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ECOTOXICOLOGICAL HAZARD ASSESSMENT OF TRIAZOLONE HERBICIDE AMICARBASONE

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Amicarbazone is a representative of innovative herbicides that protects corn crops from annual and perennial plant pests. The test substance accumulates in the growth shoots and leaves upon contact with the root system of the plant, inhibits the process of photosynthesis, as a result of leaves turn yellow and weeds die [1].

Amicarbazone is a part of the new preparation Vizhn, VG, which was proposed to ensure stable growth and high yields of corn crops. Failure to follow the instructions for use of the preparation there is a potential risk of environmental pollution and the risk of toxic effects on various species of living organisms.

The aim of our study was the ecological and hygienic evaluation of the herbicide amicarbazone from the chemical class of triazolinone compounds in terms of ecotoxicity and environmental behavior.

Data on the physicochemical properties of amicarbazone, its toxicometry parameters for different species of living organisms and behavior in soil were obtained from printed and electronic sources of information [1-3]. The stability of amicarbazone in the reasoned assessment was also assessed by the results of natural studies that were tested in Ukraine.

According to classification of pesticides for acute toxicity to mammals [4] amicarbazone is moderately toxic, hazard class IV (LD_{50} 1015 mg/kg [1], ≈1200 mg/kg [2]). In terms of acute toxicity to birds [5] is mildly toxic class III (LD_{50} 1965 mg/kg [1], > 2000 mg/kg [2]). In terms of contact toxicity for honey bees [5] is virtually non-toxic (LD_{50} > 200 μg/bee [2]). According to the average lethal concentration for earthworms [6], amicarbazone is a mildly toxic pesticide, class III (LC_{50} 931 mg/kg [2]).

The integrated assessment of ecotoxicological hazards (taking into account the maximum rate of consumption and persistence according to the results of studies in different countries (EU, USA, Australia)), which we carried out according to the method [7], showed that in various soil-climatic conditions the ecotox of the studied pesticide within (7,88×10-5 – 1,71×10-3) and is lower by (3–5) orders of magnitude than the ecotox of the persistent organochlorine pesticide dichlorodiphenyltrichloroethane (DDT).

According to results of field studies conducted with our participation in Ukraine, the half-life and ecotox of amicarbazone were (13,5±0.5) days and 2,66 × 10^{-4}, respectively. That is, in soil-climatic conditions of Ukraine the ecotoxicological danger of amicarbazone was 4 orders of magnitude lower than DDT, (1-2) orders of magnitude lower than the herbicides of previous generations: sim-triazines (atrazine, propazine, simazine) and six-membered heterocycles (bentazone, metribuzin), and comparable to imazethapyr from the class of imidazolinone derivatives [8, 9].

The danger of the studied pesticide for aquatic organisms, as well as for terrestrial ones, was assessed by acute toxicity [10]. It was found that amicarbazone for invertebrates is mildly toxic, class III (EC_{50} > 40,8 mg/l [1], 41 mg/l [2]), for fish - almost non-toxic (LC_{50} > 120 mg/l [1], > 100 mg/l [2]), extremely toxic for algae (EC_{50} 0,035 mg/l [2]) and highly toxic for higher aquatic plants (HAP), class I (EC_{50} 0,21 mg/l [1]).

Amicarbazone, both in laboratory (DT_{50} 14–87 days) and in field (DT_{50} 4–87 days) experiments [3], according to International Classification [1] can be classified as moderately resistant pesticides (III class), but according to the current Ukrainian hygienic classification of pesticides by the degree of hazard (DSP 8.8.1.2.002-98) - to highly resistant (I hazard class). In soil-climatic conditions of Ukraine, amicarbazone is low persistent (IV class) according to classification [1] and moderately stable (III class) according to the national classification (DSP 8.8.1.2.002-98).

According to the SSLRC (Soil Survey and Land Research Center) classification [1] according to the value of the K_{oc} sorption constant (16,7–44 ml/g, [3]), the studied herbicide is mobile in the soil (II hazard class), which indicates a high the probability of its entry into groundwater, in particular soil water.

In terms of persistence in water, amicarbazone is highly stable (I class) both in hydrolysis in a neutral buffer solution (pH 7) at a temperature of 20 °C (half-life T_{50} 64 days) and in the system "water - sediment" (T_{50} 116 days) according to DSP 8.8.1.2.002-98 and the International Classification [1].

Since the bioaccumulation factor (BCF) of amicarbazone has not been determined, the ability of living organisms to be absorbed from the environment has been assessed by the n-octanol-water partition coefficient [1]. It was found that amicarbazone has a low level of bioaccumulation (log P = 1,23). Therefore, despite the significant persistence of the substance in the aquatic environment, the low probability of crossing of biological membranes with amicarbazone makes its effect on aquatic organisms unlikely.

The ability of amicarbazone to evaporate was evaluated by saturated vapor pressure ($3,0×10^{-3}$ MPa at 25 °C) and Henry's constant ($6,78×10^{-8}$ Pa m^3 mol^{-1}) [3]. It was found that the studied herbicide is non-volatile according to the classification given in [1], ie contamination of the surface layer of atmospheric air due to evaporation from soil or leaves of plants is unlikely.

Conclusion. The herbicide amicarbazone was found to be extremely toxic to algae and highly toxic to higher aquatic plants, moderately toxic to mammals, mildly toxic to birds, soil mesofauna and invertebrates, and virtually non-toxic to bees and fish. Amicarbazone is moderately stable and mobile in soil, non-volatile by Henry's constant and highly resistant in water. At the same time, the effect of amicarbazone on aquatic organisms is unlikely, as the substance has a low level of bioaccumulation. The ecotoxicological hazard of the studied herbicide in soil and climatic conditions of Ukraine is 4 orders of magnitude lower than DDT and (1-2) orders of magnitude lower than its predecessors from the classes of sym-triazines and six-membered heterocycles.

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