How well do we understand and manage multiple herbicide resistance in wild radish with the existing chemistries?

Roberto Busi, Mechelle Owen and Stephen Powles

Australian Herbicide Resistance Initiative, School of Agriculture and Environment, The University of Western Australia, Perth, WA 6009, Australia.

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Key messages

- Herbicide efficacy on wild radish and TT canola (pot studies) provide insight for improved wild radish control and future research work.
- Three-way herbicide mixtures (herbicide groups C+F+I and C+H+I) appear the most effective options to control multiple resistant wild radish.

Aim

Improve practices for weed control of multiple-resistant wild radish with current herbicides

Background

Wild radish is the second most damaging weed in Australia which is clearly affecting famers' decisions. Multiple-resistant wild radish is an acute problem in the Western Australian grain-belt. Research was conducted to assess the efficacy of two-way and three-way herbicide mixtures on multiple-resistant wild radish and TT-canola plants. Herbicide efficacy data provide insight on how to maintain high-level herbicide efficacy in the early stages of resistance evolution and delay the onset of multiple-resistance.

Results

Study 1.
A study conducted on wild radish populations randomly collected in 2010 in WA cropped fields shows high level of resistance to the sulfonylurea (SU) herbicide chlorsulfuron (Group B) versus a relatively low level resistance to 2,4-D and diflufenican (DFF) across different rainfall zones (Figure 1). Two-way mixtures of three herbicides including 10 g chlorsufuron ha^{-1} (Group B), 100 g diflufenican ha^{-1} (Group F), and 625 g 2,4-D ha^{-1} (Group I) did not provide greater wild radish control than than diflufenican or 2,4-D applied alone (Figure 1).

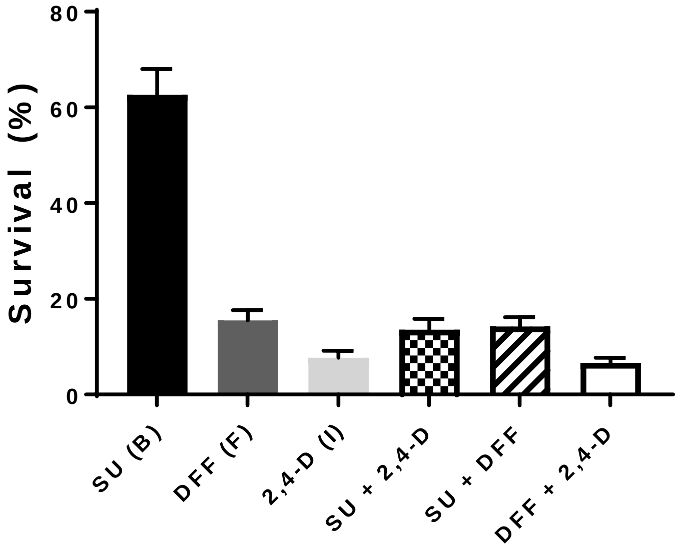

Figure 1. Plant survival (%) to the full dose of individual herbicide [(Chlorsufuron, SU – B), Diflufenican, DFF, F) or (2,4D, I)] or herbicide mixtures (SU + 2,4-D, SU + DFF or DFF + 2,4-D) in wild radish populations collected in different rainfall zones (High, Medium and Low). Bars are mean ± standard errors. (Data source: Owen and Powles, unpublished). Plant growth stage 2-3 leaves.

Study 2.

In another study we quantified the efficacy of the herbicide picolinafen (F) versus two-way mixtures with MCPA (I) or bromoxynil (C) versus three-way mixture of picolinafen + MCPA + Bromoxynil on triazine-tolerant (TT) canola plants. We used TT canola to simulate the response of a generic wild radish population with resistance to the group C herbicide atrazine.

Results show that at a given rate of picollinafen (3 g ha^{-1}), a two-way mixture with MCPA or Bromoxynil (50g ha^{-1}) can increase plant mortality up to 34%, whereas a three-way mixture can increase mortality up to 64% (Figure 2A ↑).

Similarly, the HPPD herbicide pyrasulfotole (H) at the same rate (3 g pyrasulfotole ha^{-1}) provides no weed control (no mortality). At such a low rate of pyrasulfotole the addition of 25 g bromoxynil ha^{-1} does not appear to increase the level of control, whereas a two-way mixture of pyrasulfotole with MCPA (25 g ha^{-1}) can increase control up to 70%. This was a very significant and unexpected result. The mixture of pyrasulfotole + MCPA appears to be more effective than mixture pyrasulfotole + bromoxynil, known to be synergistic and provide greater than additive control (Figure 2B ↑). (Figure 2B ↑). Similar results were achieved with the commercial product “Precept®” (two-way mixture of pyrasulfotole + MCPA) found to be more effective than Velocity® (two-way mixture of pyrasulfotole + bromoxynil). The dose – response study show that plant survival (%) (Figure 2C ↑) and biomass (not shown) after the treatment with Precept® appear substantially lower than survival and biomass after Velocity® treatment. Importantly a three way mixture pyrasulfotole + MCPA + Bromoxynil delivered the most effective control with 83% mortality (Figure 2B). End-users should be aware of these results to potentially improve current practice for herbicide control of wild radish field populations.

