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Wild oats in W.A.

A summary of background information, recent research findings and current recommendations for the control of wild oats in Western Australia.

The author, Research Officer Dr. John Paterson, shows the contrast in growth habit and maturity of the southern form of *Avena barbata* (left) with the southern form of *A. fatua*.

Wild oats have been agricultural weeds for at least 4000 years. They are thought to have originated in the Mediterranean region, spreading to England and then to Tasmania in wheat and barley seed. It is thought that they entered Western Australia in seed wheat from Launceston in the early 1830's.

In some countries wild oats are an immense problem; for example, in Canada more than half of the area sown to cereals is infested. They are now a problem in all Australian States.

Identification

Seedlings

It is often difficult to distinguish between wild oat and wheat seedlings. Suspected plants should be examined a few days after they emerge, as one of the recommended herbicides (barban) must be applied soon after seedling emergence.

The differences are shown in Fig. 1.

Wild oat seedlings are easily identified by the *anti-clockwise twist in the first leaf*. In contrast, wheat seedlings have a *clockwise twist in the first leaf*.

Wheat seedlings also have *two auricles* (ear-like projections) and a *rim of fine hairs* at the base of each leaf-blade, where it joins the leaf-sheath surrounding the stem. The auricles and hairs are not present on oat plants. Barley seedlings have auricles but no hairs at the base of each leaf-blade.

Plants

Wild oats belong to the same group of plants as cultivated oats, the genus *Avena*. This classification was first established in the 1700's. Recent more detailed investigation of the relationship between the various types of cultivated and wild oats has allowed classification into several major sub-groups or species. These are distinguished by the way their seed is shed at maturity, on the external characteristics of their seed, and on the cellular characteristics which control their breeding habits.

Life cycle of wild oats

Germination

Different oat types germinate under different specific conditions. This may give one type an advantage over others, leading to the predominance of one or other species, depending on their suitability to each environment. Seed germination can therefore be important in controlling the relative distribution of various species.

Vegetative growth

Differences between and within species are also important during the

![Fig. 1—The difference between wild oats and wheat seedlings. Wild oats have no auricles and a hairless ligule.](image)
vegetative stage of growth, as they can give an advantage to the best suited type in the prevailing environmental conditions, such as temperature and daylength.

Most wild oat seedlings, like some cereals, require a period of cold winter temperatures (vernalization) before they can begin to flower. The amount of cold treatment required can differ between and within species, and types with a large vernalization requirement are likely to be restricted to cold districts.

Varying daylength requirement becomes important once the vernalization requirement has been satisfied. Types which flower late in the season do not do so until a critical day-light period each day has been reached in spring.

The wild oat problem

In the 1960's it became obvious that the density of wild oats increased rapidly with multiple cereal cropping. Multiple cropping gave little opportunity for control by grazing, which reduces seed setting considerably.

The problem was accentuated by widespread use of "hormone-like" herbicides—which control broad-leaved weeds and allow grass weeds to grow with reduced competition—and the greater use of header-harvesters, which work better in a fully mature crop after the wild oats have shed.

At this time little was known of the actual species of wild oats present.

This situation led to a detailed study of wild oats in Western Australia.
Wild oat survey

Little information was available on the natural variation within Western Australian wild oats and for this reason a study was undertaken to define the species present, their distribution, and the conditions preferred for their survival and growth.

The species present were surveyed to determine their local preferences. The information gained was used to plan experiments concerned with plant development, seed survival, nutritional requirements and soil moisture preferences.

Western Australian species

Two wild species of *Avena* were found to predominate: *Avena barbata*, comprising 50 per cent, and *Avena fatua*, 47 per cent of the population. The remaining 3 per cent was *Avena sterilis*.

The differences between the seed characteristics of these species are shown in Figure 2.

The very low incidence of *A. sterilis* may seem surprising in view of its widespread distribution in eastern Australia.

However, it is likely that *A. sterilis* is poorly adapted to local conditions. This species is reported to have a lower temperature requirement for germination than *A. fatua*, so would germinate later in Western Australia. This would place it at a disadvantage.

The evidence available suggests that *A. sterilis* is unlikely to become a serious weed in south western Australia.

| Table 1.—Frequency of occurrence (percentage of all plants examined) of *Avena fatua* and *Avena barbata* on various soil types in Western Australia. |
| Soil type | *A. barbata* | *A. fatua* |
| Gravel* | 18.6 | 7.9 |
| Sand* | 20.7 | 18.7 |
| Loamy sand* | 20.5 | 16.7 |
| Loam† | 20.5 | 32.4 |
| Silt loam† | 12.8 | 15.2 |
| Clay loam† | 6.9 | 9.1 |
| Totals— Light* | 59.9 | 43.3 |
| Heavy† | 40.1 | 56.7 |

* Light soils with more than 50 per cent by weight particles greater than 0.2 mm.
† Heavy soils with less than 50 per cent by weight particles greater than 0.2 mm.

