Northern IWM fact sheet

Flaxleaf fleabane

A weed best management guide

This difficult-to-control weed can be managed by applying a combination of chemical and non-chemical tactics in the cropping and fallow phases. However, this requires diligent monitoring and a focus on controlling sprayed survivors. This approach will drive the seed bank down to very low numbers within several years, with few problems in following years. To achieve this, consider the following key aspects of management.

Key messages

- Flaxleaf fleabane is very susceptible to several residual herbicides that can be used in fallows and a range of crops.
- A strategic soil disturbance can create a soil environment unfavourable for germination.
- Small, actively growing weeds should be targeted—weed age and, to a lesser extent, moisture stress have a substantial adverse impact on efficacy of knockdown and selective herbicides.
- The mix of glyphosate and 2,4-D (Amicide Advance 700®) or picloram + 2,4-D (Tordon 75-D®) effectively controls low-density infestations of young flaxleaf fleabane in fallows.
- The double-knock tactic is needed for controlling dense infestations, especially if the weeds are more than 1 month old in fallows.
- Several selective Group I herbicides provide good control of young flaxleaf fleabane in wheat.
- Crop competition suppresses flaxleaf fleabane growth and seed production.
- Good on-farm hygiene needs to be maintained, with emphasis on controlling flaxleaf fleabane in areas surrounding paddocks to prevent new incursions.

The problem

Flaxleaf fleabane (*Conyza bonariensis*) is a major cropping weed in southern Queensland and northern New South Wales. It is also emerging as a problem in other cropping regions of Australia. For many growers, fallow weed control costs have increased markedly due to this weed alone, and some zero-till farmers have needed to reintroduce cultivation as a last-resort control tactic. Uncontrolled flaxleaf fleabane, even at a low density, has reduced sorghum yields by 60% to 100%.

Furthermore, populations of flaxleaf fleabane have been confirmed recently as being resistant to glyphosate. These populations were found in zero- or minimum-tilled paddocks in southern Queensland and northern New South Wales. As well, glyphosate-resistant populations were identified along roadsides near these cropping paddocks.

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Despite this, a strategic approach using integrated weed management (IWM) will greatly reduce the impact of flaxleaf fleabane upon crop production. The key to getting on top of flaxleaf fleabane is to attack all parts of the weed life cycle and keep the seed bank low. Adopting an IWM strategy, which includes chemical and non-chemical tactics for controlling seedlings and preventing seed production on survivors, will result in substantially fewer flaxleaf fleabane problems and resistant populations in the future.

Know the enemy

Description

Although there are seven *Conyza* species naturalised in Australia, flaxleaf fleabane is the most widespread and the only one found in a recent survey of cropping paddocks in northern New South Wales and southern Queensland.

Flaxleaf fleabane grows up to 1 m in height and has erect multiple-branching stems covered with stiff hairs. Leaves are grey-green, deeply indented, coarsely toothed and covered in fine hairs. Its branches often grow taller than the main plant axis .

This contrasts with tall fleabane (*C. sumatrensis*), commonly found in roadsides and horticultural and other non-cropping areas, which grows up to 2 m and has a single stem with a pyramid-shaped inflorescence. Its leaves are less indented than flaxleaf fleabane and its branches do not grow taller than the main plant axis (Figure 1).

Flaxleaf fleabane has a smoothly pitted receptacle (stalk of the flowering head), while tall fleabane has a roughly pitted receptacle. Both species are characterised by the production of fluffy, cream seed heads.

Figure 1. *Flaxleaf fleabane (top) and tall fleabane (bottom)*

Emergence

Flaxleaf fleabane emerges when temperatures are between 10 and 30 ˚C, with the optimal temperature around 20 to 25 ˚C. Seed will only germinate in the presence of light, and seedlings will emerge only from the top 1 cm of soil, explaining partly why this weed proliferates in zero-tilled systems (Figure 2). Some seedlings can emerge under low light conditions, such as under dense stubble.

In southern Queensland, flaxleaf fleabane emerges predominantly in autumn, early winter and spring. There may be limited emergence if conditions are mild during mid-winter and early summer.

Figure 2. *Flaxleaf fleabane seedlings emerging in zero-tilled fallow*

Figure 3. *A mature flaxleaf fleabane flowering prolifically*

While seedlings that emerge in autumn grow slowly above-ground during winter, roots continue to grow deep into the soil to absorb available water. The building of such a strong root system during winter provides sufficient food reserve for rapid growth during the following spring. These over-wintered flaxleaf fleabane plants are therefore more difficult to control.

Seed production

A single mature flaxleaf fleabane plant can produce an average of 100 000 seeds (Figure 3)! Each seed carries its own pappus, or umbrella of light hairs. This enables the seed to be easily lifted and dispersed by wind over considerable distances.

Such seed characteristics make flaxleaf fleabane a major weed problem, and highlight the importance of controlling all plants (including adjacent non-crop areas) to prevent major replenishment of the seed bank.

Seed persistence in soil

The majority (90–95%) of flaxleaf fleabane seeds lose their viability within 12 to 18 months in the surface soil. However, a small percentage can persist for several years, particularly if seeds are buried 2 to 5 cm below the surface.

Resistance to herbicides

Many populations of flaxleaf fleabane in the cropping areas of southern Queensland and northern New South Wales have developed resistance to glyphosate (Figure 4). Small rosettes of glyphosate-susceptible plants can be controlled well with glyphosate alone, unlike glyphosate-resistant seedlings. Irrespective of resistance status, mature plants are very difficult to control with glyphosate alone and need other management tactics.

