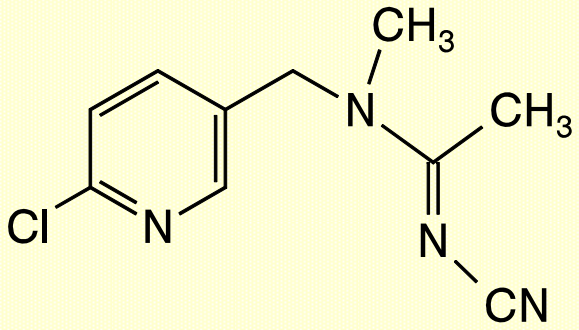
The Practice of IRM in Eastern Fruit Crops



John C. Wise, Ph.D. &

David Mota-Sanchez, Larry Gut and Mark Whalon

MSU Department of Entomology

Primary Insect Pests of Apples

CM

OFM

PC

AM

OBLR

Secondary Insect Pests of Apples

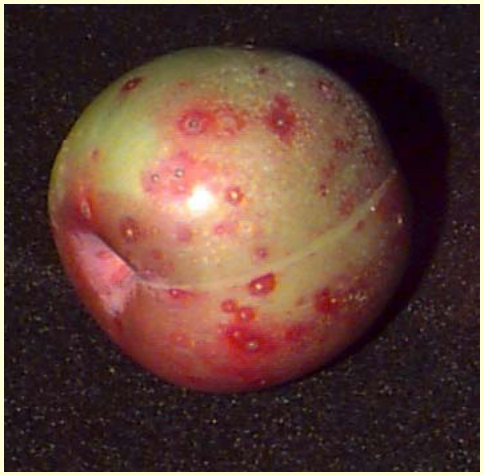
WALH

STLM

RAA

PLH

SJS



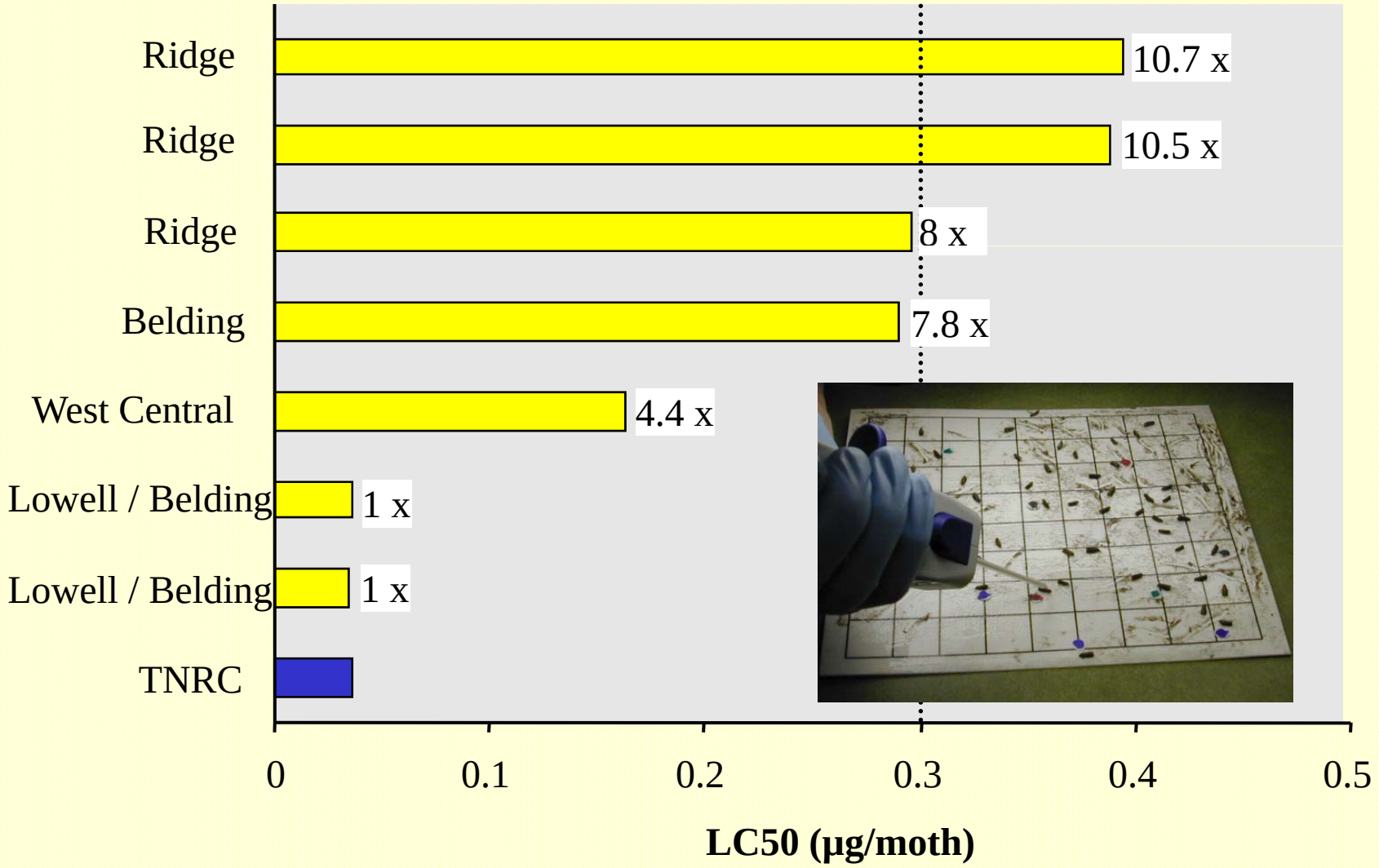
WAA

Primary Drivers of Apple IPM Programs in Michigan

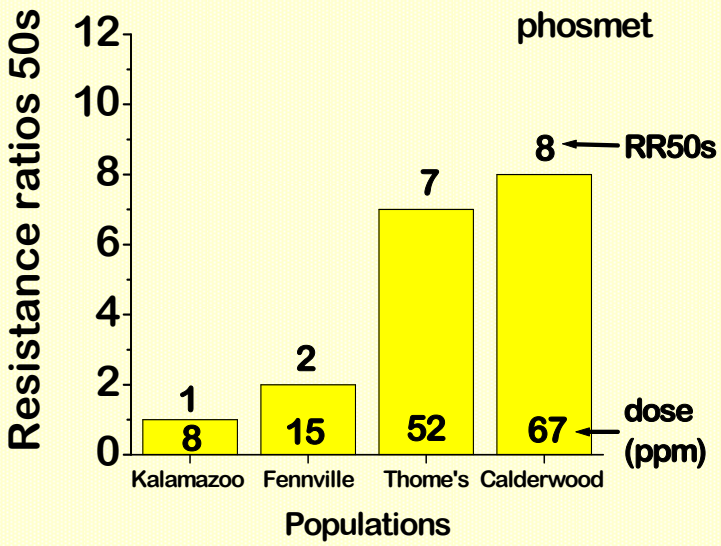
- Control of key direct pest: Codling moth.
- Control other direct pests (OBLR, OFM, PC, AM).
- Manage secondary pests when needed.
- Develop programs that are economically sustainable.
- Optimize strategies for resistance management

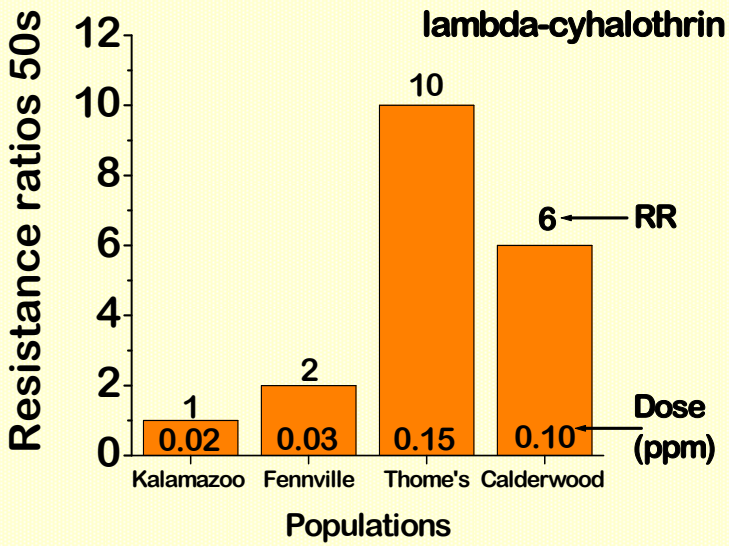
Rejected loads: 2000 - 2004

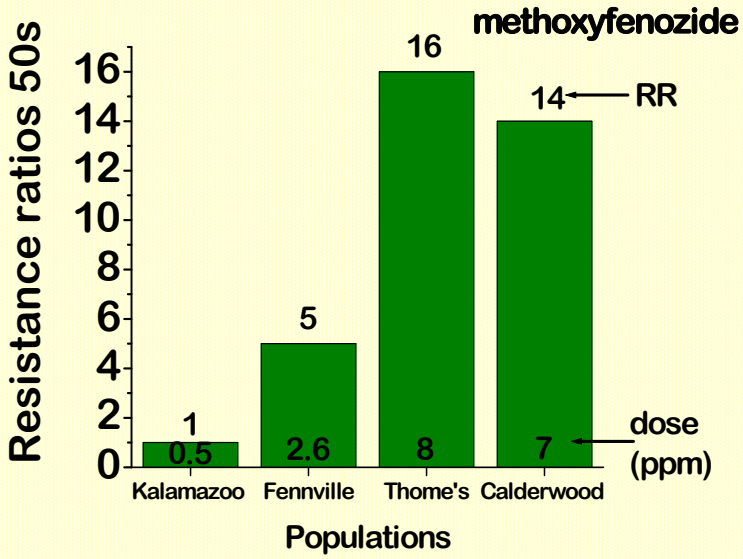
CM Susceptibility to Azinphosmethyl in MI, 2001

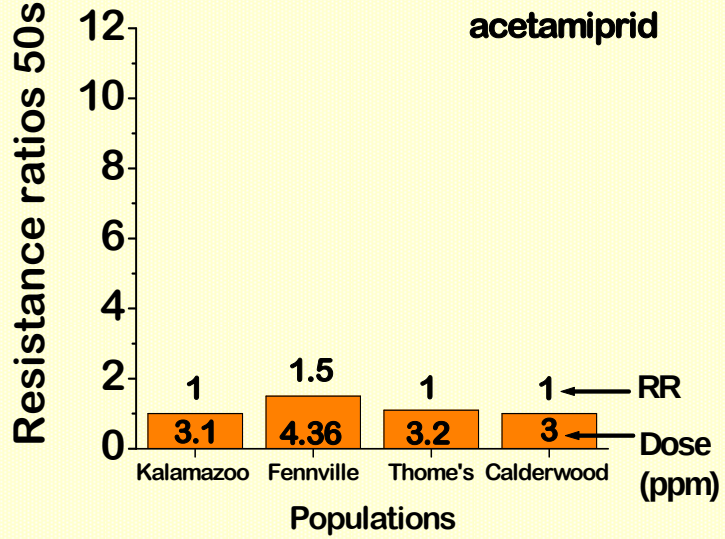


Awareness of Cross Resistance









(Mota-Sanchez et al. 2008. *Pest Manag Sci* 64:881–890.)

