Investigating pesticide applications of organophosphates and copper on prune (*Prunus domestica* L.) orchards in the Central Valley of California

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Introduction

There is evidence that prune growers in Sutter, Tehama, and Tulare Counties in California have a history of using a combination of in-organic copper (Cu) and organophosphates (OP) to treat wintering insects such as peach twig borer, San Jose scale, European red mite, and prune aphids (mealy plum and leaf curl plum aphids). Some growers apply copper to help improve the condition of prune trees infected with bacterial canker, *Pseudomonas syringae* (Pomology notes 2003). However, according to UC IPM guidelines, copper hydroxide and copper sulfate are not recommended as an effective fungicide or bacteriocide treatment on prunes (Strand 1999). Persistent use of copper on prune trees has the potential to diminish sustained soil productivity (Epstein and Bassein 2001). The efficacy of OP may be reduced when Cu is applied with an OP (Pomology notes 2003). Furthermore, dormant season applications of OPs are a major source of surface water contamination in the Central Valley (Epstein et al. 2001).

Objectives

1.) Identify the number of fields with Cu and OP applications.

2.) Examine trends in organophosphate use intensity among fields with and without copper application records.

3.) Investigate if growers with high rates of copper use also have high rates of organophosphate use through regression analysis.

Methodology

Data sources

- Data were obtained 1993 through 2002 by the California Department of Pesticide Regulation.
- ArcView GIS and PUR database query tools were used.
- Simple statistical analysis were performed

Geographic level of investigation

- Pesticide use data was analyzed at the field level.
- The pesticide use intensity was weighted using the following formula:

$$\frac{\left[\frac{\sum(\text{lbs of active ingredient} * \text{acres planted})}{\sum \text{acres planted}}\right]}{\text{total number of fields*}}$$

* Total number of prune fields in a county that use OPs only or OPs and Cu

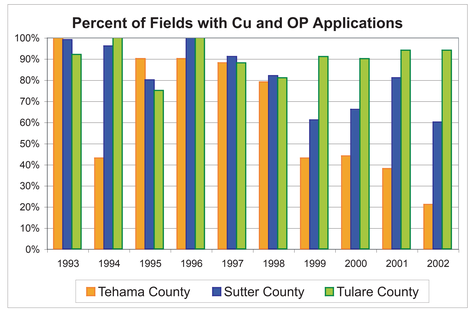
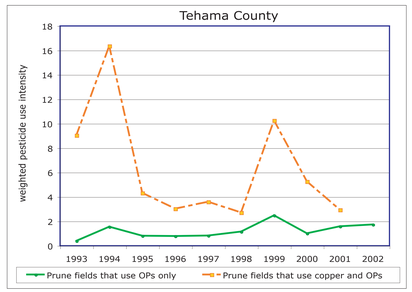
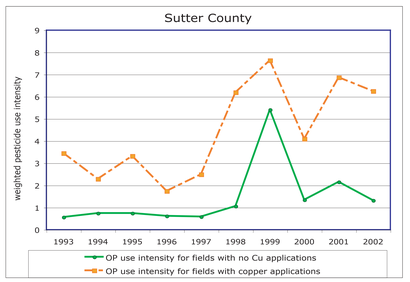


Fig 1. Changes over time in the percentage of fields with recorded OP and Cu use.

Fig 2. Weighted Organophosphate use intensity: Comparing fields with and without Cu applications





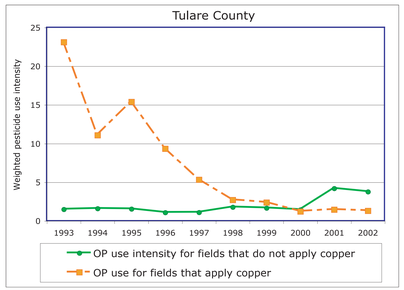


Fig 3. OP use (lbs of active ingredient) on prunes in Sutter, Tehama, and Tulare Counties

