WASHINGTON STATE UNIVERSITY
World Class. Face to Face.

Management of Organophosphate Resistant Codling Moth

In the Field

John E. Dunley
Washington State University
Tree Fruit Research and Extension Center
Wenatchee, WA

Background

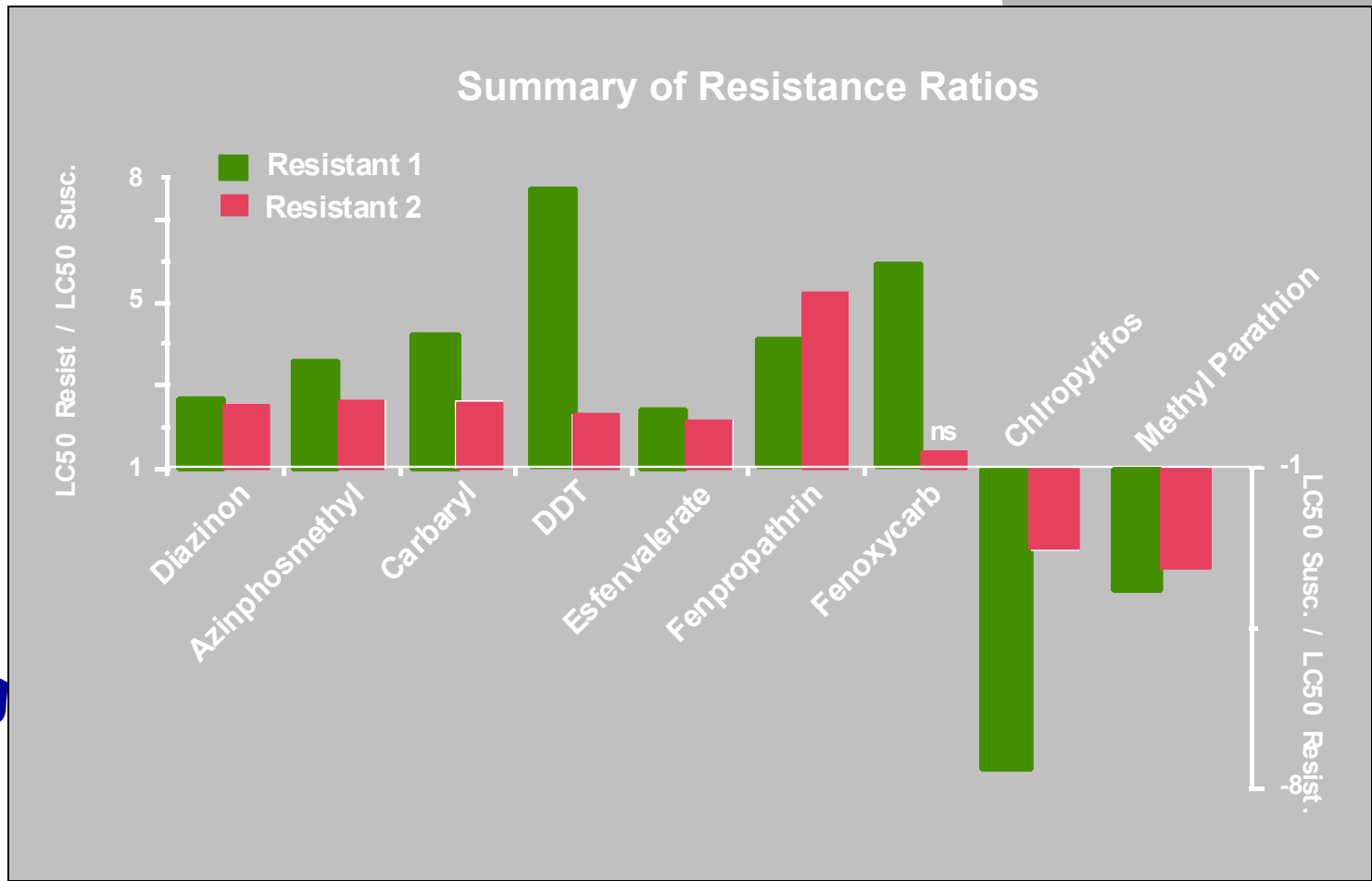
- Codling moth has increased as a problem in the past several years

