



# Residues in Fresh Produce: 1995 Monitoring Program, Executive Summary

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## *Executive Summary*

California spends more than \$48 million each year for the nation's most comprehensive program to regulate pesticide use. Under this program:

- A pesticide's safety and efficacy is scientifically evaluated before it can be used.
- All agricultural pesticide use must be reported.
- Pesticide specialists enforce restrictions to ensure safe use of pesticides in the workplace and elsewhere.
- Domestic and imported produce is sampled and tested for traces of pesticide residue.

Annually, only a small fraction of the samples violated established standards. Since the standards include a safety margin, illegal residues rarely present a health risk, according to leading scientific experts.

There are two elements in the Department of Pesticide Regulation's (DPR) residue testing program: Marketplace Surveillance and Priority Pesticide. In 1995, there were 7,706 samples taken. Recent findings are consistent with those from previous years. There are few violative residues, and pesticide detections in produce are generally well below the allowable levels.

## **Marketplace Surveillance Program**

There were 5,502 samples taken throughout the channels of trade: at seaports and other points of entry into the State, packing sites, wholesale, and retail outlets. All samples are tested with multi-residue screens capable of detecting more than 200 pesticides and breakdown products. No residue were detected in 64.6 percent of the samples. Residues within tolerance (the legal limits set by the U.S. Environmental Protection Agency) were found in about 33.7 percent. The majority of these samples had residues at less than 10 percent of the tolerance level. There were 1.64 percent of the samples with an illegal residue. This consisted of 0.31 percent with residues over the tolerance level; and 1.33 percent with residues of a pesticide not registered for the crop.

## **Priority Pesticide Program**

In this program, DPR concentrates monitoring on pesticides of special health interest. Only crops known to have been treated with a targeted pesticide are sampled. Because the crop is known to have been treated, DPR obtains accurate residue data on which to base estimates of dietary exposure and evaluate preharvest intervals (the time between pesticide application and before crop harvest). Analyses were completed on 2,204 samples. Twenty-three pesticide active ingredients applied to 43 different commodities were sampled in 1995. Even though 100 percent of the samples had been treated, only 14 percent contained detectable residues. A majority of the samples (85.9 percent) contained no detectable residues. There were four samples (0.18 percent) with residues over the tolerance level.

# Residues In Fresh Produce

## 1995 Monitoring Program

### *Results and Discussion*

The Department of Pesticide Regulation (DPR) has the primary responsibility for regulating all aspects of pesticide sales and use to protect the public health and the environment.

DPR's mission is to evaluate and mitigate impacts of pesticide use, maintain the safety of the pesticide workplace, ensure product effectiveness, and encourage the development and use of reduced-risk pest control practices while recognizing the need for pest management in a healthy economy.

The results of DPR pesticide residue monitoring each year correspond to the findings of 30 years of extensive monitoring. Residues above established tolerance levels are rarely found. Violations more commonly involve commodities that contain traces of pesticides not registered for the commodity on which they are found. Most illegal residues are below 1 parts per million (ppm) and are the result of residual traces of pesticides in soil, or drift from adjacent applications, and not from direct misuse.

DPR's two residue monitoring programs are Marketplace Surveillance and Priority Pesticide. In 1995, there were 7,706 samples taken in these two monitoring programs. County agricultural commissioners, under contract to DPR, collect all the Priority Pesticide Program samples. DPR staff in four field offices collect most of the Marketplace Surveillance Program samples, with assistance from the county agricultural commissioners.

### **Marketplace Surveillance Program**

There were 5,502 samples collected in the Marketplace Surveillance Program in 1995. Routine Marketplace Surveillance samples are collected throughout the channels of trade

sites, seaports and border stations, and wholesale and retail markets. All samples were tested with multi-residue screens. In addition, selected samples were also analyzed for non-screenable pesticides of enforcement concern.

In 1995, 132 different commodities were sampled in the Marketplace Surveillance Program. Many were major production commodities such as potatoes, oranges, and grapes, although many specialty fruits and vegetables were sampled as well.

