THE COST OF WILD OATS (Avena spp.) IN AUSTRALIAN WHEAT PRODUCTION

B.J. WILSON
Department of Primary Industries, Queensland Wheat Research Institute, 13 Holberton Street, Toowoomba, Qld 4350, Australia.

ABSTRACT
The cost of uncontrolled Avena spp. (Avena ludoviciana L. and A. sterilis L.) through yield losses and dockages for contamination when used as a control method is reviewed. In competition and herbicide trials in Australia, grain yield losses due to Avena spp. range from nil to 75 percent. In a group margin analysis using a yield of 2500 kg ha⁻¹, a yield loss of 76% results in a gross margin loss of 56%. A gross margin analysis shows the importance of using high cost herbicides correctly. If dinitro-methyl and fluridone-methyl were applied incorrectly on soybean as was instead of a maximum yield increase, there is no yield increase, the gross margin is reduced from $115 to $44 per ha. A gross margin analysis shows that Avena spp. control by rotating winter wheat and summer crops in Queensland is achieved at no cost. The significant points demonstrated in this review are applicable in many cropweed situations.

INTRODUCTION
A. ludoviciana and A. sterilis, wild oats, occur in winter all cropping areas in Australia. One of the worst words of winter crops, it is usually difficult and expensive to control. It is therefore important to consider carefully the effect of uncontrolled Avena spp. on the farmer's profit from a crop, and the nature and costs of control methods. The significant points demonstrated in this review are applicable in many cropweed situations.

COST OF UNCONTROLLED WILD OATS
Grain yield loss
The loss of grain yield caused by Avena spp. can be ascertained from specific competition trials or from any trial with an untreated check and a weed-free control. Yield losses recorded in two trials carried out in Australia are shown in Tables 1 and 2. In all Australian experiments, Avena spp. reduced wheat yields by 22, 39, 44 and 57% at Tamworth (N.S.W.), 1956, and by 40, 71 and 75% at Narrabri (N.S.W.), 1972.

Herbicides which do not have a weed-free control can also be useful for assessing the yield loss caused by Avena spp., especially for extension purposes. Estimating yield loss is a proportion of the highest yield from a herbicide treatment may result in an underestimation of the actual loss, although in the experiments shown in Table 3 this method was relatively accurate.

In five trials carried out in 1975 and 1976 on the Darling Downs, Queensland, Wilson (1975) found that Avena spp. caused yield reductions that herbicide treatments versus untreated of 15 to 56%.

Reves et al (1973) found yield reduction of nil to 46 percent in 21 trials conducted in Victoria. In three trials in South Australia, Avena spp. caused yield reductions of 71, 20 and 20 percent (Catt, personal communication, 1974). In a gross margin analysis to examine what effect these yield reductions have on a farmer's profit, it is assumed that an Avena spp. infestation reduces wheat yield by 37.8%. Wood-free wheat yields of 2500 and 1250 kg ha⁻¹ are considered. It is assumed that the price of wheat is $2.85 per tonne, with variable costs of $69 per hectare, comprising $38.50 for fuel, oil, machinery repairs and maintenance, $16.80 for seed, $19.70 for fertilizer and $3.80 for herbicides. Threshold wheat weed indices from Blewitt (1979).

In the absence of Avena spp., the gross margin is $147 and $37 per hectare respectively on the two yield levels (fig. 1). However, when wheat is reduced by one third by the presence of Avena spp., gross margins are reduced to $72 and $27 respectively. This disproportionate reduction in gross margin is important when assessing the effect of Avena spp. yield losses can only be assessed from "profit".

Dockage or grading costs
Wheat and heavily contaminated with Avena spp. is downgraded and thus a dockage. In Queensland, this occurs when the number of seeds is 30% and the dockage varies from $3 to $12 per tonne. The downgrading also results in loss of premium payments if wheat would otherwise have been Prime Hard or Hard No. 1. If the combined loss in payments is sufficient, growers have their wheat graded before delivery and the loss in income is then limited to the cost of grading.

