# Draft Regulation Regarding Pesticide Applications near Schoolsites: Potential Economic Effects for Agriculture

Prepared for
California Dept. of Food and Agriculture
Office of Pesticide Consultation and Analysis


Rachael Goodhue[1]
Karen Klonsky[2]
Christopher DeMars[3]
Robert Van Steenwyk[4]

[1]Professor, Dept. of Agricultural & Resource Economics

[2]UCCE Specialist Emerita, Dept. of Agricultural & Resource Economics

[3]PhD Student, Hydrological Science, LAWR

University of CA, Davis

[4]UCCE Specialist Emeritus & Research Entomologist
Dept. Environmental Science, Policy, and Management
University of CA, Berkeley

# Table of Contents

# Table of Tables

# Table of Figures

# Executive Summary

This report examines the potential economic effects of the draft regulation governing the use of pesticides in agricultural production near public K-12 schools and licensed child daycare facilities (except family daycare homes) proposed by the California Department of Pesticide Regulation (CDPR). These schools and facilities are grouped under the collective term schoolsite.[1] The regulation includes mandatory actions for agricultural property operators, voluntary actions for schoolsites, and the option for property operators and schoolsites to collaborate on agreements that may modify some aspects of notification and timing in the draft regulation. Thirteen major agricultural counties were examined collectively (Fresno, Imperial, Kern, Kings, Madera, Merced, Sacramento, San Joaquin, Santa Barbara, San Luis Obispo, Stanislaus, Ventura, and Yolo), and two more detailed case studies of Kern and Stanislaus Counties were conducted. (Two major agricultural counties, Tulare and Monterey, are not included due to data considerations.) The thirteen counties included in the analysis account for two-thirds of California's total value of crop production.

This analysis addresses economic impacts of three provisions of the draft regulation for mandatory actions for agricultural property owners: the annual plan notification requirement, the 48-hour notification requirement, and the prohibited pesticide application stipulation. Each provision of the draft regulation addresses specified classes of pesticide applications within buffers extending ¼ mile from a schoolsite between 6 AM and 6 PM on weekdays. It does not consider the 25-foot buffer for non-prohibited pesticide applications, nor does it consider the potential effects of three-party written agreements. For the three provisions examined, the analysis considers all schoolsites year-round using the period July 1, 2013 through June 30, 2014. Voluntary actions by schoolsites and voluntary agreements between schoolsites and agricultural property owners are not included.

Specifications of the draft regulation were provided December 3, 2015 in a personal communication from Randy Segawa, Pesticide Programs Division, CDPR. CDPR provided data regarding weather (integrated with information on soil type and spray programs provided by the research team) on May 16, 2016 for almond and May 26, 2016 for grape. Weather is an important determinant of the estimated cost of prohibiting certain applications during certain time windows. CDPR provided a clarification of the meaning of a single application under the draft regulation as one or more pesticide products applied simultaneously on June 24, 2016. Whether a notification is required for each individual use report or a single notification is required for all products applied simultaneously affects notification costs.

**Data.** The analysis required identifying sites with "pesticide applications made for the production

---

[1] According to Education Code section 17609(f), "schoolsite" means any facility used as a child daycare facility, as defined in Section 1596.750 of the Health and Safety Code, or for kindergarten, elementary, or secondary school purposes. The term includes the buildings or structures, playgrounds, athletic fields, vehicles, or any other area of property visited or used by pupils. "Schoolsite" does not include any postsecondary educational facility attended by secondary pupils or private kindergarten, elementary, or secondary school facilities.

of an agricultural commodity (PAPACs)" located within ¼ mile of schoolsites.[2] (Such sites will be referred to as PAPAC fields.) Pesticide Use Report (PUR) data provided information on pesticide product applications from July 1, 2013, to June 30, 2014.[3] The PUR data supplied the crop treated, the pesticide used, application type (aerial or ground) as well as the date and time of day of the application and information identifying the grower and site. Attributes of pesticide applications incorporated into the data include federal and state restriction status, sprinkler chemigation label options, and whether the application occurred during the week or a weekend. Data regarding field boundaries, parcel maps, public school addresses, licensed child daycare addresses, street and number geocoding data to map those addresses were obtained from a variety of sources. For the analysis of the effect of weather on the economic impact of the regulation, weather data and data on the geophysical distribution of soils by soil hydrologic group was integrated with the other data.

Economic impacts were evaluated at a number of levels of aggregation: crop, grower, PAPAC field, all acreage in PAPAC fields, acreage within the ¼ mile buffer (PAPAC buffer acreage), and applications. The levels capture different types of costs and management decisions. For example, one grower could operate a large PAPAC field that is an alfalfa field and a very small PAPAC field that is an almond orchard. The alfalfa field could have a very small percentage of its acres within the buffer, and be treated four times, while the almond orchard could have a large percentage of its acreage within its buffer and be treated six times. Thus, the different aggregations are one grower, two crops, two PAPAC fields and associated acreages, two PAPAC buffer acreages, and ten applications.

**Growers, PAPAC fields, and acreage subject to draft regulation**. According to 2014 PUR data, there were 25,836 unique grower identification numbers in the thirteen counties.[4] Of those, 1,439 (5.6 percent) would have one or more PAPAC fields.[5] Accordingly, each of those growers would need to become familiar with the regulatory requirements. In total, there are 2,571 PAPAC fields. Each PAPAC field would need to have an annual notification of planned pesticide use delivered to schoolsites and the County Agricultural Commissioner's Office (CAC). 36,471 acres would be buffer zone acres within PAPAC fields (acres within ¼ mile of a schoolsite).

**Notification costs.** 1,212 growers would have been affected by the 48-hour notification requirement and/or the prohibition on certain classes of applications in the draft regulation. The total number of PAPAC fields with at least one application affected by the draft regulation was

---

[2] According to Title 3, California Code of Regulations, section 6000 "agricultural commodity" means an unprocessed product of farms, ranches, nurseries and forests (except livestock, poultry and fish). Agricultural commodities include fruits and vegetables; grains, such as wheat, barley, oats, rye, triticale, rice, corn and sorghum; legumes, such as field beans and peas; animal feed and forage crops; rangeland and pasture; seed crops; fiber crops such as cotton; oil crops, such as safflower, sunflower, corn and cottonseed; trees grown for lumber and wood products; nursery stock grown commercially; Christmas trees; ornamentals and cut flowers; and turf grown commercially for sod.

[3] Pesticide Use Report data can be downloaded from ftp://transfer.cdpr.ca.gov/pub/outgoing/pur_archives/.

[4] Growers operating in more than one county will have more than one grower identification number.

[5] Note that PAPAC fields include nursery facilities. Some of these facilities have relatively large numbers of pesticide applications.

2,105, an average of 1.7 fields per grower. 36,471 acres would have been in PAPAC buffers (30.1 buffer acres per grower). A total of 11,176 48-hour notifications would have been required (9.2 per grower).

- Total estimated notification costs are $1,776,899.
- Total costs (notification costs plus indirect costs) are $3,553,798.

The majority of these costs (90%) are accounted for by the preparation of the annual notification of pesticides that might be applied: $1,594,843. The average annual cost per grower is $1,234, and the average annual cost per affected PAPAC field is $691 (Table ES-1).

Table ES-1 Estimated Notification Costs

| Activity | Total annual cost | Cost/grower | Cost/PAPAC field |
|---|---|---|---|
| Preparation of annual notifications | $1,594,843 | $1,108 | $620 |
| Delivery of annual notifications | $17,787 | $12 | $7 |
| Understanding requirements | $37,198 | $26 | $14 |
| 48-hr notifications | $127,071 | $88 | $49 |
| Total | $1,776,899 | $1,234 | $691 |

It is important to keep in mind that averages do not provide a complete picture of notification costs. Notification costs are heterogeneous across growers. Differences in notification costs are driven by differences in the number of PAPAC fields, the number of pesticide applications requiring notification for each PAPAC field, and the number of schoolsites that must be notified.

**Economic impact of compliance with prohibited applications provision.** The analysis identified the applications in the thirteen counties from July 1, 2013 through June 30, 2014 that would have been prohibited if the proposed regulation was in place. The proposed regulation defines prohibited applications in the buffer zone as the use of sprinkler chemigation, aerial, air blast (including air assist), dust, and fumigation between 6 AM and 6 PM Monday through Friday. Fumigation has an additional requirement that the school cannot be occupied 36 hours following application and other restrictions, including fumigant-specific buffer zone distances. An analysis of the effect of the time window requirement is evaluated for two prohibited application methods: aerial and air blast.[6] Using the start times reported in the PUR database, all applications using aerial or air blast methods were divided into four time periods: Weekdays between 6 AM and 6 PM, weekdays before 6 AM, weekdays after 6 PM, and weekends.

A total of 6,907 applications would have been impacted by the draft regulation out of the total of 12,005 aerial and air blast applications: 1,089 aerial applications and 5,818 air blast

[6] Sprinkler chemigation is excluded because it is assumed that its timing could be altered to comply with the weekday time constraints without any economic impact. Fumigation is excluded due to the additional post-application requirement.

applications occurred during prohibited times. Overall, 58 percent of these applications would have been prohibited under the regulation. The percentage was slightly lower for air blast (57 percent prohibited) than aerial (60 percent prohibited).

The commodities with the largest numbers of applications impacted were almond and grape with 1,757 applications to almond, 1,559 applications to grape (includes wine, table and raisin). These two crops comprised 48 percent of all prohibited applications. Of the field crops, alfalfa has the largest number of impacted applications followed by corn, cotton, and processing tomato.

The analysis revealed that evening and weekend applications are already being done. Weekday evening applications accounted for 18 percent of all applications, and 24 percent of the total took place on weekends. Just over half of all aerial and air blast applications (58 percent) occurred during the prohibited weekday time period between 6 AM and 6 PM. It's important to remember that these numbers are for fields within ¼ mile of schoolsites for the thirteen counties analyzed and not all applications in these counties. It is possible that growers are already avoiding weekday applications between 6 AM and 6 PM near schoolsites. At a minimum, growers appear to already have some flexibility to make applications outside the prohibited time window, provided weather and field conditions permit.

However, weather and field conditions are not always suitable for applying pesticides. For example, rain can prevent applications and result in fields too wet to treat with ground rig applied air blast methods after the rain itself stops. Forecasted rain events can in themselves prohibit certain pesticide applications. Thus, growers may sustain losses as a result of the draft regulation because they lose the option of treating during the weekday 6 AM-6 PM window.

To examine the implications of this loss of flexibility, the potential impacts of the prohibition of aerial and air blast applications on almond, walnut, grape, cherry, peach and nectarine in the critical treatment window of late winter/early spring is considered using two sets of assumptions regarding the effect of the draft regulation on yields. University of California and U.S. Department of Agriculture personnel provided estimates of yield losses when zero fungicide applications can be completed using air blast or air assist application methods during critical periods: bloom (almond, cherry, peach, and nectarine) and, for walnut and grape, the most sensitive part of the spring. Springtime fungicide applications were selected as the UC and USDA personnel believed those to have the largest potential impact on yield if they could not be applied due to the regulation. These losses are based on an extreme assumption: weather would allow zero applications to be completed under the draft regulation while simultaneously allowing all applications to be completed in the absence of the draft regulation.

The second component of the analysis takes a closer look at potential yield loss with and without the regulation by integrating weather data, soils data, bloom data, and number of fungicide sprays that could not be completed within a multi-spray program for the top two affected crops as measured by buffer acreage in the thirteen counties: almond (7,245 acres) and grape (5,319 acres). The majority of the state's production of the two crops is in the counties examined: almond production value represents 81% of the statewide almond production and grape 55% of statewide production. Based on information from UC and USDA personnel, fungicide applications during late winter/early spring, when rain is relatively common, are some of the most sensitive components of pest management programs in these crops. For this component of the analysis the critical late winter/spring growth periods were analyzed over a ten-year period (1996-2005). A ten-year period accounts for variations in precipitation across years. This specific ten-year period was chosen given the availability of bloom dates for almonds in the Central Valley. Soil hydrologic data and weather data were necessary because ground applications are possible only if the soil is not too wet from precipitation, which is a function of the amount and duration of precipitation and hydrologic soil type. Weather data included the day of the week, time of day, amount of precipitation, and duration of rain events. Rules were developed to determine the potential for spraying after rain events given particular soil types. Probabilities that one or more fungicide sprays could not be completed were calculated by applying these rules to each year in the historical weather dataset (1996-2005) and actual soil hydrologic type data for schoolsite buffers. Another set of rules was developed for grape, which was analyzed for the same ten-year period for consistency with almond. Aerial applications were not considered as an alternative to missed ground sprays for either crop.

- Estimated direct losses averaged across years for almond in the Central Valley counties examined were $173,547.
- Estimated direct losses averaged across years for grape in the Central Valley counties examined were $21,840.

Estimated losses using historical weather data and soils data are dramatically smaller than losses estimated assuming zero applications can be completed under the draft regulation. The simplistic zero application scenario could only occur under weather conditions that allowed daytime weekday applications and also prohibited applications at night and weekends for several weeks in a row. By ignoring weather data, this over-simplifying assumption increases estimated losses dramatically from when weather data is considered. Most notably, if no sprays are applied then virtually all of a grape crop can be lost to powdery mildew. Once weather and soils data are utilized, it is apparent that no more than one or two consecutive sprays are ever missed for these two crops, and even these cases are uncommon in the 1996-2005 period analyzed on a county and soil hydrologic group basis. When only one spray is missed, there are zero estimated yield losses. Thus, there are very small estimated revenue losses.

**Multiplier effects on total economic activity.** Effects on total economic activity, which includes indirect effects on other economic sectors due to the reduction in revenues in the agricultural sector, has two components: the effect of notification costs and the effect of prohibited applications. The California Department of Finance's recommended rule of thumb for estimating the indirect effects when a detailed analysis is not feasible is a multiplier of two times the direct effects.

- The total reduction in economic activity in the thirteen counties due to the cost of the notification requirement would be $3,553,798.

- The total reductions in economic activity due to the prohibition on certain classes of applications in the weekday 6 AM-6 PM time window for almond and grape in the counties examined were less than $400,000 ($390,772).

**Caveats and Limitations.** The GIS analysis provided a robust characterization of the number of growers, fields, acres, crops, and applications that would have been impacted between July 1, 2013 and June 30, 2014 in thirteen major agricultural counties collectively and in Kern and Stanislaus counties individually, had the draft regulation been in effect. It is critical to remember that this analysis applies only to a single year of data and specific counties. Notably, two important agricultural counties, Monterey and Tulare, were not included due to data limitations. Extrapolation of these results to other years and other counties is inadvisable, owing to differences in weather, pest conditions and crop mixes over time and space. Importantly, 2013-2014 was part of a prolonged drought, which increases the potential for problematic inferences.

The analysis does not consider the costs of possible strategies for adaptation to the draft regulation, including change in crops or pest management practices. Changes in crop choices or varieties would change costs of production, revenue, and profit at the farm level. With respect to changes in pest management, prohibitions on applications that limit growers' ability to time applications may induce them to choose pesticides that have longer residuals and/or are more toxic, to replace applications of targeted pesticides with applications of broad spectrum pesticides, to replace monitoring and applications of pesticides only as needed with a schedule of preventative applications, or apply at maximum label rates instead of lower ones. Such responses will have economic implications, although the direct effect on per-acre costs may be an increase or decrease. Similarly, if the efficacy of pest control changes with a change in materials, application method, or timing, the income to the grower could increase or decrease, impacting profit. There also may be implications for environmental quality and human health. With the important exception of current county permit conditions regarding pesticide applications near schools, the analysis does not consider interactions with other regulations that could affect how growers would respond to the draft regulation. The effects of existing regulations are reflected in growers' current decisions.

Nonetheless, in spite of these caveats the one clear broad implication is that the impacts will not be uniform across growers, crops, or counties. The majority of growers (and fields) would be unaffected. Among affected growers, those with multiple PAPAC fields with acreage within 1/4 mile of a schoolsite or multiple schoolsites, those using aerial or air blast applications, or those whose pest management program include many pesticide applications are most affected by the draft regulation.

# Introduction

This report presents an analysis of the potential economic effects on agriculture of the draft regulation governing the use of pesticides in agricultural production near public K-12 schools and licensed child daycare facilities proposed by the California Department of Pesticide Regulation (CDPR). Geographic Information Systems (GIS) academic experts and economists from the University of California, Davis were first briefed on an early draft on Monday, November 2, 2015. CDPR and the California Department of Food and Agriculture (CDFA) agreed that the version addressed in this report would be the one extant Thursday, December 3. Specifications of the draft regulation were provided December 3, 2015 in a personal communication from Randy Segawa, Pesticide Programs Division, CDPR. CDPR provided data regarding weather (integrated with information on soil type and spray programs provided by the research team) on May 16, 2016 for almond and May 26, 2016 for grape.

The basic components of the draft regulation were presented in CDPR's "Concepts to Address Pesticide Use near Schools" (CDPR 2015a). They included notifications provided to schools of planned applications within a certain distance within a specified time period ("when the school is in session") for certain pesticides, and restrictions on pesticide applications within a certain distance for particular pesticide application methods. Any such measures would be in addition to existing ones, including label restrictions, regulations, and county permit conditions for restricted materials. Many counties already have permit conditions regarding pesticide applications near schools (Appendix 2, CDPR 2015a).

The analysis considers the effects on thirteen major agricultural counties in total, and on Kern and Stanislaus Counties individually. It considers only the direct costs to growers associated with three provisions in the draft regulation: the requirement for the preparation of an annual plan of anticipated pesticide use and its delivery to schoolsites and the county agricultural commissioner (CAC), the requirement to notify schoolsites and the CAC regarding specific classes of applications 48 hours in advance, and the prohibition on other specific classes of applications during certain time intervals. The cost of the notification requirement is estimated.

Evaluating the cost of prohibitions on certain classes of applications (i.e. aerial and air blast) during specific time intervals is more challenging. The analysis evaluates the distribution of aerial and air blast applications across days of the week and time of day and discusses implications for grower flexibility in the timing of applications. If growers do not have sufficient flexibility then their crops may sustain yield reductions. Potential crop loss from untimely or eliminated disease control is discussed for almond and grape, the crops with the highest schoolsite buffer value. Losses depend on the effect of missing applications on yield, and the frequency of weather conditions preventing the completion of applications, which in turn depends on soil type. Further, there are recognized potential effects that could not be quantified for this work and could be quite substantial.

The analysis does not consider growers making changes in pest management programs that include changes in products, materials, application rates, or the number of applications. Arguably, these are likely responses to the proposed regulation; however, there is no reasonable way to predict these responses or how they would vary across growers, as there are many factors that would enter into each grower's decision. Also, the analysis does not include any additional application costs growers incur due to switching the time of day or day of the week to comply with the regulations as weekend, early morning, and evening applications are already being done. These costs could also vary considerably across growers based on crops and pest pressure. Owing to a variety of considerations, it is inadvisable to extrapolate the findings of this study to other counties or to California as a whole; counties differ in cropping patterns, the locations of public K-12 schools and licensed child daycare facilities relative to commercial agriculture, and other factors. Important caveats and limitations are discussed at the end of the introduction.

## Draft Regulation

Specifications of the draft regulation were provided December 3, 2015 in a personal communication from Randy Segawa, Pesticide Programs Division, CDPR. CDPR provided data regarding weather (integrated with information on soil type and spray programs provided by the research team) on May 16, 2016 for almond and May 26, 2016 for grape. The scope of the draft regulation includes all public K-12 schools, and all licensed child daycare facilities (except family daycare homes). These schools and facilities are grouped under the collective term "schoolsite."[7] The draft regulation applies to applications within ¼ mile of a schoolsite from 6 AM to 6 PM, Monday to Friday, unless no classes are scheduled for the entire day.[8] The regulation includes mandatory actions for property operators, voluntary actions for schoolsites, and the option for property operators and schoolsites to collaborate on agreements that may modify some aspects of notification and timing in the draft regulation.

The regulation addresses "Pesticide Applications made for the Production of an Agricultural Commodity" (PAPAC).[9,10] There are three components that apply to PAPACs near a schoolsite. First, the property operator must prepare an annual notification in writing for each location with one or more PAPACs anticipated for the coming year within ¼ mile of a schoolsite and provide it to that schoolsite and the CAC between January 1 and April 30. (Such locations will be referred

---

[7] According to Education Code section 17609(f), "schoolsite" means any facility used as a child daycare facility, as defined in Section 1596.750 of the Health and Safety Code, or for kindergarten, elementary, or secondary school purposes. The term includes the buildings or structures, playgrounds, athletic fields, vehicles, or any other area of property visited or used by pupils. "Schoolsite" does not include any postsecondary educational facility attended by secondary pupils or private kindergarten, elementary, or secondary school facilities.

[8] For brevity, the exception "unless no classes are scheduled for the entire day" will be excluded from the remainder of the text. It always applies.

[9] According to Title 3, California Code of Regulations, section 6000 "agricultural commodity" means an unprocessed product of farms, ranches, nurseries and forests (except livestock, poultry and fish). Agricultural commodities include fruits and vegetables; grains, such as wheat, barley, oats, rye, triticale, rice, corn and sorghum; legumes, such as field beans and peas; animal feed and forage crops; rangeland and pasture; seed crops; fiber crops such as cotton; oil crops, such as safflower, sunflower, corn and cottonseed; trees grown for lumber and wood products; nursery stock grown commercially; Christmas trees; ornamentals and cut flowers; and turf grown commercially for sod.

[10] An application is one or more pesticide products applied simultaneously at a single PAPAC field.

to as PAPAC fields.) The notification must include information on all pesticides (including adjuvants) expected to be used, including the active ingredients and sample product names and registration numbers in the following year from July 1 to June 30. It must also include information summarizing the regulation, the voluntary options for the schoolsite, the operator's name and contact information, a map showing the location of the PAPAC field and schoolsite, contact information for the CAC, and the National Pesticide Information Center (NPIC) website address. Second, applications of the following types are prohibited from 6 AM to 6 PM on weekdays within ¼ mile of the schoolsite: aerial applications, airblast applications (including air assist), field fumigant applications (which also must meet the pre-existing requirement that the schoolsite will not be in session for 36 hours afterwards (CDPR 2013)), sprinkler chemigations, and dust applications. Most other ground-based applications are prohibited within 25 feet of the schoolsite.

Third, for all ground-based applications that are not otherwise prohibited between 6 AM and 6 PM on weekdays, the property operator must provide written notices to schoolsites and the CAC at least 48 hours in advance. The notice must include a summary of notification requirements and the institution's options, whether or not the active ingredient(s) (including adjuvants) were included in the annual plan submitted to the schoolsite, and additional information**.** The additional information includes the property operator's name and contact information, a map, contact information for the CAC, the NPIC web address, information regarding the specific application. Pesticide application information must include the product name or names if a tank mix, registration number(s) and active ingredient(s) (including adjuvants), the application location, acres to be treated, application method, and the date and starting time of the application. Hand applications, such as backpack, applications inside enclosed spaces (e.g. greenhouses), bait stations, and granule-formulated products are exempt from this requirement.

The draft regulation has two components regarding voluntary actions that a schoolsite can take. The first component is the schoolsite's actions after receipt of the annual plan: it could provide a list of the pesticides included to staff and parents, and could, in addition, ask recipients of the list if they wish to be notified prior to applications. The second component of the voluntary actions is that the schoolsite may choose to notify parents/staff/other recipients 24 hours in advance of individual pesticide applications. These voluntary actions parallel mandatory actions regarding pesticide applications on the school grounds under the Healthy Schools Act (CDPR 2005).

The draft regulation includes an option for a voluntary written agreement among the property operator, schoolsite, and CAC. If all parties agree, then the 48-hour notification requirement can be modified. The scope for modifications of the 48-hour notification is quite broad: the schoolsite can receive notifications of applications outside the regulatory weekday 6 AM – 6 PM interval, or the notification requirement can be waived completely. The scope for voluntary modifications to the regulatory prohibitions is more limited; agreements can only implement modifications that provide the same or a greater level of protection as the prohibitions specified in the draft regulation, such as increasing the length of the time period when some classes of applications are prohibited.

## Scope of Analysis

The analysis focuses on the potential economic effects of the draft regulation on agriculture in thirteen California counties which are major agricultural producers, and on Kern and Stanislaus Counties specifically, using July 1, 2013-June 30, 2014 Pesticide Use Report (PUR) data to identify which applications, crops, and growers would have been affected and potential costs to agriculture. It does not address costs potentially incurred by schoolsites or CACs. It addresses three provisions of the draft regulation: the annual plan notification requirement, the 48-hour notification requirement, and the prohibited application stipulation, each of which includes specified classes of applications within ¼ mile of a schoolsite between 6 AM and 6 PM on weekdays. It does not consider the 25-foot buffer for non-prohibited applications, nor does it consider possible effects of potential three-party written agreements. The analysis abstracts from the complexities of identifying calendars for individual schoolsites and assumes that the prohibited application and 48-hour notification requirement apply to all schoolsites from 6 AM – 6 PM on weekdays year-round.

The draft regulation is defined spatially, providing information on the number of PAPAC fields, acreage within ¼ mile of a schoolsite in a PAPAC field (referred to as PAPAC buffer acreage), and the number of affected growers. It also provides the foundation for the economic component. The GIS code is reported in Appendix Three.

The thirteen major California agricultural counties which were included in the analysis are Fresno, Imperial, Kern, Kings, Madera, Merced, Sacramento, San Joaquin, San Luis Obispo, Santa Barbara, Stanislaus, Ventura, and Yolo. They were selected based on the volume of pesticide use reported and the availability of GIS data of sufficient detail and quality to evaluate a spatially based regulation. Counties that received more than approximately three million pounds of active ingredients during 2014, and have available land use data were selected for the study. Table 1 lists all counties, sorted by pounds of active ingredients applied during 2014. Counties used in this study are in bold.

Two counties, Kern and Stanislaus, were selected for case studies focusing on the distribution of PAPAC buffer acreage across growers and PAPAC fields, the number of growers, PAPAC fields, notifications required per schoolsite, and notification costs. They were selected due to their importance to California agriculture and other factors that made them particularly well-suited for this analysis. In 2013, Kern County was ranked second in the state in terms of the value of agricultural production and Stanislaus County was ranked sixth (CDFA 2015). Kern County is distinguished by its high quality GIS data. Stanislaus County has a relatively large number of schoolsites that would be impacted by the draft regulation, and the number of PAPAC fields per schoolsite would be relatively large.

Noticeably absent from the study, given their extensive pesticide use in agricultural production, are Tulare and Monterey counties. Tulare spatial data were not available until the study was almost complete and thus Tulare was not included. Monterey spatial data were available, but were of unusable quality. This is because Monterey maps “ranch” borders instead of field borders within each property. Field borders are not digitized. Usually a ranch contains multiple fields with multiple crops. Furthermore, Monterey's crop acres within a ranch often do not add up to the size of the ranch polygon (number of acres in the area delimited by the spatial data). Table 2 lists the 25 Monterey ranches within a quarter mile of a school or licensed child day care facility that reported pesticide applications to four or more crops in 2014, the size of the Ranch polygon and the total acreage across crops in the PUR data. Acreage differences occur even when only one crop is reported on a ranch, although single-crop ranches are not included in the table.

Table 1. California Counties by Pounds of Pesticide Active Ingredient Applied: 2014

| Top 30 Counties | Pounds AI | Other Counties | Pounds AI |
|---|---|---|---|
| **Fresno** | **29,650,200** | Mendocino | 878,314 |
| **Kern** | **24,486,900** | Tehama | 724,642 |
| Tulare | 11,833,800 | San Benito | 616,518 |
| **San Joaquin** | **11,322,200** | Lake | 572,084 |
| **Madera** | **8,775,520** | San Bernardino | 560,609 |
| Monterey | 8,739,010 | Contra Costa | 384,621 |
| **Merced** | **8,191,900** | Alameda | 282,691 |
| **Stanislaus** | **6,365,160** | Placer | 269,352 |
| **Kings** | **6,318,420** | San Mateo | 251,954 |
| **Ventura** | **6,286,840** | Shasta | 178,131 |
| **Santa Barbara** | **4,518,950** | El Dorado | 123,608 |
| **Imperial** | **4,226,860** | Lassen | 104,466 |
| **Sacramento** | **3,886,290** | Amador | 90,196 |
| **Yolo** | **3,265,610** | Modoc | 84,573 |
| **San Luis Obispo** | **2,905,410** | Marin | 75,075 |
| Sutter | 2,672,620 | Tuolumne | 56,934 |
| Butte | 2,588,190 | Calaveras | 51,285 |
| Colusa | 2,183,510 | Nevada | 47,846 |
| Sonoma | 2,132,540 | San Francisco | 39,696 |
| Los Angeles | 2,062,230 | Humboldt | 27,024 |
| Riverside | 1,996,210 | Del Norte | 25,006 |
| Santa Cruz | 1,872,990 | Plumas | 17,842 |
| Glenn | 1,773,150 | Inyo | 9,678 |
| San Diego | 1,600,150 | Trinity | 8,834 |
| Siskiyou | 1,568,200 | Mariposa | 8,469 |
| Napa | 1,326,830 | Sierra | 7,824 |
| Santa Clara | 1,290,040 | Mono | 7,304 |
| Solano | 1,179,900 | Alpine | 227 |
| Yuba | 897,674 | | |
| Orange | 878,693 | | |

Source: 2014 Pesticide Use Reporting data

Table 2. Polygon Acres, PUR Total Crop Acres, and Crops Grown: Monterey County Ranches with Four or More Crops, 2014

| Polygon acres | PUR total crop acres | Num. crops | Crops (PUR acres[a]) |
|---:|---:|---:|---|
| 588 | 90 | 8 | Parsley (7), Kale (2), Broccoli (12), Mustard Greens (7), Mizuna (12), Arrugula (13), Lettuce, Leaf (22), Spinach (14) |
| 261 | 72 | 8 | Broccoli (3), Mustard Greens (11), Parsley (7), Spinach (9), Lettuce, Leaf (11), Lettuce, Head (8), Arrugula (10), Celery (12) |
| 1328 | 99 | 8 | Mizuna (4), Broccoli (22), Kale (7), Artichoke, Globe (16), Spinach (6), Lettuce, Leaf (22), Lettuce, Head (18), Arrugula (4) |
| 406 | 168 | 7 | Cauliflower (14), Artichoke, Globe (113), Lettuce, Leaf (8), Uncultivated Ag (8), Cardoon (2), Broccoli (14), Brussels Sprout (8) |
| 421 | 92 | 6 | Kale (12), Broccoli (22), Squash, Zucchini (28), Mizuna (2), Swiss Chard (4), Spinach (22) |
| 552 | 117 | 6 | Pimento (20), Uncultivated Ag (15), Celery (7), Lettuce, Leaf (48), Parsley (8), Broccoli (19) |
| 412 | 93 | 5 | Cauliflower (11), Lettuce, Leaf (16), Lettuce, Head (31), Celery (16), Cauliflower (18) |
| 673 | 92 | 5 | Broccoli (17), Spinach (21), Lettuce, Leaf (2), Lettuce, Head (52), Carrot (0) |
| 131 | 83 | 5 | Spinach (13), Broccoli (16), Lettuce, Leaf (26), Lettuce, Head (28), Onion, Dry (0) |
| 702 | 280 | 5 | Lettuce, Head (24), Lettuce, Leaf (78), Cauliflower (44), Carrot (45), Onion, Dry (90) |
| 243 | 101 | 5 | Brussels Sprout (26), Artichoke, Globe (26), Spinach (13), Lettuce, Leaf (20), Fennel (16) |
| 327 | 86 | 4 | Broccoli (16), Spinach (28), Arrugula (7), Lettuce, Leaf (35) |
| 285 | 64 | 4 | Broccoli (28), Parsley (4), Spinach (18), Lettuce, Leaf (15) |
| 264 | 96 | 4 | Broccoli (30), Soil Fumigation/Preplant (24), Celery (19), Lettuce, Head (22) |
| 182 | 28 | 4 | Chinese Cabbage (Napa) (3), Bok Choy (1), Lettuce, Leaf (8), Lettuce, Head (15) |
| 338 | 62 | 4 | Lettuce, Leaf (20), Broccoli (18), Spinach (10), Lettuce, Head (14) |
| 115 | 37 | 4 | Chicory (27), Kale (6), Vegetables, Leafy (1), Fennel (3) |
| 555 | 31 | 4 | Swiss Chard (5), Lettuce, Leaf (11), Lettuce, Head (12), Broccoli (4) |
| 490 | 59 | 4 | Lettuce, Head (12), Lettuce, Head (12), Broccoli (21), Cauliflower (14) |
| 625 | 90 | 4 | Broccoli (17), Broccoli (28), Lettuce, Leaf (18), Lettuce, Head (26) |
| 136 | 35 | 4 | Lettuce, Leaf (5), Broccoli (12), Lettuce, Leaf (14), Lettuce, Head (5) |
| 427 | 184 | 4 | Lettuce, Head (56), Broccoli (67), Lettuce, Leaf (23), Onion, Dry (39) |
| 664 | 131 | 4 | Celery (16), Pimento (40), Broccoli (43), Lettuce, Leaf (31) |
| 805 | 177 | 4 | Brussels Sprout (12), Broccoli (20), Artichoke, Globe (122), Uncultivated Ag (23) |
| 178 | 75 | 4 | Lettuce, Leaf (14), Fennel (7), Spinach (5), Artichoke, Globe (50) |

[a]PUR crop acres may not sum to PUR total crop acres due to rounding.

Sources: CalAg Permits system, 2014 Pesticide Use Reporting data

## Caveats and Limitations

There are some important broad caveats and limitations regarding this analysis.

- First, it does not consider the possibility that growers may alter their crop choices in response to the draft regulation. Changes in crop choice could increase or decrease cost of complying with the draft regulation.

- Second, and related to the first caveat, the analysis does not consider changes in pest management programs regarding growers' choices of pesticide products and application methods. More specifically, prohibitions on applications may limit growers' ability to time applications, and may induce them to choose pesticides that have longer residuals and/or are more toxic to replace applications of more targeted pesticides with applications of broad spectrum pesticides, to replace monitoring and applications of pesticides only as needed with a schedule of prophylactic applications, or apply at the maximum label rate instead lower rates. Such responses will have economic implications, although the direct effect on per-acre costs may be an increase or decrease. Similarly, if efficacy of pest control changes with a change in materials, application method, or timing, the income to the grower could increase or decrease, impacting profit. There also may be implications for environmental quality and human health.

- Third, the analysis does not consider two provisions of the draft regulation that may have economic implications.

    - The first provision is the 25-foot buffer zone for non-prohibited applications near schoolsites from 6 AM – 6 PM on weekdays. Due to the minor size of the buffer there is likely to be sufficient flexibility in most cases to treat the buffer outside the prohibited time intervals.

    - The second provision is the option for three-party written agreements to supersede the draft regulation. Anecdotally, we know that some informal cooperative arrangements already exist between applicators and schools, and that both Kern and Stanislaus counties encourage communication between school personnel and growers (and applicators). However, there is no information available to provide any indication of how the draft regulation would affect the number of voluntary agreements or the content of existing ones. For example, if an existing arrangement already provided for the schoolsite to be notified of all pesticide applications then the proposed regulation would have no effect on notification costs. Similarly, if the voluntary written agreement established that the schoolsite would waive 48-hour notifications for non-restricted materials, then the notification costs would be the same as the status quo in which no notifications for those applications are required. On the other hand, the annual notifications may induce greater concern on the part of schoolsites' staff and parents, and lead to time-consuming negotiations between the schoolsite and property operator which may or may not lead to more notifications or additional voluntary prohibitions that would increase costs.

- Fourth, with the important exception of current county permit conditions regarding pesticide applications near schools, the analysis does not consider interactions with other regulations that could affect how growers would respond to the draft regulation. The effects of existing regulations, including pesticide use regulations, are reflected in growers' current decisions. Evaluating interactions between the draft regulation and existing ones requires identifying how existing regulations could limit options for growers responding to the draft regulation, if at all, and identifying how existing regulations could reduce the incremental cost of compliance because growers would also be complying with the draft regulation as a consequence of complying with existing ones. Thus, this omission could underestimate total costs to agriculture because the draft regulation leave growers with fewer options that comply with all regulations. It could also overestimate total costs to agriculture if existing requirements are more restrictive, so the draft regulation has no net effect. For example, county permit conditions that prohibit some pesticide applications "when children are present" may prohibit applications during time periods outside the weekday 6 AM – 6 PM window.

- Fifth, there are data limitations.

    - The analysis utilizes a single year of pesticide use report data, beginning July 1, 2013, and ending June 30, 2014. This decision has multiple dimensions affecting consistency and realism. These PUR data correspond to the date of the GIS data, maximizing consistency between applications and information obtained through the spatial analysis, such as the locations of schoolsites. Using one year of actual applications to evaluate impacts does not reflect weather variability, year to year differences in pest pressure or differences in crop. On the other hand, it reduces the potential for changes in regulatory requirements and available products (and application methods) to cause changes on pesticide applications across years.

    - The analysis does not adjust for weekdays when children are not present. It assumes children are present on all weekdays year-round. Exact dates vary by individual school or district, depending on the beginning and ending of the school year. Summer school dates also vary by school or may not be offered at all. In addition, school holidays, when school is not in session within the school year, vary across schools. No information is available regarding days when no children are present at licensed child daycare facilities.

    - Pesticide use report (PUR) data regarding application methods do not enable the complete categorization of applications into prohibited applications and applications subject to the 48-hour notification requirement. Most importantly, air blast and air assist applications are labeled ground applications. We utilize rules of thumb to define these applications; to the extent that there are exceptions to these rules the actual number of applications will differ from the number used here.

    - Technical considerations regarding the difference between available GIS data on the physical boundaries of schools and licensed child daycare facilities and the regulatory definition of schoolsite imply that buffers are likely overestimates to some unknown extent for some schoolsites. Though the extent is most likely minor for the ¼ mile buffers included in this analysis, it could lead to significant distortions in the evaluation of 25-foot buffers, a second consideration behind omitting those buffers from the analysis.

   - GIS data sufficient to evaluate spatially based regulations are not available for all counties, including Tulare and Monterey, both important agricultural counties.

- Finally, there are a number of factors that limit the applicability of the results to other counties or other time periods. Counties differ in many ways, including cropping patterns, the distribution of schools relative to farmland, and existing county-level regulations, among others. This caveat is particularly important owing to the lack of appropriate GIS data for many counties. Regarding time periods, 2013-2014 was part of a severe multi-year drought.

# Methodology and Data

The discussion of data and methodology is separated into five components: 1) the GIS analysis, 2) identifying pesticide applications excluded from the analysis due to existing regulations, 3) separating the remaining applications into ones subject to the prohibition provision, ones subject to the 48-hour notification requirement and those not subject to either requirement, 4) the notification cost analysis, and 5) the cost of complying with the prohibited applications provision.

## GIS Data and Methods

Spatial analysis necessitated locating PAPAC fields with pesticide applications located within ¼ mile of public schools and licensed child daycare facilities. Data regarding PAPAC field boundaries, parcel maps, public school addresses, licensed child daycare addresses, street and number geocoding to map those addresses, and pesticide applications were obtained from the sources described in Table 3. All data were loaded into a PostgreSQL database with all spatial data projected into a common coordinate system. Individual county crop maps were normalized to a common naming scheme and joined into a single layer.

Neither the schools nor daycare datasets contained the boundaries of the parcel site; both datasets had addresses while some of the school records had latitude and longitude columns. All addresses in the school, daycare, and parcel map datasets were normalized to the same format using the PostGIS normalize_address function. Then daycare and school addresses were compared to the parcel map addresses and if a match was found, the school or daycare was assigned the parcel polygon (physical shape and area defined by the spatial data) from the parcel map. For school parcels that didn't have an address match, but had latitude and longitude data, the latitude/longitude fields were converted into a spatial point, and then the nearest parcel that does not represent a roadway was used as the parcel boundary. For schools without an address match or latitude/longitude data and for daycare sites without an address match, their addresses were geocoded into a point using PostGIS' TIGER geocoder, then the nearest non-road parcel to that point was assigned.[11]

School and daycare parcel polygons were then buffered by ¼ mi (1320ft, 402.336m). Those buffers were intersected with the joint crop map. Each PAPAC field in the crop map that intersects a buffer is assigned a polygon for school, daycare, and both school and daycare that represents the area covered by the buffer (PAPAC buffer).

The joint crop map was then correlated with the PUR database using grower_id (stripped of the first four characters which represent the reporting county and year) and site_loc_id. PUR product applications during 2013-2014 that occurred on PAPAC fields that intersect either a school or daycare buffer were extracted and used as the basis for the output table. PUR data include the crop treated, the pesticide used as well as the date and time of day of the application. Attached to the basic PUR data, data fields were added summarizing PAPAC field acreage included in the

[11] Note that a parcel may not correspond to the legal definition of a schoolsite; some of a parcel may not be accessible to children.

PAPAC buffer, along with a count of how many schools and daycare sites were within a ¼ mile of the affected field. Flags were added to describe the application type, federal and state restriction status, chemigation legality, and whether the application occurred on a weekday.

Table 3. GIS Data Sources

| Data | Source |
|---|---|
| PAPAC field boundaries | Provided by CDPR via the CalAgPermits system |
| Parcel map | Used with permission from Digital Map Products http://www.digmap.com/products/landvision/landvision-professional/ |
| Schools | CA Dept. Education current school list: http://www.cde.ca.gov/ds/si/ds/pubschls.asp |
| Licensed child daycare facilities* | http://ccld.ca.gov |
| Pesticide applications | CDPR pesticide use reports: ftp://transfer.cdpr.ca.gov/pub/outgoing/pur_archives/ |
| Streets and address numbering for geocoding | https://www.census.gov/geo/maps-data/data/tiger.html |
| Weather | Provided by CDPR via CIMIS |
| Soil hydrologic groups | Natural Resource Conservation Service Soil Survey geographic database |

*DPR has defined 'daycare' to include four facility types from the CCLD dataset: Child Care Facility, Child Care Facility - Mildly Ill, Infant Facility, School Age Child Care Facility. Layer used for analysis downloaded 6/5/14.

In addition to the PUR usage table, basic statistics were summarized on a county basis and include the total number of schools and daycare sites, the number of schoolsites within a ¼ mile of a PAPAC field, the number of PAPAC fields impacted, and the number of applications on PAPAC fields. Maps were generated for each county that plotted the schools, daycare sites, and PAPAC fields.

The composition of buffer zone acreage by soil hydrologic group was obtained by intersecting the information computed regarding buffer zones with data on the geographic distribution of soils by hydrologic group.

The SQL code used to generate the data is included as Appendix Three.

## Pesticide Applications Excluded due to Existing Regulations

The purpose of this analysis is to evaluate the potential economic effects of the draft regulation *given* current regulations. Some pesticide applications near schoolsites are already prohibited by existing product labels, federal and state use regulations, or county permit conditions. There is no additional cost to growers of adjusting such applications due to the draft regulation.

Under California law, CDPR has the authority to add controls to those mandated by federal regulations on the use of specific pesticides, owing to negative effects of their use on human health and/or the environment. Existing county permit conditions address a specific class of California restricted materials. The class of restricted materials of interest for this analysis includes those that require county permits and notices of intent and may be used only by certified applicators (CDPR 2015b). These controls are implemented through a permit system managed by county agricultural commissioners (CDPR 2008). Permits require that certified applicators use the pesticide and restrict the time, location, and method of applications. Permits are generally issued annually or once a season, and are accompanied by Notices of Intent filed at least 24 hours before the planned application (CDPR 2000).

All thirteen counties considered in the report have permit conditions that restrict application of certain pesticides near schools. These restrictions are summarized in Appendix 2 of "Concepts to Address Pesticide Use near Schools" (CDPR 2015a). Here we consider additional information regarding the two case study counties: Kern County and Stanislaus County. In Kern County, 2015 general permit conditions include the following provision: "No applications of Restricted Materials are to be made within 1/4 mile of a school in session or during school sponsored activities when children are present" (Kern County Agricultural Commissioner 2014). Based on communications with five school principals and administrators in Kern County, it is not uncommon for high school students to be present after 6 PM, often to 8 PM or later, although it is uncommon for grade school students. Thus, for restricted materials the county general permit conditions would sometimes be more restrictive than the draft regulation regarding when applications of restricted materials are applied. Therefore the 6 AM – 6 PM weekday provision in the draft regulation does not affect costs associated with the use of restricted materials near schools.

According to communications with Kern County personnel, all activities occurring on school grounds with the knowledge of the school are considered to be covered under the schools provision in the general permit conditions. In such instances, the 6 AM – 6 PM weekday provision in the draft regulation does not affect costs associated with the use of restricted materials near licensed daycare facilities located on school grounds.

In Stanislaus County, all restricted material permits (unless specifically conditioned otherwise), include the permit condition that "No applications of Restricted Use pesticides for production agricultural use shall be made within ¼ mile of a school in session or during school sponsored activities when children are present" (Stanislaus County 2014). Except to the extent that there is any difference between a county's interpretation of "when children are present" and the specific time period present in the draft regulation, there will be no change in the requirements governing the applications of restricted materials near schools. It should be noted that "during school sponsored activities when children are present" could include all after-school clubs, sports team practices, and various events, such as student games and concerts. Based on communications with six school principals and administrators in Stanislaus County, it is not uncommon for high school students to be present after 6 PM, often to 8 PM or later, although it is uncommon for grade school students. Thus, for restricted materials the county general permit conditions would sometimes be more restrictive than the draft regulation. Therefore the 6 AM – 6 PM weekday provision in the draft regulation does not affect the costs associated with the use of restricted materials near schools.

According to communications with Stanislaus County CAC personnel, licensed child daycare facilities are not included in the county permit conditions. Thus, applications to acreage within a ¼ mile of a licensed child daycare that is not already in a PAPAC buffer for a school will be affected by all of the provisions of the draft regulation. At the other extreme, when a licensed child daycare facility is located on a public school land parcel, the only effects of the draft regulation would be the notification of the licensed child daycare facility and the addition of any 6 AM – 6 PM weekday times when "when children are present" at the daycare facility and not at the school. The number of PAPAC fields, acreage, and the number of affected growers are not altered, but the hours and days of the year of prohibition for restricted materials might be impacted, and an additional notification will be required.

Both counties' general permit conditions are silent with respect to the application of pesticides other than CA restricted materials near schools. Depending on method, some applications will be prohibited between 6 AM and 6 PM and some will be subject to notification requirements during those hours. Others will remain unaffected. The next section will discuss how applications are separated into these categories.

