



Department of Pesticide Regulation



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MEMORANDUM

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SUBJECT: CHANGE IN RESTRICTED ENTRY INTERVAL FOR SULFUR USE ON
GRAPES FROM A DATE TIME RELATIONSHIP TO TEMPERATURE
AND WEATHER CONDITIONS.

HSM-00002

The current restricted entry interval (REI) for sulfur applied to grapes is three days from May 15 through harvest in the counties of Fresno, Kern, Kings, Madera, Merced, San Joaquin, Stanislaus, and Tulare and during March and April in Riverside County¹. Due to unusual weather patterns during 1998 and 1999, a Declaration of Agricultural Emergency was issued each year. During this emergency, the three-day REI allowed for an exemption up to June 15. This was to prevent or mitigate a substantial economic loss to an agricultural establishment in those counties with the REI². In these cases critical hand labor practices required completion at times coinciding with sulfur treatments. As part of the hand labor tasks early reentry was allowed when temperatures did not exceed 90 degrees Fahrenheit and at 24 hours had elapsed since the sulfur treatment. Except for cases involving spray drift or exposure to direct spray there were no outbreaks of skin or eye injuries involving field residues to sulfur in 1998 or 1999³.

In 1986, the sulfur REI was extended to three days. This was an attempt to alleviate some of the skin injuries occurring in the San Joaquin Valley. The data from 1982 to 1985 was used to support the 3-day change but no follow up was completed to review the effect of the regulation. The three years following the regulatory change did not show a downward trend in the number of injuries occurring from sulfur (Figure 1). Not until the propargite reentry interval was extended to 21 days (Figure 1, 1989), did the number of skin and eye incidents begin to show a downward trend.

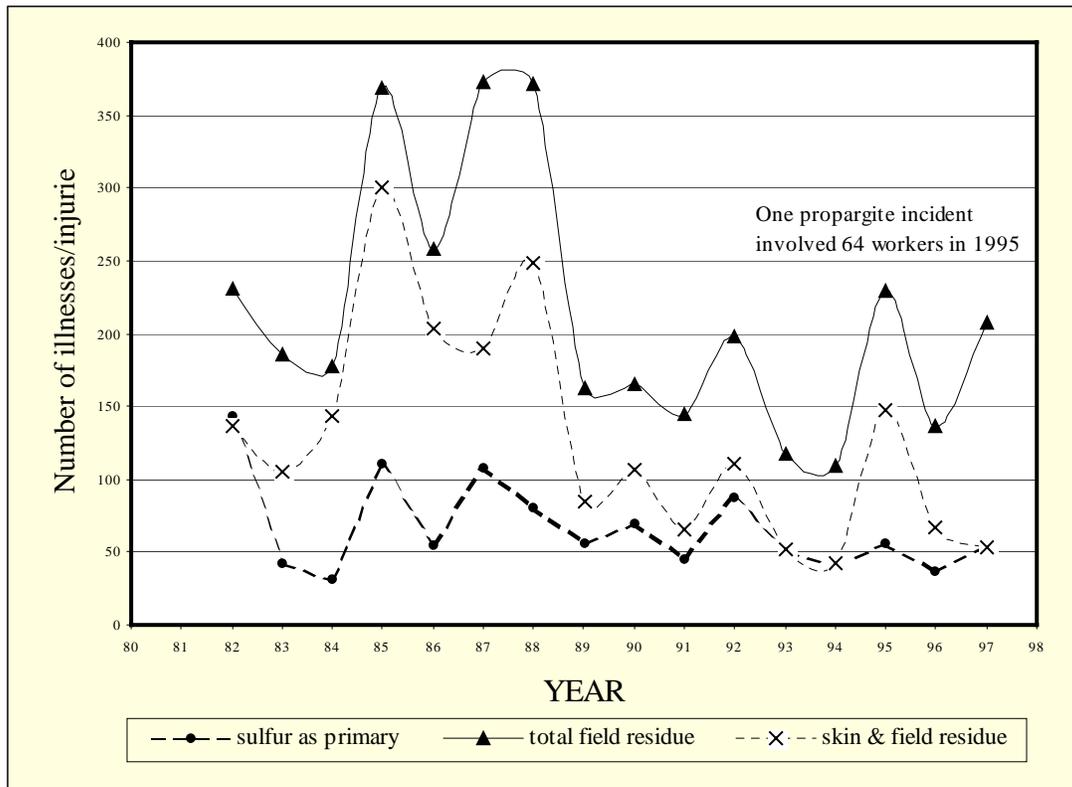
Illness investigations conducted in the 1980's did not have detailed work histories for field workers. Current investigations often have a five-day work history. Workers can repeatedly enter any number of fields that have been treated with sulfur or other compounds from one day to two weeks or more before developing a skin injury⁴. The illness relationship can be tied to the last field entered when a more detailed work history would show cumulative exposure to sulfur and/or other pesticide residues. The entry into numerous sulfur treated fields where sulfur is present in combination with another pesticide could have caused worker dermatitis. Since the



propargite REI was extended, dermatitis cases attributed to other or multiple pesticide exposures also have declined⁵. “Possible interpretations of this phenomenon include misclassification of cases in previous years (i.e., propargite-induced cases may have been attributed to other compounds applied more recently) and multifactorial etiology (i.e., propargite exposure may have been one of a number of irritant conditions contributing to the development of dermatitis).”⁵

Sulfur has been increasingly used for resistance management⁶. The introduction of dimethylation inhibitors saw sulfur use decline when first introduced in the 1980’s. Powdery mildew has shown resistance to dimethylation inhibitors (DMI’s) resulting in an increase in sulfur applications. “Raisin growers rely almost exclusively on sulfur; wine and table grape growers employ both sulfur and DMI’s.”⁶ Sulfur is approved for use on organic grapes. Sulfur would also be part of any sustainable viticulture program⁷. These factors, resistance management and organic production, drive the increased use of sulfur.

