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SHIFTING PATTERNS IN INSECTICIDE USE IN CALIFORNIA - 1993 TO 2004

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Abstract

A subset of data from the California Department of Pesticide Regulation's pesticide use data base was used to develop insecticide use trends in cotton from 1993-2004. These data indicated a sharp spike in insecticide use in 1995 with a decline through 1999 and a leveling of use through 2004. The data are presented as *treatment acre* to reflect the number of applications applied to the acres of cotton planted. This approach removes the problem of fluctuating acres of cotton between years as well as the reduction of active ingredient per acre utilized by newer classes of insecticides. The leveling of insecticide use during the 2000's might reflect the shift in pest pressure later in the season and the demand for protect lint from aphid and whitefly honeydew. There was a substantial decline in high risk insecticides and a large increase in low risk insecticides, especially since 2000.

Introduction

California has the largest and most complete pesticide use data base in the world. These data provide an important record in pesticide use trends. Public concern about the environmental quantity and human health risks have caused cotton production to come under scrutiny in the past decade. California cotton has been noted as an intensive pesticide consumer (Sweazy and Goldman, 2002) and in particular, an increase in the amount of insecticides used in the 1990's (Kegley et al, 2000).

This overview will examine the insecticide use from 1993 to 2004.The question it seeks to answer is: what is the trend in insecticide use during the 1990's and what if any shift in products has occurred.

Approach

Pesticide use in California has been tracked since in some for over 50 years. The current system has been in place since 1990 (Montez and Grafton-Cardwell, 2004) and is overseen by the Department of Pesticide Regulation (CDPR). During that period, CDPR has collected information on every pesticide application by growers and commercial pesticide control operators. The pesticide use reports (PUR) are used for a wide variety of environmental and public health purposes including, risk assessments, promoting farm worker health and safety, analyzing human exposure patterns, protecting threatened and endangered species, monitoring and investigating environmental issues, and improving pest management (Wilhoit et al, 2001).

The data are collected at the county level through the County Agricultural Commissioners offices as part of the pesticide permitting and reporting system. These data include specific location, commodity, product, rate, application method and permitee information. For PUR purposes, specific information is removed but commodity, product (active ingredient), general location (township, section and range), application method, area treated, and pounds used are entered. This data base is filtered through extensive quality assurance processes. It is an extremely large data base and accessible to the public. However, due to its size, it is unwieldy to the average user. To provide information to the public on pesticide use in California, CDPR issues an annual report summarizing pesticide use in by product, site and county which is provided as a searchable data base (Anon., 2005).

The data base may be summarized in other ways as well. For this study, annual cotton data were extracted and summarized from 1993 to 2004 in an Excel spreadsheet. These data could be further organized by pounds applied or acres treated using searchable fields, including active ingredient type (herbicide, insecticide, etc), region (five in state), county and "risk". Risk categories consisted of high, low, adjuvant and other. High risk products contained active ingredients identified on lists including Proposition 65 hazards (chronic and reproductive toxicants), acutely toxic (cholinesterase inhibitors), groundwater hazards and toxic air contaminants (volatile organic chemicals). Low risk products were those active ingredients classified as reduced risk by EPA.

The data searches were limited to insecticides. The focus was on acres treated rather than pounds applied and data reported is *treatment acre*. Treatment acre is the number of acres treated with a product or risk class divided by total acres of cotton planted. When a tank mixes are used (e.g. mix of two active ingredients), it is reported as two applications.

This approach provides a useful evaluation of insecticide use and IPM. It removes the fluctuation caused by differences in annual planting acreage. It improves the estimate over “pounds on the ground” by eliminating the bias introduced when products used at high rates (e.g. sulfur dust) are replaced by products used at very low rates. For example, the number of applications used to treat spider mites might not change, but the amount of product could decline substantially. In evaluating IPM programs, the number of applications applied over time often reflects an increasing sophistication or can indicate the breakdown of an IPM program.

