M strategies for oriental fruit moth manageme

iental Fruit Moth

Native to China; introduced about 1913

Hosts include peach, apple, pear, plum, cherry, apricot, nectarine

Egg laid on leaf surface

Larva is damaging stage

- tunnel in shoots & fruit
- 4-5 instars, ranging from 0.06 to 0.5”; OW stage

Pupa

- small, 3/8” brown, in silk cocoon

Adult is small, 1/4”, dark moth

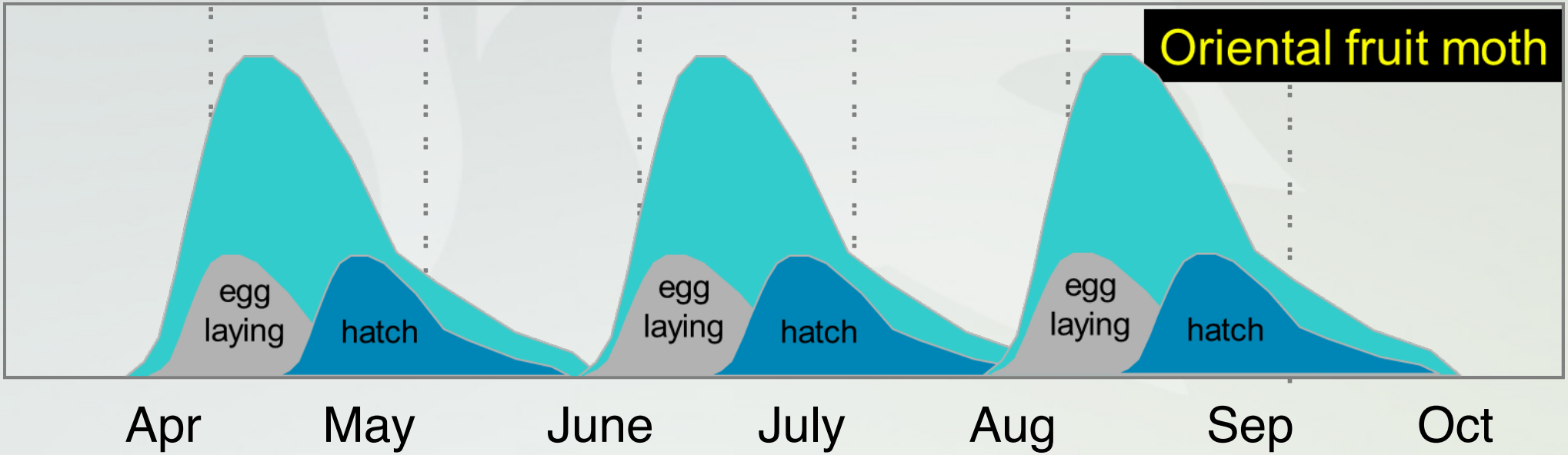
M Life Cycle in MI

OW as mature larvae in silken cocoon

Early spring = pupate & moths emerge

- late April-early May

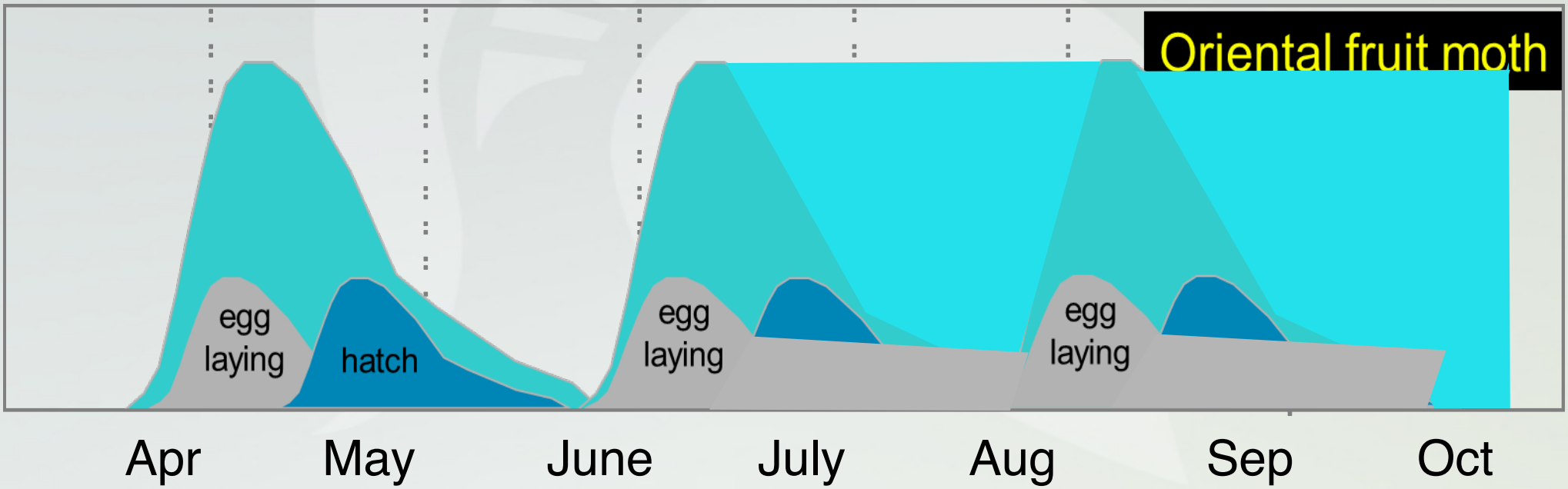
3-5 overlapping gen/yr



M Life Cycle in MI

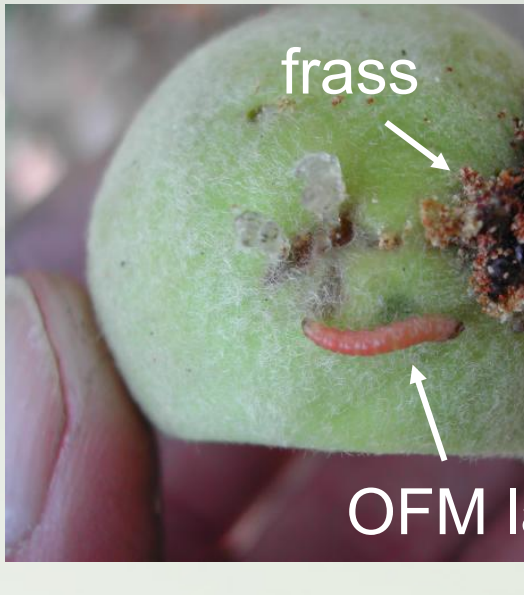
3-5 overlapping gen/yr

- 1st gen. most uniform life stages
- following generations s p r e a d o u t



FM Injury

- 1st gen feed on shoots
- enter at leaf axil and tunnel into shoot; flagging/shepherd's crook
- damage to young trees can cause prolific shoot development
- tunnel directly into fruit or enter via stem
- frass and gummy exudate
- young fruit may drop



