PROTECTING AND ENHANCING CRANBERRY POLLINATORS

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Cranberry School, Bandon, OR January 31, 2019



Oregon State University Extension Service

CLICKERS



Press channel button Type '41' Press channel button

WAS POLLINATION ADEQUATE IN 2018?



WAS THE PROBLEM PRIMARILY

- A. Stocking rate wasn't high enough.
- B. Colonies were weak.
- C. Weather conditions.
- D. Native bees were not around.
- E. Other

Have you taken this training with me before?

A.Yes B.No



73%

GOT A SMART PHONE?



Oregon State University Extension Service



Available on

iTunes



A PACIFIC NORTHWEST EXTENSION PUBLICATION + PNW 591 Oregon State University • University of Idaho • Washington State University

P	X
	(🌪)

Reduce Bee Poisoning from Pesticides

Quinolone insecticide/miticide, metabolic poison

Acetamiprid

Neonicotinoid insecticide (cyano group)

Common Product Names Assail, Tristar, Transport

Toxicity information N/A

Notes and Special Precautions

Length of residual toxicity to honey

HOME	KEY	HELP	ABOUT
------	-----	------	-------

Have you ever seen this publication or app?

- A. Yes
- B. No



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53% 47%



How can you find out if a pesticide is toxic to bees?

- A. On the label "Specific Use Directions"
- B. On the label –"Environmental Hazards"
- C. Bee toxicity does not appear on the label – you have to exercise judgement.



By law you can apply a pesticide when honey bees are in the area if the label indicates the **product is toxic to bees?**

48% A.Yes **B.No** Yes No

52%



Pesticide products applied to a plant's roots pose very little risk to bees visiting the flowers?



The warnings on bee toxicity in the Environmental Hazards section are:



LESSON OBJECTIVES:

- 1. Use pollinator resources efficiently to maximize profits.
- Explain the difference between a pesticide's <u>toxicity</u> and <u>risk</u> to bees
- Tell <u>how risky</u> a pesticide treatment is to bees from the <u>toxicity</u> and <u>residual toxicity</u> sections of the label in conjunction with PNW 591

WHY ISN'T FRUIT SET PERFECT?

- 1. POLLEN DOESN'T MOVE ENOUGH
- 2. POLLEN ISN'T TRANSFERRED FAST ENOUGH
- 3. POLLEN ISN'T COMPATABLE
- 4. POLLINATION ISN'T EVERYTHING





Stephens et al. 2012

WHY DOESN'T POLLEN MOVE ENOUGH?

1. NOT ENOUGH BEES

BEE VS MECHANICAL POLLINATION STEPHENS CULTIVAR – FIELD PLOTS (1.5 FEET²)



Gaines-Day and Gratton 2015

A Pacific Northwest Extension Publication Oregon State University • University of Idaho • Washington State University

PNW 623 • January 2011

Evaluating Honey Bee Colonies for Pollination

A Guide for Commercial Growers and Beekeepers

R.R. Sagili and D.M. Burgett

 $\mathbf{3}_{hives/acre}$

6 frames of bees

6 frames w/ brood



100 bees/min (65F, <10mph - incoming)

Honey bee colony strength in eastern and western Washington blueberry, 2014 and 2015.



All sites below recommended 100 bees per minute (Sagili and Burgett, 2011)



Hive densities up to 8 hives/ac have led to larger berries and increase yields in Duke.







STOCKING RATE AND YIELD 38 WISCONSIN GROWERS (2000-2011) – % FOREST WITHIN 1KM



STOCKING RATE AND YIELD

38 WISCONSIN GROWERS (2000-2011) – % FOREST WITHIN 1KM

	0	1	2	3	4	5	6	7
10	176	207	238	268	299	330	360	391
10	(143-210)	(180-234)	(214-262)	(243-293)	(270-328)	(293-366)	(316-405)	(337-444)
20	184	211	237	264	290	316	343	369
20	(158-211)	(189-232)	(218-256)	(244-283)	(268-312)	(289-344)	(309-376)	(329-409)
30	192	214	237	259	281	303	325	348
	(172-213)	(197-231)	(222-252)	(243-274)	(263-299)	(282-325)	(300-351)	(317-378)
40	200	218	236	254	272	290	308	326
	(183-217)	(204-232)	(223-249)	(240-268)	(255-289)	(269-311)	(283-333)	(296-356)
50	208	222	236	249	263	277	291	304
	(191-225)	(207-236)	(221-250)	(233-266)	(242-284)	(250-303)	(258-323)	(266-343)
60	216	225	235	245	254	264	273	283
00	(194-238)	(208-243)	(217-253)	(223-266)	(226-282)	(228-299)	(230-317)	(231-334)
70	224	229	234	239	245	250	256	261
/0	(196-252)	(206-252)	(212-257)	(212-267)	(209-281)	(205-296)	(200-312)	(194-328)
00	232	233	234	235	236	237	238	240
80	(196-267)	(204-261)	(206-262)	(201-269)	(192-280)	(181-294)	(169-308)	(157-322)

