THE INFLUENCE OF SOIL MICROORGANISMS AND BIO- OR -ORGANIC FERTILIZERS ON DISSIPATION OF SOME PESTICIDES IN SOIL AND POTATO TUBERS

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Abstract: The influence of soil microorganisms, biofertilizer and compost fertilization on the persistence of the two organphosphorus insecticides, chlorpyrifos, ethoprophos and carbamate insecticide, carbofuran were studied under semifield experimental conditions. Residue analysis of the initial samples of the three applied pesticides, chlorpyrifos, ethoprophos and carbofuran was relatively high (68.3, 76.0 and 80.9 ppm, respectively) in uncultivated, unfertilized and unsterilized soil. These amounts were decreased to 10.12, 14.6 and 12.0 ppm showing 85.18, 80.79 and 85.17% loss, respectively at 6 weeks after treatments. The initial deposits of these pesticides in potato cultivated soils (control) were 70.77, 74.17 and 81.17 ppm, respectively, graduate dissipation of tested pesticides was noticed through the successive intervals. At the end of the experimental period, residues detected revealed 93.0, 91.5 and 94.37% loss, respectively.
Addition of certain bioactive (microbal and compost) amendments was able to induce the pesticide degradation in the contaminated soil (the highest degradation levels was noticed in biofertilized soil, > 99.99, 99.33 and 96.11%). On the other hands, obtained data clearly showed that microorganisms living in soil play role in pesticide biodegradation. In other words, the percentages of loss of chlorpyrifos, ethoprophos and carbofuran residues were 86.35, 83.91 and 82.32% in sterilized soils, respectively, at 6 weeks after treatments. Obtained data indicated also, the residual values of tested insecticides on or in potato tubers were more than the maximum residue limits (MRL) in all treatments, this means that the tested insecticides have a translocation and accumulating properties in potato tubers.

Key words: pesticide bioremediation, compost, biofertilizer, soil microorganisms, potato

INTRODUCTION

The use of agricultural pesticides has increased dramatically during the past two decades for the control of insect pests, weeds and diseases in Egypt. Nevertheless, approximately 90% of agricultural pesticide application never reaches its target organisms but is, instead, dispersed through the air, soil, and water (Moses *et al*. 1993). As a result, they are routinely detected in air, surface and ground water, sediment, soil, vegetable, and to some extent in foods. In addition, many soil-applied pesticides are also intentionally introduced into the soil environment for the control of soilborne pests and pathogens, which results in the accumulation of their residues and metabolites in soil at unacceptably high levels (Redondo *et al*. 1997; Gamo´n *et al*. 2003). However, soil still constitutes a major environmental compartment, and persistence and degradation of insecticides in soil have been the subjects of many research projects (Mora *et al*. 1996; Trabue *et al*. 1997; Shalaby and Abdalla 2006). When an insecticide reaches the soil, its fate is depended on a host of conditions including soil type, pH, organic content, mineral ion content, moisture content, the nature of the soil colloids, the flow of liquid and air through the soil, the amount of cultivation and plant growth present, and the exposure to environmental parameters, such as wind, sunlight, rain, temperature, humidity, etc. (Hirahara *et al.* 1997; Jones and Norris 1998). A variety of microorganisms (bacteria and fungi) have been used in soil inoculations intended to improve the supply of nutrients to crop plants, to stimulate plant growth, to control or inhibit the activity of plant pathogens and to improve soil structure. Other more recent objectives for introduction of microorganisms into the soil are mineralization of organic pollutants (bioremediation of polluted soils) Van Veen *et al.* (1997). In the same respect, some microorganisms living in soil are known to be detoxification agents of pesticides, although pesticides may have a degree of persistence despite of the same microorganisms. That maybe due to the difference in physico-chemical properties of soils and also the environmental factors such as pH, moisture content and temperature as well (Abdel-Rahman 1999).

So, the objective of this study was to determine the potentials of soil microorganisms, biofertilizer and compost fertilizer to degrade of two organophosphorus insecticides chlorpyrifos and ethoprophos and also, carbamate insecticide carbofuran in the potato cultivated soils as

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one of the promising agents to rid of pesticide contamination.

MATERIALS AND METHODS

I – Pesticides used:

1. Chlorpyrifos: O,O-diethyl O-(3,5,6-trichloro-2-pyridinyl) phosphorothioate (Dursban E.C. 48%).
2. Ethoprophos: O-ethyl S,S-dipropyl phosphorodithioate (Mocap G 10%).
3. Carbofuran: 2,3-dihydro-2,2-dimethyl benzofuran-7-yl methyl carbamate (Furadan G 10%).

II – Experiment:

This study was carried out at Experimental station of National Research Centre. Potato tubers King Edward were planted in earthenware pots of 7 kg soil capacity at 15 April 2008. This experiment comprised of three main treatments with chloropyrifos, ethoprophos and carbofuran insecticides. Each main treatment was divided into 5 submain treatments which included:

1. Uncultivated soil.
2. Cultivated soil without fertilization and without sterilization (control).
3. Cultivated sterilized soil, to determine the influence of soil microorganisms on the degradation of tested insecticides [soil was autoclaved at 120°C for 1 h three consecutive days (Abdel-Rahman 1999).
4. Cultivated soil with microbal biofertilizer [A mixture of four microbial species in equal portions (*Bacillus megatherium*, *Azotobacter* sp., *Azospirillium* sp. and *Pseudomonas* sp.). It was produced by General Organization of Agric. Fund, Ministry of Agric. Egypt and used commercially as biofertilizer], microorganism suspensions were adjusted at $1x10^8$ cells/ml. Treated soils were amended with bioagents suspensions at the rate of 50 ml/kg soil (Zidan *et al.* 2002).
5. Cultivated soil fertilized by Compost Elwadi (Wastes of food industries that were exposed to technological bacterial fermentation and maturation processes using certain beneficial bacteria to be standardized organic fertilizer. It was produced by Delta Bio-Tec, Egypt.), compost added to the soil at rates of 2.5% of the pot soil weight, this addition was thoroughly mixed with soil before cultivation, according to El-Menesy *et al*. (2005).

A small amount of chlorpyrifos pesticide was dissolved in 100 ml water and added to soil in pots (7 kg), resulting in final concentration of 100 ppm, while ethoprophos and carbofuran was distributed in 100 g of fine soil and added to soil in pots, resulting the same previous concentration. Irrigation was done immediately at 5 days interval after soil treatment.

Samples of the treated soil were taken at depth of 5 cm from the pots of the treated soil before irrigation. These samples were taken after one hour as well as 1 day and 1, 2, 4 and 6 weeks from pesticide application. The collected soil samples were air dried and passed through 2 mm sieve. Also, potato tuber samples were collected at the end of experiment for pesticide residues determination. The sieved soil and potato tuber samples were weighted and stored in clean polyethylene bags at –20°C until residue analysis.

III – Residue analysis techniques:

1. Soil.
   The adopted method of Krause *et al*. (1986). Was followed through partitioning by chloroform. 50 grams of soil was shaken mechanically with 100 ml of acetone – water (3/1 v/v) for one hour in 250 ml glass stopper bottle. The extract was carefully decanted and filtered through a clean pad of cotton 75 ml of filtrate was concentrated by using a rotary evaporator on a water bath at 40°C to remove acetone and then extracted twice with 100 ml of chloroform. The combined chloroform extract was dried using anhydrous sodium sulfate and then evaporated near dryness at 40°C using a rotary evaporator. Then, the residues of chlorpyrifos and ethoprophos insecticides were determined by Gas Liquid Chromatographic method (GLC).
2. Potato tubers.
   The method of Mollhaff (1975) was adopted for extraction of some organophosphorus pesticides from potato tubers. The potato tubers were chopped into small pieces and homogenized in the blender using 200 ml methanol for 5 min, the insoluble fragments were removed from the homogenate by filtration. Then the extract was partitioned with chloroform, drained through anhydrous sodium sulphate and evaporated to dryness. Then, the residues of chlorpyrifos and ethoprophos insecticides were determined by Gas Liquid Chromatography (GLC).
3. Clean-up of carbofuran extraction.
   The clean up procedure for carbofuran extract was done according to the method of Al-Samariee *et al*. (1988). The extract was mixed with two grams of activated charcoal, and shaked for 2 min. The mixture was filtered through filter paper and the supernatant rinsed with additional 50 ml chloroform and concentrated just to dryness using a rotary evaporator at 30°C. The residues were ready for High Performance Liquid Chromatography (HPLC) determination.
4. Residue determination.
   Quantitative analysis of chlorpyrifos and ethoprophos insecticides residues was performed by GLC, HP 6890 serial equipped with flame photometric detector (FPD) operated in the phosphorus mode (529 nm filter), under the following conditions: Capillary column PAS1701 30 m x 0.32 mm x 0.52 μm. Detector temp. 250°C; Injector temp. 245°C; Oven temperature program: Initial temp. 160°C, Initial time 2 min., Rise 10°C/min. Final temp. 240°C., Hold time: 8 min. Nitrogen Carrier gas: 3 ml/min. Hydrogen Flows: 75 ml/min. Airflows: 10 ml/min.

Quantitative analysis of carbofuran was performed by HPLC, Agilent 1 100 Series with work station. The U.V. Diod-array detector set at 220 nm and the analytical column Nucleosil-C18, 5 μm (4 x 250 mm) were used. The mobile phase was acetonitrile-water at flow rate 1 ml/min.

The retention time of carbofuran under these conditions was 3.7 min.

Under these conditions, the retention times for chlorpyrifos, ethoprophos and carbofuran were 26.97, 14.354 and 3.7 min, respectively. The reliability of the analytical methods were examined by fortifying untreated soil and potato samples with known quantities of tested pesticides, following by the same producers extracts, and analysis. The data were adjusted by the rates of the recovery percentages. The recovery rates of chloropyrifos, ethoprophos and carbofuran from fortified soil samples were 87.0, 85.3 and 81.2%, while in case of fortified potato tubers they were 84.0, 86.4 and 80.0%, respectively. The residual half – lives ($t_{1/2}$) values were calculated using Moye *et al*. (1987) equation.

RESULTS AND DISCUSSION

1. The fate of chlorpyrifos, ethoprophos and carbofuran in uncultivated soil and in potato cultivated soil.
   Obtained data shown in table 1 revealed that the initial amounts of chloropyrifos, ethoprophos and carbofuran were 68.3, 76.0 and 80.9 ppm in uncultivated soil, respectively. These figures decreased gradually till they reached 10.12, 14.6 and 12.0 ppm after 6 weeks of application, respectively. The corresponding amounts of prementioned insecticides initially detected in cultivated soils were 70.77, 74.17 and 81.17 ppm, respectively, these amounts decreased gradually with time till they reached 4.95, 6.3 and 4.57 ppm after 6 weeks of treatment, respectively.
   Obtained data indicated the important role of potato cultivation on dissipation of tested pesticides in soil when compared with uncultivated treatments. The degradation per cent of chlorpyrifos, ethoprophos and carbofuran in cultivated soils reached 93.0, 91.5 and 94.37%, respectively at 6 weeks of applications, while the corresponding amounts in uncultivated soils were 85.18, 80.79 and 85.17%, respectively. Nasr and Shokr (2004) mentioned that the initial deposits of carbofuran, cadusafos and ethoprophos were decreased by 93.19, 70.1 with 76.97% loss, respectively, within the first five days after application in the sandy clay loam soil. They added that carbofuran was degraded more rapidly than the other two compounds.
2. The influence of soil microorganisms and biofertilizer on the dissipation of chlorpyrifos, ethoprophos and carbofuran in soil.
   Results listed in table 2 clearly showed that the amounts of premention pesticides initially detected in sterilized soil were 78.6, 81.6 and 76.7 ppm, respectively. These amounts decreased gradually by the time till reached 10.73, 13.13 and 13.56 ppm at the end of experiment, respectively. On the other hand, obtained data clearly showed that microorganisms living in soil have a role in pesticides biodegradation, the percent-

Table 1. Fate of chlorpyrifos, ethoprophos and carbofuran in uncultivated treatments and potato cultivated soil

Treatments / Periods	Chlorpyrifos				Ethoprophos				Carbofuran			
	uncultivated		control		uncultivated		control		uncultivated		control	
	[ppm]	loss %	[ppm]	loss %	[ppm]	loss %	[ppm]	loss %	[ppm]	loss %	[ppm]	loss %
Zero time*	68.3	–	70.77	–	76.0	–	74.17	–	80.9	–	81.17	–
1 day	51.6	24.45	50.67	28.4	63.1	16.97	60.23	18.79	67.1	17.06	65.7	19.06
1 week	36.7	46.27	25.8	63.54	37.13	51.14	26.4	64.41	38.0	53.03	26.45	67.41
2 weeks	23.0	66.33	13.13	81.45	24.0	68.42	10.36	86.03	23.0	71.57	15.3	81.15
4 weeks	15.8	76.87	8.6	87.85	19.1	74.87	8.1	89.1	12.9	84.05	7.6	90.64
6 weeks	10.12	85.18	4.95	93.0	14.6	80.79	6.3	91.5	12.0	85.17	4.57	94.37

*one hour after application; control – cultivated soil without fertilizing and without sterilizing

Table 2. The effect of soil microorganisms and microbial fertilizer on dissipation of chlorpyrifos, ethoprophos and carbofuran pesticides

Treatments / Periods	Chlorpyrifos				Ethoprophos				Carbofuran			
	sterilized soil		microbial fertilizer		sterilized soil		microbial fertilized		sterilized soil		microbial fertilized	
	[ppm]	loss %	[ppm]	loss %	[ppm]	loss %	[ppm]	loss %	[ppm]	loss %	[ppm]	loss %
Zero time*	78.6	–	73.1	–	81.6	–	74.6	–	76.7	–	79.6	–
1 day	60.8	22.65	56.4	22.85	63.8	21.81	55.9	25.07	62.6	18.38	60.3	24.25
1 week	28.7	63.49	17.0	76.74	21.6	73.53	16.7	77.61	33.5	56.32	25.7	67.71
2 weeks	20.13	74.39	12.1	83.45	17.5	78.55	11.9	84.05	21.4	72.1	15.4	80.65
4 weeks	12.9	83.59	4.3	94.12	14.5	82.23	8.5	88.61	18.74	75.57	9.2	88.44
6 weeks	10.73	86.35	N D	>99.99	13.13	83.91	0.5	99.33	13.56	82.32	3.1	96.11

*one hour after application

ages of loss of chlorpyrifos, ethoprophos and carbofuran residues decreased from 93.0, 91.5 and 94.37% in control treatment (Table 1) to 86.35, 83.91 and 82.32% in sterilized soils, respectively, at 6 weeks of treatments. Similar results were obtained by Abdel-Rahman (1999), who reported that carbofuran degraded faster than pirimicarb and both products converted to their metabolites in non-sterilized soil faster than in sterilized ones. In the same respect, Karpouzas *et al.* (2004) reported that a rapid degradation of cadusafos was evident in soils collected from previously-treated field sites from a potato monoculture area in northern Greece. A slower degradation of cadusafos observed in corresponding antibiotic-treated soils as well as in soils from an adjacent previously-untreated field demonstrated the microbial involvement in the rapid degradation of cadusafos in soils from the previously-treated sites. The author reported also, that the bacterial population of the cadusafos-adapted soil was also able to rapidly degrade a chemically related nematicide ethoprophos but not fenamiphos and oxamyl. Also, El-Metwally and Shalaby (2007) reported that microorganisms living in soil and in root nodules play a great role in pesticides biodegradation.

