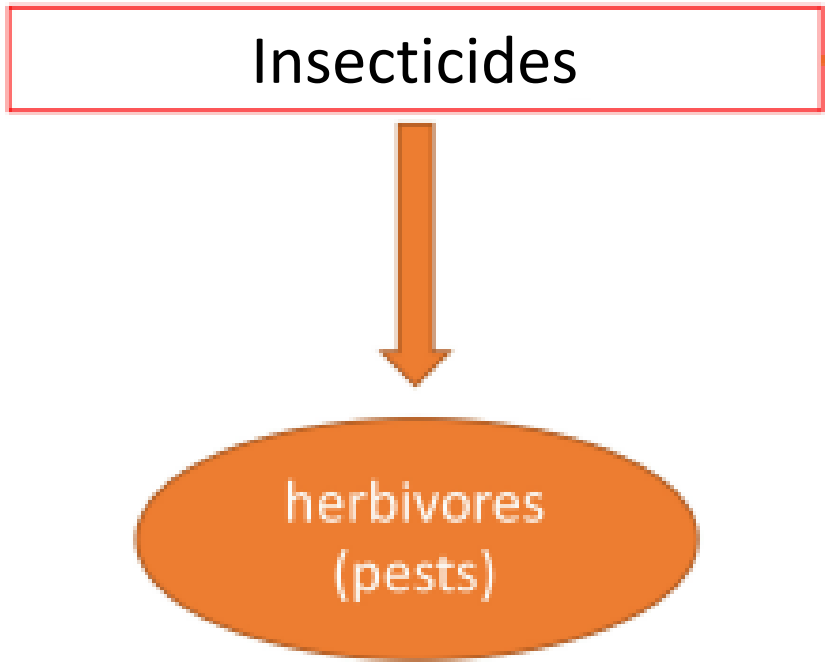
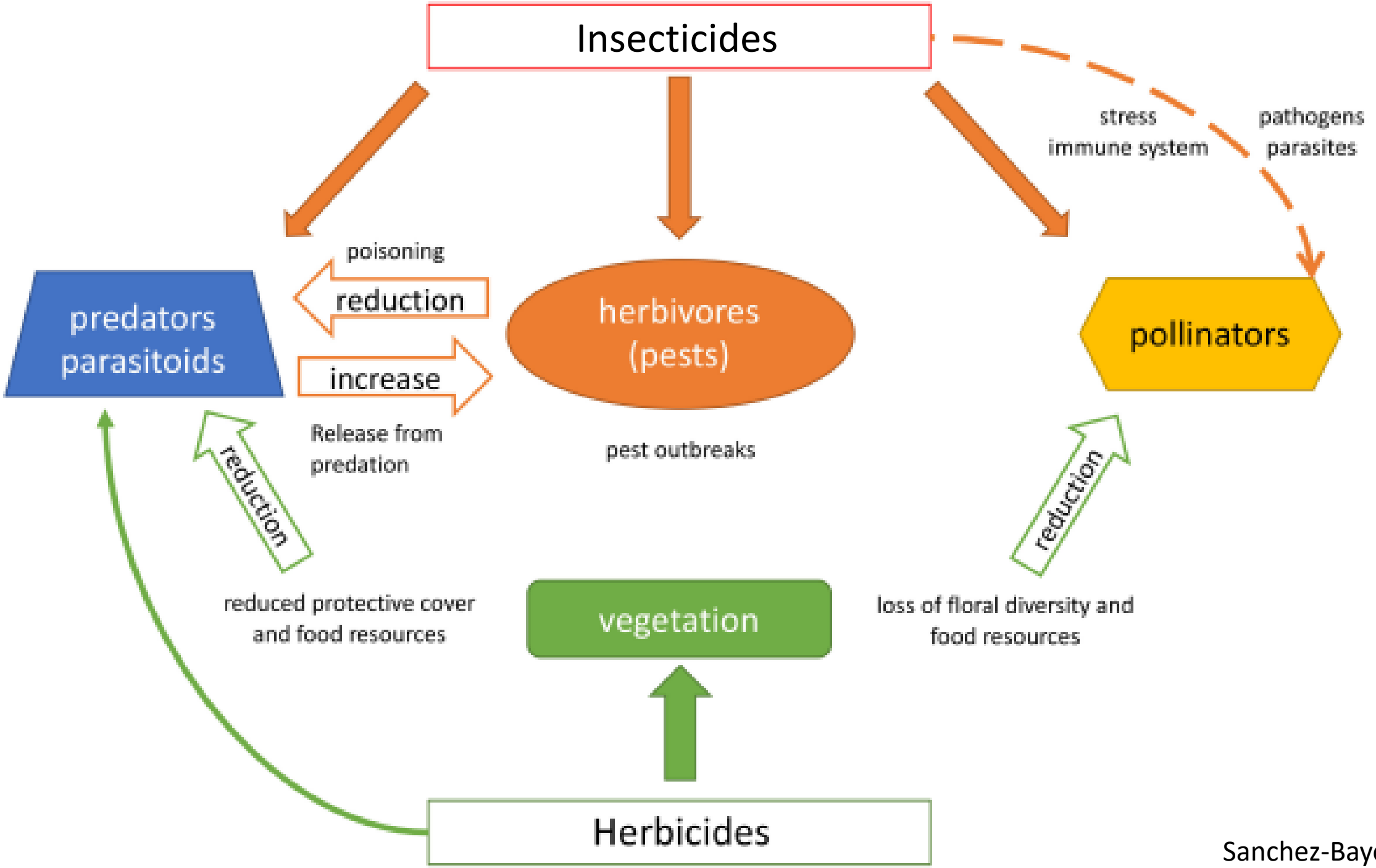
Targeted insecticide use to preserve beneficial insects

