

## Weed seed contamination in cereal and pulse crops

Sharon Roya Niknam<sup>1</sup>, Michael Moerkerk<sup>2</sup> and Roger Cousens<sup>3</sup>

<sup>1</sup> Joint Centre for Crop Innovation, Private Bag 260, Horsham, Victoria 3401, Australia

<sup>2</sup> Department of Natural Resources and Environment, Victorian Institute for Dryland Agriculture, Private Bag 260, Horsham, Victoria 3401, Australia

<sup>3</sup> Joint Centre for Crop Innovation, Institute of Land and Food Resources, The University of Melbourne, Victoria 3010, Australia

**Summary** This paper reports on surveys of farmers' seed boxes, which were carried out in the Wimmera and Mallee regions of Victoria in 2001. From seeds ready to be sown, 160 cereal and pulse samples were collected and the level and species of weed seed were determined. For lentils (28 samples), the seed box survey was followed up with a paddock survey at flowering and the determination of foreign seed material in the final harvested grain.

A wide range of weed species was found in the farmer-retained seed. Farmer-retained seed also contained more weed seeds than certified seed. For lentils, a number of common weeds were identified which tend to persist in the cropping system and replenish the seed bank. Annual ryegrass (*Lolium rigidum* Gaudin) was identified as the most problematic weed. Other weeds such as vetch and bedstraw could become serious problems in pulses if effective management practices are not found soon.

**Keywords** Weeds, survey, Victoria, management practices.

### INTRODUCTION

A recent survey showed that management of weeds is the top priority in Australian winter cropping systems (Jones *et al.* 2000). Weed control costs farmers millions of dollars each year and limits their choice of rotation crops. Sowing clean seed and therefore preventing the introduction of new weed species to farms plays an important role in the overall management of weeds. There is belief among farmers that the introduction of wild radish to some farms was by sowing contaminated canola seeds.

Pulses are an integral part of the cropping systems in the Victorian Wimmera and southern Mallee regions. Weed control, especially of broadleaf weeds, is difficult in pulses mainly due to the limited selection of herbicides that farmers can use. In this study, a survey of pulse seed boxes was carried out in order to determine the extent of weed contamination in crop seed and to establish possible links between this and the actual weeds that farmers were having difficulty managing.

The results presented in this paper show the level and species of foreign seeds in farmers' seed boxes. The aim is to give a more complete picture of weed problems from planting to harvest, with special emphasis on weeds that persist in the cropping system in spite of all management practices.

### MATERIALS AND METHODS

Seed samples were collected directly from farmers or with the assistance of TopCrop coordinators. Approximately 1200 g samples were collected from the seeds ready to be sown in the paddock.

Later in the season a survey of 28 lentil crops was conducted at flowering. These were the same paddocks where seeds were collected at the beginning of the year. The densities of weeds in the lentil crops were determined in 24 one-square-metre quadrats. In these paddocks weed seed contaminations were also measured in the harvest sample off the header. Paddock records of agronomic practices and preceding crop histories were obtained from each grower.

### RESULTS

**Weed contamination in cereal samples** A total of 72 cereal samples, mainly wheat and barley, were collected. The main foreign seeds in cereal samples were annual ryegrass, volunteer canola, volunteer barley, wild oats (*Avena* spp.), silver grass (*Vulpia bromoides* L.), volunteer wheat, lesser canary grass (*Phalaris minor* Retz.), brome grass (*Bromus* spp.), volunteer oats and paradoxa grass (*Phalaris paradoxa* L.). The percentage of weed-free samples in wheat and barley samples were 26% and 21% respectively (Figure 1). In both cereals, the majority of samples had seeds of three or fewer species of weed present. From the total number of 39 wheat and 29 barley samples, 77 and 90 percent respectively were retained seed. Fifty percent of the certified samples were weed-free, while the other 50% had between one to two weed seeds per kg. The retained samples had between zero and 3727 weed seeds per kilogram of seed.

**Weed contamination in pulse samples** A total of 88 pulse samples mainly lentils, beans and peas were

collected. The main foreign seeds in pulse samples were narrowleaf clover (*Trifolium angustifolium* L.), wireweed (*Polygonum aviculare* L.), annual ryegrass, common sowthistle (*Sonchus oleraceus* L.), bedstraw (*Galium tricornutum* Dandy), *Medicago* spp., volunteer lentil, volunteer field peas, vetch (*Vicia sativa* L.) and woolly burr medic (*Medicago minima* L. Barta). The percentage of weed free samples was lower in lentils than beans or peas/chickpeas (Figure 2). The majority of lentil samples had between 1–3 species of weed seed (Figure 2).