At the same table 2, the initial residues of chlorpyrifos, ethoprophos and carbofuran were 73.1, 74.6 and 79.6 ppm in microbial fertilizer soil, respectively. A slight degradation per cent in pesticide residues occurred 1 day after treatment by 22.85, 25.07 and 24.25%, respectively. The time elapsed to 6 weeks showed more degradation of the tested compounds in control treatment whereas, in biofertilizer treatments, chloropyrifos was the most degradable compound [residues were below the detection limit, (0.001 ppm) at this period followed by ethoprophos (99.33 %) and carbofuran (96.11 %), respectively]. Similar results were obtained by Shalaby and Abdalla (2006), who reported that addition of microbial fertilizer to carbofuran and ethoprophos- treated soil fell to the half life values ($t_{1/2}$) from 8.86 and 8.04 days to 3.38 and 4.8 days, respectively. In the same respect, Fang *et al.* (2008) reported that the degradation rates of chlorpyrifos in inoculated soils with *Verticillium* sp. were 3.61, 1.50 and 1.10 times faster in comparison with the sterilized soil, previously chlorpyrifos-untreated soil, and previously chlorpyrifos-treated soil under laboratory conditions they also recorded that in contrast to the controls, the half-lives of chlorpyrifos were significantly shortened by 10.9% and 17.6% in treated pakchoi (*Brassica chinensis* L.), 12.0% and 37.1% in inoculated soils, respectively, in the greenhouse and open field.

3. The influence of compost fertilizer on dissipation of chloropyrifos, ethoprophos and carbofuran residues in the soil

The results in table 3 show the effect of adding compost to the soil at the rate of 2.5% of the pot soil weight on degradation tested pesticides. The initial residues of chloropyrifos, ethoprophos and carbofuran in compost fertilized soils were 75.65, 80.94 and 77.54 ppm, respectively; 18.97, 18.83 and 13.34% of these amounts degraded after 1 day of treatment. These figures dissipated gradually till they reached 2.57, 4.0 and 2.3 ppm

Table 3. The effect of compost fertilizer on dissipation of chlorpyrifos, ethoprophos and carbofuran pesticides

Treatments / Periods	Chloropyrifos				Triazophos				Ethoprophos			
	control		compost fertilized		control		compost fertilized		control		compost fertilized	
	[ppm]	loss %	[ppm]	loss %	[ppm]	loss %	[ppm]	loss %	[ppm]	loss %	[ppm]	loss %
Zero time*	70.77	–	75.65	–	74.17	–	80.94	–	81.17	–	77.54	–
1 day	50.67	28.4	61.3	18.97	60.23	18.79	65.7	18.83	65.7	19.06	67.2	13.34
1 week	25.8	63.54	22.64	70.10	26.4	64.41	20.74	74.38	26.45	67.41	21.6	72.14
2 weeks	13.13	81.45	10.8	85.72	10.36	86.03	8.77	89.16	15.3	81.15	10.6	86.33
4 weeks	8.6	87.85	5.57	92.64	8.1	89.1	6.03	92.55	7.6	90.64	8.45	89.1
6 weeks	4.95	93.0	2.57	96.60	6.3	91.5	4.0	95.05	4.57	94.37	2.3	97.03

*one hour after application; control – cultivated soil without fertilized and without sterilized

Table 4. Chlorpyrifos, ethoprophos and carbofuran pesticides residues on potato tubers at the end of experiment

Pesticides / Treatments	Chloropyrifos		Ethoprophos		Carbofuran	
	[ppm]	% changes	[ppm]	% changes	[ppm]	% changes
Unfertilized	4.67	–	4.43	–	3.9	–
Sterilized	7.0	+50.0	6.13	+38.37	5.67	+45.38
Microbien Fertilized	3.12	–33.19	2.6	–41.31	2.14	–45.13
Compost fertilized	3.65	–21.84	3.0	–32.28	2.85	–26.92

% change (+ above or – below the residues were detected in potato tubers of unferitilized and unsterilized treatment)

after 6 weeks of treatment indicating 96.60, 95.05 and 97.03% loss of the initial deposits, respectively.

