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# Influence of Temik (Aldicarb) on Herbicide Persistence in Cultivated Cotton Field Soil Under Field Conditions

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There are numerous reports of herbicidal activity being influenced by insecticides (CHANG et al. 1971, KAUFMAN et al. 1970). These interactions most commonly result in increases in phytotoxicity due to an inhibition of herbicide degradation by the insecticides (MATSUNAKA 1968, SWANSON and SWANSON 1968, YIH et al. 1968). Certain organophosphate and carbamate insecticides have also been found to inhibit the microbial degradation of several amide carbamate, or urea herbicides (KAUFMAN et al. 1970). While the most frequently observed interactions are synergistic in terms of phytotoxicity, some antagonistic effects have also been noted in herbicide-insecticide combinations (CHANG et al. 1971).

The present paper reports an investigation of the effects of Temik on the persistence of Cotoran and Cobex in the field.

## MATERIALS AND METHODS

The experiment was conducted at the Experimental Farm of the Faculty of Agriculture, Zagazig University in a randomized complete block design with 4 replications, during the season of 1975. The plot area was 1/700 of a Feddan (1 Fed. = 4200 $m^2$). The treatments consisted of untreated control, Cotoran at 1.2 kg a.i., Cotoran at 1.2 kg plus Temik at 1.0 kg a.i., Cobex at 0.25 kg a.i., and Cobex at 0.25 kg a.i. plus Temik at 1.0 kg a.i. per feddan. The pesticides were applied to the soil a day after planting. The herbicide applications were made with a back-mounted plot sprayer, while granulated Temik was broadcasted onto the soil surface.

The cotton seeds (Giza 69) were planted on 24th March, 1975. Before planting a basal dose of 100 kg of superphosphate was applied per feddan. A nitrogen fertilizer was applied at the rate of 30 kg N per feddan in three equal doses. The normal cultural practices of growing cotton were then followed.

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Soil samples were taken separately from the upper 15 cm layer of the soil at four sites from each treatment plot, at intervals of 0,1,15,30,45,60,75,90, 105 and 120 days after treatment. A metal cylinder 9.0 cm in diameter and 15.0 cm in height was used for sampling. Samples collected from the same plot were thoroughly mixed together and transferred to laboratory. The soil samples were air dried, until they contained only 8% moisture, ground to a powder and sieved through a 20-mesh sieve. Each sample (100 g) was processed for residue determination.

The unchanged Cotoran residues were determined according to the method developed by LOWEN and BAKER (1952), BLEIDNER et al. (1954) and LOWEN et al. (1964). Some minor modifications were made, as suggested by GEISSBUHLER and SCHREDT (1966 a,b) and SCHREDT and GEISSBUHLER (1966 a,b) among others. In this method, Cotoran is converted to m-trifluoro-methylaniline by alkaline hydrolysis. The hydrolysis product is steam-distilled, followed by diazotization and coupling with N-ethyl-l-naphthylamine to yield a purple dye which is measured at 565 nm, using distilled water as reference.

The average recovery after deduction of the mean blank values was found to be 80%.

Cobex residues were determined according to a bioassay method after 0,15,30,45,60,75 and 90 days after mixing. Bioassays were conducted as follows: Each 100 g of soil sample was removed from its container, mixed thoroughly with the extracted residues and placed in small waxed-paper cups (5.5 x 5 x 4 cm). The cups were irrigated to the field capacity. Ten grains of wheat (Giza 155) were planted 1.5 cm deep in each cup. After emergence, the cups were surface irrigated as needed by adding constant quantity of water. The wheat seedlings were thinned to 5 per cup one week after planting.

The wheat plants were kept under observation for 21 days and then harvested by cutting at the soil surface. Oven-dry weights were determined.

A series of known concentrations of Cobex was prepared in 4 replications by mixing the required microgram quantities of Cobex in untreated soil. A standard curve of Cobex herbicidal toxicity was constructed by plotting the dry weight of wheat grown in these soils as a function of Cobex concentrations (Fig 1). The concentrations of Cobex in the treated soil samples were estimated by fitting the dry weight of wheat to the standard curve.

## RESULTS

The decomposition of Cotoran when applied alone or in combination with Temik in cultivated cotton field soil, in presented in Table 1. The data indicated that Cotoran, when applied alone, decomposed rapidly within the first 45 days, then slowly the next 75 days. The decomposition percentage was 73% and 97% after 45 and 120 days from application respectively. When applied in combination with Temik Cotoran decomposed more slowly within the first 15 days after application. In combination, Cotoran decomposed slowly within the first 15 days, faster within the period from 15 to 45 days after treatment and then slowly again within the last 75 days. Fifteen days after application, the decomposition percentage of Cotoran, when applied alone and in combination with Temik, was only 38% and 17% respectively.

