

**COTTON PESTICIDE USE DATA BASED ON
ARIZONA'S DEPARTMENT OF AGRICULTURE'S 1080L FORMS FOR 2004**

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ABSTRACT

The University of Arizona's Pesticide Information and Training Office in cooperation with the Arizona Department of Agriculture were able to summarize over 27,000 pesticide use records for cotton in 2004. From these records just over 2 million acres received at least one pesticide application. A total of 681,233 units of pesticides were applied to cotton, of which were 367,697 pounds of dry formulation and 313,536 gallons of liquid pesticides. The top 30 pesticides used on Arizona cotton production represented 91.9% of the total records obtained, with insecticides accounting for 50% of the top 10 products used with defoliant close behind. Acephate and Endosulfan were the top two insecticides applied to Arizona cotton in 2004. Arizona's lower desert counties of Maricopa, Pima, Pinal and Yuma have more reported acreage of cotton and thus more products applied than the upper desert counties of Cochise, Graham, La Paz and Mohave. Aerial application is the method of choice (92%) but that is probably because all application by air are required to be filed with the Department of Agriculture on there ADA 1080L form. A discussion of data limitation is presented.

Introduction

The College of Agriculture and Life Sciences (CALs) at the University of Arizona offers an array of technology tools to assist growers and producers. The goal is to provide growers reliable information on cotton pest management and pesticide use in Arizona. Cotton growers in consultation with regional experts can then collaborate, evaluate options, and develop strategies based upon balanced and reasonable information. Because Arizona cotton growers face many challenges outside the pest arena, it is critical that valued information is available for decision-making strategies.

Public health and environmental concerns regarding the protection of Arizona's groundwater has lead to an improved statewide Arizona Department of Agriculture (ADA) 1080L pesticide use report form, and thus offers opportunities for pesticide research. Since 1996, Arizona Agricultural Statistics Service (AASS), under cooperative agreement with ADA's Environmental Services Division (ESD), has provided raw pesticide use data to the University of Arizona's Pesticide Information and Training Office. This office is in support of research aimed at understanding agricultural pesticide use to assist Arizona regulators, growers, researchers and interested stakeholders.

Arizona's ADA 1080 pesticide use reporting form continues to be revised. Since initiation, subsequent modifications have incorporated data on aerial applications, licensing, and materials registered under Section 18's. Later, reporting requirements were expanded to include more pesticide applications. In 1993, pesticides on the Arizona Department of Environmental Quality (ADEQ) Groundwater Protection List (GPL) were incorporated into the reporting process. At present, pesticides subject to ADA monitoring include all commercial agricultural applications and soil applied pesticides that are on the ADEQ Groundwater Protection List.

The last report compiled by Ken Agnew of the U of A's Pesticide Information and Training Office titled *Crop Profile For Cotton in Arizona* contains detailed information on cotton production methods and pests common to Arizona (Agnew, 1999). In 2001, a

total of 33,377 target pest reports were generated for all the ADA 1080's form all the crops in Arizona. Target pest reports on cotton were separated into Insect/Non-insect groupings, and categorized by pest species. Of target pests on cotton, approximately 60% were reported as Insect pests, while the other 40% were reported as Non-Insect pests. *Lygus* continues to be the most frequently reported target pest on all Arizona crops in 2001. On reports submitted for cotton, results showed 3,124 listings for the pest *Lygus* out of 15,774 (19.8%) from the total pesticide application reports. This was followed by the sweet potato whitefly with 2,711 (17.2%), and pink bollworm with 1,218 (7.7%). The remaining 26% of cotton pest frequencies were distributed across categories of aphid, (3.5%), budworm/bollworm (3.5%), silverleaf whitefly (3.4%), armyworm (2.6%), thrip (0.9%), and cotton leaf perforator (0.9%) (Shanley and Baker, 2002).

The availability of ADA 1080 data on agricultural pesticides affords numerous enhancements to research endeavors, linking growers, regulators, and stakeholders toward common pest management solutions. The quality and utility of this data continue to improve and increase in value. The long-term goal is to help growers by providing meaningful pesticide use information in "real time". This means that the information would be available via a website that would be only weeks old. This information will hopefully allows regulators, researchers, stakeholders and other interested parties to take part in a variety of pesticide related issues. It is in our societies' cumulative interest to strengthen local pest management initiatives and also to provide a regional, long-term perspective.

