



INTERPRETING HERBICIDE RESISTANCE TEST RESULTS

NIAB test reports are provided in a format like the diagram in Figure 1. It conveys a great deal of information about the sample submitted for testing as well as wider information about the resistance status of a species to different herbicides nationally.

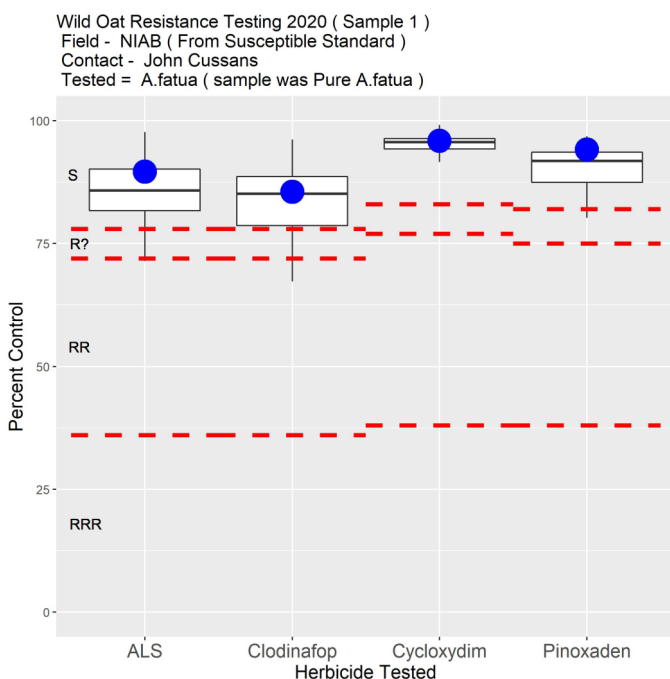


Figure 1: Typical herbicide resistance test report. In this case these are the results for susceptible population of wild oats.

The header contains all the information required to identify the sample (year, location and weed species) and it also indicates a sample number that NIAB uses to keep track of the samples each year. Along the bottom are the herbicides that were used in the tests, usually by active ingredient but for resistance to ALS inhibiting herbicide (Atlantis, Niantic, Broadway Star, Hatra, Horus, Monolith etc) which effect all herbicides within the group we simply state 'ALS' as the herbicide family. The test herbicides will be different for each weed species.

National status

The 'box and whisker' element of the graphic provides information about the entire collection of populations for that species tested by NIAB to indicate the status of that weed with respect to the tested herbicide. The effectiveness data for half of the samples tested falls within the box and

the 'whiskers' above and bellow give and indication of the results for 95% of all the samples. The 'box' and 'whiskers' will differ dramatically between different weed/herbicide combinations and are likely to change with time as the dataset is updated. As an example, Figure 2 contrasts the same box and whisker plots for the most recent data on ALS herbicides in Italian ryegrass and wild oats.

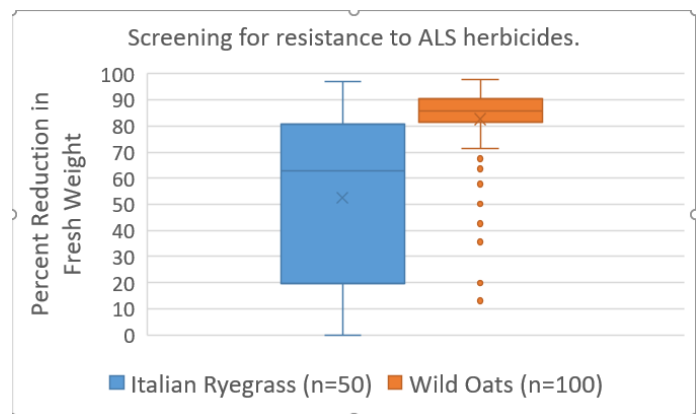


Figure 2: The status of ALS sensitivity in Italian ryegrass and wild oats (both species combined).

Tested sample relative to the national status

The effectiveness of each herbicide on the individual sample submitted is plotted using a blue dot (a single dot for each herbicide). The position of the dot allows you to judge where the individual population lies with respect to the overall national picture. If it is within the 'box' then the sample is considered as within the typical range for that species. If the result is outside the 'box' then it can be considered atypical. If the result is towards the end of or beyond the end of the 'whisker' the results is very much at the extreme end of what has been observed.