Erik Wenninger
Kimberly Research & Extension Center



Sanchez-Bayo 2021



Sanchez-Bayo 2021

Types of Beneficials

Predators

Parasitoids

Pollinators

Types of Natural Enemies

- **Predators** – consume other animals
  - insects and spiders

- **Parasitoids** – develop on or in their host, eventually killing it
  - wasps, some flies

- **Pathogens** – disease-causing microorganisms

True bugs

Lacewings

Lady beetles

Ground beetles

Parasitoid wasps

Hover flies

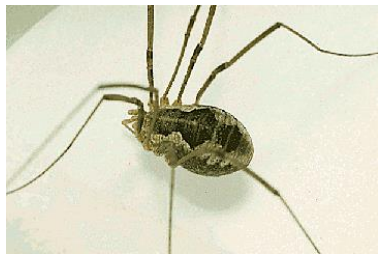
Spiders

Rove beetles

Predatory wasps

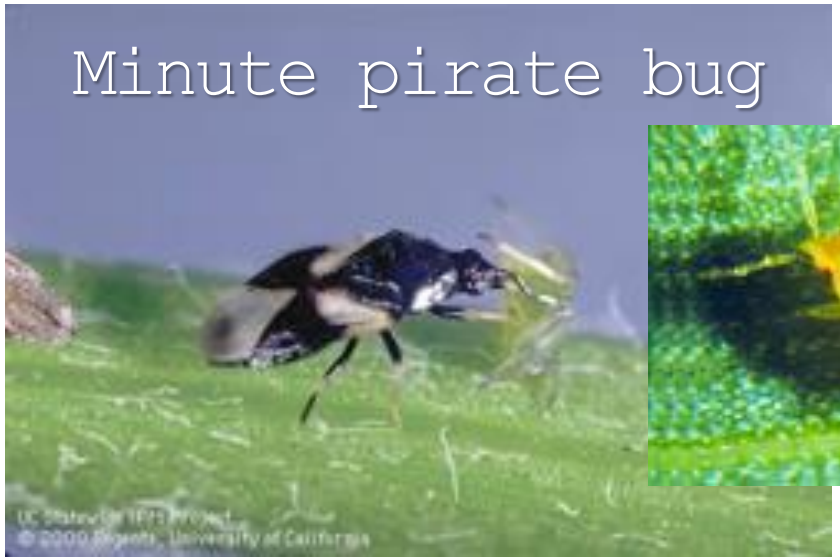
Six-spotted thrips

Mites



Harvestman

Predatory True Bugs



% mortality of minute pirate bugs after residual exposure (7 days after app.)

acephate (Orthene, others)	dimethoate	imidacloprid (Admire, others)	hexythiaxoz (Onager)
100	100	100	10.2

