

Charles Sturt University
2006 Herbicide Resistance
Testing Service Report

Samples Received

The testing service screened 350 samples in 2006. This is a similar number to 2005 when 333 samples were received.

The majority of these samples were annual ryegrass (265) but a number of wild oat, wild radish, Indian hedge mustard and brome grass samples were received (Table 1).

The number of wild oat samples received remained at a similar level to last year, and provided 15% of all samples.

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

Table 1: Number of samples received since 2003 (includes WeedSense receivals).

	2003	2004	2005	2006
Annual ryegrass	643	387	241	265
Wild oats	86	28	56	55
Wild radish	30	15	21	23
Brome grass	4	8	6	5
Others	6	6	3	2
WeedSense	585	-	-	-
Direct to CSU	184	444	327	350
Total	769	444	327	350

Summary of Results

The results obtained from the 2006 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, 265 annual ryegrass samples were received, of which 245 were tested to the standard cross-resistance test (Table 2). Twenty nine of these samples were also tested to one to three additional herbicides. In addition, 10 samples were tested to glyphosate. Twenty 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)

	2002	2003	2004	2005	2006
A (fops)	253	118	374	214	246
A (dims)	263	136	378	250	264
B	256	129	341	239	268
C	224	125	363	215	238
D	224	117	362	217	241

Ninety 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 higher than the results of the previous four years for samples sent direct to the Farrer Centre.

Sixteen percent of samples tested to a 'dim' herbicide were classed as resistant or developing resistance (Table 3). This is a reduction compared to last years result but similar to previous years. This year only six percent of samples tested to a 'dim' were tested to Achieve compared to 17% last year. Achieve normally has a higher level of resistance when compared to Select.

Eighty seven percent of samples were resistant to Group B herbicides. This was a similar level to last years results which were over double the level of previous years. No samples were resistant to simazine (Group C) and five percent 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)

	2002	2003	2004	2005	2006
A (fops)	85	81	77	90	97
A (dims)	22	17	10	27	16
B	47	38	48	88	87
C	0	1	0	0	0
D	4	4	13	9	5

Cross and Multiple Resistance

Of the 245 samples submitted for the standard cross resistance test, 82% were resistant or developing resistance to two or more herbicides, a similar level to that recorded last year. This reflects the major increase in the level of resistance to the group B herbicides in the last two years. There was a marked reduction in the number of samples resistant to three herbicide groups; this reflects the

decrease in the level of 'dim' resistance as a result of the reduced number of samples tested to Achieve. One sample was 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	2002 (%)	2003 (%)	2004 (%)	2005 (%)	2006 (%)
5	0	0	0	0	0
4	0.4	0	1.9	0.9	0.4
3	10.5	6.6	8.2	22.8	12.1
2	40.4	32.2	32.0	60.0	69.0
1	41.2	47.1	45.6	13.0	17.4
0	7.5	14.1	12.3	3.3	1.1
No. of samples	228	121	366	215	245

The number of samples susceptible to all tested herbicide groups was the lowest recorded since testing began in 1991 with only 3 samples susceptible to all groups tested.

Herbicide Groups

Among all samples there were major differences between the various groups and in some cases within the different herbicide groups.

Group A herbicides

While Hoegrass and Select were the main herbicides tested, a number of samples were also screened to Verdict, Targa, Tristar, 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	%
<u>'fops'</u>				
Hoegrass	234	209	16	89
Verdict	8	8	0	100
Targa	1	1	0	100
Tristar	3	3	0	100
<u>'dims'</u>				
Select	234	14	10	10
Sertin	3	1	0	33
Achieve	17	10	4	82
Aramo	10	0	4	40
<u>'fop' & 'dim'</u>				
Fusion	6	1	0	17

Group B herbicides

Glean, Logran and Hussar were the major herbicides screened from the Group B herbicides with resistance detected to these three herbicides

(Table 7). Other Group B herbicides screened in limited numbers were On Duty, Atlantis and Oust.

