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Determination of Dimethoate Residue in Some Vegetables and Cotton Plants

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Considerable attention has recently been focussed on the possible health hazards of pesticide residues in food, and in Egypt, thousands of tons of pesticides are used annually. Dimethoate is recommended in Egypt for control of various pests infesting vegetables and crops. The undesirable side effects of dimethoate can be minimized by monitoring the presence of the residue and determining preharvest safety intervals. The Food and Agricultural Organization (FAO) and World Health Organization (WHO) have published a series of reports dealing with the general principles of pesticide residue safety in food. For some pesticides tolerances and temporary tolerances have been recommended (FAO/WHO 1968 a and b, 1969 a and b).

The side effects of pesticides are not always predictable. They depend on a number of factors as the characteristics of the chemical in question, and the extent of its use (VAN MIDDELEM and WAITS 1964).

The purpose of the present investigation was the determination of the persistance of dimethoate on cotton and some vegetable crops.

MATERIALS AND METHODS

Three experimental plots (each 3x2 m) of tomatoes, cucumber, common bean and cotton plants in field (Zagazig) were sprayed twice 15 days apart in June and July 1975 at the rate of ½ liter of dimethoate 40% E.C. per feddan (1 Feddan = 4200 m^2). A water emulsion was sprayed by a manual, air blast sprayer. Complete coverage of the treated plants was attained. Control plots were left unsprayed.

From each treatment, three vegetative samples of ½ kg each were collected at random just after the second spraying and on the 1st, 3rd, 7th, 14th, and 21st days after application.

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Each sample was chopped, macerated with 2 measured volumes of chloroform (about 2 ml per gram of vegetable plants was usually sufficient) in a blender for about 2 min., and then strained through cheesecloth.

The method of clean-up and analysis described by GIANG and SCHECHTER (1963), was then followed. Recovery from plant materials was between 87% and 91%.

RESULTS and DISCUSSION

Table 1 shows clearly that the initial deposits and the subsequent residues of dimethoate varied on the leaves of different plant species. Individual plants, in general, often exhibit pronounced differences in their ability to accumulate insecticides. The persistence of dimethoate residues in leafy crops varied with different crops BECK et al. (1966), NELSON et al. (1966). The data presented in the table show that the highest dimethoate residues were found on/in tomato. In fact, after 21 days only tomato leaves evidenced any determinable residue at all, which at 2.1 ppm was above the tolerance level.

In each plant species examined, dimethoate residues decreased more rapidly during the first time period, then slowly within the further periods and finally approached (either) undetectable or very low concentration after the third week following application.

Similar results on field crops were obtained by DAUTERMAN et al. (1960), PELLEGRINI et al. (1963) ENOS et al. (1964), VAN MIDDELEM et al. (1964) and SHAW et al. (1964). During the first 14 days the amounts of residue of dimethoate in the different plants were higher than the established tolerance levels (see FAO/WHO, 1974).

In the kinetic study the logarithms of the concentrations of dimethoate residues in plant materials were plotted against time (see Fig. 1). The data fell very closely on straight lines, in accordance with the requirements of a first order reaction, in which the rate of reaction is directly proportional to the concentration of the reacting substance (i.e. dimethoate). The condition could be expressed mathematically in the form

$$- dc/dt = kc \qquad (1)$$

where c is the concentration of dimethoate at time t, $- dc/dt$ is the rate at which the concentration of dimethoate decreases, and k is the velocity constant. The integration of equation (1) results in the form (2):

$$\log c = \frac{k}{2.303} t - \frac{constant}{2.303} \quad \ldots\ldots\ldots(2)$$

Equation (2) indicates that a straight line relationship is produced when the logarithm of the concentration of dimethoate residues is plotted against time (see Fig. 1).

Accordingly, the velocity constant (i.e. the rate of decomposition k) of dimethoate could be calculated by multiplying the slopes of the lines obtained in the figure by - 2.303. The rate of dimethoate decomposition on each plant may be described by giving the time necessary for half the given quantity of dimethoate to decompose. Accordingly, the half-life period ($t\frac{1}{2}$) of dimethoate was calculated using the following equation:

$$t\tfrac{1}{2} = \frac{Ln\ (2)}{k} = \frac{0.693}{k} \quad \ldots\ldots\ldots\ldots\ldots(3)$$

TABLE 1

Determination of Dimethoate Residue (R) (ppm) on Bean, Tomato, Cucumber and Cotton plants.

