Agricultural Experiment Station
Cooperative Extension

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29 September 2006

Dr. Debbie Edwards, Director
Special Review and Reregistration Division
U.S. Environmental Protection Agency
Office of Pesticide Programs
Division Mail Code 7508P
1200 Pennsylvania Ave. NW
Washington, D.C. 20460

Dear Dr. Edwards,

Please find enclosed comments that I have prepared in the form of a report on endosulfan usage in Arizona cotton. I am aware that EPA has identified significant issues surrounding the aerial application of this insecticide. This report identifies precisely the use patterns for endosulfan in Arizona cotton and proposes a specific and effective mitigation measure that will meet your agency's goals in re-registration of this insecticide while preserving a very useful and effective rate structure for Arizona's cotton growers. Furthermore, this mitigation measure is more easily enforced by our state's lead regulatory agency, Arizona Department of Agriculture, than the alternatives. I can also assert that the Arizona Pest Management Center and University of Arizona Cooperative Extension are capable of developing effective educational programs for this small user group (about 25 applicators) in conjunction with the Arizona Department of Agriculture.

While our proposed mitigation measure will certainly change and limit the daily usage of endosulfan, we believe it best serves our mutual goals of protecting worker safety and providing growers with economical and effective pest management tools.

I am happy to respond to any questions or comments you may have regarding these data and our proposal.

Respectfully,

Peter C. Ellsworth, Ph.D.
Director, Arizona Pest Management Center
IPM Specialist & State IPM Coordinator
University of Arizona

cc: Anne Overstreet (EPA),
Rick Lavis (Arizona Cotton Growers Association),
Jack Peterson (Arizona Department of Agriculture),
Scott Rawlins (Makhteshim Agan of North America),
Frank Carter, Angus Kelly (National Cotton Council)

Endosulfan, A Critical Insecticide for Pest Control in Arizona Cotton

Prepared & Submitted by
Peter C. Ellsworth, Ph.D.
Director, Arizona Pest Management Center
IPM Specialist & State IPM Coordinator
University of Arizona

Summary
Endosulfan remains one of the most used active ingredients in Arizona cotton. It serves several key roles within the desert production system of Arizona by controlling Lygus spp., whiteflies, aphids, and a variety of lepidopterans among other pests. The rates used against these pests are at the upper end of the currently labeled rate range. When used alone (ca. 20% of the time), use rates are over 1.4 lbs ai / A on average. When used in mixture with other crop chemicals, use rates remain high just below 1 lb ai / A. Few applications are made at or below 0.75 lbs ai / A and are generally targeted towards easier to control species or on younger cotton. Despite introductions of major new chemistries over the last decade, endosulfan remains a critical insecticide and tool for pest management by Arizona cotton growers. EPA seeks to mitigate potential exposure of mixers, loaders, and aerial applicators (m/l/a) to this active ingredient due to risks calculated from a model. This model suggests that this user group is subject to unacceptable risk when using more than 900 lbs ai / day. EPA proposes to mitigate this risk through a reduction in the current maximum labeled rate, 1.5 lbs ai down to 0.75 lbs ai / A. Such a reduction will severely undercut the utility of the product for growers who have documented usage patterns well in excess of this rate. Arizona's Form L-1080 data, which document all aerial applications of endosulfan, clearly show that this mitigation measure will be inadequate in preventing daily usage in excess of 900 lbs ai / d. Instead, a more prudent and more easily enforceable mitigation measure is proposed here, where users (aerial applicators or pilots) will be limited to just 900 lbs ai / d regardless of the rate mixed. This will serve to eliminate the EPA-modeled risk to this user group and maintain the utility of Arizona's second most popular cotton active ingredient. Furthermore, education of the regulated users can be accomplished relatively easily due to the size of the group (ca. 25 pilots statewide). Arizona Department of Agriculture, the lead regulatory agency of this state, requires the filing of the prescriptive uses of custom-applied endosulfan, maintains a complete database of these filings, and through this system can enforce a daily usage limit on this active ingredient. In addition, together with Cooperative Extension, ADA can incorporate these changes into educational programs that successfully reach this client group.