### Defining Days Subject to Prohibition and 48-Hour Notification Requirements

Weekdays are identified using a calendar function in the GIS analysis. This approach overstates the number of affected weekdays because it does not adjust for school holidays or other days when children are not present. It does not adjust for comparable weekday closures for licensed child care facilities. The year begins July 1, 2013, and ends June 30, 2014, following the period for the annual plan specified in the draft regulation.

### Identifying Applications Affected by Draft Regulation: Prohibited Applications and Applications Requiring a 48-hour Notification

The draft regulation prohibits the use of specific pesticide application methods on weekdays between 6 AM and 6 PM. In addition, all application methods are prohibited within 25 feet of a schoolsite, except backpack sprayers or granular formulations. Other pesticide applications during those periods must comply with the 48-hour notification requirements.[12] Utilizing 2013-

[12] Hand applications, such as with a backpack, and applications inside enclosed spaces are exempted from the 48-hour notification requirement and are not prohibited. Information that allows reliable identification of such

2014 PUR data, applications conducted on the weekend or outside the specified time interval on weekdays were removed from the set of affected applications. All granular applications, which are exempt from the draft regulation, are removed using the formulation code variable in the PUR data.

The PUR data enable the identification of three additional types of prohibited applications: aerial applications, fumigations, and dust applications. The data include an aerial vs. ground indicator variable and a fumigation indicator variable, as well as the formulation code variable discussed earlier. All aerial applications and all dust applications are not currently prohibited, and would be prohibited under the draft regulation, so applications of these types from 6 AM – 6 PM on weekdays would be affected. In both case study counties, fumigant applications are already prohibited near schools for the distance and time intervals specified in the draft regulation and therefore do not impact this analysis. For licensed child daycare facilities, as noted earlier, only applications of fumigant products with certain active ingredients within 1/8 mile are already prohibited under US EPA Phase II product labels (CDPR 2012).

PUR data do not provide information differentiating among other application methods. For air blast sprayer applications, rules of thumb obtained from interviews with UC Cooperative Extension personnel were used for identification (Table 4). Based on the rules of thumb, prohibited air blast sprayer applications are identified using the site code/name variables and the active ingredient specific type variable contained in the PUR data. This approach may overstate the number of air blast applications if other methods are used for some of the applications defined as air blast under the rules of thumb. It may understate the number of air blast applications if this method is used for treatments of other crops. Any differences will affect the determination of the number of prohibited applications and associated estimated costs only if the actual application method is not also subject to the prohibition requirement. Remaining applications are considered ground-based applications that are subject to the 48-hour notification requirement.

Table 4. Air Blast Application Rules of Thumb

| | |
|---|---|
| 1 | Only orchards and vineyards use air blast sprayers |
| 2 | All insecticide and fungicide applications on orchards and vineyards use air blast sprayers |
| 3 | No herbicide applications on orchards and vineyards use air blast sprayers |

Source: UC personnel

Pest management will be complicated by the draft regulation. In tree crops and grape, the majority of insecticides, fungicides and plant growth regulators are applied with air blast speed sprayers, with some insecticides and fungicides applied by aircraft. Herbicides are applied by

---

applications is not available, so they are not excluded. Thus, the number of applications subject to 48-hour notification is overstated, although it is unlikely to be a significant share of the total.

ground equipment (boom sprayers) and are not as time sensitive as other pesticides; most applications can be made on the weekends or at night. With appropriate lighting equipment, insecticides, fungicides and plant growth regulators can be applied with air blast speed sprayers from 6 PM to 6 AM. Some growers may need to purchase lighting for spray equipment (~$1,000 per spray rig) and the mixing and loading areas (~$500 per area). For liability reasons, some growers employ two or more workers for nighttime applications, an additional possible expense.

Aerial applications are used when muddy conditions make it impossible to apply fungicides by air blast equipment. Wet conditions are a bigger problem in the rainy northern counties. Optimal wind speeds for aerial applications are around 3-12 miles per hour. At higher wind speeds pesticide drift is a concern. Lower wind speeds can ead to inversion layers. Air applications are also used on very tall trees, e.g., walnut, where air blast sprayers cannot reach the top of the canopy. A possible work-around for the ¼ mile buffer zone would be to reduce the ground speed of the air blast sprayer to less than 1 mph, thus increasing the chances of reaching the upper portion of the tree.

In grape, the majority of insecticides, fungicides and plant growth regulators are applied with air-assist sprayers, though neonicotinoid insecticides are usually applied through a drip system. Herbicides are applied with ground equipment and, as with orchard crops, applications are less time sensitive than other pesticides and can be done on weekends or at night. With proper lighting equipment, vineyards can be treated via airblast sprayers with insecticides, fungicides and plant growth regulators at night.

Application equipment in field crops, e.g., alfalfa, cotton, tomato, beans, oats and corn, is dependent on the crop and stage of development. Applications are made with ground equipment (boom sprayers) or aerial equipment when the crop is young. However, as certain field crops mature, e.g., cotton, oats, processing tomato and watermelon, growth reaches a stage where ground equipment cannot enter the field without damaging the crop. At this point, termed "lay-by," pesticides must be applied by air. In the other field crops, e.g., alfalfa, field corn, dried bean and potato, growers could treat the buffer adjacent to the school before 6 AM, and treat remaining acreage with ground equipment or by air.

## Notification Cost Analysis

Costs of complying with the draft regulation are incurred at the grower, PAPAC field, schoolsite per PAPAC field, and application levels. Growers with one or more PAPAC fields have the following costs: the preparation of the annual notification of pesticides that may be used for each site, the delivery of the annual list to schoolsites and the CAC for each site, and the grower's time for reviewing and understanding the requirements in general. Applications subject to the notification requirement incur the additional cost of the 48-hour notification, which must be provided to each schoolsite and the CAC.

Time and wage information. Time estimates for specific activities are obtained by utilizing information for similar activities used by the U.S. EPA in its "Supporting Statement for an Information Collection Request" regarding its risk mitigation measures adapted as part of its

2009 Reregistration Eligibility Decisions for a group of fumigant chemicals (U.S. Environmental Protection Agency 2013). The preparation of the annual notification of pesticides that may be used is assumed to be equivalent to the preparation of an initial fumigation plan, the cost per schoolsite of delivering that notification is the same as the cost of filing and disclosing a fumigant management plan, and the cost of reviewing and understanding the requirements is the cost of understanding requirements. The time per 48-hour notification is assumed to be the same as the time per notice to the State Lead Agency (SLA).

The cost of each activity is calculated by updating the wage information from the U.S. Department of Labor source used by the U.S. EPA to the 2014 values. Grower cost per hour is based on the average hourly wage for occupation code 11-9013, Farmers, Ranchers, and Other Agricultural Managers, drawn from NAICS 115100-Support Activities for Crop Production, $35.41/hour (U.S. Department of Labor 2014). The wage is then "loaded" with the average benefit rate for all U.S. civilian workers: 46% (U.S. Department of Labor 2015). The loaded hourly wage is $51.69. Table 5 reports the activity, its base, the amount of time required, and the cost.

Table 5. Annual Cost of Compliance by Activity

| **Activity** | **Base** | **Hours** | **Cost** |
|---|---|---|---|
| *All growers with one or more PAPAC fields* | | | |
| Understanding requirements | Grower | 0.50 | $25.85 |
| *All PAPAC fields* | | | |
| Preparation of annual notification of pesticides that may be used | PAPAC field | 12.00 | $620.32 |
| Delivery of annual notification to schoolsite | Schoolsite | 0.05 | $2.58 |
| *Applications subject to 48-hour notification requirement* | | | |
| 48-hr notification cost | Schoolsite | 0.22 | $11.37 |

## Economic Impacts of Compliance with Prohibited Applications Provision

The analysis includes crop loss scenarios for selected orchard crops and vineyards, assuming that disease sprays during bloom periods were impacted due to poor weather conditions on weekends, early mornings, and evenings. Air blast and air assist applications are the only effective methods of applying materials to orchards and vineyards respectively with the exception of herbicides. Because these application methods are not differentiated from other application classes in the PUR data, we use information regarding crops and pesticide type to identify them (Table 4). Once identified, we assume that applications with air blast, air assist, and aerial applications will not be changed to a different method of application in response to the regulations.

Based on information from UC and USDA personnel, fungicide applications during late winter/early spring, when rain is relatively common, are the most sensitive components of pest management programs in many crops. The draft regulation would be more likely to affect disease management than insect or weed management because of strict timing requirements for disease mitigation sprays. We use data on county acreage, prices, yields and value of production, along with regional yield losses estimated by UC and USDA personnel as a function of the number of sprays completed to consider potential per acre revenue losses. We first present per acre revenue losses if zero fungicide sprays are completed. We then pair yield loss estimates for varying numbers of sprays with hourly weather data, soils data, and pesticide treatment rules developed in cooperation with other UC personnel to see whether yield losses would have occurred over a ten-year period. For any yield and revenue loss to be attributable to the draft regulation a particular spray would have to be possible under current requirements, but not legally possible under the draft regulation. Thus, we compare the number of completed sprays with and without the regulation for each year. We then estimate the economic impact of any decrease in spray applications due to the regulation as the value of the crop loss associated with the number of missed sprays.

The analysis does not include changes in materials due to the large number of pesticide products, active ingredients, and costs considered. We do not include changes in costs owing to changes in pest management programs that alter the number of applications due to changing the timing of applications or other changes. Therefore, due to the many unknown and unknowable factors involved, costs may be considerably higher, income may be lower, and profits may be lower for affected growers than the cost of the yield losses considered here.

Costs and determinants of aerial and ground applications. There are many factors which influence the use and cost of specific application methods but cannot be considered here. Aerial applications are used when the soil is too wet for ground applications and/or when large acreage needs to be treated in a short period of time. Weekend, early morning, and evening applications are already standard when weather permits. In the mornings the concerns are inversion layers, temperature, and fog. In the late afternoons the primary concerns are the same with the addition of wind speeds.

Many factors influence the cost of aerial applications. Aerial applicators usually do not impose a surcharge for Saturday applications. There may be a surcharge on Sundays, although we do not consider this in our analysis. The cost of aerial applications varies depending on the type of aircraft used, the type of material applied, the rate of material per acre, and the distance to the nearest airstrip. Splitting the applications into two dates, one for near schoolsites and one for outside the buffer, is possible but would increase costs and would probably decrease efficacy of the spray. The setup cost per acre is higher for small acreages. For fields smaller than 10 acres there is typically a separate setup charge and charge per acre. For more than 10 acres there may not be a setup charge.

Ground applications in the early morning, evening, and weekends are also standard practice. Additional costs for lights and possible overtime pay are already included in standard budgeted operating costs and therefore are not included as additional costs here.

## Estimated Indirect Effects on Economic Activity

Although not a direct effect on crop production agriculture, we calculate the indirect effect of the costs of the regulation on overall economic activity at the request of the California Department of Finance (DOF). We utilize the DOF's rule of thumb that the indirect effect on economic activity equals the direct effect on agriculture, so that the economic activity multiplier equals 2 (Charles Liao, DOF, personal communication, March 3, 2016). That is, the overall effects on the California economy will be twice the direct effects on production agriculture.

# Thirteen Counties

Thirteen major California agricultural counties were included in the main analysis: Fresno, Imperial, Kern, Kings, Madera, Merced, Sacramento, San Joaquin, San Luis Obispo, Santa Barbara, Stanislaus, Ventura, and Yolo. As noted earlier, they were selected based on the availability of GIS data adequate to evaluate a spatially based regulation as well as their status as major agricultural counties. This section begins with basic background information on the thirteen counties in order to provide some context for the results which follow.

## Background

This subsection places the thirteen counties analyzed in the overall context of California agriculture using a number of measures: their shares of the total value of production and acreage, and their distribution of the value of production and acreage across crop categories compared to the distributions for California. The discussion also compares the two case study counties, Kern and Stanislaus, to the entire group of thirteen analyzed counties and to California as a whole.

### Shares of California's value of production and acreage in 2014. The thirteen counties included in the analysis account for over half of California's total value of crop production. There are six broad categories utilized by CDFA: field and seed crops; fruit and nut crops; berries; vines; vegetable crops; and nursery products, flowers and foliage. The thirteen counties' share of the value of production by category ranged from a low of 28 percent for nursery products, flowers and foliage, to 65 percent for fruit and nut. Table 6 reports the value of production for each category and in total for each of the thirteen counties, their combined total, other counties, and the state as a whole. Shares of the value of production are also reported.

Kern County's share of the state value of production of fruit and nut crops (15 percent) is close to its share of all state crop production (12 percent). Its share of the state value of production of vines is notably larger (25 percent). Its share in all other categories is noticeably smaller. Stanislaus County accounts for only five percent of the value of all California crop production, but accounts for 10 percent of the value of fruit and nut crops.

Table 6. Value of Production by Crop Category: County, All Analyzed Counties, and California

| County | Field and Seed | | Fruit and Nut | | Berries | | Vines | |
|---|---|---|---|---|---|---|---|---|
| | VOP *$1000* | Percent of State Total | VOP *$1000* | Percent of State Total | VOP *$1000* | Percent of State Total | VOP *$1000* | Percent of State Total |
| Fresno | 319,001 | 6% | 2,472,161 | 13% | 22,414 | 1% | 905,099 | 13% |
| Imperial | 539,269 | 9% | 89,054 | 0% | N/A | N/A | N/A | N/A |
| Kern | 477,395 | 8% | 2,837,814 | 15% | 23,757 | 1% | 1,718,183 | 25% |
| Kings | 493,783 | 9% | 524,919 | 3% | N/A | N/A | 44,099 | 1% |
| Madera | 70,200 | 1% | 1,121,510 | 6% | N/A | N/A | 317,503 | 5% |
| Merced | 559,088 | 10% | 953,357 | 5% | N/A | N/A | 33,402 | 0% |
| Sacramento | 81,027 | 1% | 64,860 | 0% | 1,199 | 0% | 130,864 | 2% |
| San Joaquin | 344,543 | 6% | 1,257,826 | 7% | 27,510 | 1% | 481,440 | 7% |
| San Luis Obispo | 9,668 | 0% | 61,889 | 0% | 205,765 | 7% | 203,785 | 3% |
| Santa Barbara | 9,569 | 0% | 85,470 | 0% | 509,876 | 17% | 155,256 | 2% |
| Stanislaus | 327,825 | 6% | 1,881,521 | 10% | N/A | N/A | 52,663 | 1% |
| Ventura | 9,252 | 0% | 445,523 | 2% | 892,480 | 30% | N/A | N/A |
| Yolo | 274,415 | 5% | 219,158 | 1% | N/A | N/A | 68,960 | 1% |
| Total (13 counties) | 3,515,035 | 62% | 12,015,062 | 65% | 1,683,001 | 56% | 4,111,254 | 60% |
| State Total | 5,703,406 | 100% | 18,397,743 | 100% | 2,993,398 | 100% | 6,823,266 | 100% |

| County | Vegetables | | Nursery Products, Flowers, and Foliage | | All Crops | |
|---|---|---|---|---|---|---|
| | VOP *$1000* | Percent of State Total | VOP *$1000* | Percent of State Total | VOP *$1000* | Percent of State Total |
| Fresno | 1,129,471 | 11% | 62,725 | 2% | 4,910,871 | 10% |
| Imperial | 670,417 | 7% | N/A | N/A | 1,298,740 | 3% |
| Kern | 344,950 | 4% | 93,720 | 3% | 5,495,819 | 12% |
| Kings | 219,293 | 2% | N/A | N/A | 1,282,094 | 3% |
| Madera | 31,066 | 0% | 23,178 | 1% | 1,563,457 | 3% |
| Merced | 476,284 | 5% | 66,299 | 2% | 2,088,430 | 4% |
| Sacramento | 22,195 | 0% | 24,229 | 1% | 324,374 | 1% |
| San Joaquin | 312,804 | 3% | 96,396 | 3% | 2,520,519 | 5% |
| San Luis Obispo | 195,329 | 2% | 84,394 | 2% | 760,830 | 2% |
| Santa Barbara | 493,634 | 5% | 196,271 | 5% | 1,450,076 | 3% |
| Stanislaus | 132,842 | 1% | 138,884 | 4% | 2,533,735 | 5% |
| Ventura | 549,746 | 6% | 228,114 | 6% | 2,125,115 | 4% |
| Yolo | 191,432 | 2% | 13,053 | 0% | 767,018 | 2% |
| Total (13 counties) | 4,769,463 | 48% | 1,027,263 | 28% | 27,121,078 | 57% |
| State Total | 9,842,090 | 100% | 3,690,438 | 100% | 47,450,342 | 100% |

Source: CDFA 2015

Table 7 reports harvested acreage for the thirteen counties by crop category and in total. In total, the thirteen counties accounted for almost two-thirds of California's harvested crop acreage. Acreage in nursery products, flowers and foliage, which is difficult to measure, accounted for almost a quarter of the state's total acreage. Acreage in other crop categories in the thirteen counties ranged from 61 percent for field and seed to 69 percent for vines. Kern and Stanislaus Counties showed comparable differences in acreage shares as in value of production shares.

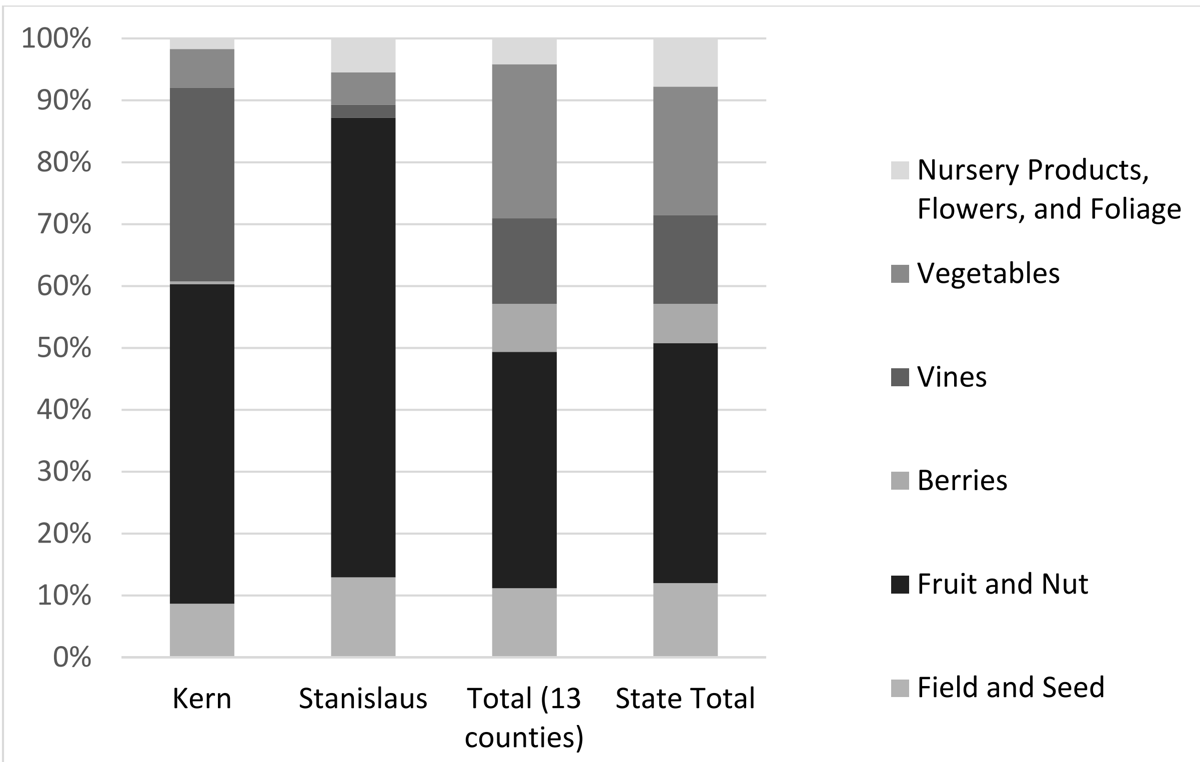
Table 7. Harvested Acreage by Crop Category: County, All Analyzed Counties, and California

| County | Field and Seed | | Fruit and Nut | | Berries | | Vines | |
|---|---|---|---|---|---|---|---|---|
| | Acres Harvested | Percent of State Total | Acres Harvested | Percent of State Total | Acres Harvested | Percent of State Total | Acres Harvested | Percent of State Total |
| Fresno | 181,700 | 5% | 324,930 | 14% | 719 | 1% | 204,200 | 23% |
| Imperial | 338,356 | 9% | 8,925 | 0% | N/A | N/A | N/A | N/A |
| Kern | 276,841 | 7% | 372,560 | 16% | 608 | 1% | 106,200 | 12% |
| Kings | 292,794 | 7% | 69,054 | 3% | N/A | N/A | 7,698 | 1% |
| Madera | 57,240 | 1% | 150,050 | 6% | N/A | N/A | 71,000 | 8% |
| Merced | 400,780 | 10% | 119,343 | 5% | N/A | N/A | 12,900 | 1% |
| Sacramento | 86,518 | 2% | 7,749 | 0% | 100 | 0% | 30,000 | 3% |
| San Joaquin | 333,472 | 8% | 152,181 | 6% | 1,310 | 2% | 102,000 | 11% |
| San Luis Obispo | 17,110 | 0% | 10,387 | 0% | 3,469 | 6% | 37,400 | 4% |
| Santa Barbara | 10,823 | 0% | 11,320 | 0% | 9,290 | 17% | 21,100 | 2% |
| Stanislaus | 237,186 | 6% | 223,767 | 9% | N/A | N/A | 12,400 | 1% |
| Ventura | 4,713 | 0% | 40,395 | 2% | 16,788 | 30% | N/A | N/A |
| Yolo | 184,909 | 5% | 44,580 | 2% | N/A | N/A | 12,600 | 1% |
| Total (13 counties) | 2,422,442 | 61% | 1,535,241 | 64% | 32,284 | 58% | 617,498 | 74% |
| State Total | 3,976,151 | 100% | 2,395,187 | 100% | 55,469 | 100% | 893,338 | 100% |

| County | Vegetables | | Nursery Products, Flowers, and Foliage | | All Crops | |
|---|---|---|---|---|---|---|
| | Acres Harvested | Percent of State Total | Acres Harvested | Percent of State Total | Acres Harvested | Percent of State Total |
| Fresno | 179,410 | 14% | 0 | 0% | 890,959 | 10% |
| Imperial | 135,000 | 11% | N/A | N/A | 482,281 | 6% |
| Kern | 44,720 | 4% | 3,356 | 8% | 804,285 | 9% |
| Kings | 47,200 | 4% | N/A | N/A | 416,746 | 5% |
| Madera | 6,200 | 0% | 320 | 1% | 284,810 | 3% |
| Merced | 62,470 | 5% | 1,680 | 4% | 597,173 | 7% |
| Sacramento | 5,660 | 0% | 524 | 1% | 130,551 | 2% |
| San Joaquin | 61,303 | 5% | 0 | 0% | 650,266 | 8% |
| San Luis Obispo | 28,982 | 2% | 0 | 0% | 97,348 | 1% |
| Santa Barbara | 69,506 | 6% | 656 | 2% | 122,695 | 1% |
| Stanislaus | 26,434 | 2% | 2,240 | 5% | 502,027 | 6% |
| Ventura | 36,199 | 3% | 735 | 2% | 98,830 | 1% |
| Yolo | 46,930 | 4% | 422 | 1% | 289,441 | 3% |
| Total (13 counties) | 750,014 | 60% | 9,933 | 24% | 5,367,412 | 62% |
| State Total | 1,255,617 | 100% | 41,946 | 100% | 8,617,708 | 100% |

Source: CDFA 2015

Distribution of value of production and acreage across crop categories. To compare the shares of each crop category in the total value of production or acreage for each geographic unit of analysis, Figure 1 and Figure 2 show the distribution of the value of production and acreage, respectively by crop category as percentages of totals for Kern and Stanislaus counties, the thirteen analyzed counties, and California as a whole. The fruit and nut tree crop category accounts for 74 percent of Stanislaus County's total value of production and 52 percent of Kern County's total value of production. Both counties show a significantly higher proportion of fruit and nut tree crops than California does (about 39 percent). In terms of acreage, both Kern and Stanislaus counties have fruit and nut tree crops accounting for a fairly large share of their respective counties' total acres harvested (46 percent for Kern County and 45 percent for Stanislaus County), once again higher than the 28 percent represented by fruit and nut tree crops for California. Table 8 and Table 9 report the detailed information underlying the summaries in Figure 1 and Figure 2 and include the percentage breakdown for each county.




Source: CDFA 2015

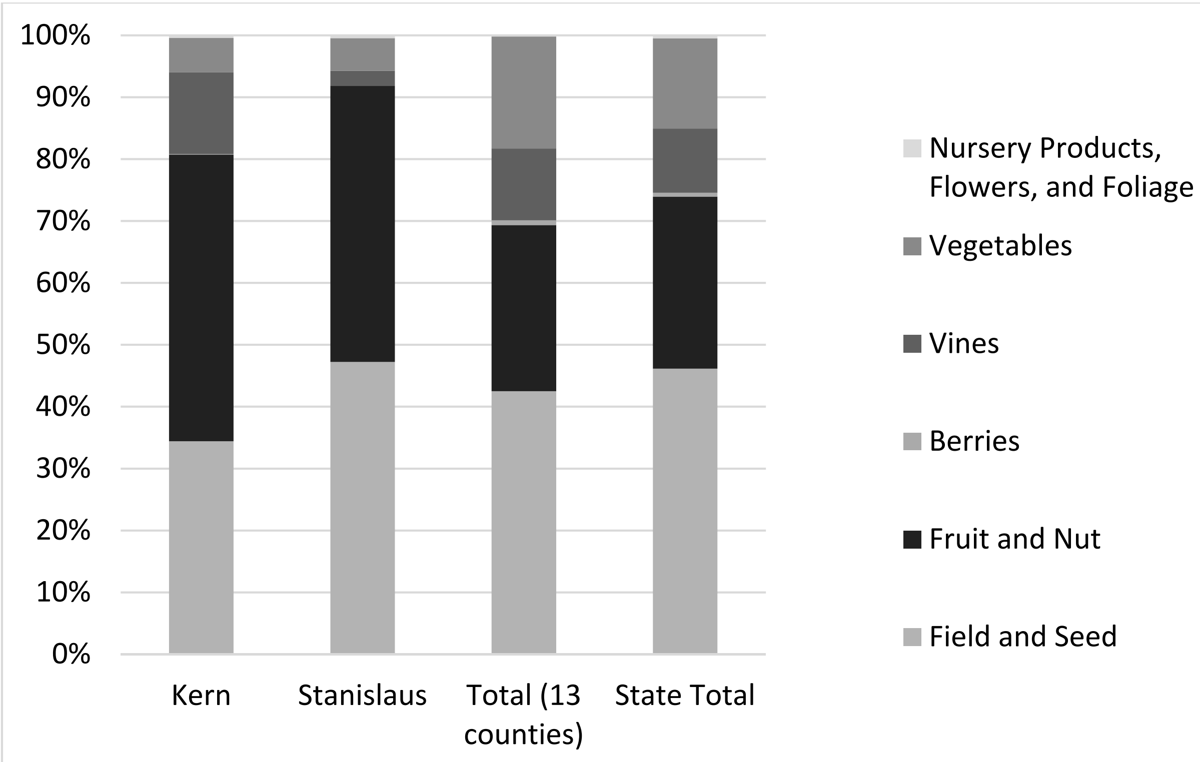
Figure 1. Percent of value of production by crop category: Kern, Stanislaus, all analyzed counties, and California

Table 8. Percent of Value of Production by Crop Category: County, All Analyzed Counties, and California

| County | Field and Seed | | Fruit and Nut | | Berries | | Vines | |
|---|---|---|---|---|---|---|---|---|
| | VOP *$1000* | Percent of County Total | VOP *$1000* | Percent of County Total | VOP *$1000* | Percent of County Total | VOP *$1000* | Percent of County Total |
| Fresno | 319,001 | 6% | 2,472,161 | 50% | 22,414 | 0% | 905,099 | 18% |
| Imperial | 539,269 | 42% | 89,054 | 7% | N/A | N/A | N/A | N/A |
| Kern | 477,395 | 9% | 2,837,814 | 52% | 23,757 | 0% | 1,718,183 | 31% |
| Kings | 493,783 | 39% | 524,919 | 41% | N/A | N/A | 44,099 | 3% |
| Madera | 70,200 | 4% | 1,121,510 | 72% | N/A | N/A | 317,503 | 20% |
| Merced | 559,088 | 27% | 953,357 | 46% | N/A | N/A | 33,402 | 2% |
| Sacramento | 81,027 | 25% | 64,860 | 20% | 1,199 | 0% | 130,864 | 40% |
| San Joaquin | 344,543 | 14% | 1,257,826 | 50% | 27,510 | 1% | 481,440 | 19% |
| San Luis Obispo | 9,668 | 1% | 61,889 | 8% | 205,765 | 27% | 203,785 | 27% |
| Santa Barbara | 9,569 | 1% | 85,470 | 6% | 509,876 | 35% | 155,256 | 11% |
| Stanislaus | 327,825 | 13% | 1,881,521 | 74% | N/A | N/A | 52,663 | 2% |
| Ventura | 9,252 | 0% | 445,523 | 21% | 892,480 | 42% | N/A | N/A |
| Yolo | 274,415 | 36% | 219,158 | 29% | N/A | N/A | 68,960 | 9% |
| Total (13 counties) | 3,515,035 | 13% | 12,015,062 | 44% | 1,683,001 | 6% | 4,111,254 | 15% |
| State Total | 5,703,406 | 12% | 18,397,743 | 39% | 2,993,398 | 6% | 6,823,266 | 14% |

| County | Vegetables | | Nursery Products, Flowers, and Foliage | | All Crops | |
|---|---|---|---|---|---|---|
| | VOP *$1000* | Percent of County Total | VOP *$1000* | Percent of County Total | VOP *$1000* | Percent of County Total |
| Fresno | 1,129,471 | 23% | 62,725 | 1% | 4,910,871 | 100% |
| Imperial | 670,417 | 52% | N/A | N/A | 1,298,740 | 100% |
| Kern | 344,950 | 6% | 93,720 | 2% | 5,495,819 | 100% |
| Kings | 219,293 | 17% | N/A | N/A | 1,282,094 | 100% |
| Madera | 31,066 | 2% | 23,178 | 1% | 1,563,457 | 100% |
| Merced | 476,284 | 23% | 66,299 | 3% | 2,088,430 | 100% |
| Sacramento | 22,195 | 7% | 24,229 | 7% | 324,374 | 100% |
| San Joaquin | 312,804 | 12% | 96,396 | 4% | 2,520,519 | 100% |
| San Luis Obispo | 195,329 | 26% | 84,394 | 11% | 760,830 | 100% |
| Santa Barbara | 493,634 | 34% | 196,271 | 14% | 1,450,076 | 100% |
| Stanislaus | 132,842 | 5% | 138,884 | 5% | 2,533,735 | 100% |
| Ventura | 549,746 | 26% | 228,114 | 11% | 2,125,115 | 100% |
| Yolo | 191,432 | 25% | 13,053 | 2% | 767,018 | 100% |
| Total (13 counties) | 4,769,463 | 18% | 1,027,263 | 4% | 27,121,078 | 100% |
| State Total | 9,842,090 | 21% | 3,690,438 | 8% | 47,450,341 | 100% |

Source: CDFA 2015




Source: CDFA 2015

Figure 2. Percent of harvested acreage by crop category: Kern, Stanislaus, all analyzed counties, and California

## Table 9. Percent of Harvested Acreage by Crop Category: County, All Analyzed Counties, and California

| County | Field and Seed | | Fruit and Nut | | Berries | | Vines | |
|---|---|---|---|---|---|---|---|---|
| | Acres Harvested | Percent of County Total | Acres Harvested | Percent of County Total | Acres Harvested | Percent of County Total | Acres Harvested | Percent of County Total |
| Fresno | 181,700 | 20% | 324,930 | 36% | 719 | 0% | 204,200 | 23% |
| Imperial | 338,356 | 70% | 8,925 | 2% | N/A | N/A | N/A | N/A |
| Kern | 276,841 | 34% | 372,560 | 46% | 608 | 0% | 106,200 | 13% |
| Kings | 292,794 | 70% | 69,054 | 17% | N/A | N/A | 7,698 | 2% |
| Madera | 57,240 | 20% | 150,050 | 53% | N/A | N/A | 71,000 | 25% |
| Merced | 400,780 | 67% | 119,343 | 20% | N/A | N/A | 12,900 | 2% |
| Sacramento | 86,518 | 66% | 7,749 | 6% | 100 | 0% | 30,000 | 23% |
| San Joaquin | 333,472 | 51% | 152,181 | 23% | 1,310 | 0% | 102,000 | 16% |
| San Luis Obispo | 17,110 | 18% | 10,387 | 11% | 3,469 | 4% | 37,400 | 38% |
| Santa Barbara | 10,823 | 9% | 11,320 | 9% | 9,290 | 8% | 21,100 | 17% |
| Stanislaus | 237,186 | 47% | 223,767 | 45% | N/A | N/A | 12,400 | 2% |
| Ventura | 4,713 | 5% | 40,395 | 4 1% | 16,788 | 17% | N/A | N/A |
| Yolo | 184,909 | 64% | 44,580 | 15% | N/A | N/A | 12,600 | 4% |
| Total (13 counties) | 2,422,442 | 45% | 1,535,241 | 29% | 32,284 | 1% | 617,498 | 12% |
| State Total | 3,976,151 | 46% | 2,395,187 | 28% | 55,469 | 1% | 893,338 | 10% |

| County | Vegetables | | Nursery Products, Flowers, and Foliage | | All Crops | |
|---|---|---|---|---|---|---|
| | Acres Harvested | Percent of County Total | Acres Harvested | Percent of County Total | Acres Harvested | Percent of County Total |
| Fresno | 179,410 | 20% | 0 | 0% | 890,959 | 100% |
| Imperial | 135,000 | 28% | N/A | N/A | 482,281 | 100% |
| Kern | 44,720 | 6% | 3,356 | 0% | 804,285 | 100% |
| Kings | 47,200 | 11% | N/A | N/A | 416,746 | 100% |
| Madera | 6,200 | 2% | 320 | 0% | 284,810 | 100% |
| Merced | 62,470 | 10% | 1,680 | 0% | 597,173 | 100% |
| Sacramento | 5,660 | 4% | 524 | 0% | 130,551 | 100% |
| San Joaquin | 61,303 | 9% | 0 | 0% | 650,266 | 100% |
| San Luis Obispo | 28,982 | 30% | 0 | 0% | 97,348 | 100% |
| Santa Barbara | 69,506 | 57% | 656 | 1% | 122,695 | 100% |
| Stanislaus | 26,434 | 5% | 2,240 | 0% | 502,027 | 100% |
| Ventura | 36,199 | 37% | 735 | 1% | 98,830 | 100% |
| Yolo | 46,930 | 16% | 422 | 0% | 289,441 | 100% |
| Total (13 counties) | 750,014 | 14% | 9,933 | 0% | 5,367,412 | 100% |
| State Total | 1,255,617 | 15% | 41,946 | 0% | 8,617,708 | 100% |

Source: CDFA 2015

## Spatial Results

According to 2014 PUR data, there were 25,836 unique grower identification numbers in the thirteen counties.[13] Of those, 1,439 (5.6 percent) would have one or more PAPAC fields. There were 139,861 fields in the thirteen counties, defined using the grower identification number and the site_loc_id to identify unique fields. There are 2,571 PAPAC fields with acreage within ¼ mile of a schoolsite. Each of these fields would have had to provide an annual notification to the CAC and all schoolsites within ¼ mile. 478,773 acres are in PAPAC fields. Of that acreage, 36,471 acres are within a PAPAC buffer (within ¼ mile of a schoolsite). PAPAC buffer acres are 9.4 percent of PAPAC field. There were 2,105 PAPAC fields (1.5 percent of all fields) for which one or more pesticide applications would have been affected by the draft regulation. In total, 12,771 applications would have been affected by the draft regulation because they occurred in the 6 AM to 6 PM weekday window. They either would have been prohibited (9,402) or would have required one or more 48-hour notifications to be completed (3,369). Table 10 reports affected applications by category and county.

Table 10. All Affected Applications, Prohibited Applications, and Applications Requiring 48-hour Notification by County

| County | All affected applications | Prohibited applications | Applications requiring 48-hour notification |
|---|---:|---:|---:|
| Fresno | 1,975 | 1,618 | 357 |
| Imperial | 122 | 102 | 20 |
| Kern | 525 | 436 | 89 |
| Kings | 402 | 311 | 91 |
| Madera | 672 | 532 | 140 |
| Merced | 636 | 481 | 155 |
| Sacramento | 99 | 63 | 36 |
| San Joaquin | 1,253 | 1,060 | 193 |
| San Luis Obispo | 398 | 321 | 77 |
| Santa Barbara | 2,977 | 1,908 | 1,069 |
| Stanislaus | 951 | 751 | 200 |
| Ventura | 2,576 | 1,679 | 897 |
| Yolo | 185 | 140 | 45 |
| Total | 12,771 | 9,402 | 3,369 |

The thirteen counties have 2,853 public K-12 schools, of which 795 are within ¼ mile of PAPAC fields. The draft regulation would affect 28 percent of all public K-12 schools. They have 2,972 licensed child daycare facilities, of which 896 are within ¼ mile of PAPAC fields. The draft regulation would affect 30 percent of all licensed child daycare facilities.

[13] Growers operating in more than one county will have more than one grower identification number.

Schoolsites may be sufficiently close to each other for some PAPAC fields to be within ¼ mile of more than one schoolsite. Each schoolsite must be notified of an application and provided an annual notification, so notification costs are higher the more schoolsites are nearby. Although notification costs increase with each schoolsite, PAPAC buffer acreage may not increase very much if two schoolsites are near each other or are co-located. Slightly more than half of PAPAC fields are located near schools (1,112), a quarter (519) are within ¼ mile of only licensed child daycare facilities, and the remaining 23 percent (474) are located near schoolsites of both types.

Impacts on growers. Based on one or more applications falling within the mandatory notification time window or under the prohibition of certain classes of applications at certain times, 1,212 growers would have had at least one pesticide application affected by the draft regulation. The total number of affected PAPAC fields was 2,105, an average of 1.7 fields per grower, each requiring an annual plan. 36,471 acres would have been affected (30.1 acres per grower). A total of 11,176 48-hour notifications would have been required (9.2 per grower). Table 11 reports the values of relevant variables and their per-grower value in total and by schoolsite type. Comparing the two classes of schoolsites, the total number of growers operating PAPAC fields located near schools was noticeably higher than those operating ones located near licensed child care facilities: 971 vs. 605. (Recall that some PAPAC fields may be near both schools and licensed child daycare facilities. These are reported in the totals for both types of schoolsites.) The number of PAPAC fields near schools (1,586) was significantly larger than the number near licensed child daycare facilities (993). The average number of PAPAC fields per grower was identical for those near schools and those near licensed child daycare facilities (1.6).

For growers operating PAPAC fields near schools, average PAPAC buffer acreage per grower was 26.9 acres. For growers operating ones near licensed child daycare facilities, the average PAPAC buffer acreage per grower was 23.5 acres. The overall average per grower is higher than the averages for each schoolsite class because some growers operate PAPAC fields with PAPAC buffer acreage near schoolsites in both classes. This can be seen most easily by comparing the total number of growers affected. There were 1,212 growers affected by all schoolsites with 971 of these impacted by schools and 605 of these impacted by licensed child care facilities meaning that 364 growers are impacted by both daycare facilities and schools.

Unlike PAPAC fields and PAPAC buffer acreage, which can be double-counted if the PAPAC field is proximate to schoolsites of both classes, notifications are provided on a per schoolsite basis, plus a notification to the CAC. The number of 48-hour notifications for all schoolsites, 11,176 includes 4,871 notifications to schools, 2,936 licensed child daycare facilities and 3,369 notifications to the CAC.

Table 11. Total and per Grower Impacts

| | **All Schoolsites** | | **Schools** | | **Licensed Child Day Care Facilities** | |
|---|---|---|---|---|---|---|
| | Total | Per grower | Total | Per grower | Total | Per grower |
| Growers | 1,212 | --- | 971 | --- | 605 | --- |
| PAPAC fields | 2,105 | 1.7 | 1,586 | 1.6 | 993 | 1.6 |
| PAPAC buffer acres | 36,471 | 30.1 | 26,161 | 26.9 | 14,203 | 23.5 |
| 48-hr notifications* | 11,176 | 9.2 | 4,871 | 5.0 | 2,936 | 16.4 |

*All schoolsites includes notifications to CAC (3,369)

Impacts by PAPAC field. Table 12 reports total and average values per PAPAC field with one or more affected applications for PAPAC buffer acres and notifications. The average number of buffer acres per PAPAC field for all schoolsites is 17.3, for schools is 16.5, and for daycare facilities is 14.3. As was the case in the table of impacts per grower, 48-hour notifications to the CAC are included in the all schoolsites column, so that average (5.3) is noticeably larger than the ones by schoolsite class (3.1 for schools and 3.0 for licensed child day care facilities). As noted above, there are 2,105 impacted PAPAC fields overall, 1,586 near school sites and 993 near daycares, with 474 PAPAC fields near both at least one daycare and at least one school.

Table 12. Total and per PAPAC Field Impacts

| | **All Schoolsites** | | **Schools** | | **Licensed Child Day Care Facilities** | |
|---|---|---|---|---|---|---|
| | Total | Per PAPAC field | Total | Per PAPAC field | Total | Per PAPAC field |
| PAPAC fields | 2,105 | | 1,586 | | 993 | |
| PAPAC buffer acres | 36,471 | 17.3 | 26,161 | 16.5 | 14,203 | 14.3 |
| 48-hr notifications* | 11,176 | 5.3 | 4,871 | 3.1 | 2,936 | 3.0 |

*All schoolsites includes notifications to CAC (3,369)

Affected applications.

Table *13* summarizes applications that would have been affected by the notification requirement in the draft regulation by county and the type of notification recipient.

Table 13. 48-hour Notifications by Recipient Type and County

| | Schools | Licensed Child Day Care Facility | CACs | Total |
|---|---|---|---|---|
| Fresno | 357 | 280 | 357 | 994 |
| Imperial | 33 | 6 | 20 | 59 |
| Kern | 127 | 31 | 89 | 247 |
| Kings | 94 | 57 | 91 | 242 |
| Madera | 87 | 101 | 140 | 328 |
| Merced | 203 | 91 | 155 | 449 |
| Sacramento | 35 | 31 | 36 | 102 |
| San Joaquin | 234 | 210 | 193 | 637 |
| San Luis Obispo | 72 | 72 | 77 | 221 |
| Santa Barbara | 2,421 | 1,348 | 1,069 | 4,838 |
| Stanislaus | 285 | 95 | 200 | 580 |
| Ventura | 898 | 549 | 897 | 2,344 |
| Yolo | 25 | 65 | 45 | 135 |
| Total | 4,871 | 2,936 | 3,369 | 11,176 |

Crop-level effects. 112 different crops were reported on the PURs for the impacted PAPAC fields. Of these, 26 are perennial crops including alfalfa, almond, apple, apricot, avocado, cherimoya, cherry, citrus, fig, grape, grape (wine), grapefruit, lemon, nectarines, olive, peach, pear, pistachio, plum, pluot, pomegranate, prune, quince, stone fruit, tangerine, and walnut. Cherimoya, citrus, grapefruit, pluot, quince, and stone fruit have five or fewer acres impacted. Combined, perennial crops represent 48 percent of the PAPAC buffer acreage. Table 14 reports PAPAC buffer acreage, 2014 harvested acreage and value of production for the thirteen counties, value of production on PAPAC buffer acreage, and the percentage of acreage and value of production within a PAPAC buffer for the 30 crops with the largest buffer acreage.

The crops with the largest acreage near schoolsites are perennial crops with almond at 7,245 acres, and grape plus winegrape at 5,319 acres.[14] However, this is only 1 percent of the almond acreage and 1 percent of the grape acreage in the analyzed counties. Among the perennial crops, lemon (5 percent) and avocado (4 percent) had the highest percentage of acreage affected. It is highly doubtful that a short run response to the draft regulation by growers would be to change a perennial crop to another crop given the high investment in establishment. The highest absolute impact on an annual crop is field corn with 2,817 PAPAC buffer acres representing 1 percent of 2014 harvested acres.

[14] Grape (2,824 acres) and grape, wine (1,969 acres) are listed separately in the table, corresponding to PUR crop definitions.

Table 14. Affected Acreage and Value of Production Impacts by Crop

| PAPAC category | Acres near Schoolsites | 2014 Total Harvested Acreage | 2014 Value of Production /Acre ($) | PAPAC Buffer Acres x Value of Production/ Acre ($) | Percent of Acreage, Value of Production Impacted |
|---|---|---|---|---|---|
| Alfalfa | 3,350 | 561,140 | 1,811 | 6,067,253 | 1% |
| Almond | 7,245 | 838,400 | 7,953 | 57,621,651 | 1% |
| Avocado | 1,186 | 31,630 | 6,659 | 7,897,175 | 4% |
| Bean, Dried | 478 | 29,932 | 1,397 | 667,685 | 2% |
| Cherry | 717 | 35,590 | 4,708 | 3,377,901 | 2% |
| Corn (Forage - Fodder) | 2,817 | 441,800 | 1,489 | 4,193,017 | 1% |
| Corn, Human Consumption | 122 | 14,334 | 3,627 | 442,794 | 1% |
| Cotton | 1,665 | 196,610 | 2,472 | 4,116,667 | 1% |
| Grape | 2,824 | 269,898 | 9,427 | 26,623,347 | 1% |
| Grape, Wine | 1,969 | 347,600 | 4,508 | 8,876,293 | 1% |
| Lemon | 1,236 | 27,380 | 15,056 | 18,611,075 | 5% |
| Lettuce, Leaf | 395 | 18,872 | 5,355 | 2,112,674 | 2% |
| Nectarine | 285 | 12,835 | 11,827 | 3,367,608 | 2% |
| Oat | 81 | 1,400 | 499 | 40,459 | 6% |
| Oat (Forage - Fodder) | 307 | N/A | N/A | N/A | N/A |
| Orange | 426 | 69,214 | 7,742 | 3,298,248 | 1% |
| Peach | 735 | 30,407 | 10,832 | 7,960,715 | 2% |
| Pear | 69 | 6,525 | 8,324 | 570,661 | 1% |
| Pistachio | 653 | 208,710 | 5,988 | 3,912,085 | 0% |
| Plum | 166 | 12,887 | 10,694 | 1,771,481 | 1% |
| Prune | 186 | 5,850 | 4,165 | 775,664 | 3% |
| Sorghum (Forage - Fodder) | 323 | 13,100 | 798 | 258,059 | 2% |
| Sudangrass | 145 | 78,034 | 962 | 139,272 | 0% |
| Sugarbeet | 178 | 24,400 | 1,863 | 332,118 | 1% |
| Tangerine | 301 | 40,296 | 13,125 | 3,946,044 | 1% |
| Tomato | 281 | 22,098 | 14,426 | 4,057,968 | 1% |
| Tomato, Processing | 1,527 | 258,600 | 4,240 | 6,472,866 | 1% |
| Walnut | 1,927 | 147,780 | 7,193 | 13,863,194 | 1% |
| Wheat | 455 | 179,280 | 893 | 406,029 | 0% |
| Wheat (Forage - Fodder) | 1,079 | N/A | N/A | N/A | N/A |

Source: CDFA (2015)

## Estimated Notification Costs

Table 15 reports notification costs in total, per grower, and per PAPAC field. **Total estimated annual notification costs are $1,776,899, or $1,234 per affected grower.** The majority of these costs are accounted for by the preparation of the annual notification of pesticides which could be applied in the following July 1 to June 30 period: $1,594,843. The annual notification must be delivered to the CAC and to every schoolsite within ¼ mile. Note that growers cannot reduce this cost by altering pest management practices. The average annual cost per PAPAC field would be $691.