Results and Discussion

The trends in insecticide use in cotton were not different between acres treated and pounds applied (Figure 1). Insecticide use spiked in 1995 due primarily to widespread treatments for *Lygus*, cotton aphids and spider mites (Hardee and Herzog, 1996; Goodell et al, 1997). Insecticide use dropped steadily after 1995 and leveled off after 1999. The number of pounds applied appears to continue to decline slightly more than acres treated, due perhaps to the change in products, formulation and reduce amount of active ingredient per acre.

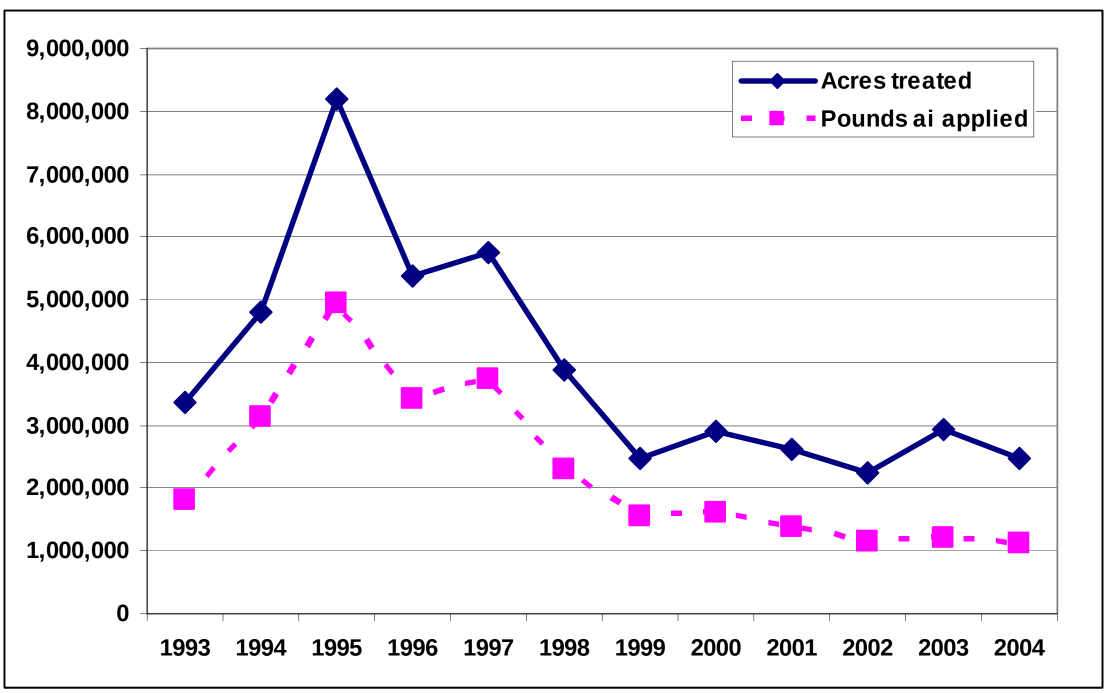

Figure 1. Insecticide use in cotton, 1993 to 2004.

The number of acres of cotton planted has also declined during this period (Figure 2) and might explain some of the decline in insecticide use. However, when the number of acre treatments is tracked (Figure 3), the trend demonstrates the same spike in 1995 followed by a decline and leveling after 1999 at about 3 treatments/acre of cotton to a level similar that prior to 1995. This leveling of insecticide use might reflect the more conservative approach to sticky cotton prevention (Godfrey, et al, 2003, 2005) adopted by California cotton industry. The increase in 2003 is attributable to increased insect pressure (Adamczyk and Burris, 2004) while to the decline in 2004 reflects a reduction in overall insect pest pressure (Adamczyk and Burris, 2005).

