Use Information and Air Monitoring Recommendation for the Organophosphate Pesticide Active Ingredients Chlorpyrifos, Diazinon, and Malathion:
Seasonal Ambient Air Monitoring Studies in Kern County, Fresno and Tulare Counties, and Imperial County

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By

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INTRODUCTION

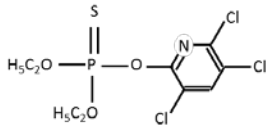
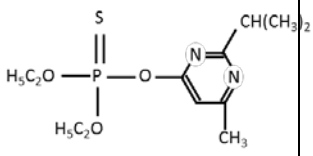
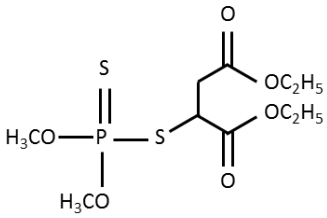
The California Department of Pesticide Regulation (DPR) provides this recommendation to assist the California Air Resources Board (ARB) with the selection of appropriate locations to perform a total of three (3) ambient air monitoring studies for the pesticide active ingredients (AI) chlorpyrifos, diazinon, and malathion in Kern, Fresno and Tulare, and Imperial Counties as part of the proposed monitoring included in the 2016 Budget Act. This recommendation includes the physical-chemical properties and historical use patterns of chlorpyrifos, diazinon, and malathion in the state.

Chlorpyrifos is a clear-to-white crystalline solid insecticide used in agricultural applications for the removal of termites, mosquitos, and roundworms (Christensen *et al.*, 2009). Chlorpyrifos was first registered in the U.S. in 1965 as an organophosphate insecticide that functions by inhibition of signaling through the nervous system (Christensen *et al.*, 2009). Environmental movement is hindered by the low water solubility and high degree of soil adsorption of chlorpyrifos, therefore volatilization is the major route of dispersion of chlorpyrifos after application (ATSDR, 1997).

Diazinon and malathion are both colorless liquids with low vapor pressures (ATSDR 2003; ATSDR 2008). Based on its low vapor pressure, diazinon will likely exist in the vapor and particulate phases in the atmosphere and transport may occur via precipitation, fog, and wind (ATSDR, 2008). Minor volatilization of diazinon has been observed following aerial applications (ATSDR, 2008). The toxicity of diazinon is moderate in comparison to other organophosphates (ATSDR, 2008). Malathion is subject to drift and movement either as a vapor or adsorbed to particulate matter (ATSDR, 2003). Although, some volatilization of malathion from crop surfaces has also been observed, the vapor pressure and Henry's law constant indicate a low potential for this (ATSDR, 2003).

The pesticides chlorpyrifos, diazinon, and malathion are all included in the organophosphate chemical class. Organophosphate pesticides work through the inhibition of the enzyme acetylcholinesterase (AChE) (ATSDR, 2008). This inhibition results in the accumulation of the neurotransmitter acetylcholine at post-synaptic receptors in the peripheral, neuromuscular, and central nervous system (ATSDR, 2008). The key physical and chemical properties of chlorpyrifos, diazinon, and malathion are presented in Table 1.

Table 1 - Physical and chemical properties of chlorpyrifos, diazinon, and malathion

Common Name	Chlorpyrifos	Diazinon	Malathion
Chemical Name	O,O-diethyl O-[3,5,6-trichloro-2-pyridyl] phosphorothioate	O,O-Diethyl O-(2-isopropyl-6-methyl-4-pyrimidinyl) phosphorothioate	Diethyl[(dimethoxyphosphinothioyl)thio]butanedioate
Chemical Formula	$C_9H_{11}Cl_3NO_3PS$	$C_{12}H_{21}N_2O_3PS$	$C_{10}H_{19}O_6PS_2$
Chemical Structure			
Molecular Weight	350.57	304.35	330.36
CAS Number	2921-88-2	333-41-5	000121-75-5
Color	Clear to white	Colorless	Colorless
Physical State	Crystalline solid	Liquid	Liquid
Odor	Mercaptan	Faint ester-like	Mercaptan
Solubility	0.7 mg/L @ 20 °C	40 mg/l @ 20°C	145 mg/l @ 20°C
Log K_{OW}	4.82	3.81	2.36 - 2.89
Log K_{OC}	3.73	1.602 - 2.635	3.25
Vapor Pressure	1.87×10^{-5} mmHg @ 20°C	9.01×10^{-5} mmHg @ 20° C; 1.1×10^{-3} mmHg @ 40° C	5.03×10^{-6} @ 25°C
Henry's Law Constant	1.23×10^{-5} atm*m^3/mol	1.17×10^{-7} atm*m^3/mol	4.9×10^{-9} atm*m^3/mol
Data Source	*ATSDR Toxicological Profiles 1997, 2003, and 2008*		

2 - Use in California

Consideration of Use, by County

Pesticide use information was obtained for the calendar years 2012-2014 from the Pesticide Use Report (PUR) database maintained by DPR. The top five counties for each AI (chlorpyrifos, diazinon, and malathion) are shown in Figure 1 and the reported use rankings are presented in Table 2. Due to the higher amounts of chlorpyrifos used, in terms of pounds of AI; chlorpyrifos is the dominant factor in the determination of top overall counties.

