

### Samples Received

The testing service screened 558 samples in 2015. This was about 100 less than received in 2014 but nearly double the 2013 number. This was the fifth highest number of samples since the testing service commenced in 1991. The majority of the samples came from two sources, Landmark in WA supplied 347 samples including 76 wild radish samples and the Stirlings to Coast Farmer Group from WA supplied 55 samples.

As is always the case the majority of these samples were annual ryegrass (408) but the 89 wild radish samples was the second most ever received in one year, the highest being the 128 samples received last year. A large number of wild oat samples were also received (Table 1).

Table 1: Total number of samples received since 2011

	2012	2013	2014	2015
Annual ryegrass	256	236	462	408
Wild oats	73	51	58	58
Wild radish	18	14	128	89
Brome grass	0	1	5	2
Others	4	3	2	1
<b>Total</b>	<b>351</b>	<b>305</b>	<b>655</b>	<b>558</b>

### Summary of Results

The results obtained from the 2015 resistance screening are similar in the majority of cases to the results from previous years.

#### Annual ryegrass

This year, 408 annual ryegrass samples were received, all of which were tested to five or more herbicides (Table 2). However, only two of these were tested to the standard cross-resistance test (Groups A 'fop', A 'dim', B, C and D). Of the remaining 407 samples, 260 had both the substitution of one herbicide from another group, usually Roundup, and changes to herbicides within the standard groups while 142 samples tested one or more additional herbicides. Sixty seven samples were also tested to a sixth herbicide, 51 to seven, 5 to eight, 3 to nine and 4 to 10 herbicides.

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 within the range experienced in previous years. The samples provided through Landmark

WA were not tested to the 'fop' or Group B herbicides unless specifically requested by the client.

Table 2: Number of samples tested to each of seven herbicide groups

	2011	2012	2013	2014	2015
A (fops)	36	75	190	123	61
A (dims)	42	394	255	552	480
A (dens)	1	42	43	33	45
B	35	172	190	127	99
C	39	218	190	452	394
D	39	236	212	729	396
L	1	1	1	65	312
M	23	186	167	403	393

Twenty four percent of samples tested to a 'dim' herbicide were classed as resistant or developing resistance, a higher percentage than both 2013 and 2014 (Table 3). The majority of samples screened to 'dim' herbicides were screened to Select and/or Factor. In 2012 when 50% of the samples tested to 'dims' were resistant, of the 394 tests, 151 (38%) were screened to a herbicide other than Select, mostly Achieve (141 tests). This year only 15 (3%) of the 480 'dim' tests were to a herbicide other than Select or Factor. The proportion of samples resistant to Select and Factor is always much lower than for most of the other 'dim' herbicides, this year 21% of samples were resistant to Select and 25% to Factor, compared to 80% to Achieve (Table 5). Of the 45 samples screened to Axial 84% were resistant or developing resistance.

Eighty four percent of samples were resistant to Group B herbicides, a similar level to two of the last four years. No samples were resistant to atrazine (Group C), and 5% were resistant to trifluralin (Group D similar to the last three years (Table 3).

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

	2011	2012	2013	2014	2015
A (fops)	83	96	90	84	97
A (dims)	43	50	12	14	24
A (dens)	100	81	84	69	84
B	74	85	93	70	84
C	0	1	0	0.4	0
D	3	5	3	2	5

#### Cross and Multiple Resistance

Of the 408 samples screened to five or more herbicides 372 were screened to five or more herbicide groups. The majority of the 272

Landmark WA samples were screened to herbicides from five groups but they were not screened to ‘fop’ or Group B herbicides but instead to Group L & M herbicides. The 45 samples from the Stirlings to Coast Farmer Group were also not screened to a ‘fop’ or Group B herbicide but to two ‘dim’ herbicides and Group J/K, L and M herbicides.

Fifty three of the samples were tested to one or more herbicides from the following groups; A ‘fop’, A ‘dim’ B, C and D. The proportion of samples resistant to three herbicide groups (37.7%) was markedly higher than previous years. A lower percentage of samples were resistant to either one herbicide group (7.5%) while the proportion of samples resistant to zero or two herbicide groups was within the range experienced in previous years (Table 4).

As stated in a previous paragraph the Landmark WA and the Stirlings to Coast Farmer Group samples were not tested to a ‘fop’ or B herbicide due to the high probability that the samples would be resistant to these herbicides. Twenty four percent (66 samples) of the Landmark and 11% (6 samples) of the Stirlings to Coast samples were resistant to one of the selective herbicide groups tested (‘dim, C and D) with an additional 3% (7 samples) of the Landmark samples resistant to two of these groups, no samples were resistant to all three of the selective herbicide groups and none of the Stirlings to Coast samples were resistant to two groups. It is therefore probable that some of these samples would be resistant to three or four of the five selective herbicide groups listed in the previous paragraph.