The level of resistance to both Glean and Logran was similar to last year's results, despite the level of resistance comparative to previous years increasing markedly in 2005 (Table 8).

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

	Tested	Res	DR	%	Susc
Glean	200	149	33	91	18
Logran	30	22	5	83	3
Atlantis	3	0	0	0	3
On Duty	4	4	0	100	0
Hussar	21	13	1	67	7
Oust	10	6	2	80	2

Table 8: Level of resistance to Glean and Logran since 2001 (percentage of samples tested)

	2002	2003	2004	2005	2006
Glean	35	42	56	94	91
Logran	36	45	23	97	83

Other herbicides

Annual ryegrass samples were screened to four other herbicides, simazine, atrazine, trifluralin, Dual Gold, Kerb 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 9).

Table 9: Results for ryegrass samples screened to other herbicide groups.

	Tested	Res	DR	%	Susc
<u>Group C</u>					
Simazine	233	0	0	0	233
Atrazine	5	0	0	0	5
<u>Group D</u>					
Trifluralin	241	7	5	5	229
<u>Group K</u>					
Dual Gold	2	0	0	0	2
Kerb	1	0	0	0	1
<u>Group M</u>					
Roundup	10	0	0	0	10

No samples were found to be resistant to Roundup leaving the number at five 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.

State by State

Samples were received from four states with major decreases in numbers received from Victoria; however New South Wales provided 56% of samples and Western Australia 35% (Table 5).

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

	2003	2004	2005	2006
NSW	29	70	60	122
Vic	17	68	86	48
SA	48	101	9	3
WA	37	148	86	92

With the very low number of samples received from South Australia the data for that state has not been analysed separately. The level of 'fop' resistance detected was similar for the other three states (Figure 1). This is different to years prior to 2005 in which the level of resistance has varied to some degree between the states.

No differences were observed in the level of 'dim' resistance between the states. This was similar to last year when only samples tested to Select were considered for 2005. In 2005 the majority of the resistant samples from Victoria had been screened to Achieve. (Figure 1).

Unlike the last year, but similar to 2003 and 2004 Western Australia had the highest group B resistance overall. This year 96% of samples from Western Australia were resistant to group B herbicides compared to 86% from New South Wales and 76 % from Victoria. When only the sulfonylurea herbicides are considered the level of resistance in samples from Western Australia and New South Wales remained the same but the level of resistance in Victorian samples increased to 85%. The majority of the Hussar samples were received from Victoria (Figures 1 and 2, Table 7).

Similar to 2005 but in comparison to the prior to 2005 the level of group B resistance has increased markedly. The reason for this is unknown however the availability and use of the newer group B (On Duty, Hussar and Atlantis) herbicides may be a factor. Another reason could be that the failure of a Group B herbicide is now acting as a critical factor in the decision to supply a sample for resistance testing.

As has been the case in previous years Victorian samples (22%) have had higher level of resistance to group D than samples from New South Wales or Western Australia. No samples were resistant to group C herbicides (Figure 1).

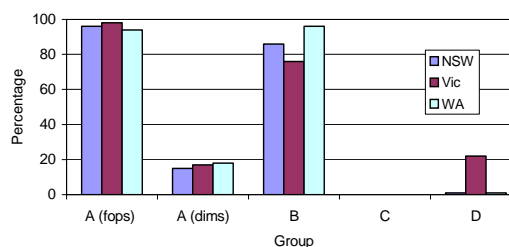


Figure 1: Percentage of ryegrass samples resistant and developing resistance for each state.

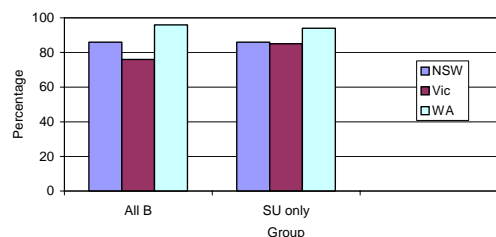


Figure 2: Percentage of ryegrass samples resistant and developing resistance for each state within two groups.

