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INFLUENCE OF DIMILIN 25 WP ON CHARACTERISTICS OF EARTHWORM *Eisenia fetida* Sav., VERMICOMPOSTING ORGANIC WASTE

WPŁYW DIMILINU 25 WP NA CECHY POPULACJI DŻDŻOWNIC *Eisenia fetida* Sav., WERMIKOMPOSTUJĄCYCH ODPADY ORGANICZNE

Abstract: Vermicomposting of organic kitchen residues at a place where waste is produced can be conducted in small containers – an earthworm ecology box. The serious problem for the user can be the presence of *Diptera*. In laboratory experiment, the influence of the insecticide Dimilin 25 WP was tested on *Eisenia fetida* Sav. population characteristics, in addition to its influence on the rate of kitchen residues vermicomposting.

The experiment showed that Dimilin limited the number of *Dipteran* larvae, when it was applied to ecological boxes ($p < 0.001$). After four months, the mean number of the *E. fetida* population in boxes with insecticide was only 1 % lower than in boxes without Dimilin, and the population biomasses did not differ statistically ($p < 0.05$). When no differences were present in number and biomass of mature and immature specimens, differences between laid cocoons were noticed, depending on Dimilin treatment ($p < 0.001$).

Keywords: earthworm ecology box, kitchen organic waste, *E. fetida, Diptera,* Dimilin 25 WP

The household-scale vermiculture, run in ecology boxes enables a bio-transformation of organic waste at the spot of their generation, which is significant both ecologically and economically. Apart from difficulties with sustaining earthworm number and their reproductive capacity in small containers [1–3], the serious problem for the user of ecological box is the presence of *Diptera*.

In order to remove the trouble with these insects, we can introduce an insecticide to the mixture of vermicomposted residues. How will that influence the earthworm population and the speed of kitchen residues vermicomposting?

In this laboratory experiment, the influence of the insecticide Dimilin 25 WP – popular in Polish mushroom-growing cellars, was tested on *Eisenia fetida* (Sav.)

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population characteristics, in addition to its influence on the rate of kitchen residues vermicomposting.

Material and methods

Fifty *E. fetida* specimens (all clitelled, with biomass equalized in each of the pots) were bred in the laboratory, in each of ten pots with dimension of (15 × 22 × 9) cm^3 – width, length and depth. All of the pots were filled with two litre of universal garden soil protecting plant growth, prepared from peat and sand: humidity 70 %, pH = 6.5; salinity 1 g NaCl · dm^{-3}.

Pots 1–5 were treated as control, pots 6–10 also contained the insecticide Dimilin 25 WP (in concentrations of 4 g · m^{-2} – conformable to instruction of the producer), what was giving 0.13 g per pot). During four month lasting experiment, every earthworm population was then fed regularly once a month, the same amount of organic kitchen waste (900 cm^3 of boiled macaroni and potatoes, soaked bread and apple peelings, mixed with soaked cartoon cellulose in proportion 1:1:1:1:2 – to try to overcome declining earthworm populations [2]). All pots were regularly watered, to keep the 70 % of bed moisture (to limit the evaporation all pots were covered).

Earthworms and their cocoons were regularly counted and weighed, by manual sorting of the media. At the same time the amount of not transformed residues and the number of *Diptera* larvae found in both types of media (in each eight, 0.1 dm^3, random samples taken, analysed by wet funnel method), were checked. The data obtained were subjected to analysis using a two-factor ANOVA, as well as Tukey's test at the significance level of 0.05.

Results and discussion

The experiment showed that Dimilin limited the number of *Dipteran* larvae, when it was applied to ecological boxes (to a mean of (1.0 ± 3.1) dm^{-3} in comparison to (168.4 ± 178.5) dm^{-3} in boxes without Dimilin).

The average number of whole *E. fetida* populations in pots with insecticide (128 ± 29 ind./pot) and the average number in controlled pots (130 ± 37 ind.) were similar ($p > 0.05$) (Fig. 1).

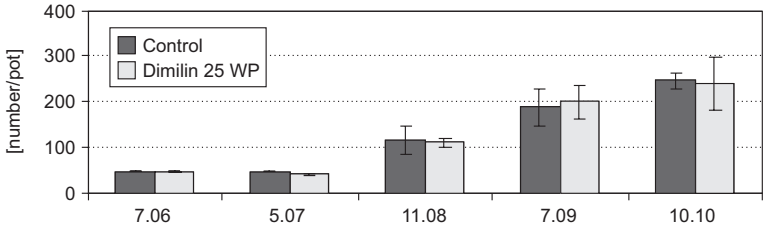

Fig. 1. Influence of Dimilin 25 WP on the dynamics of average number of *E. fetida* [number/pot]

The average sum of *E. fetida* populations biomass in pots with and without insecticide did not differ statistically ($p > 0.05$) (Fig. 2).