Severe shoot flagging

OFM/CM worms in harvested apples SW Michigan

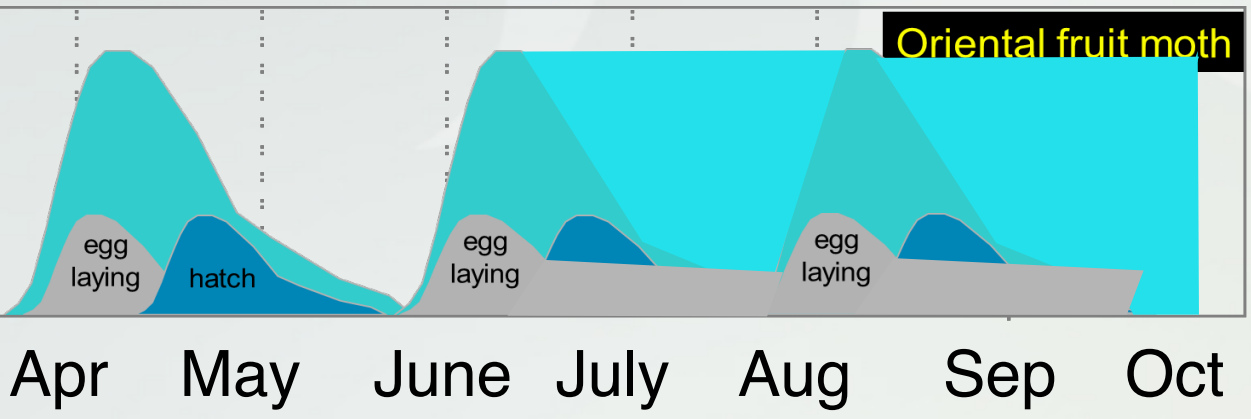
Totals of 67 - 334 worms/yr detected in loads

Larvae from rejected loads

	%CM	%OFM
• 2001	60	40
• 2002	48	52
• 2003	79	21
• 2004	75	25
• 2005	74	26

easons for OFM control failure

- verlapping later generations
  - multiple stages present
- reatments not timed right
  - poorly timed based on “general” trapping info
- reatment gaps
  - stretching sprays; rain washoff
- educed pesticide efficacy



FM Management – Chemical Control

1st step for chemical control

- establish biofix with pheromone trap
- degree day model

2010 Model in Peach

	GDD Base 45°F Post Biofix	Event	Action
	0 GDD = BIOFIX	1st sustained moth captures	Set GDD = 0 (This is BIOFIX)
1st Brood	170-195 GDD 350-375 GDD	10-15% egg hatch 55-60 % egg hatch	1st treatment if warranted
2nd Brood	1,150-1,200 GDD 1,450-1,500 GDD	15-20 % 2nd generation egg hatch 65-7% egg hatch	1st treatment if warranted
3rd Brood	2,100-2,200 GDD	10-20 % 3rd generation egg hatch	If average >10 moths/trap/week and/or fruit injury is found.
	Information above derived from peach data, Hull & Krawczyk, Penn State University, 2010		

Trap
thres
>15/
per w
for 1

If using Rimon, or other material targeting eggs, 100-150 GDD

OFM Resistance

Courtesy of R. V

❖Reduced-risk insecticides:

- Chlorantraniliprole (Altacor 35WG)
- Spinosad (Entrust 80W)
- Spinetoram (Delegate 25WG)
- Acetamiprid (Assail 30SG)

No resistance found

❖ Pyrethroids: Adult Topical Bioassays

- Esfenvalerate (Asana)
- Lambda-cyhalothrin (Warrior)

Suspected Resistance
Moderate = 9%
High level = 82%

Population	Year	Sampling Dates	N	Mean Percent Survivorship (SEM)
Rutgers colony	2009	29 July	310	1.29
Urbana Field	2009	25, 26, 27, and 28 Apr., 03 and 04 July	286	0.70 (0.45)
Calhoun colony	2009	29 June, 03, 07, 11, and 21 July, 12 Aug.	240	3.13 (1.41)
Calhoun County CHA	2009	17 July, 13, 14, 15, and 28 Aug.	156	9.40* (2.90)
Calhoun County CEI	2010	6, 7, 13, 14 April	218	81.92* (7.24)

Preliminary assay for OFM pyrethroid resistance, 2016

Treatment	Rate	Total OFM assayed	% Live	% Mortality
Aug 30				
Asana 0.66XL	2 oz	484	76.4	23.6
Acetone control		685	72	28
Sep 6				
Asana 0.66XL	2 oz	221	80.1	19.9
Asana 0.66XL	4 oz	271	61.6	38.4
Acetone control		314	70.4	29.6

Insecticides registered for OFM control in peach

Compound trade name	Chemical class	Effectiveness	Residual activity
Imidan	OP	Excellent	14 days
Exirel Altacor	Diamide	Excellent	10-14 days
Delegate	Spinosyn	Excellent	7-10 days
Assail	Neonicotinoid	Excellent	10-14 days
Rimon	IGR	Excellent	10-14 days
Asana Danitol Lambda-Cy Baythroid Perm-up	Pyrethroid	Excellent	7-10 days

Insecticides registered for OFM control in peach

Compound trade name	Chemical class	Effectiveness	Residual activity
Intrepid	IGR	Good	10-14 days
Diazinon	OP	Good	10-14 days
Avaunt	Oxadiazine	Fair	7-10 days
Lannate, Sevin	Carbamate	Fair	7-10 days
Esteem	IGR	Fair	7-10 days
Voliam Flexi, Leverage, Endigo, Voliam Express	Premix	Excellent	10-14 days

Relative activity of various products against peach pests

	OFM	OBLR	SJS	JB	Thrips	SWD	BMSB
Exirel-3	* * *	* * *		* *		* * *	
Apta-14						* *	
Grandevo-0						* *	
Imidan-14	* * *			* *		* * *	
Lannate-4	*			*	* *	* * *	* * *
Sevin-3	*		* *	* *			
PermUp-14							
Asana XL-14	* *			* *			
Danitol-3	* * *	* *		* *		* *	* * *
Spintor-14					* *		
Intrepid-7	* *						
Actara-14				* *			* * *
Assail-7	* * *		* *	* *			* *
Warrior-14	* *		* * *	* *			* * *
Belay-21			* *				* *
Rimon-8	* * *	* * *					
Baythroid-7	* *			* *		* *	
Venom-3							* * *
Admire Pro-0				* *	* *		* *
Delegate-7	* *				* *	* * *	
Mustang Max-14	* *			* *		* * *	
Altacor-10	* * *	* * *					
Belt-7	* * *	* * *					
Movento-7						* *	

