Study 228: Monitoring the Concentrations of Detected Pesticides in Wells Located in Highly Sensitive Areas (Well Network Sampling) Annual Update 2020

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Introduction:

This update summarizes the annual results of pesticide concentrations detected in a network of domestic wells monitored for more than 20 years in California's San Joaquin Valley. Due to the COVID-19 pandemic in 2020, the California Department of Pesticide Regulation (DPR) had to reduce chemical analyses and alter the sampling schedule. The impact resulted in staff sampling all 59 wells for herbicides using the Triazine Screen, and only seven wells for pesticides on the Multi-Analyte Screen. Additionally, plans to sample for other pesticides that have the potential to contaminate groundwater were postponed until a future season.

In 1999, DPR initiated the Well Network Study to monitor potential changes in groundwater pesticide concentrations due to new regulations with enforceable management practices designed to minimize pesticide movement to groundwater (Garretson, 1999). When this study was initiated, the selected wells had already been sampled by DPR and had residues of simazine, bromacil, or diuron. The wells in this network continued to be sampled for triazine pesticides at least annually through 2020.

The Well Network is located in areas susceptible to pesticide movement to groundwater within Fresno and Tulare Counties. Areas vulnerable to groundwater contamination from the agricultural use of pesticides are typified by either sections with coarse soils that are vulnerable to pesticides leaching through the soil into groundwater, or by sections containing hardpan soils vulnerable to pesticide runoff into sensitive areas with conduits to groundwater. Due to the vulnerability of the study area, this study has also served as an experimental area to sample for additional pesticides that have the potential to contaminate groundwater.

A statistical analysis of data collected from 2000–2012 is reported in Troiano et al. (2013), along with a full description of this study, including characterization of the conditions of the vulnerable areas, pesticide use, and the required mitigation measures. Updates of the study results have been reported annually since 2008.

Study Area:
Fresno and Tulare Counties

Most Recent Sampling Period:
5/4/20 – 8/31/20

Number of Wells Sampled:
Fifty-nine wells were sampled for the Triazine Screen, and seven of those wells were also sampled for the Multi-Analyte Screen.

Sampling and Analytical Methods:
Well sampling was conducted according to SOP FSWA001.03 (Kocis, 2020a). The California Department of Food and Agriculture, Center for Analytical Chemistry, analyzed all well samples using the Triazine Screen analytical method EM 62.9 (CDFA, 2020) and seven well samples with the Multi-Analyte Screen analytical method EMON-SM-05-032 (CDFA, 2013). Both methods are highly specific and have been determined by DPR to qualify for unequivocal detection designation (Aggarwal, 2020; 2016). The reporting limit for each analyte was 0.05 ppb (µg/L) (Tables 1, 2, and 3). The Triazine Screen includes 11 analytes by Liquid Chromatography Mass Spectrometry (LCMS) (Table 1) and the Multi-Analyte Screen includes nine analytes by Gas Chromatography Mass Spectrometry (GCMS) and 25 analytes by LCMS (Tables 2 and 3).

Table 1. Triazine Screen method detection limits (MDL) and reporting limits (RL) in ppb (µg/L).

Analyte	MDL	RL
ACET	0.00580	0.05
Atrazine	0.00316	0.05
Bromacil	0.00241	0.05
DACT	0.00235	0.05
DEA	0.00226	0.05
Diuron	0.00241	0.05
DSMN	0.00181	0.05
Hexazinone	0.00197	0.05
Norflurazon	0.00252	0.05
Prometon	0.00240	0.05
Simazine	0.00286	0.05

Table 2. Multi-Analyte Screen (GCMS) method detection limits (MDL) and reporting limits (RL) in ppb (µg/L).

Analyte	MDL	RL
Clomazone	0.0168	0.05
Dichloran	0.0235	0.05
Dichlobenil	0.4059	0.05
Ethoprophos	0.0178	0.05
Malathion	0.0272	0.05
Phorate	0.0168	0.05
Prometryn	0.0204	0.05
Propanil	0.0217	0.05
Triallate	0.0147	0.05

Table 3. Multi-Analyte Screen (LCMS) method detection limits (MDL) and reporting limits (RL) in ppb (µg/L).