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

No. of groups	2011 (%)	2012 (%)	2013 (%)	2014 (%)	2015 (%)
5	0	0	0	0	0
4	5.6	1.3	0.5	0	0
3	19.4	12.8	10.8	11.1	37.7
2	47.2	66.0	68.6	50.0	52.8
1	27.8	18.0	16.8	28.6	7.5
0	0	1.9	3.2	10.3	1.9
No. of samples	36	156	185	126	53

### 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, samples were also screened to Verdict, Achieve, Axial and Factor (Table 5).

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

	Tested	Res	DR	%	Susc
<i>‘fops’</i>					
Hoegrass	49	47	0	<b>96</b>	2
Verdict	12	12	0	<b>100</b>	0
<i>‘dims’</i>					
Select	405	46	41	<b>21</b>	318
Achieve	15	10	2	<b>80</b>	3
Factor	60	10	5	<b>25</b>	45
<i>‘den’</i>					
Axial	45	33	5	<b>84</b>	7

### Group B herbicides

While most of the samples screened to Group B herbicides were screened Glean or Intervix samples were also screened to Logran, Atlantis, Hussar and Crusader (Table 6).

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

	Tested	Res	DR	%	Susc
<i>Sulfonylureas</i>					
Glean	36	28	4	<b>79</b>	4
Logran	8	7	1	<b>100</b>	0
Atlantis	5	5	0	<b>100</b>	0
Hussar	15	12	0	<b>80</b>	3
<i>Imidazolinones</i>					
Intervix	32	22	4	<b>71</b>	6
<i>Sulfonamides</i>					
Crusader	3	0	0	<b>0</b>	3

### Other herbicides

Annual ryegrass samples were screened to nine other herbicides, simazine, atrazine, trifluralin, Kerb, Boxer Gold, Sakura, Roundup and Gramoxone. The observed incidence of resistance to these herbicides was lower than the resistance to the higher risk Group A and B herbicides (Table 7).

Forty of the 393 samples were found to be resistant or developing resistance to Roundup. This adds to the more than 350 confirmed cases of annual ryegrass resistance to Roundup in Australia and this herbicide needs to be treated carefully due to its importance in Australian agriculture.

Table 7: Results for ryegrass samples screened to other herbicide groups.

	Tested	Res	DR	%	Susc
<i>Group C</i>					
Simazine	62	0	0	<b>0</b>	62
Atrazine	332	0	0	<b>0</b>	332
<i>Group D</i>					
Trifluralin	395	12	6	<b>5</b>	377
<u>Kerb</u>	1	0	0	<b>0</b>	1
<i>Group J/K</i>					
Boxer Gold	53	0	0	<b>0</b>	53
<i>Group K</i>					
Sakura	11	0	0	<b>0</b>	11
<i>Group L</i>					
Gramoxone	312	0	2	<b>0.6</b>	310
<i>Group M</i>					
Roundup	393	23	17	<b>10</b>	353

### State by State

The majority of samples came from Western Australia and New South Wales. Most of the Western Australian samples came from either the Landmark WA offer (272) or the Stirlings to Coast Farmers Group (45). Eighty three samples came from New South Wales while one sample came from each of Victoria and South Australia (Table 8).

Table 8: Number of ryegrass samples received from each state.

	2011	2012	2013	2014	2015
NSW	25	196	93	88	83
Vic	2	5	7	1	1
SA	0	1	0	1	1
WA	15	50	126	371	323
Tas	0	3	10	1	0

With only one sample received from each of Victoria and South Australia only the data for New South Wales and Western Australia has been analysed separately (Figure 1). Additionally, the results for the Western Australian samples are skewed as the Landmark WA and Stirlings to Coast samples were not screened to Group A 'fop' or B herbicides.

For all but the Group A 'dim' herbicides similar results were found for samples from New South Wales and Western Australia. Thirty eight percent of the samples from New South Wales were resistant to a 'dim' herbicide compared to 20% of the Western Australian samples (Figure 1).

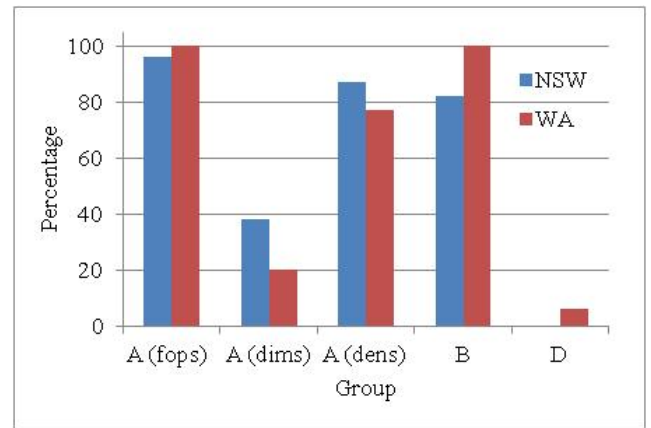


Figure 1: Percentage of ryegrass samples resistant and developing resistance for NSW and WA

### Wild Oats

The number of wild oat samples (58) received was similar to last year. On a percentage basis the number of samples was similar to last year and much lower than most previous years (Table 9). All but four of the wild oat samples came from New South Wales, two samples were supplied from Western Australia and one each from Queensland and South Australia.

