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2006 Ground Water Monitoring of Hexazinone

The following is a summary of the results of ground water sampling activities conducted in blueberry growing regions of the state in 2006, compared with 1994, 1998, and 2002 results.

I. Goal

The goal of this project is to assess the quality of drinking water from private domestic wells in blueberry growing areas of Maine to determine if measures -- voluntary and regulatory -- implemented by blueberry growers are mitigating the impact of hexazinone on water quality.

II. Background

In the early spring of 1994, the Board of Pesticides Control conducted a statewide assessment to determine the impact of highly leachable pesticides on ground water in Maine. This assessment targeted a variety of agricultural and nonagricultural pesticide use sites. The most frequently detected pesticide was hexazinone, an herbicide used in the production of blueberries. Fifteen of twenty sites sampled in blueberry growing areas had detectable levels of the herbicide. Follow-up and expanded sampling of sites down gradient and within one-quarter mile of active blueberry fields was conducted in the late summer of that year. Those results found detectable levels of hexazinone in 35 of 48 sites sampled.

Simultaneously that spring, a citizen petition drive was underway to cancel the registration of hexazinone. Following public hearings and lengthy discussions, the Board of Pesticides Control chose to allow continued use of the pesticide, yet directed the formation of a pesticide-specific state management plan (SMP) advisory committee to look at management options for hexazinone. The advisory committee, working closely with the Board, created the *Hexazinone State Management Plan for the Protection of Ground Water.* This pesticide-specific SMP, the only one of its kind to date in Maine, was adopted by the Board in July 1996.

As described in Section VII of the plan, the Board of Pesticides Control is committed to conducting an assessment of private domestic wells in hexazinone-use areas every four years. The 1994 study is used as the benchmark. Four years was selected as the time interval to allow for two full cycles of blueberry production and hexazinone use.

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III. Program Design

A. Site Selection

Fifty-three sites sampled in 1994 near blueberry growing areas were targeted for resampling in 1998, 2002, and 2006. Twenty of these sites were originally selected using stratified-random-sampling criteria; the remaining sites were selected using the triple-point sampling principle, whereby sites with hexazinone detections in the first round of sampling were evaluated by sampling two other sites in the same local watershed with similar geological and pesticide use characteristics as the first site.

Generally, all sites that were sampled have the following characteristics:

- the site contains a private domestic well, currently used for drinking water;
- the site is within one-quarter mile of an active blueberry field; and
- the site is down gradient or of equal elevation with the blueberry field.

B. Sample Collection and Protocol

The BPC field staff collected 46 samples during the months of January and February, 2006. The time period was selected to coincide with the time of year sampling was done in 1994, 1998, and 2002, and to attempt sampling while water tables were at their lowest before the spring recharge.

Field staff collected samples from as many previously sampled domestic plumbing systems as possible after ensuring the water supply was not filtered. At most sites, water was collected from the tap that was allowed to run for at least ten minutes. In 2002, 8 of the 49 samples were from new sites chosen when existing sites proved difficult or impossible to sample due to various reasons such as lack of electricity to power the well or fire damage to the home housing the well. The new sites followed the old criteria of being within one-quarter of a mile from an active blueberry field and at an elevation equal to or less than the field. New sites were as close to the site that didn't work as possible. In 2006, 18 of 46 samples were from new sites. In some cases a well changed ownership and the new owner did not want to participate. In other cases new filters had been set up on the water system.

Well water was collected in 950 ml amber glass jars (one jar per sample, unless QA/QC required) and placed immediately in iced coolers. This was done to preserve the samples by maintaining the cool temperatures and preventing exposure to sunlight. Samples were delivered weekdays, except Fridays, to the University of Maine, Department of Food Science Laboratory, within three days of collection. Chain-of-custody procedures were observed throughout the sampling program.

C. Data Collection

The BPC staff updated their preprinted sample information sheets for well and site characteristics. The BPC staff also gathered longitude and latitude data, where needed, using portable, hand held global positioning system (GPS) units.

D. Analytic Methodology

The University of Maine, Food Chemical Safety Laboratory performed the sample analyses. Samples were analyzed for hexazinone and one of its primary metabolites using solid phase extraction and gas chromatography with a mass spectrometer (GCMS). The limit of quantification (LOQ) was 0.1 parts per billion (ppb), as it was in 2002 (also with GCMS). In 1998 the LOQ was 0.2 ppb (GCMS), and in 1994 it was 0.05 ppb obtained with high performance liquid chromatography (HPLC). The 2006 samples were also analyzed for captan, terbacil, azinphos-methyl, phosmet, propiconazole, methoxychlor, chlorothalonil, and malathion although none of these active ingredients were detected.

