

OBLR Resistance Management in Tree Fruits

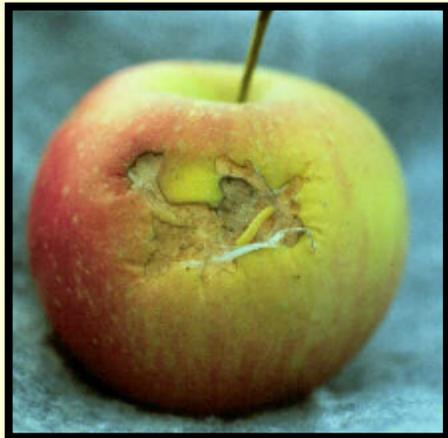


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AgBioResearch



OBLR Damage in Apple

- Overwintering larvae feed on buds, leaves, and flowers
- Also feed on developing fruit causing deformed and scarred fruit
- Summer larvae feed on skin and flesh of apple just below surface

Damage in Cherry

- Not as well documented in cherry
- Overwintering larvae feed on buds, leaves, and flowers
- Summer larvae shelter in rolled leaves.
- No evidence of economically important fruit feeding



- Summer larval generation often coincides with harvest
 - Larvae in tanks!



Conventional Insecticides

Organophosphates

~~Guthion~~

Imidan

Lorsban

Carbamates

Lannate

Synthetic Pyrethroids

Asana

Danitol

Warrior

Baythroid

Battalion

Warrior

New Insecticides for OBLR Control

Spinosyns

Delegate

Entrust*

Diamides

Altacor, Exirel

~~Belt~~ → Harvanta

Pre-mixes

Voliam Flexi (chlorantraniliprole + thiamethoxam)

Voliam Express (chlorantraniliprole + lamda-cyhalothrin)

~~Tourismo~~ (flubendiamide + buprofezin) * OMRI

Avermectins

Proclaim

Insect Growth Regulators

Rimon, Intrepid

Biopesticides

Dipel*, Grandevo*

Venerate*

Insecticides Tested in 2013-15:

1. Field collect OBLR populations from commercial apples.
2. Establish baseline susceptibility values (LD50, LD90)

Insecticides tested in 2013 research:

Mode of action

Active ingredient and brand name

Acetylcholinesterase (AChE) inhibitors

phosmet (Imidan ®)

Sodium channel modulators

bifenthrin (Bifenture ®)

Nicotinic acetylcholine receptors allosteric activators

spinetoram (Delegate®)

Chloride channel activators

emamectin benzoate (Proclaim®)

Inhibitor of chitin synthesis biosynthesis, type 0

novaluron (Rimon®)

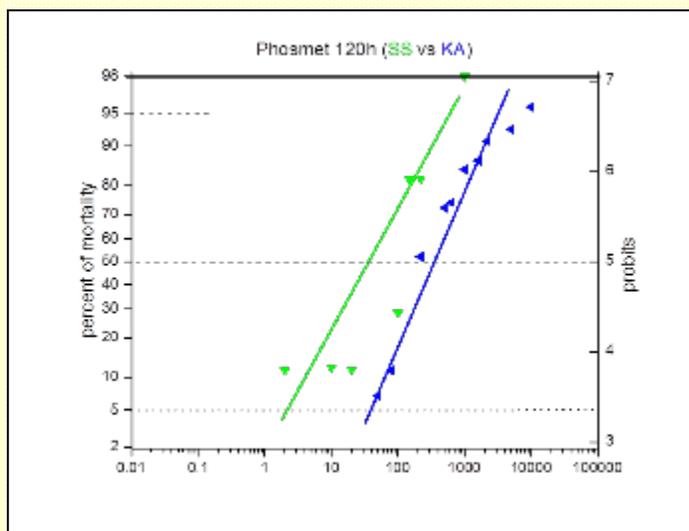
Ryanodine receptor modulator

chlorantraniliprole (Altacor®)

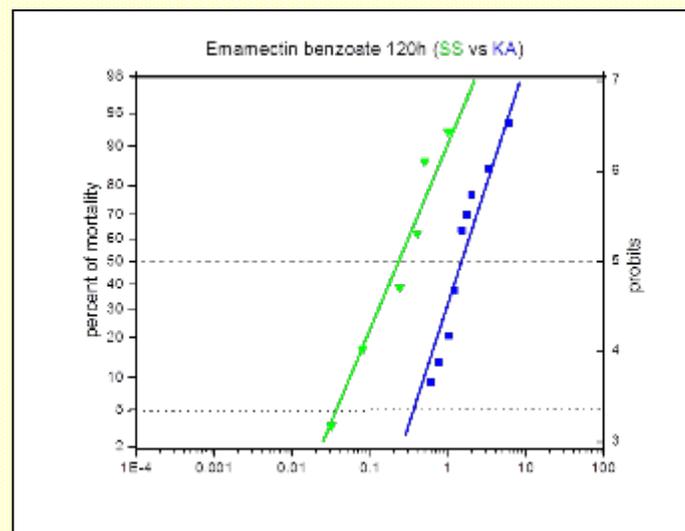


Results from Bioassays in Apple:

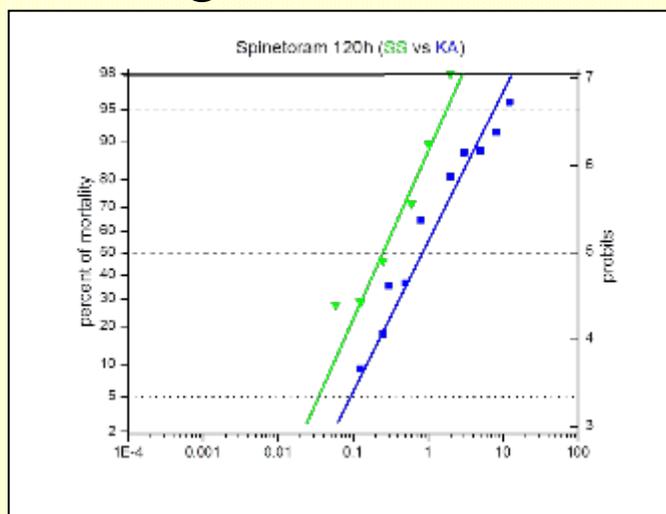
Imidan – 16X RR



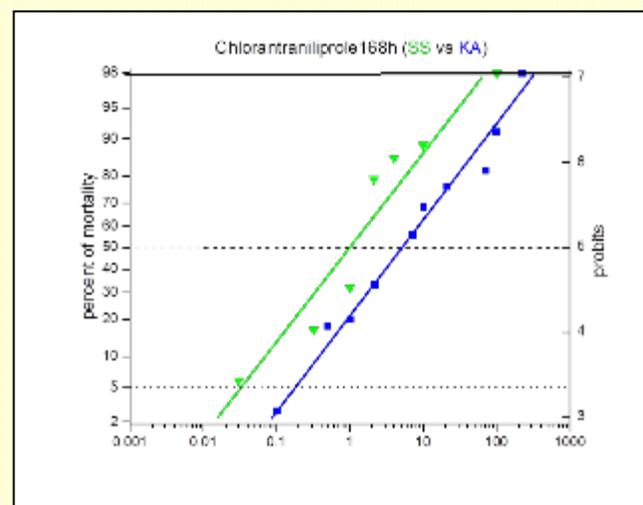
Proclaim – 6.3X RR



Delegate – 5.3X RR

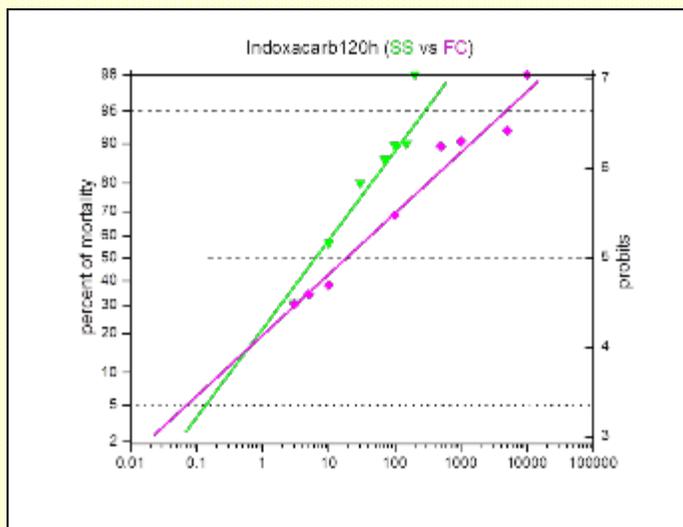


Altacor – 4.7X RR

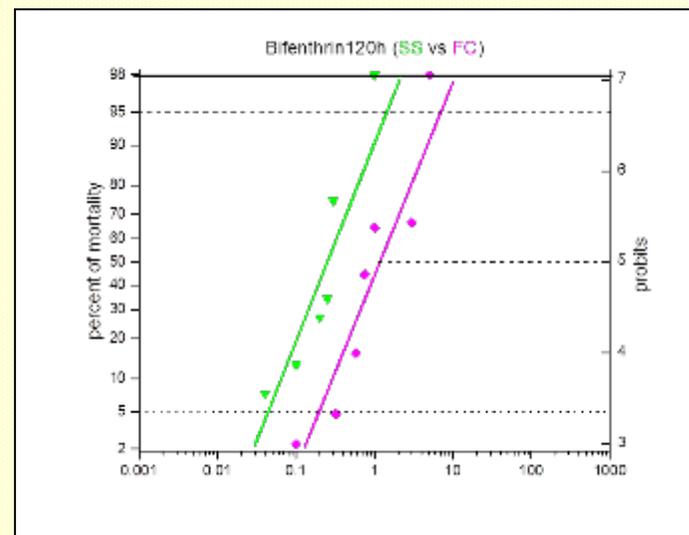


Results from Bioassays in Cherry:

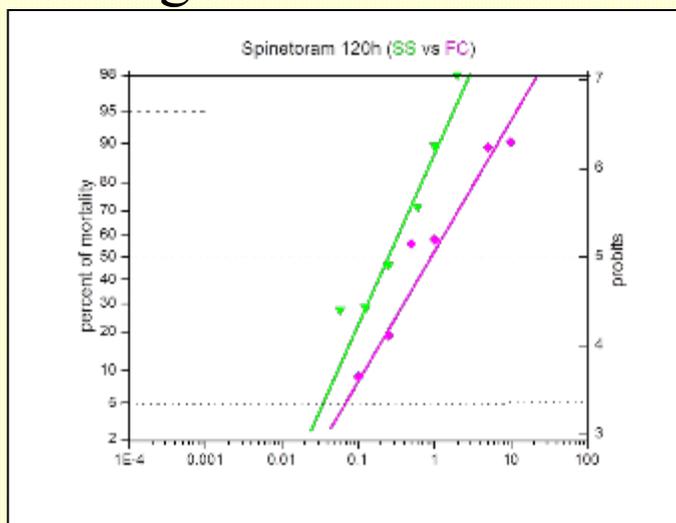
Avaunt – 21X RR



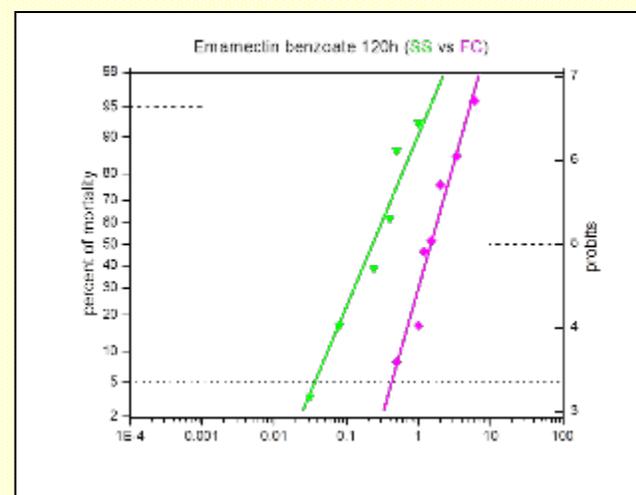
Bifenthrin – 4.9X RR



Delegate – 4.1X RR



Proclaim – 5.8X RR



Orchard-level impact of resistance

cont

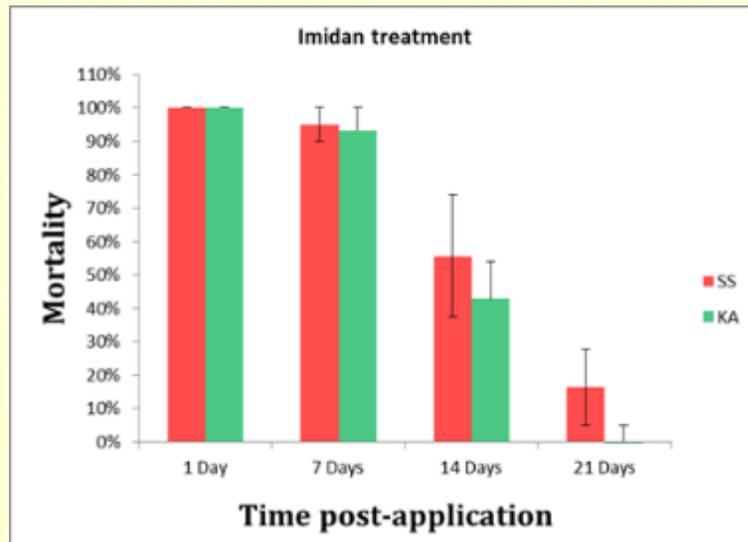
Residual Toxicity Bioassays

- Field spray w/ airblast sprayer at labeled rates.
- Expose OBLR larvae to apple leaves at 1, 7, 14, 21 post application
- Measure mortality in lab
- Collect parallel residue samples for analysis