Hives/acre

Yield Low High

 $yield_{hives=0} < yield_{mives=7} \le yield_{hives=7}$

Gaines-Day and Gratton 2016





HORTSCIENCE 46(6):885-888. 2011.

Native Bees, Honeybees, and Pollination in Oregon Cranberries

Melissa Broussard¹, 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 Spring: *Erica carnea, E. x darleyensis* Summer: *E. cinerea* Dr. Kim Patten, Washington State University Long Beach

SOME BUMBLEBEES LIKE CRANBERRIES ...AND SOME DON'T

Bumble bee species	Percentage of	total bumble		15 Sept	
	<u>3 June</u>	1 July			10 Aug
	Cranberries	Cranberri	es Bee plants	Bee plants	Bee plants
B. caliginosus	0	2	73	74	43
B. californicus	<u> </u>	ō	4	7	30
B. occidentalis	42	76	13	17	27
B. mixtus	30	14	5	2	0
B. sitkensis	24	4	5	0	Ō
B. melanopygus	3	4	0	0	0

THINGS THAT WOULD BE NICE TO KNOW ABOUT BUMBLE BEES AND CRANBERRIES

- Can you make more bumble bees nest around your bog?
- 2. Do the bumble bees that pollinate cranberries nest in artificial boxes?
- 3. Can you move those boxes into bogs for pollination?
- 4. Where do they like to nest?

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OSU Bandon Bumble Bee Project - 1



Step 1: Install boxes (early February)



Step 2: Enter GPS



Step 3: Check entrances every month.

Record (Feb-June):

- Do you see poop?
- Are the bees flying in and out?



Step 4: In June, determine which nests have established. Catch a worker, freeze it and give it to Cassie.

OSU Bandon Bumble Bee Project - 2



Step 5: Move the colony into the bog and see if it "transplants".







FLAGSHIP FARM

David Hauter



Join Us

FLAGSHIP FARMS

OREGON BEE ATLAS OREGON INNOVATORS The Flagship Program is comprised of farmers and nursery owners who lead the way in promoting pollinator diversity through a combination of practices such as creating and maintaining habitat, utilizing Integrated Pest Management strategies, judicious use of pesticides, demonstrating good communication with beekeepers, and supporting crops that provide floral






Dec 18, 2018 525 downloads

Nov 4, 2018 661 downloads

57,107 downloads





Oregon Bee Project

🐉 Published by Andony Melathopoulos 🖓 · August 14, 2018 · 🔇

Oregon is a world leader in producing high quality radish seed. Honey bees play an indispensable role in crossing different radish lines and setting seed. These seeds will end up making everything from the radishes you eat in a taco to cover crops that promote soil health. Recently radish seed growers worked with the Oregon Bee Project, OSU Extension and the Oregon State Beekeepers Association on the state's first Bee Protection Protocol. Just one more example of how Oregon seeds help bees and Oregon bees help seeds. #beesloveseeds.







...

Oregon Bee Project

Published by Andony Melathopoulos [?] - July 25, 2018 - 🔇

Specialty seed crops like this sunflower seed field in Monmouth is a great source of nectar and pollen for both wild and managed bees. This morning we counted 13 different species of feasting bees! #beesloveseeds.



