2014 Air Monitoring Network Results

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Background

- On February 2011, the Department of Pesticide Regulation (DPR) implemented a long-term statewide **A**ir **M**onitoring **N**etwork (AMN) for measuring pesticides in various agricultural communities.

- The AMN is the first long-term air monitoring study conducted by DPR.

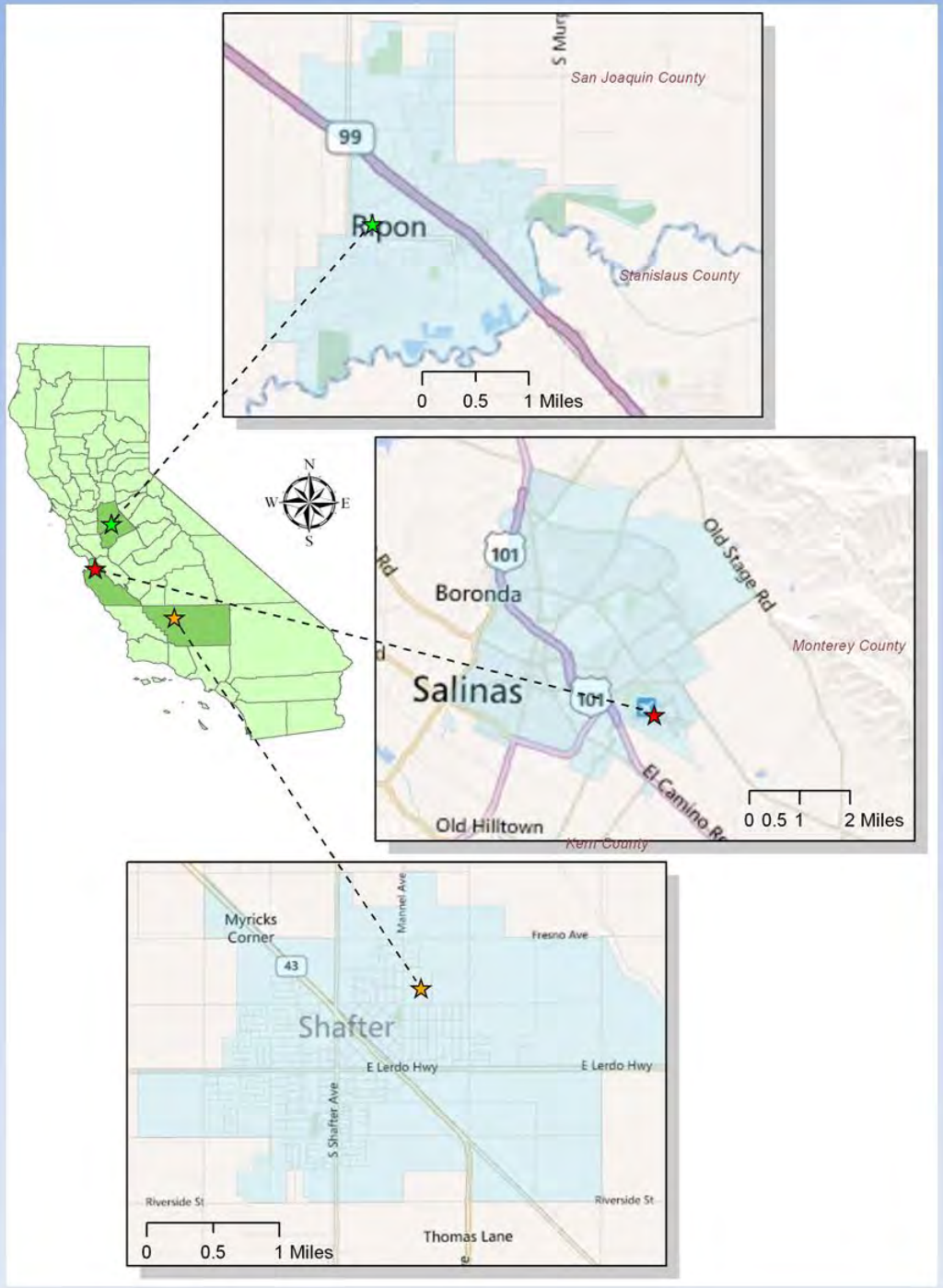
- This presentation contains AMN results from January 1, 2014 to December 31, 2014.