Australian Dollars.
Table 1. The effect of Avena spp. on wheat yield in herbicide screening trials at Tamworth (McNamara, personal communication, 1971):

<table>
<thead>
<tr>
<th>Year</th>
<th>wheat/foes</th>
<th>best herbicide treatment</th>
<th>untreated</th>
<th>Percent yield reduction relative to untreated</th>
<th>Avena spp. density (m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970</td>
<td>3242</td>
<td>3242</td>
<td>2536</td>
<td>22</td>
<td>58</td>
</tr>
<tr>
<td>1971</td>
<td>3403</td>
<td>3282</td>
<td>2744</td>
<td>19</td>
<td>64</td>
</tr>
</tbody>
</table>

Table 2. The effect of Avena spp. on wheat yield in the Boguten area, Darling Downs (Radford et al., 1980).

<table>
<thead>
<tr>
<th>Wheat Equivalent</th>
<th>Avena spp. population (m²)</th>
<th>LSD</th>
<th>P = 0.05</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production sewing rate</td>
<td>0  7.5  18.9  30.2  60.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20.0</td>
<td>12 1015 (96%) 402 (18%) 681 (22%) 544 (18%)</td>
<td>302</td>
<td></td>
</tr>
<tr>
<td>22.2</td>
<td>22 1422 (1332 (69%) 1163 (18%) 980 (31%) 781 (45%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.0</td>
<td>26 1520 (1147 (25%) 1435 (69%) 1238 (19%) 1098 (22%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13.5</td>
<td>56 1293 (1451 (1%) 1470 (1%) 1376 (6%) 1144 (12%)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 3. The effect on gross margin per hectare of using herbicides for control of Avena spp.

<table>
<thead>
<tr>
<th>Avena spp. Presence</th>
<th>Gross Margin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Present</td>
<td>$143</td>
</tr>
<tr>
<td></td>
<td>$72</td>
</tr>
</tbody>
</table>

Maximum yield increase after using:
- Triallate (5S) = $129
- Dalixate (5I) = $132
- Barnax (59) = $134
- Diflufenoxuron (22S) = $120
- Dicklofos-methyl (57B) av. = $28
- flamprop-methyl (529) av. = $28
- No yield increase after using:
- Triallate (5S) = $18
- Dalixate (5I) = $61
- Barnax (59) = $63
- Diflufenoxuron (22S) = $49
- Dicklofos-methyl (57B) av. = $28

Gross Margin for uncontrolled wild oats situation less cost of herbicide.

* Assumes 15% emergence and 32000 seeds ha⁻¹.

1 Percent yield reduction shown in brackets.

2 Gross margin for weed-free situation less cost of herbicide.

3 Gross margin for wild oats situation less cost of herbicide.
Fig. 1. The effect of Avena spp. on the gross margin at two yield levels, assuming the wheat causes a yield loss of one-third variable costs from Blunfield, 1979.

COST OF CONTROL METHODS

Chemical control

The herbicides available for control of Avena spp. and their cost per hectare (including application costs) are shown in Table 3. If the use of a herbicide results in the maximum yield then the gross margin is that for a weed-free crop less the cost of the herbicide (Table 3). The wheat yield response necessary to simply recover the cost of the herbicide varies from 105 kg ha\(^{-1}\) for hexazinone to 341 kg ha\(^{-1}\) for fluometuron-methyl based on the $35 per tonne net price for wheat. Yield increases smaller than these will result in a monetary loss from using the herbicide.

The profit or loss from using a herbicide can be found by comparing the gross margin after using the herbicide with the gross margin for the untreated crop. With a maximum yield increase in the higher yield situation (2500 kg ha\(^{-1}\)) there is a gain of $43 to $62 per hectare from using a herbicide. With the lower yield situation, the maximum yield increase is less and the monetary gain is smaller (7 to $16 per hectare). In this case, it is doubtful if the use of the higher priced herbicides is worthwhile because of the small profit from their use. If there is no yield increase, the loss of the money spent on the herbicide can lead to an overall loss (i.e. negative gross margin).

