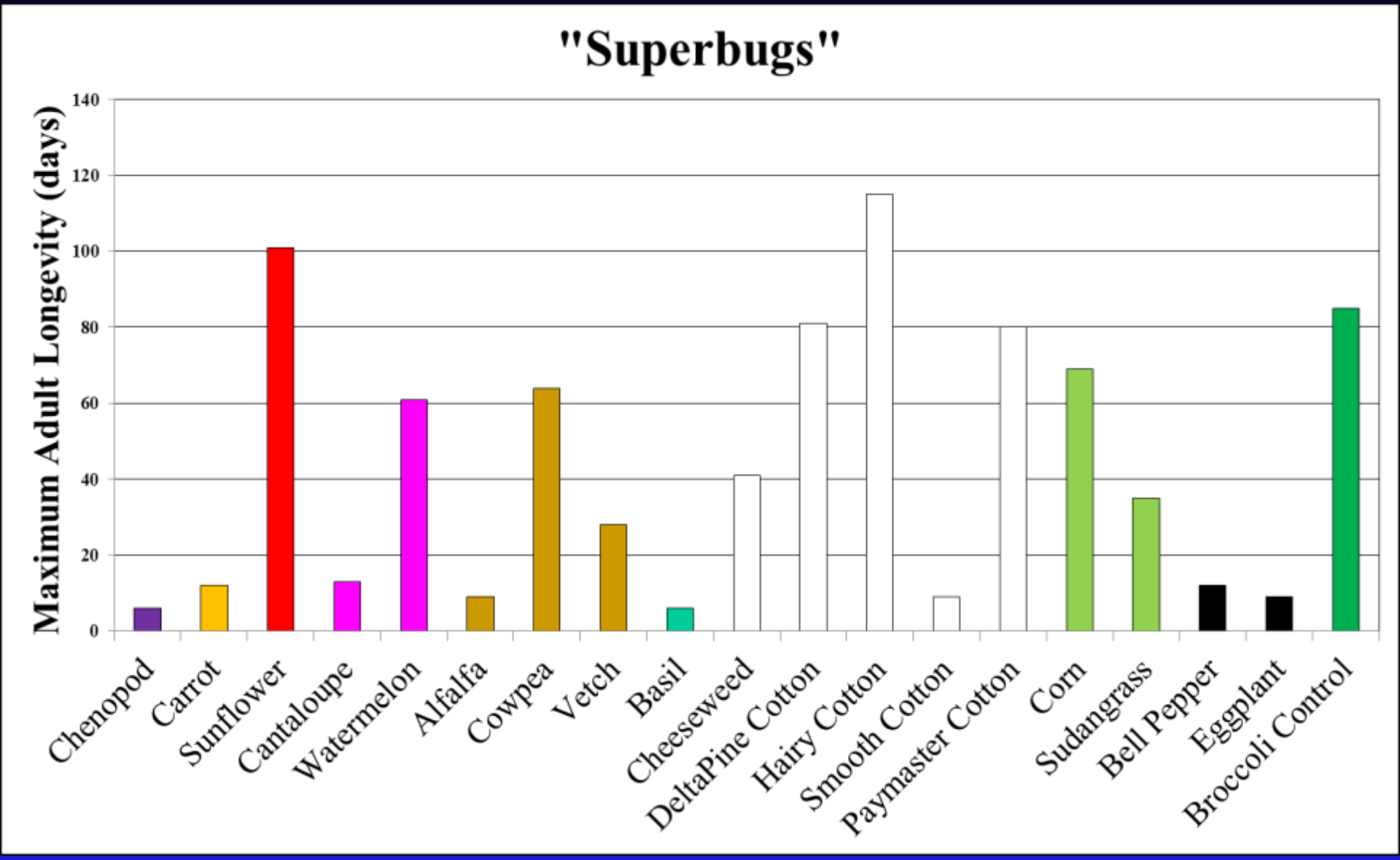
Plant tested	Plant Family	Date Started	Generation	Stage
Altor*	Brassicaceae	Aug 2012	F1	Nymph
Artichoke	Asteraceae	June 2012	F1	Nymph
Bermuda grass*	Poaceae	Nov 2011	F3	Nymph
Bluegrass	Poaceae	Sept 2011	F2	Nymph
Broccoli*	Brassicaceae	Feb 2011	F14	Nymph
Cauliflower	Brassicaceae	Feb 2011	F9	Adult
Corn, Bantam	Poaceae	Apr 2011	F1	Nymph
Corn, Brighton	Poaceae	Feb 2011	F1	Nymph
Cowpea	Fabaceae	May 2011	F1	Nymph
Sudan grass*	Poaceae	Mar 2011	F9	Adult
Sunflower hybrid	Asteraceae	Oct 2011	F1	Nymph
Sunflower, wild	Asteraceae	May 2012	F1	Nymph
Sunflower, ornamental	Asteraceae	July 2011	F2	Nymph
Vetch	Fabaceae	Feb 2011	F2	Adult