Angeli et al. 2005

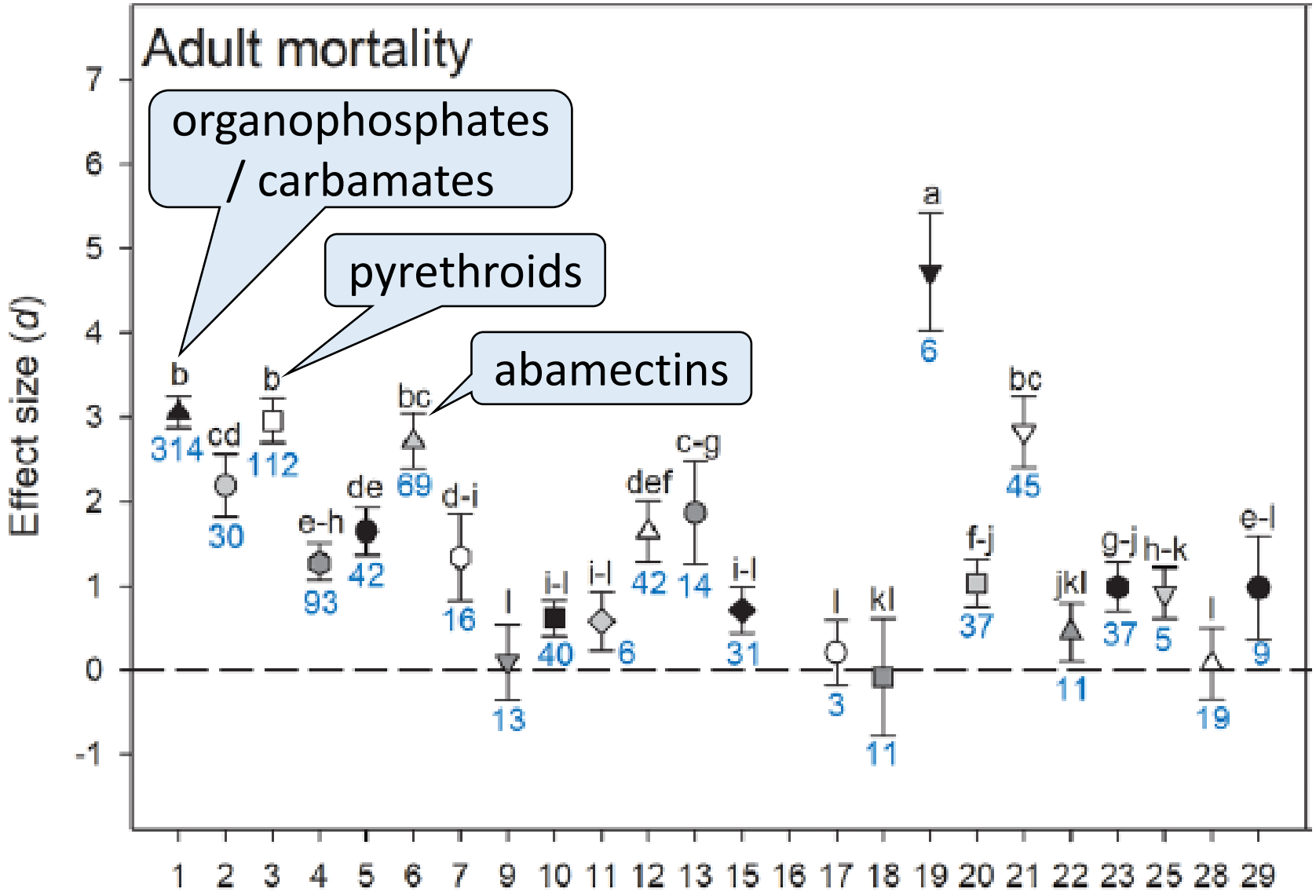




		Curinus coeruleus	*Cycloneda sanguinea*	*Harmonia axyridis*	*Olla v-nigrum*	*Chrysoperla rufilabris*
		% mortality				
bifenthrin (Mustang, Hero)	full rate	100	100	100	100	100
	1/10	100	100	100	100	7
	1/100	100	100	100	53	0
zeta-cypermethrin (Hero)	full rate	100	100	100	100	100
	1/10	100	100	100	100	21
	1/100	100	100	100	18	11

Michaud and Grant 2003

Most insecticide groups kill predatory mites



Above the line = kills predatory mites

Schmidt-Jeffris et al. 2021

aphids	thrips	mites	common	trade	MOA
		x	abamectin	Agri-Mek SC	6
x	x		acephate	Orthene; many others	1B
x			Beauveria bassiana	Mycotrol ESO	-
x	x	x	borate complex	Prev-Am	8D
x	x		chlorantraniliprole/lambda-cyhalothrin	Voliam Xpress	28/3A
x		x	dimethoate	(various)	1B
x			esfenvalerate	Asana	3A
x			flupyradifurone	Sivanto	4D
x			gamma-cyhalothrin	Proaxis	3A
		x	hexythiozox	Onager Optek	10A
x			imidacloprid	Admire	4A
x			imidacloprid	Provado, Prey	4A
x		x	insecticidal soap	M-Pede	-
x	x		lambda-cyhalothrin	Warrior II	3A
x	x		malathion	(various)	1B
x	x		methomyl	Lannate	1A
x		x	naled	Dibrom	1B
x	x	x	phorate	Thimet	1B
		x	propargite	Comite	12C
	x		spinetoram	Radiant SC	5
	x		spinosad	Success	5
x	x		spirotetremat	Movento HL	23
x			sulfoxaflor	Transform WG	4C
		x	sulfur	(various)	-
x			zeta-cypermethrin	Mustang; Mustang Max	3A
x		x	zeta-cypermethrin/bifenthrin	Hero	3A

