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# Pesticide Exposure and Health Effects in Young Children

## Part I: Pesticide Data

EPA/600/R-99/008
September 1998

# PESTICIDE EXPOSURE AND HEALTH EFFECTS IN YOUNG CHILDREN

## PART I: PESTICIDE DATA

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## Notice

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## Foreword

The mission of the National Exposure Research Laboratory (NERL) is to provide scientific understanding, information and assessment tools that will quantify and reduce the uncertainty in EPA's exposure and risk assessments for environmental stressors. These stressors include chemicals, biologicals, radiation, and changes in climate, land use, and water use. The Laboratory's primary function is to measure, characterize, and predict human and ecological exposure to pollutants. Exposure assessments are integral elements in the risk assessment process used to identify populations and ecological resources at risk. The EPA relies increasingly on the results of quantitative risk assessments to support regulations, particularly of chemicals in the environment. In addition, decisions on research priorities are influenced increasingly by comparative risk assessment analysis. The utility of the risk-basked approach, however, depends on accurate exposure information. Thus, the mission of NERL is to enhance the Agency's capability for evaluating exposure of both humans and ecosystems from a holistic perspective.

The National Exposure Research Laboratory focuses on four major research areas: predictive exposure modeling, exposure assessment, monitoring methods, and environmental characterization. Underlying the entire research and technical support program of the NERL is its continuing development of state-of-the-art modeling, monitoring, and quality assurance methods to assure the conduct of defensible exposure assessments with known certainty. The research program supports its traditional clients – Regional Offices, Regulatory Program Offices, ORD Offices, and Research Committee – and ORD's Core Research Program in the areas of health risk assessment, ecological risk assessment, and risk reduction.

Understanding and evaluating the nature of pesticide exposure to the pediatric population (i.e., multiple pathway/multiple pesticide exposure) and potential health implications are of national interest and is highly relevant to residents along the U.S./Mexico border. Initial efforts will be focused on identifying potential sources of pesticides and examining innovative techniques and methods for collecting, identifying, and quantifying pesticides in various matrices (e.g., air, water, soil, dust, and urine). These efforts will be followed by a full-scale epidemiological study that includes detailed biological monitoring of "high exposure" individuals and measurements of their environmental exposure for levels of specific pesticide compounds to identify major predictors and pathways of pesticide exposures to the children. The efforts described in this report provide preliminary data concerning the most frequently used pesticides, quantities of pesticides applied, and crop types, locations, and acreages to which the pesticides were applied by year along the U.S./Mexico border.

Gary J. Foley
Director
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## Abstract

Understanding and evaluating the nature of pesticide exposure to the pediatric population is of national interest and highly relevant to U.S./Mexico border residents. To identify potential exposure areas for future studies, the first step was to inventory and gather existing agricultural and pesticide usage information in counties within 100 kilometers of the U.S./Mexico border. The resulting data and estimates of past pesticide usage can be used to provide a relative measure of exposure potential to residents living within the study area.

The most agriculturally active counties in the border region were Imperial county, California, Cameron and Hidalgo counties, Texas, and Yuma county, Arizona. These 4 counties yielded 78.8% of the total harvested acres for all 12 counties examined in this report. The most commonly grown crops in these four counties were cotton, citrus, and vegetables. As a result of the intensive, large-scale agriculture in these counties, as well as in San Diego county, California, the highest pesticide usage was also identified in these counties. In general, insecticides were the most frequently applied pesticides with herbicides and fungicides ranked as the second and third most frequently applied pesticide, respectively. Other pesticides, such as fumigants, were also used in the border region.

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# Chapter 1
# Introduction

The passage of the North American Free Trade Agreement (NAFTA) and the accompanying environmental side agreements commit the U.S. government and the U.S. Environmental Protection Agency (EPA) to insure a safe environment as industrialization, trade, and population growth occur along the U.S./Mexico border. Even before the passage of NAFTA, many communities along the border were beset by infrastructure deficiencies, e.g., lack of public drinking water, sewage system, and garbage disposal. These infrastructure deficiencies are a direct result of the rapid growth along the border, especially over the past 15 years. During this period, the population of the border region has doubled to more than six million people [1]. Economic growth has been accompanied by increased potential for water and air quality degradation. Residents of these communities have strong concerns about their possible exposures to environmental contaminants, including those which may be coming from across the border (transboundary pollution), or from local sources, including traffic, refuse burning, and extensive pesticide use throughout the agricultural areas.

There have been periodic reports of adverse health effects which reinforce the concerns of the community. For example, in April 1991, there was a report of three anencephalic deliveries in one Brownsville, Texas hospital during a 36-hour period. At this same hospital, six anencephalic deliveries occurred between March 27 and May 7, 1991. Because of this unusual cluster, the Texas Department of Health and the Centers for Disease Control and Prevention (CDC) collaborated in a comprehensive case-control study to define potential risk factors. Results of this study were released in mid-summer 1992 [2]. However, the investigators were unable to associate the higher number of neural tube defects with any environmental factors, although they were careful to report that, in general, environmental data did not exist from which such associations might be inferred. They encouraged increased environmental and health data gathering along the border. In addition, they began an intervention/prevention effort based upon folic acid supplements for women in the community of child bearing age.

In response to the need for data about actual human exposure to environmental contaminants in the Valley, the U.S. EPA began an environmental monitoring program in Cameron and Hidalgo Counties, Texas, in 1993 to investigate the potential for human contact with environmental pollutants. Results of this scoping study are documented in the community report [3] and in the scientific literature [4-9]. Even though the monitoring only covered a limited portion of the year, at several locations in a predominantly agricultural area along the U.S./Mexico border, detectable levels of pesticides were found in all media sampled (except public drinking water) and in the biological samples collected from the adults participating in the study. These results elevated the issues as to the extent to which exposures to pesticides, even at very low levels, might be contributing to the potential health risks of the residents living along the U.S./Mexico border. Of special concern are developing children whose behaviors and developmental vulnerability may substantially increase the health risks from pesticide exposure. It should be noted that pesticides are widely used to control the growth and spread of undesirable

insects, weeds, or biological organisms which could cause damage to crops, buildings, and/or humans. Some pesticides are relatively non-toxic, including sulfur which is used as a fungicide on many different crops. Others are more toxic and some are long-lived, once applied to the environment, such as DDT. Although approximately 85% of pesticide usage is for agricultural purposes [10], many pesticides are used in homes and for non-agricultural purposes. Unfortunately, there are health effects which may be associated with exposures to pesticides, and a recent National Academy of Sciences (NAS) report entitled *Pesticides in the Diets of Infants and Children* emphasizes the need for further examination of possible associations between pesticide exposures incurred by young children and adverse health effects [11].

Understanding and evaluating the nature of pesticide exposure to the pediatric population (i.e., multiple pathway/multiple pesticide exposure) and potential health implications are of national interest and certainly relevant to border residents. As a result of discussions with the state agencies and border communities, this project was identified as one of the priority areas for the Environmental Health Workgroup of the Border XXI program. In a general way, the project is a first step of a multi-phase program to assess the effects (if any) of multiple pathway, multiple pesticide exposures on children's health. It is anticipated that the data will be useful to state agencies to examine the estimated pesticide use data for the counties along the border with that used in neighboring states.

The goal of this first phase of the program is to inventory and gather the data available in each of the four border states, namely, Arizona, California, New Mexico, and Texas. Data will be obtained related to existing agricultural and pesticide usage practices in counties within 100 kilometers of the U.S./Mexico border (Figure 1-1). These data will be summarized and examined to provide descriptive analyses of simple comparisons (e.g., counties of highest pesticide usage, pesticides used most heavily in these counties, and major pesticide usage by crop) among counties within each state. Additionally, pediatric health data (i.e., a very broad grouping of symptoms and illnesses), for children 11 years old and younger, will be gathered from several health clinics and hospitals within Arizona, New Mexico, and Texas counties within 100 kilometers of the U.S./Mexico border. Both pesticide and health data will be shared with each state for use in developing Geographic Information Systems (GIS) maps for graphical presentation of the results.

# U.S.-Mexico Border Regional Map

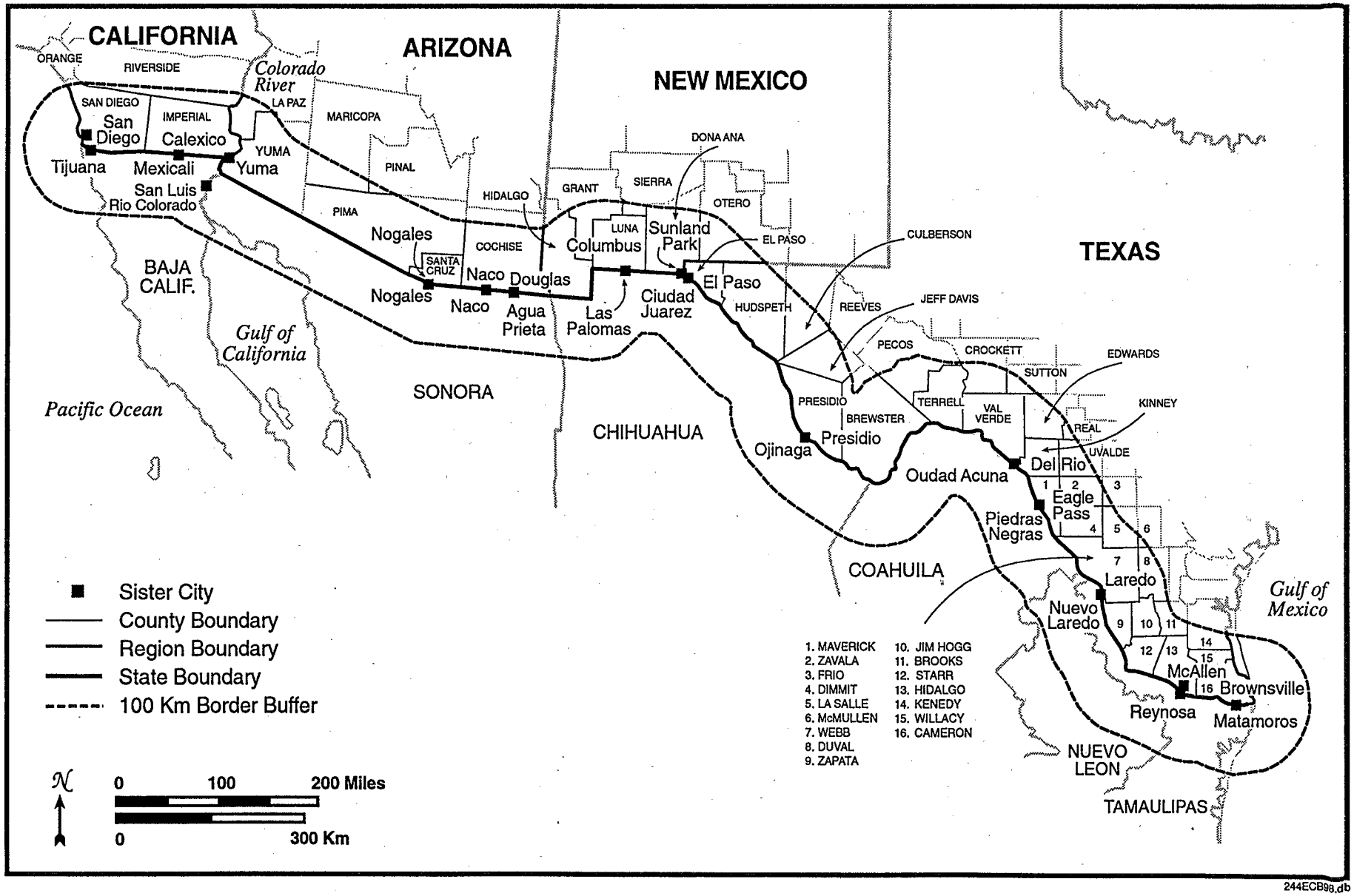


Figure 1-1. U.S.-Mexico Border Regional Map.

# Chapter 2
# Pesticide Data Collection

Implementation of the project began with a meeting with officials in the State Health Department, State Department of Agriculture, and other interested parties in each of the four states: Arizona, California, New Mexico and Texas. During the meetings, the project was introduced and the need for pesticide and health information was discussed together with identifying the appropriate state and local contacts who could provide the local, county and state data. These meetings served to make the state officials aware of the study and obtain their approval and involvement in the study. Contact lists were developed to help expedite the field logistics of data collection. The type of pesticide information of interest was discussed, including the common names and chemical formulae of pesticides, when and where they were typically applied, and the frequency and typical rates of application.

Since this phase was designed to cast a broad net, information was sought in whatever form and format available, depending on the capabilities of each state or data collection agency (either at the state or federal level). In both New Mexico and Texas, actual pesticide usage or complete sales data for all major agricultural counties were unavailable and, as a result, estimates were derived from crop and acreage information and application rates available from California and Arizona. [Note: The methodology for estimation of pesticide usage will be discussed in a later section.]

As a result of the state contact meetings, the area for data collection was clearly defined in each state. Based on discussions with the state officials in California and Arizona, each of the border counties was to be included in the study area. Only two counties in New Mexico and four counties in Texas were to be included in this phase of the project because the state officials felt that they would adequately represent both the major agricultural areas within the state and the majority (~90%) of the population living along the border (Table 2-1).