Generational Study

*Continuing

- 5 female/5 males to begin


Host Plant Suitability
Mean Adult Longevity (days)
35
30
25
20
15
10
5
0
Chenopod
Carrot
Sunflower
Cantaloupe
Watermelon
Alfalfa
Alfalfa
Cowpea
Vetch
Basil
Cheeseweed
DeltaPine Cotton
Hairy Cotton
Smooth Cotton
Paymaster Cotton
Corn
Sudangrass
Bell Pepper
Bell Pepper
Eggplant
Broccoli Control


"Superbugs"
Maximum Adult Longevity (days)
140
120
100
80
60
40
20
0
Chenopod
Carrot
Sunflower
Cantaloupe
Watermelon
Alfalfa
Cowpea
Vetch
Basil
Cheeseweed
DeltaPine Cotton
Hairy Cotton
Smooth Cotton
Paymaster Cotton
Corn
Sudangrass
Bell Pepper
Eggplant
Broccoli Control

Host-Switch Experiment

Plants tested:	Family	How many Bagrada survived:	Adult Survival % From original 100 adults	Same Host Plant No. Nymphs	Switch to Broccoli No. Nymphs
Sunflower, wild	Asteraceae	2♀ 2♂	4	1	0
Artichoke	Asteraceae	17♀ 0♂	17	na	na
Groundsel	Asteraceae	6♀ 4♂	10	0,0	13,10
Sowthistle	Asteraceae	2♀ 6♂	8	0	0
Watermelon	Cucurbitaceae	20♀ 14♂	34	pending	pending
Cowpea	Fabaceae	33♀ 33♂	66	2,9	7,16
Cheeseweed	Malvaceae	22♀ 24♂	46	1,0	24,25
Cotton, Hairy Leaf	Malvaceae	0	0	0	0
Corn, Bantam	Poaceae	14♀ 12♂	26	6,6	7,13
Bermuda grass	Poaceae	17♀ 6♂	23	0,0	15,0
Sudan grass	Poaceae	43♀ 15♂	58	8,3	25,10

Lacerate /Flush Feeding

Effects of Feeding Damage

- Wilting
- Scorching

Recognition: Feeding Damage

Effects of Feeding Damage

- Wilting – esp. leafy mustards
- Scorching – old feeding lesions
- Blind plants- death of apical meristem
  - "Macho" plant

“Macho” plant


JC Palumbo

“Blind” cauliflower plant

JC Palumbo

Effects of Feeding Damage

- Wilting
- Scorching
- Blind plants- death of apical meristem
- Adventitious stems/ multiple heads