Resistance status as an 'R' rating

To ensure herbicide resistance test results are presented consistently an 'R' rating system was developed and is supported across the industry (older resistance test may have used a '*' system but this has been superseded). This classifies the status of individual samples relative to a susceptible standard. The 'R' rating is universally used because it gives consistency of reporting across weed species, herbicides and different testing organisations (Table 1).

Crucial to the 'R' rating is a consistent susceptible standard for each weed species – the standards are maintained and

Table 1. Resistance ratings explained

Older '*' ratings	Resistance ('R') Ratings	Interpretation
5*/4*	RRR	Highly resistant. Resistance is confirmed and is highly likely to reduce herbicide performance
3*/2*	RR	Resistance confirmed, probably reducing herbicide performance
1*	R?	Early indications that resistance may be developing, possibly reducing herbicide performance
S	S	Fully susceptible

constantly tested. At least one susceptible standard and often two or more will always be used as a reference in all resistance testing and this is a vital part of the quality assurance. In this way the overall national status may change over time and be different between weed species but because the rating is relative to a constant reference population the 'R' rating will remain consistent.

In the herbicide resistance reports the boundaries between 'R' ratings is denoted with horizontal dashed lines (Figure 3). While the level of control for the susceptible standard is consistent for the same herbicide/weed combinations, it does vary between herbicides for the same weed so the actual percent control levels for 'R' ratings will be different. This means that the dashed lines do not line up between the different herbicides tested.

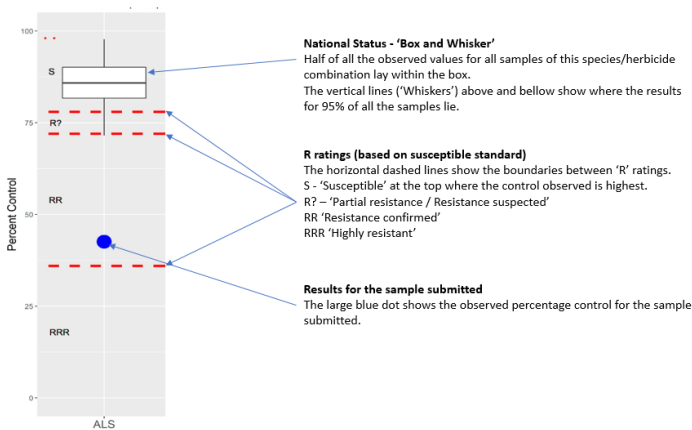


Figure 3. Herbicide resistance test results for a single species and herbicide in detail.

Q & A

What factors need to be considered when review resistance test results?

Testing previously treated samples. If the sample submitted has already been treated with the herbicide tested (or in some cases the same mode of action) the resistance test result will be skewed and will over emphasise the background status of that resistance trait.

Understanding the relatively small size of the sample tested relative to the size of the population. Even with a large weed sample which NIAB will mix carefully to extract a homogenous sub-sample this is a tiny fraction of the total weed population in the field and this sample size can lead to variability in test results between years for example.

Is the same testing appropriate for different weed species?

Simple answer no; The aim of testing is to assist decision making about approaches to controlling individual weed populations and to be effective resistance testing package must be tailored to different weed species. NIAB only provides resistance testing packages which are different for different weed species and reflect the different herbicide resistance status in different weed species. For some weed species there is considerable variability in resistance level between herbicides within the ACCase family ('fops', 'dms and 'dens') and these need to be tested separately but for other species this is much less the case and a single test is sufficient. For some weed species including flufenacet as a test herbicide has now become a priority for the majority it is not required.

How consistent between fields on a farm and between neighbouring farms are herbicide resistance test results?

It is important to understand that weed populations vary a great deal in terms of herbicide resistance status even between neighbouring fields. Put another way; a resistance test on a sample from one field is not a good predictor of resistance in the same weed in a neighbouring field.

If you are planning to use resistance testing as the basis for systematic herbicide resistance monitoring as one plank of an IWM strategy it's important to be consistent in sample collection and to monitor resistance on a single field scale.

Can resistance test results indicate reduced levels of resistance year to year?

Yes, they can but these apparent reductions are not a result of different resistance traits declining or going away but rather are a result of sampling 'error'; the relatively small sample size and differences in the location where sample was collected and mixing in the seedbank; cultivation that mixes the seedbank can bring older individuals to the surface layer which have been exposed to less selection for resistance.