Table 2.—Frequency of occurrence (percentage of all plants examined) of *Avena fatua* and *Avena barbata* in three different habitats in Western Australia.

| Habitat | *A. barbata* | *A. fatua* |
| Crop | 11.1 | 53.2 |
| Pasture | 13.9 | 8.8 |
| Roadside | 75.0 | 38.0 |

Distribution

The geographic distribution of the major wild oats in Western Australia is shown in Figure 3. *A. barbata* predominates in the South-West, in areas of high rainfall and long growing season. *A. fatua* is most common in the lower rainfall, warmer and shorter growing season northern and inland areas.

*A. fatua* and *A. barbata* were found on a wide range of soil types, but *A. fatua* was most common on heavy soils and *A. barbata* on light soils, especially gravels (Table 1).

*A. fatua* was the most common species in cereal crops and *A. barbata* on roadsides (Table 2).

Seed type and colour

Differences in the seed colour or seed characteristics, such as hairiness or size of wild oats, could not be related to any particular district. There was no reason to believe that such characteristics were related to particular types of wild oat.

Adaptive features

Plant development

Both *A. fatua* and *A. barbata* apparently became well established with early agricultural development in Western Australia more than 140 years ago. Since then, a close association has developed between the environmental requirements of these species and climatic features.

*A. barbata* has become well adapted to the climate of the South-West. The later-maturing types found within this species give it an advantage in the South-West where cooler, wetter, and longer days are experienced in the spring.

*A. fatua* was found to have a poorly developed association with its environment; there was little evidence of any mechanism, such as a vernalization requirement, which could de-
lay flowering to make this species more suitable for a long growing season. *A. fatua* is the wild oat found in cereal crops, where such a restraint would be a disadvantage. Also, in the drier, warmer north-east of the agricultural areas, where *A. fatua* predominates, the growing season is relatively short and a rapid rate of development is an advantage.

Thus, *A. fatua* is unlikely to be a problem in the far south-west of Western Australia. More importantly, the life-cycle of this species is well adapted to the climate of the cereal growing districts, causing it to be a major weed problem there.

**Frost resistance**

Frosts are more frequent and more intense inland than near the coast. *A. barbata* seedlings are more susceptible to frosting than those of *A. fatua*, which restricts the north-eastern migration of *A. barbata*.

**Germination**

A large proportion of *A. fatua* seed will not germinate with the opening rains, in April or May. In contrast, *A. barbata* seed germinates at the break of the season. These seedlings are easily killed by cultivation and few live seeds remain to germinate in the sown crop.

For this reason *A. barbata* is rare in Western Australian cereal crops, but is common on roadsides.

Research has also shown that seed of wild oats from the northern, intermediate, and southern parts of the agricultural areas differ in their germination characteristics. On the south coast up to 30 per cent of *A. barbata* seed could survive the opening rains without germinating, so making it potentially difficult to control in cereal crops; however, cereals are not grown in this area.

**Soils and nutrition**

To determine the effect of rainfall patterns on the growth of wild oats both *A. fatua* and *A. barbata* were tested under experimentally-imposed restricted and excess moisture, on a range of soil types. Both species reacted similarly, suggesting that high rainfall is not responsible for the predominance of *A. barbata* in the south-west.

Other trials revealed no difference in the response of the two species to applied fertiliser. While fertile conditions would be advantageous to both species, *A. fatua* could suffer apparent nutrient deficiency on low fertility light soils because of its more rapid development.

This could account for the observed predominance of *A. fatua* on heavy soils (which are usually fertile); highly fertile light soils often carried a high population of both species.

**Importance as weeds**

Wild oats can produce a large number of seeds, between 250 and 500 per plant. At this rate an infestation of 50 plants per square metre could provide a population of 15 000 seeds per square metre. This is at least 50 times the number of cereal seeds sown in an average crop.

The greatest benefit to be gained from the removal of wild oats occurs in high yielding cereal crops. This is illustrated in Figure 5.

For example, in a wheat crop with a potential yield of 1 000 kg/ha a wild oat infestation as low as 50 plants per square metre reduces the yield by about 200 kg/ha. Where there are more than 400 wild oat plants per square metre the yield of wheat is unlikely to be further reduced by an increase in the wild oat density.

The illustration also shows the large reduction in wheat yield in a 1 000 kg crop caused by a relatively low infestation of wild oats compared with its negligible effect in a 400 kg crop. Therefore a reliable estimation of the effect of wild oats cannot be made without an estimation of wheat yield.

In addition to the reduction of cereal yields caused by plant competition, wild oats are considered a contaminant in harvested grain and are subject to dockage by grain handling authorities.

**CONTROL OF WILD OATS**

The control of wild oats depends on the identification of problem areas and on the correct application of control techniques.

**Cultural control**

*A. barbata* is easily controlled with a single cultivation and is rarely a weed in cereal crops. In contrast, *A. fatua* is difficult to control by cultivation, due to its highly dormant seed. It is unlikely that this species could be

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**Fig. 6—The emergence of seedlings from seed of *A. fatua* planted at a range of depths.**

![Diagram of emergence from seed](Diagram)
controlled by cultural practices without complete suppression of fresh seed formation for at least three years.

