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Potential Impacts of Citrus Pesticide Use on Surface Water

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Abstract

This study aims to identify potential risks of citrus use pesticides to surface waters in California. Top use pesticides on citrus were identified using the pesticide use information from 2005 to 2008. Surface water monitoring data was retrieved to explore their detections in surface water. Pesticides with both high use rates and frequent detections include diuron, simazine and chlorpyrifos. GIS maps were made to reveal the spatial distributions of the use and detection sites of these three pesticides. These maps indicated that most of the detection sites were not located near or downstream of the use sites. The results suggested that it was unlikely that the detections of these chemicals in surface waters were attributed to their use on citrus crops.

Introduction

The purpose of this study is to provide a preliminary understanding on whether pesticides used on California citrus could pose a potential risk to surface water. Pesticide use data from 2005 to 2008 were retrieved to identify top use pesticides. Further analyses were then conducted to verify if these pesticides have been detected in surface waters of California and whether their detections were related to the use on citrus crops.

Methods

Pesticide use data from 2005 to 2008 were obtained from the Pesticide Use Reporting (PUR) database. Surface water monitoring data from year 1991 to 2006 were retrieved from the Surface Water Monitoring Database for the pesticides that were used on citrus crops. Pesticides with one or no detection were removed from the list, while those with frequent detections and high use were identified for further investigation. GIS maps were made to visualize the spatial distributions of detection and use of these chemicals.

Results and discussion

A total of 338 pesticide active ingredients (AIs) were used on citrus crops between year 2005 and 2008, 47 had use rates of more than 10,000 pounds per year (Table 1). Monitoring data was available for these 47 AIs. A total of 34 AIs were detected more than once in the surface water (Table 2). Pesticides with both high detection rates and high use include diuron, simazine and chlorpyrifos. Chlorpyrifos ranked 9th by total use statewide per year and was also the second most heavily monitored pesticide with 9,218 samples and 2,272 detections (detection rate =24.6%) (Table 2). Diuron and simazine ranked 11th and 12th by annul use, respectively, and were among the most frequently detected with detection rates over 40%.

Since diuron, simazine and chlorpyrifos were also commonly used on other crops, the frequent detections of these pesticides do not necessarily relate to their use on citrus. While detailed transport and fate analysis was beyond the scope of this study, GIS maps were made to investigate the spatial relationships between the sites of detection and locations of pesticide use. Figure 1, 2 and 3 show the locations of monitoring sites where the chemicals were detected and the location of township range sections where they were used. These three pesticides were mainly used in the counties of Tulare, Kern and Fresno. It seems that most of the detection sites were not located near or downstream of the use sites (Fig. 1, 2, 3). Therefore, it was unlikely that the detections of these pesticides in surface waters were attributed to their use on citrus crops.

Conclusions

Between 2005 and 2008, a total of 338 pesticide AIs were used on citrus crops, 34 of which were detected more than once in the surface waters of California. However, the detection sites were mainly located away from citrus groves where pesticides were used. Therefore, it was unlikely that the detections of these pesticides were attributed to their use on citrus crops.

Table 1: Top pesticide active ingredients used on citrus (2005-2008)

Chemical Name	Annual use (lbs of AI)
Calcium Hydroxide	4,754,770
Petroleum Oil, Unclassified	3,301,850
Mineral Oil	2,582,750
Copper Sulfate (Basic)	556,428
1,3-Dichloropropene	343,603
Sulfur	335,828
Copper Hydroxide	321,192
Glyphosate, Isopropylamine Salt	300,686
Chlorpyrifos	258,495
Glyphosate, Potassium Salt	193,433
Diuron	190,486
Simazine	184,472
Kaolin	127,823
Bentonite	119,689
Petroleum Distillates	118,999
Sodium Hypochlorite	109,776
Copper	92,895
Pendimethalin	68,881
Cryolite	65,692
Dimethoate	54,630
Carbaryl	38,207
Malathion	35,474
Copper Oxide (Ous)	34,773
Modified Phthalic Glycerol Alkyd Resin	34,344
Petroleum Oil, Paraffin Based	33,289
Alpha-(Para-Nonylphenyl)-Omega-Hydroxypoly(Oxyethylene)	33,081
Bromacil	24,196
Metaldehyde	23,297
Imazalil	22,133
Oryzalin	20,363
Molasses	19,800
Alpha-Alkylaryl-Omega-Hydroxypoly(Oxyethylene)	19,772
Formetanate Hydrochloride	17,574
Norflurazon	17,530
Glyphosate	16,946
Thiabendazole	15,479
Styrene Butadiene Copolymer	13,555
Imidacloprid	13,548
Spinosad	13,408
Methylated Soybean Oil	12,982
Fatty Acids, C16-C18 And C18-Unsaturated, Methyl Esters	12,585