Criteria for Successful IRM Programs

- Select high performance tools for CM control.
- Rotate insecticide MOA between generations.
- Select complementary partners within a given CM generation:
  - Optimize CM control
  - Cover secondary pests

Codling Moth Control Options

1st Generation

- Rimon
- Calypso/Assail/Clutch
- CM virus
- Delegate
- Altacor/Belt
- Organophosphates
- Pyrethroids
- Voliam flexi
- Tourismo
- Leverage

2nd Generation

- Rimon
- Calypso/Assail
- Delegate
- Altacor/Belt
- Organophosphates
- Voliam flexi

Relative activity spectrum for new materials - Apple

Insecticide	CM	OFM	OBLR	PC	AM	STLM	RAA	LH	SJS	TPB
Avaunt	**	**	*	***	*		*	*		**
Intrepid	**	**	***			**				
Movento						**	***	**	***	
Esteem	**	*	*			**	**		***	
Rimon	***	***	**	*	*	*				
Assail	***	***		***	***	***	***	***	**	**
Calypso	***	***		***	***	***	***	***	**	**
Delegate	***	***	***	*	**	**			*	
Proclaim	**	**	***			**				
Altacor	***	***	***		*	**		*		
Belt	***	***	**		*	**		*		

Partnering for Broad Spectrum Control

Spring:

CM + PC + aphids

- Neonics/CM virus
- Neonics /Altacor
- Voliam Flexi

OBLR +CM

- Rimon / Delegate
- Rimon / Belt
- Proclaim / Neonics

Summer:

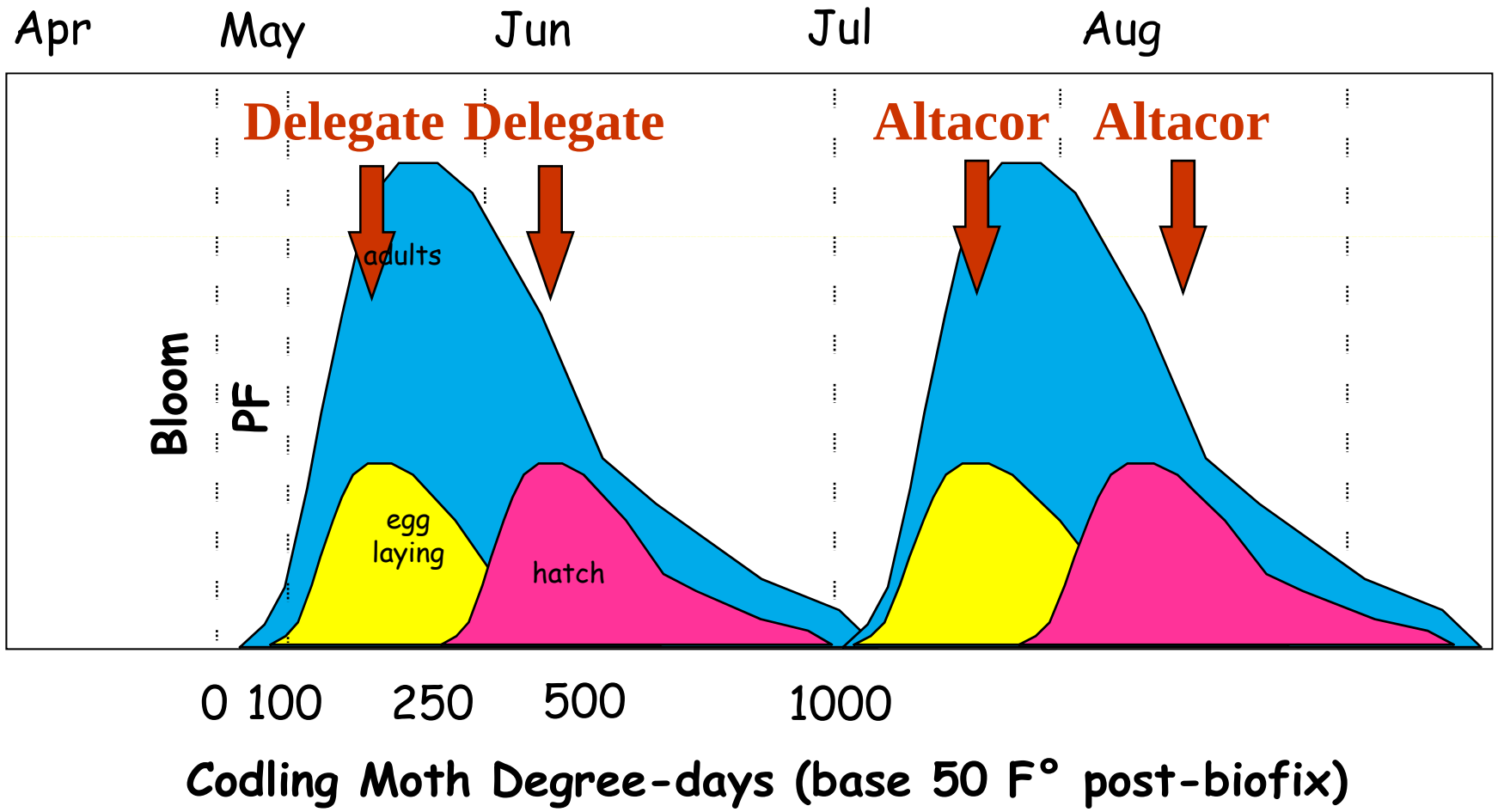
CM/OFM + AM + STLM

- Voliam flexi / Altacor
- Neonics/ Delegate
- Neonics / Belt

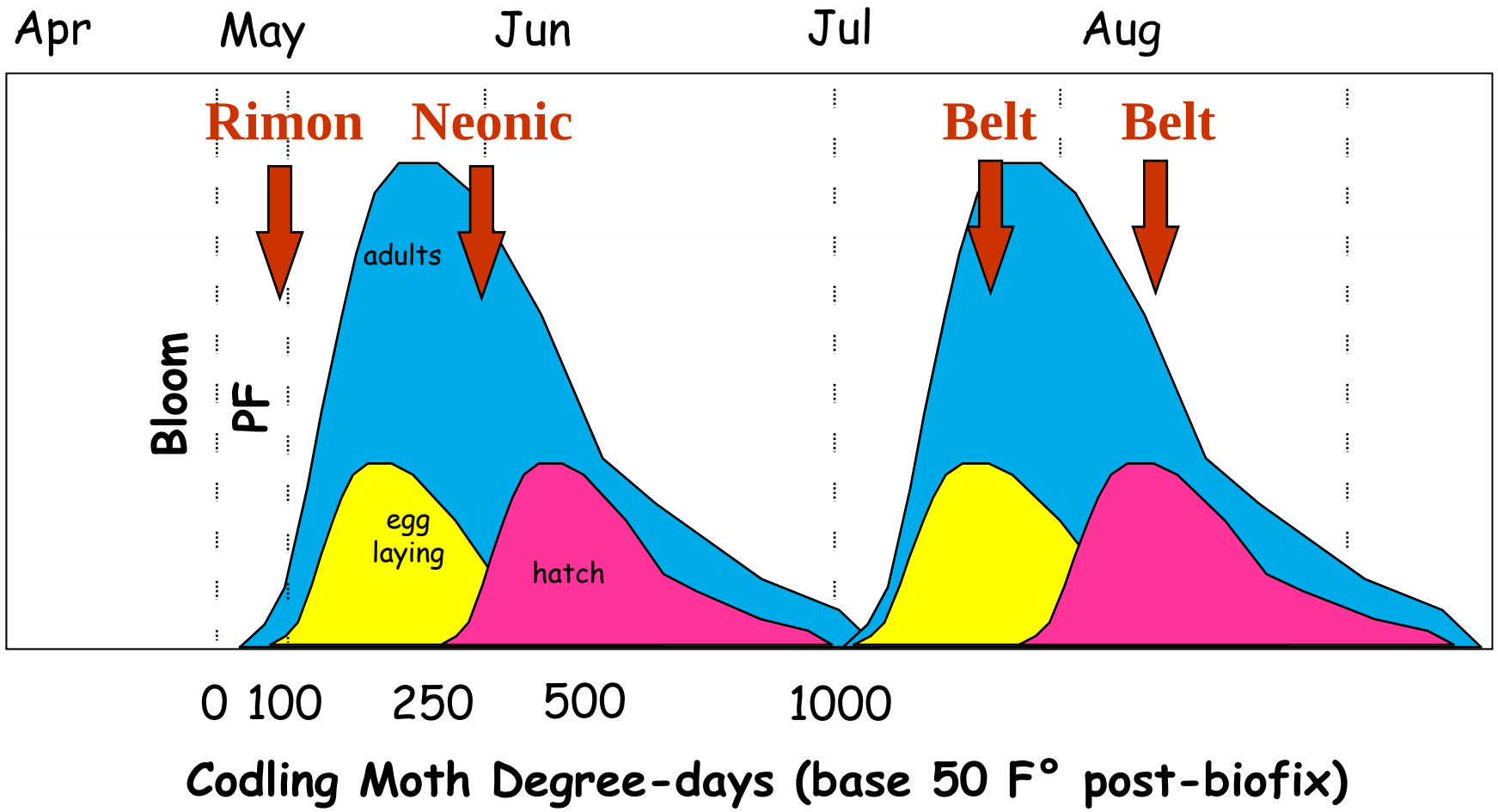
CM/OFM + SJS

- /Assail
- Belt/Tourismo
- Leverage/Warrior

