2020 Herbicide Resistance Testing Service Report

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GRAHAM CENTRE for Agricultural Innovation

Samples Received

The testing service screened 79 samples in 2020. This was a smaller number than every year since 2011 when only 62 samples were received and much smaller than last year's 142 samples that was previously the second lowest for this period making this only the second year since 1997 with less than 100 samples received.

As is always the case the majority of these samples were annual ryegrass (52) with samples of wild oats, wild radish and sow thistle also received (Table 1). Despite the low numbers for the first time a sample of charlock was received for testing.

Table 1: Total number of samples received since 2017

	2017	2018	2019	2020
Annual ryegrass	438	115	97	52
Wild oats	31	37	23	19
Wild radish	22	13	21	6
Brome grass	2	3	0	0
Barley grass	0	2	0	1
Sow thistle	0	0	1	0
Charlock	0	0	0	1
Total	496	171	142	79

Summary of Results

The results obtained from the 2020 resistance screening are similar in the majority of cases to the results from previous years.

Annual ryegrass

This year, 52 annual ryegrass samples were received, of which 51 were tested to five or more herbicides (Table 2). However, only one of these was tested to the standard cross-resistance test (Hoegrass, Select, Glean, simazine and trifluralin) with no additions or changes, in 2019 none were. The most commonly requested herbicide for testing was Roundup, requested for all but one sample, followed by Select (48 samples) and trifluralin (47 samples). One sample was tested to only one herbicide (Roundup) and six to the standard cross resistance test number of five herbicides. Two thirds (35) of the samples were tested to six herbicides, three to seven, five to eight and two samples were tested to nine herbicides.

Of the 13 samples tested to a 'fop' herbicide 12 were classed as either resistant or developing resistance to that herbicide a similar level to most of the previous years (Table 3). As in the previous two years, many samples were not tested to the 'fop' or Group B herbicides unless specifically requested by the client (Table 2).

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

	2016	2017	2018	2019	2020
A (fops)	46	63	42	16	13
A (dims)	201	259	132	137	71
A (dens)	30	336	32	7	6
B (SU)	38	58	56	13	17
B (Imi)	47	35	26	12	14
C	143	117	84	46	28
D	181	414	108	104	47
J	1	7	5	29	18
J/K	88	357	20	49	12
K	4	339	18	16	12
L	91	356	31	53	13
M	140	159	109	96	51

Forty five percent of samples tested to a 'dim' herbicide were resistant, higher than most previous years (Table 3). The samples screened to 'dim' herbicides were screened to Select, Achieve and/or Factor. As is usually the case the proportion of samples resistant to Select and Factor was lower than for the other 'dim' herbicides tested. This year 34% of samples were resistant to Select and 50% to Factor, compared to 100% to Achieve (Table 6).

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

	2016	2017	2018	2019	2020
A (fops)	87	75	92	94	92
A (dims)	15	20	40	26	45
A (dens)	55	75	94	100	100
B (SU)	89	90	84	46	1
B (Imi)	85	83	85	92	86
C	4	0	0	2	1
D	6	9	24	5	11
M	5	16	24	20	24

All six samples screened to Axial were resistant, the same as last year.

Seventy seven percent of samples were resistant to a sulfonylurea herbicide and 86% to an imidazolinone, a similar level to the majority of previous years. As mentioned previously the proportion of samples being tested to the sulfonylureas is decreasing. This may be the result of those clients from areas with a higher incidence of resistance requesting changes to the standard test to look for susceptible options and

dropping the 'fop' and Group B test whereas clients from areas with lower resistance incidence are still confirming if the herbicides are still effective.

No samples were resistant to Group C, J, J/K, K or L herbicides this year. In previous years samples resistant to Groups C or L have been received. Eleven percent of samples were resistant to trifluralin, a level within the range of previous years (Table 3).

Probably the most concerning finding is the continued significant proportion of samples resistant to Roundup (Table 3; 7). For the third consecutive year over 20% of samples were resistant or developing resistance to this herbicide, one of the, if not the, most important herbicides available. A number of these samples have been provided from non-agricultural settings (eg. roadsides) which will increase the risk profile for resistance

Cross and Multiple Resistance

Forty nine samples were screened to five or more herbicides with 42 of these screened to five or more herbicide groups. However, as many clients are now customising the testing to suit their circumstances only six samples were sprayed to the five standard selective herbicide groups ('fop', 'dim', B, C and D). Of these, half were resistant to three groups and half to two groups.

