The Duration and Effect of 2,4-D Toxicity to Crops Grown on Calcareous Soil Under Controlled Irrigation Conditions

LAMBERT C. ERICKSON AND HARRY S. GAULT

Several workers (1, 3, 4, 5) have investigated various factors which influence the persistance of 2,4-D (2,4-dichlorophenoxyacetic acid) in soils. Results of these studies indicate that moderately high organic matter content in soils, high pH, i.e., neutral to slightly alkaline, high soil temperatures, and high soil moisture, all tend to reduce the period of soil sterility or the toxicity due to 2,4-D. Kries (4) found that when lime was added to a soil and the soil 2,4-D treated, toxicity persisted longer.

Earlier studies on the duration of 2,4-D in soil, conducted under greenhouse conditions at Idaho, indicated that the toxicity of 2,4-D in soil could be eliminated in a few weeks time. The toxic effects of 2,4-D rates ranging from 1 to 16 pounds per acre, applied directly to the soil, were entirely removed in periods of 1 to 6 weeks. The duration of the soil sterility was in direct relation to the quantity of 2,4-D applied. Toxicity was determined by observing the germination and growth of alfalfa, beans, corn, and wheat as compared to the performance of these crops in untreated check flats.

In these greenhouse studies, the treated and untreated soil flats were watered daily and constantly maintained at a high moisture level. Greenhouse temperatures varied between 70° and 90° F. Thus the soil temperatures were constantly higher than would exist under most field conditions. The rates of dissipation of 2,4-D obtained in these studies are in general agreement with other studies conducted under greenhouse conditions (1, 5).

Under field conditions, quite contrary soil sterility effects from 2,4-D have been observed. Preplanting and postplanting treatments usually have affected the crop stand adversely. Fall applications, in some instances, have shown toxic effects upon various crops planted the following spring. Sterility from spring applications has in a few instances persisted until fall. In one instance, a summer application gave evidence of toxicity to sugar beets a year later.

Preplanting and pre-emergence weed control treatments using 2,4-D have given erratic results. Dunham (2) reports that in Wisconsin, 2,4-D was rarely applied as a soil sterilant.

Recently, Kries (4) attempted to determine how long such toxicity might persist under field conditions. Conclusions were made: “Weeds, including competing species, emerged rapidly; 2,4-D in lethal quantities. In 1948, corn was not planted until the normal date; weeds, especially many grasses, germinated late; 2,4-D no longer remains in lethal amounts.”

Obviously, there are factors other than temperature, and pH that influence the duration of sterility resulting from 2,4-D treatments. Recent studies have shown that these factors have been significantly altered between the 1947 and 1948 seasons in the North Central region. Probably one of the most important factors influencing the duration of toxicity is soil moisture. The influence of soil moisture on the duration of 2,4-D is a difficult factor to estimate in the field. Investigations on this phase are being conducted under conditions of at least periodic soil moisture levels or the irrigated farming systems common to the western states.

The Practical Problem of 2,4-D Toxicity

Applications of 2,4-D as preplanting or pre-emergence treatments are essentially selective, temporary, soil sterilants. They are applied with the objective of preventing the germination or delaying their germination until a weed is in a good to optimum competitive stage of growth. 2,4-D should persist as a selective soil toxicant, i.e., for germinating weed seeds throughout the growing season. At this point its toxicity should end so that there will be no toxic effect upon the succeeding crop.

Throughout Idaho, 2,4-D is rarely applied after planting. It is used most extensively as a postemergence soil sterilant in grain fields and, secondly, as a nonselective herbicide along roadsides, canal banks, and waste areas, and, occasionally, as a substitute for cultivation in dryland areas during the cropping year. Treatments with 2,4-D for weed control under these conditions are applied at any time from spring to fall, depending upon the weed species, the plant population, and location.

Under such diverse weed control operations, soil toxicity becomes an important factor in weed control. Farmers may treat a dense emergence of noxious weeds in the spring before planting their crops. Others treat late in the fall, depending upon the weed species, the plant population, and location.

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