Insecticides for Control of OFM in Peach

Organophosphates
~~Guthion~~
Diazinon
Imidan

Oxadiazines
Avaunt

IGR's
Rimon
Intrepid
Esteem

Diamides
Belt
Altacor

Carbamates
Lannate
Sevin

Neonicotinoids
Assail
Calypso

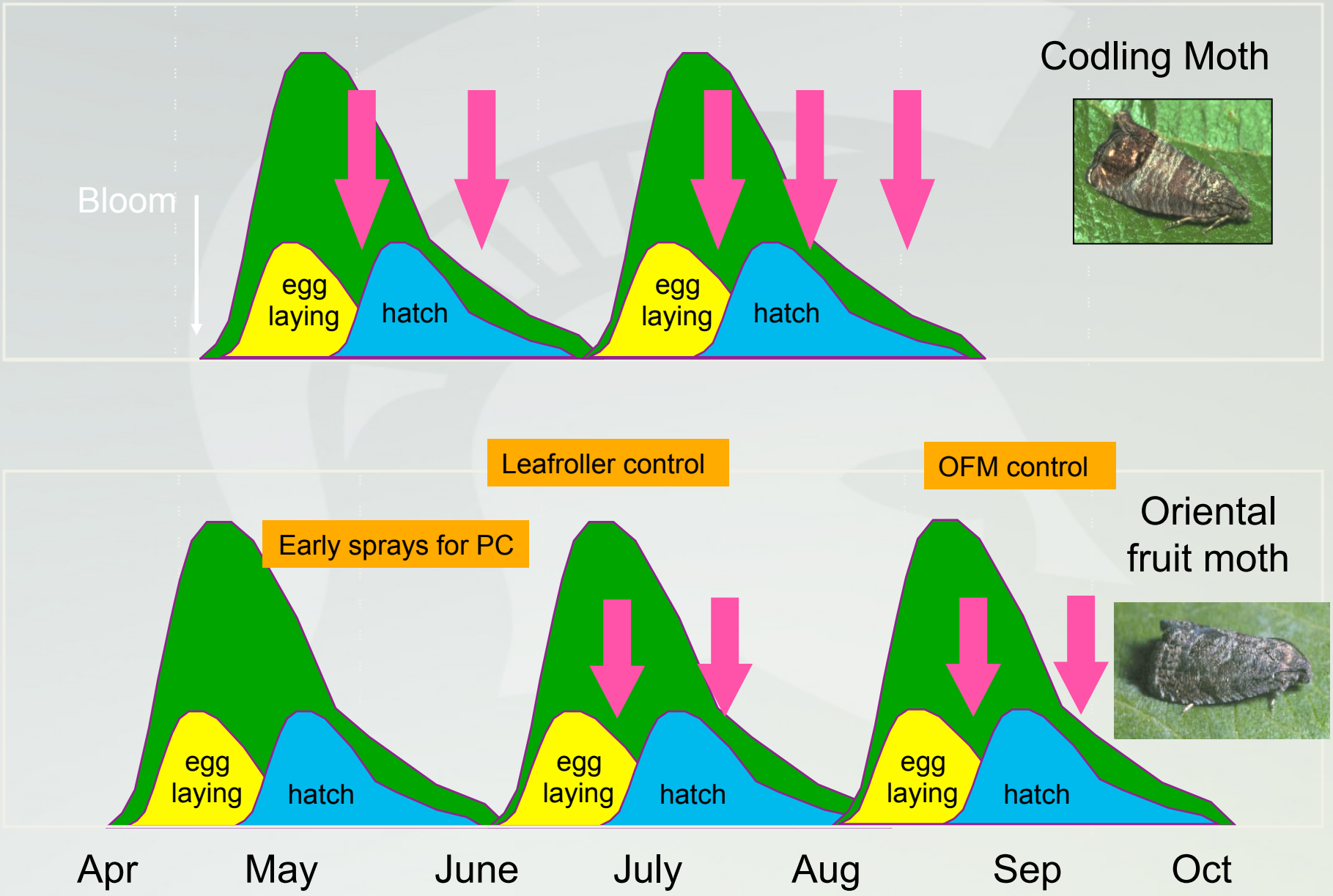
Spinosyns
Delegate
Entrust

Avermectins
Proclaim

Pyrethroids
Ambush
Pounce
Asana
Warrior
Baythroid
Mustang Max
Proaxis
Danitol
Decis
Batallion