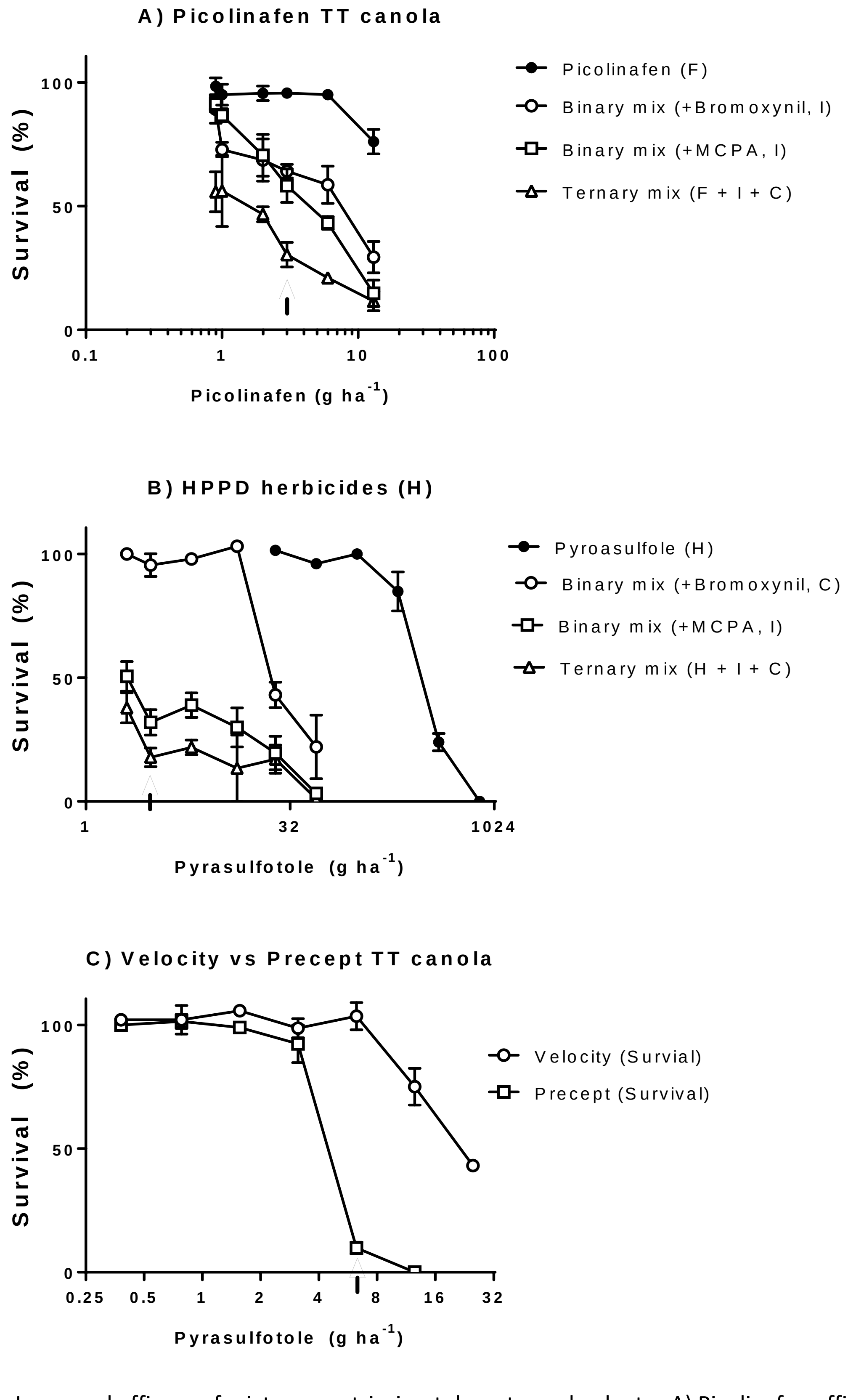

Figure 2. Increased efficacy of mixtures on triazine-tolerant canola plants. A) Picolinafen efficacy (F), versus binary or ternary mixtures. B) Pyrasulfotole efficacy (H), versus binary or ternary mixtures. C) Herbicide efficacies (as survival and biomass %) after treatment with Velocity (H+C) vs. Precept (H+I). Plant growth stage 2-3 leaves.

In 2016 we have started to purify wild radish populations and arranged crosses with individual plants surviving treatment with single herbicides or a sequence of two herbicides. We aim to build and stack multiple resistance traits in single plants and assess the effect of herbicide mixtures on these multiple-resistant wild radish lines.

Conclusion

Wild radish has the potential to evolve resistance to all selective herbicides currently available for its control and escape herbicide control. Thus, a major aim of this study is to investigate and optimize the use of current herbicides that provide effective control of wild radish. This work will help minimize the risk of resistance to existing herbicides that still provide highly effective control of continuously evolving wild radish field populations (e.g. herbicide groups C, F, H, I) before resistance is reported from the field.

From this study it appears that three-way mixtures (for example bromoxynil + MCPA + picolinafen or bromoxynil + MCPA + pyrasulfotole) are the most effective options and they can help achieve optimal wild radish control. Future studies with pot-cultured wild radish plants (followed by field trials) will further investigate these mixtures on well characterized multiple-resistant populations. We aim to answer these important questions: "Can herbicide mixtures provide satisfactory control of stacked multiple-resistant wild radish"? Results of future research work will be timely delivered to growers and agronomists at national conferences (eg next GRDC Grains Research Update), field days, AHRI Insight Newsletter and WeedSmart.

Useful resources

http://ahri.uwa.edu.au/people/dr-roberto-busi/

References

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Contact details

Name Roberto Busi

Business Address 35 Stirling Hwy Crawley 6009 WA

Phone 0415185553 08 64881423

Email roberto.busi@uwa.edu.au

Twitter handle *@robbert115*

Reviewed by

Peter Newman