



### Diversity of cross-resistance patterns to ACCase-inhibiting herbicides in wild oat (*Avena ludoviciana*) biotypes (448)

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Wild oat (*Avena ludoviciana*) is a prevalent weed in wheat fields of Iran. Accordingly, ACCase (Acetyl-CoA carboxylase) inhibitors, which include aryloxyphenoxypropionate (APP), cyclohexanedione (CHD) and phenylpyrazolin (PPZ) herbicides, are selectively applied to control wild oat and other weedy grasses. The continued reliance on ACCase inhibitor herbicides during the last two decades is associated with the extensive appearance of resistant wild oat biotypes. Resistance across ten ACCase-inhibiting herbicides was characterized in fifteen *Avena ludoviciana* biotypes from the southern grain belt of Iran (Fars and Khuzestan Provinces). Whole plant bioassays were conducted at the Iranian Research Institute of Plant Protection, Tehran, during 2014-2015 to determine the diversity of cross-resistance patterns to diclofop, fenoxaprop-P, clodinafop, quizalofop-R, haloxyfop, sethoxydim, cycloxydim, clethodim, pinoxaden and clodinafop + pinoxaden among wild oat populations. The different biotypes showed different ranges of resistance to given herbicides. Thus based on results, all biotypes (exception of ES that was susceptible to clodinafop) exhibited cross-resistance to diclofop, fenoxaprop-P and clodinafop. Moreover, nearly 53% of populations were resistant to quizalofop-R, whereas 27% were resistant to haloxyfop. Two biotypes of four sethoxydim-resistant populations showed cross resistance to cycloxydim. However, none of the wild oat biotypes were resistant to clethodim or pinoxaden. Cross-resistance in wild oat within the APP herbicides at 75% was much greater than within CHD herbicides at 13%. It is evident that most wild oat populations from the grain production belt of Iran have evolved resistance to a number of ACCase-inhibiting herbicides. Pinoxaden and clethodim can be suitable alternatives to control ACCase-resistant wild oats biotypes when combined with herbicide rotation and non-chemical weed management.

**Keywords:** ACCase inhibitor, cross-resistance, herbicide resistance, wild oat, whole-plant assay

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### Determination of ALS and ACCase inhibiting herbicide resistant biotypes of *Lolium* spp. in wheat fields (304)

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*Lolium* species are the most important grass weeds in Turkey, because of their wide distribution and abundance in winter cereals and other crops. Recently, many growers in various areas of Turkey complained of reduced control of *Lolium* species in winter cereals after use of ALS and ACCase inhibitor herbicides. There is no information in the scientific literature concerning *Lolium* species response to these herbicides and their level of resistance in Turkey. With this aim the seeds of these species were collected from 456 different wheat fields in South Marmara, Middle Anatolia and Black Sea regions. Greenhouse experiments for whole plant bioassays were conducted to confirm herbicides resistance in *Lolium* species (*Lolium perenne* L., *Lolium rigidum* L., *Lolium temulentum* L. and *Lolium multiflorum* L.), and to determine the levels of resistance to available herbicides. These accessions were tested for resistance to Pyroxulam+Cloquintocet mexyl (Safener), mesosulfuron methyl+iodosulfuron-methyl-sodium, clodinafop-propargyl (cloquintocet mexyl), pinoxaden, pinoxaden+clodinafop propargyl, propoxycarbazone sodium+ mesosulfuron-methyl+(mefenpyr-diethyl) (Safener) at registration doses. If the efficacy of herbicides were less than 80% these populations were included in further dose-response experiments according to this method. Of the 456 accessions tested, 160 accessions were not controlled by ALS and ACCase inhibitors when applied at recommended field rate. Some accessions exhibited the highest survival to treatment with field rates of these herbicides. The Weibull dose-response curve, an asymmetric sigmoid curve, was fitted to data to obtain ED<sub>10</sub>, ED<sub>50</sub> and ED<sub>90</sub> in R program. Thirty-nine of *Lolium* spp. (12 of *L. perenne*, 21 of *L. rigidum*, 3 of *L. temulentum*, and 2 of *L. multiflorum*) accessions tested were not controlled by ALS and ACCase inhibitors and these were accepted as a resistant population. The authors thank The Scientific and Technological Research Council of Turkey (TUBITAK) and Ondokuz Mayıs University for supporting the Project (Numbers TOVAG 1130417 and PYO.ZRT. 1905.14.009).

**Keywords:** ALS and ACCase inhibitörs, wheat, *Lolium* spp., herbicide resistance

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