

SELECTIVITY OF SOME PESTICIDES OVER DETRITIVORE SOIL MACROFAUNA (*Eisenia foetida*)

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Abstract. The use of pesticides on a large scale led to a considerable increase in agricultural production. In addition to the beneficial effects of pesticides, a risk assessment is required for their use on some soil and aquatic environment organisms. Earthworms are a bioindicator of chemical contamination of soil ecosystems. For these reasons, *Eisenia foetida* is used as standard species in ecotoxicological tests. For determining the selectivity of pesticides to this species it was tested the insecticide Nuprid 200 SC (imidacloprid), herbicide Sencor 600 SC (metribuzin) and the fungicide Consento 450 SC (propamocarb hydrochloride + fenamidone). Testing was performed according to OECD guideline applying the method with artificial soil; the products tested being applied at the doses used in agriculture, a double and a half. There were calculated the percentages of mortality and according to their values, was determined the selectivity of the test substances at 7 and 14 days after the treatment. Based on the results, products Nuprid SC 200 and SC 600 Sencor falls in the highly selective and the fungicide Consento 450 SC belongs to the group of selective regarding detritivore soil entomofauna, registering percentages of mortality between 20% and 23%. The studies show that the plant protection products provide protection for detritivore macrofauna having a low environmental impact.

Key words: plant protection products, *Eisenia foetida*, selectivity

INTRODUCTION

Earthworms provide key soil functions that favour many positive ecosystem services. These services are important for agroecosystem sustainability but can be degraded by intensive cultural practices such as use of pesticides. Many literature reports have investigated the effect of pesticides on earthworms. Non-target organisms such as earthworms incorporate decaying organic matter into the soil and also improve soil aeration, water-holding capacity and drainage. But the use of toxic pesticides may reduce the number of earthworms and their activity which results in adverse effects on soil fertility and can lead to a decrease in food supply for their predators (Céline et.al. 2014)

As the OECD guideline highlights, earthworms play an important role in the soil biocenosis since they enhance soil characteristics such as the soil function of litter breakdown, soil fertility and soil microstructure. Therefore, earthworms are used as a standard test species to investigate the impact of a substance that is applied on soil or when a contamination of soil is possible. Usually, is in a first step the acute toxicity tested. Persistent substances or substances with several applications per season cause a longer exposure for the earthworm community. In these cases the performance of a study on sublethal effects is required. (OECD No. 1)

The aim of the ecotoxicological tests was to determine the selectivity of chemical plant protection products with low impact on *Eisenia foetida*, taking into account the percentage of mortality.

MATERIALS AND METHODS

The chemical plant protection products tested in order to determine their selectivity over detritivore soil macrofauna, were Nuprid 200 SC, Sencor 600 SC and Consento 450 SC.

Nuprid 200SC is a systemic insecticide with toxic action by contact and ingestion, the active substance imidaclopride is absorbed through the leaves and roots and distributed in entire plant, ensuring a very good protection on a variety of harmful insects. In our studies, it is used in controlling the Colorado beetle, at dose of 0.25 to 0.3 l/ha (Tomlin, 2003).

Sencor 600 SC is a selective herbicide used to control annual weeds in potato crops. The active substance is metribuzin 600g/l which is taken up through the roots in the case of a pre-emergence treatment (Tomlin, 2003).

Consento 450 SC is a fungicide with systemic and penetrating action for potato diseases control, having in its composition propamocarb hydrochloride 375 g/l and fenamidone 75 g/l. It has a dual mechanism of action both systemic and penetrant, acting on manna preventive and curative, its effectiveness being high even applied after appearance of pathogen. Because of its composition, propamocarb is absorbed at a rate of 100% in less than one hour after treatment; the protective fungicide effect is transmitted also in newly formed bodies. Propamocarb reduce fungus mycelium development, and inhibits the formation of zoospore. By linking the two active substances, propamocarb and fenamidone, with a different mode of action, it conducted a pronounced synergistic effect that can be easily observed in field conditions due to a very good efficacy on late blight (Tomlin, 2003).

The biological material used in the tests under laboratory conditions in order to set an ecotoxicological impact was *Eisenia foetida* species. The group of earthworms tested was formed of adults with fully developed clitellum and body weight between 300 and 600 mg.

The studies were carried out using the technical procedure "Toxicity to earthworms-artificial soil test" which is property of ecotoxicology laboratory certified under Good Laboratory Practice, procedure which complies with OECD Guidelines concerning the testing of chemicals.