Background
In December 2002, EPA sought public comment on the re-registration of endosulfan. This report extends on the findings submitted by the author to docket ID no. OPP-2002-0262 and entitled, "Endosulfan Re-Registration Eligibility Decision, Arizona Pesticide Usage Data." The current study updates usage statistics for the most recent five-year period, 2001–2005.

Through cooperative agreements with AZ-NASS and Arizona Department of Agriculture, the Arizona Pest Management Center now obtains use of and conducts studies with ADA's Form L-

1080 database. This database, among other prescriptions, contains data on 100% of custom-applied pesticides in the state of Arizona.

Importance of Endosulfan to the Arizona Cotton Industry

Review of the most recent five-year period shows that endosulfan remains a very frequently-used active ingredient in terms of cotton acres treated each year (Table 1). Annually, it has remained among the top four insecticides used by cotton growers, and ranks second over this entire period just behind acephate and just ahead of chlorpyrifos. Over the last decade, indeed over the last five years, several new and important insecticidal active ingredients have been registered for use in cotton (e.g., acetamiprid, buprofezin, pyriproxyfen, spiromesifen). Despite this fact, endosulfan's critical role has not diminished. It remains among growers' principal choices in combating whiteflies, Lygus spp., and pink bollworms, the three key pests of Arizona cotton. ***Used alone and at the highest rate, it can be effective on all three targets. This attribute alone sets it apart from nearly all other chemistry available to growers.*** It is also used as a synergist with pyrethroids and other insecticides for outstanding control of whiteflies and other insects. Over this term, prescriptions for over 5000 fields were written for endosulfan use targeting *Lygus hesperus*, our principal yield-limiting insect pest of cotton. A similar number of fields were sprayed with endosulfan for the control of whiteflies. Nearly 2000 fields were sprayed with endosulfan for the control of pink bollworm and other lepidopteran pests. Furthermore, endosulfan has been useful in the control of an array of secondary pests (e.g., on > 2000 fields for aphid control).

Endosulfan Rates Required for Efficient Pest Control

In our previous study, the rates used by Arizona cotton growers were high relative to the label. There has been very little change in the last five years. When used alone (ca. 20% of the time), endosulfan is applied by air at 1.42 lbs ai / A on average (Table 2). When used in combination with other crop chemicals, rates decline somewhat to 0.99 lbs ai / A on average. Averaging all uses, endosulfan is used at a rate of 1.09 lbs ai / A. Clearly, the critical role for endosulfan in Arizona cotton is linked directly to the rates permitted on the current label (i.e., up to 1.5 lbs ai / A). During 2001–2005 period, Arizona has had some historically low and some historically high years of insect pressure. Despite these year-to-year differences, endosulfan usage rates remain very stable and never average less than 1 lb ai / A (Table 2).

Daily Usage of Endosulfan

EPA's proposed changes to the endosulfan cotton label seek to reduce potential exposures of mixers, loaders and aerial applicators (m/l/a) based on modeled risks. Based on this model, EPA calculates that m/l/a should not handle or apply more than 900 lbs ai endosulfan per day. EPA proposes to achieve this safe limit for endosulfan by cutting the maximum labeled rate for endosulfan in cotton, from 1.5 lbs ai / A to 0.75 lbs ai / A.

Without commenting on the propriety of the model used, ***this study seeks to understand how and when m/l/a are applying more than 900 lbs ai / d of endosulfan and to propose a mitigation measure that better protects this group while better serving the producers who have come to depend on the current rate structure for endosulfan.*** In just over 1500 written prescriptions, about 6000 fields were sprayed with endosulfan during the term examined (2001–2005). Of these, there were a handful of days when individual pilots applied more than 900 lbs ai

(Table 3). On average, there were about 30 pilot-days each year when EPA's proposed limit was exceeded under the current label. This represents about 10% of all the L-1080 prescriptions written for endosulfan.