## 2.1 Preliminary Assessment of Pesticide Usage along the Border

The existence and availability of the pesticide data were determined to be dependent on the state specific regulations which permitted collection of the information either from sales or actual usage reports submitted by the licensed distributor or pesticide applicator. For example, Texas and New Mexico do not have state regulations which would require pesticide data submission to the state authorities, so pesticide usage data are not available (Table 2-2). Furthermore, each state (with the exception of California) indicated that records of non-agricultural use of pesticides are non-existent. For the purposes of this project, it may be sufficient to assume that the estimate of non-agricultural pesticide use is approximately 15% of the agricultural use, in units of pounds of active ingredient applied [12]. About 90% of all U.S. households use pesticides with insecticides being 12 of the 14 most commonly used [13].

**Table 2-1. States and Counties Identified as the Study Area.**

| TEXAS | NEW MEXICO | ARIZONA | CALIFORNIA |
|---|---|---|---|
| Cameron (580)* | Doña Ana (2,436) | Cochise (3,949) | Imperial (2,672) |
| Hidalgo (1,004) | Luna (1,898) | Santa Cruz (792)** | San Diego (2,691) |
| Webb (2,148) | | Pima (5,880) | |
| El Paso (648) | | Yuma (3,529) | |

* numbers in brackets are approximate acres per county × 1000.
** No pesticide usage data were provided by Arizona for this county.

**Table 2-2. Availability of Pesticide Information Data by State.**

| State | ARIZONA | CALIFORNIA | NEW MEXICO | TEXAS |
|---|---|---|---|---|
| **Type of data** | applicator reports | applicator reports | sales data | sales data* |
| **years** | 1992-1995 | 1991-1994 (1995 state-wide data available in hard copy) | 1996 | 1992 |
| **format** | computerized | computerized | hard copy | hard copy |
| **units** | lbs/gal used | active ingredient in pounds | lbs/gals sold | lbs/gals sold |

* - sales data presented only as combined sales data for Cameron, Hidalgo, and Willacy counties. The 1992 sales data was obtained from a survey of approximately 130 licensed pesticide dealers identified as having potential sales within the three counties. According to Texas Department of Agriculture (TDA) officials, the data collected appears to represent most of the pesticide sales in the three counties.

Pesticide data assessment is complicated by how the data are reported. "Pounds of active ingredient" is the metric for analysis. However, pesticide records, in the form of applicator reports, are often only available for the amount of pesticide applied in pounds or gallons of material which contains other ingredients than the pesticide, such as inert materials. Furthermore, each pesticide manufacturer has its own EPA number for the pesticide, so there may be many numbers for a specific pesticide. The Internet provides a link to a California EPA database which

can be searched by EPA pesticide number to obtain the corresponding pesticide label with pounds of active ingredient (http://www.cdpr.ca.gov/docs/label/epanum.htm). For example, Arizona records indicate that in 1993, 3235 pounds of chemical number 10163-130 were applied in the border counties. By entering the EPA pesticide number 10163-130 into the California database, it can be seen that the chemical name is Thiodan™ (endosulfan) and the amount of active ingredients is 50%. In this example, 1617.5 pounds of endosulfan were applied in 1993. Actually, there were more pounds of endosulfan applied in 1993, since there are 5 EPA numbers listed for endosulfan (see Appendix) and our example only accounts for one of the five listings.

Where actual pesticide usage/application data were unavailable, state sales data were converted into amount of active ingredients for comparison. This "conversion" process was performed to obtain pesticide usage estimates for the states of New Mexico and Texas.

## 2.2 General Discussion of Pesticide Data

California has an extensive, computerized database starting in 1991 and continuing through 1994. (Note: The electronic copy of validated 1995 county data should be available by January 1998. Hard copy reports are available [14,15].) The data are reported by the pesticide applicators to the State of California Environmental Protection Agency (Cal EPA). The information allows pesticide usage to be tracked specifically by pesticide, by crop, and by year, and the data are available in pounds of active ingredient (# A.I.). This information is made available in reports provided by Cal EPA, such as the 1995 Pesticide Use Report by commodity [14] and by chemical [15]. The tables and information present in this project report have been compiled from the raw data by Impact Assessment Inc., a subcontractor to RTI. This subcontractor is familiar with the California Pesticide Database and has direct access to employees of the California Department of Health Services to address questions and resolve issues which might arise.

Arizona also has a relatively complete, electronic information base for pesticide data with a data record for 1992 through 1995. The pesticide data are reported by commercial applicators to the Arizona Department of Agriculture in pounds or gallons of pesticide used by crop, acres, field location, date of application, pesticide used (EPA number), and amounts applied. To be comparable for analysis, the available data must be converted to pounds of active ingredient, the standard pesticide reporting unit.

New Mexico does not have nor maintain pesticide usage records. This is largely because New Mexico does not have a state requirement for pesticide applicators to report usage. However, pesticide sales information is reported to the New Mexico Department of Agriculture (NMDA) annually by county (and by registered applicators identification number) for verification of compliance with the federal requirement that restricted use chemicals can only be purchased by licensed applicators. These data are not stored, however, a copy of the most recent sales data (1996) was obtained from the NMDA Bureau of Pesticide Management. As was the case with the Arizona data, the New Mexico sales data are recorded by EPA number, product name, and

quantity sold (in pounds or gallons). A conversion process as described above was followed to convert the pounds or gallons of the product to pounds of active ingredient.

Texas, like New Mexico, does not have a legal requirement for the pesticide sales and usage information to be maintained at the state level, nor has there been any systematic effort to collect pesticide usage data. Pesticide usage data for Texas, as reported by federal agencies (such as the U.S. Geological Survey), are the result of estimation procedures based on usage patterns in neighboring states. However, one small project that collected pesticide sales data was undertaken by the Texas Department of Agriculture (TDA) as part of the effort to understand the unusual number of reported cases of neural tube defects occurring along the Lower Rio Grande Valley. For this project, the TDA collected pesticide sales data for Cameron, Hidalgo and Willacy counties in 1992 through a survey of approximately 130 licensed pesticide dealers identified as having potential sales within the three counties. (Note: TDA stated that the data collected appears to represent most of the pesticide sales in Cameron, Hidalgo, and Willacy counties.) These sales data were reported by product name and total number or gallons of product sold. TDA has made the total sales of the 20 most frequently sold pesticide products for the three counties in 1992 available for inclusion in this report.

## 2.3 Methodology for Estimating Pesticide Usage

For California and Arizona, pesticide usage and crop acreage by county are available from state computerized systems. The pesticide usage estimates for New Mexico and Texas are estimated using pesticide usage information by crop (# A.I./acre) obtained from the Arizona data and actual crop acreage grown within New Mexico and Texas. California usage patterns were not used to estimate pesticide usage in New Mexico and Texas because California pesticide usage patterns are higher than for the rest of the nation [16].

The process for estimating pesticide usage in New Mexico and Texas was done as follows. First, the average usage rates of active ingredient per acre by crop category—cotton, vegetables, orchard and other, where other is defined as everything but cotton, vegetables, or orchard—was determined for Cochise, Pima, and Yuma counties in Arizona (Tables 3-12, 3-13, and 3-14). Second, the number of acres by crop category in each border county for the study area in New Mexico and Texas were obtained by year from 1992-1995, where available (Tables 3-15, 3-20, and 3-21). Third, county agricultural extension agents in New Mexico and Texas were asked for their opinions as to how crops, farming practices, and other factors might be similar to like factors in the three Arizona counties to be used for the pesticide usage estimations. Based on these discussions, the usage rates for the Doña Ana and Luna counties in New Mexico and for El Paso and Webb counties in Texas were derived from the average rates of use shown for Cochise and Pima counties (Tables 3-12 and 3-13). Yuma county rates (Table 3-14) were used to characterize pesticide usage for Hidalgo and Cameron counties in Texas. Finally, the appropriate county's average usage rate of active ingredients per acre by crop categories was multiplied by the number of acres in that county to obtain the final estimated pesticide usage figures (Tables 3-18, 3-20, 3-21, 3-23 and 3-24).

## 2.4 Limitations

Any attempt to summarize and compare the pesticide use data across states inherently will reflect the limitation of what data may be available, the quality of the available data, and the extent to which comparable methodologies exist for each state. The first issue of data availability pertains only to California and Arizona (as discussed above). For the purposes of this report, it is assumed that the quality of the data is sufficient for the project objectives. However, it is possible to note several apparent discrepancies, or errors, in the raw data reported for Arizona, but the consequences of the error are probably not significant. (Note: The data from California were already pre-processed, so judgments about data quality are not possible.) For example, several EPA numbers for pesticides reportedly used in Arizona on a specific crop for a specific year, did not show enough digits to allow proper identification of the pesticide used, such as, 275-0, instead of something like, 275-2659. In other cases, the label identification for the EPA number indicated that the pesticide was a solid granular formulation but the reporting units were in gallons. To the extent possible, formulations according to the registration label were followed, so that if the label stated that it was in a solid form, then pounds were the reported unit. Otherwise, it was assumed that a liquid formulation was acceptable and the reporting unit was gallons.

To judge the issue of data comparability across states is difficult since the reporting requirements differ for each state. For California, beginning in 1970, anyone who used restricted use pesticides (RUPs) was required to file a pesticide use report with the county agricultural commissioner. In addition, commercial pest control operators were required to report all pesticides used, whether restricted or nonrestricted. (Note: the criteria established by U.S. EPA to designate a pesticide as a restricted material include: hazard to public health, farm workers, domestic animals, honeybees, the environment, wildlife, or other crops.) In Arizona, commercial pesticide applicators are required to submit pesticide usage reports. (Note: Arizona state officials estimate that approximately 85% of the RUPs are applied by commercial applicators.) Data comparability is further confounded due to differences among states in which chemicals should be reported. For example, in California, data on spray adjuvants (including emulsifiers, wetting agents, foam suppressants, and other efficacy enhancers ) and petroleum products are included. Examples of these types of chemicals include the "alkyls" and petroleum distillates. California also includes in its data base, items such as soap, fertilizers, disinfectants, etc., which are not included in the Arizona data reports.

Other limitations and caveats include issues related to how chemicals are commonly reported; i.e., by the chemical or trade name. For example, most farmers might report using Lorsban™ or Dursban™, but the chemical name is chlorpyrifos. To summarize the total amount of chlorpyrifos used in a given county, one must first know all the trade names (or corresponding EPA numbers) so that the total reflects the total usage of the chemical. Secondly, sales data (the comparison data used for New Mexico and Texas) are limited as accurate indicators of pesticide usage because even though they may be purchased in one county, they could be used in another county or several counties, depending on the location of the farms. In addition, even though the pesticides may have been purchased in one year, they may actually be used in subsequent years. A

third limitation relates to the possibility of chemicals being purchased in Mexico and used on farms in the study area. No records of pesticide usage will thus exist when this situation occurs.

Other limiting factors associated with the data involve the difficulties related to use of an EPA pesticide registration number for identifying the pesticide and amount of active ingredient. A unique coding method for the pesticide, possibly the CAS number, would help identify each compound. The actual amount of active ingredient of the applied or sold product would also help control this problem. Coding problems were observed in the Arizona pesticide data, for example, which might suggest that all databases with pesticide data are extremely difficult to manage and analyze.

The large number of pesticides and formulations being used throughout the border region (over 400 pesticides were used in 1995 in the Arizona counties, and over 800 in California) meant that a paper saving criterion be used to summarize the most meaningful information and not get overwhelmed by the magnitude of number of pesticides involved. This criterion was applied when summarizing the most heavily used pesticides (see for example, Tables 3-6, 3-7, and 3-8.) In these examples, an arbitrary number of 500 pounds of active ingredient was chosen as the minimal tabled value. However, the totals shown in the tables included all identified pesticide values.

These limitations and caveats reveal the complexity and difficulty in accurately determining the pesticide usage in each county within each state. However, despite these limitations, the listing of pesticide use information (actual use or by estimation) can provide a rough estimate of pesticide use over a large area, provide some rough comparison data by county, and provide a measure of potential exposure for estimating potential human health and environmental risks.

# Chapter 3
# Results by State

## 3.1 California

Crop data presented for Imperial and San Diego counties are based on the 1992 United States Department of Agriculture (USDA) survey of crop acreage [17]. Harvested crop lands in Imperial county were approximately four times greater than in San Diego county (Table 3-1). The dominant crops raised in both counties included: hay, small grains, vegetables, and orchard crops (including nuts, citrus, and non-citrus fruits). Additionally, 6619 acres of cotton were grown in Imperial county. More acres were devoted to raising vegetables, hay, small grains, and other field crops in Imperial county while 85% of the harvested cropland in San Diego county was in orchards, especially citrus.

Along with the increased number of acres of crop land in Imperial county came the increased use in irrigation, fertilization, and pesticides (Table 3-1). A majority of the pesticides used in Imperial county were insecticides and herbicides with a proportionally smaller use of fungicides. Similarly, in San Diego county, insecticides and herbicides were the most often used pesticides but a much larger proportion (based on acres farmed) of fungicides were used, possibly reflecting the increased use of fungicides on fresh and citrus fruits.

In San Diego county, the most heavily used pesticides were the fumigants - methyl bromide and chloropicrin (Table 3-2). These fumigants are used extensively to control insects and weeds prior to planting vegetable crops. Using the 1994 data as a reference point, pesticide use on vegetables consisted primarily of four compounds: methyl bromide (100%), metam sodium (87.2%), chlorothalonil (100%), and chloropicrin (100%). In contrast, for fruit crops, the primary pesticide usage consisted of applying sulfur (73.8%), Roundup™ (80%), and propargite (100%).

