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An Arsenic Survey in Utah

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AN ARSENIC SURVEY IN UTAH 1/

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Northern Utah beekeepers have, at irregular intervals, sustained serious and often extensive loss of adult honeybees. Sturtevant et al 3/ found that soil samples showed a certain amount of arsenic, which was often excessive in cases where soils were taken in the neighborhood of smelters or in sprayed orchards. Subsequent studies by these workers and their associates have further indicated that arsenic has been a very common cause of bee poisoning losses investigated during the period 1939 through 1947. In some areas plant blossoms also have shown substantial amounts of arsenic upon analysis.

The arsenic survey reported here was made during 1946 in an effort to establish a rough "arsenic level" for the areas that have sustained most frequent adult bee losses through contact with poisons. The survey extended from the Utah-Idaho line (northeast of Lewiston) to Nephi. The data have been averaged for the counties (other than Salt Lake County) through which the survey extended, along U. S. highway 91 through Cache County to Brigham and following this highway through Salt Lake, Provo, and to Nephi. Samples for this study purposely were taken from uncultivated soils and plants, in an effort to avoid possible influence of agricultural sprays or dusts. However, the effects of such agricultural practices doubtless are reflected in the pollen and bees.

In the Jordan Valley of Salt Lake County, numerous smelters operated in the past but were nearly all closed by injunction when arsenic and other metals, passing up the flues, seriously contaminated farm land and crops. Not until about 1908 was the first baghouse installed in a Utah smelter. About 1914 the Cottrell system was installed in the Garfield smelter. This system was much improved about 1918. At the present time it appears that most of the arsenic is being trapped by the two processes. The smelters at Murray, Garfield, and Midvale, in Salt Lake County, were closed because of labor troubles from approximately January 21 to July 28, 1946. Only the Tooele smelter, on the west of the mountains from the area of study, operated throughout 1946.

1/ This project is conducted in cooperation with the U. S. Bureau of Entomology and Plant Quarantine, Division of Bee Culture.

2/ Research professor, assistant professor, and former graduate research assistant, respectively.

3/ A report of investigations of the extent and causes of heavy losses of adult honeybees in Utah. U. S. D. A., Ent. E-545, 18, 1 fig., 1941. By Sturtevant, Knowlton, Hitchcock, Vansell, Holst, and Nye.

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A study of figure 1 shows some fluctuation in soil arsenic level, with the highest arsenic average being in the vicinity of Murray. Next highest soil arsenic occurred in the vicinity of Sandy and Midvale. The several large smelters, closed years ago by injunction, poured out a large proportion of the arsenic which now contaminates soils of this particular region. At this time, one smelter operates at Murray, one at Midvale, and one to the northwest of Garfield, in this area. Some smelters apparently have operated on a reduced schedule during the summer. However, under the recent urgency of World War II, maximum output was essential from all smelters to meet the needs of our armed services.

The highest average soil arsenic was for the Murray area, with 171, micrograms per gram of soil (expressed as arsenic trioxide). The second highest peak of soil arsenic was found near Sandy; samples from this area averaged 26.61. Here again a large slag dump attests to the smelters which once operated, adding arsenic and other metals to the soils of the area. The data show less arsenic near the smelter at Midvale, or 17.49 micrograms, with a substantial reduction in the Draper area to the south which averaged 5.03 micrograms per gram of soil. Soils, in general, varied from 4 to 10 micrograms per gram; however, this does not apply to orchard soils which often show substantially higher quantities of arsenic.

While arsenic in pollen generally followed the same trend as that in the soil, being high at Murray and Midvale, this was not true at Sandy where soil arsenic samples were relatively high, but pollen arsenic averaged lower than elsewhere. Also, in early spring arsenic was high in trap pollen in Cache, Weber, Davis, Murray, Midvale, and in Draper but tended to drop to a lower level at the same localities during midsummer. An increase in pollen arsenic again was apparent during October. The high arsenic in pollen from Juab County likely was caused by orchard or other agricultural chemical application.

Table 1. Monthly average of arsenic content of bees, pollen, and sweet clover blossoms, 1946 (Arsenic expressed as micrograms arsenic trioxide equivalent per gram of pollen and sweet clover blossoms and per bee)

Month	Number of samples	Bees	Number of samples	Pollen	Number of samples	Sweet clover
April			5	4.54		
May	3	.15	35	3.20		
June	20	.167	45	1.49	11	2.99
July	36	.167	63	2.36	47	2.68
August	37	.117	46	1.68	45	2.41
September	16	.10	44	1.72	31	2.83
October	1	.24	5	5.86	2	6.52
November	3	.13				

Arsenic in bees, most of which were dead bees collected in front of the hives, tended to average approximately 0.1 micrograms of arsenic trioxide equivalent per bee, except at Murray and in Utah County, where it averaged approximately twice this amount. (No bees were available for analysis from Midvale.)