Materials and Methods

At The University of Arizona Pesticide Information and Training Office, ongoing efforts to improve and enhance the database have culminated in a comprehensive information system, representing agricultural pesticides on crops grown in Arizona. This work is done in collaboration with Arizona Agricultural Statistics Service (USDA-NASS). Pesticides subject to ADA monitoring include custom applications, soil applied pesticides on the ADEQ Groundwater Protection List (GPL), and Section 18 use (A.R.S. §§ 3-341 et seq.

and 3-3101 et. seq.). The data fields that are collected include active ingredient (AI), EPA registration number, quantity, crop, acres treated, harvest date, re-entry intervals, wind velocity, aerial and ground applications, equipment codes, and license/permit ID numbers for regulated sellers, applicators, and growers.

In 1996, collaborative agreements were formed with USDA-NASS in Arizona. Arizona Agricultural Statistics Service (USDA-NASS) re-configured the database structure as a relational database in Standard Query Language (SQL) to execute in Microsoft FoxPro™. From the expanse of Arizona's pesticide use data, the information for cotton was retrieved and isolated for further quantitative analysis focusing on the quantity and type of pesticides that were used. We then developed relational queries leading to the cotton sub-set of ADA 1080 data that are presented in this paper.

This data is initially entered as a direct transcript of the applicators handwriting. Therefore as one can imagine, due to this transcription process there are minor inconsistencies with the names of the products and the way they are input into the database. Therefore, considerable time is spent validating each data entry. When applicable, certain brand name corrections and active ingredient determinations have been corrected for by using the information found on product labels. Though, this validated ADA 1080 data is considered a relatively good indicator of commercial applications, it should be noted that the ADA 1080 data does not comprise the total amounts applied for all pesticide in a given year. In fact, not all applications are required to be reported to the ADA, this is because growers are not required to submit use reports of private pesticide applications, nor foliar applications of the pesticides that are on the groundwater protection list. Federal law requires that records be kept of these uses yet ADA request them only on site visits or for other regulatory reasons.

Results and Discussion

There is no intention to endorse individual products or to warranty the effectiveness of the products presented in the ADA 1080L pesticide use data. It is also important to recognize that the way in which a product goes into formulation plays an important role in how the product is manufactured either as a liquid or in a dry form. It is also imperative to understand that these data represent only a portion of what is applied to cotton each year. As previously discussed, record keeping of all pesticide applications is required by state and Federal laws of all growers. However, they need not submit them but only to have them available to state officials. In the case of restricted use pesticides, Arizona requires the applicator to submit a pesticide use record either using the ADA’s 1080L form or equivalent. The results presented are a summary of these state 1080L forms.

The results of the pesticides used on cotton grown in Arizona during 2004 are presented in Tables 1-5. The unit of measure reported here is dictated by the pesticide formulations themselves, for example, “solid” formation materials such as dusts, powders, and granules are measured by weight in pounds and pesticides purchased as either quarts or gallons are reported as “liquids”. In 2004 a total of 681,233 units of pesticides were applied to cotton (Table 1). From that total, 367,697 pounds and 313,536 gallons of pesticides were applied.

Table 1. Total quantities of cotton pesticides applied to Arizona cotton as reported in 1080L data for 2004.

2004 Arizona 1080-Form Pesticide Use Data for Cotton, Solid Formulations:	
Total Pounds	367,697
2004 Arizona 1080-Form Pesticide Use Data for Cotton, Liquid Formulations:	
Total Gallons	313,536
<i>Source: NASS 2005 1080 Form Database</i>	

The ratio of the quantity of pesticides for solids to liquids was 53.9 to 46.1 indicating nearly an even split between products. However, the liquid formulation records of 21,733 constituted 81.3 % of the total, but comprised less than half (46.1%) of the total quantities applied. In order to rank the products based on number of records, a data query was run for the top 30 pesticides used in Arizona cotton production during 2004; which represented 91.9% of the total records available (Table 2). From Table 2, insecticides represent 50% of the top 10 products used with defoliant close behind. A summary of the types of pesticides is presented in Table 3.