Objectives

- Identify common pesticides in air.
- Compare air concentration with human health screening levels.
- Track trends in air concentrations over time.
- Estimate cumulative exposure to multiple pesticides.
- Correlate air concentrations with pesticide use and local weather pattern.

Community Selection Process

- 226 California communities were evaluated for AMN inclusion.
  - 1,267 communities were re-evaluated in 2013.
- Communities were prioritized based on:
  - pesticide use (community, local and regional),
  - demographic data, and
  - availability of other exposure and health data.
- Other factors (e.g., sampling feasibility, weather patterns, and potential collaboration with other projects) were also considered.
- Three communities were chosen (Ripon, Salinas, and Shafter) to be part of the AMN.



Ripon:

- Located in San Joaquin County.
- Major crops: almonds, grapes and other field crops.
- Station Location: Nearby City Hall

Salinas:

- Located in Monterey County.
- Major crops: strawberries, lettuce and other field crops.
- Station Location: At the center of Municipal Airport

Shafter:

- Located in Kern County.
- Major crops: almonds, grapes, and alfalfa.
- Station Location: At the vicinity of high school and edge of town

Pesticides Monitored

- Pesticides included in AMN were selected based on:
  1. Pounds of use by area/region (indicator of exposure)
  2. Volatility (indicator of exposure)
  3. DPR risk assessment priority (indicator of toxicity)
  4. Feasibility of including in multi-residue monitoring method

- Most of the pesticides monitored in AMN were included in 2006 Parlier pilot study and thus sample methods and collection techniques were already developed and used by DPR staff.

- In 2014 – A total of 32 pesticides and 5 pesticide breakdown products are monitored in the AMN.

Sampling Methods - Current

Four sampling methods were used for collection and examination of pesticides:

	Multi-Pesticide	VOC	MITC	Chloropicrin
# of pesticides	32	3	1	1
Sampling Media	XAD-4	Air vacuum	Coconut charcoal	XAD-4
Flow Rate	15 L/min	~3.5 mL/min	1500 mL/min	50 mL/min
Analysis Type	GC/MS & LC/MS	GC/MS	GC-NPD	GC-ECD

Pesticides Monitored

Multi-pesticide analysis – XAD-4 resin

Pesticide	Chemical Class	Pesticide	Chemical Class
Acephate	Organophosphate	Iprodione	Dicarboximide
Bensulide	Organophosphate	Malathion	Organophosphate
Chlorothalonil	Chloronitrile	Malathion Oxygen Analog	
Chlorpyrifos	Organophosphate	Methidathion	Organophosphate
Chlorpyrifos Oxygen Analog		Metolachlor (S-metolachlor)	Chloracetanilide
Chlorthal-dimethyl	Phthalate	Naled as dichlorvos (DDVP)	Organophosphate
Cypermethrin	Pyrethroid	Norflurazon	Pyridazinone
Diazinon	Organophosphate	Oryzalin	Dinitroaniline
Diazinon Oxygen Analog		Oxydemeton-methyl	Organophosphate
Dicofol	Organochlorine	Oxyfluorfen	Diphenyl ether
Dimethoate	Organophosphate	Permethrin	Pyrethroid
Dimethoate Oxygen Analog		Phosmet	Organophosphate
Diuron	Urea	Propargite	Organosulfite
Endosulfan	Organochlorine	Simazine	Triazine
Endosulfan Sulfate		SSS-tributylphosphorotrithioate	Organophosphate
EPTC	Carbamate	Trifluralin	Dinitroaniline

Pesticides Monitored

Fumigant analysis – Canister

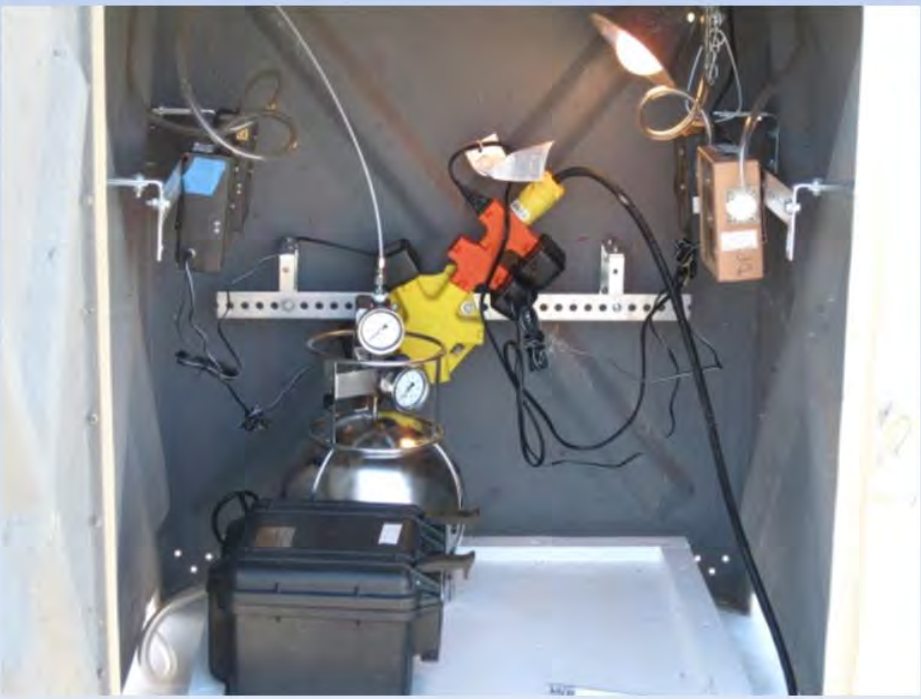
Pesticide	Chemical Class
1,3-dichloropropene	Halogenated organic
Methyl bromide	Halogenated organic
Carbon disulfide	Inorganic

Fumigant analysis – Coconut charcoal and XAD-4 tubes

Pesticide	Chemical Class
MITC	
Chloropicrin	Halogenated organic

Sampling Collection Procedure

- 24-hour samples were collected every week at each of the 3 sites.
- Sampling days were randomly selected and varied by week
- Sampling start times ranged from 9:00 a.m. to 2:00 pm and ran for 24 hours.



Screening Levels

- DPR developed health screening levels for the monitored pesticides to place the results in a health-based context.
- Screening levels:
  - Although not a regulatory standard, they can be helpful in the process of evaluating air monitoring results.
    - Air concentration **below** the screening level → would generally not undergo further evaluation.
    - Air concentration **above** the screening level → would indicate the need for a further and more refined evaluation.

Results

- DPR collected 157 sets of samples (each set consist of four samples that makes total of 628 samples) in 2014.
- A grand total of 5,966 analyses were conducted on the air samples collected from all three sampling locations from January 1, 2014 to December 31, 2014.
  - 498 analyses (8 %) contained detectable concentrations (both quantifiable and trace detections)
  - 225 analyses (4 %) contained quantifiable concentrations.

- 14 chemicals monitored were not detected (ND) at concentrations above the detection limit.

1. Acephate
2. Bensulide
3. Cypermethrin
4. Diazinon
5. Dimenthoate
6. Dimethoate OA
7. DEF
8. Endosulfan Sulfate
9. Methidathion
10. Metolachlor
11. Norflurazon
12. Oxydementon methyl
13. Phosmet
14. pp-Dicofol

