The Effect of 2,4-Dichlorophenoxyacetic Acid on the Hydrocyanic Acid and Nitrate Content of Sudan Grass

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SUBLETHAL concentrations of 2,4-dichlorophenoxyacetic acid (2,4-D) have been shown to produce marked alterations in the physiology and chemical composition of a variety of plant species. A special phase of this problem is the effect of 2,4-D on the qualitative or quantitative change in plant toxins, or substances potentially toxic in nature. The relationship between 2,4-D treatment and hydrocyanic acid (HCN) content in wild cherry plants has been studied by Lynn and Barrons (7) and Grigsby and Ball (6). They found a decrease in HCN after treatment with the herbicide and concluded that application of 2,4-D or 2,4,5-trichlorophenoxyacetic acid (2,4,5-T) does not increase the danger already present in wild cherry to livestock.

Stahler and Whitehead (10) investigated the effect of 2,4-D on the nitrate content of sugar beets and found that nitrates were increased to levels lethal to ruminants. Although nitrates themselves are not poisonous, microorganisms in the rumen convert nitrates to the poisonous nitrites. Fertig (2) has shown that in some weed species sprayed with 2,4-D there was an increase in nitrate content over controls for 2 or 3 days after spraying, followed by a gradual decrease to 8 days.

The uncertainties and lack of substantiating evidence involved in many reported cases of livestock poisoning where vegetation was treated with 2,4-D have been discussed by Willard (12) and Fertig (3). Entirely apart from the immediate concern of livestock poisoning by sprayed plants, it is important to understand the fundamental responses of cyanogenic plants to 2,4-D, and the relationship between cyanogenic glucosides and their possible precursors or degradation products in treated plants.

In the present investigations, experiments were conducted under greenhouse and field conditions to determine the effect of several rates of application of 2,4-D at various stages of growth of the subsequent formation or accumulation of HCN in Sudan grass.

METHODS

Preliminary studies with wild cherry showed variability in hydrocyanic acid content between branches on the same tree. In order to avoid variability experienced with wild cherry, another of Sudan grass, was chosen for further study. The method permitted more accurate application of known to replicated plots of uniform plants, facilitated sampling procedures, and made it possible to under greenhouse conditions.

Tift, a variety of Sudan grass containing only of HCN, was used in both the field and greenhouse. The plants were sprayed with the propylene glycol butyl ether of 2,4-D using application equipment described by Shaw and Swanson (8). Sample harvests were made on each date of harvest to avoid diurnal variations of hydrocyanic acid content (4). Nitrate determinations were dry samples according to the Devarda method as KNO₃. For hydrocyanic acid determinations, 8 gm. leaf samples were cut into ⅛-inch lengths in water overnight. The amount of HCN in the the samples was determined by the quantitative method (11).

In the greenhouse experiment, Sudan grass was flats and sprayed with 4 pounds per acre of 2,4-D at the 2, 4, 6, 9 and 12-inch stages of growth. were replicated 4 times in a randomized block design were harvested 8 days after treatment.

Sudan grass was planted in the field on June plots 25 feet long. The treatments, 0, 1, 2, and acid equivalent per acre, were applied at the 6-inch on July 14 and at the 12-inch stage of growth. The experimental design was a randomized block. Samples for HCN and nitrate analyses were harvested 8. 16 and 32 days after treatment.

RESULTS

Greenhouse Studies

In the greenhouse studies soil moisture was maintained near the optimum for vigorous atmospheric temperatures were not excessive growth of the Sudan grass was obtained. Results of treatment represent the effect of plants were at a high level of physiological applied at any of the several stages of growth caused stunting of the Sudan grass. Plants 2-inch (2 leaf) stage of growth were all preventing analyses of HCN or nitrates. Severity