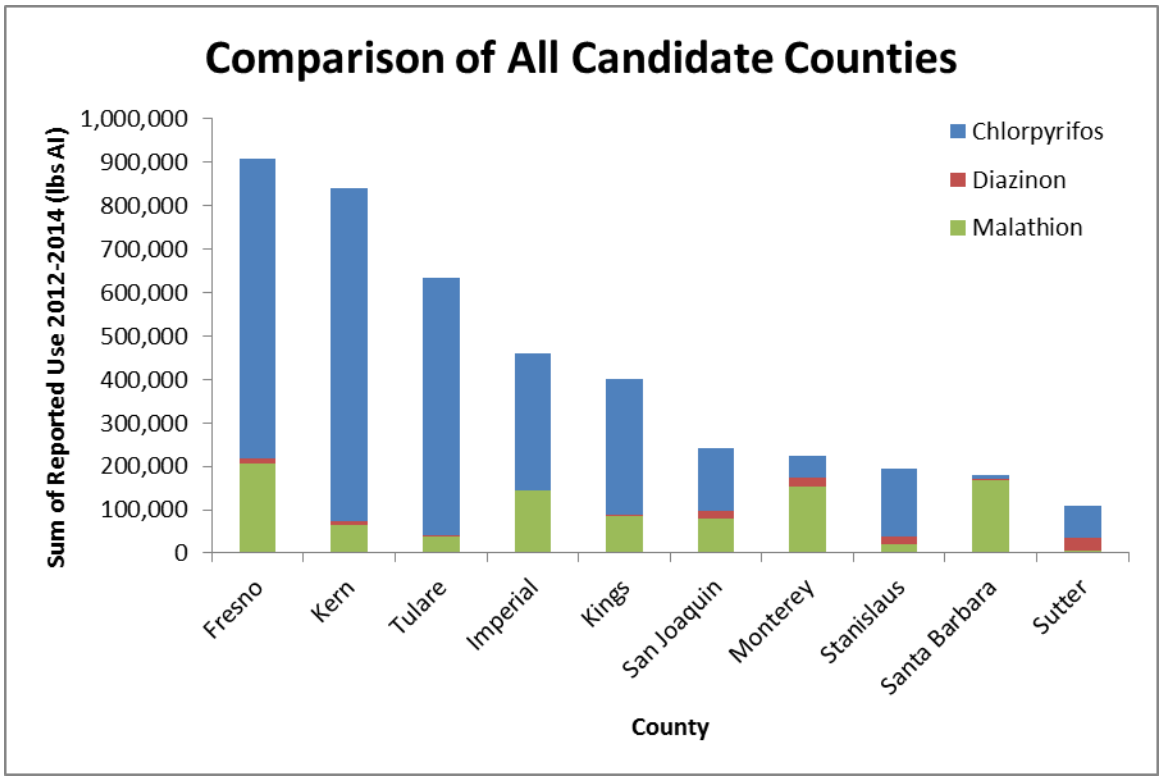


Figure 1 - Comparison of candidate counties.

Table 2 - Ranking of counties by reported use of individual and summed AI's[1]

	Chlorpyrifos		Diazinon		Malathion		Total	
Rank	**County**	**lbs AI**	**County**	**lbs AI**	**County**	**lbs AI**	**County**	**lbs AI**
1	Kern	764,700	Sutter	29,400	Fresno	205,500	Fresno	907,000
2	Fresno	687,600	Monterey	18,700	Santa Barbara	167,500	Kern	838,800
3	Tulare	593,300	Stanislaus	18,000	Monterey	154,100	Tulare	633,700
4	Imperial	313,300	San Joaquin	15,900	Imperial	143,200	Imperial	458,900
5	Kings	313,000	Colusa	14,100	Kings	86,500	Kings	400,700

[1]Numbers are rounded to hundreds

PUR database provides location information as a one square mile section defined by the Public Land Survey System (PLSS). Figure 2 shows combined 2012-2014 use of chlorpyrifos, diazinon, and malathion in California on a township level (6x6 mile area; 36 mi^2). Additionally, Figures 6 - 8 provide a view of the spatial use patterns at the section level of resolution for the area of reported use in each of the areas of interest.

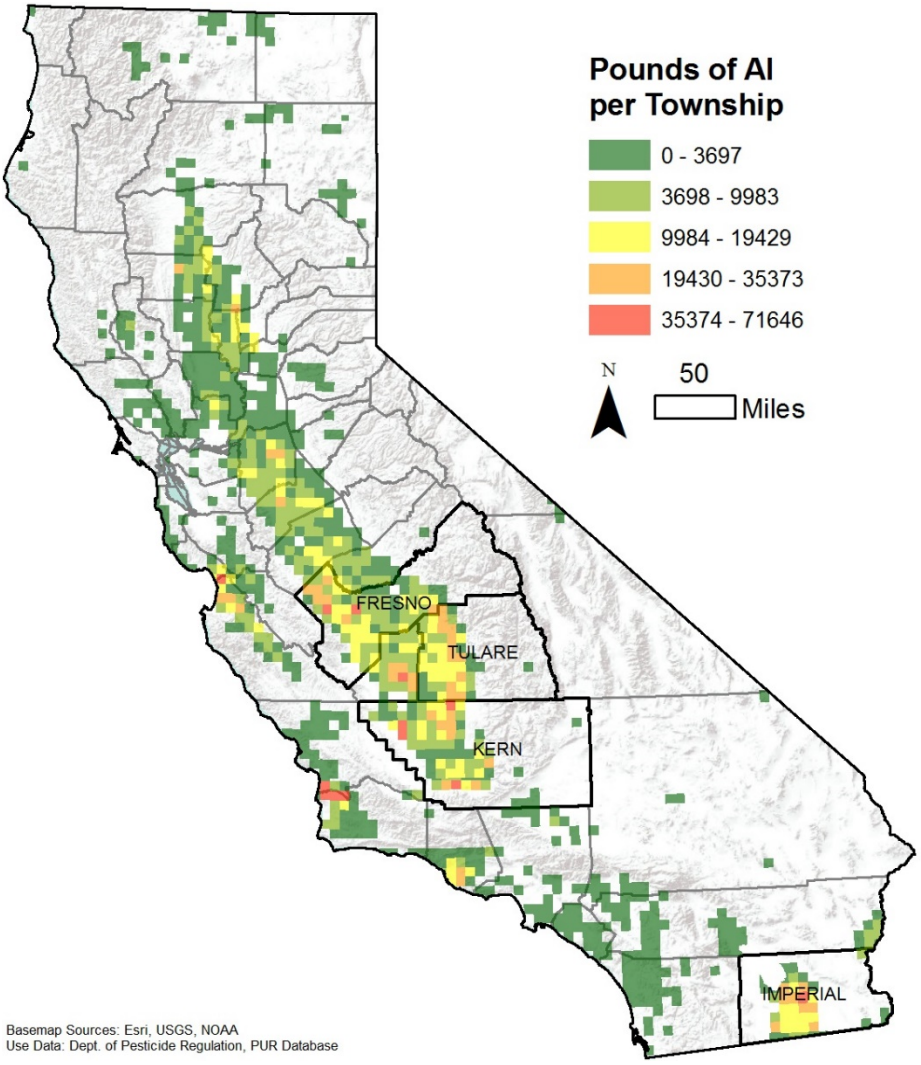


Figure 2 – Combined 2012-2014 reported use of chlorpyrifos, diazinon, and malathion by township.

Seasonal Use in Top Counties

Temporal use patterns were analyzed for counties with highest use by using the same data obtained from the PUR. The top 4 counties in terms of total reported use of the three organophosphate AI's considered are presented together in Figure 3. The monthly use information is detailed in Table 3 and Table 4.