Examining pilot-days when more than 900 lbs ai of endosulfan was used, there were 12 instances when the rate was at or below 0.75 lbs ai / A. Based on the EPA model, m/l/a were exposed to an unacceptable risk on these 12 days (1% of all L-1080 prescriptions). In fact, using just 0.75 lbs ai / A, these pilot-days applied as much as 1413 lbs ai of endosulfan (in 2004, Table 3). Clearly, reducing the label rate to 0.75 lbs ai / A is inadequate to protect m/l/a from unacceptable risk. In this dataset, the EPA recommendation to reduce the label rate would have reduced the number of occurrences when 900 lbs ai / pilot-day was exceeded, but it would not have eliminated all instances. ***In fact, a major rate reduction might have the opposite effect as growers attempt to use endosulfan more frequently in order to achieve the same level of control.*** In addition, the carrying capacity of agricultural aircraft is increasing creating additional opportunities for pilots to exceed 900 lbs ai / d even at the lower, EPA-proposed, label limit.

Arizona's Proposal for Mitigating Risks to M/L/A

Rather than mitigating the risk indirectly and incompletely by lowering the maximum label rate, Arizona proposes a more prudent and more effective measure that preserves effective use patterns for growers while protecting m/l/a from unnecessary exposure. ***We propose that the label reflect a daily limit for the m/l/a community set at 900 lbs ai / d and retain the current rate range (i.e., up to 1.5 lbs ai / A)***. This would eliminate the lawful use of more than 900 lbs ai / d by m/l/a. At the same time, growers and their pest control advisors could still prescribe the rate range required for effective pest control in Arizona cotton.

The 900 lbs ai daily limit is easily enforced through the current L-1080 system maintained by ADA. Each applicator has an identification number that must be recorded on each L-1080 form along with an array of other information including the chemical brand name, total applied, and date of application. ADA can track the daily usage of endosulfan by aerial applicators very readily through its enforcement services. Furthermore, with such a small community to regulate (e.g., ca. 24 aerial applicators), educational efforts can be relatively easily and effectively deployed in conjunction with the Arizona Pest Management Center and University of Arizona Cooperative Extension.

Growers are faced with economic choices daily. The margins for economic profitability in cotton are thin. Pest pressures in cotton in the deserts of Arizona are significant and present an on-going threat to profitability. Having access to all effective tools is central to the dramatic gains cotton growers have made in pest management over the last decade. Much of this has been centered around the availability of selective technologies like Bt cotton, whitefly-specific insect growth regulators, and other reduced-risk chemistries. However, availability of broad-spectrum, effective, and economical options like acephate, chlorpyrifos, oxamyl, and endosulfan is also critical to grower economic success. Preserving the existing label rate range allows growers access to this important tool. Limiting the daily usage of endosulfan by applicators will protect this segment of the industry from unneeded exposure and meet the mandate set-forth to EPA. Arizona views this as a progressive effort to balance risks and benefits within the industry and welcomes the opportunity to enforce and educate on this important label modification.

Table 1. Ranked active ingredients (a.i.) for cotton in Arizona by year expressed in total acres. Source: Arizona Pest Management Center (APMC).

From AZ	2001–2005 Cumulative		2005		2004		2003		2002		2001	
1080	Acres	A.I.	Acres	A.I.	Acres	A.I.	Acres	A.I.	Acres	A.I.	Acres	A.I.
1	753256	Acephate	167839	Acetamiprid	117011	Acephate	152337	Acephate	154173	Acephate	204098	Acephate
2	557180	**Endosulfan**	125793	**Endosulfan**	85848	Chlorpyrifos	147481	Chlorpyrifos	127087	Chlorpyrifos	158015	**Endosulfan**
3	544333	Chlorpyrifos	125638	Acephate	78339	Acetamiprid	136406	**Endosulfan**	66147	**Endosulfan**	98518	Chlorpyrifos
4	357475	Acetamiprid	85400	Chlorpyrifos	70819	**Endosulfan**	91278	Acetamiprid	47912	Pyriproxyfen	92236	Pyriproxyfen
5	296852	Pyriproxyfen	66104	Pyriproxyfen	45837	Pyriproxyfen	48527	Oxamyl	39516	Cyfluthrin	52468	Fenpropathrin

Table 2. Endosulfan use pattern for cotton in Arizona by year expressed in No. of Fields and Acres sprayed, and average a.i. / A. Source: Arizona Pest Management Center (APMC).

From AZ	2001–2005 Average			2005			2004			2003			2002			2001		
1080	No. Fields	Acres	A.I.	No. Fields	Acres	A.I.	No. Fields	Acres	A.I.	No. Fields	Acres	A.I.	No. Fields	Acres	A.I.	No. Fields	Acres	A.I.
Endosulfan alone	245	25424	1.42	218	21565	1.41	138	15069	1.41	368	32623	1.50	179	20435	1.38	323	37425	1.38
Endosulfan mix	1018	84096	0.99	1266	100413	1.01	622	55295	0.93	1257	102002	1.13	543	44457	0.92	1402	118314	0.97
Endosulfan total	1263	109520	1.09	1484	121978	1.08	760	70364	1.03	1625	134625	1.22	722	64891	1.06	1725	155739	1.07
%Used Alone	19.41			14.69			18.16			22.65			24.79			18.72		

Table 3. Endosulfan use summary statistics by pilot (aerial applicator) for cotton in Arizona by year. Source: Arizona Pest Management Center (APMC).

Endosulfan Break Down	2001	2002	2003	2004	2005	Average	% of Applications
No. of days that endosulfan use exceeded **900 lbs ai**	39	14	47	11	38	29.8	10%
No. of Pilots (Aerial Applicators) involved	12	6	8	5	9	8	
No. of days that endosulfan use exceeded **900 lbs ai @ 0.75 lbs ai/A or less**	6	0	2	2	2	2.4	1%
Max. daily amount (lbs ai) delivered **@ 0.75 lbs ai/A or less**	1138	–	1325	1413	1042	1229.5	

From: Peter Ellsworth <peterell@cals.arizona.edu>
Subject: **Re: Endosulfan**
Date: October 23, 2006 9:17:01 AM MST
To: Perry.Tracy@epamail.epa.gov
Cc: overstreet.anne@epamail.epa.gov, Scott Rawlins <scottr@manainc.com>, Jack Peterson <JPeterson@azda.gov>, Rick Lavis <acga1@aol.com>, Frank Carter <FCarter@cotton.org>, Al Fournier <fournier@Ag.arizona.edu>
1 Attachment, 39.3 KB Save

You're welcome, Tracy. I'm glad the 3rd page reached you electronically.

With respect to your first question, I am attaching a new table that I generated this morning from our database (Table 4) and wish to, by way of this email, append to my report sent previously. As you can see from the previous data, the modal use of endosulfan is in mixture with other compounds. I think this trend has increased as fewer sprays are made season-long. Many practitioners see this as an efficient way to deliver insecticides when there are so few opportunities to spray.

In Table 4, I've listed the 10 most popular insecticide tank-mix partners with endosulfan, cumulatively over the 5-year period examined. Not surprisingly, many of the most popular active ingredients overall (acephate, pyriproxyfen, chlorpyrifos, acetamiprid, cyfluthrin, oxamyl) end up being very popular tank-mix partners. You will also note that plant growth regulators (PGRs) are quite often mixed in with various insecticide sprays including endosulfan, and I've grouped these all together. [FYI, strictly speaking, the acres and fields shown are not additive. That is, some fields are sprayed with mixtures of more than two chemicals. In these cases, a field may be counted more than once in this table if it received a spray with more than one other tank-mix partner in this list.]

In ADA's 1080 system, we also have the opportunity to capture the intended target(s) of each spray. Because up to 5 different targets can be associated with any prescriptive spray, the potential combination targets is vast. I've scanned through this list and given you my impression of the likely targets based on this information and the my own knowledge of the activity of these mixtures.