Pre-Mix
Voliam flexi
Leverage
Tourismo

Life histories and spray timings

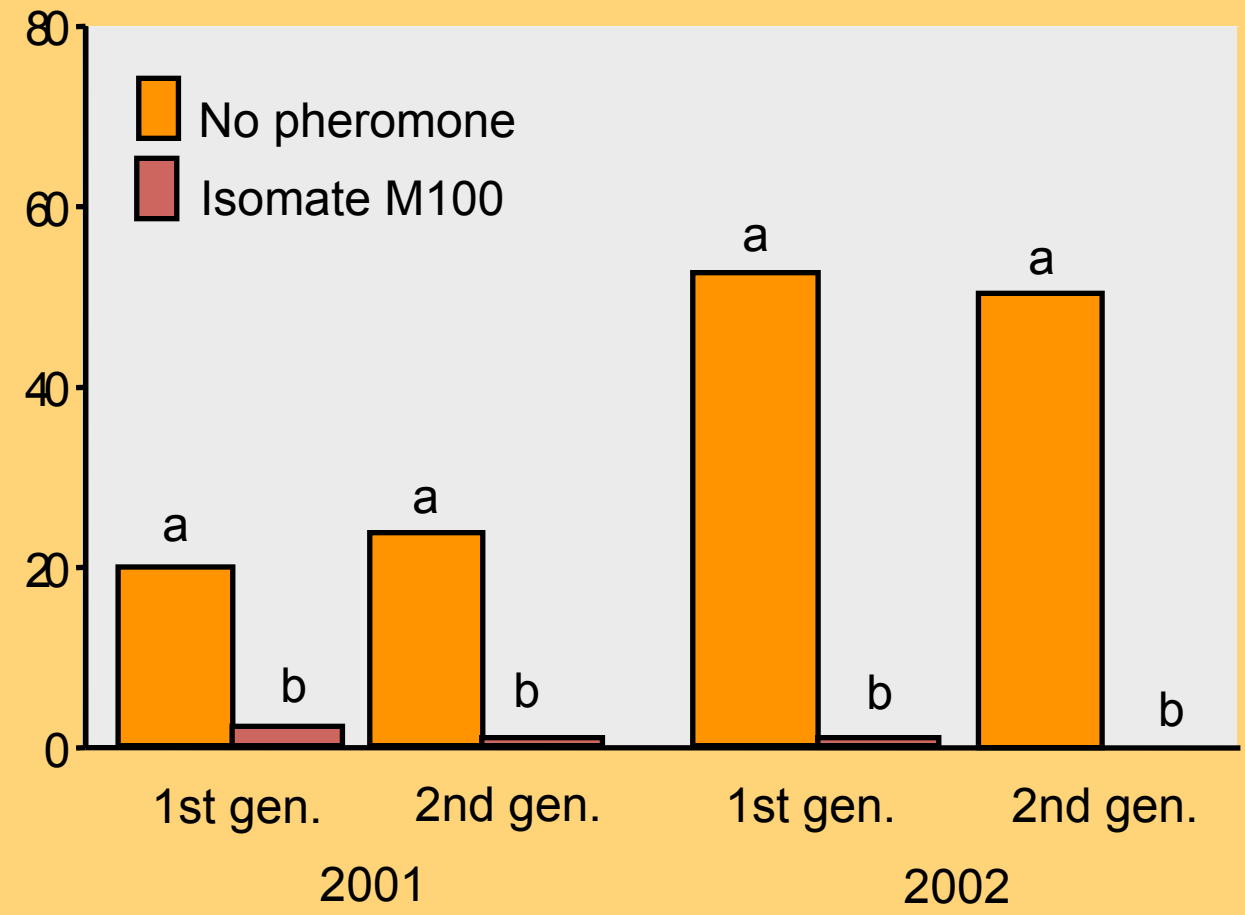


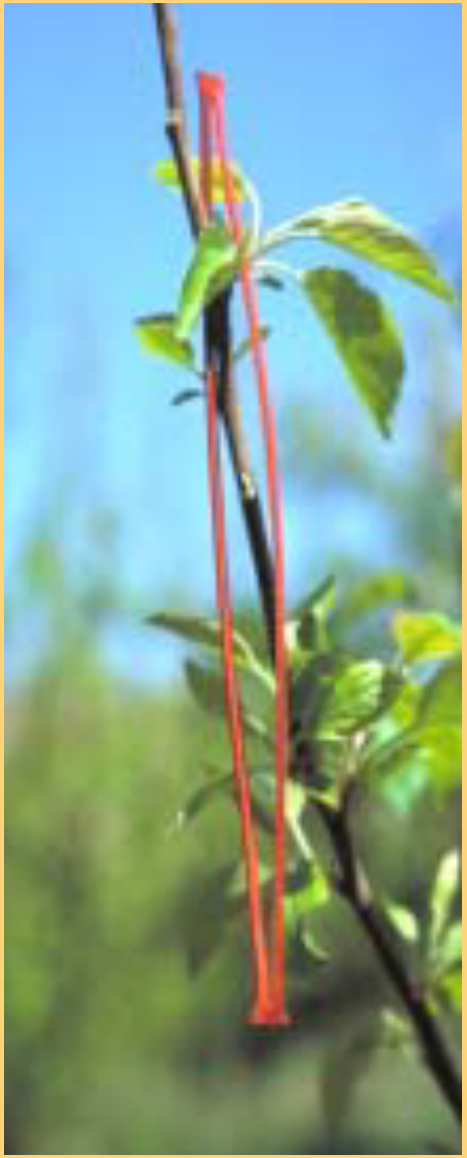
FM Management – Mating Disruption

Mating disruption

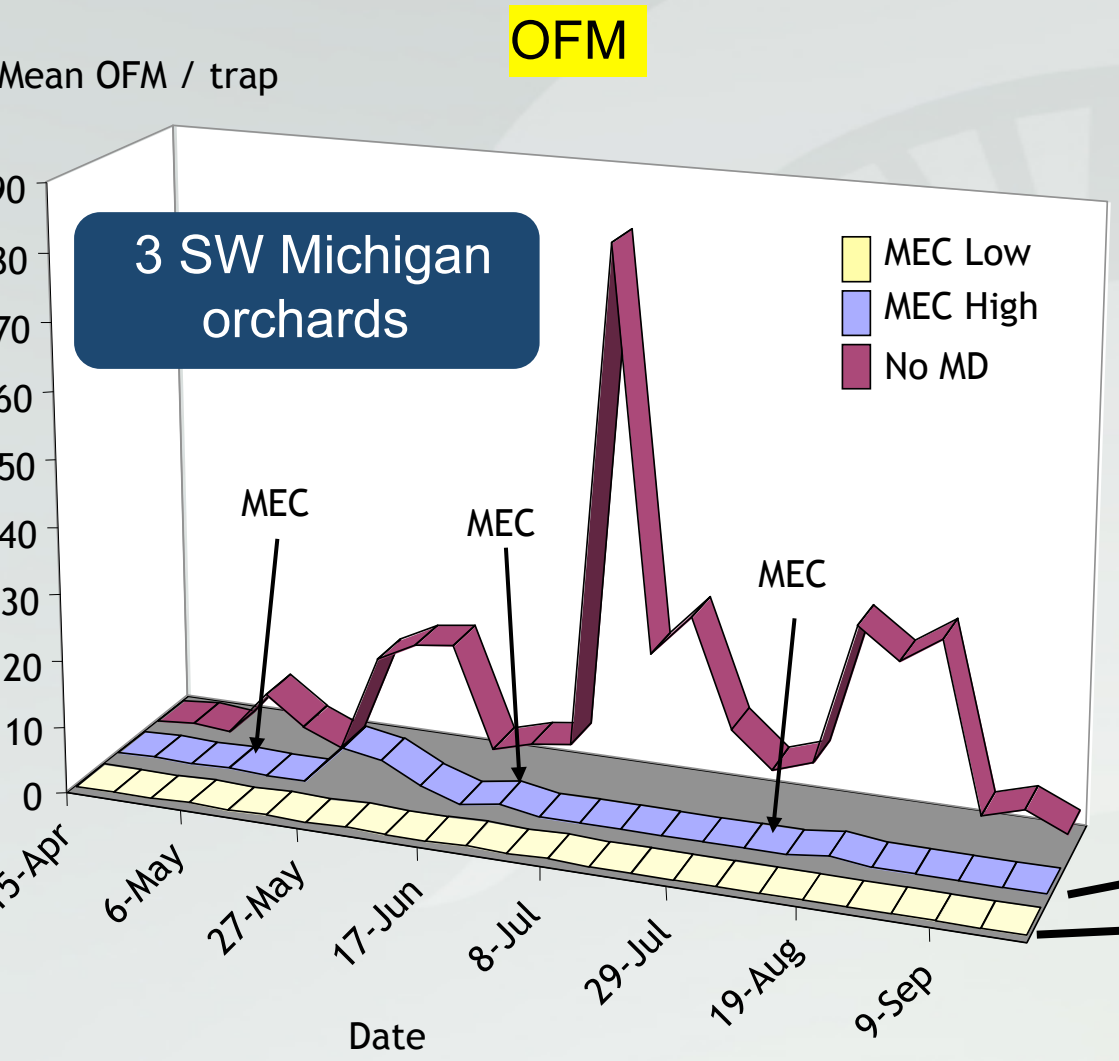
- up by pink in Elberta
- up before bloom or up by 1st moth catch for spray
- for season long want 120+ days
- use in conjunction with chemical control to bring population down
- several products to choose from

