

Charles Sturt University
2007 Herbicide Resistance
Testing Service Report

Samples Received

The testing service screened 110 samples in 2007. This is less than has been screened in any 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 (66) but a number of wild oat, wild radish and phalaris samples were received (Table 1).

The number of wild oat samples received decreased to a lesser degree than the other species and provided 29% of the samples compared to 15% last year.

Table 1: Number of samples received since 2004

	2004	2005	2006	2007
Annual ryegrass	387	241	265	66
Wild oats	28	56	55	32
Wild radish	15	21	23	9
Brome grass	8	6	5	0
Others	6	3	2	3
Total	444	327	350	110

Summary of Results

The results obtained from the 2007 resistance screening are similar in the majority of cases to the results from previous years.

Annual ryegrass

This year, 66 annual ryegrass samples were received, of which 55 were tested to the standard cross-resistance test (Table 2). Seven of these samples were also tested to one to three additional herbicides. In addition, five samples were tested to glyphosate. Eleven 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

	2004	2005	2006	2007
A (fops)	374	214	246	61
A (dims)	378	250	264	68
B	341	239	268	59
C	363	215	238	51
D	362	217	241	57

Ninety one 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 for last year but similar to 2005 when 90% of samples were resistant to a 'fop' herbicide.

Forty one percent of samples tested to a 'dim' herbicide were classed as resistant or developing resistance (Table 3). This is a marked increase on previous years. The percentage of samples tested to Select and Achieve was similar to 2005, and the results for Achieve were similar to previous years the level of resistance to Select increased from 10% last year to 36 % this year (Table 4).

Eighty one percent of samples were resistant to Group B herbicides. This was a similar level to the last two years results which were over double the level of previous years. No samples were resistant to simazine (Group C) and seven percent were resistant to trifluralin (Group D) (Table 3).

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

	2004	2005	2006	2007
A (fops)	77	90	97	91
A (dims)	10	27	16	41
B	48	88	87	81
C	0	0	0	0
D	13	9	5	7

Table 4: Percentage of samples resistant or developing resistance to two 'dim' herbicides (number tested in brackets)

	2005	2006	2007
Select	14 (299)	10 (234)	36 (58)
Achieve	87 (43)	82 (17)	87 (8)

Cross and Multiple Resistance

Of the 55 samples submitted for the standard cross resistance test, 83% were resistant or developing resistance to two or more herbicides, a similar level to that recorded the last two years. This reflects the major increase in the level of resistance to the group B herbicides in the last three years. There was a marked increase 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 reduced number of samples tested to Achieve. No samples were resistant to four of the groups tested (Table 5).

Table 5: Results of cross resistance screening showing percentage of samples resistant or developing resistance to different groups.

No. of groups	2003 (%)	2004 (%)	2005 (%)	2006 (%)	2007 (%)
5	0	0	0	0	0
4	0	1.9	0.9	0.4	0
3	6.6	8.2	22.8	12.1	32.7
2	32.2	32.0	60.0	69.0	50.9
1	47.1	45.6	13.0	17.4	16.4
0	14.1	12.3	3.3	1.1	0
No. of samples	121	366	215	245	55

None of the samples tested to the five herbicide group cross resistance test were susceptible to all herbicides, the first time this has occurred. The three samples that were susceptible to all tested herbicides were all only tested to one herbicide.

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, Sertin, Achieve, Aramo and Axial (Table 6).

Group B herbicides

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

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	51	49	0	96
Verdict	7	4	0	57
Targa	1	0	1	100
<u>'dime'</u>				
Select	58	6	15	36
Sertin	1	0	0	0
Achieve	8	5	2	88
Aramo	1	0	0	0
<u>'den'</u>				
Axial	2	1	0	50

The level of resistance to both Glean and Logran was similar to last two years 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	45	34	4	84	7
Logran	9	6	2	89	1
Hussar	3	0	1	33	2
On Duty	2	0	1	50	1

Table 8: Level of resistance to Glean and Logran since 2003 (percentage of samples tested)

	2003	2004	2005	2006	2007
Glean	42	56	94	91	84
Logran	45	23	97	83	89

Other herbicides

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

One sample was found to be resistant to Roundup increasing the number to six 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.

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

	Tested	Res	DR	%	Susc
<u>Group C</u>					
Simazine	51	0	0	0	51
<u>Group D</u>					
Trifluralin	57	3	1	7	53
<u>Group K</u>					
Dual Gold	3	0	0	0	3
<u>Group L</u>					
SpraySeed	1	0	0	0	1
<u>Group M</u>					
Roundup	5	1	0	20	4

State by State

Samples were received from four states with major decreases in numbers received from all states; however New South Wales provided 34% of samples and Western Australia 56% (Table 10). This is the reverse of 2006 when New South Wales provided 56% and Western Australia provided 34% of samples.

Table 10: Number of ryegrass samples received from each state.

	2004	2005	2006	2007
NSW	70	60	122	23
Vic	68	86	48	3
SA	101	9	3	3
WA	148	86	92	37

With the very low number of samples received from both Victoria and South Australia the data for that state has not been analysed separately. The level of 'fop' resistance detected was different between New South Wales and Western Australia (Figure 1). In the last two years the level of resistance to samples from these two states has been similar.

Minimal differences were observed in the level of resistance to all other herbicide groups between New South Wales and Western Australia. This has been the case in the last two years (Figure 1).