Analyte	MDL	RL
Atrazine	0.0152	0.05
Azoxystrobin	0.0111	0.05
Bensulide	0.0392	0.05
Bromacil	0.0120	0.05
Carbaryl	0.0254	0.05
Diazinon	0.0493	0.05
Dimethenamide	0.0207	0.05
Dimethoate	0.0150	0.05
Diuron	0.0111	0.05
Ethofumesate	0.0180	0.05
Fludioxonil	0.0117	0.05
Imidacloprid	0.0118	0.05
Linuron	0.0134	0.05
Mefenoxam/ Metalaxyl*	0.0199	0.05
Methiocarb	0.0146	0.05
Metolachlor	0.0166	0.05
Metribuzin	0.0117	0.05
Napropamide	0.0174	0.05
Norflurazon	0.0112	0.05
Oryzalin	0.0128	0.05
Prometon	0.0130	0.05
Simazine	0.0141	0.05
Tebuthiuron	0.0141	0.05
Thiamethoxam	0.0086	0.05
Thiobencarb	0.0169	0.05

*Mefenoxam and metalaxyl are stereoisomers and cannot be analytically distinguished

Results for Annual Triazine Screen and Multi-Analyte Screen Monitoring:

Sample results for 2020

The Well Network monitoring results for the Triazine Screen analytes are shown in Table 4. Table 5 includes the concentrations for all detected pesticides from the Multi-Analyte Screen and for the analytes that are on both screens. Due to the 2020 COVID-19 pandemic and the resulting reduced lab capacity, only wells with recent Multi-Analyte Screen detections were selected to be sampled for this screen. All wells that had detections above the reporting limit in 2019 on the Multi-Analyte Screen were resampled. For this screen, imidacloprid and fludioxonil were detected (Table 8). Both of these analytes are currently being investigated further by DPR (Aggarwal, 2019; Kocis, 2020b). The analytes not detected in samples analyzed with this screen are listed in the footnotes below Table 5. This year's data have been entered into DPR's Well Inventory Database (CDPR, 2021).

Results from previous years

Summaries of previous years' results are presented in Tables 6 to 8. Tables 6 and 7 present Triazine Screen results from 1999 through 2020, including the percent of wells with positive detections above the reporting limit (RL) and the means of those detections. Table 8 presents an overview of the Multi-Analyte Screen detections from 2014 through 2020 (not including analytes reported on the Triazine Screen).

Table 4. Triazine Screen sampling results from 2020. Concentrations in ppb (µg/L).

Well Number**	ACET	Atrazine	Bromacil	DACT	DEA	Diuron	DSMN	Hexazinone	Norflurazon	Prometon	Simazine	Propazine* Recovery (%)
1	T	nd	nd	T	T	T	T	T	T	T	T	79.0
2	T	nd	nd	T	nd	nd	T	nd	nd	nd	T	93.5
3	T	nd	nd	T	nd	nd	0.080	nd	nd	nd	0.060	87.0
4	0.265	T	10.30	1.250	T	T	0.296	nd	0.220	T	0.066	85.5
5	0.267	nd	nd	0.541	nd	nd	0.222	nd	nd	nd	0.088	79.5
7	0.102	nd	nd	0.491	T	nd	T	T	nd	nd	0.059	90.0
8	0.099	nd	T	0.130	T	T	T	nd	nd	nd	0.076	84.5
12	0.215	nd	0.271	0.273	nd	T	T	nd	nd	nd	T	80.0
13	0.089	nd	0.453	0.211	nd	T	0.145	nd	0.093	nd	T	83.0
14	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	94.0
15	T	nd	nd	0.077	nd	T	0.109	nd	T	nd	0.061	82.5
16	0.102	nd	nd	0.465	nd	T	0.366	nd	0.121	nd	0.073	83.0
19	T	nd	nd	0.091	nd	nd	0.105	nd	nd	nd	T	85.5
20	T	nd	nd	nd	nd	nd	nd	nd	nd	nd	T	87.0
21	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	86.5
22	0.127	nd	nd	0.392	nd	nd	0.085	nd	nd	nd	0.067	76.0
23	0.155	nd	0.191	0.265	nd	0.088	0.086	nd	nd	nd	0.071	85.5
24	nd	nd	nd	T	nd	nd	0.235	nd	T	nd	nd	83.5
25	0.060	nd	nd	0.069	nd	nd	T	nd	nd	nd	T	80.5
26	T	nd	nd	T	nd	nd	T	nd	nd	nd	nd	90.5
28	T	nd	nd	0.053	nd	nd	nd	nd	nd	nd	T	93.0
29	T	nd	nd	0.095	nd	nd	0.202	nd	T	nd	T	86.0
30A	0.185	nd	nd	0.288	T	T	T	nd	0.050	nd	0.108	94.5
32	0.122	nd	nd	0.223	nd	nd	0.381	nd	0.208	nd	0.060	88.0
35	0.111	nd	nd	0.174	nd	T	0.109	nd	T	nd	0.085	87.5
36	T	nd	nd	nd	nd	nd	nd	nd	nd	nd	T	82.0
37	T	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	83.0
43	0.141	nd	nd	0.103	nd	T	0.071	nd	0.066	nd	0.087	89.5
44	0.063	nd	T	0.088	nd	T	T	nd	nd	nd	T	83.5
45	nd	nd	nd	T	nd	nd	nd	nd	nd	nd	nd	83.0
47	0.283	nd	nd	0.692	0.057	T	T	nd	T	nd	T	81.5

