O.31 - Herbicide resistance in Italy: situation and management with the contribution of the Italian herbicide resistance working group (GIRE)

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Abstract

Herbicides are essential tools for weed management in conventional agriculture. However, their widespread use creates an intense selection pressure on target weeds. As a result, there has been a rapid increase in the number of resistant biotypes and resistant populations within biotypes. In Italy, 23 biotypes involving 16 weed species and five herbicide groups have been reported as resistant to one or more groups of herbicides. The worst situations are related to ALS-resistant populations in rice crops (*Schoenoplectus (Scirpus) mucronatus and Cyperus difformis*) and to both ALS- and ACCase-resistant populations in durum wheat (*P. rhoeas, Lolium* spp*., A. sterilis*). Resistant populations of summer weeds, *Sorghum halepense* and *Digitaria sanguinalis* resistant to ACCase inhibitors and *Echinochloa crus-galli* resistant to ALS inhibitors, have also been found recently in dicot crops (soyabean, melon, tomato) and maize, respectively. The Italian Herbicide Resistance Working Group (GIRE) began its activity in 1997. The group is formed by seven agrochemical companies with herbicides directly or potentially involved in herbicide resistance, plus academic, research and extension personnel. Screening test procedures have been agreed on and about 600 weed populations have been tested, of which more than 200 have shown resistance to one or more herbicides. The GIRE mission is to facilitate herbicide resistance management through cooperation and communication between public and private stakeholders. To prevent and/or limit the impact of herbicide resistance it will be important to preserve the relatively high diversity in Italian farming systems and adopt integrated weed management.

Weeds are controlled by disturbance, either chemical, physical or biological, which all result in the survival and selection of the best-adapted weeds, i.e. certain species and individuals within species. Even mechanical control, if the same operation is repeated regularly over time, can favour and therefore select some weeds over others. However, the most dramatic selection of weeds is brought about by the repeated use of the same herbicide(s) with the same mode of action on the same field. In large weed populations with sufficient genetic diversity some rare weed plants are naturally resistant to the herbicide(s) because they have genetically endowed traits enabling them to survive and reproduce at the herbicide rate used. Under continuous herbicide selection pressure, resistant individuals are quickly selected and, within a few years, will become the most important component of the weed flora. The development of herbicide resistance is therefore an evolutionary process influenced by selection pressure (i.e. herbicide efficacy and application frequency), initial frequency of resistant alleles and relative fitness of the susceptible and resistant biotypes.

Until the mid-1990s herbicide resistance had only a marginal impact in Italy (Porceddu et al., 1997), with three atrazine-resistant biotypes that at their peak infested about 8-10% of maize fields. Since then the situation has been evolving fast (Sattin, 2005) and there are now 23 resistant biotypes involving 16 weed species and five herbicide groups (A, B, C1, C2 and O). The worst situations are related to ALS-resistant populations in rice crops (*Schoenoplectus (Scirpus) mucronatus* and *Cyperus difformis*) (Tabacchi et al, 2004) and to both ALS- and ACCase-resistant populations in durum wheat (*P. rhoeas, Lolium* spp*., A. sterilis*) (Sattin et al., 2001; Scarabel et al., 2003). Herbicide resistance has appeared most frequently in areas where monoculture and use of herbicide(s) with the same mode of action were and are common practices. It is now estimated that about 20% of rice paddies and 2-3% of durum wheat fields are infested by ALS- and ACCase-resistant populations, respectively. The weeds involved are often the most susceptible to the herbicides used, indicating that the resistance mechanism in these biotypes is related to an insensitive target-site. However, several biotypes have also been identified with non-target-site multiple resistance.

Resistant populations of summer weeds, *Sorghum halepense* and *Digitaria sanguinalis* resistant to ACCase inhibitors and *Echinochloa crus-galli* resistant to ALS inhibitors, have recently been found in dicot crops (soyabean, melon, tomato) and in maize, respectively (Pignata et al., 2008). One population of *E. crus-galli* resistant to ALS inhibitors has also been recently found in a rice field. This represents a further threat to the sustainability of weed management in rice crops.

The increasing resistance problems in paddy rice led to the setting up of the Italian Herbicide Resistance Working Group (GIRE) in 1997. The group is formed by seven agrochemical companies (Basf, Bayer CropScience, Dow Agrosciences, Dupont, Monsanto, SIPCAM and Syngenta) that have a.i. directly or potentially involved in herbicide resistance, plus academic, research and extension personnel. Screening test procedures have been agreed and about 600 weed populations have been tested, of which more than 200 have shown resistance to one or more herbicides. The GIRE mission (see www.resistenzaerbicidi.it) is to facilitate herbicide resistance management through cooperation and communication between public and private stakeholders in order to 1) foster a responsible attitude to herbicide use, 2) improve knowledge on herbicide resistance in Italy, including monitoring causes and consequences, 3) effectively communicate and disseminate resistance management strategies, and 4) stimulate collaboration between public and private research, especially in the area of devising and implementing resistance management strategies. There is a regular exchange of information with the Herbicide Resistance Working Group of the European Weed Research Society (EWRS). GIRE regularly publishes updates of the resistance situation and guidelines for resistance management.

The situation of herbicide resistance seems to be evolving faster in southern European countries like Italy, with a wider variety of biotypes, herbicides and cropping systems involved. Standardisation in herbicide usage and in the agro-ecosystem where selection is occurring creates the conditions for resistance proliferation. The constantly increasing reliance on target-site-specific herbicides such as ALS and ACCase inhibitors and reduced opportunities for rotating different modes of action due to tougher EU regulations (e.g. the so-called “Pesticide Package”) will increase the resistance risk. The relatively high diversity in Italian farming systems must be preserved if we are to prevent and/or limit the impact of herbicide resistance. Integrated weed management should be widely adopted, so more effort must be made to convey a common, effective and science-based message to farmers.

References

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