Similarly, Nicholls (1988) stated that a rate of pesticide degradation in soil does not depend on organic contents of soil. Although, adsorption to pesticides increases with soil organic matter content and that possibly results in the reduction in availability of pesticides for degradation in soil water. This is often offset by the increase in microbial biomass, which increases the rate of degradation. In the same trend Shalaby and Abdalla (2006) found that adding compost or manure to carbofuran and ethoprophos- treated soil reduced the half life values from 8.86 and 8.04 days to 5.66 or 4.83 and 4.57 or 6.3 days, respectively.

4. Chlorpyrifos, ethoprophos and carbofuran residues in potato tubers at the end of experiment

Data in table 4 indicated the amount of tested pesticides residues in potato tubers at the end of the experiment. The amount of chlorpyrifos, ethoprophos and carbofuran residues were 4.67, 4.43 and 3.9 ppm in potato tubers of unfertilized and unsterilized treatments, respectively. These figures were increased in sterilized soils till reached 7.0, 6.13 and 5.67 ppm (50.0, 38.37 and 45.38% above the residues detected in unfertilized and unsterilized treatments), respectively. On the contrary, microbial biofertilizer caused the decrease in residues of tested pesticides in potato tubers till they reached 3.12, 2.6 and 2.14 ppm (33.19, 41.31 and 45.13% below the amounts found in potato tubers of unfertilized and unsterilized soils), respectively. Similar effects were noticed in case of adding compost to the soil, the amount of residues were 3.65, 3.0 and 2.85 ppm (–21.84, –32.28 and –26.92%), respectively.

Obtained data clearly showed that the residual values of tested insecticides on or in potato tubers were more than the Maximum residue limits (MRL) in all treatments [MRLs values of chlorpyrifos, ethoprophos and carbofuran in potato tubers were 0.05, 0.02 and 0.5 mg/kg (Anonymous 2003)]; this may due to we use a high concentration of tested insecticides (100 ppm) in each pot. Also, data revealed that, the amount of residues detected in potato tubers more than those found in soils of microbial fertilizer treatments, this means that the insecticides have a translocation and accumulating properties in tubers. In the same trend, El-Morshedy *et al.* (1990) reported that the residues of cadusafos in potato tubers taken from treated soil at harvest (12 weeks after soil treatment) were 0.027 ppm. Hegazy *et al.* (1997) reported that fenitrothion insecticide residues were detected in potato tubers samples collected from four markets, they exceeded the MRL (0.05 ppm) in all of these markets.

5. The half-lives ($t_{1/2}$) of chlorpyrifos, ethoprophos and carbofuran insecticides in defferent treatments

The half-lives of residues in days proved a slow decline of carbofuran residues in comparison with chlorpyrifos and ethoprophos (Table 5). The half-lives ($t_{1/2}$) declined from 6.37 days in control (uncultivated treatment) to 4.7, 5.7, 4.0 and 5.0 days after amending chlorpyrifos soil with cultivated, sterilized microbial fertilizer soil and compost soil, respectively, indicating that the degradation rate was 1.36, 1.12, 1.6 and 1.27 times faster than in the uncultivated treatment. The corresponding half-lives of ethoprophos residues were 7.6, days in control treatment and decreased to 5.5, 5.3, 4.17 and 4.76 days, recording the degradation rate of 1.38, 1.43, 1.82 and 1.6 times faster than that in the uncultivated soil, respectively. Also, half-lives ($t_{1/2}$) of the residues of cabofuran were 7.0 days in control, and decreased to 5.4, 6.9, 4.87 and 5.5 days of the same prementioned treatments, indicating 1.3, 1.01, 1.44 and 1.27 times faster decomposition than that in the uncultivated soil.

Racke *et al.* (1988) reported that the half life of chlorpyrifos in soil varies from 10 to 120 days. Also, Nasr and Shokr (2004) reported that carbofuran was degraded more rapidly than ethoprophos, the RL_{50} values were 2.68 and 3.25 days, respectively. This high variation in half-life was attributed to variation in factors such as pH, temperature, moisture content, organic carbon content, and pesticide formulation (Getzin 1981).