The experimental treatments were as follow: I. Nuprid 200 SC; II. Sencor 600 SC; III Consento 450 SC. Each of these was tested in three concentrations namely: V_1 = the registered dose for use in the field; $V_2 = V_1 \times 2$ and $V_3 = V_1/2$.

The test is designed to be reproducible as much as possible for the test substrate and organism. In order the study to be valid, the percentage of mortality in the control groups must not exceed 10% ($\% M \leq 10$) at the end of the test.

Before testing, the earthworms were acclimatized at least 24 hours in an artificial soil with the same characteristics, basic substrate, in a plastic container, in a room with a temperature of $20 \pm 20C$ and continuous light with 400-800 lux intensity. As a base substrate it was used a defined artificial soil, containing 10% peat, with a pH of 5.5 to 6.0; Kaolin 20%, preferably more than 50% kaolinite, about 69% industrial quartz sand and approximately 1% of pure chemical calcium carbonate ($CaCO_3$) powder, added to adjust the pH to 6.0 ± 0.5 .

The test substrate contained the base substrate, the tested substance and deionized water. The control substrate contained only the base substrate and water. The water content was approximately 25-42% of the dry weight of the base substrate. For the test were used glass jars with a capacity of about 1 l which were filled with an certain amount of wet test substrate and control wet substrate. During the experiment, test jars were kept in a climate-controlled chamber at a temperature of $20^\circ C \pm 2^\circ C$ under conditions of continuous light with an intensity of 400 to 800 lux (Mincea, 2013)

For each treatment, an amount of testing wet substrate was distributed in each glass jar, an equivalent to 500g of dry substrate. The earthworms were kept 24 hours in a similar wet

basic substrate. First they were rinsed quickly with water and the excess water was absorbed on a filter paper, were weighed and then placed in the glass jars (Figure 1-a).

Both chemical and untreated control was tested in three repetitions, meaning a glass jar with 10 earthworms for each repetition. The final step was to cover the jars with sheets of perforated plastic (Figure 1-b) to prevent drying the substrate and keep them under testing conditions during the entire test.

The test period was 14 days, but mortality was also evaluated at 7 days after starting the test by examining the contents of the jars on a plastic tray, in that way being determined the number of dead organisms (Figure 1-c). The organisms are considered dead if they do not respond to a mechanical stimulus easily applied to the anterior extremity. The remaining exposed surviving earthworms at the end of the test were weighed in order to assess the change in their body weight as an indicator of sub lethal effects.



Figure 1. Aspects during the tests

RESULTS AND DISCUSSIONS

Plant protection products are classified according to the percentage of mortality respectively survival percentage, in the following classes of selectivity (Baicu, 1990): for a percentage of survival greater than 80%, the product is highly selective, between 80% -63% the product is considered to be selective, 63% to 37% of survival means the product is medium selective, poorly selective in case if survival range 37 to 20% and non-selective if the percentage rate drops below 20% survival.

The average values for mortality % was recorded for *Eisenia foetida*, at 7 and 14 days after treatment. The results are described in the table below.

Table 1. Results for impact of plant protection products on earthworms expressed in % of mortality

Treatment			Average of mortality (%) after:	
			7 days	14 days
Chemical plant protection products	I – Nuprid 200 SC	V1	0	3.33
		V2	0	16.6
		V3	0	0
	II – Sencor 600 SC	V1	0	3.33
		V2	0	6.66
		V3	0	0
	III Consento 450 SC	V1	0	20.0
		V2	0	23.33
		V3	0	6.66
Control group			0	3.33

According to the table data (Table 1), the insecticide Nuprid 200 SC recorded a mortality of 3.33% at 14 days after the treatment, for the tested species *Eisenia foetida*, applying the registered dose. When a double dose was tested, the mortality recorded was 16.6% and for the half dose was not recorded mortality at all. These values correspond to 96.66% and 83.4% of survival for the tested useful organism.

For herbicide Sencor 600 SC, mortality for *Eisenia foetida* after applying the dose of use, was 3.33% and for the double dose was 6.66%, after 14 days of treatment, to which belongs 96.66 and 93.34 percentage of survival.

Regarding recorded results for the fungicide Consento 450 SC, the rates of mortality to the test species were 20% for the registered dose and 23% for the doubled dose, while at the lowest dose, mortality was 6.66%.

CONCLUSIONS

The tested pesticides are classified as follows: Nuprid SC 200 and Sencor 600 SC in the group of very selective; the fungicide Consento 450 SC in the group of selective.

The presented study shows that chemical plant protection products provide protection for detritivore macrofauna, with a low environmental impact. Due to a very good selectivity, these plant protection products can be used in potato crop protection.

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