Table 3 – Reported use in Imperial and Fresno Counties separated by month and by AI (2012-2014)[1]

	Imperial				Fresno			
	Chlorpyrifos	Diazinon	Malathion	**Total**	Chlorpyrifos	Diazinon	Malathion	**Total**
Jan	39,600	0	9,800	**49,400**	19,000	2,200	200	**21,400**
Feb	52,600	0	38,100	**90,600**	26,300	1,400	5,700	**33,500**
Mar	32,400	100	45,600	**78,100**	38,200	1,200	30,100	**69,500**
Apr	19,200	0	19,700	**38,800**	15,700	1,300	24,100	**41,200**
May	3,500	0	3,400	**6,900**	45,400	1,400	64,700	**111,500**
Jun	4,100	0	200	**4,300**	62,200	300	9,400	**71,900**
Jul	9,100	0	6,200	**15,200**	192,900	200	40,500	**233,700**
Aug	4,900	0	2,600	**7,500**	191,200	1,100	11,600	**203,800**
Sep	28,500	300	1,500	**30,300**	68,900	1,500	4,800	**75,200**
Oct	77,600	1,100	3,900	**82,600**	17,400	1,200	12,600	**31,200**
Nov	19,000	800	6,300	**26,100**	5,300	1,300	1,000	**7,600**
Dec	23,000	100	6,100	**29,100**	4,900	700	1,000	**6,600**

[1]Numbers are rounded to hundreds

Table 4 – Reported Use in Kern and Tulare Counties separated by month and by AI (2012-2014)[1]

	Kern				Tulare			
	Chlorpyrifos	Diazinon	Malathion	**Total**	Chlorpyrifos	Diazinon	Malathion	**Total**
Jan	94,800	300	0	**95,100**	10,000	0	200	**10,300**
Feb	53,400	1,300	0	**54,700**	20,900	500	1,600	**22,900**
Mar	108,100	100	300	**108,500**	53,900	0	1,400	**55,300**
Apr	105,800	100	18,500	**124,500**	28,900	100	3,800	**32,900**
May	140,800	1,000	23,800	**165,700**	83,800	0	12,600	**96,400**
Jun	23,000	400	10,000	**33,400**	93,500	200	6,000	**99,700**
Jul	67,100	200	5,300	**72,700**	143,100	0	3,200	**146,200**
Aug	59,200	0	800	**60,000**	89,600	0	3,700	**93,200**
Sep	60,900	2,800	1,500	**65,200**	33,700	0	1,600	**35,400**
Oct	20,200	1,300	3,100	**24,600**	27,800	0	3,300	**31,100**
Nov	5,500	1,300	900	**7,700**	7,400	0	1,900	**9,300**
Dec	25,900	900	0	**26,900**	800	0	200	**1,000**

[1]Numbers are rounded to hundreds

The three highest months of summed use in any county occur consecutively in Fresno County during July through September. The second highest peak use is that of Kern County, which is closely followed by that of Tulare County. The peak occurring in Kern County occurs in May, is led by a high use month in April, and use falls off rapidly in June. The peak occurring in Tulare County occurs in July and among adjacent months June has slightly higher use than August. Imperial County has two peaks, the higher of which occurs in February and is followed by high use in March. The smaller peak in October is not preceded nor followed by a month of high use.