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x	x		chlorantraniliprole/lambda-cyhalothrin	Voliam Xpress	28/3A
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x		x	naled	Dibrom	1B
x	x	x	phorate	Thimet	1B
		x	propargite	Comite	12C
	x		spinetoram	Radiant SC	5
	x		spinosad	Success	5
x	x		spirotetremat	Movento HL	23
x			sulfoxaflor	Transform WG	4C
		x	sulfur	(various)	-
x			**zeta-cypermethrin**	**Mustang; Mustang Max**	3A
x		x	**zeta-cypermethrin/bifenthrin**	**Hero**	3A

red = very harsh on beneficials

The problem with pyrethroids

- Repellant to predatory mites
- Flare spider mites:
  - Repellant
    - disperse and become more uniform
    - reduced competition increases populations
  - Shortened development time
  - Female-biased sex ratio

How to not kill natural enemies

- spray only when justified by scouting
- limit use of group 1 / 3 insecticides
- avoid spraying during bloom
- use cultural and biological control

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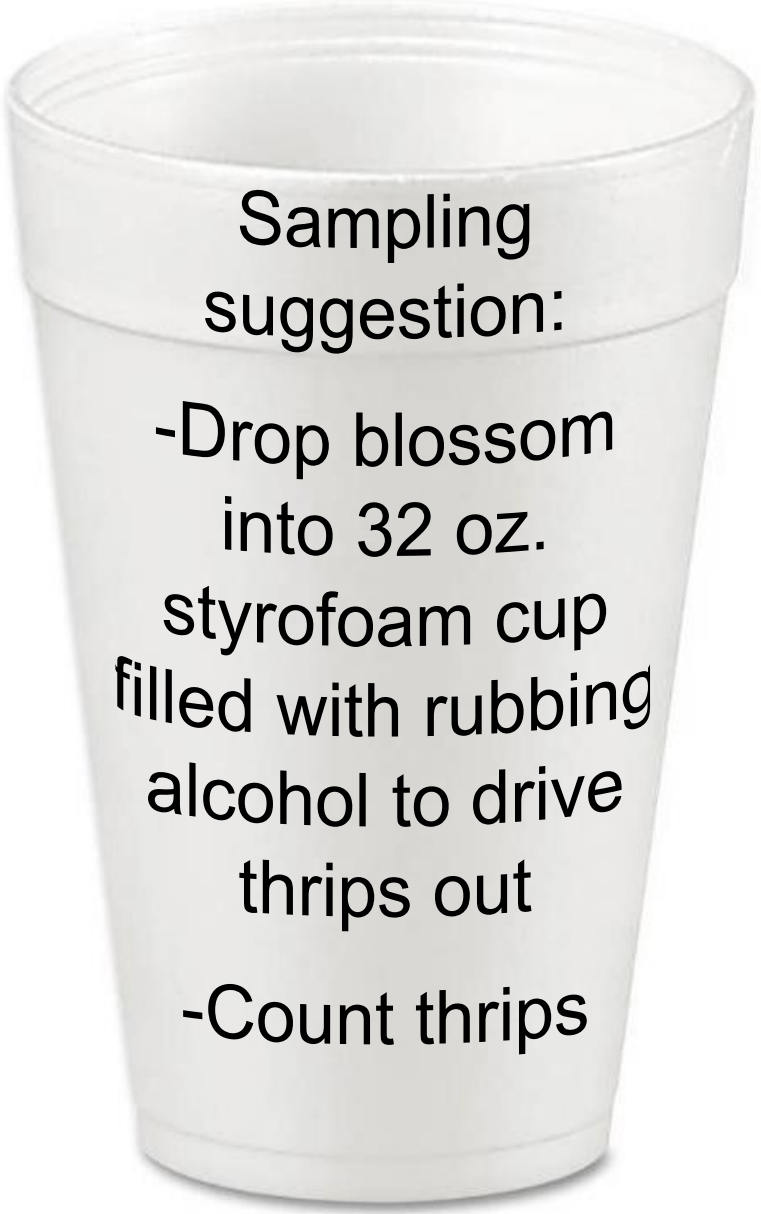
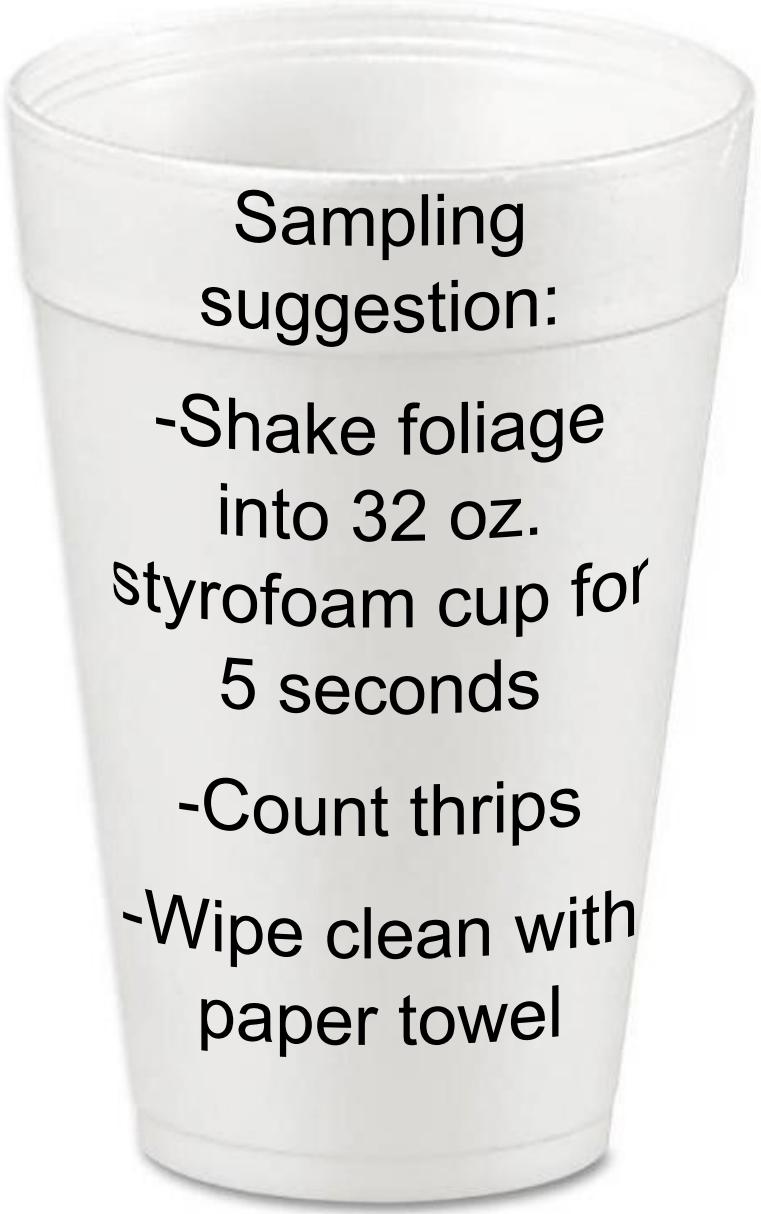
Western Flower Thrips
Scouting / Thresholds

