The (flea)bane of reduced tillage systems

Fleabane is now recognised as one of the major difficult-to-control weeds in northern NSW and southern Queensland. For many growers, fallow weed control costs have doubled due to this weed alone. Worse still, no-till farming systems are being threatened by the increasing need for cultivation as a control tactic. Despite this grim outlook, a sensible approach to integrated weed management (IWM) will greatly reduce the impact of fleabane upon crop production.

Knowing the culprit

The fleabane problem is thought to have arisen from recent changes in farming practice. These changes include adoption of no-till farming, a significant reduction in use of group B herbicides in wheat, and the introduction of wide row spacing in sorghum. It is also likely that recent seasonal conditions have further favoured the spread of this problem weed.

Although there are three fleabane species in Australia (flaxleaf fleabane, Canadian fleabane and tall fleabane), flaxleaf fleabane is the most common in dryland cropping systems. It's easy to see why — a single mature flaxleaf fleabane produces an average 110,000 seeds. In addition to being a prolific seed producer, each seed carries its own pappus, or umbrella of light hairs. The pappus enables the seed to be easily lifted and dispersed by wind over great distances. Such seed characteristics make fleabane a major weedy problem.

Emergence of fleabane occurs predominantly over spring/summer, continuing into autumn. Although very limited emergence occurs in mid-winter, young autumn or early-winter seedlings actively grow during winter despite cold and dry conditions. Surprisingly, while there doesn't appear to be much growth above ground, root growth progresses extremely well. Roots grow as deeply as 35 centimetres into the soil to absorb available water. The building of such a strong rooting system during winter provides sufficient food reserve for rapid growth during following spring. These over-wintered fleabane plants are therefore very difficult to control.

This makes it a major weedy problem.

What can be done?

For known infestations of fleabane, tackling the problem in different parts of the cropping system will require a strategic approach based on IWM principles. An IWM approach to fleabane control is similar to that needed for any weed problem, namely:
1. Develop a weed management strategy: in doing so, take care to account for risk of development of herbicide resistance, in particular to Group M herbicides.

2. Aim to maximise competition against weeds: crop rotations such as winter cereals and sorghum can be used in competitive planting configurations to maximise competition against fleabane.

3. Closely monitor fleabane emergence throughout the cropping system: this will ensure adequate treatment of young seedlings and maximise herbicide effectiveness. Small weeds can be covered with stubble.

4. Aim to prevent seed set: carefully select suitable herbicides (Amitrol T for fleabane) and ensure that application is suitably timed.

IWM takes planning and vigilance. Paddocks infested with fleabane will therefore need a weed plan prior to spraying and planting. A good plan must consider the best cropping and planting options, and the role of residual herbicides, tank mixes and pre-harvest sprays.

**Control of small seedlings in fallows**

Herbicide performance depends largely on weed size and growing conditions at spraying. In the last few years, over 180 herbicide treatments have been tested on fleabane in fallows in northern grain region, however, most of these treatments did not achieve consistent effective control. Interestingly, herbicide actions on fleabane plants proved to be extremely slow, with visual herbicide effects appearing as late as one month after treatment application.

Correct timing of herbicide application is essential for a good IWM program. It is crucial to apply herbicides when the plant is small, prior to stem elongation. Control efficacy will decline as plants mature. Unfortunately, putting this simple theory into practice can be a little more complicated: significant rain events can stimulate emergence flushes and result in the simultaneous presence of fleabane at various growth stages. In such instances, plant maturity may range from very small seedlings to large mature plants, thereby making the timely application of herbicides difficult – another good reason why implementation of a fleabane management program should not be delayed.

Recent Queensland Department of Primary Industries and Fisheries (DPI&F) research (partly funded by Grains Research and Development Corporation) showed that glyphosate alone is normally ineffective, except on very small weeds. As plants matured, control was reduced from 88\% mortality for weeds 5cm in diameter to 13\% mortality for weeds 10cm in diameter or larger. However, a number of unregistered glyphosate mixes provided better control of young plants at the rosette stage. Suitable mixing partners to glyphosate include 2,4-D ester, Grazon DS, Tordon 75D, Ally, and Surpass. Atrazine also provided residual control of several flushes. Split applications of glyphosate followed by Spraysure or paraquat were also very effective. These follow-up treatments need to be applied at higher water volumes. When choosing the tank mixture with glyphosate, plant-back periods and crop rotation need to be taken into consideration.

**Preventing seed set**
Prevention of seed set of weed survivors is an integral part of weed management. Our research has shown that Amitrole T could be strategically used as a late treatment to target mature survivors. Although it did not completely kill the plant, its damaging effects on elongated shoots and flowering heads could substantially reduce the replenishment of new seeds into the soil. Late application of glyphosate to flowering plants also seems to be effective in sterilising seeds.

**In-crop options**

Good in-crop control of fleabane is believed to greatly reduce the problem in the following fallow. As fleabane is thought to be susceptible to sulfonylurea and triazine residual herbicides, a sulfonylurea herbicide could be applied in-crop for wheat. This may be followed or mixed with Tordon 242, or 2,4-D amine. Late flushes in spring could be treated with a pre-harvest spraying of 2,4-D amine after the wheat dough stage.

Due to emergence patterns, fleabane is likely to be a problem in spring-sown sorghum grown in wide rows. Effective management options need to be properly planned and implemented. Prior to sorghum, winter fallow flushes should be treated with glyphosate + Surpass, which could be followed by Spraysed or paraquat to control survivors. Early spring flushes could be treated with atrazine + 2,4-D or atrazine + Spraysed prior to planting sorghum, or atrazine + glyphosate at planting. Later flushes in-crop should be treated with atrazine + Starane or atrazine + 2,4-D with shielded sprayer or boom with droppers. The atrazine is likely to provide some residual control of seedlings.

If chickpea is grown, fallow treatment with Flame and in-crop treatment with Balance + Simazine are thought to be reasonable options.

If dryland cotton is grown, treatment combinations of diuron, fluometuron and prometryn followed by inter-row cultivation or chipping are thought as possible control options.

**Non-chemical control options**

Fleabane flourishes in bare fallow, cropping gaps, or in poorly competitive crops. Growing more competitive winter cereals and avoiding the use of skip rows in sorghum should therefore be seen as an important part of sustainable weed management packages. Winter cereal should be sown at optimum seeding rates in rows <35cm. Conversely, less competitive crops such as chickpea, dryland cotton and sunflower should be avoided in paddocks heavily infested with fleabane.

There is potential for the strategic use of tillage to control mature and stressed weeds. This would be useful in fallows and for inter-row cultivation in wide row crops such as sorghum and cotton. Cultivation is not likely to reduce subsequent fleabane emergence, unless the tillage operation inverts the soil to bury seed below 2 cm.

**Herbicide resistance**

Alarmingly, overseas reports have shown that biotypes of fleabane species have evolved resistance to a range of herbicides across different groups, particularly to glyphosate. The wide spread of glyphosate resistance in Canadian fleabane in the
USA and the first report of flaxleaf fleabane resistant to glyphosate in South Africa in 2003 have raised great concern in our cotton and grain industries.

Although herbicide resistant biotypes of flaxleaf fleabane have not yet been documented in Australia, a preliminary study indicated that a population has developed resistance to glyphosate in the Goondiwindi region. This is a somewhat controversial issue, as some believe that the weed has become more difficult to control with glyphosate over time, whereas others consider that fleabane has always been difficult to control with glyphosate alone.

There is a need to clarify whether or not the flaxleaf fleabane is naturally tolerant to glyphosate, and if there are any differences in herbicide tolerance between populations. The presence of any resistance to glyphosate also needs to be confirmed. These are study areas to be addressed in a PhD project funded by Australian Weeds CRC.

Current research
In response to the fleabane problem, the Queensland DPI&F hosted a national workshop on fleabane in February 2004. The workshop brought together industry experts to compile and examine all available research on the weed. In doing so, the workshop team identified which areas of scientific knowledge of fleabane were lacking. This enabled the team to prioritise future research efforts and resulted in a draft management strategy. Proceedings from the workshop are available from the website of the CRC for Australian Weed Management.

The DPI&F continues with its fleabane research. Current studies are examining effective control options using both post-emergent and residual herbicides in winter fallow, wheat and sorghum. These experiments aim to optimize fleabane management in rotational crops and fallows with dryland cotton, thereby reducing fleabane infestation in cotton crop. In addition, studies are investigating seed persistence, germination requirement, and emergence patterns. The next phase of research will focus on control options in summer fallow prior to cropping with dryland cotton.

Conclusion
The success of fleabane is attributed to prolific seeding, its ability to emerge throughout the year, and its relative tolerance to herbicides due to its hairy characteristics. It is important to closely monitor flushes to ensure timely application and to maximise herbicide performance. The best long-term management strategy for fleabane control is to treat weeds early and to reduce soil seedbank by effective control of weed survivors. Crop rotations and planting configurations should be managed to maximise competition against fleabane. An IWM program would need to be implemented in order to prevent or retard fleabane resistance to herbicides.

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THE COMMERCIAL VIEW

Recent commercial experience has shown a ‘double knock’ herbicide application of glyphosate followed by 2,4,D amine or Sprayseed is providing relatively consistent fleabane results with use of atrazine during the winter fallow also providing good benefits when leading in to a summer crop.

The Grains Research and Development Corporation (GRDC)-funded Northern Grower Alliance’s (NGA) chief executive officer, Richard Daniel says a strategic cultivation may also be a tool we need to consider for problem fields.

“Fleabane is a small-seeded weed that wasn’t a problem in our farming system until the increased popularity of minimum or zero till. Cultivation may provide two benefits. Firstly, it can be used in situations where there are high numbers of advanced weed stages to achieve effective control. Secondly, research has shown the seed requires exposure to light to enable germination, so incorporation can reduce weed establishment. However there are a number of disadvantages to using cultivation so it is unlikely to be a first choice option.”

“Historically growers and agronomists have had great difficulty getting consistent and effective control of large fleabane plants during fallows,” Richard said.

“If you are having trouble controlling a pest in one stage of the life cycle it is always worth looking at control options at other stages.”

“Although fleabane generally causes most problem in the summer fallow, a large proportion of the problem is driven by what happens in the winter,” Richard said.

“It comes up with the winter crop as a small and insignificant weed and quite often isn’t noticed until after the crop is harvested.

“Headers cut the top off the fleabane and suddenly when the grower inspects the fallow a couple of weeks later they find weeds that are about 15-20 centimetres tall and tough and woody.”

Richard said GRDC-funded collaborative trials by NSW DPI and Northern Grower Alliance in 2006 included a core group of six common treatments in all trials conducted at Bellata and Biniguy (both winter herbicide knockdown sites) and at North Star (a winter herbicide residual control site).

“Queensland Department of Primary Industries and Fisheries (DPI&F) data from 2004 and 2005 showed winter crop herbicides hold some promise for controlling the weed before it gets out of control and this has been supported by anecdotal commercial usage,” Richard said.

“The overall intention is to validate a variety of management options that growers can pick and choose from to provide the best management package for their individual farming approach”

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