TABLE 1

The residues (µg/g dry soil) and the decomposition percentages of Cotoran and Cobex, in clay soil under field conditions, as affected by Temik.

| Days after application | Cotoran | | Cotoran + Temik | | Cobex | | Cobex + Temik | |
|---|---|---|---|---|---|---|---|---|
| | ppm | % | ppm | % | ppm | % | ppm | % |
| 00 | 1.33 | -- | 1.33 | -- | 0.33 | -- | 0.33 | -- |
| 1 | 1.2 | 9.8 | 1.6 | -- | 0.32 | 3.0 | 0.4 | -- |
| 15 | 0.82 | 38 | 1.1 | 17 | 0.21 | 36 | 0.28 | 15 |
| 30 | 0.54 | 59 | 0.74 | 44 | 0.14 | 58 | 0.19 | 42 |
| 45 | 0.36 | 73 | 0.49 | 63 | 0.092 | 72 | 0.12 | 64 |
| 60 | 0.24 | 82 | 0.33 | 75 | 0.06 | 82 | 0.08 | 76 |
| 75 | 0.16 | 88 | 0.22 | 83 | 0.039 | 88 | 0.051 | 85 |
| 90 | 0.10 | 92 | 0.15 | 89 | 0.026 | 92 | 0.035 | 89 |
| 105 | 0.07 | 95 | 0.098 | 93 | 0.016 | 95 | 0.023 | 93 |
| 120 | 0.046 | 97 | 0.066 | 95 | 0.011 | 97 | 0.016 | 95 |

Forty five days after application it had increased markedly to 73% and 63%. Thereafter the increase was more gradual, reaching 97% and 95% respectively, 120 days after application.

It seems that the presence of Temik in the soil slowed the decomposition of Cotoran, especially within the first 15 days after application.

Figure 1 indicates the relationship between the logarithms of the concentrations of Cotoran residues in soil and time in days. Straight lines were obtained indicating that the decomposition of Cotoran was a first order process. The presence of Temik in the soil did not change the order of the decomposition reaction. (GOMAA and ABDEL HALEEM 1973).

The rate constant of Cotoran decomposition (**k**) and its half-life ($t\frac{1}{2}$) are shown in Table 2. Data indicated that the rate of Cotoran decomposition and its half-life period were the same for Cotoran alone and Cotoran-Temik treatments. Under each condition Cotoran decomposed at the rate constant of 0.0267, with a half-life period of 26 days.

TABLE 2

The values of the rate of decomposition (k) and the half-life period ($t\frac{1}{2}$) of Cotoran and Cobex as affected by Temik under field conditions.

| Treatments | Slope | k | $t\frac{1}{2}$ (days) |
|---|---|---|---|
| 1 - Cotoran alone | -0.011577 | 0.0267 | 26 |
| 2 - Cotoran with Temik | -0.011577 | 0.0267 | 26 |
| 3 - Cobex alone | -0.01204 | 0.0277 | 25 |
| 4 - Cobex with Temik | -0.01204 | 0.0277 | 25 |

The decomposition of Cobex applied alone or in combination with Temik in cultivated cotton field soil, is presented in Table 1. The data indicated that Cobex decomposed slower when combined with Temik than when applied alone. The data showed also that