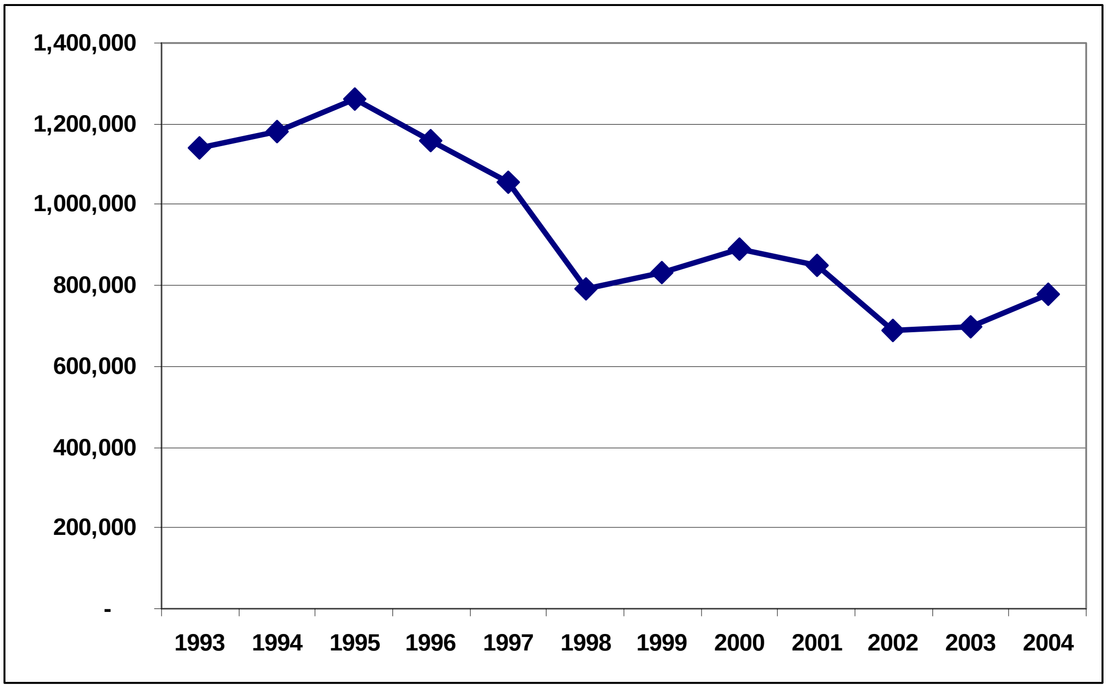

Figure 2. Cotton acres in California, 1993-2004.