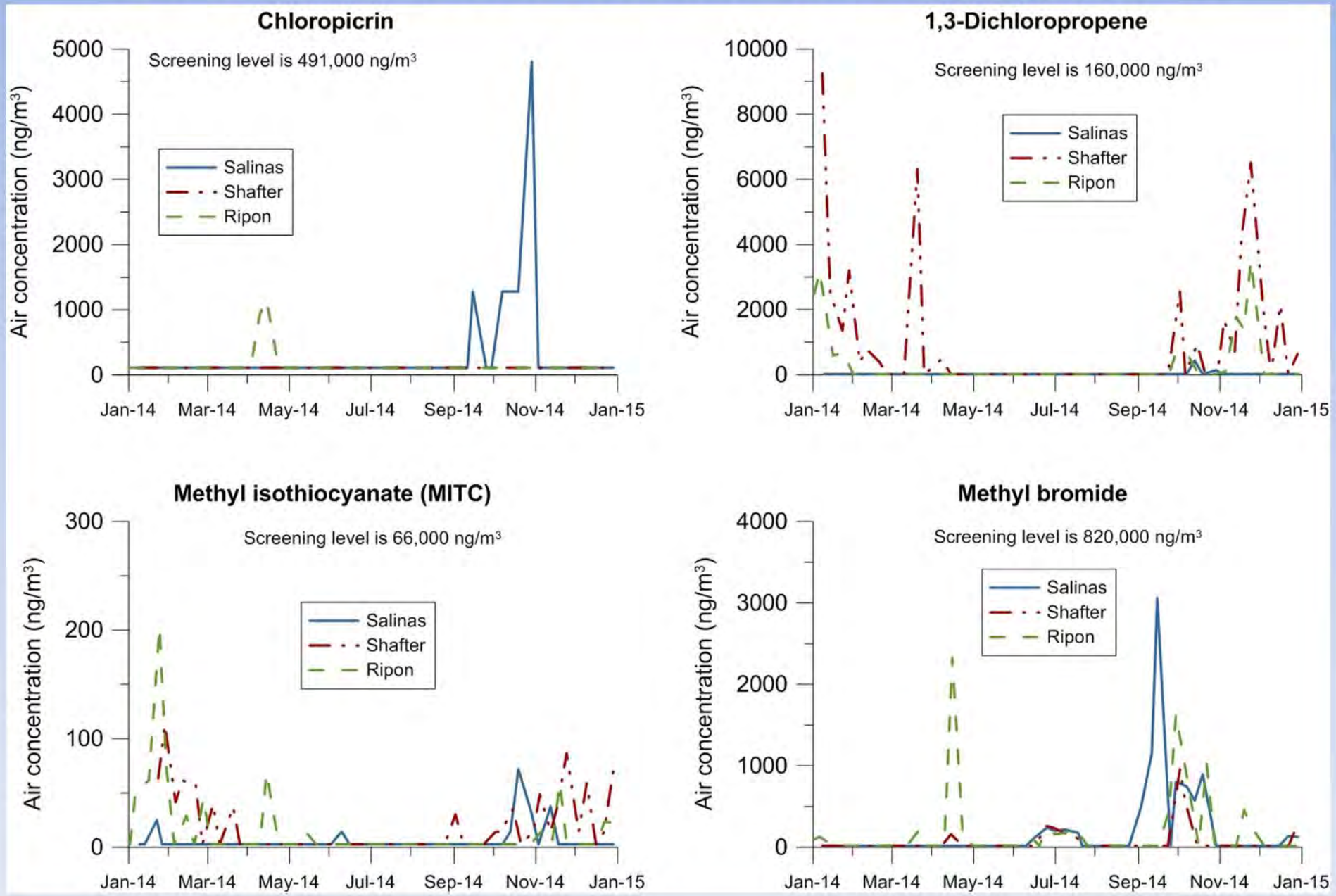
Results

- Number of detections of monitored chemicals by sampling location

Location	Number of possible detections	Percent of possible detections*	Percent of quantifiable detections
Salinas	1,976	6.3%	2.4%
Shafter	1,976	11.1%	5.3%
Ripon	2,014	7.7%	3.6%
Total	**5,966**	**8.3%**	**3.8%**

*Includes trace and quantifiable detections

24-hour concentrations over time for selected pesticides



Acute Exposure

- Highest 24-hour concentrations for chemicals with quantifiable detections per sampling location in 2014.