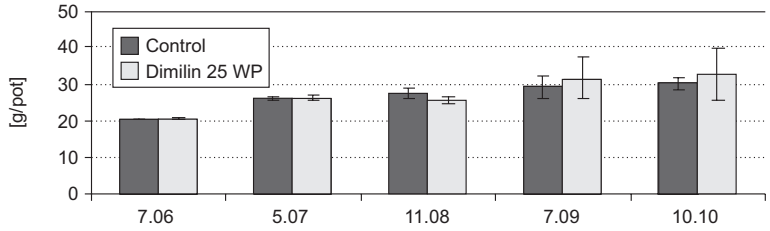

Fig. 2. Influence of Dimiln 25 WP on average sum of biomass of *E. fetida* [g/pot]

It was noticed that the insecticide did not affect mature and immature specimens ($p > 0.05$) (Table 1). Dimilin 25 WP did affect the average number and sum of biomass of cocoons laid. Pots with insecticide included smaller number of cocoons, and the difference (mean 38 ± 8 and 60 ± 10 ind./pot) was statistically important ($p < 0.001$). Populations also differed considerably as far as sum of cocoon's biomass were concerned ((0.658 ± 0.109) g/pot and (0.976 ± 0.182) g/pot) ($p < 0.01$) (Table 1).

It was proven that populations also differed considerably as far as mean biomass of immature individuals and cocoons were concerned (Table 2).

The amount of kitchen waste that was not processed, was fluctuating in particular months and was dependent on the temperature (Table 3). In July, when the temperature was the highest all waste in both types of pots disappeared. Gradual decreasing of average temperature in August, September and October caused increasing of unprocessed waste amount (equally in both types of containers ($p > 0.05$)).

The negative influence of dumping sites to environment is a result, among the other, of organic waste's presence. Food wastes make up even to 40 % of all municipal waste mass [4, 5]. One of the ways of rendering organic waste, is its selection and vermicomposting in earthworm ecological boxes. Thus produced vermicompost may be used to feed plants, vegetables and flowers up in houses and gardens. The vermicomposting rate depends on number and form of earthworms, that are dependent on soil humidity and aeration, pH, and providing with waste mixed with cellulose [2]. There may happen that *Diptera* multiply excessively near the box, which may not be pleasant, however, there is a way of handling this problem, shown in the experiment. It was proved that using Dimilin 25 WP (at the level of $4 \text{ g} \cdot \text{m}^{-2}$) had been efficacious in decreasing the number of *Diptera* larvae. It was also proved that the presence of insecticide had not affected the effectiveness of earthworm ecological box. In July all wastes were vermicomposted in both type of the pots. In August and September, when temperature was lower, the waste's disappearing decreased. Rate of vermicomposting decreased most in lowest temperature – in October.

The average sum of earthworm number in controlled pots was only about 1 % higher than in pots with insecticide, and the average sum of both type of population biomass did not differ. This fact had probably had crucial influence on examined waste

Table 1

Mean number [ind./pot] and mean sum of biomass [g/pot] of *E. fetida* as dependent on Dimilin 25 WP presence

Pots	VI	VII	VIII	IX	X	Mean
Matured (clitelled and possessing *tuberculae pubertatis*)						
Control [ind./pot]	50	41 ± 1	32 ± 7	24 ± 5	23 ± 6	34 ± 3[a]
Dimilin	50	42 ± 1	36 ± 2	21 ± 5	27 ± 5	35 ± 2[a]
Control [g/pot]	25.986 ± 0.393	25.458 ± 1.700	16.441 ± 4.000	10.043 ± 2.333	9.114 ± 2.249	17.360 ± 1.878[b]
Dimilin	25.914 ± 0.574	25.388 ± 0.929	18.000 ± 1.700	8.951 ± 2.333	10.886 ± 1.348	18.060 ± 1.378[b]
Immature						
Control [ind./pot]	—	7 ± 2	84 ± 32	165 ± 40	223 ± 21	96 ± 18[a]
Dimilin	—	0.8 ± 0.8	75 ± 8	180 ± 32	212 ± 58	94 ± 16[a]
Control [g/pot]	—	2.058 ± 0.519	8.789 ± 3.368	19.292 ± 2.777	26.886 ± 6.426	11.240 ± 1.604[b]
Dimilin	—	0.174 ± 0.050	9.662 ± 0.680	22.540 ± 4.153	21.210 ± 2.628	10.854 ± 1.686[b]
Cocoons						
Control [ind./pot]	—	34 ± 6	54 ± 23	112 ± 44	98 ± 39	60± 10[a]
Dimilin	—	34 ± 6	36 ± 6	60 ± 17	56 ± 20	38 ± 8[b]
Control [g/pot]	—	0.539 ± 0.100	0.930 ± 0.427	1.734 ± 0.683	1.678 ± 1.153	0.976 ± 0.182[a]
Dimilin	—	0.560 ± 0.084	0.613 ± 0.086	0.963 ± 0.315	0.702 ± 0.458	0.658 ± 0.109[b]

— – lack of immatured or cocoons; a, b – describe significant difference ($p < 0.001$).