Well Number**	ACET	Atrazine	Bromacil	DACT	DEA	Diuron	DSMN	Hexazinone	Norflurazon	Prometon	Simazine	Propazine* Recovery (%)
49	0.459	nd	nd	3.110	nd	nd	0.198	nd	T	nd	0.072	77.5
50	T	nd	nd	0.081	nd	nd	nd	nd	nd	nd	nd	89.5
51	T	nd	nd	T	nd	nd	nd	nd	nd	nd	nd	83.5
52	0.054	nd	nd	nd	nd	nd	0.052	nd	T	nd	0.066	83.0
53A	nd	nd	nd	0.121	nd	nd	nd	nd	nd	nd	nd	86.5
54	T	nd	nd	T	nd	nd	nd	nd	nd	T	0.057	88.5
56	0.275	nd	nd	0.770	nd	nd	nd	nd	nd	nd	0.096	80.0
57	0.131	nd	nd	0.294	nd	nd	T	nd	nd	nd	T	89.5
58	T	nd	nd	nd	nd	nd	nd	nd	nd	nd	T	89.5
59A	0.281	T	0.855	0.615	T	T	0.967	nd	0.344	nd	T	77.5
61	0.143	nd	0.528	1.070	T	nd	nd	nd	nd	nd	T	78.0
63A	nd	nd	nd	T	nd	nd	nd	nd	nd	nd	nd	90.5
65	T	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	82.0
68	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	82.0
69	0.468	nd	0.339	2.240	nd	T	nd	nd	nd	nd	T	75.0
71	0.369	nd	1.100	0.916	nd	T	0.807	nd	0.236	nd	T	73.0
72	0.618	nd	T	1.530	T	T	T	nd	T	nd	0.067	79.5
73	0.122	nd	nd	1.040	T	nd	0.061	nd	nd	nd	nd	78.5
74	0.618	nd	0.424	0.993	T	T	T	nd	T	nd	0.079	83.0
75A	0.802	nd	0.346	0.883	nd	T	nd	nd	nd	nd	0.068	79.0
80	0.051	nd	T	0.314	nd	nd	nd	nd	nd	nd	nd	84.5
84	T	nd	T	T	nd	nd	nd	nd	nd	nd	nd	82.0
86	0.671	nd	nd	4.830	T	nd	nd	nd	nd	nd	T	76.0
89	0.059	nd	T	0.058	nd	T	0.066	nd	nd	nd	T	86.5
90	0.167	0.083	0.069	0.177	0.156	0.079	T	T	T	nd	0.081	83.0
92	0.262	nd	nd	0.229	nd	T	0.104	nd	0.057	nd	T	79.0
94	0.508	nd	nd	3.360	nd	nd	0.195	nd	T	nd	T	74.0
95	nd	nd	nd	T	nd	nd	nd	nd	nd	nd	nd	86.5

nd = not detected (below the method detection limit listed in Table 1)

