Lolium rigidum Gaud. biotypes from Greece with Resistance to Glyphosate and other Herbicides

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Abstract

Monoculture and extensive use of glyphosate, ACCase and ALS inhibitors can greatly increase the risks of reduced efficacy of these herbicides on several weeds. In our study, seed samples of five *Lolium rigidum* accessions were collected from wheat fields and olive orchards in 2012 and 2013. Most of the sites were known as having poor *L. rigidum* control and pot experiments were conducted in order to evaluate the sensitivity of the biotypes to glyphosate, clodinafop and chlorsulfuron. Data analysis confirmed significant differences in biomass reduction of the several biotypes in response to the herbicides. In particular, one biotype was found to be resistant to glyphosate, one to clodinafop and two to chlorsulfuron, while several biotypes had an intermediate response. These findings confirm that the reported unsatisfactory control of rigid ryegrass could be attributed to herbicide resistance and therefore rotational use of herbicides and several non-chemical methods are required.

Keywords: *Lolium rigidum*, glyphosate, herbicide resistance

INTRODUCTION

Resistance to herbicides such as glyphosate, ACCase and ALS inhibitors is globally a serious problem (Travlos and Chachalis, 2010; Travlos *et al.*, 2011). Herbicide resistance is a serious problem that is the reality in all Mediterranean countries including Greece, with frequent reports of low efficacy of the previously mentioned herbicides against increasingly problematic weeds, such as *Conyza* spp. or *Lolium* spp. (Walsh *et al.*, 2011; González-Torralva *et al.*, 2012).

Lolium includes several species such as *L. rigidum* (rigid ryegrass), *L. perenne* (perennial ryegrass) and *L. multiflorum* (Italian ryegrass). Among them, rigid ryegrass is very abundant in winter cereals, orchards, vineyards, alfalfa and non-arable lands. Furthermore, it is regarded to be one of the most important weeds in terms of developing resistance to multiple herbicides due to the high levels of genetic diversity (Tranel and Trucco, 2009).

Taking into account the several reports of inadequate chemical control of *Lolium* spp. across Greece, the aim of this study is to evaluate the resistance of ryegrass (*L. rigidum*) accessions collected from winter cereals and perennial crops to glyphosate, clodinafop and chlorsulfuron.

MATERIALS AND METHODS

Mature seed samples of five *L. rigidum* accessions were collected from wheat fields and olive orchards in 2012 and 2013. Most of the sites were known as having poor *L. rigidum* control, while an accession from an olive grove never treated with herbicides was used as our reference susceptible. Moreover, a biotype of confirmed resistance to glyphosate (R1) was also included in our study (De Prado, personal communication). Plants were grown in 1 L pots (12 cm diameter) containing perlite and soil (1:2 by volume) and watered as required. When seedlings were at 3-5 leaves stage, they were sprayed with the maximum

Fig.1. Response of several *L. rigidum* biotypes to glyphosate

recommended rates (and also two and four times the recommended rates) of the above-mentioned herbicides using a low pressure flat-fan nozzle sprayer delivering herbicide in 300 L/ha water at 250 kPa. Fresh weight reduction was used as an indication of the herbicide resistance according to the rating system proposed by Moss *et al.* (1999).

RESULTS AND DISCUSSION

Data analysis confirmed significant differences in biomass reduction of the several biotypes in response to glyphosate, clodinafop propargyl and chlorsulfuron. In Fig.1 such differences are shown. It has to be noted that among the biotypes, one proved to be resistant to glyphosate and three to clodinafop, chlorsulfuron or both. These findings are in accordance with previous studies (Busi and Powles, 2009; Han *et al.*, 2014).

CONCLUSION

Our results revealed at least one biotype resistant to glyphosate (E4), one to clodinafop (D2) and two to chlorsulfuron (M1, H5). Conclusively, in the present research work, we demonstrated that there is an emerging problem of herbicide resistance in ryegrass. This is the first report of glyphosate resistance in ryegrass in Greece,

while it seems that we have an ongoing situation with many biotypes with intermediate response. Moreover, multiple resistance might cause an even bigger challenge. Consequently, the developing resistance of *L. rigidum* to the several herbicides implies the need of lower reliance to chemical control methods.

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