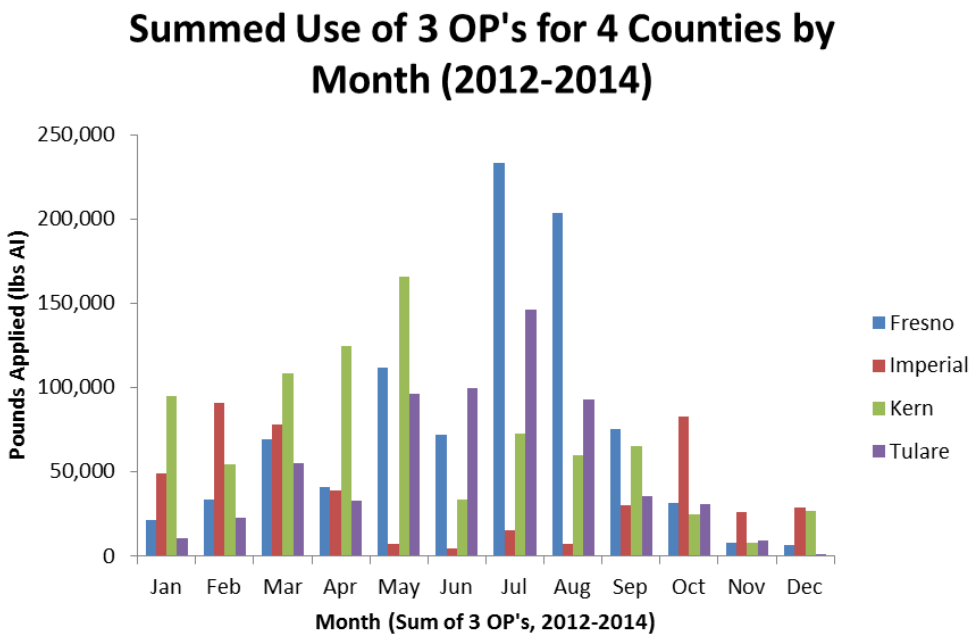


Figure 3 - Comparison of combined use in top counties, by month

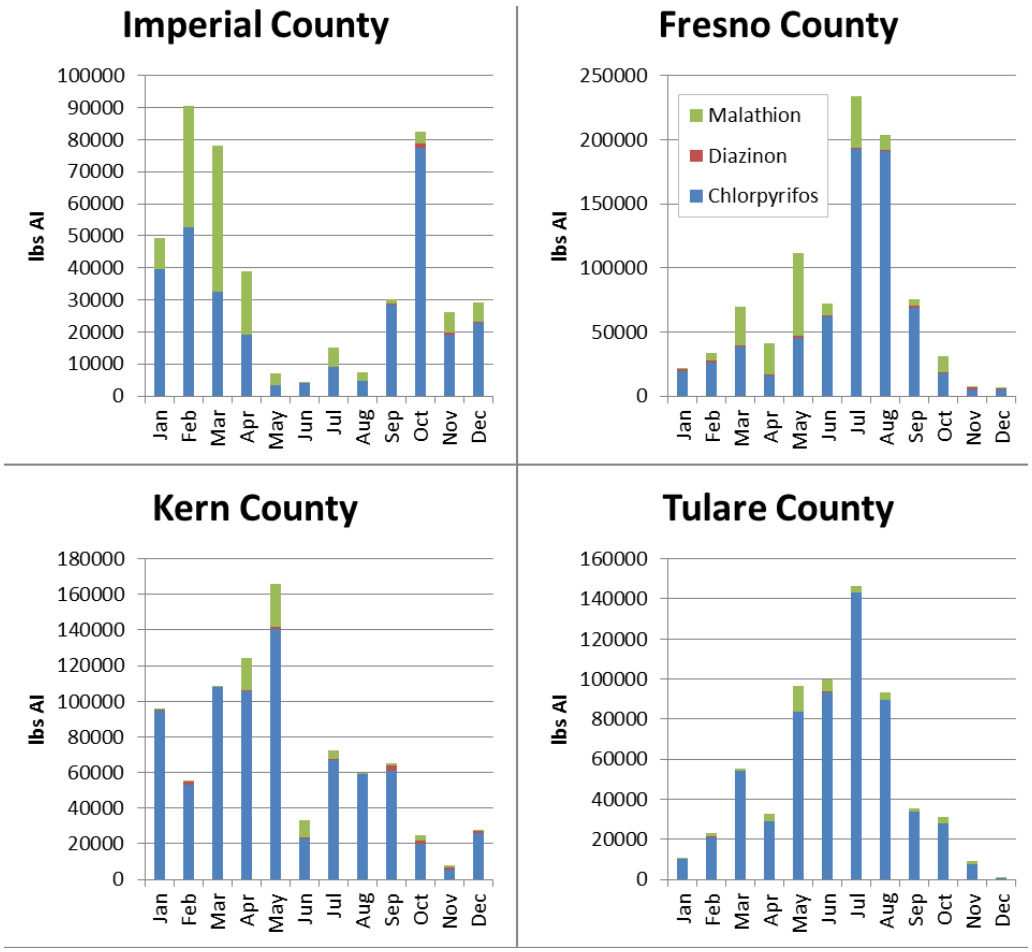


Figure 4 - Use in Imperial, Fresno, Kern, and Tulare Counties by month and by AI (2012-2014)

Peak Use by Week during Peak Use Seasons

The timing of sampling will ideally be set to coincide with the periods of peak seasonal use as seen in Figure 4. For this reason, reported use has been separated into the sum of use in each week during the 20 consecutive week of highest use. A 12-week period has been isolated which will bracket the highest summed use in each county. This finer temporal resolution is been depicted in Figure 5. The data is then presented in detail in Tables 5-7, with the ideal weeks for sampling in bold text and shaded in green.

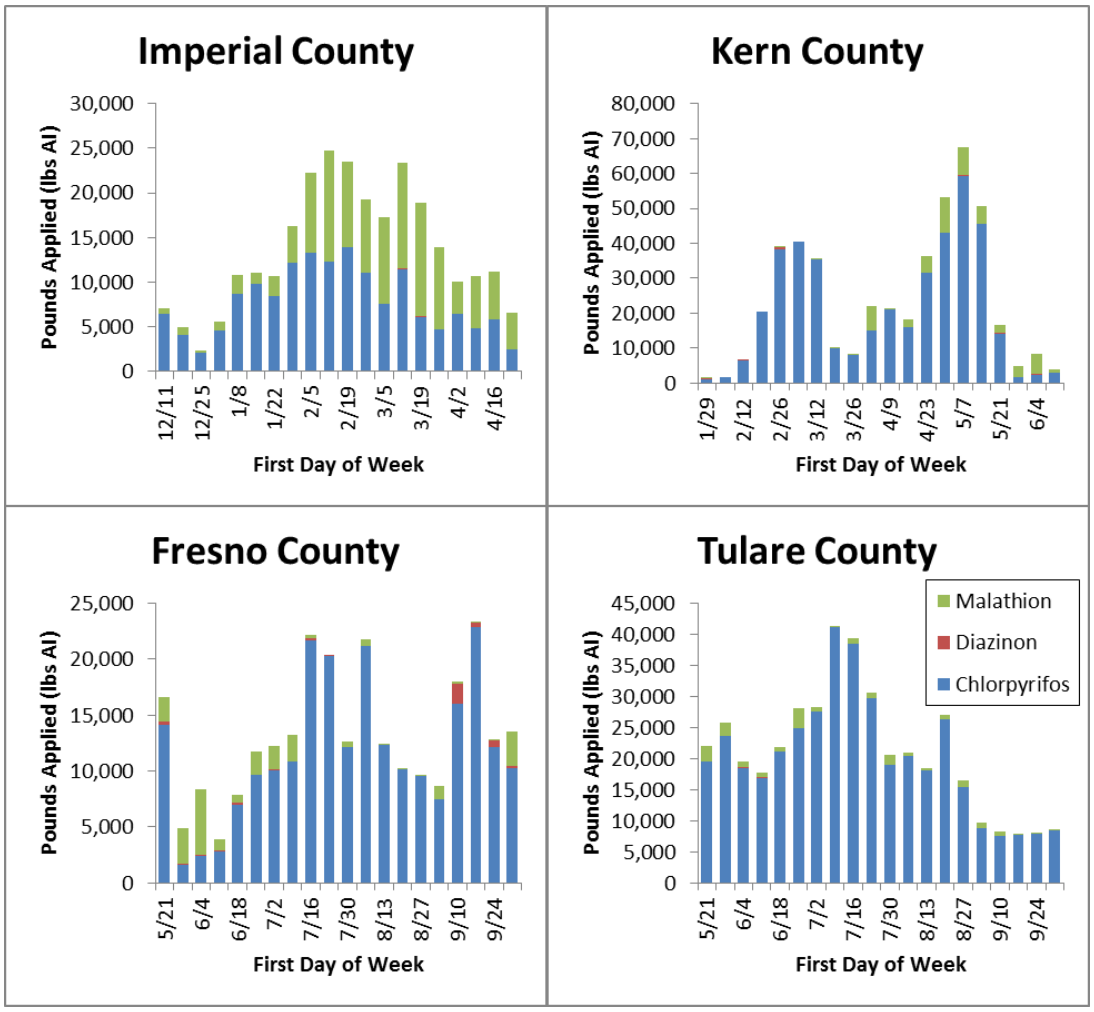


Figure 5 – Use in each county detailed by week during 12 sequential weeks of highest use (as well as preceding and following 4 week periods) in that county (2012-2014 sum)

Table 5 - Reported use by week in Imperial County (2012-2104)[1]

	Reported Use (as lbs AI)			
Week	**Chlorpyrifos**	**Diazinon**	**Malathion**	**Total**
12/11	6,500	0	700	7,100
12/18	4,100	0	900	5,000
12/25	2,100	0	100	2,300
1/1	4,600	0	1,100	5,600
1/8	**8,700**	**0**	**2,100**	**10,800**
1/15	**9,700**	**0**	**1,300**	**11,000**
1/22	**8,500**	**0**	**2,200**	**10,600**
1/29	**12,200**	**0**	**4,200**	**16,300**
2/5	**13,300**	**0**	**8,900**	**22,200**
2/12	**12,300**	**0**	**12,400**	**24,700**
2/19	**13,900**	**0**	**9,600**	**23,400**
2/26	**11,100**	**0**	**8,200**	**19,300**
3/5	**7,500**	**0**	**9,700**	**17,200**
3/12	**11,500**	**0**	**11,900**	**23,400**
3/19	**6,100**	**0**	**12,800**	**18,900**
3/26	**4,700**	**0**	**9,300**	**13,900**
4/2	6,400	0	3,700	10,000
4/9	4,800	0	5,900	10,700
4/16	5,800	0	5,400	11,200
4/23	2,500	0	4,100	6,500