Ammonium Sulfate	11,904
Polyethylene Glycol Mono(3-(Tetramethyl-1-(Trimethylsiloxy)Disiloxanyl)Propyl)Ether	11,715
Copper Sulfate (Pentahydrate)	11,581
2,4-D, Isopropyl Ester	10,821
Paraquat Dichloride	10,766
2,4-D, Dimethylamine Salt	10,335

Table 2: Citrus use pesticides with more than one detection in surface water

Chemical name	**Number of samples**	**Number of detections**	**Detection rate (%)***	**Annual use (lbs)**
Diazinon	9,848	4,255	43.2%	6
Diuron	2,064	862	41.8%	190,486
Simazine	5,501	2,283	41.5%	184,472
Chlorpyrifos	9,218	2,272	24.6%	258,495
Trifluralin	3,935	604	15.3%	1,317
2,4-D	823	113	13.7%	7
Pendimethalin	2,660	364	13.7%	68,881
Imidacloprid	91	10	11.0%	13,548
Methomyl	2,062	221	10.7%	2,134
Norflurazon	928	99	10.7%	17,530
Dimethoate	3,894	380	9.8%	54,630
Propargite	1,853	174	9.4%	523
Napropamide	2,420	218	9.0%	805
Oxyfluorfen	156	10	6.4%	6,874
Bromacil	1,617	102	6.3%	24,196
Bifenthrin	1,221	62	5.1%	22
Oryzalin	715	36	5.0%	20,363
Endosulfan	816	41	5.0%	0
Methidathion	5,503	252	4.6%	9,269
Malathion	7,847	352	4.5%	35,474
Carbaryl	5,479	200	3.7%	38,207
Glyphosate	456	14	3.1%	16,946
Metalaxyl	108	3	2.8%	17
Propiconazole	108	3	2.8%	29
Benomyl	394	7	1.8%	12
Dicofol	711	12	1.7%	7,858
Pyriproxyfen	203	3	1.5%	5,295
Ethyl Parathion	4,611	57	1.2%	5
Oxamyl	1,866	14	0.8%	4
Paraquat Dichloride	312	1	0.3%	10,766
Fenamiphos	635	1	0.2%	1,469
Dinoseb	698	1	0.1%	55
Methiocarb	1,784	2	0.1%	86
Phosmet	3,092	2	0.1%	255