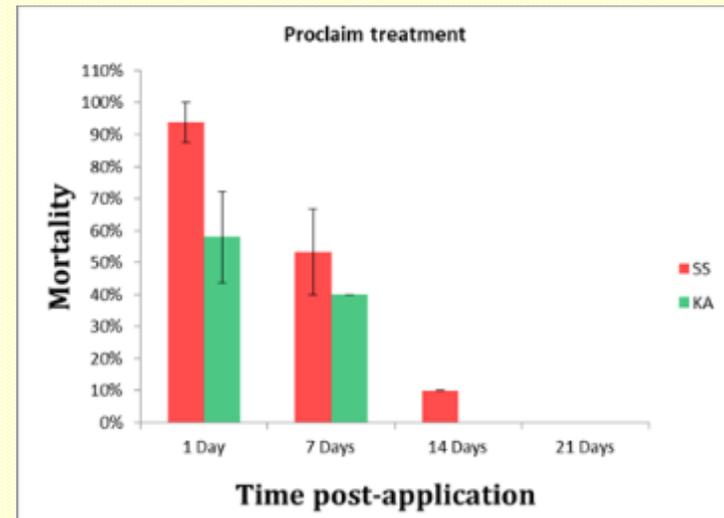


2015 orchard-level impact of resistance

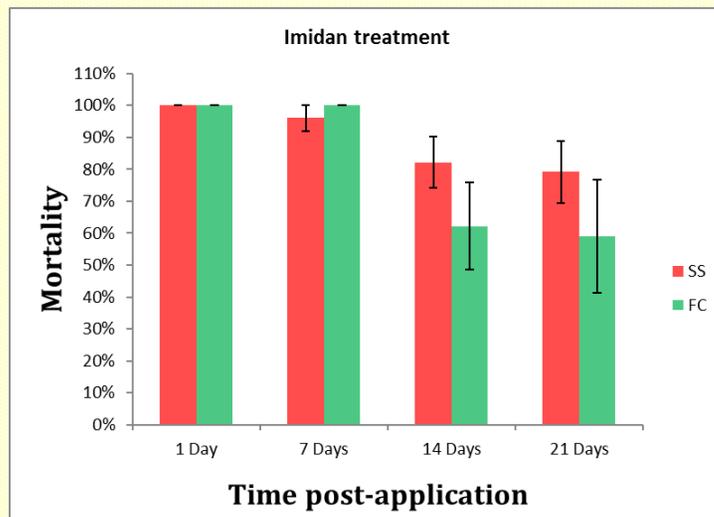
Imidan – 16X RR Apple



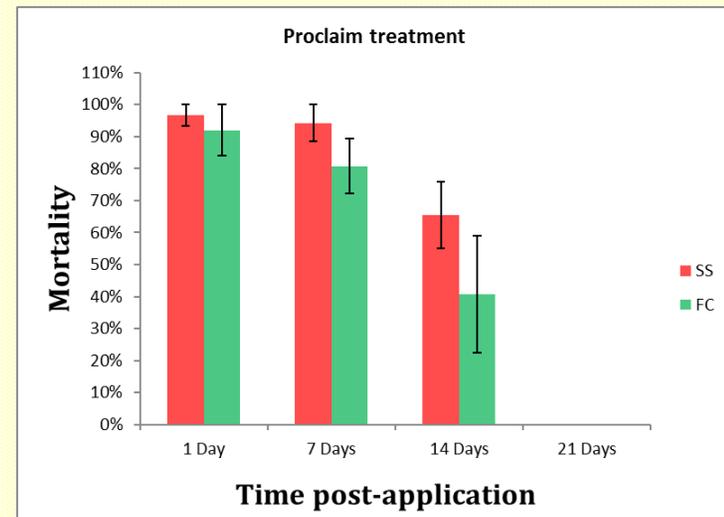
Proclaim – 6.3X RR Apple



Imidan – 2.5X RR Cherry

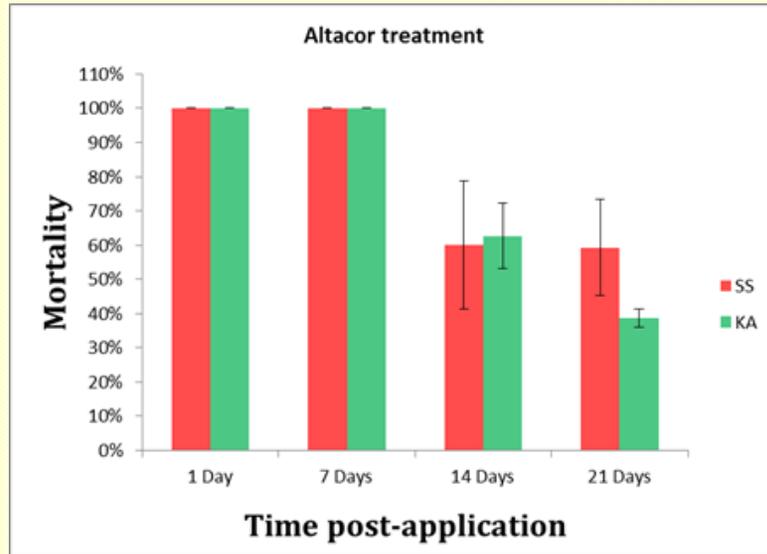


Proclaim – 5.8X RR Cherry

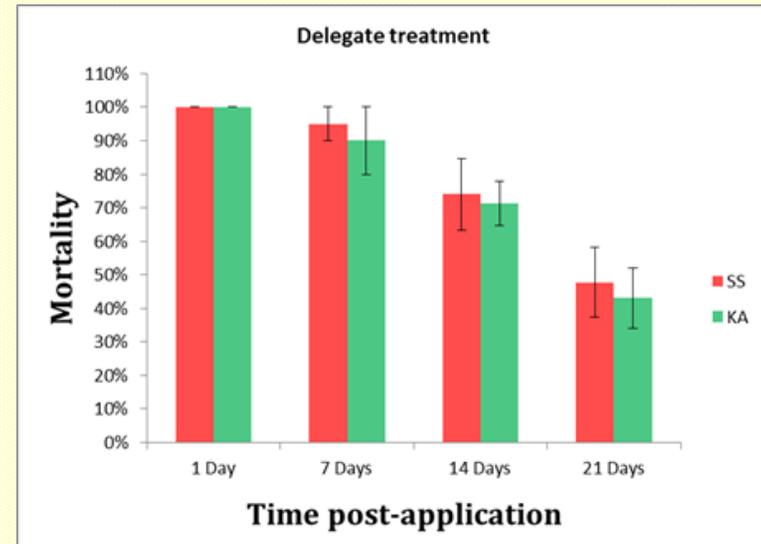


2015 orchard-level impact of resistance

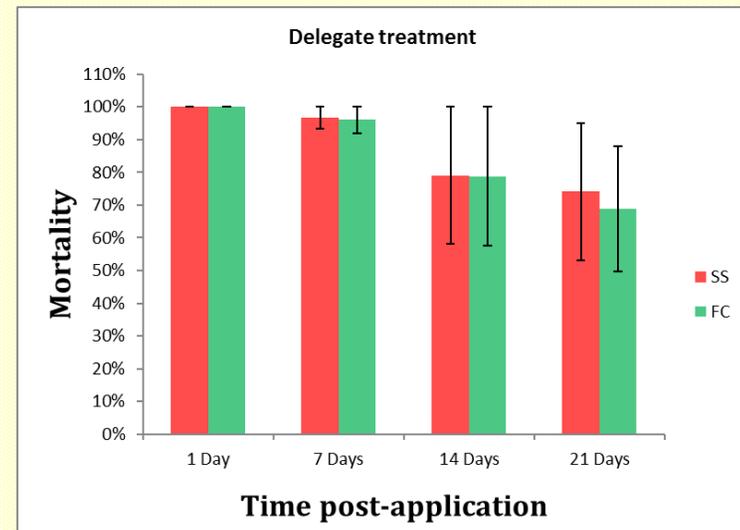
Altacor – 4.7X RR Apple



Delegate – 4.3X RR Apple



Delegate – 4.1X RR Cherry



Early Season Options for OBLR Control in Apples

Compound	OBLR	Plum Curculio	Codling moth
OPs	poor	excellent	poor
Carbamates	fair	good	fair
Pyrethroids	good	fair	fair
Rimon	excellent	fair-good	excellent
Delegate	excellent	fair-good	excellent
Entrust	excellent	poor	fair
<i>Bts</i>	good	poor	poor
Proclaim	excellent	poor	good
Diamides	excellent	poor-fair	excellent
Voliam Flexi	excellent	good-excellent	excellent

