Farrer Centre

2004 Herbicide Resistance

Testing Service Report

Samples Received

The testing service screened 444 samples in 2004. This is 40% higher than the number of samples previously sent direct to the testing service. The Dow WeedSense (WS) program provided between 400 and 600 additional samples while the program was offered between 2001 and 2003.

The majority of these samples were annual ryegrass (387) but a number of wild oat, wild radish and brome grass samples were received (Table 1).

There was a major reduction in the number of wild oat samples received compared to the last two years with numbers reducing to the level received before 2002.

This report compares this years results with those of previous years for the non WeedSense samples only unless otherwise stated.

Table 1: Number of samples received since 2001 (includes WeedSense receivals).

	2001	2002	2003	2004
Annual ryegrass	555	735	643	387
Wild oats	20	126	86	28
Wild radish	4	21	30	15
Brome grass		4	4	8
Others		9	6	6
WeedSense	409	607	585	-
Direct to CSU	170	288	184	444
Total	579	895	769	444

Summary of Results

The results obtained from the 2004 resistance screening are similar in the majority of cases to the results from previous years for samples sent direct to the testing service.

Annual ryegrass

This year, 387 annual ryegrass samples were received of which 366 were tested to the standard cross-resistance test (Table 2). Seventy-one of these samples were tested to one to three additional herbicides. In addition, 48 samples were tested to glyphosate. Twenty-one samples were tested to a herbicide or combination of herbicides other than the standard cross-resistance test.

Table 2: Number of samples tested to each of five herbicide groups (non WeedSense samples only)

	2000	2001	2002	2003	2004
A (fops)	149	144	253	118	374
A (dims)	147	137	263	136	378
B	132	137	256	129	341
C	126	110	224	125	363
D	125	121	224	117	362

Seventy-seven percent of all samples tested to a 'fop' herbicide were classed as either resistant or developing resistance to that herbicide (Table 3). This is slightly lower than the results of previous years for samples sent direct to the Farrer Centre.

Ten percent of samples tested to a ‘dim’ herbicide were classed as resistant or developing resistance (Table 3). This is the lowest level of resistance observed to the ‘dims’ since the commencement of the service in 1991.

Forty-eight percent of samples were resistant to Group B herbicides. This was higher than any year since 1997 when 58% of samples were resistant to group B herbicides. No samples were resistant to simazine (Group C) and 13% were resistant to trifluralin (Group D) (Table 3).

Table 3: Percentage of samples resistant or developing resistance to each of five herbicide groups (excluding WeedSense samples)

	2000	2001	2002	2003	2004
A (fops)	98	86	85	81	77
A (dims)	15	34	22	17	10
B	32	43	47	38	48
C	1	0	0	1	0
D	10	8	4	4	13

Cross and Multiple Resistance

366 samples were tested to five herbicide groups in the Farrer Centre cross resistance test. Of the 366 samples, 42% were resistant or developing resistance to two or more herbicides, similar to last years 39% of samples. Seven samples were resistant to four of the groups tested (Table 4).

Table 4: Results of cross resistance screening showing percentage of samples resistant or developing resistance to different groups.

No. of groups	2000 (%)	2001 (%)	2002 (%)	2003 (%)	2004 (%)
5	0	0	0	0	0
4	2.5	0	0.4	0	1.9
3	10.8	10.8	10.5	6.6	8.2
2	35.8	46.0	40.4	32.2	32.0
1	48.4	36.0	41.2	47.1	45.6
0	2.5	7.2	7.5	14.1	12.3
No. of samples	120	111	228	121	366

As was the case in 2003 a larger percentage of samples were susceptible to all tested herbicides (Table 4). This may suggest that farmers are using resistance testing as a pro-active measure rather than reactive.

State by State

Samples were received from four states with major decreases in numbers received from three states, however the number of samples received from Western Australia increased providing 38% of samples (Table 5). Discounting the WeedSense receivals, the number of samples from each state increased.

Table 5: Number of ryegrass samples received from each state.

	2003			
	CSU	WS	Total	2004
NSW	29	94	**123**	**70**
Vic	17	103	**120**	**68**
SA	48	224	**272**	**101**
WA	37	91	**128**	**148**

The level of 'fop' resistance detected was highest in New South Wales' samples, with South Australia and Western Australia returning similar results and Victoria the lowest percentage of resistant samples. This is different to previous years in which the level of resistance among Victorian samples was either level or higher than New South Wales (Figure 1).

