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METHODS OF APPLICATION OF DBCP (1, 2-DIBROMO-3-CHLOROPROPANE) FOR THE CONTROL OF PLANT PARASITIC NEMATODES

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The nematicidal efficacy of 1, 2-dibromo-3-chloropropane (DBCP) was demonstrated for the first time by McBeth and Bergeson (1955). The efficacy of different methods of application of DBCP have been reported by O'Banon (1958) Good & Steele (1959), Morton (1959), Souer & Giles (1959), Van Gundy *et al.* (1960) and Birat (1965). The present studies were undertaken to gather information on the relative efficacy of different methods of application of DBCP with special reference to its diffusion pattern, penetration and extent of nematode kill that could be achieved upto a depth of 60 cm by a field trial and a glass house experiment involving polythene column plant culture.

Materials and Methods

The field trial was conducted in small plots of $3m^2$ with eight treatments (Table 1) which were randomised and replicated thrice. Provision was made for irrigating the plots separately to avoid diffusion of chemical from plot to plot. Soil samples were drawn from three locations in each plot at 0-15, 15-30, 30–45 and 45-60 cm depths from the same bore hole and nematodes were extracted from a composite sample of 100 ml. The dosage of DBCP was 28.5 litres of ai per hectare. Post-treatment soil samples were drawn twelve days after application of the nematicide. Seven weeks old seedlings of the tomato variety Pusa ruby was planted at ten per plot after drawing out soil samples. The plants were cut 119 days after nematicidal application and root systems were carefully removed to count the number of galls. The root knot index was recorded on a 0-4 scale. Nematode population before and after DBCP treatment was estimafed by the modified Baerman funnel technique (Chrstie & Perry, 1951) and drawing the suspension after 48 nrs. The suspension was then made up to a constant volume of 100 ml and an aliquot of 5 ml pipetted out for counting nematodes under stereoscopic binocular microscope at 50 x magnification and the total population of plant parasitic forms were estimated as the average of three such counts.

For the glass house experiment with polythene columns, *Meloidogyne incognita* (Kofoid and White, 1919) Chitwood, 1949 was used as the test organism. Pure population of the test organism was maintained in 23 cm earthern pots containing soil sterilised with methyl bromide in which tomato seedlings var. Pusa

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rubi were planted. Polythene tubings (400 gauge) with a circumfrence of 53 cm were cut into pieces of 70 cm length. One end of the tube was sealed and the tube was filled with soil to a height of 60 cm. This soil was prepared by mixing infested soil from culture pots and additional quantity of sterilised soil inoculated with *M. incognita* larvae which were extracted from roots in order to ensure a population of 200 larvae per 100 ml soil. The quantity of DBCP per column based on top surface area worked out to 0.64 ml of ai. The water required for wetting entire column depth was kept at 1200 ml. Twelve days after DBCP application, tomato var. Pusa ruby aged 35 days were planted in the columns. The treatments were the same as for the field experiment and there were five replications in all. One hundred and two days after application of the nematicides, composite samples of 100 ml soil from the four depths zones were taken for estimation of final population of active larvae. The roots were also recovered from the soil zones for counting galls. Seven days after application of nematicide, one set of replicate from each column was cut transversely to represent the four zones and DBCP residues were detected by tha extent of phytotoxicity to onion seedlings planted in soil segments.

Results and Discussion

The population of plant parasitic nematodes prior to and 12 days after DBCP application and the percentage reduction in population following DBCP treatment are given in Table 1 (a), (b) and (c). The pre-treatment nematode population per 100 ml soil ranged from 111 to 199, 106to240, 84 to 180 and 41 to 158 in depth zones 0 to 15 cm, 15 to 30 cm, 30 to 45 cm and 45to60cm respectively, Thefinal population in the treated plots ranged from 54–103, 60-103, 52–101 and 31–113 in the 0-15, 15-30, 30 45 and 45-60 cm depths respectively in the treatment plots T_1 to T_6 as compared to the untreated check plots T_7 and T_8 were the population ranged from 131-172, 146–161, 78-128 and 103-116 in the four depth ranges- There was a steady decline in the plots under T_1, the maximum being at 0–15 cm depth and minimum at 45-60 cm depth. The same trend is also exhibited by the plots under T_2, the percentage of decline however being much less than that of T_1. In plots under T_3 the decline is seen only in depths 0-33 cm. The plots under T_4 recorded more appreciable reduction in population at 15-45 cm depth and under T_5 it is observed to be more at 15-30 cm depth. Under T_6, the plots showed maximum reduction at 30-45 cm depth, followed by 15-30 cm and 45-60 cm depths. The plots under T_7 and T_8 also recorded some decline, but this was not appreciable when compared with nematicide treated plots. The effect of various metods of DBCP application on different plant characters are given in Table 2.

In the polythene column experiment, the observations on growth factors of plants did not show any significant difference due to their erratic growth. The final population levels of larvae of *M. incognita* and root-knot index (Table 3) show that only negligible numbers of free larvae have been recovered at 0-1 5 cm depth range, while only very few larvae were recovered at progressively deeper layers In case of columns under T_7 and T_8, the increase in larval population was 139 and 83% [respec-

TABLE I

a) Population of plant parasitic nematodes* per 100 ml soil in different plots before nematicidal treatment at different depths

Depth cm	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8
0-15	199	112	145	111	123	148	179	163
15-30	131	106	154	152	206	215	177	240
30-45	84	136	89	95	179	180	125	145
45-60	76	153	66	41	138	158	118	124
b) Population level 12 days after nematicidal application.								
0-15	68	54	49	103	58	93	172	133
15-30	60	62	91	103	83	93	142	161
30-45	52	101	91	59	90	54	79	128
45-60	66	113	84	39	93	71	103	116
c) Per cent population reduction following nematicidal treatments.								
0-15	65.8	48.2	66.2	7.2	52.8	37.1	–	19,6
15–30	50.7	41.5	40.9	32.2	59.7	56.7	19.7	23.3
30-45	38,1	25.7	–	37.9	49.7	70.5	36.8	11.7
45-60	15.8	15.0	–	4.8	32.6	55.0	12.7	6.4

*Main species identified were : *Meloidogyne incognita, Pratylenchus thornei, Rotylenchulus reniformis Tylenchorhynchus indicus, Helicotylenchus indicus, Hoplolaimus indicus, Xiphinema insigne, Trichoderus mirzai, Hemicycliophora transvalensis.*

T_1 Application on the soil surface along with irrigation water as flood irrigation.