Six samples were screened to less than five herbicide groups, the sample tested to only one herbicide was resistant to that herbicide, the two tested to two groups were resistant to both while of the five tested to four groups, one was resistant to one group two to two groups and two to three groups (Table 4).

Table 4: Number of groups samples were tested to in 2020 and the number of resistant groups

	Herbicide groups tested					
Resistant groups	1	3	4	5	6	8
0	0	0	0	7	0	1
1	1	0	2	14	2	1
2	0	2	2	7	6	0
3	0	0	0	2	3	0
4	0	0	1	0	1	0
5	0	0	0	0	0	0
Total	1	2	5	30	12	2

Of the remaining 44 samples that were tested to five or more groups, eight (19.0%) were susceptible to all herbicide groups (Table 4). Seventeen (40.5%) samples were resistant to only one group while 12 (28.6%) were resistant to two, four (9.5%) to three groups and one (2.4%) to four (Table 4). No sample was resistant to five or more groups.

The level of cross and/or multiple resistance is much lower in these samples as in most cases the herbicide groups not tested are the A 'fops' and/or B. These groups have the highest level of resistance (Table 3) suggesting that the farmers or their agronomists are acknowledging these populations are resistant to these groups and are investigating the susceptibility of alternative herbicide groups. With only 11 of the 42 samples that were screened to five herbicide groups tested to both 'fop' and B herbicides, it is probable that some of the other 40 samples would be resistant to an additional one or two herbicide groups.

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 Select and Factor were the main herbicides tested, samples were also screened to Hoegrass, Topik and Achieve (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
'fops'					
Hoegrass	8	5	2	**88**	1
Topik	5	5	0	**100**	0
'dims'					
Select	48	7	9	**33**	32
Achieve	9	9	0	**100**	0
Factor	14	5	2	**50**	7
'den'					
Axial	6	5	1	**100**	0

Group B herbicides

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

Other herbicides

Annual ryegrass samples were screened to 11 other herbicides, simazine, atrazine, trifluralin, Kerb, Avadex Xtra, Arcade, Boxer Gold, Sakura, Gramoxone, Roundup and Luximax. The observed incidence of resistance to these herbicides was lower than the resistance to the higher risk Group A and B herbicides (Table 7).

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

	Tested	Res	DR	%	Susc
Sulfonylureas					
Glean	11	6	2	**73**	3
Logran	2	1	0	**50**	1
Hussar	4	4	0	**100**	0
Imidazolinones					
Intervix	14	11	1	**86**	2

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

	Tested	Res	DR	%	Susc
Group C					
Simazine	9	0	0	**0**	9
Atrazine	19	0	0	**0**	19
Group D					
Trifluralin	47	3	2	**11**	42
Kerb	15	0	0	**0**	15
Group J					
Avadex Xtra	8	0	0	**0**	8
Arcade	10	0	0	**0**	10
Group J/K					
Boxer Gold	12	0	0	**0**	12
Group K					
Sakura	12	0	0	**0**	12
Group L					
Gramoxone	13	0	0	**0**	13
Group M					
Roundup	51	10	4	**27**	37
Group Z					
Luximax	1	0	0	**0**	1

Twelve of the 49 samples tested to Roundup were found to be resistant or developing resistance. This herbicide needs to be treated carefully due to its importance in Australian agriculture. No samples were found to be resistant to Gramoxone this year (Table 7). No samples were resistant to any of the Group J or K herbicides or their mixture or to the Group D herbicide Kerb. With significant levels of resistance to other herbicides these herbicides are very important, and need to be managed well, through crop and herbicide rotations in conjunction with non-chemical weed control to maintain their effectiveness for as long as possible.

State by State

Western Australia and New South Wales supplied the most samples with samples also received from Tasmania, Victoria and South Australia (Table 8). The larger number of samples from Victoria and South Australia in 2017 was the result of the Syngenta Boxer Gold stewardship package with only three and eight samples respectively from these states this year. For the second consecutive year the lower number of samples from New South Wales is an indication of the drought conditions experienced across that state in 2018-19.

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

	2016	2017	2018	2019	2020
NSW	30	109	52	21	14
Vic	2	65	3	2	3
SA	0	70	1	5	8
WA	115	188	56	69	22
Tas	5	6	3	0	5

With only limited samples received from Victoria and the samples from South Australia and Tasmania each coming from a single agronomist only the data for New South Wales and Western Australia has been analysed separately (Figure 1). There are some differences in the proportion of NSW and WA samples resistant to the different herbicide groups. Only three NSW samples were tested to the Group A 'fop' herbicides, with one of these susceptible, this had a major influence on the results. Similarly fewer Group B tests were done for WA than NSW samples (7 cf. 17) again the few susceptible samples have greater influence. However the important difference is in the glyphosate resistance with nearly half (46%) of NSW samples resistant compared with 18% of WA samples (Figure 1).