I would be happy to provide additional information or discuss any of this with you should the need arise. I will address your second question in a follow-up email.

Best Regards,
Peter

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On Oct 23, 2006, at 5:45 AM, Perry.Tracy@epamail.epa.gov wrote:

> Thanks for the information, Peter. Regarding the tables, we were missing the entire table page, not just Table 3. I mentioned Table 3 because this table was referenced in your letter.
>
> In Table 2, which chemical(s) are most often mixed with endosulfan? Also, are the aerial applicators also the ones who mix and load endosulfan...or are these separate workers?
>
> Thanks,
>
> Tracy L. Perry
> Chemical Review Manager
> Special Review and Reregistration Division
> (703) 308-0128

Table 4. Endosulfan use pattern for cotton in Arizona over a 5-year period when used in combination with other crop chemicals. Source: Arizona Pest Management Center (APMC).

From AZ 1080	2001–2005 Cumulative (top 10 insecticides)		
	No. Fields	Acres	Likely Targets
Acephate	1028	99552	Lygus & whiteflies
Pyriproxyfen	727	61454	Whiteflies (adults and immatures) & Lygus
Acetamiprid	741	56816	Whiteflies & Lygus
Chlorpyrifos	569	51950	Pink bollworm (or other leps) & Lygus
PGRs*	627	40906	Plant height management & Lygus and/or whiteflies
Cyfluthrin	391	16348	Whiteflies, leps, & Lygus
PBW Pheromone	142	14717	Pink bollworm, Lygus and/or whiteflies
Bifenthrin	210	11810	Whiteflies, leps, & Lygus
Sulfur	124	11608	Mites & Lygus and/or whiteflies
Buprofezin	122	11434	Whiteflies (adults and immatures) & Lygus
Oxamyl	77	8776	Lygus & whiteflies
Sum	4758	385372	

* Includes products with the active ingredients: Mepiquat chloride, Bacillus cereus, Mepiquat pentaborate, Kinetin.

From: Perry.Tracy@epamail.epa.gov
Subject: **Re: Endosulfan**
Date: October 27, 2006 8:15:43 AM MST
To: Peter Ellsworth <peterell@cals.arizona.edu>
Cc: overstreet.anne@epamail.epa.gov

Peter,

I'm not sure what you mean by "...EPA's position on this class of workers..." In our risk assessments, we need to determine that risk to workers (whether they be applicators, mixers, or loaders) is acceptable. The exposure scenarios are different for applicators versus mixers and loaders. Mixer/loader exposure to a chemical is greater than that of aerial applicators. My point is, I can imagine a scenario (and this may be totally off-base with actual practices), where a mixer/loader handles endosulfan for 2 applicators: thus, even though an individual applicator handles 900 lb AI/day, theoretically, a mixer/loader could handle much more than 900 lbs AI/day if he was servicing 2 applicators. Educating applicators and making sure they did not apply more than 900 lbs AI/day would not necessarily ensure that a mixer/loader only handled 900 lbs AI/day. Does this help make my point a little clearer?

If, as you say below, typically 2 workers supply one applicator (and only one), then limitations on the applicator (lbs/day) would also be protective of mixer/loaders.

Tracy L. Perry
U.S. Environmental Protection Agency
Office of Pesticide Programs
(703) 308-0128
(703) 308-8005 (FAX)
perry.tracy@epa.gov

Peter Ellsworth <peterell@cals.arizona.edu> 10/27/2006 10:40 AM

To: Tracy Perry/DC/USEPA/US@EPA
cc: Anne Overstreet/DC/USEPA/US@EPA, Jack Peterson <JPeterson@azda.gov>
Subject: Re: Endosulfan

Tracy,

I am headed to Tucson to teach today and will not have an opportunity to respond to this until the first of next week. However, I see that you are inquiring about the same issues. In preparation for my response, I guess I would like to understand better EPA's position on how this class of worker is to be protected?

FYI, typically it is two handlers supplying one plane and not the other way around. One typically handles the chemical directly, and the other is at the loading point on the plane and monitors the volume delivered.

Peter

On Oct 27, 2006, at 6:59 AM, Perry.Tracy@epamail.epa.gov wrote:

> Peter,

From: Peter Ellsworth <peterell@cals.arizona.edu>
Subject: **Re: Endosulfan**
Date: October 31, 2006 5:48:18 PM MST
To: Perry.Tracy@epamail.epa.gov
Cc: overstreet.anne@epamail.epa.gov, Scott Rawlins <scottr@manainc.com>, Jack Peterson <JPeterson@azda.gov>, Rick Lavis <acga1@aol.com>, Frank Carter <FCarter@cotton.org>, Al Fournier <fournier@Ag.arizona.edu>
1 Attachment, 36.7 KB Save

Hi Tracy,

I apologize for not responding sooner. However, I have taken this time to revisit our 1080 database and to develop some new information that might help frame my comments and with which I would like to amend my previous submissions by way of this email.

First, let me return to the question I put forth previously and explain my position. I was trying to understand what EPA would view as a viable option in protecting this class of workers. That class being mixers and loaders. You point out potential weaknesses in our proposed mitigation, which I will address. However, you have not identified for me how it is EPA's proposal will improve the situation. EPA's suggestion to cut the maximum labeled rate in half does nothing to explicitly protect this class of workers. Through real-world use data over a significant period of time (5 yrs), I've shown you that this mitigation measure will not ensure protection of this class based on the modeled limit of 900 lbs ai / d.

My point is that our mitigation proposal, that of limiting the usage to a defined limit of ai / d, does much more to protect this class of worker. Furthermore, it can be readily enforced, and education is likely to be a very effective adjunct in protecting this class of workers especially give the exceptionally small group of individuals that this involves.

This leads me to my follow-up information regarding the scope of the aerial application business and the distribution of individuals within these businesses. Please find attached three new tables that describe this industry in terms of real world data associated with endosulfan aerial application in Arizona cotton over the last five years.

In the 1080 database, we are able to determine the number of planes and pilots engaged in endosulfan application on a daily basis. Again, we are dealing with a very small industry here. There were a total of 11-14 businesses engaged in aerial application of endosulfan between 2001 and 2005. Of these, 4-7 of these businesses were made up of just 1 pilot and 1 plane presenting no opportunity for a mixer/loader to service more than one plane. Of the remaining businesses, some are larger with multiple aircraft and pilots, but also multiple strips and remote locations. Thus, some of the data presented here includes single pilot - single plane per location of a larger business unit, again with no chance of a mixer/loader servicing multiple planes.

Table 5 isolates those days when endosulfan was aerially applied to Arizona cotton and details how many planes were deployed per business unit. In the vast majority of cases, only one plane is applying endosulfan on any given day. About 77% of the time, only one plane is spraying endosulfan per business unit. In looking at the data, it is clear that pilots numbers are directly related to the number of aircraft in a business unit. Furthermore, pilots tend to fly the same equipment each time. Not surprisingly, Table 6 shows that usually (76%) only one pilot is engaged in the application of endosulfan on any given day per business unit. Similarly we expect a nearly one to one correspondence between mixer/loaders to pilots.

Only 23% of time are there multiple pilots of the same business unit spraying endosulfan on the same day. It is very likely that much of this is related to two planes in the same business operating from different strips and operating with different crews, e.g., strips located in Yuma Valley vs. Wellton-Mohawk Valley 30 miles apart. It is also apparent that only a very small number of businesses are large enough to support multiple planes and pilots, and that these entities are responsible for the majority of multi-pilot endosulfan application days. Just two businesses (Table 7) account for over half (65%) of the instances when endosulfan is applied by multiple pilots on the same day and 97% are operating out of just 4 business units. Only 3 businesses had instances in every year examined (2001-2005) where their pilots were operating two planes on the same day in the application of endosulfan.