E. Quality Assurance/Quality Control Procedures

The University of Maine, Food Chemical Safety Laboratory maintains a QA/QC plan for the Board of Pesticides Control and the United States Environmental Protection Agency for the analysis of samples used in the enforcement of state and federal pesticide regulations. This plan is updated biennially. Three field blanks and duplicates of three of the 46 samples were run.

IV. Sample Results

In 2006, 32 of 46 samples (or 69.6%) showed detectable levels of hexazinone. Table 1 compares this percentage to the percentages in 1994, 1998, and 2002. Table 1 also displays mean and median concentrations of all of the samples analyzed per year, and the highest reading per year.

Table 1.
Hexazinone Detection Rate, Mean and Median Concentration, and Highest Reading per Sampling Period

	Spring 1994	**Spring 1998**	**Spring 2002**	**Spring 2006**
Total Number of Samples Collected	20	42	49	46
Number of Positive Detections	15	18	29	32
Percentage with Positive Detections	**75%**	**42.8%**	**59.2%**	**69.6%**
Mean Concentration*(ppb)	**1.07**	**0.44**	**1.45**	**0.98**
Median Concentration (ppb)	**0.31**	**ND**	**0.43**	**0.34**
Highest Reading (ppb)	**5.97**	**2.15**	**11.41**	**8.43**

*For statistical purposes only, mean concentration was calculated assuming that non detections (ND) were equal to half of the limit of quantification (LOQ).

Data collected in 1994, 1998, 2002, and 2006 is displayed below in Table 2.

TABLE 2. Maine BPC Hexazinone Detections in Private Wells (ppb)

Well Parameters			Year (spring sampling)			
ID	**Depth (ft)**	**Distance to Hexazinone Use Site (ft)**	**1994**	**1998**	**2002**	**2006**
03BPCG012	unknown	400	**ND***	**ND**	**NA****	**NA**
05BPCG005	unknown	150	**2.57**	**ND**	**2.27**	**1.48**
05BPCG006	80	240	**4.78**	**NA**	**7.86**	**NA**
05BPCG007	unknown	240	**NA**	**ND**	**11.41**	**3.35**
05BPCG008	unknown	300	**NA**	**0.34**	**0.55**	**NA**
05BPCG009	212	200	**NA**	**NA**	**0.15**	**NA**
05BPCG010	300	125	**NA**	**NA**	**1.05**	**1.11**
05BPCG023	unknown	100	**NA**	**NA**	**NA**	**ND**
05BPCG024	unknown	100	**NA**	**NA**	**NA**	**0.37**
05BPCG025	65	50	**NA**	**NA**	**NA**	**3.55**
05BPCG026	100	75	**NA**	**NA**	**NA**	**ND**
05BPCG027	unknown	50	**NA**	**NA**	**NA**	**ND**
05BPCG028	unknown	100	**NA**	**NA**	**NA**	**0.75**
05BPCG029	4	0	**NA**	**NA**	**NA**	**3.08**
06BPCG026	75	75	**0.09**	**0.30**	**1.68**	**1.21**
06BPCG027	unknown	1000	**ND**	**NA**	**NA**	**NA**
06BPCG028	16	400	**0.55**	**0.30**	**ND**	**ND**
06BPCG030	16	125	**NA**	**1.16**	**1.50**	**NA**
06BPCG031	100	125	**NA**	**ND**	**0.16**	**0.34**
06BPCG032	300	800	**NA**	**NA**	**0.29**	**0.24**
06BPCG033	200	800	**NA**	**NA**	**NA**	**0.43**
06BPCG047	110	0	**NA**	**NA**	**3.62**	**NA**
06BPCG049	125	200	**NA**	**NA**	**NA**	**0.52**
06BPCG058	dug	800	**NA**	**NA**	**NA**	**2.26**
08BPCG008	5	240	**1.50**	**1.66**	**3.81**	**8.43**
08BPCG009	200	350	**0.30**	**0.14**	**0.74**	**0.57**
08BPCG010	115	200	**NA**	**2.10**	**1.73**	**1.39**
08BPCG011	unknown	1000	**NA**	**0.33**	**ND**	**1.01**
08BPCG012	350	250	**NA**	**ND**	**1.18**	**ND**
08BPCG013	500	250	**NA**	**ND**	**ND**	**NA**
08BPCG021	deep	600	**NA**	**NA**	**NA**	**ND**

