AMMATE IN THE DIET OF DEER

ARNOLD O. HAUGEN, Leader, Alabama Cooperate Wildlife Research Unit

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The die-off in the deer herd in the Choccolocco Game Management Area of the Talladega National Forest during the summer of 1949 attracted considerable attention both from game authorities and the general public. Because the die-off coincided with the period when Ammate (ammonium sulfamate) was used by the U. S. Forest Service to kill certain trees on the area, circumstantial evidence indicated this chemical may have been responsible for the mortality. Ammate was used in the forest from June 28 to August 15. It was applied to oaks and other broadleaved species of trees for the purpose of timber stand improvement.

Application was made by chopping one or more notched "cups" in the trunks of the trees at a height of about one and one-half to two feet above the ground, and then applying about a dessert-spoonful of Ammate into each cup-shaped wound. A tree ten to twelve inches in diameter at breast height usually had three or four "cups" chopped out and treated. In the earlier part of the period when Ammate was applied, the sap was flowing freely in the trees. At that time the sap combined with the Ammate to form a gummy, and salty tasting paste. This paste, however, is reported to have been absorbed by the tree within six or eight hours after application.

It was the third week after "poisoning" began that most dead deer were found. On the basis of a field survey, it is estimated that as many as 600 deer may have died in the area, which contains approximately 20,000 acres of good deer habitat and considerably more fair deer area. Most of the mortality, however, was concentrated near streams in the best deer habitat.

Many people in the state believed that Ammate was responsible for the die-off. This belief was strengthened by the fact that the State Department of Toxicology recovered from the intestines of two deer found in the area, a residue "having the properties of ammonium sulfamate."

A search of the literature failed to yield any data which indicated whether or not Ammate is poisonous to large animals such as deer or cattle. Two publications dealing with tests on toxicity to rodents have appeared, neither of which are available in the local library. Because none of the publications gave any indication as to the possible effect of Ammate on deer, experiments to determine this were initiated.

Facilities for the study consisted of a series of two pens and three doe deer. In each test at least one and sometimes two deer were used as check animals. Tests on crystalline Ammate and Ammate-treated foliage of sweet gum and post oak were conducted in the summer of 1950. Tests with water oak, parsimmon and black cherry were conducted in 1951. The reason for using these particular species in the tests is that they are commonly treated in timber stand improvement work. Approximately a two-week interval was left between the tests. The diet during the rest period consisted of corn, sweet cow feed and alfalfa hay.

FREE CHOICE OF CRYSTALLINE AMMATE

"Raw" crystalline Ammate was placed in the pen with two yearling does from June 20 to July 24, 1950. Because the Ammate sample gained in weight from 315 grams to 607 grams during this period, as a result of its hygroscopic qualities, it was impossible to determine how much Ammate had been consumed. However, a yearling doe (Number 3001) was observed eating Ammate on three separate days. The animals were fed hay, water and a portion of sweet cow feed. No other salt of any kind had been given the animals for approximately a month previous to this experiment.

At no time during the experiment did either of the deer to which crystalline Ammate was available show any signs of illness or lack of condition. In fact, one deer gained 13½ lbs. and the other 7½ lbs. These yearlings were still growing at the time and could be expected to gain in weight. The check animal, a mature doe, showed no significant change in weight during the same period.

Two calves to which Ammate was made available on a free-choice basis along with calf meal and hay for one week at the Alabama Polytechnic Institute Veterinary School were not affected. As far as could be determined, they consumed none of the Ammate (Hokanson 1951). Hokanson then force fed one calf one ounce and a second calf two ounces of Ammate each day for 10 days. He states, "no harmful effects were noticed, in fact, the calves seemed to improve in appetite and in the quality of their condition — No change in the blood count or in appearance of the blood picture was noted."

FEEDING OF FOLIAGE TREATED WITH AMMATE

The possibility that Ammate might become poisonous to deer when combined with sap in the twigs and leaves of a plant in the process of being killed was next considered. There also existed the possibility that Ammate might stimulate growth and make palatable certain poisonous plants which normally are not eaten in sufficient quantities to be toxic. In order to evaluate these possiblities, experiments were set up to feed foliage from plants wilting because of having been "poisoned" with Ammate a few days earlier. In each case, the Ammate was applied in one or two V-shaped cuts in the bark. Most of the plants so treated usually began wilting in two or three days. As soon as the foliage showed a marked degree of wilting or discoloration, the small terminal branches with leaves were cut and brought to the deer pens for feeding.In most cases, the samples were cut between 4 to 7 days after the Ammate was applied. Freshly cut foliage was provided the deer daily. One pen of deer received the wilted Ammate-treated foliage, the deer in the second pen served as a check and received freshly cut untreated foliage of the same species.