While we agree that the objective is to protect all classes of workers with potential exposure to endosulfan, we do not see data that supports cutting the label rate as an effective measure to doing so. Instead, daily limits imposed on pilots, enforced by ADA, and taught to a very small user group through programs of outreach by ADA and University of Arizona Cooperative Extension represents our best option in protecting all at-risk classes of workers engaged in the business of

aerial application of endosulfan. Furthermore, we believe that whatever daily limits suggested by current data used in EPA models will be quite conservative in the protection of this class, given that the modal operation of these businesses is two mixer/loaders per plane (or pilot).

Clearly, as you suggest, education alone cannot guarantee the safeguarding of this or any other class of user. However, no label restriction either, alone, can make this guarantee. So theoretical scenarios aside, we have ample evidence of three important things. One, endosulfan remains a very important tool used by many growers in a flexible management system and that this very use pattern argues against lower label rates both from an insect control standpoint but also as an effective mitigation measure. Two, our challenge to regulate and educate such a small class is within our abilities and is to great collective advantage to the industry and using community. And three, this process demonstrates that we have ready access and monitoring of aerial application use patterns such that Arizona is empowered to closely monitor the progress of any mitigation measure and adjust accordingly. We believe that our mitigation proposal is strengthened by the right combination of understanding of current and potential use patterns, regulatory compliance monitoring and enforcement, and user education and outreach.

Please contact me should any clarification or new information be required. I would be happy to visit with you or others by phone at any time.

Regards,
Peter

Peter C. Ellsworth, Ph.D.
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Table 5. No. & % of days when 1, 2, or 3 **planes** of an applicator business were applying endosulfan in Arizona cotton. Source: Arizona Pest Management Center (APMC).

YEAR	Days	1 Plane	2 Planes	3 Planes
2001	286	72%	26%	3%
2002	190	84%	15%	1%
2003	295	72%	27%	1%
2004	184	81%	18%	1%
2005	264	75%	23%	2%
		77%	22%	1%

Table 6. No. & % of days when 1, 2, or 3 **pilots** of an applicator business were applying endosulfan in Arizona cotton. Source: Arizona Pest Management Center (APMC).

YEAR	Days	1 Pilot	2 Pilots	3 Pilots
2001	286	72%	25%	3%
2002	190	80%	20%	0%
2003	295	73%	25%	1%
2004	184	82%	18%	1%
2005	264	75%	23%	2%
	1219	76%	22%	1%

Table 7. Businesses engaged in aerial application of endosulfan in cotton over a 5-year period where more than 1 pilot was used on any given day in Arizona cotton. Source: Arizona Pest Management Center (APMC).

Business ID	No. of Years (5) with Multi-pilot Days	Days > 1 pilot	% of Multi-pilot Days
1	5	80	27%
7	5	113	38%
17	4	38	13%

Table 5. No. & % of days when 1, 2, or 3 **planes** of an applicator business were applying endosulfan in Arizona cotton. Source: Arizona Pest Management Center (APMC).

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Business ID	No. of Years (5) with Multi-pilot Days	Days > 1 pilot	% of Multi-pilot Days
1	5	80	27%
7	5	113	38%
17	4	38	13%
26	2	2	1%
159	3	7	2%
187	5	57	19%
		297	100%

22 November 2006

Dear Tracy,

Thank you for your inquiry regarding the usage of endosulfan over consecutive days in Arizona cotton. How often endosulfan is used over the course of the season should be an important consideration in the risk mitigation process. The EPA model likely makes some assumptions about the daily usage by mixers, loaders, and applicators. The typical use season for endosulfan ranges from about 15 June to 15 September. However, as you will see in our analyses, the likelihood of m/l/a's being involved with the application of endosulfan over a 90 consecutive day period is impossible. In fact, the modal and median run of days that a pilot, or indeed an entire business, might apply endosulfan is just one.