Time after the second spraying (days)	Bean		Tomato		Cucumber		Cotton	
	R	Log R	R	Log R	R	Log R	R	Log R
0	16.1	1.2068	27.3	1.4362	11.8	1.0719	23.1	1.3636
1	13.7	1.1367	22.1	1.3444	10.3	1.0128	17.9	1.2529
3	9.8	0.9912	17.8	1.2504	6.3	0.7993	11.2	1.0493
7	5.3	0.7243	10.1	1.0043	3.2	0.5051	5.5	0.7404
14	1.8	0.2553	4.7	0.6721	0.8	0.0969	1.3	0.1139
21	0.0	-	2.1	0.3222	0.0	-	0.0	-

TABLE 2

The values of the velocity constant (k), and half-life time ($t_{\frac{1}{2}}$) of Dimethoate on Bean, Tomato, Cucumber and Cotton plants.

Plant	Slope	Velocity of constant (k)	Half-life time ($t_{\frac{1}{2}}$) in days
Bean	-0.07	0.16121	4.3
Tomato	-0.05	0.11515	6.0
Cucumber	-0.08	0.18424	3.8
Cotton	-0.09	0.20727	3.3

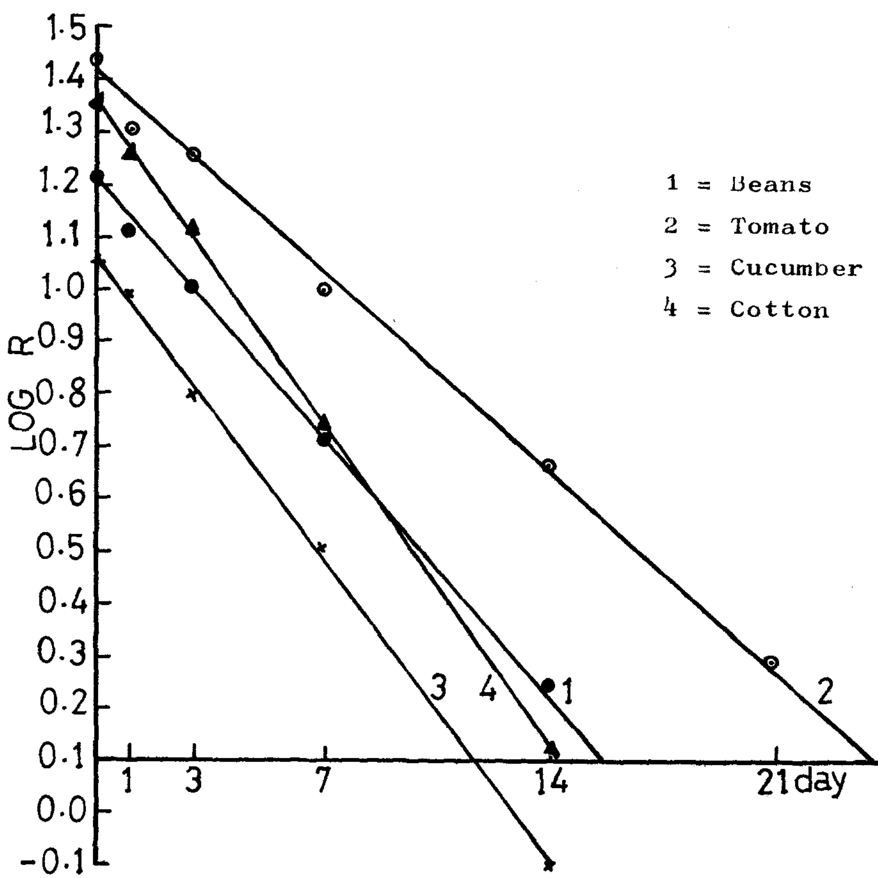

Fig. 1 : The logarithm of the concentration of Dimethoate residues against time.

Table (2) shows in addition to the rate of decomposition (k), the values of the half-life time ($t\frac{1}{2}$). The values of ^{K}dimethoate were higher for cotton and cucumber plants than for bean and tomato plants. Consequently, $t\frac{1}{2}$ of dimethoate was shorter for cotton and cucumber than for tomato and bean plants. Similar results were obtained from the residue data (Table 1).

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