'Rope' dispensers for control of OFM





Sprayable pheromone



Low Rate Frequent Application (LRFA) is a GOOD approach

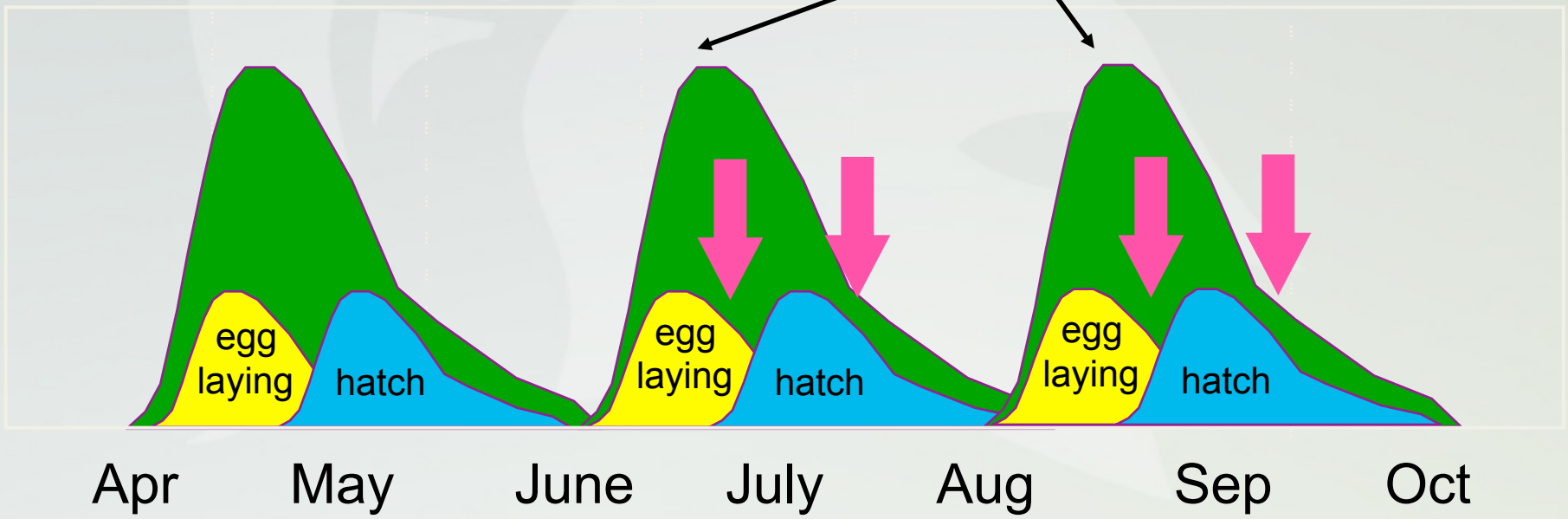
Weekly applications of 2-4 oz/ac

45 gm ai/acre per season

20 gm ai/acre per season

6 apps at low rate = cost of 1 app at hig

Sprayable OFM pheromone

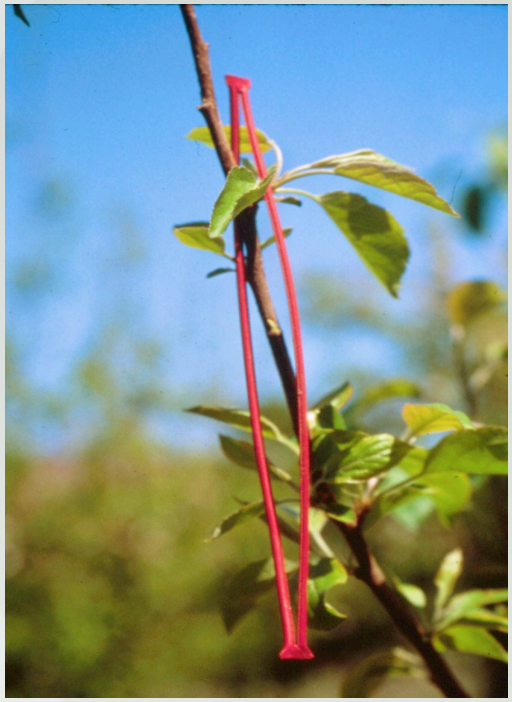


Multispecies disruption

- Single application of a dual-species dispenser, e.g., CM/OFM
  - *Must compromise on application density*

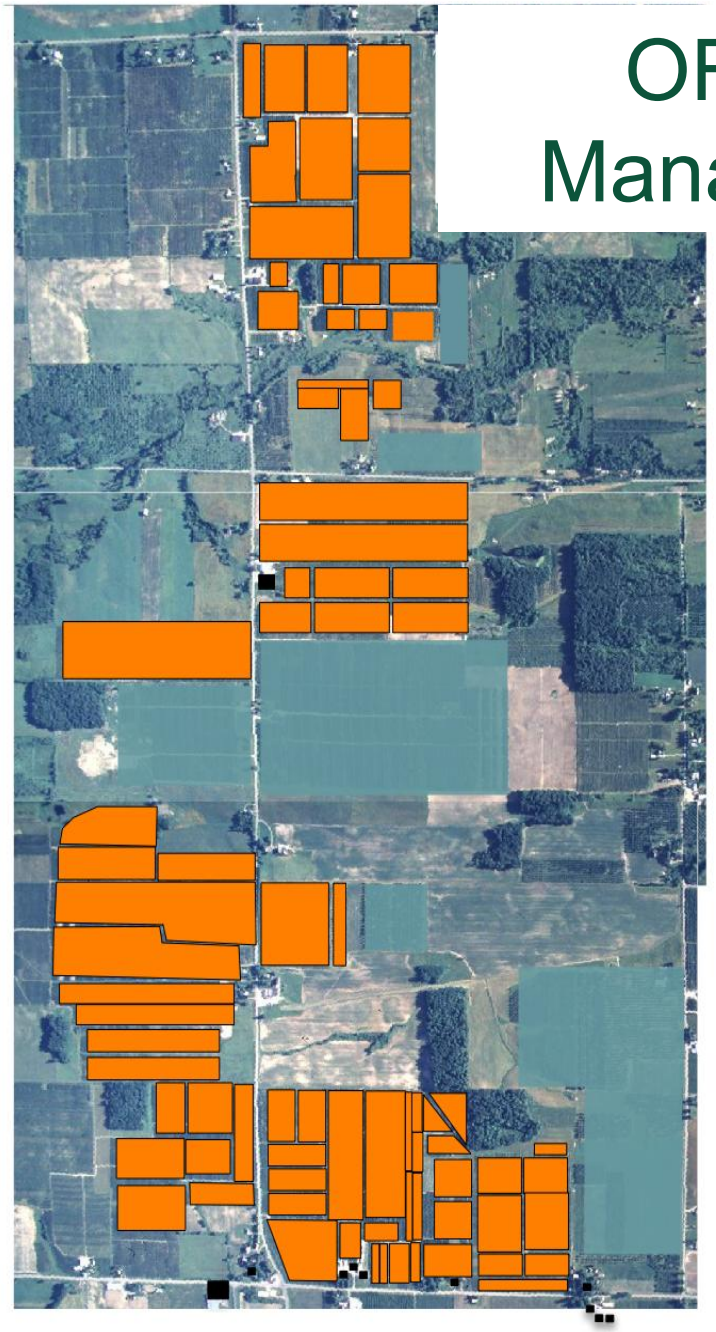
    CM - 300-400
    OFM - 100-200

  - *Deployment at the CM rate of 400/ac results over-treating for OFM by 200-300 dispensers/ac*



