EFFECT OF APPLICATION TIME OF TWO SELECTIVE HERBICIDES ON PANICLE AND SEED PRODUCTION OF WILD OATS (*AVENA* SPP.)

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Summary. The effect of time of herbicide application on the fecundity of wild oats was examined in a glasshouse experiment as part of a program to evaluate the potential for selective spray-topping in wheat. Seven times of spraying were studied on wild oat plants ranging in growth stages from late tillering to early panicle emergence. Two herbicides, fenoxaprop-ethyl and flamprop-methyl were applied at 17.25 and 225 g ai/ha respectively. Wild oat seed production was reduced by between 64 and 99.9% and panicle control ranged from a 10% increase to 99% reduction. Results confirmed that early application (late tillering) is optimal in terms of plant kill and seedset reduction but late applications (early boot) still have value in reducing seedset, which might be useful for controlling wild oat populations on a long term basis.

INTRODUCTION

Simulation modelling of wild oat control strategies by Medd and Pandey (3) indicated that a reduction in seedset/seed rain of greater than 70% over and above that achieved by normal herbicide applications could be justified economically. Under conditions where populations were increasing, 70% control of seed input to the seed bank returned a small monetary loss with an expected crop yield of 1.5 t/ha. The tactic became profitable following increases in either crop yield or seed kill efficiency. If this tactic could be developed commercially, it has potential to improve the effectiveness of wild oat control in wheat and other crops, thereby reducing both the overall cost and volume of herbicide used in the long term.

Preliminary field experiments indicated that the late application of herbicides for wild oat control in wheat has potential for reducing seed production by up to 96% (2). The experiments showed that fenoxaprop-ethyl and flamprop-methyl were far more effective for late application than diclofop-methyl or tralkoxydim. Medd *et al.* (2) suggested the term 'selective spray-topping' to describe the use of selective herbicides applied late post emergence with the aim of reducing seed production.

In order to examine the relationship between application time and reduction in wild oat seedset, a glasshouse experiment was undertaken using the two most promising herbicides, applied over a range of times from late tillering to early panicle emergence.

METHODS

A glasshouse experiment was conducted at the Agricultural Research and Advisory Station, Glen Innes, to examine the effect of two herbicides at seven times of application on seedset in wild oats. The growth stage of every tiller on each plant was recorded using Zadok's scale (4). Herbicides were applied to ten single plant replicates at each time of application. Fenoxaprop-ethyl and flamprop-methyl were applied at half the minimum labelled rates (17.25 and 225 g/ha respectively). Ten pots were also used as unsprayed controls. Temperatures and relative humidities at the time of spraying are given in Table 1 for each time of spraying.

Wild oat seeds were planted on 8 August 1992 into black plastic pots (15 cm diameter) filled with a sand/loam/peat mixture. Seedlings were thinned to one per pot between 8 and 20 days after sowing. Pots were watered by hand immediately after sowing and by an automatic overhead sprinkler system twice daily thereafter. Ammonium nitrate was applied on 10 September 1992. Pots to be treated were removed, sprayed, then returned the glasshouse. Herbicides were applied through a three metre hand held boom fitted with 8003 Teejet® flat fan nozzles (spaced 50 cm apart) at 240 kPa and spray volume 189 L/ha.

Regular assessments included visual scoring of plant damage and tiller/panicle counts. Panicles were harvested as they ripened and before the commencement of seed shedding. A zero to five score was used to visually rank panicle/seed control (zero = no control and five = 100% control). Scores above three are considered commercially acceptable which corresponds to at least 80% control (1). Post harvest measurements were glume counts and filled seed counts per plant.

Table 1. Wild oat growth stages and spraying conditions at the time of application.

Application time	1	2	3	4	5	6	7
Spraying details							
Date of spraying	27.9.92	2.10.92	6.10.92	13.10.92	19.10.92	26.10.92	30.10.92
Days after first spray	0	5	9	9	22	29	33
Temperature (°C)	17	18	19	19	15	21	20
Humidity (%)	41	38	54	62	54	39	58
Wild oat growth stage for fenoxaprop-ethyl pots[1]							
Tillers/plant	12.6	13.0	14.3	14.5	15.4	19.6	16.6
Tillers - vegetative (%)	100	100	100	81	43	33	17
Tillers - elongating (%)	0	0	0	28	56	48	52
Tillers - booting (%)	0	0	0	0	1	19	26
Tillers - panicle (%)	0	0	0	0	0	0	5
Wild oat growth stage for flamprop-methyl pots[1]							
Tillers/plant	11.5	13.6	14.5	17.1	19.0	15.7	18.7
Tillers - vegetative (%)	100	100	99	79	57	19	29
Tillers - elongating (%)	0	0	1	21	42	64	42
Tillers - booting (%)	0	0	0	0	1	17	26
Tillers - panicle (%)	0	0	0	0	0	0	3

[1] Assessed using Zadok's scale. Vegetative = 10 to 29; elongating = 30 to 39; booting = 40 to 49; panicle = 50 to 59.

