PROTECTING AND ENHANCING CRANBERRY POLLINATORS

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Pollinator Health Extension
Cranberry School
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Oregon State University
Extension Service

LESSON OBJECTIVES:

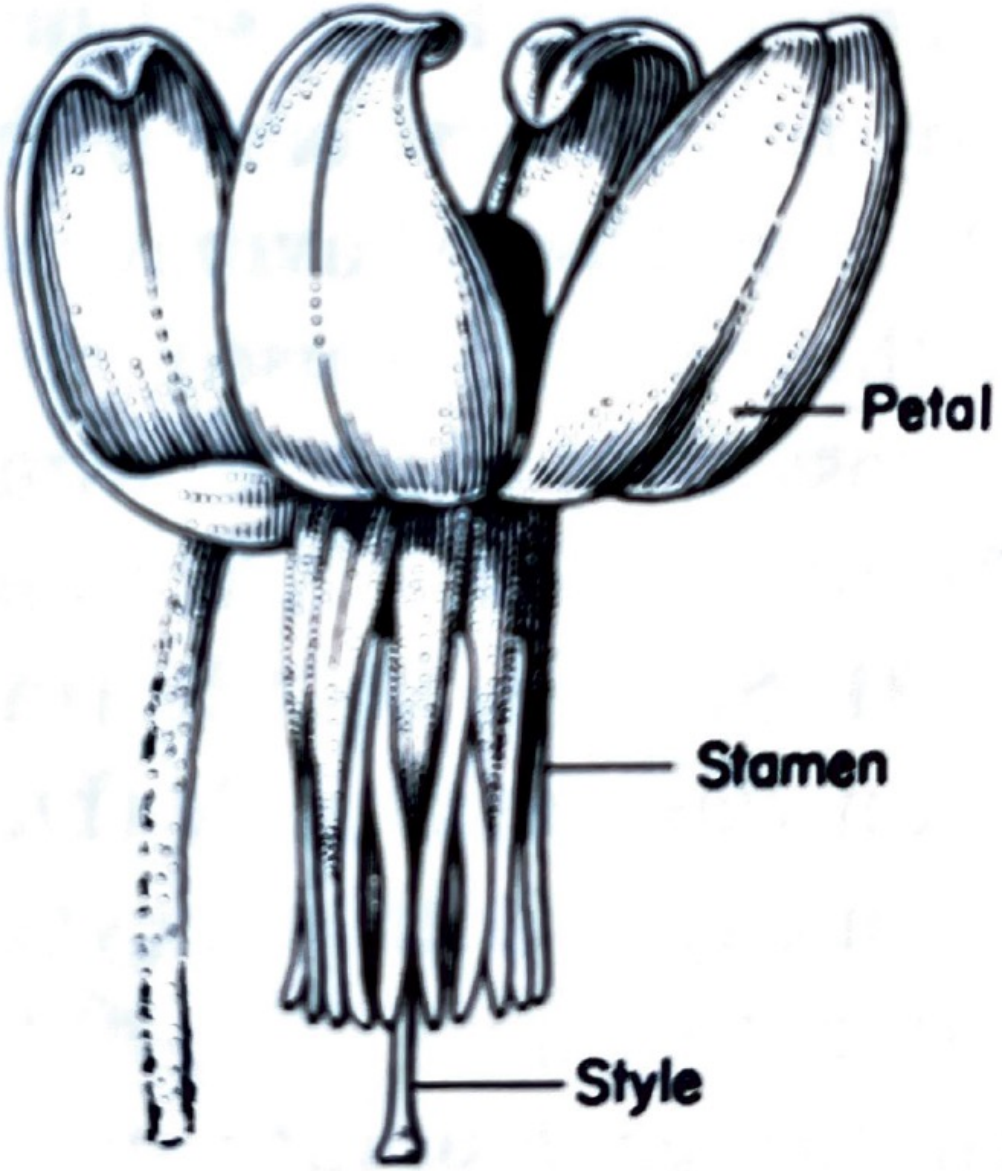
1. Understand key features of cranberry pollination biology.

2. Encouraging bumble bees.

3. Colony placement, pollination and pesticide exposure.

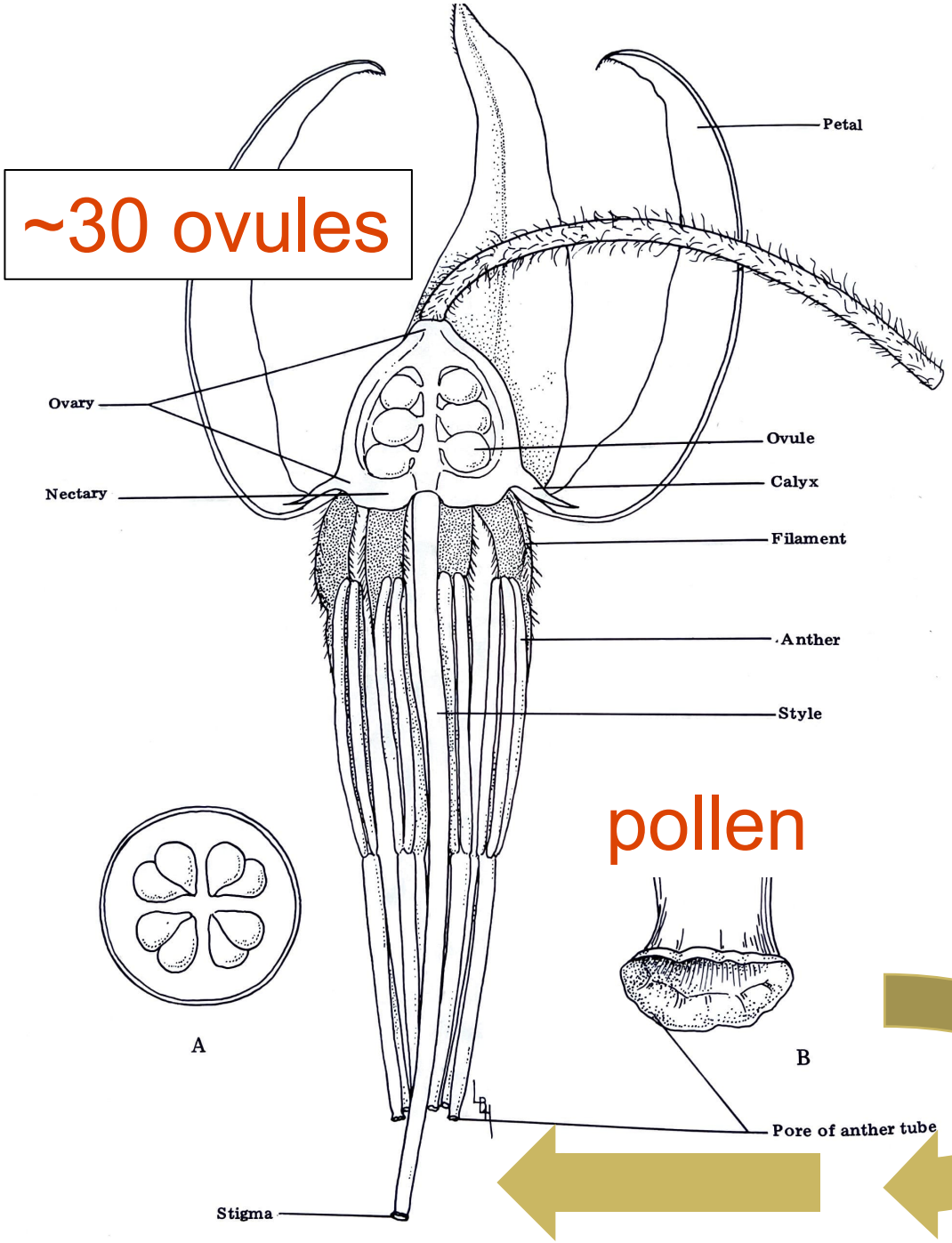
4. Update on residual toxicity and risk assessment that goes into new labels.

POLLINATION 101



- Pollen shed when stigma is dry and hidden.
- Stigma receptive 2 days after pollen shed.
- Heavy pollen – no wind pollination.
- Typically, only 50% blossoms set.

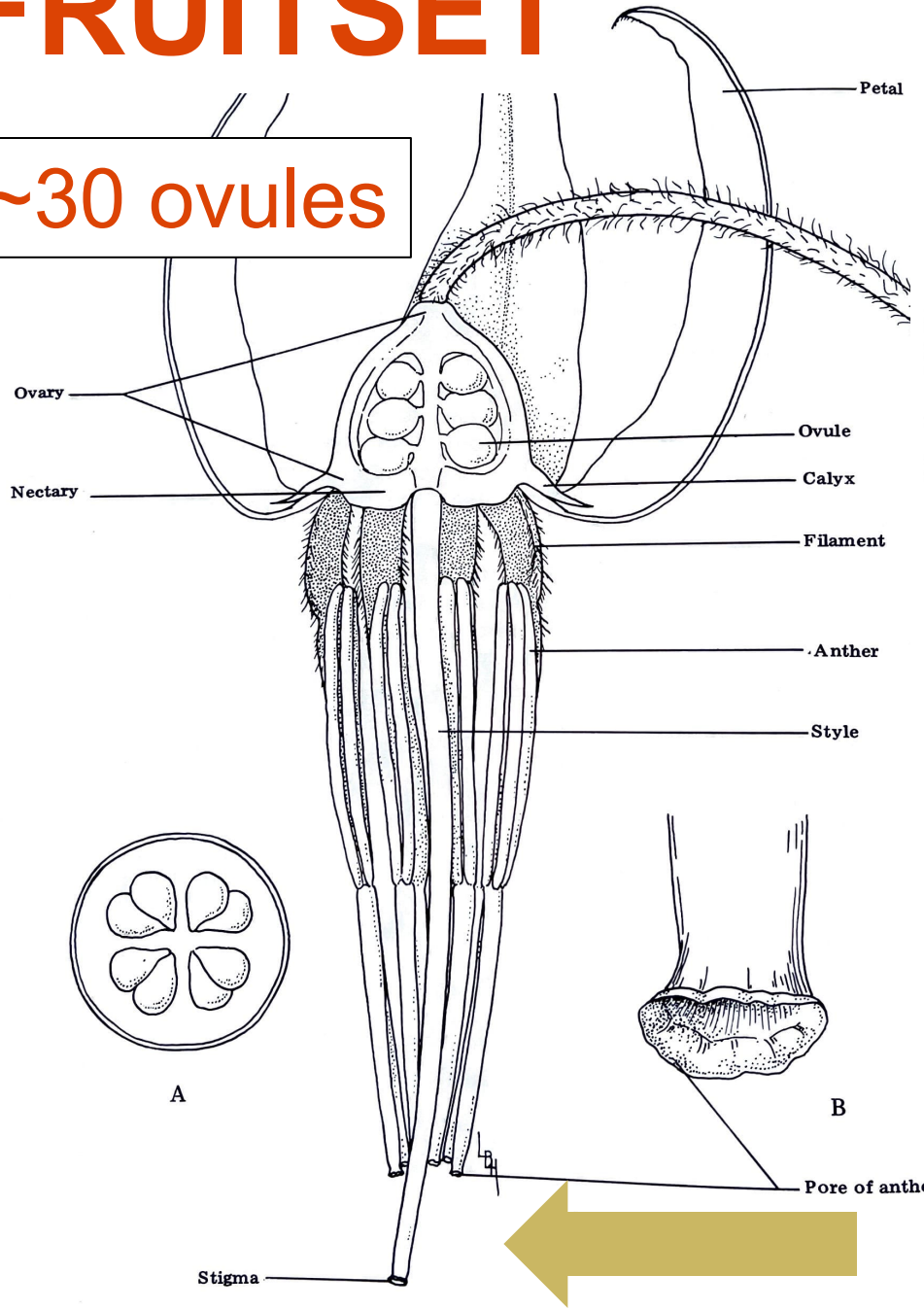
~30 ovules

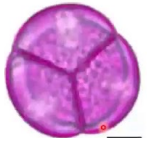


pollen

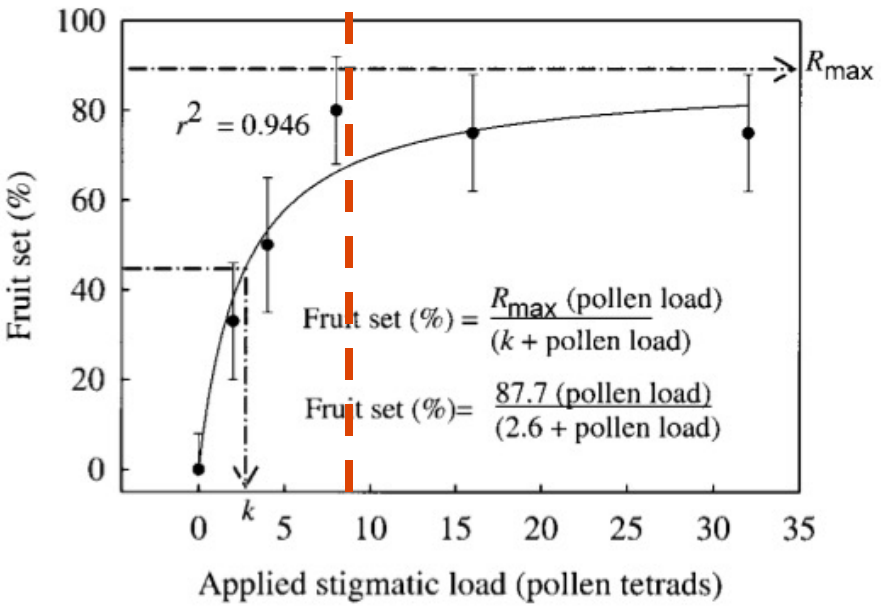
FRUITSET

~30 ovules





8 tetrads

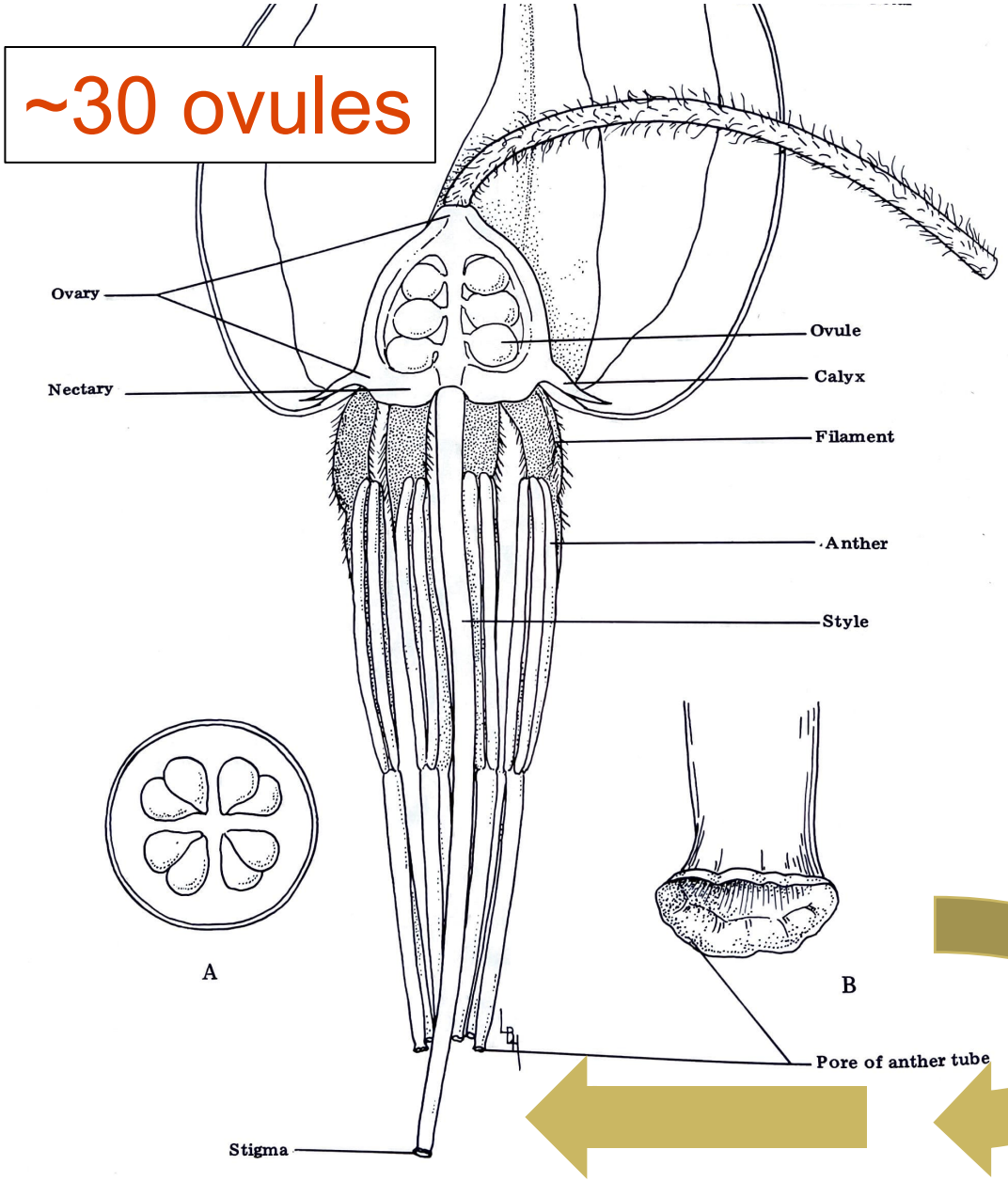


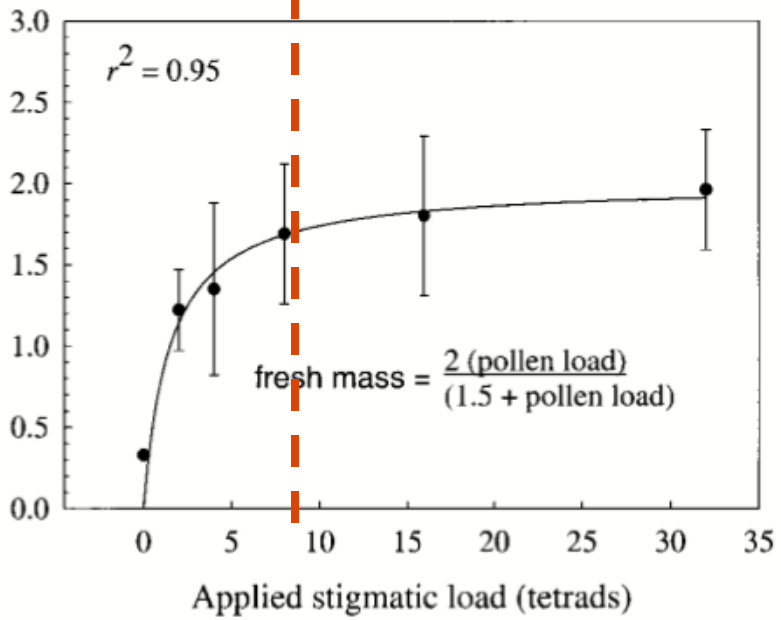
Cane and Schiffhauer 2003

FRUIT WEIGHT

8 tetrads

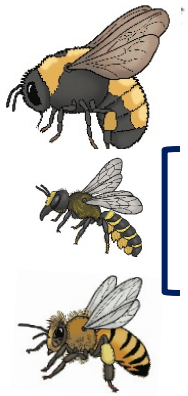
~30 ovules

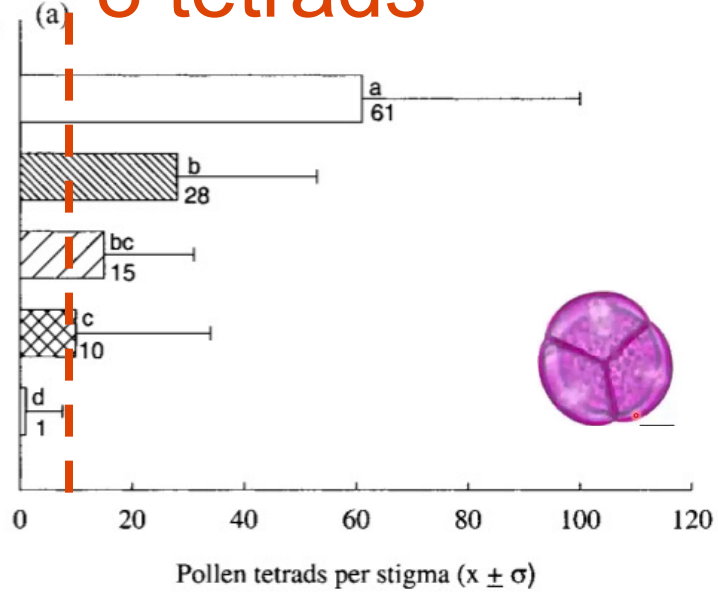


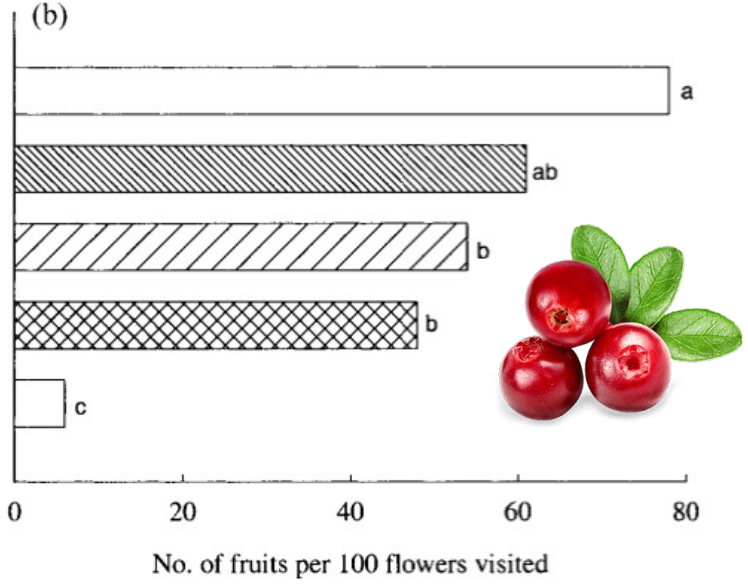


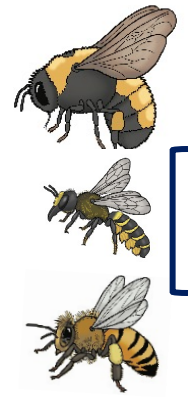
Cane and Schiffhauer 2003

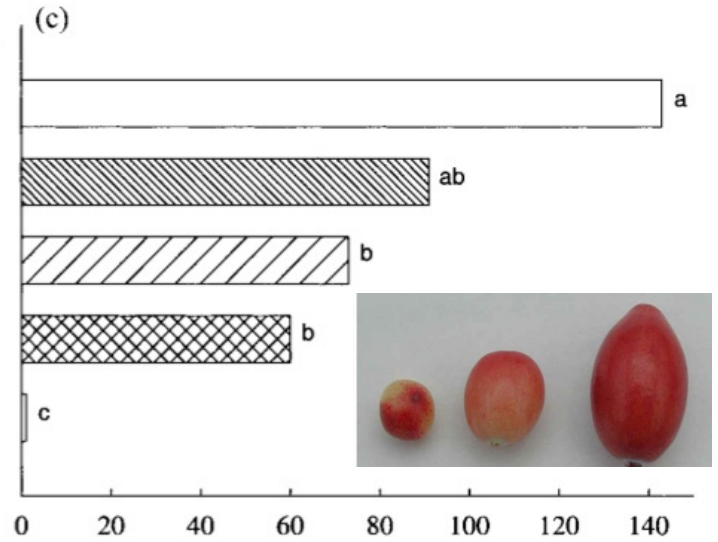
8 tetrads

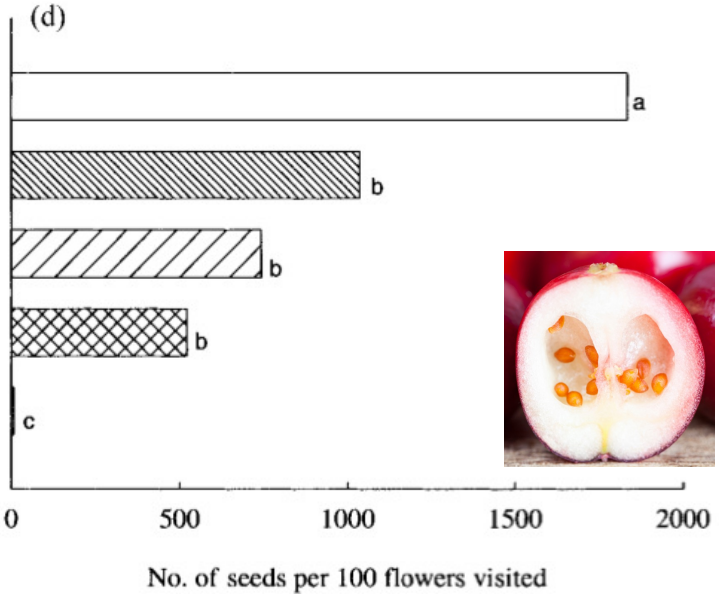




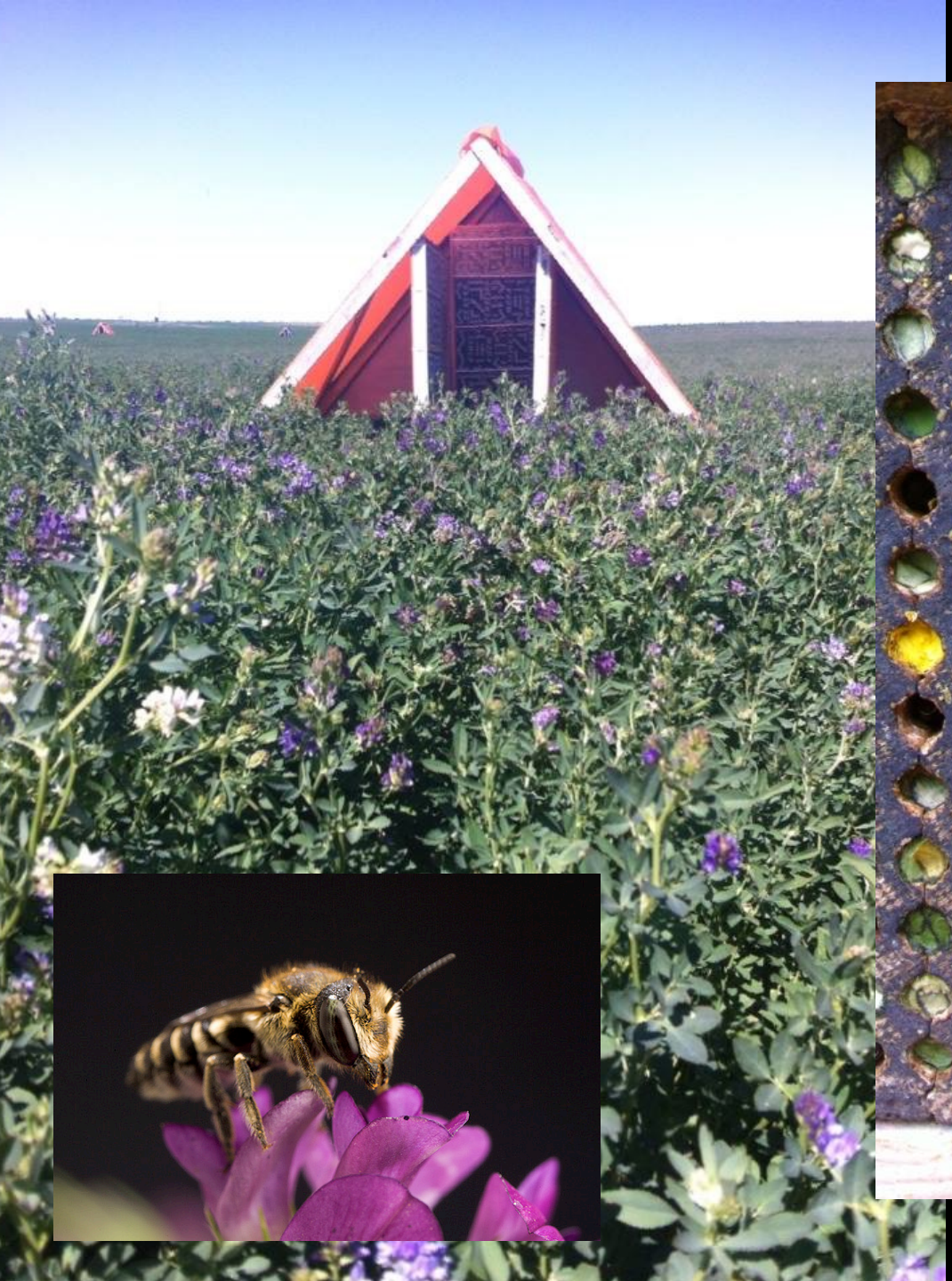


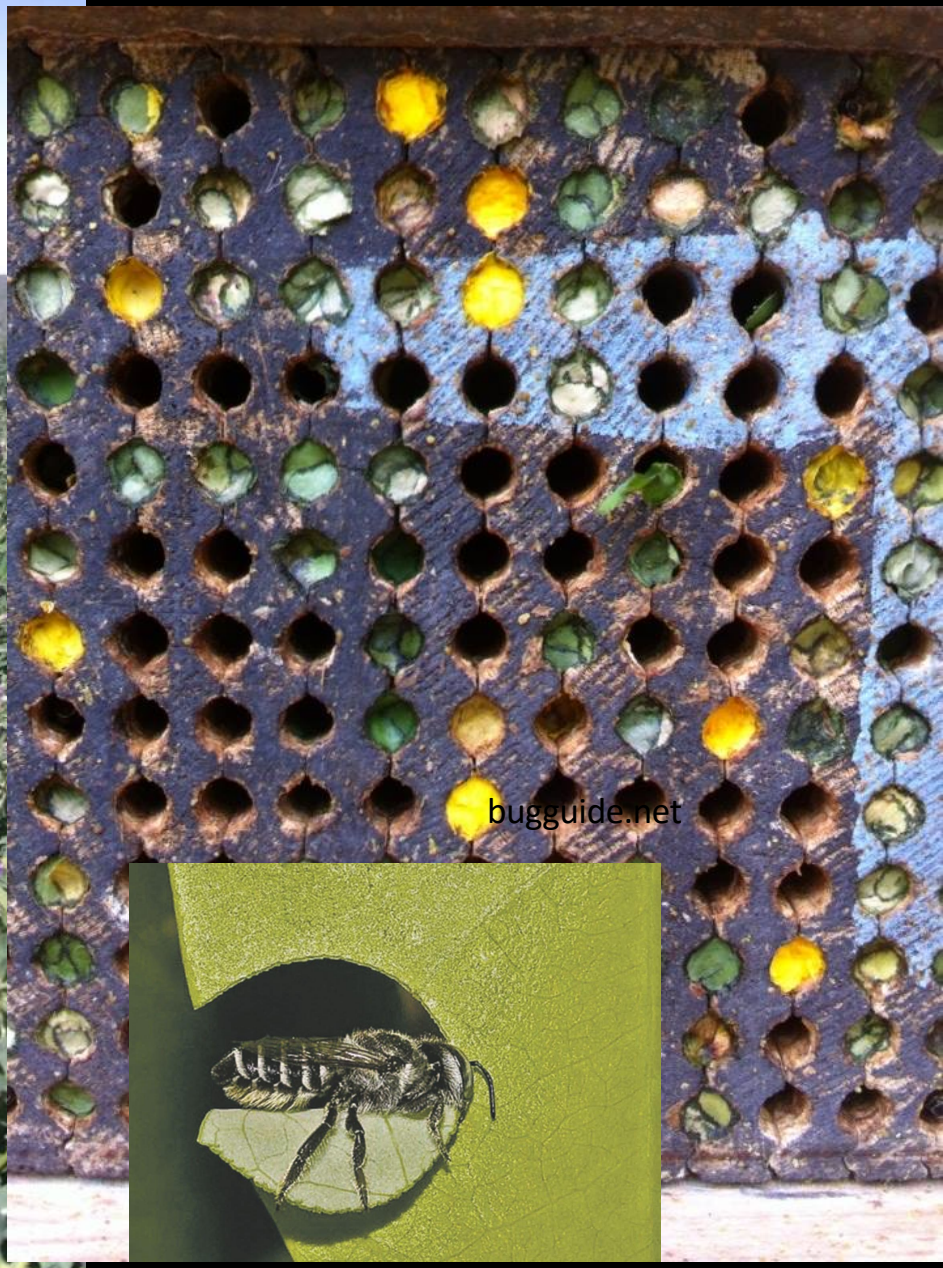






Cane and Schiffhauer 2003

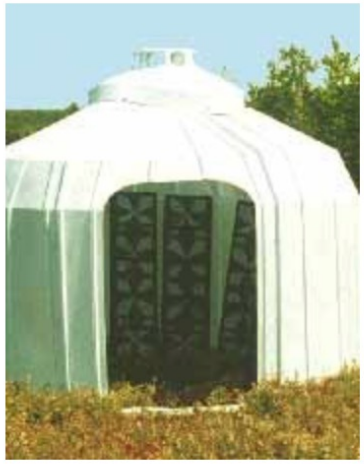



bugguide.net

Alfalfa Leafcutter Bees for the Pollination of Wild Blueberries

INTRODUCTION

The development of alfalfa leafcutter bee management arose from the need for better pollination of the alfalfa seed crop in North America. Poor pollination and inconsistent cropping was a result of insufficient numbers of native bees, and honey bees are not an efficient option because they do not adequately pollinate alfalfa. In the 1960's when commercial scale populations of alfalfa leafcutter bees (ALBs) became available, alfalfa seed production