Effects of Atrazine on Reproduction in Rats*

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Atrazine is a herbicide widely used in agriculture. Michigan dairy farmers have raised questions concerning the possible adverse effects of atrazine on reproduction in cattle. In order to provide a basis for predicting the levels of atrazine that might be required to affect reproduction, initial studies were conducted using rats. The results are reported in this communication.

Methods

Experiment 1. In all experiments vaginal smears were made to detect sperm. Rats were divided into eight groups of 4 rats each. Atrazine was fed in the feed from day 1 of pregnancy throughout gestation at the level of 0, 50, 100, 200, 300, 400, 500 and 1000 PPM.

Experiment 2. Four groups of 4 rats each were injected subcutaneously with atrazine in 1 ml of DMSO at days 3, 6, and 9 of gestation at the level of 0, 50, 100 and 200 mg/kg body weight. Controls were injected with 1 ml of DMSO.

Experiment 3. Three groups of 4 rats each were injected at days 3, 6, and 9 of gestation with atrazine in DMSO at the level of 0, 800 and 2000 mg/kg body weight. Atrazine injected at the level of 2000 mg/kg body weight could not be dissolved in 1 ml of DMSO. Therefore, 1 ml of a suspension of atrazine in DMSO was injected.

Experiment 4. Three groups of rats (5-7 rats/group) were injected with atrazine in DMSO at days 3, 6, and 9 of gestation at the level of 0, 1000 and 2000 mg/kg body weight. Controls were injected with 1 ml of DMSO.

Experiment 5. Six groups of 3 rats each were injected with atrazine at days 3, 6, or 9 of gestation at the level of 0, 1000 and 2000 mg/kg body weight. Controls were injected with 1 ml of DMSO.

*Published with the approval of the Director of the Agricultural Experiment Station as Journal Article No. 5951.

Bulletin of Environmental Contamination & Toxicology,
Vol. 9, No. 5 © 1973 by Springer-Verlag New York Inc.

Results and Discussion

The results of the first experiment are presented in table 1. When fed at levels ranging from 0 to 1000 PPM in the feed, atrazine did not affect the number of pups/litter or weaning weight. When atrazine was injected at levels up to 200 mg/kg body weight, there was no effect on the number of pups/litter (table 2).

TABLE 1

Effects of Various Levels of Atrazine in the Feed on Reproduction in Rats (4 Rats/Group)

Treatment	Pups/Litter	Weaning Weight Per Pup (g)
Control	11	33.2
50 ppm	11	28.2
100 ppm	11	30.7
200 ppm	10	32.0
300 ppm	12	25.7
400 ppm	12	28.5
500 ppm	10	30.2
1000 ppm	10	32.5

TABLE 2

Effects of Atrazine On Reproduction in Rats When Injected Subcutaneously At Days 3, 6 and 9 of Gestation (4 Rats/Group)

Treatment	Pups/Litter
Control (DMSO)	11
50 mg/kg	10
100 mg/kg	11
200 mg/kg	11

However, atrazine injected at the level of 800 or 2000 mg/kg body weight was embryotoxic (table 3). At the high level none of the rats had pups, yet uterine resorption sites were readily apparent. In the fourth experiment atrazine was injected at the level of 1000 and 2000 mg/kg body weight (table 4). With the exception of one rat treated at the lower level, atrazine was embryotoxic.

TABLE 3

Effects of Atrazine on Production in Rats When Injected at Days 3, 6 and 9 of Gestation (4 Rats/Group)

Treatment	Pups/Litter	Resorption Sites/ Uterus
Control (DMSO)	10	--
800 mg/kg (3 rats)	8	--
(1 rat)	0	11
2000 mg/kg	0	9

TABLE 4

Effects of Atrazine on Reproduction in Rats When Injected Subcutaneously at Days 3, 6 and 9 of Gestation

Treatment	Pups/Litter	Resorption Sites/ Uterus
Control (4 rats)	13	-
1000 mg/kg (1 rat)	11	-
(6 rats)	0	7
2000 mg/kg (1 rat)	3(3 dead)	6
(1 rat)	7(2 dead)	-
(3 rats)	0	9

An experiment was conducted to determine the critical stage of gestation at which atrazine affects organogenesis. The results are shown in table 5. Atrazine injected on day

6 of gestation at the level 1000 mg/kg body weight reduced the number of pups per litter by 50%. The other treatments did not affect reproduction. The data suggest that the critical stage of organogenesis may be day 6 which is just after implantation. Since the high level of treatment did not affect reproduction it may be that atrazine injected as a suspension is not readily absorbed into the blood.

TABLE 5

Effect of Atrazine on Reproduction in Rats When Injected Subcutaneously at Days 3, 6 or 9 of Gestation (3 Rats/Group)

Treatment	Pups/Litter
3 Day Control	10
1000 mg/kg	12
2000 mg/kg	9
6 Day Control	13
1000 mg/kg	6
2000 mg/kg	14
9 Day Control	11
1000 mg/kg	10
2000 mg/kg	12

To our knowledge there is one other report of the effects of atrazine on reproduction in mammals (1). In this experiment atrazine when administered to mice at the level of 46.4 mg/kg body weight from the sixth to 14th day of pregnancy did not affect reproduction.

It is clear that atrazine was not embryotoxic except when administered at extremely high levels. If the toxicity of atrazine in the rat and a 500 kg cow are comparable, then a cow would need to consume one pound or more in order to affect reproduction. One would not expect this level of contamination even if atrazine was used in a careless manner.

Even though high levels of atrazine are necessary to affect reproduction in rats, it is possible that much lower levels would affect reproduction in cattle. It is well known that there is considerable species variation in susceptibility to poisons.

References

1. U.S. Dept. Health, Education and Welfare. Report of the Secretary's Commission on Pesticides and Their Relationship to Environmental Health. p. 673, Dec. (1969).