6,117 People Reached	336 Engagemer	Boost Post
10 10 10 5 3		1 Comment 33 Shares 1.1K Views
🖒 Like	Comment	🖒 Share 🛛 🔞 🗸
Most Relevant -		•
Write a comment		
Stacie Olson-Men	e zes Beauty! 🧡	



Follow V

Listening to PolliNation podcast and my new favourite phrase is "bumblebees the size of house cats". That's truly the dream. #BeesAsPets #bees @oregonbeeproj

-> Garth Mulkey

11:25 AM - 13 Dec 2018



2. BEES ARRIVE TOO EARLY OR TOO LATE 10-15% bloom

MONTH OF BLOOM





POLLINATOR ECONOMICS 101 2016 OSU PNW POLLINATION SURVEY



almond 117,322 colonies, \$185.85 (\$150-199)

clover

6,618 colonies, <u>\$42.00</u> (\$10-65)

Cranberry 1,554 colonies, <u>\$41.10</u> (\$30-60)



How frequently do you call your beekeeper per season?

- A. Once
- B. Twice
- C. Three times
- D. More



What statement most characterizes your interaction with your beekeeper.

- A. "Fraught and combative"
- B. "Okay, but beekeeper makes too many demands"
- C. "Okay, but there is a lot of miscommunication"
- D. "Productive we work through problems.



What is the typical quality of colonies brought in for pollination?

- A. Weak
- B. "A mixed bag" some strong, but inconsistent.
- C. Consistently strong.
- D. I am not sure.



Based on what you learned, what <u>might</u> you change?

- A. Increase stocking colony stocking rate
- B. Decrease stocking rate
- C. Inspect colony strength
- D. Participate in the bumble bee study
- E. Pay more for better colonies.
- F. Other
- G. Nothing, I plan to do what I always do.



LESSON OBJECTIVES:

- 1. Use pollinator resources efficiently to maximize profits.
- Explain the difference between a pesticide's <u>toxicity</u> and <u>risk</u> to bees
- Tell <u>how risky</u> a pesticide treatment is to bees from the <u>toxicity</u> and <u>residual toxicity</u> sections of the label in conjunction with PNW 591



RISK =



RISK =

1. Toxicity





RISK =

1. Toxicity +



2. Bloom +



RISK =

1. Toxicity +



2. Bloom +



RISK =

1. Toxicity +



2. Bloom +
3. Residual Time +



RISK =

1. Toxicity +



2. Bloom +



- 3. Residual Time +
- 4. Application/ Formulation

LESSON OBJECTIVES:

- 1. Be able to recognize a bee pollinator, their nests and their role in enhancing crop yields.
- 2. Explain the difference between a pesticide's <u>toxicity</u> and <u>risk</u> to bees
- Tell <u>how risky</u> a pesticide treatment is to bees from the <u>toxicity</u> and <u>residual toxicity</u> sections of the label in conjunction with PNW 591

PESTICIDE TOXICITY





Acute toxicity

LETHAL TOXICITY Death within a few hours









Acetamiprid 8.5% by wt. INERT INGREDIENTS: 91.5% by wt. TOTAL: 100.0% by wt. Contains 0.76 pounds of acetamiprid per gallon

ENVIRONMENTAL HAZARDS

This product is toxic to wildlife. This product is toxic to bees and other pollinating insects exposed to direct treatment. Do not apply this product while bees or other pollinating insects are actively visiting the treated area. Risk to managed bees and native pollinators from contact with pesticide spray or residues can be minimized when applications are made at dawn or dusk or when temperature is below 55°F at the site of application. Do not apply directly to water, or to areas where surface water is present or to intertidal areas below the mean high water mark. Do not contaminate water when disposing of equipment washwater or rinsate. Do not contaminate water used for irrigation or domestic purposes.

"...highly toxic to bees..." "...toxic to bees..."

ACUTE TOXICITY & THE LABEL



"Highly Toxic to Bees" – LD50 is *less than or equal* to <u>2 μg/bee</u>



"Toxic to Bees" – LD50 is *less than* <u>11 μg/bee</u> but *greater than* <u>2 μg/bee</u>

Relatively Nontoxic – LD50 is greater than <u>11 µg/bee</u>

Nothing on the label



Table 4. Active ingredients of commonly used pesticides and their effect on bees in California, Idaho, Oregon, and Washington



A PACIFIC NORTHWEST EXTENSION PUBLICATION • PNW 591 Oregon State University = University of Idaho = Washington State University

Table 4 (p. 16-27)

Active Ingredient Abamectin (Avermectin) Fermentation products derived from soil bacterium, offects nerve and muscle action of insects and mites	Highly Toxic to Bees (RT) X 0.025 lb ai/acre 1-3 days ERT, ≤ 0.025 lb ai/acre 8 hours RT [1] Car vary with formulation and application rate	Toxic to Bees (RT)	No Bee Precautionary Statement (PS) on Label	Common Product Names Abacide, Abacus, Abba, Agmectin, Agri-Mek, Ardent, Avert, Avicta, Avid, Epi-Mek, Reaper, Solera, Solero, Temprano, Timectin, Zoro	Notes and Special Precautions ERT to bumble bees [2], short RT to alfalfa leafcutting bees and alkali bees at 0.025 lb ai/acre [1].
Acephate Organophosphate insecticide	X > 3 days ERT [1] Can vary with formulation and application rate			Bracket, Orthene, Orthonex	Incompatible with bumble bees [2], ER1 to alfalfa leafcutting bees and alkali bees [1].
Acequinocyl Quinolone insecticide/miticide, metabolic			x	Kanemite, Shuttle	
Acetamiprid Neonicourino insecticide (cyano group)		X Yes		Assall Tristar Transport	Length of residual toxicity to honey bees is unknown. ERT to alfalfa leafcutting bees and alkali bees [3]. 2 da ERT to bumble bees [2]. Cyano group neonicotinoids exhibit lower toxicity to bees than nitro group neonicotinoids [4].
Aldicarb Systemic carbamate insecticide and nematicide	x			Temik Only available as granular formulation [5]	Not hazardous to bees when applied at least 4 weeks prior to bloom [1]. May be a persistent contaminant of beeswax [6].
Alpha-cypermethrin Pyrethroid insecticide	X Yes			Fastac	Length of residual toxicity to bees unknown.
Aluminum tris O-ethyl phosphonate Systemic organophosphate fungicide			x	Aliette, Fosetyl-Al, Chipco, Flanker, Linebacker, Legion	
Azadirachtin Insecticidal extract of neem oil Ecdysone antagonist		X <2 hours RT [1] Can vary with formulation and application rate		Neemix, Amazin, Azera, Aza, Ecozin, Ornazin	Must be ingested to be toxic [7].
Azinphos-methyl Organophosphate insecticide	X 4 days ERT [1] 5 days ERT [8] Con way with formulation and opplication rate			Guthion is being phased out	ERT to alfalfa leafcutting bees and alkali bees [1].
Azoxystrobin B-methoxyacrylate fungicide			х	Abound, Dynasty, Heritage, Quadris	
Bacillus subtilis Fungicide derived from naturally occurring soil bacterium			x	Kodiak, Rhapsody, Serenade, Optiva, Companion, Cease	Laboratory tests suggest potential effects on bumble bees [9].

Quinolone insecticide/miticide, metabolic poison



SWIPE

L. Hooven R. Sagili E. Johansen

> **Common Product Names** Assail (Tristar,) Transport

Neonicotinoid insecticide

Toxicity information N/A

Acetamiprid

(cyano group)

Notes and Special Precautions

Length of residual toxicity to honey

HOME	KEY	HELP	ABOUT
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FIC NORTHWEST EXTENSION PUBLICATION • PNW 591 **Oregon State University** University of Idaho Washington State University

AN EXERCISE there are seven products listed for a pest you need to control...

LEAST ACUTELY TOXIC TO BEES?



D

F

DuPont[™] Acelepryn[™]





WHICH PRODUCT IS LEAST TOXIC TO BEES?



LEAST ACUTELY TOXIC TO BEES?





MOST

MOST



F



LEAST





ACUTE TOXICITY & THE LABEL

ENVIRONMENTAL HAZARDS

"...highly toxic to bees..." "...toxic to bees..."

ACUTE TOXICITY & THE LABEL

ENVIRONMENTAL HAZARDS

"...highly toxic to bees..." "...toxic to bees..."



New EPA Advisory Box <u>Nitro-group neonicotinoids:</u>

- imidacloprid,
- dinotefuran,
- clothianidin, and
- thiamethoxam

applied outdoor to foliage.