Weed contamination in lentil seed box samples Weed contamination in lentil seed samples (28 samples) ranged from nil to 22 seeds per kilogram. In these samples, 18% were weed free, 32% had less than 5 seed kg<sup>-1</sup>, 25% had between 5 and 15 seeds kg<sup>-1</sup> and 25% had over 15 seeds kg<sup>-1</sup>. The main weeds present

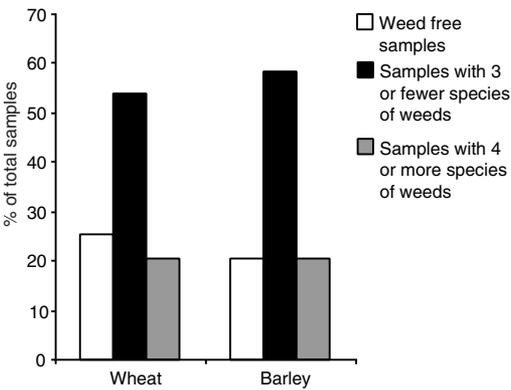


Figure 1. The frequency of the number of weed species found in wheat and barley samples.

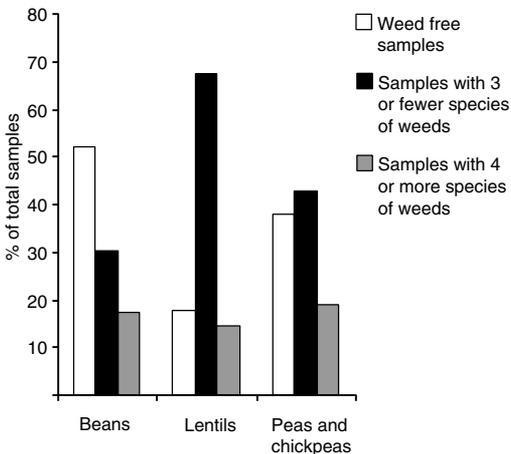


Figure 2. The frequency of the number of weed species found in pulse samples.

were volunteer barley, muskweed (*Myagrurn perfoliatum* L.), annual ryegrass, mallow (*Malva parviflora* L.), *Avena* spp., vetch, wild radish (*Raphanus raphanistrum* L.), volunteer canola, *medicago* spp. and bedstraw. Farmer retained seed had a higher level of weed contamination than certified seed.

Weed densities in lentil paddocks at flowering Although not high in number, prickly lettuce (*Lactuca serriola* L.) was the most widespread weed when the 28 paddocks were inspected at flowering time (Figure 3). In spite of additional grass weed control in August/September, over 57% of paddocks contained annual ryegrass. The main weeds, in terms of number, found in 28 lentil paddocks were annual ryegrass, deadnettle (*Lamium amplexicaule* L.), Indian hedge mustard (*Sisymbrium orientale* L.), vetch, prickly lettuce, common sowthistle, amsinckia (*Amsinckia intermedia* Fisch & C.A.Meyer), wireweed, hyssop loosestrife (*Lythrum hyssopifolia* L.) and hoary cress (*Cardaria draba* L. Desv.). Weed densities in paddocks at flowering did not correlate with seed levels observed in pre-sowing seed box samples. However, trends were found: for example, where vetch and bedstraw were detected in seed box samples it was also found in the field.

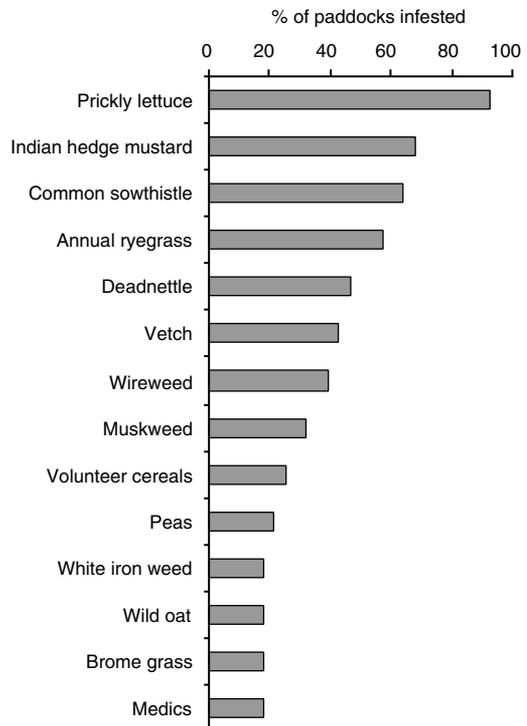


Figure 3. The percentage of farms infested with the top 14 weeds recorded at flowering.