- Field edges; next to pasture, small grain, alfalfa, weeds
- *May feed on spider mite eggs early season*
- Congregate later in the season on bean flowers
- Five flower thrips per blossom can reduce the number of pods per plant



Onion Thrips
Scouting / Thresholds

- Field edges, next to pasture, small grain, alfalfa, weeds
- Most common in surface-irrigated fields near winter wheat
- Feed on leaves
- Consider treatment if leaf cupping is observed and more than 15 onion thrips per plant



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common	trade	MOA
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spirotetremat	Movento HL	23
sulfoxaflor	Transform WG	4C
sulfur	(various)	-
zeta-cypermethrin	Mustang; Mustang Max	3A
zeta-cypermethrin/bifenthrin	Hero	3A

1A = carbamates

1B = organophosphates

3A = pyrethroids

RESTRICTED USE PESTICIDE
Toxic to fish and aquatic organisms
For retail sale to and use only by certified applicators, or persons under their direct supervision and only for those uses covered by the certified applicator's certification.

ZETA-CYPERMETHRIN GROUP 3A INSECTICIDE

MUSTANG®

INSECTICIDE

EPA Reg. No. 279-3126 EPA Est. 279-NY-1

Active Ingredient:	By Wt.
Zeta-Cypermethrin* S-Cyano (3-phenoxy-Phenyl)methyl (±) cis/trans 3-(2,2-dichloro-Ethenyl)-2,2 dimethylcyclopropane carboxylate	17.1%
Other Ingredients	82.9%
	100.0%

Contains 1.5 pounds active ingredient per gallon.
*Cis/trans ratio: Max. 55% (±) cis and min. 45% (±) trans

KEEP OUT OF REACH OF CHILDREN
WARNING
AVISO

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.)

FIRST AID

If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferably by mouth-to-mouth if possible. Call a poison control center or doctor for further treatment advice. Have person sip a glass of water if able to swallow. Do not induce vomiting unless told to do so by a poison control center or doctor. Do not give anything by mouth to an unconscious person. If on skin or clothing, take off clothing and rinse skin immediately with plenty of water for 15 to 20 minutes. Call a poison control center or doctor for treatment advice. If in eyes, rinse slowly and gently with water for 15 to 20 minutes. Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. Call a poison control center or doctor for treatment advice.

HOTLINE NUMBER

Have the product container or label with you when calling a poison control center or doctor, or going for treatment. You may also contact 1-800-331-3148 for emergency medical treatment information.

