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**Variation in susceptibility of giant buttercup (*Ranunculus acris*
L. subsp. acris) populations to herbicides**

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ABSTRACT

Giant buttercup (*Ranunculus acris* L.) is a serious weed of dairy pastures throughout New Zealand causing substantial economic losses from lost pasture productivity. It has developed resistance to the phenoxy herbicides (MCPA and MCPB) at many sites around New Zealand, particularly in Golden Bay. Since the discovery of resistance in the 1980s, two newer herbicides from a different mode-of-action group (acetolactate synthase inhibitor, ALS), flumetsulam and thifensulfuron-methyl, have been used widely, which appeared to overcome the resistance problem. A survey of farmers in Golden Bay indicated that most have herbicide control programmes for giant buttercup based around flumetsulam but some have reported poor control with this herbicide, particularly after several years of use. The research in this thesis was undertaken to determine whether this may be due to evolved resistance.

Seedling progeny from 15 populations of giant buttercup, with known spraying history, were sprayed with a range of doses of flumetsulam, thifensulfuron-methyl and MCPA (Experiment 1) to test for differences in susceptibility. The experiment revealed a large difference in susceptibility between the populations (83-100% and 58-100% mortality at the recommended rate and 2.2 times that rate of flumetsulam applied, respectively). The population with the highest past exposure to flumetsulam showed the lowest mortality and 25% of plants in this population survived a treatment with 5 times the recommended rate. There was a significant declining trend between percent mortality and historical exposure of these populations to flumetsulam. However, most populations with low previous exposure had no or few resistant individuals and only a few populations with high previous exposure had several resistant individuals present, as indicated by their survival above recommended rates. Calculated LD₅₀ values did not correlate well to the survival data or to historical exposure to flumetsulam, because the herbicide rates chosen in this experiment were too high.

Measurements of the biomass of giant buttercup, obtained several times after spraying in Experiment 1, showed some evidence of cross resistance to thifensulfuron-methyl but not to MCPA. Biomass yields 3 months after treatment were 1, 2 and 22% of untreated for the recommended rates of flumetsulam, MCPA and thifensulfuron respectively, indicating that flumetsulam and MCPA were equally effective, but that thifensulfuron-methyl was less effective.

In Experiment 2, plants from the most resistant and susceptible populations in Experiment 1, were grown from spare seeds and treated with a wider range of doses (including lower doses) of flumetsulam than in Experiment 1. The LD₅₀ values for the two populations in this second experiment differed 5.3-fold and this difference was highly significant. Twenty-nine percent of plants from the population with high past

exposure survived treatment with 25 times the recommended rate of flumetsulam compared to 0% from the population with no past exposure.

In a third experiment the same three herbicides and rates were compared for their damage to perennial ryegrass (*Lolium perenne*) and white clover (*Trifolium repens*) sown either in pots (Exp. 3a), or transplanted from the field (Exp. 3b). The total clover yield harvested over 5 months from newly-sown pasture was 80, 59 and 4% that of the untreated control for flumetsulam, thifensulfuron-methyl and MCPA applied at recommended rates, and 95, 40 and 30% respectively for transplanted swards. The total yield of grass was not reduced by any of the herbicides. Overall flumetsulam was the least pasture-damaging herbicide, but rates could not be increased above recommended rates in order to deal with resistance because pasture damage occurred.

The experiments in this study indicate that resistance to flumetsulam may be evolving in giant buttercup in dairy pastures in Golden Bay, but more research is needed in field trials to confirm this. Furthermore, the results indicate that some populations may no longer be resistant to MCPA, but this also needs further study to confirm. Currently-available herbicides may not provide adequate control of giant buttercup in the future if existing management practices continue.

KEYWORDS: *Ranunculus acris*; giant buttercup; MCPA; flumetsulam; thifensulfuron-methyl; efficacy; phenoxy herbicide; ALS inhibitor; resistance; Takaka; New Zealand; pasture tolerance.

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