Herbicide-resistant weed seeds contaminate grain sown in the Western Australian grainbelt

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Summary Long-distance seed dispersal of weed species within agro-ecosystems is mainly influenced by humans through machinery movement, particularly during harvesting and tillage, spreading of manure and by the unintentional contamination of weed seeds in harvested crop seeds (Thill and Mallory-Smith 1997, Barroso *et al.* 2006, Llewellyn and Allen 2006). In Australia it is common practice for farmers to grow and use their own crop seed rather than purchasing it. However studies have revealed that this crop seed can be contaminated with weed seeds (Powles and Cawthray 1999, Moerkerk 2002, Shimono and Konuma 2008), which are then sown back into the farming system. An essential component of good weed management is minimising the introduction of weeds into crop fields by sowing of clean crop seed. Sowing contaminated crop seed can add to the existing weed seedbank in the field, as well as introduce both new unwanted species and herbicide-resistant populations. This is a likely occurrence for Western Australian grain growers given the prevalence of herbicide-resistant weeds in Western Australian cropping regions (Owen *et al.* 2007, Owen and Powles 2009).

The purpose of this study was to determine the degree of weed seed contamination in crop seed sown in Western Australian farming systems and whether these infesting weed seeds were resistant to herbicides used for their control. We also wanted to understand the effect of seed source (i.e. farmer retained seed, certified seed) and seed cleaning methods on the level of contamination, and farmer perceptions regarding contamination of their crop seed.

During 2007–08, prior to the growing season, a total of 183 grain samples (~10 kg) were taken from 78 farms in the Western Australian grainbelt. Farmers were also asked a series of questions in regards to seed cleaning methods and seed source. These samples were then cleaned by hand and the level of contamination by weed seeds determined. Samples with adequate numbers of weed seeds were then screened for herbicide resistance using herbicides commonly used to control that species.

Of the 78 farms surveyed, the majority of farmers grew and conserved their own crop seed (95%) and most of this was cleaned prior to crop sowing (97%). However, many cleaned samples had some level of seed contamination (74%) with an average of 8.7 weed seeds per 1 kg grain, much higher than expected by farmers (2.9 seeds per 1 kg grain). Twelve different weed seed species were identified as contaminants, of which 10 were common agricultural weed species (found in 70% of samples with an average of eight seeds per 1 kg grain), and two volunteer crop species (found in 29% of samples with an average of 0.7 seeds per 1 kg grain). Annual ryegrass, wild radish, brome grass and wild oat were the most common contaminates occurring in 47%, 31%, 29% and 27% of samples, respectively. The remaining six weed species were found in fewer than 5% of samples. Uncleaned crop seed samples had 22 times greater weed seed contamination than cleaned crop seed. Samples that were cleaned by external professional seed cleaning contractors had substantially lower seed contamination compared to samples cleaned by the farmer. The type of seed cleaning method used (air, sieves, rotary screen, gravity table) and the crop species also had a significant effect on the level of weed seed contamination.

A substantial proportion of annual ryegrass populations recovered from the grain samples were resistant to diclofop-methyl (84%), clethodim (56%) and sulfometuron (91%), although glyphosate controlled all populations tested. Some resistance was also found in wild radish (chlorsulfuron 53% and diflufenican 27%) and wild oat (diclofop 40%) populations, although brome grass was susceptible to all three herbicides tested (fluazifop, clethodim, glyphosate). This study has shown that some WA farmers are sowing herbicide-resistant weed seeds into their farming systems during crop seeding.

Keywords Weed seed contamination, cleaning techniques, herbicide resistance.

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