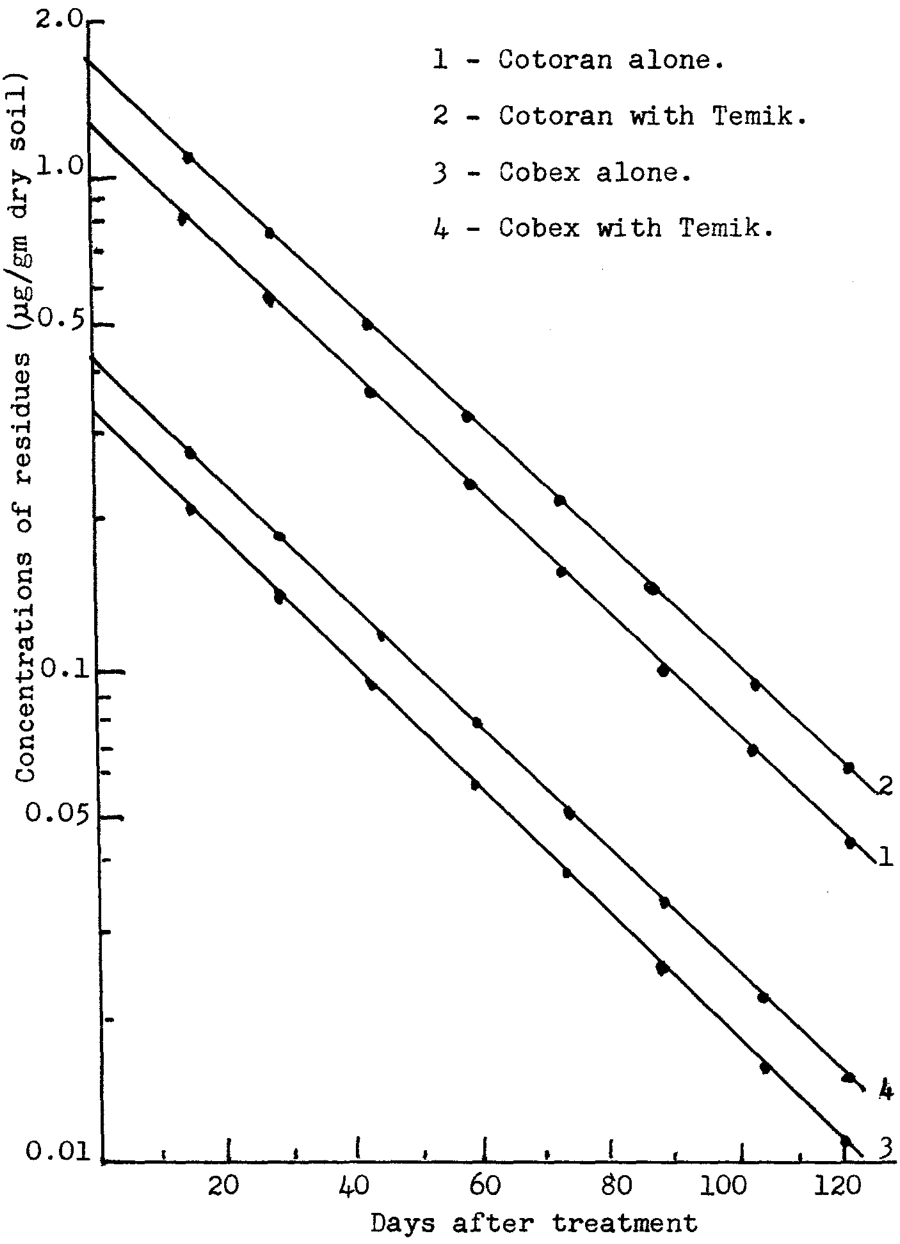


Fig. 1. Cotoran and Cobex residues in soil, as affected by Temik under field conditions.

Cobex, when applied alone, decomposed rapidly within the first 30 days, then slowly within the following 90 days. The decomposition percentage was 58% and 97% respectively after 30 and 120 days of application. In the presence of Temik, Cobex decomposed slowly within the first 15 days, faster within the period from 15 to 45 days after application and then slowly again within the last 75 days. The decomposition percentage of Cobex when applied alone and in combination with Temik was 36% and 15% respectively after 15 days of application, 72% and 64% respectively after 45 days of application, and 82% and 76% respectively after 60 days of application.

Compared to the decomposition of Cobex when applied alone, the presence of Temik clearly inhibited the decomposition of Cobex, especially within the first 15 days after application.

Figure 1 indicates the relationship between the logarithms of the concentrations of Cobex residues in soil and time in days. Straight lines were obtained, indicating that the decomposition of Cobex, when applied alone or in combination with Temik, was a first order process. In addition, the presence of Temik did not change the order of the decomposition reaction of Cobex.

The rate constant of Cobex decomposition (k) and its half-life period ($t\frac{1}{2}$) are shown in Table 2. It was found that the rate of Cobex decomposition and its half-life period were the same for Cobex either in absence or in presence of Temik. Under the experimental conditions Cobex decomposed at the rate constant of 0.0277 with half-life period of 25 days.

DISCUSSION

Experimental results indicate that, under the field conditions of the Zagazig area, Temik depresses the decomposition rate of Cotoran and that of Cobex as compared to their decomposition rates of the herbicides when applied in the absence of Temik (Tables 1 and 2, Figure 1).

In the presence of Temik, the decomposition of Cotoran and Cobex proceeds slowly within the first 15 days, faster within a second period from 15 to 45 days after application and then slowly again within the further periods until the end of experiment. In the absence of Temik, the decomposition of the herbicides goes on rapidly within the first 45 days for Cotoran and the first 30 days for Cobex, then continues slowly within the further periods. Consequently, Temik inhibits the decomposition processes of Cotoran and Cobex within the first 15 days of their application. This finding confirms the conclusion reached by ABO EL-GHAR and his co-workers (1973 a and b) that Cotoran persisted longer when combined with Temik than when used alone.