SWEET GUM DIET

The deer on the experimental diet of sweet gum *(Liquidambar styraciflua)* received an ample supply of branchlets with leaves for a period of 14 days. Two yearling does were fed foliage from saplings whose leaves were wilting from the effects of Ammate. A mature doe was fed untreated foliage to serve as a check. Each of the animals received a portion of sweet cow feed daily in addition to the foliage. Water was available in the pens.

Sweet gum foliage wilting from the effects of Ammate produced no symptoms of sickness and did not cause any loss of condition. In fact, deer 3002 and 3004 gained two and one-half and one lbs. respectively. The old deer on the check diet showed no change in weight (Table 1).

Table 1. Weights of deer in relation to diet on foliage treated with ammate and on fresh untreated foliage of the same species.

Item Tested	Other Food Available	Animal Number	Ammate foliage diet (lbs.) Start	Ammate foliage diet (lbs.) End	Untreated foliage diet (lbs.) Start	Untreated foliage diet (lbs.) End
1950						
Sweet Gum	hay and	3002	65.00	67.50		
	sweet cow	3004	67.50	63.50		
	feed	3003			98.50	95.50
Post Oak	hay and	3002	67.50	68.75		
	sweet cow	3004	63.50	65.50		
	feed	3003			98.50	94.75
1951						
Water Oak	rock salt	3003	94.00	87.50		
		3004	73.50	71.50		
		3002			83.50	72.50
Persimmon	rock salt	3002	72.50	72.50		
		3003			89.50	75.25
		3004			68.25	68.00
Wild	rock salt	3002	72.00	67.50		
Cherry		3003			79.00	68.00
		3004			65.00	52.50

Post Oak Diet

Post Oak *(Quercus stellata)* foliage was fed to three deer for 15 days. Foliage wilting from Ammate was fed two yearling does. Freshly cut untreated foliage was provided a third animal, an old doe. In addition to the foliage, a portion of sweet cow feed, and water was available in each pen.

None of the deer were noted to suffer any ill effects from the diet. Each of the two animals on a diet of Ammate-treated post oak gained weight, one adding one and 0.25 lbs. and the other 2 lbs. The old doe on a check diet of untreated foliage lost two lbs. during the diet test.

Water Oak Diet

A diet consisting exclusively of water oak *(Quercus nigra)* was maintained for a period of 14 days. Foliage wilting from Ammate was fed two adult does. Freshly cut untreated foliage was provided a third adult doe utilized as a check. Of the two animals on the Ammate-treated diet, one lost 7 lbs. and the second 2.5 lbs. A loss of 10.5 lbs. was registered by the check animal feeding on untreated foliage. No sign of discomfort or illness was noted.

PERSIMMON DIET

Persimmon *(Diospyros virginiana)* foliage wilting from the effect of Ammate was fed to an adult doe for a period of 14 days. Nothing else except water was provided. Two check animals (Adult) were provided untreated foliage. The deer receiving Ammate treated foliage showed no change in weight, but of the two check animals on the untreated foliage, one registered a loss of one-half and the other 11.25 lbs.

BLACK CHERRY DIET

Wild black cherry *(Prunus serotina)* foliage was fed to three adult deer for a period of 14 days. No other food was available to the animals during this time. The animal on a diet of wilting Ammate-treated cherry foliage lost 4.5 lbs. Losses of 11 lbs. and 12.5 lbs. were experienced by the two adult does on the freshly cut untreated foliage. No sign of sickness was noted.

DISCUSSION

Experimental feeding of "raw" crystalline Ammate to three captive deer did not result in any apparent discomfort or illness to the animals. In fact, the deer to which the Ammate was available gained in weight during the test. This checks with experiments with calves which showed a gain in general condition (J. F. Hokanson, pers. comm.).

Deer which were kept on diets of Ammate-treatd sweet gum and post oak along with a portion of sweet cow feed, gained in weight. This gain is believed to have occurred mainly as a result of continued growth of the still immature yearling animals.