Table 15. Estimated Notification Costs for PAPAC Fields

| Activity | Total annual cost | Cost/grower | Cost/PAPAC |
|---|---|---|---|
| Preparation of annual notifications | $1,594,843 | $1,108 | $620 |
| Delivery of annual notifications | $17,787 | $12 | $7 |
| Understanding requirements | $37,198 | $26 | $14 |
| 48-hr notifications | $127,071 | $88 | $49 |
| Total | $1,776,899 | $1,234 | $691 |

### Estimated Indirect Effects on Economic Activity

Based on the total estimated notification costs, the **overall effect on economic activity would be twice the total annual cost listed above or $3,553,798.**

## Economic Impacts of Compliance with Prohibited Applications Provision

This section begins with a discussion of air blast, air assist, and aerial applications prohibited by the draft regulation during specific time intervals in the thirteen counties examined in the notification cost analysis. Data show that applications in these classes are already commonly made outside the prohibited intervals, consistent with the assumption that there is no added cost of moving applications to weekends or to a different time of day on weekdays. We also address yield and associated revenue losses for selected crops in specific regions that could result if growers had limited flexibility regarding application time due to weather.

The analysis identified the applications in the 13 counties from July 1, 2013 – June 30, 2014 that would have been prohibited if the proposed regulation was in place.[15] The proposed regulation defines prohibited applications in the schoolsite buffer zone as the use of sprinkler chemigation, aerial, and air blast (including air assist) applications between 6 AM and 6 PM, Monday through Friday. We examine two classes of applications: aerial and air blast. We do not include sprinkler chemigation in this evaluation because it is assumed that the timing of sprinkler chemigation could be altered to comply with the weekday time constraints without any economic impact. We do not include fumigation due to the requirement that a school not be occupied for 36 hours after application.

PUR data include method of application that identifies aerial applications. However, the designation of ground application is not further separated out into sub-method. Therefore, we made informed assumptions concerning the use of air blast and air assist equipment for application of pesticides. All ground applications to tree and vine crops are assumed to be air blast or air assist with the exception of herbicides. In particular, all dust and fungicide applications are included as potentially prohibited depending on the time period of application. For the purposes of this report, airblast refers to any airblast, air assist or dust applications to trees or vines.

Using the start times reported in the PUR, all applications using aerial or air blast methods were divided into four time periods: Weekdays between 6 AM and 6 PM, weekdays before 6 AM, weekdays after 6 PM, and weekends. This was done foremost to determine the applications that would have been prohibited weekdays between 6 AM and 6 PM but also to describe already standard operating procedures for the timing of applications. In particular, we wanted to show whether or not growers were already making early morning and evening applications weekdays and whether or not weekend applications are already standard practice and for which crops and application methods. From this we can draw inferences about the potential to adapt to the proposed regulations by changing the timing of applications.

[15] For the purposes of the discussion, we use the term "prohibited' to refer to applications during 2013 – 2014 that would have been prohibited had the proposed regulation been in effect at that time. It does not mean that the applications actually were prohibited at the time they were made.

## Aerial and Airblast Applications by Time of Day and Day of the Week

The number of applications is one of several ways to analyze the dataset. An individual grower might treat an almond orchard 5 times and a walnut orchard 3 times. That would be a total of one grower, two PAPAC fields and 8 applications. Accordingly, the number of impacted applications is larger than the number of impacted growers and PAPAC fields. Applications are impacted by the regulation if they are applied by air or air blast sprayer on weekdays between 6 AM and 6 PM. A total of 6,907 applications would have been impacted by the proposed regulations based on the 2013-2014 reported applications (Table 16). Aerial applications accounted for 1,089 (16 percent) of the two types of prohibited applications while 84 percent (5,818 applications) of prohibited applications were air blast. As a reminderthat the use of the term prohibited means certain applications that would have been prohibited based on the proposed regulation but were not actually prohibited at the time. Overall, 58 percent of applications occurred during the period in which they would be prohibited under the proposed regulation. The percentage was slightly lower for air blast (57 percent) than aerial (60 percent). Air blast applications were more likely than aerial applications to occur weekdays after 6 PM, 20 percent of all air blast compared to 7 percent of aerial applications. In contrast, aerial applications (33 percent) were more likely to be on weekends than air blast applications (23 percent).

The largest numbers of applications impacted were almond and grape with 1,757 applications to almond, 979 applications to grape and 580 applications to wine grape. These three crops comprised 48 percent of all prohibited applications. Aerial accounted for less than six percent of all prohibited almond. Slightly over half of the almond and grape applications were prohibited, about one fourth were on the weekends and one fifth weekdays after 6 PM. Twenty-seven percent of all weekend aerial and air blast applications were on almond and 24 percent were on grape or wine grape.

Of the field crops, alfalfa has the largest number of impacted applications followed by corn, wheat, cotton and processing tomato. Well over half of the applications to these crops were prohibited aerial applications. Over a fourth of the applications to these crops were weekend aerial applications. Wheat was never treated on a weekday after 6 PM but 17 percent of processing tomato treatments were by air weekdays after 6 PM. Alfalfa applications occurred on weekdays after 6 PM only nine percent of the time.

Importantly, the analysis revealed that though just over half of the applications (58 percent) occurred during the prohibited weekday time period between 6 AM and 6 PM, evening and weekend applications are already standard. Weekday evening applications accounted for 18 percent of the total. Most striking, one fourth of all applications took place on weekends. It's important to remember that these numbers are for fields within ¼ mile of schoolsites for the 13 counties analyzed and not all applications in these counties. It is possible that growers are already avoiding weekday applications between 6 AM and 6 PM.

Table 16. Number of Aerial and Air Blast Applications by Crop and Time Period: 13 Counties

| | Weekday 6 AM-6 PM | Weekday After 6 PM | Weekends | Total | Percent Prohibited |
|---|---|---|---|---|---|
| **Aerial** | **1,089** | **137** | **601** | **1,827** | **60%** |
| Alfalfa | 187 | 27 | 97 | 311 | 60% |
| Almond | 103 | 22 | 50 | 175 | 59% |
| Corn (forage - fodder) | 115 | 13 | 45 | 173 | 66% |
| Cotton | 89 | 12 | 64 | 165 | 54% |
| Avocado | 100 | 2 | 22 | 124 | 81% |
| Tomato, processing | 70 | 19 | 26 | 115 | 61% |
| Wheat (forage - fodder) | 62 | 0 | 21 | 83 | 75% |
| Walnut | 47 | 3 | 24 | 74 | 64% |
| Wheat | 35 | 0 | 17 | 52 | 67% |
| Tomato | 29 | 7 | 15 | 51 | 57% |
| Lettuce, leaf | 17 | 1 | 18 | 36 | 47% |
| Celery | 11 | 0 | 23 | 34 | 32% |
| Oat (forage - fodder) | 18 | 2 | 11 | 31 | 58% |
| Pumpkin | 19 | 0 | 12 | 31 | 61% |
| Sugarbeet | 20 | 2 | 5 | 27 | 74% |
| Cherry | 15 | 2 | 9 | 26 | 58% |
| Other crops | 152 | 25 | 142 | 319 | 48% |
| **Air blast** | **5,818** | **2,009** | **2,351** | **10,178** | **57%** |
| Almond | 1,654 | 660 | 746 | 3,060 | 54% |
| Grape | 979 | 484 | 431 | 1,894 | 52% |
| Grape, wine | 580 | 202 | 249 | 1,031 | 56% |
| Peach | 375 | 149 | 227 | 751 | 50% |
| Walnut | 413 | 173 | 155 | 741 | 56% |
| Lemon | 577 | 12 | 58 | 647 | 89% |
| Cherry | 280 | 126 | 126 | 532 | 53% |
| Nectarine | 294 | 49 | 112 | 455 | 65% |
| Pistachio | 111 | 59 | 53 | 223 | 50% |
| Tangerine | 144 | 18 | 47 | 209 | 69% |
| Orange | 128 | 28 | 20 | 176 | 73% |
| Plum | 75 | 12 | 59 | 146 | 51% |
| Pear | 66 | 25 | 27 | 118 | 56% |
| Apple | 55 | 6 | 13 | 74 | 74% |
| Quince | 35 | 0 | 9 | 44 | 80% |
| Prune | 19 | 3 | 3 | 25 | 76% |
| Apricot | 11 | 1 | 6 | 18 | 61% |
| Other crops | 22 | 2 | 10 | 34 | 65% |
| **Total aerial and airblast** | **6,907** | **2,146** | **2,952** | **12,005** | **58%** |

## Yield Losses If Zero Fungicide Sprays Completed

University of California and U.S. Department of Agriculture personnel provided ranges of potential yield losses for a scenario where growers cannot complete any applications of fungicides during the bloom/spring season for major Central Valley crops by region. The inability to spray due to the draft regulation is a worst-case scenario: it requires that growers cannot move applications outside prohibited time windows due to weather/soil conditions and that weather/soil conditions would enable all fungicide applications included in the pest management program can be completed within 6 AM to 6 PM on weekdays. The losses are estimated for two major crops: grape (includes wine, table, and raisin grape) and almond. Appendix One presents estimates for cherry/peach/nectarine and walnut. Estimated losses vary by region, as shown in the table. For almond, yield losses are estimated for zero fungicide applications during bloom. For grape, yield losses are estimated for zero fungicide applications during the critical spring period, usually the month of March. Table 17 presents these estimated yield losses.

Table 17. Yield Loss Estimates If No Spring/Bloom Fungicide Sprays Could Be Completed

| **Crop** | **Southern San Joaquin Valley**[a] | **Northern San Joaquin Valley and Southern Sacramento Valley**[b] | **Northern Sacramento Valley**[c] |
|---|---|---|---|
| Grape | 25% to near 100% | 35% to near 100% | 35% to 100% |
| Almond | 0% to 25% | 5% to 30% | 25% to 75% |

Source: UC and USDA Personnel

[a] Southern San Joaquin Valley: Fresno, Kern, Kings, Madera and Tulare counties

[b] Northern San Joaquin Valley and Southern Sacramento Valley: Merced, Sacramento, San Joaquin, Solano and Yolo counties

[c] Northern Sacramento Valley: Butte, Colusa, Glenn, Sutter, Tehama, and Yuba counties

Note the wide range of yield loss estimates for a given region. This is particularly important because the estimates are based on an inability to treat for a single season. Over time, if control is skipped in one season, then the disease inoculum will increase, making control in future years more difficult. Table 18 summarizes the major diseases responsible for the estimated yield losses.

Table 18. Major Diseases Responsible for Estimated Yield Loss

| **Crop** | **Diseases** |
|---|---|
| Grape | Phomopsis, botryis and powdery mildew |
| Almond | Brown rot, twig blight, jacket rot |
| Peach/Nectarine | Brown rot, twig blight, jacket rot, peach leaf curl |
| Cherry | Botrytis, brown rot, twig blight, |
| Walnut | Walnut blight |

Source: UC and USDA Personnel

## Revenue Losses per Acre If Zero Fungicide Sprays Completed: Almond and Grape

Based on the yield loss estimates in Table 17, revenue losses per acre can be computed for each county reporting sales of each crop. Table 19 and Table 20 report losses for almond and grape based on the estimated range of yield losses if zero fungicide sprays can be completed. Revenues per acre are calculated based on acreage and total revenue reported in CDFA (2015). Examining the tables, differences across counties in revenue losses are a function of differences in revenues per acre by county and differences in estimated yield losses by region. In some instances, acreage and total revenues for a crop are not reported for all counties. N/A denotes when this information is unavailable.

County almond revenues per acre are higher in the southern San Joaquin Valley than in the other two regions, overall (Table 19). Due to differences in the maximum estimated percentage yield losses, however, the maximum revenue losses per acre are highest in the northern Sacramento Valley when zero fungicide sprays can be completed.

Table 19. Revenues and Estimated Revenue Losses per Acre with Zero Fungicide Sprays by County: Almond

| County | Revenues per acre | Revenue losses/acre (range) | | |
|---|---|---|---|---|
| Southern San Joaquin Valley | | | | |
| Fresno | $ 7,308 | $ 1,827 | | |
| Kern | $ 7,196 | $ 1,799 | | |
| Kings | $ 7,945 | $ 1,986 | | |
| Madera | $ 7,008 | $ 1,752 | | |
| Tulare | $ 8,449 | $ 2,112 | | |
| Northern San Joaquin/southern Sacramento Valleys | | | | |
| Merced | $ 7,915 | $ 2,375 | to | $ 396 |
| Sacramento | N/A | N/A | | N/A |
| San Joaquin | $ 9,778 | $ 2,933 | to | $ 489 |
| Solano | $ 4,127 | $ 1,238 | to | $ 206 |
| Stanislaus | $ 8,228 | $ 2,468 | to | $ 411 |
| Yolo | $ 5,397 | $ 1,619 | to | $ 270 |
| Northern Sacramento Valley | | | | |
| Butte | $ 6,149 | $ 4,612 | to | $ 1,537 |
| Colusa | $ 5,389 | $ 4,042 | to | $ 1,347 |
| Glenn | $ 4,748 | $ 3,561 | to | $ 1,187 |
| Sutter | $ 4,175 | $ 3,131 | to | $ 1,044 |
| Tehama | $ 4,506 | $ 3,380 | to | $ 1,127 |
| Yuba | $ 5,839 | $ 4,380 | to | $ 1,460 |

Source: CDFA 2015 and authors' calculations

Grape revenues per acre by county vary widely (Table 20). Because there is the potential for virtually 100% crop loss when zero fungicide sprays can be completed, maximum revenue losses could equal the revenues per acre. Examining minimum revenue losses, most counties would lose between $1,000 and $2,000 per acre with the exceptions of Tulare and Kern Counties, which have substantially higher losses due to their significant raisin and table grape production.

Table 20. Revenues and Estimated Revenue Losses per Acre by County When Zero Fungicide Sprays Can Be Completed: Grape

| County | Revenues per acre | Revenue losses/acre (range) | | |
|---|---|---|---|---|
| Southern San Joaquin Valley | | | | |
| Fresno | $ 4,432 | $ 4,432 | to | $ 1,108 |
| Kern | $ 16,179 | $ 16,179 | to | $ 4,045 |
| Kings | $ 5,729 | $ 5,729 | to | $ 1,432 |
| Madera | $ 4,472 | $ 4,472 | to | $ 1,118 |
| Tulare | $ 11,959 | $ 11,959 | to | $ 2,990 |
| Northern San Joaquin/southern Sacramento Valleys | | | | |
| Merced | $ 2,589 | $ 2,589 | to | $ 906 |
| Sacramento | $ 4,362 | $ 4,362 | to | $ 1,527 |
| San Joaquin | $ 4,720 | $ 4,720 | to | $ 1,652 |
| Solano | $ 4,023 | $ 4,023 | to | $ 1,408 |
| Stanislaus | $ 4,247 | $ 4,247 | to | $ 1,486 |
| Yolo | $ 5,473 | $ 5,473 | to | $ 1,916 |
| Northern Sacramento Valley | | | | |
| Butte | N/A | N/A | | N/A |
| Colusa | $ 4,551 | $ 4,551 | to | $ 1,593 |
| Glenn | $ 5,212 | $ 5,212 | to | $ 1,824 |
| Sutter | N/A | N/A | | N/A |
| Tehama | $ 5,074 | $ 5,074 | to | $ 1,776 |
| Yuba | N/A | N/A | | N/A |

Source: CDFA 2015 and authors' calculations

## Yield Losses If Zero Fungicide Applications Are Completed Oversimplify Impact

The per-acre values of the estimated range of losses if zero fungicide applications are completed are not sufficient to provide an estimate of industry losses, or even estimated losses for a county. These values rely on an extreme oversimplification. They are based on the assumption that weather conditions would exist that 1) would allow all necessary applications to be completed under current regulations, and 2) prevent any applications from being completed under the draft regulations. In order to more accurately estimate these potential losses, the following section incorporates weather data, disease pathology and soil data.

# Revenue Loss Due to Prohibited Applications Provision with Consideration of Weather, Disease Pathology, and Soil Type: Grape and Almond

The objective of this section is to estimate potential revenue losses for California almond and grape due to the draft regulation regarding pesticide applications near schoolsites. Revenue losses depend on yield losses, changes in revenues and costs per acre related to yield loss, and acres affected. Pest management will be more difficult if the draft regulation is implemented because pesticide application methods and timing will be restricted. Though insect and weed control may be affected by the draft regulation, disease control will be most impacted owing to critical timing required for sprays. Almond and grape disease management is very important early in the year when rain events are most likely to restrict access to orchards and vineyards. The number of fungicide applications a grower makes is dependent on weather. Temperature in particular affects the timing of plant and disease development, and precipitation affects whether or not a treatment can be made and its efficacy. The effect of the draft regulation on yield and, hence, on revenues will depend on weather and soil type, which affects how quickly the ground dries after a precipitation event. **Regardless of the number of sprays a grower could actually apply, the draft regulation would only have an effect if the number of sprays would have been different with the regulation than without it.**

This analysis develops typical management programs for each crop, which are then simulated for ten years of weather data including information on temperatures, precipitation, and wind to determine the number of sprays affected. Counties were included based on the availability of information regarding buffer zone acreage by soil hydrologic group, potential yield losses under various weather conditions, and revenues per acre. Nine counties are examined for almond: Fresno, Kern, Kings, Madera, Merced, Sacramento, San Joaquin, Stanislaus, and Yolo. Eight counties are studied for grape: Fresno, Kern, Madera, Merced, Sacramento, San Joaquin, Stanislaus, and Yolo. This represents 84% of the total CA statewide production value for almond and 55% for grape including wine, table, and raisin production.

The weather results are paired with 1) yield loss estimates based on the number of bloom sprays completed (almond) or number of weekly sprays not completed (grape), 2) revenues per acre, and 3) the share of years in which sprays were affected by weather to obtain revenue losses averaged across the ten-year study period.

Estimated yield losses for the two crops are presented in the context of the major diseases facing the crop and typical pest management program. This is followed by a detailed description of the pest management issues necessitating sprays and the pest management program for each crop. The yield losses due to disruption of the optimal pest management program is then paired with weather and soils data to evaluate what losses would have been under the draft regulations. Using this information, net revenue losses are calculated by county and crop. Finally, indirect losses and total losses are presented.

## Estimated Yield Losses

University of California and U.S. Department of Agriculture personnel, growers, and pest control advisers (PCAs) provided ranges of potential yield losses if growers were prevented from completing the fungicide spray program they would use to fully control disease in the absence of the regulation during the bloom/spring season. We present yield losses which would occur if growers were unable to complete as many applications as necessary to fully control disease. For almond, the major diseases responsible for the estimated yield losses are brown rot, twig blight and jacket rot. For grape, they are phomopsis, botryis and powdery mildew.

## Almond Yield Losses with One Spring/Bloom Fungicide Spray

Table 21 reports yield loss estimates for years in which only one fungicide spray could be completed, with the assumption that most pest management programs would necessitate that two or three sprays be made depending on the timing and length of the bloom. Estimated potential yield losses are largest in the northern Sacramento Valley.

Table 21. Almond Yield Loss Estimates When Only One Spring/Bloom Fungicide Spray Completed by Region

| Southern San Joaquin Valley[a] | Northern San Joaquin Valley and Southern Sacramento Valley[b] | Northern Sacramento Valley[c] |
|---|---|---|
| 0%-15% | 15% | 25% |

[a] Southern San Joaquin Valley: Fresno, Kern, Kings, Madera and Tulare counties
[b] Northern San Joaquin Valley and Southern Sacramento Valley: Merced, Sacramento, San Joaquin, Solano and Yolo counties
[c] Northern Sacramento Valley: Butte, Colusa, Glenn, Sutter, Tehama, and Yuba counties

Source: Growers, PCAs, UC and USDA personnel

## Grape Yield Losses When One or More Weekly Sprays Missed

Table 22 reports predicted grape yield loss based on the number of weeks of missed sprays for the San Joaquin Valley and southern Sacramento Valley. The predicted yield loss is dependent on the average powdery mildew risk index and the number of consecutive weeks sprays are missed.[16] The estimates assume an effective spray (low inoculum) at the beginning of the period. An intermediate risk index is associated with a 15-day pathogen reproduction cycle, while a high risk index is associated with a 5-day reproductive cycle. An effective spray resets the week clock at 1.

[16] UC Pest Management Guidelines for powdery mildew: http://www.ipm.ucdavis.edu/PMG/r302100311.html

Table 22. Predicted Grape Yield Losses When One or More Weekly Sprays Missed by Risk Index Assuming an Effective Spray at the Beginning of the Period: San Joaquin Valley and Southern Sacramento Valley

| | | Weeks Missed | | | |
|---|---|---|---|---|---|
| **Disease Pressure (Risk Index)** | **Pathogen Status** | 1 | 2 | 3 | 4 |
| Low (0-30) | Present | 0% | 0% | 5% | 10% |
| Intermediate (40-50) | Reproduction cycle = 15 days | 0% | 2% | 10% | 30% |
| High (60-100) | Reproduction cycle = 5 days | 0% | 20% | 40% | 60% |

Source: UC Personnel & UC IPM web site

## Cost Reductions Due to Fewer Sprays and Reduced Yields

When yields are reduced, harvest costs can decline, and when fewer sprays are applied, treatment costs decline. Therefore, the estimated loss in gross revenue from yield losses due to missed sprays is larger than the loss in net revenues. These cost savings must also be considered when estimating net losses. We assume that the cost of harvest is reduced by the same percentage as the yield reduction. For example, a 20 percent reduction in yield would mean a 20 percent reduction in harvest cost. For sprays, a reduction in sprays means a reduction in costs, i.e. the cost of the missed sprays and the decrease in harvest costs. We calculate the net revenue loss as the gross revenue loss due to the crop loss minus the unrealized harvest and spray costs. Table 23 reports reductions in spring spray and harvest costs based on the number of sprays missed and the percentage yield loss, respectively. Grape harvest cost per acre is a weighted average of harvest costs per acre for wine, table, and raisin grape. The weights used are the acres of each commodity.

Table 23. Annual Spring Sprays and Harvest Costs Unrealized Under Various Missed Spray and Yield Loss Conditions

| | **Spring Sprays Cost** | | | **Harvest Cost** | | |
|---|---|---|---|---|---|---|
| **Crop** | **Number Missed** | | | **Yield Loss** | | |
| | **1** | **2** | **3** | **10%** | **20%** | **100%** |
| | *$/Acre* | | | *$/Acre* | | |
| Almond | 40 | 81 | 121 | 40 | 79 | 395 |
| Grape | 35 | 70 | 105 | 113 | 226 | 1,131 |

Sources: CDFA 2015, various UC Cost and Return Studies and authors' calculations.

## The Effect of Weather on Fungicide Applications

The number of fungicide applications a grower makes is largely dependent on weather. Temperature particularly affects plant phenology and disease development, and precipitation affects whether or not a treatment can be made and its efficacy. In addition, soil type affects orchard and vineyard drainage and hence how quickly growers can get spray equipment on their fields after rain events. Therefore, the effect of the draft regulation on yield and revenues will depend on weather and soils. **Regardless of the number of sprays a grower could actually apply, the draft regulation would only have an effect on yield, revenue and production costs if the number of sprays would have been different with the regulation than without it.**

Based on information obtained from UC and USDA researchers, growers and PCAs, rules regarding when growers can apply fungicides were developed for almond and grape. The rules were then used to model growers' fungicide programs for each of ten years of California Irrigation Management Information System (CIMIS) weather data: 1996-2005.[17] The constraints imposed on the timing of applications by the draft regulation were then included with the rules and used to model growers' spray programs given weather for the same ten years.

The spray programs were modeled for four soil hydrologic groups developed by the USDA-Natural Resource Conservation Service: A, B, C, and D (USDA-NRCS 2007). The letter designations are based on soil runoff potential and water transmission. Soil type A is sand, loamy sand, and sandy loam; B is silt loam and loam; C is sandy clay loam, and D is clay loam, silty clay loam, sandy clay, and clay. Soils in group A tend to have higher sand content, lower clay content and faster drainage. From groups B to D, the sand content tends to decrease, clay content tends to increase, and drainage rate decreases.

### Critical Time Period for Control of Almond Spring Diseases

California is the only producer of almond in the United States (CDFA 2015a). In 2014, almond ranked second in value of all California agricultural commodities, and was the number one valued fruit or nut crop in California (CDFA 2015a). Almond are produced on 870,000 bearing acres with a gross value of $5.89 billion. Almond production is concentrated in the California Central Valley. Fresno, Kern, Madera, Merced and Stanislaus were the major producing counties in 2014, accounting for 73 percent of the total bearing acreage (NASS 2015).

Almond are the earliest blooming of all deciduous fruit, nut and vine crops in California. The first almond bloom on Nonpareil cultivar starts about the second week of February with 100% petal fall by late February or early March (Table 24). The pink bud stage precedes bloom by about one week. The start of bloom depends on the temperature in January and early February. The bloom starts first in the southern San Joaquin Valley and northern Sacramento Valley proceeding to the Sacramento Delta region. However, the total bloom period for each region occurs within about a two-week period.

Almond are susceptible to a number of early spring diseases including anthracnose, bacterial spot, brown rot, green fruit rot, leaf blight, scab and shot hole. If uncontrolled, these diseases can cause significant yield loss (up to 75%). The amount of loss depends on disease inoculum present, amount of rain and number of rain events. To control diseases, growers apply a fungicide at pink bud followed by a second application within 7 to 10 days at full bloom. These two applications are applied principally for brown rot and to a lesser extent green fruit rot and anthracnose. Growers then apply a third application at petal fall, 7 to 10 days after the second application. The third application is directed principally towards shot hole and anthracnose.

[17] UC and CDFA provided CDPR with the decision rules; CDPR then applied the rules to the weather data and returned the results to the CDFA-UC group. The 1996-2005 period was selected because almond bloom data were available for those ten years.

(PCAs, personal communications.) Thus within 14 to 20 days, three critical fungicide applications are often applied in almond production. The first application (pink bud) is the most important of the three bloom applications. If none of the three applications can be applied then crop losses would be 0 to 25% in the southern San Joaquin Valley, 5% to 30% in the northern San Joaquin Valley and 25% to 75% in the Sacramento Valley. However, if only one application can be made then crop losses will be substantially reduced and if two of the three bloom applications can be applied then crop losses would be minimal (UC personnel, personal communication).

Table 24. Mean First Bloom and 100% Petal Fall Dates for Nonpareil Cultivar: Various Locations, CA

| Years | Location/County | Mean[a] | |
|---|---|---|---|
| | | First bloom | 100% petal fall |
| 1996 – 2006 | CSU-Chico (Butte) | 15 Feb | 3 Mar |
| | Delta College- Stockton (San Joaquin) | 16 Feb | 23 Feb |
| | Paramount Farm (Kern) | 14 Feb | 1 Mar |
| 2006 – 2014 | McFarland (Kern) | 17 Feb | 5 Mar |

[a]From Lampinen et al. "Field Evaluation of almond varieties." Almond Board Report 08-HORT2-Lampinen and Lampinen et al. "Field Evaluation of almond varieties." Almond Board Report 14 – HORT2 – Lampinen.

Numerous fungicides are applied to almond during the bloom period; the most prevalent used in 2014 are listed in Table 25. The 2 to 8 February applications are applied to the pink bud stages while the 23 February to 1 March are applied at petal fall. Fungicides are used in rotation to slow the development of resistance. Rovral was one of the top four fungicides in all four-time periods. However, it is not applied repeatedly to the same orchards (PCAs, personal communication).

The majority of fungicides are applied with air-blast speed sprayers, usually during the day, but sometimes at night. When the ground is too wet for the operation of ground equipment, fungicides are applied aerially (usually with a helicopter at 20 to 30 gal/ac). However, aerial applications are slightly less efficacious as compared to ground applications and are not preferred by growers. In addition, there is a surcharge for aerial applications regardless of acres treated. Thus aerial applications are often not cost effective for smaller acreage growers. Large acreage growers will use aerial applications if they cannot apply fungicides over the entire acreage in a timely manner. Aerial applications are usually applied during the day for safety reasons. However, aerial applications can be applied at night depending on the applicator. Thus under heavy rain pressure with numerous rain events, ground applications may have to be advanced or delayed a few days in either direction over optimum timing to allow for ground application. UC plant pathologists suggest a 3 or 4 day +/- window over optimum timing provides acceptable control. As an example, if rain is projected at the optimum timing for a full bloom spray, then a grower can apply 3 or 4 days before optimum or 3 or 4 days after optimum with little adverse effect. The amount of fungicide may also be increased to maximum field level to compensate to some extent of less than optimum timing but if the ground is too wet then aerial applications are the only option. If rain events occur during the weekend and aerial applications are not possible during the daylight on weekdays, then nighttime aerial applications may be possible in certain areas and under certain restrictions.

Table 25. Top Four Fungicides Sprayed in Almond by Week, 2014

| Trade name | Chemical name(s) | Acres treated | Percent of total | Signal word |
|---|---|---|---|---|
| | | 2 to 8 Feb | | |
| Vangard | cyprodinil | 12,728 | 22.6 | caution |
| Rovral[a] | iprodione | 10,792 | 19.2 | caution |
| Tilt[b] | propiconazole | 4,879 | 8.7 | warning |
| Protocol | propiconazole, thiophanate-methyl | 3,840 | 6.8 | caution |
| | | 9 to 15 Feb | | |
| Rovral[a] | iprodione | 60,451 | 20.4 | caution |
| Vangard | cyprodinil | 43,918 | 14.9 | caution |
| Tilt[b] | propiconazole | 43,908 | 14.8 | warning |
| Scala | pyrimethanil | 25,866 | 8.7 | caution |
| | | 16 to 22 Feb | | |
| Pristine | boscalid, pyraclostrobin | 76,230 | 19.3 | caution |
| Rovral[a] | iprodione | 45,757 | 11.6 | caution |
| Vangard | cyprodinil | 43,358 | 11.0 | caution |
| Tilt[b] | propiconazole | 35,244 | 8.9 | warning |
| | | 23 Feb to 1 Mar | | |
| Pristine | boscalid, pyraclostrobin | 36,063 | 21.6 | caution |
| Rovral[a] | iprodione | 15,977 | 9.5 | caution |
| Luna Sensation | fluopyram, trifloxystrobin | 15,929 | 9.5 | caution |
| Vangard | cyprodinil | 15,150 | 9.1 | caution |

[a]Rovral, Rovral 4 Flowable, Rovral Brand 4 Flowable Fungicide
[b]Tilt, Tilt Si
Source: California Department of Pesticide Regulation Pesticide Use Report data

### Almond Spray Program

Based on the information in the previous subsection, the following spray program was identified for use in the analysis. The standard almond fungicide spray program includes sprays in each of three bloom stages: 1) pink bud (first day of bloom period) 2) full bloom (midpoint between first and last day of bloom period) 3) petal fall (last day of bloom period). There is an optimal day for each of the three applications.

Bloom stage dates for each year are reported in Table 24. The first step was to identify the number of 12-hour periods in each bloom stage in which a grower could apply fungicide based on weather conditions and soil type. These days were identified using the following rules:

- If a spray can be made 3 days before or after its optimal time, then it is efficacious and there is no yield loss

- Nighttime ground applications are possible if the rain history and soil type permit.
- Successful spray requires no rain events during a 12-hour block or in the 12-hour blocks proceeding and following that block.
- Weekend (ground or aerial) sprays are allowable during the day.
- Aerial/ground applications can occur if wind speed <10 mph for at least 6 hours in a block of 12 hours

Ground applications are possible if the soil is not too wet from precipitation, which is a function of the amount and duration of precipitation and hydrologic soil type. The re-entry rules for allowing a spray after a precipitation event for each of the soil types is the following:

- Hydrologic Soil Group A (sand, loamy sand, sandy loam):
  < 1.0" rain in any consecutive 24-hr period in the previous 36 hours
  and < 3.0" cumulative rain in the previous 96 hours

- Hydrologic Soil Group B (silt loam, loam):
  < 0.5'"rain in any consecutive 24-hr period in the previous 72 hours
  and < 1.0" rain in any consecutive 24-hr period in the previous 96 hours
  and < 2.5" cumulative rain in the previous 96 hours

- Hydrologic Soil Group C (sandy clay loam):
  < 0.5" rain in any consecutive 24-hr period in the previous 108 hours
  and < 1.0" rain in any consecutive 24-hr period in the previous 120 hours
  and < 2.5" cumulative rain in the previous 120 hours

- Hydrologic Soil Group D (clay loam, silty clay loam, sandy clay, and clay):
  < 0.5" rain in any consecutive 24-hr period in the previous 132 hours
  and < 1.0" rain in any consecutive 24-hr period in the previous 144 hours
  and < 2.5" cumulative rain in the previous 144 hours

The 12-hour time blocks within each bloom period were checked for the possibility of a nighttime ground spray or a weekend daytime spray based on the rules above. Under the regulation, a vineyard or orchard was considered protected from yield loss during bloom period if at least one nighttime or weekend daytime application were possible. Spray possibilities in the absence of regulation included weekday daytime sprays. The number of possible sprays were then compared for each bloom period, with and without the regulation.

For most years, the draft regulation would have had no effect on the number of fungicide sprays that grape growers could implement (Appendix Two, Table 56 through Table 61). 1998 accounted for many of the instances when the regulation would have reduced the number of possible sprays. February, in which the majority of almond bloom occurs, can be a critical month in determining the year's almond yields. Rain events during the bloom period can lead to disease outbreaks, and heavy rains and winds can curtail the ability of producers to perform necessary treatments. The National Weather Service reported that February 1998 was one of the wettest Februarys in recent years (NWS 1998). Precipitation records were set for numerous locations across California. Storms were heavy and persistent throughout the month. The National Agricultural Statistics Service reported a 34% reduction in almond yield for 1998 compared to 1997 and 1999 (NASS 2015).

### Early Season Control of Powdery Mildew in Grape

California produces over 88% of the grape in the United States (CDFA 2015a). Grape are ranked third in value of all California agricultural commodities. Production is distributed among fresh market/table, raisin and wine grape. Grape are produced on over 865,000 bearing acres with a gross value of $5.24 billion. In 2014, raisin grape accounted for approximately $710 million, table grape for $1.57 billion and wine grape for $2.96 billion (CDFA 2015a). There are four major areas of production in the state; these include the southern San Joaquin Valley, northern San Joaquin Valley and Sacramento Valley, coastal and desert. The southern San Joaquin Valley region produces 99% of California's raisin crop, 91% of table grape production and about 60% of the wine grape crop. Coastal areas account for about 19% of the state's wine grape production with roughly half being produced in the north coast region. Grape production in the northern San Joaquin and Sacramento Valleys focuses almost exclusively on wine grape with about 20% of the state's wine grape production. The desert (Coachella Valley) produces 9% of the State's table grape.

Mealybugs (grape mealybug: *Pseudococcus maritimus*, obscure mealybug: *Pseudococcus viburni*, longtailed mealybug: *Pseudococcus longispinus* and particularly vine mealybug: *Planococcus ficus*) are significant insect pests of grape. Control of these pests requires a delayed dormant application (chlorpyrifos) or early spring application (buprofezin). The spray windows for the delayed dormant applications are very broad, from 2 to 3 weeks, from bud swell to bud break. Early spring applications are also not time sensitive, from bud break to 6-inch shoots. Thus inclement weather would not prevent the applications of these treatments.

Powdery mildew is typically the most important disease that grape growers must control, especially early in the season when weather may limit access to fields. Nearly all grape cultivars are highly susceptible to powdery mildew and fungicides are required to prevent or suppress disease development (Table 26). The powdery mildew fungal pathogen (*Erysiphe necator*) overwinters inside dormant buds or permanent vine parts. Season-long control is necessary and treatment must begin at bud break and be repeated at appropriate intervals (UC IPM).

Table 26. Fungicide Use on Grape for California, Weeks 10-22 (Early March through Late May): 2014

| Fungicide class | Product (most used) | Acres treated | % of total |
|---|---|---|---|
| Biological | Sonata | 46,259 | 1% |
| DMI | Rally 40 WSP | 631,082 | 9% |
| Strobilurin | Sovran Fungicide | 498,446 | 7% |
| Stylet-Oil | Jms Stylet-Oil | 197,378 | 3% |
| Sulfur dust/powder | Wilbur-Ellis Dusting Sulfur | 1,498,025 | 22% |
| Sulfur wettable powder | Microsulf | 1,702,347 | 25% |

Source: 2014 Pesticide Use Report data

### Grape Spray Program

The same rules regarding weather and soil conditions for applications were utilized for grape as for almond. The relevant time period differed due to differences in crop and disease development. For grape, the time period was defined based on wettable sulfur use and weather for two regions: Sacramento and northern San Joaquin Valleys and the southern San Joaquin Valley. Each calendar year, week 1 was identified using the following rule:

- Week 1 is the first week in which wettable sulfur applications exceeded 5% of the cumulative total wettable sulfur applications through week 26 (end of May), based on acres treated. Seven to 10 weeks were considered based on grape development and weather.

In addition to soil and weather conditions, the anticipated yield losses due to sprays that could not be completed are affected by the powdery mildew risk index (Table 3). UC IPM has a well-tested model for calculating powdery mildew risk. Infections of the fungal pathogen are optimal at temperatures between 70 and 85 °F (21 - 29 °C) (UC IPM). Temperatures above 95 °F (35 °C) and less than 70 °F inhibit growth. The risk index model represents how quickly the *E. necator* pathogen can reproduce and the associated disease pressure (Table 8). Greater index values require more frequent fungicide sprays. The length of time a vineyard in protected is dependent on a number of variables including the class of fungicide. At high disease pressure, weekly spray intervals may be needed to maintain control.

To determine the potential for yield loss for grape, risk indices were calculated using CIMIS weather data for a ten-year period (1996 - 2005). To simplify calculations, the early season rule of resetting the index to zero when temperatures are less than 60 °F (16 °C) was dropped -- the resulting index values are conservative (greater) for the time before the index first reaches 60 °F. Index points are assigned for each day based on the previous day's index and the current day's hourly temperatures:

- If temperature < 6 h between 70 and 85 °F, subtract 10 points

- If temperature >= 6 h between 70 and 85 °F, add 20 points
- If temperature > 95 °F, subtract 10 points
- If temperature >= 6 h between 70 and 85 °F AND any hour > 95 °F, add 10 points

Potential yield loss was determined by comparing the need to spray (as determined by the risk index) with the possibility of spraying (based on rain events and soil type).

### Buffer Zone Acreage by Soil Hydrologic Group

The hydrologic group of a given field's soil has a strong influence on how long after a rain event mechanized sprayers can return to the field. Soils with higher sand content (A) drain quickly and can therefore support the weight of a tractor relatively soon after a precipitation event while soils with a higher clay content (B, C, & D) stay wet for a much longer period of time, preventing tractor access post storm. If a grower is unable to access their field with a ground spray rig, they must pay extra for a nighttime or weekend aerial application of pesticides.

Because the effect of the draft regulation on fungicide applications varies with soil characteristics, information on buffer zone acres by soil hydrologic group is required to calculate the economic impact of the draft regulation. Table 27 reports buffer acreage for almond by county and soil hydrologic group. Table 28 reports it for grape. Buffer zone acreage is calculated as total acreage within the ¼ mile buffer zone distance for one or more schoolsites.

To quantify the impact of the differences in soil drainage to farmers within a PAPAC buffer, a table was generated describing the acres by crop within each soil hydrologic group. To accomplish this, each field polygon and its associated schoolsite buffer polygon were intersected with the Natural Resource Conservation Service Soil Survey Geographic database (SSURGO) soil spatial layer, and then correlated with the SSURGO component table to identify the soil hydrologic group.

Table 27. PAPAC Buffer Zone Acreage by County and Soil Hydrologic Group: Almond

| | Soil Hydrologic Group | | | | |
|---|---|---|---|---|---|
| **County** | **A** | **B** | **C** | **D** | **Total** |
| Southern San Joaquin Valley | | | | | |
| Fresno | 525 | 0 | 245 | 63 | 833 |
| Kern | 592 | 108 | 168 | 27 | 895 |
| Kings | 137 | 76 | 70 | 0 | 283 |
| Madera | 557 | 143 | 264 | 181 | 1,145 |
| Northern San Joaquin/southern Sacramento Valleys | | | | | |
| Merced | 821 | 0 | 289 | 139 | 1,249 |
| Sacramento | 0 | 0 | 0 | 0 | 0 |
| San Joaquin | 952 | 13 | 155 | 0 | 1,120 |
| Stanislaus | 844 | 68 | 1,444 | 12 | 2,368 |
| Yolo | 0 | 6 | 177 | 90 | 273 |

Note: A small number of soil hydrologic groups were designated as A/D, B/D, or C/D in the original data. This indicates the presence of a water table within 2 feet of the surface, which would put that soil in the D category; however, if adequate drainage is provided (which is the assumption used to generate the numbers in this table), the soil would then fall within the A, B or C class.

Table 28. PAPAC Buffer Zone Acreage by County and Soil Hydrologic Group: Grape

| | Soil Hydrologic Group | | | | |
|---|---|---|---|---|---|
| **County** | **A** | **B** | **C** | **D** | **Total** |
| North | | | | | |
| Sacramento | 5 | 0 | 29 | 0 | 34 |
| Yolo | 0 | 2 | 5 | 0 | 7 |
| Central | | | | | |
| San Joaquin | 411 | 30 | 222 | 73 | 736 |
| Stanislaus | 70 | 40 | 52 | 0 | 162 |
| Merced | 88 | 0 | 0 | 0 | 88 |
| South | | | | | |
| Madera | 373 | 137 | 328 | 269 | 1,107 |
| Fresno | 1,848 | 128 | 186 | 77 | 2,239 |
| Kern | 573 | 15 | 10 | 0 | 598 |

Note: Of the 13 counties in the study, only those with impacted acreage are included. A small number of soil hydrologic groups were designated as A/D, B/D, or C/D in the original data. This indicates the presence of a water table within 2 feet of the surface, which would put that soil in the D category; however, if adequate drainage is provided (which is the assumption used to generate the numbers in this table), the soil would then fall within the A, B or C class.

## Almond Net Revenue Losses

Total almond net revenue losses due to the draft regulation are calculated as follows:

1. Net revenue losses per acre in a year in which only one spray could be completed are calculated by reducing gross revenues by the percentage yield loss and then adjusting for the cost reduction due to lower harvesting and spraying costs.
2. Total net revenue losses in a year in which only one spray could be completed are calculated by multiplying the net revenue losses per acre in such a year by the PAPAC buffer zone acres which would be affected by the regulation.
3. Total average net revenue losses over the ten-year period 1996-2005 are calculated by multiplying the total net revenue losses in a year in which only one spray could be completed by the share of years in which only one spray could be completed.

These total average net revenue losses incorporate both the losses when only one spray can be completed and the likelihood that only one spray can be completed. All losses are reported by county and soil hydrologic group.

### Net Revenue Losses per Acre with One Spring/Bloom Spray

Table 29 reports estimated revenue losses per acre net of the non-realized cost for sprays and reduced harvest costs due to lower yields. All counties with CDFA-reported almond acreage and revenues are included in the table. Counties for which there are no buffer acreage values from the GIS analysis are italicized. Therefore, these counties are not included in the county revenue loss calculations but are included here for comparison of per acre losses.

Table 29. Almond Revenues and Estimated Net Revenue Losses per Acre by County When Only One Spring/Bloom Spray Could Be Completed*

| **County** | **Revenue per Acre** | **Net revenue losses/acre** |
|---|---|---|
| Southern San Joaquin Valley** | | |
| Fresno | $7,308 | $916 |
| Kern | $7,196 | $899 |
| Kings | $7,945 | $1,012 |
| Madera | $7,008 | $871 |
| *Tulare* | *$8,449* | *$1,087* |
| Northern San Joaquin/southern Sacramento Valleys | | |
| Merced | $7,915 | $1,007 |
| Sacramento | N/A | N/A |
| San Joaquin | $9,778 | $1,286 |
| *Solano* | *$4,127* | *$439* |
| Stanislaus | $8,228 | $1,054 |
| Yolo | $5,397 | $629 |
| Northern Sacramento Valley | | |
| *Butte* | *$6,149* | *$1,318* |
| *Colusa* | *$5,389* | *$1,128* |
| *Glenn* | *$4,748* | *$967* |
| *Sutter* | *$4,175* | *$824* |
| *Tehama* | *$4,506* | *$907* |
| *Yuba* | *$5,839* | *$1,240* |

* Net revenue equals total revenue minus unrealized spray and harvest costs
** Reported southern San Joaquin Valley losses based on maximum yield loss; minimum yield loss and minimum net revenue loss equal zero.
Source: CDFA 2015b and authors' calculations

### Estimated Almond Net Revenue Losses in a Year When Only One Spray Could Be Completed

There are two items required to compute revenue losses:

- Revenue losses per acre net of unrealized spray costs and reduced harvest costs (Table 29).
- Buffer zone acreage (Table 27).

Table 30 reports estimated total losses on buffer zone acreage in a year in which only one spray could be applied by county and soil hydrologic group.