It has been found by BELAL et al. (1976) that 98% of Temik decomposes in the same soil within 15 days after application, which explains why Temik's inhibiting effect on Cotoran and Cobex decomposition is limited to the first 15 days.

The retarding effect of Temik may be due to either its effect on soil microflora (KUSESKE et al. 1974), or its effect on biochemical degradation reactions in soil that lead to higher persistence of the herbicides. SWANSON and SWANSON (1968), found that carbamate insecticides inhibited the degradation of Monuron in cotton leaf discs. MATSUNAKA (1971) mentioned that acyl anilide herbicides are usually hydrolysed into the corresponding anilines by some plants and soil microorganisms, but this hydrolysis is inhibited by organophosphate or carbamate insecticides.

From the kinetic point of view, the decomposition of Cotoran and Cobex either in presence or in absence of Temik are first order reactions. The same rates of reactions and the half-life periods have been found for each herbicide when applied either alone or combined with Temik (Table 2, and Figure 1).

The presence of Temik in soil treated with Cotoran or Cobex does not change the order of the herbicide degradation reaction, its velocity rate, or the half-life of the herbicide in soil.

## SUMMARY

The effect of the insecticide Temik on the persistence of the herbicides Cotoran and Cobex was investigated in cultivated cotton fields. Temik was applied to the soil which had also been treated with Cotoran or Cobex. Residues were determined at 15 day intervals for four months. Temik was found to inhibit the degradation of both compounds as long as it persisted. As Temik disappeared the degradation of Cotoran and Cobex increased, attaining after the 15th day the rates shown by Cotoran and Cobex when applied in isolation.

## REFERENCES


ABO EL-GHAR, M.R., Z.H. ZIDAN and A.M. SHAABAN: Residual interaction between Cotoran, Disyston and Temik in soil under laboratory conditions. Abstr. of papers to be read at the 1st Pest Control Conf., Assiut Univ., A.R.E., 10-12 Feb., p.96 (1973 a).

ABO EL-GHAR, M.R., Z.H. ZIDAN and A.M. SHAABAN: Residual interaction between Cotoran, Disyston and Temik in cultivated soil under field conditions. Abstr. of papers to be read at the 1st Pest Control Conf., Assiut Univ., A.R.E., 10-12 Feb., p. 98 (1973 b).

BELAL, M.H., E.A.A. GOMAA and M.B. ASHOUR: The fate of Temik (Aldicarb) in soil under laboratory conditions. Zag.J. Agric. Res. (in press) (1976).

CHANG, F.Y., L.W. SMITH and G.R. STEPHENSON: J. Agr. Food Chem. 19, 1183 (1971).

GEISSBUHLER, H. and H. SCHREDT: Patoran residue analysis in plant material. CIBA Ltd., p.7 (1966 a).

GEISSBUHLER, H. and H. SCHREDT: Determination of Patoran residues in soil samples. CIBA Ltd., p.4 (1966 b).

GOMAA, E.A.A. and S.M. ABDEL EL HALEEM: Ann.Agric. Sci., Ain Shams Univ. (In press) (1973).

KAUFMAN, D.D., P.C. KEARNEY, D.W. VON ENDT, D.E. MILLER: J. Agr. Food Chem. 18, 513 (1970).

KUSESKE, D.W. B.R. FUNKE and J.T. SCHULZ: Plant and Soil 41, 255 (1974).

LOWEN, W.K., W.E. BLEIDNER, J.J. KIRKLAND and H.L. PEASE: Analytical methods for pesticide, plant growth regulators and food additives. IV Herbicides. ed. G.Zweig, Academic Press: N.Y. London. p. 157 (1964).

MATSUNAKA, S.: Science 160, 1360 (1968).

MATSUNAKA, S.: Metabolism of the acyl anilide herbicides. Scientific Publications, 343. (c.f. Weed Abstr., 23 : 345).

SCHREDT, H. and H. GEISSBUHLER: Cotoran, residue analysis in plant material. CIBA Rep. of 18th May 1966. p. 2. (1966 a).

SCHREDT, H. and H. GEISSBUHLER: Cotoran, determination of residues in soil samples. CIBA Rep. of 18th May 1966. p. 1 (1966 b).

SWANSON, C.R. and H.R. SWANSON: Weed Sci. 16, 481 (1968).

YIH, R.Y., D.H. McRAE and H.F. WILSON: Plant Physiol. 43, 1291 (1968).