GROUP 4A INSECTICIDE







FOR FOLIAR AND SYSTEMIC INSECT CONTROL IN ORNAMENTAL PLANTS AND VEGETABLE TRANSPLANTS IN ENCLOSED STRUCTURES. FOR GREENHOUSE, NURSERY, INTERIOR PLANT-SCAPE AND OUTDOOR LANDSCAPE USE ONLY

ENVIRONMENTAL HAZARDS

<u>This product is toxic to honey bees</u>. The persistence of residues and potential residual toxicity of dinotefuran in nectar and pollen suggests the possibility of

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Active Ingredient:	nitro-group neonicoting	bid
Dinotefuran, [N-me	thyl-N'-nitro-N"-	
((tetrahvdro-3-fura)	nvl)methvl)guanidine1	20%
Other Ingredients		80%
Total:		100%

ENVIRONMENTAL HAZARDS

This product is toxic to honey bees. The persistence of residues and potential residual toxicity of dinotefuran in nectar and pollen suggests the possibility of

> 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.

DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

READ ENTIRE LABEL. USE STRICTLY IN ACCOR-DANCE WITH PRECAUTIONARY STATEMENTS AND DIRECTIONS, AND WITH APPLICABLE STATE AND FEDERAL REGULATIONS.

FOR COMMERCIALLY GROWN ORNAMENTALS NOT UNDER CONTRACT FOR POLLINATION SERVICES BUT ARE ATTRACTIVE TO POLLINATORS



- Do not apply this product while bees are foraging.
- This product is toxic to bees exposed to residue for more than 38 hours following treatment.



FOR CROPS UNDER CONTRACTED POLLINATION SERVICES

Do not apply this product while bees are foraging. Do not apply this product until flowering is complete and all petals have fallen unless the following condition has been met.

If an application must be made when managed bees are at the treatment site, the beekeeper providing the pollination services must be notified no less than <u>48-hours</u> prior to the time of the planned application so that the bees can be removed, covered or otherwise protected prior to spraying.

PESTICIDE TOXICITY





Chronic toxicity

"a lot little nicks" - repeated
Lingering effects
(e.g., impaired foraging,
↑ disease susceptibility, etc.)

Acute toxicity

LETHAL TOXICITY Death within a few hours


sublethal dose of clothianidin 10-32% exposed foragers failed to return home



Henry et al. 2012

POLLINATORS, PESTICIDES & RISK



RISK =

1. Toxicity +

2. Bloom



POLLINATORS, PESTICIDES & RISK



RISK =

1. Toxicity +



Bloom + Residual Time

RESIDUAL TIME (RT)



INSECT CONTROL

Trademark of The Dow Chemical Company ("Dow") or an affiliated company of Dow

For control of listed pests such as thrips, lepidopterous larvae, foliage feeding worms, fire ants and other listed pests infesting apple and other pome fruits, artichoke, asparagus, banana, *Brassica* (cole) leafy vegetables, bulb vegetables, bushberries, caneberries, citrus, commercial aquatic plants, cucurbits, dates, fruiting vegetables, grape, herbs, leafy vegetables, leaves of legume vegetables, leaves of root and tuber vegetables, okra, ornamentals (herbaceous and woody) growing outdoors, in nurseries or in greenhouses, peppermint, pistachio, plantain, pomegranate, popcorn, root and tuber vegetables, spearmint, spices, stone fruits, strawberry, sweet corn, tree nuts, tropical tree fruits, tree farms or plantations and turfgrass

Group	5	INSECTICIDE				
Active Ingredient: spinosad (including Spinosyn A and Spinosyn D)						
Other ingredients						
Total						

...toxic to bees exposed to treatment during the <u>**3 hours**</u> following treatment...

PESTICIDES THAT BREAK DOWN OVERNIGHT

What would you see on the label?

Breaks down in less than 8h:

- "...<u>actively visiting the treatment area</u>..."
- \rightarrow bees seen on plants
 - "visiting" replaced with "foraging" on newer labels

Remains active:

- "...visiting the treatment area..."
- \rightarrow could visit plants <u>later</u>

BRIGADE 2EC CAN BE APPLIED WHEN A CLOVER SEED CROP IS IN BLOOM?

A.True

B.False



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 actively visiting the treatment area.

Crop/Site: Clover grown for seed.

Target Pest: Aphids, Lygus Bugs, Spider Mites and Weevil



"...<u>actively</u> visiting the treatment area..."



"...<u>actively</u> visiting the treated area..." ?



"...<u>actively</u> visiting the treated area..." ?



"...<u>actively</u> visiting the treated area..."?



"...actively visiting the treatment area..."



"....actively visiting the treated area..."?





RESIDUAL TOXICITY AND RATE



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 <u>actively visiting</u> the treatment area.

