Managerial Practices to Control Wild Oats (Avena ludoviciana Dur. and A. fatua L.) in Queensland

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ABSTRACT

The repeated annual use of herbicides to control wild oats (*Avena ludoviciana* Dur. and *A. fatua* L.) was investigated. In the first trial the wild oat seed density in the soil after the wheat (*Triticum aestivum* L. 'Gamut') crop was less than the initial soil seed density only after the triallate [*S*-(2,3,3-trichloroallyl)diisopropylthio-carbamate] plus barban (4-chloro-2-butynyl *m*-chlorocarbanilate) treatment. Seed numbers in the soil had declined five months after the crop, so that the number in the triallate plots was also less than one year previously. In a four year trial, triallate and trifluralin (α,α,α-trifluoro-2,6-dinitro-*N*,*N*-dipropyl-*p*-toluidine) produced levels of wild oat control which resulted in grain yield increases between 55% and 120% in three of the years. There were still five to twelve wild oat plants per m^2 in the maturing wheat crop in the third and fourth years of applying triallate and trifluralin. Barban was less effective on the wild oats than the other herbicides, resulting in smaller yield increases. The incidence of wild oats in relation to crop rotations was surveyed over four years on five farms covering 2000 ha. Winter crops following two or three summer crops had low wild oat populations (1.0 on a scale 0 to 10). The wild oat density was rated at 2.5 and 5.0 in second and third winter crops respectively.

INTRODUCTION

Some managerial practices developed in temperate regions for controlling wild oats are not applicable in Queensland due to differences in climatic and edaphic factors. Delayed seeding, one of the best methods of cultural control available in Canada (Banting 1974), cannot be applied in Queensland because of the uncertain incidence of autumn-winter planting rains in this region of predominently summer rainfall; when a suitable rain falls, farmers must plant since further rainfall may be too light or too late for planting (Thompson and Beckmann 1959, Waring *et al* 1958). The planting of wild oat infested areas to greenfeed crops and pastures, recommended elsewhere (Banting 1974 and Reeves [2]) is also impracticable in the area considered in this paper — the Condamine

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Plains of the Darling Downs in Queensland — because for economic reasons the farms are adapted entirely to grain growing. Thus for winter crop monoculture in this area, farmers need to rely on herbicides.

The Darling Downs, however, is suitable for growing summer crops, an advantage the area has over most other parts of the world where wild oats are a problem. This allows farmers to rotate winter crops grown on summer fallow with summer crops grown on winter fallow. The success of this practice for controlling wild oats was reported by Philpotts (1975). She found that the wild oat density was reduced by 96.7% after one summer crop, and by 99.7% after two or three summer crops in northern New South Wales.

This paper reports on the effectiveness of repeated annual applications of herbicides, and of rotational cropping, as managerial practices for wild oat control.

MATERIALS AND METHODS

Winter crop monoculture trials. Trial 1. The trial was established in 1969 on the black earth plains at Bongeen, approximately 50 km west of Toowoomba, Australia. The initial population of wild oat seeds in the soil (0 to 7.5 cm) was 825 per m^2; 268 seeds per m^2 were sown on April 30, bringing the total soil seed population to 1093 per m^2. Wild oat seedlings which emerged presowing were counted on June 4 before they were killed with paraquat (1,1'-dimethyl-4,4'-bipyridinium ion). Plots 1.6 m by 30 m, replicated six times, were laid out in a randomized block design. Triallate at 0.85 kg ai/ha was applied on June 12 with a self-propelled plot sprayer and soil incorporated by the planting operation. Wheat 'Gamut' was sown at a rate of 45 kg/ha. Barban at 0.175 kg ai/ha in a volume of 112 L/ha was applied at the 1 to 2½ leaf stage of the wild oats. Results were obtained from three 0.42 m^2 quadrats per plot pulled on September 29; a whole plot grain harvest was not taken in 1969 because of severe frost damage. The number of wild oat seeds in the soil (0 to 7.5 cm) was measured again in April, 1970, before floods damaged the trial area.

Trial 2. In June, 1971, a new trial was established nearby. Trifluralin at 0.4 kg ai/ha was substituted for the triallate + barban treatment. Other treatments were applied as above for four years. One thousand wild oat seeds per m^2 were sown over the trial area on June 7, 1971. Wheat 'Gamut' was sown on July 25, and in subsequent years on June 1, July 15 and June 4.

Results were obtained from two 0.5 m^2 quadrats per plot pulled two to four weeks before crop maturity. Grain yield was obtained by header harvesting the whole plot.