In Imperial county (Table 3-3), pesticide applications on cotton and fruit accounted for less than 10 percent of the most heavily used pesticides. Vegetables, on the other hand, accounted for over 60% of the pesticide usage of metam sodium (98.9%), methyl bromide (100%), methomyl (67%), and Dacthal (100%). The other major crops (i.e., hay and small grains) accounted for over 60% usage of sulfur (66%), Trifluralin (93%), Malathion (88%), EPTC (97%), chlorpyrifos (86%) and Dimethoate (80%).

The total pesticide usage for the harvested acres can be divided into three major categories: field crops, fruits and nuts, and vegetables and melons [16]. In California, the intensity of pesticide use varies from about 8 to 60 pounds of active ingredient per acre, a factor increase of about 7.5 (Table 3-4). The most intensive use of pesticides was found for fruit and nut crops followed by vegetables and melons, with the least intensive pesticide usage occurring where field crops were grown. It should be noted that included in these statewide total pounds of pesticide used are pounds of chemicals not normally thought of as pesticides, such as the inert materials added to the pesticide formulation, fertilizers, and disinfectants.

**Table 3-1. Acres of Cropland in California by County.**

| | Imperial (1992) | San Diego (1992) |
|---|---|---|
| Harvested | 405699 | 71276 |
| Irrigated | 402395 | 63915 |
| Fertilized | 395598 | 56584 |
| Insecticides | 322478 | 38052 |
| Fungicides | 24546 | 11949 |
| Herbicides | 212286 | 25842 |
| Cotton | 6619 | 0 |
| Hay | 244651 | 5480 |
| Grain | 105152 | 349 |
| Vegetables | 76320 | 4242 |
| Orchards | 2969 | 54025 |
| (Citrus) | 1848 | 18275 |

**Table 3-2. Most Heavily-Used Pesticides in San Diego County, California: Pounds of Active Ingredient Applied by Year.**

| | | Pounds of A.I. Applied by year | | | |
|---|---|---|---|---|---|
| Pesticide | Primary Use | 1991 | 1992 | 1993 | 1994 |
| Metam Sodium | Fungicide | X* | 10408 | 50111 | 43813 |
| Sulfur | Fungicide | 24676 | 75808 | 81394 | 77727 |
| Chloropicrin | Fumigant | 135074 | 132004 | 100467 | 99828 |
| Chlorothalonil | Fungicide | 27188 | 26916 | 29751 | 51554 |
| Methyl Bromide | Fumigant | 505803 | 499750 | 475789 | 434214 |
| Roundup | Herbicide | 31883 | 32210 | 30856 | 28253 |
| Propargite | Insecticide | X | X | 27246 | 25563 |
| Diazinon | Insecticide | 11834 | X | X | X |
| Simazine | Herbicide | 10676 | 8826 | X | X |
| Acephate | Insecticide | X | 9967 | X | X |
| TOTAL | | 747134 | 795889 | 795614 | 760952 |
| | | (69.8)** | (37.3) | (38.1) | (54.3) |

* X = less than lowest number shown in column.

** ( ) = % of the sum of tabled entries in column to overall total pesticides used that given year [14].

**Table 3-3. Most Heavily-Used Pesticides in Imperial County, California: Pounds of Active Ingredient Applied by Year.**

| | | Pounds of A.I. Applied by year | | | |
|---|---|---|---|---|---|
| Pesticide | Primary Use | 1991 | 1992 | 1993 | 1994 |
| Metam Sodium | Fungicide | 983422 | 1755879 | 1115498 | 1906805 |
| Sulfur | Fungicide | 2489597 | 3520508 | 2121163 | 1724271 |
| Trifluralin | Herbicide | 303811 | 132552 | 149661 | 217380 |
| Malathion | Insecticide | 257352 | 182039 | 169643 | 214289 |
| EPTC | Herbicide | 259598 | 186045 | 143652 | 157259 |
| Methomyl | Insecticide | 138544 | 76394 | 100638 | 135844 |
| Dacthal | Herbicide | 220471 | 340050 | 157516 | 129842 |
| Chlorpyrifos | Insecticide | 141170 | 97062 | 94151 | 107145 |
| Dimethoate | Insecticide | 144548 | X* | X | 79083 |
| Endosulfan | Insecticide | 143117 | X | X | X |
| Linuron | Herbicide | X | 78985 | 159428 | X |
| Maneb | Fungicide | X | X | X | 473622 |
| Methyl Bromide | Fumigant | X | 137626 | X | 199586 |
| TOTAL | | 5081630 | 6507140 | 4211350 | 5345126 |
| | | (77.7)** | (85.7) | (68.2) | (81.3 est.) |

* X = less than lowest number shown in column.
** ( ) = % of the sum of tabled entries in column to overall total pesticides used [14].

**Table 3-4. Pesticide Use on Major Crops in California (1993).***

| Crop | Harvested Acreage | Pesticide Use (Total Pounds) | Intensity of Pesticide Use (#A.I./acre) |
|---|---|---|---|
| Field Crops | 4182800 | 32230242 | 7.70 |
| Fruits & Nuts | 1995200 | 118617779 | 59.45 |
| Vegetables & Melons | 1005700 | 27175195 | 27.02 |

* taken from [16], pp. 18-19.

## 3.2 Arizona

Crop data presented for the four counties in Arizona along the U.S./Mexico border are based on the 1992 USDA survey of crop acreage [17]. Only 1202 acres of cropland were harvested in Santa Cruz county and these acres were mostly associated with growing hay. Due to the lack of any pesticide data from Santa Cruz county and the small acreage devoted to agriculture, no discussion of pesticide usage in this county will be presented.

Yuma county has the greatest total acres devoted to agriculture, more than double the acreage of the other three counties combined (Table 3-5). To further demonstrate this size difference in agricultural land use, in Yuma county, more acres are devoted solely to raising vegetable crops than are harvested for all commodities in Cochise and Pima counties. Vegetable crops accounted for about 14%, 2%, and 36% of the harvested acres in Cochise, Pima, and Yuma counties, respectively. Cotton was the primary commodity grown in Pima county (61% of the harvested acres) with cotton accounting for 23% and 14% of the harvested crops in Cochise and Yuma counties, respectively. Hay was the dominant crop harvested (25% of the total) in Cochise county. Orchard crops accounted of approximately 16%, 22%, and 14% of the harvested acres in Cochise, Pima, and Yuma counties, respectively.

Similar to agricultural pesticide usage in California, the majority of the pesticides used in the three Arizona counties were insecticides and herbicides with proportionally smaller uses of fungicides. Interestingly, in contrast to California, no fumigants were used at rates greater than 500 pounds of active ingredient (#A.I.) in Arizona.

Along with the increased number of acres of crop land in Yuma county, there is an increased use of pounds of active ingredient of pesticides, with Yuma county applying about 37 and 13 times as much #A.I. of pesticides as Cochise and Pima counties, respectively, averaged over the years 1992-1995. The insecticides - Lannate, Lorsban, Thiodan, Dimethoate, Malathion, Orthene and the herbicide - Prometryn, are used commonly throughout all three counties (Tables 3-6, 3-7, and 3-8).

**Table 3-5. Acres of Cropland in Arizona by County.**

| Arizona | Cochise 1992 | Pima 1992 | Santa Cruz 1992 | Yuma 1992 |
|---|---|---|---|---|
| Harvested | 42546 | 24861 | 1202 | 188887 |
| Irrigated | 42215 | 24851 | 1201 | 188198 |
| Fertilized | 30251 | 22589 | 501 | NA* |
| Insecticides | 14003 | 20992 | 1126 | 153558 |
| Fungicides | 6655 | 56 | 0 | 24723 |
| Herbicides | 21023 | 15412 | 735 | 106383 |
| Cotton | 9678 | 15160 | 0 | 27210 |
| Hay | 10484 | 1137 | 985 | 45999 |
| Grain | 9144 | 2579 | 0 | 51011 |
| Vegetables | 5969 | 534 | 25 | 68963 |
| Orchards | 6943 | 5441 (est) | 233 | 26206 |

* NA = not available.

**Table 3-6. Cochise County: Most Heavily-Used Pesticides by Year in Pounds of Active Ingredient.**

| Pesticide | Primary Use | Year 1992 | 1993 | 1994 | 1995 |
|---|---|---|---|---|---|
| Lannate | Insecticide | 3153.6 | 2314.0 | 885.6 | 3839.1 |
| Lorsban | Insecticide | 2284.0 | 1943.0 | 3831.0 | 1701.5 |
| Dithane | Fungicide | 2029.6 | 1649.0 | 1725.0 | 811.2 |
| Thiodan | Insecticide | 1875.0 | 3201.0 | 963.0 | 1434.0 |
| Dimethoate | Insecticide | 1864.0 | 1252.0 | 948.0 | 1172.0 |
| Permethrins | Insecticide | 1206.9 | 1305.6 | <* | 744.4 |
| Copper Hydroxide | Fungicide | 1168.5 | < | 1507.0 | < |
| Sulfur | Fungicide | 702.0 | 2220.0 | < | 2210.0 |
| Butylate | Herbicide | < | 4080.3 | 1541.0 | < |
| Malathion | Insecticide | < | 2172.0 | < | < |
| Carbofuran | Insecticide | < | 1352.5 | < | 904.0 |
| Orthene | Insecticide | < | 1659.9 | < | < |
| Thimet | Insecticide | < | 585.0 | 1065.6 | < |
| DiSyston | Insecticide | < | 640.0 | 1312.0 | < |
| Atrazine | Herbicide | < | < | 1176.0 | < |
| Prometryn | Herbicide | < | 900.0 | 1056.0 | < |
| EPTC | Herbicide | < | 745.0 | < | 1148.0 |
| TOTALS | | 14283.6 | 26019.3 | 16010.2 | 13964.2 |
| Max (8) pesticides | | 14283.6 | 19239.2 | 13213.6 | 13219.8 |
| Insecticides | | 10383.5 (72.7%)** | 11289.9 (58.7%) | 6208.6 (47.0%) | 9050.6 (63.4) |
| Herbicides | | 0 (0%) | 4080.3 (21.2%) | 3773.0 (28.6%) | 1148.0 (8.7%) |
| Fungicides | | 3900.1 (27.3%) | 3869.0 (20.1%) | 3232.0 (24.4%) | 3021.2 (22.9%) |

* <= less than 500 pounds active ingredient.
** ( ) = % of total used within pesticide type, insecticide, herbicide, fungicide.

**Table 3-7. Pima County: Most Heavily-Used Pesticides by Year in Pounds of Active Ingredient.**

| | | Year | | | |
|---|---|---|---|---|---|
| Pesticide | Primary use | 1992 | 1993 | 1994 | 1995 |
| Orthene | Insecticide | 11077.0 | 10800.0 | 10872.0 | 10687.5 |
| Lannate | Insecticide | 7465.5 | 945.0 | 1700.1 | 2900.7 |
| Lorsban | Insecticide | 1793.0 | 7704.0 | 13616.0 | 10784.0 |
| Dimethoate | Insecticide | 1153.4 | 30399.5 | 3497.0 | 2532.0 |
| Thiodan | Insecticide | 1544.0 | 4959.0 | <* | 2724.0 |
| Dithane | Fungicide | 2010.0 | 769.5 | < | < |
| Diazinon | Insecticide | 737.0 | < | < | < |
| Prometryn | Herbicide | 515.6 | 7800.0 | 2976.0 | 5744.0 |
| Diuron | Herbicide | 1412.0 | 4043.6 | 1656.0 | 1400.0 |
| Malathion | Insecticide | 1952.0 | 5160.0 | 7456.0 | 3800.0 |
| Cyanazine | Herbicide | < | 1324.0 | < | < |
| Vydate | Insecticide | < | < | 1232.0 | 2868.0 |
| Surflan | Herbicide | < | < | 3840 | < |
| Treflan | Herbicide | < | 775.0 | < | 1930.0 |
| Parathion | Insecticide | < | < | 770.0 | 5568.5 |
| TOTAL | | 29659.5 | 74679.6 | 47615.1 | 50938.7 |
| Max (10) pesticides | | 29659.5 | 73904.6 | 47615.1 | 49538.7 |
| | Insecticides | 25721.9 (86.7%)** | 59967.5 (81.1%) | 39143.1 (82.2%) | 41864.7 (84.5%) |
| | Herbicides | 1927.6 (6.5%) | 13942.6 (18.9%) | 8472.0 (17.8%) | 7674.0 (15.5%) |
| | Fungicides | 2010 (6.8%) | 0 | 0 | 0 |

* < = less than 500 pounds active ingredient applied.
** ( ) = percent of total used within pesticide type.