South Australia had the highest level of 'dim' resistance with 17% of samples resistant, however the majority of the resistant samples had been screened to Sertin. When only samples tested to Select are considered Western Australia had the highest level of 'dim' resistance at 6% of samples (Figures 1 and 2).

As was the case in the last two years, Western Australia had the highest group B resistance overall with 73% of samples being resistant to these herbicides. South Australia had the next highest level of samples resistant to Group B herbicides (44%), in previous years South Australia has returned low levels of group B resistance. However a large number of the South Australian samples were also tested to non sulfonylurea (SU) Group B herbicides (eg. On Duty), the level of SU resistance was 32%, similar to New South Wales samples (Figures 1 and 2).

As was also the case last year South Australian (36%) and Victorian (15%) samples had the highest level of resistance to group D. No samples were resistant to group C herbicides (Figure 1).

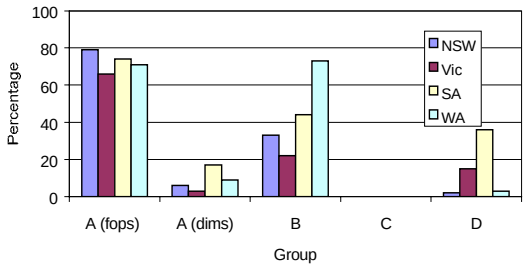

Figure 1: Percentage of ryegrass samples resistant and developing resistance for each state.

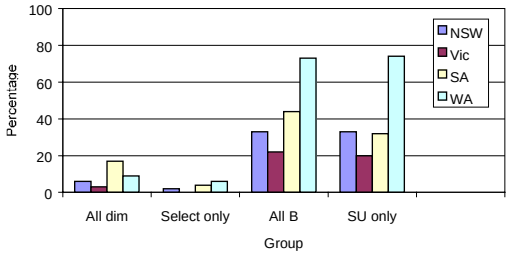

Figure 2: Percentage of ryegrass samples resistant and developing resistance for each state within two groups.

Group A herbicides

While the data below for Hoegrass and Verdict appear slightly different previous Farrer Centre trials have shown 100% correlation between Hoegrass and Verdict resistance in annual ryegrass.

The first cohort was screened using Verdict as a result of the staggered germination experienced in February due to climatic conditions. This resulted in the more advanced plants tillering when the later germinating plants were only two-leaf stage, for this reason Verdict was used. For all other 'fop' testing Hoegrass was used.

While Hoegrass, Verdict and Select were the main herbicides tested, a number of samples were also screened to Targa, Sertin, Achieve, Aramo and Fusion (Table 6).

Table 6: Results for ryegrass samples showing percentage resistant (Res) or developing resistance (DR) to individual Group A herbicides.

	Tested	Res	DR	%
'fops'				
Hoegrass	150	97	22	**79**
Verdict	216	114	38	**71**
Targa	10	3	0	**30**
'dims'				
Select	370	3	12	**4**
Sertin	3	3	0	**100**
Achieve	51	16	10	**51**
Aramo	2	0	0	**0**
'fop' & 'dim'				
Fusion	2	0	0	**0**

Group B herbicides

Glean, Logran and On Duty were the major herbicides screened from the Group B herbicides with resistance detected to all herbicides (Table 7). Other Group B herbicides screened in limited numbers were Atlantis, Hussar and Oust.

A larger difference than previous years was experienced for the Glean and Logran results. In the last two years the results have been similar (Logran slightly higher) and in 2001, 31% of Glean samples were resistant compared to 22% of Logran samples. A major cause of this difference could be that a higher proportion of the samples screened to Glean came from Western Australia while the majority of the Logran samples came from areas which in the past have exhibited lower levels of SU resistance, parts of South Australia and Victoria.

Table 7: Results for ryegrass samples screened to individual Group B herbicides

	Tested	Res	DR	%	Susc
Glean	247	92	46	**56**	109
Logran	74	8	9	**23**	57
On Duty	36	12	12	**66**	12
Atlantis	5	1	1	**40**	3
Hussar	10	4	2	**60**	4
Oust	8	6	0	**75**	2

Other herbicides

Annual ryegrass samples were screened to four other herbicides, Avadex (two samples, both Susc), simazine, trifluralin and Roundup. The observed incidence of resistance to these herbicides was lower than the resistance to the higher risk Group A and B herbicides (Table 8).