Average arsenic in sweet clover blossoms remained at a rather constant level in most counties, between 1 to 2 micrograms per gram of blossom. The exceptions were that at Murray the blossoms averaged 9.05 and at Midvale 5.27.

Table 2. Average arsenic content of bees, pollen, sweet clover blossoms, and soil for the 1946 season (Arsenic expressed as micrograms arsenic trioxide equivalent per bee and per gram of pollen, sweet clover blossoms, and soil)

County	Number of samples	Bees	Number of samples	Pollen	Number of samples	Sweet clover	Number of samples	Soil
Cache	24	.13	28	2.08	24	1.57	6	6.21
Box Elder					7	1.48	4	6.33
Weber	29	.10	67	1.44	27	1.58	3	9.10
Davis	4	.11	25	1.65	10	1.30	2	8.50
Salt Lake Murray	3	.19	26	5.43	15	9.05	3	171.01
Midvale			21	3.96	10	5.27	2	17.49
Sandy	5	.09	11	.81	6	1.86	4	26.61
Draper	2	.10	22	1.34	3	.98	2	5.03
Utah	42	.19	41	1.32	30	1.82	13	8.53
Juab	7	.06	2	3.81	4	1.77	1	4.45
Millard Delta	1	.06			1	.42	1	4.86

Fig.1. Average arsenic content of various soil samples collected in Utah during 1946 (Arsenic expressed as micrograms arsenic trioxide equivalent per gram of soil)

