THE COST OF WILD OATS (*AVENA* SPP.) IN AUSTRALIAN WHEAT PRODUCTION

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ABSTRACT

The cost of uncontrolled *Avena* spp. (*Avena fatua* L. and *A. sterilis* L.) through yield losses and dockages for contaminated wheat, and the cost of control methods, is reviewed. In competition and herbicide trials in Australia, grain yield losses due to *Avena* spp. range from nil to 75 percent. In a gross margin analysis using a yield of 2500 kg ha^{-1}, a yield loss of 35% results in a gross margin loss of 50%. A gross margin analysis shows the importance of using high cost herbicides correctly. If diclofop-methyl and flamprop-methyl are applied incorrectly or too late so that instead of a maximum yield increase, there is no yield increase, the gross margin is reduced from \$115 to \$44 ha^{-1}. A gross margin analysis shows that *Avena* spp. control by rotating winter and summer crops in Queensland is achieved at no cost. The significant points demonstrated in this review are applicable in many crop/weed situations.

INTRODUCTION

A. fatua and *A. sterilis*, wild oats, occur in almost all winter cropping areas in Australia. One of the worst weeds 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 crop/weed 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 (weedy) control and a weed-free control. Yield losses recorded in two trials carried out in Australia are shown in Tables 1 and 2. In other Australian experiments *Avena* spp. reduced wheat yields by 22, 39, 44 and 39 percent at Tamworth (NcNamara, 1976), and by 40, 71 and 75 percent at Narrabri (Philpotts, 1975).

Herbicide trials 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 as a proportion of the highest yield from a herbicide treatment may result in an underestimate of the actual loss, although in the experiment shown in Table 3 this method was reasonably accurate.

In five trials carried out in 1975 and 1976 on the Darling Downs, Queensland, Wilson (1979) found that *Avena* spp. caused yield reductions (best herbicide treatment versus untreated) of 15 to 56%. Reeves 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 11, 26 and 40 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 33%. Weed-free wheat yields of 2500 and 1250 kg ha^{-1} are considered. It is assumed that the price of wheat is \$85[1] per tonnê net, with variable costs of \$69 per hectare, comprising \$28.50 for fuel, oil, machinery repairs and maintenance, \$6.80 for seed, \$29.70 for fertiliser and \$3.80 for herbicides (broadleaf weed control) (values from Blomfield, 1979).

In the absence of *Avena* spp, the gross margin is \$143 and \$37 per hectare respectively for the two yield levels (Fig. 1). However, when yield is reduced by one-third by the presence of *Avena* spp., gross margins are reduced to \$72 and \$2 respectively. This disproportionate reduction in gross margin is important when assessing the effects of *Avena* spp.; the yield loss comes directly from "profits".

Dockage or grading costs

Wheat and barley contaminated with *Avena* spp. is downgraded and incurs a dockage. In Queensland, this occurs when the number of seeds ≥ 60 L^{-1}. 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.

[1] Australian dollars.

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

Year	Wheat yield ($kg\ ha^{-1}$) weed-free	Wheat yield best herbicide treatment	Wheat yield untreated	Percent yield reduction relative to weed-free	Percent yield reduction relative to best herbicide treatment	*Avena* spp. density (m^{-2})
1970	3242	3242	2536	22	22	58
1971	3403	3282	2744	19	16	64

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

Wheat population m^{-2}	Equivalent sowing rate (kg ha)[2]	*Avena* spp. population (m^{-1}) 0	7.5	18.9	30.2	60.7	LSD (P = 0.05)
28.9	12	1015	964 (5%)	802 (21%)	681 (33%)	544 (46%)	302
52.22	22	1422	1332 (6%)	1163 (18%)	980 (31%)	781 (45%)	
87.0	36	1520	1147 (25%)	1435 (6%)	1238 (19%)	1098 (28%)	
136.5	56	1293	1451 (+12%)	1470 (+14%)	1376 (+6%)	1144 (12%)	

[1] Percent yield reduction shown in brackets.

[2] Assuming 75% emergence and 32000 seeds kg^{-1}

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

	Gross Margin, Weed-free yield ($kg\ ha^{-1}$) 2500	1250
Avena spp. absent[1]	$143	$37
Avena spp. present[1]	$ 72	$ 2
Maximum yield increase after using -		
Triallate ($14)[3]	$129[2]	$23
Diallate ($11)	$132	$26
Barban ($9)	$134	$28
Difenzoquat ($23)	$120	$14
Diclofop-methyl ($28), Flamprop-methyl ($29) } av. = $28	$115	$ 9
No yield increase after using -		
Triallate ($14)	$ 58[4]	-$12
Diallate ($11)	$ 61	-$ 9
Barban ($9)	$ 63	-$ 7
Difenzoquat ($23)	$ 49	-$21
Diclofop-methyl, Flamprop-methyl } av. = $28	$ 44	-$26

[1] See Figure 1.

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

[3] Costs per ha are cost of herbicide plus 70 cents per ha for boom application, rounded to nearest dollar.

[4] Gross margin for uncontrolled wild oats situation less cost of herbicide.

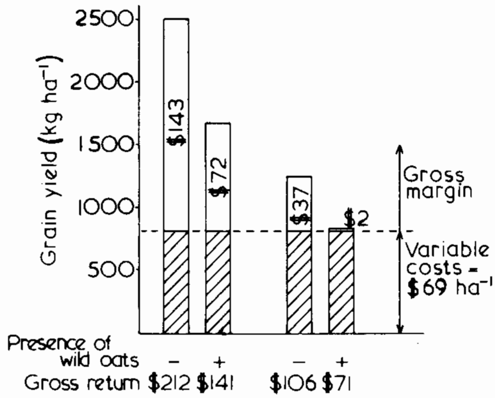

Fig. 1. The effect of *Avena* spp. on the gross margin at two yield levels, assuming the weed causes a yield loss of one-third; variable costs from Blomfield, 1979.

COST OF CONTROL METHODS

Chemical control

The herbicides available for control of *Avena* spp. and their cost per hectare (including application cost) 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 106 kg ha^{-1} for barban to 341 kg ha^{-1} for flamprop-methyl (based on the $85 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 $26 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 can 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. McNamara (1976) 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. Difenzoquat and flamprop-methyl can be applied from about the 3-leaf to end of tillering stages of *Avena* spp. but it is essential that they be applied as early as possible within this period for maximum yield increase. The other herbicides are either applied pre-emergence or can only 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 summer 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 values 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 south-west 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 oats 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/sorghum rotation versus continuous wheat with pre-emergence herbicide used for *Avena* spp. control[1] (gross margin for sorghum from Blomfield and Hodges, 1978: gross margin for wheat from Blomfield, 1979).

Rotation	
Sorghum (G.M. = \$135 ha^{-1}) 2 crops	\$270
Wheat (G.M. = \$76 ha^{-1}) 2 crops	\$152
Additional yield due to long fallow[2]	\$ 35
Less cost of *Avena* spp. control in three fallows[3]	\$ 18
(A) Net G.M.	\$439
Continuous Wheat	
Wheat (G.M. = \$76 ha^{-1}) 5 crops	\$380
Less pre-emergence herbicide for 5 crops (\$14 ha^{-1} applied)	\$ 70
(B) Net G.M.	\$310
(A) vs (B)	\$129 Advantage to the rotation

[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 weed-free 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 ha^{-1} per cultivation.

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