Pathways of Pesticides into Farmworkers' Homes in Yuma, Arizona

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Background

Yuma, Arizona

- Yuma is located in the south-western corner of Arizona, along the U.S.-Mexico border (FIG 1)
- 45% of Yuma, Arizona residents work in agriculture (1)
- Agricultural fields are found throughout communities, often next to homes & schools (FIG 2)
- Dry and dusty conditions promote resuspension of particles
- **These distinctive characteristics make in-home contamination of pesticides of particular concern for Yuma farmworker families**

FIG 1: Location of Yuma, AZ

Pesticide Pathways

- Pesticides may enter farmworkers' homes by: (a) track-in on work apparel; (b) pesticide spray drift; and (c) wind-driven resuspension of pesticides in soil from nearby fields (FIG 3) (2)
- Past interventions have focused on the track-in pathway to reduce pesticide contamination in homes (3-4)
- While some interventions have improved farmworkers' behaviors contributing to track-in, there has been no reduction of pesticides in house dust or urine of farmworkers' families (3-4)
- **It is possible that past interventions were not targeting the primary pesticide pathway into homes**

FIG 2: Playground adjacent to agricultural field in Yuma, Arizona

Relevance of Soil and Dust Particles <63 µm

- Preferentially adheres to hands, increasing potential for exposure by ingestion (5)
  - Particularly relevant for children who have increased hand-to-mouth contact
- More likely to adhere to shoes or be resuspended by wind (2)
  - Increases potential for track-in and air-infiltration into the home (FIG 3)

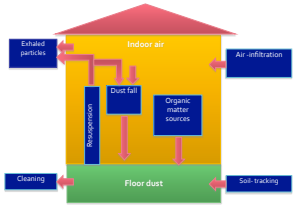

FIG 3. Conceptual model for indoor transport of pesticides depicting soil-tracking and air-infiltration as potential pathways (6)

Objectives

Objectives: (1) Improve understanding of agricultural pesticide use in Yuma, Arizona; (2) Compare Yuma potential in-home transport of outdoor contaminants to agricultural community in Fresno, CA and non-agricultural community in Tucson, Arizona; and (3) Determine relative contributions of track-in versus air-infiltration of pesticides into farmworkers' homes.

Methods

Sampling Farmworkers' Homes

- Recruited 9 farmworker households in Yuma
- Obtained household samples of:
  - (1) **Soil**: swept along pathway to entrance
  - (2) **Outdoor air:** used PUF-XAD-PUF tube and SKC Aircheck XR5000 at 4 L/min for 48 hours following EPA method TO-10A
  - (3) **Dust:** vacuumed with online filter on floor inside home
- Dust loading computed and compared to agricultural community in Fresno and non-agricultural community in Tucson
- Dust and soil sieved to <63 µm and compared to non-agricultural community in Tucson

Analysis of AZ Department of Agriculture Pesticide Application Database

- Assessed monthly application of pesticides for 2006-2011
- Ranked pesticides used in Yuma based on average application from 2006-11 & categorized potential health effects of highest ranked pesticides

Results

The majority of the top 20 ranked pesticides are associated with potential health effects (TABLE 1). Additionally, although peak application periods vary each year, the most consistent period is between August-November (FIG 4). Total dust loading in farmworkers' homes in Yuma, AZ is significantly higher than non-farmworkers' homes in Tucson, AZ but not farmworkers' homes in Fresno, CA (FIG 5). Sieving results indicate that the fraction of <63µm particle size is much higher in house dust both in Yuma, AZ and Tucson, AZ (FIG 6). Pesticide analysis of household dust, soil and outdoor air has not yet been completed.

TABLE 1: Top 20 ranked pesticides and potential health effects in Yuma, AZ.

Top Ranked Active Ingredients	Average Application/ Year for Past 5 Years	Total 5 Year Application	Pounds per Acreage for Past 5 Years	EPA Carcinogen Class	Suspected Developmental or Reproductive Toxicants	Suspected Endocrine Disruption
Aspergillus flavus	1,280,450	6,402,249	179.58			
Bensulide*	326,278	1,631,389	2.24			
Trifluralin	242,585	1,212,926	13.77	C		Y
Sodium methyl-carbamodithioate/ Metam sodium	327,605	628,031	34.03	B	Y	Y
Bifenthrin**	220,270	220,270	0.64	C	Y	Y
Sulfur	205,510	1,021,387	5.68			
Maneb	155,113	775,567	4.16	B		Y
Fenamidone	150,005	750,024	16.22			
Spinetoram	117,182	585,909	1.24			
Chlorpyrifos*	110,342	551,711	4.62			Y
Tribufos *	107,012	535,059	0.04	Likely		
Dimethomorph	102,659	513,293	3.50			
Endosulfan	101,466	507,329	3.87			Y
Cypermethrin**	97,476	487,380	0.06	C		Y
Mineral oil - inc	95,213	476,065	8.75	Known (NTP list)		
Iprodione	70,293	351,466	3.87	B	Y	Y
Abamectin	70,279	70,279	1.03		Y	Y
Spinosad	67,733	338,666	0.81			
Pronamide/ Propyzamide	62,651	313,257	1.61	B		Y
Paraquat dichloride	60,567	302,833	5.72			Y

Notes: *Organophosphate **Pyrethroid B=probable carcinogen C=possible carcinogen NTP=National Toxicology Program
Pesticides in red indicate analytes for future household sampling

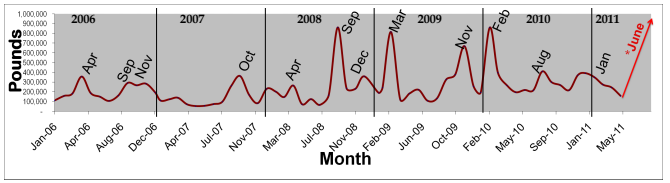

FIG 4: Yuma, AZ monthly applications of pesticides for 2006-2011. *June 2011 application off-the-charts at 6,264,587 lbs

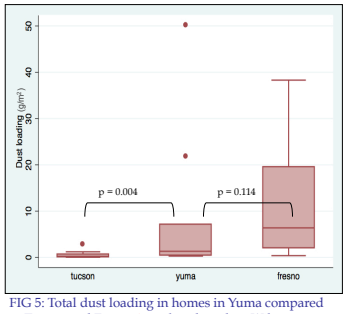

FIG 5: Total dust loading in homes in Yuma compared to Tucson and Fresno *p-values based on Wilcoxon Rank Sum

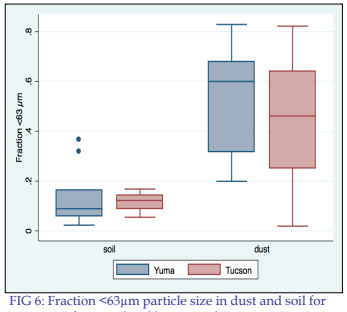

FIG 6: Fraction <63µm particle size in dust and soil for Yuma, AZ farmworkers' homes and Tucson, AZ non-farmworkers' homes

Conclusions & Future Directions

- The <63µm particle size fraction is much greater in house dust than soil for both farmworkers' households in Yuma, AZ and non-farmworkers' households in Tucson, AZ, suggesting that finer particles are more likely to enter homes and expose families through hand-to-mouth contact with house dust.
- Dust loading is significantly higher in farmworkers' homes in Yuma, AZ compared to non-farmworkers' homes in Tucson, AZ, but not to farmworkers' homes in Fresno, CA suggesting that farmworkers' homes may be at heightened risk for in-home transport of outdoor contaminants.
- Future household samples will be obtained between August-November and analyzed for: *Bensulide, Trifluralin, Bifenthrin, Endosulfan, Cypermethrin,* and *Iprodione*.
- Once pesticide residues quantified, a dust transport model will be used to elucidate the relative contributions of the track-in and air-infiltration pathways of pesticides into homes, as depicted in FIG 3.
- This study shows the importance of assessing characteristics unique to each agricultural community so that locally-relevant interventions can be developed.

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Acknowledgements

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