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Pesticide Use for Commercial Citrus Production in California, 2005-2008

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Abstract

This analysis is to characterize pesticide use for citrus production during 2005 through 2008 in California. Annual average pesticide use is 15.0 million pounds, and there is a general decreasing trend from 16.5 million pounds in 2005 to 13.2 million pounds in 2008. Top ten pesticides by application amounts explain about 87% total use, including calcium hydroxide, petroleum oil, mineral oil, copper sulfate, 1.3-dichloropropene, sulfur, copper hydroxide, glyphosate isopropylamine salt, chlorpyrifos, and glyphosate potassium salt. About 92% of total pesticides for citrus production are applied in the four counties of Tulare, Kern, Ventura, and Fresno. Taking chlorpyrifos, a pesticide frequently detected in surface water, as an example, the section-level average application rate for citrus production (219 pounds/year) in the four counties is higher than the average for all agricultural uses (188 pounds/year). The applications in Ventura County may have potential impacts on the surface water quality in the Santa Clara River, where chlorpyrifos has been detected.

Introduction

Pesticide uses in citrus production were evaluated for their potential impacts on surface water quality. Pesticide use amounts for the years of 2005-2008 were retrieved from the Pesticide Use Reporting (PUR) database maintained in the Department of Pesticide Regulation (DPR). Statistical analyses were conducted to identify the temporal trend and spatial distribution of pesticides uses. In addition, geographic locations of pesticide uses were mapped to characterize the potential contribution of pesticide residues from citrus fields to the adjacent surface waters.

Query criteria

[1] Citrus sites

The following site codes (“site_code” in PUR) are included in the query:

Table 1. Site codes used in the query (sorted by site codes)

Site code	Description
2000	CITRUS FRUITS (ALL OR UNSPEC)
2002	GRAPEFRUIT
2004	LEMON
2006	ORANGE (ALL OR UNSPEC)
2007	TANGELO
2008	TANGERINE (MANDARIN, SATSUMA, MURCOTT, ETC.)
2010	ORANGE, SWEET

[2] Years

The four-year period of 2005-2008 is used in the query.

[3] Acreage

The query and data analysis included all citrus sites in the counties with total planted area of citrus larger than 100 acres.

Summary of Results

[1] Statistics by chemical

More than 300 pesticides have been used for citrus crops, with total use of 59.8 million pounds for the 4-year period of 2005-2008. About 87% of total uses were attributed to the ten pesticides, including calcium hydroxide (31.8%), petroleum oil (22.1%), mineral oil (17.3%), copper sulfate (3.7%), 1.3-dichloropropene (2.3%), sulfur (2.2%), copper hydroxide (2.2%), glyphosate isopropylamine salt (2.0%), chlorpyrifos (1.7%), and glyphosate potassium salt (1.3%). Detailed analysis on the uses of pesticides with >1% surface water detection frequency was provided in Table 2. Three of those pesticides accounted for more than 30% of statewide total use, including bromacil (36.5%), simazine (32.9%), and pyriproxyfen (48.4%) during 2005-2008. The detection frequency was determined based on the statewide surface water monitoring results reported in DPR's Surface Water Database. For each pesticide, its detection frequency is calculated as the fraction of samples with pesticide concentration above the respective detection limit. It's noteworthy that detection frequencies were calculated based on all available sampling periods in the database, which might not be consistent with the study period of 2005-2008.

Table 2. Annual average pesticide uses for citrus production and statewide total use during 2005-2008, for chemicals with >1% surface water detection frequency (sorted by chemical codes)