Table 2. The top 30 pesticides reported on the ADA's 1080L form for the 2004 cotton use season

2004 Cotton use data from 1080L's				
Chemical	Type**	Recorded #	total records	Percent of total
Acephate	1	3,316		
(Z,Z)-7,11-Hexadecadien-1-ol	3	2,342		
Endosulfan	1	2,041		
Diuron	3	1,806		
Thidiazuron	3	1,750		
Acetamprid	1	1,687		
Mepiquat Chloride	3	1,633		
Chlopyrifos	1	1,583		
Glyphosate	2	1,330		
cyfluthrin	1	877		
Sodium Chlorate	3	659		
Bifenthrin	1	543		
Ethephon	3	491	20,058	74.1
Tribuphos	3	455		
Carfentrazone-ethyl	2	449		
Paraquat	2	441		
Mepiquat Pentaborate	3	402		
Oxamyl	1	339		
Fenprothrin	1	334		
Bacillus cereus	1	306		
Lambda-Cyhalothrin	1	300		
Dicofol	1	278		
Pyriproxyfen	1	265		
Zeta-cypermethrin	1	259		
Pendimethalin	2	246		
Pyraflufen ethyl	3	196		
Endothall	3	170		
Sulfur	1	136		
Esfenvalerate	1	132		
Cytokinins	3	103	24,869	91.9
			27,066	
** 1= Insecticides, 2= Herbicides, 3= others				
28 other products below 100 records range from 88-2 recorders				

Table 3. The main types of pesticides used on cotton production in Arizona, 2004.

Type	Gallons	Record #	Pounds	Record #
Defoliants	81,205	7,847	0	0
Fungicides	1,841	95	9,235	68
Herbicides	26,228	2,235	41,150	79
IGR's	331	1,313	29	6
Insecticides	103,345	9,136	317,283	5,155
Plant Regulators	81,556	3,798	0	0
Soil Fumigants	19,030	35	0	0
Totals	313,536		367,697	

The majority of pesticide products used for cotton production in 2004 are represented by three type's defoliants, insecticides, and plant regulators. These types of pest management products in general are reflective of the majority of pesticide inputs into the cotton farming system in Arizona and would probably not change radically if private grower records were obtained. Based on the number of pounds applied, applicators used dry formulations of insecticides over 86% of the time with no defoliants, plant regulators or soil fumigants being applied in the dry form.

Arizona historically has eight counties that grow cotton. According to the Arizona Agricultural Statistics Service (2004), 243,000 acres were planted in the eight counties with 88% of the acres harvested, yielding 1,451 lbs per acre. This is up slightly from previous two years of approximately 217,000 acres. In 2004, just over 27,000 records were received and the total acres receiving a pesticide was just over 2 million (Table 4). From the table, one can determine that the lower desert counties of Maricopa, Pima, Pinal and Yuma have more acreage and thus more products applied than the upper desert counties of Cochise, Graham, La Paz and Mohave (Table 4). Aerial application is the primary method of choice (92%), but that is probably because all application by air are required to be filed with the Department of Agriculture on there ADA 1080L form.

Table 4. Summary of total pesticides applied by counties on cotton in 2004 using the ADA 1080 L data.

County	Records	Total Acres	Chemical used	Application Aerial	Method Ground
Cochise	148	10,270	5,777	100	0
Graham	68	3,177	2,225	100	0
La Paz	3,025	209,464	73,319	96.7	3.2
Maricopa	3,064	275,939	90,251	66.7	33.3
Mohave	26	2,115	255	100	0
Pima	445	42,600	16,134	100	0
Pinal	13,812	1,313,444	431,783	96.5	3.5
Yuma	6,478	213,215	61,891	75.8	24.2
Totals	27,066	2,070,228	681,233	Mean 92	Mean 8

A further breakdown by counties into liquid and dry applications and the method of application is presented in Table 5. From the table, the lower desert counties applied 89.7% of the liquids and 96.5% of the dry materials for the 2004 season. In addition, 2 counties Pinal and Maricopa had nearly 81% of the liquid applications, while in the dry category, Pinal and Yuma had over 89% of the totals applied for that year. Thus, Pinal received the largest quantity of chemical applications of all eight counties.

Table 5. Pesticide applied and the method of application used to Arizona cotton in 2004 utilizing ADA 1080L data.

