Wildlife Kill Resulting from the Misuse of Arsenic Acid Herbicide

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Although the use of arsenical herbicides in both crop and non-crop areas has been widely accepted, the use of certain formulations of these chemicals may have a disastrous effect on wildlife. The following incident emphasizes the sometimes tragic effects of the indiscriminate use of these herbicides by qualified and/or non-qualified persons.

Field Investigation

On the morning of June 10, 1971, Arsenic Acid was applied by air to approximately 600 acres in extreme southwest Shelby County, Tenn. As a result of this herbicide application, state wildlife restoration efforts sustained a considerable loss to the herd of white-tailed deer Odocoileus virginiana in that area.

Interviews with the aerial applicator involved confirmed the herbicide to be Delta Brand Arsenic Acid, U.S.D.A. Reg. #295-6, labeled for use on Bermuda grass Cynodon dactylon lawns for controlling Dallis grass Paspalum dilatatum and Crab-Grass Digitaria sanquinalis.

During one of the interviews with the aerial applicator, an empty container, bearing the complete label and analysis of the product used in the spraying, was secured. The total arsenic (water soluble), expressed as metallic arsenic, was 39.61%, and the arsenic trioxide equivalent was 52.3%. This Arsenic Acid was applied to kill a heavy growth of Johnson grass Sorghum halapense to prepare the field for planting soybeans Glycine max. The formulation was prepared in the ratio of 1/2 gal. of Arsenic Acid to 4 1/2 gal. of water and dispensed at the rate of 5 gal. per acre. Meterological conditions during the spraying were as follows:

June 10, 1971	Wind	Humidity	Temp.
7:30 AM	E 7 MPH	74%	76°F
9:30 AM	SW 5 MPH	63%	83°F
11:00 AM	SW 5 MPH	57%	84°F
12:00 PM	SW 5 MPH	57%	84°F

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TABLE I

Deer Found in Shelby County Wildlife Kill - June 1971

Date	Sex	Age (Yrs.)	Location	Condition When Found	Necrop-sied	Remarks
6-16-71	F	2	20 yd. from field	decaying	yes	2 fawns (unborn)
6-16-71	M	3	60 yd. from field	decaying	yes	large deer & ant.
6-16-71	M	5	in field	decaying	yes	large deer & ant.
6-16-71	F		in field	decaying	no	
6-16-71	F		in field	decaying	no	
6-17-71	F	7+	in field	decaying	yes	2 fawns (unborn)
6-17-71	F	3	in field	decaying	yes	2 fawns (unborn)
6-18-71	F	3	in field	decaying	yes	2 fawns (unborn)
6-18-71	M	1	in field	decaying	no	
6-18-71	F	1	in field	decaying	no	
6-18-71	F	1	3/4 mi. E. of field on river bank	decaying	no	

Toxicology of Arsenic

The mortality in acute arsenic poisoning is high (50-75%), with death usually occurring in 48 hours. The lethal dose varies with the compound, but 0.2 to 0.3 g. of the trioxide is usually fatal in adult man (2).

In most cases the presenting symptoms are those of a severe gastritis or gastroenteritis. Because the lesions are due to vascular damage from the absorbed arsenic (2, 3), the onset of symptoms may be delayed several minutes or even a few hours. Eventually, a violent hemorrhagic gastroenteritis leads to a profound loss of fluid and electrolytes, resulting in collapse, shock, and death (4) This perhaps explains the fact that all of the deer were found near or in a water source. Severe blood dyscrasias result from depression of cellular elements in bone marrow (5, 6). These effects may be related to inhibition of folic acid metabolism (7). In advanced poisoning, nervous symptoms are prominent; encephalopathies have been described (5, 8), but peripheal neuritis is more common (9). Sensation (paresthesia, hyperthesia, pain) is involved first but eventually paralysis and muscular atrophy appear, usually in the legs.

The toxic principle is presumably the ion of arsenious acid, rather than the element itself. The *in vivo* conversion to arsenite explains why all but one chemical form of arsenic produce the same toxic syndrome. The exception is gaseous AsH_3, or arsine, which is a potent hemolytic agent, unlike the other arsenic derivatives (10, 11, 12, 13).

Although this information was compiled from human exposure records, it relates biomedically to other vertebrate mammals in which the symptomatology and progression of the poison are similar.