Survey of wild oat density versus cropping practices. The density of wild oats was rated in 101 strips or paddocks on five farms in the Bongeen area (including the farm where the above trial was located). The total area of the farms was 2000 ha. Each strip or paddock was rated on a scale of 0 to 10 : 0 = no wild oats, 1 to 2 = scattered wild oats, 5 to 6 moderate infestation, 8 to 10 = dense wild oats. The ratings were made by one person or two people in consultation over the years 1973 to 1976. They were made just prior to harvest when wild oat panicles were clearly visible above the crop. Cropping histories for three to six years prior to 1973, were obtained from the farmers.

RESULTS AND DISCUSSION

Winter crop monoculture trials. Trial 1. Triallate used alone or together with barban was far more effective than barban alone in reducing the wild oat plant density and wild oat seed production in 1969 (Table 1).

Table 1. Effect of three herbicide treatments on wild oat seed production and the subsequent soil seed density (0 to 7.5 cm).

Treatment	1969				April, 1970
	Initial soil seed density (seeds/m^2)	Wild oat density in crop (plants/m^2)	Seed production (seeds/m^2)	Post-harvest[1] soil seed density (seeds/m^2)	Soil seed density (seeds/m^2)
Control	1093	261 a[2]	3260 a	3721	1923 a
Triallate	1093	43 b	624 c	1085	739 b
Triallate + Barban	1093	29 b	346 c	807	387 b
Barban	1093	224 a	2240 b	2701	2023 a

[1] Calculated by: initial soil seed density minus number germinated presowing (371 per m^2), minus number germinated in crop (261 per m^2), added to number of seeds produced in crop.

[2] Means with the same letter are not significantly different at $P < 0.05$ (Duncan's multiple range test).

The postharvest seed density in the soil was calculated as described in Table 1. Triallate + barban was the only treatment in which the post-harvest seed density was less than the initial soil seed density. In this year there was no grain harvest, but normally the numbers of wild oat seeds shown in Table 1 would be reduced by removal with the wheat grain.

The number of wild oat seeds in the soil (0 to 7.5 cm) four and a half months later (Table 1) was less than the calculated values, but the same trends are shown. This reduction could be expected as the high temperatures and rainfall (Table 2) over summer would aid the decay of wild oat seeds (Quail and Carter 1968). The results in Table 1 thus show that triallate and triallate + barban should result in a decline in wild oat numbers whereas barban alone would be ineffective.

Table 2. Monthly rainfall (mm)

Year	Months												Annual total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1969	49	11	45	11	95	23	6	70	28	101	92	52	583
1970	112	38	36	23	17	15	2	3	72	37	64	270	689
1971	291	159	2	13	14	9	35	50	36	70	93	133	905
1972	113	23	27	16	37	27	0	17	37	205	153	69	724
1973	91	62	29	9	11	14	90	43	72	42	46	86	595
1974	116	3	8	13	38	23	0	41	32	85	168	98	625
Monthly Means	129	49	25	14	35	19	22	37	46	90	103	118	687

Trial 2. Triallate was as effective in 1971 as in 1969 (Figure 1). Wild oat plant density and dry weight were reduced by 86.3% and 80% respectively and the wheat yield was increased by 120%. Again in 1971, barban did not reduce the wild oat plant density. However the dry weight of wild oats was reduced sufficiently for a 36% increase in grain yield. Trifluralin was intermediate between triallate and barban in effectiveness.

Statistical analysis of the data in Figure 1 is restricted to within years. The error terms in these analyses were too heterogeneous for a between years analysis.

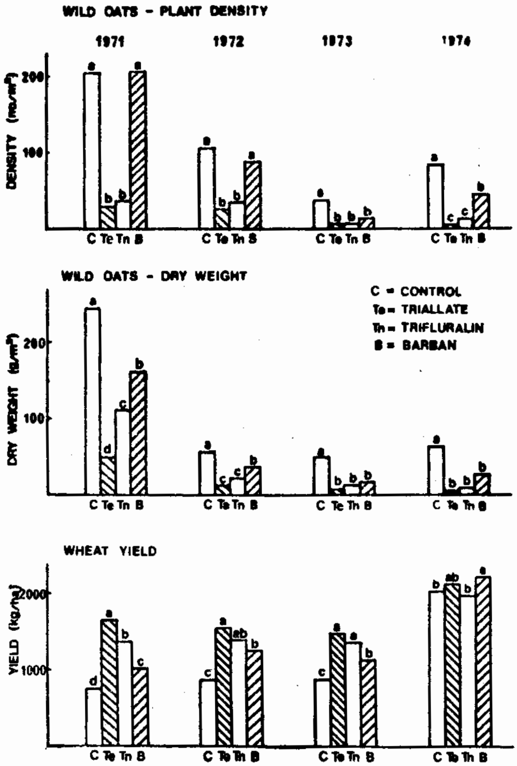

Figure 1. Effect of repeated application on triallate, trifluralin and barban on wheat grain yield and the density and dry weight of wild oats. Means with the same letter are significantly different within years (Duncans multiple range test).