	Salinas	Shafter	Ripon	
Chemical	**Highest 24-hr concentration**	**Highest 24-hr concentration**	**Highest 24-hr concentration**	**24-hour acute screening level**
	Units of ng/m³			
1,3-Dichloropropene	440	**9,251**	**3,512**	160,000
Carbon Disulfide	691	548	370	1,550,000
Chloropicrin	**4,809**	ND	1,150	491,000
Chlorothalonil	Trace	118	Trace	34,000
Chlorpyrifos	Trace	423	Trace	1,200
Chlorpyrifos OA	ND	110	Trace	1,200
Chlorthal-dimethyl (Dacthal)	10	ND	ND	23,500,000
Diuron	14	Trace	Trace	170,000
EPTC	Trace	216	ND	230,000
Methyl Bromide	3,063	963	2,329	820,000
MITC	72	113	203	66,000

ND = Not Detected
Trace = Detection above MDL but below LOQ

Subchronic exposure

- Subchronic exposure calculations using 4-week rolling concentrations with quantifiable detections in 2014.

	Salinas	Shafter	Ripon	
Chemical	Highest 4-wk rolling concentration	Highest 4-wk rolling concentration	Highest 4-wk rolling concentration	Subchronic screening level
	Units of ng/m³			
1,3-Dichloropropene	158	**4,077**	**1,740**	120,000
Carbon Disulfide	319	304	227	800,000
Chloropicrin	**2,162**	ND	578	2,300
Chlorothalonil	Trace	67	Trace	34,000
Chlorpyrifos	Trace	92	Trace	850
Chlorpyrifos OA	ND	32	Trace	850
Chlorthal-dimethyl (Dacthal)	7	ND	ND	470,000
Diuron	8	Trace	Trace	17,000
EPTC	Trace	86	ND	24,000
Methyl Bromide	1,262	389	867	19,400
MITC	36	75	98	3,000

ND = Not Detected
Trace = Detection above MDL but below LOQ

Chronic exposure

- Overall average concentrations for chemicals with quantifiable detections in 2014.

	Salinas	Shafter	Ripon	
Chemical	Overall Average concentration	Overall Average concentration	Overall Average concentration	Chronic screening level
	Units of ng/m³			
1,3-Dichloropropene	33	**909**	**302**	120,000
Carbon Disulfide	85	87	77	800,000
Chloropicrin	**291**	ND	146.2	1,800
Chlorothalonil	Trace	22	Trace	34,000
Chlorpyrifos	Trace	16	Trace	510
Chlorpyrifos OA	ND	7	Trace	510
Chlorthal-dimethyl (Dacthal)	Trace	ND	ND	47,000
Diuron	Trace	Trace	Trace	5,700
EPTC	Trace	Trace	ND	8,500
Methyl Bromide	187	70	172	3,900
MITC	Trace	21	15	300

ND = Not Detected
Trace = Detection above MDL but below LOQ

Health Evaluation Methods

- The cumulative exposure and risk were estimated using a hazard quotient and index approach.

- The potential risk evaluation
  - 24 hours – Acute exposure
  - 4 weeks – Subchronic exposure
  - 1 year - Chronic exposure

$$Hazard\ Quotient\ (HQ) = \frac{\text{Air concentration detected } (ng\ /\ m^3)}{\text{Screening level concentration } (ng\ /\ m^3)}$$

- Cumulative Risk from multiple pesticides (organophosphates)

$$Hazard\ Index(HI) = HQ_1(pesticide\,1) + HQ_2(pesticide\,2) + HQ_3(pesticide\,3) + \ldots (and\ so\ forth)$$

Cumulative Exposures

- Cumulative exposures were only calculated for organophosphate pesticides. These were the only pesticides that have a common mode of action (cholinesterase inhibition) and were detected at quantifiable concentrations.

Community	Acute hazard index	Subchronic hazard index	Chronic hazard index
Salinas	0.027	0.028	0.031
Shafter	**0.387**	**0.159**	**0.067**
Ripon	0.067	0.043	0.036

- Findings:
  - None of the hazard indices exceeded one, indicating that the screening levels were not exceeded for all organophosphates combined.
  - Shafter had higher risk than Salinas and Ripon for all exposure periods.
  - The acute risk was higher for Shafter and Ripon communities, in comparison to the subchronic and chronic risk.