Table 8: Results for ryegrass samples screened to other herbicide groups.

	Tested	Res	DR	%	Susc
Group C					
Simazine	358	0	0	**0**	358
Group D					
Trifluralin	362	26	23	**13**	313
Group M					
Roundup	48	1	0	**2**	47

Another sample was found to be resistant to Roundup making four that have been identified by the testing service since the first case of Roundup resistance was identified in a sample provided to the testing service in 1996. There are approximately 40 confirmed cases of annual ryegrass resistance to Roundup in Australia.

Wild Oats

The number of wild oat samples (28) received decreased again in 2004 compared to 2003 (86) and in 2002 (126). This decline can be accounted for by the absence of WeedSense samples, which provided all but 24 samples last year and all but 33 in 2002.

The level of 'fop' resistance among the samples was 96%, slightly higher than the 88% observed last year in the non-WeedSense samples (Table 9). Samples were also screened to Verdict, Topik, Pantera and Wildcat. All four herbicides had samples resistant to them.

Of the 'dim' herbicides only one sample was found to be resistant to Achieve and none to Select. No samples were found to be resistant to herbicides from groups B, C, D or E.

Table 9: Group A resistance percentage for wild oat samples since 2002 (number tested in brackets)

	2001	2002	2003	2004
	% (no.)	% (no.)	% (no.)	% (no.)
'fops'	78(9)	87(31)	88(24)	96(28)
'dims'	14(7)	0(29)	5(20)	4(26)

However, two samples out of 23 tested were confirmed as resistant to Mataven. This adds to the first case of resistance to Mataven in Australia confirmed in 2003 in a sample provided to this service in 2002. One of the samples resistant to Mataven this year was also resistant to Topik, Wildcat and Achieve creating a worrying management dilemma for the farmer.

Other grass species

Eight brome grass samples were received, two of which were found to be resistant to 'fops' (Verdict –1 and Targa –1) with one of these also resistant to the 'dim', Aramo.

One sample of phalaris was received which was resistant to Fusilade and developing resistance to Select.

Broadleaf species

Twenty broadleaf weed samples (fifteen wild radish and five Indian hedge mustard) were provided for resistance screening.

Resistance was observed in wild radish samples to four Group B herbicides (Table 10). Two samples were found to be resistant to Brodal (11 tested) and one each to 24-D Amine (3 tested) and Ester 80 (5 tested). No samples were found to be resistant to Simazine (11), Atrazine (1), Sniper (1) or MCPA Amine (9).

Table 10: Results for broadleaf species screened to Group B herbicides (number in brackets denotes samples tested)

	Tested	WR	IHM	%
Glean	16	6 (11)	5 (5)	**69**
Logran	3	1 (2)	1 (1)	**66**
Ally	1	-	1 (1)	**100**
Eclipse	3	1 (3)	-	**33**
Broadstrike	3	-	1 (3)	**33**
On Duty	1	1 (1)	-	**100**

Indian hedge mustard samples were also found to be resistant to four Group B herbicides (Table 10). One sample was tested to each of Simazine, Brodal and Roundup, with no resistance detected.

Final Observations

- One ryegrass sample was found to be resistant to Roundup.
- Two wild oat samples were resistant to Mataven, both samples were also resistant to 'fops' and one to 'dims' as well.
- There was a large increase in samples compared to non WeedSense samples received in previous years.
- For ryegrass samples the level of resistance declined for 'fops' and 'dims' but increased for Group B and D.
- The variation in the level of 'fop' resistance between states was reduced compared to previous years.
- A large difference was observed in the level of resistance to the 'dim' herbicides, Select and Achieve
- Western Australian samples exhibited a higher level of resistance to group B herbicides compared to all other states.
- Highest trifluralin resistance was in samples from South Australia and Victoria.
- The level of resistance in wild oats to group A 'fop' herbicides has remained constant in samples sent direct to the Farrer Centre.
- Resistance was found to most herbicide groups (B, F and I) tested in wild radish samples.

Testing Service findings 1991-2004

A paper detailing findings of the testing service since its commencement in 1991, plus random surveys the Farrer Centre has conducted, is being prepared for publication in a scientific journal. The submission date is expected to be later this year.

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