Why has resistance evolved more slowly to pre-emergent herbicides than to post-emergent herbicides?

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Summary Populations of *Lolium rigidum* Gaudin (annual ryegrass) have generally evolved resistance to pre-emergent herbicides more slowly than to post-emergent herbicides. One example is the pre-emergent herbicide trifluralin, which was in steady use from the 1960s until the 1980s with few indications of resistance evolution. In contrast, diclofop, a post-emergent herbicide released in the 1980s, lost effectiveness due to resistance evolution within just a few years of its first use. It has been speculated that the slower evolution of resistance to pre-emergent herbicides may be due to a number of factors including lower initial frequencies of resistance genes, differences in herbicide use patterns or reduced herbicide efficacy.

Individual based simulation modelling was used to investigate the effect of two herbicide application timings, (pre and post emergent), herbicide efficacy and resistance allele frequency on the evolutionary rate of a single dominant gene for herbicide resistance within a population of annual ryegrass in a wheat field.

This study determined that the observed slower evolution of resistance to pre-emergent herbicides (e.g. trifluralin) in annual ryegrass populations is most likely due primarily to reduced efficacy (70%) of trifluralin with a low initial gene frequency (1×10^{-8}) contributing secondarily. Differences in herbicide use patterns (pre- versus post-emergent) had minimal effect on rates of resistance evolution when similar weed cohorts were affected.

Keywords Resistance, modelling, herbicide, trifluralin.