Charles Sturt University

2008 Herbicide Resistance

Testing Service Report

Samples Received

The testing service screened 109 samples in 2008. This was a similar number to last year, but less than had been screened in any other year since 1996. Every year from 1997 on has seen at least 150 samples received.

As is always the case the majority of these samples were annual ryegrass (79) but several wild oat and wild radish samples were received (Table 1).

For the first time a similar number of wild oat and wild radish samples were received. In all previous years at least twice as many wild oat samples have been received compared to wild radish.

Table 1: Number of samples received since 2005

	2005	2006	2007	2008
Annual ryegrass	241	265	66	79
Wild oats	56	55	32	13
Wild radish	21	23	9	15
Brome grass	6	5	0	0
Others	3	2	3	2
Total	327	350	110	109

Summary of Results

The results obtained from the 2008 resistance screening are similar in the majority of cases to the results from previous years.

Annual ryegrass

This year, 79 annual ryegrass samples were received, of which 75 were tested to the standard cross-resistance test (Table 2). Twenty of these samples were also tested to one or two additional herbicides. A total of 11 samples were tested to glyphosate and 15 samples to Axial. Only four 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

	2005	2006	2007	2008
A (fops)	214	246	61	67
A (dims)	250	264	68	78
B	239	268	59	71
C	215	238	51	76
D	217	241	57	75

Ninety three percent of all samples tested to a 'fop' herbicide were classed as either resistant or developing resistance to that herbicide (Table 3). This is within the normal range experienced in previous years.

Fifty eight percent of samples tested to a ‘dim’ herbicide were classed as resistant or developing resistance (Table 3). This is a marked increase on 2007 which was also a major increase compared to previous years. One sample was tested to each of Sertin and Achieve, both samples were resistant. Of the 15 samples tested to Axial 87% were resistant.

Eighty five percent of samples were resistant to Group B herbicides. This was a similar level to the last three years results which were over double the level of previous years. No samples were resistant to simazine (Group C) and 19% were resistant to trifluralin (Group D) a major increase on previous years (Table 3).

Table 3: Percentage of samples resistant or developing resistance to each of five herbicide groups

	2005	2006	2007	2008
A (fops)	90	97	91	93
A (dims)	27	16	41	58
B	88	87	81	85
C	0	0	0	0
D	9	5	7	19

Cross and Multiple Resistance

Of the 75 samples submitted for the standard cross resistance test, 85% were resistant or developing resistance to two or more herbicides, a similar level to that recorded the last three years. This reflects the major increase in the level of resistance to the group B herbicides since 2005. There was a slight

increase compared to last year in the number of samples resistant to three herbicide groups; this reflects the increase in the level of 'dim' resistance as a result of the major increase in the level of Select resistance and reduced number of samples tested to Sertin and Achieve. Five samples were resistant to four of the groups tested, the highest level for several years (Table 4).

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

No. of groups	2004 (%)	2005 (%)	2006 (%)	2007 (%)	2008 (%)
5	0	0	0	0	0
4	1.9	0.9	0.4	0	6.7
3	8.2	22.8	12.1	32.7	40.0
2	32.0	60.0	69.0	50.9	38.7
1	45.6	13.0	17.4	16.4	13.3
0	12.3	3.3	1.1	0	1.3
No. of samples	366	215	245	55	75

Only one sample tested to the five herbicide group cross resistance test was susceptible to all herbicides.

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, Sertin, Achieve, Fusion and Axial (Table 5).

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 6). One sample was also screened to Oust.

Table 5: Results for ryegrass samples showing percentage resistant (Res) or developing resistance (DR) to individual Group A herbicides.

	Tested	Res	DR	%
'fops'				
Hoegrass	63	56	5	**97**
Verdict	4	1	0	
'dims'				
Select	76	28	15	**57**
Sertin	1	1	0	
Achieve	1	1	0	
'fop' & 'dim'				
Fusion	7	7	0	
'den'				
Axial	15	12	1	**87**

The level of resistance to both Glean and Logran was similar to last three years results, despite the level of resistance comparative to previous years increasing markedly in 2005 (Table 7).

Table 6: Results for ryegrass samples screened to individual Group B herbicides

	Tested	Res	DR	%	Susc
Glean	44	37	6	**98**	1
Logran	10	5	2	**70**	3
Hussar	16	7	2	**56**	7
Oust	1	1	0		0

Table 7: Level of resistance to Glean and Logran since 2003 (percentage of samples tested)

	2004	2005	2006	2007	2008
Glean	56	94	91	84	98
Logran	23	97	83	89	70

Other herbicides

Annual ryegrass samples were screened to seven other herbicides, simazine, atrazine, trifluralin, Dual Gold, Boxer 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 8).

Two samples were found to be resistant or developing resistance to Roundup increasing the number to eight 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 more than 40 confirmed cases of annual ryegrass resistance to Roundup in Australia.

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

	Tested	Res	DR	%	Susc
Group C					
Simazine	72	0	0	**0**	72
Atrazine	2	0	0	**0**	2
Group D					
Trifluralin	68	6	7	**19**	55
Group K					
Dual Gold	1	0	0	**0**	1
Kerb	6	0	0	**0**	6
Boxer Gold	1	0	0	**0**	1
Group M					
Roundup	11	1	1	**18**	9

State by State

Samples were received from five states in similar numbers to last year, with the number of samples from Victoria returning to a similar percentage as in the years before 2007. This was the first year in which samples had been received from Tasmania (Table 9). .

Table 9: Number of ryegrass samples received from each state.