improved dramatically. Currently, Canada produces 4 billion ALB's per year which are used to service domestic and international alfalfa seed crops as well as an increasing array of other crops.



The alfalfa leafcutter bee, one of the few commercially managed pollinators other than the honeybee, has been investigated as a pollinator of the Atlantic region wild blueberry crop since the early 1990's. They were tried in the region in order to help meet the high demand which the burgeoning wild blueberry industry has placed on beekeeping services in the Atlantic region. Attention focused on Albs because of their commercial availability, well established management guidelines, and desirable pollination attributes. Albs were used on over three hundred acres in New Brunswick in 1995, and this service is likely to undergo significant expansion in the Atlantic region in the next few years. Despite some requirements for fine-tuning the technology for use in Eastern Canada, adaptation of the Western Canadian technology for rearing and using Albs in wild blueberry fields is advancing smoothly.

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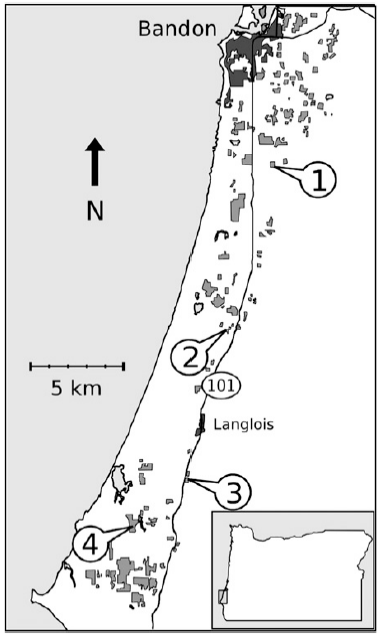


68%

Honey Bee

31%

Bombus vosnesenskii

Bombus mixtus

Bombus melanopygus

7 : 3 : 1

HortScience 46(6):885–888. 2011.

Native Bees, Honeybees, and Pollination in Oregon Cranberries

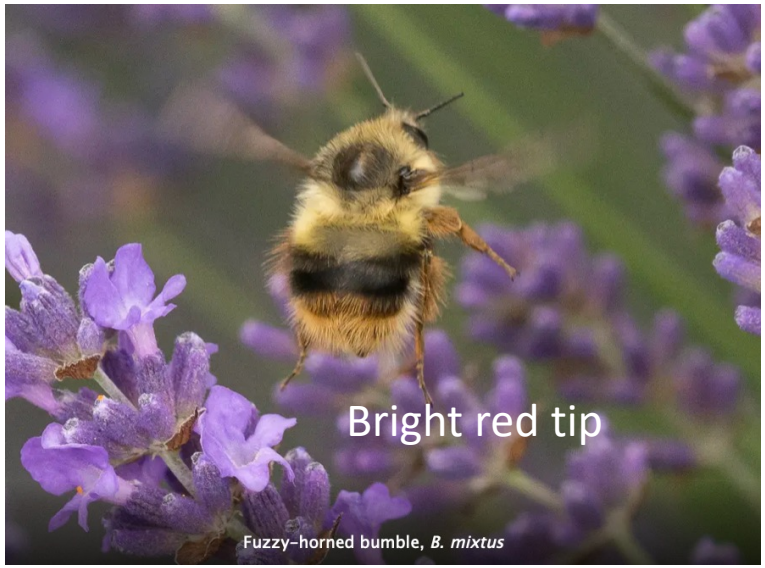
Melissa Broussard[1], Sujaya Rao, and William P. Stephen
Department of Crop and Soil Sciences, Oregon State University, 3017 ALS, Corvallis, OR 97331

Linda White
Department of Horticulture, Oregon State University Extension, 631 Alder Street, Myrtle Point, OR 97458

Bumble Bees During and After Pollination

on cranberry and ”bee plants”

Bumble bee species	Percentage of total bumble bees				
	3 June	1 July		10 Aug	15 Sept
	Cranberries	Cranberries	Bee plants	Bee plants	Bee plants
B. caliginosus	0	2	73	74	43
B. californicus	1	0	4	7	30
~~*B. occidentalis*~~	~~42~~	~~76~~	~~13~~	~~17~~	~~27~~
B. mixtus	30	14	5	2	0
B. sitkensis	24	4	5	0	0
B. melanopygus	3	4	0	0	0



Bumble Bee (Bombus spp.)

22 species in Oregon

worker

queen

Oregon Approved Invertebrate List

The following insects and other invertebrates are approved for use as pets, pet food, biological control agents, educational displays, and release in Oregon. Note that shipment of some plant pests and some biological control agents across state lines requires a U.S. Department of Agriculture permit (form 526). If you have questions about invertebrates not on this list, permits, releases, etc., check with the Oregon Department of Agriculture (Plant Programs), 635 Capitol Street N.E., Salem, OR 97301-2532, (503) 986-4636. You may view the Oregon Administrative Rules at https://secure.sos.state.or.us/oard/viewSingleRule.action?ruleVrsnRsn=158460

Bumblebees native to Oregon	e.g. *Bombus vosnesenskii, B bifarius, B. californicus, B. griseocolis, B. melanopygus, B. mixtus*	PL

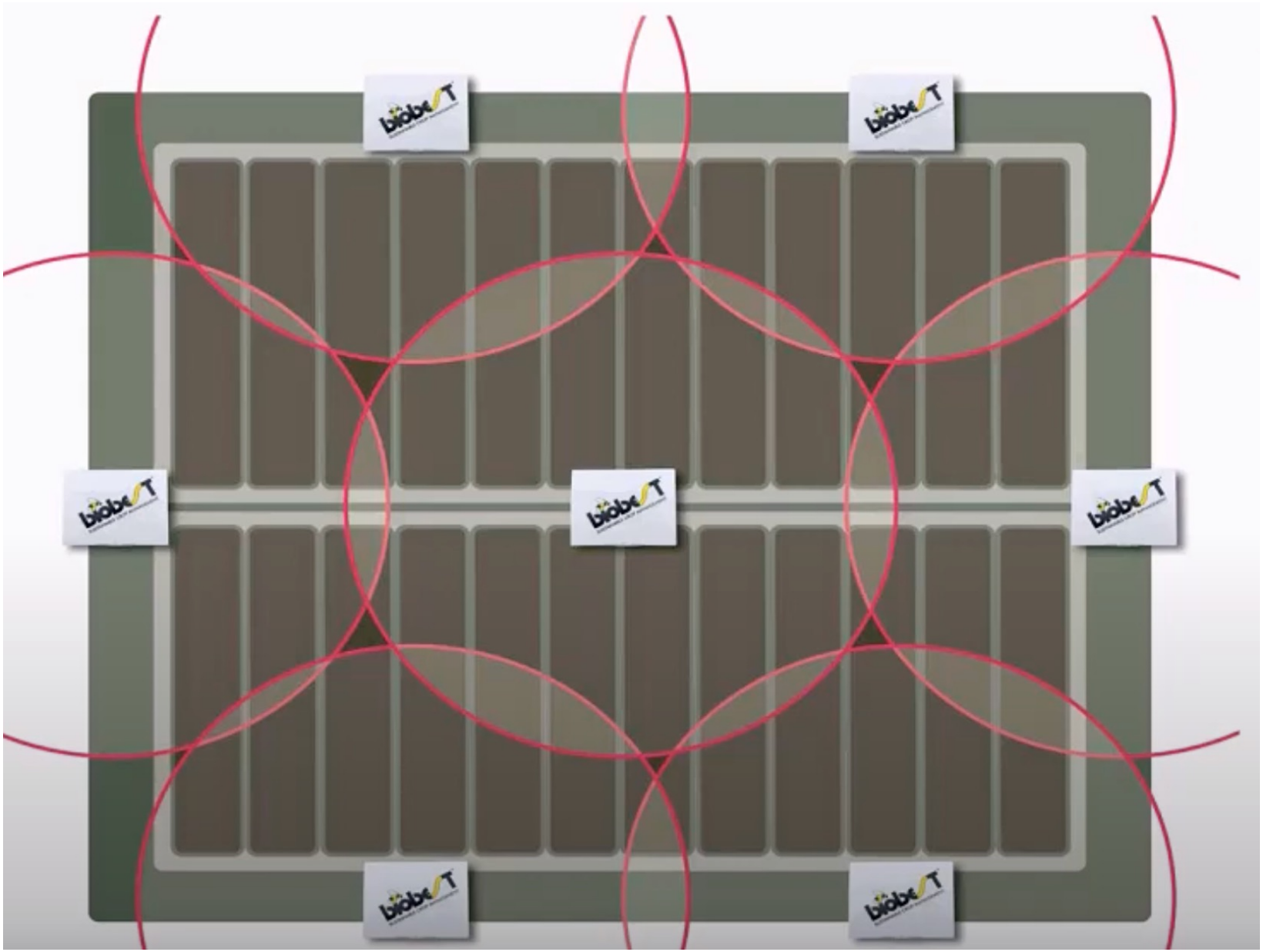

QUAD
QUAD
QUAD
QUAD
KOPPERT
BIOLOGICAL SYSTEMS
IN/OUT
10°C
50°F
≥ 80 F / 27 C

Considerations for bumble bees

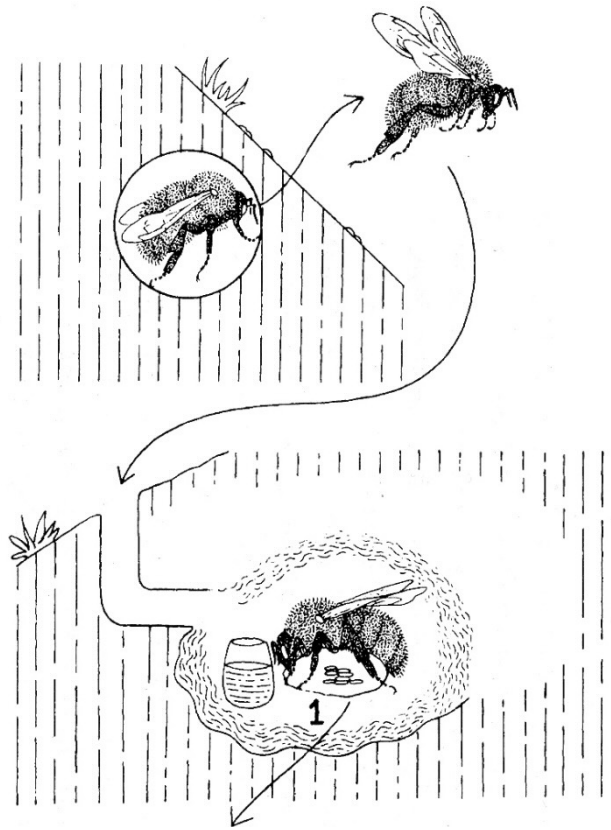
Ann Coleman (Koppert) – 734 231 4330

- Takes 10 weeks to make a unit – give them a heads up.
- Don't place in direct sunlight (overheating).
- Put on a pallet.
- Same stocking rate as honey bees (2-3 colonies per acre).
- Install at 5% bloom and pollinates for 4 weeks.