Note to Physician: Vomiting should be supervised by a physician or the professional staff because of the possible pulmonary damages by aspiration of the solvent.

For Emergency Assistance Call (800) 331-3148.

See other panels for additional precautionary information.

PRECAUTIONARY STATEMENTS
Hazards to Humans (and Domestic Animals)

WARNING
May be fatal if swallowed. Harmful if inhaled or absorbed through the skin. Causes moderate eye irritation. Avoid breathing vapors or spray mist. Avoid contact with skin, eyes or clothing. Wash hands thoroughly with soap and water after handling and before eating, drinking, chewing gum, using tobacco, or using the toilet. The active ingredient may cause sensitization reaction in some individuals.

Personal Protective Equipment:

Handlers who may be exposed to the dilute through application or other tasks must wear: Long-sleeved shirt and long pants, Chemical-resistant gloves, made of Barrier Laminate or Viton, and Shoes plus socks.

Handlers who may be exposed to the concentrate through mixing, loading, application or other tasks must wear: Long-sleeved shirt and long pants, Chemical-resistant gloves, made of Barrier Laminate or Viton, Shoes plus socks, and Protective eyewear.

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

DIMETHOATE 400

GROUP 1B INSECTICIDE

Organophosphate Insecticide
SYSTEMIC INSECTICIDE-MITICIDE

ACTIVE INGREDIENT:	
Dimethoate (O,O-dimethyl-S-[(methylcarbamoyl) methyl] phosphorodithioate)	43.5%
OTHER INGREDIENTS:*	56.5%
	100.0%

*This product contains petroleum distillates.
(1.0 gallon contains 4.0 pounds of dimethoate)

KEEP OUT OF REACH OF CHILDREN
WARNING—AVISO

entiende la etiqueta, busque a alguien para que se la explique a usted en detalle. (If you do not understand this label, to explain it to you in detail.)

dditional Precautionary Statements

DO NOT STORE BELOW 45 °F.

FIRST AID

son control center or doctor immediately for treatment advice.
any liquid to the person.
vomiting unless told to do so by the poison control center or doctor.
thing by mouth to an unconscious person.
d rinse slowly and gently with water for 15 to 20 minutes.
ses, if present, after the first 5 minutes, then continue rinsing eye.
center or doctor for treatment advice.
clothing.
with plenty of water for 15 to 20 minutes.
or doctor for treatment advice.

911 or an ambulance, then give artificial respiration, preferably by mouth-to-mouth,

or for further treatment advice.

g a poison control center or doctor, or going for treatment.
miting may cause aspiration pneumonia. Contains an organophosphate that
ms of cholinesterase inhibition are present. Pralidoxime chloride (2-PAM)
ine. Use according to label directions.
LL: 1-866-944-8565.

34704-207

How to not kill natural enemies

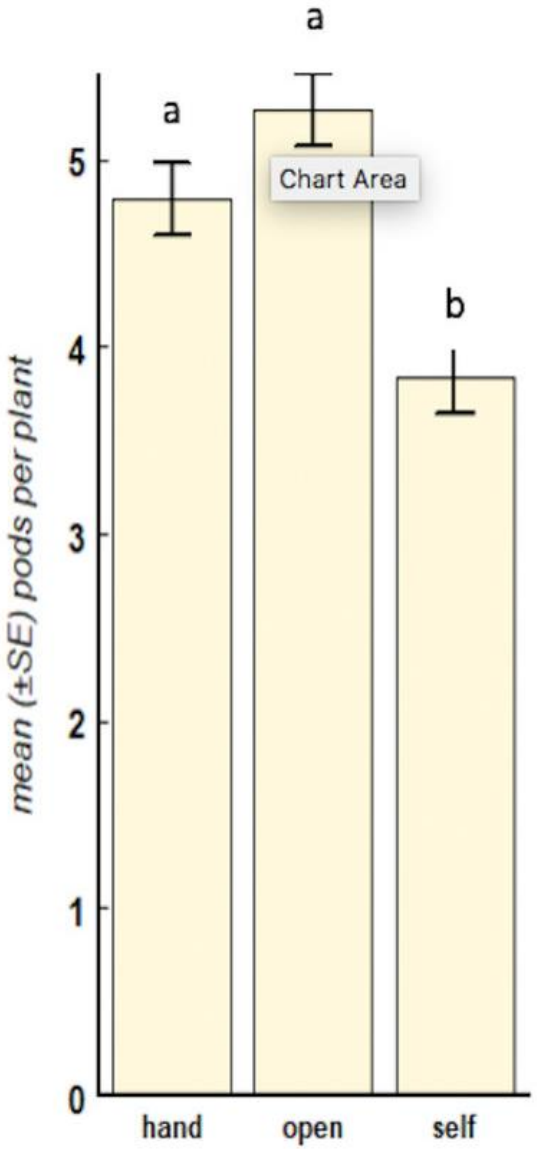
- spray only when justified by scouting
- limit use of group 1 / 3 insecticides
- **avoid spraying during bloom**
- use cultural and biological control