Summer Options for OBLR Control in Apples

Compound	OBLR	OFM	AM
OPs	poor	excellent	excellent
Carbamates	fair	fair	fair
Pyrethroids	good	fair	fair
Rimon	good	good	fair
Delegate	excellent	excellent	good
Entrust	excellent	fair	fair
<i>Bts</i>	good	poor	poor
Proclaim	excellent	fair	poor
Altacor/Belt	excellent	excellent	fair
Exirel/Harvanta	excellent	excellent	excellent
Voliam Flexi	excellent	excellent	excellent

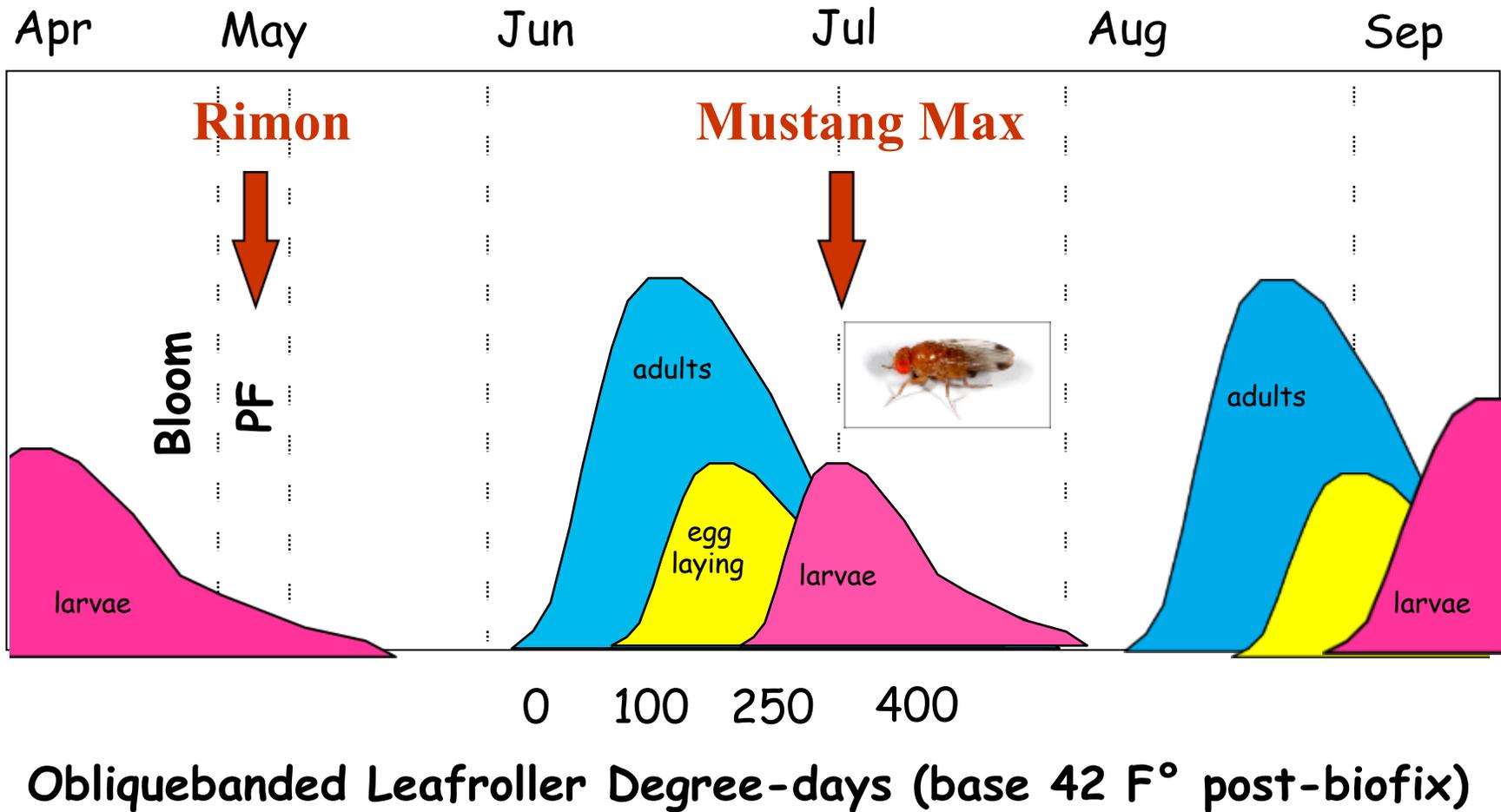
Early Season Options for OBLR Control in Cherries

Compound	OBLR	Plum Curculio
OPs	poor	excellent
Carbamates	fair	good
Pyrethroids	fair	fair
Rimon	excellent	good (sublethal)
Delegate	excellent	fair (ingestion-active)
Entrust	excellent	poor
<i>Bts</i>	good	poor
Proclaim	excellent	poor
Diamides	excellent	fair-good
Voliam Flexi	excellent	good-excellent