T = Trace (positive result between the method detection limit and the reporting limit listed in Table 1)

* = Propazine added as a surrogate for QA/QC purposes

** = The well numbers DPR uses to differentiate sampling locations are not consecutive for various reasons including changes in homeowner participation and wells going dry

Table 5. Multi-Analyte Screen sampling results from 2020. Concentrations in ppb (µg/L). The table includes results for the two analytes with detections that are only included in the Multi-Analyte Screen and for the six analytes that are duplicated in the two screens.

	Analytes Unique to Multi-Analyte Screen*		Analytes in Both Screens (Multi-Analyte Screen/Triazine Screen)					
Well Number	**Fludioxonil**	**Imidacloprid**	**Atrazine**	**Bromacil**	**Diuron**	**Norflurazon**	**Prometon**	**Simazine**
2	nd	nd	nd	nd	nd	nd	nd	T
5	nd	nd	nd	nd	nd	nd	nd	0.120/0.088
15	nd	0.106	nd	nd	T	T	nd	0.072/0.061
23	nd	0.073	nd	0.308/0.191	0.138/0.088	T/nd	nd	0.086/0.071
24	nd	0.112	nd	nd	nd	0.060/T	nd	nd
29	nd	0.053	nd	nd	nd/T	T	nd	nd/T
30A	0.333	nd	nd	nd	T	0.076/0.050	nd	0.121/0.108

nd = not detected (below the method detection limit listed in Tables 1 to 3)

T = Trace (positive result between the method detection limit and the reporting limit listed in Tables 1 to 3)

* = the following 26 analytes are unique to the Multi-Analyte Screen but were not detected in any of the samples: azoxystrobin, bensulide, carbaryl, diazinon, dimethenamide, dimethoate, ethofumesate, linuron, mefenoxam/metalaxyl, methiocarb, metolachlor, metribuzin, napropamide, oryzalin, tebuthiuron, thiamethoxam, thiobencarb, clomazone, dichloran, dichlobenil, ethoprophos, malathion, phorate, prometryn, propanil, and triallate

Table 6. Yearly percent (%) of wells positive above the reporting limit (RL) for each analyte on the Triazine Screen.

Year	ACET	Atrazine	Bromacil	DACT	DEA	Diuron	DSMN	Hexazinone	Norflurazon	Prometon	Simazine
1999	94.7	5.3	40.0	85.3	8.0	60.0	NA	0.0	17.3	1.3	86.7
2000	89.2	4.1	37.8	89.2	4.1	50.0	NA	1.0	17.6	1.4	82.4
2001	94.4	4.2	39.4	85.9	8.5	59.2	NA	1.4	22.5	1.4	85.9
2002	94.3	4.3	38.6	88.6	12.9	64.3	NA	0.0	15.7	1.4	92.9
2003	88.9	4.2	40.3	86.1	9.7	61.1	NA	0.0	20.8	1.4	86.1
2004	86.8	4.4	33.8	85.3	8.8	57.4	44.1	0.0	25.0	1.5	80.9
2005	88.2	4.4	33.8	75.0	5.9	54.4	45.6	0.0	23.5	1.5	70.6
2006	83.3	4.5	37.9	83.3	7.6	51.5	44.0	0.0	22.7	1.5	72.7
2007	85.5	2.9	31.9	85.5	5.8	46.4	44.9	0.0	29.0	1.4	76.8
2008	85.3	4.4	33.8	85.3	5.9	50.0	44.0	0.0	20.6	1.5	69.1
2009	88.2	2.9	30.9	85.3	4.4	45.6	47.1	0.0	20.6	1.5	60.3
2010	80.9	2.9	29.4	85.3	4.4	38.2	50.0	1.5	27.9	1.5	63.2
2011	76.5	4.4	30.9	79.4	5.9	32.4	52.9	1.5	27.9	0.0	55.9
2012	82.4	2.9	25.0	80.9	4.4	36.8	50.0	0.0	27.9	0.0	58.8
2013	76.1	1.5	26.9	83.6	6.0	13.4	41.8	0.0	20.9	0.0	58.2
2014	75.0	3.1	31.3	79.7	6.3	15.6	45.3	1.6	21.9	1.6	57.8
2015	76.2	1.6	23.8	84.1	3.2	9.5	34.9	0.0	19.0	1.6	49.2
2016	78.7	1.6	26.2	82.0	3.3	16.4	41.0	0.0	21.3	1.6	50.8
2017	60.7	1.6	23.0	70.5	1.6	6.6	36.1	0.0	21.3	0.0	39.3
2018	57.4	1.6	23.0	65.6	4.9	4.9	36.1	0.0	21.3	0.0	36.1
2019	61.7	1.7	20.0	63.3	1.7	1.7	35.0	0.0	13.3	0.0	31.7
2020	59.3	1.7	22.0	67.8	3.4	6.8	35.6	0.0	16.9	0.0	39.0
Mean	80.2	3.2	30.9	80.8	5.7	35.5	42.8	0.3	21.6	1.0	63.8
SD	11.5	1.3	6.5	7.5	2.7	21.9	5.7	0.6	4.1	0.7	18.1

NA = Not Analyzed - DSMN was not included in the analysis until 2004

Table 7. Yearly mean concentrations in ppb (µg/L) for each analyte on the Triazine Screen.

Year	ACET	Atrazine	Bromacil	DACT	DEA	Diuron	DSMN	Hexazinone	Norflurazon	Prometon	Simazine
1999	0.48	0.08	0.96	0.82	0.11	0.35	NA	nd	0.16	0.07	0.13
2000	0.47	0.08	1.31	0.75	0.13	0.35	NA	0.07	0.14	0.06	0.11
2001	0.50	0.10	1.12	0.97	0.13	0.33	NA	0.05	0.11	0.10	0.12
2002	0.58	0.08	0.85	1.08	0.09	0.31	NA	nd	0.28	0.09	0.13
2003	0.55	0.11	0.99	0.89	0.12	0.31	NA	nd	0.18	0.08	0.14
2004	0.50	0.12	1.12	0.85	0.15	0.28	0.22	nd	0.21	0.09	0.10
2005	0.38	0.10	0.95	0.66	0.17	0.25	0.25	nd	0.24	0.09	0.10
2006	0.42	0.09	0.88	0.82	0.13	0.28	0.27	nd	0.23	0.06	0.10
2007	0.40	0.07	0.85	0.80	0.10	0.26	0.26	nd	0.13	0.06	0.10
2008	0.38	0.07	0.81	0.68	0.10	0.21	0.25	nd	0.24	0.07	0.09
2009	0.39	0.07	0.79	0.67	0.12	0.20	0.23	nd	0.21	0.06	0.09
2010	0.41	0.11	0.83	0.70	0.15	0.17	0.27	0.05	0.19	0.09	0.10
2011	0.40	0.09	0.82	0.71	0.15	0.12	0.23	0.07	0.19	nd	0.09
2012	0.39	0.09	0.65	0.82	0.12	0.10	0.24	nd	0.19	nd	0.09
2013	0.39	0.08	0.82	0.75	0.08	0.13	0.25	nd	0.19	nd	0.09
2014	0.35	0.10	0.67	0.68	0.06	0.13	0.26	nd	0.20	0.10	0.08
2015	0.32	0.06	0.64	0.69	0.12	0.13	0.22	nd	0.19	0.11	0.08
2016	0.36	0.08	0.71	0.90	0.14	0.07	0.24	nd	0.18	0.09	0.08
2017	0.24	0.07	0.83	0.85	0.12	0.06	0.19	nd	0.11	nd	0.07
2018	0.28	0.08	0.59	0.87	0.09	0.08	0.24	nd	0.13	nd	0.07
2019	0.25	0.08	0.38	0.72	0.16	0.08	0.19	nd	0.13	nd	0.07
2020	0.24	0.09	1.24	0.77	0.10	0.07	0.24	nd	0.15	nd	0.07
Mean	0.40	0.09	0.86	0.79	0.12	0.19	0.24	0.06	0.18	0.08	0.10
SD	0.09	0.02	0.22	0.11	0.03	0.10	0.02	0.01	0.04	0.02	0.02

NA = Not Analyzed - DSMN was not included in the analysis until 2004

nd = not detected (below the method detection limits listed in Table 1)

Table 8. Summary of wells with Multi-Analyte Screen detections (other than Triazine analytes) from 2014 through 2020. Concentrations in ppb (µg/L).