**Table 3-8. Yuma County: Most Heavily-Used Pesticides by Year in Pounds of Active Ingredient.**

| Pesticide | Primary Use | Year 1992 | 1993 | 1994 | 1995 |
|---|---|---|---|---|---|
| Guthion | Insecticide | 111194.0 | <* | < | < |
| Lorsban | Insecticide | 43808.2 | 49228.5 | 32553.5 | 54753.0 |
| Orthene | Insecticide | 23493.8 | 23447.1 | 36595.5 | 44919.6 |
| Sulfur | Fungicide | 142158.4 | 60029 | 113073 | 95522.0 |
| Diazinon | Insecticide | 10864 | 12375 | < | 19497.5 |
| Dimethoate | Insecticide | 18644.3 | 34891.1 | 12484.4 | 45931.9 |
| Lannate | Insecticide | 108559.1 | 110768.1 | 20056.5 | 139597.6 |
| Kerb | Herbicide | 20990.5 | < | < | < |
| Phosdrin | Insecticide | 27196.0 | 33200.0 | 30796.0 | 17560.0 |
| Thiodan | Insecticide | 29215.0 | 59220.0 | 29771.0 | 54337.5 |
| Balan | Insecticide | 19494.6 | 24010.8 | 13761.0 | 33856.2 |
| Dacthal | Herbicide | 24120.8 | 29779.5 | < | 22847.2 |
| Permethrin | Insecticide | 14649.2 | 16171.9 | < | 24551.8 |
| Malathion | Insecticide | 10341.6 | 32029.0 | 42808.0 | 37929.6 |
| Treflan | Herbicide | 25775.7 | 15585.6 | 20390.9 | 17163.2 |
| Alliette | Fungicide | < | 64264.0 | < | 93392.0 |
| Carzol | Insecticide | < | 16663.5 | < | 11929.6 |
| Diuron | Herbicide | < | 27856.5 | < | 29154.5 |
| DiSyston | Insecticide | 12442.8 | < | < | < |
| Ridomil | Fungicide | < | 20721.7 | < | < |
| Maneb | Fungicide | < | 76382.6 | 10400.8 | 26230.1 |
| Prowl | Herbicide | < | < | 10128.8 | < |
| Prometryn | Herbicide | < | < | 12232.0 | < |
| Prefar | Herbicide | < | < | < | 25940.0 |
| EPTC | Herbicide | < | < | < | 15388.0 |
| TOTAL | | 542,948 | 706624 | 385,052 | 810,501 |
| | Insecticide | 310408 (57.2%)** | 387954 (54.9%) | 205064.9 (53.2%) | 451008.1 (55.6%) |
| | Herbicide | 90381.6 (16.6%) | 97232.4 (13.8%) | 56512.7 (14.7%) | 144349.1 (17.8%) |
| | Fungicide | 142158.4 (26.2%) | 221397.3 (31.3%) | 123473.8 (32.1%) | 215144.1 (26.5%) |

* <= less than 500 pounds active ingredient applied.
** ( ) = % of total used within pesticide type.

The Arizona pesticide usage data were collected by pesticide application to a specific crop and are presented by the type of pesticide (insecticide, herbicide, and fungicide), the major crop grown (cotton, vegetables, other), and the four years (1992-1995) for which data were obtainable (Tables 3-9, 3-10, and 3-11). In Arizona, a majority of the insecticides were applied to vegetables in Cochise and Yuma counties while in Pima county, cotton received the greatest application of insecticides. Herbicide and fungicide usage was more variable (i.e., crop dependant) with herbicides generally being applied to cotton and "other crops" while the fungicides were routinely applied to all crop types.

The types of crops grown, climate, pests, and growing season all combine to influence the amount of pesticides used. For example, Cochise county with an overall average pesticide usage of 0.37 pounds/acre (Table 3-12) has about one third the pesticide loading of Pima county (Table 3-13) with an overall average of 1.19 pounds/acre, and one tenth the pesticide loading of Yuma county (Table 3-14) with an overall average of 3.33 pounds/acre. In all three counties, the average amount of pesticides applied per acre was least for crops in the "other" category (e.g., hay, grain, etc.) with intermediate amounts of pesticides being applied to cotton and the maximum pesticide usage occurring on vegetable crops. In areas where a substantial number of acres are devoted to fruit crops (especially citrus), the pesticide loading is noticeably higher than for vegetable crops.

It should be noted that the last column in Tables 3-12, 3-13, and 3-14 were used to derive the estimation of pesticide usage figures for counties in New Mexico and Texas (see section 2.3).

### 3.3 New Mexico

Crop data presented for Doña Ana and Luna counties are based on the 1992 USDA survey of crop acreage [17]. Additionally, the New Mexico Agricultural Statistics Service also maintained historic records of acreage by crop for the years 1992 through 1995 [18-23]. These data are important in the estimation process for pesticide usage in New Mexico. For example, acres devoted to cotton in Doña Ana county were declining during the period of 1992 to 1995, which could indicate, in the absence of other information such as weather or other pest-related factors, that pesticide usage declined over the same period. In contrast, acres of cotton in Luna county increased over the same time period, while acres of vegetables decreased. From this information and pesticide application rates typical for the same crops in Arizona, it appears that pesticide use has declined in Luna county in relationship to the decline in vegetable acres.

Overall, Doña Ana county had about three times more acres of harvested cropland than Luna county (Table 3-15). Orchard crops, vegetables, and hay were the major crops grown in Doña Ana county with lesser quantities of cotton (with markedly declining acreages) and small grains also being grown. In contrast, vegetables were the dominant crop in Luna county. Noticeably fewer acres were devoted to cotton, hay, and small grains (approximately 3000 to 4000 acres) with orchard crops being grown on only 1160 acres.

**Table 3-9. Pesticide Usage by Major Crop in Cochise County, Arizona, 1992-1995, in Pounds of Active Ingredient.**

| | 1992 | 1993 | 1994 | 1995 |
|---|---|---|---|---|
| Insecticides | | | | |
| Cotton | <* | 3450.7 | < | 2178.4 |
| Vegetables | 8710.0 | 7568.6 | 1848.6 | 5011.1 |
| Other Crops | 3504.0 | 5340.0 | 7156.6 | 1701.5 |
| (Total) | 12214.0 | 16359.3 | 9005.2 | 8891.0 |
| Herbicides | | | | |
| Cotton | < | 2553.0 | 1056.0 | < |
| Vegetables | < | 745.0 | 735.0 | 1148.0 |
| Other Crops | < | 4740.3 | 4789.0 | < |
| (Total) | < | 8038.3 | 6580.0 | 1148.0 |
| Fungicides | | | | |
| Cotton | 2029.6 | 1649.0 | 1725.0 | 811.2 |
| Vegetables | 1237.0 | 3022.4 | < | 2210.0 |
| Other Crops | < | 1352.5 | < | 904.0 |
| (Total) | 3266.6 | 6023.9 | 1725.0 | 3925.2 |
| All Pesticides/All Crops | 15480.6 | 30421.5 | 17310.2 | 13964.2 |
| Average all years | 19294.12 | | | |

* < = less than 500 pounds active ingredient used.

**Table 3-10. Pesticide Usage by Major Crop in Pima County Arizona, 1992-1995, in Pounds of Active Ingredient.**

| | 1992 | 1993 | 1994 | 1995 |
|---|---|---|---|---|
| Insecticides | | | | |
| Cotton | 22636.6 | 51875.5 | 30635.2 | 38015.9 |
| Vegetables | 1133.3 | <* | < | 1390.2 |
| Other Crops | 1952.0 | 8592.0 | 9748.0 | 3800.0 |
| (Total) | 25712.9 | 60467.5 | 40383.2 | 43206.1 |
| Herbicides | | | | |
| Cotton | 515.6 | 15458.1 | 4632.0 | 9074.0 |
| Vegetables | < | < | < | < |
| Other Crops | 1412.0 | < | 3840.0 | < |
| (Total) | 1927.6 | 15458.1 | 8472.0 | 9074.0 |
| Fungicides | | | | |
| Cotton | 2010.0 | 769.5 | < | < |
| Vegetables | < | < | < | < |
| Other Crops | < | < | 960.0 | < |
| (Total) | 3266.6 | 769.5 | 960.0 | < |
| All Pesticides/All Crops | 29659.5 | 83620.6 | 49815.2 | 52280.1 |
| Average all years | 53843.85 | | | |

* < = less than 500 pounds active ingredient.

**Table 3-11. Pesticide Usage by Major Crop in Yuma County, Arizona, 1992-1995, in Pounds of Active Ingredient.**

| | 1992 | 1993 | 1994 | 1995 |
|---|---|---|---|---|
| Insecticides | | | | |
| Cotton | 60245.2 | 50559.8 | 54936.7 | 101526.4 |
| Vegetables | 217159.4 | 256243.6 | 102798.2 | 261811.7 |
| Orchard | 49513.8 | 63594.9 | 23682.8 | 60296.3 |
| Other Crops | 18944.4 | 50220.0 | 55908.0 | 66969.1 |
| (Total) | 345862.8 | 420618.3 | 237325.7 | 490603.5 |
| Herbicides | | | | |
| Cotton | 8007.1 | 11593.1 | 17036.0 | 19322.4 |
| Vegetables | 74833.9 | 95861.5 | 32037.8 | 118104.3 |
| Orchard | 1494.6 | 5955.3 | 8342.1 | 4656.7 |
| Other Crops | 36604.3 | 55238.5 | 43683.5 | 43519.3 |
| (Total) | 120939.9 | 168648.4 | 101099.4 | 185602.7 |
| Fungicides | | | | |
| Cotton | 38808.4 | 1163.0 | < | < |
| Vegetables | 18449.6 | 163310.6 | 20008.2 | 138825.6 |
| Orchard | 102371.0 | 60952.0 | 116459.2 | 97507.3 |
| Other Crops | 2451.5 | 3844.0 | 2364.0 | 6884.3 |
| (Total) | 162080.5 | 229269.6 | 138831.4 | 243217.2 |
| All Pesticides/All Crops | 628883.2 | 818536.3 | 477256.5 | 919423.4 |
| Average all years | 711024.85 | | | |

* <= less than 500 pounds active ingredient.

**Table 3-12. Cochise County: Pounds of Active Ingredient by Major Farm Commodity.**

| Commodity | Acres (1992) | Pounds | Pounds/Acre |
|---|---|---|---|
| Cotton | 9678 | 2029.6 | 0.21 |
| Vegetables | 5969 | 9947 | 1.67 |
| Other | 26899 | 3504.0 | 0.13 |
| Overall: | 42546 | 15480.6 | 0.37 |

**Table 3-13. Pima County: Pounds of Active Ingredient by Major Farm Commodity.**

| Commodity | Acres | Pounds of A.I. | Pounds/Acre |
|---|---|---|---|
| Cotton | 15160 | 25162.2 | 1.66 |
| Vegetables | 534 | 1133.3 | 2.12 |
| Other | 9167 | 3364 | 0.37 |
| Overall: | 24861 | 29659.5 | 1.19 |

**Table 3-14. Yuma County: Pounds of Active Ingredient by Major Farm Commodity.**

| Commodity | Acres | Pounds of A.I. | Pounds/Acre |
|---|---|---|---|
| Cotton | 27210 | 107060.7 | 3.93 |
| Vegetables | 68963 | 310442.9 | 4.50 |
| Orchard | 26206 | 153379.4 | 5.85 |
| Other | 66508 | 58000.2 | 0.87 |
| Overall: | 188887 | 628883.2 | 3.33 |

**Table 3-15. Acres of Cropland in New Mexico by County.**

| New Mexico | Doña Ana 1992 | Luna 1992 |
|---|---|---|
| Harvested | 78282 | 28501 |
| Irrigated | 76586 | 28420 |
| Fertilized | 70597 | 26724 |
| Insecticides | 37108 | 15768 |
| Fungicides | 10792 | 5773 |
| Herbicides | 34489 | 11962 |

| | 1992 | 1993 | 1994 | 1995 |
|---|---|---|---|---|
| **Doña Ana** | | | | |
| Cotton | 19050 | 18950 | 8650 | 8050 |
| Hay | 14700 | 14100 | 15300 | 15900 |
| Grain | 2200 | 2050 | 2600 | 2000 |
| Vegetables | 16040 | 16040 | 16040 | 16040 |
| Orchards | 17600 | 17600 | 17600 | 17600 |
| **Luna** | | | | |
| Cotton | 2500 | 3500 | 3950 | 4800 |
| Hay | 3200 | 3050 | 3000 | 3700 |
| Grain | 3200 | 5450 | 3300 | 4100 |
| Vegetables | 15255 | 13700 | 12000 | 12300 |
| Orchards | 1160 | 1160 | 1160 | 1160 |

Similar to both California and Arizona, insecticides were used on the most acres, followed closely by herbicide use. Fungicides, the least used pesticides in New Mexico, were used on only about one third the number of acres as insecticides or herbicides.

New Mexico has a state regulation that requires that pesticide sales information be reported annually to the New Mexico Department of Agriculture (NMDA) to monitor compliance with the federal requirement that restricted-use pesticides be sold only to licensed applicators. These data are checked for compliance, but not routinely stored. The most recent pesticide sales data for the year 1996 were provided by the NMDA for Doña Ana and Luna counties (Tables 3-16 and 3-17). These data, in conjunction with the acres of cropland data (Table 3-15), were used to develop the pesticide usage information for these two counties (Table 3-18) using the estimation technique described in section 2.3.

The ten most heavily-used pesticides in each county based on these 1996 sales data are also commonly used in the U.S./Mexico border counties in Arizona and California. All of the pesticides with greatest usage (where usage is > 500 # A.I.) in Luna county (Table 3-17) are included in the top ten pesticides used in Doña Ana county (Table 3-16). With the exception of Telone (a fumigant), the types of pesticides sold in Doña Ana county in 1996 are very similar to the pesticides used in Pima county, Arizona; whereas the pesticides and quantities sold in Luna county are more like the usage figures for Cochise county, Arizona.