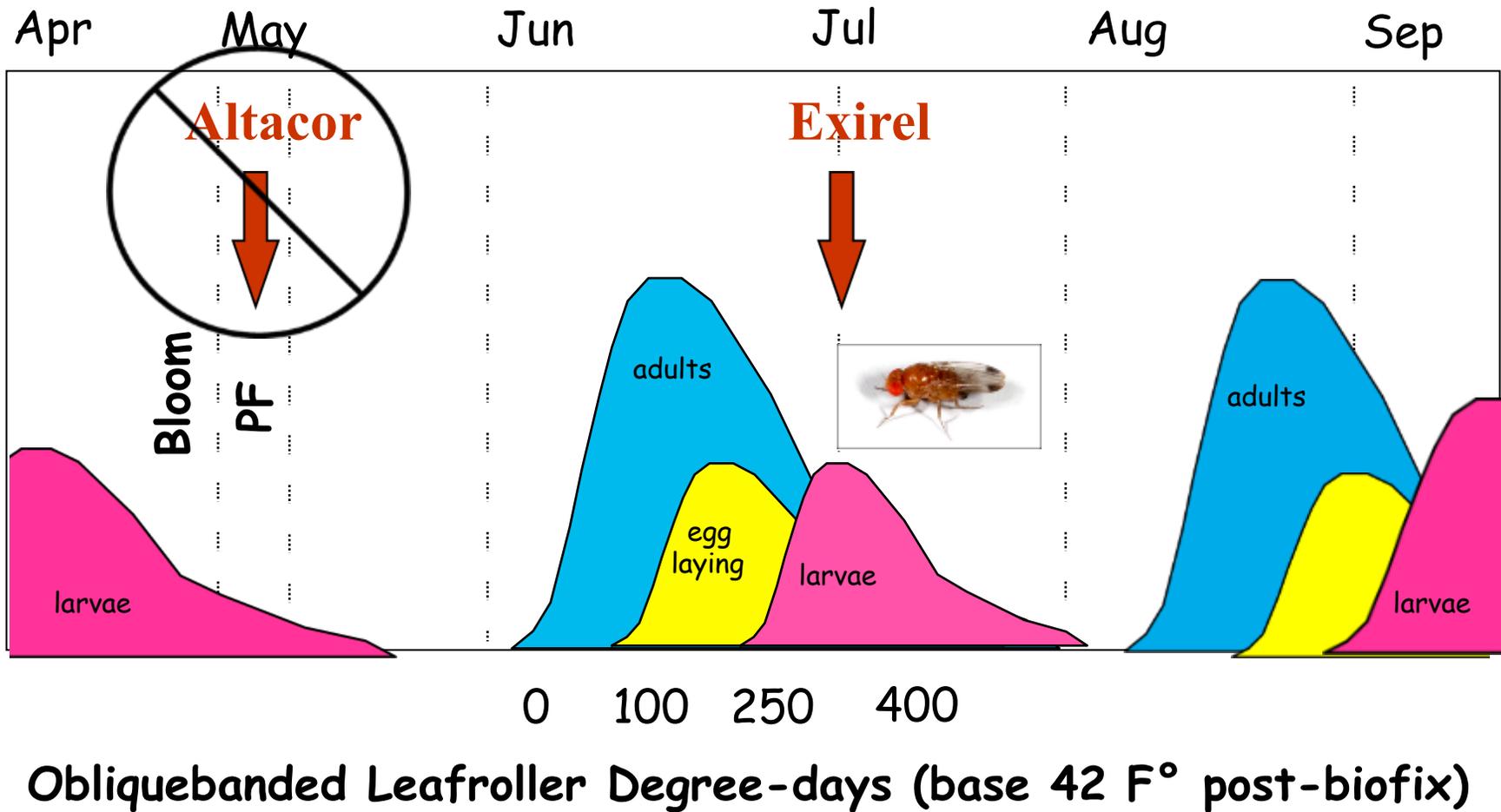
Pre-harvest Options for OBLR Control Cherries

Compound	OBLR	SWD	CFF
OPs	poor	excellent	excellent
Carbamates	fair	good	fair
Pyrethroids	fair	excellent	fair
Rimon	excellent	fair-good	good
Delegate	excellent	good	good
Entrust	excellent	excellent	fair
<i>Bts</i>	good	poor	poor
Proclaim	excellent	poor	poor
Altacor	excellent	-	good
Exirel/Harvanta	excellent	excellent	excellent
Voliam Express	excellent	excellent	excellent

