#59 Glyphosate resistant brome – gene amplification

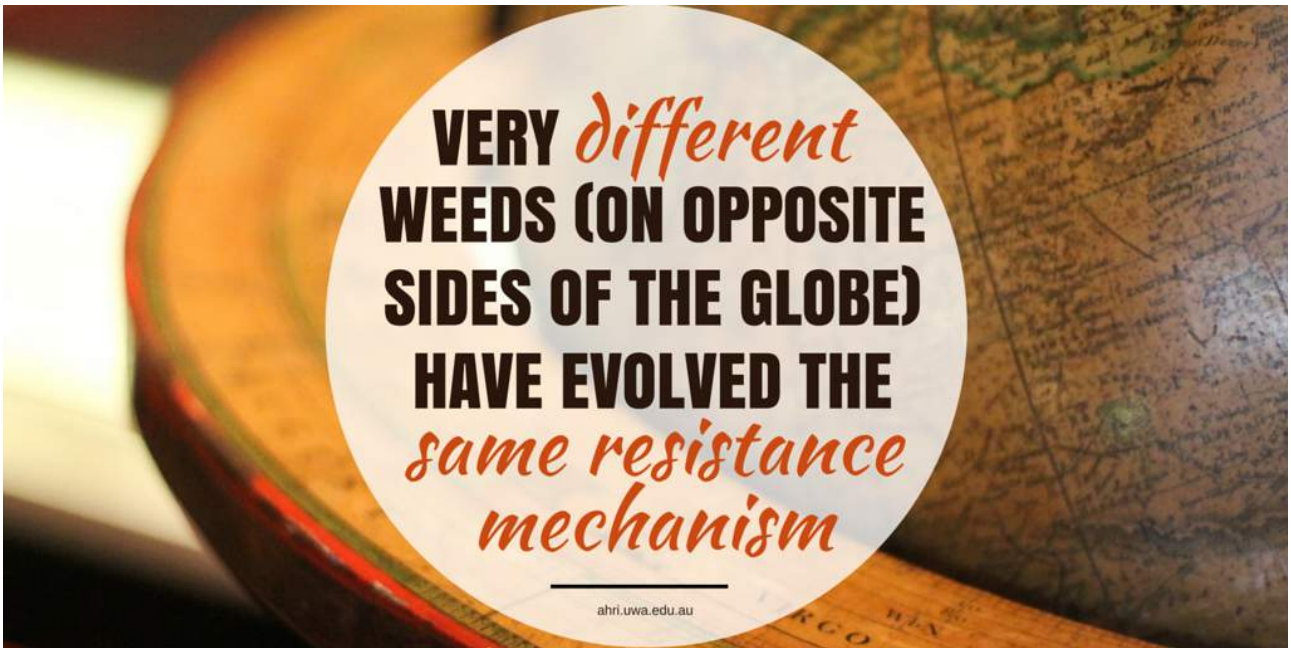
Two years ago, a meeting was held in Australia to gather researchers who study weed, pest and disease resistance to see what they could learn from each other. There was a mind-blowing moment when an entomologist realised that the P450 enzymes he had been studying that gave resistance to an insecticide were the same as those that a weed researcher was studying that caused resistance to a herbicide (well… we thought it was mind-blowing. But then again, we're weeds geeks!).

Some new research by Jenna Malone, Chris Preston and others from the University of Adelaide weed research team have found that glyphosate resistant brome grass in Australia has the same resistance mechanism as glyphosate resistant Pigweed in the USA.

We'll admit it's not quite as mind-blowing as insects and weeds sharing the resistance mechanism. BUT it's still pretty amazing that very ***different*** weeds (on opposite sides of the globe) have evolved the ***same*** resistance mechanism.

Glyphosate kills plants by 'knocking out' the EPSPS enzyme. These glyphosate resistant brome grass have about 20-fold the number of copies of the EPSPS gene as a normal plant resulting in 5-fold glyphosate resistance. Glyphosate can still knock out some of this enzyme, but the plant has produced so much of the enzyme that there's plenty leftover for normal plant growth and the plant survives normal field rates of glyphosate. This mechanism is called gene amplification.

Want to learn a little more about this mechanism? Keep reading for a short video that explains how it works.



Arguably the world's biggest herbicide resistance problem is the glyphosate resistant Pigweed (Palmer amaranth) infesting millions of acres across the USA. As we reported here, Palmer amaranth resists glyphosate through gene amplification. Glyphosate resistant Palmer amaranth has been documented to have 5 to 160-fold the number of copies of the EPSPS enzyme resulting in up to 40-fold resistance to glyphosate.

The University of Adelaide weed research team is led by Chris Preston and is funded by GRDC. The brome grass in this study by Jenna Malone, Sarah Morran, Neil Shirley, Peter Boutsalis and Chris has the same resistance mechanism as Palmer amaranth.

This is only the second grass species in the world to be found to have this resistance mechanism (the other is Italian ryegrass).