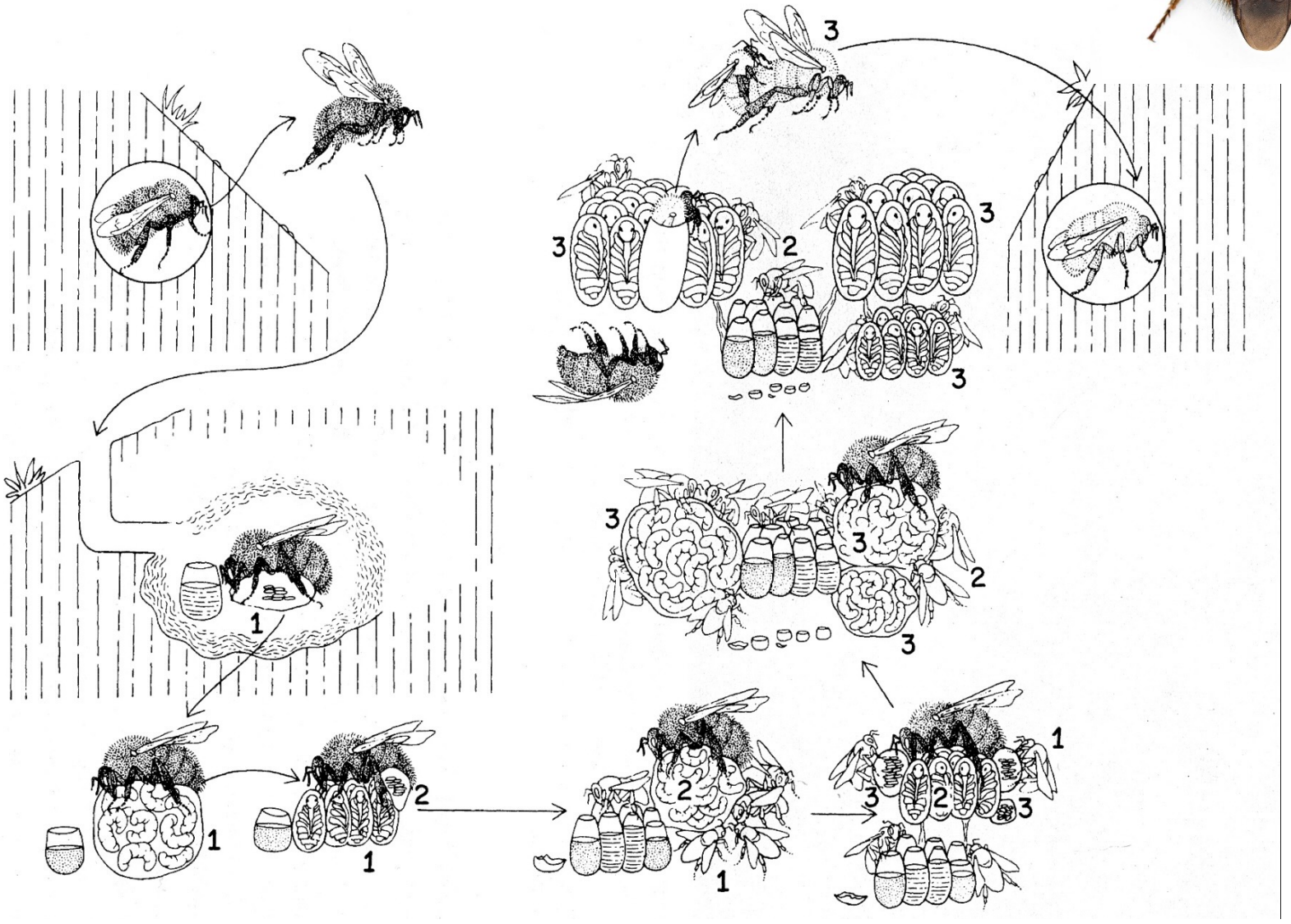
Bumble bees should be dispersed



Bumble Bee Lifecycle



Bumble Bee Lifecycle

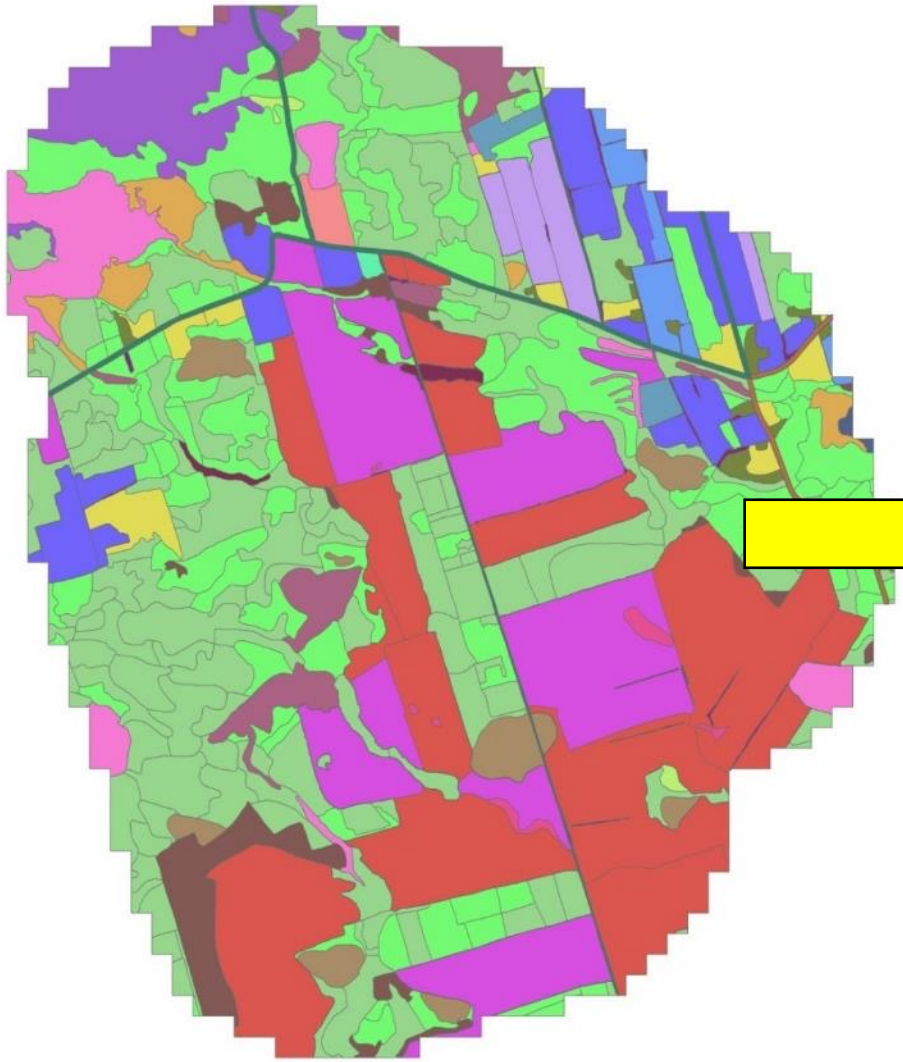


POLLINATOR'S PERSPECTIVE

No Resources
Very Low

Low
Moderate

High
Very High



Crop in Bloom

POLLINATOR'S PERSPECTIVE

April

August


Spring: *Erica carnea*, *E. x darleyensis*
Summer: *E. cinerea*
Dr. Kim Patten, Washington State University Long Beach

“Protect what you have. Add what you can."

- Mark Wonneck’s rule-of-thumb

Land taken out of production for foraging habitat (meadows)

Expand Buffer (Bog/Field)

Shelterbelt (Greenlane)

Forest Clearing (maintain early successional plant community)


Steve Javorek

Willows
Salix spp.

Oregon grape (*Mahonia aquifolium*)

Blooms March-April – evergreen shrub

Attracts many pollinating bees and essential for bumble bee queens

photo Michael O'Loughlin

Nootka Rose (*Rosa spp.*)

Blooms May-June – shrub

Attracts a broad range of bees. Does best in wet spots, but also tolerates summer drought.