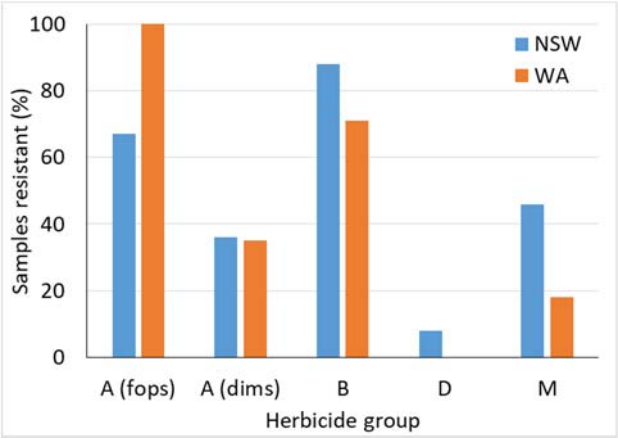

Figure 1: Percentage of ryegrass samples resistant and developing resistance for NSW and WA samples

Wild Oats

The number of wild oat samples (19) received was lower than previous years due in part to the decrease in total samples received. On a percentage basis the number of samples was the second highest ever slightly lower than the 29.1% of 110 samples received in 2007 (Table 9). As normally occurs the vast majority of wild oat samples (15) were received from New South Wales with three samples from Queensland and one from Victoria.

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

	2016	2017	2018	2019	2020
Total	235	498	170	142	78
Wild oats	37	31	37	23	19
Percentage	15.7	6.2	21.8	16.2	24.4

The level of 'fop' resistance among the samples was 72%, similar to previous years (Table 10). Thirteen samples were tested to Topik (10 resistant) and five to Verdict (3 resistant).

For the 'dim' herbicides, none of the eleven samples tested to Select were resistant while two out of four were resistant to Achieve. Eight samples were tested to Axial with four of these resistant (Table 10).

All samples tested to Atlantis (11), Intervix (7), trifluralin (1), Avadex (7), Mataven (1) or Roundup (2) were susceptible.

Table 10: Percentage of wild oat samples found to be resistant since 2017 (number tested in brackets)

	2017 % (no.)	2018 % (no.)	2019 % (no.)	2020 % (no.)
'fops'	75 (28)	76 (29)	78 (18)	72 (18)
'dims'	9 (33)	6 (34)	18 (23)	13 (15)
'dens'	17 (23)	36 (25)	36 (14)	50 (8)
B	11 (27)	9 (36)	4 (27)	0 (18)
Z	17 (6)	6 (18)	30 (10)	0 (1)

Broadleaf species

Six wild radish samples were provided for resistance screening with three from Western Australia, two from NSW and one from Victoria.

The only resistance detected was to Hussar (one tested) The other tested herbicides for which all samples were susceptible were Intervix (2), atrazine (3), Terbyne (1), bromoxynil (1), Jaguar (1), Brodal (6), 2,4-D Amine (5), Ester 80 (1), MCPA LVE 570 (1) and Roundup (1).

Table 11: Percentage of wild radish samples found to be resistant since 2015 (number of tests in brackets)

	2017 % (no.)	2018 % (no.)	2019 % (no.)	2020 % (no.)
B	80 (12)	38 (8)	21 (19)	33 (3)
C	25 (28)	16 (18)	6 (35)	0 (5)
F	78 (22)	33 (12)	90 (20)	0 (6)
I	59 (22)	53 (15)	26 (23)	0 (7)
M	0 (20)	0 (10)	0 (19)	0 (4)

Other species

One barley grass sample was received from NSW. This sample was resistant to Verdict and Select but susceptible to Monza, simazine and trifluralin.

The first ever sample of charlock was received for testing, it was resistant to Intervix but susceptible to Brodal and MCPA Amine.

Final Observations

- As normal NSW and WA supplied the most annual ryegrass samples and wild oats mainly received from NSW.
- For ryegrass samples the level of resistance remained similar to previous years for the major herbicide groups.
- For the third consecutive year over 20% of ryegrass samples were resistant or developing resistance to Roundup. This is a major concern.
- Wild oat resistance for all groups was within the range experienced in previous years.
- Only one wild radish samples was resistant to any herbicide, maybe reflected 50% of samples came from the eastern states.

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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

Note: