The Effect of Benzene Hexachloride on the Growth and Nodulation of Peanut Plants

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Pesticides especially chlorinated hydrocarbons applied as spray, dust or directly added to the soil ultimately reach the soil environment and are likely to persist there for a considerable period of time. In cases where crop rotations are practised, in addition to the pesticides applied to the leguminous crop, the residual pesticides from the main crop will also add to the contamination of biosphere. These chemicals may have an effect on the legume-rhizobium symbiosis by direct interaction with soil rhizobia or on plants or by both. Benzene hexachloride (BHC) is widely used in many countries for the control of various insects on many crop plants. The toxic effects of BHC on growth of plants like tomato, cereals, beets and potatoes are known (MARTIN, 1972). However, there are only few reports on the effect of BHC on nodulation as in red clover, soybean, lucerene, hairy vetch (WILSON and CHOUDRI, 1948) and in cow pea (ABOU-EL-FADL and FAHMY, 1958). The effect of BHC on the growth and nodulation of peanut plants in two types of soil is reported here.

MATERIALS AND METHODS

Pots were filled with two types of soil : (1) black clay loam (pH, 7.8; organic carbon, 0.92%); (2) red sandy loam (pH, 6.8; organic carbon, 0.73%). BHC was added at the rate of 10, 50 and 100 ppm to the soil, the normal rate of field application being 10 ppm. Commercial grade of BHC (wettable powder containing 50% technical BHC) was used for experiments. Seeds of peanut (Arachis hypogeae Linn.), Spanish variety, were sown in pots. Pots without the insecticide served as control. Pots were maintained in open air and irrigated uniformly. At the end of 30 days the plants were carefully removed from the pots and flushed with water to remove soil particles adhering to the roots. The number and fresh weight of nodules were recorded. The plants were oven-dried to obtain the dry matter weight. The experiments were con-

ducted in two seasons, viz. summer and winter.

RESULTS AND DISCUSSION

BHC, when added at 50 and 100 ppm concentrations to black clay loam soil, had no inhibitory effect on dry matter weight of plants, and on the number and weight of nodules. Table 1 represents the results obtained in summer. A slight stimulation in dry matter weight and nodulation was noticed at 10 ppm BHC treatment in black loam soil. However, when plants were grown simultaneously in red sandy loam soil under similar conditions, plants showed differential response to the insecticide. Thus there was a marked reduction in the dry matter weight of peanut plants grown in red sandy loam soil containing 10, 50 and 100 ppm of BHC, the effect being more pronounced at 50 and 100 ppm levels.

TABLE 1

Effect of BHC on dry matter weight and nodulation of peanut plants

Treatment ppm	Dry matter weight g/plant*	Nodule number/ plant*	Nodule weight (total) mg/plant*
BLACK CLAY LOAM SOIL			
Control	1.78	38.2	170.5
10	1.89	49.2	238.0
50	1.58	37.1	154.6
100	1.54	30.2	162.5
RED SANDY LOAM SOIL			
Control	2.14	40.1	144.4
10	1.49	31.0	101.7
50	0.59	**	**
100	0.47	**	**

* Average of 15 plants; ** nodules were not formed.

The nodules were not formed in plants grown at 50 and 100 ppm BHC treatments in red sandy loam soil. Also the plants grown at these two concentrations in red sandy loam soil showed severe stunting of growth in shoots (Fig. 1). The

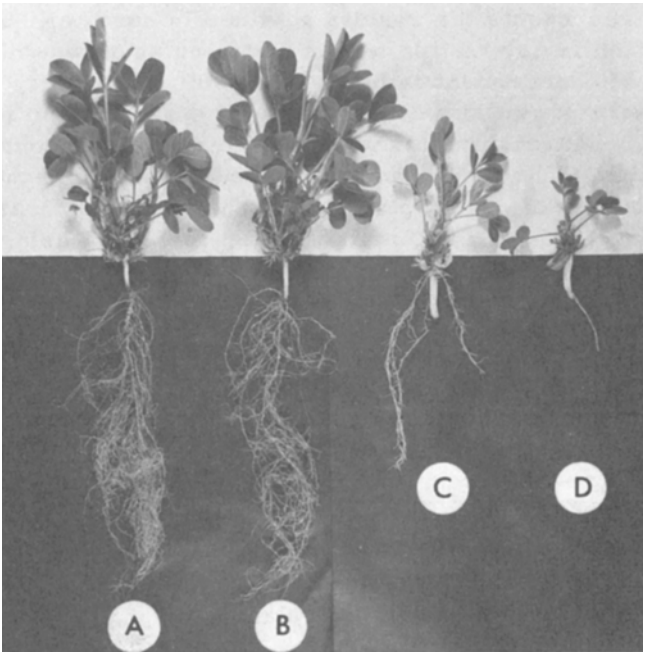

Figure 1. Effect of BHC applied to red sandy loam soil on peanut plants A. Control (untreated), B. BHC, 10 ppm, C. BHC, 50 ppm, D. BHC, 100 ppm.

tap roots were much stunted with only few lateral roots with the treatment of 50 ppm BHC and at 100 ppm the lateral roots were completely absent. The hypocotyl portion was thickened. Such an atypical growth of thickening in root and stem had been reported earlier with BHC (REYNOLDS, 1958). The phytotoxic symptoms might be due to the effect of insecticide on the dis-function of phytohormone metabolism. Recently KARANTH and VASANTHARAJAN (1972) reported the inhibition of tap root elongation and nodulation of sunnhemp with the fungicide Dexon and indicated that Dexon inhibits the conversion of tryptophan

to IAA. The inhibition of root nodulation in peanut plants could be due to the inhibition of rhizobia in the soil and/or indirectly due to metabolic changes in plants.

A similar trend of results was observed when the experiments were done in winter. In black clay loam soil there was no phytotoxic or inhibitory effect on nodulation of peanut plants with 10, 50 and 100 ppm of BHC. However, in red sandy loam soil the phytotoxic and marked inhibitory effects on nodules were seen even with 10 ppm of BHC (results not presented.) It may be pointed out that in experiments done in summer, BHC at 10 ppm in red sandy loam had no such marked inhibitory effects. Lindane (gamma isomer of BHC) has been shown to be volatilized from the soil (RAGHU and MACRAE, 1966). It is likely that increased volatilization of gamma and other isomers of BHC from the soil in summer might have reduced the inhibitory effect on plant growth and nodulation at 10 ppm of BHC in red sandy loam soil.

It is interesting to note that phytotoxic effects and absence of nodulation in peanut plants were seen only with red sandy loam soil and not with black clay loam soil. EDWARDS et al (1957) showed that lindane is adsorbed less in sandy loam soil than in clay loam soil. That insecticides damaged crops more in light sandy soil than in heavy clay soil is also known (EDWARDS, 1972). Most of the added BHC might have been adsorbed in black clay loam soil and hence not made available at the site of rooting or nodulation.

While the reasons for this behaviour of BHC in two types of soil have to be investigated further, nevertheless the above experiments have clearly shown that effects of the insecticide on phytotoxicity and nodulation of plants are dependent on soil type. Also where crop rotations are practised the application of chlorinated hydrocarbons like BHC, both for main crops like cereals and subsequent legume crops, have to be carefully scheduled.

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