# Wild oats—what is the problem?

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## Introduction

Wild oats are weeds of great economic importance and represent a serious form of degradation in Australian winter cropping systems.

According to Harden (1994), four genotypes of wild oats occur in New South Wales *Avena fatua* L. and *A. ludoviciana* Durieu (synonym *A. sterilis* subsp. *ludoviciana*) are the main species which infest crops, and *A. barbata* Pott. ex Link and *A. sterilis* L. occur mostly along roadsides and in waste places, the latter being much less common and confined to the south east. Nationally, *A. ludoviciana* is recorded as being more common in the sub-tropical (north eastern) grain belt, whereas *A. fatua* has tended to predominate throughout the southern areas (McNamara 1966, Whalley and Burfitt 1972, Paterson 1976). Widespread variation in morphotypes of wild oats has been observed, particularly in relation to seed colour and hairiness, but has not been documented. ***Does this matter unless there is a genotype-by-control interaction?***

There are anecdotal indications that the species distribution pattern is changing, though there have been no recent surveys of either inter- or intra-specific genetic variation, other than of herbicide resistance (Nietschke and Medd 1996). If specific distributions are changing, how important is it to know what management factors are driving the shift? ***Are there region-by-species differences in selection for herbicide resistance?***

## Distribution

*Avena* spp. occur throughout the Australian grain belt and probably rank as the most widespread, prevalent and important weeds of cropping systems overall.

From a survey, Hoechst Australia Ltd. found that, nationally, wild oats occurred on two out of three farms in the winter cereal grain belt, were increasing on over 40% of the infested farms and the managers of more than one third of these farms have difficulty in controlling wild oats (P. Howat personal communication). Earlier regional surveys include Carne and Gardiner (1924), Whalley and Burfitt (1972), Paterson (1976), Velthuis and Amor (1982–83) and Amor (1986). ***If it is desirable to have better extent and distribution data, can this be obtained through collaboration with chemical companies undertaking market research?***

## Spread

Wild oats seeds have no adaptations to aid long distance dispersal and under natural conditions most seeds probably fall within a 1 m radius of their origin (Thurston and Phillipson 1976). The same authors also reported birds can act as vectors of dissemination for wild oats, but seeds that are consumed by birds are unlikely to survive. In arable systems, spread appears to be mainly by transportation in fodder, as a contaminant of grain or on agricultural machinery. In a run down pasture, to which the weed had been deliberately introduced, Auld (1988) found a single daughter plant of *A. fatua* 14 m from the nearest mother plant. The population growth, dispersal and area occupied by the species was similar, irrespective of whether the pasture was mown or grazed. There was a suspicion that the mowing may have disseminated seeds to the same extent as grazing animals. ***How can the naturally low spreading characteristics of wild oats be exploited?***

## Detrimental importance

### Disease

Annual grasses are important (but not exclusive) alternate hosts to several serious root diseases of winter cereals (Rovira 1987). There are few data identifying the specific role of wild oats in this morass. Kidd (1995) in repeated pot experiments showed that wild oats can be infected by take-all (*Gaeumannomyces graminis* (Sacc.) Von Arx & Oliv.) but to a lesser extent than other grasses, and had little impact on subsequent growth of wheat. Current studies in South Australia have indicated that wild oats do not act as hosts for take-all fungi, but are one of the main hosts for cereal cyst nematode (Roget *et al.* personal communication). It is apparent that there are considerable differences between grass species in their hosting ability, and that the carry over of disease depends on the rate of breakdown of host tissue (Murray personal communication). Burdon *et al.* (1992) identified wild oats as important refugia for several pathogenic diseases of cultivated oats, and warned of their involvement in the development, maintenance and evolution of such pathogens. Riley and McKay (1991) reported that *A. fatua* acted as a minor alternate host for second stage juveniles of the nematode *Anguina funesta*, a vector of *Clavibacter* sp., the toxigenic bacterium associated with annual ryegrass toxicity. Costing of disease refugia may arise out of Co-operative Research Centre for Soils and Land Management studies. ***Should not the Weeds Co-operative Research Centre be promoting stronger links with the Soils Co-operative Research Centre on this subject to ensure mutual outcomes?***

### Competition

Wild oats are renowned for their competitive ability, significantly reducing crop yields, and to a much lesser extent, crop quality (Combellack 1992). They are among the most competitive of the annual grass weeds in wheat (Poole and Gill 1987), but yield loss is strongly influenced by crop density (Martin *et al.* 1987). Using Martin *et al.*'s yield loss model, Medd and Pandey (1990) estimated a national yield loss of 102 330 t (0.82% of total harvest) based on silo grain contamination data and assuming 10% of the wild oat seed produced was harvested. On current prices this represents a loss of approximately \$20 million $yr^{-1}$.

