LETTER TO THE EDITOR

CAN CARBOFURAN BE OF USE IN 'CHEMICAL CONTROL' OF HOOK WORM ?

Sir,

(Received on June 21, 1982)

From amongst the pesticides deletering effect of nemagon has been shown on the survival of infective larvae of *Necator amercainus*; *Ancylostoma doudenale*, and *Ancyclostoma caninum* (8) and on the transformation from eggs to larvae and on the survival of infective larvae of *Haemonchus contortus* (11). However, no report is available of the effect of Carbofuran (2, 3-dihydro-2, 2-dimethyl-7-benzofuranyl methyl carbamate) on nematodes infesting man and livestock.

The present investigation was designed to study the effect of this insecticide-nematocide having excellent biological efficacy on wide variety of pests affecting crops (6), on the development of sheep hook worm, *Haemonchus contortus*, from egg to infective larvae in soils of different composition and on survival of larvae in liquid media.

Soil samples (0-30 cm) were collected from representative areas of Aligarh (Soil type I, II, III) and Lucknow district of Uttar Pradesh, Kota district of Rajasthan (Black cotton soil); Kanke district of Bihar (Red soil) and Imphal district of Manipur. Soils were dried, crushed and passed through 4 mm sieve and analysed for various physico-chemical properties.

The faece matter of sheep artificially infected with *H. contortus* was collected in muslin bags attached to rams or withers so as to avoid contamination with urine. Eggs were counted by Stoll's ova counting technique (12). The faeces were mixed with different soils separately and this mixture was adjusted such that it contained 500 eggs/g of the mixture.

Carbofuran was applied in varying concentrations (10 to 1000 $\mu g/g$) to each 30 g of soil faeces mixture. The mixture was spread uniformaly over Petri dishes. A set of Petri dishes without the addition of carbofuran was kept as control. The Petri dishes were incubated in a B.O.D. incubator in dark at 27°C for 7 days. On the 8th day, the infective larvae were harvested from the soil faeces mixture in Baermann's apparatus (2). The larvae were counted under a microscope and the per cent transformation was calculated. Each set of experiment was repeated ten times and mean concentration causing 50% (LD_{50}) and 90% (LD_{90}) transformation was calculated.

Results, summarized in Table I indicate that the clay ratio was directly proportional to the recovery of infective larvae. Other factors in soil exerted no significant influence on the development of eggs to infective larvae. Furthermore, carbofuran caused concentration-dependent inhibition of transformation of eggs to infective larvae in all the soils. The maximum efficacy was observed in Red soil followed by Imphal, Aligarh III, Aligarh II, Lucknow and Black cotton soils. It was least effective in Aligarh I soil. In further experiments, the infective larvae separated from pesticide-free cultures (2) and larvae were suspended in half strength Ringer solution (NaCl 4.5 *g*, KCl 0.21 *g*, $CaCl_2$ 0.12 *g* and $NaHCO_3$ 0.25 *g* per litre). Counts of larvae per *ml* was made. Equal number of infective larvae (approximately 2000) suspended in 4 *ml* of half strength Ringer's solution were placed in each of the fourteen culture tubes. Carbofuran was added in the concentration range of 10-1000 *µg/ml*. One culture tube was without the addition of carbofuran (control). The culture tubes were incubated at 27°C in a B.O.D. incubator. Count of motile surviving larvae was done after every 24 hr for five consecutive days and per cent survival was calculated. Each set of experiment was repeated ten times and mean concentration inhibiting 50% (LD_{50}) and 90% (LD_{90}) transformation was calculated (9). Addition of carbofuran reduced the survival time of infective larvae suspended in Ringer's solution. The effect was related to the concentration of the pesticide and duration of exposure. Larvae which survived, showed reduction in motility. The concentration of carbofuran required to kill 50 per cent of the infective larvae (LD_{50}) was 109.6, 86, 60.3, 46.9, and 34.7 *µg/ml* at 24, 48, 72, 96 and 120 hr respectively. However, much higher concentration of carbofuran in solution was required to kill 90 per cent of the larvae; LD_{90} being 588.8, 467.7, 331, 251.2 and 186.2 *µg/ml* at 24, 48, 72, 96 and 120 hr respectively. Those larvae which survived showed reduction in motility of varying degree.

TABLE I : Transformation of eggs of H. contortus into larvae in soils with different characterstics and concentrations of Carbofuran required for 50%. (EC_{50}) and 90% (EC_{90}) inhibition.

Soil type	*Clay ratio*	*pH*	*% eggs transformed into larvae*	*Carbofuran µg/g*	
				EC_{50}	EC_{90}
Aligarh type I	32.3	9.2	91	100	512.9
Aligarh type II	8.7	8.0	87.5	57.54	295.1
Lucknow	7.33	8.3	85	70.79	371.5
Red	4.3	6.4	82	23.99	120.2
Manipur	3.31	6.7	78	32.36	166
Aligarh type III	2.4	7.8	75.5	44.67	223.9
Black cotton	1.2	7.4	53	83.18	426.6

Amongst other factors, degradation of carbofuran is largely influenced by hydrogen ion concentration (1). In general, carbofuran is stable at acidic pH and is degraded with relative case in alkaline pH. The adjustment of pH at a higher level in the same soil appreciably increases the degradation of carbofuran (4, 7). The relative low activity of carbofuran in black cotton soil as compared to other soils which is apparently unrelated to the pH, indicates that the pesticide, besides being degraded can also be adsorbed resulting in its reduced bioavailability. This is expected because of highest clay content (Table I) and cation exchange capacity (31.5 meq/100 *g*) of the black cotton soil.

Carbofuran is generally applied to the soil in a concentration of 40 *ppm* (3). This concentration is sufficient to inhibit transformation of Haemonchus eggs to infective larvae in Red, Imphal and Aligarh III soils and kill preformed infective larvae within 120 hr.

Carbofuram is finding increasing use in the control of plant parasitic insects and nematodes (5, 10) and the evidence presented in the present study indicate its probable efficacy in limiting propagation of hook worm disease. It will be of interest to evaluate the impact of this drug on the incidence of hook worm infestation.

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