Without actual pesticide usage information, it is not possible to provide actual yearly estimates of pesticides by crops comparable to those shown for the Arizona counties (see Tables 3-12, 3-13, and 3-14). However, Table 3-18 provides an estimate of pesticide usage for Doña Ana and Luna counties for the years 1992 through 1995. The estimates were obtained using the crop acreage shown in Table 3-15 and the average # A.I. per acre applied for Pima and Cochise counties, Arizona, due to similarities in crops grown and pesticides purchased/used in all four counties.

The majority of the pesticides used in both Doña Ana and Luna counties are applied to vegetable crops with lesser quantities being applied to cotton and the least to "other" crops. As a result of the noticeable decline in cotton acreage in Doña Ana county, the overall pesticide usage estimates for that county have declined over the 4-year period. Similarly, the decline in acres of vegetables in Luna County resulted in a corresponding decline in pesticide usage between the years 1993 and 1994.

By way of comparison between the estimated pesticide use and the 1996 pesticide sales data, total pounds of active ingredients used in Doña Ana and Luna are 85517 and 12437, respectively. It appears that the estimated pesticide use for Doña Ana is only about 50% of the pounds of pesticide sold in 1996 (44000 versus 85517). However, this discrepancy can be accounted for by the fact that Telone usage was not reported in either Cochise or Pima counties, Arizona, and thus not included in the pesticide usage estimate. If the quantity of Telone sold in Doña Ana county is removed from the total pesticide data, the resulting estimate (44000 versus

**Table 3-16. Doña Ana County: The Most Used Pesticides Based on 1996 Sales Data.**

| Chemical | Type | Pounds of Active Ingredient |
|---|---|---|
| Telone | Fumigant | 37,995.0 |
| Temik | Insecticide | 12,030.5 |
| Lannate | Insecticide | 11,156.0 |
| Bladex | Herbicide | 6,848.2 |
| Furidan | Insecticide | 4,026.0 |
| Diazinon | Insecticide | 1,648.4 |
| Paraquat | Herbicide | 1,525.0 |
| Counter | Insecticide | 1,372.0 |
| M. Parathion | Insecticide | 1,085.0 |
| DiSyston | Insecticide | 964.0 |

Major Insecticides: 32281.9 lbs. of A.I.
% of all insecticide sales: 86.9%

Major Herbicides: 8373.2
% of all herbicide sales: 83.9%

Major Fungicides & Other: 37995.0
% of all Other sales: 95+%

Note: Total sales of all pesticides equal 85516.9 pounds.

**Table 3-17. Luna County: The Most Heavily Used Pesticides Based on 1996 Sales Data.**

| Chemical | Type | Pounds of Active Ingredient |
|---|---|---|
| DiSyston | Insecticide | 4006.5 |
| Telone | Fumigant | 3851.0 |
| Bladex | Herbicide | 1180.0 |
| Lannate | Insecticide | 574.5 |
| Diazinon | Insecticide | 558.7 |
| Temik | Insecticide | 501.8 |

(All others less than 500 pounds)

| | | |
|---|---|---|
| Major Insecticides: 5641.5 | Major Herbicides: 1180.0 | Other: 3851.0 |
| % of total sales: 78.5% | % of total sales: 88.6% | % of total sale: 95+% |

Note: Total sales of all pesticides equals 12436.8 pounds.

**Table 3-18. Estimate of Pesticide Usage for Doña Ana And Luna Counties (# A.I.)***

| Commodity | 1992 | 1993 | 1994 | 1995 |
|---|---|---|---|---|
| Doña Ana | | | | |
| Cotton | 17800 | 17700 | 8100 | 7500 |
| Vegetables | 30400 | 30400 | 30400 | 30400 |
| Other | 6200 | 5900 | 6500 | 6500 |
| Est. Total | 54400 | 54000 | 45000 | 44400 |
| Luna | | | | |
| Cotton | 2300 | 3300 | 3700 | 4500 |
| Vegetables | 28900 | 26000 | 22700 | 23300 |
| Other | 2300 | 3100 | 2300 | 2800 |
| Est. Total | 33500 | 32400 | 28700 | 30600 |

* estimated derived using average pesticide application rates from Pima and Cochise counties, Arizona.

47522 # A.I.) of pesticide usage is within 10% of the 1996 sales figures. Conversely, the estimate for pesticide usage in Luna county is too high by a factor of about 2.5 (30600 versus 12437) and removing the contribution of Telone makes the comparison between the estimate and 1996 sales data too high by a factor of 3.6 (30600 versus 8515 # A.I.). Perhaps this is not unreasonable for the crude methodology employed for estimating pesticide usage and the assumptions of similarity with Arizona usage. It should be noted that overall usage of pesticides is likely to be relatively low for New Mexico.

## 3.4 Texas

Crop data for the four counties in Texas along the U.S./Mexico border are based on the 1992 USDA survey of crop acreage [17] and are presented in Table 3-19. Further detailed acreage statistics for various crops grown all four counties were obtained for the years 1992-1995 were obtained from the Texas county extension agents (Tables 3-20, 3-21, 3-22, and 3-23). These detailed data are important in the estimation process for pesticide usage in Texas.

Hidalgo county has the greatest amount of cropland acres with about double the acres of cropland of Cameron county and 8 times the acres of El Paso and Webb counties combined (Table 3-19). Cotton and small grains were the dominant crops in the two eastern most counties of Texas (Cameron and Hildago counties). Other crops grown in Cameron and Hildago counties include: vegetables, sugar cane, hay, and various orchard crops (predominantly citrus). Although not specifically broken out in the Tables 3-22 and 3-23, the acres of citrus orchards grown in Hidalgo and Cameron counties have been steadily increasing following a devastating freeze that had occurred in 1989. In El Paso county, cotton and hay are the most widely grown crops while in Webb county, hay is the dominant crop.

In the absence of actual data to determine the major pesticides used in Texas, a literature search provided some information about which chemicals are being used for cotton [24, 25], as well as typical pesticides used on various crops as provided by the Texas Agricultural Extension Office (crop sheets [26], and local guidance [27, 28]). Use of pesticides in the four Texas counties, based on their usage on cotton, vegetables, and citrus crops, indicate that similar chemicals to those used in Arizona are also being used in Texas (Table 3-24).

Similar to the findings in the other three states, the primary pesticides applied to croplands are the insecticides with herbicides being applied to slightly fewer acres. Fungicides are used on very few acres, only about one-tenth the cropland acres harvested.

Similar to New Mexico, actual pesticide usage data does not exist for any of the counties in Texas. Following the same approach and methodology (see section 2.3) used in New Mexico, with the assumption that El Paso and Webb counties are more likely to have pesticide usage patterns similar to Cochise and Pima counties than Yuma county, Arizona, the estimates of pesticide usage have been generated (Tables 3-20 and 3-21). One significant finding/result was that pesticide usage estimates for El Paso county in 1995 (Table 3-20) are similar to the estimates for Doña Ana county, New Mexico (Table 3-18). This result was especially encouraging and

**Table 3-19. Acres of Cropland in Texas by County.**

| Texas | Cameron 1992 | Hidalgo 1992 | El Paso 1992 | Webb 1992 |
|---|---|---|---|---|
| Harvested | 189297 | 383507 | 42081 | 5154 |
| Irrigated | 119744 | 218423 | 41197 | 3405 |
| Fertilized | 167076 | 257384 | 31200 | 1622 |
| Insecticides | 110017 | 200551 | 18738 | 0 |
| Fungicides | 10885 | 49960 | 3455 | 0 |
| Herbicides | 99192 | 192360 | 16796 | 12078* |
| Cotton | 82154 | 92533 | 25858 | 0 |
| Hay | 3249 | 7469 | 13612 | 3958 |
| Grain | 84002 | 179210 | 1271 | 0 |
| Vegetables | 5988 | 52369 | 3990 | 425 |
| Orchards | 3372 | 29101 | 5930 | 422 |
| Sugar Cane | 8784 | 21168 | 0 | 0 |
| Other | 0 | 2865 | 6735 | 349 |

* herbicide usage is included for acres not associated with harvested cropland.

**Table 3-20. Estimated Acres And Pesticide Usage by Major Crop Category For El Paso County, Texas, 1992-1996.**

| | Acres | | | | Pesticide Usage (# A.I.) | | | |
|---|---|---|---|---|---|---|---|---|
| Crop Category | 1992 | 1993 | 1994 | 1995 | 1992 | 1993 | 1994 | 1995 |
| cotton | 25858 | 22200 | 24771 | 27549 | 24300 | 20900 | 23300 | 25900 |
| grains | 1271 | 650 | 823 | 300 | 500 | 200 | 300 | 100 |
| vegetables | 3990 | 5073 | 5689 | 2454 | 7600 | 9600 | 10800 | 4700 |
| hay/silage | 13612 | 15221 | 13810 | 14306 | 4900 | 5500 | 5000 | 5200 |
| other | 6735 | 7255 | 7475 | 7494 | 2400 | 2600 | 2700 | 2700 |
| TOTAL | 51466 | 50399 | 52568 | 52103 | 47300 | 38800 | 42100 | 38600 |

**Table 3-21. Estimated Acres And Pesticide Usage by Major Crop Category For Webb County, Texas, 1992-1995.**

| | Acres | | | | Pesticide Usage (# A.I.) | | | |
|---|---|---|---|---|---|---|---|---|
| Crop Category | 1992 | 1993 | 1994 | 1995 | 1992 | 1993 | 1994 | 1995 |
| vegetables | 425 | 425 | 425 | 425 | 808 | 808 | 808 | 808 |
| hay/silage | 3958 | 3958 | 3958 | 3958 | 1425 | 1425 | 1425 | 1425 |
| other | 422 | 422 | 422 | 422 | 152 | 152 | 152 | 152 |
| TOTAL | 4805 | 4805 | 4805 | 4805 | 2400 | 2400 | 2400 | 2400 |

**Table 3-22. Estimated Acres and Pesticide Usage by Major Crop Category For Cameron County, Texas, 1992-1995.**

| | Acres | | | | Pesticide Usage (# A.I.) | | | |
|---|---|---|---|---|---|---|---|---|
| Crop Category | 92 | 93 | 94 | 95 | 92 | 93 | 94 | 95 |
| Vegetables | 5988 | 5551 | 6119 | 4589 | 26946 | 24980 | 27536 | 20650 |
| Orchard | 3372 | 3600 | 4160 | 4580 | 19726 | 21060 | 24336 | 26793 |
| Cotton | 76200 | 94100 | 92100 | 64000 | 299466 | 369813 | 361953 | 251520 |
| Grain + Others | 87251 | 87251 | 87251 | 87251 | 75908 | 75908 | 75908 | 75908 |
| TOTALS | 172811 | 190502 | 189630 | 160420 | 422046 | 491761 | 489733 | 374871 |

**Table 3-23. Estimated Acres and Pesticide Usage by Major Crop Category for Hidalgo County, Texas, 1992-1995.**

| Crop Category | Acres | | | | Pesticide Usage (# A.I. x 1000) | | | |
|---|---|---|---|---|---|---|---|---|
| | 1992 | 1993 | 1994 | 1995 | 1992 | 1993 | 1994 | 1995 |
| Vegetables | 52369 | 44522 | 45990 | 39306 | 235.7 | 200.3 | 207.0 | 176.9 |
| Orchard | 29101 | 21804 | 25204 | 27754 | 170.2 | 127.6 | 147.4 | 162.4 |
| Cotton | 92533 | 88400 | 87300 | 71700 | 363.7 | 347.4 | 343.1 | 281.8 |
| Grain + Others | 186679 | 186679 | 186679 | 186679 | 162.4 | 162.4 | 162.4 | 162.4 |
| TOTALS | 360682 | 341405 | 345173 | 325439 | 932.0 | 837.7 | 697.5 | 783.4 |

**Table 3-24. Major Pesticides Used on Crops in Cameron And Hidalgo Counties.**

| Insecticides | | Herbicides | | Fungicides & Other |
|---|---|---|---|---|
| Counter | Diazinon** | Prefar ** | Kerb** | Chlorthalonil |
| DiSyston** | Thiodan** | Treflan | Diuron | Rovral |
| Dacthal | M. Parathion | Roundup | Dacthal** | Ridomil** |
| Carbofuran | Orthene** | Simazine | | Maneb** |
| Guthion | Temik | Prometryn | | |
| Lannate ** | Malathion | Pendimethalin | | |
| Profenofos | Lorsban | | | |

** = included in the most heavily used pesticides in Yuma county, Arizona.

supports our estimation technique since both El Paso and Doña Ana counties border each other across state lines and thus were expected to be agriculturally similar. Due to the limited farming activity in Webb county, the pesticide usage estimates for that county indicate very low overall pesticide usage (Table 3-21).

In contrast to the assumptions used to derive the pesticide usage estimates for El Paso and Webb counties, it was assumed that Hidalgo and Cameron counties were more likely to have pesticide usage patterns similar to Yuma county, Arizona. These assumptions are based on the similarity in crops grown, the scale of agriculture in each county, and on discussions with the Texas county extension agents. As a result of these assumptions, pesticide usage estimates were generated for Cameron (Table 3-22) and Hidalgo counties (Table 3-23). It is interesting to note that the estimated pesticide usage totals for Hidalgo county are approximately equal to the usage in Yuma county, Arizona, even though Yuma county has more acres associated with agricultural cropland.

