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ASPECTS REGARDING THE INFLUENCE OF PESTICIDES ON THE TROPHIC SYSTEM: SOIL-WATER-PLANT

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ABSTRACT

The issue of residual pesticides in food is of great importance worldwide today. This situation has led many countries to draw up rules with limited quantities allowed in food. Their very high toxicity causes acute intoxications, accumulation in the body and chronic poisoning. Pesticides are highly dangerous compounds due to the persistence in the environment, accumulation of residues in food, infiltration into soil, transmission into wastewater, rivers and lakes, migration into deep soil layers, interstitial and groundwater, and atmospheric formation by air currents. Uncontrolled accumulation and migration into soil and groundwater of pesticides can lead to significant distortions in environmental factor parameters. The purpose of the work was to quantify the results by applying a neonicotinoid pesticide treatment on onion cultivation throughout the life cycle. The work demonstrates the need, but also the toxicity of pest control substances.

KEYWORDS: remanence, insecticide, onion cultivation, ecosystem

1. Introduction

Pollution is the contamination of the natural environment with harmful external substances, which affect it directly or indirectly, in the long run. Chemicals, which are a permanent presence today, can cause damage depending on the dose, the time of exposure and its frequency [8].

Pesticides are chemicals used to control pests (microbes, plants, insects, animals, fungi, algae), to prevent the development or regulation of plant growth, defoliation and drying [6]. Pesticides are mixtures of active substance and various auxiliary substances (diluents, wetting agents, adhesives, emulsifiers) [5]. They are produced and marketed in the form of solid (powder), liquid, gaseous or paste products. In the moment they reach the ground, in addition to their action on diseases, pests and weeds, pesticides extend their action to microorganisms [9]. Thus, quantitative and qualitative changes occur both in the structure of the edaphic population and in the physiological activities.

The importance of knowing these changes is supported by the protection of the edaphic ecosystems [7].

Toxic pesticide residues pass into the human body with the fruits and vegetables consumed [11]. Others pass into the body of animals that consume pesticide-treated feed, then humans consume milk, meat, etc [1]. Tolerance to pesticides is the amount of pesticide that can be ingested daily by humans, without it being considered toxic [4]. In this context, it is absolutely necessary to knowledge the influence that pesticides have on the biochemical processes that take place in the soil.

The persistence or degradation of chemical insecticides into the soil depend on factors such as: the chemical nature of the pesticides, the soil type, the microorganisms presence, the soil temperature, the soil cultivation, the treatment and conditioning of the

pesticide, the residue level after repeated annual soil treatments, the transfer of insecticides to edible parts of crops [3].

In general, the toxic effect of pesticides may cause hepatitis, neurotoxic, carcinogenic and embryotoxic effect on the activity of the organism or on the endocrine glands.

The main consequence of the use of pesticides is the increase of the mortality rate of human species, animals and plants [4]. In the extreme case, this may lead to extinction of the species, destruction of the natural habitat, damage of the soil, water and air quality, destruction of useful fauna (bees), etc [2].

The purpose of the work was to quantify the influence of the neonicotinoid insecticide on the onion cultivation throughout its lifecycle. This study demonstrates the need, but also the toxicity of pest control substances. This work is part of a comprehensive research study on the influence and the reshuffle of pesticides in the soil-water-plant-animal-human food chain.

2. Materials and working methods

2.1. The onion culture

The systematic classification of the onion assortment used is [9]: Regn - Plantae, Branch - Spermatophyta, Class - Monocotyledoneae, Order - Liliales, Family - Alliaceae (Liliaceae), Genus - Allium, Species - A. cepa.

The ecological requirements for the onion:

- The optimum temperature for the bulbs to grow is of 25-30˚C;
- Light: Onion's claims to light are quite high. The leaves grow at 8-12 hours of daylight, and the bulbs at 16-18 hours of daylight, the onion being a long day species.
- Water: Water requirements are high, mainly due to the superficial root system.
- Soil: Onions are grown on light, fertile soils, with good water retention capacity, well drained, with favorable exposure and low weeding.