- More economical approach: *CM/OFM dual @ 100-20*
  CM @ 100-300/ac

OFM Area-wide Management Project



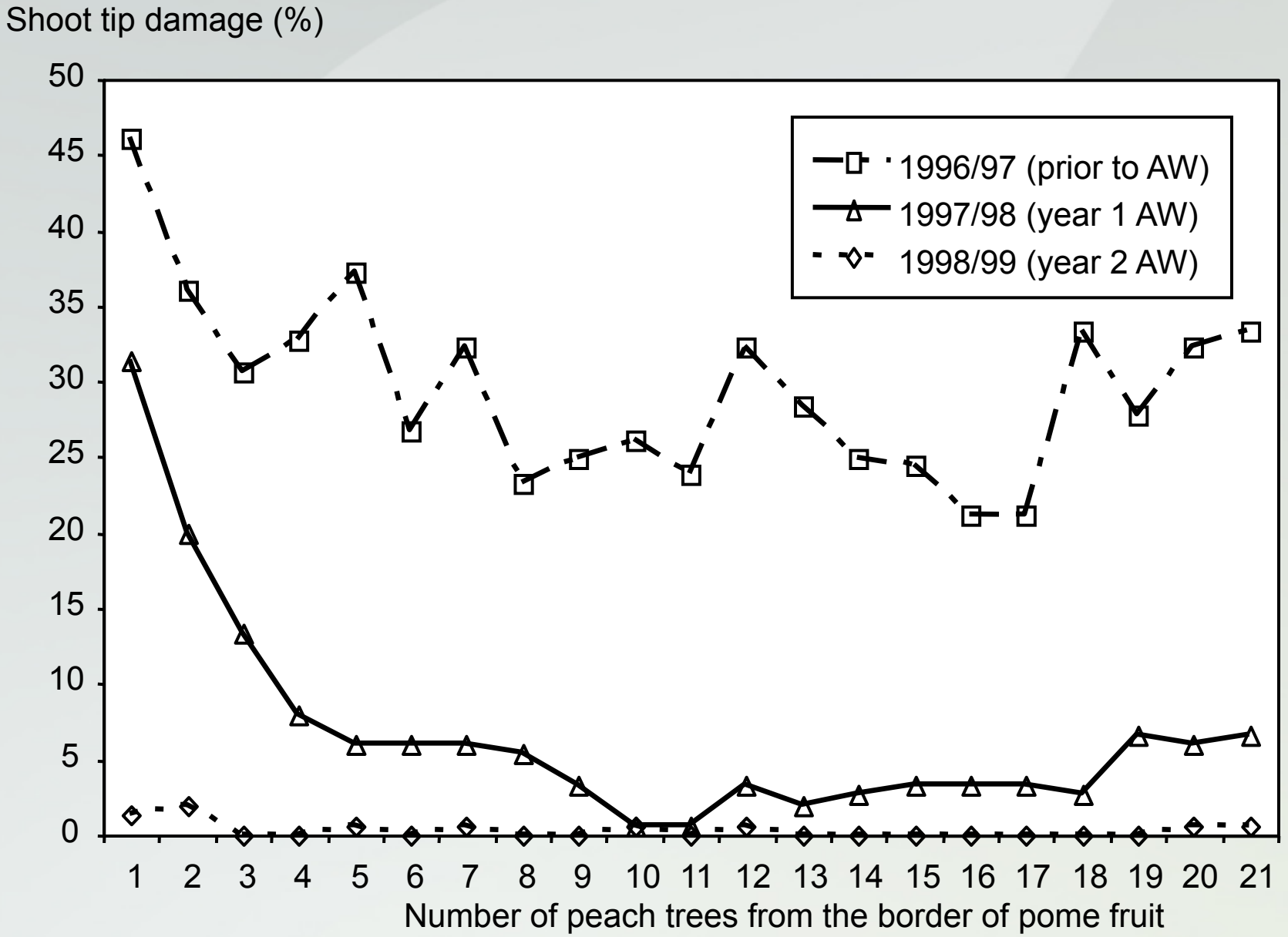
Victoria, Australia

ca. 2000 acres

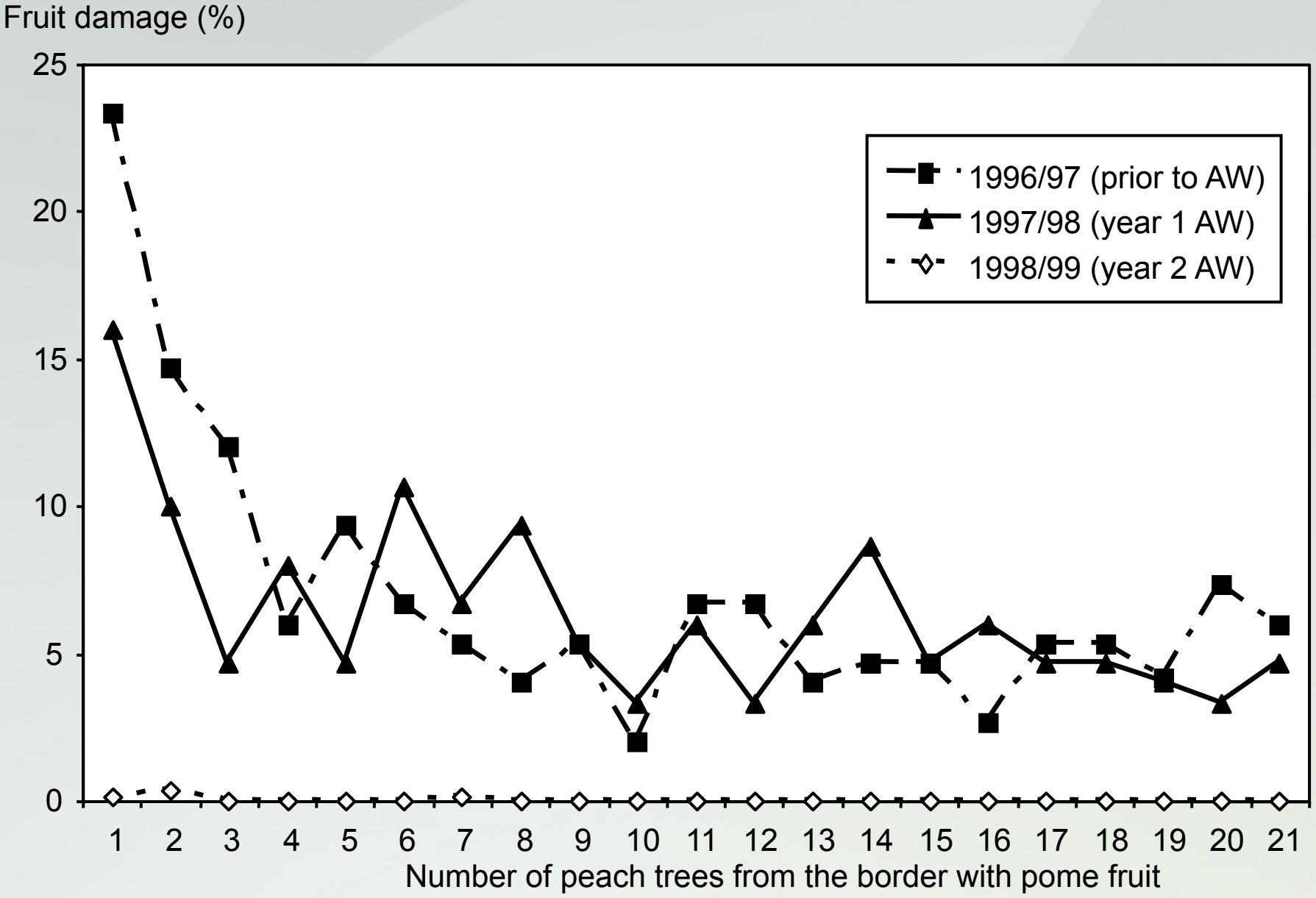
Peach only in 1996/97

Peach and pear in 98 & 99

Area-wide OFM mating disruption, Victoria Australia