			Sample Year						
Well #	**Township/Range-Section**	**Analyte**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
2	13S/22E-33	Imidacloprid	nd	nd	nd	nd	T	T	nd
4	13S/23E-32	Imidacloprid	nd	nd	nd	T	nd	nd	NS
5	14S/21E-13	Imidacloprid	nd	nd	nd	T	T	T	nd
15	14S/22E-14	Imidacloprid	nd	nd	nd	0.066	0.091	0.085	0.106
18	14S/22E-31	Imidacloprid	0.059	0.665	Dry	NLS	NLS	NLS	NLS
21	14S/23E-33	Imidacloprid	NS	0.065	nd	nd	nd	nd	NS
22	14S/23E-34	Imidacloprid	NS	0.120	0.080	0.090	T	T	NS
23	14S/23E-35	Imidacloprid	NS	0.218	0.209	0.534	0.536	0.470	0.073
24	15S/21E-03	Imidacloprid	nd	nd	nd	T	T	T	0.112
26	15S/21E-09	Imidacloprid	T	0.051	0.072	0.167	0.053	nd	NS
29	15S/22E-03	Imidacloprid	nd	T	nd	5.970	0.095	T	0.053
47	15S/24E-14	Imidacloprid	NS	nd	0.644	nd	nd	nd	NS
48	15S/24E-36	Imidacloprid	NS	nd	T	T	NLS	NLS	NLS
37	15S/22E-21	Oryzalin	T	nd	nd	nd	nd	nd	NS
44	15S/23E-02	Oryzalin	NS	T	nd	nd	nd	nd	NS
29	15S/22E-03	Mefenoxam/ Metalaxyl*	nd	T	nd	nd	nd	nd	nd
74	19S/26E-01	Metolachlor	NS	T	nd	nd	nd	nd	NS
30A	15S/22E-05	Fludioxonil	NS	nd	T	0.066	0.165	0.380	0.333
4	13S/23E-32	Propanil	nd	nd	nd	0.060	nd	nd	NS

nd = not detected (below the method detection limit listed in Tables 2 and 3)

T = Trace (positive results between the method detection limit and the reporting limit listed in Tables 2 and 3)

NS = Well not sampled

Dry = Well went dry

NLS = Well is no longer sampled

*Mefenoxam and metalaxyl are stereoisomers and cannot be analytically distinguished

Results for Quality Control:

Laboratory and field quality control were conducted according to SOP QAQC001.01 (Peoples, 2019) and the results are summarized in Table 9.

Triazine Screen QC samples

Sixteen total matrix spikes (as duplicates) were analyzed along with eight sets of samples for the Triazine Screen. All analytes were spiked at 0.2 ppb. The average recoveries for the 11 analytes and the propazine surrogate analytes ranged from 81.3 to 86.4% (Table 10). The standard deviation of the recoveries ranged from 3.9 to 7.1%. Two analytes were beyond the upper control limits out of 176 spiked analytes in two of the 16 QC samples. The propazine surrogate recoveries were within the control limits in both the continuing QC (Table 10) and the 59 samples analyzed (Table 4).

Multi-Analyte Screen QC samples

For the Multi-Analyte Screen, one matrix spike was extracted and split to be analyzed along with sets of samples for both the LCMS and GCMS instruments. All analytes that were analyzed with LCMS were spiked at 0.2 ppb. The recoveries for the 29 analytes ranged from 79.0 to 110% (Table 11). All 29 analytes were within the control limits. For the split QC spikes analyzed with the GCMS, all analytes were spiked at 0.1 ppb. The recoveries for the 15 analytes ranged from 83.6 to 99.1% (Table 12). All 15 analytes were within the control limits.