When only the sulfonylurea herbicides are considered the level of resistance in samples from Western Australia remained the same but the level of resistance in New South Wales samples increased to 94%. All of the Hussar and On Duty samples were received from New South Wales (Figures 1 and 2, Table 7).

Similar to 2005 and 2006 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.

Of the four samples resistant to trifluralin three came from the six samples received from Victoria and South Australia and one from Western Australia. No samples were resistant to group C herbicides (Figure 1).

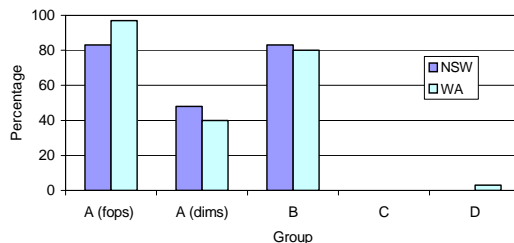


Figure 1: Percentage of ryegrass samples resistant and developing resistance for each state.

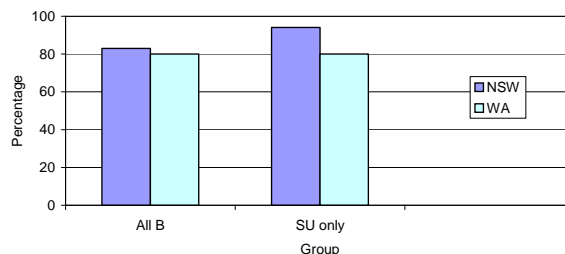


Figure 2: Percentage of ryegrass samples resistant and developing resistance for each state within two groups.

Wild Oats

The number of wild oat samples (32) received was similar to last year. Although the number this year is less than was received in all years since 2003 except for 2004, wild oats make up a larger proportion of the samples received (Table 11). All of the samples came from New South Wales.

Table 11: Number of wild oat samples received and percentage of total samples

	2003	2004	2005	2006	2007
Total	769	444	327	350	110
Wild oats	86	28	56	55	32
Percentage	11.2	6.3	17.1	15.7	29.1

The level of 'fop' resistance among the samples was 100%, no samples being susceptible (Table 12). While the majority of samples were screened to Hoegrass samples were also screened to Verdict, Topik and Tristar.

Of the 'dim' herbicides two samples were found to be resistant to Achieve, two to Select and one to

Aramo. No samples were found to be resistant to herbicides from groups B, E or M.

Two samples out of 15 samples were confirmed as resistant to Mataven (Table 12). 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 eight others in the last three years. Both of these samples were also resistant to Group A ‘fops’ but not to ‘dims’.

Table 12: Group A resistance percentage for wild oat samples since 2004 (number tested in brackets)

	2004	2005	2006	2007
	% (no.)	% (no.)	% (no.)	% (no.)
‘fops’	96(29)	93 (51)	77 (51)	100 (22)
‘dims’	4(26)	7 (50)	5 (42)	15 (33)
K	9 (23)	14 (28)	9 (22)	13 (15)

Other grass species

Three phalaris samples were received to be tested to Atlantis, one was resistant and two were susceptible.

Broadleaf species

Nine wild radish samples were provided for resistance screening. Seven of the samples were from Western Australia and one each from New South Wales and Victoria.

Resistance was observed in wild radish samples to two Group B herbicides 75% of samples were resistant to Glean (six out of eight tested) and the only sample tested to Logran was resistant. No samples were found to be resistant to Brodal (nine tested) and three to 24-D Amine (six tested). One sample was developing resistance to bromoxynil (Group C). No samples were found to be resistant to simazine (five tested, atrazine (one tested) or Roundup (five tested).

Three samples that were resistant to both Group B and I, one sample resistant to Group B and C and one resistant to Group B only were all from Western Australia, and of the two samples developing resistance to Group B one was from Western Australia and one from New South Wales. This is the first wild radish sample from New South Wales, and only the third from outside of Western Australia to be classed as resistant to any herbicide by the testing service at CSU.

Final Observations

- The number of samples received was markedly lower than previous years showing the extent and degree of the drought.
- For ryegrass samples the level of resistance remained constant for ‘fops’ and Group B but increased markedly for the ‘dims’ as the result of an increase in the level of resistance to Select.
- Marked variation in the level of ‘fop’ resistance between New South Wales and Western Australia, different to last year.
- As normal a large difference was observed in the level of resistance to the ‘dim’ herbicides, Select and Achieve. This difference was reduced due to the increased level of Select resistance.
- The level of Group B resistance was similar to the last two years; all three years were markedly higher than prior to 2005.
- Most trifluralin resistance was in samples from Victoria and South Australia despite only six samples being received from those states.
- Two wild oat samples were resistant to Mataven.
- The level of resistance in wild oats to group A ‘fop’ herbicides was the highest experienced, with no susceptible samples received.
- Resistance was found to two herbicide groups (B and I) tested in wild radish samples.

For further information contact:

Charles Sturt University
 Locked Bag 588
 Wagga Wagga NSW 2678
 Ph: 02 6933 2420
 Fax: 02 6933 2924

John Broster 02 6933 4001
 0427 296 641
jbroster@csu.edu.au

Note:

The use of material contained in this report for commercial gain is not permitted without prior approval of the author and Charles Sturt University.