- Possible explanations for problems…
  - Evolution of resistance to mating disruption
    - no
  - Evolution of resistance to Guthion
    - maybe
  - Inadequate control tactics
    - ? hmmmm

- New materials are available
  - Assail, Calypso, Diamond, Avaunt
    - More expensive
    - More applications

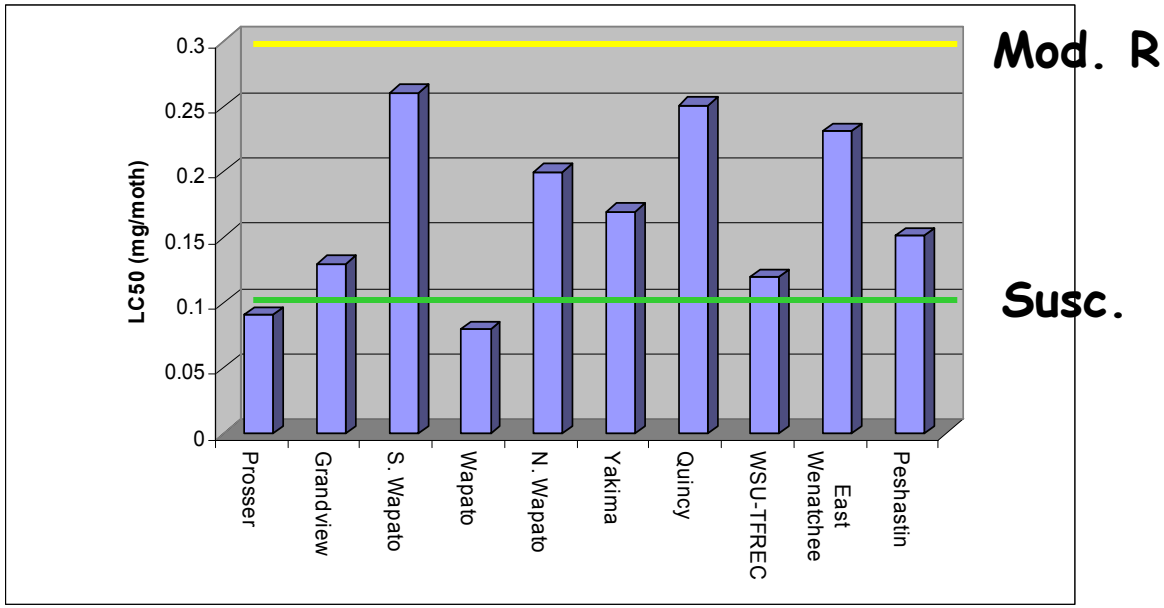
Resistance in CM

- Cross-resistance with OP-
- resistance is very broad
  - X-R possible with just about everything