The majority of pesticides used in El Paso, Cameron, and Hildago counties were applied to cotton. Vegetable crops generally had the second highest pesticide usage rates except in Cameron county where "other" crops required the second highest pesticide use. In Webb county, hay and other silage crops accounted for the majority of pesticide applied with lesser quantities of pesticides being used on vegetables and "other" crops.

## 3. 5 Comparison with Other Estimates of Pesticide Sales and/or Usage Data

Texas, like New Mexico, does not have a state requirement to obtain pesticide sales or usage information. However, it is possible to obtain some independent confirmation as to the

relative accuracy of the our estimates of pesticide use using data from two different independent sources. The first source of independent pesticide use information is a published report in which the use of pesticides is based on surveys of cotton growers in Texas [24]. Included in this report are summary statistics of insecticide and herbicide usage in the four counties along the border which are designated as the Lower Rio Grande Valley. The four counties of the Lower Rio Grande Valley are Cameron, Hidalgo, Starr, and Willacy counties. Cameron and Hidalgo counties accounted for 62.7% of the cotton acres grown in 1994 in the report. The report's authors estimate of pesticide usage for these four counties was 1,059,000 pounds, which can be adjusted by percentage of acres in Cameron and Hidalgo counties to provide an estimate of 664,000 pounds of pesticide used in the two counties of interest. This quantity underestimates the true total pesticide usage on cotton because it only represents the insecticides and herbicides applied to cotton (i.e., no fungicides, fumigants, etc.). The authors also provided an estimate of the amount of pesticides used on cotton for other purposes to be 16% for this region [24]. Hence, adjusting the 664000 pounds higher by 16% provides an adjusted total of 770,000 pounds. The resultant pesticide usage figure is within 10% (higher) of the estimated total pesticide use for cotton in 1994 of 705,000 pounds (Tables 3-22 and 3-23) supporting the estimation technique used in this report.

The second possible comparison to be made is with the sales data supplied by the Texas Department of Agriculture (TDA) for Cameron, Hidalgo and Willacy counties in 1992. In 1993, TDA asked dealers in these three counties to provide pesticide sales records for a four year period, including 1992. TDA considers the reported data to be representative of the pesticide sales, even though not all dealers responded to the survey. TDA provided the results of the top 20 pesticide sales for these counties and their quantities sold (Table 3-25). The top 20 pesticides sold in these three counties are very similar to those used in Arizona and sold in New Mexico. To arrive at the # A.I. sold, the average active ingredients rates were determined using the pesticide's trade name and EPA number (see the Appendix) to identify the percentage in pounds for solids or pounds per gallon for liquids of each pesticide formulation. For comparison with other data used in this report, biological pesticides, such as Javelin WG, were not included in the total pesticide quantities. In addition, since the sales data provided by TDA included Willacy county sales, the ratio (expressed in percent) of harvested acres to combined total acres for the 3 counties was used (65.6%, 19.2%, and 15.2% for Hidalgo, Cameron and Willacy counties, respectively) to adjust the quantities of pesticide sold. With these assumptions and adjustments, the combined total # A.I. of the 19 most heavily sold pesticides in Cameron and Hidalgo counties represented a total of 166,558 and 569,072 pounds, respectively. These figures compare with the 422,000 and 932,000 pounds estimated in this report, which are higher by factors of 2.5 and 1.6, respectively.

**Table 3-25. Pesticide Sales Data (1992) of the 20 Most Sold Pesticide Products from Cameron, Hidalgo, and Willacy Counties, Texas*.**

| Formulation (active ingredient) | Quantity Sold (in lbs or lbs/gal) | # A.I.* |
|---|---|---|
| Temik 15G (aldicarb) | 184842 | 27726.3 |
| Lorsban 15G (chlorpyrifos) | 124890 | 18733.5 |
| Ridomil/Bravo 81W SP (metalaxyl & chlorothalonil) | 116366 | 94256.5 |
| Furadan 15G (carbofuran) | 112950 | 16942.5 |
| Dacthal 75% WP (DCPA) | 95280 | 71460. |
| Terrachlor Super X (PCNB) | 50000 | 5000. |
| Iron Sulphate (Iron Sulphate) | 47870 | 47870. |
| Javelin WG (Bacillus thuriglensis var. kurstaki) | 47689 | ** |
| Bravo 90 DF (chlorothalonil) | 48809 | 43928.1 |
| Orthene 90S (acephate) | 43280 | 38952. |
| Atrazine 4L (atrazine) | 40665 | 162660. |
| Guthion 2L (azinphos-methyl) | 30975 | 61950. |
| Roundup (glyphosate) | 28980 | 101430. |
| Karmex DF (diuron) | 28104 | 22483.2 |
| Methyl Parathion4 (MP) | 26806 | 107224. |
| Treflan TR-10 (trifluralin) | 23900 | 2390. |
| DiSyston 15G (disulfoton) | 22560 | 3384. |
| Dropp 50 WP (thidiazuron) | 22218 | 11109. |
| Solicam (norflurazon) | 22100 | 17370.6 |
| Ridomil MZ 58 (mancozeb & metalaxyl) | 21756 | 12618.5 |
| | Total | 819,618.2 |

* - data compiled by Texas Department of Agriculture.

** - only chemically-based pesticides included in total pounds of A.I.

# Chapter 4
# Summary

Understanding and evaluating the nature of pesticide exposure to the pediatric population (i.e., multiple pathway/multiple pesticide exposure) and potential health implications are of national interest and relevant to residents who live along the U.S./Mexico border. As a result of discussions with the state agencies and border communities, this project was identified as one of the priority areas for the Environmental Health Workgroup of the Border XXI program. This project is a first step of a multi-phase project to assess the effects (if any) of multiple pathway, multiple pesticide exposures on children's health. The pesticide data will be shared with state agencies to examine the estimated pesticide usage in selected counties within 100 kilometers of the border. These data provide insight into possible exposure areas along the U.S./Mexico border which in turn can be used to develop future Border XXI study designs that are more efficient and cost-effective by selecting areas with the highest exposure potential.

## 4.1 Data Availability

In the absence of a federal reporting requirement for pesticide data, the state specific pesticide regulations and reporting requirements determine what, if any, pesticide information is available. As a result, California has the most extensive and complete data record. Pesticide usage data in California is a computerized database and readily available for use for the years 1991 through 1994 with 1995 data currently being added to the database. Arizona also requires data reporting of commercially-applied pesticides. Arizona has a relatively complete electronic database of pesticide application for the years 1992 to 1995.

In contrast, New Mexico and Texas do not have state regulations requiring the reporting of pesticide sales or usage. However, pesticide sales information is required to be reported to the New Mexico Department of Agriculture for verification of compliance with federal regulations on restricted use chemicals. Unfortunately, these records are not maintained. Texas has no state regulations requiring the reporting of pesticide sales or usage. Only a few small projects conducted within Texas have collected any specific pesticide sales/usage information. As a result of this lack of data, estimation techniques are necessary to generate the pesticide usage data presented in this report.

## 4.2 Pesticide Data Summary

Chapter 3 presents the county-level tables of crop acres and pesticide usage by county for study period 1992-1995 in Arizona, New Mexico, and Texas while California data are presented for the years 1991 through 1994. When summarized for all four states, it is apparent that the most agriculturally active counties (as indicated by the most acres harvested) are Imperial county, California; Hidalgo county, Texas; Yuma county, Arizona; and Cameron county, Texas, in that order for calendar year 1992 (Table 4-1). These 4 counties comprised 78.8% of the total

harvested acres associated with all 12 counties examined in this report. The most commonly grown crops in these four counties are cotton, citrus, and vegetables.

In general, across all counties in the four border states, insecticides were the most frequently applied pesticides and accounted for greater than 50% of all the pesticides used. Herbicides, accounting for about 30% to 40% of all pesticides used, were the second most frequently applied pesticides. The use of fungicides ranked third (about 15% or less of the total pesticides used) in the U.S./Mexico border region and were generally associated with orchard and vegetable crops. The least used (<5% of total applied pesticides) of the major classes of pesticides were the soil fumigants (except in California) and defoliants.

The counties where the greatest total # A.I. were applied per acre are Imperial and San Diego counties, California, Hidalgo county, Texas, Yuma county, Arizona, and Cameron county, Texas, in order of decreasing # A.I. used (Table 4-1). The pesticide usage rates in the two counties in California should be compared with the other agriculturally active counties only with the caveat that the Department of Pesticide Regulation in California includes a number of chemicals not necessarily included in the estimates of usage in other states, such as chlorine, a common disinfectant used for many purposes [15].

Table 4-2 provides a summary list of the most abundantly used pesticides that were applied in at least 3 of the 4 years during the study period in Arizona and California and the top ten most frequently sold pesticides in New Mexico (based on NMDA 1996 sales data) and Texas (based on the TDA 1992 sales data study). It should be noted that there are eight organophosphorus (OP) pesticides included in the list (Counter, Cythion, DiSyston, Guthion, Lorsban, Methyl Parathion, Orthene, and Phosdrin).

Overall, counties with orchards required the highest pounds of pesticide per acre, followed by vegetables and cotton with "other crops" (hay, grain, etc.) requiring the least amounts of pesticides. This fact is confirmed by examination of the absolute # A.I. applied in Yuma and Hidalgo counties which have the greatest acreages of orchards and vegetables for the 10 counties in the border region outside California and consequently, have the greatest absolute # A.I. of pesticides being used (Table 4-1). However, when the absolute # A.I. figures are adjusted for acres farmed to determine an application rate (in # A.I./acre), Yuma county, Arizona, has the highest overall application rate (3.76), followed by Cameron county (2.35), Texas, Pima county (2.17), Arizona, and Hidalgo county (2.12), Texas (Table 4-3). Yuma county, Arizona, used at least 50% more pounds of active ingredient applied to the acres harvested each year on average than elsewhere in the 10 border region counties (Imperial and San Diego counties excluded).

A possible factor associated with the interpretation of the assembled pesticide usage/sales information for consideration of exposure estimates is the number of people who live and work in areas that use the greatest quantities of pesticides. The population estimates for the study area are obtained from the 1990 Bureau of Census (Table 4-4). Subsequent analyses using population estimates and location of major agricultural areas where there may be high pesticide usage could improve the assessment of potential exposure to populations of interest.

**Table 4-1. Summary Table of Acres and Estimated Total Pesticide Usage for Selected Border Counties.**

| | | Acres (× 1000) | | | | # A.I. (× 10,000) | | | |
|---|---|---|---|---|---|---|---|---|---|
| State | County | 1992 | 1993 | 1994 | 1995 | 1992 | 1993 | 1994 | 1995 |
| CA | Imperial | 405.7 | na* | na | na | 759.2 | 617.5 | 657.5 | 848.1 |
| | San Diego | 71.3 | na | na | na | 213.4 | 208.9 | 140.1 | 177.8 |
| AZ | Cochise | 42.5 | na | na | na | 1.5 | 3.0 | 1.7 | 1.4 |
| | Pima | 24.9 | na | na | na | 3.0 | 8.4 | 5.0 | 5.2 |
| | Santa Cruz | 1.2 | na | na | na | --** | -- | -- | -- |
| | Yuma | 188.9 | na | na | na | 62.9 | 81.9 | 47.7 | 91.9 |
| NM | Doña Ana | 78.3 | 77.3 | 67.7 | 67.0 | 5.4 | 5.4 | 4.5 | 4.4 |
| | Luna | 28.5 | 30.2 | 26.4 | 29.3 | 3.4 | 3.2 | 2.9 | 3.1 |
| TX | Cameron | 172.8 | 190.5 | 189.6 | 160.4 | 42.2 | 49.2 | 49.0 | 37.5 |
| | El Paso | 51.5 | 50.4 | 52.6 | 52.1 | 4.7 | 3.9 | 4.2 | 3.9 |
| | Hidalgo | 360.7 | 341.4 | 345.2 | 325.4 | 93.2 | 83.8 | 69.8 | 78.3 |
| | Webb | 4.8 | 4.8 | 4.8 | 4.8 | 0.2 | 0.2 | 0.2 | 0.2 |

* - na = not available.
** - "--" = missing data.