Table 30. Estimated Total Losses on Buffer Zone Acreage in Any Year in which Only One Spray Could Be Completed: Almond

| | Soil Hydrologic Group | | | | |
|---|---|---|---|---|---|
| **County** | **A** | **B** | **C** | **D** | **Total** |
| Southern San Joaquin Valley | | | | | |
| Fresno | $480,874 | $0 | $224,408 | $57,705 | $762,986 |
| Kern | $532,297 | $97,108 | $151,057 | $24,277 | $804,739 |
| Kings | $138,576 | $76,874 | $70,805 | $0 | $286,255 |
| Madera | $485,119 | $124,546 | $229,931 | $157,642 | $997,238 |
| Northern San Joaquin/southern Sacramento Valleys | | | | | |
| Merced | $826,747 | $0 | $291,023 | $139,973 | $1,257,743 |
| Sacramento | $0 | $0 | $0 | $0 | $0 |
| San Joaquin | $1,224,700 | $16,724 | $199,400 | $0 | $1,440,824 |
| Stanislaus | $889,534 | $71,669 | $1,521,904 | $12,647 | $2,495,754 |
| Yolo | $0 | $3,776 | $111,386 | $56,637 | $171,799 |
| **Total** | $4,577,846 | $390,696 | $2,799,913 | $448,881 | $8,217,337 |

### Percentage of Years When Only Possible to Complete One Spray

Table 31 summarizes the share of years in which almond growers in each county could make only one fungicide application for each soil hydrologic group with and without the regulation. If there is a 0% entry, then two or more sprays could be applied every year for soil of that type in that county. The table summarizes the information in Table 56 to Table 61 in the appendix. These tables include the number of sprays that could have been completed each year by regulation status.

Table 31. Percentage of Years When Only Possible to Complete One Spray by Soil Hydrologic Group and Regulation Status: Almond, 1996-2005

| Soil Hydrologic Group | With Regulation | | | | Without Regulation | | | | Increase with Regulation | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | A | B | C | D | A | B | C | D | A | B | C | D |
| Southern San Joaquin Valley | | | | | | | | | | | | |
| Fresno | 0% | 10% | 30% | 30% | 0% | 10% | 10% | 10% | 0% | 0% | 20% | 20% |
| Kern | 0% | 10% | 10% | 10% | 0% | 10% | 10% | 10% | 0% | 0% | 0% | 0% |
| Kings | 0% | 0% | 10% | 10% | 0% | 0% | 10% | 10% | 0% | 0% | 0% | 0% |
| Madera | 0% | 10% | 30% | 30% | 0% | 10% | 10% | 10% | 0% | 0% | 20% | 20% |
| Northern San Joaquin/Southern Sacramento Valleys | | | | | | | | | | | | |
| Merced | 0% | 10% | 10% | 20% | 0% | 0% | 10% | 10% | 0% | 10% | 0% | 10% |
| Sacramento | 0% | 0% | 10% | 20% | 0% | 0% | 10% | 20% | 0% | 0% | 0% | 0% |
| San Joaquin | 0% | 0% | 10% | 20% | 0% | 0% | 10% | 20% | 0% | 0% | 0% | 0% |
| Stanislaus | 0% | 10% | 10% | 20% | 0% | 0% | 10% | 10% | 0% | 10% | 0% | 10% |
| Yolo | 10% | 30% | 40% | 40% | 0% | 20% | 30% | 30% | 10% | 10% | 10% | 10% |

### Estimated Almond Net Revenue Losses Averaged across All Years

There are two items required to compute revenue losses averaged across all years:

- Total revenue losses in a year in which only one fungicide spray can be completed (Table 30)
- Share of years in the ten-year period in which it was possible to apply only one spray under the draft regulation while it was possible to apply two or more without the regulation (Table 31)

The percentage of years in which only one spray could be applied reported in Table 31 should be interpreted as the "expected" annual revenue losses (losses averaged across ten years). This does not represent the yield loss in any one year. Rather, it adjusts the loss estimate to reflect how often growers are able to apply only one spray during bloom. The resulting estimated expected annual losses are reported in Table 32. **Total losses for almond in the eight counties averaged across ten years are less than $175,000: $173,547.**

Table 32. Estimated Almond Net Revenue Losses Averaged across Years by County and Soil Hydrologic Group: Almond, 1996-2005

| | Soil Hydrologic Group | | | | |
|---|---|---|---|---|---|
| **County** | **A** | **B** | **C** | **D** | **Total** |
| Southern San Joaquin Valley | | | | | |
| Fresno | $0 | $0 | $44,882 | $11,541 | $56,423 |
| Kern | $0 | $0 | $0 | $0 | $0 |
| Kings | $0 | $0 | $0 | $0 | $0 |
| Madera | $0 | $0 | $45,986 | $31,528 | $77,514 |
| Northern San Joaquin/southern Sacramento Valleys | | | | | |
| Merced | $0 | $0 | $0 | $13,997 | $13,997 |
| Sacramento | $0 | $0 | $0 | $0 | $0 |
| San Joaquin | $0 | $0 | $0 | $0 | $0 |
| Stanislaus | $0 | $7,167 | $0 | $1,265 | $8,432 |
| Yolo | $0 | $378 | $11,139 | $5,664 | $17,181 |
| **Total net revenue losses averaged over 10 years** | $0 | $7,545 | $102,007 | $63,995 | $173,547 |

* Net revenue equals total revenue minus unrealized spray and harvest costs

### Estimated Indirect Losses

A reduction in net revenue losses is expected to result in a reduction in associated economic activity. We utilize the California Department of Finance's rule of thumb that the indirect effect on economic activity equals the direct effect on agriculture, so that the economic activity multiplier equals 2 (Charles Liao, DOF, personal communication, March 3, 2016). In the case of almond, the draft regulation resulted in $173,547 in revenue losses, so **estimated direct and indirect losses would be less than $350,000 for the eight counties**.

## Grape Net Revenue Losses

Total grape net revenue losses due to the draft regulation are calculated by identifying the share of years with one or more weeks in which a spray could not have been completed under the regulation and could have been completed without the regulation. The number of weeks with no sprays is paired with the powdery mildew risk index to determine the potential yield loss (Table 22). Yield losses can then be mapped to revenue reductions. As with almond, harvest costs are avoided in proportion to the crop loss and spray costs are avoided when sprays are not applied. Net revenue loss is equal to the gross revenue loss minus the unrealized harvest and spray costs associated with the crop loss. Gross revenue without crop loss is shown in Table 33, as are the net revenue losses when one or two consecutive weekly sprays are not completed. Table 23 shows the cost per acre for spring spray and harvest costs. Multiplying the gross revenue by the yield loss from Table 22 gives the expected gross revenue loss from the yield loss. Multiplying the percent yield loss by the harvest cost gives the reduction in harvest cost. The spray cost from

Table 23 divided by Table 22 equals the avoided spring spray cost. The net revenue losses reported in Table 33 equal the gross revenue loss minus the unrealized spray and harvest costs.

### Estimated Grape Net Revenue Losses per Acre in a Year When One or Two Consecutive Weekly Sprays Not Completed and a High Powdery Mildew Risk Index

Table 33 reports gross grape revenues and net revenue losses per acre by Central Valley county when one or two consecutive sprays are not completed. Gross revenues per acre are weighted averages of table, raisin, and wine grape revenues based on their shares of total acreage in each county. Italicized counties were not included in the GIS analysis. Yield losses are reported for the case of a high powdery mildew risk index (Table 22).

Table 33. Gross Revenue and Net Revenue Losses Per Acre with One or Two Consecutive Weekly Missed Sprays Not Completed and a High Powdery Mildew Risk Index by County: Grape

| **County** | **Gross Revenue per Acre** | **Net revenue losses/acre** | |
|---|---|---|---|
| | | **Miss 1 week 0% loss** | **Miss 2 weeks 20 % loss** |
| Southern San Joaquin Valley | | | |
| Fresno | $4,432 | $0 | $625 |
| Kern | $16,179 | $0 | $2,975 |
| Kings | $5,729 | $0 | $885 |
| Madera | $4,472 | $0 | $633 |
| *Tulare* | *$11,959* | *$0* | $2,131 |
| Northern San Joaquin/southern Sacramento Valleys | | | |
| Merced | $2,589 | $0 | $257 |
| Sacramento | $4,362 | $0 | $611 |
| San Joaquin | $4,720 | $0 | $683 |
| *Solano* | *$4,023* | $0 | $543 |
| Stanislaus | $4,247 | $0 | $588 |
| Yolo | $5,473 | $0 | $833 |
| Northern Sacramento Valley | | | |
| *Butte* | *N/A* | *N/A* | *N/A* |
| *Colusa* | *$4,551* | *$0* | *$649* |
| *Glenn* | *$5,212* | *$0* | *$781* |
| *Sutter* | *N/A* | *N/A* | *N/A* |
| *Tehama* | *$5,074* | *$0* | *$754* |
| *Yuba* | *N/A* | *N/A* | *N/A* |

* Net revenue equals total revenue minus unrealized spray and harvest costs assuming 20% yield loss with 2 weeks missed.

Sources: CDFA 2015b, various UC Cost and Return Studies, and authors' calculations

### Percentage of Years with One or Two Consecutive Weeks in which a Spray Could Not Be Completed

There are very few year-county-soil hydrologic group combinations in which one or two weekly sprays could not be completed. There are even fewer for which the number of completed sprays is different under the draft regulation than the number without the regulation. Table 34 summarizes these cases. Of the 320 county-year-soil type combinations, only nine had weeks in which a spray could not be completed. Of those, five had at least one soil type for which two consecutive weekly sprays could not be completed. The remaining four had at least one soil type for which one weekly spray could not be completed. The four boxed county-year pairs have a soil type for which the number of sprays completed is different with and without the regulation.

Table 34. County-Year Pairs for which at Least One Spray Cannot Be Completed on at Least One Soil Hydrologic Group: Grape, 1996-2005

| **County** | **Year** | **Sprays not completed** | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | **With Regulation** | | | | **Without Regulation** | | | |
| | **Soil Hydrologic Group** | **A** | **B** | **C** | **D** | **A** | **B** | **C** | **D** |
| Fresno & Madera | 1998 | 0 | 1 | 2 | 2 | 0 | 1 | 2 | 2 |
| Fresno & Madera | 2005 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 1 |
| Kern | 1998 | 1 | 2 | 2 | 2 | 1 | 2 | 2 | 2 |
| San Joaquin & Sacramento | 1996 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 |
| San Joaquin & Sacramento | 1998 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 2 |
| Stanislaus & Merced | 1996 | 1 | 2 | 2 | 2 | 0 | 2 | 2 | 2 |
| Yolo (Colusa) | 1996 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 1 |
| Yolo (Colusa) | 1998 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 |
| Yolo (Colusa) | 2005 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 |

NOTE: Weather data for Yolo County are from Colusa County.

Based on the analysis of the 1996-2005 weather data for the selected counties, there was never a year in which a spray could not have been completed in two or more consecutive weeks under the regulation and could have been completed in *both* of those weeks without the regulation. Only two types of differences occur: 1) cases in which a single weekly spray can be completed without the regulation and can't with it, and all other sprays can be completed regardless of the regulatory status, and 2) cases in which one spray cannot be made regardless of the regulatory status and the following weekly spray cannot be made under the regulation but can be made in its absence. There were no instances in which three or more consecutive weekly sprays could not have been completed.

There are three county-year-soil hydrologic group combinations for which there was one week in which a spray could not have been completed under the draft regulation but could have been completed without it:

- Soil hydrologic group B in Yolo County (using Colusa weather data)
- Soil hydrologic group C in San Joaquin and Sacramento Counties
- Soil hydrologic group A in Stanislaus and Merced Counties

For these cases, the relevant yield loss is the one due to not completing one spray. In each instance, there was one year in ten in which there was a difference in the number of weeks in which an application could be completed, or a 10% chance of such a year.

There was one county-year-soil hydrologic group combination for which one application could not be made without the regulation, and for which two consecutive applications could not be made with the regulation:

- Soil hydrologic group D in Fresno and Madera Counties. The powdery mildew risk index was high for the week in question.

In this case, the relevant yield loss is the difference in yield between missing two consecutive sprays and missing one. There was one year in ten in which there was a difference in the number of weeks in which an application could be completed, or a 10% chance of such a year.

Tables detailing the results of the weather-completed application analysis are in the appendix (Table 62 to Table 71).

### Estimated Total Grape Net Revenue Losses in a Year in which Two Consecutive Weekly Sprays Could Not Be Completed

Table 22 reported yield losses as a function of the powdery mildew risk index and the number of consecutive weeks in which a spray could not be completed. Regardless of the value of the risk index, the estimated yield loss due to one week in which a spray could not be completed is zero. Thus, estimated grape revenue losses are zero under the draft regulation for all counties except Fresno and Madera Counties.

When the powdery mildew risk index is high, the difference between being unable to complete one weekly spray and being unable to complete sprays in two consecutive weeks is a 20% yield loss (Table 22). Gross revenues per acre are $4,432 in Fresno County and $4,472 in Madera County. Thus, gross revenue losses per acre in a year in which two consecutive weekly sprays cannot be completed due to the draft regulation and at least one of those can be completed in the absence of regulation are $886 for Fresno County and $894 for Madera County. Adjusting for the reduction in harvest and spray costs equals a net revenue loss per acre of $625 in Fresno County and $633 in Madera County.

There are 77 Fresno County buffer acres and 269 Madera County buffer acres in soil hydrologic group D (Table 28). Total net revenue losses in a year in which two consecutive weekly sprays cannot be completed under the regulation while one of those sprays can be completed in its absence equals the net revenue loss with the regulation minus the net revenue loss with the regulation (Table 33). Multiplying the buffer acres by the per-acre losses, total net revenue losses in such a year are $48,125 in Fresno County and $170,277 in Madera County (Table 35).

### Estimated Grape Net Revenue Losses Averaged across All Years

Based on the 1996-2005 weather data analysis, there is a 10% chance of a year occurring in which two consecutive applications cannot be made under the draft regulation, while only one of those cannot be made in its absence. Thus, estimated grape net revenue losses averaged across all years due to the draft regulation are $4,813 in Fresno County and $17,028 in Madera County (Table 35). **Total estimated grape net revenue losses averaged across all years due to the draft regulation are $21,840.**

Table 35. Components of Estimated Grape Total Net Revenue Losses

| | Fresno | Madera | Total |
|---|---:|---:|---:|
| Gross revenue per acre | $4,432 | $4,472 | N/A |
| 20% gross revenue loss per acre | $886 | $894 | N/A |
| Net revenue loss per acre | $625 | $633 | N/A |
| Buffer acres | 77 | 269 | 346 |
| Total net revenue losses in a year when two consecutive sprays cannot be completed | $48,125 | $170,277 | $218,402 |
| Total net revenue losses averaged over 10 years | $4,813 | $17,028 | $21,840 |
| Total direct and indirect losses averaged over 10 years* | | | $43,680 |

*Equals twice the total average net revenue losses

### Estimated Indirect Losses

We utilize the California Department of Finance's rule of thumb that the indirect effect on economic activity equals the direct effect on agriculture, so that the economic activity multiplier equals 2 (Charles Liao, DOF, personal communication, March 3, 2016). In the case of grape, the draft regulation resulted in slightly under $22,000 in revenue losses, so **estimated direct plus indirect losses would be less than $44,000.**

# Kern County

This section begins with basic background information on Kern County in order to provide some context for the following results.

## Background

Kern County is located at the southern end of California's fertile San Joaquin Valley, bordered by Los Angeles and Ventura counties to the south, Kings and Tulare counties to the north, San Luis Obispo County to the west and San Bernardino County to the east. Kern County encompasses 8,132 square miles. Kern is California's number one producer of oil and gas (CDOC 2014). The total population of Kern County in 2014, was 868,610, making Kern County the eleventh largest county by population in California (CDOF 2015).

Kern County is the number two ranked California county in agricultural production by value. (NASS 2012a). Agriculture employed 59,550 people in 2013 (KEDC 2014). In 2012, there were 1,938 farms in Kern County covering approximately 3,641 square miles, with 58% in pastureland, 39% in cropland and 4% in other uses (NASS 2012a). The 2014 value of agricultural commodities produced in the county was $ 7,552,323,690, a 12% increase over the previous year. (Kern County 2015). The 2012 average per farm value of agricultural products sold was $2,063,462 (NASS 2012a). The top five commodities in terms of value of production in 2014 were grape, almond, dairy, citrus, and cattle and calves. The top five commodities with respect to acreage were almond, pistachio, vegetables and forage (Kern County 2015). Table 36 reports the top ten crops by acreage and by value of production; non-crop commodities are excluded in order to later compare the county's top crops to those most affected by the draft regulation. Their rankings are listed in the footnote to the table.

Table 36. Kern County Top Ten Crops by Acreage and by Value of Production: 2014

| Crop Name | Harvested Acreage | Crop Name | Value of Production ($) |
|---|---|---|---|
| Almond | 199,000 | Grape, All | 1,718,183,000 |
| Hay, Alfalfa | 109,000 | Almond, incl. by-products | 1,488,182,000 |
| Grape | 106,200 | Citrus, Fresh & Proc. | 892,874,000 |
| Pistachio | 102,900 | Pistachios | 401,049,000 |
| Silage | 85,000 | Carrot, Fresh & Proc. | 288,063,000 |
| Citrus, All | 64,234 | Hay, Alfalfa | 227,973,000 |
| Cotton, Lint | 34,435 | Cotton, incl. proc. seed | 117,568,000 |
| Wheat | 27,600 | Pomegranate, Fresh & Proc. | 87,313,000 |
| Tomato, Fresh & Proc. | 14,840 | Potato, Fresh & Proc. | 84,751,000 |
| Potato, All | 12,470 | Tomato, Fresh & Proc. | 81,768,000 |

*Excluded non-crop commodities from value of production ranking: Milk, Market & Manufacturing - 3rd, Calves and Cattle - 5th, Apiary Products - 12th

Source: Kern County 2015

## Spatial Results

According to 2014 PUR data, there were 696 unique grower identification numbers in Kern County. Of those 65 (9.3 percent) would have one or more PAPAC fields. There were 8,844 unique fields with at least one pesticide application defined using the grower identification number and the site_loc_id in the PUR data. Of those, 130 were PAPAC fields (1.5 percent).

Kern County has 324 public K-12 schools, of which 56 are within ¼ mile of PAPAC fields. The draft regulation would affect 17 percent of all public K-12 schools. It has 243 licensed child daycare facilities, of which 49 are within ¼ mile of PAPAC fields. The draft regulations would affect 20 percent of all licensed child daycare facilities. Figure 3 plots all schools (blue), all daycares (purple) and all potential PAPAC buffer acreage (green) in Kern County. The locations and acreage are determined solely by geographic proximity.

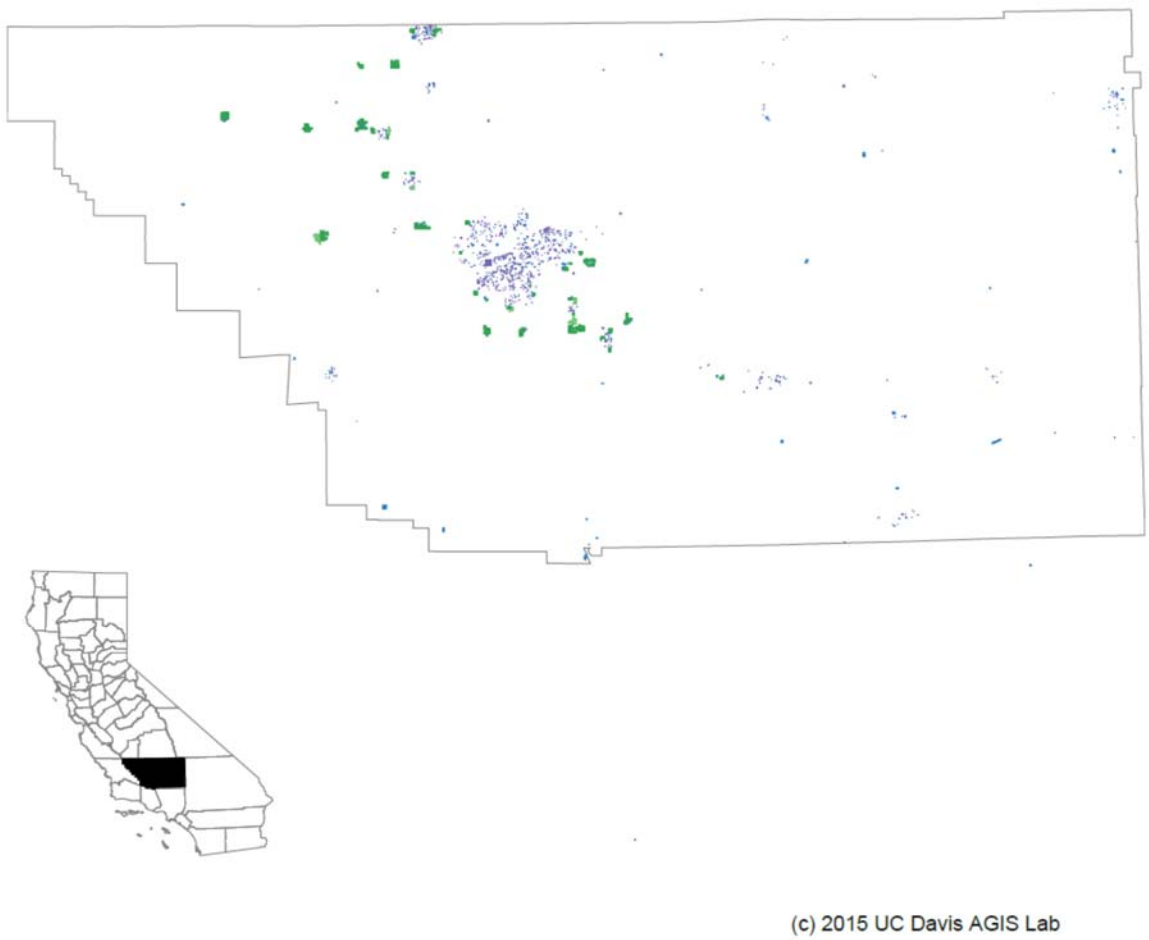



Figure 3. All schoolsites and PAPAC fields within 1/4 mile: Kern County

Schoolsites may be sufficiently close to each other for some PAPAC fields to be within ¼ mile of more than one schoolsite. Each schoolsite must be notified of an application, so notification costs are higher the more schoolsites are nearby. Although notification costs increase with each schoolsite, affected acreage may not increase very much if two schoolsites are near each other or are co-located. Figure 4 reports the share of PAPAC fields depending on which type of schoolsite is located within a ¼ mile: only schools, only licensed child daycare facilities, or both. The majority are located near schools (82, or 63 percent) or schools and licensed child daycares (22, or 17 percent). 20 percent (26) are within ¼ mile of only licensed child daycare facilities.

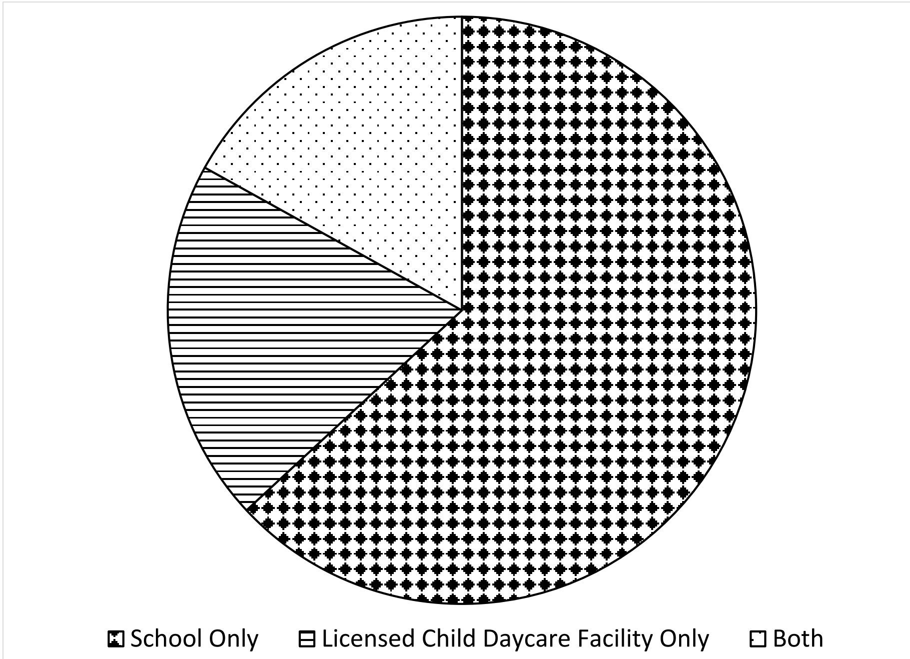



Figure 4. Percent of PAPAC fields by type of schoolsite within ¼ mile: Kern County (N=130)

Impacts on growers. Table 37 reports the values of relevant variables and their per-grower value. In total, 65 growers would have been affected by the draft regulation. The total number of PAPAC fields was 130, yielding an average of two fields per grower. Comparing the two classes of schoolsites, the total number of growers affected by the draft regulation due to PAPAC fields located near schools was noticeably higher than those due to PAPAC fields located near licensed child care facilities: 61 vs. 23. (Recall that some fields may be near both schools and licensed child daycare facilities. These are reported in the totals for both types of schoolsites.) The number of PAPAC fields near schools (104) was slightly over twice the number near licensed child daycare facilities (48). Comparing the effects for the two schoolsite types, the average number of PAPAC fields per grower was lower for ones near schools (1.7) than ones near licensed child daycare facilities (2.1). Figure 5 plots the total number of PAPAC fields by grower. With the exceptions of two outliers with 18 and eight PAPAC fields, respectively, growers had four or fewer. Over half had only one.

Overall, an average of 39.3 acres per grower would have been included in PAPAC buffers under the draft regulation, for a total of 2,552 acres. For growers with PAPAC fields near schools, average PAPAC buffer acreage per grower was 34.9. For growers with PAPAC fields near licensed child daycare facilities, the average was 26.4. There were 65 growers affected by all schoolsites with 61 of these impacted by schools and 23 of these impacted by licensed child care facilities meaning that 19 growers are affected by at least one school and at least one daycare facility.

Unlike PAPAC fields and PAPAC buffer acreage, which can be double-counted if the PAPAC field is proximate to schoolsites of both classes, notifications are provided on a per schoolsite basis, plus as notification to the CAC. The number of 48-hour notifications for all schoolsites, 247, includes all of the notifications to schools and licensed child daycare facilities and 89 notifications to the CAC.

Table 37. Total and per Grower Impacts: Kern County

| | **All Schoolsites** | | **Schools** | | **Licensed Child Daycare Facilities** | |
|---|---|---|---|---|---|---|
| | Total | Per grower | Total | Per grower | Total | Per grower |
| Growers | 65 | --- | 61 | --- | 23 | --- |
| PAPAC fields | 130 | 2.0 | 104 | 1.7 | 48 | 2.1 |
| PAPAC buffer acres | 2,552 | 39.3 | 2,127 | 34.9 | 606 | 26.4 |
| 48-hour notifications* | 247 | 3.8 | 127 | 2.1 | 31 | 1.4 |

*Total includes notifications to CAC (89)

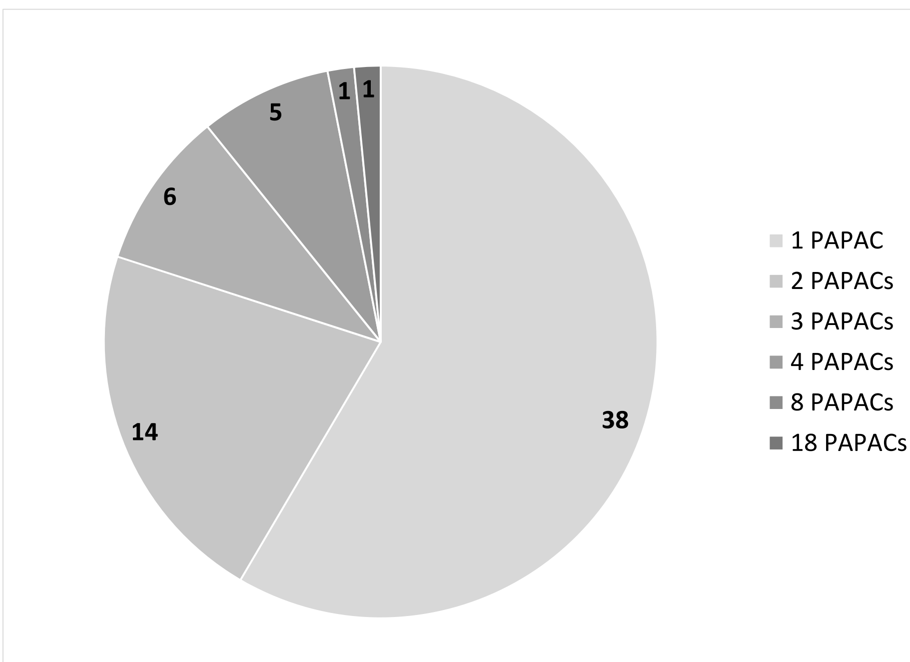



Figure 5. Number of PAPAC fields per grower: Kern County (N=65)

The number of 48-hour notifications that a grower would be required to do by the draft regulation depends on the number of PAPAC fields operated, the number of schoolsites within ¼ mile of each PAPAC field, and the crop and management system. The extent to which the applications could have been adjusted had the draft regulation been in effect is unknown.

Impacts by PAPAC field. Table 38 reports average values per PAPAC field for PAPAC buffer acres and 48-hour notifications. The number of buffer acres is larger on a per field basis for each schoolsite class than for all schoolsites due to the presence of multiple schoolsites per PAPAC field. As was the case in the previous table, notifications to the CAC are included in the all schoolsites column, so that average is noticeably larger than the ones by schoolsite class.

Table 38. Total and per PAPAC Field Impacts: Kern County

| | **All Schoolsites** | | **Schools** | | **Licensed Child Daycare Facilities** | |
|---|---|---|---|---|---|---|
| | Total | Per PAPAC field | Total | Per PAPAC field | Total | Per PAPAC field |
| PAPAC fields | 130 | --- | 104 | --- | 48 | --- |
| PAPAC buffer acres | 2,552 | 19.6 | 2,127 | 20.5 | 606 | 12.6 |
| 48-hour notifications | 247 | 1.9 | 127 | 1.2 | 31 | 0.6 |

*Total includes notifications to CAC (89)

There is considerable heterogeneity in the potential economic effects of the draft regulation across growers. The number of PAPAC fields, acreage, and 48-hour notifications varies significantly by grower. As noted earlier, there are many considerations which will impact economic effects and their differences across growers, such as differences in crops, pest pressure, and flexibility in management systems.

The distribution of PAPAC buffer acres by field is shown in Figure 6. Figure 7 and Figure 8 plot PAPAC buffer acres within ¼ mile of a K-12 public school and within ¼ mile of a licensed child daycare facility, respectively, by PAPAC field. In both figures, PAPAC fields which are not within ¼ mile of the type of schoolsite presented are omitted. The distributions of PAPC buffer acres are similar for the two types of schoolsites. Relatively few PAPAC fields are within ¼ mile of a licensed child daycare facility, and a few of those PAPAC fields account for most of the PAPAC buffer acres. This can be seen easily in the figure below, in which the size of the PAPAC fields ranked from highest to lowest starts at 70 acres, drops sharply and soon becomes zero.

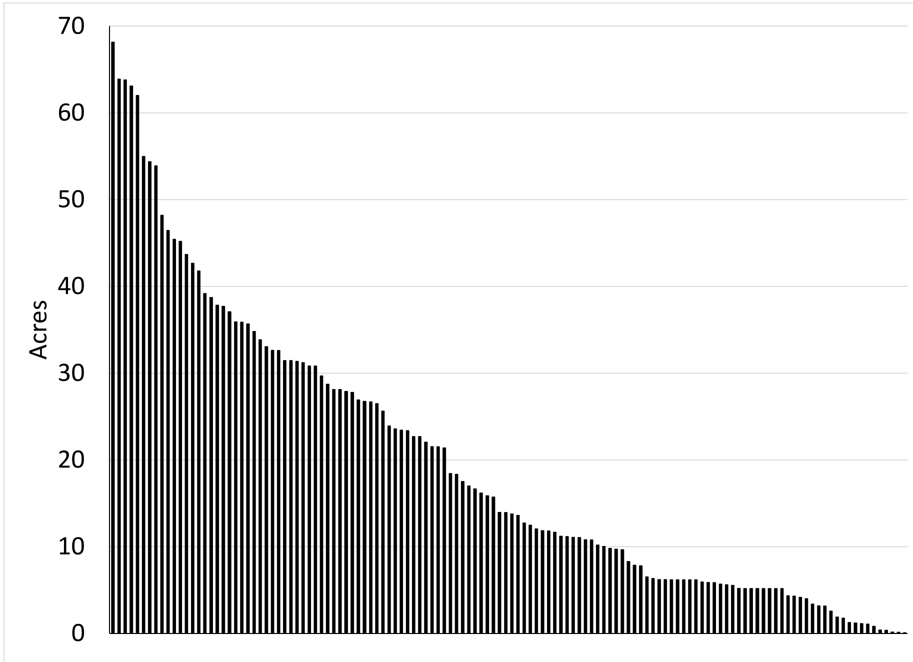



Figure 6. PAPAC buffer acres per PAPAC field within 1/4 mile of schoolsite: Kern County (N=130)

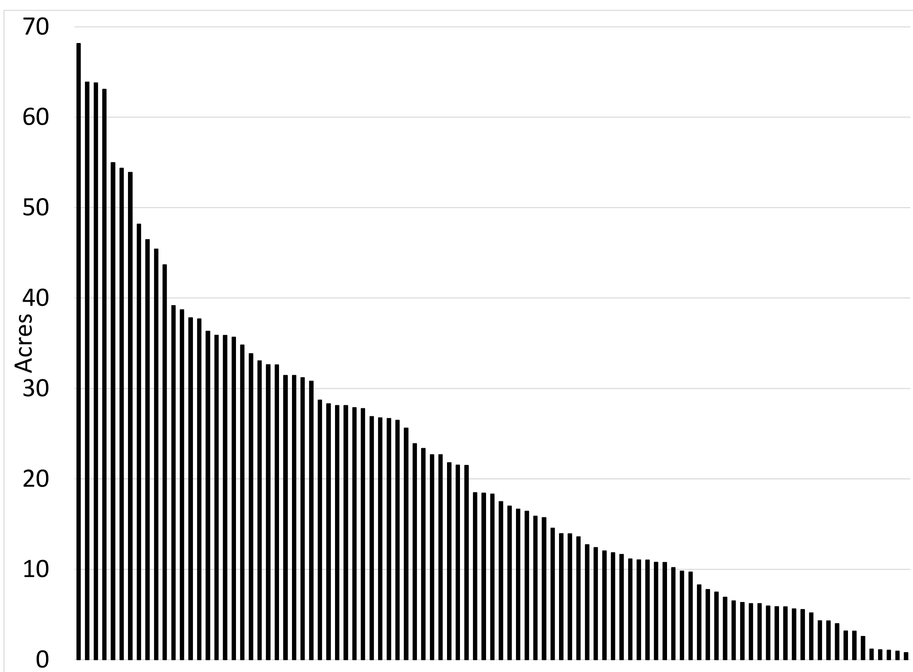



Figure 7. PAPAC buffer acres per PAPAC field within 1/4 mile of K-12 public school: Kern County (N=104)

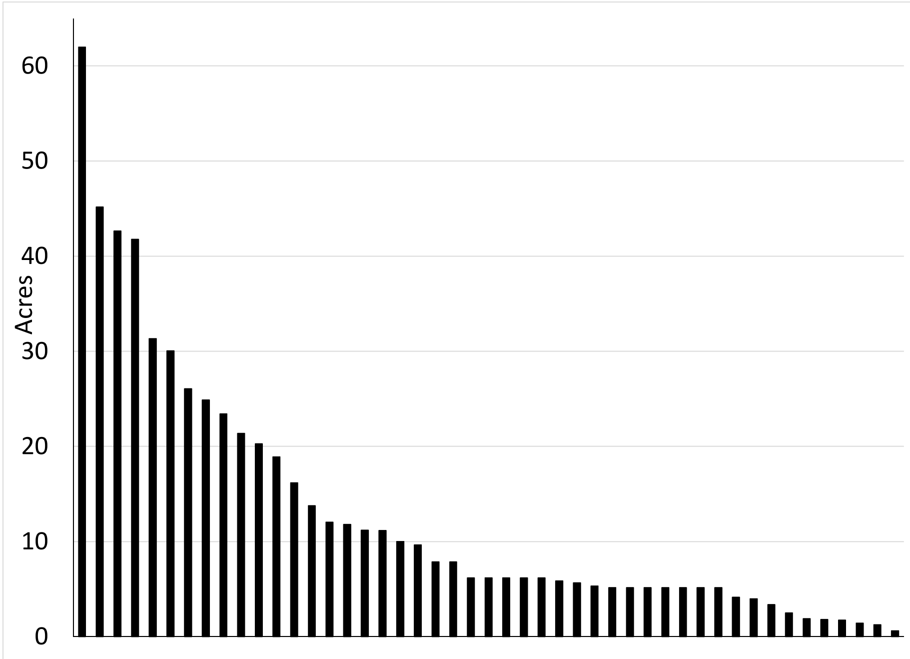


Figure 8. PAPAC buffer acres within 1/4 mile of licensed child daycare facility by PAPAC field: Kern County (N=48)

Impact by schoolsite. By CDPR's request, impacts by schoolsite are presented for the two case study counties. It is important to keep in mind that if a PAPAC field is within ¼ mile of more than one schoolsite an application subject to any of the provisions of the draft regulation will be counted once per schoolsite. One way to disaggregate the effects of schoolsites is to consider the number of affected growers and PAPAC fields per schoolsite. Table 39 presents descriptive statistics regarding these ratios. (Importantly, an affected grower or PAPAC field may be within ¼ mile of more than one schoolsite.) On average, there are 2.06 affected growers per schoolsite. The median is 2. The average number of PAPAC fields per schoolsite is higher: 3.26. The median is also 2. The variability of the number of fields per schoolsite is higher than the number of growers per schoolsite, as shown by the larger standard deviation and coefficient of variation.

Table 39. Number of Affected Growers and PAPAC Fields per Schoolsite: Kern County

| **Growers per schoolsite** | | **PAPAC fields per schoolsite** | |
|---|---|---|---|
| mean | 2.06 | mean | 3.26 |
| median | 2 | median | 2 |
| min | 1 | min | 1 |
| max | 6 | max | 18 |
| std dev | 1.36 | std dev | 3.22 |
| coeff var | 0.66 | coeff var | 0.99 |

A second way to disaggregate the effects of schoolsites is to consider the number of schoolsites per affected grower and PAPAC field. Table 40 reports descriptive statistics for these ratios. On average, affected growers operate PAPAC fields within ¼ mile of 2.06 schoolsites. PAPAC fields are, on average, within ¼ mile of 1.63 schoolsites. The variability of the number of schoolsites per grower is larger than that for the number of schoolsites per field, as shown by the larger standard deviation and coefficient of variation.

Table 40. Number of Schoolsites per Affected Grower and PAPAC Field: Kern County

| **Schoolsites per grower** | | **Schoolsites per PAPAC field** | |
|---|---|---|---|
| mean | 2.06 | mean | 1.63 |
| median | 2 | median | 1 |
| minimum | 1 | minimum | 1 |
| maximum | 6 | maximum | 5 |
| std. deviation | 1.27 | std. deviation | 0.89 |
| Coeff. variation | 0.62 | coeff variation | 0.55 |

Crop-level effects. 35 different crops were reported in the PUR data for PAPAC fields (Table 41). Of these, eight are perennial crops including alfalfa, almond, cherry, grape, grape (wine) orange, pistachio, and tangerine. These crops combined represent almost two thirds of the impacted acreage. As noted earlier, it is highly doubtful that a short-term response to the draft regulation by growers would be to change a perennial crop to another crop given the high investment in establishment. The crops with the greatest PAPAC buffer acreage near schoolsites are perennial crops with almond at 813 acres and grape (508) plus grape, wine (21) at 529 acres. However, this is only 0.4 percent of Kern County almond acreage and 0.7 percent of the grape acreage.

The highest impact on an annual crop is cotton with 242 PAPAC buffer acres, representing 0.7 percent of the 34,435 harvested acres in 2014. For crops with smaller total acreage, the percent of acreage impacted tends to be higher. For example, 6 percent of the 1,028 acres of dry bean are PAPAC buffer acres. There are 21 out of 840 fresh market tomato acres impacted or 2.5 percent. For the much more extensive processing tomato crop, a larger number of acres, 137, is in PAPAC buffers, but the total acreage is 14,000 so the percentage of acreage impacted is only 1 percent. For many of the crops impacted, the total harvested acreage was not reported in the Kern County Agricultural Commissioner's annual Crop Report so the percentage of acreage impacted could not be calculated.

Table 41. PAPAC Buffer Acreage and Value of Production Impacts by Crop: Kern County

| Crop | PAPAC Buffer Acres | Total Harvested Acreage (2014) | Value of Production/ Acre (2014) | PAPAC Buffer Acres x Value of Production /Acre | Percent of Acreage & Value of Production Impacted |
|---|---|---|---|---|---|
| Alfalfa | 153 | 109,000 | 2,091 | 319,923 | <1 |
| Almond | 813 | 199,000 | 7,478 | 6,079,614 | <1 |
| Arugula | 11 | N/A | N/A | - | N/A |
| Bean, Dried | 60 | 1,028 | 2,190 | 131,400 | 6 |
| Beet | 6 | N/A | N/A | - | N/A |
| Carrot | 35 | N/A | N/A | - | N/A |
| Cherry | 68 | 5,180 | 5,679 | 386,172 | 1 |
| Collard | 11 | N/A | N/A | - | N/A |
| Corn (Field) Fodder) | 37 | N/A | N/A | - | N/A |
| Cotton Lint | 242 | 34,435 | 2,603 | 629,926 | 1 |
| Daikon | 6 | N/A | N/A | - | N/A |
| Eggplant | 2 | N/A | N/A | - | N/A |
| Grape | 508 | 78,400 | 20,821 | 10,577,068 | <1 |
| Grape, Wine | 21 | 27,800 | 3,086 | 64,806 | <1 |
| Kale | 11 | N/A | N/A | - | N/A |
| Mustard | 11 | N/A | N/A | - | N/A |
| N-Outdr Plants In | 15 | 3,356 | 26,905 | 403,575 | <1 |
| Onion, Dry | 22 | 3,650 | 5,508 | 121,176 | 1 |
| Orange | 17 | 37,080 | 9,786 | 166,362 | <1 |
| Parsley | 35 | N/A | N/A | - | N/A |
| Pepper Fruiting | 17 | 2,200 | 35,224 | 598,808 | 1 |
| Pistachio | 70 | 102,900 | 3,897 | 272,790 | <1 |
| Potato | 95 | 13,470 | 6,292 | 597,740 | 1 |
| Radish | 21 | N/A | N/A | - | N/A |
| Rutabaga | 5 | N/A | N/A | - | N/A |
| Sorghum/Milo | 26 | N/A | N/A | - | N/A |
| Swiss Chard | 6 | N/A | N/A | - | N/A |
| Tangerine | 0.4 | 23,000 | 19,210 | 7,684 | <1 |
| Tomato, fresh | 21 | 840 | 18,493 | 388,353 | 3 |
| Tomato, proc. | 137 | 14,000 | 4,731 | 648,147 | 1 |
| Turnip | 5 | N/A | N/A | - | N/A |
| Watermelon | 64 | 2,380 | 8,329 | 533,056 | 3 |
| Wheat | 6 | 27,600 | 947 | 5,682 | <1 |
| Wheat, Forage - Fodder) | 8 | N/A | N/A | - | N/A |

N/A denotes not available.

Source: Kern County 2015

### Notification Costs

Table 42 reports notification costs for Kern County in total, per grower, and per PAPAC field. Total estimated notification costs are $86,013. The majority of these costs is accounted for by the preparation of the annual notification of pesticides which could be applied in the following July 1 to June 30 period: $80,642. The average annual cost per grower would be $1,323, and the average annual cost per PAPAC field would be $662.

Table 42. Estimated Notification Costs: Kern County

| **Activity** | **Total annual cost** | **Cost/grower** | **Cost/PAPAC field** |
|---|---|---|---|
| Preparation of annual notifications | $80,642 | $1,241 | $620 |
| Delivery of annual notifications | $882 | $14 | $7 |
| Understanding requirements | $1,680 | $26 | $13 |
| 48-hr notifications | $2,808 | $43 | $22 |
| Total | $86,013 | $1,323 | $662 |

### Indirect Effects on Economic Activity

Based on the notification costs, the total reduction in economic activity in Kern County would be $172,026.

## Stanislaus County

This section begins with basic background information on Stanislaus County in order to provide some context for the results regarding the spatial analysis and notification costs which follow.

### Background

Stanislaus County is located near the northern end of California's fertile San Joaquin Valley, bordered by Merced County to the south, San Joaquin County to the north, Santa Clara County to the west and Calaveras and Tuolumne counties to the east. Stanislaus County encompasses 1,515 square miles. The total population of Stanislaus Count, in 2014, was 528,157, making Stanislaus County the sixteenth largest county by population in California (CDOF 2015).

Stanislaus County is the number seven ranked California county in agricultural production by value. (NASS 2012b). Agriculture employed 14,000 people in 2014 (CEED 2015) In 2012, there were 4,143 farms in Stanislaus County covering approximately 1,200 square miles, with 50% in pastureland, 44 percent in cropland and 6 percent in other uses (NASS 2012b). The 2014 value of agricultural commodities produced in the county was $4,397,286,000, a 20 percent increase over the previous year (Stanislaus County 2015). The 2012 average per farm value of agricultural products sold was $537,807 (NASS 2012b). The top five commodities in terms of value of production in 2014 were almond, dairy, cattle and calves, walnut, and poultry; with respect to acreage; almond, silage, walnut, hay (oat), hay (alfalfa) (Stanislaus County 2015). Table 43 reports the top 10 crops by acreage and by value of production; non-crop commodities are excluded in order to later compare the county's top crops to those most affected by the draft regulation. Their rankings are listed in the footnote to the table.