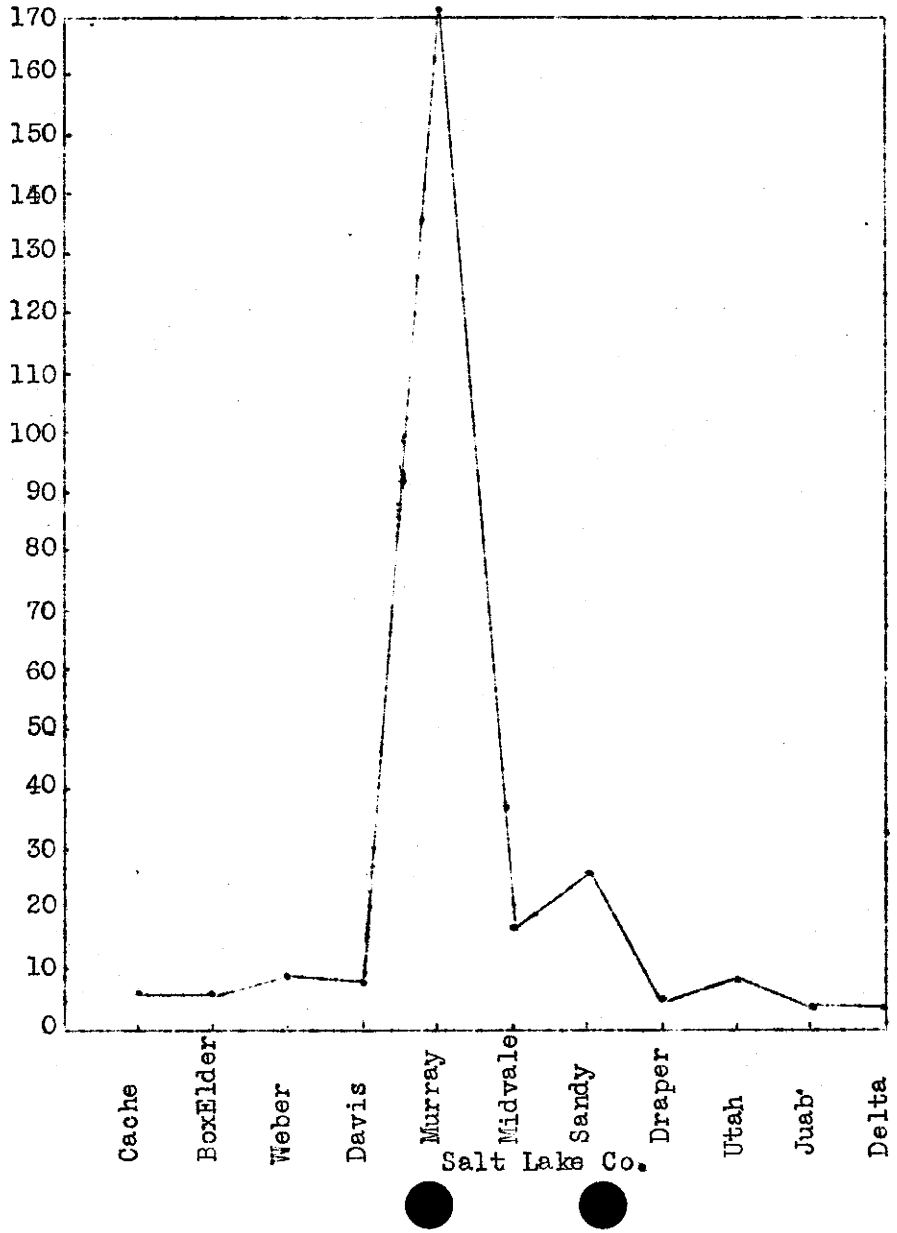

Fig.2. Average arsenic content of various pollen samples collected in Utah during 1946 (Arsenic expressed as micrograms per gram of pollen)

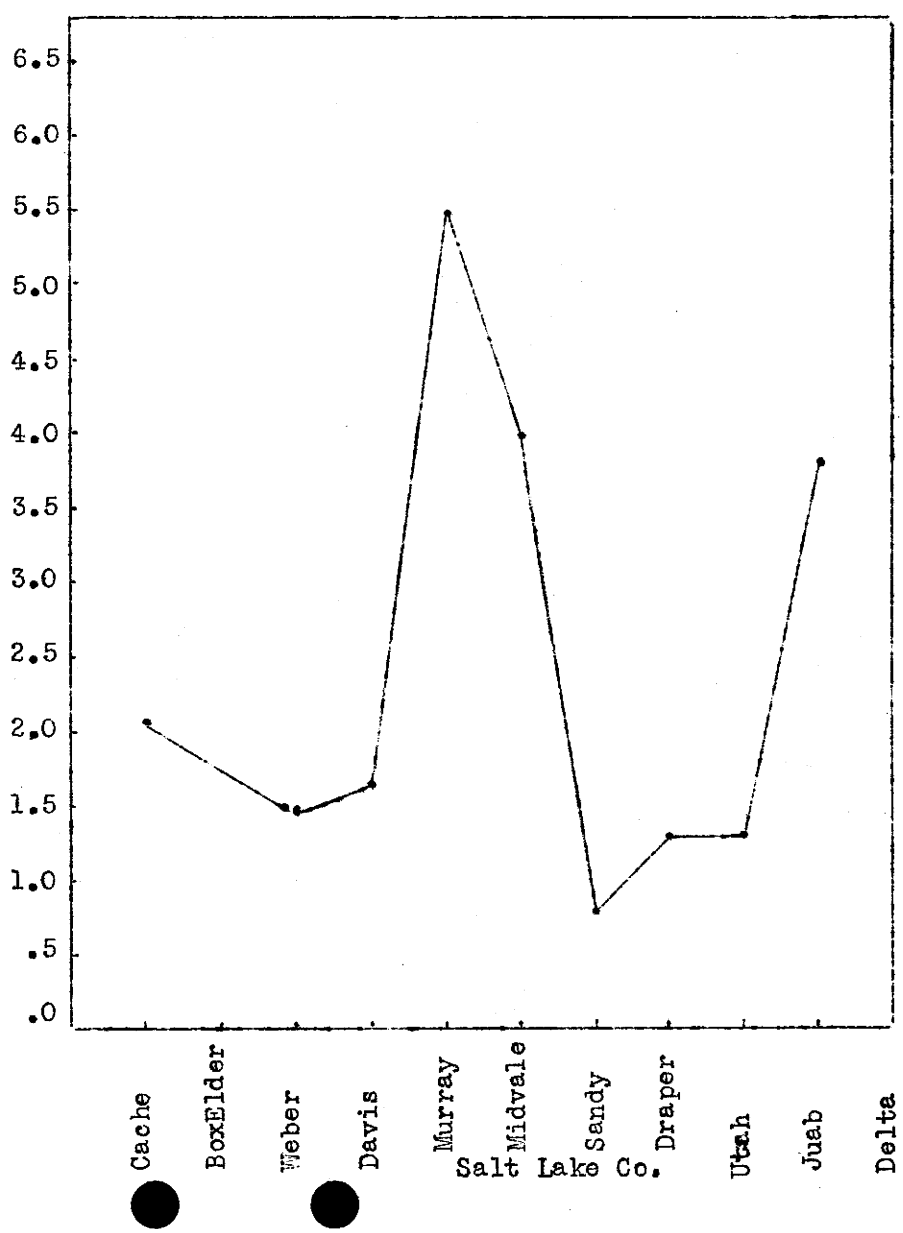

Fig. 3. Average arsenic content of white sweet clover blossoms collected in Utah during 1946 (Arsenic expressed as micrograms arsenic trioxide equivalent per blossoms)