**Table 4-2. Primary Pesticides Used along the U.S./Mexico Border.***

| Trade Name | EPA No.** (Use†*) | Common Name/Active Ingredient | CAS No. |
|---|---|---|---|
| Atrazine | 19713-11 (H) | Atrazine | 1912-24-9 |
| Balan | 34704-746 (H) | Benefin | 1861-40-1 |
| Bladex | 352-470 (H) | Cyanazine | 21725-46-2 |
| Bravo | 50534-188 (F) | Chlorothalonil | 1897-45-6 |
| Caparol | 100-620 (H) | Prometryn | 7287-19-6 |
| Counter | 241-314 (I) | Terbufos | 13071-79-9 |
| Cythion | 5905-196 (I) | Malathion | 121-75-5 |
| Dacthal | 50534-10 (H) | DCPA (Dimethyl tetrachloro terephthalate | 1861-32-1 |
| Diazinon | 5905-248 (I) | Diazinon | 333-41-5 |
| Dimethoate | 51036-110 (I) | Dimethoate | 60-51-5 |
| DiSyston | 3125-307 (I) | Disulfoton | 298-04-4 |
| Dithane | 707-180 (F) | Mancozeb | 8018-01-7 |
| EPTC (EPTAM) | 10182-220 (H) | Ethyl dipropyl thiocarbamate | 759-94-4 |
| Furadan | 279-2876 (I) | Carbofuran | 1563-66-2 |
| Guthion | 3125-102 (I) | Azinphos-Methyl | 86-50-0 |
| Iron Sulphate | -‡ (Defoliant) | Iron Sulphate | - |
| Karmex | 352-508 (H) | Diuron | 330-54-1 |
| Lannate | 352-342 (I) | Methomyl | 16752-77-5 |
| Lorsban/Dursban | 62719-220 (I) | Chlorpyrifos | 2921-88-2 |
| Maneb | 4581-371 (F) | Manganese ethylene bis dithiocarbamate | 12427-38-2 |
| Metam Sodium | 10182-150 (F) | Metam Sodium | 137-42-8 |
| Methyl Bromide | - (Fumigant) | Methyl Bromide | 74-83-9 |
| M. Parathion | 4787-11 (I) | Methyl Parathion | 298-00-0 |
| Omite | 400-427 (I) | Propargite | 2312-35-8 |
| Orthene | 59639-33 (I) | Acephate | 30560-19-1 |

| Trade Name | EPA No.** (Use†*) | Common Name/Active Ingredient | CAS No. |
|---|---|---|---|
| Paraquat | 10182-280 (H) | Paraquat | 2074-50-2 |
| Phosdrin | 5481-114 (I) | Mevinphos | 7786-34-7 |
| Pounce/Ambush | 10182-35 (I) | Permethrins | 52645-53-1 |
| Ridomil | 100-607 (F) | Metalaxyl | 57837-19-1 |
| Roundup | 524-475 (H) | Glyphosate | 38641-94-0 |
| Sulfur | 5905-437 (F) | Sulfur | 7704-34-9 |
| Telone | 62719-32 (Fumigant) | Chloropicrin | 76-06-2 |
| Temik | 264-330 (I) | Aldicarb | 116-06-3 |
| Thiodan | 10163-100 (I) | Endosulfan | 115-29-7 |
| Treflan | 62719-131 (H) | Trifluralin | 1582-09-8 |

* - this list is a summary of the most abundantly used pesticides that were applied in at least 3 of the 4 years during the study period in Arizona and California and the top ten most sold pesticides in New Mexico and Texas (based on the TDA 1992 sales data study).

** - the EPA number is for a commonly sold product in the U.S./Mexico border region. The first portion of the number is associated with the manufacturer and the second with the product formulation. These numbers are not unique for the chemical used.

† - I = insecticide; H = herbicide; F = fungicide.

‡ - unknown or non-existent.

**Table 4-3. Pounds of A.I. per Acre by County and Year*.**

| State | County | Year | Insecticide | Herbicide | Other | Average |
|---|---|---|---|---|---|---|
| AZ** | COCHISE | 1992 | 0.87 | <0.03 | 0.49 | 0.36 |
| | | 1993 | 1.17 | 0.38 | 0.91 | 0.72 |
| | | 1994 | 0.64 | 0.31 | 0.26 | 0.41 |
| | COCHISE | 1995 | 0.63 | 0.05 | 0.59 | 0.33 |
| | | ***OVERALL*** | ---------- | ---------- | ---------- | 0.45 |
| | PIMA | 1992 | 1.22 | 0.12 | 58.3 | 1.19 |
| | | 1993 | 2.88 | 1.00 | 13.7 | 3.36 |
| | | 1994 | 1.92 | 0.55 | 17.14 | 2.00 |
| | | 1995 | 2.06 | 0.59 | 8.93 | 2.10 |
| | | ***OVERALL*** | ---------- | ---------- | ---------- | **2.17** |
| | YUMA | 1992 | 2.25 | 1.14 | 6.56 | 3.33 |
| | | 1993 | 2.74 | 1.59 | 9.27 | 4.33 |
| | | 1994 | 1.55 | 0.95 | 5.62 | 2.53 |
| | | 1995 | 3.19 | 1.74 | 9.84 | 4.87 |
| | | ***OVERALL*** | ---------- | ---------- | ---------- | **3.76** |
| TX† | CAMERON | 1992 | 2.11 | 0.81 | 10.08 | 2.23 |
| | | 1993 | 2.28 | 1.04 | 12.65 | 2.60 |
| | | 1994 | 2.23 | 1.04 | 13.05 | 2.59 |
| | | 1995 | 1.81 | 0.76 | 9.30 | 1.98 |
| | | ***OVERALL*** | ---------- | ---------- | ---------- | **2.35** |

| State | County | Year | Insecticide | Herbicide | Other | Average |
|---|---|---|---|---|---|---|
| | EL PASO | 1992 | 2.10 | 0.08 | 1.92 | 1.12 |
| | | 1993 | 1.30 | 0.51 | 1.68 | 0.92 |
| | | 1994 | 1.48 | 0.70 | 0.73 | 1.00 |
| | | 1995 | 1.52 | 0.28 | 1.56 | 0.92 |
| | | ***OVERALL*** | ---------- | ---------- | ---------- | **0.99** |
| | HIDALGO | 1992 | 2.56 | 0.92 | 4.85 | 2.43 |
| | | 1993 | 2.13 | 0.91 | 4.69 | 2.18 |
| | | 1994 | 1.74 | 0.76 | 4.05 | 1.82 |
| | | 1995 | 2.07 | 0.81 | 4.23 | 2.04 |
| | | ***OVERALL*** | ---------- | ---------- | ---------- | **2.12** |
| | WEBB | 1992 | 0.41 | 0.02 | 0.07 | 0.50 |
| | | 1993 | 0.32 | 0.11 | 0.07 | 0.50 |
| | | 1994 | 0.33 | 0.14 | 0.03 | 0.50 |
| | | 1995 | 0.37 | 0.06 | 0.07 | 0.50 |
| | | ***OVERALL*** | ---------- | ---------- | ---------- | **0.50** |
| NM‡ | DOÑA ANA | 1992 | 0.64 | 0.19 | 2.22 | 0.69 |
| | | 1993 | 0.64 | 0.19 | 2.20 | 0.69 |
| | | 1994 | 0.53 | 0.16 | 1.83 | 0.57 |
| | | 1995 | 0.53 | 0.15 | 1.81 | 0.57 |
| | | ***OVERALL*** | ---------- | ---------- | ---------- | **0.63** |

| State | County | Year | Insecticide | Herbicide | Other | Average |
|---|---|---|---|---|---|---|
| | LUNA | 1992 | 1.23 | 0.31 | 1.80 | 1.18 |
| | | 1993 | 1.19 | 0.30 | 1.74 | 1.14 |
| | | 1994 | 1.06 | 0.26 | 1.54 | 1.01 |
| | | 1995 | 1.13 | 0.28 | 1.64 | 1.07 |
| | | ***OVERALL*** | --------- | ---------- | ---------- | **1.10** |

* - Data for California are not included in this table because of the inclusion of chemicals (e.g., petroleum oil, mineral oil, and potash soap) in their usage inventory that are not reported in the other states. Calculation of the # A.I. per acre by county and year would thus result in an inaccurate assessment of pesticide usage in the state when compared to pesticide usage in the other states.

** - Tables 3-9, 3-10, and 3-11 pesticide usage total values were divided by corresponding acres from Table 3-5.

† - Tables 3-20, 3-21, 3-22, 3-23 pesticide usage total values were adjusted by average percentage of insecticide, herbicide and fungicide as determined by Cochise and Pima (for El Paso and Webb) counties, and Yuma counties (for Cameron and Hidalgo) divided by corresponding acres from Table 3-19.

‡ - Table 3-18 pesticide usage total values were adjusted by average percentage of insecticide, herbicide, and fungicide as determined by Cochise and Pima counties divided by corresponding acres from Table 3-15.

**Table 4-4. Population Statistics For The Study Area Counties*.**

| State | County | Total Population | Children <11 Yrs |
|---|---|---|---|
| California | Imperial | 109,303 | 25,062 |
| | San Diego | 2,498,016 | 433,068 |
| Arizona | Cochise | 97,624 | 17,243 |
| | Pima | 666,880 | 113,978 |
| | Santa Cruz | 29,676 | 6,815 |
| | Yuma | 106,895 | 21,482 |
| New Mexico | Doña Ana | 135,510 | 27,938 |
| | Luna | 18,110 | 3,440 |
| Texas | Cameron | 260,120 | 51,079 |
| | Hidalgo | 383,545 | 90,522 |
| | El Paso | 591,610 | 127,363 |
| | Webb | 133,239 | 32,487 |

* - population figures are for the 1990 census. These figures may grossly underestimate current populations since the population on the U.S./Mexico border has been markedly growing since the time of the 1990 census.

## 4.3 Comparison with U.S. Geological Survey Data

The U.S. Geological Survey (USGS) provides estimates of pesticide usage based on a similar, yet different, estimation methodology than used in this report. Overall, the USGS estimates were higher than our estimates by factors ranging from 1 to 22 (Table 4-5). The USGS pesticide usage estimates are higher than our estimates due to a procedural bias in which non-chemical pesticides or chemicals not necessarily thought of as pesticides (e.g., chlorine) are included in their pesticide usage estimates. However, when looking at the three most agriculturally active counties (i.e., Yuma county, Arizona, and Cameron and Hildago counties, Texas), the estimates of pesticide usage in # A.I. were much closer with the USGS estimates being only slightly higher than our estimates by a factor of no greater than 1.5. Further, when ranking counties by pesticide use, close agreement can be seen by the two estimation methods in which the top 3 and bottom 2 counties are identical with slight differences occurring for the middle ranked counties.

**Table 4-5. Comparison of Estimates of Total Pesticides Used in Border Counties With U.S. Geological Survey Estimates*.**

| State | County | USGS Estimate | RTI Estimate |
|---|---|---|---|
| Arizona | Cochise | 210.2 | 15.5 |
| | Pima | 284.3 | 29.7 |
| | Santa Cruz | 11.9 | 0 |
| | Yuma | 913.5 | 628.9 |
| New Mexico | Doña Ana | 210.7 | 54.4 |
| | Luna | 60.7 | 33.5 |
| Texas | Cameron | 438.9 | 422.0 |
| | El Paso | 118.2 | 47.3 |
| | Hidalgo | 1475.5 | 932.0 |
| | Webb | 53.6 | 2.4 |

* - estimates are in # A.I. × 1000.

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# APPENDIX

## COMMONLY-USED PESTICIDES BY EPA NUMBER AND POUNDS OF ACTIVE INGREDIENT

| NAME | CHEMICAL NAME | EPA NO. | A.I. #/GAL | A.I. LBS (%) |
|---|---|---|---|---|
| ACCELERATE | ENDOTHALL | 4581-284 | | |
| ADMIRE | IMIDACLOPRID | 3125-422 | 2 | |
| ALIETTE | FOSETHYL-ALUMINUM | 264-467 | | 80 |
| | | 264-515 | | 80 |
| | | 264-516 | | 80 |
| AMBUSH | PERMETHRIN | 10182-18 | 2 | |
| | | 10182-110 | | 25 |
| | | 10182-35 | | 25 |
| AMMO | CYPERMETHRIN | 2793027 | 2.5 | |
| | | 279-3084 | | 25 |
| ANTOR | (DISCONT. '93) | 45639-54 | 4 | |
| ASANA | ESFENVALERATE | 352-515 | 0.66 | |
| | | 352-502 | 1.9 | |
| ATRAZINE | ATRAZINE | 19713-11 | 4 | |
| | | 352-490 | 4 | |
| | | 9779-255 | 4 | |
| AVENGE | DIFENZOQUAT-METHYL SULFATE | 241-266 | | |
| BALAN | BENEFIN | 1471-140 | | 60 |
| | | 34704-746 | | 60 |
| | | 62719-129 | | 60 |
| | | 62719-94 | | 60 |
| BANVEL | DICAMBA | 55947-1 | | |
| | | 876-25 | | |
| BASAGRAN | BENTAZONE | 7969-45 | | |
| BAYTHROID | CYFLUTHRIN | 3125-564 | 2 | |
| BAYLETON | TRIADIMEFON | 3125-320 | | 50 |
| | | 3125-340 | | 50 |

| NAME | CHEMICAL NAME | EPA NO. | A.I. #/GAL | A.I. LBS (%) |
|---|---|---|---|---|
| BENLATE | BENOMYL | 352-354 | | 50 |
| | | 352-447 | | 50 |
| | | 352-564 | | 50 |
| BLADEX | CYANAZINE | 352-468 | | 80 |
| | | 352-495 | | 90 |
| | | 352-470 | 4 | |
| BOLL'D | ??? | 51036-218 | | |
| BOLSTAR | SULPROFOS | 3125-321 | 6 | |
| BOTRAN | DCNA | 10163-189 | | 75 |
| BRAVO | CHLORO- | 50534-8 | 5 | |
| | THALONIL | 50534-188 | 7 | |
| BUCTRIL | BROMOXYNIL | 264-437 | 2 | |
| BUTONE | 2,4-DB | 56077-26 | 2 | |
| BUTYRAC | 2,4-DB | 264-105 | 2 | |
| CAPAROL | PROMETRYN | 100-620 | 4 | |
| | | 100-757 | 4 | |
| | | 10163-94 | 4 | |
| | | 34704-692 | 4 | |
| CAPTURE | BIFENTHRIN | 279-3069 | 2 | |
| | | 279-3114 | 2 | |
| CARZOL | FORMETANATE | 45639-163 | | 5 |
| | HYDROCHLORIDE | 45639-74 | | 92 |
| CHAMP | COPPER HYDROXIDE | 55146-41 | | |
| CHLORATE | SODIUM OR | 49517-3 | 5 | |
| | MAGNESIUM CHLORATE | 7001-335 | 5 | |
| CLEAN CROP | ??? | 34704-610 | | |
| CONCLUDE | BENTAZONE | 7969-58 | 2.67 | |