In 1995, findings in the Marketplace Surveillance Program included:

- No residues were detected in 64.6 percent of the samples.
- Residues at less than 50 percent of the tolerance level were detected in 32.8 percent of the samples.
- Residues from 50 to 100 percent of the tolerance were detected in 0.96 percent of the samples.
- Illegal residues were found in 1.64 percent of samples. Of these, 0.31 percent had residues that were over the tolerance level, and 1.33 percent had residues of a pesticide not authorized for use on the commodity. In most of the latter situations, residues detected were well below what would be allowed for the same pesticide on other crops. These illegal residues are usually caused by leftover pesticides in the soil or by pesticides drifting on the commodity when applied to a nearby field.

Sampling in the Marketplace Surveillance Program is not designed to produce data that are statistically representative of the overall residue situation for a particular pesticide, commodity, or place of origin. It should be noted that the percentage of samples with detectable residues is the average for all samples. Certain

commodities may have a higher percentage of residues within tolerance because of post-harvest applications or applications made close to harvest, while other commodities rarely contain detectable residues due to the nature of pest populations and crop production practices. In DPR's surveillance sampling, some bias may be incurred because sampling is weighted toward such factors as patterns of pesticide use; relative number and volume of pesticides typically used to produce a commodity; relative dietary importance of the commodity; past monitoring results; and knowledge of local pesticide use. Therefore, the results may be biased toward finding produce more likely to contain illegal residues than if samples were collected in a true statistically random fashion. In addition, the number of samples of a given commodity analyzed for a particular pesticide each year may not be sufficient to draw specific conclusions about the residue situation for the whole volume of that commodity in commerce.

DPR targets imported commodities at points of entry into California and samples foreign produce at wholesale and retail markets. Produce grown outside California represented about 40 percent of the sample: 10.3 percent from other states and 29.7 percent from foreign countries. The most frequently sampled countries of origin were Mexico, with 1,273 samples and Chile, with 128 samples, reflecting the volume and variety of commodities imported to California from those nations, especially during the winter months.

DPR's Pesticide Enforcement Branch continued to target imported peppers (such as Serrano, Anaheim, and yellow bell) and melons (cantaloupe and honeydew), and added papaya and kale to the list for surveillance based on U.S. Food and Drug Administration (FDA) referrals and a history of illegal residue problems in the past. This resulted in a higher proportion of these commodities being sampled.

The proportion of illegal residues found in produce of foreign origin was 3 percent in 1995, up from 2.83 percent in 1994. The increase in detected illegal residues in produce imported from foreign countries is a result of the targeted enforcement strategies of DPR and FDA.

## **Priority Pesticide Program**

In the Priority Pesticide Program, DPR concentrates monitoring on pesticides of special health interest. In this program, samples are taken only of crops that are known to have been treated with a targeted pesticide. Because the crop is known to have been treated, DPR obtains accurate residue data on which to base estimates of dietary exposure.

The pesticides and commodities to be targeted in the Priority Pesticide Program are selected in a coordinated effort by DPR's Medical Toxicology and Pesticide Enforcement Branches. The primary focus of the program is on pesticides of known toxicological concern. DPR considers factors, including the amount of pesticide used on California crop acreage, and the dietary significance of those commodities. Working under contract to DPR, county agricultural commissioners collect samples of the targeted commodities.

In 1995, findings in the Priority Pesticide Program included:

- Analyses were completed on 2,204 samples in the Priority Pesticide Program.
- Twenty-three pesticide active ingredients applied to 43 different commodities were sampled in 1995.
- Although 100 percent of the samples were treated, residues were found in only 14 percent. Four of the 2,204 samples (0.18 percent) contained illegal residues over tolerance.

- Chemicals analyzed: *Insecticides* acephate, carbaryl, diazinon, dicofol, dimethoate, endosulfan, methamidophos, methomyl, mevinphos, naled, oxamyl, phosmet and propargite. *Herbicides* 2,4-D, chlorthal-dimethyl, and simazine. *Fungicides* benomyl, captan, chlorothalonil, mancozeb, maneb, thiabendazole, and triadimefon.

## Regulatory Program History

California's pesticide regulatory program had its beginnings in 1902, when the first state law regulating pesticide product quality was passed. That bill was limited to one product—copper acetoarsenite, an arsenic-based chemical better known as "Paris Green." In 1910, Congress passed an omnibus pesticide product quality law and one year later, the California Legislature followed suit. The state took its next step in 1921, when the Legislature began a program requiring that all pesticides manufactured and sold within the state be registered with the Director of Agriculture. Though the intent of this law, like earlier ones, was to protect consumers from misbranded or adulterated products, it also allowed the Director to cancel the registration of any chemical that was dangerous to animals or to public health, even when used properly. This law was one of the first attempts to use the pesticide registration process to protect the environment and the public from potentially harmful effects of pesticides.