Table 9: Number of wild oat samples received and percentage of total samples

	2011	2012	2013	2014	2015
Total	62	351	305	655	558
Wild oats	11	73	51	58	58
Percentage	17.7	20.8	16.7	8.8	10.4

The level of 'fop' resistance among the samples was 69%, slightly lower than in previous years (Table 10). 49 samples were tested to Topik (34 resistant), four to Verdict (2 resistant), one to Wildcat (resistant) and one to Hoegrass (resistant).

For the 'dim' herbicides, none of 48 samples tested were resistant to Select and one out of seven were resistant to Achieve. Twenty nine samples were tested to Axial with eight of these resistant (Table 10).

Table 10: Percentage of wild oat samples found to be resistant since 2011 (number tested in brackets)

	2012 % (no.)	2013 % (no.)	2014 % (no.)	2015 % (no.)
'fops'	74 (71)	81 (43)	78 (53)	69 (55)
'dims'	7 (75)	9 (55)	10 (61)	2 (56)
'dens'	12 (51)	46 (26)	47 (30)	27 (29)
B	12 (52)	8 (52)	20 (54)	8 (51)
Z	67 (3)	44 (9)	11 (9)	47 (15)

Forty three samples were tested to Atlantis with four resistant while no samples were resistant to

Intervix (3 tested), Crusader (4 tested) or Hussar (1 tested). Fifteen samples were tested to Mataven (Group Z), with seven of these resistant (Table 10). All samples tested to Avadex (44), Roundup (15) or atrazine (4) were susceptible.

### Broadleaf species

Eighty nine wild radish samples were provided for resistance screening with 86 coming from Western Australia of which 76 were provided as part of the Landmark WA deal and 10 from the Stirlings to Coast Farmers Group. The other three came from New South Wales.

Sixty seven percent of samples were resistant to Group B herbicides with 11 samples screened to Intervix (7 resistant), one to Glean (resistant) and three to Logran (2 resistant). A significant level of resistance was also found to Brodal (17/84). Resistant samples were found to Tigrex (2/77), MCPA LVE 570 (4/78), Jaguar (1/76) and Ester 680 (1/2), while no samples were found to be resistant to atrazine (14), bromoxynil (13), 24D Amine (11) or Roundup (86).

Table 11: Percentage of wild radish samples found to be resistant since 2010 (number tested in brackets)

	2012 % (no.)	2013 % (no.)	2014 % (no.)	2015 % (no.)
B	75 (20)	55 (9)	88 (130)	67 (15)
C	0 (15)	13 (8)	11 (158)	0 (27)
F	6 (17)	9 (11)	46 (128)	20 (84)
I	0 (22)	9 (11)	16 (129)	5 (91)
M	0 (12)	0 (2)	1 (122)	0 (86)

### Other species

Two brome grass samples and one three corner Jack sample, all from WA, were received this year. The brome grass samples were screened to Verdict, Select, Intervix, Crusader, atrazine, trifluralin, Gramoxone or Roundup all of which were susceptible. The three corner Jack sample was tested to Sencor and was susceptible.

### Final Observations

- The number of samples received was the fifth highest of the 25 years the testing service has been operating. The majority of the samples came from two sources, a Landmark WA deal and the Stirlings to Coast Farmers Group.
- The majority of annual ryegrass was received from two states (NSW and WA), with wild oats mainly received from NSW and wild radish from WA.
- For ryegrass samples the level of resistance remained similar to last year for all herbicide groups
- A larger percentage than normal of the ryegrass samples were resistance to Roundup. Whether this is a result of the increased number of tests or samples being sent in after a failure for that herbicide is unknown.
- Wild oat resistance for all groups was within the range experienced in previous years.
- Wild radish samples were resistant to three herbicide groups (B, F and I) compared to four last year, three in both 2010 and 2012 (B, C and I) and two (B and I) in 2011, an indication of the larger number of Western Australian samples. Many of the Western Australian samples were not tested to a Group C herbicide, it is likely that some of these may have been resistant to that herbicide group.

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Testing forms and annual reports are available at:

<http://www.csu.edu.au/research/grahamcentre/>

and click on Herbicide Resistance in the Quicklinks box

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