*detection rate = number of detections / total number of samples

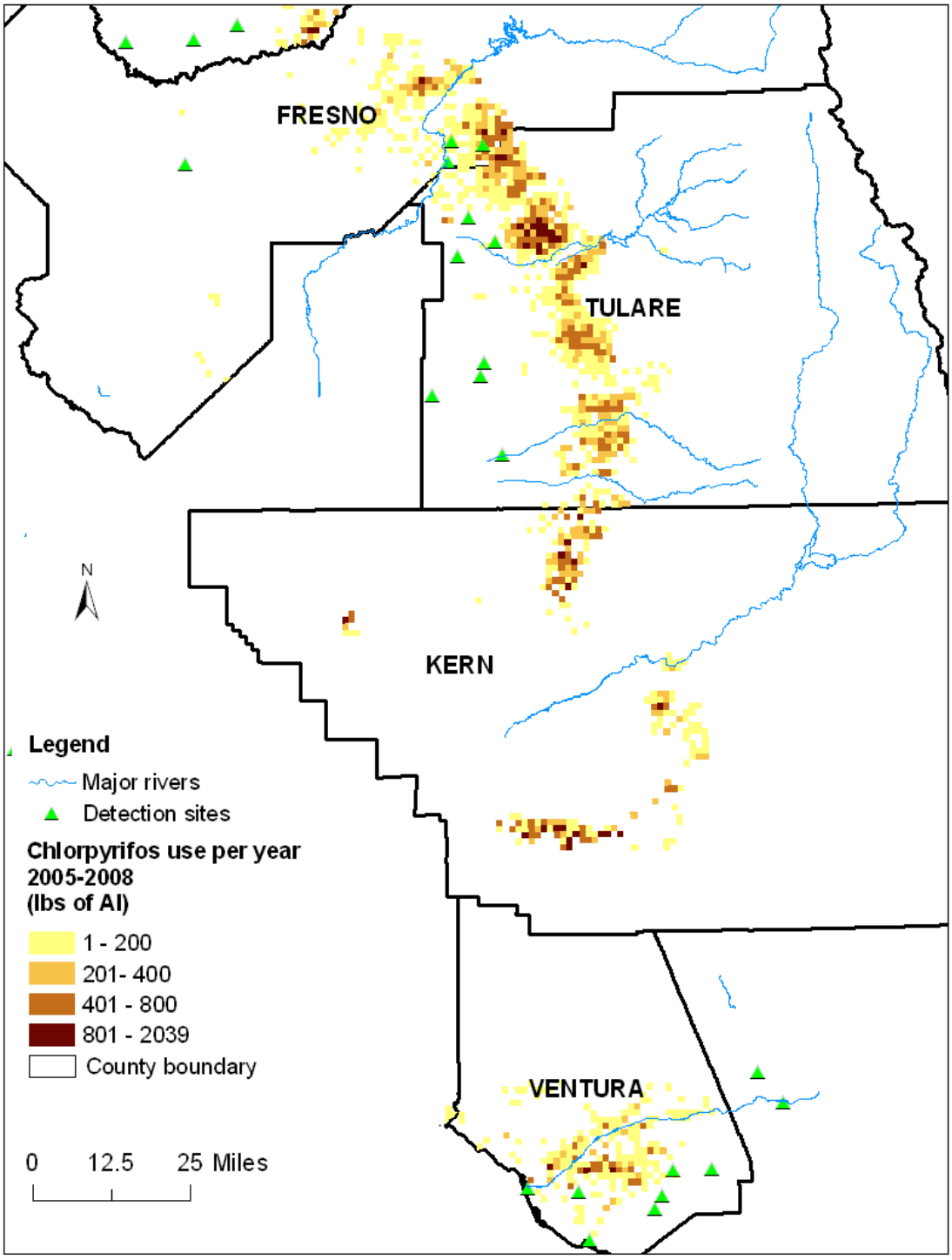

Figure. 1. Chlorpyrifos detection sites and use on citrus crops