CHEM CODE	Chemical Name	Citrus use		Statewide use (pounds)
		Pounds	Fraction	
83	BROMACIL	24,196	36.5%	66,240
105	CARBARYL	38,207	24.8%	153,946
216	DIMETHOATE	54,630	18.1%	302,000
231	DIURON	190,486	21.1%	901,431
253	CHLORPYRIFOS	258,495	15.3%	1,688,662
346	DICOFOL	7,858	7.9%	99,222
367	MALATHION	35,474	8.0%	446,044
531	SIMAZINE	184,472	32.9%	561,120
1689	METHIDATHION	9,269	18.7%	49,604
1868	ORYZALIN	20,363	2.7%	742,639
1929	PENDIMETHALIN	68,881	7.2%	963,033
1973	OXYFLUORFEN	6,874	1.0%	691,116
2019	NORFLURAZON	17,530	20.8%	84,254
2997	GLYPHOSATE	16,946	3.2%	524,153
3849	IMIDACLOPRID	13,548	6.4%	210,436
4019	PYRIPROXYFEN	5,295	48.4%	10,937

[2] Statistics by year

There is a general decreasing trend of pesticide use for citrus production from 2005 to 2008 (Figure 1). Annual total uses decreased from 16.5 million pounds in 2005 to 13.2 million pounds in 2008.

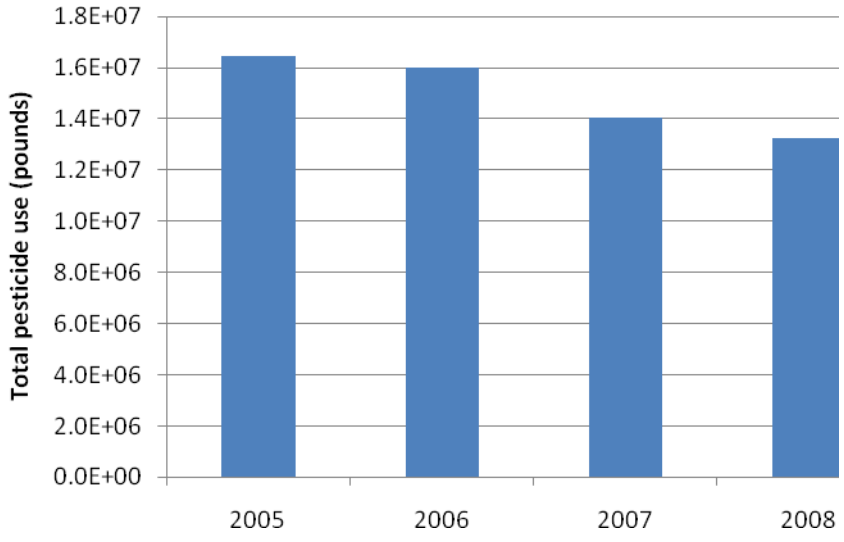

Figure 1. Total pesticide use in citrus production, 2005-2008

[3] Statistics by county

About 92% of pesticides used for citrus production were applied in the four counties of Tulare (48%), Kern (22%), Ventura (12%), and Fresno (10%).

Table 3. Query results summarized by county as annual average pesticide use during 2005-2008 (sorted by uses)

COUNTY_CD	County	Use (pounds)
54	Tulare	7,213,307
15	Kern	3,322,419
56	Ventura	1,727,682
10	Fresno	1,564,887
33	Riverside	375,521
20	Madera	295,386
42	Santa Barbara	118,576
37	San Diego	99,581
40	San Luis Obispo	71,372
13	Imperial	57,030
27	Monterey	46,378
36	San Bernardino	28,575
30	Orange	22,977

[3] Geographic locations of pesticide use

Note: chlorpyrifos is taken as example in this analysis

In the four counties of Fresno, Kern, Tulare, and Ventura, citrus orchards received a significantly higher application rate of chlorpyrifos at 219 pounds/section (Figure 2), compared to the average for all crops of 188 pounds/section during 2005-2008. Since the Tulare Basin does not have an integrated surface-water-flow system, pesticide concentrations and associated ecosystem risks in surface water are not usually reported. However, the chlorpyrifos use for citrus production in Ventura County may generate residues for runoff or drift to the Santa Clara River watershed. Historical records in the DPR surface water database showed that chlorpyrifos has been detected in the Santa Clara River Estuary.

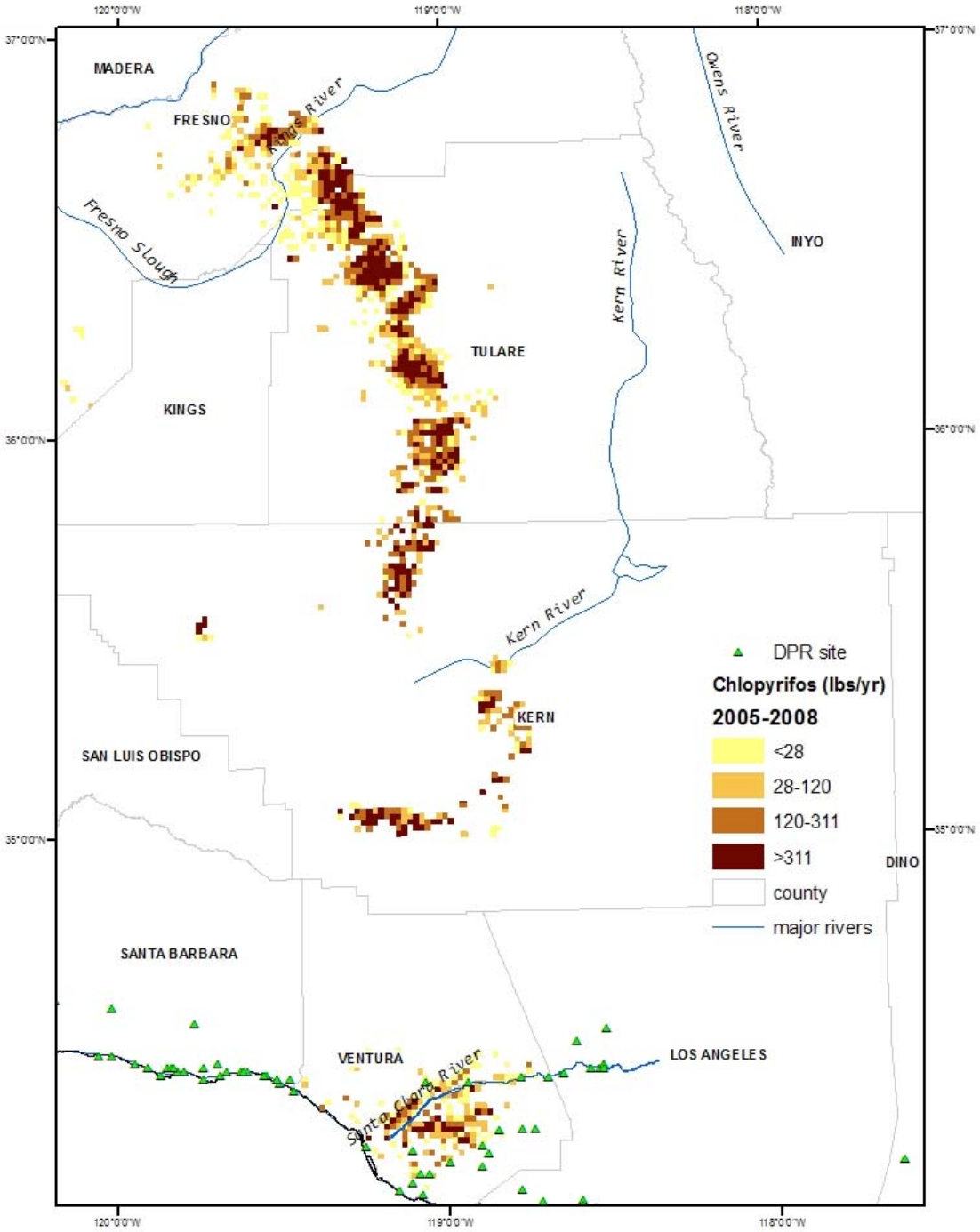

Figure 2. Geographic distribution of chlorpyrifos use (annual average in pounds) for citrus production in Fresno, Kern, Tulare, and Ventura during 2005-2008 (categorized by quartiles of uses)