The State's pesticide regulators (then part of the State Department of Agriculture) began analyzing small quantities of produce for pesticide residues in 1926. This was after the U.S. Bureau of Chemistry established the pesticide tolerances, setting allowable residue levels for arsenic on apples and pears in interstate commerce and for export.

In 1927, there was a public outcry over excessive arsenic residues detected in some fruits and vegetables, and the British government threatened an embargo against

American-grown fruit. The California Legislature responded by passing the Spray Residue Act. It created a program to control residues of arsenic-based sprays on fruits and vegetables. There were only about 30 pesticide active ingredients in use at the time. Many were arsenical compounds, and arsenic was then considered the major pesticide residue of health concern.

The new law established a monitoring program designed not only to safeguard the consumer against harmful residue levels, but also to promote marketing of California products. The goal was to ensure that no shipments of California fruit were confiscated because of excess residues. The Department had both a regulatory program designed to monitor compliance with the law, and a program to provide certification to growers. The latter was a voluntary, fee-based program that allowed growers to obtain state certification that their crops were free from arsenic residue. Without such certification, growers often found it impossible to export fruit. The service was phased out by the 1940s.

As part of its regulatory monitoring program, Department inspectors made daily visits to wholesale and retail markets in Los Angeles, San Diego, and San Francisco. Samples were sent to Department laboratories in these cities for analysis. Throughout the 1930s, the spray residue program was expanded to include sampling for residues of lead, fluorine and copper. The number of samples also grew from 1,675 samples in 1931 to 3,779 in 1938. With the introduction of many new synthetic pesticides in the late 1940s, residue sampling expanded to test for DDT and other newly introduced organic compounds.

During the 1980s, the Department added three new programs to complement marketplace surveillance. They included a program to test raw produce destined for processing, another to sample crops before harvesting, and the most significant to target sampling of commodities known to have been treated with pesticides of health concern. This new program was designed to provide data needed for accurate assessments of dietary risk.

In addition to adding new programs, the number of pesticides for which routine tests were done increased. In 1988, residue program chemists were using multi-residue analytical methods (called screens) that could detect 108 pesticide active ingredients, metabolites, and breakdown products; by 1991, that number had increased to more than 200. The results are usually available within eight hours.

## Findings and Their Significance

The validity of any sampling program lies in its design and in its ability to replicate the results. Over the past decade, even as the number of samples varied, the findings have been consistent from year to year. Most residues are below detectable limits. Residues that are found are usually at levels that are measured at a fraction of a part per million (ppm). Less than one percent of samples have residues over the allowable levels established by the U.S. Environmental Protection Agency (U.S. EPA). These levels are called "tolerances." A tolerance is the highest residue level of the particular pesticide that is legally allowed on the particular commodity. A tolerance is set by U.S. EPA for regulatory purposes and is established at a level that incorporates a margin of safety, and usually assumes a lifetime of consumption of the commodity at the maximum allowable residue level.

While the goal of DPR's regulatory program is to ensure that all food is in compliance with pesticide safety standards that include a safety margin, an occasional produce item slightly above tolerance should not automatically be considered a health hazard. The results from years of DPR residue monitoring document the safety of produce grown and consumed in California.

The effectiveness of DPR's monitoring program is enhanced by the Department's formal cooperative agreement with FDA, which has an extensive nationwide produce monitoring program. DPR and FDA staff meet regularly to plan sampling strategies that complement rather than duplicate the other. The two agencies share monitoring results and

cooperate on investigations. This cooperative agreement leads to a more comprehensive understanding of the incidence of pesticide residues in the food supply.

## Enforcement and Compliance Options

DPR, working with the county agricultural commissioners, has wide-ranging authority to deal with violators of pesticide laws and regulations. Enforcement options include administrative actions; criminal and civil actions; and crop quarantine, crop abatement, and crop seizure. Administrative actions can be taken by the Department or the county agricultural commissioner to refuse, revoke or suspend the right of a pest control business to apply pesticides, or a farmer to use certain pesticides. The Department and the commissioners also have the authority to levy agricultural civil penalties to enforce certain pesticide regulations, including those prohibiting the packing, shipping or selling of produce containing illegal pesticide residues.