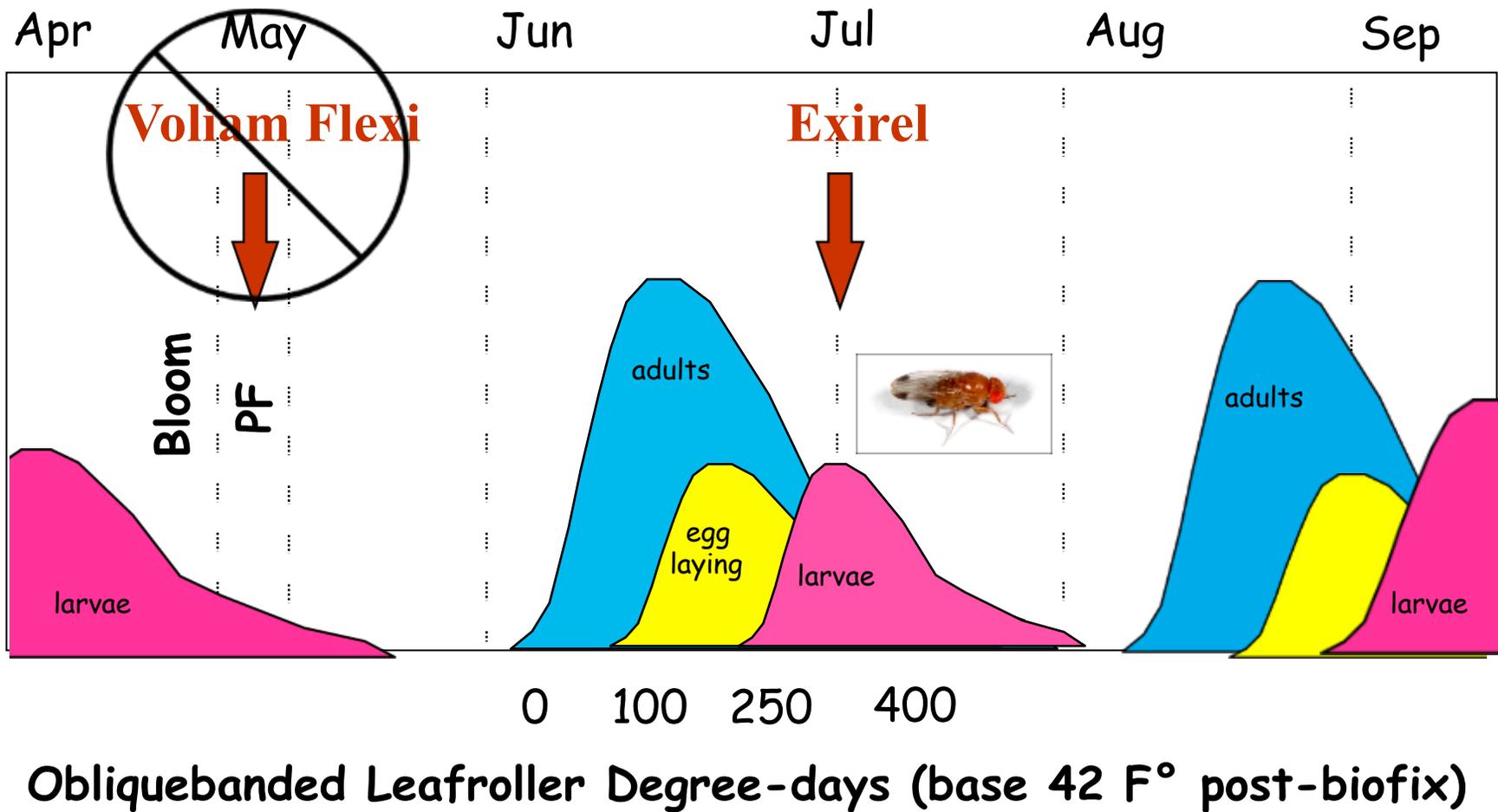
Seasonal Program Under Resistance Management In Cherries



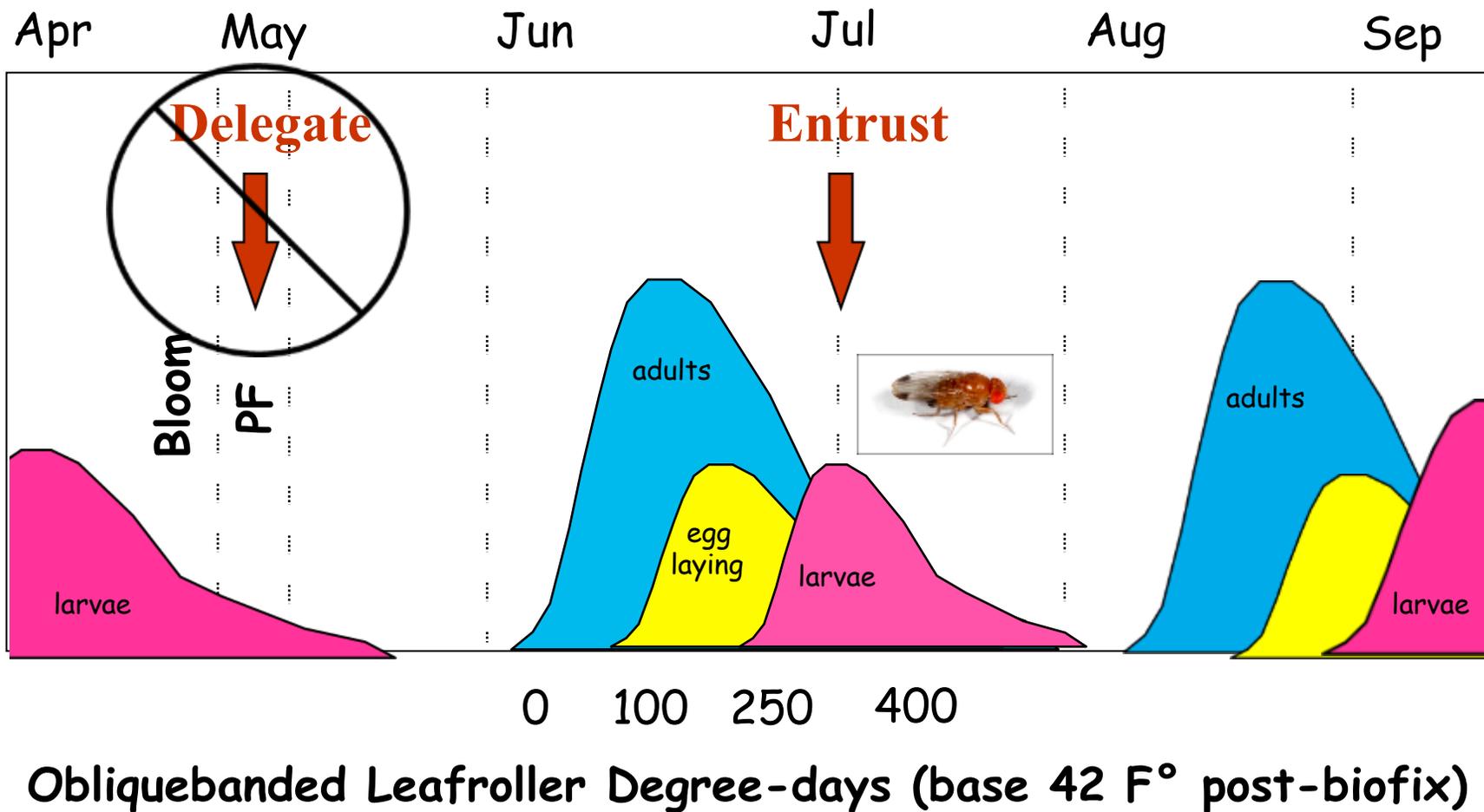
Seasonal Program Under Resistance Management In Cherries