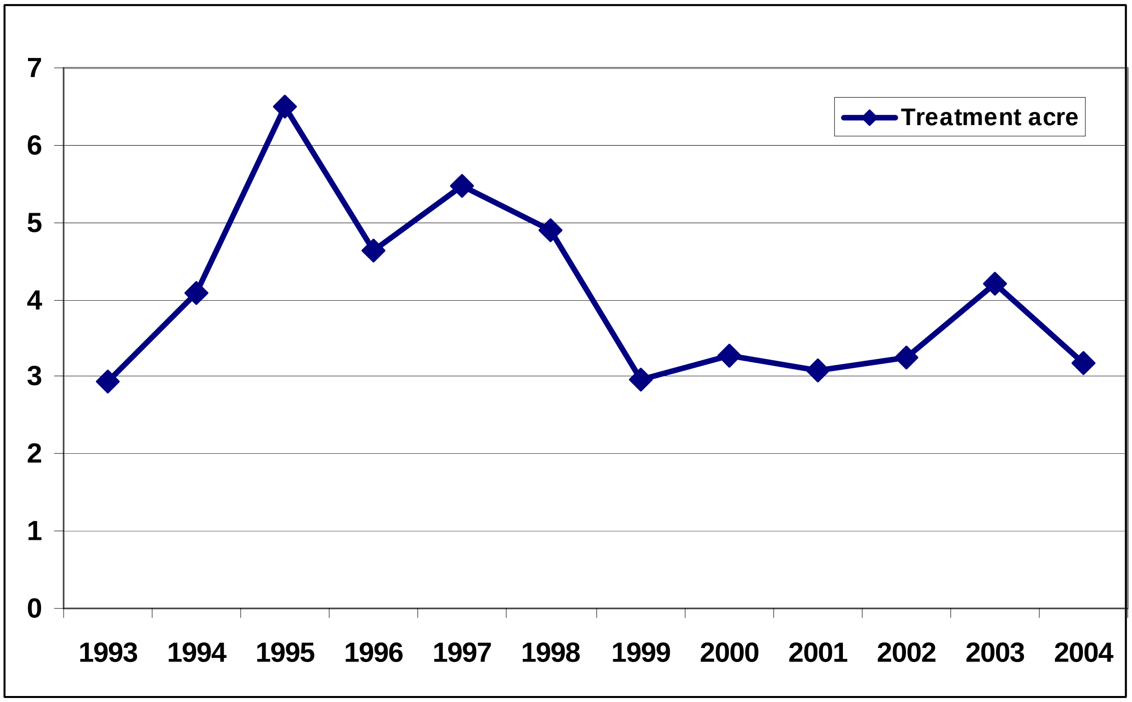

Figure 3. The number of insecticide applications per acre of planted cotton, 1993-2004.
We next examined the composition of the insecticide application by active ingredient risk category (Figure 4). High risk included carbamates and organophosphate while low risk included *Bacillus thuringiensis*, indoxocarb, spinosad, thiamethoxam, acetamiprid, and various insect growth regulators. There has been a steady decline in the high risk products, with the exception of oxamyl which has increased since 2001 from 53,000 to 93, 000 acres treated. Pyrethroid use also declined during this period and the increased use of oxamyl may be attributed to a shift in products for *Lygus* management.

Low risk insecticides have steadily increased from 2000 to 2004 (Figure 4). A steep increased occurred in 2002 as new products were registered for use. In 2004, thiamethoxam accounted for 22% of the low risk treatments applied was and acetamiprid accounted for 42% (Figure 5). Acetamiprid is highly effective against aphids and whiteflies and has activity against *Lygus.* Overall in 2004, neonicotinoids accounted for nearly one in four insecticide applications. Although neonicotinoid use is not universal, the increasing dependence on this mode of action will continue as organophosphates continue to be restricted. An increased concern about the development of resistance to this mode of action will also continue (Palumbo et al, 2003).