[1]Numbers are rounded to hundreds

Table 6 - Reported use by week in Kern County (2012-2014)[1]

	Reported Use (as lbs AI)			
Week	**Chlorpyrifos**	**Diazinon**	**Malathion**	**Total**
1/29	900	300	0	1,300
2/5	1,800	0	0	1,800
2/12	6,400	500	0	6,900
2/19	20,300	0	0	20,300
2/26	**38,200**	**800**	**100**	**39,100**
3/5	**40,400**	**0**	**0**	**40,400**
3/12	**35,400**	**0**	**0**	**35,400**
3/19	**9,800**	**0**	**200**	**10,000**
3/26	**8,100**	**0**	**100**	**8,200**
4/2	**15,000**	**100**	**7,000**	**22,200**
4/9	**21,100**	**0**	**300**	**21,400**
4/16	**16,100**	**0**	**2,100**	**18,200**
4/23	**31,600**	**0**	**4,700**	**36,300**
4/30	**43,100**	**0**	**10,200**	**53,300**
5/7	**59,200**	**400**	**8,000**	**67,700**
5/14	**45,600**	**100**	**5,000**	**50,600**
5/21	14,100	300	2,100	16,600
5/28	1,600	200	3,200	4,900
6/4	2,400	100	5,800	8,400
6/11	2,800	100	1,000	3,900

[1]Numbers are rounded to hundreds

Table 7 - Reported use by week in Fresno and Tulare Counties combined (2012-2014)[1]

	Reported Use (as lbs AI)			
Week	**Chlorpyrifos**	**Diazinon**	**Malathion**	**Total**
5/21	25,300	100	4,900	30,400
5/28	26,900	300	4,300	31,500
6/4	24,100	200	2,200	26,600
6/11	31,300	100	3,800	35,100
6/18	**33,000**	**100**	**1,300**	**34,400**
6/25	**50,300**	**0**	**6,600**	**57,000**
7/2	**50,000**	**100**	**7,500**	**57,600**
7/9	**84,100**	**200**	**8,200**	**92,400**
7/16	**90,600**	**0**	**14,400**	**105,000**
7/23	**80,900**	**0**	**10,400**	**91,300**
7/30	**78,300**	**200**	**8,700**	**87,200**
8/6	**58,200**	**200**	**2,600**	**60,900**
8/13	**65,600**	**200**	**2,300**	**68,100**
8/20	**64,600**	**400**	**3,300**	**68,300**
8/27	**53,500**	**0**	**2,800**	**56,400**
9/3	**37,200**	**300**	**1,900**	**39,400**
9/10	27,900	600	1,500	30,100
9/17	18,100	600	0	18,800
9/24	15,100	0	2,600	17,700
10/1	14,700	400	12,400	27,500

[1]Numbers are rounded to hundreds

RECOMMENDATIONS

Ambient Air Monitoring

DPR is most interested in considering monitoring in those counties where use for chlorpyrifos, diazinon, and malathion is the highest: Kern, Fresno, Tulare, and Imperial Counties. Therefore, DPR requests that ARB conduct three (3) seasonal ambient monitoring studies for chlorpyrifos, diazinon, and malathion in 6-8 locations per study within Kern, Fresno and Tulare, and Imperial Counties near areas of high use, as well as in one background site located away from areas of use.

DPR recommends that monitoring sites be located on schools or other public properties, near the edge of the community and downwind of high use areas (Figures 6 - 8). Monitoring should be conducted over a 12-week period for each ambient monitoring study as shown in Table 11. At each sampling site, DPR recommends collecting four 24-hour samples per week in sequence during each week of the 12-week sampling period. The four-day sampling period should begin each week on a randomly chosen day over the full seven-day week, including weekends. In addition to the primary samples, replicate (co-located) samples are needed for at least 10% of the total number of samples collected during the 12-week period. Field spike samples should be collected under the same environmental conditions (e.g., temperature, humidity, exposure to sunlight) and monitoring study conditions (e.g., air flow rates, sample transportation and storage) as those occurring at the time of ambient air sampling. Field blanks should also be collected. DPR recommends the following target 24-hour quantitation limits for chlorpyrifos, diazinon, and malathion to be between 13 – 40 ng/m^3.

DPR requests that ARB provide the following in its ambient air monitoring report submitted to DPR:

1. Location of each sampler (if at a school, location of sampler within school grounds);
2. Sampling height and any information relevant to the study (presence of trees, buildings, particular industrial or commercial facilities and activities);
3. Proximity of the sampler to treated or potentially treated fields, including distance and direction;
4. Latitude and longitude coordinates for sampling sites, including the Datum used (e.g., NAD 27 or NAD 83); and
5. A map of the monitoring site locations and photographs of sample locations.

Suggested Communities for Air Monitoring

DPR evaluated 1,267 communities for chlorpyrifos, diazinon, and malathion use. The communities included all cities and census designated places (CDPs) in California, except those within the urban counties of Los Angeles, Orange, San Diego, and San Francisco (Andrews and Verder-Carlos, 2014).

DPR evaluated and rated each of the 1,267 California communities using the average of the following criteria:

a) Regional use density (lbs of AI used) during 2012-2014 (between 1 and 5 miles outside community boundary)
b) Local use density during 2012-2014 (within 1 mile outside community boundary)
c) Community use density during 2012-2014 (within the community boundary)

Ratings were given to the communities according to the statewide rankings of the 1,267 communities evaluated. Tables 8 - 10 summarize the results of the evaluation of pesticide use and the Office of Environmental Health Hazards Assessment's (OEHHA) CalEnviroScreen 2.0 (CES 2.0) Population Characteristics percentile for those communities. For any California census tract, the CES 2.0 Population Characteristics percentile factors the following parameters: percent of children and elderly in the population, percent of low birth-weight births, and the rates of asthma emergency department visits, educational attainment, linguistic isolation, poverty, and unemployment (OEHHA, 2014).

Ambient Air Monitoring Organophosphate Study #1: Kern County

The region recommended for the first seasonal organophosphate ambient air monitoring is Kern County. Kern County ranked as the highest use county for the combined use of chlorpyrifos, diazinon, and malathion. Figure 6 shows the use and locations of the communities surrounded by the highest summed use of these organophosphates relative to a section level resolution depiction of use during 2012-2014 in Kern County.

Ratings were given to the communities according to the statewide rankings of the 1,267 communities evaluated. Table 8 summarizes the results of the reported pesticide use and the CES 2.0 Population Characteristics percentiles for communities within Kern County. The highest use of chlorpyrifos, diazinon, and malathion in Kern County from 2012 to 2014 occurred in the

cities of Lost Hills, Mettler, Shafter, Delano, and Arvin. Bakersfield, Delano, and Fuller acres had the highest CES 2.0 Population Characteristics percentiles among the communities in Kern County. DPR recommends ARB select communities where there is high use of all three organophosphates, guided by the community ratings from Table 8 and where the CES 2.0 Population Characteristics percentiles are the highest. Special consideration should be given to the communities of Lost Hills, Mettler, Shafter, Delano, and Arvin.

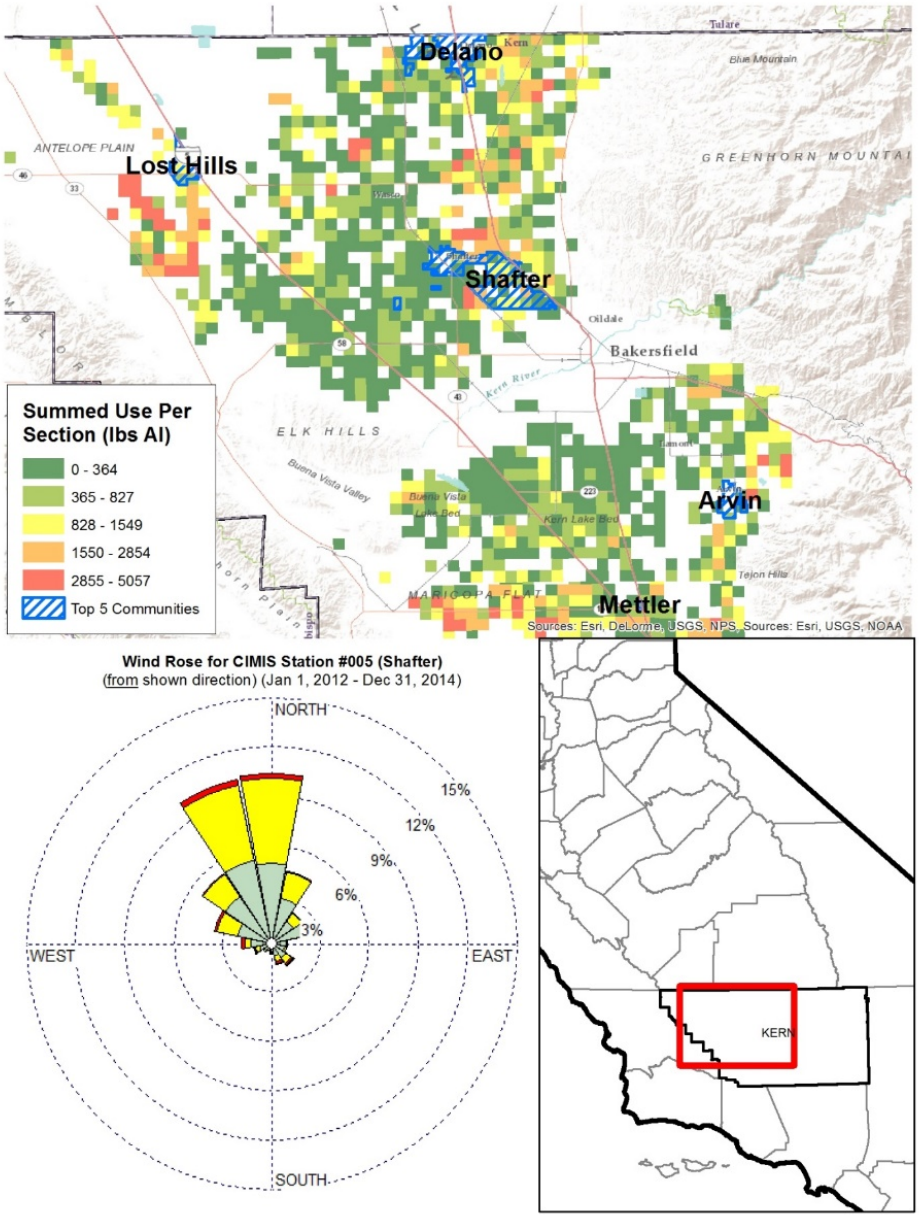


Figure 6 - Use by section around top 5 reported use communities by use in Kern County

Table 8 – Organophosphate reported use and environmental justice factor rankings for communities in Kern County during 2012-2014.

	Reported Organophosphate Use		CES 2.0 Population Characteristics	
Community Name	**Statewide Rank[1]**	**County Rank[2]**	**Percentile**	**Rank[3]**
Lost Hills	8	1	78	18
Mettler	25	2	79	16
Shafter	32	3	85	13
Delano	60	4	99	2
Arvin	66	5	93	4
Smith Corner	75	6	75	19
Cherokee Strip	77	7	50	26
Wasco	82	8	93	4
Rosedale	91	9	12	36
McFarland	102	10	89	8
Edmundson Acres	108	11	83	15
Buttonwillow	117	12	69	20
Fuller Acres	119	13	97	3
Mexican Colony	123	14	79	16
Bakersfield	222	15	100	1
Lamont	237	16	92	6
Weedpatch	250	17	92	6
Greenfield	260	18	86	12
Dustin Acres	322	19	37	31
Taft	322	19	87	10
Tupman	346	21	37	31
Bear Valley	357	22	34	34
Greenacres	428	23	29	35
Valley Acres	460	24	37	31
South Taft	466	25	61	24
Maricopa	473	26	50	26
Oildale	491	27	84	14
Ford City	553	28	87	10
Mojave	588	29	89	8
Keene	589	30	64	23
Golden Hills	606	31	45	28
Taft Heights	614	32	61	24
Tehachapi	664	33	65	22
China Lake Acres	804	34	38	29
Inyokern	808	35	38	29
Ridgecrest	811	36	69	20

[1] Community pesticide reported use ranking is out of possible 1,267 California communities evaluated.
[2] Community rankings based on reported use in Kern County, with lower numbers indicate higher nearby pesticide use.
[3] Rankings for the top organophosphate reported use communities in Kern County, with lower numbers indicating higher environmental justice priority.