The experimental diets of water oak, persimmon and black cherry were maintained without the availability of other food. Results indicate that each of these three species are in themselves inadequate as food for deer when fed exclusively. Although each of the animals on the water oak, persimmon and black cherry diets lost weight, it is significant that in each case the animal or animals on the Ammate-treated foliage lost less weight than the animals on freshly cut untreated foliage of the same species.

The experimental feeding of black cherry was conducted last because it was feared the experimental animals would die from "cherry poisoning." Wild black cherry when consumed is commonly fatal to livestock. It is one of several cyanogentic plants which commonly result in death to sheep and cattle because of the liberation of hydrocyanic acid (prussic acid). The poisonous properties of hydrocyanic acid (HCN) are variable, being dependent on the presence of a glucoside called amygdalin, an enzyme capable of hydrolizing the glucoside, and conditions favorable for the accumulation of lethal amounts of the hydrocyanic acid (Muencher 1939). Both fresh and wilted leaves of cherry are reported as poisonous. However, the maximum amount of HCN is found in leaves which have wilted in sunlight until they appear slightly limp (Morse and Howard 1898). Morse also concluded that *Prunus serotina* was more poisonous than *P. virginiana* and *P. pennsylvanica.* Duncan and Jones (1949) report that twigs as well as leaves contain hydrocyanic acid.

Although the three deer ate leaves, buds and twigs of the black cherry for 2 weeks, they suffered no ill effect except a continued loss of weight, which loss also occurred on diets of persimmon and water oak. In general, there was a gradual decline of weight during each of the three test (Table 1). One of the animals even lost some weight between experiments when it was on a regular diet of corn, sweet cow feed and hay. The animal was near death from starvation when the tests were concluded. Common rock salt was available during each of tests with water oak, persimmon and cherry.

The diet of black cherry was provided from August 14 to August 27. In Nevada, chokecherry leaves are reported to be most poisonous from late April to the end of August, and by October they have lost their poisonous properties (Fleming et al. 1926). Accordingly it seems probable that the cherry fed contained normal amounts of poison but that the deer were not affected significantly. Mule deer on the California-Oregon State line are known to include wild cherry *(Prunus spp.)* in their summer diet (Interstate Deer Herd Committee 1951). Perhaps their habit of nibbling at food a little at a time made it possible for them to eliminate HCN rapidly enough to prevent fatal results. Sheep and cattle are reported to be able to consume several times the quantity sufficient to produce death, provided the feeding is done a little at a time over the period of a day (Fleming et al. 1926). Since a deer does not have a gall bladder it is also possible that conditions in its stomach are not favorable for a rapid chemical breakdown of the glucoside to form a lethal dose of HCN. Morse et al. (1898) stated that in cattle the character of the juices within the animal's stomach is such as to render that organ a most favorable place for the conduct of the reaction in which hydrocyyanic acid is formed. In sheep the production of a lethal dose of HCN is reported to be facilitated or speeded by the drinking of water (Fleming et al. 1928). In fact, some flocks were unaffected until they passed a stream where they drank water, quickly became sick and died. Such cases were at first thought to have resulted from poisoned water. It is to be recalled that a majority of the deer found in the Choccolocco Area of the Talladega National Forest were lying in stream bottoms. Whether the deer came there in search of water before dying or because of the thicker cover available in those areas is not known. Animals are sometimes known to seek out secluded places in which to die. There is no information, however, to indicate that the eating of cherry foliage was in any way connected with the die-off in the Choccolocco Area or anywhere else where the mortality occurred.

Average consumption of water per animal for the two adult deer on a diet of untreated black cherry was 3 lbs., 5.2 ozs., and for the animal on the Ammate-treated cherry, 2 lbs., 9.7 ozs. This indicates an average daily consumption of roughly 1.75 and 1.25 quarts of water respectively (Table 2). This rate of water consumption is slightly greater than that accompanying the diet of water oak and persimmon.

Table 2. Average daily water consumption by deer.

Diet	On Untreated Foliage	On Wilting Ammate-Treated Foliage
Water Oak	1 lb., 15.1 ozs. Water	2 lbs., 11.5 ozs. Water
Persimmon	2 lbs., 7.5 ozs. Water	2 lbs., 1.8 ozs. Water
Black Cherry	3 lbs., 5.5 ozs. Water	2 lbs., 9.7 ozs. Water

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