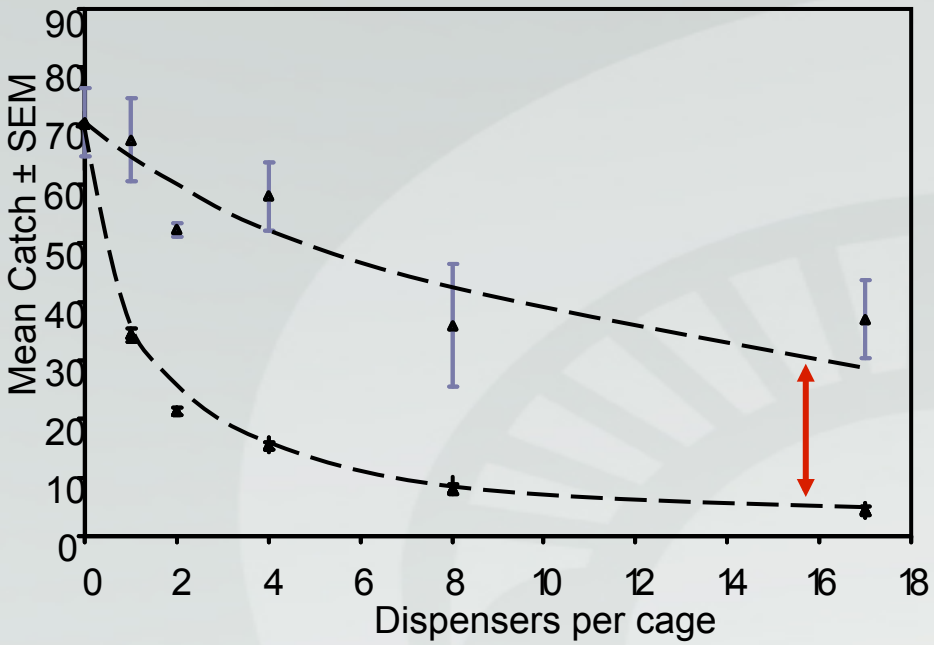


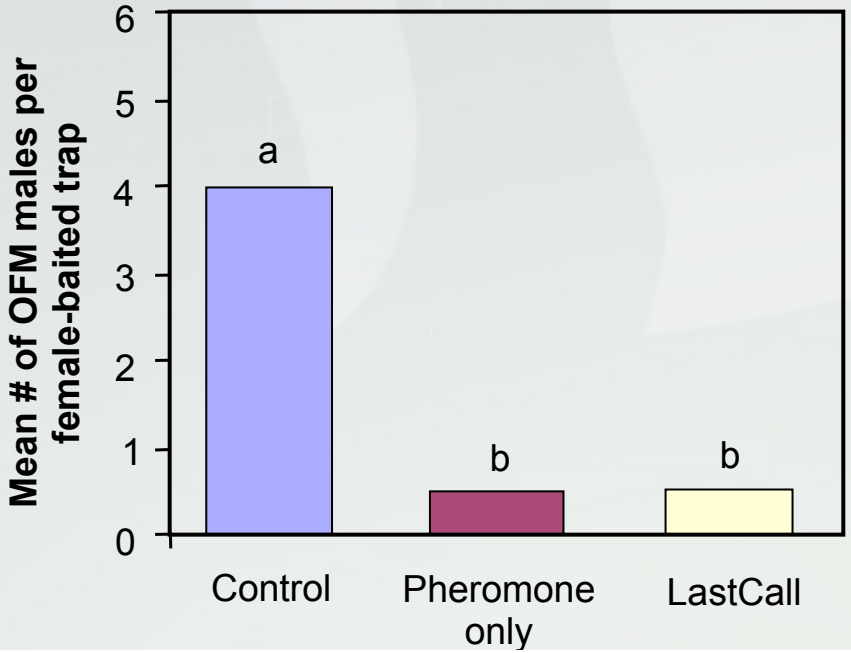
Area-wide mating disruption, Victoria Australia



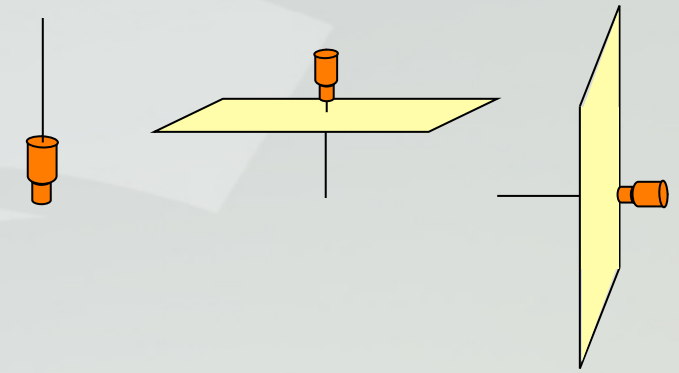
Attract and Kill

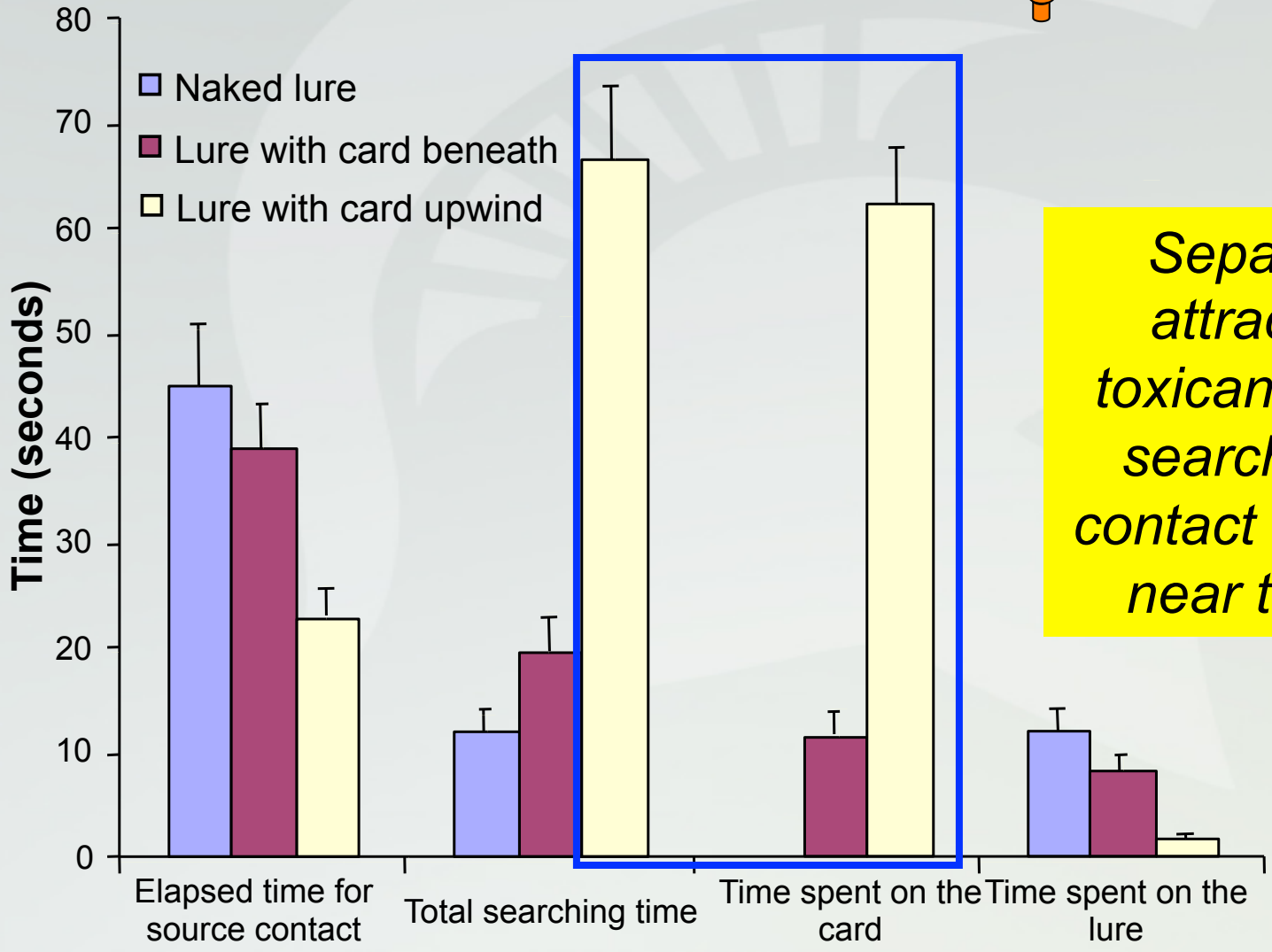
Technology has fallen short o
the apparent potential of
attract-and-kill formulations