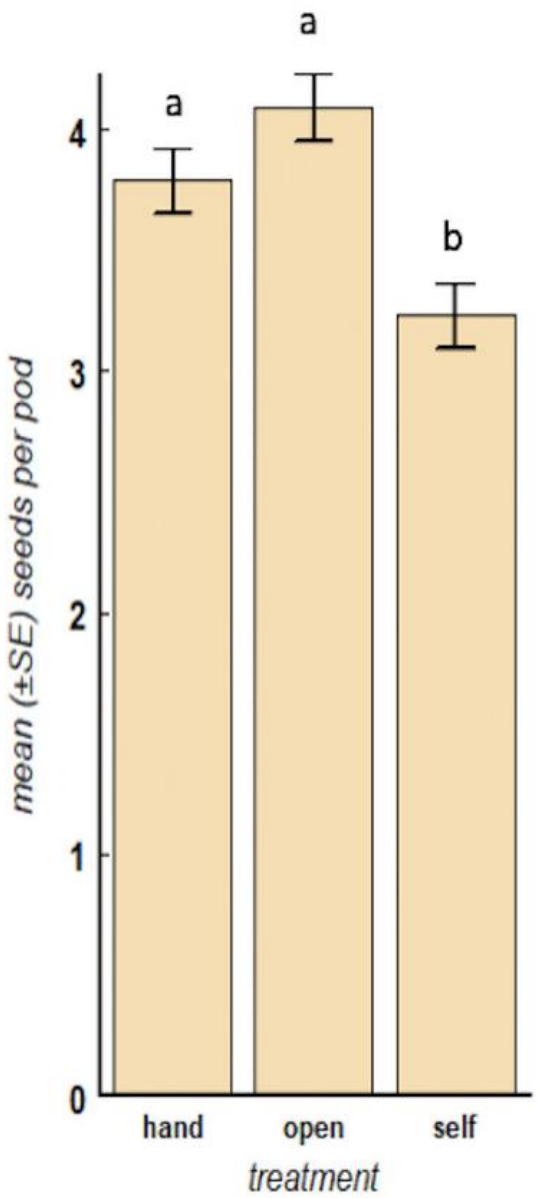
Avoid spraying during bloom

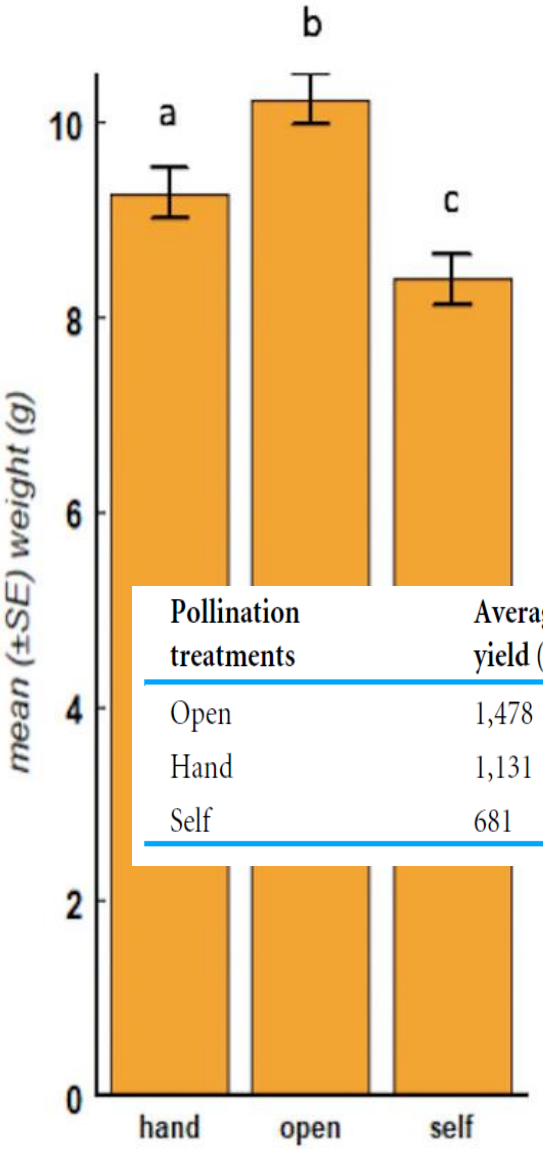
- Many predators, parasitoids, (and bees!) feed on nectar and pollen




Bean flowers are self fertile, but...







