

CONSERVATION MANAGEMENT PRACTICES GUIDE:  
REDUCING VOLATILE ORGANIC COMPOUND (VOC)  
EMISSIONS FROM AGRICULTURAL PESTICIDE APPLICATIONS



## Background

### What are volatile organic compounds (VOCs)?

VOCs are gases that can combine with nitrogen oxides (NO<sub>x</sub>) in the air to form ground-level ozone (smog). Ozone can damage lung tissue, cause respiratory illness, and harm farm crops. Vehicle exhaust and industrial operations are VOC sources, as are thousands of products. The active and other ingredients in many pesticide products contain VOCs.

### How is California reducing VOCs?

Under the U.S. Clean Air Act, each state must meet federal air quality standards. States must specify their plans to meet these standards in a federally approved “State Implementation Plan” (SIP). Areas that do not meet air quality standards under the SIP are called non-attainment areas (NAA). California has five NAAs for ozone pollution: Sacramento Metro, San Joaquin Valley, Southeast Desert, South Coast, and Ventura. Under California’s SIP, the Department of Pesticide Regulation (DPR) must track and control VOC emissions from pesticide products used in agriculture and by commercial structural applicators in NAAs. Currently, DPR limits VOC emissions by regulating field soil fumigations.

### What about non-fumigant pesticides?

In the San Joaquin Valley, non-fumigants contribute roughly 65% of the total VOC emissions from pesticide products. The VOC emission potential of non-fumigant pesticides is heavily dependent on their formulation. Products formulated as emulsifiable concentrates typically contain solvents and tend to have the highest emissions, while solid formulations have the lowest emissions. DPR is working with pesticide manufacturers to reformulate products with high VOC emissions. The Department has also sponsored university research into insecticides with low VOC emissions and is promoting cleaner, more efficient application technologies.

## What Can Growers Do?

### Minimize VOC emissions from fumigant sources

First, determine which soil pests are present and whether fumigation treatments are necessary. Applicators must follow DPR’s restrictions for field fumigant applications in an NAA. By doing this, the applicator can be assured that they are using fumigants in a manner that will minimize VOC emissions and comply with regulations. VOC emissions vary with fumigant and fumigation method. DPR has assigned emission ratings to different fumigant and fumigation method combinations. Certain low-emission fumigation methods must be used in NAAs during the peak ozone season (May 1 through October 31). In some cases, growers and applicators have a choice of several low-emission methods. Selecting the fumigation method with the lowest emission rating feasible will achieve the greatest VOC reductions. More information on DPR’s fumigant regulations can be found at the VOC reduction web page: [http://www.cdpr.ca.gov/docs/emon/vocs/vocproj/reg\\_fumigant.htm](http://www.cdpr.ca.gov/docs/emon/vocs/vocproj/reg_fumigant.htm).

## Adopt more integrated pest management (IPM) practices

IPM programs incorporate various reduced risk pest management practices such as cover-cropping, crop rotation, insect baiting, pest exclusion, sanitation, use of pest-resistant or tolerant cultivars and rootstocks, release of natural enemies, and mating disruption using pheromones. A properly designed IPM program can help reduce the number of applications of VOC-emitting pesticides.



Pheromone traps can be used to monitor pest populations.

Some specific examples of IPM practices that can reduce the number of pesticide applications include:

- ◇ Proper scientific monitoring for pests to prevent unneeded pesticide applications,
- ◇ Crop sanitation to remove overwintering sites and shelter for pests, such as post-harvest removal of unharvested nuts in almond orchards,
- ◇ Providing habitat for beneficial insects to help keep pest populations below economic injury thresholds.

Implementing an IPM program in your field or orchard can help reduce air pollution in two ways. By using non-chemical management practices, the overall amount of pesticides applied can be reduced. In addition, fewer pesticide applications means less diesel fuel used by the application equipment, thus reducing VOC and NO<sub>x</sub> emissions, particulate emissions, and dust. When making pest management decisions, remember that practices that require burning fossil fuels will increase air pollution.