Flight tunnel experiments looking at 3 possible modes of exposure

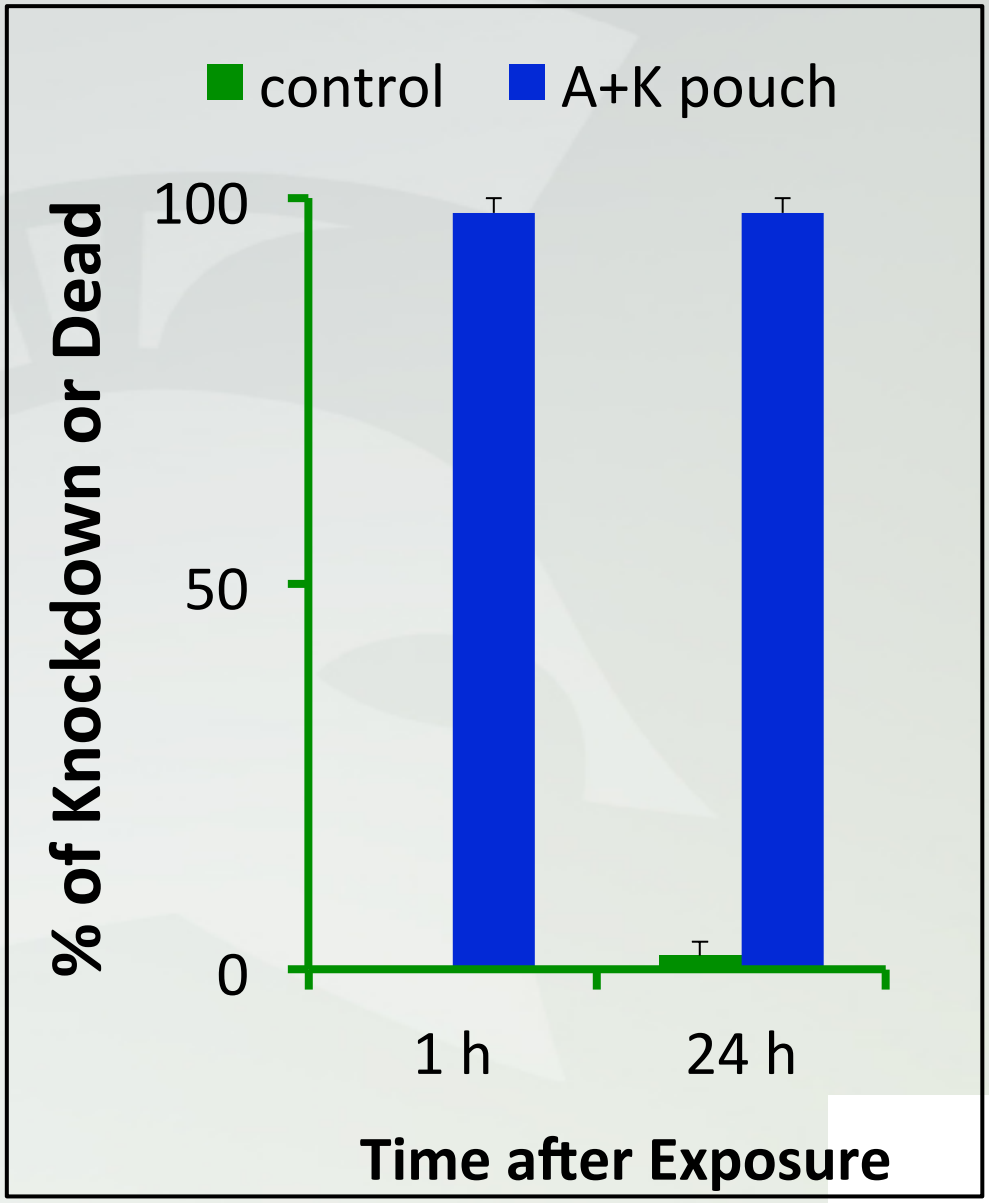




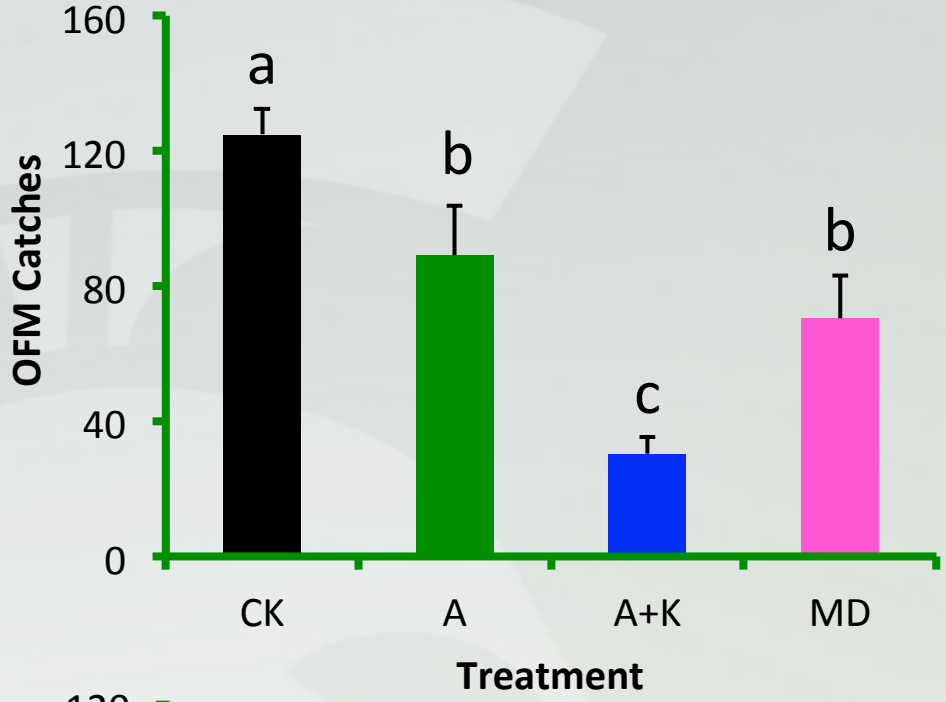
Separating the attractant and toxicant increased search time and contact with surface near the source

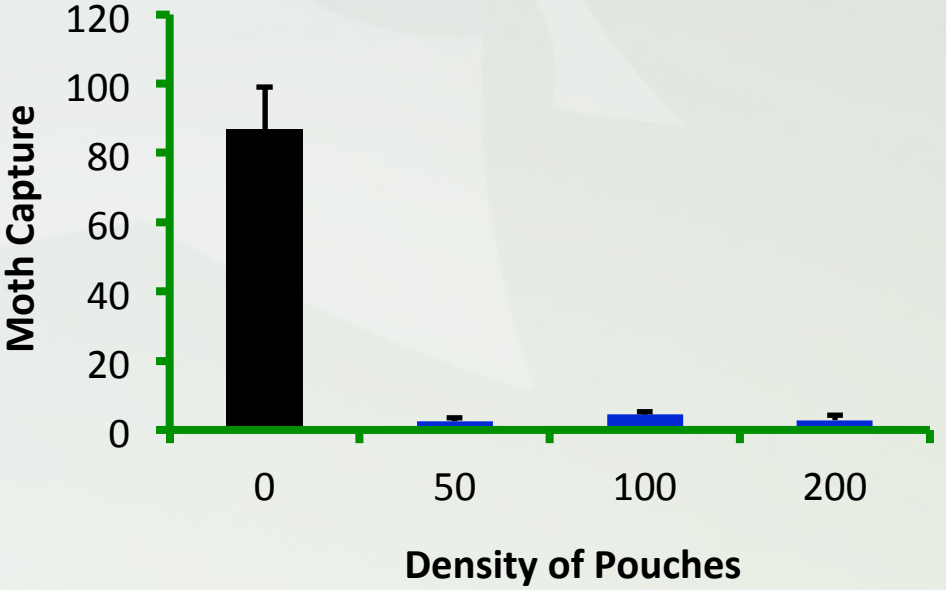
ttract and kill pouch

ang et al. 2015. Entomol.
perimentalis et Appl. 154:102-109.



Small-plot trials with the attract and kill pouch





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- verlapping later generations
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- reatment gaps
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