Photos Jerry Paul and Lori Humphrey

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USDA NIFA

MICHIGAN STATE UNIVERSITY

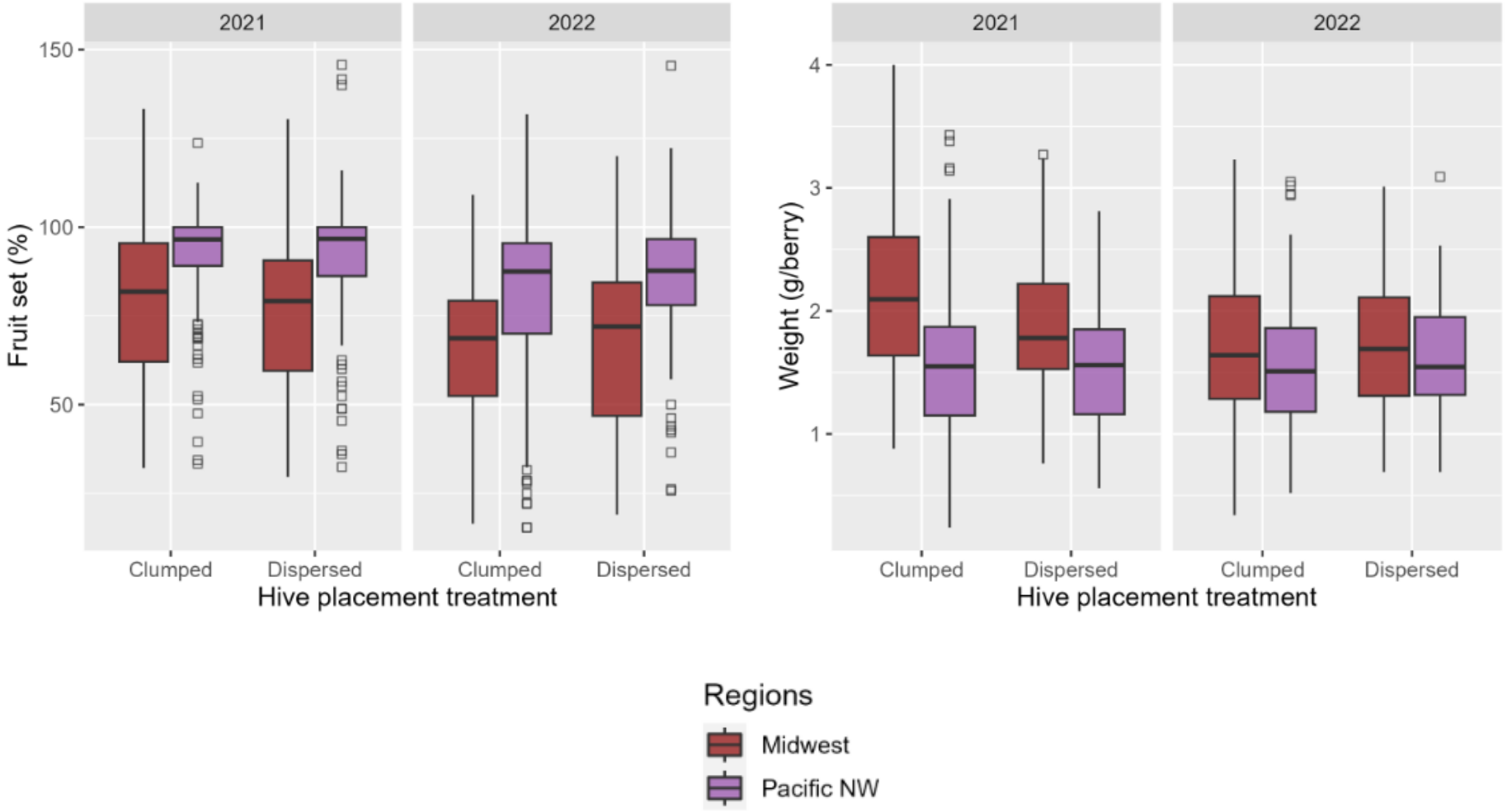
Oregon State University

UF UNIVERSITY of FLORIDA

WASHINGTON STATE UNIVERSITY

BEES AND BERRIES

NO BENEFIT OF DISPERSING COLONIES



DISPERSING COLONIES AND SPRAY DRIFT

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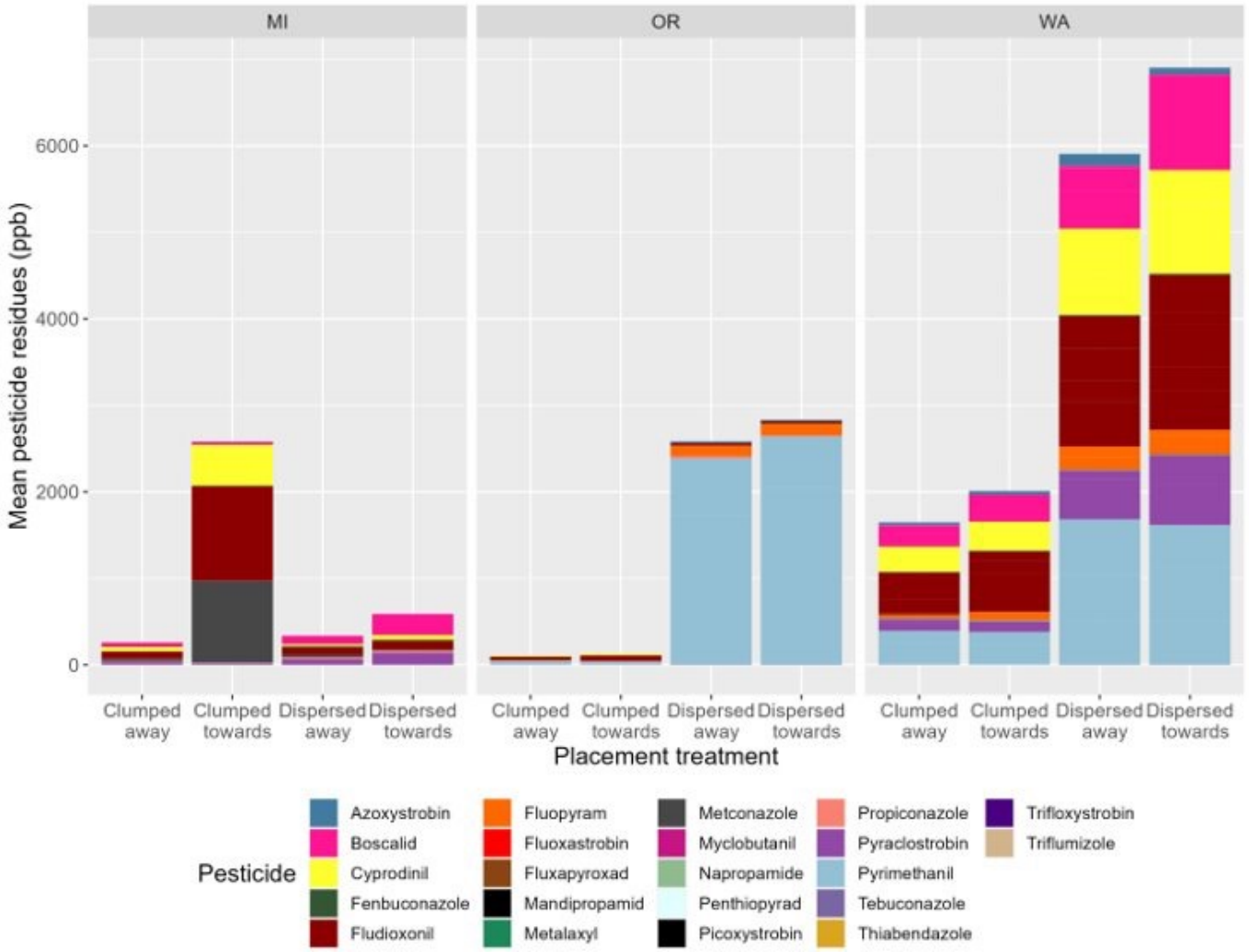
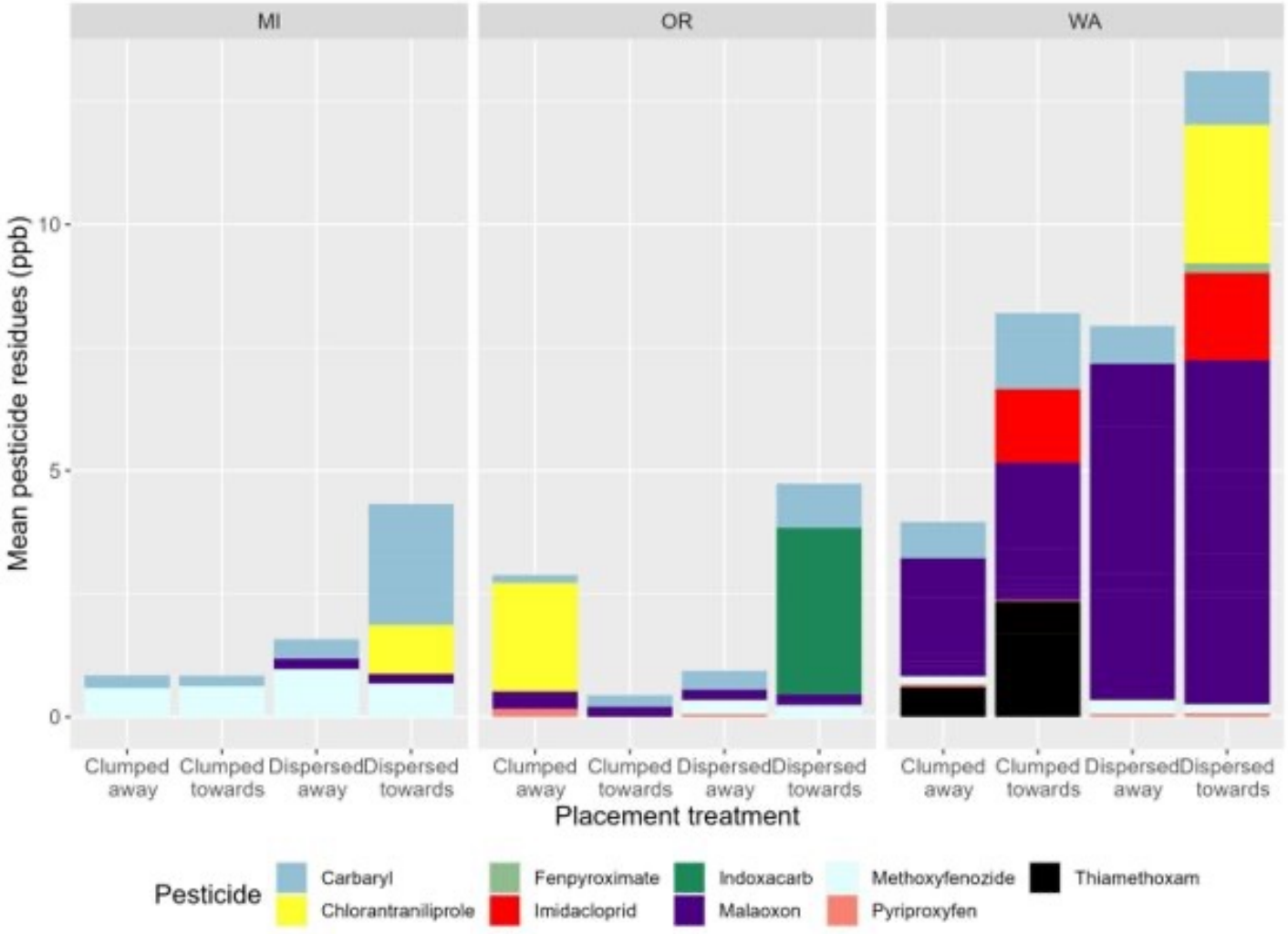
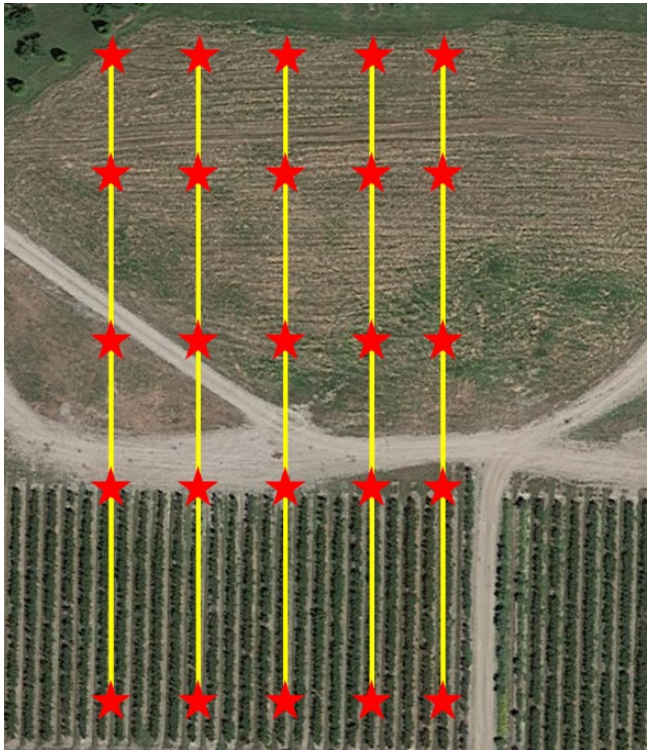


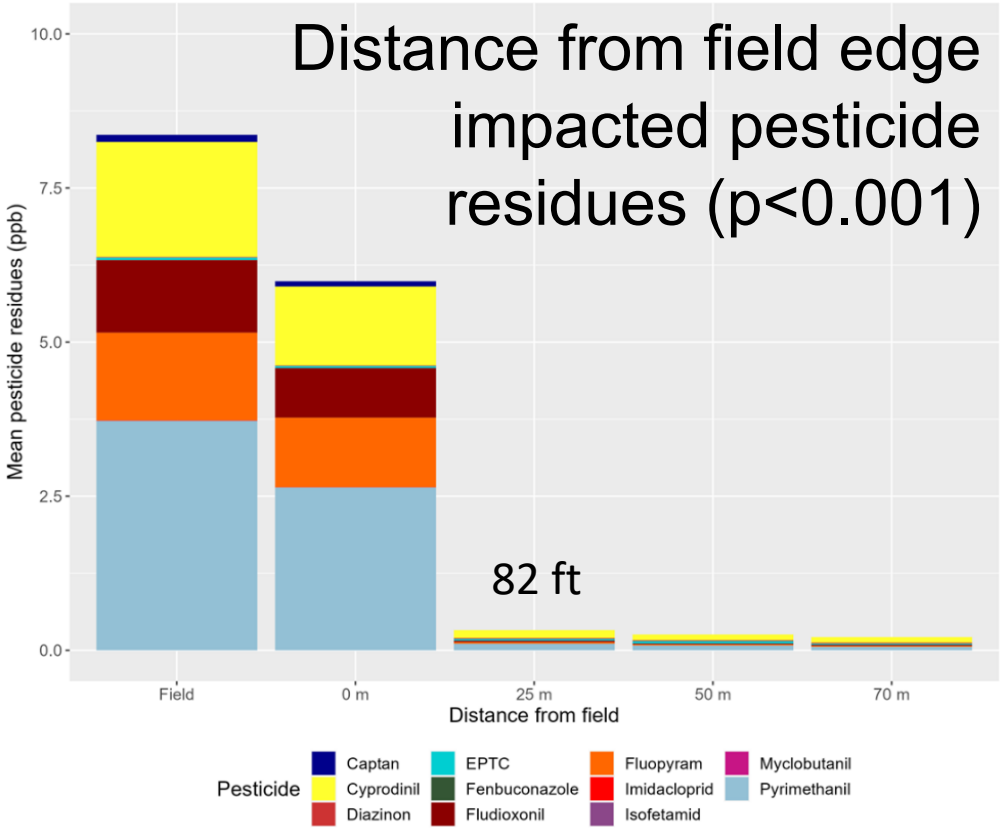
DISPERSING COLONIES AND SPRAY DRIFT



SPRAY DRIFT DROPS OFF LESS THAN 82 ft



Silicone bands deployed at one WA field in 2023



NO EVIDENCE THAT DISPERSING COLONIES BENEFITS POLLINATION

BUT

IT REDUCES PESTICIDE EXPOSURE

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ENVIRONMENTAL HAZARDS: This product is highly toxic to bees exposed to direct treatment or residues on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops or weeds while bees are foraging in the treated area.

“…highly toxic to bees…”

“…toxic to bees…”

Photo by Ellen Topitzhofer

Systematic review of residual toxicity studies of pesticides to bees and veracity of guidance on pesticide labels

Leah Swanson[1], Andony Melathopoulos[2] and Matthew Bucy[3]

[1] Oregon State University, Corvallis, OR, United States of America
[2] Department of Horticulture, Oregon State University, Corvallis, OR, United States of America
[3] Oregon Department of Agriculture, Salem, OR, United States of America

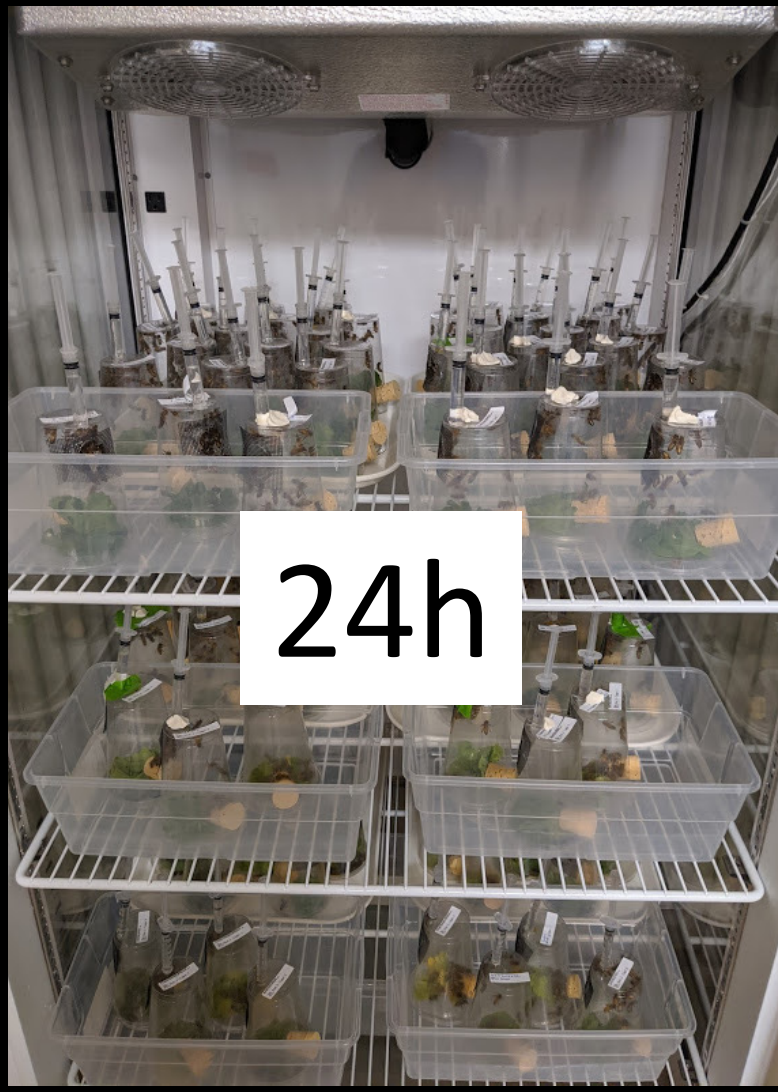
Residual Toxicity – RT_{25}

RT_{25} is the residual time needed to reduce the activity of the test substance and bring bee mortality down to 25 percent (25%) in cage test exposures to field-weathered spray deposits.

- OCSPP 850.3030: Honey Bee Toxicity of Residues on Foliage


GRAND FORMAT | LARGE SIZE | TAMAÑO GRANDE
Use in large coolers
Utiliser à l'intérieur des grosses glacières
Para uso en neveras grandes
WWW.CRYOPAKRETAIL.COM
Ziploc


25 bees


24h

toxicity 3h after spray

bifenthrin (e.g., Brigade)

cyantraniliprole (e.g., Exirel)

untreated

toxicity 24h after spray

bifenthrin (e.g., Brigade)

cyantraniliprole (e.g., Exirel)

untreated

Fanfare® EC

ENVIRONMENTAL HAZARDS: This product is highly toxic to bees exposed to direct treatment or residues on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops or weeds while bees are foraging in the treated area.