RESULTS AND DISCUSSION

Seed production was controlled by at least 89% for the first four times of application (late tillering to late stem elongation). After early booting, control of seedset declined but did not fall below 63%. Flamprop-methyl was consistently better than fenoxaprop-ethyl over the last five application times (Tables 2 and 3).

The wild oats in this experiment were not subject to competition from other species, moisture stress or other factors normally present in the field. Furthermore, although growth stages between the times of treatment were similar (Table 1) for pots assigned to each herbicide, maturity of plants was accelerated by glasshouse conditions and late planting. For instance, the period from the start of tiller elongation to panicle emergence was 17 days. Thus, levels of seedset control indicated by this experiment might not be achievable in the field situation where it is more difficult to minimise the effects of adverse environmental constraints. This is borne out by field experiments over two seasons and two sites which gave between 30% and 99% reduction in seed production using the same herbicides applied at similar growth stages and rates. In 1992, half the flamprop-methyl and 70% of the fenoxaprop-ethyl treatments produced greater than 75% seedset control. Also, flamprop-methyl appeared slightly less effective than fenoxaprop-ethyl under field tests and this could have been caused by the different growing conditions experienced in the glasshouse (Cook, unpublished data).

Table 2. Visual assessments and harvest data for wild oats sprayed at various times with fenoxaprop-ethyl.

Application time	1	2	3	4	5	6	7	Control
Panicle reduction (0-5)	4.9 a	3.9 b	3.8 bc	3.6 bcd	3.3 bcd	3.0 cd	2.8 d	0.0 e
Whole seeds/plant	1.2 a	53.0 a	35.0 a	40.0 a	133.0 b	189.0 b	173.0 b	517.0 c
Panicles/plant	0.2 a	2.7 ab	1.8 ab	3.4 ab	6.2 bc	7.6 bc	7.3 bc	11.3 c
Glumes/plant	1.0 a	47.0 ab	45.0 a	47.0 ab	98.0 bc	107.0 c	102.0 c	256.0 d
Whole seeds/glume	1.16bcd	1.05abc	0.64a	0.71ab	1.37cde	1.64de	1.77ef	2.20f
Whole seeds/panicle	1.2 s	17.6 bc	12.6 abc	7.9 ab	17.4 bc	23.4 c	20.5 c	45.7 d

Differences between means followed by the same letter are not significantly different (P=0.05) within parameters.

Table 3. Visual assessments and harvest data for wild oats sprayed at various times with flamprop-methyl.

Application time	1	2	3	4	5	6	7	Control
Panicle reduction (0-5)	5.0 a	4.0 bc	4.6 ab	4.4 a	3.3 cd	3.1 cd	2.8 d	0.0 e
Whole seeds/plant	0.4 a	55.0 ab	13.0 a	21.0 ab	91.0 b	78.0 ab	95.0 b	517.0 c
Panicles/plant	0.1 a	7.7 bc	3.8 ab	4.2 ab	12.8 c	10.6 c	8.5 bc	11.3 c
Glumes/plant	0.4 a	39.0 ad	13.0 a	14.0 a	69.0 b	71.0 b	85.0 b	256.0 c
Whole seeds/glume	1.56ab	1.45b	0.86a	1.36b	1.29ab	1.11ab	1.19ab	2.20c
Whole seeds/panicle	0.4 a	3.6 ab	1.4 ab	3.4 ab	6.5 ab	8.6 ab	12.1 d	45.7 c

Differences between means followed by the same letter are not significantly different (P=0.05) within parameters.

In the field, wild oat emergence is staggered and mixed seedling cohorts produce a range of growth stages, complicating the decision making process. Early application of post-emergence herbicides is generally recommended to minimise yield loss through competition, but this allows later germinating cohorts to survive and produce seed. This experiment confirms the potential for late application to control later germinating cohorts and also to significantly reduce seed production of fertile tillers not killed by earlier treatments. Consequently, where the objective is to minimise seed production, optimal timing is likely to be later in the field where mixed cohorts are present.

Both herbicides appear to warrant further investigation of the selective spray-topping concept which might also have advantages with regard to managing herbicide resistance. Field work aimed at optimising both rate and timing of herbicide application is in progress. Other aspects being examined include tank mixtures and additives, crop phytotoxicity and herbicide residues. A three year experiment is also examining the effects of pre- and post- emergence herbicide applications alone and in conjunction with selective spray-topping to quantify their effects on competition from wild oats and on soil seed bank populations.

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