Ambient Air Monitoring Organophosphate Study #2: Fresno & Tulare Counties

The counties of Fresno and Tulare ranked 1st and 3rd, respectively, in total use of combined pounds of chlorpyrifos, diazinon, and malathion among all California counties for the 2012-2014 calendar years. Figure 7 shows the use and locations of the communities surrounded by the highest summed use of these organophosphates relative to a section level resolution depiction of use during 2012-2014 in Fresno and Tulare counties. These two counties were grouped into one study to optimize use of logistical resources during simultaneous peak periods of use.

DPR recommends ARB select communities where there is high use of all three organophosphates, guided by the community rating from Table 9 and where the CES 2.0 Population Characteristics percentiles are the highest. Special consideration should be given to the communities of San Joaquin, Tranquility, Richgrove, and Lindsey. Multiple sampling locations can be placed within a single community.

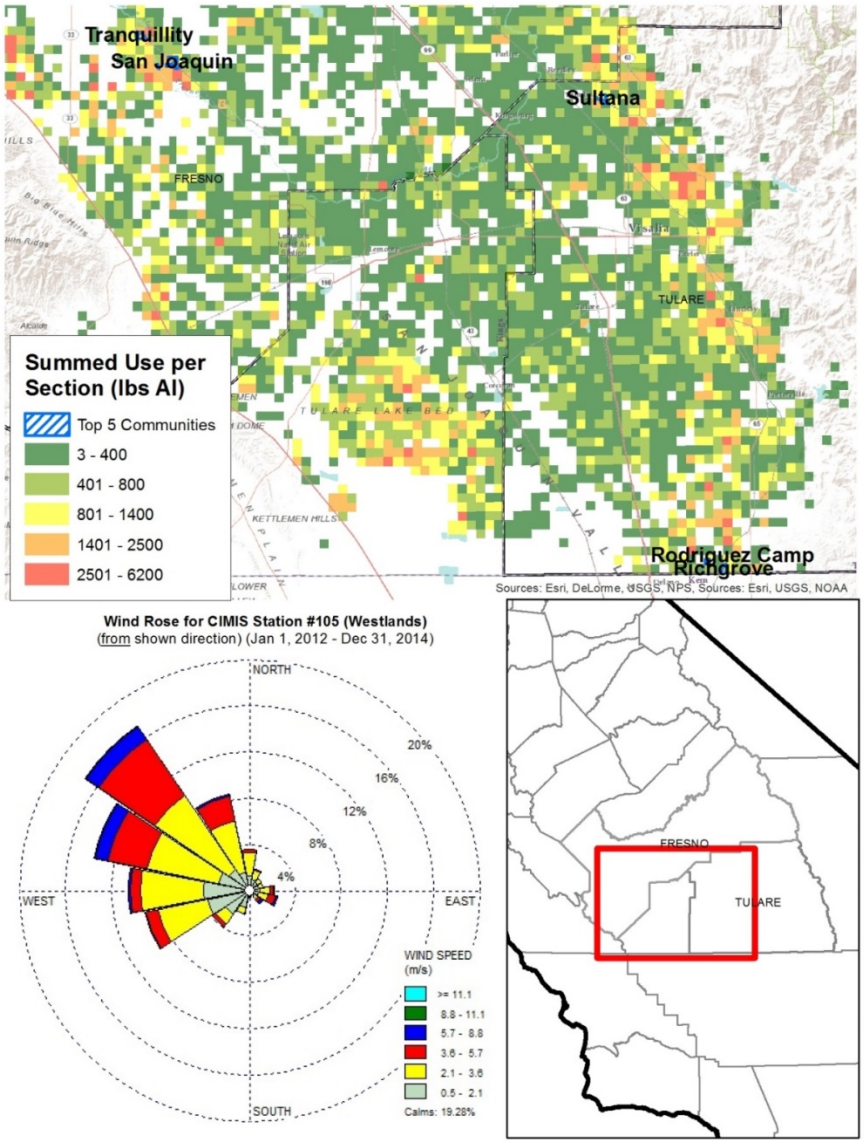


Figure 7 – Reported organophosphate use by section around top 5 communities in Fresno and Tulare Counties

Table 9 - Organophosphate reported use and environmental justice factor rankings for communities in Fresno and Tulare Counties during 2012-2014.

	Reported Organophosphate Use		CES 2.0 Population Characteristics		
Community Name	**Statewide Rank[1]**	**Regional Rank[2]**	**Percentile**	**Rank[3]**	**County**
San Joaquin	3	1	82	60	Fresno
Tranquility	6	2	82	60	Fresno
Richgrove	7	3	96	21	Tulare
Rodriguez	9	4	96	21	Tulare
Sultana	11	5	67	75	Tulare
Ivanhoe	13	6	80	63	Tulare
Lindsay	14	7	93	29	Tulare
Orange Cove	15	8	99	3	Fresno
Cutler	16	9	89	44	Tulare
Cantua Creek	17	10	82	60	Fresno

[1] Community pesticide reported use ranking is out of possible 1,267 California communities evaluated.
[2] Community rankings based on reported use in Fresno and Tulare Counties, with lower numbers indicate higher nearby pesticide use.
[3] Rankings for the top organophosphate reported use communities in Fresno and Tulare Counties, with lower numbers indicating higher environmental justice priority.

Ambient Air Monitoring Organophosphate Study #3: Imperial County

Imperial County ranked 4th in total use of combined pounds of chlorpyrifos, diazinon, and malathion among all California counties for the 2012-2014 calendar years. Figure 8 shows the use and locations of the communities surrounded by the highest summed use of these organophosphates relative to a section level resolution depiction of use during 2012-2014 in Imperial County.

DPR recommends ARB select communities where there is high use of all three organophosphates, guided by the community rating from Table 10 and where the CES 2.0 Population Characteristics percentiles are the highest. Special consideration should be given to the communities of Seeley, Westmorland, Imperial, Brawley, Heber, and El Centro. DPR recognizes that locations for siting of monitoring stations may be limited but would request at least four locations are selected for monitoring.