Undamaged cabbage plant **Multi-headed cabbage plant**


JC Palumbo

Undamaged broccoli plant

Multi-crowned broccoli plant


JC Palumbo

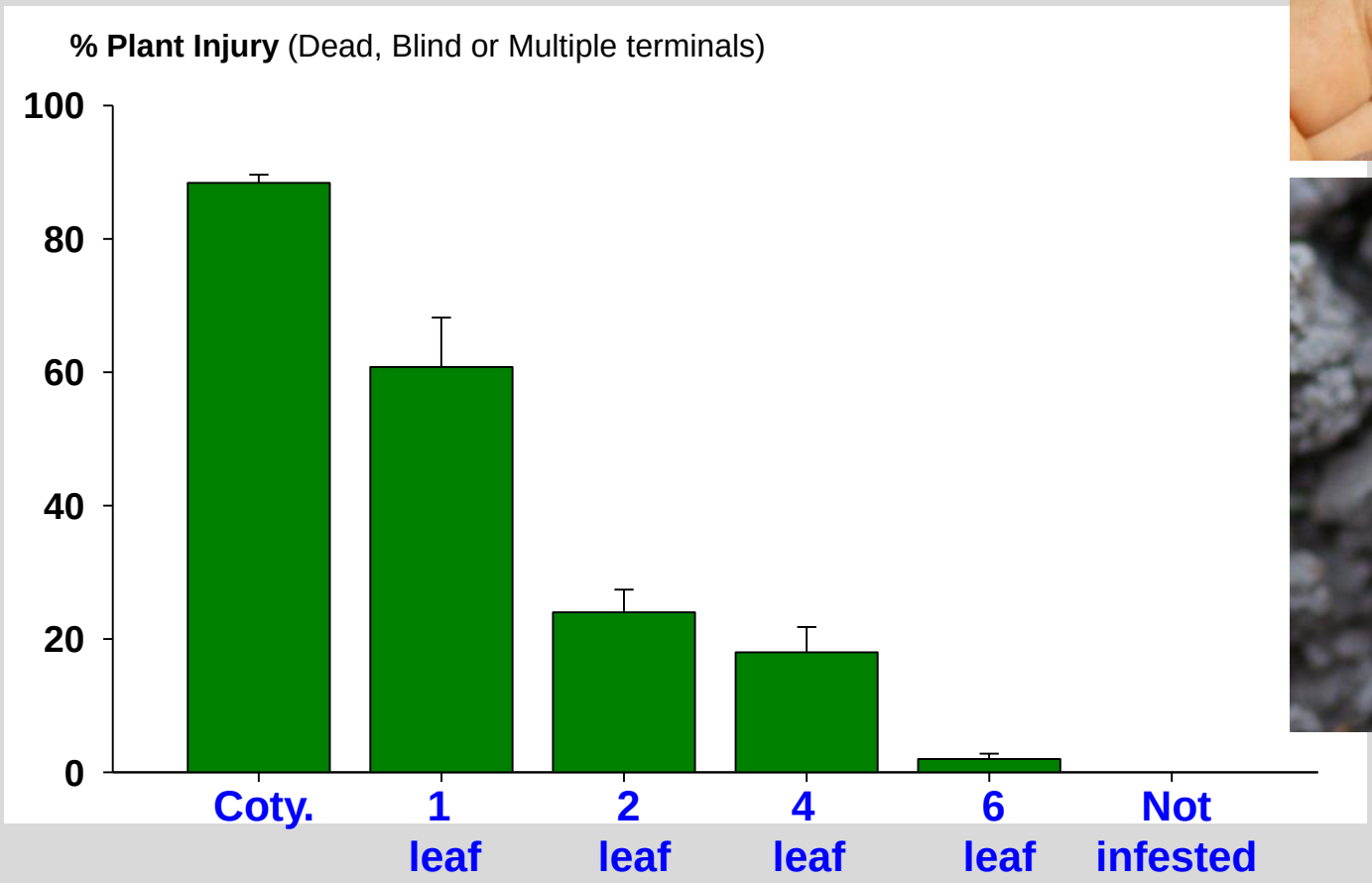
Effects of Feeding Damage

- Wilting
- Scorching
- Blind plants- death of apical meristem
- Adventitious stems/ multiple heads
- Stunted plants
- Death

