Some Effects of Ammonium and Sodium 2,4-Dichlorophenoxyacetates on Legumes and the Rhizobium Bacteria

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RECENTLY the new herbicide 2,4-dichlorophenoxyacetic acid has come into wide use by farmers and agricultural workers. A review of the literature on this compound, commonly referred to as 2,4-D, reveals considerable information regarding its effect on certain legumes (1, 2, 3, 7, 8, 9, 10, 11, 12). However, little exact information is available regarding its effect on the symbiotic nitrogen-fixing rhizobia and their relation to legumes under the influence of the herbicide. In addition most of the literature refers to the use of the 2,4-dichlorophenoxyacetic acid rather than the ammonium and sodium 2,4-dichlorophenoxyacetates which some manufacturers have recently made available. Both of these salts have the advantage of being soluble in water, which greatly simplifies the ease of application.

Field observations in Idaho and recent research by Payne and Fults (4) have revealed that 2,4-D caused growth abnormalities and reduction in nodulation in bean plants. Smith, et al. (5) and Stevenson and Mitchell (6) studied the effect of 2,4-D on certain soil microorganisms, but the rhizobia were not included in these studies.

Since legumes are important in many crop rotations, the effect of applications of 2,4-D may be of considerable significance in the nitrogen economy of the soil. This is particularly true if the herbicide has a deleterious effect on all legumes and nodulation such as reported on beans by Payne and Fults (4).

The situation resolves itself into three closely related parts as far as the rhizobia and legumes are concerned, viz., first, the effect of 2,4-D on the rhizobia which exist as free-living soil organisms during part of their life cycle; second, the effect of the herbicide on the legume plant itself; and third, the effect of the 2,4-D on the ability of the bacteria and the legume to form nodules.

With these questions in mind, laboratory and greenhouse studies were undertaken as follows: (A) To determine, using a synthetic medium, the concentration of ammonium and sodium 2,4-dichlorophenoxyacetates that would inhibit growth of Rhizobium leguminosarum, R. phaseoli, R. trifolii, R. lupini, R. japonicum, and R. meliloti; (B) to determine the effects of the 2,4-D salts on nodulation and growth of beans, peas, red clover, and alfalfa; and (C) to compare the effects of the ammonium 2-4-D with the effects of the sodium salt.