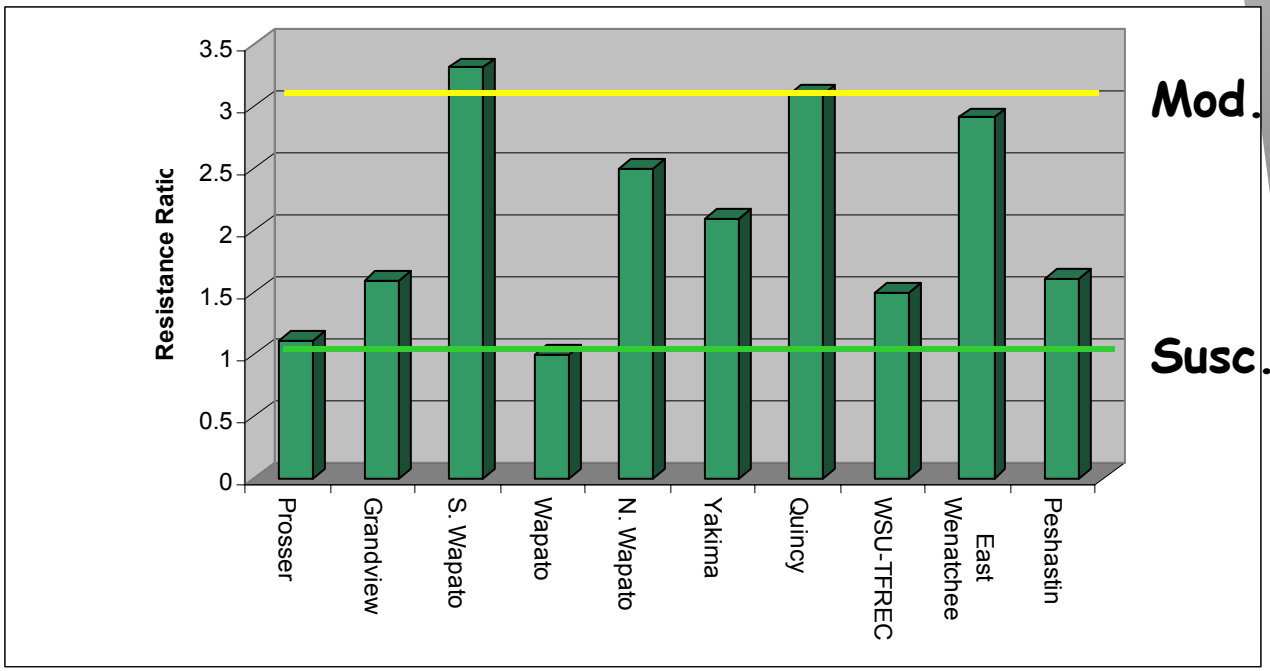
Guthion bioassays – Statewide survey Washington 2003

- First generation
  - Susceptible generally around 0.6 to 0.1 μg / moth
  - Moderate resistance to 0.3 μg / moth
  - High resistance > 0.4 μg / moth
- Variable in resistance
  - Low to moderate