	2005	2006	2007	2008
NSW	60	122	23	22
Vic	86	48	3	22
SA	9	3	3	3
WA	86	92	37	26
Tas	0	0	0	6

With the very low number of samples received from both South Australia and Tasmania the data for these states has not been analysed separately. However all samples from Tasmania were resistant to 'fops' and Group B, and 50% were resistant to the 'dims'. Victoria was the only state which provided samples susceptible to the 'fops' (Figure 1).

The percentage of samples with 'dim' resistance from Western Australia was double the level in samples from both New South Wales and Victoria. Victoria had the lowest number of samples resistant to Group B herbicides but the highest number of samples with resistance to the Group D herbicides (Figure 1).

When only the sulfonylurea herbicides are considered the level of resistance in samples from New South Wales and Western Australia remained the same but the level of resistance in Victorian samples decreased to 70%. All of the samples tested to Hussar were received from Victoria (Figures 1 and 2, Table 6).

Similar to the last three years 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.

All samples from South Australia were resistant to trifluralin, while one sample from Western Australia was resistant and nine (20 tested) from Victoria. No samples were resistant to group C herbicides (Figure 1).

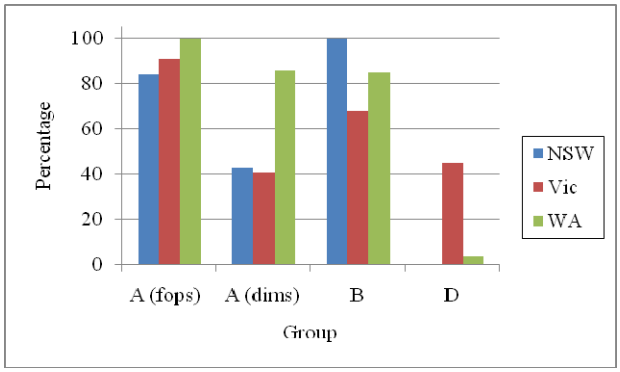

Figure 1: Percentage of ryegrass samples resistant and developing resistance for each state.

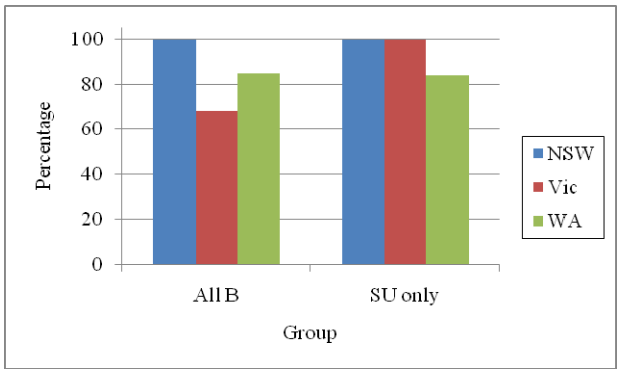

Figure 2: Percentage of ryegrass samples resistant and developing resistance for each state within two groups.

Wild Oats

The number of wild oat samples (13) received was the lowest number received since1996 (Table 10). Eleven of the samples came from New South Wales and two from Victoria.

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

	2004	2005	2006	2007	2008
Total	444	327	350	110	109
Wild oats	28	56	55	32	13
Percentage	6.3	17.1	15.7	29.1	11.9

The level of 'fop' resistance among the samples was 77%, with three samples (one tested to two herbicides) being susceptible to the tested herbicides (Table 11). While the majority of samples were screened to Hoegrass, one sample was also screened to Topik and Tristar.

For the 'dim' herbicides, one sample was resistant to Select and one to Axial. No samples were found to be resistant to herbicides from groups B, E or M.

Three out of 10 samples 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 ten others in the last four years. These samples were also resistant to Group A 'fops' but not to 'dims'.

Table 11: Group A resistance percentage for wild oat samples since 2004 (number tested in brackets)

	2005	2006	2007	2008
	% (no.)	% (no.)	% (no.)	% (no.)
'fops'	93 (51)	77 (51)	100 (22)	69 (13)
'dims'	7 (50)	5 (42)	15 (33)	14 (14)
K	14 (28)	9 (22)	13 (15)	30 (10)

Other grass species

One barley grass sample was received. It was susceptible to Verdict, Select and Diuron but resistant to SpraySeed.

Broadleaf species

Fifteen wild radish samples and one Indian hedge mustard sample were provided for resistance screening. The Indian hedge mustard sample was from Victoria, while all but one of the wild radish samples were from Western Australia, the other one was from South Australia.

Resistance was observed in wild radish samples to four Group B herbicides 100% of samples were resistant to Glean (eleven tested), two of these samples were also tested to Oust and both were resistant. One of the two samples tested to Logran was resistant, as were four of the five tested to Eclipse. Five samples were resistant to Brodal (twelve tested) and one to 24-D Amine (nine tested). No samples were found to be resistant to MCPA amine (four tested), simazine (eleven tested), atrazine (four tested) or Roundup (two tested).

Five samples were resistant to both Group B and F and one was resistant to Group B and I. One of the samples resistant to B and F was from South Australia, the rest were from Western Australia.

Final Observations

- The number of samples received was similar to last year but markedly lower than years prior to 2007 showing the extent and degree of the drought.
- The first samples were received from Tasmania; all were resistant to 'fops' and half were resistant to Select.
- For ryegrass samples the level of resistance remained constant for 'fops' and Group B but increased for the second year in a row for the 'dims' as the result of an increase in the level of resistance to Select.
- The level of Group B resistance was similar to the last three years; all three years were markedly higher than prior to 2005.
- Most trifluralin resistant samples were received from Victoria.
- Three wild oat samples were resistant to Mataven.
- The level of resistance in wild oats to group A 'fop' herbicides was the lower than in 2007, with four susceptible samples among the thirteen received.
- Wild radish samples were resistant to three of the herbicide groups (B, F and I) tested.

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