Ecology and herbicide tolerance of the native weeds that cause pimelea poisoning

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Summary Three annual species of native *Pimelea* (Thymelaeaceae) cause intermittent but serious problems for cattle producers in inland Australia. The causal toxin and related compounds have been known for decades but no well-defined relationship between the incidence and abundance of the plant in pastures and levels of animal morbidity has been established.

We report on early efforts to germinate the seeds reliably so that appropriate toxicity and herbicide trials can be conducted. A strong embryonic dormancy has been shown to exist in fresh seed, particularly in *P. simplex*. Also, germination and recruitment conditions for *P. elongata* are apparently very different to those favourable to recruitment of *P. trichostachya*, even though they often grow in close proximity.

Keywords *Pimelea*, weed, cattle, disease.

INTRODUCTION

Reports of cattle ill-health and death with similar symptoms due to an unknown toxic plant in the Marree and St George districts date back to before World War II. The suspect was a plant but it was not until the early 1970s that a definite culprit was identified – *Pimelea simplex* F.Muell. and *P. trichostachya* Lindl. (Clarke 1973). No easy remedy could be found but, around St George, moving animals from red soil country to heavy clay soil areas seemed to help.

The disease was not a significant problem again until the early 1990s when further work was done on the epidemiology of the disease and a vaccine sought unsuccessfully (Dadswell *et al.* 1993). There is still great uncertainty about what sets off serious poisoning events rather than the chronic diarrhoea that sheep also can display (Berry *et al.* 2005, Burton and Dadswell 2005, Collins and Scholz 2006). Problems arose again in 2005–06 in NSW, South Australia and Queensland and research support from the Natural Heritage Trust has been directed towards more accurate assays of the toxin and a better understanding of the ecology of the plants.

This paper reports on recent learnings about the ecology, seed viability and herbicide tolerance of the three main plants believed involved – *P. simplex*, *P. trichostachya* and *P. elongata* Threlfall.

DISTINGUISHING THE SPECIES

Most of the 170 species of *Pimelea* in Australia contain the toxin simplexin. However, currently there are three recognised problem taxa at the species level and four if two subspecies of *P. simplex* are counted (NSW Flora Online 2007). Unfortunately taxonomists often find intergrades between these subspecies whose identity is based mostly on the length of the inflorescence rachis. Other taxonomic criteria based on stem colour are also inconsistent and very easily affected by environmental conditions.

In Southern and Central Queensland and Northern NSW, our field observations since October 2006 reveal three taxa with relatively consistent appearance and ecological niches:

- *P. simplex* which has a dense, swollen inflorescence rachis 5–15 mm long, long dense floral hairs and a slightly curved seed tapered at both ends. There seems to be great variability in the degree of hairiness of seeds between regions.
- *P. trichostachya* (Figure 1) which has a thin floral rachis that usually elongates considerably (30–80 mm), hairy flowers (Figure 2) and a pear-shaped, dimpled seed that has a covering of white hairs before falling when ripe.
- *P. elongata* which also has a thin rachis that always elongates to spaced fruits but has no distinct floral hairs, and has a mat of very short, crinkled bristles covering the seed. Its flowers often have a sweet fragrance, especially at dusk, and the seed is pear-shaped like those of *P. trichostachya*.

PLANT HABITATS

Habitat preferences for the three species are as follows:

- *P. simplex* is found on alkaline clay soils, including those with gibbers.
- *P. trichostachya* is found on acidic, sandy surfaced soils or hard-setting loams.
- *P. elongata* is found on slightly acid to neutral soils of varying texture but mostly in ephemeral swamps, lake edges or places with impeded drainage or perched water tables.

If the soil type is appropriate, all are found in roadside table drains, spoon drains and depressions like gilgais when rainfall is inadequate for widespread germination in grazed paddocks. However, it is rare to find the species intermingled within a habitat. It is very rare to find any of them under a woodland or shrubland but they can be found in sizeable openings in the canopy (>10 m across) and under isolated trees.

Figure 1. *Pimelea trichostachya* mature plant.

Figure 2. *Pimelea trichostachya* inflorescence rachis and diaspores (left), *P. elongata* diaspores (centre) and *P. simplex* diaspores and inflorescence rachis (right).

SEED PRODUCTION AND VIABILITY

All species produce lots of flowers. Each tubular floret bears one seed that falls within the floral appendages. Each seed is a nut with a loose outer hairy or pubescent covering, and a thin, tightly-adhering layer beneath that which sticks to the dark dimpled, outer seed wall. There is another single cell layer between the smooth, hydrophobic inner seed wall and the pale embryo sac that encloses the linear embryo within.

During fruit ripening, the true seed wall of a pollinated ovule turns deep blackish-purple within the green membranous layer under the floral tube. Then the embryo sac inflates within the semi-hardened seed coat wall in preparation for embryo enlargement. It is common for the embryo sac to fully inflate within the tough seed coat without the embryo actually maturing. If the plant runs out of soil moisture before the embryo reaches full size, the result can be a normal tough dark dimpled seed coat with only a dry, crumpled embryo sac inside.

The embryo is very soft, moist and easily damaged if the seedcoat wall is fractured or penetrated. Full *P. simplex* diaspores generally weigh over 2 mg; those of *P. trichostachya* 1.3 mg; and *P. elongata* about 1.1 mg each. The freshly shed diaspores are hydrophobic and float high on the surface of water and do not sink readily even if stirred vigorously. However, they are quickly trapped by any surface roughness on soil and, if moistened by rain or dew while in contact with soil, adhere to the soil surface very quickly. They are thereafter quite hard to shift from that spot irrespective of whether the soil is wet or dry. So fresh *Pimelea* seeds can be transported some distance by running water and by wind while dry. Dry seed is readily trapped by surface irregularities and plant litter and hence plants tend to not be found on scalded spots in a paddock.

Freshly ripened seed is impossible to germinate. Treating the seeds (with heat, fire, hot and cold water cycles, scarification) did not improve fresh seed germination. An occasional embryo of *P. trichostachya* that was a few months old and had been removed from its seed coat did have the cotyledons slowly turn green after about seven days in mild, lit conditions and some of those germinated and grew normally. Placing seeds in the field in mesh bags to weather semi-naturally resulted in significant germination of *P. elongata* after two months with a smaller degree of success with

P. trichostachya. This response continued at the three-month sampling time with 70% of retrieved *P. elongata* seeds germinating at 15/25°C compared to <10% for *P. trichostachya* and zero for *P. simplex*. At the same time, seeds from the same original lots that had been kept in laboratory storage would still not germinate at all.

CONTROL WITH HERBICIDE

There are no published data about the herbicide susceptibility of these *Pimelea* species so we conducted two screening trials in the Maranoa region where enough plants had grown in 2007. Preliminary results show that both *P. elongata* and *P. trichostachya* are very susceptible to glyphosate and to common hormone (Group I) sprays like 2,4-D and dicamba. Other herbicides such as Group B Broadstrike® and Raptor® have had little impact on large, well established plants after 1–2 months.

DISCUSSION

An inability to grow pimelea plants for trials is a major hindrance to progress. *P. elongata* is the easiest to induce to germinate but germinability is generally low. Of the few *P. trichostachya* plants that have germinated, many have succumbed to a collar rot of some type before reaching flowering. The three species look quite similar to an untrained person's eye and we now suspect that differing triggers exist to begin germination for each species. This, combined with differing habitat preferences, may be partly to blame for the lack of a consistent pattern surrounding cattle poisonings. There is also the possibility of interactions with associated annual herbs and grasses in the animals' diets that may nullify or exacerbate the inherent toxicity of the *Pimelea* plants.

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