THE CLETHODIM OPTION FOR USE AGAINST A 'FOP' RESISTANT *LOLIUM RIGIDUM* POPULATION – REPORT ON A CONTINUING STUDY INITIATED IN 1993

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Summary Results from the first three years of a continuing study illustrate that the performance of clethodim in controlling a 'fop' resistant *Lolium rigidum* Gaud. (annual ryegrass) population differs markedly from that of sethoxydim. Clethodim applied at 60 g a.c. ha^{-1} maintained a high degree of efficacy as reflected by a level of control of the order of 90% following three applications during the period 1993–95. In contrast the level of control attained by sethoxydim after three applications dropped to 24%. The population became totally resistant to haloxyfop.

The different performance of two herbicides from the 'dim' group suggests that, with careful planning within an integrated weed management program, the product life of a compound such as clethodim may be extended against *Lolium rigidum* populations beyond what has been previously expected.

As the sensitivity of *Lolium rigidum* populations to herbicides may vary, caution will be required in extending such a finding by way of field recommendation.

INTRODUCTION

Reports, following the introduction of clethodim (Select™) for the control of grass weeds in lupin crops, indicated that this herbicide was effectively controlling populations of *Lolium rigidum* which were apparently resistant to the 'fops' and which were not being adequately controlled by sethoxydim.

A long term field trial was established in 1993 to examine these reports. The site was selected in a paddock where recent history indicated that the *Lolium rigidum* population was not being adequately controlled by herbicides of the 'fop' group.

It was determined at the outset that the selection pressure process would be accelerated markedly by continuing to apply the same treatments each year. This was done knowing that it was contrary to good agronomic practice.

MATERIALS AND METHODS

A plot trial was established in 1993 and continued through seasons 1994–1995 on a property in the East Beverley area of Western Australia (32° 10'S, 117° 10'E). The trial was of complete randomized block design with four replications and plot dimensions of 4 × 20 m. Treatments were applied by means of an LPG plot sprayer with an output of 90 L ha^{-1} using 11001 TeeJets at 260 kPa.

Crops were established in each of the three years—1993/Lupins, 1994/Canola, and 1995/Lupins—following the application of a knockdown herbicide treatment to control early grass germinations. In the 1993 and 1995 seasons this was combined with pre-emergence applications of simazine (1000 g a.c. ha^{-1}).

Treatments applied to the same plots each year were clethodim at 30, 42 and 60 g a.c. ha^{-1}, sethoxydim at 93.4 g a.c. ha^{-1}, and haloxyfop at 52 g a.c. ha^{-1}. The treatments were applied early post-emergence with the growth stages of *Lolium rigidum* plants ranging from one leaf to early tillering. Application dates were 18 June 1993, 10 July 1994 and 19 June 1995. D-C-Trate was used in conjunction with the clethodim treatments at 2% v/v, D-C-Tron with sethoxydim at 1% v/v and Uptake with haloxyfop at 1% v/v.

Surviving *Lolium rigidum* plants and subsequent seed heads were assessed by counting; four quadrats being used in each plot.

RESULTS

The *Lolium rigidum* population level was estimated prior to treatment each year (Table 1).

A number of subsequent assessments were made following treatment applications – the key data being summarized in Tables 2 and 3.

Later seed head population assessments were made to more adequately reflect the contribution being made to the seed bank as a result of the respective treatments.

Plant population levels and seed head numbers reflect a combination of direct plant competition pressure, seasonal influences and treatment effects.

Table 1. *Lolium rigidum* population at time of treatment (plants m^{-2}).

Year	Location	Mean
1993	whole site	864
1994	untreated control plots	910
1995	untreated control plots	1419

Table 2. Surviving *Lolium rigidum* population – plants m^{-2}.

Treatment	Rate (g a.c. ha^{-1})	1993 34DAT	1994 39DAT	1995 42DAT
clethodim	30	21	195	180
clethodim	42	13	75	113
clethodim	60	9	15	63
sethoxydim	93	45	173	318
haloxyfop	52	26	248	593
untreated	–	356	538	645
LSD (P=0.05)		54	195	91

DAT = days after treatment.

Table 3. *Lolium rigidum* seed head population m^{-2}.

Treatment	Rate (g a.c. ha^{-1})	1993 129DAT	1994 94DAT	1995 92DAT
clethodim	30	303	368	455
clethodim	42	345	130	245
clethodim	60	158	23	103
sethoxydim	93	328	370	795
haloxyfop	52	383	743	1130
untreated	–	708	903	1050
LSD (P=0.05)		170	297	197

DAT = days after treatment.

Table 4. Level of *Lolium rigidum* control achieved as measured by seed head counts (%).

Treatment	Rate (g a.c. ha^{-1})	1993	1994	1995
clethodim	30	57	59	57
clethodim	42	51	86	77
clethodim	60	78	97	90
sethoxydim	93	54	59	24
haloxyfop	52	46	18	-8

DISCUSSION

'Conventional wisdom' regarding the development of resistance at field level suggests that once a *Lolium rigidum* population becomes dominated by 'fop' resistant types then the anticipated life of herbicides of the 'dim' group will be limited. This has been aptly demonstrated in broadacre farming in Western Australia. Switches to the first generally available 'dim' (sethoxydim) initially offered excellent control of 'fop' resistant *Lolium rigidum* populations. Farmer observations subsequently indicated that after two applications the level of control attained became marginal in terms of commercial acceptability in some populations.

The data indicate that the alternative 'dim' herbicide, clethodim has enhanced activity. If it is used within a carefully managed integrated weed management program, then, in practical terms, it appears that the product should have an extended 'life' beyond that which has been earlier postulated.

Converting the seed head data to per cent control clearly illustrates the trends which occurred within the trial during the 1993–95 period (Table 4).

The population has moved from being partially resistant to haloxyfop to one exhibiting total resistance. At the same time the degree of resistance to sethoxydim has increased markedly to a level which would not allow its commercial use.

During the same period the profile of the clethodim performance has not changed with the top rate of 60 g a.c. ha^{-1} maintaining a high degree of efficacy. The efficacy of clethodim was markedly reduced by cutting the rate to 42 and 30 g a.c. ha^{-1} but the data suggest that during the three year period the actual level of performance of these treatments, like the 60 g a.c. ha^{-1} rate, did not vary greatly in contrast with the performance of both the haloxyfop and sethoxydim.

In terms of seed bank dynamics, the data for clethodim emphasise the need to use a robust rate when using a herbicide. Sub-optimal rates will allow a population number build up. This provides a platform for rapid explosion once the critical selection pressure for resistance take-off has been reached.

In the 1996 season, the same treatments will be applied across, rather than along historic plots. This will not only examine the performance of clethodim following four successive years of selection pressure, but will also search for cross resistance patterns.

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