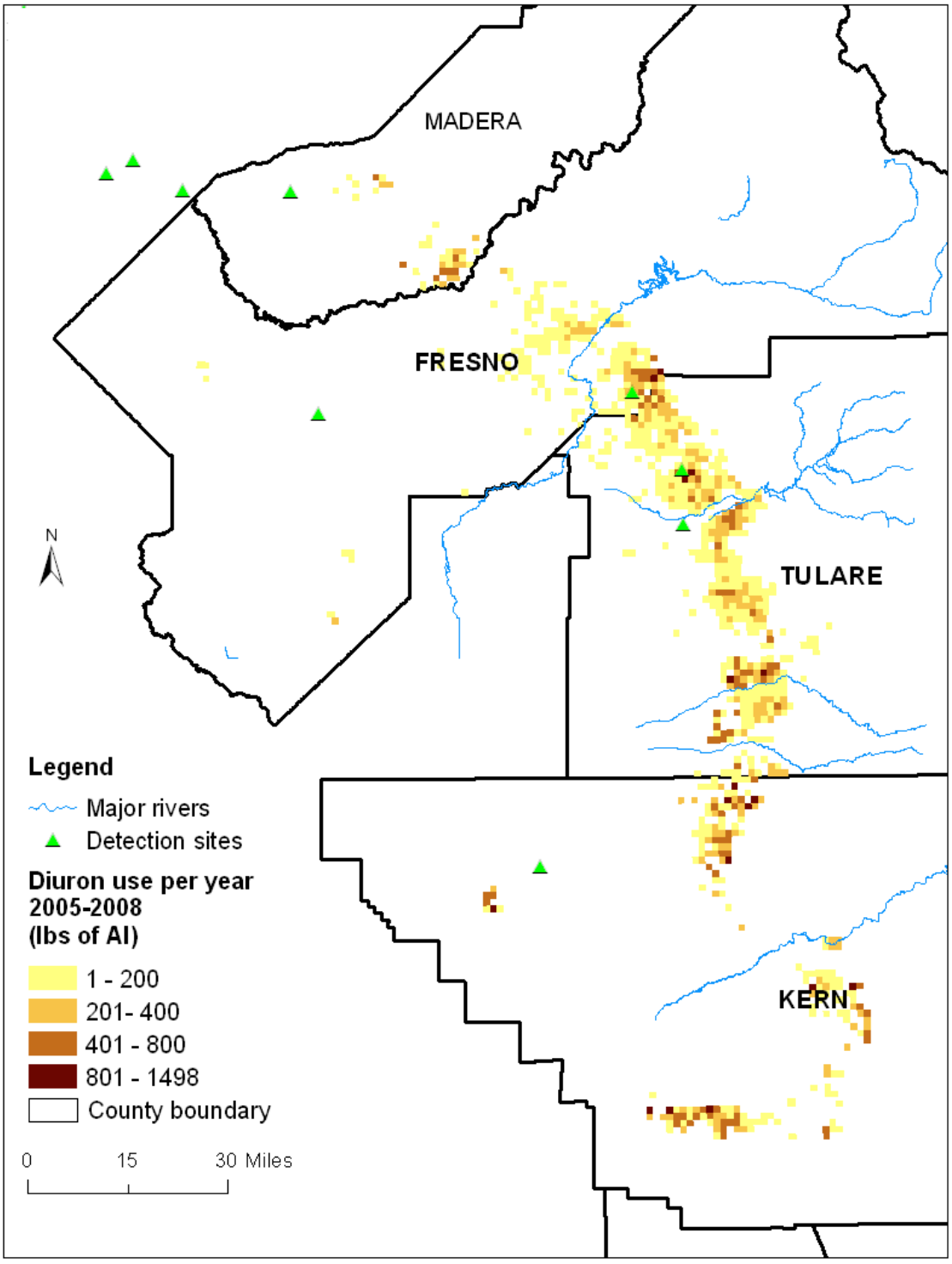

Figure. 2. Diuron detection sites and use on citrus crops

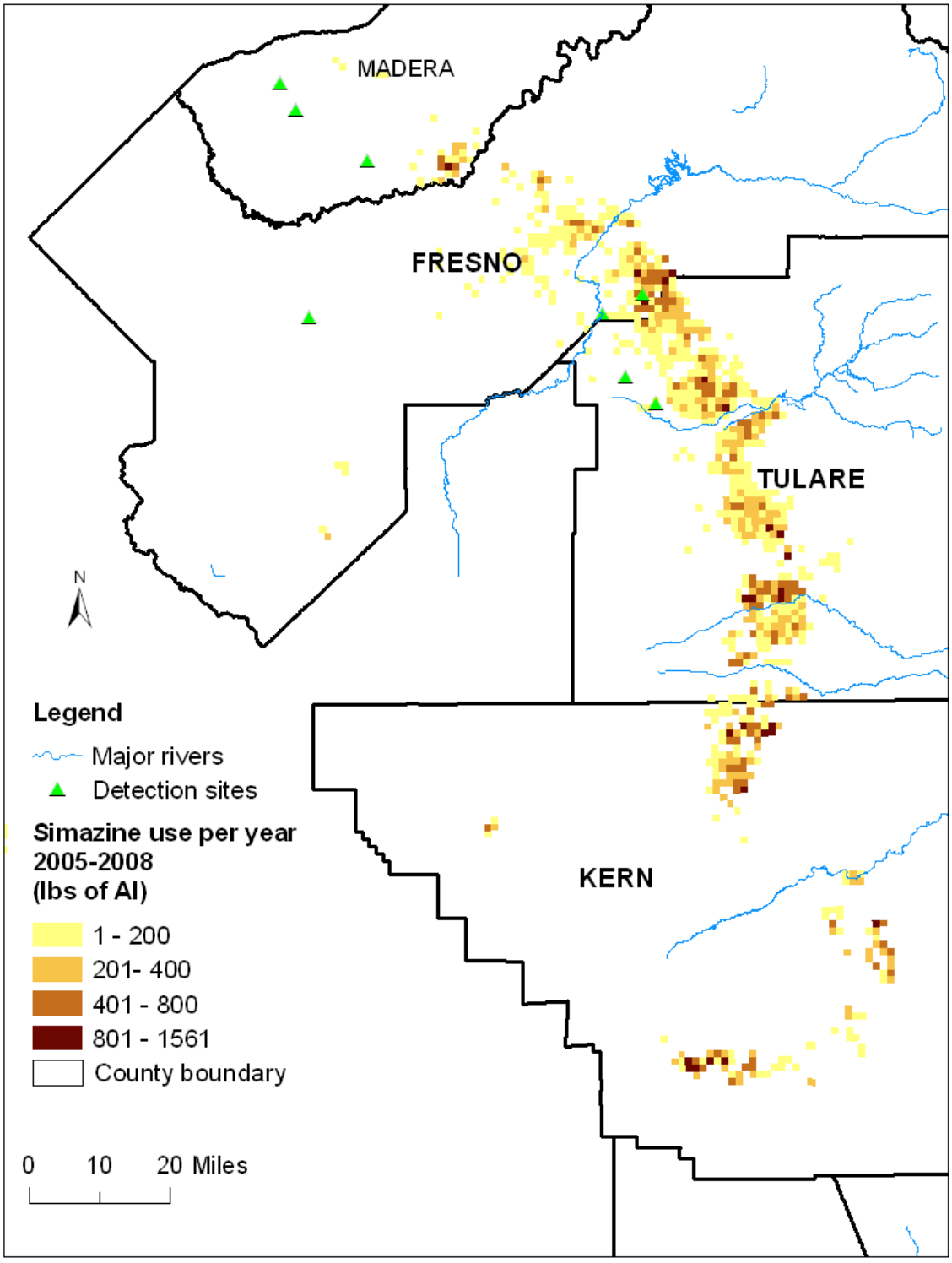

Figure.3. Simazine detection sites and use on citrus crops