For more information on IPM practices that are applicable to your particular cropping system, please visit the UC Statewide IPM Program Website at <http://www.ipm.ucdavis.edu>.

## Reduce amount of pesticides applied

Practices that reduce the overall amount of pesticides applied may also reduce VOC emissions. If you can reduce either the treated acreage or number of applications, you can reduce VOC emissions from both the pesticide products used and the exhaust from the application equipment. Such practices can have other benefits as well, including cost savings, reduced fuel use, and reduced soil compaction. Spot-treating for pest problems, when appropriate, is one option. Remote sensing of pest populations and use of target-sensing application equipment can help reduce pesticide use by ensuring that products are only applied where needed. These practices can also help reduce off-site pesticide movement.

## Consider alternative pesticide formulations

Products formulated as emulsifiable concentrates (ECs) have the highest VOC emissions of the various liquid formulations. This is primarily due to the solvents and other ingredients in these products. Solid formulations, such as granules or wettable powders, have much lower VOC emission rates. Table 1 shows the reduction in VOC emissions that can be made by switching from



ECs to other formulations. When selecting a pesticide for application, consider the potential for VOC emissions as well as efficacy, economics, and other environmental factors.

Target-sensing application equipment can reduce pesticide use without sacrificing efficacy.

## Make applications before May or after October

Peak ozone season in California runs from May 1 through October 31. It is most important to reduce VOC emissions during this period. While pest pressure may prevent pesticide applications from being shifted, some application dates may be flexible. In some ways, shifting applications outside the May-October window

can be more effective in reducing ozone pollution from VOC emissions than changing formulations, or other reduction options.

Product	Formulation	Application rate	VOC emissions
Lorsban 4E	Emulsifiable conc.	4 pints/acre	229 pounds
Lorsban Advanced	Other (Liquid)	4 pints/acre	86 pounds
Goal 2XL	Emulsifiable conc.	5 pints/acre	350 pounds
Goatender	Flowable concentrate	3 pints/acre	18 pounds

**Table 1.** VOC emissions for a selected insecticide and herbicide. Calculations are based on a 100-acre non-dormant application in almonds using high label rates.

## How Can I Calculate My VOC Emissions?

### Non-fumigants

DPR has developed a VOC emissions calculator for non-fumigant pesticide applications. The calculator allows the user to enter product information and application rates for multiple products and obtain potential VOC emissions for the application scenario. This is a Web-based tool, and should work with most popular browsers such as Firefox and Internet Explorer. The calculator can be accessed at <http://apps.cdpr.ca.gov/voc-calculator>.

## Fumigants

DPR has posted a VOC emissions calculator for fumigants at <http://www.cdpr.ca.gov/docs/emon/vocs/vocproj/calculate.htm>. You will need Microsoft Excel (version 2000 or later) installed on your computer to use this tool.

## Where Can I Find More Information?

### Government agencies:

- ◇ *U.S. Environmental Protection Agency:* <http://www.epa.gov>
- ◇ *California Department of Pesticide Regulation (DPR):* <http://www.cdpr.ca.gov>  
DPR is responsible for tracking pesticide VOC emissions and, if necessary, implementing regulatory requirements to reduce emissions. DPR tracks emissions and develops the requirements based on data provided by registrants and others. Extensive information on VOC emissions and regulatory requirements are available from DPR's Web site.
- ◇ *California Air Resources Board (ARB):* <http://www.arb.ca.gov>  
ARB protects public health and welfare and ecological resources through the effective and efficient reduction of air pollutants while recognizing and considering the effects on the economy of the state. ARB oversees all air pollution control efforts in California, including the activities of local air districts. ARB and local air districts regulate most sources of air pollutants, such as vehicles, consumer products, businesses, and industry. ARB conducts research, maintains emission inventories, monitors and models air pollutant levels, and implements voluntary and regulatory measures to reduce air pollutants, including VOCs.
- ◇ *Natural Resources Conservation Service (NRCS):* <http://www.ca.nrcs.usda.gov>  
NRCS, formerly known as the Soil Conservation Service, is a branch of the U.S. Department of Agriculture that works with farmers, ranchers, and others to improve environmental stewardship on private lands. NRCS provides technical and financial assistance to develop and implement conservation activities. In California, there are special programs designed to help producers address pesticide and air quality concerns, including reducing pesticide VOC emissions. Participation in NRCS programs is voluntary. Please contact your local NRCS office for additional information.
- ◇ *County Agricultural Commissioners:* Agricultural Commissioners promote and protect the agricultural industry, environmental quality, and the public welfare in the state of California. In their respective counties, they carry out state pesticide laws and regulations and enforce local ordinances. By doing so, they protect the community and the environment from harm caused by inappropriate or illegal use of pesticides. They also assist in developing and implementing pesticide regulations such as those that will reduce the emissions of VOCs from appropriate pesticide usage. Please contact your local Agricultural Commissioner's office for information in your specific county. Contact information for each county can be found at [http://www.cdfa.ca.gov/exec/county/County\\_Contacts.html](http://www.cdfa.ca.gov/exec/county/County_Contacts.html).