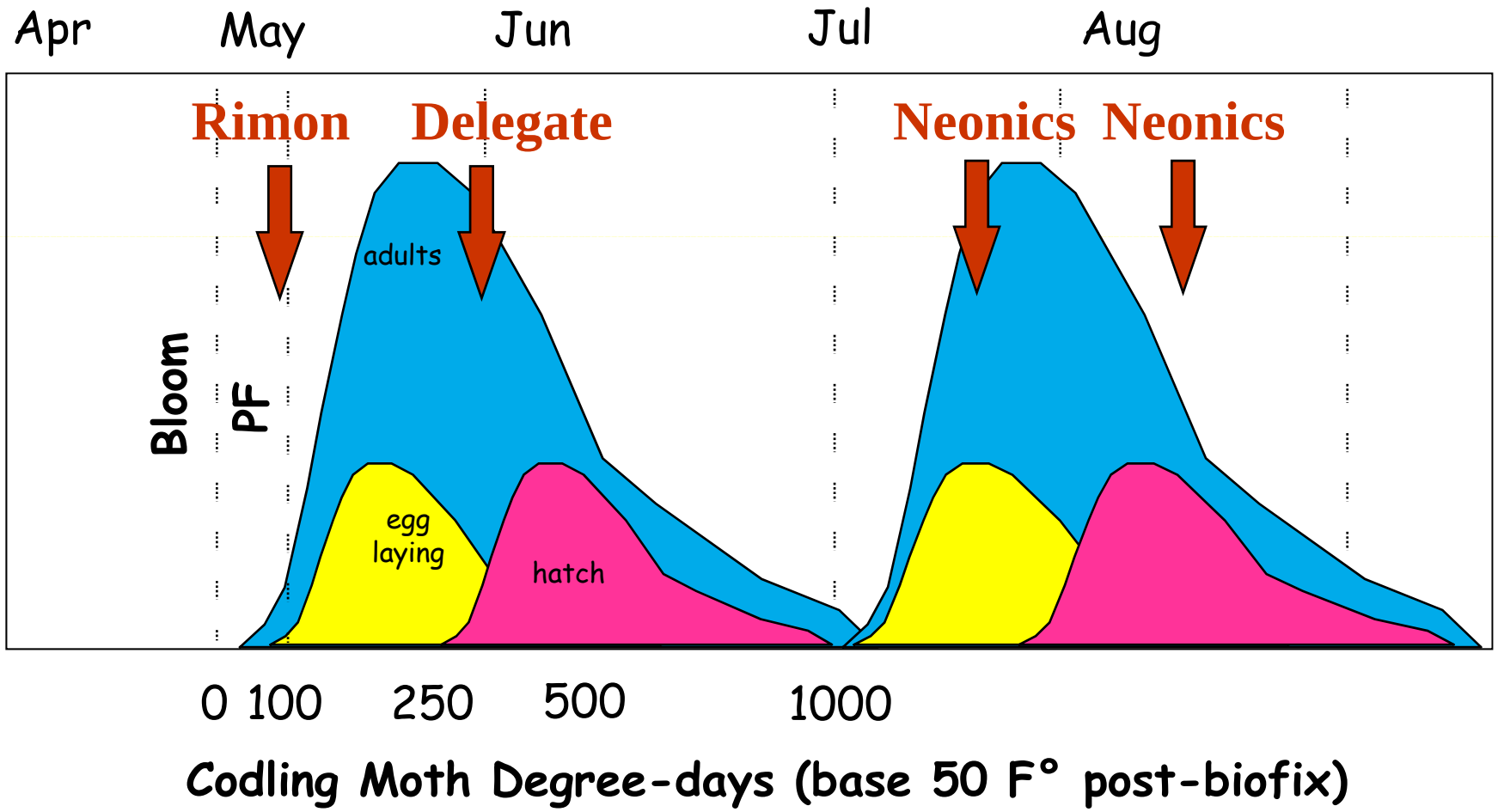
Seasonal Program Under Resistance Management



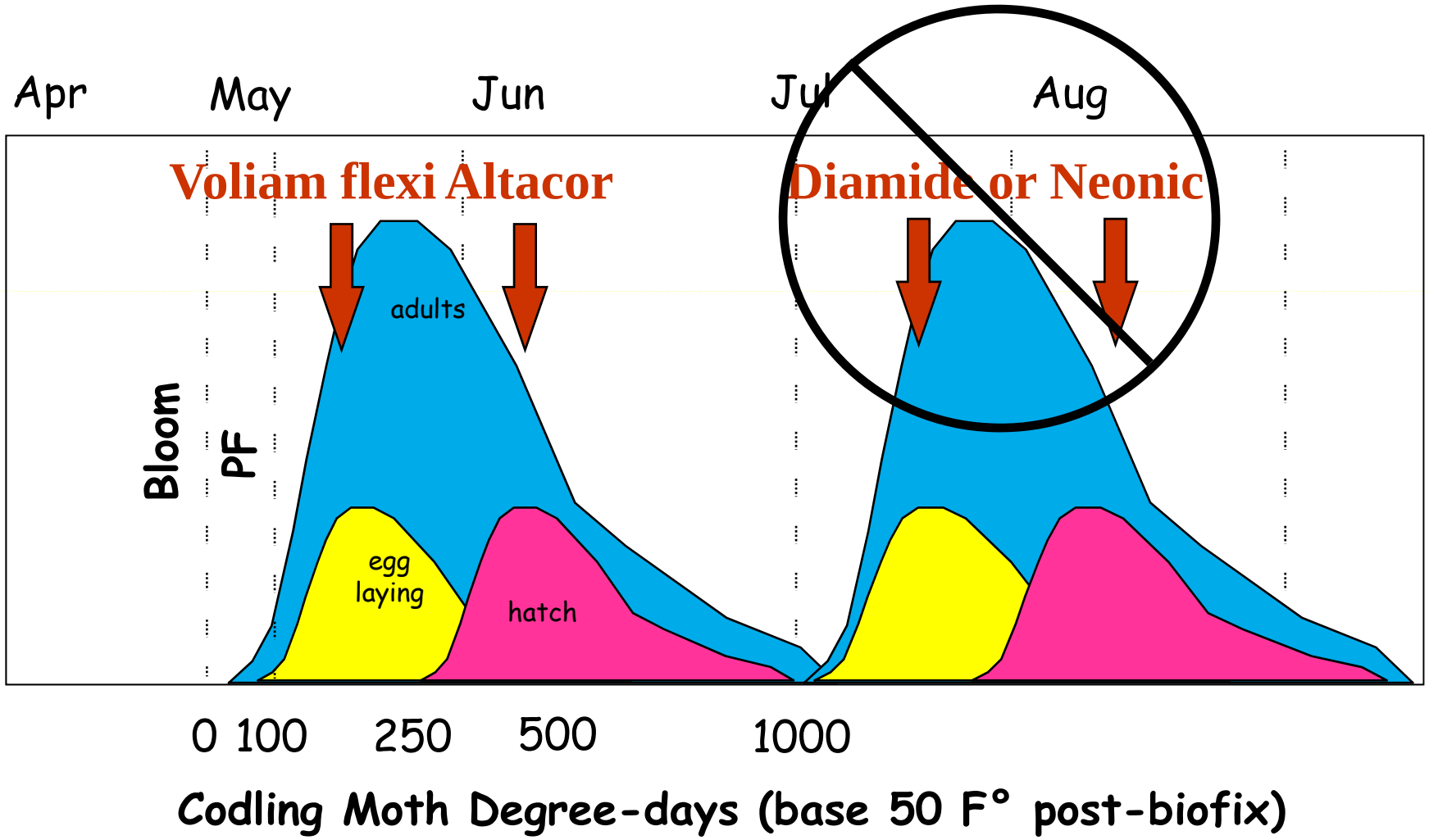
Seasonal Program Under Resistance Management (with OBLR, PC, and aphids present)