09BPCG018	40	50	**5.97**	**2.15**	**2.57**	**1.95**
09BPCG020	60	250	**NA**	**ND**	**ND**	**0.14**
09BPCG021	50	160	**NA**	**ND**	**ND**	**NA**
14BPCG004	unknown	400	**0.71**	**0.93**	**0.63**	**ND**
14BPCG005	20	50	**ND**	**ND**	**ND**	**ND**
14BPCG006	13	150	**0.32**	**ND**	**ND**	**NA**
14BPCG007	unknown	35	**0.84**	**NA**	**NA**	**NA**
14BPCG008	143	10	**0.49**	**ND**	**0.85**	**1.22**
14BPCG009	380	45	**0.25**	**ND**	**ND**	**NA**
14BPCG010	365	35	**0.25**	**ND**	**ND**	**ND**
14BPCG011	140	300	**2.53**	**0.45**	**5.75**	**2.42**
14BPCG012	132	300	**NA**	**1.52**	**9.24**	**3.35**
14BPCG013	120	180	**NA**	**ND**	**ND**	**NA**
14BPCG014	unknown	100	**NA**	**ND**	**NA**	**NA**
14BPCG015	350	75	**NA**	**NA**	**ND**	**NA**
14BPCG016	25	300	**NA**	**ND**	**ND**	**NA**
14BPCG017	12	180	**NA**	**NA**	**ND**	**ND**
14BPCG018	220	100	**NA**	**ND**	**ND**	**ND**
14BPCG019	100	35	**NA**	**NA**	**2.96**	**NA**
14BPCG020	unknown	275	**NA**	**ND**	**ND**	**NA**
14BPCG021	200	50	**NA**	**ND**	**ND**	**NA**
14BPCG022	unknown	175	**NA**	**ND**	**ND**	**NA**
14BPCG023	405	125	**NA**	**0.37**	**ND**	**NA**
14BPCG024	unknown	30	**NA**	**0.57**	**6.72**	**ND**
14BPCG026	unknown	450	**NA**	**1.02**	**0.43**	**NA**
14BPCG027	unknown	200	**NA**	**0.57**	**NA**	**0.26**
14BPCG040	unknown	75	**NA**	**NA**	**1.22**	**NA**
14BPCG041	190	40	**NA**	**NA**	**1.12**	**NA**
14BPCG042	500	0	**NA**	**NA**	**ND**	**NA**
14BPCG046	12	200	**NA**	**NA**	**NA**	**0.39**
14BPCG047	12	200	**NA**	**NA**	**NA**	**ND**
14BPCG048	220	0	**NA**	**NA**	**NA**	**0.16**
14BPCG049	285	0	**NA**	**NA**	**NA**	**0.15**
15BPCG016	100	230	**0.18**	**ND**	**0.24**	**0.27**
15BPCG018	208	70	**ND**	**ND**	**ND**	**ND**
15BPCG019	125	75	**NA**	**1.07**	**1.37**	**1.06**
15BPCG020	160	100	**NA**	**ND**	**0.51**	**0.35**
15BPCG021	unknown	250	**NA**	**1.23**	**4.08**	**0.16**
15BPCG032	25	100	**NA**	**NA**	**NA**	**ND**
15BPCG033	325	150	**NA**	**NA**	**NA**	**2.54**
16BPCG016	25	1000	**ND**	**ND**	**NA**	**NA**

* ND=Not Detected
**NA=Not Analyzed

Of the 49 samples collected in 2002, the primary metabolite of hexazinone (hexazinone metabolite B) was detected 17 times, all below 1.71 ppb. In 2006 hexazinone metabolite B was detected 15 times, all below 2.12 ppb. This data was not included in Table 2 since the BPC does not have metabolite data from 1994 and 1998 for comparison. Specific hexazinone metabolite B data can be obtained by contacting the BPC at 287-2731.

V. Conclusions and Discussion

The 2006 ground water sampling results show an increased frequency of hexazinone detections compared to 1998 and 2002 results. Overall concentrations of hexazinone in 2006 samples were not higher than in 2002, however. All results continue to be well below the EPA Health Advisory of 400 ppb.

A probable explanation for the apparent difference in 1998 results is that the laboratory LOQ was 0.2 ppb in 1998 compared to 0.1 ppb in 2002 and 2006. In addition, the LOQ for hexazinone in 1994 was 0.05 ppb, which could explain the difference in data that year. Also noteworthy is that the State Climatologist has declared 2001 the driest year on record, and 2005 the wettest in about 100 years of data.