How to Reduce Bee Poisoning from Pesticides



Bee Safety

Available on

iTunes

Google Play

GET IT ON





PESTICIDE APPLICATOR EDUCATION

INFOGRAPHIC CARDS FOR TRAINING



PROTECT BEES READ PESTICIDE LABELS

Five steps to reading a pesticide label to determine how risky a treatment is to bees.



www.oregonbeeproject.org

Graphic by Iris Kormann, Andony Melathopoulos - Oregon State University and Gilbert Uribe - Oregon Department of Agriculture



www.oregonbeeproject.org

Gráfico por Iris Kormann y Andony Melathopoulos - Universidad Estatal de Oregon Rose Kachadoorian y Gilberto Uribe - Departamento de Agricultura de Oregon

POLLINATORS, PESTICIDES & RISK



RISK =

1. Toxicity+



- 2. Residual Time +
- 3. Bloom +
- 4. Application/ Formulation

APPLICATION/FORMULATION formulations



Organophosphate insecticide



Up to 7 days ERT for alkali bees and alfalfa leafcutting bees [1]. Incompatible with bumble bees [2].

MALATHION 57 EC

Organophosphate Insecticide

ACTIVE INGREDIENTS:			% by wi
Malathion*	 		57.00 %
INERT INGREDIENTS**	 		<mark> 43.00</mark> %
		TOTAL	100.00%

ENVIRONMENTAL HAZARDS

This pesticide is highly toxic to bees exposed to direct treatment on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops or weeds while bees are actively visiting the treatment area.

APPLICATION/FORMULATION tank mixes and pre-packs



More uncertainty around toxicity of tank mixing insecticides with fungicides.

FRAC M: Multi-site Contact Activity: e.g., Captan, Bravo FRAC 3: DeMethylation Inhibitors: e.g., Rally, Tilt



No Effect

Mortality

Chlorantraliprole (e.g. Altacor)

Methoxyfenozide (e.g. Intrepid)

Propiconazole (e.g. Tilt)

Iprodione (e.g. Rovral)

Boscalid + Pyraclostrobin (e.g. Pristine)

Chlorantraniliprole + Propiconazole

Chlorantraniliprole + Iprodione

Methoxyfenozide + Iprodione



"There's no easy money in agriculture, and banging your fist on the table and pointing your finger will put walls up. I want to build bridges."







Do you call the beekeeper if you put a treatment on immediately before bloom?

- A. Yes
- B. Sometimes.
- C. No.

Do you call the beekeeper if you put a treatment on during bloom?

- A. Yes
- B. Sometimes.
- C. No.

How do you figure out if a product is safe to apply to bees (select all that apply)?

- A. Beekeeper.
- B. Crop consultant.
- C. PNW Insect Management Handbook
- D. PNW-591
- E. Label
- F. Other



Where do you have the beekeeper place their colonies (select all)?

- A. A location more than 20ft from the edge of the crop.
- B. I flag locations where I want the colonies dropped.
- C. Away from irrigation equipment.
- D. Away from busy highways.
- E. Wherever the beekeeper wants to put them I don't give specific directions.





Call beekeeper 10 days before plants bloom and indicate:

- Approximate hive delivery date
- Pest control immediately before bloom



Apply pest control prior to bloom:

- Check residual times in PNW-591





Flag locations for honey bee placements. Avoid:

- Close a busy highway or where irrigation water pools.
- Maintain a 20 foot buffer from pesticide spray areas.





Bees should arrive at approximately 10% bloom.



Monitor for pest and disease pressure. If treatment required:

- Contact beekeeper to determine whether colonies should be moved out.
- Restrict spraying to evenings.





Ensure irrigation equipment is not in the path of bee colonies.





Begin moving colonies at 90% bloom


Ensure beekeeper has access to colonies during the entire time colonies are in pollination.



WHAT DID WE LEARN?

BEFORE BLOOM



WHAT DID WE LEARN?

BEFORE BLOOM



AFTER BLOOM



WHAT DID WE LEARN?

BLOOM



What will you change based on what you learned?

- A. More communication with beekeeper around sprays.
- B. Avoiding pesticide use on flowering bee attractive plants in bloom.
- C. Selecting non-toxic pesticides or products with short residual times applied at night.
- D. More attention to avoid drift onto bee habitat.
- E. Using PNW-591 for product selection.
- F. I won't be changing much