"…actively foraging…" RT_{25}<8h

"…foraging…" RT_{25}>8h

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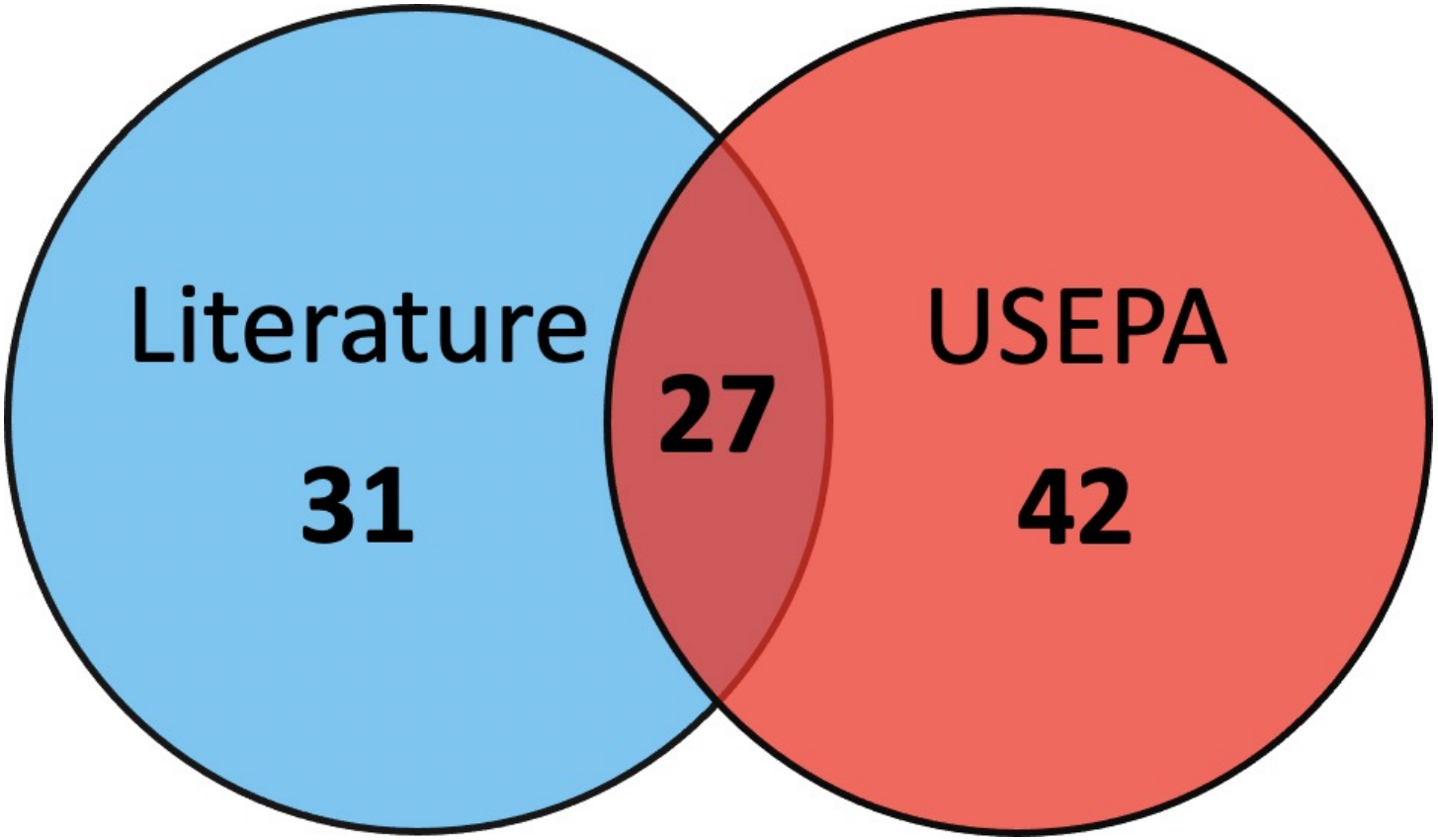
Residual Time to 25% Bee Mortality (RT25) Data

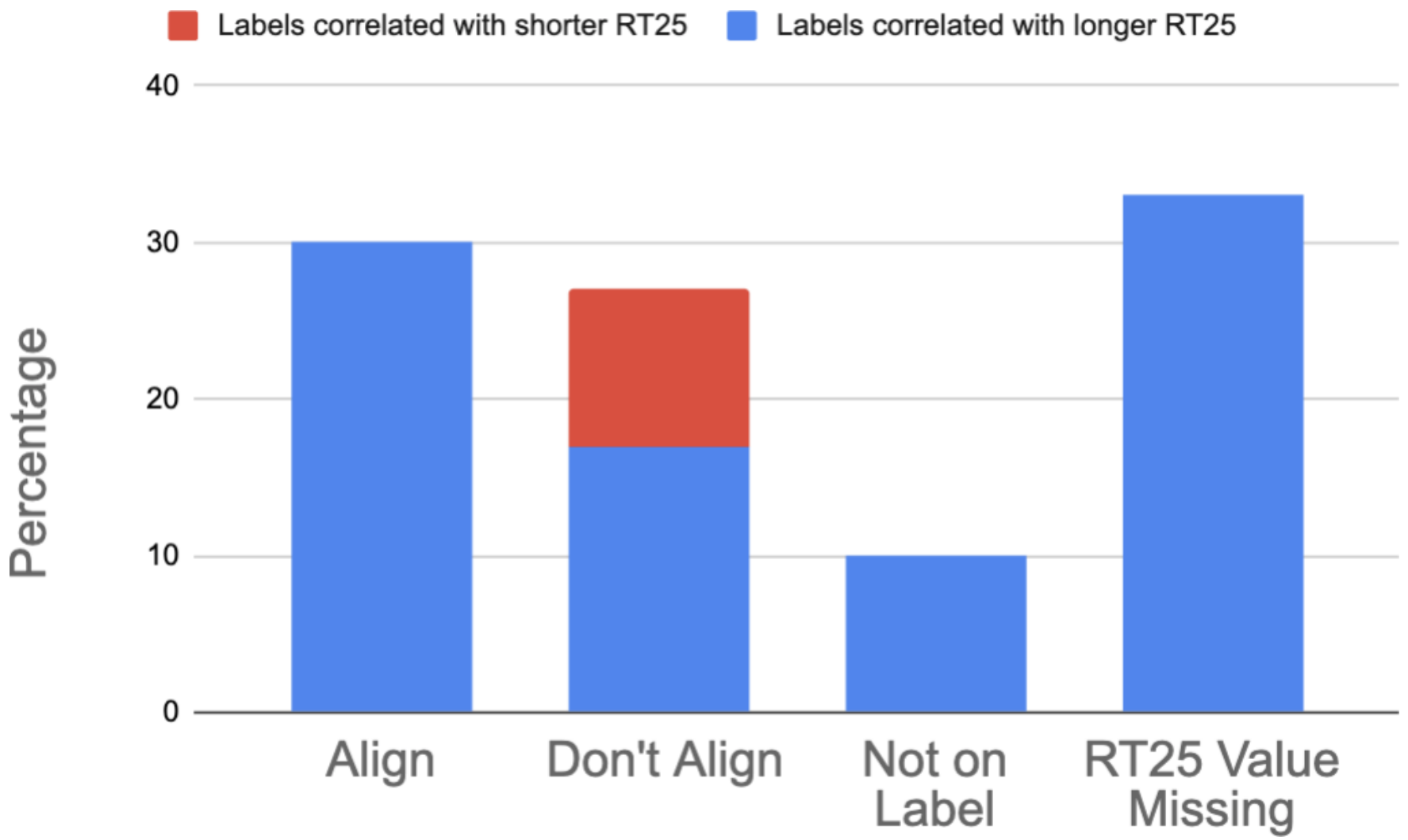
OPP Residual Time to 25% Mortality (RT_{25})

Active Ingredient	Formulation [2] (% a.i.)	Application Rate	Crop [3]	Qualifier[4]	RT_{25}[5] (hours)	Test Species Name Common (*Scientific*)
Abamectin	0.15 EC	0.0234 lb a.i./A	alfalfa	--	7.96	Honey bee (*Apis mellifera*)
Abamectin (avermectin)	L 676, 863-28W02	0.0016 lb a.i./tree	citrus	--	60	Honey bee (*Apis mellifera*)
		0.0008 lb a.i./tree		--	41.5	
		0.0008 lb a.i./tree		--	30	
		0.0003 lb a.i./tree		<	8	
		0.1 lb a.i./A		<	48	

create a comprehensive RT_{25} database



database vs label language



HOOK STAGE

140h

Active Ingredient: Indoxacarb
Pests (at bloom): cranberry weevil, blackheaded fireworm
Environmental Hazards: Highly toxic to bees, RT_{25}>8h
Specific Use Directions: none for bees

>8h

Soluble Insecticide

Active Ingredient: Acephate
Pests (at bloom): blackheaded fireworm, fruitworm
Environmental Hazards: Highly toxic to bees, RT_{25}>8h
Specific Use Directions: none for bees

>8h

Active Ingredient: Fenpropathrin
Pests (at bloom): blackheaded fireworm, tipworm
Environmental Hazards: Highly toxic to bees, RT_{25}>8h
Specific Use Directions: none for bees

WP	0.125	>18
	0.25	>18
	0.5	>42
	1	>42

Diazinon 50W

A Wettable Powder Insecticide Packaged In Water-Soluble Bags

Active Ingredient: Diazinon
Pests (at bloom): blackheaded fireworm, fruitworm
Environmental Hazards: Highly toxic to bees, RT_{25}>8h
Specific Use Directions: none for bees

?

Active Ingredient: Spinetoram
Pests (at bloom): blackheaded fireworm, fruitworm
Environmental Hazards: Toxic to bees, RT_{25}=3h
Specific Use Directions: none for bees

?

Active Ingredient: Spinetoram
Pests (at bloom): blackheaded fireworm, fruitworm
Environmental Hazards: Toxic to bees, RT_{25}=3h
Specific Use Directions: none for bees

BLOOM

Active Ingredient: Chlorantraniliprole
Pests (at bloom): blackheaded fireworm, fruitworm
Environmental Hazards: none for bees
Specific Use Directions: none for bees

Dow AgroSciences

Intrepid® 2F

INSECTICIDE

Active Ingredient: Methoxyfenozide
Pests (at bloom): blackheaded fireworm, fruitworm
Environmental Hazards: none for bees
Specific Use Directions: none for bees

RESIDUAL TOXICITY ON LABELS MAY NOT REFLECT TRIALS

BUT

CRANBERRY LABELS ALIGN

HARVANTA® 50SL
INSECTICIDE

Environmental Hazards

This product is highly toxic to bees and other pollinating insects exposed to direct treatment or to residues in/on blooming crops or weeds. Protect pollinating insects by following label directions intended to minimize drift and to reduce risk to these organisms. Do not apply this product or allow it to drift to blooming crops or weeds while bees or other pollinating insects are foraging the treatment area.

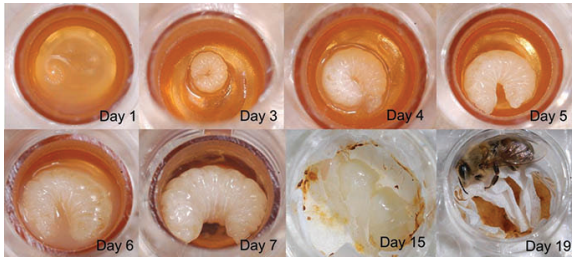
Crop	Insects	Use Rate Fl. Oz. Product Per Acre	Instructions
Leafy Vegetable Group (Crop Group 4-16)*	Beet armyworm Cabbage looper Corn earworm Cross striped cabbage moth Diamondback moth Imported cabbageworm Flea beetles Fall armyworm Western yellowstriped armyworm Leafminers (*Liriomyza* species) Western flower thrips** Whiteflies** Stink bug spp.**	10.9 to 16.4 fl oz (0.036 to 0.054 lb. a.i. /A)	**Aphids** For best results use with an effective adjuvant. Use the higher labeled rate for best performance. **Resistance Management:** Do not apply HARVANTA 50SL INSECTICIDE or other Group 28 insecticide more than 3 times within a single generation of insect pest(s) on a crop. **Restrictions:** Foliar application of this product is prohibited to a crop from onset of flowering until flowering is complete unless: • the application is being made in the time period between 2 hours prior to sunset until sunrise; OR, • the application is being made at a time when the temperature at the application site is 50 degrees F or less.