Figure 1



Sulfur is exempt from pesticide tolerance⁸. It is primarily a skin and eye irritant. Exposure in very hot weather seems to present the highest potential for injury^{4,5}. On a pounds per acre basis

there is as much sulfur used in Sonoma County area as there is in Fresno County, when averaging the pounds applied by the number of acres treated. But few incidents of sulfur injuries have been reported from the north coast grape growing area. This suggests a temperature/duration relationship to the number of illnesses that occur in the Southern San Joaquin Valley. A 1982 study⁴ showed a positive relationship between increasing temperature and the incidence of rashes occurring during thinning. The average high temperature on days the rashes occurred was 91.7 degrees while the average on days in which thinning was performed in the absence of rashes was 87.0 degrees ($p= 0.05$).

Sulfur occurs in the free state and in combination, mainly as sulfides and sulfates, and constitutes 0.05% of the crust of the earth and has been known since early times⁹. Since sulfur is an element,¹⁰ it does not degrade after being applied to leaves. There is slight oxidation of sulfur on leaves primarily through incorporation into physiological substances¹¹. Removal of sulfur from leaves also occurs through physical means such as rainfall, wind, abrasion, and leaf senescence or through dilution by leaf growth. While time will eventually influence the dislodgeable foliar residues, data from a propargite illness¹² incident suggest this may not be significant over the short term. Sulfur was found at three locations where spray histories were collected for the preceding 68 days. Sulfur was not reported in the spray histories for three sites where residues ranged from 0.17 – 1.065 $\mu\text{g}/\text{cm}^2$, while one site treated 58 days prior detected 0.16 $\mu\text{g}/\text{cm}^2$. This branch also has unpublished data¹³ on sulfur residues ranging from 0.01 – 21.0 $\mu\text{g}/\text{cm}^2$, but the data was collected as part of another study and no spray histories on the date of treatment are available. There appears to be a dearth of data on sulfur foliar residues with application histories and sampling conducted over time. This is most likely due to its relative safety, long history of use, and any replacement would pose a greater hazard or become less efficacious over time. As a non-metal element, it will not degrade significantly in three days, especially if applied late in the growing season. Regulatory changes now require more supporting documentation, including scientific peer review. Sulfur's unique status as an element precludes collecting the required corroborative data.

Recommend that at CCR 3 Division 6 §6772 (b) footnote (H) include that after May 15 an agricultural establishment may allow early entry activities under the following conditions:

- Hand labor tasks are not conducted when the temperature exceeds 90 degrees Fahrenheit.
- At least 24 hours have elapsed since the sulfur treatment.
- The requirements of 3 CCR sections 6768 and 6771 and applicable provisions of section 6770 have been met.

References

- 1 Title 3, Division 6, Chapter 3, Pest Control Operations Subchapter 3, Pesticide Worker Safety Article 3 Field Worker Safety Section 6772 (b), footnote (H). Sacramento, CA.
- 2 Declaration of Circumstances That Could Cause An Agricultural Emergency. 5 May, 1999. Department of Pesticide Regulation, Sacramento, CA.
- 3 Pesticide Illness Surveillance Program. D. Richmond personal communication. Department of Pesticide Regulation, Worker Health and Safety Branch, Sacramento, CA.
- 4 Winter C and Kurtz P. An Investigation Into Factors Influencing Grape Worker Susceptibility to Skin Rashes. 1985. Bulletin of Environmental Contamination and Toxicology. 35:418-426.
- 5 Mehler L, O'Malley M, and Krieger R. Acute Pesticide Morbidity and Mortality: California. 1992. Reviews of Environmental Contamination and Toxicology. 129:51-66.
- 6 Wilhoit L, Supkoff D, Steggall J, Braun A, Goodman C, Hobza B, Todd B, and Lee M. An Analysis of Pesticide Use in California, 1991 – 1995. 1998. Department of Pesticide Regulation, Environmental Monitoring and Pest Management Branch, Sacramento, CA. PM 98 – 01.
- 7 Mayse M, Striegler R, O'Keefe W, Perez-Munoz V, Garcia F and Njokom M. Sustainable Viticulture Practices in the San Joaquin Valley of California. 1995. Viticulture and Enology Research Center, California Agricultural Technology Institute. Fresno, California. CATI Publication #951201.
- 8 Code of Federal Regulations. Title 40, Parts 150 to 189. 1998. U. S. Government Printing Office, Washington, DC.
- 9 Windolz, M. The Merck Index: An Encyclopedia of Chemicals . Ninth Edition. 1976. Merck & Co., Inc. Rahway, N. J.
- 10 Los Alamos National Laboratory's Periodic Table of the Elements.
<http://www.dayah.com/periodic/> (accessed April 2000)
- 11 Extension Toxicology Network. Pesticide Information Profiles, Sulfur.
<http://ace.orst.edu/cgi-bin/mfs/01/pips/sulfur.htm?6#mfs>. (accessed April 2000)
- 12 O'Malley M. Irritant Chemical Dermatitis Among Grape Workers In Fresno County, August 1995. 1998. Department of Pesticide Regulation, Worker Health and Safety Branch, Sacramento, CA. HS-1741.
- 13 Hernandez, B., Spencer, J., Schneider, F., Welsh, A. and Fredrickson, F. A Survey of Dislodgeable Pesticide Residues on Crop Foliage at Field Reentry, 1994 - 1995. 1997. California Department of Pesticide Regulation, Worker Health and Safety Branch, Sacramento, California. HS-1728.