The study material represented by the species Allium cepa (onion) was planted in vegetation pots measuring 70 cm x 20 cm. The growth stages of the onion samples, per week, are shown in fig. 1.

2.2. The neonicotinoid pesticide

The neonicotinoid pesticide is a systemic insecticide from the unnicotinoidal product group, with a wide spectrum of control of a wide range of pests on different crops. It combats all stages of development (egg, larva, adult).

The product is quickly absorbed into the plant and its effectiveness is not subjected to the air temperature. The naked covers have very good washing resistance (rain, irrigation, sprinklers) and provide a long protection time of up to three weeks. It has a short period from application to harvest. It does not affect the bees. The active substance of the neonicotinoid pesticide is: Acetamiprid 20%, Formulation: SG (soluble granules), Approval certificate no. 2616 din 02.03.2006. He acts on pests like Thrips, Whitefly, Aphids, Lice, Colorado potato beetle, on the cultures of potato, cucumber, apple, pear, pepper, plum, vine, cabbage, onion, wheat, corn, and rapeseed.

2.3. The working methods

The analyzes performed for the soil and the plant samples are presented below. After establishing the soil samples (fig. 2) and preparing the soil extract (fig. 3), the following parameters were determined [10]:

- pH - by the potentiometric method (fig. 4);
- Salt content - by conductometric method;
- Alkaline earthy carbonates - by gaso-volumetric method;
- Humus - by the oxidimetric method.

The parameters determined for the plants are:

- Humidity - by drying in the oven at 80℃, until constant mass (fig. 5);
- Ash content - by calcination at 550℃ (fig. 6);
- Proteins - by the Kjeldahl method;
- Lipids - by the Soxhlet method;
- Total phosphorus - by colorimetric method;
- Potassium - by the flamphotometric method.

After a double application of the neonicotinoid insecticide, at an interval of 14 days, the patterns of onions both from vegetation vessels and soil samples were subjected to a further analysis.

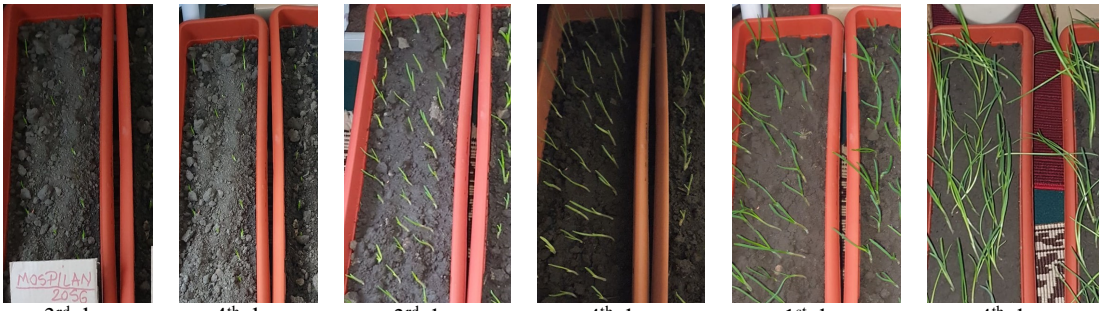


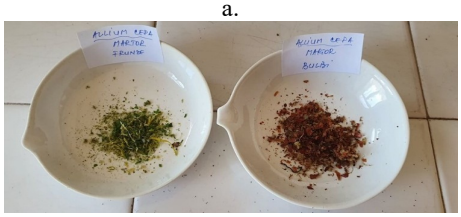
Fig. 1 The growth stages of the onion samples


Fig. 2 Preparation of soil samples


Fig. 3 Preparation of the soil extract

Fig. 4 Determination of pH in the soil

a.



b.