Table 43. Stanislaus County Top Ten Crops by Acreage and by Value of Production: 2014

| Crop Name | Harvested Acreage | Crop Name | Value of Production ($) |
|---|---:|---|---:|
| Almond | 164,314 | Almond, All | 1,405,106,000 |
| Silage | 148,905 | Walnut | 299,099,000 |
| Walnut | 35,380 | Silage | 206,193,000 |
| Hay, Oat | 30,011 | Decid. Fruit & Nut Nursery | 94,319,000 |
| Hay, Alfalfa | 29,197 | Tomato, All | 58,950,000 |
| Tomato, All | 13,854 | Peaches | 58,600,000 |
| Grape | 12,372 | Hay, Alfalfa | 54,648,000 |
| Bean, All | 10,216 | Grape | 52,663,000 |
| Peach | 6,698 | Apricot | 30,498,000 |
| Apricot | 4,701 | Hay, Oat | 27,060,000 |

*Excluded non-crop commodities from value of production ranking: Milk – 2nd, Cattle & Calves – 3rd, Turkeys – 7th, Eggs, Chicken Market – 9th, Pollination, Almond - 10th

Source: Stanislaus County 2015

## Spatial Results

According to 2014 PUR data, there were 1,795 unique grower identification numbers in Stanislaus County. Of those, 208 (11.6 percent) would have one or more PAPAC fields. There were 7,007 unique pesticide application sites defined using the grower identification number and the site_loc_id. Of those, 303 (4.3 percent) are PAPAC fields. Both percentages are higher than the values for Kern County.

Stanislaus County has 222 public K-12 schools, of which 116 are within ¼ mile of PAPAC fields. The draft regulation would affect 52 percent of all public K-12 schools. It has 180 licensed child daycare facilities, of which 129 are within ¼ mile of PAPAC fields. The draft regulation would affect 72 percent of all licensed child daycare facilities. Figure 9 plots all schools (blue), all licensed child daycare facilities (purple) and all potentially affected acreage (green) in Stanislaus County.

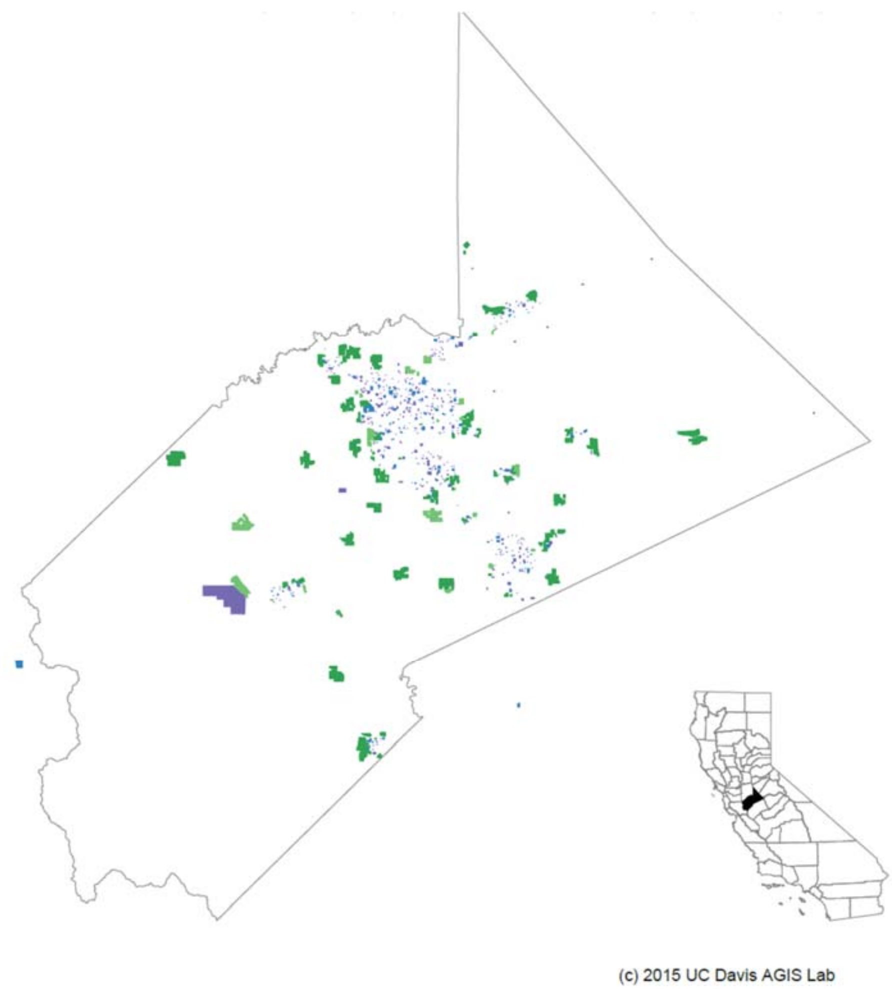



Figure 9. All schoolsites and PAPAC fields within 1/4 mile: Stanislaus County

Schoolsites may be sufficiently close to each other for some PAPAC fields to be within ¼ mile of more than one schoolsite. Each schoolsite must be notified of an application, so notification costs are higher the more schoolsites are nearby. Although notification costs increase with each schoolsite, PAPAC buffer acreage may not increase very much if two schoolsites are near each other or are co-located. Figure 10 reports the share of PAPAC fields depending on which type of schoolsite is located within a ¼ mile: only schools, only licensed child daycare facilities, or both. Two-thirds of PAPAC fields are located near schools (204), 13 percent (40) are within ¼ mile of only licensed child daycare facilities, and the remaining 29 are located near schoolsites of both types.

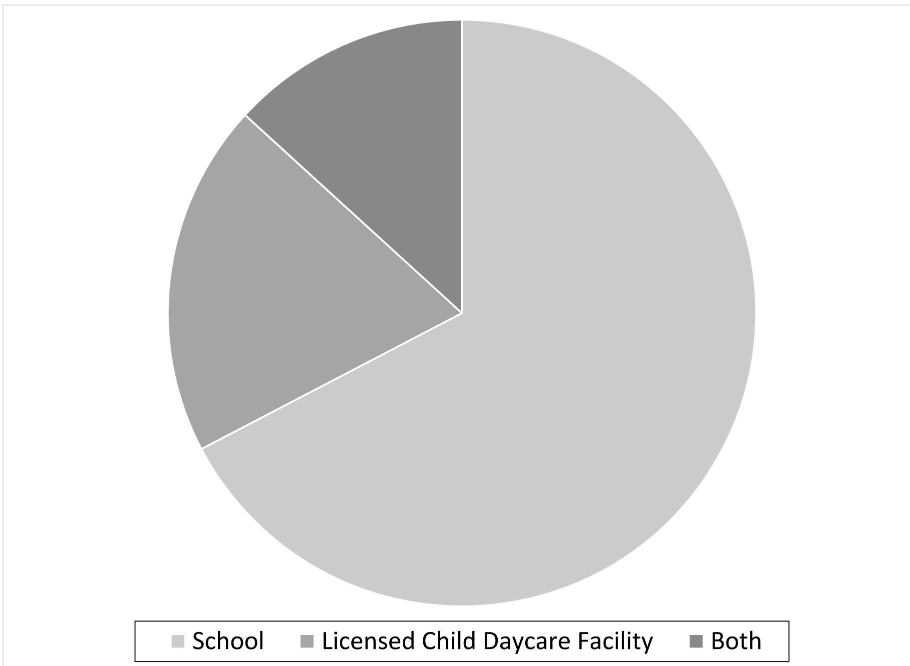



Figure 10. Percent of PAPAC fields by type of schoolsite within ¼ mile: Stanislaus County (N=303)

Impacts on growers. Table 44 reports the values of relevant variables and their per-grower value. In total, 208 growers would have been affected by the draft regulation. The total number of PAPAC fields was 303, yielding an average of 1.5 per grower. Comparing the two classes of schoolsites, the total number of growers affected by the draft regulation due to operating PAPAC fields located near schools was noticeably higher than those located near licensed child care facilities: 175 vs. 73. (Recall that some m,429ay be near both schools and licensed child daycare facilities. These are reported in the totals for both types of schoolsites.) The number of PAPAC fields near schools (244) was well over twice the number of PAPAC fields near licensed child daycare facilities (99). The average number of PAPAC fields per grower was identical for those near schools and those near licensed child daycare facilities (1.4).

Overall, an average of 20.9 acres per grower would have been PAPAC buffer acreage under the draft regulation, for a total of 4,348 acres. For growers operating PAPAC fields near schools, average PAPAC buffer acreage per grower was 19.3 acres. For growers with PAPAC fields near licensed child daycare facilities, the average PAPAC buffer acreage per grower was also 19.3 acres. The overall average per grower is higher than the averages for each schoolsite class added together because some growers operate PAPAC fields near schoolsites in both classes. This can be seen most easily by comparing the total number of growers affected. There were 208 growers affected by all schoolsites with 175 of these impacted by schools and 73 of these impacted by licensed child care facilities meaning that 40 growers are impacted by both daycare facilities and schools.

Unlike PAPAC fields and acreage, which can be double-counted if the field is proximate to schoolsites of both classes, notifications are provided on a per schoolsite basis, plus a notification to the CAC. The number of 48-hour notifications for all schoolsites, 580, includes all of the notifications to schools and licensed child daycare facilities and 200 notifications to the CAC.

Table 44. Total and per Grower Impacts: Stanislaus County

| | **All Schoolsites** | | **Schools** | | **Licensed Child Daycare Facilities** | |
|---|---|---|---|---|---|---|
| | Total | Per grower | Total | Per grower | Total | Per grower |
| Growers | 208 | --- | 175 | --- | 73 | --- |
| PAPAC fields | 303 | 1.5 | 244 | 1.4 | 99 | 1.4 |
| PAPAC buffer acres | 4,348 | 20.9 | 3,382 | 19.3 | 1.412 | 19.3 |
| 48-hour notifications* | 580 | 2.8 | 285 | 1.6 | 95 | 1.3 |

*Total includes 200 notifications to CAC

There is considerable heterogeneity in the potential economic effects of the draft regulation across growers, due to differences in the number of PAPAC fields, PAPAC buffer acreage, crops, and management systems. (As noted in the discussion of the results for Kern County, there are other considerations that are not addressed here.) Figure 11 summarizes the number of PAPAC fields per grower. Almost three-fourths of affected growers operated only one PAPAC field within ¼ mile of a schoolsite: 149/208. Another 39 (19 percent) operated two, and the remaining 20 (10 percent) operated between three and eight PAPAC fields.

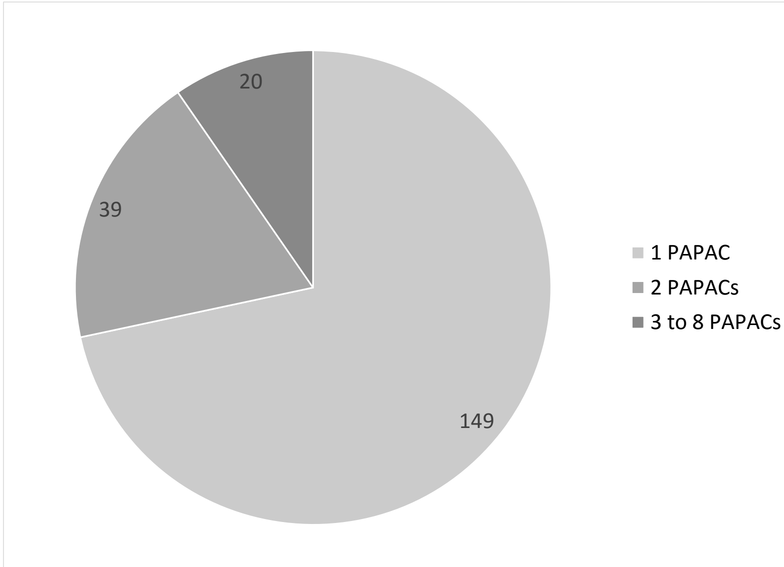



Figure 11. Number of PAPAC fields per grower: Stanislaus County, 208 growers

Impacts by PAPAC field. Table 45 reports total and average values per PAPAC field for PAPAC buffer acres, notifications, and prohibited applications. The number of PAPAC buffer acres is larger on a per PAPAC field basis for each schoolsite class than for all schoolsites due to the presence of multiple schoolsites near some fields. The average number of PAPAC buffer acres per PAPAC field for all schoolsites is 14.4, for schools is 13.9, and for daycare facilities is 14.3. As was the case in the table of impacts per grower, 48-hour notifications to the CAC are included in the all schoolsites column, so that average is noticeably larger than the ones by schoolsite class.

Table 45. Total and per PAPAC Field Impacts: Stanislaus County

| | **All Schoolsites** | | **Schools** | | **Licensed Child Daycare Facilities** | |
|---|---|---|---|---|---|---|
| | Total | Per PAPAC field | Total | Per PAPAC field | Total | Per PAPAC field |
| PAPAC fields | 303 | --- | 244 | --- | 99 | |
| PAPAC buffer acres | 4,348 | 14.4 | 3,382 | 13.9 | 1,412 | 14.3 |
| 48-hour notifications* | 580 | 1.9 | 285 | 1.2 | 95 | 1.0 |

*Total includes 200 notifications to CAC

The distribution of PAPAC buffer acreage by field is shown in Figure 12. In Stanislaus County, the majority of PAPAC fields have less than 20 PAPAC buffer acres (236 of 303, or 78 percent). There are a few significant outliers with large PAPAC buffer acreages: 155 acres, 102 acres, and 87 acres. Another fifteen have 41-60 buffer acres. 48 have 21-40 buffer acres. Figure 13 and Figure 14 plot

PAPAC buffer acres within ¼ mile of a K-12 public school and within ¼ mile of a licensed child daycare facility, respectively, by PAPAC field.

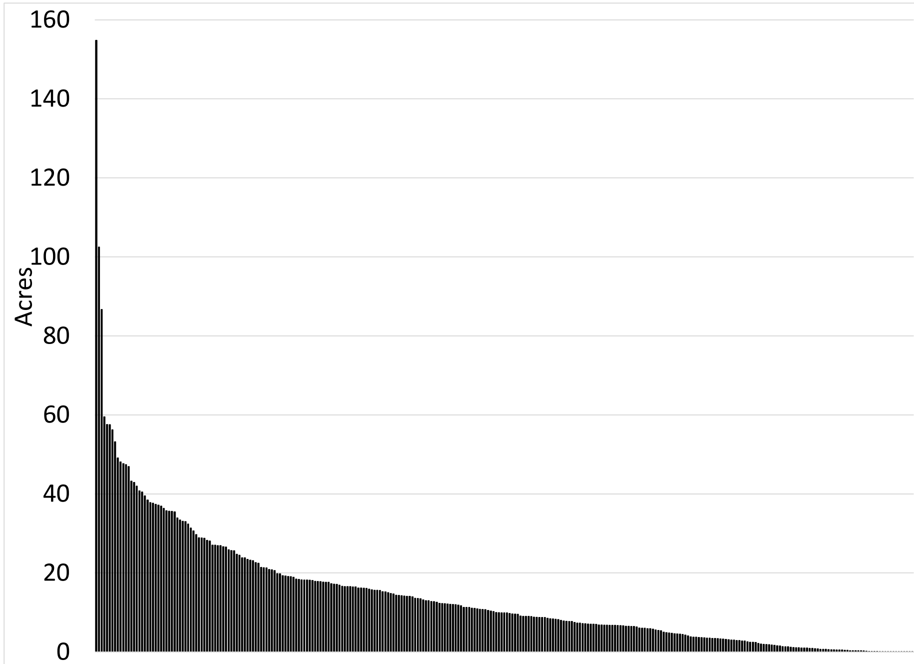



Figure 12. PAPAC buffer acres by PAPAC field: Stanislaus County (N=303)

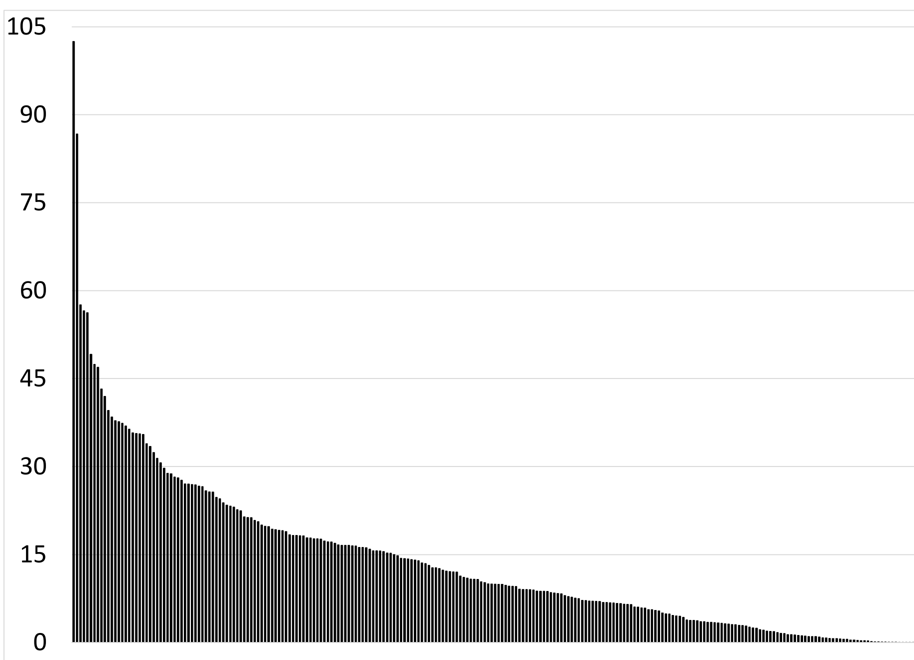



Figure 13. PAPAC buffer acres within 1/4 mile of K-12 public schools by PAPAC field: Stanislaus County (N=244)

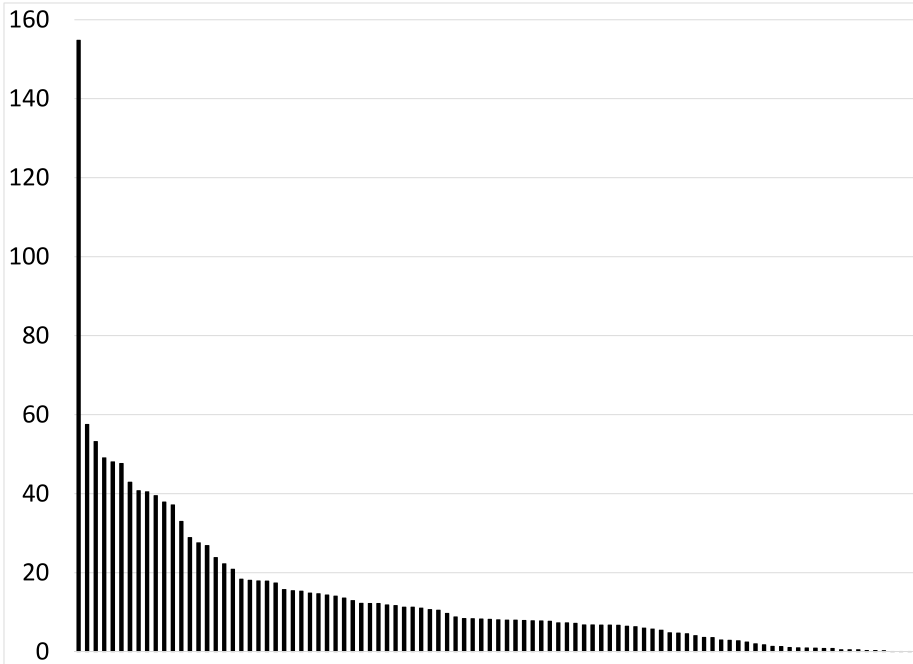


Figure 14. PAPAC buffer acres within 1/4 mile of licensed child daycare facility by PAPAC field: Stanislaus County (N= 99)

Impact by schoolsite. Another way of examining the impact of the proposed regulation is to consider the effects by schoolsite. It is important to keep in mind that if a PAPAC field is within ¼ mile of more than one schoolsite an application subject to any of the provisions of the draft regulation will be counted once per schoolsite. As noted earlier, Stanislaus County was chosen for a county-level analysis due to the large number of schoolsites near PAPAC fields. One way to disaggregate the effects of schoolsites is to consider the number of affected growers and PAPAC fields per schoolsite. Table 46 presents descriptive statistics regarding these ratios. (Importantly, an affected grower or PAPAC field may be within ¼ mile of more than one schoolsite.) On average, there are 3.03 affected growers per schoolsite. The median is 2. The average number of PAPAC fields per schoolsite is higher: 3.85. The median is also 2. The variability of the number of growers per schoolsites is lower than the number of PAPAC fields per schoolsites, as shown by the latter's larger standard deviation and coefficient of variation.

Table 46. Number of Affected Growers and PAPAC Fields per Schoolsite: Stanislaus County

| **Growers per schoolsite** | | **PAPAC fields per schoolsite** | |
|---|---|---|---|
| Mean | 3.03 | Mean | 3.85 |
| Median | 2 | Median | 2 |
| Minimum | 1 | Minimum | 1 |
| Maximum | 12 | Maximum | 17 |
| Standard deviation | 2.44 | Standard deviation | 3.29 |
| Coefficient of variation | 0.81 | Coefficient of variation | 0.86 |

A second way to disaggregate the effects of schoolsites is to consider the number of schoolsites per grower and per PAPAC field. Table 47 reports basic descriptive statistics for these ratios. On average, affected growers operate PAPAC fields within ¼ mile of 2.25 schoolsites. PAPAC fields are, on average, within ¼ mile of 1.97 schoolsites. The variability of the number of schoolsites per grower is larger than that for the number of schoolsites per PAPAC field, as shown by the larger standard deviation and coefficient of variation.

Table 47. Number of Schoolsites per Affected Grower and PAPAC Field: Stanislaus County

| **Schoolsites per grower** | | **Schoolsites per PAPAC Field** | |
|---|---|---|---|
| Mean | 2.25 | Mean | 1.97 |
| Median | 2 | Median | 2 |
| Minimum | 1 | Minimum | 1 |
| Maximum | 13 | Maximum | 10 |
| Standard deviation | 1.75 | Standard deviation | 1.34 |
| Coefficient of variation | 0.78 | Coefficient of variation | 0.68 |

Crop-level effects. 27 different crops were reported in the PURs for PAPAC fields (Table 48). *Of* these, 14 are perennial crops including alfalfa, almond, apple, apricot, cherry, grape, grape (wine), nectarines, olive, peach, plum, pluot, pomegranate, and walnut. (It should be noted that four of these, apple, olive, plum and pluot, are minor crops and each have less than a half an acre impacted). The perennial crops combined represent 80 percent of PAPAC buffer acreage. The crops with the greatest PAPAC buffer acreage near schoolsites are perennial crops with almond at 2,128 acres and walnut at 505 acres. However, this is only 1.3 percent of the county almond acreage and 1.4 percent of the walnut acreage. For crops with smaller total acreage, the percent of acreage in PAPAC buffers tends to be higher. The highest percentage is cherry with 7.3 percent of the 3,496 harvested acres in PAPAC buffers. As noted previously, it is highly doubtful that a short run response to the draft regulation by growers would be to change a perennial crop to another crop given the high investment in establishment.

Table 48. PAPAC Buffer Acreage and Value of Production by Crop: Stanislaus County

| Crop | PAPAC Buffer Acreage | Total Harvested Acreage (2014) | Value of Production/ Acre (2014) | PAPAC Buffer Acres x Value of Production/Acre | Percent of Acreage and Value of Production Impacted |
|---|---|---|---|---|---|
| Alfalfa | 339 | 29,197 | 1,872 | 633,608 | 1 |
| Almond | 2,128 | 164,314 | 8,551 | 18,196,528 | 1 |
| Apple | <0.5 | 631 | 14,155 | 650 | <1 |
| Apricot | 2 | 4,701 | 649 | 1,298 | <1 |
| Bean, Dried | 101 | 10,216 | 1,943 | 196,243 | 1 |
| Cantaloupe | 29 | 2,132 | 8,371 | 242,759 | 1 |
| Cherry | 256 | 3,496 | 4,441 | 1,136,896 | 7 |
| Corn -Feed | 434 | 90,890 | 1,751 | 759,934 | <1 |
| Grape | <0.5 | N/A | N/A | N/A | N/A |
| Grape, Wine | 163 | 12,372 | 4,257 | 693,891 | 1 |
| Nectarine | 7 | N/A | N/A | N/A | N/A |
| N-Outdr Plants In Containers | 31 | 1,124 | 83,914 | 2,601,334 | 3 |
| Oat -Feed | 67 | 30,011 | 902 | 60,434 | <1 |
| Olive | <0.5 | N/A | N/A | N/A | N/A |
| Peach | 191 | 6,698 | 8,749 | 1,671,059 | 3 |
| Pepper, Fruiting | <0.5 | N/A | N/A | N/A | N/A |
| Plum | <0.5 | N/A | N/A | N/A | N/A |
| Pluot | <0.5 | N/A | N/A | N/A | N/A |
| Pomegranate | 7 | N/A | N/A | N/A | N/A |
| Rice | 36 | 903 | 1,896 | 68,256 | 4 |
| Strawberry | 16 | N/A | N/A | N/A | N/A |
| Sweet Potato | 18 | 1,267 | 12,076 | 217,368 | 1 |
| Tomato, Proc. | 51 | 13,092 | 4,007 | 204,357 | <1 |
| Triticale | 29 | N/A | N/A | N/A | N/A |
| Walnut | 505 | 35,580 | 8,406 | 4,245,030 | 1 |
| Watermelon | 42 | N/A | N/A | N/A | N/A |
| Wheat | 30 | 2,898 | 1,586 | 47,580 | 1 |

N/A denotes not available

Source: Stanislaus County 2015

The highest absolute impact on an annual crop is field corn with 434 PAPAC buffer acres representing 0.5 percent of the 90,890 harvested acres in 2014. On a percentage basis rice sustains the largest impact: 4 percent of 903 acres. For many of the crops impacted, the total harvested acreage was not reported in the Stanislaus County Agricultural Commissioner's annual Crop Report and the percentage of PAPAC buffer acres could not be calculated.

## Notification Costs

Table 49 reports notification costs for Stanislaus County in total, per grower, and per PAPAC field. Total estimated annual notification costs are $202,250, or $973 per affected grower. The majority of these costs is accounted for by the preparation of the annual notification of pesticides which could be applied in the following July 1 to June 30 period: $187,957. The average annual cost per PAPAC field would be $668.

Table 49. Estimated Notification Costs: Stanislaus County

| **Activity** | **Total annual cost** | **Cost/grower** | **Cost/PAPAC field** |
|---|---:|---:|---:|
| Preparation of annual notifications | $187,957 | $904 | $620 |
| Delivery of annual notifications | $2,322 | $11 | $8 |
| Understanding requirements | $5,377 | $26 | $18 |
| 48-hr notifications | $6,595 | $32 | $22 |
| Total | $202,250 | $973 | $668 |

## Indirect Effects on Economic Activity

Based on the notification costs, the total reduction in economic activity in Stanislaus County would be $404,500.

# References

[CDOC 2014] California Department of Conservation. 2014. "2014 Well Count and Production of Oil, Gas and Water by County." ftp://ftp.consrv.ca.gov/pub/oil/annual_reports/2014/2014%20County%20Production.pdf Accessed December 18, 2015.

[CDOF 2015] California Department of Finance. 2015. "E-1 Population Estimates for Cities, Counties and the State - January 1, 2014 and 2015". http://www.dof.ca.gov/research/demographic/reports/estimates/e-1/view.php Accessed December 18, 2015.

California Department of Food and Agriculture (2015a). California Agricultural Statistics Review 2014-2015. https://www.cdfa.ca.gov/Statistics/PDFs/2015Report.pdf.

[CDFA 2015] California Department of Food and Agriculture. 2015. *California County Agricultural Commissioners' Reports Crop Year 2012-2013*. http://www.nass.usda.gov/Statistics_by_State/California/Publications/AgComm/2013cropyearcactb00.pdf Accessed November 17, 2015.

[CDPR 2015b] California Department of Pesticide Regulation. "California Restricted Materials." July. http://www.cdpr.ca.gov/docs/enforce/dpr-enf-013a.pdf Accessed December 3, 2015.

[CDPR 2015a] California Department of Pesticide Regulation. "Concepts to Address Pesticide Use near Schools." May 20. http://www.cdpr.ca.gov/docs/legbills/pesticide_concepts.pdf Accessed November 24, 2015.

[CDPR 2005] California Department of Pesticide Regulation. "The Healthy Schools Act: Frequently Asked Questions." May. http://www.cdpr.ca.gov/docs/county/cacltrs/pmlltrs/pml2005/2005atch/attach1004.pdf Accessed December 8, 2015.

[CDPR 2000] California Department of Pesticide Regulation. "Pesticide Use Reporting: An Overview of California's Unique Full Reporting System." May. http://www.cdpr.ca.gov/docs/pur/purovrvw/ovr52000.pdf Accessed December 1, 2015.

[CDPR 2012] California Department of Pesticide Regulation. "Phase II Fumigation Labeling (2012): Buffer Zones. Presentation materials, Jim Walsh, DPR Enforcement Branch. http://www.cdpr.ca.gov/docs/county/training/buff_zones_phs_2.pdf Accessed December 9, 2015.

[CDPR 2013] California Department of Pesticide Regulation. "Soil Fumigant 2012 Labeling and Permit Conditions---Questions and Answers." ENF 13-09. May 21. http://www.cdpr.ca.gov/docs/county/cacltrs/penfltrs/penf2013/2013009.htm Accessed December 8, 2015.

[CDPR 2008] California Department of Pesticide Regulation. 2008. "What You Need to Know about the Permit Process for Restricted Pesticides." February. http://www.cdpr.ca.gov/docs/dept/factshts/permitting.pdf Accessed December 1, 2015.

[CEDD 2015] California Employment Development Department. 2015. "Industry Employment Data in Stanislaus County, Annual Average 1990-2014." http://www.labormarketinfo.edd.ca.gov/county/stanis.html Accessed December 18, 2015.

Duncan, R. A., Holtz, B. A., Doll, D. A., Klonsky, K., Sumner, D. A., Gutierrez, C. A., and Stewart, D. (2016). "Sample Costs to Establish an Orchard and Produce Almond, San Joaquin Valley North." University of California, Cooperative Extension. Department of Agricultural and Resource Economics, University of California, Davis. Retrieved June 1, 2016 from http://coststudies.ucdavis.edu/current/

Ingels, C. A., Klonsky, K. M., De Moura, R. L. (2013). "Sample Costs to Establish a Vineyard and Produce Wine Grape, Chardonnay Variety, Sacramento Valley." University of California, Cooperative Extension. Department of Agricultural and Resource Economics, University of California, Davis. Retrieved June 01, 2016 from http://coststudies.ucdavis.edu/current/

[Kern County 2015] Kern County Department of Agriculture and Measurement Standards. 2015. *2014 Kern County Agricultural Crop Report*. http://www.kernag.com/caap/crop-reports/crop10_19/crop2014.pdf Accessed November 10, 2015.

Kern County Agricultural Commissioner. 2015. "Kern County-General Permit Conditions." http://www.kernag.com/ep/forms/kern-general-permit-conditions.pdf Accessed November 24, 2015.

[KEDC 2014] Kern Economic Development Corporation. 2014. *2014 Kern County Economic Forecast*. http://kedc.com/wp-content/uploads/2013/12/2014-Kern-County-Economic-Forecast.pdf Accessed December 19, 2015.

[NASS 2012a] National Agricultural Statistics Service, U.S. Department of Agriculture. 2012. "County Profile: Kern County, California." Census of Agriculture. http://www.agcensus.usda.gov/Publications/2012/Online_Resources/County_Profiles/California/cp06029.pdf Accessed December 18, 2015.

[NASS 2012b] National Agricultural Statistics Service, U.S. Department of Agriculture. 2012 “County Profile Stanislaus County, California.” Census of Agriculture. http://www.agcensus.usda.gov/Publications/2012/Online_Resources/County_Profiles/California/cp06099.pdf Accessed December 18, 2015.

[NASS 2015] National Agricultural Statistics Service, USDA. 2015. 2015 California Almond Forecast. Retrieved May 26, 2016, from https://www.nass.usda.gov/statistics_by_state/California/publications/Fruit_and_Nuts/201505almpd.pdf

[NWS 1998] National Weather Service. 1998. The California Winter of 1997 -98, March 3. http://www.wrcc.dri.edu/enso/femacal9803.html.

Pope, K. S., Lightle, D. M., Buchner, R.P., Niederholzer, F., Klonsky, K., Sumner, D. A., Stewart, D., and Gutierrez, C. A. (2016). "Sample Costs to Establish an Orchard and Produce Almond, Sacramento Valley." University of California, Cooperative Extension. Department of Agricultural and Resource Economics, University of California, Davis. Retrieved June 01, 2016 from http://coststudies.ucdavis.edu/current/

[UC IPM] University of California Integrated Pest Management Program. Pest Management Guidelines for Grape Powdery Mildew. http://www.ipm.ucdavis.edu/PMG/r302100311.html. Accessed June 18, 2016.

[Stanislaus County 2014] Stanislaus County Agricultural Commissioner. “B. General Permit Conditions.”

[Stanislaus County 2015] Stanislaus County Office of Agricultural Commissioner and Sealer of Weights and Measures. *2015. Stanislaus County Agricultural Crop Report: 2014*. Modesto, CA. http://www.stanag.org/pdf/cropreport/cropreport2014.pdf Accessed December 10, 2015.

[USDA-NRCS 2007] U.S. Department of Agriculture, Natural Resources Conservation Service. 2007. National Engineering Handbook. Part 630, chapter 7: Hydrologic Soil Groups. Washington, D.C.

U.S. Department of Labor. 2015. “Economic News Release: Table 1. Civilian Workers, by Major Occupational and Industry Group.” http://www.bls.gov/news.release/ecec.t01.htm Accessed November 24, 2015.

U.S. Department of Labor. 2014. “May 2014 National Industry-Specific Occupational Employment and Wage Estimates: NAICS 115100 - Support Activities for Crop Production.” http://www.bls.gov/oes/current/naics4_115100.htm#11-0000 Accessed November 24, 2015.

U.S. Environmental Protection Agency. 2013. "Supporting Statement for an Information Collection Request: Soil Fumigant Risk Mitigation, OMB Control No. 2070-NEW, EPA No. 2451.01. March 25. http://www.reginfo.gov/public/do/DownloadDocument?objectID=42205000 Accessed December 1, 2015.

Vasquez, S. J., Fidelibus, M. W., Christensen, L. P., Peacock, W. L., Klonsky, K. M., De Moura, R. L. (2006). "Sample Costs to Produce Grape for Raisins, Continuous Tray – Harvest Equipment Purchased New, San Joaquin Valley." University of California, Cooperative Extension. Department of Agricultural and Resource Economics, University of California, Davis. Retrieved June 01, 2016 from http://coststudies.ucdavis.edu/archived/

Vasquez, S. J., Hashim-Buckey, J. M., Peacock, W. L., Klonsky, K. M., De Moura, R. L. (2007). "Sample Costs to Establish a Vineyard and Produce Table Grape, Thompson Seedless, San Joaquin Valley South." University of California, Cooperative Extension. Department of Agricultural and Resource Economics, University of California, Davis. Retrieved June 01, 2016 from http://coststudies.ucdavis.edu/archived/

Verdegaal, P. S., Klonsky, K. M., De Moura, R. L. (2012). "Sample Costs to Establish a Vineyard and Produce Wine Grape, Cabernet Sauvignon Variety, San Joaquin Valley North." University of California, Cooperative Extension. Department of Agricultural and Resource Economics, University of California, Davis. Retrieved June 01, 2016 from http://coststudies.ucdavis.edu/current/

# Appendix One. Yield Losses, Revenue per Acre and Estimated Revenue Losses per Acre for Cherry, Peach, Nectarine and Walnut When Zero Fungicide Sprays Can Be Completed

The tables below present estimated yield losses if zero sprays could be completed under the draft regulation. The base for the percentage loss is the yield if all sprays could be completed under current restrictions. Estimated yield losses vary by region, as shown in the table. For cherry/peach/nectarine yield losses are estimated for zero fungicide applications during bloom. For walnut, yield losses are estimated for zero fungicide applications during the critical spring period, usually the month of March. Note the wide range of yield loss estimates for a given crop in a given region. This is particularly important because the estimates are based on an inability to treat for a single season. Over time, if control is skipped in one season, then the disease inoculum will increase, making control in future years more difficult.

Table 50. Yield Loss Estimates If No Spring/Bloom Fungicide Sprays Could Be Completed

| Crop | Southern San Joaquin Valley[a] | Northern San Joaquin Valley and Southern Sacramento Valley[b] | Northern Sacramento Valley[c] |
|---|---|---|---|
| Cherry, Peach, Nectarine | 0% to 25% | 0% to 40% | 40% to 80% |
| Walnut | 5% to 20% | 10% to 30% | 30% to 70% |

Source: UC and USDA Personnel

[a] Southern San Joaquin Valley: Fresno, Kern, Kings, Madera and Tulare counties

[b] Northern San Joaquin Valley and Southern Sacramento Valley: Merced, Sacramento, San Joaquin, Solano and Yolo counties

[c] Northern Sacramento Valley: Butte, Colusa, Glenn, Sutter, Tehama, and Yuba counties

Table 51 summarizes the major diseases responsible for the estimated yield losses. Apart from yield losses observed in the orchard or vineyard, another consideration is that if brown rot is not controlled in cherries, peaches and nectarines by spraying during bloom, it can result in total product loss post-harvest.

Table 51. Major Diseases Responsible for Estimated Yield Loss

| Crop | Diseases |
|---|---|
| Peach/Nectarine | Brown rot, twig blight, jacket rot, peach leaf curl |
| Cherry | Botrytis, brown rot, twig blight, |
| Walnut | Walnut blight |

Source: UC and USDA Personnel

Revenue losses for cherry can be computed for only a few counties due to the lack of information on county-specific acreage and revenues (Table 52). Although most counties in the southern San Joaquin Valley have higher revenues per acre, the maximum revenue losses per acre are mostly comparable to those in the northern San Joaquin and southern Sacramento Valleys, which has a higher maximum estimated yield loss. Although the northern Sacramento Valley has the highest maximum estimated yield loss, no data on acreage and revenues were available for these counties and the region is omitted from the table.

Table 52. Revenues and Estimated Revenue Losses per Acre by County: Cherry

| **County** | **Revenues per acre** | **Revenue losses/acre (range)** | | |
|---|---|---|---|---|
| Southern San Joaquin Valley | | | | |
| Fresno | $ 5,532 | $ 1,383 | to | $0 |
| Kern | $ 5,679 | $ 1,420 | to | $0 |
| Kings | $ 8,806 | $ 2,201 | to | $0 |
| Madera | $ 2,940 | $ 735 | to | $0 |
| Tulare | $ 4,142 | $ 1,036 | to | $0 |
| Northern San Joaquin/southern Sacramento Valleys | | | | |
| Merced | N/A | N/A | | N/A |
| Sacramento | $ 3,394 | $ 1,358 | to | $0 |
| San Joaquin | $ 4,194 | $ 1,678 | to | $0 |
| Solano | N/A | N/A | | N/A |
| Stanislaus | $ 4,436 | $ 1,774 | to | $0 |
| Yolo | N/A | N/A | | N/A |

Source: CDFA 2015 and authors' calculations

Table 53 reports revenues and estimated revenue losses for peach. Although generally revenues are highest in the southern San Joaquin Valley, maximum estimated revenue losses are roughly comparable for counties there and in the northern San Joaquin and southern Sacramento Valleys. Losses are largest in the northern Sacramento Valley.

Table 53. Revenues and Estimated Revenue Losses per Acre by County: Peach

| County | Revenues per acre | Revenue losses/acre (range) | | |
|---|---|---|---|---|
| Southern San Joaquin Valley | | | | |
| Fresno | $ 13,084 | $ 3,271 | to | $0 |
| Kern | N/A | N/A | N/A | |
| Kings | $ 11,243 | $ 2,811 | to | $0 |
| Madera | $ 8,048 | $ 2,012 | to | $0 |
| Tulare | $ 14,116 | $ 3,529 | to | $0 |
| Northern San Joaquin/southern Sacramento Valleys | | | | |
| Merced | $ 7,598 | $ 3,039 | to | $0 |
| Sacramento | N/A | N/A | N/A | |
| San Joaquin | $ 7,186 | $ 2,874 | to | $0 |
| Solano | N/A | N/A | N/A | |
| Stanislaus | $ 8,746 | $ 3,499 | to | $0 |
| Yolo | N/A | N/A | N/A | |
| Northern Sacramento Valley | | | | |
| Butte | $ 7,733 | $ 6,186 | to | $ 3,093 |
| Colusa | N/A | N/A | | N/A |
| Glenn | N/A | N/A | | N/A |
| Sutter | $ 8,233 | $ 6,586 | to | $ 3,293 |
| Tehama | N/A | N/A | | N/A |
| Yuba | $ 6,806 | $ 5,445 | to | $ 2,722 |

Source: CDFA 2015 and authors' calculations

Table 54 reports revenues and estimated revenue losses per acre for nectarines in southern San Joaquin Valley counties. No data on acreage and revenues were available for counties in the other regions, which are omitted from the table.

Table 54. Revenues and Estimated Revenue Losses per Acre by County: Nectarine

| County | Revenues per acre | Revenue losses/acre (range) | | |
|---|---|---|---|---|
| Southern San Joaquin Valley | | | | |
| Fresno | $ 11,651 | $ 2,913 | to | $0 |
| Kern | $ 12,708 | $ 3,177 | to | $0 |
| Kings | $ 12,767 | $ 3,192 | to | $0 |
| Madera | N/A | N/A | N/A | |
| Tulare | $ 15,653 | $ 3,913 | to | $0 |

Table 55 reports revenues and estimated revenue losses per acre for walnut. The southern San Joaquin Valley has the largest range of estimated revenue losses.

Table 55. Revenues and Estimated Revenue Losses per Acre by County: Walnut

| **County** | **Revenues per acre** | **Revenue losses/acre (range)** | | |
|---|---|---|---|---|
| Southern San Joaquin Valley | | | | |
| Fresno | $ 4,681 | $ 3,276 | to | $ 234 |
| Kern | $ 4,992 | $ 3,495 | to | $ 250 |
| Kings | $ 6,533 | $ 4,573 | to | $ 327 |
| Madera | $ 5,790 | $ 4,053 | to | $ 290 |
| Tulare | $ 6,562 | $ 4,593 | to | $ 328 |
| Northern San Joaquin/southern Sacramento Valleys | | | | |
| Merced | $ 5,119 | $ 1,536 | to | $ 512 |
| Sacramento | $ 9,306 | $ 2,792 | to | $ 931 |
| San Joaquin | $ 8,000 | $ 2,400 | to | $ 800 |
| Solano | $ 4,832 | $ 1,450 | to | $ 483 |
| Stanislaus | $ 8,401 | $ 2,520 | to | $ 840 |
| Yolo | $ 4,993 | $ 1,498 | to | $ 499 |
| Northern Sacramento Valley | | | | |
| Butte | $ 5,249 | $ 3,674 | to | $ 1,575 |
| Colusa | $ 6,108 | $ 4,275 | to | $ 1,832 |
| Glenn | $ 6,809 | $ 4,766 | to | $ 2,043 |
| Sutter | $ 6,408 | $ 4,485 | to | $ 1,922 |
| Tehama | $ 6,885 | $ 4,820 | to | $ 2,066 |
| Yuba | $ 6,676 | $ 4,673 | to | $ 2,003 |

Source: CDFA 2015 and authors' calculations

# Appendix Two. Weather Analysis for Almond and Grape

This appendix contains detailed information regarding the weather-based analysis for almond and grape.

