THE RELATIONSHIP BETWEEN THE CONCENTRATION OF ETHYLENE DIBROMIDE AND NEMATICIDAL EFFECTS IN SOIL FUMIGATION

BY

F. CALL and N. G. M. HAGUE

Imperial College Field Station, Silwood Park, Sunninghill, Ascot, Berks., England

Chemical determinations were made of the concentration of ethylene dibromide at a number of points inside the soil throughout the duration of the fumigation and it was confirmed that the soil porosity is the most important factor controlling the spread of the fumigant through the soil. The concentration-time product at any point in the soil varied inversely as the soil porosity and directly as the dosage of fumigant.

With Heterodera rostochiensis Woll. using the final cyst count, even at the lowest concentrations which could be determined, the nematode kill was too high to give a good regression of mortality on dose.

The aim of this work was to measure the concentrations of ethylene dibromide inside a soil during fumigation under conditions closely simulating those in the field, and to correlate the concentrations with the nematicidal effects on cysts of Heterodera rostochiensis. The chemical techniques used were those of Call (1957a).

Fumigations were carried out in cylindrical sheet metal bins 45 cm in diameter and 60 cm tall, filled with soil which was a light sand with the moisture content adjusted to field capacity, about 21% moisture. Each bin was filled in four layers, of 15 cm depth, by adding a weighed quantity of soil sufficient to give a 15 cm layer at the required bulk density and compressing the soil evenly to this thickness.

The three upper layers were inoculated with cysts of H. rostochiensis as follows: after partially compressing each layer, cylindrical cores of soil were removed by means of a 4 cm diameter copper tube passed through holes in a circular wooden template which lay on the soil surface. This template was drilled with 4 cm holes arranged in a double spiral so that no one hole could interfere with the radial diffusion of fumigant to any other hole, the distances of the centres of these holes from the centre of the template being in simple multiples of 2.5 cm from 5 to 17.5 cm. The holes in each layer were filled with the same weight of soil containing 20 cysts/g and the soil was compacted to the final thickness. The template was replaced in alignment so that the patterns of cores in the layers coincided and the soil thus had a double spiral of inoculated cores each 30 cm long by 4 cm diameter.

In the first experiment four such bins were filled each with soil of different porosity. They were then covered with polythene sheets and left in a constant temperature room at 8° C for 8 days to come to temperature equilibrium. Sampling
spares of No. 20 s.w.g. stainless steel hypodermic tubing were inserted through the soil surface into the inoculated cores to the depth at which chemical samples were required, usually 15 cm. The injection was made by withdrawing a 1 cm diam. core of soil 15 cm deep at the centre of the soil surface, running into this hole 1 ml of ethylene dibromide and replacing the soil. By means of an apparatus already described (Call, 1957b) samples of soil air were withdrawn from the sampling points and analysed for ethylene dibromide at intervals. When concentration gradients were relatively steep the sample volume was 1.5 ml but after some days, when the gradients had become flatter and the concentrations were lower, the sample volume was increased to 12 ml to obtain greater sensitivity. The bins were kept covered with polythene sheets between sampling times. The experiment was terminated when the concentration had fallen below the minimum detectable level of about 0.01 μg/ml. Successive 5 cm cores of soil were now removed from each of the inoculated regions by means of a 4 cm diameter tube. These cores were air-dried, the cysts recovered, and the viability of batches of 100 cysts in threefold replication determined by a 3-week hatching test.

The concentration-time curves, Fig. 1, show clearly that diffusion of the fumi-