EPA evaluates RISK in a 3-Tiered Assessment Process

NAPPC

TO EVALUATE THE EFFECTS ON NON-TARGET ORGANISMS LIKE BEES:

TIER I (LAB)



TIER II (SEMI-FIELD)

TIER III (FIELD)

photo credit Smithers Viscient

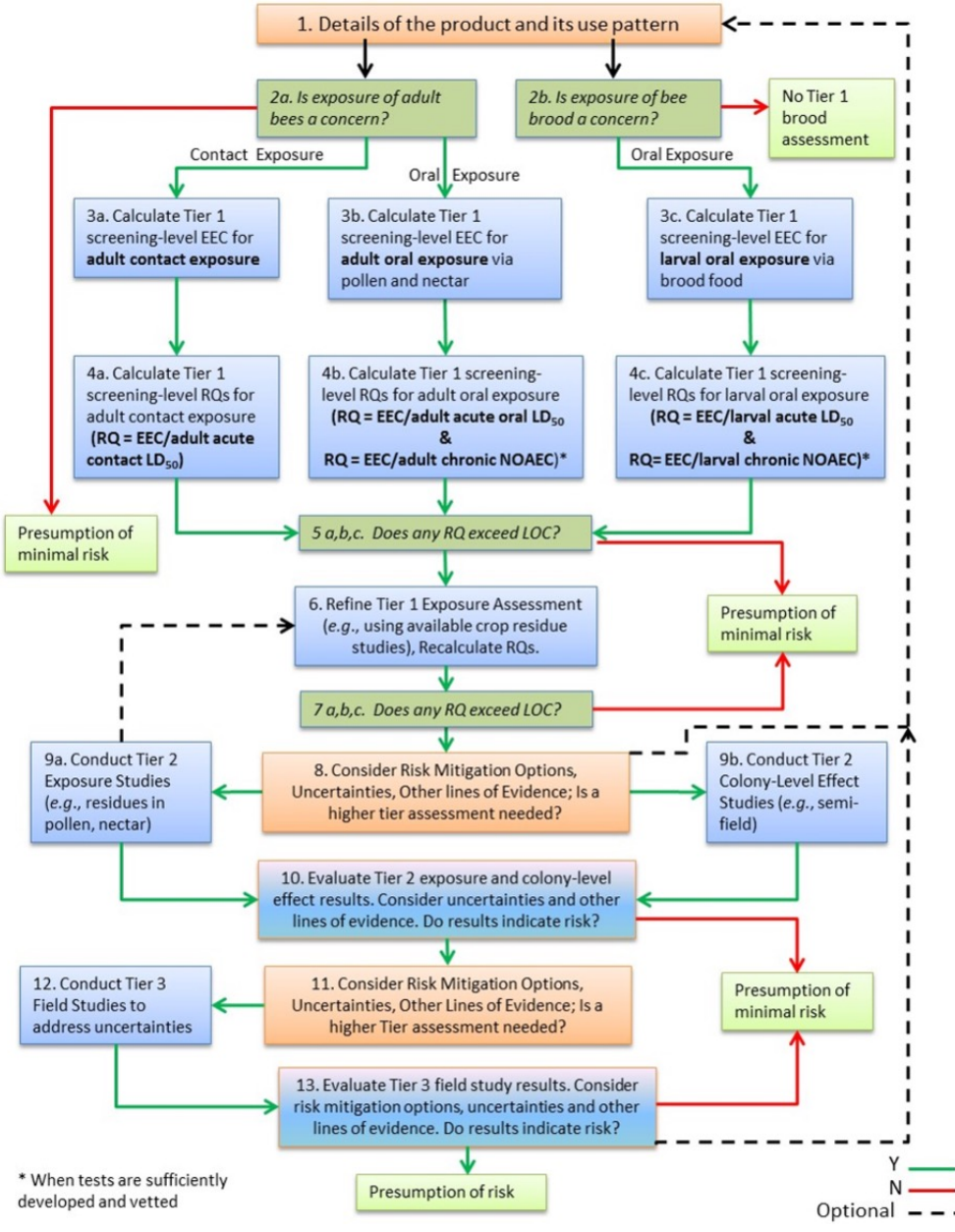
MOVE FROM TIER I TO TIER II TO TIER III

TIER I (LAB)

TIER II (SEMI-FIELD)

TIER III (FIELD)

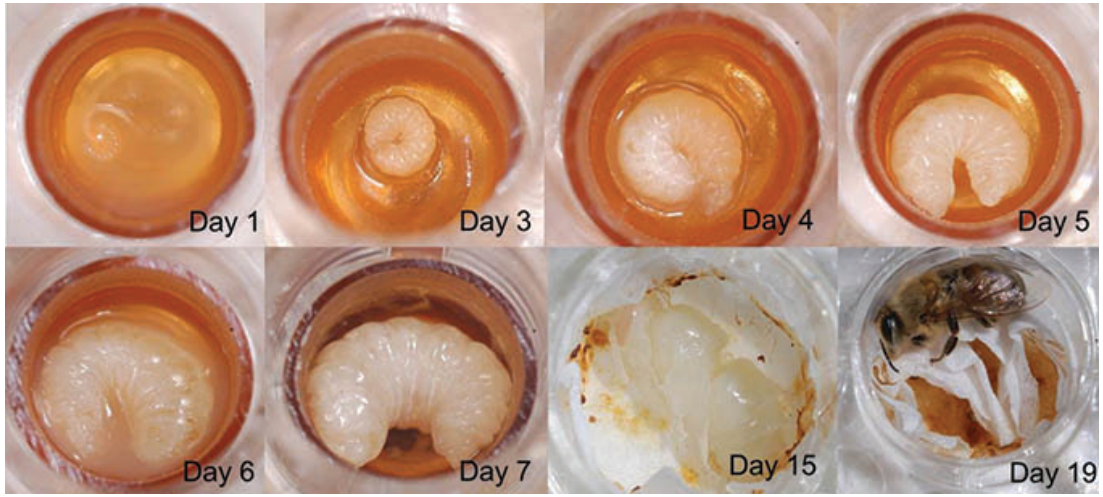
More refined



TIER I

Individual bees tested in the lab

ACUTE ADULT CONTACT



CHRONIC LAVAL ORAL

photo credit Smithers Viscient

Fluazaindolizine: Ecological Risk Assessment for Section 3 New Chemical

July 12, 2021

Table 5-5. Terrestrial Toxicity Endpoints for Degradates of Fluazaindolizine

Study Type	Test Substance (% a.i.)	Test Species	Toxicity Value in µg a.i./L (of degradate) (unless otherwise specified)	MRID No./ Classification	Comments
Acute contact and oral (adult)	IN-F4106 (97.2% a.i.)	Honey bee (*A. mellifera* L.)	Contact **48-h LD_{50} =17.8 µg a.i./bee** Oral 48-h LC_{50} >100 µg a.i./bee	50932357 Acceptable	Sublethal effects were observed in contact groups (affected/moribund). Volume of food consumption per bee decreased as concentration level increased.
 Acute contact and oral (adult)	IN-F4106 (97.2% a.i.)	Bumble bee (*Bombus terrestris*)	Contact 48-h LD_{50} >100 µg a.i./bee Oral 48-h LC_{50} >67.4 µg a.i./bee	50932365 Acceptable	No sublethal effects were observed.
Chronic (adult)	IN-F4106 (97.2% a.i.)	Honey bee (*A. mellifera* L.)	**NOAEL =2.8 µg a.i./bee/d** LOAEL = 4.3 µg a.i./bee/d	50932359 Supplemental	NOAEL based on food consumption. Food consumption effects seemed to be solvent related in the lower doses and control groups.
Chronic oral (larva)	IN-F4106 (97.2% a.i.)	Honey bee (*A. mellifera* L.)	NOAEL = 2.78 µg a.i./larva/d **LD_{50} = 6.53 µg a.i./larva/d**	50932362 Supplemental	NOAEL based on mortality. Mortality reached 100% in the highest treatment level. Unconsumed food was noted at all treatment levels on day 8.

TIER I

These lab test results are contextualized

How much of the pesticide the bee is likely to encounter in the field after application

This is called the **Estimated Environmental Concentration** or

EEC

TIER I

conservative estimates of risk

$$\text{risk quotient (RQ)} = \frac{\text{estimated environmental concentration (EEC)}}{LD_{50}}$$

TIER I

conservative estimates of risk using contact route of exposure

$$0.01 = \frac{0.10\ \mu g/bee}{10\ \mu g/bee}$$

(dose a bee is expected to contact in the environment)

(lethal dose)

✓

TIER I

What does a level of concern of 0.4 mean?

0.4 =

background mortality

TIER I

conservative estimates of risk using contact route of exposure

$$0.5 \times = \frac{\text{0.10 µg/bee (dose a bee is expected to contact in the environment)}}{\text{0.20 µg/bee (lethal dose)}}$$

Refining – further lines of evidence

photo credit Smithers Viscient

TIER II and III

colony level and semi-field/field trials

Exposure Potential of Bees

Tier I (Lab)
- Individual-level effects
- Default or refined exposure

Tier II (Semi-Field)
- Colony-level effects
- Tunnel, feeding

Tier III (Full-Field)
- Colony-level effects
- Actual crop, use pattern

Measure residue in pollen and nectar

A. Melathopoulos

TIER II and III

colony level and semi-field/field trials

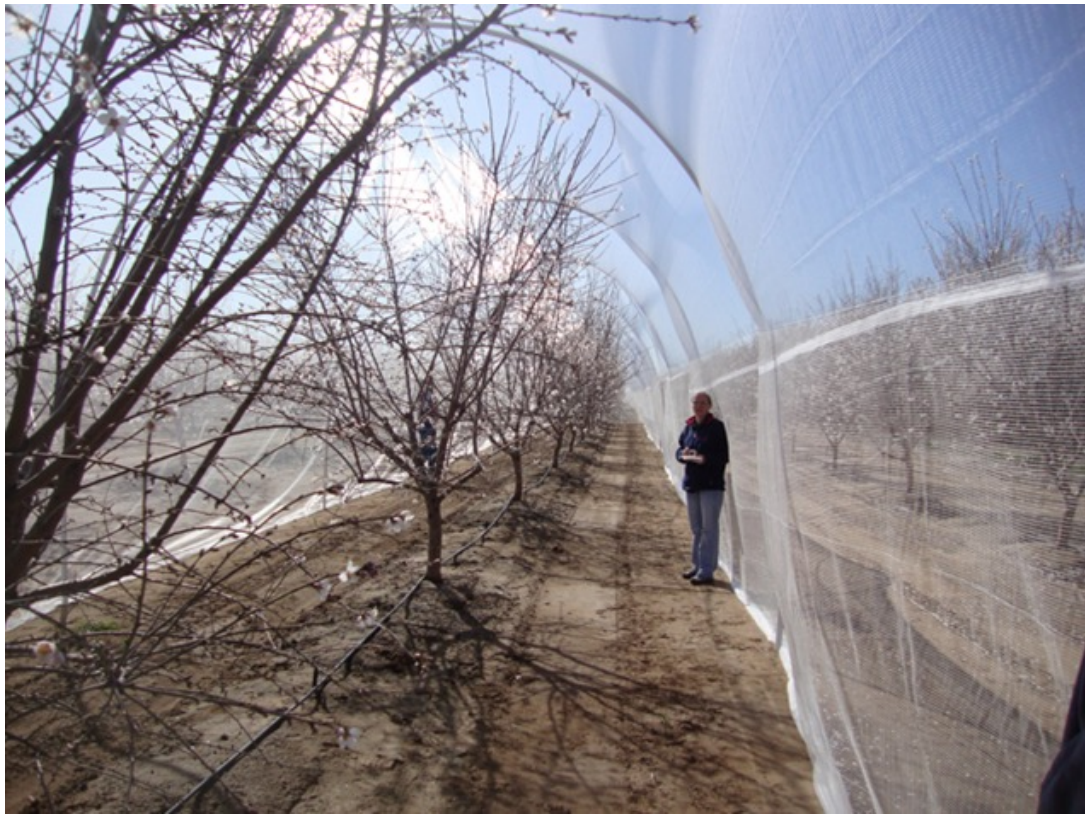


photo credit Smithers Viscient

oregonbeeplate.org

THANK YOU!

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