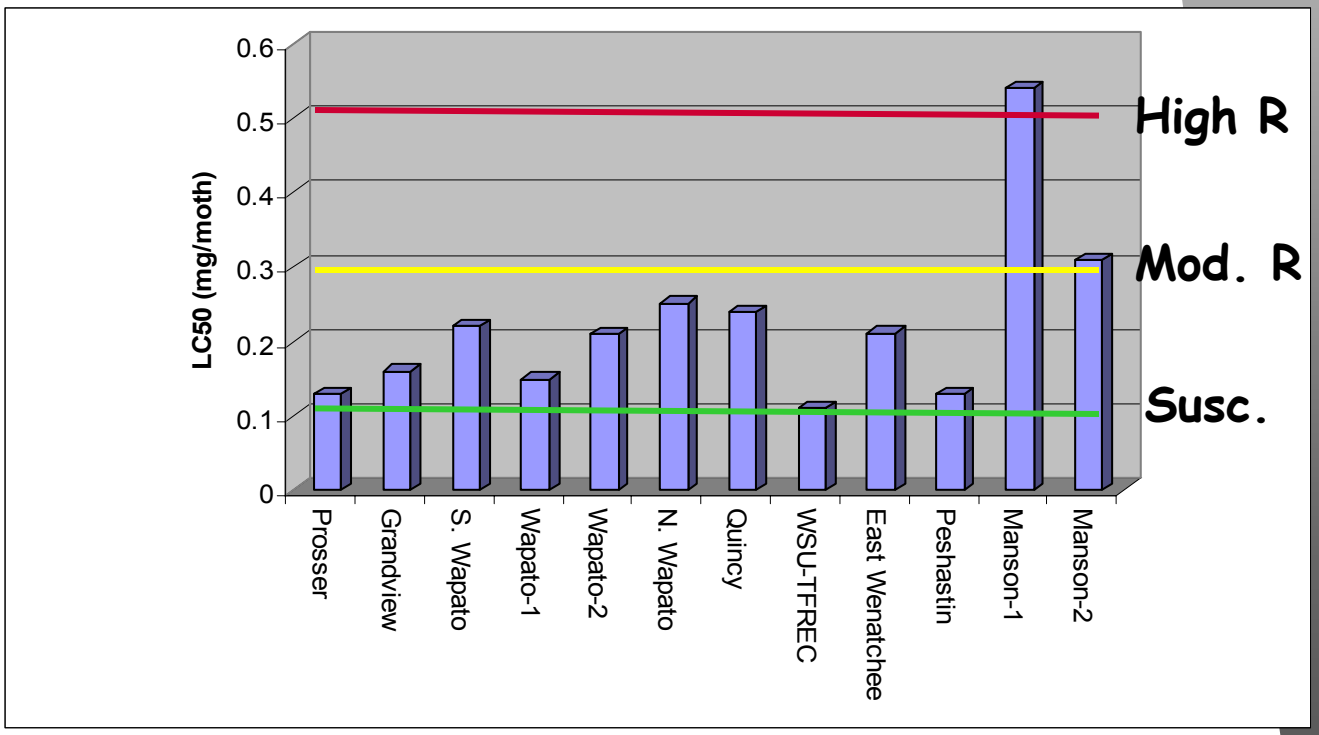
First Generation – Resistance Ratios

- Some variation
  - But no significant differences



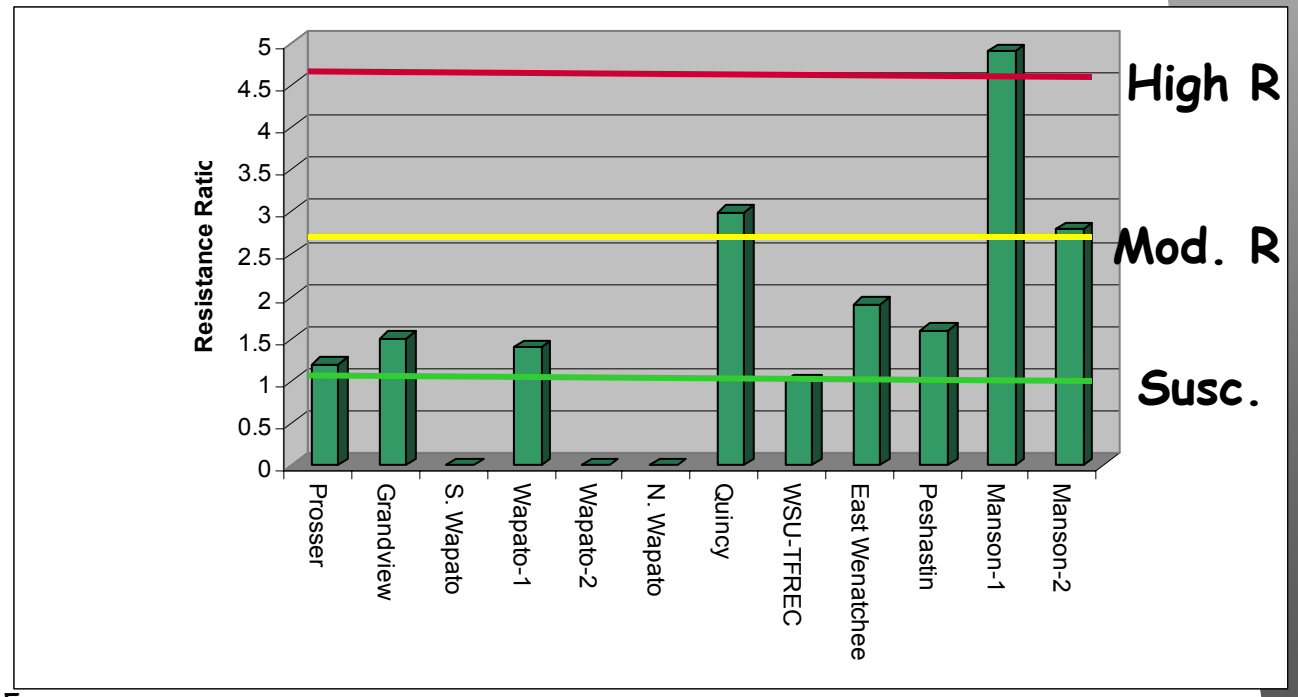
Guthion bioassays

- **Second generation**
  - More variation
  - Location with high resistance



Second Generation – Resistance Ratios

- Guthion resistance – mostly low levels
- Codling moth resistance low to moderate
  - But one location was significantly high



