Synthetic Auxin Resistant Weeds

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HERBICIDE RESISTANCE ACTION COMMITTEE

Synthetic Auxin Resistant Weeds

Despite synthetic auxin herbicides being used longer and on a greater area than any other herbicide mechanism of action the area infested with synthetic auxin resistant weeds is low in comparison to many other herbicide mechanisms of action. Twenty seven weeds have evolved resistance to synthetic auxins. This excludes grasses resistant to quinclorac since the biochemical mechanism of resistance in these cases appears to differ from other auxin resistance. Sixteen of the 27 species have documented resistance to 2,4-D, seven to MCPA, and six to dicamba. In the United States six weed species have evolved resistance to synthetic auxin herbicides, with only one, *Kochia scoparia*, being widespread and a serious economic problem. Globally the most important synthetic auxin resistant weeds are Kochia, Wild Radish, Corn poppy, and Wild Mustard. Synthetic auxin resistance in two other species, tall waterhemp and common lambsquarters, are not widespread yet, but have the potential to become serious problems in the United States if they are not managed properly.

This fact sheet is an introduction to a series of fact sheets on auxin resistant weeds, covering kochia, wild radish, corn poppy, wild mustard, tall waterhemp, and common lambsquarters.

Table 1. The occurrence of synthetic auxin resistant weeds worldwide.

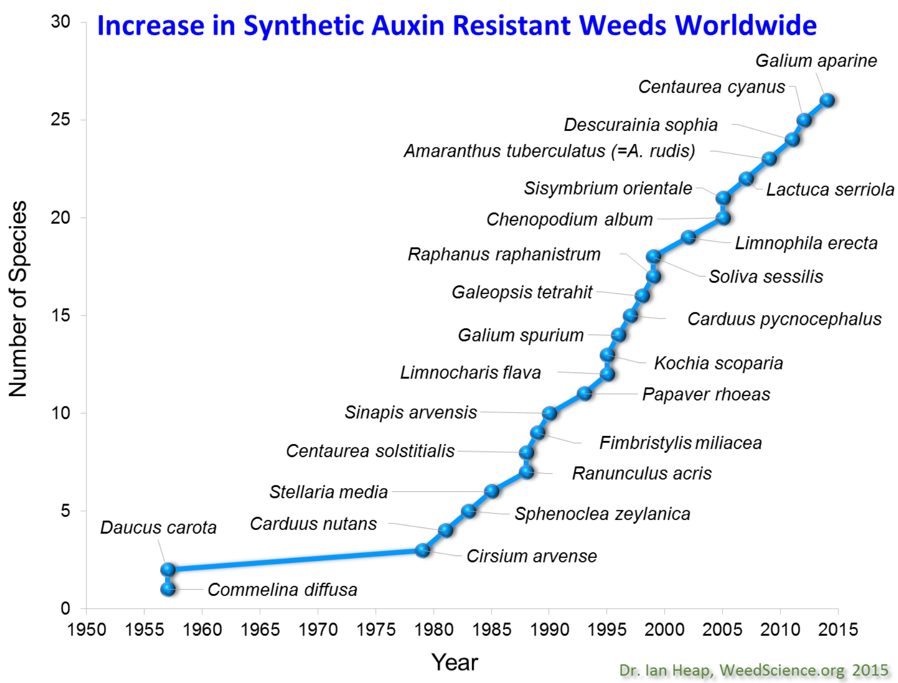
Species	First Year	Herbicides	Country
Amaranthus tuberculatus	2009	2,4-D	United States
Carduus nutans	1981	2,4-D	New Zealand
Carduus pycnocephalus	1997	2,4-D, MCPA, MCPB	New Zealand
Centaurea cyanus	2012	dicamba	Poland
Centaurea solstitialis	1988	picloram	United States
Chenopodium album	2005	dicamba	New Zealand
Cirsium arvense	1985	2,4-D, MCPA	Hungary, Sweden
Commelina diffusa	1957	2,4-D	United States
Daucus carota	1957	2,4-D	Canada, United States
Descurainia sophia	2011	MCPA	China
Fimbristylis miliacea	1989	2,4-D	Malaysia
Galeopsis tetrahit	1988	dicamba, fluroxypyr, MCPA	Canada
Galium aparine	2014	fluroxypyr	China
Galium spurium	1996	quinclorac	Canada
Kochia scoparia	1994	dicamba, fluroxypyr	United States
Lactuca serriola	2007	2,4-D, dicamba, MCPA	United States
Limnocharis flava	1995	2,4-D	Indonesia, Malaysia
Limnophila erecta	2002	2,4-D	Malaysia
Papaver rhoeas	1993	2,4-D	Italy, Spain
Ranunculus acris	1988	MCPA	New Zealand
Raphanus raphanistrum	1999	2,4-D	Australia
Sinapis arvensis	1990	2,4-D, dicamba, dichlorprop, MCPA, mecoprop, picloram	Canada, Turkey
Sisymbrium orientale	2005	2,4-D	Australia
Soliva sessilis	1999	clopyralid, picloram, triclopyr	New Zealand
Sonchus oleraceus	2015	2,4-D	Australia
Sphenoclea zeylanica	1983	2,4-D	Malaysia, Philippines, Thailand
Stellaria media	1985	fluroxypyr, MCPA, mecoprop	China, United Kingdom