Once again we are very fortunate to have access to an outstanding reporting system in the form L-1080 as required by the Arizona Department of Agriculture. In brief, this is a reporting system required for, among other uses, all custom applied pesticides in the state of Arizona. The pest control advisor (PCA) provides a prescriptive recommendation for the application of pesticides to grower fields. The aerial applicator then carries out these instructions, completes the 1080 form and returns it to ADA for processing. ADA in collaboration with Arizona Agricultural Statistics Service and USDA-NASS keys in the 1080 data. Through cooperative agreements with the University of Arizona, the Arizona Pest Management Center then continues processing of these data for research and educational purposes. These data are complete with respect to the aerial application of endosulfan in Arizona cotton. The period of analysis is 2001–2005 and spans the gamut of lower to higher pest pressure years.

Given this system and our ability to exercise the data, the results provided here should be considered definitive and descriptive of the behaviors you wish to know more about, in this case consecutive daily use of endosulfan in cotton. In brief, we examined the usage of endosulfan by pilot and then by custom application business, which potentially represents multiple pilots, planes, and airstrips. The latter should be considered an absolute upper limit in the potential involvement of any one mixer and loader, ignoring the fact that a single mixer or loader cannot be at multiple locations at the same time. In each analysis, we quantified the number of consecutive days involved in endosulfan application, and then developed summary statistics on the distribution of these data including means, medians, quantiles, and 95% upper and lower limits.

Table 8 shows quantile statistics for the consecutive daily usage of endosulfan by pilot and by business unit. The maximum number of consecutive days that a given pilot was involved with application of endosulfan was ten (10), with a mean of 1.7 (± 1.3) days (Table 9). For a business unit, the maximum number of consecutive days of endosulfan application was 16, with a mean of 2.1 (± 2.0) days (Table 10).

These results suggest that the vast majority of endosulfan usage occurs in a single day followed by one or more days without any endosulfan usage. There were some stretches of 2 or more consecutive days; however, even when application frequency was high, the maximum number of consecutive days of application was only 10 for pilots and 16 for an entire business unit over a five year period. So while endosulfan remains an important, even critical insecticide for cotton growers in this state, the aerial application industry is infrequently engaged in back to back days of endosulfan spraying. These facts should help better calibrate existing models of endosulfan worker exposure risks.

Thanks again for your inquiry and please let me know if you have any questions at all arising from these or other endosulfan data.

Best Regards,

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Table 8. Quantile statistics for consecutive daily usage of endosulfan by **pilots** and **business units** in cotton over a 5-year period. Source: Arizona Pest Management Center (APMC).

Quantiles (Pilot usage)		
100.0%	maximum	10
99.5%		8
97.5%		6
90.0%		3
75.0%	quartile	2
50.0%	median	1
25.0%	quartile	1
10.0%		1
2.5%		1
0.5%		1
0.0%	minimum	1

Quantiles (Business usage)		
100.0%	maximum	16
99.5%		13
97.5%		7.925
90.0%		4
75.0%	quartile	2
50.0%	median	1
25.0%	quartile	1
10.0%		1
2.5%		1
0.5%		1
0.0%	minimum	1

Table 9. Average consecutive daily usage of endosulfan by **pilots** in cotton over a 5-year period. Source: Arizona Pest Management Center (APMC).

Year	N	Consecutive Daily Usage (mean ± SD in d)		Lower 95%	Upper 95%
2001	200	1.81	± 1.5	1.6	2.0
2002	152	1.53	± 1.1	1.4	1.7
2003	196	1.70	± 1.2	1.5	1.9
2004	169	1.60	± 1.1	1.4	1.8
2005	185	1.78	± 1.4	1.6	2.0
Average	902	1.69	± 1.3	1.6	1.8

Table 10. Average consecutive daily usage of endosulfan by **business** in cotton over a 5-year period. Source: Arizona Pest Management Center (APMC).

Year	N	Consecutive Daily Usage (mean ± SD in d)		Lower 95%	Upper 95%
2001	121	2.29	± 2.3	1.9	2.7
2002	111	1.76	± 1.6	1.5	2.1
2003	133	2.02	± 1.8	1.7	2.3
2004	113	2.02	± 1.9	1.7	2.4
2005	124	2.18	± 2.3	1.8	2.6
Average	602	2.06	± 2.0	1.9	2.2