County	Gallons	% total	Pounds	% total	% Aerial
Cochise	608	0.2	3,635	1.1	100
Graham	1,287	0.4	828	0.3	100
La Paz	26,467	8.9	6,047	2.0	92.2
Maricopa	108,798	36.8	19,042	6.2	77.6
Mohave	2,111	0.7	38	0.0	100
Pima	11,589	3.9	2,735	0.9	98.1
Pinal	130,314	44.1	167,270	54.7	95.0
Yuma	14,428	4.8	105,924	34.7	75.6

A pesticide reporting database such as the ADA 1080L gives us a continuous opportunity to evaluate pesticide use trends. From these reports a products pattern of life expectancy

emerges. It is from a five/ten-year pesticide use data set that a life of a pesticide product can be outlined. It appears once a product is adopted by growers, or even recommended by experts, its use increases. Most of the time the growth in its use is substantial and the product seems to flood the market. When a product hits its peak, sometimes it may be used for a couple of years or sometimes just a year, and then there is a corresponding reduction in the use of the product. This product reduction is most likely caused by efficacy, competition or safety issues because the pest problems continue to be present. The ADA 1080 database gives us a unique opportunity to look over the life cycle of pesticides and thus in the future be able to investigate these trends.

As previously discussed, however, the data presented is based on a limited set of data submitted to the ADA. It also became apparent from the data set that several interpretative problems are inherent in the data. First, the data set is focused on a regulatory function and thus is not implicit in its ease of understanding. Secondly, in some cases it was difficult to tease out the appropriate information from the reported data. This can be seen by the multiple products being referenced on a single form. Thirdly, a so-called tank mix and/or a combination of products may be listed making it more difficult to identify individual products that contribute to the overall pesticide load. This is particularly difficult if the actual raw data sheet is not available. In addition, products are now being applied as mg or as IGR's making quantities extremely small and hard to quantify because of their means of application. While it is important to collect this data even if it has its inherent shortcomings. However, as we move toward a more complete data set, adjustments can be made in the 1080L form that would enable others outside ADA and the regulatory community to be more user friendly.

In the future, it is our intent to continue to illuminate long-term trends and regional pesticide use patterns derived from the ADA 1080 data. It is imperative that this data continue to be collected and analyzed. This ADA 1080 data has an eminent role in determining statewide pest management decision-making. In order to prepare a system of regional Integrated Pest Management that can respond to pest problems as they arise and change, pesticide use data becomes a critical component for success. On a societal scale

our level of communication has increased to the point that now we see whole regions responding to pest problems with a greater awareness. Cooperative extension research and education is the foundation on which farmers, applicators, legislators, and business meet and communicate their pest management ideas. Thus, funding and strengthening scientific based cooperative extension research provides methods of community interaction, which becomes the corner stone of sustainable pest management over large regions and over the long term of agricultural production.

Summary

The Pesticide Information and Training Office in cooperation with the Arizona Department of Agriculture were able to summarize over 27,000 pesticide use records for 2004 on cotton, with a total acreage receiving at least one pesticide application at just over 2 million. For the year, a total of 681,233 units of pesticides were applied to cotton, of which was 367,697 pounds of dry formulation and 313,536 gallons of liquid pesticides. A data query of the top 30 pesticides used on Arizona cotton production represented 91.9% of the total records obtained, with insecticides accounting for 50% of the top 10 products used with defoliant close behind. Arizona's lower desert counties of Maricopa, Pima, Pinal and Yuma have more acreage and thus more products applied than the upper desert counties of Cochise, Graham, La Paz and Mohave. Aerial application is the method of choice (92%) but that is probably because all application by air are required to be filed with the Department of Agriculture on there ADA 1080L form. It was apparent from the data set analysis that there are inherent problems that need to be addressed in order to strength the value of the reported data.

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REFERENCES

2004 Arizona Agricultural Statistic Bulletin (Issued Sept 2005). Webpage: <http://www.nass.usda.gov/az/>.

Agnew, Kenneth. (1999). *Crop Profile for Cotton*. Compiled by Ken Agnew, University of Arizona Department of Entomology, available at the National Science Foundation sponsored Industry/University Cooperative Research Center for Integrated Pest Management, located at North Carolina State University, Raleigh, NC., <http://cipm.ncsu.edu/CropProfiles/docs/Azcotton.html>.

Shanley, E.H. and Baker, P.B. (2002). 2001 Update On Pesticide Use In Arizona Cotton. *Proceedings of the 2002 Beltwide Cotton Conferences, Atlanta, GA. January 8-12*, http://ag.arizona.edu/pito/az_pmc/pdf/2002%20Cotton%20Beltwide.pdf.