## Possible Number of Sprays by Soil Hydrologic Group, Regulation Status, and County: Almond, 1996-2005

Table 56. Possible Number of Sprays by Soil Hydrologic Group and Regulation Status: Almond, Fresno and Madera Counties, 1996-2005

| | With Regulation | | | | Without Regulation | | | | Difference | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Soil type** | **A** | **B** | **C** | **D** | **A** | **B** | **C** | **D** | **A** | **B** | **C** | **D** |
| **1996** | 2 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 0 | 0 | 0 | 0 |
| **1997** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 0 |
| **1998** | 2 | 2 | 1 | 1 | 3 | 3 | 3 | 3 | -1 | -1 | -2 | -2 |
| **1999** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 0 |
| **2000** | 3 | 3 | 1 | 1 | 3 | 3 | 2 | 1 | 0 | 0 | -1 | 0 |
| **2001** | 3 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 0 | 0 | 0 | 0 |
| **2002** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 0 |
| **2003** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 0 |
| **2004** | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | -1 |
| **2005** | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 0 | 0 | 0 | 0 |
| **Annual Average** | 2.7 | 2.5 | 2.2 | 2.1 | 2.8 | 2.6 | 2.5 | 2.4 | -0.1 | -0.1 | -0.3 | -0.3 |

Table 57. Possible Number of Sprays by Soil Hydrologic Group and Regulation Status: Almond, Kern County, 1996-2005

| | With Regulation | | | | Without Regulation | | | | Difference | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Soil type** | **A** | **B** | **C** | **D** | **A** | **B** | **C** | **D** | **A** | **B** | **C** | **D** |
| **1996** | 2 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 0 | 0 | 0 | 0 |
| **1997** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 0 |
| **1998** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 0 |
| **1999** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 0 |
| **2000** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 0 |
| **2001** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 0 |
| **2002** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 0 |
| **2003** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 0 |
| **2004** | 3 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 0 | 0 | 0 | 0 |
| **2005** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 0 |
| **Annual Average** | 2.9 | 2.7 | 2.7 | 2.7 | 2.9 | 2.7 | 2.7 | 2.7 | 0 | 0 | 0 | 0 |

Table 58. Possible Number of Sprays by Soil Hydrologic Group and Regulation Status: Almond, Kings County, 1996-2005

| | With Regulation | | | | Without Regulation | | | | Difference | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Soil type** | **A** | **B** | **C** | **D** | **A** | **B** | **C** | **D** | **A** | **B** | **C** | **D** |
| **1996** | 2 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | 0 | 0 | 0 | 0 |
| **1997** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 0 |
| **1998** | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | -1 | 0 | 0 | 0 |
| **1999** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 0 |
| **2000** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 0 |
| **2001** | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | -1 | -1 | -1 | -1 |
| **2002** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 0 |
| **2003** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 0 |
| **2004** | 3 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 0 | 0 | 0 | 0 |
| **2005** | 3 | 3 | 2 | 2 | 3 | 3 | 2 | 2 | 0 | 0 | 0 | 0 |
| **Annual Average** | 2.7 | 2.6 | 2.4 | 2.4 | 2.9 | 2.7 | 2.5 | 2.5 | -0.2 | -0.1 | -0.1 | -0.1 |

Table 59. Possible Number of Sprays by Soil Hydrologic Group and Regulation Status: Almond, San Joaquin and Sacramento Counties, 1996-2005

| | With Regulation | | | | Without Regulation | | | | Difference | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Soil type** | **A** | **B** | **C** | **D** | **A** | **B** | **C** | **D** | **A** | **B** | **C** | **D** |
| **1996** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 0 |
| **1997** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 0 |
| **1998** | 3 | 2 | 1 | 1 | 3 | 2 | 2 | 1 | 0 | 0 | -1 | 0 |
| **1999** | 3 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 0 | -1 | -1 | -1 |
| **2000** | 3 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 0 | 0 | 0 | 0 |
| **2001** | 3 | 3 | 2 | 2 | 3 | 3 | 2 | 2 | 0 | 0 | 0 | 0 |
| **2002** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 0 |
| **2003** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 0 |
| **2004** | 3 | 2 | 2 | 1 | 3 | 2 | 2 | 1 | 0 | 0 | 0 | 0 |
| **2005** | 3 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 0 | 0 | 0 | 0 |
| **Annual Average** | 3.0 | 2.5 | 2.3 | 2.2 | 3.0 | 2.6 | 2.5 | 2.3 | 0 | -0.1 | -0.2 | -0.1 |

Table 60. Possible Number of Sprays by Soil Hydrologic Group and Regulation Status: Almond, Stanislaus and Merced Counties, 1996-2005

| | With Regulation | | | | Without Regulation | | | | Difference | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Soil type** | **A** | **B** | **C** | **D** | **A** | **B** | **C** | **D** | **A** | **B** | **C** | **D** |
| **1996** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 0 |
| **1997** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 0 |
| **1998** | 2 | 1 | 1 | 1 | 3 | 2 | 2 | 1 | -1 | -1 | -1 | 0 |
| **1999** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 0 |
| **2000** | 3 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 0 | 0 | 0 | 0 |
| **2001** | 3 | 3 | 3 | 1 | 3 | 3 | 3 | 1 | 0 | 0 | 0 | 0 |
| **2002** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 0 |
| **2003** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 0 |
| **2004** | 3 | 3 | 2 | 2 | 3 | 3 | 2 | 2 | 0 | 0 | 0 | 0 |
| **2005** | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 0 | 0 | 0 | 0 |
| **Annual Average** | 2.8 | 2.6 | 2.5 | 2.3 | 2.9 | 2.7 | 2.6 | 2.3 | -0.1 | -0.1 | -0.1 | 0 |

Table 61. Possible Number of Sprays by Soil Hydrologic Group and Regulation Status: Almond, Yolo (Colusa) County, 1996-2005

| | With Regulation | | | | Without Regulation | | | | Difference | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Soil type** | **A** | **B** | **C** | **D** | **A** | **B** | **C** | **D** | **A** | **B** | **C** | **D** |
| **1996** | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 0 | 0 | 0 | 0 |
| **1997** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 0 |
| **1998** | 3 | 1 | 1 | 1 | 3 | 1 | 1 | 1 | 0 | 0 | 0 | 0 |
| **1999** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 0 |
| **2000** | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | -1 |
| **2001** | 2 | 2 | 0 | 0 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 |
| **2002** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 0 |
| **2003** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 0 |
| **2004** | 3 | 1 | 1 | 1 | 3 | 1 | 1 | 1 | 0 | 0 | 0 | 0 |
| **2005** | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | -1 | -1 | -1 | -1 |
| **Annual Average** | 2.7 | 2.3 | 2.1 | 1.9 | 2.8 | 2.4 | 2.2 | 2.1 | -0.1 | -0.1 | -0.1 | -0.2 |

NOTE: Weather data for Yolo County are from Colusa County.

## Grape Weather Analysis: Powdery Mildew Control Sprays

This section of the appendix includes the detailed results of the weather spray program analysis. The first set of table reports the number of weeks in which a powdery mildew control spray could not be completed by season. The second set of tables reports whether or not a powdery mildew spray could be completed in each week of each season.

## Number of weeks in which powdery mildew control spray could not be completed

Table 62. Number of Weeks in which Powdery Mildew Control Spray Could Not Be Completed by Soil Hydrologic Group and Regulation Status: Fresno and Madera Counties, 1996-2005

| | With Regulation | | | | Without Regulation | | | | Difference | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Soil type | A | B | C | D | A | B | C | D | A | B | C | D |
| 1996 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1997 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1998 | 0 | 1 | 2 | 2 | 0 | 1 | 2 | 2 | 0 | 0 | 0 | 0 |
| 1999 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2001 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2002 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2003 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2004 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2005 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | -1 |

Table 63. Number of Weeks in which Powdery Mildew Control Spray Could Not Be Completed by Soil Hydrologic Group and Regulation Status: Kern County, 1996-2005

| | With Regulation | | | | Without Regulation | | | | Difference | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Soil type | A | B | C | D | A | B | C | D | A | B | C | D |
| 1996 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1997 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1998 | 1 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 0 | 0 | 0 | 0 |
| 1999 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2001 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2002 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2003 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2004 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2005 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Table 64. Number of Weeks in which Powdery Mildew Control Spray Could Not Be Completed by Soil Hydrologic Group and Regulation Status: San Joaquin and Sacramento Counties, 1996-2005

| | With Regulation | | | | Without Regulation | | | | Difference | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Soil type** | **A** | **B** | **C** | **D** | **A** | **B** | **C** | **D** | **A** | **B** | **C** | **D** |
| 1996 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | -1 | 0 |
| 1997 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1998 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 |
| 1999 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2001 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2002 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2003 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2004 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2005 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Table 65. Number of Weeks in which Powdery Mildew Control Spray Could Not Be Completed by Soil Hydrologic Group and Regulation Status: Stanislaus and Merced Counties, 1996-2005

| | With Regulation | | | | Without Regulation | | | | Difference | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Soil type** | **A** | **B** | **C** | **D** | **A** | **B** | **C** | **D** | **A** | **B** | **C** | **D** |
| 1996 | 1 | 2 | 2 | 2 | 0 | 2 | 2 | 2 | -1 | 0 | 0 | 0 |
| 1997 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1998 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1999 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2001 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2002 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2003 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2004 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2005 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Table 66. Number of Weeks in which Powdery Mildew Control Spray Could Not Be Completed by Soil Hydrologic Group and Regulation Status: Yolo (Colusa) County, 1996-2005

| | With Regulation | | | | Without Regulation | | | | Difference | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Soil type** | **A** | **B** | **C** | **D** | **A** | **B** | **C** | **D** | **A** | **B** | **C** | **D** |
| 1996 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | -1 | 0 | 0 |
| 1997 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1998 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 |
| 1999 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2001 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2002 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2003 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2004 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2005 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 |

NOTE: Weather data for Yolo County are from Colusa County.

### Powdery mildew cumulative risk index and opportunity to complete at least one spray per 7-day interval by week, soil hydrologic group and regulation status, by county

Tables in this subsection denote a week in which a spray could be completed by a 1.

Table 67. Powdery Mildew Cumulative Risk Index and Opportunity to Complete at Least One Spray per 7-Day Interval by Soil Type and Regulation Status: Grape, Fresno and Madera Counties, 1996-2005

| | 7-Day Spray Interval | With Regulation (Soil Type) | | | | Without Regulation (Soil Type) | | | | Difference (Soil Type) | | | | Average Cumulative Risk Index | Maximum Cumulative Risk Index |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Year** | | **A** | **B** | **C** | **D** | **A** | **B** | **C** | **D** | **A** | **B** | **C** | **D** | | |
| 1996 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 23 | 80 |
| 1996 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 39 | 70 |
| 1996 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 51 | 50 |
| 1996 | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 33 | 100 |
| 1996 | 5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 94 | 100 |
| 1996 | 6 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 100 | 100 |
| 1996 | 7 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 100 | 100 |
| 1996 | 8 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 100 | 100 |
| 1996 | 9 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 99 | 100 |
| 1997 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 86 | 100 |
| 1997 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 94 | 80 |

| Year | 7-Day Spray Interval | With Regulation (Soil Type) | | | | Without Regulation (Soil Type) | | | | Difference (Soil Type) | | | | Average Cumulative Risk Index | Maximum Cumulative Risk Index |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | A | B | C | D | A | B | C | D | A | B | C | D | | |
| 1997 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 61 | 60 |
| 1997 | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 26 | 100 |
| 1997 | 5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 97 | 100 |
| 1997 | 6 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 99 | 100 |
| 1997 | 7 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 100 | 100 |
| 1997 | 8 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 100 | 100 |
| 1997 | 9 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 100 | 100 |
| 1997 | 10 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 100 | 70 |
| 1998 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 40 | 0 |
| 1998 | 2 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1998 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 80 |
| 1998 | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 29 | 100 |
| 1998 | 5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 90 | 100 |
| 1998 | 6 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 94 | 80 |
| 1998 | 7 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 50 | 40 |
| 1998 | 8 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 10 | 80 |
| 1998 | 9 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 51 | 0 |
| 1999 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1999 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 100 |
| 1999 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 71 | 100 |
| 1999 | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 94 | 80 |
| 1999 | 5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 67 | 100 |
| 1999 | 6 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 93 | 100 |
| 1999 | 7 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 99 | 100 |
| 1999 | 8 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 100 | 100 |
| 2000 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 43 | 100 |
| 2000 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 96 | 100 |
| 2000 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 70 | 70 |
| 2000 | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 51 | 100 |
| 2000 | 5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 93 | 100 |
| 2000 | 6 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 100 | 100 |
| 2000 | 7 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 87 | 100 |
| 2000 | 8 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 91 | 100 |
| 2001 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 96 | 100 |
| 2001 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 40 | 70 |
| 2001 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 9 | 40 |
| 2001 | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 43 | 60 |
| 2001 | 5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 96 | 100 |
| 2001 | 6 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 99 | 100 |

| Year | 7-Day Spray Interval | With Regulation (Soil Type) A | B | C | D | Without Regulation (Soil Type) A | B | C | D | Difference (Soil Type) A | B | C | D | Average Cumulative Risk Index | Maximum Cumulative Risk Index |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2001 | 7 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 100 | 100 |
| 2001 | 8 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 100 | 100 |
| 2001 | 9 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 100 | 100 |
| 2002 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 43 | 100 |
| 2002 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 90 | 100 |
| 2002 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 96 | 100 |
| 2002 | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 77 | 100 |
| 2002 | 5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 79 | 100 |
| 2002 | 6 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 83 | 100 |
| 2002 | 7 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 99 | 100 |
| 2002 | 8 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 96 | 100 |
| 2002 | 9 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 100 | 100 |
| 2003 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 10 |
| 2003 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 29 | 60 |
| 2003 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 17 | 40 |
| 2003 | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 36 | 60 |
| 2003 | 5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2003 | 6 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2003 | 7 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2003 | 8 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 17 | 60 |
| 2003 | 9 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 87 | 100 |
| 2003 | 10 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 100 | 100 |
| 2004 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 100 | 100 |
| 2004 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 69 | 90 |
| 2004 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 50 | 70 |
| 2004 | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 81 | 100 |
| 2004 | 5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 54 | 80 |
| 2004 | 6 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 87 | 100 |
| 2004 | 7 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 100 | 100 |
| 2004 | 8 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 99 | 100 |
| 2004 | 9 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 100 | 100 |
| 2004 | 10 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 100 | 100 |
| 2005 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 9 | 30 |
| 2005 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2005 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 17 | 40 |
| 2005 | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 9 | 30 |
| 2005 | 5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 16 | 40 |
| 2005 | 6 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 40 | 60 |
| 2005 | 7 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 43 | 90 |

| Year | 7-Day Spray Interval | With Regulation (Soil Type) | | | | Without Regulation (Soil Type) | | | | Difference (Soil Type) | | | | Average Cumulative Risk Index | Maximum Cumulative Risk Index |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | A | B | C | D | A | B | C | D | A | B | C | D | | |
| 2005 | 8 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 83 | 100 |
| 2005 | 9 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | -1 | 90 | 100 |
| 2005 | 10 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 100 | 100 |

Table 68. Powdery Mildew Cumulative Risk Index and Opportunity to Complete at Least One Spray per 7-Day Interval by Soil Type and Regulation Status: Grape, Kern County, 1996-2005

| Year | 7-Day Spray Interval | With Regulation (Soil Type) | | | | Without Regulation (Soil Type) | | | | Difference (Soil Type) | | | | Average Cumulative Risk Index | Maximum Cumulative Risk Index |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | A | B | C | D | A | B | C | D | A | B | C | D | | |
| 1996 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 23 | 40 |
| 1996 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 39 | 80 |
| 1996 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 51 | 70 |
| 1996 | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 33 | 50 |
| 1996 | 5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 94 | 100 |
| 1996 | 6 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 100 | 100 |
| 1996 | 7 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 100 | 100 |
| 1996 | 8 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 99 | 100 |
| 1996 | 9 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 100 | 100 |
| 1997 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 97 | 100 |
| 1997 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 94 | 100 |
| 1997 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 61 | 80 |
| 1997 | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 43 | 90 |
| 1997 | 5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 100 | 100 |
| 1997 | 6 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 94 | 100 |
| 1997 | 7 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 99 | 100 |
| 1997 | 8 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 100 | 100 |
| 1997 | 9 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 100 | 100 |
| 1997 | 10 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 100 | 100 |
| 1998 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 60 | 90 |
| 1998 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 20 |
| 1998 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1998 | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 17 | 60 |
| 1998 | 5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 74 | 100 |
| 1998 | 6 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 91 | 100 |
| 1998 | 7 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 30 | 60 |
| 1998 | 8 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 3 | 20 |
| 1998 | 9 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 31 | 60 |
| 1999 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1999 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 3 | 20 |
| 1999 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 83 | 100 |
| 1999 | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 94 | 100 |
| 1999 | 5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 67 | 80 |
| 1999 | 6 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 93 | 100 |
| 1999 | 7 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 99 | 100 |
| 1999 | 8 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 100 | 100 |

| Year | 7-Day Spray Interval | With Regulation (Soil Type) A | B | C | D | Without Regulation (Soil Type) A | B | C | D | Difference (Soil Type) A | B | C | D | Average Cumulative Risk Index | Maximum Cumulative Risk Index |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2000 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 43 | 100 |
| 2000 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 99 | 100 |
| 2000 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 79 | 100 |
| 2000 | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 17 | 40 |
| 2000 | 5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 61 | 100 |
| 2000 | 6 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 100 | 100 |
| 2000 | 7 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 94 | 100 |
| 2000 | 8 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 97 | 100 |
| 2001 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 90 | 100 |
| 2001 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 40 | 70 |
| 2001 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 4 | 20 |
| 2001 | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 17 | 40 |
| 2001 | 5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 90 | 100 |
| 2001 | 6 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 99 | 100 |
| 2001 | 7 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 100 | 100 |
| 2001 | 8 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 99 | 100 |
| 2001 | 9 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 99 | 100 |
| 2002 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 57 | 100 |
| 2002 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 83 | 100 |
| 2002 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 94 | 100 |
| 2002 | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 66 | 100 |
| 2002 | 5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 79 | 100 |
| 2002 | 6 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 69 | 100 |
| 2002 | 7 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 100 | 100 |
| 2002 | 8 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 96 | 100 |
| 2002 | 9 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 94 | 100 |
| 2003 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 4 | 20 |
| 2003 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 43 | 100 |
| 2003 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 64 | 90 |
| 2003 | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 83 | 100 |
| 2003 | 5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 21 | 50 |
| 2003 | 6 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2003 | 7 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2003 | 8 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 17 | 60 |
| 2003 | 9 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 97 | 100 |
| 2003 | 10 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 100 | 100 |
| 2004 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 100 | 100 |
| 2004 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 73 | 90 |
| 2004 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 80 | 100 |

| Year | 7-Day Spray Interval | With Regulation (Soil Type) A | B | C | D | Without Regulation (Soil Type) A | B | C | D | Difference (Soil Type) A | B | C | D | Average Cumulative Risk Index | Maximum Cumulative Risk Index |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2004 | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 93 | 100 |
| 2004 | 5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 54 | 80 |
| 2004 | 6 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 69 | 100 |
| 2004 | 7 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 99 | 100 |
| 2004 | 8 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 99 | 100 |
| 2004 | 9 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 100 | 100 |
| 2004 | 10 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 100 | 100 |
| 2005 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2005 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 4 | 20 |
| 2005 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 34 | 60 |
| 2005 | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 29 | 50 |
| 2005 | 5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 17 | 40 |
| 2005 | 6 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 31 | 50 |
| 2005 | 7 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 70 | 100 |
| 2005 | 8 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 83 | 100 |
| 2005 | 9 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 90 | 100 |
| 2005 | 10 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 99 | 100 |

Table 69. Powdery Mildew Cumulative Risk Index and Opportunity to Complete at Least One Spray per 7-Day Interval by Soil Type and Regulation Status: Grape, San Joaquin and Sacramento Counties, 1996-2005

| Year | 7-Day Spray Interval | With Regulation (Soil Type) | | | | Without Regulation (Soil Type) | | | | Difference (Soil Type) | | | | Average Cumulative Risk Index | Maximum Cumulative Risk Index |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | A | B | C | D | A | B | C | D | A | B | C | D | | |
| 1996 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 4 | 20 |
| 1996 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 30 | 60 |
| 1996 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 13 | 30 |
| 1996 | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 3 | 20 |
| 1996 | 5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 83 | 100 |
| 1996 | 6 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 99 | 100 |
| 1996 | 7 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 97 | 100 |
| 1996 | 8 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | -1 | 0 | 60 | 90 |
| 1996 | 9 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 71 | 100 |
| 1997 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 83 | 100 |
| 1997 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 70 | 100 |
| 1997 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 26 | 50 |
| 1997 | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 9 | 40 |
| 1997 | 5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 89 | 100 |
| 1997 | 6 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 83 | 100 |
| 1997 | 7 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 96 | 100 |
| 1997 | 8 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 100 | 100 |
| 1997 | 9 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 100 | 100 |
| 1997 | 10 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 99 | 100 |
| 1998 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1998 | 2 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1998 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1998 | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 17 | 60 |
| 1998 | 5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 74 | 100 |
| 1998 | 6 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 79 | 100 |
| 1998 | 7 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 14 | 40 |
| 1998 | 8 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1998 | 9 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 4 | 20 |
| 1999 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 70 | 100 |
| 1999 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 89 | 100 |
| 1999 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 77 | 100 |
| 1999 | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 87 | 100 |
| 1999 | 5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 90 | 100 |
| 1999 | 6 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 96 | 100 |
| 2000 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 83 | 100 |
| 2000 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 70 | 100 |
| 2000 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 17 | 40 |

| Year | 7-Day Spray Interval | With Regulation (Soil Type) | | | | Without Regulation (Soil Type) | | | | Difference (Soil Type) | | | | Average Cumulative Risk Index | Maximum Cumulative Risk Index |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | A | B | C | D | A | B | C | D | A | B | C | D | | |
| 2000 | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 56 | 90 |
| 2000 | 5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 79 | 100 |
| 2000 | 6 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 14 | 40 |
| 2000 | 7 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 71 | 100 |
| 2000 | 8 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 100 | 100 |
| 2001 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 86 | 100 |
| 2001 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 30 | 60 |
| 2001 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 3 | 20 |
| 2001 | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 4 | 20 |
| 2001 | 5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 61 | 100 |
| 2001 | 6 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 100 | 100 |
| 2001 | 7 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 99 | 100 |
| 2001 | 8 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 100 | 100 |
| 2001 | 9 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 99 | 100 |
| 2002 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 41 | 70 |
| 2002 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 36 | 70 |
| 2002 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 30 | 60 |
| 2002 | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 16 | 40 |
| 2002 | 5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 53 | 100 |
| 2002 | 6 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 86 | 100 |
| 2002 | 7 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 87 | 100 |
| 2003 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 24 | 60 |
| 2003 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 17 | 40 |
| 2003 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 10 |
| 2003 | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2003 | 5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2003 | 6 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2003 | 7 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 17 | 60 |
| 2003 | 8 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 76 | 100 |
| 2003 | 9 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 100 | 100 |
| 2004 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 49 | 70 |
| 2004 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 39 | 60 |
| 2004 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 83 | 100 |
| 2004 | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 40 | 70 |
| 2004 | 5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 57 | 100 |
| 2004 | 6 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 100 | 100 |
| 2004 | 7 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 96 | 100 |
| 2004 | 8 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 99 | 100 |
| 2004 | 9 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 90 | 100 |
| 2005 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 4 | 20 |
| 2005 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 4 | 20 |

| Year | 7-Day Spray Interval | With Regulation (Soil Type) | | | | Without Regulation (Soil Type) | | | | Difference (Soil Type) | | | | Average Cumulative Risk Index | Maximum Cumulative Risk Index |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | A | B | C | D | A | B | C | D | A | B | C | D | | |
| 2005 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 4 | 20 |
| 2005 | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 41 | 60 |
| 2005 | 5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 36 | 70 |
| 2005 | 6 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 30 | 60 |
| 2005 | 7 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 67 | 100 |
| 2005 | 8 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 99 | 100 |
| 2005 | 9 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 99 | 100 |

Table 70. Powdery Mildew Cumulative Risk Index and Opportunity to Complete at Least One Spray per 7-Day Interval by Soil Type and Regulation Status: Grape, Stanislaus and Merced Counties, 1996-2005

| Year | 7-Day Spray Interval | With Regulation (Soil Type) | | | | Without Regulation (Soil Type) | | | | Difference (Soil Type) | | | | Average Cumulative Risk Index | Maximum Cumulative Risk Index |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | A | B | C | D | A | B | C | D | A | B | C | D | | |
| 1996 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1996 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 30 | 60 |
| 1996 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 13 | 30 |
| 1996 | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 9 | 40 |
| 1996 | 5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 91 | 100 |
| 1996 | 6 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 100 | 100 |
| 1996 | 7 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 99 | 100 |
| 1996 | 8 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 69 | 90 |
| 1996 | 9 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | -1 | 0 | 0 | 0 | 76 | 100 |
| 1997 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 53 | 100 |
| 1997 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 70 | 100 |
| 1997 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 26 | 50 |
| 1997 | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 9 | 40 |
| 1997 | 5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 90 | 100 |
| 1997 | 6 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 87 | 100 |
| 1997 | 7 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 99 | 100 |
| 1997 | 8 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 100 | 100 |
| 1997 | 9 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 100 | 100 |
| 1997 | 10 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 99 | 100 |
| 1998 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1998 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1998 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1998 | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 17 | 60 |
| 1998 | 5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 74 | 100 |
| 1998 | 6 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 86 | 100 |
| 1998 | 7 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 21 | 50 |
| 1998 | 8 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 4 | 20 |
| 1998 | 9 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 17 | 40 |
| 1999 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 70 | 100 |
| 1999 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 83 | 100 |
| 1999 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 69 | 90 |
| 1999 | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 87 | 100 |
| 1999 | 5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 90 | 100 |
| 1999 | 6 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 99 | 100 |
| 2000 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 64 | 90 |

| Year | 7-Day Spray Interval | With Regulation (Soil Type) | | | | Without Regulation (Soil Type) | | | | Difference (Soil Type) | | | | Average Cumulative Risk Index | Maximum Cumulative Risk Index |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | A | B | C | D | A | B | C | D | A | B | C | D | | |
| 2000 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 70 | 100 |
| 2000 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 17 | 40 |
| 2000 | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 56 | 90 |
| 2000 | 5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 79 | 100 |
| 2000 | 6 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 27 | 40 |
| 2000 | 7 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 57 | 100 |
| 2000 | 8 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 100 | 100 |
| 2001 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 74 | 100 |
| 2001 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 30 | 60 |
| 2001 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2001 | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 3 | 20 |
| 2001 | 5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 77 | 100 |
| 2001 | 6 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 100 | 100 |
| 2001 | 7 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 97 | 100 |
| 2001 | 8 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 100 | 100 |
| 2001 | 9 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 100 | 100 |
| 2002 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 67 | 100 |
| 2002 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 66 | 100 |
| 2002 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 60 | 90 |
| 2002 | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 33 | 80 |
| 2002 | 5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 99 | 100 |
| 2002 | 6 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 91 | 100 |
| 2002 | 7 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 91 | 100 |
| 2003 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 24 | 60 |
| 2003 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 17 | 40 |
| 2003 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 14 | 40 |
| 2003 | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2003 | 5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2003 | 6 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2003 | 7 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 17 | 60 |
| 2003 | 8 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 91 | 100 |
| 2003 | 9 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 99 | 100 |
| 2004 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 59 | 80 |
| 2004 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 27 | 40 |
| 2004 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 73 | 100 |
| 2004 | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 40 | 70 |
| 2004 | 5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 57 | 100 |
| 2004 | 6 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 100 | 100 |

| Year | 7-Day Spray Interval | With Regulation (Soil Type) | | | | Without Regulation (Soil Type) | | | | Difference (Soil Type) | | | | Average Cumulative Risk Index | Maximum Cumulative Risk Index |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | A | B | C | D | A | B | C | D | A | B | C | D | | |
| 2004 | 7 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 96 | 100 |
| 2004 | 8 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 96 | 100 |
| 2004 | 9 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 90 | 100 |
| 2005 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2005 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2005 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 4 | 20 |
| 2005 | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 4 | 20 |
| 2005 | 5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 17 | 60 |
| 2005 | 6 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 21 | 50 |
| 2005 | 7 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 47 | 80 |
| 2005 | 8 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 91 | 100 |
| 2005 | 9 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 99 | 100 |

Table 71. Powdery Mildew Cumulative Risk Index and Opportunity to Complete at Least One Spray per 7-Day Interval by Soil Type and Regulation Status: Grape, Yolo (Colusa) County, 1996-2005

| | 7-Day Spray Interval | With Regulation (Soil Type) | | | | Without Regulation (Soil Type) | | | | Difference (Soil Type) | | | | Average Cumulative Risk Index | Maximum Cumulative Risk Index |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | | A | B | C | D | A | B | C | D | A | B | C | D | | |
| 1996 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 14 | 40 |
| 1996 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 39 | 80 |
| 1996 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 43 | 60 |
| 1996 | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 7 | 20 |
| 1996 | 5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 79 | 100 |
| 1996 | 6 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 100 | 100 |
| 1996 | 7 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 100 | 100 |
| 1996 | 8 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | -1 | 0 | 0 | 69 | 90 |
| 1996 | 9 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 91 | 100 |
| 1997 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 43 | 100 |
| 1997 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 87 | 100 |
| 1997 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 56 | 80 |
| 1997 | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 21 | 60 |
| 1997 | 5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 91 | 100 |
| 1997 | 6 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 96 | 100 |
| 1997 | 7 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 99 | 100 |
| 1997 | 8 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 100 | 100 |
| 1997 | 9 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 100 | 100 |
| 1997 | 10 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 99 | 100 |
| 1998 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 21 | 50 |
| 1998 | 2 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1998 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1998 | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 30 | 60 |
| 1998 | 5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 64 | 90 |
| 1998 | 6 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 91 | 100 |
| 1998 | 7 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 77 | 100 |
| 1998 | 8 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 19 | 40 |
| 1998 | 9 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 17 | 40 |
| 1999 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 91 | 100 |
| 1999 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 91 | 100 |
| 1999 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 83 | 100 |
| 1999 | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 97 | 100 |
| 1999 | 5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 99 | 100 |
| 1999 | 6 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 99 | 100 |
| 2000 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 97 | 100 |

| Year | 7-Day Spray Interval | With Regulation (Soil Type) | | | | Without Regulation (Soil Type) | | | | Difference (Soil Type) | | | | Average Cumulative Risk Index | Maximum Cumulative Risk Index |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | A | B | C | D | A | B | C | D | A | B | C | D | | |
| 2000 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 70 | 100 |
| 2000 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 60 | 90 |
| 2000 | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 96 | 100 |
| 2000 | 5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 96 | 100 |
| 2000 | 6 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 60 | 90 |
| 2000 | 7 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 83 | 100 |
| 2000 | 8 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 100 | 100 |
| 2001 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 90 | 100 |
| 2001 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 40 | 70 |
| 2001 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 3 | 20 |
| 2001 | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 10 | 40 |
| 2001 | 5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 90 | 100 |
| 2001 | 6 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 100 | 100 |
| 2001 | 7 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 99 | 100 |
| 2001 | 8 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 100 | 100 |
| 2001 | 9 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 100 | 100 |
| 2002 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 93 | 100 |
| 2002 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 87 | 100 |
| 2002 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 79 | 100 |
| 2002 | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 73 | 100 |
| 2002 | 5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 99 | 100 |
| 2002 | 6 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 91 | 100 |
| 2002 | 7 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 91 | 100 |
| 2003 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 24 | 60 |
| 2003 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 17 | 40 |
| 2003 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 14 | 40 |
| 2003 | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2003 | 5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2003 | 6 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2003 | 7 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 17 | 60 |
| 2003 | 8 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 91 | 100 |
| 2003 | 9 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 100 | 100 |
| 2004 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 71 | 90 |
| 2004 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 57 | 70 |
| 2004 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 90 | 100 |
| 2004 | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 50 | 80 |
| 2004 | 5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 44 | 70 |
| 2004 | 6 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 91 | 100 |
| 2004 | 7 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 96 | 100 |

| Year | 7-Day Spray Interval | With Regulation (Soil Type) | | | | Without Regulation (Soil Type) | | | | Difference (Soil Type) | | | | Average Cumulative Risk Index | Maximum Cumulative Risk Index |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | A | B | C | D | A | B | C | D | A | B | C | D | | |
| 2004 | 8 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 99 | 100 |
| 2004 | 9 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 99 | 100 |
| 2005 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2005 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2005 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 17 | 40 |
| 2005 | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 21 | 40 |
| 2005 | 5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 21 | 60 |
| 2005 | 6 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 21 | 50 |
| 2005 | 7 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 54 | 80 |
| 2005 | 8 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 69 | 100 |
| 2005 | 9 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 99 | 100 |