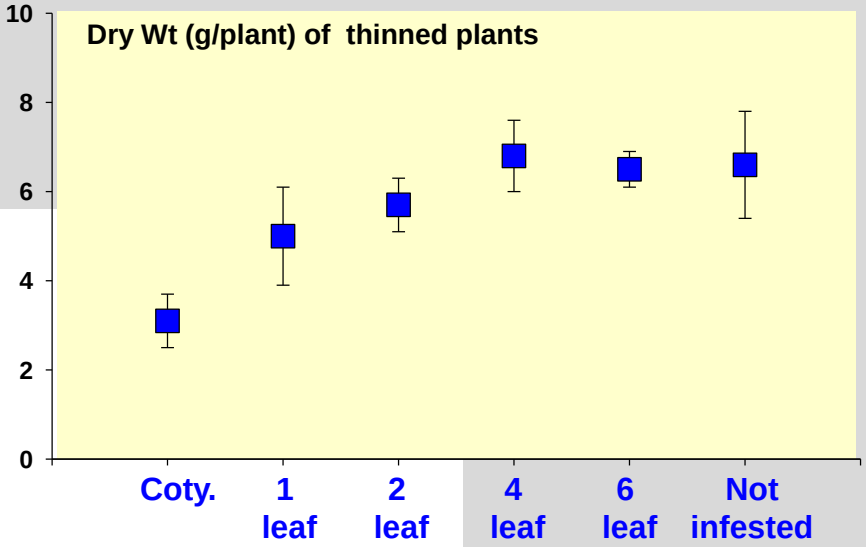
At what plant stage is a direct-seeded broccoli crop no longer in danger from *Bagrada* bug feeding ?

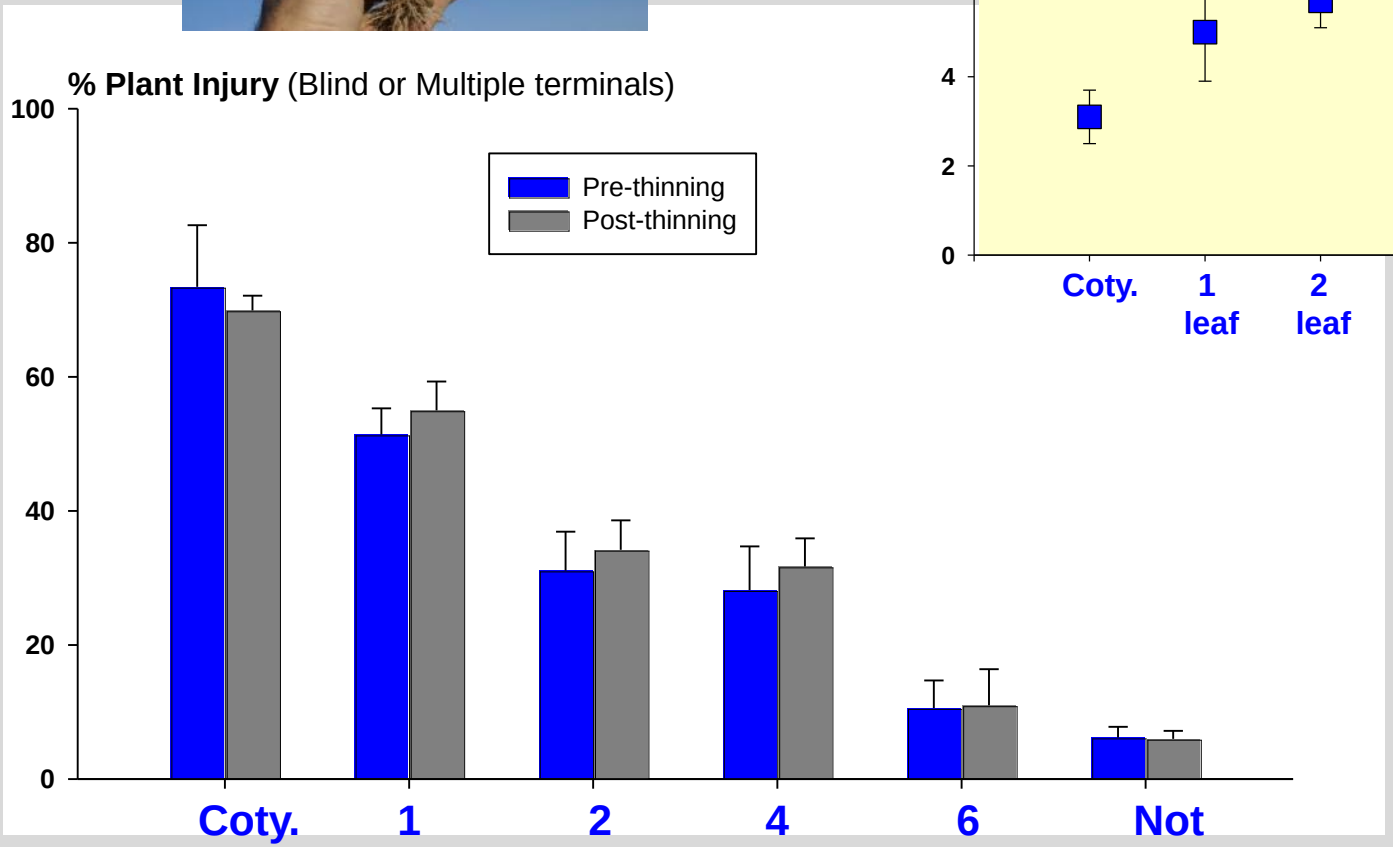
Impact of Bagrada on Broccoli 14-d after infestation