## University of California:

- ◇ *University of California Statewide IPM Program:* <http://www.ipm.ucdavis.edu>  
The UC IPM Online Website contains many valuable pest management resources to help reduce VOC emissions. These include pest management guidelines, seasonal guides, identification keys, degree-day and disease models, and access to UC IPM publications.
- ◇ *UC Cooperative Extension:* <http://ucanr.org>  
UC Cooperative Extension (UCCE) works to enhance California's agricultural productivity and competitiveness. County-based farm advisors collaborate with campus-based UCCE specialists and agriculture experiment station scientists to research, adapt, and field test agricultural improvements or solutions and promote the use of research findings.

## Local organizations:

- ◇ *Resource Conservation Districts (RCDs)* are special districts set up under California law to be locally governed agencies with locally appointed, independent boards of directors. They are empowered to conserve resources by implementing projects on public and private lands and educating landowners and the public about resource conservation. RCDs remain one of the primary links between local citizens and government agencies on issues related to conservation. Due to their unique role in their communities, RCDs are an important tool for educating, coordinating, and working with producers, agencies, organizations, and the public on local conservation efforts. An important element of this effort is their commitment to reducing VOC emissions from agricultural practices. Contact information for RCDs can be found on the California Association of Resource Conservation Districts Web site, located at <http://www.carcd.org>.

## Outreach events:

- ◇ *Pest Management Alliances (PMAs)* are DPR-funded public/private partnerships dedicated to the demonstration of environmentally responsible pest management practices to manage economic pests in a range of different crops. PMA priorities include IPM, reductions in the use of pesticides that are of concern for human health or are found in air or water, and reduction of VOC emissions. PMAs often hold field days to discuss important pest management practices and demonstrate new field equipment technologies. For more information on PMA activities, contact DPR or a local commodity group representative.

## Financial assistance:

- ◇ The Environmental Quality Incentives Program (EQIP) is a voluntary conservation program administered by NRCS. It provides technical and cost-share support to assist farmers and ranchers address natural resource concerns, including VOC emission reduction. Applications for EQIP are accepted throughout the year. For more information on eligible practices and program requirements, please contact your local NRCS office.

- ◇ The ARB administers the Carl Moyer Memorial Air Quality Standards Attainment Program, which provides incentive grants for cleaner-than-required engines, equipment and other sources of pollution providing early or extra emission reductions. The program achieves near-term reductions in emissions of NO<sub>x</sub>, particulate matter (PM), and VOCs, helping California meet its clean air commitments under the State Implementation Plan. NO<sub>x</sub> and VOCs combine in the presence of sunlight to form ground-level ozone, while PM, a component of diesel exhaust, has been identified as a toxic air contaminant by ARB. For more information, visit ARB's Web site at <http://www.arb.ca.gov/msprog/moyer/moyer.htm>.
- ◇ U.S. EPA Region 9 provides grants to support agricultural projects for education, extension, demonstration, and implementation of IPM practices to reduce environmental pollution from use of pesticides. More information can be found at <http://www.epa.gov/region09/funding/funding-sources/index.html>.

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