Blind spikes

A blind spike consists of analyte-free groundwater (matrix-blank sample) fortified with the chosen analytes and is spiked by a chemist other than the chemist extracting and analyzing that screen. The EM QA Officer submitted the blind spike to the lab disguised as a field sample according to SOP QAQC008.00 (Ganapathy, 2005). Usually between five and ten percent of samples submitted for this study have been blind spikes. Due to logistical issues caused by the pandemic, one blind spike containing all 11 analytes in the Triazine Screen was submitted and included with samples extracted on June 16, 2020. All 11 analytes were within the control limits and the results are presented in Table 13.

Table 9. Laboratory and field quality control (QC) summary.

QC Type	Triazine Screen	Multi-Analyte Screen	Total Number	Number Out of Control Limits
Continuing QC matrix-spikes	16	1	17	2 analytes out of control limits in 2 of 17 samples
Blind spikes	1	0	1	No analytes out of control
Lab matrix-blanks	8	1	9	All non-detected
Field blanks	6	1	7	All non-detected

Table 10. Triazine Screen continuing quality control (QC) percent recovery (%) results including the propazine surrogate.

Extraction Date	Spike #*	Spiked Level	ACET	Atrazine	Bromacil	DACT	DEA	Diuron	DSMN	Hexazinone	Norflurazon	Prometon	Simazine	Propazine (Surrogate)
5/20/2020	1	0.2	76.5	81.5	82.5	87.0	79.0	84.5	84.5	78.5	82.0	84.0	81.5	81.5
5/20/2020	2	0.2	83.0	86.5	88.0	92.0	83.0	90.0	81.5	86.5	87.5	86.0	87.0	87.5
5/21/2020	1	0.2	78.5	84.0	81.5	86.0	82.0	88.5	82.5	82.0	88.5	90.0	83.5	86.5
5/21/2020	2	0.2	76.5	84.0	83.5	86.0	79.5	86.0	81.5	80.5	87.0	87.0	83.5	83.5
6/2/2020	1	0.2	75.5	81.0	81.0	73.0	75.5	82.0	76.5	77.5	81.5	80.5	81.0	79.0
6/2/2020	2	0.2	80.5	87.0	85.0	85.0	83.0	87.5	82.0	79.5	86.5	86.5	87.5	84.5
6/3/2020	1	0.2	78.5	77.0	78.5	83.5	75.0	81.0	76.0	73.0	79.5	83.5	81.0	78.0
6/3/2020	2	0.2	87.0	85.5	85.0	89.5	82.0	90.5	84.0	80.5	87.5	88.0	90.0	86.5
6/15/2020	1	0.2	77.0	80.0	80.5	80.5	75.5	80.5	75.5	79.0	77.0	81.5	82.0	81.0
6/15/2020	2	0.2	80.5	84.0	86.0	88.0	82.0	89.5	81.5	86.5	85.0	84.5	84.5	85.0
6/16/2020	1	0.2	77.0	86.5	85.0	85.0	79.5	85.5	83.5	81.5	87.0	88.0	86.5	87.0
6/16/2020	2	0.2	72.0	80.5	77.5	82.0	74.5	81.5	80.0	76.5	80.5	83.5	80.0	81.0
9/21/2020	1	0.2	93.5	96.5	95.0	91.5	90.0	91.0	92.0	91.0	96.5	92.5	92.5	89.0
9/21/2020	2	0.2	100	96.5	103**	99.5	93.5	94.0	95.0	99.5	92.5	95.0**	97.5	92.0
9/8/2020	1	0.2	84.5	87.5	89.5	84.5	85.0	88.0	89.5	86.5	92.0	89.0	87.0	87.0
9/8/2020	2	0.2	81.5	82.0	83.0	82.5	81.5	82.0	79.5	81.0	81.0	83.5	78.5	79.5
Average Recovery			81.4	85.0	85.3	86.0	81.3	86.4	82.8	82.5	85.7	86.4	85.2	94.3
Standard Deviation			7.1	5.3	6.4	5.8	5.2	4.1	5.5	6.4	5.3	3.9	5.0	16.0
Upper Control Limit			100	103	102	114	99.0	106	100	111	103	94.0	98.0	93.0
Lower Control Limit			51.3	68.7	57.6	59.7	58.2	63.0	64.7	68.6	64.9	65.4	58.4	59.8

* = Spike 1 and 2 represent the duplicate spikes analyzed for each extraction set

** = Beyond the upper control limit

Table 11. Multi-Analyte Screen (LCMS) continuing quality control (QC) percent recovery (%) results of the single extraction set.