The best way to get your head around this mechanism is to watch this short video (click here or the image below):

If you enjoyed the video and you'd like to learn about all of the known resistance mechanisms, join our free Herbicide Resistance 101 course with WeedSmart's Diversity Era. The next live round starts Monday, March 21. Register your interest now and be the first to know when the doors reopen for new members!

The research

Two populations of glyphosate resistant brome grass (*Bromus diandrus*) were studied, one from Arthurton, South Australia and the other from Ouyen, Victoria. Given that these populations are over 400km apart it is highly likely that they evolved resistance independently from one another.

What it's not….

The research team looked at a number of known resistance mechanisms.

They determined that glyphosate resistance was ***not*** due to reduced glyphosate absorption, translocation, or root extrusion.

They also did some gene sequencing to see if the brome grass had the proline106 mutation, a common cause of glyphosate resistance in other weeds. This mutation was ***not*** present and could be ruled out also.

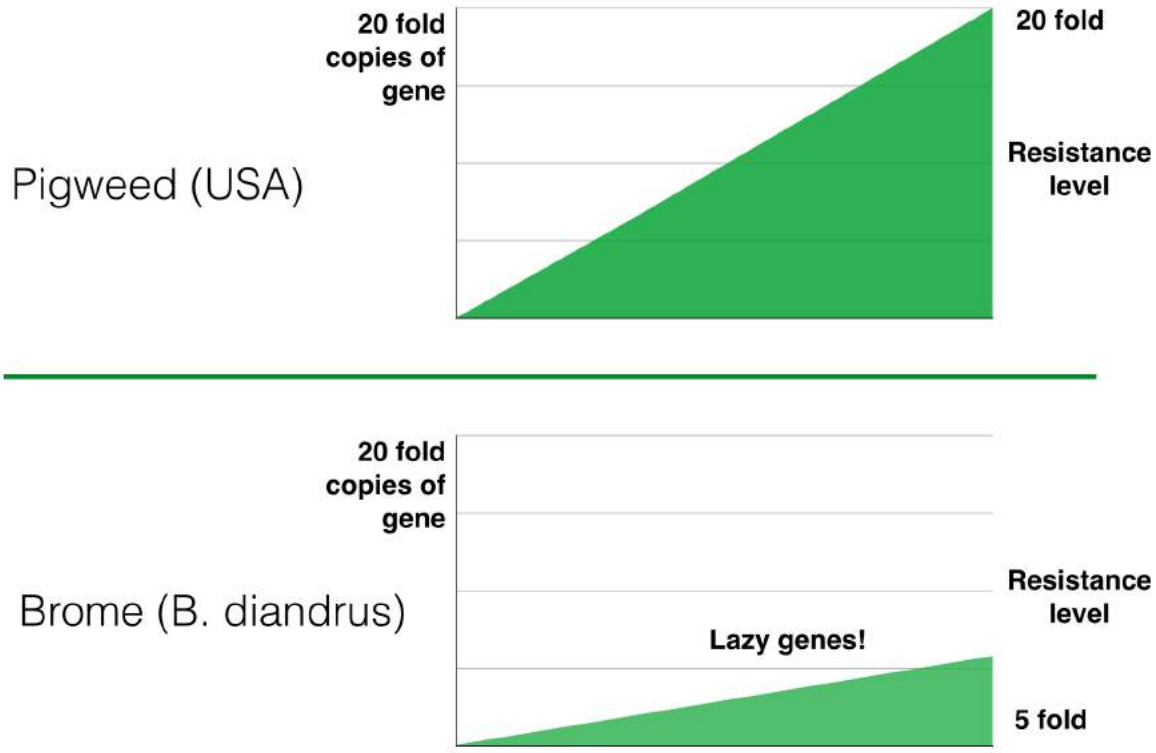
What it is…

Gene amplification. The resistant individuals had about 20-fold the number of copies of the EPSPS gene.

More copies of the gene results in more EPSPS enzyme produced right?

Yes, but…

The resistant plants had 20-fold copies of the gene but only 5-fold resistance. Perhaps not all copies of the gene are being expressed (some are a little lazy). Regardless, the plants with the gene amplification mechanism produced too much of EPSPS enzyme for glyphosate to overcome.



Gene amplification / expression explained

If a farmer wants to increase wheat production he can either increase crop area, or increase yield per hectare, or both.

If a plant wants to increase enzyme production it can either increase the number of genes for the enzyme (crop area), or increase gene expression (crop yield), or both.

The brome grass in this study is like a low rainfall farmer with a huge crop area (extra copies of the gene), but low yield (low gene expression), producing a lot of grain (enzyme).

The future – higher level resistance?

In other species with the gene amplification resistance mechanism, further selection with glyphosate led to greater amplification of the EPSPS gene and resistance levels increased. The brome grass in this study has only low-level resistance (5-fold), but this could change for the worse if glyphosate selection continues to occur.

Summary

It's mind-blowing that insects and weeds contain the same resistance mechanism and that very different weeds on opposite sides of the globe have ***independently*** evolved the same resistance mechanism. We're all more closely related than we think we are!

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