The density and dry weight of wild oat plants in the control declined particularly in 1972 (Figure 1). Although this decline in wild oats is not consistent with the findings in trial 1, the farm survey (see below), or the report of Wilson and Cussans (1975), it has occurred elsewhere (Hughes 1975, Philpotts 1975). This may be due to the removal of wild oat seed with harvested grain, the decay of seeds over summer, and the control by cultivation of wild oats which germinate presowing.

Triallate and trifluralin were equally effective in the years following 1971 (Figure 1). However, there were still five to twelve wild oat plants per m² in the maturing wheat crop in the third and fourth years of applying triallate or trifluralin. Barban generally remained less effective than the other herbicides; even in 1973 when its effect on wild oats was not significantly different, grain yield remained lower than in the other treatments. Our results agree with Selman (1975) and Hughes (1975) in that the repeated use of triallate reduced but did not eradicate wild oats, and that triallate is superior to barban.

Yields were higher in 1974 than in previous years (Figure 1). This is at least partly attributable to a near optimum planting time (June 1) with good following rainfalls in late August to October (Table 2) (Doyle and Marcellos 1974). Inadequate rainfall delayed planting in 1971 and 1973 (Table 2) and this could be expected to result in lower yields. In 1972, drought followed by heavy late rainfalls adversely affected yields; the values presented are from the quadrat harvest.

The wheat was apparently able to tolerate a higher wild oat density under the conditions of 1974, compared with 1973. Yield was more than doubled in 1974 despite the increase in wild oat density.

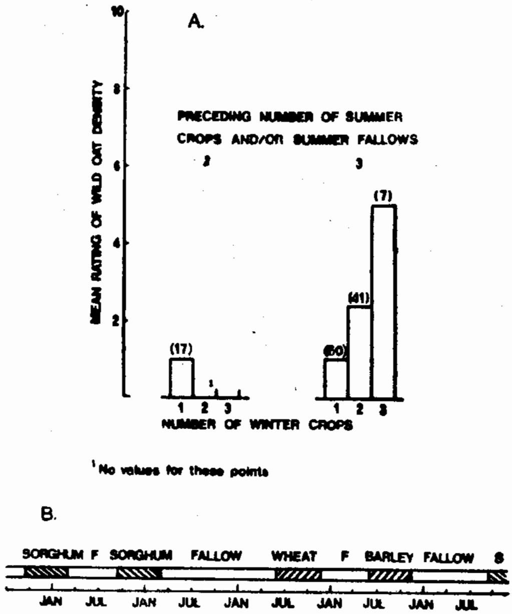

Figure 2A. Effect on wild oat plant density of successive winter crops planted after two or three summer crops and/or summer fallows. The number of ratings in each mean is shown in brackets.

2B. Example of the most common cropping sequence - two winter crops after three summer fallows and/or summer crops.

Survey of wild oat density versus cropping practices. The results of the survey are shown in Figure 2A. The density of wild oats in second and third winter crops was successively higher than in the first winter crop after three years of summer fallow and/or summer crops grown on winter fallow. Seed populations apparently build up with successive wheat crops as shown also by trial 1 and by Wilson and Cussans (1975). The wild oat densities in the first winter crops after two and three summer crops were similar, thus agreeing with the results of Philpotts (1975).

The number of values in each mean in Figure 2A show that two winter crops followed by three summer crops (or summer fallows) is the most common cropping sequence. A typical cropping sequence is illustrated in Figure 2B. Sunflowers (*Helianthus annuus*) may be substituted for the summer fallow or one of the sorghum (*Sorghum vulgare* Pers.) crops. Canary (*Phalaris canariensis* L.) may occasionally be substituted for the wheat or barley (*Hordeum distichum* L.).

A rating of 2 to 3 on our scale would equal no more than one or two wild oats per m^2. Provided these farmers do not go beyond two successive winter crops, they would not on average be incurring any yield losses due to wild oats (Philpotts 1975 and McNamara.[8])

It should be noted that the fluctuating density of wild oats shown in Figure 2A is occurring in an ongoing system of rotations. The result of introducing summer crops grown on winter fallow into an area heavily infested with wild oats may well produce more dramatic results than shown here.

The survey shows that the farmers in the Bongeen area have developed a rotational system which is providing good control of wild oats. Also, at current grain prices the system has proved to be economically sound. If a price differential developed in favour of winter crops, the length of the summer cropping phase could be reduced from three to two years; this would permit two winter crops in four instead of five years. If the price differential was still greater, the summer cropping phase could be reduced to one year, possibly without a serious increase in the incidence of wild oats (Philpotts 1975). The next step would be a winter crop monoculture. Our results show that this could be successfully conducted by relying on the repeated use of triallate; trifluralin is not registered for use in wheat and barley in Queensland.

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[8] Personal communication.

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