Extraction Date	Spiked Level (ppb)	Pesticide	Percent Recovery (%)	Lower Control Limit	Upper Control Limit
6/16/2020	0.2	Atrazine	101	73.1	115
6/16/2020	0.2	Azoxystrobin	93.0	74.3	125
6/16/2020	0.2	Bensulide	106	62.3	130
6/16/2020	0.2	Bromacil	88.0	75.2	109
6/16/2020	0.2	Carbaryl	109	64.1	143
6/16/2020	0.2	Diazinon	96.0	61.7	115
6/16/2020	0.2	Dimethenamide	104	71.0	118
6/16/2020	0.2	Dimethoate	97.5	72.5	116
6/16/2020	0.2	Diuron	100	76.9	114
6/16/2020	0.2	Ethofumesate	97.0	45.9	132
6/16/2020	0.2	Fludioxonil	109	62.1	122
6/16/2020	0.2	Imidacloprid	99.5	70.7	117
6/16/2020	0.2	Linuron	104	76.1	112
6/16/2020	0.2	Mefenoxam/Metalaxyl*	104	74.7	119
6/16/2020	0.2	Methiocarb	106	67.7	140
6/16/2020	0.2	Metolachlor	101	68.0	134
6/16/2020	0.2	Metribuzin	80.5	75.7	110
6/16/2020	0.2	Napropamide	104	76.7	115
6/16/2020	0.2	Norflurazon	101	79.3	114
6/16/2020	0.2	Oryzalin	103	79.6	113
6/16/2020	0.2	Prometon	110	79.7	118
6/16/2020	0.2	Simazine	102	75.3	111
6/16/2020	0.2	Tebuthiuron	105	69.7	129
6/16/2020	0.2	Thiamethoxam	79.0	65.5	107
6/16/2020	0.2	Thiobencarb	97.5	75.0	113

*Mefenoxam and metalaxyl are stereoisomers and cannot be analytically distinguished

Table 12. Multi-Analyte Screen (GCMS) continuing quality control (QC) percent recovery (%) results of the single extraction set.

Extraction Date	Spiked Level (ppb)	Pesticide	Percent Recovery (%)	Lower Control Limit	Upper Control Limit
6/16/2020	0.1	Dichlobenil	90.7	34.7	149
6/16/2020	0.1	Propanil	92.1	58.2	149
6/16/2020	0.1	Clomazone	93.6	42.4	156
6/16/2020	0.1	Prometryn	92.9	46.3	155
6/16/2020	0.1	Dichloran	99.1	51.3	148
6/16/2020	0.1	Ethoprophos	83.6	52.0	144
6/16/2020	0.1	Triallate	94.8	52.0	144
6/16/2020	0.1	Malathion	97.7	51.0	163
6/16/2020	0.1	Phorate	89.7	61.5	141

Table 13. Blind spike levels and recoveries.

Extraction Date	Analysis	Analyte	Spike Level (ppb)	Result (ppb)	Percent Recovery (%)	Control Limit Exceeded*
6/16/2020	Triazine Screen	ACET	0.10	0.092	92.0	No
		Atrazine	0.10	0.098	98.0	No
		Bromacil	0.10	0.093	93.0	No
		DACT	0.10	0.094	94.0	No
		DEA	0.10	0.092	92.0	No
		Diuron	0.10	0.100	100	No
		DSMN	0.10	0.092	92.0	No
		Hexazinone	0.10	0.091	91.0	No
		Norflurazon	0.10	0.106	106	No
		Prometon	0.10	0.104	104	No
		Simazine	0.10	0.099	99.0	No

* = Control limits listed in Table 10

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