Pollination treatments	Average bean yield (Kg Ha^{-1})	% Increase in bean yield	Average Income Ha^{-1} (USD)
Open	1,478	117	1,020
Hand	1,131	66	780
Self	681	–	470

Elisante et al. 2021

THE NEW EPA BEE ADVISORY BOX

On EPA's new and strengthened pesticide label to protect pollinators

PROTECTION OF POLLINATORS

APPLICATION RESTRICTIONS EXIST FOR THIS PRODUCT BECAUSE OF RISK TO BEES AND OTHER INSECT POLLINATORS. FOLLOW APPLICATION RESTRICTIONS FOUND IN THE DIRECTIONS FOR USE TO PROTECT POLLINATORS.

Look for the bee hazard icon in the Directions for Use for each application site for specific use restrictions and instructions to protect bees and other insect pollinators.

This product can kill bees and other insect pollinators.

Bees and other insect pollinators will forage on plants when they flower, shed pollen, or produce nectar.

Bees and other insect pollinators can be exposed to this pesticide from:

- Direct contact during foliar applications, or contact with residues on plant surfaces after foliar applications
- Ingestion of residues in nectar and pollen when the pesticide is applied as a seed treatment, soil, tree injection, as well as foliar applications.

When Using This Product Take Steps To:

- Minimize exposure of this product to bees and other insect pollinators when they are foraging on pollinator attractive plants around the application site.
- Minimize drift of this product on to beehives or to off-site pollinator attractive habitat. Drift of this product onto beehives can result in bee kills.

Information on protecting bees and other insect pollinators may be found at the Pesticide Environmental Stewardship website at:
http://pesticidestewardship.org/pollinatorprotection/Pages/default.aspx

Pesticide incidents (for example, bee kills) should immediately be reported to the state/tribal lead agency. For contact information for your state/tribe, go to: www.aapco.org. Pesticide incidents can also be reported to the National Pesticide Information Center at: www.npic.orst.edu or directly to EPA at: beekill@epa.gov

Alerts users to separate restrictions on the label. These prohibit certain pesticide use when bees are present.

The new bee icon helps signal the pesticide's potential hazard to bees.

Makes clear that pesticide products can kill bees and pollinators.

Bees are often present and foraging when plants and trees flower. EPA's new label makes it clear that pesticides cannot be applied until all petals have fallen.

Warns users that direct contact and ingestion could harm pollinators. EPA is working with beekeepers, growers, pesticide companies, and others to advance pesticide management practices.

Highlights the importance of avoiding drift. Sometimes, wind can cause pesticides to drift to new areas and can cause bee kills.

The science says that there are many causes for a decline in pollinator health, including pesticide exposure. EPA's new label will help protect pollinators.

EPA

Read EPA's new and strengthened label requirements: http://go.usa.gov/jHH4

Protecting pollinators

- OSU Ext. Bull. 591

- UC online tool

MENU FAQ UC IPM

UC IPM / Bee precaution pesticide ratings

○ Common name
◉ Trade name → Insecticide → All Insecticides Add to list

Common name (Example trade name)	Type	Mode of action	Rating	Other effects on bees	Toxic to honey bee brood	Toxic to other bee species
ABAMECTIN/CYANTRANILIPROLE (Minecto Pro)	Acaricide; Insecticide	6/28; 6/28	I	—	✔	✔
ACETAMIPRID (Assail)	Insecticide	4A	II	FRAC3	—	✔
AZADIRACHTIN (Neemix)	Acaricide; Insecticide	UN; UN	II	—	—	—
BIFENTHRIN (Brigade)	Acaricide; Insecticide	3A; 3A	I	FRAC3 FRACM05	—	✔
CHLORANTRANILIPROLE (Altacor, Coragen)	Insecticide	28	III	FRAC2 FRAC3	✔	—
CHLORPYRIFOS (Lorsban)	Acaricide; Insecticide	1B; 1B	I	FRAC3 FRAC7 FRAC11	—	✔
CLOTHIANIDIN	Insecticide	4A	I	FRAC3	—	✔

How to not kill natural enemies

- spray only when justified by scouting
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- **use cultural and biological control**

Cultural control

changing how the crop is grown to make it less suitable for the pest

- Keep fields, margins, waste areas free of weed hosts

black nightshade, dandelion, common lambsquarters, pigweeds, prickly lettuce, sowthistles

Cultural control

changing how the crop is grown to make it less suitable for the pest

- Maintain optimal irrigation and fertilization
  - draught-stressed plants more susceptible
  - excess N can flare mites and some insects
- Mites especially often reduced by sprinkler irrigation

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Conservation Biological Control

- Alternative food sources: flowering plants adjacent to crop
- Stable habitat: perennials, hedge rows, cover crops, reduced tillage, beetle banks
  - Moderated microclimate, in-season shelter, overwintering sites

→ NRCS Conservation Buffers

Fiedler et al. 2007