Lorsban bioassays

- **Limited information for Lorsban**
  - Negative cross-resistance may be there
    - Not statistically significant, however

Location	LC50 (µg ai / moth)	Resistance Ratio
Prosser	0.028	-1.8
Grandview	0.03	-1.7
WSU-TFREC	0.05	1.0

Asana bioassays

- **Limited information for Asana**
  - No differences

Location	LC50 (µg ai / moth)	Resistance Ratio
Prosser	0.06	1.2
Grandview	0.03	0.6
WSU-TFREC	0.05	--

Assail bioassays

- **Assail results not statistically robust**
  - **Cross-resistance appears likely, though**

Location	LC50 (µg ai / moth)	Resistance Ratio
Prosser	0.32[1]	na
Grandview	0.11	1.0
WSU-TFREC	0.11	--
Manson-1	0.76[1]	6.9[1]
Manson-2	0.27[1]	2.5[1]

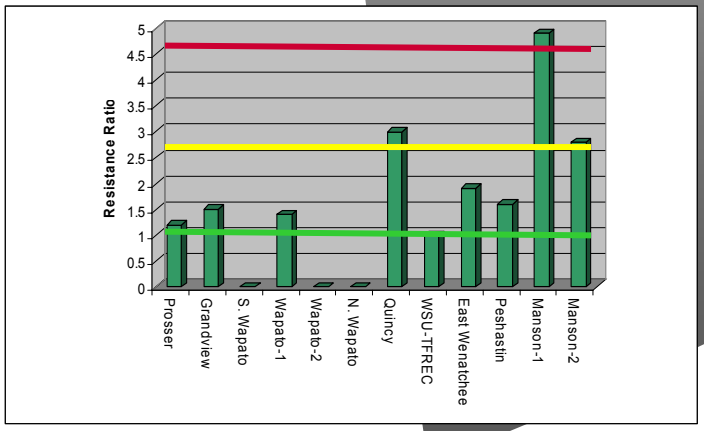
[1] estimates – probit lines are not statistically significant

Conclusions about resistance

- Pressure related performance
  - Increased resistance / tolerance led to decreased Guthion performance
  - Reduce management tactics compounded problems
  - High pressure led to reduced performance
    - Portion attributable to Guthion resistance

Codling moth resistance

- Worry about OP resistance in CM
  - High levels rare
  - Many areas have low to moderate levels
- Worry about cross-resistance
  - Guthion resistance gives some level of resistance to almost everything
  - Assail / Calypso?



Bioassays in 2004

- In OP-Resistant apple orchard

Location	LC50 (µg ai / moth)	Resistance Ratio
Guthion	0.39	3.6
Assail	0.80	6.1
Asana	0.10	2.0
Lorsban	0.03	-1.7

2004 Field Trials

- In OP-R orchard
- Large plots
- Standard and 'new' season long programs
- Each generation assessed separately
- Same program on each experimental unit for 1st and 2nd generation

Field trials in 2004 -- % damage

- In OP-Resistant population in apple

Tmt	1st gen	2nd gen
Calypso 6 oz (2 covers / gen)	0.0	0.3
Assail 3.4 oz (2 covers / gen)	0.2	0.0
Guthion 3 lb (2 covers / gen)	0.1	0.0
Diamond 40 oz, Assail 3.4 oz (1 combination cover / gen)	0.6	0.1
Success 6 oz (2 apps 1st gen, 3 apps 2nd)	1.2	0.2
Lorsban 2 lb (2 covers / gen)	0.0	0.1
Asana 14.5 oz (2 covers / gen)	0.0	0.0

Conclusions

- All of the programs were effective
- OP resistance can be managed
- Cross-resistance with neonicotinyls is likely
- But it doesn't appear to affect field performance at field rates