Organophosphate	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Tehama										
DIAZINON	13,767	3,234	11,295	9,216	6,791	6,697	3,848	3,291	2,942	2,705
CHLORPYRIFOS	131	6	728	213	753	174	22	118	107	105
METHIDATHION	1,401	224	1,582	1,739	1,620	383	499	226	92	60
PHOSMET	58	0	217	249	1,704	1,104	84	0	17	2
AZINPHOS METHYL	0	0	8	0	0	0	0	0	0	0
Sutter										
DIAZINON	22,924	16,375	18,560	18,493	17,793	13,396	7,917	14,110	7,822	9,589
CHLORPYRIFOS	22	258	0	12	181	1,727	724	898	0	1,430
MALATHION	0	46	384	61	143	83	0	0	0	0
METHIDATHION	12,700	7,425	6,973	10,300	6,358	4,179	1,122	4,429	1,525	1,192
PHOSMET	126	50	226	56	174	53	0	0	0	0
AZINPHOS METHYL	745	134	497	701	1,121	18	153	0	0	0
Tulare										
DIAZINON	5,888	6,247	6,397	6,199	3,615	3,680	4,525	5,561	3,340	3,632
CHLORPYRIFOS	1,698	1,765	1,076	1,524	1,179	2,341	2,635	1,986	883	980
MALATHION	0	0	0	0	0	96	0	0	0	0
METHIDATHION	2,340	1,561	2,131	1,790	2,843	1,260	892	945	777	333
PHOSMET	46	228	460	1,289	158	610	494	8	988	33
OXYDEMETON-METHYL	0	22	0	0	0	0	0	0	0	0
AZINPHOS METHYL	698	60	0	0	214	0	0	0	0	0
TOTAL	62,542	37,635	50,533	51,843	44,648	35,801	22,915	31,572	18,492	20,060

Fig 4. Changes in OP and Cu use in Tehama, Sutter, and Tulare Counties, 1993 -2002

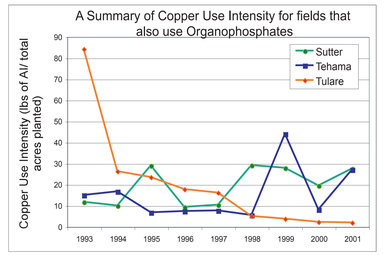


Fig 4.1. Cu use intensity (lbs of active ingredient / acres planted) in Tulare County has declined steadily since 1993. In Sutter and Tehama Counties, Cu use intensity has increased slightly.

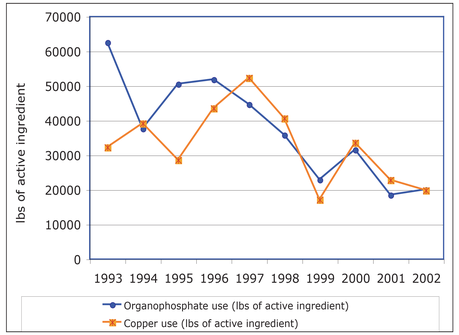
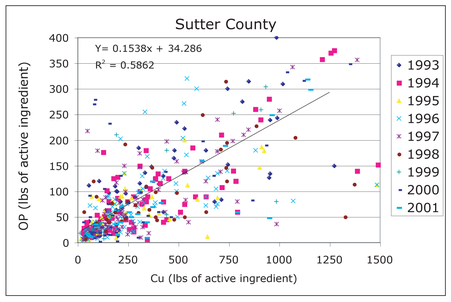
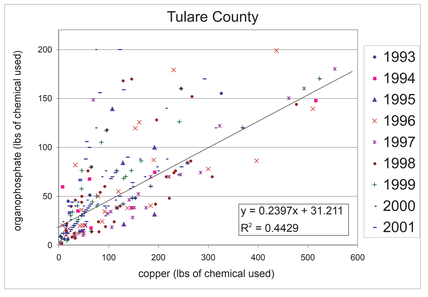


Fig 4.2. The amount of OP and Cu applied (lbs of active ingredient) in all three counties has been declining simultaneously since 1997

Fig 5. Regression Analysis: The relationship between the amount of Cu and OP applied on a prune field (lbs of active ingredient), 1993- 2001





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Results

- PUR data indicates that prune growers who apply Cu use more OPs in Tehama, Sutter, and Tulare Counties.
- In 2002, 21%, 60%, and 94% of the prune fields in Tehama, Sutter, and Tulare Counties respectively had reported applications of Cu and OP during the dormant season.
- Since 1993, the percentage of fields with Cu and OP applications has declined most rapidly in Tehama County.
- The use of OPs is strongly correlated with the use of Cu when data from all three counties is added together. When examined separately, Sutter and Tulare counties show a slight positive correlation.

Conclusion

- Grower education about pest management alternatives is necessary to reduce the environmental impact of these pesticides.
- PUR data can be used to strengthen prune grower outreach programs.
- The use of OPs on prunes is declining; however, it remains a concern that even small levels of exposure will result in lethal and sublethal effects on specific communities of predators in prune orchards.

Future research avenues

- Examine the impact of OPs on arthropod community structures, especially natural enemies in prune orchards.
- Examine the impact of Cu on microflora and fauna in prune orchard soils.
- Work with prune growers to develop alternatives to OPs and Cu. Alternatives need to be researched and implemented so that prune growers can adjust to approaching regulations and the current economic environment.

References

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