The reason for this can be seen in Figure 6.

When seed of *A. fatua* was buried at depths between 0.5 and 17.5 cm it was found that seedlings emerged best from depths between 2.5 and 12.5 cm deep, in each of the three years they were observed. At the end of this period only 3 per cent of the original seed remained alive and only one third of this was germinable in the following year.

In Western Australia stubble-soil populations of live *A. fatua* seed can be as high as 1 500 per square metre. The above result suggests that less than 15 seedlings per square metre would be expected after three years of control-grazed pasture. This number of plants would be unlikely to cause an economical yield reduction in a cereal crop.

Where cereal cropping is planned, a minimum of three prior years pasture, with regulated grazing to stop seed formation is therefore suggested.

Seed near the surface was more viable and therefore, before pasture establishment, shallow cultivation to bury surface seed would improve the chance of germination and weed control.

Pre-crop cultural treatments should be designed to kill as many weeds as possible and to suppress those remaining in the crop. The initial ploughing should be delayed as long as possible to allow emergence of the wild oats. Where most of the wild oat seeds are near the soil surface, such as in a first crop, this ploughing should be deeper than usual. Subsequent cultivations should be much shallower.

Where the break of the season permits, some delay in seeding-time can be used to give additional weed-killing cultivations.

End-of-season crop vigour and potential yield can be improved by sowing early-maturing varieties at a shallower depth and at a higher rate of seeding than normal. This will lessen the stress caused by retarded growth resulting from weed competition. A seeding rate of at least 60 kg of wheat per hectare is suggested where the wild oat problem is likely to be severe.

**Chemical control**

Two herbicides are available for the control of wild oats in wheat and barley crops. Other materials are continually under test but at present cannot be recommended.

Within each species it has been shown that many types of wild oats occur. These ranged from rapid growing *A. fatua* to slow growing *A. barbata*. The effect that these differences could have in their susceptibility to herbicides requires further investigation. Current herbicide recommendations are based on field experience.

**Triallate** is a pre-emergent material and is sold as Avadex BW*. It acts on the germinating seed and must be placed as close to this as possible, necessitating incorporation into the soil immediately after application.

Where this is not done the chemical rapidly disperses into the atmosphere and is lost. For this reason the seed bed should not be cloddy, nor too wet or dry.

The herbicide should be sprayed on to the soil surface at the rate of 2.1 litres in 80 to 110 litres of water per hectare and immediately incorporated with five or six-row harrows, dragged behind the boom. This could be followed by cross-harrowing to complete the incorporation before seeding at least 5 cm deep.

**Triallate** is equally effective if applied either two days before or two days after seeding; no toxic effects on wheat can be expected. Triallate cannot be applied effectively from an aircraft.

**Barban** is a post-emergent material, sold as Neoban†, and is closely related to Carbyne‡ which has been available for a number of years. It can be applied after a wild oat infestation becomes obvious. Barban stops the growth of wild oats, allowing the crop to outgrow the weed and smother it. Thus, competition from the wheat or barley is essential for successful control of wild oats with barban.

**Barban** must be applied when the wild oat plants have from one to 2½ leaves (Figure 7). This period only lasts for about seven days and occurs between 2½ and five weeks after planting. Spraying outside this growth stage will give poor results, except in southern districts where recent research has indicated that later spraying may be effective.

† Neoban: Registered trade name of Fisons Pty. Ltd.
‡ Carbyne: Registered trade name of Fisons Pty. Ltd.
Barban can be applied either by ground boom spray at the rate of 550 ml per hectare or from an aircraft at 500 ml per hectare.

With ground equipment a relatively high pressure of 350 kPa will increase the effectiveness and an efficient boom with nozzles giving a fine spray will give the best results. Aerial treatment is generally more effective than application from the ground; the rate can be slightly reduced when this method is used.

**Crop tolerance**
Both triallate and barban are relatively safe to apply to all recommended wheat varieties even if there is a slight error in application techniques. Similarly Beecher and Dampier barley can be treated with safety. Barban can damage Prior and Atlas 57 barley if the application techniques are not correct. Clipper and Proctor barley are easily damaged and should not be treated.

**Wild oat recommendations—in brief**
Where wild oats are a problem, a three-year pre-cropping plan should be developed.

In each year grazing pressure in spring should be increased to stop all wild oat seed production. In this way the likelihood of wild oats in a following cereal crop will be minimised.

The ability of the crop to compete with wild oats which survive the pre-sowing cultural treatments is important. If it is anticipated that the crop will be vigorous and high yielding, herbicide treatment with triallate or barban should be considered. Herbicide treatment is unlikely to give an economical return in low-yielding crop.

The two main species of wild oats in Western Australia: *Avena fatua* (left) and *A. barbata*, characterised by the drooping habit of its seed head.