Generally, obtained results indicated that the degradation of chlorpyrifos, ethoprophos and carbofuran was due not only to chemical hydrolysis but might also be due to the biological activity of soil microorganisms (these microorganisms are capable of utilizing pesticides as a sole source of carbon). Also, the addition of compost to the soil caused increased adsorption of pesticides and also the increase in microbial biomass, which increase the rate of degradation. In addition, tested insecticides had a translocation and accumulating properties in potato tubers.

In the same trend, Gruzdyve *et al.* (1983) reported that a rapid dissipation of the residues of the applied pesticides from the soil through few weeks could be attributed to the removal from the soil as a result of volatilization, evaporation, irrigation, downward movement, chemical and microbial degradation.

Table 5. The residues half-lives ($t_{1/2}$) of residues of chlorpyrifos, ethoprophos and carbofuran insecticides in different treatments

Treatments / Pesticides	Uncultivated [days]	Unfertilized and cultivated soil		Sterilized soil		Microbial fertilizer soil		Compost-fertilized soil	
		days	time*	days	time*	days	time*	days	time*
Chlorpyrifos	6.37	4.7	1.36	5.7	1.12	4.0	1.6	5.0	1.27
Ethoprophos	7.6	5.5	1.38	5.3	1.43	4.17	1.82	4.76	1.6
Carbofuran	7.0	5.4	1.3	6.9	1.01	4.87	1.44	5.5	1.27

*time – the rate of residues dissipation in different treatments in comparison with uncultivated treatments

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POLISH SUMMARY

WPŁYW MIKROORGANIZMÓW GLEBOWYCH ORAZ BIOORGANICZNYCH LUB ORGANICZNYCH NAWOZÓW NA ROZMIESZCZENIE NIEKTÓRYCH PESTYCYDÓW W GLEBIE I BULWACH ZIEMNIAKA

Badano wpływ mikroorganizmów glebowych, nawożenia bionawozem i kompostem na przetrwanie dwóch insektycydów fosfoorganicznych, chloropyrifos, ethoprophos i fungicydu karbaminianowego karbofuran, w częściowo polowych warunkach doświadczalnych. Analiza pozostałości w pierwotnych próbkach trzech zastosowanych pestycydów: chloropyrifosu, ethoprophosu i karbofuranu wykazała względnie wysokie wartości (68,3, 76,0 i 80,9 ppm) w nieuprawianej, nienawożonej i niesterylizowanej ziemi. Te ilości były zmniejszone do 10,12, 14,6

i 12,0 ppm, wykorzystując odpowiednio stratę w wysokości: 185, 18, 80,79 i 85,17%, w 6 tygodni po zabiegu. Początkowe depozyty tych pestycydów w glebie spod uprawy ziemniaków (kontrola) wynosiły odpowiednio 70,77, 74,17 i 81,17 ppm, stopniowe rozproszenie badanych pestycydów zauważono w toku kolejnych przerw. W końcu okresu doświadczalnego wykryte pozostałości ujawniły odpowiednio straty wynoszące: 93,0, 91,5 i 94,37%. Dodanie niektórych bioaktywnych składników (microbien i kompost) indukowało degradację pestycydu w zakażonej ziemi (najwyższy poziom degradacji zauważono w biologicznie nawożonej ziemi > 99,99, 99,33 i 96,11%). Z drugiej strony uzyskane dane jasno wskazywały, że mikroorganizmy żyjące w ziemi odgrywają rolę w biodegradacji pestycydów. Procenty strat chlorpyrifosu, ethoprophosu oraz pozostałości karbofuranu wynosiły odpowiednio: 86,39, 83,91 i 82,32% w sterylizowanej ziemi, sześć tygodni po zabiegach. Otrzymane wyniki wskazywały także, że szczątkowe wartości badanych insektycydów na/lub w bulwach ziemniaka przekraczały maksymalne granice pozostałości (MRL) we wszystkich kombinacjach. To oznacza, że badane insektycydy mają właściwości przemieszczania się i akumulacji w bulwach.