CALCIUM ARSENATE AND UNPRODUCTIVENESS IN CERTAIN SOILS[1]

THE economic necessity of combating the constantly increasing number of insects that attack crop plants has resulted in the employment of increasing quantities of insecticides. For control of the cotton boll-weevil, calcium arsenate dust is commonly used in amounts varying from 20 to 50 pounds an acre annually. Therefore, relatively large amounts of arsenic are added to the soil in a comparatively short time.

It is beyond the scope of this paper to review studies of the physiological effects of arsenic upon plants except to mention that it is well established that appreciable concentrations of soluble arsenic in the medium in which plants are grown are more or less toxic. Observations with a Norfolk fine sandy loam soil at Florence, South Carolina, show that frequent applications of calcium arsenate dust for boll-weevil control over a period of years may render such soils unproductive for certain crops. It has been found extremely difficult, except under highly favorable seasonal conditions, to obtain normal appearing cotton, oats and cowpeas when the preceding crop has received these frequent applications.

Soil that contained thirty parts per million of arsenic and which would not produce a normal growth of cowpeas and oats was transferred to a greenhouse soil bed. A soil of similar type containing eight parts per million of arsenic and which would produce a normal growth of cowpeas and oats was used as a check. Oats and cowpeas were planted and at about the time of maximum vegetative development samples of roots and tops were obtained and subsequently analyzed for some of the minerals. The data pertaining to the arsenic content in parts per million on a dry weight basis are presented in Table 1. In all cases the concentration of arsenic in the tops and roots was appreciably higher in the plants grown on the high arsenic soil although the tops had much lower concentrations of arsenic than did the roots.

Portions of soil from the low arsenic bed were then treated with calcium arsenate at the rates of 200 and 400 pounds per acre and, after being allowed to stand for one week, were planted to cowpeas. Marked differences in germination and rates of growth were apparent after four days and most of the seedling plants in the treated beds died within two weeks. Arsenic analyses of the roots of seedling plants ten days after planting showed a content of 25, 288 and 330 parts per million in the untreated, 200 pounds, and 400 pounds per acre applications of calcium arsenate, respectively.

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Various salts were added to an arsenic treated soil in collodion sacks and the diffusates analyzed for soluble arsenic. Calcium carbonate and certain iron salts were the only electrolytes used that decreased the arsenic in the diffusate. Greenhouse and field tests with sufficient amounts of calcium hydroxide to neutralize the soil acidity indicate some improvement in this condition.

It has been noted that cowpeas grow in a normal manner on virgin forest soil and on red clay soil to which calcium arsenate has been added. This suggests that the arsenic fixing power of soil is associated with its organic matter and colloidal contents.

A heavy growth of various forms of algae and fungi were observed in these unproductive soils. Studies on the possibility of soil micro-organisms reducing arsenates to the more toxic compounds are in progress.

The observations and data presented definitely indicate that the addition of large amounts of calcium arsenate to gray light sandy loam soils may be expected to interfere seriously, sooner or later, with the subsequent growing of such arsenic sensitive crops as cowpeas, oats, cotton, and various grasses.

TABLE 1

ARSENIC CONTENTS OF OATS AND COWPEAS GROWN ON SOILS CONTAINING HIGH AND LOW AMOUNTS OF ARSENIC

Arsenic contents of soil in p.p.m.	Arsenic in p.p.m.			
	Oats		Cowpeas	
	Roots	Tops	Roots	Tops
30	180	6	40	11
8	80	3	10	3

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