| NAME | CHEMICAL NAME | EPA NO. | A.I. #/GAL | A.I. LBS (%) |
|---|---|---|---|---|
| CURACRON | PROFENOFOS | 100-599 | 6 | |
| | | 100-669 | 8 | |
| DACTHAL | DCPA | 59534-1 | | 75 |
| DANITOL | FENPROPATHRIN | 59639-35 | 2.4 | |
| DEF | TRIBUFOS | 3125-282 | 6 | |
| | | 45115-1 | 6 | |
| DEFOL | SODIUM CHLORATE | 19713-265 | 6 | |
| DEVRINOL | NAPROPAMIDE | 10182-258 | | 50 |
| DIACIDE | PYRETHRINS | 1021-1091 | | |
| DIATECT INSECT | PYRETHRON + | 42850-2 | | |
| DIAZINON | DIAZINON | 100-461 | 4 | |
| | | 34704-41 | 4 | |
| | | 19713-91 | 4 | |
| | | 10163-100 | 4 | |
| | | 10163-68 | 4 | |
| | | 279-2945 | 4 | |
| | | 2935-388 | 4 | |
| | | 5905-248 | 4 | |
| | | 279-3051 | | 50 |
| | | 10163-163 | | 50 |
| | | 10163-103 | | 50 |
| | | 100-460 | | 50 |
| | | 10163-104 | | 14 |
| DICOFOL | KELTHANE | 10163-97 | 4 | |
| | | 34704-513 | 4 | |
| | | 707-205 | | 35 |
| DIMATE | DIMETHOATE | 9779-263 | 4 | |
| | | 9779-273 | 4 | |

| NAME | CHEMICAL NAME | EPA NO. | A.I. #/GAL | A.I. LBS (%) |
|---|---|---|---|---|
| DIMETHOATE | DIMETHOATE | 10163-56 | 2 | |
| | | 19713-231 | 4 | |
| | | 34704-207 | 4 | |
| | | 51036-110 | 4 | |
| | | 9779-273 | 4 | |
| | | 2749-41 | 2.67 | |
| | | 279-2821 | 2.67 | |
| | | 400-278 | 2.67 | |
| | | 34704-489 | 2.67 | |
| | | 10163-55 | | 25 |
| | | 5905-87 | 5 | |
| DIQUAT HERB | DIQUAT DIBROMIDE | 10182-353 | 3.6 | |
| DISYSTON | DISULFOTON | 3125-172 | | 15 |
| | | 3125-307 | 8 | |
| DITHANE | DITHIO-CARBAMATES | 707-78 | | 45 |
| | | 707-180 | | 45 |
| | | 707-156 | | 45 |
| (MANCOZEB) | | 4581-370 | | 45 |
| DIURON | KARATE | 10182-96 | 1 | |
| | DIREX | 1812-257 | 4 | |
| | | 19713-36 | 4 | |
| | KARMEX | 352-508 | | 80 |
| DROPP | THIDRAZURON | 45639-89 | | 50 |
| DUAL | METOLOCHLOR | 100-597 | 8 | |
| | | 100-673 | 8 | |
| EPTAM | EPTC | 10182-160 | | 10 |
| | | 10182-199 | | 20 |
| | | 10182-220 | 7 | |
| FOLEX | TRIBUFOS | 264-498 | 6 | |
| FURADAN | CARBOFURAN | 279-2876 | 4 | |
| FURY (MUSTANG) | Z-CYPERMETHRIN | 279-3125 | 1.5 | |
| | | 279-3126 | 1.5 | |

| NAME | CHEMICAL NAME | EPA NO. | A.I. #/GAL | A.I. LBS (%) |
|---|---|---|---|---|
| FUSILADE | FLUAZIFOP-BUTYL | 10182-104 | 2 | |
| | | 10182-367 | 2 | |
| GINSTAR | THIDIAZURON + DIURON | 45639-161 | | |
| GOAL | OXYFLUORFEN | 707-174 | 1.6 | |
| GUTHION | AZINOPHOS-M | 10163-78 | | 50 |
| | | 10163-80 | 2 | |
| | | 3125-301 | | 50 |
| | | 3125-102 | 2 | |
| HINDER | AMMONIUM SOAP | 400-383 | | |
| HOELAN HERB | DICLOFOP-METHYL | 45639-173 | 3 | |
| | | 8340-20 | 3 | |
| IMIDAN | PHOSMET | 10163-56 | 2 | |
| | | 10163-184 | | 70 |
| | | 10182-173 | | 50 |
| | | 10182-17310 | | 50 |
| | | 10163-166 | | 50 |
| | | 10163-175 | | 50 |
| KERB | PRONAMIDE | 707-159 | | 50 |
| KOCIDE | COPPER HYDROXIDE | 1812-288 | | 77 |
| | | 1812-28 | | 77 |
| | | 1812-338 | | 77 |
| | | 1812-303 | 6 | |
| LANNATE | METHOMYL | 352-342 | | 90 |
| | | 352-384 | 2.4 | |
| LOROX | LINURON | 352-394 | | 29 |
| LEGION | ????? | 59639-15 | | |

| NAME | CHEMICAL NAME | EPA NO. | A.I. #/GAL | A.I. LBS (%) |
|---|---|---|---|---|
| LORSBAN | CHLORPYRIFOS | 62719-220 | 4 | |
| | | 62719-79 | 4 | |
| | | 62719-23 | 4 | |
| | | 62719-35 | 4 | |
| | | 464-612 | 4 | |
| | | 62719-22 | 4 | |
| | | 62719-221 | | 50 |
| | | 464-552 | | 50 |
| | | 62719-39 | | 50 |
| | | 62719-34 | | 15 |
| | | 464-523 | | 15 |
| MALATHION | CYTHION | 10163-21 | 8 | |
| | | 5905-250 | 8 | |
| | | 34704-474 | 8 | |
| | | 2935-83 | | 57 |
| | | 246-47 | 5.7 | |
| | | 2393-280 | 5.7 | |
| | | 34704-110 | | 6 |
| | | 10163-44 | | 91 |
| MANEB | MANEB | 4581-255 | | 80 |
| | | 707-48 | | 80 |
| | | 4581-371 | | 75 |
| MANEX | | 1812-251 | | |
| MANZATE | DITHIO-CARBAMATES | 352-449 | 2 | |
| MCPA | MCPA | 228-143 | 4 | |
| | | 264-47 | 4 | |
| | | 464-394 | 4 | |
| | | 62719-13 | 4 | |
| METAM SODIUM | METAM SODIUM | 10182-150 | 3 | |
| | | 5481-423 | 3 | |
| MEPIQUAT | MEPIQUATE CHLORIDE | 10163-186 | 4.2 | |
| | | 7969-52 | 4.2 | |
| MESUROL | METHIOCARB | 10163-23 | | 75 |

| NAME | CHEMICAL NAME | EPA NO. | A.I. #/GAL | A.I. LBS (%) |
|---|---|---|---|---|
| METASYSTOX | DEMETON | 10163-220 | 2 | |
| | METHYL | 3125-111 | 2 | |
| MITICIDE | ??? | 618-98 | 0.15 | |
| MONITOR | METHEMIDOPHOS | 3125-280 | 4 | |
| | | 59639-56 | 4 | |
| MSMA | MSMA (ORGANIC | 50534-6 | 6 | |
| | ARSENICAL) | 5905-164 | 5 | |
| NEMACUR | FENAMIPHOS | 3125-236 | | 15 |
| | | 3125-283 | 3 | |
| NEMAGARD | ??? | 11688-5 | 0.25 | |
| ORTHENE | ACEPHATE | 239-2418 | | 75 |
| | | 59639-26 | | 90 |
| | | 59639-33 | | 90 |
| | | 59639-75 | | 15 |
| | | 59639-86 | | 90 |
| | | 59639-89 | | 75 |
| PARAQUAT | GRAMOXONE | 10182-103 | 4 | |
| | | 10182-280 | 2.5 | |
| | | 182-280 | 4 | |
| PARATHION | PENNCAPP-M | 10163-1 | 4 | |
| | | 4581-292 | 2 | |
| | | 5905-55 | 4 | |
| | | 5905-414 | 7.5 | |
| PCNB | QUINTOZENE | 400-399 | 7.5 | |
| TERRACHLOR | | 400-402 | | 10 |
| | | 400-411 | | 6.5 |
| PHOSDRIN | MEVINPHOS | 352-471 | 4 | |
| | | 5481-114 | 4 | |
| | | 5481-412 | 4 | |
| POAST | SETHOXYDIM | 7969-88 | 1.6 | |

| NAME | CHEMICAL NAME | EPA NO. | A.I. #/GAL | A.I. LBS (%) |
|---|---|---|---|---|
| POUNCE | PERMETHRIN | 279-3014 | 3.2 | |
| | | 279-305 | | 25 |
| | | 279-3059 | | 25 |
| | | 279-3083 | | 25 |
| PREFAR | BENSULIDE | 10163-200 | 4 | |
| | | 10182-184 | 4 | |
| PREP (pgr) | ETHEPHON | 264-418 | | |
| PRINCEP | SIMAZINE | 100-603 | | 90 |
| PROVADO | IMIDACLOPRID | 3125-457 | 1.6 | 75 |
| PROWL | PENDIMETHALIN | 241-243 | 4 | |
| | | 241-337 | 4 | |
| PURSUIT | IMAZETHAPYR | 241-310 | | |
| | | 241-350 | | |
| RIDOMIL | METALAXYL | 100-607 | 2 | |
| | | 100-628 | | 5 |
| | | 100-629 | | 58 |
| | | 100-664 | | 11 |
| RIDOMIL-BRAVO | METALAXYL + CHLORTHALONIL | 100-658 | | 81 |
| RONILAN | VINCLOZOLIN | 7969-53 | | 50 |
| | | 7969-62 | | 50 |
| | | 7969-85 | | 50 |
| ROUNDUP | GLYPHOSATE | 524-308 | 3 | |
| | | 524-445 | 4 | |
| ROVRAL | IPRODIONE | 264-453 | | 50 |
| | | 464-482 | 4 | |
| SCOUT XTRA | TRALOMETHRIN | 34147-3 | 4 | |
| | | 34704-207 | 4 | |
| SELECT (PRISM) | CLETHODIM | 59639-3 | 2 | |
| SENCOR | METRIBUZIN | 3125-325 | | |

| NAME | CHEMICAL NAME | EPA NO. | A.I. #/GAL | A.I. LBS (%) |
|---|---|---|---|---|
| SEVIN | CARBARYL | 10163-32 | | 5 |
| | | 241-233 | 4 | |
| | | 264-333 | 4 | |
| | | 264-335 | 4 | |
| | | 2935-366 | | 5 |
| SOLICAM HERB | NORFLURAZON | 55947-78 | | 78.6 |
| SULFUR | SULFUR | 2935-92 | | |
| | | 4581-373 | | |
| | | 55947-48 | | |
| | | 7969-61 | | |
| SUPRACIDE | METHIDATHION | 100-501 | 2 | |
| SURFLAN | ORYZALIN | 62719-112 | 4 | |
| | | 62719-113 | 4 | |
| SUTAN | BUTYLATE | 10182-222 | 6.7 | |
| | | 62719-113 | 6.7 | |
| TELONE | 1,3-DICHLORO-PROPENE | 62719-32 | 9.4 | |
| TEMIK | ALDICARB | 264-330 | | 15 |
| | | 264-417 | | 15 |
| | | 264-426 | | 15 |
| THIMET | PHORATE | 241-257 | | 20 |
| THIODAN | ENDOSULFAN | 10163-98 | | 50 |
| | | 10163-110 | 3 | |
| | | 10163-130 | | 50 |
| | | 279-2659 | 2 | |
| | | 279-2924 | 3 | |
| THIODICARB | LARVIN | 264-379 | 3.2 | |
| | | 264-530 | 3.2 | |
| TILT | PROPICONAZOLE | 100-617 | 4 | |

| NAME | CHEMICAL NAME | EPA NO. | A.I. #/GAL | A.I. LBS (%) |
|---|---|---|---|---|
| TREFLAN | TRIFLURALIN | 10163-99 | 5 | |
| TRILAN | | 10163-120 | | 10 |
| | | 10163-166 | | 50 |
| | | 10163-175 | | 50 |
| | | 1471-120 | 5 | |
| | | 1812-328 | | 10 |
| | | 1812-353 | 5 | |
| | | 62719-93 | | |
| | | 62719-98 | 5 | |
| | | 62719-118 | 5 | |
| | | 62719-131 | | 10 |
| TRIGARD | CYROMAZINE | 100-654 | | |
| VERATRIN D (BOTANICAL INSECTICIDE) | SABADILLA | 39834-1 | | |
| VYDATE | OXYMIL | 352-372 | 2 | |
| | | 352-532 | 2 | |
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