Environmental Impact

Six of the 11 dead deer were does; at necropsy four of them were found to be carrying twin fawns (Table I), bringing the deer loss to 19 head. In addition, each of the two does which were not necropsied were probably carrying twin fawns. If so, the loss would amount to 23 head of deer. All of the deer appeared to have died on the same day and had been dead for several days when found. The 11 dead deer by no means represent the total mortality, but merely the findings of a systematic search of the 600-acre treated field and a cursory survey of the surrounding woods. Presumably, the lethal effects of the spray were lost within a day or so; otherwise, one would expect more deer to be found even from the limited search conducted.

Use of this herbicide had little effect in controlling the grass but resulted in the confirmed deaths of 11 adult white-tailed deer. Six of the 11 deer were necropsied and specimens of liver, kidney and rumen contents were collected from five of the deer found in the treated area (Table I). Samples of water, soil, and vegetation were also taken in the treated field.

Qualitative chemical analysis was made on specimens from three of the deer by the C. E. Kord Animal Disease Laboratory of the Tennessee Department of Agriculture, Division of Foods, Drugs and Dairies in Nashville, Tennessee. Qualitative and quantitative analyses of all the samples collected were made by the Environmental Protection Agency Toxicology Laboratory at Chamblee, Georgia.

Laboratory Findings

The C. E. Kord Laboratory found a very strong positive test for arsenic and interpreted their analyses as follows: "Arsenic levels in all tissue specimens were sufficient to have caused death."

Analyses made by the Environmental Protection Agency Toxicology Laboratory revealed arsenic concentrations of 2.4 ppm in the combined soil and vegetation; 0.48 and 0.36 ppm in the water; with average levels of 18.96, 17.78, and 22.50 ppm in the liver, kidney and rumen contents, respectively (Table II). All of the quantitative analyses for arsenic were done by the Fisher Mod. of the Gutzeit method as reported by Curry (1). This laboratory's interpretation of their results was "The concentrations of arsenic found indicate an acute exposure."

TABLE II

Arsenic Concentrations in Deer Tissues and Rumen Contents
Shelby County, Tenn. - June 1971

Deer Number	Residues in ppm		
	Liver	Kidney	Rumen Contents
1	19.5	20.0	19.7
2	24.3	33.0	24.4
3	16.8	16.7	18.6
4	14.7	7.6	31.8
5	19.5	11.6	18.0
Average	18.96	17.78	22.50

TABLE III

Costs of Deer Restoration in Tennessee, 1959-1970

Fiscal Year	Number of Deer Stocked	Total Costs Expended ($)	Average Cost per Deer
1959-60	251	$ 16,955.97	$ 67.55
1960-61	238	18,034.53	75.78
1961-62	210	14,548.02	69.28
1962-63	150	14,070.15	93.80
1963-64	123	15,466.92	125.74
1964-65	174	10,875.50	62.50
1965-66	202	10,791.89	53.42
1966-67	175	13,053.91	74.59
1967-68	173	10,620.68	61.39
1968-69	126	11,176.68	88.70
1969-70	118	15,785.83	133.78
1970-71	240	23,290.00	97.04
Total	2,180	$174,670.08	$ 80.12
Last 2 Years	358	$ 39,075.83	$109.15

TABLE IV

Minimum Losses Attributable to
Shelby County Deer Kill - June 1971

Item	Total Cost
Animal Losses (Deer)	$2,510.45
Investigation Salaries:	
(Biologist)	195.00
(Biologist)	57.34
(Enforcement Officer)	127.86
Travel: (Lodging, etc.)	118.00
Equipment: (Boots, gloves, boxes, etc.)	62.90
Consultant Fee (Estimate)	2,000.00
TOTAL COST	$5,071.55

This loss of deer, in terms of potential production, is significant; the $5,071.55 loss is estimated as the sum of the cost to replace the wildlife and the amount spent in investigating the cause and extent of the kill (Tables III and IV).

Comments

The use of Arsenic Acid for the control of Johnson grass on agricultural land violated the U.S.D.A. registration of the chemical, and the pilot who applied the chemical violated the Federal Aviation Administration Code, Part 137.39, paragraphs 1, 2, and 3.

This misuse of a registered pesticide resulted in an appreciable loss of wildlife. Similar incidents may well occur quite often but go unreported. The misuse, as well as the overuse, of pesticide chemicals has been too long neglected, overlooked, or justified as a trend of the times; however, we can no longer afford this unnecessary and willful slaughter of wildlife and depletion of natural resources. This documented incident emphasizes the need for stricter control of pesticide use and all the applicators of such chemicals.

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