T_2 Application on the soil surface as a drench.

T_3 Application by soil injection with Maclean's fumigun at 15 cm depth at 30 cm apart.

T_4 Application by soil injection with Maclean's fumigun at 23 cm depth at 30 cm apart.

T_5 Same as T3 followed by Hood irrigation.

T_6 Same as T4 followed by flood irrigation,

T_7 Check plot without irrigation.

T_8 Check plot with irrigation.

tiveiy at 0–15 cm depth and 26 and 27% respectively at 15-30 cm depth. In respect of gall formation, no galling of roots was noticed where DBCP was applied along with irrigation water (T_1). At 0-15 cm depth range, severe galling of roots was observed in T_3. In case of checks severe galling were observed at 0-15 cm depth and moderate galling at 15–30 cm depths.

The effect of various methods of application on the diffusion of DBCP at different depths as revealed by phytotoxicity to the onion seedlings, is furnished in Table-4. The data revealed the DBCP penetrated in the soil column within 30-45 cm rangebut not beyond, when applied along with irrigation water (T_1). Soil drenching on surface aided its penetration only within 1 5-30 cm depth range. The

Table – 2

Growth characters of Tomato plants under different treatments

Treat-ments	Height (cm)	No. of shorts/ plant*	No. of flowers produced	Yield/ plot (gm)	No. of fruits/ plot	Root-knot index/ plot**	Remarks
T1	73.5	105	167	5741	132	0.26	* 52 days after nematicide application
T2	83.8	106	141	4963	116	1.10	** Rootknot index scale
T3	69.5	51	70	3007	81	0.43	0: Nil galls
T4	74.0	77	118	4842	119	0.44	1:1-50 galls
T5	81,8	61	85	2898	76	0.00	2:51-100 ,,
T6	78.9	84	80	3075	69	0.28	3:101-200 ,,
T7	75.8	58	87	2809	66	2.80	4: over 201 galls
T8	90.5	68	78	3762	105	1.41	
CD	NS	++21.93 + P=0.05	++41.11	+ 609.2 ++P=0.01	+ + 14.6	+ 1.05	

Table – 3

Mean number of larvae of *M. incognita* present per 100ml of soil at different depths and root-knot index 102 days after nematicidal application.

Depth (cm)	T1		T2		T3		T4		T5		T6		T7		T8		CD (P = 0.01)	
	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R
0–15	4		38	2.7	101	4.0	64	2.3	37	2.7	38	2.7	479	4.0	366	4.0	348	0.71
15-30	2	—	8	1.3	23	1.0	6	0.7	18	0.7	13	0.7	252	3.0	254	2.7	38	0.45
30-45	—	—	3	0.7	8	0.7	8	0.7	—	0.3		0.3	191	—	166	—	—	—
45-60	5	—	4	—	5	—	7	—	19				52	—	45	—	—	—

L = larvae; R = root-knot index on a 0 - 4 scale

Table—4

Extent of phytotoxicity to onion seedlings due to DBCP residues

Depth cm	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8
0–15	+	+			+			
15-30	+	+	+	+	+	+	—	—
30-40	+	—	—	+	—	+		—
45-60	—	—	—	—	—	—	—	—

+ = positive, ——— negative

injection of the nematicide at 15 cm depth resulted in its retention at 15–30 cm depth range. Injection at 23 cm depth aided the nematicide to penetrate beyond 30 cm depth, but not beyond 45 cm depth. When injection at 15 cm was followed with irrigation (T_5) the nematicide had diffused upwards to surface soil layers, but not beyond 30 cm depth. This shows that application of DBCP along with irrigation water or flood irrigation after spot injection have resulted in better diffusion of the chemical, as compared to other methods. This implies that for deep rooted plants the root system of which are beyond 30 cm depth, spot injection at 23 cm followed by irrigation may be a better method than surface application of DBCP along with irrigation water. Thus water is found to be one of the main factors essential for an efficient dispersion and diffusion of DBCP in deeper layers of soil Johnson and Lear (1968) reported that the zone of estimation of effective nematode control would be less than 30.5 cm for DBCP, when applied as emulsion along with water.

Summary

Six methods of application of DBCP were evaluated with reference to the diffusion and penetration of the material into soil and the knock-down of plant parasitic nematode population in field and polythene column experiments. Under field conditions application of DBCP along with irrigation water gave maximum crop response and best kill in the 0-30 cm layer, but in deeper layers, injection followed by irrigation has given higher percentage kill. The Onion test in the polythene column experiment indicated that DBCP was able to penetrate 30-45 cm deep, when applied along with irrigation water. Injections at 15 and 23 cm depths resulted in the restricted movement of DBCP within 0-30 and 15–45 cm depths, respectively. When injections were given at 23 cm depth followed by irrigation, an upward as well 3s downward movement of the nematicide seems to have occurred. The depth of application by spot injegtion with without irrigation seems to be a critical factor jn obtaining highest percentage kill of the plant parasitic nematode population.

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