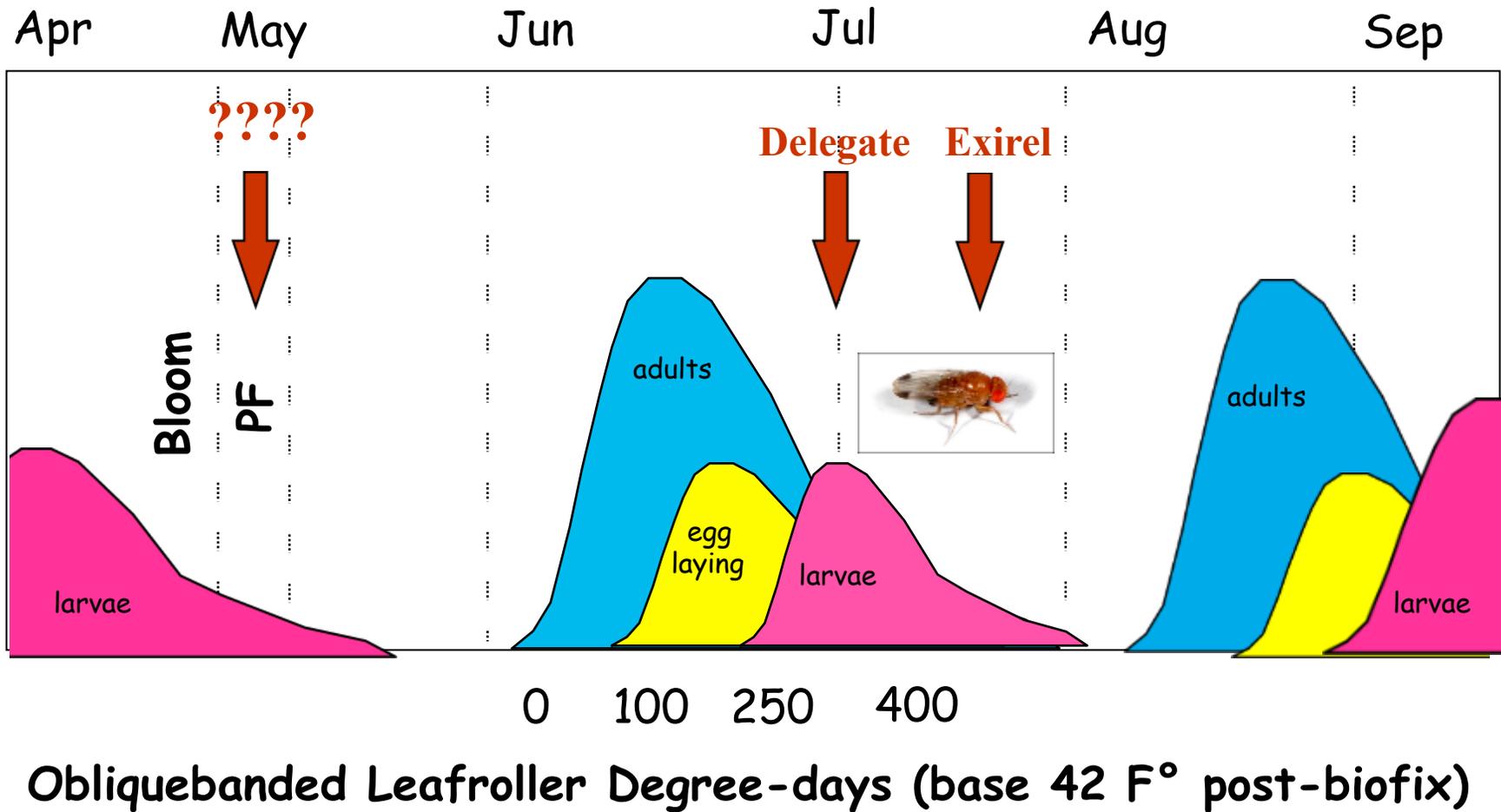
Seasonal Program Under Resistance Management In Cherries



Seasonal Program Under Resistance Management In Cherries



Seasonal Program Under Resistance Management In Cherries



Products without Resistance Management Compatibility Issues

OBLR only

- Intrepid
- *Bts*
- Proclaim

SWD only

- Apta
- Grandevo
- Movento
- Neonicotinoids

Conclusions

- OBLR is showing signs of low-level resistance in Michigan apples and cherries.
- Orchard-level symptoms of resistance include lower mortality and reduced residual control.
- Use rotation of materials (according to MOA) to limit progression of resistance.
- Be aware of how sprays targeting other pests will impact OBLR resistance if/when are exposed.

The TNRC staff say thank you to the
Michigan Apple Committee
Michigan Cherry Committee &
Project GREEN
for making this research possible