- 1 adult / 8 plants
- 14-d infestation period

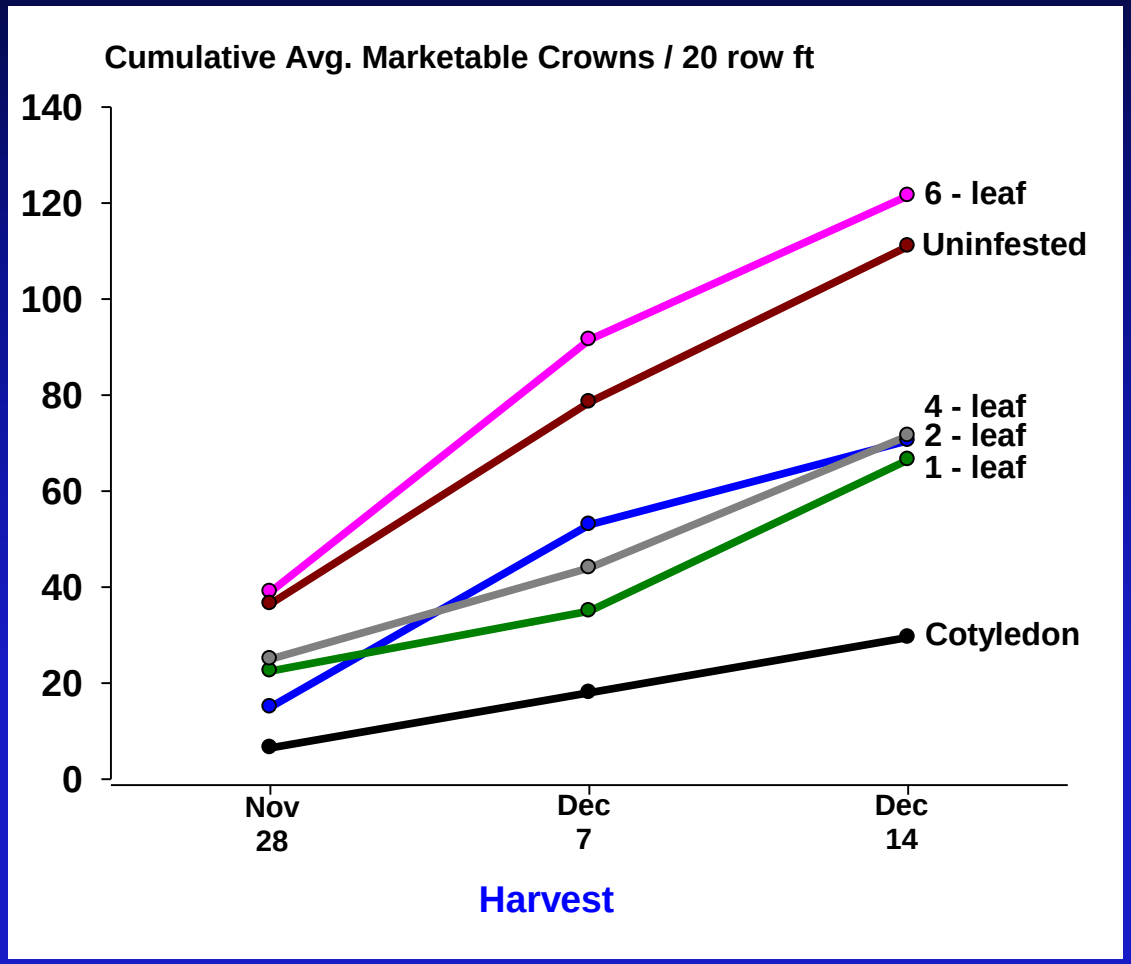


Impact of Bagrada on Broccoli Plant Growth, Pre- and Post-thinning

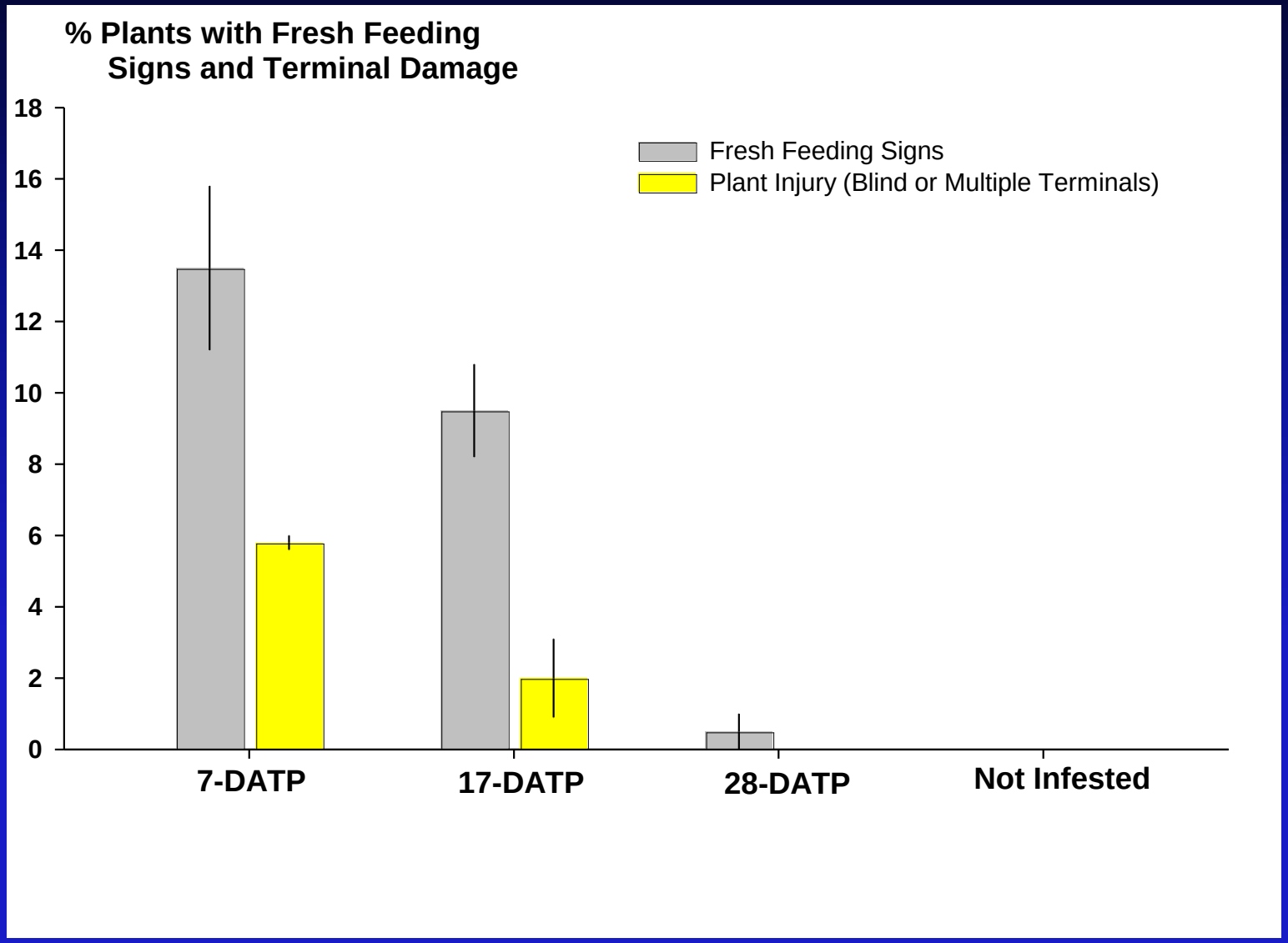




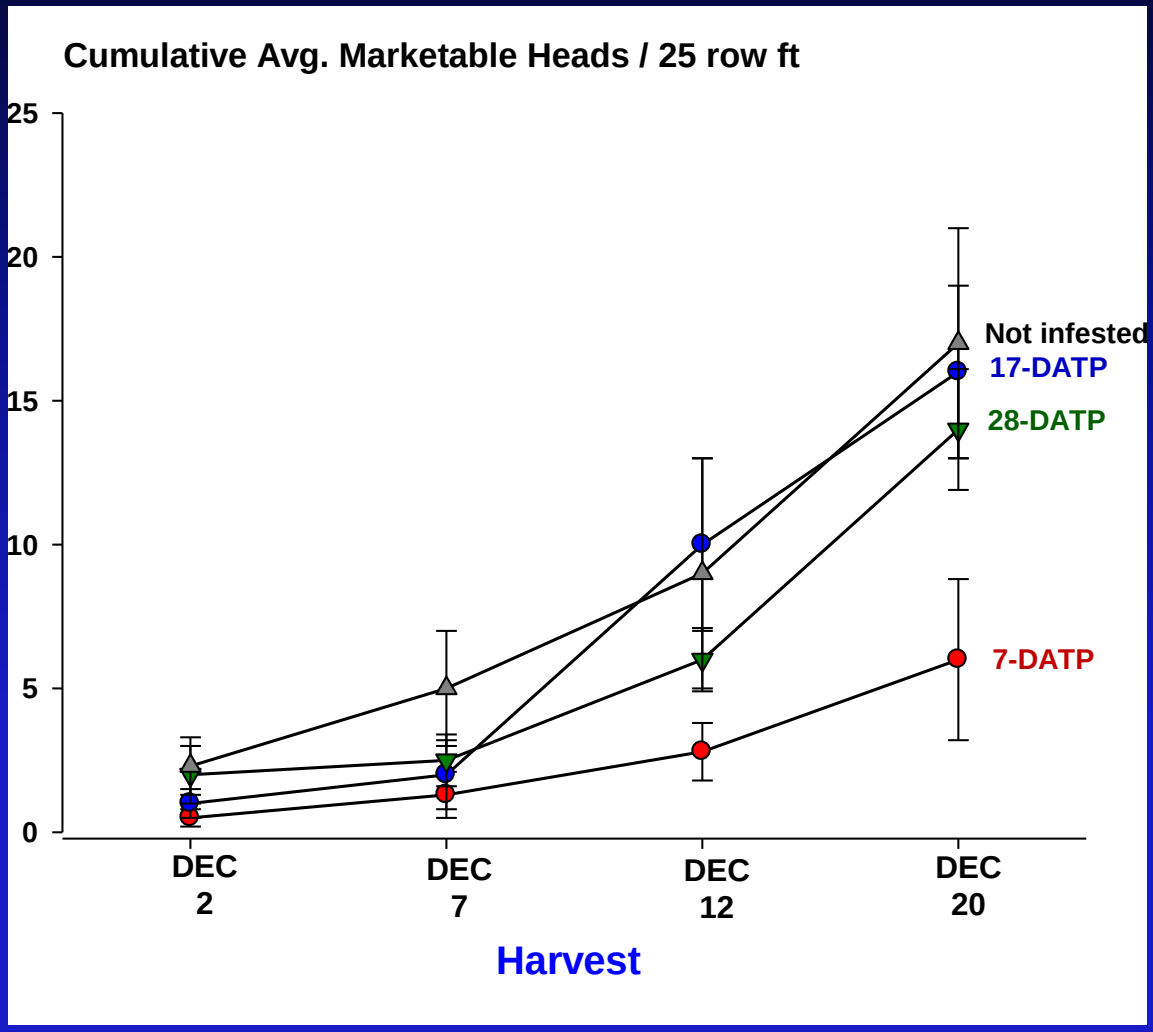
Impact of Bagrada on Broccoli Yield



Impact of Bagrada on Plant Growth / Yield - Cauliflower



Impact of Bagrada on Plant Growth / Yield - Cauliflower



Control Measures

- Cultural Control
  - Reduce weedy mustards, remove post-harvest vegetation
  - Monitoring, proximity crops

Weed Control

Control Measures

- Cultural Control
  - Reduce weedy mustards, remove post-harvest vegetation
  - Monitoring, proximity crops
  - Row covers?

Row cover efficacy?

Control Measures

- Cultural Control