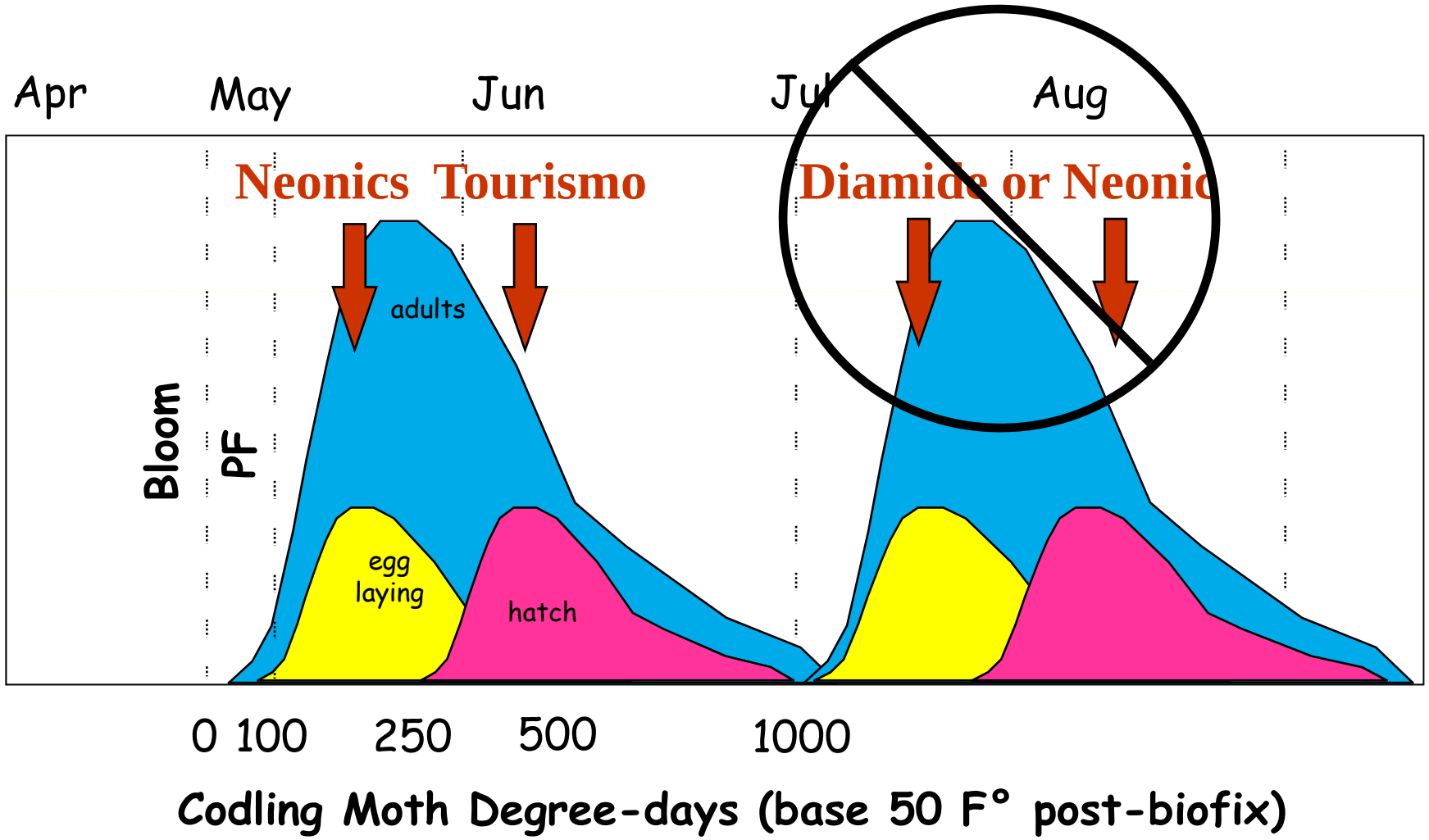
Seasonal Program Under Resistance Management (with OBLR and apple maggot, SJS present)