Criminal or civil actions may also be taken, with fines ranging from a minimum of \$500 up to \$50,000. Criminal and civil proceedings are considered for repetitive or intentional violations, or violations that have created a hazard to human health or the environment.

Crop quarantine, crop abatement, and crop seizure are additional tools in the enforcement arsenal. The Department may quarantine and hold any lot of produce domestic or imported that contains pesticide residues over the tolerance levels. DPR may also quarantine produce suspected of containing illegal residues. The produce is then tested, and should illegal residues be present, the quarantine is maintained. The owner of the produce has the option of reconditioning the produce to remove the illegal residues. If the illegal residues cannot be removed, the produce must be destroyed. Should an illegal residue be found on a crop in the field, the Department can prohibit harvest and, in some cases, order the crop destroyed.

The Department investigates every case of illegal residue detected in its residue

monitoring programs. Enforcement staff interview shippers and packers to determine where the produce was grown. If the produce came from out of state, the produce remains under quarantine and information is forwarded to the FDA for further enforcement action. If the produce was grown within California, enforcement staff interview growers, pest control applicators, and others to learn how the produce was contaminated before determining appropriate enforcement action.

## **Enhancements in Analytical Technology**

California's participation in the U.S. Department of Agriculture's Pesticide Data Program (USDA's PDP) helped give rise to significant enhancements of the multi-residue screens that can simultaneously detect a number of pesticides. These analytical tools are particularly useful for testing the large numbers of samples in the Marketplace Surveillance Program, whose pesticide treatment history is not usually known at the time of sampling. The screens now used by DPR can detect a total of more than 200 pesticides, metabolites, and breakdown products at exceedingly low levels.

The focus of USDA's PDP is gathering comprehensive data on minute traces of residues. To do this, multi-residue methods were enhanced to be sensitive to residue levels of well under 100 parts per billion. Some of these analytical advances are being used to analyze samples taken in DPR's monitoring programs, making it possible to detect smaller levels of residues.

Beginning in 1991 and continuing through 1995, this has resulted in an increased percentage of samples with detectable residues. The increase in detected residues does not mean there is more risk; minute traces of pesticides in food are to be expected, and are not considered significant health threats. As the chart on page 12 indicates, much of the increase in detectable residues has been at levels that are 10 percent or less of the tolerance level.

Between 1987 and 1990, the percentage of samples with detectable residues varied little, averaging 21 percent. Samples that had detected residues at 10 percent or less of the tolerance level also held steady, between 12 and 13 percent each year. Samples with residues between 50 and 100 percent of tolerance were about 1 percent each year.

In 1991, as technology made possible the routine detection of lower residue levels, the percentage of samples with detectable residues increased to 25 percent. Much of the increase was in lower-level residues: the percentage of residues at 10 percent or less of tolerance jumped to 16 percent, while residues at 50 to 100 percent of tolerance continued a slight decline to 0.8 percent.

In 1995, the percentage of samples with detectable residues remained at 34 percent. The percentage of detections at 10 percent or less of tolerance was 24 percent. The percentage of residues at 50 to 100 percent of tolerance was below 1 percent.

<b>Year</b>	<b>Total Samples</b>	<b>Percentage of Samples with Detectable Residues</b>	<b>Percentage of Samples at 0-10% of Tolerance</b>	<b>Percentage of Samples at 50-100% of Tolerance</b>
1987	7,010	20%	12%	1.1%
1988	9,232	22%	13%	1.1%
1989	9,403	22%	13%	0.9%
1990	8,278	20%	12%	0.7%
1991	7,446	25%	16%	0.8%
1992	7,319	31%	21%	0.8%
1993	6,066	34%	23%	1.3%
1994	5,588	34%	23%	1.3%
1995	5,502	34%	24%	0.96%

To detect pesticides not picked up by the multi-residue screens, single-residue methods or selective screens are used. A single-residue method generally detects one pesticide; a selective screen measures a small number of chemically related pesticides, such as the phenylurea herbicides. These types of methods are more resource-intensive per residue, and may require as much time to do as a multi-residue screen. These analytical methods can

generally detect levels well below tolerance values. The minimum level of detection in the screens may vary from 0.02 to 0.2 ppm; for individual analyses, the minimum level of detection may vary from about 0.005 to 1 ppm. These variations may be caused by the particular commodity being tested, the sample size, and by other factors.