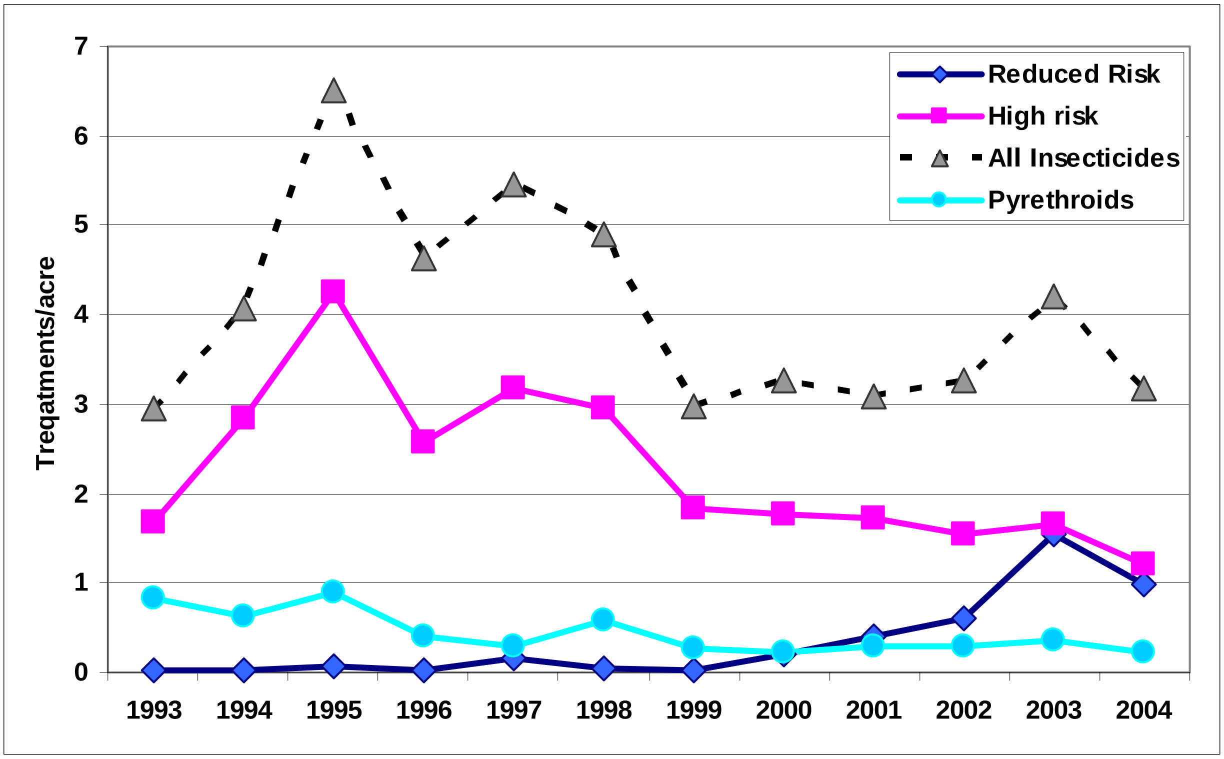

Figure 4. Insecticide use by risk category.

These data (Figure 4) indicated a general decline in the use of insecticides in cotton from 1995 to 2000 and a leveling of use to 3-4 treatment acre from 2000 to 2004. This level is higher then the estimated 1.5 applications reported in the mid-1980's (Goodell, et al, 1997), prior to universal pesticide reporting. The probability of reducing the number of insecticide applications is limited due to introduction of silverleaf whitefly and the absolute requirement for honey-dew free cotton. The introduction of effective, reduced-risk products has provided replacement alternatives to organophosphate and carbamate chemistry and has allowed a substantially reduction in high risk insecticides between 1995 and 2004. However, the risk for developing tolerance and resistance to the neonicotinoid class requires the continued development of biologically reliant IPM and improved understanding of the agro-ecosystem in which cotton is embedded. Product replacement is only a temporary fix, the long term solution is improved pest management over the wider landscape.

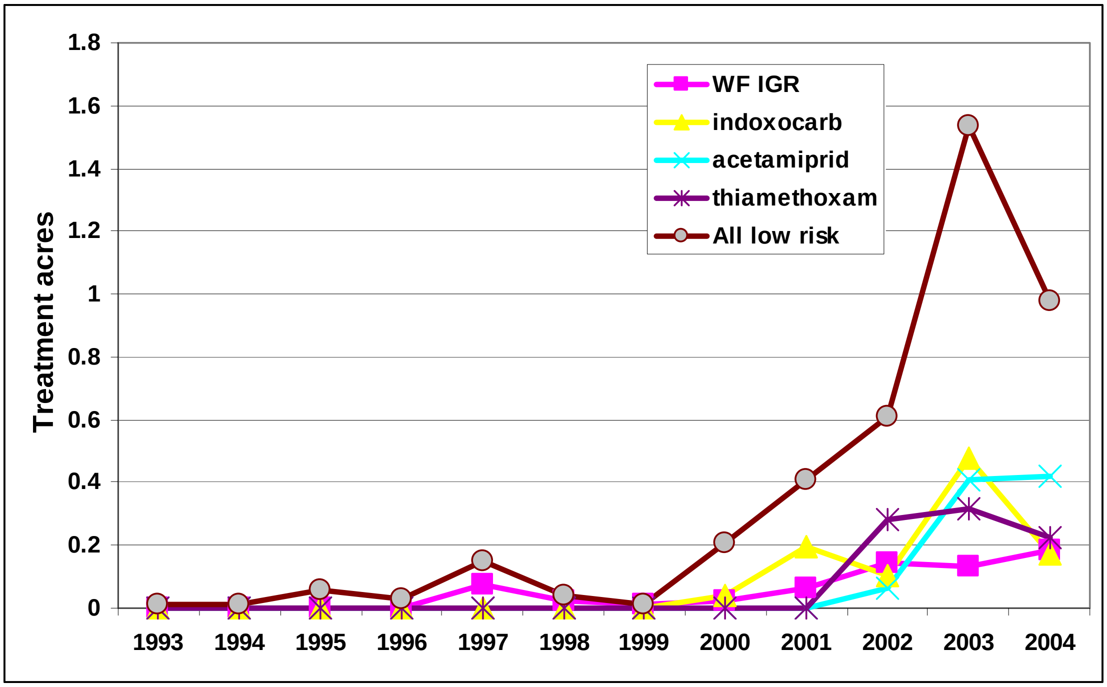

Figure 5. Number of treatments of reduced risk products applied to cotton, 1993 to 2004.

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