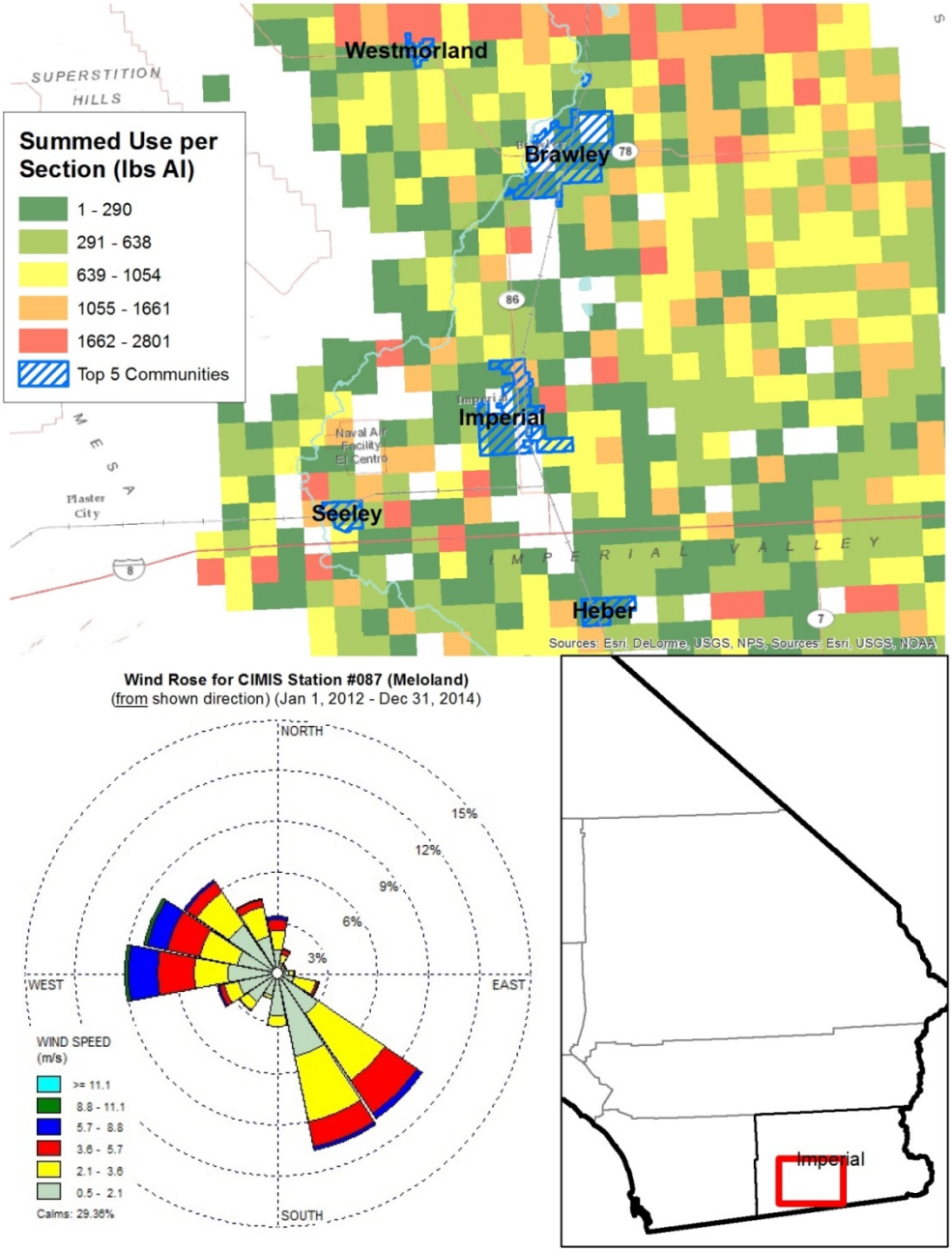


Figure 8 - Use by section around top 5 reported use communities by use in Imperial County

Table 10 - Organophosphate reported use and environmental justice factor rankings for communities in Imperial County during 2012-2014.

	Reported Organophosphate Use		CES 2.0 Population Characteristics	
Community Name	**Statewide Rank[1]**	**County Rank[2]**	**Percentile**	**Rank[2]**
Seeley	4	1	83	13
Westmorland	10	2	98	2
Imperial	20	3	61	14
Brawley	38	4	96	5
Heber	58	5	92	10
El Centro	59	6	99	1
Holtville	89	7	98	2
Calipatria	122	8	92	10
Palo Verde	139	9	96	5
Calexico	158	10	97	4
Niland	302	11	92	10
Desert Shores	527	12	94	8
Salton Sea Beach	617	13	94	8
Winterhaven	625	14	96	5

[1] Community pesticide reported use ranking is out of possible 1,267 California communities evaluated.
[2] Community rankings based on reported use in Imperial County, with lower numbers indicate higher nearby pesticide use.
[3] Rankings for the top organophosphate reported use communities in Imperial County, with lower numbers indicating higher environmental justice priority.

Ambient Air Monitoring Recommended Periods

Based on consideration of the combination of use patterns of each AI described in the previous section and environmental justice considerations, as follows, DPR is recommending ambient monitoring in the following locations and dates:

Table 11- Recommended monitoring periods for each selected region

Seasonal Monitoring Study #	Location	Recommended Monitoring Period
1	Imperial County	January 8th – April 1st
2	Fresno & Tulare counties	June 18th – September 9th
3	Kern County	February 26th – May 20th

References

Andrews, C., Verder-Carlos, M. 2014. Recommended Air Monitoring for 2014. Memorandum dated February 18, 2014 to Chris Reardon. California Environmental Protection Agency, Department of Pesticide Regulation, Sacramento, CA. Available at: http://www.cdpr.ca.gov/docs/emon/airinit/amn_plan2014.pdf. Accessed 31 August, 2016.

ATSDR. 1997. Toxicological Profile For Chlorpyrifos. Agency For Toxic Substances And Disease Registry, Atlanta, GA. Available at: http://www.atsdr.cdc.gov/ToxProfiles/tp84.pdf. Accessed 7 July, 2016

ATSDR. 2008. Toxicological Profile For Diazinon. Agency For Toxic Substances And Disease Registry, Atlanta, GA. Available at: http://www.atsdr.cdc.gov/toxprofiles/tp86.pdf. Accessed 27 July, 2016

ATSDR. 2003. Toxicological Profile For Malathion. Agency For Toxic Substances And Disease Registry, Atlanta, GA. Available at: http://www.atsdr.cdc.gov/toxprofiles/tp154.pdf. Accessed 7 July, 2016.

CDPR. 2016. Pesticide Use Report database. California Environmental Protection Agency, Department of Pesticide Regulation, Sacramento, CA.

Christensen, K.; Harper, B.; Luukinen, B.; Buhl, K.; Stone, D. 2009. Chlorpyrifos General Fact Sheet; National Pesticide Information Center, Oregon State University Extension Services. Available at: http://npic.orst.edu/factsheets/chlorpgen.html. Accessed 30 August, 2016.

OEHHA (2014). California Communities Environmental Health Screening Tool, Version 2.0 (CalEnviroScreen 2.0). Guidance and Screening Tool. California Environmental Protection Agency, Office of Environmental Health Hazard Assessment, Sacramento California. http://oehha.ca.gov/media/CES20FinalReportUpdateOct2014.pdf