Wild Oats

The number of wild oat samples (55) received was similar to last year. Although the number this year is less than was received in 2002 and 2003 wild oats make up a larger proportion of the samples received (Table 10). Forty nine of the samples came from New South Wales, of the six other samples two each came from Victoria, South Australia and Western Australia.

Table 10: Number of wild oat samples received and percentage of total samples

	2002	2003	2004	2005	2006
Total	895	769	444	327	350
Wild oats	126	86	28	56	55
Percentage	14.1	11.2	6.3	17.1	15.7

The level of 'fop' resistance among the samples was 77%, lower than the last three years (Table 11). While the majority of samples were screened to Hoegrass samples were also screened to Verdict, Topik and Wildcat. Hoegrass, Verdict and Wildcat all had samples resistant to them. Neither of the two samples tested to Topik were resistant to that herbicide.

Of the 'dim' herbicides two samples were found to be resistant to Achieve and none to Select. No samples were found to be resistant to herbicides from groups B, E or M.

Two samples out of 22 completed tests were confirmed as resistant to Mataven (Table 11). This

adds to the first case of resistance to Mataven in Australia confirmed in 2003 in a sample provided to this service in 2002 and six others in the last two years. These two samples were only tested to Mataven so their full resistance status is unknown.

Table 11: Group A resistance percentage for wild oat samples since 2002 (number tested in brackets - 2002 and 2003 non WeedSense only)

	2003	2004	2005	2006
	% (no.)	% (no.)	% (no.)	% (no.)
'fops'	88(24)	96(29)	93 (51)	77 (51)
'dims'	5(20)	4(26)	7 (50)	5 (42)
K	0 (18)	9 (23)	14 (28)	9 (22)

Other grass species

Five brome grass samples were received, three of which were found to be resistant to 'fops' (Verdict) and 'dims' (Select). None of the samples were resistant to any of the other herbicides tested. All samples tested were from Victoria.

Broadleaf species

Twenty five broadleaf weed samples (twenty three wild radish and two Indian hedge mustard) were provided for resistance screening. Twenty two of the wild radish samples were from Western Australia, the other was from Victoria. The Indian hedge mustard samples come from Queensland and Victoria.

Resistance was observed in wild radish samples to two Group B herbicides (Table 12). Fourteen samples were found to be resistant to Brodal (21 tested), three to 24-D Amine (15 tested) and one to MCPA Amine (14 tested). No samples were found to be resistant to Simazine (19).

Table 12: Results for broadleaf species screened to Group B herbicides (number in brackets denotes samples tested)

	Tested	WR	IHM	%
Glean	18	12 (16)	1 (2)	72
Logran	4	5 (6)	-	83

One Indian hedge mustard sample was found to be resistant to the Glean (Table 12). The other sample was tested to each of Glean, Brodal and MCPA Amine with no resistance detected.

Final Observations

- The number of samples received was comparable to last year.
- For ryegrass samples the level of resistance increased for 'fops', 'dims' and Group B but declined for Group D, mainly as a result of the reduction in samples from Victoria.
- The variation in the level of 'fop' resistance between states was similar to last year.
- A large difference was observed in the level of resistance to the 'dim' herbicides, Select and Achieve
- The level of Group B resistance was similar to last year; both years were markedly higher than all other years. Unlike 2005 but similar to previous years there were differences between the states in the level of resistance to group B herbicides.
- Highest trifluralin resistance was in samples from Victoria.
- Two wild oat samples were resistant to Mataven.
- The level of resistance in wild oats to group A 'fop' herbicides was lower than experienced in previous years in samples sent direct to Charles Sturt University.
- Resistance was found to most herbicide groups (B, F and I) tested in wild radish samples.

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