Summary

Evaluation of the level of resistance of loose silky-bent (Apera spica-venti (L.) P.B.) to some active substances of herbicides

Loose silky-bent is a very competitive species to crop plants and its presence in a crop causes large yield losses. As an expansive species, *Apera spica-venti* is commonly found not only in Poland, but also across the world, and a rapid increase in its numbers can be noticed in recent years. Its significant proportion in segetal communities is due to, among others, the high percentage of cereals in the crop structure and the growing number of populations resistant to herbicides.

The aim of the present study was to evaluate the level of resistance of *Apera spica-venti* occurring in agricultural ecosystems in Lubelskie and Podlaskie Voivodeships (regions) to some active substances from the group of acetolactate synthase (ALS) inhibitors (HRAC 2), acetyl-CoA-carboxylase (ACCase) inhibitors (HRAC 1), PSII inhibitors (HRAC 5) and microtubule formation inhibitors (HRAC 3), to explain the resistance mechanism of selected populations, and to characterize agricultural practices in fields in which loose silky-bent resistant to herbicides was found.

The research hypothesis was that *Apera spica-venti* populations resistant to the active substances tested are found in the above-mentioned regions and that most populations are characterized by resistance to ALS inhibitors. Based on an analysis of the crop structure and information obtained from farmers, an assumption was made that more loose silky-bent populations resistant to herbicides can be found in Lubelskie Voivodeship.

Samples of seeds of 133 potentially herbicide resistant populations of *Apera spica-venti* were taken from fields located in Lubelskie and Podlaskie Voivodeships over the period 2017-2020. Biological tests were conducted under controlled conditions. Resistance of loose silky-bent to four active substances applied after emergence (iodosulfuron-methyl-sodium, pyroxsulam, fenoxaprop-P-ethyl and pinoxaden) and two active substances of soil-applied herbicides (chlorotoluron and pendimethalin) was tested. Based on the tests conducted, the median effective dose (ED_{50}) and the resistance index (RI) were determined, which were used to identify the level of resistance of the populations studied. Six *Apera spica-venti*

populations resistant to iodosulfuron-methyl-sodium were subjected to molecular analysis of the acetolactate synthase gene.

Herbicide resistant *Apera spica-venti* populations were primarily found in fields where winter wheat grown under the tillage system was predominant and where the farmers most frequently used active substances from the group of ALS inhibitors (HRAC 2) for weed control in the crops. 129 populations resistant to iodosulfuron-methyl-sodium and 72 populations resistant to pyroxsulam were identified, among which 71 were characterized by cross resistance to both above-mentioned substances from the group of ALS inhibitors. The resistance index for iodosulfuron-methyl-sodium was from 2.5 to 333.0, whereas for pyroxsulam it ranged between 2.1 and 43.0. Most of the populations analyzed exhibited a medium (RR) or high (RRR) level of resistance to ALS inhibitors. The occurrence of 19 loose silky-bent populations resistant to fenoxaprop-P-ethyl and 2 populations resistant to pinoxaden was confirmed. In most cases, the *Apera spica-venti* populations resistant to ACCase inhibitors showed lower sensitivity (r) to the active substances tested. Only three populations were characterized by a high level of resistance to fenoxaprop-P-ethyl (RI=11.4-45.9). This study confirmed the efficacy of soil-applied herbicides in controlling loose silky-bent. Only one population exhibited resistance to chlorotoluron, while all the populations were sensitive to pendimethalin. 20 *Apera spica-venti* populations with multiple resistance to ALS inhibitors and ACCase inhibitors as well as one population resistant to ALS inhibitors and PSII inhibitors were identified. The molecular analysis of the six studied populations resistant to ALS inhibitors demonstrated that target-site resistance resulting from mutations in the *als* gene occurred in five of them.

Key words: *Apera spica-venti, herbicide resistance, ALS inhibitors, ACCase inhibitors, PSII inhibitors, microtubule formation inhibitors*