Rarity of Synthetic Auxin Resistant Weeds

Gressel and Segel (1982) suggested that the low incidence of synthetic auxin resistant weeds may be due to the auxinic herbicides having multiple sites of action, requiring multiple mutations within an individual to confer resistance. This seems a reasonable assumption, however in most cases (*Sinapis arvensis, Kochia scoparia, Centaurea solstitialis, and Galium spurium*) research have shown resistance to be due to a single mutation (single gene) with only one case where resistance was confirmed by two additive genes (*Galeopsis tetrahit*). Alternative theories for the paucity of synthetic auxin resistant weeds are that resistant mutations are extremely rare, or that mutations conferring resistance are lethal.

Transgenic Crops and Synthetic Auxin Resistant Weeds

Synthetic auxin resistant crops (corn, cotton, and soybeans) have been developed to provide an additional herbicide mechanism of action to help manage and mitigate the evolution of herbicide resistant weeds. The synthetic auxin herbicides are inherently low risk herbicides for the selection of herbicide-resistant weeds. However low risk does not mean "**No Risk**" and as we have seen with glyphosate (another low risk herbicide) if synthetic auxins are used over large areas without sufficient rotation with other herbicide mechanisms of action and use of non-herbicidal weed control strategies then they are likely select for resistance relatively rapidly. If used wisely they will provide a way to extend the life of existing herbicides used in these crops.



Synthetic Auxin Herbicides

Synthetic auxins were the first highly effective, and selective organic herbicides. They have been used for over 60 years and are still being used extensively worldwide for control of broadleaf weeds in many crops and non-agricultural areas. Synthetic auxins are structurally similar to the natural plant hormone IAA and mimic their effects to kill weeds.

Best Management Practices

Diversity in weed control practices is key to delay and manage herbicide resistance in weeds. This involves:

1. Rotation or mixtures of herbicide mechanisms of action.
2. Using at least two herbicides a year from different herbicide mechanisms of action that are still effective on the particular population of the target weed. This may include use of pre-emergence herbicides.
3. Using cultural/mechanical weed control methods including shallow tillage in the spring, crop rotation, and cleaning equipment.
4. Using full herbicide rates applied at the correct weed size and to carefully monitor results.
5. Scouting fields after herbicide application and controlling escapes.

See Norsworthy et. Al. Reducing the Risks of Herbicide Resistance: Best Management Practices and Recommendations, Weed Science, 2012, 60, sp1, 31 for detailed information on resistance management.

REFERENCES

Mithila J., Hall J.C., Johnson W.G., Kelley K.B., and Riechers D.E. 2011. Evolution of Resistance to Auxinic Herbicides: Historical Perspectives, Mechanisms of Resistance, and Implications for Broadleaf Weed Management in Agronomic Crops. *Weed Science* 59:445