# Appendix Three. SQL Code

The following SQL code encompasses all the database work done to produce the final output tables. The only missing aspects from this code is the initial data loading of spatial crop map layers from the various county agriculture commissioners, PUR database, school and daycare site locations, and the statewide parcel map. Once loaded, the county crop map layers are joined into a common format that can easily be linked to the PUR database. The school and daycare sites are also joined into a unified layer, then buffered by 1/4mi. This buffered layer is then intersected with the joint crop map to identify fields within the buffer distance and the exact acreage within the buffer. These fields impacted by the regulation are used in concert with the PUR data to quantify the impact of the proposed regulations.

```
-- Joint crop map table that unifies the various county level crop maps

drop table if exists landuse.cropmap;
create table landuse.cropmap (
    gid serial primary key,
    year                        integer,
    county_cd                   char(2),
    grower_id                   varchar(11),
    site_loc_id                 varchar(8)
);
select AddGeometryColumn('landuse', 'cropmap', 'geom', 3310, 'MULTIPOLYGON', 2);
create index landuse_cropmap_geom_idx on landuse.cropmap using gist (geom);

create index landuse_cropmap_countycd_idx on landuse.cropmap (county_cd);
create index landuse_cropmap_growerid_idx on landuse.cropmap (grower_id);
create index landuse_cropmap_sitelocid_idx on landuse.cropmap (site_loc_id);



-- load stanislaus into joint cropmap
insert into landuse.cropmap (year, county_cd, grower_id, site_loc_id, geom)
(select distinct 2015, '50', l.permit_num, l.site_id, l.geom from landuse.stanislaus_2015 as l
 where exists (select * from pur.udc as p
               where p.year = 2014
                 and p.county_cd = '50'
                 and p.site_loc_id = l.site_id
                 and substring(p.grower_id from 5) = l.permit_num
                 )
);


-- load kern into joint cropmap
insert into landuse.cropmap (year, county_cd, grower_id, site_loc_id, geom)
(select distinct 2014, '15', l.permit, l.siteid, l.geom from landuse.kern2014 as l
 where exists (select * from pur.udc as p
               where p.year = 2014
                 and p.county_cd = '15'
                 and p.site_loc_id = l.siteid
                 and substring(p.grower_id from 5) = l.permit
                 )
);


-- Load remaining counties

insert into landuse.cropmap (year, county_cd, grower_id, site_loc_id, geom)
(select distinct 2015, '10', l.permit_num, l.site_id, l.geom from landuse.fresno_2015 as l
 where exists (select * from pur.udc as p
               where p.year = 2014
```

```
                  and p.county_cd = '10'
                  and p.site_loc_id = l.site_id
                  and substring(p.grower_id from 5) = l.permit_num
                  )
);

insert into landuse.cropmap (year, county_cd, grower_id, site_loc_id, geom)
(select distinct 2015, '13', l.permit_num, l.site_id, l.geom  from landuse.imperial_2015 as l
 where exists (select * from pur.udc as p
               where p.year = 2014
                 and p.county_cd = '13'
                 and p.site_loc_id = l.site_id
                 and substring(p.grower_id from 5) = l.permit_num
                 )
);
-- where permit_num <> '13VC76N' and site_id <> '1341'


insert into landuse.cropmap (year, county_cd, grower_id, site_loc_id, geom)
(select distinct 2015, '16', l.permit_num, l.site_id, l.geom  from landuse.kings_2015 as l
 where exists (select * from pur.udc as p
               where p.year = 2014
                 and p.county_cd = '16'
                 and p.site_loc_id = l.site_id
                 and substring(p.grower_id from 5) = l.permit_num
                 )
);

insert into landuse.cropmap (year, county_cd, grower_id, site_loc_id, geom)
(select distinct 2015, '20', l.permit_num, l.site_id, l.geom  from landuse.madera_2015 as l
 where exists (select * from pur.udc as p
               where p.year = 2014
                 and p.county_cd = '20'
                 and p.site_loc_id = l.site_id
                 and substring(p.grower_id from 5) = l.permit_num
                 )
);

insert into landuse.cropmap (year, county_cd, grower_id, site_loc_id, geom)
(select distinct 2014, '24', l.permit_num, l.site_id, l.geom  from landuse.merced_2014 as l
 where exists (select * from pur.udc as p
               where p.year = 2014
                 and p.county_cd = '24'
                 and p.site_loc_id = l.site_id
                 and substring(p.grower_id from 5) = l.permit_num
                 )
);

-- where permit_num <> '2401376' and site_id <> '001');

-- Monterey dropped from study due to data problems
--
-- drop table if exists landuse.monterey_tmp;
--
-- create table landuse.monterey_tmp as (select * from landuse.monterey_2015);
-- delete from landuse.monterey_tmp as m
-- where exists (select * from landuse.monterey_tmp as mm
--                where m.site_id = mm.site_id and m.permit_num = mm.permit_num and mm.permit_yr >
m.permit_yr);
-- delete from landuse.monterey_tmp as m
-- where m.status = 'Issued'
--  and exists (select * from landuse.monterey_tmp as mm
--                where m.site_id = mm.site_id and m.permit_num = mm.permit_num and mm.status =
'Revised');
-- delete from landuse.monterey_tmp as m
-- where exists (select * from landuse.monterey_tmp as mm
--                 where m.site_id = mm.site_id and m.permit_num = mm.permit_num and mm.version >
m.version);
-- delete from landuse.monterey_tmp as m
-- where m.is_active = 0;
--
```

```
-- insert into landuse.cropmap (year, county_cd, grower_id, site_loc_id, geom)
-- (select distinct 2015, '27', l.permit_num, l.site_id, l.geom  from landuse.monterey_tmp as l
--  where exists (select * from pur.udc as p
--                where p.year = 2014
--                  and p.county_cd = '27'
--                  and p.site_loc_id = l.site_id
--                  and substring(p.grower_id from 5) = l.permit_num
--                  )
-- );
--
-- drop table if exists landuse.monterey_tmp;


-- where gid <> 22623);

insert into landuse.cropmap (year, county_cd, grower_id, site_loc_id, geom)
(select distinct 2014, '34', l.permit_num, l.site_id, l.geom  from landuse.sacramento_2014 as l
 where exists (select * from pur.udc as p
               where p.year = 2014
                 and p.county_cd = '34'
                 and p.site_loc_id = l.site_id
                 and substring(p.grower_id from 5) = l.permit_num
                 )
);

-- where gid <> 336);

insert into landuse.cropmap (year, county_cd, grower_id, site_loc_id, geom)
(select distinct 2015, '39', l.permit_num, l.site_id, l.geom  from landuse.san_joaquin_2015 as l
 where exists (select * from pur.udc as p
               where p.year = 2014
                 and p.county_cd = '39'
                 and p.site_loc_id = l.site_id
                 and substring(p.grower_id from 5) = l.permit_num
                 )
);

insert into landuse.cropmap (year, county_cd, grower_id, site_loc_id, geom)
(select distinct 2015, '42', l.permit_num, l.site_id, l.geom  from landuse.santa_barbara_2015 as
l
 where exists (select * from pur.udc as p
               where p.year = 2014
                 and p.county_cd = '42'
                 and p.site_loc_id = l.site_id
                 and substring(p.grower_id from 5) = l.permit_num
                 )
);

-- where gid <> 35383);

insert into landuse.cropmap (year, county_cd, grower_id, site_loc_id, geom)
(select distinct 2014, '40', l.permit_num, l.site_id, l.geom  from landuse.slo_2014 as l
 where exists (select * from pur.udc as p
               where p.year = 2014
                 and p.county_cd = '40'
                 and p.site_loc_id = l.site_id
                 and substring(p.grower_id from 5) = l.permit_num
                 )
);

insert into landuse.cropmap (year, county_cd, grower_id, site_loc_id, geom)
(
 select distinct 2014, '56', l.op_id, btrim(to_char(l.siteid, '9999')), l.geom
 from landuse.ventura_2014 as l
 where exists (select * from pur.udc as p
               where p.year = 2014
                 and p.county_cd = '56'
                 and substring(p.grower_id from 5) = l.op_id
                 and btrim(to_char(l.siteid, '9999')) =
                    trim(trailing 'ABCDEFG' from (trim(leading '0' from p.site_loc_id)))
                 )
```

```sql
);

insert into landuse.cropmap (year, county_cd, grower_id, site_loc_id, geom)
(select distinct 2015, '57', l.permit_num, l.site_id, l.geom  from landuse.yolo_2015 as l
 where exists (select * from pur.udc as p
               where p.year = 2014
                 and p.county_cd = '57'
                 and p.site_loc_id = l.site_id
                 and substring(p.grower_id from 5) = l.permit_num
                 )
);

-- where permit_num <> '570387A' and site_id <> 'B1');



-- Normalize addresses for daycare and schools and index on it
alter table landuse.daycare add column address_norm text;
update landuse.daycare set address_norm = null;
update landuse.daycare set address_norm =
    upper(btrim(pprint_addy(normalize_address(street_address ||', '|| city ||', '|| state ||'
'|| zip))));
create index landuse_daycare_address_norm_idx on landuse.daycare(address_norm);

alter table landuse.public_schools add column address_norm text;
update landuse.public_schools set address_norm = null;
update landuse.public_schools set address_norm =
    upper(btrim(pprint_addy(normalize_address(street ||', '|| city ||', '|| state ||' '||
zip))));
create index landuse_public_schools_address_norm_idx on landuse.public_schools(address_norm);


-- Normalize addresses for parcel map

-- first fix funky fields
update landuse.parcelmap set sthsnum = null where sthsnum = E'b\'';
update landuse.parcelmap set stdir = null where stdir = E'b\'';
update landuse.parcelmap set ststname = null where ststname = E'b\'';
update landuse.parcelmap set stsuffix = null where stsuffix = E'b\'';
update landuse.parcelmap set stquadrant = null where stquadrant = E'b\'';
update landuse.parcelmap set stunitprfx = null where stunitprfx = E'b\'';
update landuse.parcelmap set stunitnum = null where stunitnum = E'b\'';
update landuse.parcelmap set stcity = null where stcity = E'b\'';
update landuse.parcelmap set ststate = null where ststate = E'b\'';
update landuse.parcelmap set stzip = null where stzip = E'b\'';
update landuse.parcelmap set stzip4 = null where stzip4 = E'b\'';


alter table landuse.parcelmap add column address_norm text;
update landuse.parcelmap set address_norm = null;
update landuse.parcelmap set address_norm =
    upper(btrim(pprint_addy(normalize_address(
            concat_ws(' ',sthsnum, stdir, ststname, stsuffix, stquadrant, stunitprfx, stunitnum)
|| ', ' ||
            stcity ||', '||ststate||' '||stzip))));
create index landuse_parcelmap_address_norm_idx on landuse.parcelmap(address_norm);
vacuum analyze;

-- Get parcel boundary of school using address
select AddGeometryColumn('landuse', 'public_schools', 'parcel_geom', 3310, 'MULTIPOLYGON', 2);
create index landuse_public_schools_parcel_geom_idx on landuse.public_schools using gist
(parcel_geom);
update landuse.public_schools set parcel_geom = null;

-- do the same for day care sites
select AddGeometryColumn('landuse', 'daycare', 'parcel_geom', 3310, 'MULTIPOLYGON', 2);
create index landuse_daycare_parcel_geom_idx on landuse.daycare using gist (parcel_geom);
update landuse.daycare set parcel_geom = null;

-- add geometry column for hybrid method
select AddGeometryColumn('landuse', 'public_schools', 'best_geom', 3310, 'MULTIPOLYGON', 2);
```

```sql
create index landuse_public_schools_best_geom_idx on landuse.public_schools using gist
(best_geom);
update landuse.public_schools set best_geom = null;

select AddGeometryColumn('landuse', 'daycare', 'best_geom', 3310, 'MULTIPOLYGON', 2);
create index landuse_daycare_best_geom_idx on landuse.daycare using gist (best_geom);
update landuse.daycare set best_geom = null;-- do the same for day care sites

-- For sites with null parcel_geom,
-- ...try using lat/lon
-- ...try geocoding

-- Get parcel boundary of school using point
select AddGeometryColumn('landuse', 'public_schools', 'parcel_gc_geom', 3310, 'MULTIPOLYGON',
2);
create index landuse_public_schools_parcel_gc_geom_idx on landuse.public_schools using gist
(parcel_gc_geom);
update landuse.public_schools set parcel_gc_geom = null;



-- do the same for day care sites
select AddGeometryColumn('landuse', 'daycare', 'parcel_gc_geom', 3310, 'MULTIPOLYGON', 2);
create index landuse_daycare_parcel_gc_geom_idx on landuse.daycare using gist (parcel_gc_geom);
update landuse.daycare set parcel_gc_geom = null;

-- Parcel boundary using the normalized address
update landuse.public_schools set parcel_geom = p.geom
from landuse.parcelmap as p
where p.address_norm = public_schools.address_norm
  and p.address_norm is not null;

update landuse.daycare set parcel_geom = p.geom
from landuse.parcelmap as p
where p.address_norm = daycare.address_norm
  and p.address_norm is not null;

-- Parcel boundary using geocoded point
update landuse.public_schools set parcel_gc_geom =
(select pm.geom from landuse.parcelmap as pm
    where
        (pm.usecdstdsc = 'APARTMENT HOUSE (100+ UNITS)' or
        pm.usecdstdsc = 'APARTMENT HOUSE (5+ UNITS)' or
        pm.usecdstdsc = 'APARTMENTS (GENERIC)' or
        position(' HOME, ORPHANAGE' in pm.usecdstdsc) > 0 or
        pm.usecdstdsc = 'CITY, MUNICIPAL, TOWN, VILLAGE OWNED (EXEMPT)' or
        pm.usecdstdsc = 'CLUBS, LODGES, PROFESSIONAL ASSOCIATIONS' or
        pm.usecdstdsc = 'CLUSTER HOME (RESIDENTIAL)' or
        pm.usecdstdsc = 'COLLEGES, UNIVERSITY-PUBLIC' or
        pm.usecdstdsc = 'COLLEGE, UNIVERSITY, VOCATIONAL SCHOOL-PRIVATE' or
        pm.usecdstdsc = 'COMMERCIAL BUILDING, MAIL ORDER, SHOW ROOM (NON-AUTO), COMMERCIAL WHSE'
or
        pm.usecdstdsc = 'COMMERCIAL CONDOMINIUM (NOT OFFICES)' or
        pm.usecdstdsc = 'COMMERCIAL (GENERAL)' or
        pm.usecdstdsc = 'COMMERCIAL OFFICE (GENERAL)' or
        pm.usecdstdsc = 'COMM/OFC/RES MIXED USE' or
        pm.usecdstdsc = 'COMMUNITY CENTER (EXEMPT)' or
        pm.usecdstdsc = 'COMMUNITY: SHOPPING PLAZA, SHOPPING CENTER, MINI-MALL' or
        pm.usecdstdsc = 'CONDOMINIUM OFFICES' or
        pm.usecdstdsc = 'CONDOMINIUM (RESIDENTIAL)' or
        pm.usecdstdsc = 'CONDOMINIUMS (INDUSTRIAL)' or
        pm.usecdstdsc = 'COOPERATIVE (RESIDENTIAL)' or
        pm.usecdstdsc = 'COUNTY OWNED (EXEMPT)' or
        pm.usecdstdsc = 'DAY CARE, PRE-SCHOOL (COMMERCIAL)' or
        pm.usecdstdsc = 'DORMITORY, GROUP QUARTERS (RESIDENTIAL)' or
        pm.usecdstdsc = 'DUPLEX (2 UNITS, ANY COMBINATION)' or
        pm.usecdstdsc = 'GARDEN APT, COURT APT (5+ UNITS)' or
        pm.usecdstdsc = 'GOVERNMENTAL/PUBLIC USE (GENERAL)' or
        pm.usecdstdsc = 'HIGHRISE APARTMENTS' or
        pm.usecdstdsc = 'INDUSTRIAL (GENERAL)' or
        pm.usecdstdsc = 'INDUSTRIAL LOFT BUILDING, LOFT BUILDING' or
```

```
        pm.usecdstdsc = 'INDUSTRIAL PARK' or
        pm.usecdstdsc = 'INSTITUTIONAL (GENERAL)' or
        pm.usecdstdsc = 'LIGHT INDUSTRIAL (10% IMPROVED OFFICE SPACE; MACHINE SHOP)' or
        pm.usecdstdsc = 'MISCELLANEOUS (GENERAL)' or
        pm.usecdstdsc = 'MISC RESIDENTIAL IMPROVEMENT' or
        pm.usecdstdsc = 'MIXED USE (COMMERCIAL/INDUSTRIAL)' or
        pm.usecdstdsc = 'MOBILE HOME' or
        pm.usecdstdsc = 'MOBILE HOME PARK, TRAILER PARK' or
        pm.usecdstdsc = 'MULTI-FAMILY DWELLINGS (GENERIC, ANY COMBINATION 2+)' or
        pm.usecdstdsc = 'MULTI-TENANT INDUSTRIAL BLDG.' or
        pm.usecdstdsc = 'NEIGHBORHOOD: SHOPPING CENTER, STRIP CENTER, ENTERPRISE ZONE' or
        pm.usecdstdsc = 'OFFICE BLDG (GENERAL)' or
        pm.usecdstdsc = 'OFFICE BLDG (MULTI-STORY)' or
        pm.usecdstdsc = 'PAROCHIAL SCHOOL, PRIVATE SCHOOL' or
        pm.usecdstdsc = 'PROFESSIONAL BLDG (LEGAL; INSURANCE; REAL ESTATE; BUSINESS)' or
        pm.usecdstdsc = 'PUBLIC SCHOOL (ADMINISTRATION; CAMPUS; DORMS; INSTRUCTION)' or
        pm.usecdstdsc = 'QUADRUPLEX (4 UNITS, ANY COMBINATION)' or
        pm.usecdstdsc = 'RECREATIONAL/ENTERTAINMENT (GENERAL)' or
        pm.usecdstdsc = 'RECREATIONAL NON-TAXABLE (CAMPS, BOY SCOUTS)' or
        pm.usecdstdsc = 'RECREATION CENTER' or
        pm.usecdstdsc = 'REGIONAL: SHOPPING CENTER, MALL (W/ANCHOR)' or
        pm.usecdstdsc = 'RELIGIOUS, CHURCH, WORSHIP (SYNAGOGUE, TEMPLE, PARSONAGE)' or
        pm.usecdstdsc = 'RESIDENTIAL COMMON AREA (CONDO/PUD/ETC.)' or
        pm.usecdstdsc = 'RESIDENTIAL (GENERAL) (SINGLE)' or
        pm.usecdstdsc = 'RESIDENTIAL INCOME (GENERAL) (MULTI-FAMILY)' or
        pm.usecdstdsc = 'RETAIL STORES ( PERSONAL SERVICES, PHOTOGRAPHY, TRAVEL)' or
        pm.usecdstdsc = 'RURAL IMPROVED / NON-RESIDENTIAL' or
        pm.usecdstdsc = 'RURAL RESIDENCE (AGRICULTURAL)' or
        pm.usecdstdsc = 'SINGLE FAMILY RESIDENTIAL' or
        pm.usecdstdsc = 'SKYSCRAPER/HIGHRISE (COMMERCIAL OFFICES)' or
        pm.usecdstdsc = 'STATE OWNED (EXEMPT)' or
        pm.usecdstdsc = 'STORE/OFFICE (MIXED USE)' or
        pm.usecdstdsc = 'STORES & APARTMENTS' or
        pm.usecdstdsc = 'STRUCTURES ON LEASED LAND (MAY INCLUDE MOBILE HOMES -- SEE "MH LAND
USE")' or
        pm.usecdstdsc = 'TIMESHARE (RESIDENTIAL)' or
        pm.usecdstdsc = 'TOWNHOUSE (RESIDENTIAL)' or
        pm.usecdstdsc = 'TRIPLEX (3 UNITS, ANY COMBINATION)' or
        pm.usecdstdsc = 'WELFARE, SOCIAL SERVICE, LOW INCOME HOUSING (EXEMPT)' or
        pm.usecdstdsc = 'ZERO LOT LINE (RESIDENTIAL)' or
        pm.usecdstdsc is null)
    order by pm.geom <-> public_schools.geom
    limit 1)
;

update landuse.daycare set parcel_gc_geom =
(select pm.geom from landuse.parcelmap as pm
    where
        (pm.usecdstdsc = 'APARTMENT HOUSE (100+ UNITS)' or
        pm.usecdstdsc = 'APARTMENT HOUSE (5+ UNITS)' or
        pm.usecdstdsc = 'APARTMENTS (GENERIC)' or
        position(' HOME, ORPHANAGE' in pm.usecdstdsc) > 0 or
        pm.usecdstdsc = 'CITY, MUNICIPAL, TOWN, VILLAGE OWNED (EXEMPT)' or
        pm.usecdstdsc = 'CLUBS, LODGES, PROFESSIONAL ASSOCIATIONS' or
        pm.usecdstdsc = 'CLUSTER HOME (RESIDENTIAL)' or
        pm.usecdstdsc = 'COLLEGES, UNIVERSITY-PUBLIC' or
        pm.usecdstdsc = 'COLLEGE, UNIVERSITY, VOCATIONAL SCHOOL-PRIVATE' or
        pm.usecdstdsc = 'COMMERCIAL BUILDING, MAIL ORDER, SHOW ROOM (NON-AUTO), COMMERCIAL WHSE'
or
        pm.usecdstdsc = 'COMMERCIAL CONDOMINIUM (NOT OFFICES)' or
        pm.usecdstdsc = 'COMMERCIAL (GENERAL)' or
        pm.usecdstdsc = 'COMMERCIAL OFFICE (GENERAL)' or
        pm.usecdstdsc = 'COMM/OFC/RES MIXED USE' or
        pm.usecdstdsc = 'COMMON AREA (COMMERCIAL, NOT SHOPPING CENTER OR ASSOCIATION ASMNT.)' or
        pm.usecdstdsc = 'COMMON AREA (INDUSTRIAL)' or
        pm.usecdstdsc = 'COMMON AREA (MISC.)' or
        pm.usecdstdsc = 'COMMUNITY CENTER (EXEMPT)' or
        pm.usecdstdsc = 'COMMUNITY: SHOPPING PLAZA, SHOPPING CENTER, MINI-MALL' or
        pm.usecdstdsc = 'CONDOMINIUM OFFICES' or
        pm.usecdstdsc = 'CONDOMINIUM (RESIDENTIAL)' or
        pm.usecdstdsc = 'CONDOMINIUMS (INDUSTRIAL)' or
```

```
        pm.usecdstdsc = 'COOPERATIVE (RESIDENTIAL)' or
        pm.usecdstdsc = 'COUNTY OWNED (EXEMPT)' or
        pm.usecdstdsc = 'DAY CARE, PRE-SCHOOL (COMMERCIAL)' or
        pm.usecdstdsc = 'DORMITORY, GROUP QUARTERS (RESIDENTIAL)' or
        pm.usecdstdsc = 'DUPLEX (2 UNITS, ANY COMBINATION)' or
        pm.usecdstdsc = 'GARDEN APT, COURT APT (5+ UNITS)' or
        pm.usecdstdsc = 'GOVERNMENTAL/PUBLIC USE (GENERAL)' or
        pm.usecdstdsc = 'HIGHRISE APARTMENTS' or
        pm.usecdstdsc = 'INDUSTRIAL (GENERAL)' or
        pm.usecdstdsc = 'INDUSTRIAL LOFT BUILDING, LOFT BUILDING' or
        pm.usecdstdsc = 'INDUSTRIAL PARK' or
        pm.usecdstdsc = 'INSTITUTIONAL (GENERAL)' or
        pm.usecdstdsc = 'LIGHT INDUSTRIAL (10% IMPROVED OFFICE SPACE; MACHINE SHOP)' or
        pm.usecdstdsc = 'MISCELLANEOUS (GENERAL)' or
        pm.usecdstdsc = 'MISC RESIDENTIAL IMPROVEMENT' or
        pm.usecdstdsc = 'MIXED USE (COMMERCIAL/INDUSTRIAL)' or
        pm.usecdstdsc = 'MOBILE HOME' or
        pm.usecdstdsc = 'MOBILE HOME PARK, TRAILER PARK' or
        pm.usecdstdsc = 'MULTI-FAMILY DWELLINGS (GENERIC, ANY COMBINATION 2+)' or
        pm.usecdstdsc = 'MULTI-TENANT INDUSTRIAL BLDG.' or
        pm.usecdstdsc = 'NEIGHBORHOOD: SHOPPING CENTER, STRIP CENTER, ENTERPRISE ZONE' or
        pm.usecdstdsc = 'OFFICE BLDG (GENERAL)' or
        pm.usecdstdsc = 'OFFICE BLDG (MULTI-STORY)' or
        pm.usecdstdsc = 'PARK, PLAYGROUND, PICNIC AREA' or
        pm.usecdstdsc = 'PAROCHIAL SCHOOL, PRIVATE SCHOOL' or
        pm.usecdstdsc = 'PROFESSIONAL BLDG (LEGAL; INSURANCE; REAL ESTATE; BUSINESS)' or
        pm.usecdstdsc = 'PUBLIC SCHOOL (ADMINISTRATION; CAMPUS; DORMS; INSTRUCTION)' or
        pm.usecdstdsc = 'QUADRUPLEX (4 UNITS, ANY COMBINATION)' or
        pm.usecdstdsc = 'RECREATIONAL/ENTERTAINMENT (GENERAL)' or
        pm.usecdstdsc = 'RECREATIONAL NON-TAXABLE (CAMPS, BOY SCOUTS)' or
        pm.usecdstdsc = 'RECREATION CENTER' or
        pm.usecdstdsc = 'REGIONAL: SHOPPING CENTER, MALL (W/ANCHOR)' or
        pm.usecdstdsc = 'RELIGIOUS, CHURCH, WORSHIP (SYNAGOGUE, TEMPLE, PARSONAGE)' or
        pm.usecdstdsc = 'RESIDENTIAL COMMON AREA (CONDO/PUD/ETC.)' or
        pm.usecdstdsc = 'RESIDENTIAL (GENERAL) (SINGLE)' or
        pm.usecdstdsc = 'RESIDENTIAL INCOME (GENERAL) (MULTI-FAMILY)' or
        pm.usecdstdsc = 'RETAIL STORES ( PERSONAL SERVICES, PHOTOGRAPHY, TRAVEL)' or
        pm.usecdstdsc = 'RURAL IMPROVED / NON-RESIDENTIAL' or
        pm.usecdstdsc = 'RURAL RESIDENCE (AGRICULTURAL)' or
        pm.usecdstdsc = 'SINGLE FAMILY RESIDENTIAL' or
        pm.usecdstdsc = 'SKYSCRAPER/HIGHRISE (COMMERCIAL OFFICES)' or
        pm.usecdstdsc = 'STATE OWNED (EXEMPT)' or
        pm.usecdstdsc = 'STORE/OFFICE (MIXED USE)' or
        pm.usecdstdsc = 'STORES & APARTMENTS' or
        pm.usecdstdsc = 'STRUCTURES ON LEASED LAND (MAY INCLUDE MOBILE HOMES -- SEE "MH LAND
USE")' or
        pm.usecdstdsc = 'TIMESHARE (RESIDENTIAL)' or
        pm.usecdstdsc = 'TOWNHOUSE (RESIDENTIAL)' or
        pm.usecdstdsc = 'TRIPLEX (3 UNITS, ANY COMBINATION)' or
        pm.usecdstdsc = 'WELFARE, SOCIAL SERVICE, LOW INCOME HOUSING (EXEMPT)' or
        pm.usecdstdsc = 'ZERO LOT LINE (RESIDENTIAL)' or
        pm.usecdstdsc is null)
    order by pm.geom <-> daycare.geom
    limit 1);

-- hybrid approach

update landuse.public_schools set best_geom = parcel_geom where parcel_geom is not null;
update landuse.public_schools set best_geom = parcel_gc_geom where parcel_gc_geom is not null
and best_geom is null;

update landuse.daycare set best_geom = parcel_geom where parcel_geom is not null;
update landuse.daycare set best_geom = parcel_gc_geom where parcel_gc_geom is not null and
best_geom is null;

-- School
--   address: 5494
--   geocoded: 12076
-- Daycare
--   address: 27733
--   geocoded: 15365
```

```sql
-- Create buffer layers: 1/4mi = 1320ft = 402.336m
--
drop table if exists fumenote.schoolbuff;
drop index if exists fumenote_schoolbuff_geom_idx;
create table fumenote.schoolbuff (id text, source text);
select AddGeometryColumn('fumenote', 'schoolbuff', 'geom', 3310, 'MULTIPOLYGON', 2);
create index fumenote_schoolbuff_geom_idx on fumenote.schoolbuff using gist (geom);

insert into fumenote.schoolbuff (id, source, geom)
(select cdscode,
        'CDE active - hybrid'::text,
        ST_Multi(ST_Union(ST_Buffer(best_geom, 402.336))) as geom
 from landuse.public_schools
 where statustype='Active'
 group by cdscode);

-- Daycare
drop table if exists fumenote.daycarebuff;
drop index if exists fumenote_daycarebuff_geom_idx;
create table fumenote.daycarebuff (id text, source text);
select AddGeometryColumn('fumenote', 'daycarebuff', 'geom', 3310, 'MULTIPOLYGON', 2);
create index fumenote_daycarebuff_geom_idx on fumenote.daycarebuff using gist (geom);

insert into fumenote.daycarebuff (id, source, geom)
(select to_char(fac_num, '999999999'),
        'CCLD - hybrid'::text,
         ST_Multi(ST_Union(ST_Buffer(best_geom, 402.336)))
 from landuse.daycare
 where fac_code = 5 or fac_code = 6 or fac_code = 13 or fac_code = 17
 group by fac_num);


-- intersect crop and buffers
-- sb = school buffer
-- dc = day care
-- pm = parcel map
-- gc = geocoded
-- ad = address


-- temp intersection table
drop table if exists fumenote.cropmap_school_intersection;
create table fumenote.cropmap_school_intersection (
    county_cd       char(2),
    grower_id       varchar(11),
    site_loc_id     varchar(8),
    fac_id          text,
    type            varchar(7),
    source          text
);
select AddGeometryColumn('fumenote', 'cropmap_school_intersection', 'geom', 3310, 'geometry',
2);
create index fumenote_cropmap_school_intersection_geom_idx on
fumenote.cropmap_school_intersection using gist (geom);
create index fumenote_cropmap_school_intersection_countycd_idx on
fumenote.cropmap_school_intersection  (county_cd);
create index fumenote_cropmap_school_intersection_growerid_idx on
fumenote.cropmap_school_intersection  (grower_id);
create index fumenote_cropmap_school_intersection_sitelocid_idx on
fumenote.cropmap_school_intersection (site_loc_id);
create index fumenote_cropmap_school_intersection_type_idx on
fumenote.cropmap_school_intersection (type);

insert into fumenote.cropmap_school_intersection
(select c.county_cd, c.grower_id, c.site_loc_id, s.id, 'School', s.source,
        ST_Union(ST_Intersection(c.geom, s.geom))
 from landuse.cropmap as c, fumenote.schoolbuff as s
 where c.geom && s.geom
 group by c.county_cd, c.grower_id, c.site_loc_id, s.id, s.source
);
```

```sql
insert into fumenote.cropmap_school_intersection
(select c.county_cd, c.grower_id, c.site_loc_id, s.id, 'Daycare', s.source,
        ST_Union(ST_Intersection(c.geom, s.geom))
 from landuse.cropmap as c, fumenote.daycarebuff as s
 where c.geom && s.geom
 group by c.county_cd, c.grower_id, c.site_loc_id, s.id, s.source
);

update fumenote.cropmap_school_intersection set geom = ST_Multi(ST_CollectionExtract(geom,3));


-- main cropmap table
select AddGeometryColumn('landuse', 'cropmap', 'sb_hy_geom', 3310, 'MULTIPOLYGON', 2);
create index landuse_cropmap_sb_hy_geom_idx on landuse.cropmap using gist (sb_hy_geom);
select AddGeometryColumn('landuse', 'cropmap', 'dc_hy_geom', 3310, 'MULTIPOLYGON', 2);
create index landuse_cropmap_dc_hy_geom_idx on landuse.cropmap using gist (dc_hy_geom);
select AddGeometryColumn('landuse', 'cropmap', 'both_geom', 3310, 'MULTIPOLYGON', 2);
create index landuse_cropmap_both_geom_idx on landuse.cropmap using gist (both_geom);

alter table landuse.cropmap add column num_schools integer;
alter table landuse.cropmap add column num_daycare integer;

update landuse.cropmap set dc_hy_geom = null;
update landuse.cropmap set sb_hy_geom = null;
update landuse.cropmap set both_geom = null;

update landuse.cropmap set sb_hy_geom =
(select ST_Multi(ST_Union(i.geom))
 from fumenote.cropmap_school_intersection as i
 where i.county_cd = cropmap.county_cd
   and i.grower_id = cropmap.grower_id
   and i.site_loc_id = cropmap.site_loc_id
   and i.type = 'School'
   and i.source = 'CDE active - hybrid');

update landuse.cropmap set num_schools =
(select count(i.*)
 from fumenote.cropmap_school_intersection as i
 where i.county_cd = cropmap.county_cd
   and i.grower_id = cropmap.grower_id
   and i.site_loc_id = cropmap.site_loc_id
   and i.type = 'School'
   and i.source = 'CDE active - hybrid');


update landuse.cropmap set dc_hy_geom =
(select ST_Multi(ST_Union(i.geom))
 from fumenote.cropmap_school_intersection as i
 where i.county_cd = cropmap.county_cd
   and i.grower_id = cropmap.grower_id
   and i.site_loc_id = cropmap.site_loc_id
   and i.type = 'Daycare'
   and i.source = 'CCLD - hybrid');

update landuse.cropmap set num_daycare =
(select count(i.*)
 from fumenote.cropmap_school_intersection as i
 where i.county_cd = cropmap.county_cd
   and i.grower_id = cropmap.grower_id
   and i.site_loc_id = cropmap.site_loc_id
   and i.type = 'Daycare'
   and i.source = 'CCLD - hybrid');

update landuse.cropmap set both_geom =
(select ST_Multi(ST_Union(i.geom))
 from fumenote.cropmap_school_intersection as i
 where i.county_cd = cropmap.county_cd
   and i.grower_id = cropmap.grower_id
   and i.site_loc_id = cropmap.site_loc_id
   and position('hybrid' in source) > 0);
```

```sql
update landuse.cropmap set dc_hy_geom = null where ST_IsEmpty(dc_hy_geom);
update landuse.cropmap set sb_hy_geom = null where ST_IsEmpty(sb_hy_geom);
update landuse.cropmap set both_geom = null where ST_IsEmpty(both_geom);



-- School days

drop table if exists fumenote.school_days;
create table fumenote.school_days (
    county_cd        char(2),
    holiday          text,
    start_dt         date,
    end_dt           date
);

-- Fresno:
-- http://www.nctq.org/docs/Fresno_2013-2014_Calendar.pdf
insert into fumenote.school_days values
    ('10', 'Summer',            '2013-06-12', '2013-08-19'),
    ('10', 'Summer',            '2014-06-12', '2014-08-19'),
    ('10', 'Labor Day',         '2013-09-02', '2013-09-02'),
    ('10', 'Veterans Day',      '2013-11-11', '2013-11-11'),
    ('10', 'Thanksgiving',      '2013-11-25', '2013-11-29'),
    ('10', 'Winter',            '2013-12-23', '2014-01-10'),
    ('10', 'MLK',               '2014-01-20', '2014-01-20'),
    ('10', 'Lincolns Birthday', '2014-02-10', '2014-02-10'),
    ('10', 'Presidents Day',    '2014-02-17', '2014-02-17'),
    ('10', 'Spring',            '2014-04-14', '2014-04-21'),
    ('10', 'Memorial Day',      '2014-05-26', '2014-05-26');


-- Imperial:
-- https://docs.google.com/file/d/0B6UAqOR-9SnBNVM0Q3dIdjNCakE/edit
insert into fumenote.school_days values
    ('13', 'Summer',            '2013-06-13', '2013-08-25'),
    ('13', 'Summer',            '2014-06-13', '2014-08-25'),
    ('13', 'Labor Day',         '2013-09-02', '2013-09-02'),
    ('13', 'Veterans Day',      '2013-11-11', '2013-11-11'),
    ('13', 'Thanksgiving',      '2013-11-25', '2013-11-29'),
    ('13', 'Winter',            '2013-12-23', '2014-01-03'),
    ('13', 'MLK',               '2014-01-20', '2014-01-20'),
    ('13', 'Lincolns Birthday', '2014-02-10', '2014-02-10'),
    ('13', 'Presidents Day',    '2014-02-17', '2014-02-17'),
    ('13', 'Spring',            '2014-04-18', '2014-04-25'),
    ('13', 'Memorial Day',      '2014-05-26', '2014-05-26');

-- Kern:
-- http://kern.org/wp-content/uploads/sites/11/2013/11/2013-14-School-District-Holiday-
Calendar1.pdf
-- NOTE: Kern does not have a county unified district; using the most common dates for each
holiday
insert into fumenote.school_days values
    ('15', 'Summer',            '2013-05-29', '2013-08-19'),
    ('15', 'Summer',            '2014-05-29', '2014-08-19'),
    ('15', 'Labor Day',         '2013-09-02', '2013-09-02'),
    ('15', 'Veterans Day',      '2013-11-11', '2013-11-11'),
    ('15', 'Thanksgiving',      '2013-11-25', '2013-11-29'),
    ('15', 'Winter',            '2013-12-23', '2014-01-03'),
    ('15', 'MLK',               '2014-01-20', '2014-01-20'),
    ('15', 'Lincolns Birthday', '2014-02-10', '2014-02-10'),
    ('15', 'Presidents Day',    '2014-02-17', '2014-02-17'),
    ('15', 'Spring',            '2014-04-14', '2014-04-21'),
    ('15', 'Memorial Day',      '2014-05-26', '2014-05-26');

-- Kings:
-- http://www.kings.k12.ca.us/HR/Calendar%20Archive/2013-2014/13-14%20SB-KCS%20Calendar.pdf
-- Note: might be for only a couple of schools and not the whole county
insert into fumenote.school_days values
    ('16', 'Summer',            '2013-06-04', '2013-08-14'),
```

```sql
    ('16', 'Summer',            '2014-06-04', '2014-08-14'),
    ('16', 'Labor Day',         '2013-09-02', '2013-09-02'),
    ('16', 'Veterans Day',      '2013-11-11', '2013-11-11'),
    ('16', 'Thanksgiving',      '2013-11-27', '2013-11-29'),
    ('16', 'Winter',            '2013-12-23', '2014-01-10'),
    ('16', 'MLK',               '2014-01-20', '2014-01-20'),
    ('16', 'Lincolns Birthday', '2014-02-10', '2014-02-10'),
    ('16', 'Presidents Day',    '2014-02-17', '2014-02-17'),
    ('16', 'Spring',            '2014-04-14', '2014-04-21'),
    ('16', 'Memorial Day',      '2014-05-26', '2014-05-26');

-- Madera:
-- http://www.madera.k12.ca.us/cms/lib04/CA01001210/Centricity/domain/13/2013-
2014%20classified%20calendars/CL218.pdf
insert into fumenote.school_days values
    ('20', 'Summer',            '2013-06-07', '2013-08-09'),
    ('20', 'Summer',            '2014-06-07', '2014-08-09'),
    ('20', 'Labor Day',         '2013-09-02', '2013-09-02'),
    ('20', 'Veterans Day',      '2013-11-11', '2013-11-11'),
    ('20', 'Thanksgiving',      '2013-11-25', '2013-11-29'),
    ('20', 'Winter',            '2013-12-23', '2014-01-10'),
    ('20', 'MLK',               '2014-01-20', '2014-01-20'),
    ('20', 'Lincolns Birthday', '2014-02-10', '2014-02-10'),
    ('20', 'Presidents Day',    '2014-02-17', '2014-02-17'),
    ('20', 'Spring',            '2014-04-14', '2014-04-21'),
    ('20', 'Memorial Day',      '2014-05-26', '2014-05-26');

-- Merced:
-- http://www.mcsd.k12.ca.us/files/root/2013-2014%20Calendar.pdf
insert into fumenote.school_days values
    ('24', 'Summer',            '2013-06-07', '2013-08-18'),
    ('24', 'Summer',            '2014-06-07', '2014-08-18'),
    ('24', 'Labor Day',         '2013-09-02', '2013-09-02'),
    ('24', 'Veterans Day',      '2013-11-11', '2013-11-11'),
    ('24', 'Thanksgiving',      '2013-11-25', '2013-11-29'),
    ('24', 'Winter',            '2013-12-20', '2014-01-07'),
    ('24', 'MLK',               '2014-01-20', '2014-01-20'),
    ('24', 'Lincolns Birthday', '2014-02-10', '2014-02-10'),
    ('24', 'Presidents Day',    '2014-02-17', '2014-02-17'),
    ('24', 'Spring',            '2014-04-18', '2014-04-25'),
    ('24', 'Memorial Day',      '2014-05-26', '2014-05-26');

-- Monterey:
-- http://mpusd-ca.schoolloop.com/file/1325750652966/1317567579720/8957329275248925823.pdf
insert into fumenote.school_days values
    ('27', 'Summer',            '2013-06-07', '2013-08-06'),
    ('27', 'Summer',            '2014-06-07', '2014-08-06'),
    ('27', 'Labor Day',         '2013-09-02', '2013-09-02'),
    ('27', 'Veterans Day',      '2013-11-11', '2013-11-11'),
    ('27', 'Thanksgiving',      '2013-11-25', '2013-11-29'),
    ('27', 'Winter',            '2013-12-20', '2014-01-03'),
    ('27', 'MLK',               '2014-01-20', '2014-01-20'),
    ('27', 'Lincolns Birthday', '2014-02-10', '2014-02-10'),
    ('27', 'Presidents Day',    '2014-02-17', '2014-02-17'),
    ('27', 'Spring',            '2014-03-24', '2014-04-04'),
    ('27', 'Memorial Day',      '2014-05-26', '2014-05-26');

-- Sacramento:
-- http://www.scusd.edu/calendar/2014
-- NOTE: not all of Sacramento county is unified. Using Sac-city unified for dates
insert into fumenote.school_days values
    ('34', 'Summer',            '2013-06-11', '2013-09-02'),
    ('34', 'Summer',            '2014-06-11', '2014-09-02'),
    ('34', 'Labor Day',         '2013-09-02', '2013-09-02'),
    ('34', 'Veterans Day',      '2013-11-11', '2013-11-11'),
    ('34', 'Thanksgiving',      '2013-11-25', '2013-11-29'),
    ('34', 'Winter',            '2013-12-23', '2014-01-03'),
    ('34', 'MLK',               '2014-01-20', '2014-01-20'),
    ('34', 'Lincolns Birthday', '2014-02-10', '2014-02-10'),
    ('34', 'Presidents Day',    '2014-02-17', '2014-02-17'),
    ('34', 'Spring',            '2014-04-14', '2014-04-18'),
```

```sql
    ('34', 'Memorial Day',      '2014-05-26', '2014-05-26');

-- San Joaquin
-- http://www.sjcoe.org/SJCDistricts/PDF/20132014ApprovedGeneralCalendar.pdf
insert into fumenote.school_days values
    ('39', 'Summer',            '2013-05-30', '2013-08-13'),
    ('39', 'Summer',            '2014-05-30', '2014-08-13'),
    ('39', 'Labor Day',         '2013-09-02', '2013-09-02'),
    ('39', 'Veterans Day',      '2013-11-11', '2013-11-11'),
    ('39', 'Thanksgiving',      '2013-11-25', '2013-11-29'),
    ('39', 'Winter',            '2013-12-23', '2014-01-03'),
    ('39', 'MLK',               '2014-01-20', '2014-01-20'),
    ('39', 'Presidents Week',   '2014-02-17', '2014-02-21'),
    ('39', 'Spring',            '2014-04-21', '2014-04-25'),
    ('39', 'Memorial Day',      '2014-05-26', '2014-05-26');

-- San Luis Obispo
-- https://www.slcusd.org/images/cms/files/instructional_2014-
150.pdf_ac7004f3ab6789cd95111b4e73209a0c.pdf
-- NOTE: only 2014-2015 calendar available
--       Using other counties for labor, vetrans, MLK, Lincolns, Presidents, & Memorial days.
--       Snapping other holidays to the nearest work week
insert into fumenote.school_days values
    ('40', 'Summer',            '2013-06-12', '2013-08-26'),
    ('40', 'Summer',            '2014-06-12', '2014-08-26'),
    ('40', 'Labor Day',         '2013-09-02', '2013-09-02'),
    ('40', 'Veterans Day',      '2013-11-11', '2013-11-11'),
    ('40', 'Thanksgiving',      '2013-11-25', '2013-11-29'),
    ('40', 'Winter',            '2013-12-23', '2014-01-03'),
    ('40', 'MLK',               '2014-01-20', '2014-01-20'),
    ('40', 'Lincolns Birthday', '2014-02-10', '2014-02-10'),
    ('40', 'Presidents Day',    '2014-02-17', '2014-02-17'),
    ('40', 'Spring',            '2014-04-04', '2014-04-11'),
    ('40', 'Memorial Day',      '2014-05-26', '2014-05-26');

-- Santa Barbara-
-- http://www.sbunified.org/districtwp/wp-content/uploads/2013/01/2013-14_Calendar.pdf
insert into fumenote.school_days values
    ('42', 'Summer',            '2013-06-05', '2013-08-26'),
    ('42', 'Summer',            '2014-06-05', '2014-08-26'),
    ('42', 'Labor Day',         '2013-09-02', '2013-09-02'),
    ('42', 'Veterans Day',      '2013-11-11', '2013-11-11'),
    ('42', 'Thanksgiving',      '2013-11-27', '2013-11-29'),
    ('42', 'Winter',            '2013-12-23', '2014-01-06'),
    ('42', 'MLK',               '2014-01-20', '2014-01-20'),
    ('42', 'Lincolns Birthday', '2014-02-10', '2014-02-10'),
    ('42', 'Presidents Day',    '2014-02-17', '2014-02-17'),
    ('42', 'Spring',            '2014-03-24', '2014-03-28'),
    ('42', 'Memorial Day',      '2014-05-26', '2014-05-26');

-- Stanislaus
-- http://www.oakdale.k12.ca.us/School_Year_1314
-- NOTE: Stanislaus does not have a unified school district and worse yet, their calendar is not
--       unified over the different districts. I am using Oakdale because its calendar was easy
to
--       find. Other districts will be slightly different, but doing them all individually would
--       take more effort than all the other counties combined. For start/stop days for 2015-
2016
--       for all districts see: http://www.sbunified.org/districtwp/wp-
content/uploads/2013/01/2013-14_Calendar.pdf
insert into fumenote.school_days values
    ('50', 'Summer',            '2013-05-23', '2013-08-07'),
    ('50', 'Summer',            '2014-05-23', '2014-08-07'),
    ('50', 'Labor Day',         '2013-09-02', '2013-09-02'),
    ('50', 'Veterans Day',      '2013-11-11', '2013-11-11'),
    ('50', 'Thanksgiving',      '2013-11-25', '2013-11-29'),
    ('50', 'Winter',            '2013-12-23', '2014-01-03'),
    ('50', 'MLK',               '2014-01-20', '2014-01-20'),
    ('50', 'Lincolns Birthday', '2014-02-10', '2014-02-10'),
    ('50', 'Presidents Day',    '2014-02-17', '2014-02-17'),
    ('50', 'Spring',            '2014-04-18', '2014-04-25');
```

```
-- Ventura
-- http://www.venturausd.org/Portals/0/Calendars/FINAL_2013-2014_SY_Calendar_Appv_5-28-13.pdf
insert into fumenote.school_days values
    ('56', 'Summer',            '2013-06-13', '2013-08-19'),
    ('56', 'Summer',            '2014-06-13', '2014-08-19'),
    ('56', 'Labor Day',         '2013-09-02', '2013-09-02'),
    ('56', 'Fall',              '2013-10-21', '2013-10-25'),
    ('56', 'Veterans Day',      '2013-11-11', '2013-11-11'),
    ('56', 'Thanksgiving',      '2013-11-27', '2013-11-29'),
    ('56', 'Winter',            '2013-12-23', '2014-01-03'),
    ('56', 'MLK',               '2014-01-20', '2014-01-20'),
    ('56', 'Lincolns Birthday', '2014-02-14', '2014-02-14'),
    ('56', 'Presidents Day',    '2014-02-17', '2014-02-17'),
    ('56', 'Spring',            '2014-03-31', '2014-04-04'),
    ('56', 'District holiday',  '2014-04-18', '2014-04-18'),
    ('56', 'Memorial Day',      '2014-05-26', '2014-05-26');

-- Yolo
-- http://djusd-ca.schoolloop.com/file/1356617245223/1356617245942/4416953204384726345.pdf
-- NOTE: like stanislaus, Yolo is not unified county wide. Worse, no 2013-2014 calendars are
available
--       online from any of the districts. Using 2014-2015 Davis Unified calendar because it was
the
--       earliest year I could find. Federal holidays were gleamed from other schools, local
holidays
--       were snapped to the school week.
insert into fumenote.school_days values
    ('57', 'Summer',            '2013-06-12', '2013-08-20'),
    ('57', 'Summer',            '2014-06-12', '2014-08-20'),
    ('57', 'Labor Day',         '2013-09-02', '2013-09-02'),
    ('57', 'Veterans Day',      '2013-11-11', '2013-11-11'),
    ('57', 'Thanksgiving',      '2013-11-25', '2013-11-29'),
    ('57', 'Winter',            '2013-12-23', '2014-01-03'),
    ('57', 'MLK',               '2014-01-20', '2014-01-20'),
    ('57', 'Lincolns Birthday', '2014-02-10', '2014-02-10'),
    ('57', 'Presidents Day',    '2014-02-17', '2014-02-17'),
    ('57', 'Spring',            '2014-03-24', '2014-03-28'),
    ('57', 'Memorial Day',      '2014-05-26', '2014-05-26');



-- limit it to July 1, 2013 through June 30, 2014
-- 1. We would like to know for each combination of County and Application method,
--    the total number of growers, acres, applications, and PAPACs by application time.
-- 2. For each of the combination of County, application method, and application time,
--    we would like a summary by crop.  For each crop we would like the number of acres,
--    number of growers, and number of fields.
-- 3. For each combination of County, application method, and application time, we would
--    like to know the average, mean, medial, high, and low values of acres and number of fields
for growers.

-- Table format
-- Columns: weekday 6-6, weekday after 6, weekday before 6, weekend
-- table 1: aerial applications -- rows = growers, acres, PAPACs, applications
-- table 2: same as above but with an extra column for crop type (DWR class)
-- table 3: fields per grower -- rows = average, median, high, low
-- table 4: acres per grower

-- Table 2. Air Blast Application Rules of Thumb for Preliminary Analysis
--           1       Only orchards use air blast sprayers
--           2       All insecticide and fungicide applications on orchards use air blast
sprayers
--           3       No herbicide applications on orchards use air blast sprayers


drop table if exists fumenote.school_years;

create table fumenote.school_years (
    school_year            text,
    start_dt               date,
```

```
    end_dt                  date
);

insert into fumenote.school_years values
    ('2013-2014', '7-1-2013', '6-30-2014'),
    ('2012-2013', '7-1-2012', '6-30-2013'),
    ('2011-2012', '7-1-2011', '6-30-2012'),
    ('2010-2011', '7-1-2010', '6-30-2011'),
    ('2009-2010', '7-1-2009', '6-30-2010'),
    ('2008-2009', '7-1-2008', '6-30-2009'),
    ('2007-2008', '7-1-2007', '6-30-2008'),
    ('2006-2007', '7-1-2006', '6-30-2007'),
    ('2005-2006', '7-1-2005', '6-30-2006'),
    ('2004-2005', '7-1-2004', '6-30-2005');


-- PUR excerpt

drop table if exists fumenote.pur_aerial_applications;
create table fumenote.pur_aerial_applications as (
    select  p.county_cd,
                    (p.year-2000) + (p.use_no * 100) as use_no,
                    substring(p.grower_id from 5) as grower_id,
                    p.site_loc_id,
                    p.site_code,
                    p.acre_treated,
                    p.acre_planted,
                    y.school_year,
                    case when (p.aer_gnd_ind = 'A') then 'Aerial'
                         when ((s.dwrclass = 'D' or s.dwrclass = 'C') and not aicat.ai_type =
'HERBICIDE')
                            or (s.dwrclass = 'V' and not (aicat.ai_type = 'HERBICIDE')) then
'Airblast'
                    end app_type,
                    (extract(DOW from p.applic_dt) = 0 or extract(DOW from p.applic_dt) = 6) as
weekend,
                    ((p.applic_time >= 600 and p.applic_time <= 1800) or p.applic_time is null
or p.applic_dt is null) as daytime,
                    (p.applic_time < 600) as pre_six_am,
                    (p.applic_time > 1800) as post_six_pm
    from pur.udc as p left outer join pur.dpr_ai_categories as aicat on (p.chem_code =
aicat.chem_code),
         pur.site as s,
         fumenote.school_years as y
    where p.year > 2003
      and (p.applic_dt between y.start_dt and y.end_dt)
      and p.site_code = s.sitecode
      and exists (select * from landuse.cropmap as c where p.county_cd = c.county_cd limit 1)
      and (p.aer_gnd_ind = 'A' or
           ((s.dwrclass = 'D' or s.dwrclass = 'C') and not aicat.ai_type = 'HERBICIDE') or
           (s.dwrclass = 'V' and not (aicat.ai_type = 'HERBICIDE')))
);

create index fumenote_pur_aerial_applications_county_cd_idx on
fumenote.pur_aerial_applications(county_cd);
create index fumenote_pur_aerial_applications_app_type_idx on
fumenote.pur_aerial_applications(app_type);
create index fumenote_pur_aerial_applications_grower_id_idx on
fumenote.pur_aerial_applications(grower_id);
create index fumenote_pur_aerial_applications_school_year_idx on
fumenote.pur_aerial_applications(school_year);
vacuum analyze;

insert into fumenote.pur_aerial_applications
select county_cd, use_no, grower_id, site_loc_id, site_code, acre_treated, acre_planted,
school_year, 'Either',
       weekend, daytime, pre_six_am, post_six_pm
from fumenote.pur_aerial_applications;


drop table if exists fumenote.aerial_applications_by_buffer_status;
```

```sql
create table fumenote.aerial_applications_by_buffer_status (
    buffer_status          text,
    county_cd              char(2),
    use_no                 integer,
    grower_id              text,
    site_loc_id            varchar(8),
    site_code              integer,
    acre_treated           real,
    acre_planted           real,
    school_year            text,
    app_type               text,
    weekend                boolean,
    daytime                boolean,
    pre_six_am             boolean,
    post_six_pm            boolean
);

create index fumenote_aerial_applications_by_buffer_status_bufferstatus_idx on
fumenote.aerial_applications_by_buffer_status (buffer_status);
create index fumenote_aerial_applications_by_buffer_status_countycd_idx on
fumenote.aerial_applications_by_buffer_status (county_cd);
create index fumenote_aerial_applications_by_buffer_status_growerid_idx on
fumenote.aerial_applications_by_buffer_status (grower_id);
create index fumenote_aerial_applications_by_buffer_status_sitelocid_idx on
fumenote.aerial_applications_by_buffer_status (site_loc_id);
create index fumenote_aerial_applications_by_buffer_status_sitecode_idx on
fumenote.aerial_applications_by_buffer_status (site_code);
create index fumenote_aerial_applications_by_buffer_status_schoolyear_idx on
fumenote.aerial_applications_by_buffer_status (school_year);
create index fumenote_aerial_applications_by_buffer_status_apptype_idx on
fumenote.aerial_applications_by_buffer_status (app_type);
create index fumenote_aerial_applications_by_buffer_status_weekend_idx on
fumenote.aerial_applications_by_buffer_status (weekend);
create index fumenote_aerial_applications_by_buffer_status_daytime_idx on
fumenote.aerial_applications_by_buffer_status (daytime);
create index fumenote_aerial_applications_by_buffer_status_pre6am_idx on
fumenote.aerial_applications_by_buffer_status (pre_six_am);
create index fumenote_aerial_applications_by_buffer_status_post6pm_idx on
fumenote.aerial_applications_by_buffer_status (post_six_pm);
--vacuum analyze;

insert into fumenote.aerial_applications_by_buffer_status
select distinct 'All'::text,
                county_cd, use_no, grower_id, site_loc_id, site_code, acre_treated,
acre_planted,
                school_year, app_type, weekend, daytime, pre_six_am, post_six_pm
from fumenote.pur_aerial_applications;

insert into fumenote.aerial_applications_by_buffer_status
select distinct 'None'::text,
                county_cd, use_no, grower_id, site_loc_id, site_code, acre_treated,
acre_planted,
                school_year, app_type, weekend, daytime, pre_six_am, post_six_pm
from fumenote.pur_aerial_applications as pur
where not exists (select * from fumenote.cropmap_school_intersection as cm
                              where cm.county_cd = pur.county_cd
                                and cm.grower_id = pur.grower_id
                                and cm.site_loc_id = pur.site_loc_id);

insert into fumenote.aerial_applications_by_buffer_status
select distinct 'Both'::text,
                county_cd, use_no, grower_id, site_loc_id, site_code, acre_treated,
acre_planted,
                school_year, app_type, weekend, daytime, pre_six_am, post_six_pm
from fumenote.pur_aerial_applications as pur
where exists (select * from fumenote.cropmap_school_intersection as cm
                              where cm.county_cd = pur.county_cd
                                and cm.grower_id = pur.grower_id
                                and cm.site_loc_id = pur.site_loc_id);

insert into fumenote.aerial_applications_by_buffer_status
```

```
select distinct 'School'::text,
                county_cd, use_no, grower_id, site_loc_id, site_code, acre_treated,
acre_planted,
                school_year, app_type, weekend, daytime, pre_six_am, post_six_pm
from fumenote.pur_aerial_applications as pur
where exists (select * from fumenote.cropmap_school_intersection as cm
                              where cm.county_cd = pur.county_cd
                                and cm.grower_id = pur.grower_id
                                and cm.site_loc_id = pur.site_loc_id
                                and cm.type = 'School');

insert into fumenote.aerial_applications_by_buffer_status
select distinct 'Daycare'::text,
                county_cd, use_no, grower_id, site_loc_id, site_code, acre_treated,
acre_planted,
                school_year, app_type, weekend, daytime, pre_six_am, post_six_pm
from fumenote.pur_aerial_applications as pur
where exists (select * from fumenote.cropmap_school_intersection as cm
                              where cm.county_cd = pur.county_cd
                                and cm.grower_id = pur.grower_id
                                and cm.site_loc_id = pur.site_loc_id
                                and cm.type = 'Daycare');




-- grower count, regradless of if they used aerial applications
drop table if exists fumenote.pur_growers;
create table fumenote.pur_growers as (
    select  p.county_cd,
                    (p.year-2000) + (p.use_no * 100) as use_no,
                    substring(p.grower_id from 5) as grower_id,
                    p.site_loc_id,
                    p.site_code,
                    s.dwrclass as dwr_class,
                    p.acre_treated,
                    p.acre_planted,
                    y.school_year
    from pur.udc as p,
         pur.site as s,
         fumenote.school_years as y
    where p.year > 2003
      and (p.applic_dt between y.start_dt and y.end_dt)
      and p.site_code = s.sitecode
      and exists (select * from landuse.cropmap as c where p.county_cd = c.county_cd limit 1)
      and (s.dwrclass = 'G' or s.dwrclass = 'R' or s.dwrclass = 'F' or s.dwrclass = 'P' or
s.dwrclass = 'T' or
           s.dwrclass = 'D' or s.dwrclass = 'C' or s.dwrclass = 'V')
);

drop table if exists fumenote.pur_growers_stats;
create table fumenote.pur_growers_stats as (
    with g as (select distinct county_cd, grower_id, dwr_class, site_code, school_year
               from fumenote.pur_growers),
         gs as (select county_cd, dwr_class, site_code, school_year, count(*) as num_growers
                from g
                group by county_cd, dwr_class, site_code, school_year),
         f as (select distinct county_cd, grower_id, site_loc_id, dwr_class,  site_code,
acre_planted, school_year
              from fumenote.pur_growers),
         fs as (select county_cd, dwr_class, site_code, school_year,
                count(*) as num_fields,
                avg(acre_planted) as avg_acre_planted,
                min(acre_planted) as min_acre_planted,
                max(acre_planted) as max_acre_planted