  - Reduce weedy mustards, remove post-harvest vegetation
  - Monitoring, proximity crops
  - Row covers?
  - Trap crops and borders?
- Biological Control
  - Predators
  - Parasitoids

Biological Control

- Diptera: Sarcophagidae, Tachinidae
- Hymenoptera: Scelionidae (*Trissolcus, Telenomus*)
- *Telenomus podisi*
- *Ooencyrtus* sp.

Trissolcus eushisi on *Piezodorus guildinii*

Ooencyrtus sp. on *Camptotus literalis*

Courtesy Walker Jones, USDA-ARS, Stoneville, MS

Control Measures

- Cultural Control
  - Reduce weedy mustards, remove post-harvest vegetation
  - Monitoring, proximity crops
  - Row covers?
  - Trap crops and borders?
- Biological Control
  - Predators
  - Parasitoids
- Chemical Control
  - Early pyrethroids
  - Later neonicotinoids

Insecticides

- Foliar:
  - Chlorpyrifos (Lorsban)
  - Bifenthrin (Capture)
  - Fenpropathrin (Danitol)
  - Methomyl (Lannate)
  - Dinotefuran (Venom)
  - Spirotetramat (Movento)
  - Cyazypyr
  - Novaluron
  - Pyrifluquinazone
- Systemic:
  - Imidacloprid (Admire)
  - Thiamethoxam (Platinum)

Highlights of Results

- Bifenthrin (pyrethroid) most potent against Bagrada
- Chlorpyrifos (organophosphate) is also toxic to Bagrada
- Neonicotinoids similarly active
- Movento not very active against immatures
- Cyazypyr less active
- Pyrifluquinazon has some activity

Behavior

- Patterns of Activity
  - Late Risers
  - Warm-temperature insect on cold-temperature plants
  - Often coupled as adults
  - Fly readily during hottest part of the day
  - Drop when disturbed
  - Extremely localized activity

Bagrada Bug Management Tips for the Low Desert

JC Palumbo

Fields near these areas may be at high risk:

- grassy areas (including sudangrass)
- weedy drains, river bottoms
- residential areas
- lush desert habitat

Monitoring and Scouting:

- Sampling before 9:00 am may be misleading
- Look for damage on cotyledons and young leaves
- Look for adults on undersides of cotyledons and leaves
- Keep your eyes on the soil underneath plants

Control:

- In high risk areas, chemigate at emergence (~4 d)
- Once pipe is pulled consider using the following products:
    1. Pyrethroids (Brigade, Mustang, Warrior)
    2. Lannate / Lorsban
    3. Venom / Scorpion / Belay

Bagrada bug Research Team