SUMMARY

of dissertation

„SOME ECOTOXICOLOGICAL AND BIOCHEMICAL ASPECTS OF NAPROPAMIDE RESIDUES IN SOIL"

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Napropamide ($C_{17}H_{21}NO_2$: *N*,*N*-diethyl-2-(1-naphthalenyloxy)-propionamide) is one of the few herbicide substances used in cultivation of herbs. It belongs to the group of amides, which inhibits a growth of root at the germination process. Napropamide is a herbicide applied to the soil. Its main way of dissipation is photodegradation, while microbial degradation is very slowly.

The aim of this study was to assess the rate of napropamide disipation in soil and to compare the effects of this herbicide on soil biological activity. The toxicity of napropamide against bacteria *Vibrio fischeri* and ostracod *Heterocypris incongruents*, as well as its impact on selected parameters of antioxidant herbal raw materials obtained from marigold (*Calendulla officinalis* L.) were also determined.

The study was conducted in two steps. The first step was laboratory experiment carried out in a complete randomization in controlled conditions, and the next step was a three-year field experiment conducted in a randomized blocks, with marigold (*Calendula officinalis* L.) cv. Pacific Beauty Persimmon as a test plant.In the laboratory experiment, herbicide was added to the soil in the following rates: 0 (control soil), half of the field rate, the field rate and its multiples: two times, four times, eight times and sixteen times of field rate. However, in the field experiment, the following dosages of napropamide were used: 0 (control soil), half of the field rate, the field rate and two times of field rate. Napropamide was applied into the soil in both experiments as active substance of Devrinol 450 SC.

In the laboratory experiment on days: 1, 7, 14, 28, 56 and 112 napropamide residues were determined chromatographically and activity of dehydrogenases [EC 1.1.1.x], acid phosphatase [EC 3.1.3.2], alkaline phosphatase [EC 3.1.3.1] and urease [EC 3.5.1.5] were measured spectrophotometrically. In addition, immediately after the application of the herbicide, at dosages of: 0, field rate, two times, four times and sixteen times of field rate, microbiotests were performed: Ostrocodtoxkit F^{TM}, which tested toxicity of soil containing herbicide compared to ostracods *Heterocyptis incongruens*, and Microtox® test with luminescent bacteria *Vibrio fischeri*, as a test organism.

In the field experiment, immediately after the application of napropamide (first day of the experiment) and in individual development stages of the test plant (two pairs of leaves, formation of buds and flowering), activity of dehydrogenases, urease, acid phosphatase, alkaline phosphatase, and content of biomass of living microorganisms were determined. In addition, during the flowering phase raw plant material from marigold was collected: herb (*Calendulae herba*), leaves (*Calendulae folium*) and inflorescences (*Calendulae anthodium*). The material was dried in natural conditions. After drying the material was ground and in each kind of raw material chosen antioxidant parameters were determined spectrophotometrically: content of total polyphenols, total flavonoids, total carotenoids, total chlorophyll and antioxidant activity .

The results of the laboratory experiments showed, that the time of dynamic napropamide dissipation in soil depended on the herbicide dosage. The half-life of this compound was between of 33.50 to 71.42 days, and it increased with dosages of napropamide. The effect of napropamide on soil biological activity also depended on the herbicide dosage, and on the term of measurement and type of enzyme. Very often, there was no clear relation between the biological activity and the herbicide dosage. The use of napropamide at the dosage recommended by the manufacturer or smaller, in both the laboratory and field experiments was proved to be less toxic to the enzymes involved in the metabolism of carbon compounds (dehydrogenases), nitrogen (urease) and phosphorus (acid phosphatase and alkaline), as well as the content of the biomass of living microorganisms. As a contrast, the application of higher napropamide dosages, in most cases, resulted in decrease in soil biological parameters. Among assayed enzymes dehydrogenases were the most vulnerable to the presence of napropamide. In the biotests with bacteria *Vibrio fischeri* and ostracods *Heterocypris incongruens*, there was no proof of ecotoxicity of soil containing napropamide on the tested organisms. The use of napropamide in the cultivation of marigold caused a slight effect on antioxidant properties of the herbal raw materials. Among analysed parameters in the raw herb the highest changes of concentration were observed in total flavonoids and total chlorophyll.

In conclusion, napropamide used in the rate recommended by the producer did not cause ecotoxicological risks. However, the use of herbicide at higher dosages might affect the homeostasis of soil ecosystem.