**Weed contamination in lentil samples at harvest**

Lentil samples at harvest (21 samples) contained seeds of 33 different species of weed and no samples were weed-free. Ten samples had between 1 to 5 species of weeds while the rest contained more than 5 species.

The top ten weeds were annual ryegrass, volunteer barley, bedstraw, volunteer canola, wireweed, Indian hedge mustard, wild radish, white ironweed (*Buglossoides arvensis* (L.) I.M. Johnston), muskweed and vetch. Nine out of 14 weed species in the harvest samples were also in the top 14 species recorded at flowering.

Management practices in lentil farms Paddock records of agronomic practices and preceding crop histories were obtained from each grower when weed densities at flowering were recorded. In 82% of the farms the previous crop was either wheat or barley. Pre-sowing herbicide treatment was practised by 39 % of farmers, of whom 73% used Roundup®. Trifluralin was used by 61% of farmers as a post-sowing pre-emergence control. A mixture of simazine and either imazethapyr (Spinnaker®) or diuron was used by 75% of farmers. Other herbicides, such as diflufenican (Brodal®) and metribuzin (Sencor®), were also used together with simazine. In-crop weed control was mainly done by application of haloxyfop (Verdict®), quizalofop-p-ethyl (Targa®), propaquizafop (Correct®), flumetsulam (Broadstrike®) and clethodim (Select®), mainly in September. In-crop weed control was practised by 82% of farmers.

**DISCUSSION**

One of the most important, and often overlooked, factors in crop establishment is the level of foreign seed contamination. As well as adding to the weed burden, it also contributes to the introduction of unwanted species into the farm. After harvest, professional seed cleaning is done to the farmer's specifications and that decision is influenced by the cost and level of crop seed wastage. However, we found a number of farmers who were surprised by the level of weed seed found in their professionally cleaned samples.

Weed densities in paddocks at flowering did not correlate with seed levels observed in pre-sowing seed box samples. However, vetch and bedstraw were found both in the seed box and later on in the paddock where the lentils were sown. Weed densities at flowering reflect previous agronomic practice, seed bank and in-crop weed management. Harvest samples better reflected the weed densities observed at flowering than that in the sowing seed. Of the top 14 weeds, nine were found both at flowering time and in the harvest sample. The other 5 weeds had possibly shed their seeds before harvest and replenished the seed bank.

Annual ryegrass was the most abundant weed found at flowering and final harvest, although only 57% of the paddocks were infested. This figure is fairly similar (54%) to the frequency of ryegrass found in 68 field pea farms visited in 1985 (Amor and Francisco 1987). Of course, it is impossible to tell what proportion of the non-infested fields resulted from an absence of the species from the seed bank and which were due to good weed control. This study indicates that ryegrass control in lentils was not fully effective in many fields. In addition to other weed management practices, control of grass weeds was done mainly in August/September by a single application of herbicides. Our data show that for ryegrass control this is not adequate, although other grass weeds such as wild oat were reasonably controlled. A number of farmers indicated the presence of herbicide resistant ryegrass in their field and this can to some extent explain the persistence of ryegrass in lentils. A recent survey of pulses in the Wimmera and Southern Mallee (Brand 2001) and a survey in 1998 by the CRC for Weed Management Systems (Jones *et al.* 2000) also indicated annual ryegrass to be the major problematic weed.

Cultivated and wild vetch was a concern for many farmers, mainly due to the penalties that they incur for contaminated grain. Although farmers are advised to choose their lentil paddocks carefully with regard to previous vetch infestation, over 40% of the lentil paddocks inspected contained vetch at flowering. Vetch was also in the top ten weeds that were found in the seed box samples. Small levels of vetch were also found in three certified lentil samples (average 1.7 seed kg<sup>-1</sup>).

Bedstraw is another problematic weed and is more widespread now in Victoria than, for example, in 1985. A survey of field peas and chickpeas in the Victorian Wimmera in 1985 did not report bedstraw in the large number of paddocks they visited (Amor and Francisco 1987).

A number of changes are happening in our farming systems. Some examples are the introduction of herbicide resistant crops, the development of resistance in certain weeds, and the increase in pulse production. An understanding of the effect of these changes on weed ecology and population dynamics is critical. Although many weed seeds may be present in crop seed used for sowing, this may have little impact on the population as a whole: if only a small proportion of seeds are taken up and retained by the header, and the farmer then sows them over a large area, these will have a minor impact in comparison to the numbers in the seed bank. Unfortunately, data on the phenology of seed dispersal and seed capture by headers are not available for many species (ryegrass is an exception).