               from f
               group by county_cd, dwr_class, site_code, school_year)
    select gs.school_year,
           initcap(c.county_name) as county,
           initcap(d.land_use) as dwr_crop_class,
```

```
            initcap(ps.sitename) as pur_crop,
            gs.num_growers,
            fs.num_fields,
            fs.avg_acre_planted,
            fs.min_acre_planted,
            fs.max_acre_planted
    from gs, fs, landuse.dwr_legend as d, pur.county as c, pur.site as ps
    where gs.county_cd = fs.county_cd
      and gs.site_code = fs.site_code
      and gs.school_year = fs.school_year
      and d.class = gs.dwr_class
      and d.subclass = '**'
      and gs.county_cd = c.county_cd
      and ps.sitecode = gs.site_code
);

delete from fumenote.pur_growers_stats where county = 'Monterey';

\copy fumenote.pur_growers_stats to
'/home/paradox/Dropbox/school_notification/pur_growers_stats.csv' with csv header;

drop table if exists fumenote.pur_growers;



-- Same as above, but group by DWR crop type, not pur crop



-- grower count, regradless of if they used aerial applications
drop table if exists fumenote.pur_growers_dwr;
create table fumenote.pur_growers_dwr as (
    select  p.county_cd,
                    (p.year-2000) + (p.use_no * 100) as use_no,
                    substring(p.grower_id from 5) as grower_id,
                    p.site_loc_id,
                    s.dwrclass as dwr_class,
                    p.acre_treated,
                    p.acre_planted,
                    y.school_year
    from pur.udc as p,
         pur.site as s,
         fumenote.school_years as y
    where p.year > 2003
      and (p.applic_dt between y.start_dt and y.end_dt)
      and p.site_code = s.sitecode
      and exists (select * from landuse.cropmap as c where p.county_cd = c.county_cd limit 1)
      and (s.dwrclass = 'G' or s.dwrclass = 'R' or s.dwrclass = 'F' or s.dwrclass = 'P' or
s.dwrclass = 'T' or
           s.dwrclass = 'D' or s.dwrclass = 'C' or s.dwrclass = 'V')
);

drop table if exists fumenote.pur_growers_dwr_stats;
create table fumenote.pur_growers_dwr_stats as (
    with g as (select distinct county_cd, grower_id, dwr_class, school_year
              from fumenote.pur_growers_dwr),
         gs as (select county_cd, dwr_class, school_year, count(*) as num_growers
               from g
               group by county_cd, dwr_class, school_year),
         f as (select distinct county_cd, grower_id, site_loc_id, dwr_class, acre_planted,
school_year
             from fumenote.pur_growers_dwr),
         fs as (select county_cd, dwr_class, school_year,
               count(*) as num_fields,
               avg(acre_planted) as avg_acre_planted,
               min(acre_planted) as min_acre_planted,
               max(acre_planted) as max_acre_planted
              from f
              group by county_cd, dwr_class, school_year)
    select gs.school_year,
           initcap(c.county_name) as county,
```

```
           initcap(d.land_use) as dwr_crop_class,
           gs.num_growers,
           fs.num_fields,
           fs.avg_acre_planted,
           fs.min_acre_planted,
           fs.max_acre_planted
    from gs, fs, landuse.dwr_legend as d, pur.county as c
    where gs.county_cd = fs.county_cd
      and gs.dwr_class = fs.dwr_class
      and gs.school_year = fs.school_year
      and d.class = gs.dwr_class
      and d.subclass = '**'
      and gs.county_cd = c.county_cd
);

delete from fumenote.pur_growers_dwr_stats where county = 'Monterey';

\copy fumenote.pur_growers_dwr_stats to
'/home/paradox/Dropbox/school_notification/pur_growers_dwr_stats.csv' with csv header;


-- total number of grower_ids for thirteen counties,
-- limited to 2014
with p as (select substring(grower_id from 5) as grower_id
           from pur.udc
           where year = 2014
             and exists (select * from landuse.cropmap as c where county_cd = c.county_cd limit
1)
             and county_cd <> '27'),
     g as (select distinct grower_id from p)
select count(*) from g;


-- total number (and percent) of growers with PAPACs affected by regulation,
with g as (select distinct grower_id
           from fumenote.pur_near_school_daycare
           where year = 2014
           and county_cd <> '27')
select count(*) from g;

    -- total number of unique PAPACs
with p as (select distinct use_no
           from pur.udc
           where year = 2014
             and exists (select * from landuse.cropmap as c where county_cd = c.county_cd limit
1)
             and county_cd <> '27')
select count(*) from p;


    -- total number (and percent) of PAPACs affected by regulation
with p as (select distinct use_no
           from fumenote.pur_near_school_daycare
           where year = 2014
             and (num_schools > 0 or num_daycare > 0)
             and county_cd <> '27')
select count(*) from p;


    -- total acres that reported one or more pesticide applications
with p as (select grower_id, site_loc_id, max(acre_treated) as acres
           from pur.udc
           where year = 2014
             and exists (select * from landuse.cropmap as c where county_cd = c.county_cd limit
1)
             and county_cd <> '27'
           group by grower_id, site_loc_id)
select sum(acres) from p;


    -- total acres of fields that have some portion within 1/4mi of a school/daycare site
```

```
with p as (select grower_id, site_loc_id, max(acre_treated) as acres
           from fumenote.pur_near_school_daycare
           where year = 2014
             and county_cd <> '27'
           group by grower_id, site_loc_id)
select sum(acres) from p;


    -- total acres (and percent) within 1/4mi of a school/daycare site

with p as (select distinct grower_id, site_loc_id, both_ac as acres
           from fumenote.pur_near_school_daycare
           where year = 2014
             and county_cd <> '27')
select sum(acres) from p;



-- Main aerial application table

drop table if exists fumenote.aerial_applications;
create table fumenote.aerial_applications as (select distinct
                                                      a.county_cd,
                                                      initcap(c.name_ucase) as county,
                                                      a.school_year,
                                                      a.site_code,
                                                      initcap(s.sitename) as pur_crop,
                                                      initcap(dl.land_use) as dwr_crop_type,
                                                      a.app_type,
                                                      a.buffer_status
                                               from fumenote.aerial_applications_by_buffer_status
as a,
                                                    landuse.dwr_legend as dl,
                                                    pur.site as s,
                                                    boundaries.counties as c
                                               where s.sitecode = a.site_code
                                                 and a.county_cd = c.county_cd
                                                 and s.dwrclass = dl.class
                                                 and dl.subclass = '**'
                                                 and (s.dwrclass = 'G' or
                                                     s.dwrclass = 'R' or
                                                     s.dwrclass = 'F' or
                                                     s.dwrclass = 'P' or
                                                     s.dwrclass = 'T' or
                                                     s.dwrclass = 'D' or
                                                     s.dwrclass = 'C' or
                                                     s.dwrclass = 'V')
);

alter table fumenote.aerial_applications add column num_growers              bigint;
alter table fumenote.aerial_applications add column num_growers_mf_6t6       bigint;
alter table fumenote.aerial_applications add column num_growers_mf_b6        bigint;
alter table fumenote.aerial_applications add column num_growers_mf_a6        bigint;
alter table fumenote.aerial_applications add column num_growers_ss           bigint;
alter table fumenote.aerial_applications add column num_fields               bigint;
alter table fumenote.aerial_applications add column num_fields_mf_6t6        bigint;
alter table fumenote.aerial_applications add column num_fields_mf_b6         bigint;
alter table fumenote.aerial_applications add column num_fields_mf_a6         bigint;
alter table fumenote.aerial_applications add column num_fields_ss            bigint;
alter table fumenote.aerial_applications add column num_app_total            bigint;
alter table fumenote.aerial_applications add column num_app_mf_6t6           bigint;
alter table fumenote.aerial_applications add column num_app_mf_b6            bigint;
alter table fumenote.aerial_applications add column num_app_mf_a6            bigint;
alter table fumenote.aerial_applications add column num_app_ss               bigint;
alter table fumenote.aerial_applications add column acre_treated             real;
alter table fumenote.aerial_applications add column acre_treated_mf_6t6      real;
alter table fumenote.aerial_applications add column acre_treated_mf_b6       real;
alter table fumenote.aerial_applications add column acre_treated_mf_a6       real;
alter table fumenote.aerial_applications add column acre_treated_ss          real;
```

```
create index fumenote_aerial_applications_bs_idx on fumenote.aerial_applications
(buffer_status);
create index fumenote_aerial_applications_cd_idx on fumenote.aerial_applications (county_cd);
create index fumenote_aerial_applications_sy_idx on fumenote.aerial_applications (school_year);
create index fumenote_aerial_applications_sc_idx on fumenote.aerial_applications (site_code);
create index fumenote_aerial_applications_at_idx on fumenote.aerial_applications (app_type);


update fumenote.aerial_applications set num_growers = sq.val
from (with g as (select distinct buffer_status, app_type, county_cd, school_year, grower_id,
site_code
                 from fumenote.aerial_applications_by_buffer_status)
      select buffer_status, county_cd, site_code, school_year, app_type, count(*) as val
      from g
      group by buffer_status, county_cd, site_code, school_year, app_type
    ) as sq
where aerial_applications.buffer_status = sq.buffer_status
  and aerial_applications.app_type = sq.app_type
  and aerial_applications.county_cd = sq.county_cd
  and aerial_applications.school_year = sq.school_year
  and aerial_applications.site_code = sq.site_code;

update fumenote.aerial_applications set num_growers_mf_6t6 = sq.val
from (with g as (select distinct buffer_status, app_type, county_cd, school_year, grower_id,
site_code
             from fumenote.aerial_applications_by_buffer_status
             where daytime and not weekend)
      select buffer_status, county_cd, site_code, school_year, app_type, count(*) as val
      from g
      group by buffer_status, county_cd, site_code, school_year, app_type
    ) as sq
where aerial_applications.buffer_status = sq.buffer_status
  and aerial_applications.app_type = sq.app_type
  and aerial_applications.county_cd = sq.county_cd
  and aerial_applications.site_code = sq.site_code
  and aerial_applications.school_year = sq.school_year;

update fumenote.aerial_applications set num_growers_mf_b6 = sq.val
from (with g as (select distinct buffer_status, app_type, county_cd, school_year, grower_id,
site_code
             from fumenote.aerial_applications_by_buffer_status
             where pre_six_am and not weekend)
      select buffer_status, county_cd, site_code, school_year, app_type, count(*) as val
      from g
      group by buffer_status, county_cd, site_code, school_year, app_type
    ) as sq
where aerial_applications.buffer_status = sq.buffer_status
  and aerial_applications.app_type = sq.app_type
  and aerial_applications.county_cd = sq.county_cd
  and aerial_applications.school_year = sq.school_year;

update fumenote.aerial_applications set num_growers_mf_a6 = sq.val
from (with g as (select distinct buffer_status, app_type, county_cd, school_year, grower_id,
site_code
             from fumenote.aerial_applications_by_buffer_status
             where post_six_pm and not weekend)
      select buffer_status, county_cd, site_code, school_year, app_type, count(*) as val
      from g
      group by buffer_status, county_cd, site_code, school_year, app_type
    ) as sq
where aerial_applications.buffer_status = sq.buffer_status
  and aerial_applications.app_type = sq.app_type
  and aerial_applications.county_cd = sq.county_cd
  and aerial_applications.site_code = sq.site_code
  and aerial_applications.school_year = sq.school_year;

update fumenote.aerial_applications set num_growers_ss = sq.val
from (with g as (select distinct buffer_status, app_type, county_cd, school_year, grower_id,
site_code
             from fumenote.aerial_applications_by_buffer_status
             where weekend)
```

```
      select buffer_status, county_cd, site_code, school_year, app_type, count(*) as val
      from g
      group by buffer_status, county_cd, site_code, school_year, app_type
    ) as sq
where aerial_applications.buffer_status = sq.buffer_status
  and aerial_applications.app_type = sq.app_type
  and aerial_applications.county_cd = sq.county_cd
  and aerial_applications.site_code = sq.site_code
  and aerial_applications.school_year = sq.school_year;



update fumenote.aerial_applications set num_fields = sq.val
from (with f as (select distinct buffer_status, county_cd, grower_id, site_loc_id, site_code,
school_year, app_type
            from fumenote.aerial_applications_by_buffer_status)
      select buffer_status, county_cd, site_code, school_year, app_type, count(*) as val
             from f
             group by buffer_status, county_cd, site_code, school_year, app_type
     ) as sq
where aerial_applications.buffer_status = sq.buffer_status
  and aerial_applications.app_type = sq.app_type
  and aerial_applications.county_cd = sq.county_cd
  and aerial_applications.site_code = sq.site_code
  and aerial_applications.school_year = sq.school_year;

update fumenote.aerial_applications set num_fields_mf_6t6 = sq.val
from (with f as (select distinct buffer_status, county_cd, grower_id, site_loc_id, site_code,
school_year, app_type
            from fumenote.aerial_applications_by_buffer_status
             where daytime and not weekend)
      select buffer_status, county_cd, site_code, school_year, app_type, count(*) as val
             from f
             group by buffer_status, county_cd, site_code, school_year, app_type
     ) as sq
where aerial_applications.buffer_status = sq.buffer_status
  and aerial_applications.app_type = sq.app_type
  and aerial_applications.county_cd = sq.county_cd
  and aerial_applications.site_code = sq.site_code
  and aerial_applications.school_year = sq.school_year;

update fumenote.aerial_applications set num_fields_mf_b6 = sq.val
from (with f as (select distinct buffer_status, county_cd, grower_id, site_loc_id, site_code,
school_year, app_type
            from fumenote.aerial_applications_by_buffer_status
             where pre_six_am and not weekend)
      select buffer_status, county_cd, site_code, school_year, app_type, count(*) as val
             from f
             group by buffer_status, county_cd, site_code, school_year, app_type
     ) as sq
where aerial_applications.buffer_status = sq.buffer_status
  and aerial_applications.app_type = sq.app_type
  and aerial_applications.county_cd = sq.county_cd
  and aerial_applications.site_code = sq.site_code
  and aerial_applications.school_year = sq.school_year;

update fumenote.aerial_applications set num_fields_mf_a6 = sq.val
from (with f as (select distinct buffer_status, county_cd, grower_id, site_loc_id, site_code,
school_year, app_type
            from fumenote.aerial_applications_by_buffer_status
             where post_six_pm and not weekend)
      select buffer_status, county_cd, site_code, school_year, app_type, count(*) as val
             from f
             group by buffer_status, county_cd, site_code, school_year, app_type
     ) as sq
where aerial_applications.buffer_status = sq.buffer_status
  and aerial_applications.app_type = sq.app_type
  and aerial_applications.county_cd = sq.county_cd
  and aerial_applications.site_code = sq.site_code
  and aerial_applications.school_year = sq.school_year;
```

```
update fumenote.aerial_applications set num_fields_ss = sq.val
from (with f as (select distinct buffer_status, county_cd, grower_id, site_loc_id, site_code,
school_year, app_type
            from fumenote.aerial_applications_by_buffer_status
             where weekend)
      select buffer_status, county_cd, site_code, school_year, app_type, count(*) as val
             from f
             group by buffer_status, county_cd, site_code, school_year, app_type
     ) as sq
where aerial_applications.buffer_status = sq.buffer_status
  and aerial_applications.app_type = sq.app_type
  and aerial_applications.county_cd = sq.county_cd
  and aerial_applications.site_code = sq.site_code
  and aerial_applications.school_year = sq.school_year;



update fumenote.aerial_applications set num_app_total = sq.val
from (with a as (select distinct use_no, buffer_status, county_cd, site_code, school_year,
app_type
                 from fumenote.aerial_applications_by_buffer_status)
      select buffer_status, county_cd, site_code, school_year, app_type, count(*) as val
             from a
             group by buffer_status, county_cd, site_code, school_year, app_type
     ) as sq
where aerial_applications.buffer_status = sq.buffer_status
  and aerial_applications.app_type = sq.app_type
  and aerial_applications.county_cd = sq.county_cd
  and aerial_applications.site_code = sq.site_code
  and aerial_applications.school_year = sq.school_year;

update fumenote.aerial_applications set num_app_mf_6t6 = sq.val
from (with a as (select distinct use_no, buffer_status, county_cd, site_code, school_year,
app_type
                 from fumenote.aerial_applications_by_buffer_status
                 where daytime and not weekend)
      select buffer_status, county_cd, site_code, school_year, app_type, count(*) as val
             from a
             group by buffer_status, county_cd, site_code, school_year, app_type
     ) as sq
where aerial_applications.buffer_status = sq.buffer_status
  and aerial_applications.app_type = sq.app_type
  and aerial_applications.county_cd = sq.county_cd
  and aerial_applications.site_code = sq.site_code
  and aerial_applications.school_year = sq.school_year;

update fumenote.aerial_applications set num_app_mf_b6 = sq.val
from (with a as (select distinct use_no, buffer_status, county_cd, site_code, school_year,
app_type
                 from fumenote.aerial_applications_by_buffer_status
                 where pre_six_am and not weekend)
      select buffer_status, county_cd, site_code, school_year, app_type, count(*) as val
             from a
             group by buffer_status, county_cd, site_code, school_year, app_type
     ) as sq
where aerial_applications.buffer_status = sq.buffer_status
  and aerial_applications.app_type = sq.app_type
  and aerial_applications.county_cd = sq.county_cd
  and aerial_applications.site_code = sq.site_code
  and aerial_applications.school_year = sq.school_year;

update fumenote.aerial_applications set num_app_mf_a6 = sq.val
from (with a as (select distinct use_no, buffer_status, county_cd, site_code, school_year,
app_type
                 from fumenote.aerial_applications_by_buffer_status
                 where post_six_pm and not weekend)
      select buffer_status, county_cd, site_code, school_year, app_type, count(*) as val
             from a
             group by buffer_status, county_cd, site_code, school_year, app_type
     ) as sq
where aerial_applications.buffer_status = sq.buffer_status
```

```
  and aerial_applications.app_type = sq.app_type
  and aerial_applications.county_cd = sq.county_cd
  and aerial_applications.site_code = sq.site_code
  and aerial_applications.school_year = sq.school_year;


update fumenote.aerial_applications set num_app_ss = sq.val
from (with a as (select distinct use_no, buffer_status, county_cd, site_code, school_year,
app_type
                 from fumenote.aerial_applications_by_buffer_status
                 where weekend)
      select buffer_status, county_cd, site_code, school_year, app_type, count(*) as val
             from a
             group by buffer_status, county_cd, site_code, school_year, app_type
     ) as sq
where aerial_applications.buffer_status = sq.buffer_status
  and aerial_applications.app_type = sq.app_type
  and aerial_applications.county_cd = sq.county_cd
  and aerial_applications.site_code = sq.site_code
  and aerial_applications.school_year = sq.school_year;




update fumenote.aerial_applications set acre_treated = sq.val
from (with ac as (select use_no, buffer_status, county_cd, site_code, school_year, acre_treated,
app_type
                  from fumenote.aerial_applications_by_buffer_status)
      select buffer_status, county_cd, site_code, school_year, app_type, sum(acre_treated) as
val
      from ac
      group by buffer_status, county_cd, site_code, school_year, app_type
     ) as sq
where aerial_applications.buffer_status = sq.buffer_status
  and aerial_applications.app_type = sq.app_type
  and aerial_applications.county_cd = sq.county_cd
  and aerial_applications.site_code = sq.site_code
  and aerial_applications.school_year = sq.school_year;

update fumenote.aerial_applications set acre_treated_mf_6t6 = sq.val
from (with ac as (select use_no, buffer_status, county_cd, site_code, school_year, acre_treated,
app_type
                  from fumenote.aerial_applications_by_buffer_status
                  where daytime and not weekend)
      select buffer_status, county_cd, site_code, school_year, app_type, sum(acre_treated) as
val
      from ac
      group by buffer_status, county_cd, site_code, school_year, app_type
     ) as sq
where aerial_applications.buffer_status = sq.buffer_status
  and aerial_applications.app_type = sq.app_type
  and aerial_applications.county_cd = sq.county_cd
  and aerial_applications.site_code = sq.site_code
  and aerial_applications.school_year = sq.school_year;

update fumenote.aerial_applications set acre_treated_mf_b6 = sq.val
from (with ac as (select use_no, buffer_status, county_cd, site_code, school_year, acre_treated,
app_type
                  from fumenote.aerial_applications_by_buffer_status
                  where pre_six_am and not weekend)
      select buffer_status, county_cd, site_code, school_year, app_type, sum(acre_treated) as
val
      from ac
      group by buffer_status, county_cd, site_code, school_year, app_type
     ) as sq
where aerial_applications.buffer_status = sq.buffer_status
  and aerial_applications.app_type = sq.app_type
  and aerial_applications.county_cd = sq.county_cd
  and aerial_applications.site_code = sq.site_code
  and aerial_applications.school_year = sq.school_year;
```

```
update fumenote.aerial_applications set acre_treated_mf_a6 = sq.val
from (with ac as (select use_no, buffer_status, county_cd, site_code, school_year, acre_treated,
app_type
                  from fumenote.aerial_applications_by_buffer_status
                  where post_six_pm and not weekend)
      select buffer_status, county_cd, site_code, school_year, app_type, sum(acre_treated) as
val
      from ac
      group by buffer_status, county_cd, site_code, school_year, app_type
     ) as sq
where aerial_applications.buffer_status = sq.buffer_status
  and aerial_applications.app_type = sq.app_type
  and aerial_applications.county_cd = sq.county_cd
  and aerial_applications.site_code = sq.site_code
  and aerial_applications.school_year = sq.school_year;

update fumenote.aerial_applications set acre_treated_ss = sq.val
from (with ac as (select use_no, buffer_status, county_cd, site_code, school_year, acre_treated,
app_type
                  from fumenote.aerial_applications_by_buffer_status
                  where weekend)
      select buffer_status, county_cd, site_code, school_year, app_type, sum(acre_treated) as
val
      from ac
      group by buffer_status, county_cd, site_code, school_year, app_type
     ) as sq
where aerial_applications.buffer_status = sq.buffer_status
  and aerial_applications.app_type = sq.app_type
  and aerial_applications.county_cd = sq.county_cd
  and aerial_applications.site_code = sq.site_code
  and aerial_applications.school_year = sq.school_year;


alter table fumenote.aerial_applications add column unique_acre_treated          real;
alter table fumenote.aerial_applications add column unique_acre_treated_mf_6t6   real;
alter table fumenote.aerial_applications add column unique_acre_treated_mf_b6    real;
alter table fumenote.aerial_applications add column unique_acre_treated_mf_a6    real;
alter table fumenote.aerial_applications add column unique_acre_treated_ss       real;

update fumenote.aerial_applications set unique_acre_treated = sq.val
from (with ac as (select grower_id, site_loc_id, buffer_status, county_cd, site_code,
school_year, app_type,
                         max(acre_treated) as acre_treated
                  from fumenote.aerial_applications_by_buffer_status
                  group by grower_id, site_loc_id, buffer_status, county_cd, site_code,
school_year, app_type)
      select buffer_status, county_cd, site_code, school_year, app_type, sum(acre_treated) as
val
      from ac
      group by buffer_status, county_cd, site_code, school_year, app_type
     ) as sq
where aerial_applications.buffer_status = sq.buffer_status
  and aerial_applications.app_type = sq.app_type
  and aerial_applications.county_cd = sq.county_cd
  and aerial_applications.site_code = sq.site_code
  and aerial_applications.school_year = sq.school_year;

update fumenote.aerial_applications set unique_acre_treated_mf_6t6 = sq.val
from (with ac as (select grower_id, site_loc_id, buffer_status, county_cd, site_code,
school_year, app_type,
                         max(acre_treated) as acre_treated
                  from fumenote.aerial_applications_by_buffer_status
                  where daytime and not weekend
                  group by grower_id, site_loc_id, buffer_status, county_cd, site_code,
school_year, app_type)
      select buffer_status, county_cd, site_code, school_year, app_type, sum(acre_treated) as
val
      from ac
      group by buffer_status, county_cd, site_code, school_year, app_type
     ) as sq
```

```
where aerial_applications.buffer_status = sq.buffer_status
  and aerial_applications.app_type = sq.app_type
  and aerial_applications.county_cd = sq.county_cd
  and aerial_applications.site_code = sq.site_code
  and aerial_applications.school_year = sq.school_year;

update fumenote.aerial_applications set unique_acre_treated_mf_b6 = sq.val
from (with ac as (select grower_id, site_loc_id, buffer_status, county_cd, site_code,
school_year, app_type,
                         max(acre_treated) as acre_treated
                  from fumenote.aerial_applications_by_buffer_status
                  where pre_six_am and not weekend
                  group by grower_id, site_loc_id, buffer_status, county_cd, site_code,
school_year, app_type)
      select buffer_status, county_cd, site_code, school_year, app_type, sum(acre_treated) as
val
      from ac
      group by buffer_status, county_cd, site_code, school_year, app_type
     ) as sq
where aerial_applications.buffer_status = sq.buffer_status
  and aerial_applications.app_type = sq.app_type
  and aerial_applications.county_cd = sq.county_cd
  and aerial_applications.site_code = sq.site_code
  and aerial_applications.school_year = sq.school_year;

update fumenote.aerial_applications set unique_acre_treated_mf_a6 = sq.val
from (with ac as (select grower_id, site_loc_id, buffer_status, county_cd, site_code,
school_year, app_type,
                         max(acre_treated) as acre_treated
                  from fumenote.aerial_applications_by_buffer_status
                  where post_six_pm and not weekend
                  group by grower_id, site_loc_id, buffer_status, county_cd, site_code,
school_year, app_type)
      select buffer_status, county_cd, site_code, school_year, app_type, sum(acre_treated) as
val
      from ac
      group by buffer_status, county_cd, site_code, school_year, app_type
     ) as sq
where aerial_applications.buffer_status = sq.buffer_status
  and aerial_applications.app_type = sq.app_type
  and aerial_applications.county_cd = sq.county_cd
  and aerial_applications.site_code = sq.site_code
  and aerial_applications.school_year = sq.school_year;

update fumenote.aerial_applications set unique_acre_treated_ss = sq.val
from (with ac as (select grower_id, site_loc_id, buffer_status, county_cd, site_code,
school_year, app_type,
                         max(acre_treated) as acre_treated
                  from fumenote.aerial_applications_by_buffer_status
                  where weekend
                  group by grower_id, site_loc_id, buffer_status, county_cd, site_code,
school_year, app_type)
      select buffer_status, county_cd, site_code, school_year, app_type, sum(acre_treated) as
val
      from ac
      group by buffer_status, county_cd, site_code, school_year, app_type
     ) as sq
where aerial_applications.buffer_status = sq.buffer_status
  and aerial_applications.app_type = sq.app_type
  and aerial_applications.county_cd = sq.county_cd
  and aerial_applications.site_code = sq.site_code
  and aerial_applications.school_year = sq.school_year;




update fumenote.aerial_applications set num_growers = 0 where num_growers is null;
update fumenote.aerial_applications set num_growers_mf_6t6 = 0 where num_growers_mf_6t6 is null;
update fumenote.aerial_applications set num_growers_mf_b6 = 0 where num_growers_mf_b6 is null;
update fumenote.aerial_applications set num_growers_mf_a6 = 0 where num_growers_mf_a6 is null;
```

```
update fumenote.aerial_applications set num_growers_ss = 0 where num_growers_ss is null;
update fumenote.aerial_applications set num_fields = 0 where num_fields is null;
update fumenote.aerial_applications set num_fields_mf_6t6 = 0 where num_fields_mf_6t6 is null;
update fumenote.aerial_applications set num_fields_mf_b6 = 0 where num_fields_mf_b6 is null;
update fumenote.aerial_applications set num_fields_mf_a6 = 0 where num_fields_mf_a6 is null;
update fumenote.aerial_applications set num_fields_ss = 0 where num_fields_ss is null;
update fumenote.aerial_applications set num_app_total = 0 where num_app_total is null;
update fumenote.aerial_applications set num_app_mf_6t6 = 0 where num_app_mf_6t6 is null;
update fumenote.aerial_applications set num_app_mf_b6 = 0 where num_app_mf_b6 is null;
update fumenote.aerial_applications set num_app_mf_a6 = 0 where num_app_mf_a6 is null;
update fumenote.aerial_applications set num_app_ss = 0 where num_app_ss is null;
update fumenote.aerial_applications set acre_treated = 0 where acre_treated is null;
update fumenote.aerial_applications set acre_treated_mf_6t6 = 0 where acre_treated_mf_6t6 is
null;
update fumenote.aerial_applications set acre_treated_mf_b6 = 0 where acre_treated_mf_b6 is null;
update fumenote.aerial_applications set acre_treated_mf_a6 = 0 where acre_treated_mf_a6 is null;
update fumenote.aerial_applications set acre_treated_ss = 0 where acre_treated_ss is null;
update fumenote.aerial_applications set unique_acre_treated = 0 where unique_acre_treated is
null;
update fumenote.aerial_applications set unique_acre_treated_mf_6t6 = 0 where
unique_acre_treated_mf_6t6 is null;
update fumenote.aerial_applications set unique_acre_treated_mf_b6 = 0 where
unique_acre_treated_mf_b6 is null;
update fumenote.aerial_applications set unique_acre_treated_mf_a6 = 0 where
unique_acre_treated_mf_a6 is null;
update fumenote.aerial_applications set unique_acre_treated_ss = 0 where unique_acre_treated_ss
is null;


\copy fumenote.aerial_applications to
'/home/paradox/Dropbox/school_notification/aerial_applications.csv' with csv header;



drop table if exists fumenote.aerial_applications_by_grower;
create table fumenote.aerial_applications_by_grower as (
    with ex as (select distinct buffer_status, county_cd, grower_id, site_loc_id,
                                site_code, school_year, use_no, acre_treated,
                                case when (weekend) then 'Weekend'
                                     when (not weekend and daytime) then 'Weekday 6am-6pm'
                                     when (not weekend and pre_six_am) then 'Weekday before 6am'
                                     when (not weekend and post_six_pm) then 'Weekday after 6pm'
                                 end time_period
                from fumenote.aerial_applications_by_buffer_status
                where (not weekend and daytime) or (not weekend and pre_six_am) or (not weekend
and post_six_pm)),
         f as (select distinct buffer_status, county_cd, grower_id, site_loc_id, site_code,
                      school_year, time_period, acre_treated
               from ex),
         fsum as (select buffer_status, county_cd, school_year, grower_id, site_code,
time_period,
                         count(*) as num_fields,
                         sum(acre_treated) as acre_treated
                  from f
                  group by buffer_status, county_cd, school_year, grower_id, time_period,
site_code)
    select initcap(c.county_name) as county,
           fsum.school_year as school_year,
           fsum.buffer_status as buffer_status,
           fsum.time_period as time_period,
           initcap(s.sitename) as pur_crop,
           initcap(d.land_use) as crop_type,
           sum(fsum.num_fields) as total_num_fields,
           sum(fsum.acre_treated) as total_acres,
           avg(fsum.num_fields) as num_fields_avg,
           percentile_cont(0.5) within group (order by num_fields) as num_fields_median,
           max(num_fields) as num_fields_max,
           min(num_fields) as num_fields_min,
           avg(acre_treated) as acre_avg,
           percentile_cont(0.5) within group (order by acre_treated) as acre_median,
           max(acre_treated) as acre_max,
```

```
           min(acre_treated) as acre_min
    from fsum,
         pur.county as c,
         pur.site as s,
         landuse.dwr_legend as d
    where fsum.county_cd = c.county_cd
      and s.sitecode = fsum.site_code
      and s.dwrclass = d.class
      and d.subclass = '**'
      and (d.class = 'G' or d.class = 'R' or d.class = 'F' or d.class = 'P' or d.class = 'T' or
           d.class = 'D' or d.class = 'C' or d.class = 'V')
    group by initcap(c.county_name), fsum.school_year, fsum.time_period,
             initcap(s.sitename), initcap(d.land_use), fsum.buffer_status
);

delete from fumenote.aerial_applications_by_grower where county = 'Monterey';
\copy fumenote.aerial_applications_by_grower to
'/home/paradox/Dropbox/school_notification/aerial_applications_by_grower.csv' with csv header;


-- AI based rows
-- Get the main AI in a given product (ie highest percentage AI)
drop table if exists fumenote.prod_chem_extract;
create table fumenote.prod_chem_extract as (select distinct prodno from
pur.prod_chem_no_adjuvents);
alter table fumenote.prod_chem_extract add column chem_code integer;
alter table fumenote.prod_chem_extract add column prodchem_ratio real;
update fumenote.prod_chem_extract set chem_code =
     (select pc.chem_code
      from pur.prod_chem_no_adjuvents as pc
      where pc.prodno = prod_chem_extract.prodno
      order by prodchem_pct desc
      limit 1);
update fumenote.prod_chem_extract set prodchem_ratio =
(select p.prodchem_pct / 100
 from pur.prod_chem_no_adjuvents as p
 where p.prodno = prod_chem_extract.prodno
   and p.chem_code = prod_chem_extract.chem_code);
create index fumenote_prod_chem_extract_prodno_idx on fumenote.prod_chem_extract (prodno);



-- PUR usage statistics
-- BY AI (update version 12/8)
-- year, use_no, county_cd, county, grower_id, site_loc_id, chem_code, chemname, site_code,
sitename,
-- applic_dt, applic_time, restriction, aer_gnd_ind, ai_class, ai_type, ai_tpye_specific,
lbs_prod_per_ac,
-- school_year, school_time, school_ac, daycare_ac, both_ac,
drop table if exists fumenote.pur_near_school_daycare;
create table fumenote.pur_near_school_daycare as (
select distinct p.year                                              as year,
                p.use_no                                            as use_no,
                p.county_cd                                         as county_cd,
                c.county_name                                       as county_name,
                substring(p.grower_id from 5)                       as grower_id,
                p.site_loc_id                                       as site_loc_id,
                p.prodno                                            as prodno,
                prod.product_name                                   as product_name,
                f.formula_dsc                                       as formula_dsc,
                p.aer_gnd_ind                                       as aer_gnd_ind,
                0::integer                                          as chemigation,
                0::integer                                          as fed_restricted,
                0::integer                                          as ca_restricted,
                0::integer                                          as main_chem_code,
                ''::text                                            as main_chem_name,
                ''::text                                            as ai_class,
                ''::text                                            as ai_type_specific,
                p.site_code                                         as site_code,
                s.sitename                                          as site_name,
                p.applic_dt                                         as applic_dt,
```

```sql
                extract(month from p.applic_dt)                         as month,
                p.applic_time                                           as applic_time,
                p.acre_treated                                          as acre_treated,
                0.0::real                                               as lbs_chem,
                p.lbs_prd_used                                          as lbs_prod,
                0::integer                                              as school_day,
                0::integer                                              as weekend,
                ST_Area(cm.sb_hy_geom)*0.000247105                      as school_ac,
                ST_Area(cm.dc_hy_geom)*0.000247105                      as daycare_ac,
                ST_Area(cm.both_geom)*0.000247105                       as both_ac,
                cm.num_schools                                          as num_schools,
                cm.num_daycare                                          as num_daycare
from pur.udc as p,
     pur.product as prod,
     pur.formula as f,
     pur.county as c,
     pur.site as s,
     landuse.cropmap as cm
where p.prodno = prod.prodno
  and cm.both_geom is not null
  and prod.formula_cd = f.formula_cd
  and p.county_cd = c.county_cd
  and p.site_code = s.sitecode
  and substring(p.grower_id from 5) = cm.grower_id
  and p.county_cd = cm.county_cd
  and (p.site_loc_id = cm.site_loc_id or
      (cm.county_cd = '56' and
       cm.site_loc_id =
            trim(trailing 'ABCDEFG' from (trim(leading '0' from p.site_loc_id)))))
  and (p.year = 2013 or p.year = 2014));


-- fill in restricted status flags
update fumenote.pur_near_school_daycare set fed_restricted = 1
where exists (select * from pur.prod_special_status as ss
              where ss.prodno = pur_near_school_daycare.prodno
                and (ss.specstat_cd = 'B0' or ss.specstat_cd = 'B1'));

update fumenote.pur_near_school_daycare set ca_restricted = 1
where exists (select * from pur.prod_special_status as ss
              where ss.prodno = pur_near_school_daycare.prodno
                and ss.specstat_cd = 'B2');


-- fill in chemigation flag
update fumenote.pur_near_school_daycare set chemigation = 1
from pur.prod_appl_method as pam
where pur_near_school_daycare.prodno = pam.prodno
  and pam.applmeth_cd = 'F0';


-- Chem code based columns
update fumenote.pur_near_school_daycare set main_chem_code = null;

update fumenote.pur_near_school_daycare set (main_chem_code, lbs_chem) =
(pce.chem_code, pce.prodchem_ratio * pur_near_school_daycare.lbs_prod)
from fumenote.prod_chem_extract as pce
where pce.prodno = pur_near_school_daycare.prodno;

update fumenote.pur_near_school_daycare set (ai_class, ai_type_specific) =
(aicat.ai_class, aicat.ai_type_specific)
from pur.dpr_ai_categories as aicat
where pur_near_school_daycare.main_chem_code = aicat.chem_code;

update fumenote.pur_near_school_daycare set main_chem_name = c.chemname
from pur.chemical as c
where c.chem_code = pur_near_school_daycare.main_chem_code;

-- Timing flags
update fumenote.pur_near_school_daycare set weekend = 1
where extract(DOW from applic_dt) = 0 or extract(DOW from applic_dt) = 6;
```

```sql
update fumenote.pur_near_school_daycare set school_day = 1
where weekend = 0
  and not exists (select * from fumenote.school_days as sd
                  where sd.county_cd = pur_near_school_daycare.county_cd
                    and pur_near_school_daycare.applic_dt between sd.start_dt and sd.end_dt);

-- Stats

drop table if exists fumenote.pur_near_school_daycare_stats;

create table fumenote.pur_near_school_daycare_stats
(county_name           text,
 facility_type         text,
 data_source           text,
 num_growers_impacted   integer,
 num_fields_impacted   integer,
 num_schoolday_apps    integer,
 num_apps              integer,
 acres_impacted        real);

insert into fumenote.pur_near_school_daycare_stats
(with ex as (select * from fumenote.pur_near_school_daycare where both_ac is not null),
      ex_sum as (select county_name, count(*) as ct from ex group by county_name),
      gr as (select distinct county_name, grower_id from ex),
      gr_sum as (select county_name, count(*) as ct from gr group by county_name),
      fd as (select distinct county_name, grower_id, site_loc_id from ex),
      fd_sum as (select county_name, count(*) as ct from fd group by county_name),
      sd as (select * from ex where school_day = 1 and weekend = 0),
      sd_sum as (select county_name, count(*) as ct from sd group by county_name),
      ac as (select county_name, grower_id, site_loc_id, max(both_ac) as acres from ex
             group by county_name, grower_id, site_loc_id),
      ac_sum as (select county_name, sum(acres) as acres from ac group by county_name)
 select gr_sum.county_name, 'Both School & Daycare', 'hybrid',
        gr_sum.ct,
        fd_sum.ct,
        sd_sum.ct,
        ex_sum.ct,
        ac_sum.acres
 from gr_sum, fd_sum, sd_sum, ac_sum, ex_sum
 where ex_sum.county_name = gr_sum.county_name
   and ex_sum.county_name = sd_sum.county_name
   and ex_sum.county_name = ac_sum.county_name
   and ex_sum.county_name = fd_sum.county_name
);

insert into fumenote.pur_near_school_daycare_stats
(with ex as (select * from fumenote.pur_near_school_daycare where school_ac is not null),
      ex_sum as (select county_name, count(*) as ct from ex group by county_name),
      gr as (select distinct county_name, grower_id from ex),
      gr_sum as (select county_name, count(*) as ct from gr group by county_name),
      fd as (select distinct county_name, grower_id, site_loc_id from ex),
      fd_sum as (select county_name, count(*) as ct from fd group by county_name),
      sd as (select * from ex where school_day = 1 and weekend = 0),
      sd_sum as (select county_name, count(*) as ct from sd group by county_name),
      ac as (select county_name, grower_id, site_loc_id, max(school_ac) as acres from ex
             group by county_name, grower_id, site_loc_id),
      ac_sum as (select county_name, sum(acres) as acres from ac group by county_name)
 select gr_sum.county_name, 'School', 'CDE active - hybrid',
        gr_sum.ct,
        fd_sum.ct,
        sd_sum.ct,
        ex_sum.ct,
        ac_sum.acres
 from gr_sum, fd_sum, sd_sum, ac_sum, ex_sum
 where ex_sum.county_name = gr_sum.county_name
   and ex_sum.county_name = sd_sum.county_name
   and ex_sum.county_name = ac_sum.county_name
   and ex_sum.county_name = fd_sum.county_name
);
```

```sql
insert into fumenote.pur_near_school_daycare_stats
(with ex as (select * from fumenote.pur_near_school_daycare where daycare_ac is not null),
      ex_sum as (select county_name, count(*) as ct from ex group by county_name),
      gr as (select distinct county_name, grower_id from ex),
      gr_sum as (select county_name, count(*) as ct from gr group by county_name),
      fd as (select distinct county_name, grower_id, site_loc_id from ex),
      fd_sum as (select county_name, count(*) as ct from fd group by county_name),
      sd as (select * from ex where school_day = 1 and weekend = 0),
      sd_sum as (select county_name, count(*) as ct from sd group by county_name),
      ac as (select county_name, grower_id, site_loc_id, max(daycare_ac) as acres from ex
             group by county_name, grower_id, site_loc_id),
      ac_sum as (select county_name, sum(acres) as acres from ac group by county_name)
 select gr_sum.county_name, 'Daycare', 'CCLD - hybrid',
        gr_sum.ct,
        fd_sum.ct,
        sd_sum.ct,
        ex_sum.ct,

drop table if exists fumenote.cropmap_tmp;
create table fumenote.cropmap_tmp as
select county_cd, grower_id, site_loc_id, ST_Union(geom) as geom, ST_Union(both_geom) as
both_geom
from landuse.cropmap
group by county_cd, grower_id, site_loc_id;

drop table if exists fumenote.soil_tmp;
create table fumenote.soil_tmp as
with counties as (select distinct county_cd from landuse.cropmap)
select m.mukey, (ST_Dump(ST_Union(m.wkb_geometry))).geom as wkb_geometry from ssurgo.mupolygon
as m, boundaries.counties as c
where ST_Intersects(m.wkb_geometry, c.geom)
  and exists(select p.* from counties as p where p.county_cd = c.county_cd)
group by mukey;

create index fumenote_cropmap_tmp_geom_idx on fumenote.cropmap_tmp using gist (geom);
create index fumenote_cropmap_tmp_both_geom_idx on fumenote.cropmap_tmp using gist (both_geom);
create index fumenote_soil_tmp_geom_idx on fumenote.soil_tmp using gist (wkb_geometry);

update fumenote.cropmap_tmp set geom = ST_MakeValid(ST_Buffer(geom,0.0));
update fumenote.soil_tmp set wkb_geometry = ST_MakeValid(ST_Buffer(wkb_geometry,0.0));


drop table if exists fumenote.fields_by_hydsoil_tmp;
create table fumenote.fields_by_hydsoil_tmp as
select c.county_cd, c.grower_id, c.site_loc_id,
                   com.hydgrp as soil_hyd_grp,
                   ST_Intersection(c.geom, s.wkb_geometry) as geom,
                   ST_Intersection(c.both_geom, s.wkb_geometry) as both_geom
            from fumenote.cropmap_tmp as c, fumenote.soil_tmp as s, ssurgo.component as com
            where s.mukey = com.mukey
              and c.geom && s.wkb_geometry;

update fumenote.fields_by_hydsoil_tmp set (geom, both_geom) =
(ST_MakeValid(ST_Buffer(geom,0.0)), ST_Makevalid(ST_Buffer(both_geom,0.0)));

drop table fumenote.pur_site_extract_tmp;
create table fumenote.pur_site_extract_tmp as
select county_cd, grower_id, site_loc_id, site_code, count(*) as ct
from pur.udc
where year = 2014
group by county_cd, grower_id, site_loc_id, site_code;


delete from fumenote.pur_site_extract_tmp
where exists (select * from fumenote.pur_site_extract_tmp as pset
              where pset.county_cd = pur_site_extract_tmp.county_cd
                and pset.grower_id = pur_site_extract_tmp.grower_id
                and pset.site_loc_id = pur_site_extract_tmp.site_loc_id
                and pset.ct > pur_site_extract_tmp.ct);
```

```sql
alter table fumenote.fields_by_hydsoil_tmp add column site_code integer;
update fumenote.fields_by_hydsoil_tmp set site_code = p.site_code
      from fumenote.pur_site_extract_tmp as p
      where substring(p.grower_id from 5) = fields_by_hydsoil_tmp.grower_id
        and (p.site_loc_id = fields_by_hydsoil_tmp.site_loc_id or
             (fields_by_hydsoil_tmp.county_cd = '56' and
              fields_by_hydsoil_tmp.site_loc_id =
                    trim(trailing 'ABCDEFG' from (trim(leading '0' from p.site_loc_id)))))
        and p.county_cd = fields_by_hydsoil_tmp.county_cd
;




drop table if exists fumenote.fields_by_hydsoil;
create table fumenote.fields_by_hydsoil as
select county_cd, grower_id, site_loc_id, soil_hyd_grp, site_code,
       ST_Union(geom) as geom, ST_Union(both_geom) as both_geom
from fumenote.fields_by_hydsoil_tmp
group by county_cd, grower_id, site_loc_id, soil_hyd_grp, site_code;



drop table if exists fumenote.fields_by_hydsoil_check;
create table fumenote.fields_by_hydsoil_check as
with c as (select county_cd, grower_id, site_loc_id, ST_Union(geom) as geom, ST_Union(both_geom)
as both_geom
           from landuse.cropmap
           group by county_cd, grower_id, site_loc_id),
     f as (select county_cd, grower_id, site_loc_id, ST_Union(geom) as geom, ST_Union(both_geom)
as both_geom
           from fumenote.fields_by_hydsoil
           group by county_cd, grower_id, site_loc_id),
     ca as (select county_cd, grower_id, site_loc_id,
                   ST_Area(geom)*0.000247105 as acres, ST_Area(both_geom)*0.000247105 as
sd_acres
            from c),
     fa as (select county_cd, grower_id, site_loc_id,
                   ST_Area(geom)*0.000247105 as acres, ST_Area(both_geom)*0.000247105 as
sd_acres
            from f)
select fa.county_cd, fa.grower_id, fa.site_loc_id,
       sum(fa.acres) as fbh_acres,
       sum(fa.sd_acres) as fbh_sd_acres,
       sum(ca.acres) as c_acres,
       sum(ca.sd_acres) as c_sd_acres
from ca, fa
where ca.county_cd = fa.county_cd
  and ca.grower_id = fa.grower_id
  and ca.site_loc_id = fa.site_loc_id
group by fa.county_cd, fa.grower_id, fa.site_loc_id;


drop table if exists fumenote.fields_by_hydsoil_export;
create table fumenote.fields_by_hydsoil_export as (
    with fbh as (select county_cd, soil_hyd_grp, site_code, ST_Union(geom) as geom,
ST_Union(both_geom) as both_geom
                 from fumenote.fields_by_hydsoil
                 where soil_hyd_grp is not null
                 group by county_cd, soil_hyd_grp, site_code)
    select fbh.county_cd, c.name_pcase as county, fbh.site_code, initcap(s.sitename) as
pur_crop, fbh.soil_hyd_grp,
           ST_Area(fbh.geom)*0.000247105 as acres,
           ST_Area(fbh.both_geom)*0.000247105 as sd_acres
    from fbh, pur.site as s, boundaries.counties as c
    where fbh.site_code = s.sitecode and fbh.county_cd = c.county_cd
    order by county, pur_crop, soil_hyd_grp
);
update fumenote.fields_by_hydsoil_export set acres = null where acres = 0;
update fumenote.fields_by_hydsoil_export set sd_acres = null where sd_acres = 0;
delete from fumenote.fields_by_hydsoil_export where acres is null;
```

```
\copy fumenote.fields_by_hydsoil_export to
'/home/paradox/Dropbox/school_notification/acres_by_hydsoil.csv' with csv header


drop table if exists fumenote.cropmap_stat;
create table fumenote.cropmap_stat as (
with c as (select county_cd, grower_id, site_loc_id,
                  ST_Buffer(ST_Union(geom),0.0) as geom,
                  ST_Buffer(ST_Union(both_geom),0.0) as both_geom
           from landuse.cropmap
           group by county_cd, grower_id, site_loc_id),
     cx as (select distinct c.county_cd, c.grower_id, c.site_loc_id, p.site_code, c.geom,
c.both_geom
            from c, fumenote.fields_by_hydsoil as p
            where c.county_cd = p.county_cd and c.grower_id = p.grower_id and c.site_loc_id =
p.site_loc_id),
     cs as (select county_cd, site_code, ST_Union(geom) as geom, ST_Union(both_geom) as
both_geom
            from cx
            group by county_cd, site_code)
select cs.county_cd, cc.name_pcase as county, cs.site_code, initcap(s.sitename) as pur_crop,
           ST_Area(cs.geom)*0.000247105 as acres,
           ST_Area(cs.both_geom)*0.000247105 as sd_acres
    from cs, pur.site as s, boundaries.counties as cc
    where cs.site_code = s.sitecode and cs.county_cd = cc.county_cd
);
```