### Grain contamination

Level of contamination is seasonal and price dependent as market forces determine the extent of weed control and grain cleaning (grading). I have been unable to gain any information from grain handling bodies as to the size of the industry problem of contamination. Prime hard wheat with contamination of >50 wild oat seeds per 2 litre is rejected and other categories with similar contamination would be down graded to general purpose or feed grain, with a current price differential of \$80 $t^{-1}$. Rather than incur this loss, farmers mostly opt to clean grain, on the farm at an estimated cost of \$3–5 $t^{-1}$ or through a contractor at \$6–10 $t^{-1}$ ± cartage costs ± lost value of scalpings at \$100 $t^{-1}$. Some contractors offer a mobile cleaning service. Cleaning 1% of the national wheat crop at \$5 $t^{-1}$ would cost approximately \$1 million $yr^{-1}$.

### Cost of control

A range of control methods are employed to control wild oats. Some of these are difficult to quantify as they have multiple benefits and / or costs. Tillage, for example, may promote mineralization and breakdown of organic matter which, on one hand enhances available nutrient supply and lowers disease carry over, but on the other hand can destroy soil structure and lead to accelerated erosion and lowered water infiltration.

Herbicide use is a less confounded weed control input cost, but is still difficult to estimate. Production figures are not always readily available and many herbicides have broad spectral efficacy, making it difficult to apportion benefits to a specific weed. Herbicides may also result in phytotoxic crop damage (Nietschke and Medd 1996). Not withstanding these difficulties, Medd and Pandey (1990) estimated that avenacides worth \$23.5 million were applied to approximately 1 million ha (about 11.3% of wheat area) in Australia during 1987, with an additional \$5.2 million cost of application (total cost compounded at 8% represents a current national herbicide cost of approximately \$57 million $yr^{-1}$). This was regarded as a conservative estimate, and no attempt was made to estimate subliminal effects such as phytotoxicity. Since that evaluation, several new herbicides, notably ones with selectivity on broadleaf crops, have been registered for wild oat control. Their impact on total market size is unknown.

*Herbicide resistance*

Resistance in wild oats to Group A herbicides has been reported throughout southern Australia. An overview of the incidence, patterns and management implications is given by Nietschke and Medd (1996). Herbicide resistance impacts by necessitating more expensive control options or additional control inputs, greater potential yield losses and, possibly, opportunity costs through having to divert to less profitable enterprise options. If control of herbicide resistant wild oats cost an additional \$10 $ha^{-1}$ on 1% of the national wheat producing area, this would represent an extra loss of approximately \$1 million. Alternatively, if herbicide resistance resulted in an enterprise shift from wheat to grazing oats on 1% of land, representing a drop in gross margin of approximately \$15 $ha^{-1}$, this would represent a cost of \$1.5 million $yr^{-1}$.

*Fire hazard*

Grasslands on the riverine plain in south western New South Wales dominated by *Avena* spp. and annual ryegrass (*Lolium rigidum* Gaudin), with a height of 0.9 m and fuel load of 2.1 t $ha^{-1}$, supported a wildfire fire line intensity of ca. 20 000 kW $m^{-1}$ that spread at 23 km $h^{-1}$; one of the highest rates recorded for grasslands in southern Australia (Noble 1991).

## Beneficial importance

Wild oats may provide palatable forage for grazing animals. Seed may also be a useful feed source for livestock either as whole grain or in processed feedstuffs. Perhaps the greatest value of wild oats is as a source of germplasm for improving disease resistance, seed dormancy characteristics and a range of other physiological, nutritional and agronomic traits, including herbicide resistance, in cultivated oats (Barr and Tasker 1992, Combellack 1992, Frey 1992, Harder *et al.* 1992, Kibite and Harker 1992, Ladizinsky 1992, Leggett 1992).

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