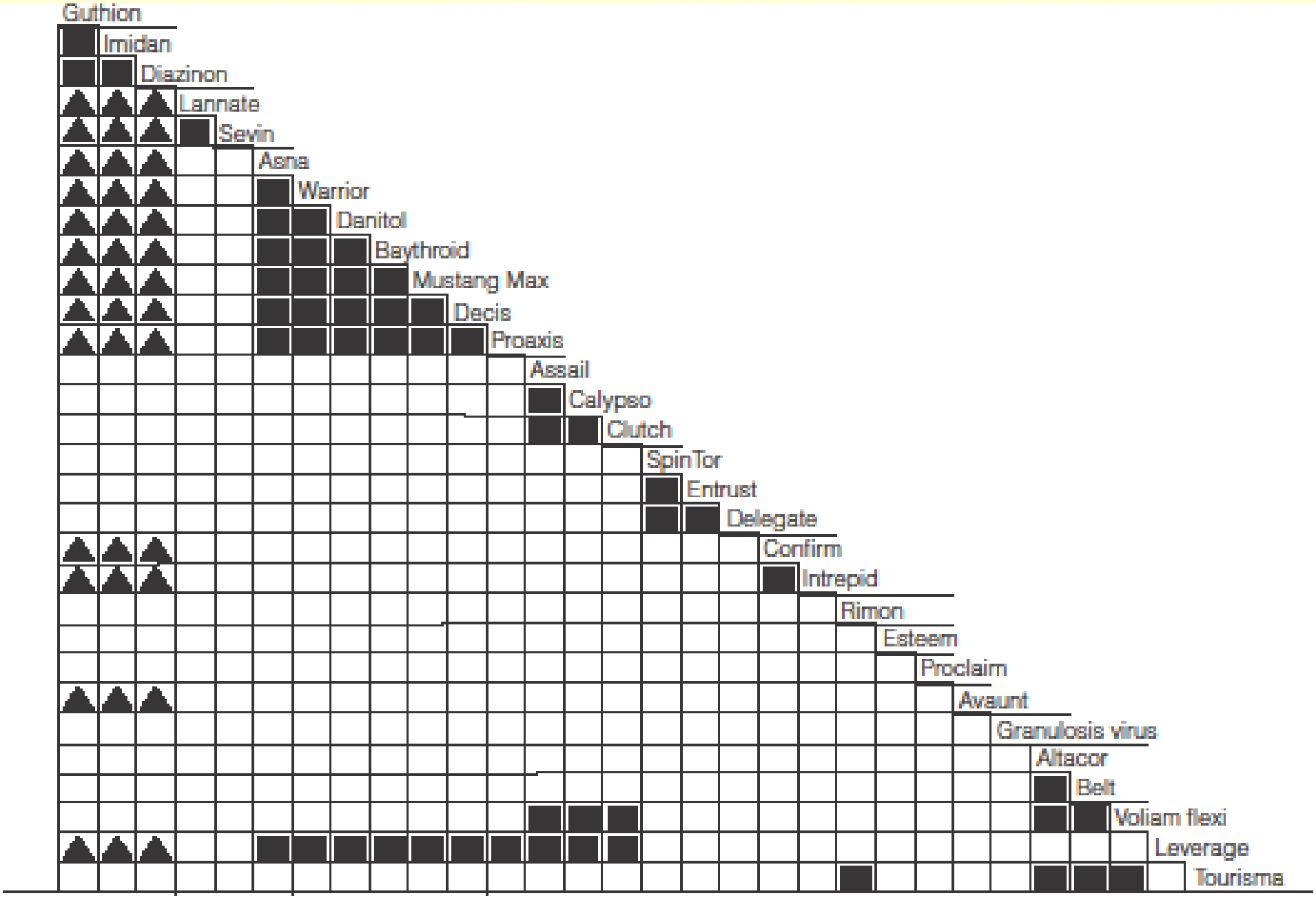
Seasonal Program Under Resistance Management