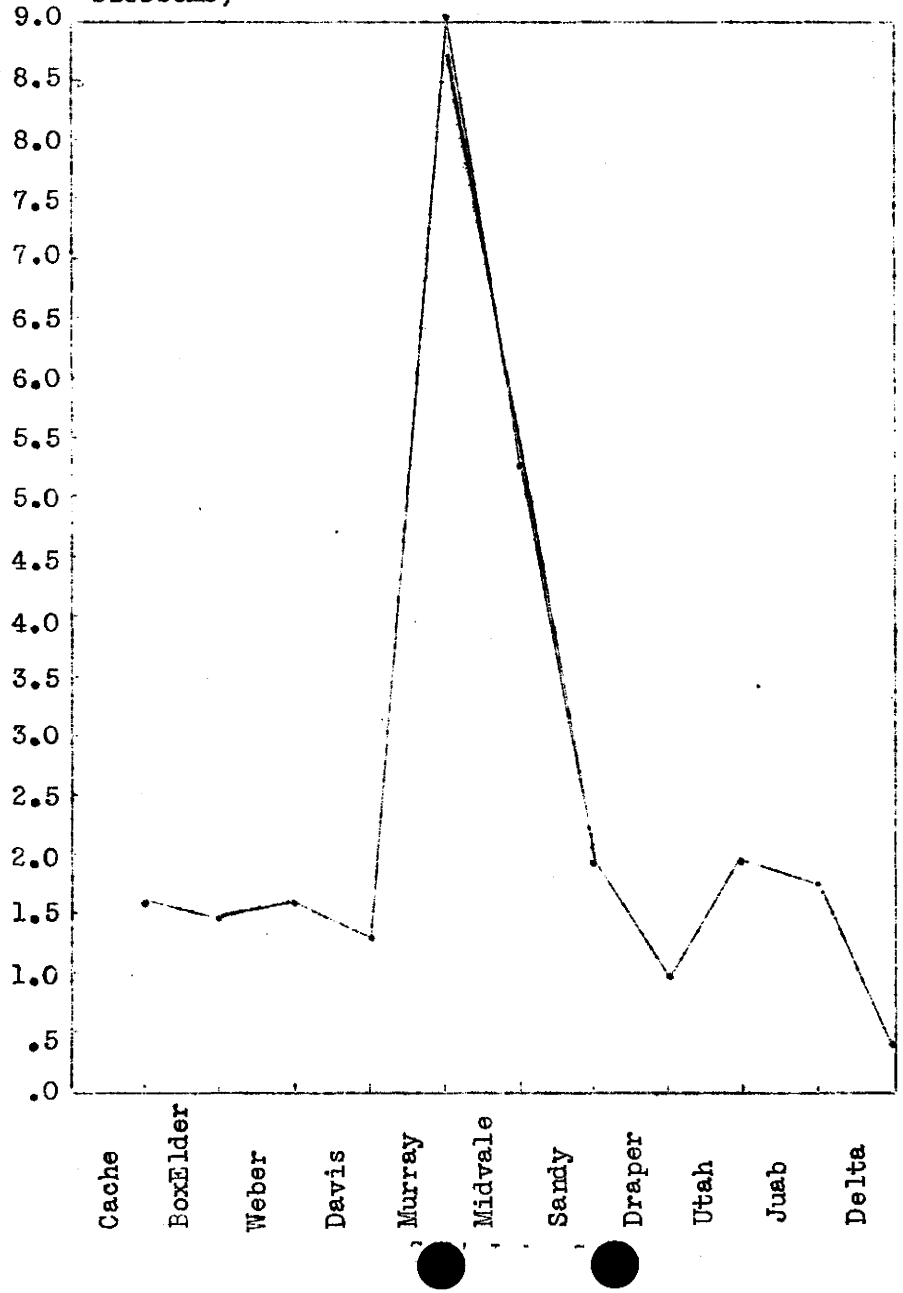

Fig. 4. Average arsenic content of honeybees collected in Utah during 1946 (Arsenic expressed as micrograms arsenic trioxide equivalent per bee)