Table 2

Mean biomass [g] of matured, immatured and cocoons, as dependent on Dimilin 25 WP presence

Individuals	Pots	VI	VII	VIII	IX	X	Mean
Matured	Control	0.519 ± 0.132	0.621 ± 0.126	0.507 ± 0.120	0.429 ± 0.081	0.393 ± 0,089	0.494 ± 0.088[a]
	Dimilin	0.519 ± 0.138	0.593 ± 0.125	0.502 ± 0.116	0.438 ± 0.087	0.409 ± 0.091	0.492 ± 0.072[a]
Immatured	Control	—	0.286 ± 0.043	0.104 ± 0.087	0.117 ± 0.084	0.095 ± 0.073	0.120 ± 0.073[a]
	Dimilin	—	0.145 ± 0.115	0.129 ± 0.085	0.125 ± 0.087	0.126 ± 0.079	0.105 ± 0.059[b]
Cocoons (weighed by 10 pieces)	Control	—	0.159 ± 0.008	0.172 ± 0.012	0.155 ± 0.020	0.171 ± 0.034	0.131 ± 0.073[a]
	Dimilin	—	0.165 ± 0.021	0.170 ± 0.011	0.159 ± 0.013	0.206 ± 0.036	0.140 ± 0.080[b]

a, b – describe significant difference ($p < 0.05$).

Table 3

The kitchen waste vermicomposting (unprocessed waste in cm^3)

Period of experiment	July of 2006	August	September	October of 2006	
	Mean month temperature [^oC]				
	31.1 ± 1.9	26.1 ± 1.7	18.2 ± 2.1	16.4 ± 0.9	
Type of pot	Unprocessed waste [cm^3]				Mean
Control	—	83 ± 10	47 ± 9	330 ± 103	156 ± 41[a]
Dimilin	—	67 ± 15	57 ± 10	320 ± 76	145 ± 30[a]

— – lack of unprocessed waste; a – lack of significant difference ($p = 0.05$).

vermicomposting, though one cannot rule out the same influence of other detritivores accompanying earthworms in ecological boxes [1, 2, 6], but this problem was not investigated in this experiment.

It has been proven, that according to the producer's indications in order to limit the occurrence of *Sciaridae* larva, the inhibitor of chitin biosynthesis under the name of Dimilin 25 WP, has no influence on the average number and biomass of the earthworm *E. fetida* Sav., vermicomposting domestic organic waste in the earthworm ecology box. It has been also found that the dose indicated by the producer was efficient with limitation of the occurrence of *Sciaridae* larva also in the conditions of the earthworm ecology box. Its presence in the bedding of the box did not influence the average rate of vermicomposting of tested kitchen wastes.

Dimilin 25 WP has not changed the number and the sum of biomass of mature specimens, as well as these individuals has not differ in average biomass. In the reach of the class of immatures, Dimilin has not influenced their number and the sum of biomass but the negative influence of this insecticide on an average mass of immature individuals ($p < 0.05$) was noticed. It should be also stressed that the insecticide Dimilin 25 WP, used in the dose indicated by the producer, influenced the breeding of earthworms. It caused the decrease in average quantity and average sum of biomass ($p < 0.001$) of the cocoons being laid. It also differentiated ($p < 0.05$) average biomass of laid cocoons (in the pot with Dimilin the living strategy of earthworms was carried out by laying heavier cocoons – but it did not suffice, to overcome the negative effects on sum of their biomass).

The case considered in the publication proves, as other authors [7, 8], that chemicals used for protection of plants, even according to the rules of protection on environment, are not indifferent for other living organisms.

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WPŁYW DIMILINU 25 WP NA CECHY POPULACJI DŻDŻOWNIC *Eisenia fetida* Sav., WERMIKOMPOSTUJĄCYCH ODPADY ORGANICZNE

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Abstrakt: Wermikompostowanie kuchennych odpadów organicznych na miejscu ich powstawania można prowadzić w małych pojemnikach – dżdżownicowych skrzynkach ekologicznych. Ponieważ problem dla ich użytkownika może stanowić obecność muchówek *Diptera,* dlatego w badaniach laboratoryjnych testowano wpływ ograniczającego je insektycydu Dimilin 25 WP na cechy populacji *Eisenia fetida* Sav. Badano również jego wpływ na tempo wermikompostowania wybranych odpadów organicznych.

Wykazano, że zastosowanie Dimilinu 25 WP ograniczyło liczebność larw muchówek w skrzynkach ekologicznych ($p < 0,001$), nie zmieniając tempa wermikompostowania odpadów. Po czterech miesiącach średnia liczebność populacji *E. fetida* w skrzynkach z insektycydem była tylko o 1 % mniejsza niż w skrzynkach kontrolnych i biomasy populacji nie różniły się statystycznie ($p < 0,05$). Podczas gdy nie stwierdzono wpływu Dimilinu 25 WP na liczebność i biomasę osobników dojrzałych, wykazano różnice w obrębie składanych kokonów. Insektycyd redukował liczebność ($p < 0,001$) i sumę biomasy ($p < 0,01$) kokonów, różnicował także ($p < 0,05$) ich średnie masy (w pojemnikach z Dimilinem strategia życiowa dżdżownic była realizowana przez składanie kokonów cięższych).

Słowa kluczowe: dżdżownicowa skrzynka ekologiczna, kuchenne odpady organiczne, *E. fetida*, *Diptera,* Dimilin 25 WP