Seasonal Program Under Resistance Management



Resistance Management Incompatibility Chart



Resistance Shortens Residual Activity of Insecticides

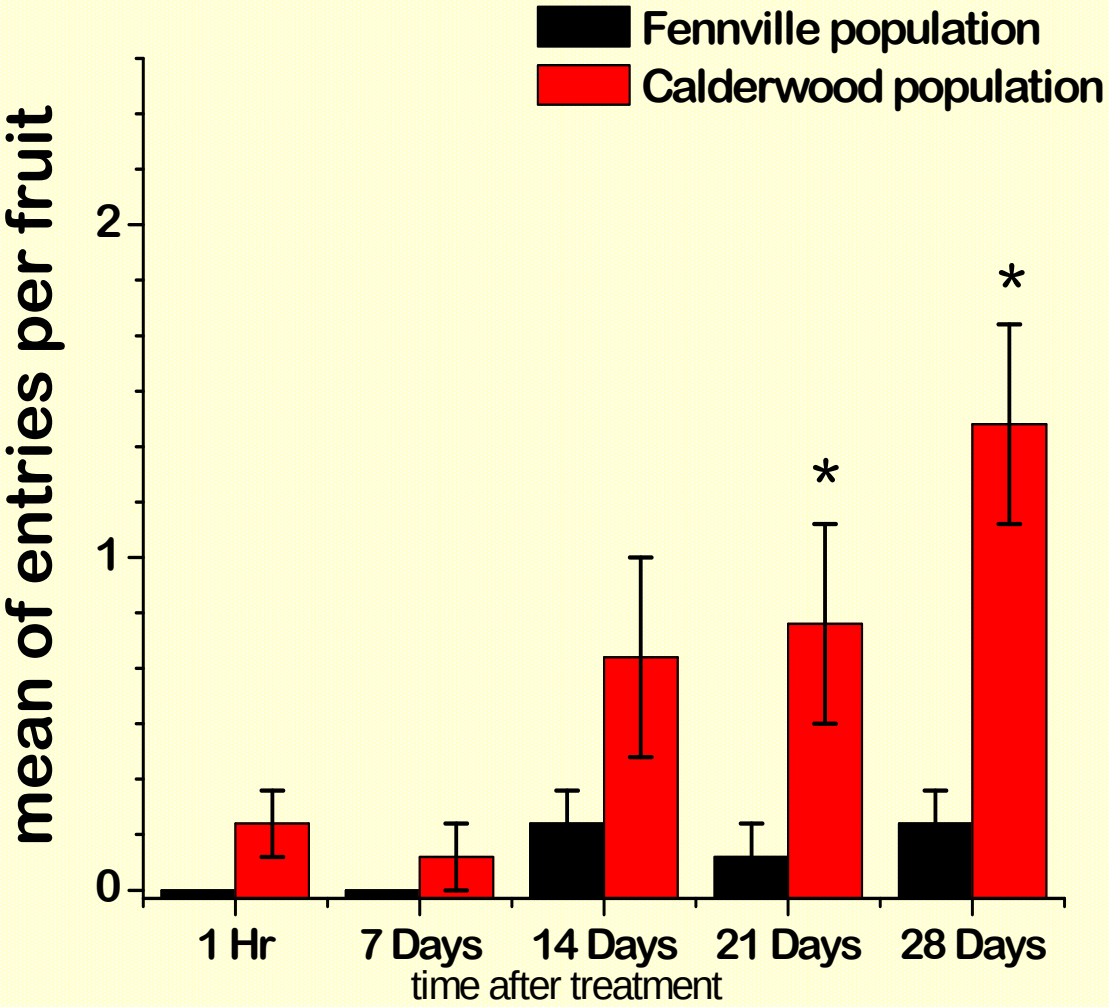
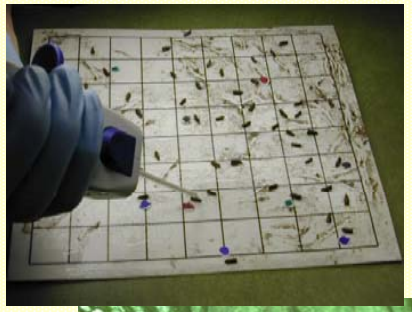
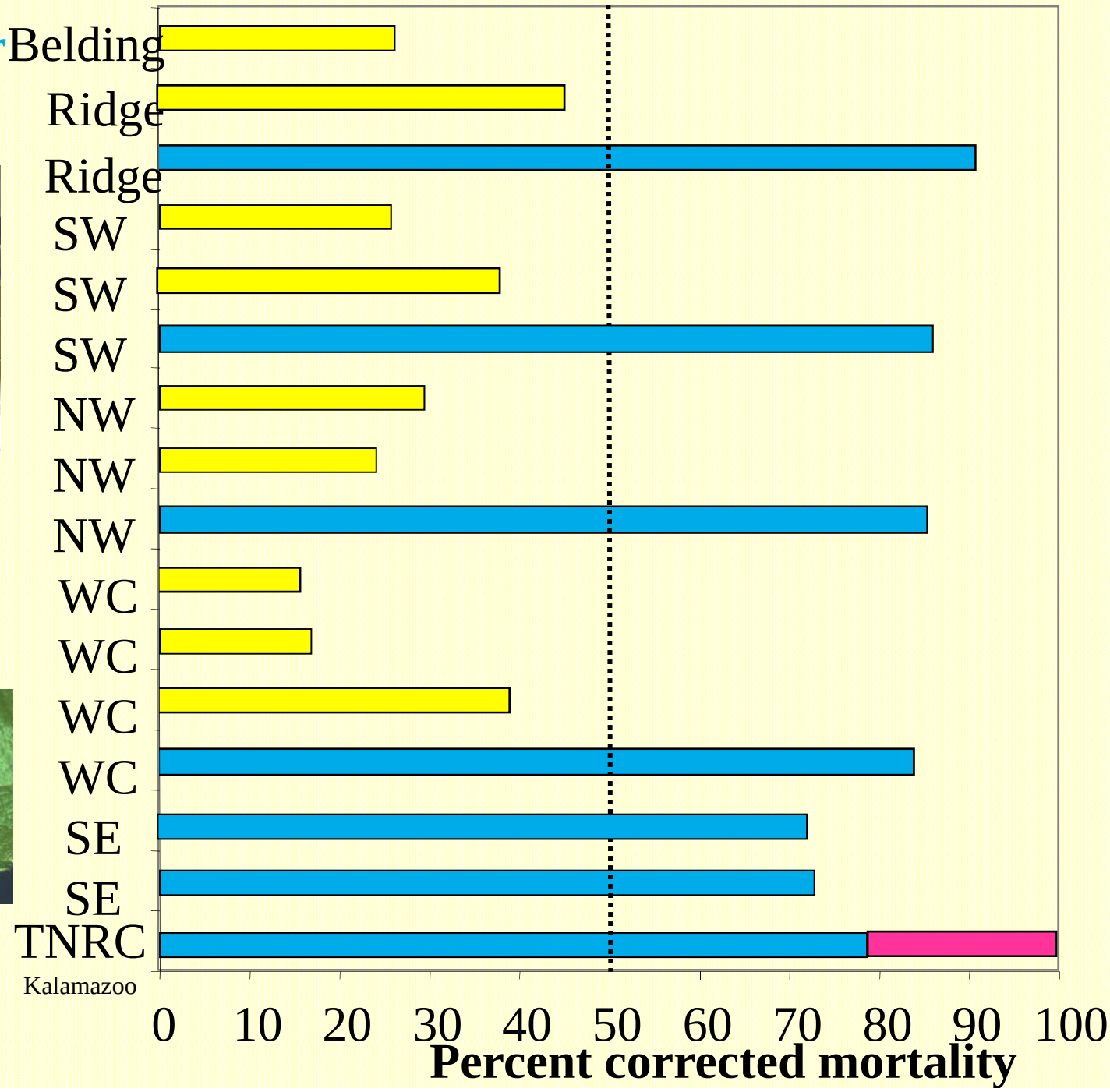


Fig 2. Mean and SE of codling moth larval entries in fruit exposed to infestation of the Fennville and Calderwood populations after a spray of azinphos methyl(Guthion 50 WP, 1.12 kg AI / ha).

(Mota-Sanchez et al. 2008. *Pest Manag Sci* 64:881–890.)

Monitoring for Resistance





IRM Concerns

- All's Quiet on the "secondary pest" front?
- Compounds targeting secondary pests may contribute to Codling Moth selection pressure?
- Differences in life-stage susceptibility and expression of resistance.
- Mechanisms responsible for cross-resistance and field tolerance?