Relative Risk

- Overall maximum relative risk for chemicals with quantifiable concentrations.
  - A concentration greater than 100% of the screening level suggests the need for further evaluation.

	Chemical	Acute Screening Level	Subchronic Screening Level	Chronic Screening Level
		%	%	%
1	1,3-Dicholoropropene	5.78	7.71	0.76
2	Carbon Disulfide	0.04	0.05	0.01
3	Chloropicrin	0.98	**93.98**	**16.18**
4	Chlorothalonil	0.35	0.23	0.06
5	Chlorpyrifos	**28.16**	10.84	3.15
6	Chlorpyrifos OA	9.14	3.76	1.33
7	Chlorthal-dimethyl (Dacthal)	0.07	3.46	0.01
8	Diuron	0.01	0.05	0.05
9	EPTC	0.09	0.36	0.09
10	Methyl Bromide	0.37	0.65	4.79
11	MITC	0.31	3.25	6.89

Percent of detected pesticides

	Chemical	2011 (143 possible detections)	2012 (156 possible detections)	2013 (159 possible detections)	2014 (157 possible detections)
1	Chlorothalonil	17%	15%	35%	52%
2	Carbon Disulfide	0%	1%	13%	48%
3	Methyl Bromide	16%	7%	8%	24%
4	1,3-Dichloropropene	4%	3%	20%	20%
5	Chlorpyrifos OA	27%	25%	26%	26%
6	MITC	31%	28%	30%	25%
7	Chlorpyrifos	32%	28%	33%	24%
8	Chlorthal-dimethyl (Dacthal)	20%	17%	19%	21%
9	Malathion OA	16%	17%	12%	13%
10	Diuron	4%	21%	8%	7%
11	Trifluralin	12%	10%	5%	6%
12	DDVP	3%	4%	9%	5%
13	Chloropicrin	2%	-	6%	4%
14	EPTC	6%	1%	4%	4%
15	Malathion	4%	5%	7%	4%
16	Propargite	2%	4%	5%	4%
17	Iprodione	1%	2%	4%	3%
18	Simazine	4%	8%	-	3%
19	Endosulfan	-	1%	1%	2%
20	Diazinon OA	8%	3%	4%	1%
21	Oryzalin	1%	3%	1%	1%
22	Oxyfluorfen	1%	2%	1%	1%
23	Permethrin	2%	-	1%	1%

Pesticides at quantifiable levels

- The pesticides monitored were detected at quantifiable concentrations (detections above LOQ).

	Chemical	2011 (143 possible detections)	2012 (156 possible detections)	2013 (159 possible detections)	2014 (157 possible detections)
1	Carbon Disulfide	-	1%	13%	48%
2	Methyl Bromide	16%	7%	8%	24%
3	1,3-Dicholoropropene	4%	3%	20%	20%
4	Chlorothalonil	-	-	3%	4%
5	MITC	31%	28%	25%	19%
6	Chlorpyrifos	1%	2%	3%	3%
7	Chloropicrin	2%	-	4%	2%
8	Chlorpyrifos OA	1%	3%	3%	2%
9	EPTC	4%	1%	3%	2%
10	Chlorthal-dimethyl (Dacthal)	-	-	-	1%
11	Diuron	-	3%	-	1%

Conclusions

- **Pesticide detections:** Of the 32 pesticides and 5 breakdown products in 2014 - 23 pesticides were detected in at least one sample. However, AMN results document low air concentrations for the pesticides and communities monitored.

- None of the pesticides exceeded their screening levels for any of the exposure periods, indicating potentially low health risk to people in the monitored communities.

- The pesticides detected at quantifiable concentrations were mostly fumigants (1,3-dichloropropene, carbon disulfide, methyl bromide, Chloropicrin, and MITC) and only one organophosphate pesticide (Chlorpyrifos and its breakdown product, Chlorpyrifos OA). The fumigants and organophosphate pesticide comprise 64 % of detected quantifiable concentrations in 2014.

- The hazard index (combined screening level) for organophosphates was less than one for all exposure periods, indicating a potential low risk from cumulative exposure.

Acknowledgments

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Comments

Please send all comments and suggestions to:

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