Fig. 5 Determination of the onion humidity, before (a.) and after (b.) drying in the oven

Fig. 6 Determination of the ash content in the onion

Qualitative tests have been carried out to identify the presence of the neonicotinoids derived from the studied inecticide application. For the plant material: there were weighed every 5 grams of onions, both from the control vessel and the vessel with plants treated with the neonicotinoid pesticide. The plants were crushed, grounded and 2% acid acetic extracts were prepared, in a ratio of 1:10 acetic acid, with charcoal to discolor the extract (fig. 7). The soil and the plant material extracts were subjected to identification tests according to Table 1 and fig. 8.

Fig. 7 The preparation of plant extract

Table 1. Identification tests for the studied extracts

Hager Reagent	Mayer Reagent	Dragendorff Reagent
Yellow precipitate only in concentrated solutions	White precipitate	Red precipitate – which changes to white-grey

3. Results and discussions

After performing analyzes, the obtained results are presented in table 2, regarding the soil properties, table 3 presents the physico-chemical properties of the plant material and table 4 presents the quality of the plant material after the second spraying.

The soil has good fertility properties and an adequate content of elements with nutrient value after the first spraying was applied to plants.

Table 2. Data on the soil properties

pH	7.89
CTSS, mg/100 g soil	240
Humus, %	5.15
Alkaline earth carbonates, %	3.2
Nitrates and ammoniacal nitrogen, ppm	30
Assimilable phosphorus, ppm AL	85
Assimilable potassium, ppm AL	260

Table 3. Data on the physico-chemical properties of the plant material

Analyze	Plant type	
	Blanck test	Treated with the neonicotinoid pesticide
Humidity, %	85.8	84.9
Ash, %	1.36	1.41
Protein, %	1.67	1.60
Saccharides, %	9.9	9.8
Lipids, %	0.18	0.17

Reagents used

Results with Hager reagent

Results with Mayer reagent

Results with Dragendorff reagent

Figure 8. Identification of the nicotinoides in soil

Table 4. Data on the quality of the plant material after the second spraying

Plant type	Humidity, %	Ash, %	Protein, %	Saccharides, %	Lipids, %
Blanck test bulbs	88.8	1.13	1.64	9.1	0.2
Blanck test leaves	91.5	0.95	1.12	7.5	0.15
Treated with the neonicotinoid pesticide – bulbs	88.9	1.31	1.55	9.5	0.21
Treated with the neonicotinoid pesticide – leaves	90.9	0.99	1.20	8.1	0.16

The plants grow vigorously and healthy, the humidity decreases, the dry matter and the ash content increases, and the nutrients show comparable values between the untreated plants and the treated plants. Under the tests of qualitative chemical analysis, the soil and the plants are not toxic after the first spraying.

After the second spraying, carried out within 14 days, the qualitative chemical analysis tests with reagents specific to the identification of neonicotinoid compounds, illustrate the presence of traces of toxicity with all three reagents used, both on the soil extract and on the onion, harvested from the vegetation vessel with sprayed plants: yellow precipitate, white precipitate, grey precipitate, slightly perceptible.

4. Conclusions

- The use of pesticides leads to the pollution of the environmental factors and concerning the effects upon life forms, they are very harmful.
- The work shows the positive influence of the use of insecticide substances on the quality of the agro-food products in that the plant can grow and develop without damage from insects.
- The experiment from the vegetation vessels is intended to determine the influence of the use of the studied insecticide on the cultivation of Allium cepa (onions), i.e. its persistence in soil and plants and the disturbance of the balance between the ecosystems and the soil - water - plants chain.
- Neonicotinic pest control products have very high efficacy and low toxicity to animals and humans, but their accumulation properties in tissues and organs lead to the conclusion that they should be used only if they are expected to decrease crop yields.
- The research can be continued by using this category of insecticides in other plant species but also by analyzing migration and accumulation in animal tissues.

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