The above example highlights the need for very careful use of high-cost herbicides in order to achieve a profit from their use. Whether or not a yield increase is achieved will depend on the timing of the herbicide application. Wilson (1979) concluded that the most consistent increases in grain yield were obtained when post-emergence herbicides were applied prior to the tillering stage of the weed. McNemar (1978) found a negative linear relationship between grain yield and the duration of Wild oat competition; that is, the earlier the competition is removed the smaller the yield loss. Differences and flowering dates for oats were applied from about the 3rd to 4th of tillering stages of Avena spp. but it is essential that they are applied as early as possible within this period for maximum yield increase. The other herbicides are either applied pre-emergence or only can be applied early in the crop life.

In this review, the herbicides have been evaluated only in terms of their effect on yield in the year of application. However, they may reduce the seed production from Avena spp. with benefits in subsequent crops, but this effect would need to be substantial before a worthwhile monetary value could be assigned.

Rotation farming for control of Avena spp.

In most regions of Queensland and Northern N.S.W., growers are able to rotate winter crops grown after a summer fallow with summer crops grown after a winter fallow; in the winter crop phase wild oats can be controlled by cultivation during winter (Wilson et al., 1977). A typical rotation would be two years of wheat and/or barley, long fallow (i.e. fallow through summer and winter), two years of summer crop (primarily sorghum), and long fallow back to winter crop.

The analysis in Table 4 shows that at present prices there is a profit in following the rotation rather than growing continuous wheat. However, continuous wheat becomes more profitable where sorghum becomes a relatively less reliable crop (e.g. in the southwest of Queensland's wheat area). When a rotation with summer crop is necessary for control of Avena spp., the reduction in profit becomes a cost of controlling the weed (Gray, 1978).

This same type of gross margin analysis can be applied to other rotations used to control Avena spp. (e.g. alternating wheat or barley with pastures, grazing or bare fallow). If the gross margin from the rotation is less than the gross margin from continuous wheat or barley this cost of controlling Avena spp. must be reduced by the value of other gains from the rotation, e.g. improved soil structure and fertility after a pasture phase.
Table 4. A comparison of gross margins from growing a five-year cycle of a wheat/legume rotation versus continuouls wheat with pre-emergence herbicide used for pre-emergence control of wheat from Blomfield and Hodges, 1978; gross margin for wheat from Blomfield, 1976.

<table>
<thead>
<tr>
<th>Crop</th>
<th>Gross Margin (G.M.)/Ha</th>
<th>Wheat (2 M)/Ha</th>
<th>Wheat (2 M)/Ha</th>
<th>Additional yield due to long fallow</th>
<th>Less one of Avane spp. control in 3 follows</th>
<th>(A) Net G.M.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sorgum 5/35</td>
<td>$270</td>
<td>$270</td>
<td>$270</td>
<td>$35</td>
<td>$10</td>
<td>$259</td>
</tr>
<tr>
<td>Wheat 6/2</td>
<td>$152</td>
<td>$152</td>
<td>$152</td>
<td></td>
<td></td>
<td>$139</td>
</tr>
<tr>
<td>Wheat 7/1</td>
<td>$380</td>
<td>$380</td>
<td>$380</td>
<td></td>
<td></td>
<td>$310</td>
</tr>
<tr>
<td>Lett pre-emergence herbicide for 5 crops ($14 Ha applied)</td>
<td>$70</td>
<td>$70</td>
<td>$70</td>
<td>$70</td>
<td>$70</td>
<td>$70</td>
</tr>
<tr>
<td>(A) Net G.M.</td>
<td>$135</td>
<td>$135</td>
<td>$135</td>
<td>$135</td>
<td>$135</td>
<td>$135</td>
</tr>
</tbody>
</table>

1. It is assumed that herbicides for control of Avena spp. will not be necessary in the two winter crops after the summer crop phase. It is also assumed that pre-emergence herbicide will need to be used each year in the continuous wheat alternative and that the use of the herbicide results in a yield equivalent to wheat fallow wheat.

2. Value derived from 10% extra yield on the first sorghum crop and the first winter crop after long fallow.

3. Three additional cultivations per winter fallow at $2.40 per cultivation.

**LITERATURE CITED**