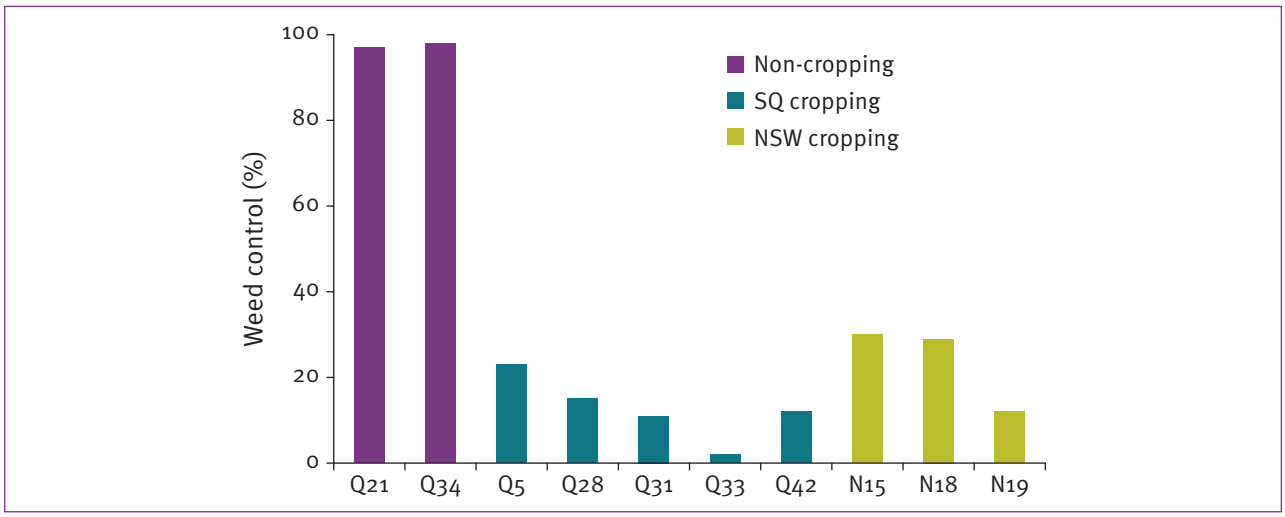

Figure 4. *Control of flaxleaf fleabane seedlings treated with field rate of glyphosate. Seedlings were grown in a glasshouse from seed collected from non-cropping areas and cropping paddocks in southern Queensland (SQ) and northern New South Wales (NSW)*

Management strategies

For paddocks infested with flaxleaf fleabane, tackling the problem will require a strategic approach based on good agronomy and integrated weed management (IWM) principles.

Successful IWM depends on having a flexible plan that is based on a good understanding of the target weed and that uses a mix of weed control tactics. Key aspects of the IWM approach include the following.

- Benchmark the current flaxleaf fleabane and paddock situation—weed density and distribution, and herbicide history.
- Closely monitor flaxleaf fleabane emergence throughout the cropping system to ensure effective treatment of young seedlings.
- Use a variety of chemical and non-chemical tactics.
- Rotate between different herbicide groups, or tank mix with effective herbicides from different mode of action groups—it is important to use robust rates for both herbicides in the mix.
- Aim for maximum effectiveness to keep weed numbers low—the primary aim of weed control is to minimise their impact on productivity, and resistance is much less likely to develop in paddocks with fewer weeds than in heavily infested paddocks.
- Ensure survivors do not set seed and replenish the soil seed bank—consider using the double-knock tactic, particularly for dense infestations or larger weeds.
- Avoid introducing or spreading flaxleaf fleabane, and manage this weed in surrounding non-crop areas to minimise the risk of seeds moving into adjacent paddocks.
- Review the control achieved, and adjust future management strategies accordingly.

Control tactics

For optimal control of flaxleaf fleabane, we recommend targeting all parts of the weed life cycle. An IWM strategy, which combines chemical and non-chemical tactics to deplete the seed bank, control seedlings, stop seed production and seed rain, and prevent introduction of new seeds, will significantly reduce the impact of this weed problem.

Seed bank depletion

Research has shown that a number of residual herbicides give good control of flaxleaf fleabane seedlings for several months in fallow, at pre-plant and during the crop phase.

Most residuals do not control emerged flaxleaf fleabane. Therefore, these herbicides need to be applied to a clean paddock; otherwise they can be applied following, or mixed with, an effective knockdown herbicide or double-knock.

The Group C triazine herbicide was very effective when applied in a winter or early spring fallow prior to sorghum when rainfall was received within 1 to 2 weeks of spraying. This is because rainfall is needed to incorporate the herbicide into the soil to control germinating seed. This residual herbicide at robust rates provided excellent control throughout the spring fallow and early sorghum crop (Figure 5).

Figure 5. *Excellent residual control from Group C triazine herbicide (right) applied following a double-knock in spring fallow prior to sowing sorghum, compared with untreated (left)*

As well, the Group C urea (used prior to cotton), Group B sulfonylurea (used prior to wheat) and Group H isoxazole (used prior to chickpea) were very effective in reducing emergence for several months. Figure 6 shows the level of control achieved for 6 months when these residuals were mixed with the double-knock of glyphosate + 2,4-D or glyphosate + Tordon 75-D®.

Interestingly, there was good residual control with the Tordon 75-D® component of the double-knock, providing 88% control over approximately 6 months.

Research is underway investigating options for residual control in cotton rotations.

Research has also shown that tillage operations alter the distribution of flaxleaf fleabane seeds in the soil profile and consequently reduce the number of seedlings emerging. One harrow operation reduced emergence compared to zero till by approximately 90% (Figure 7).

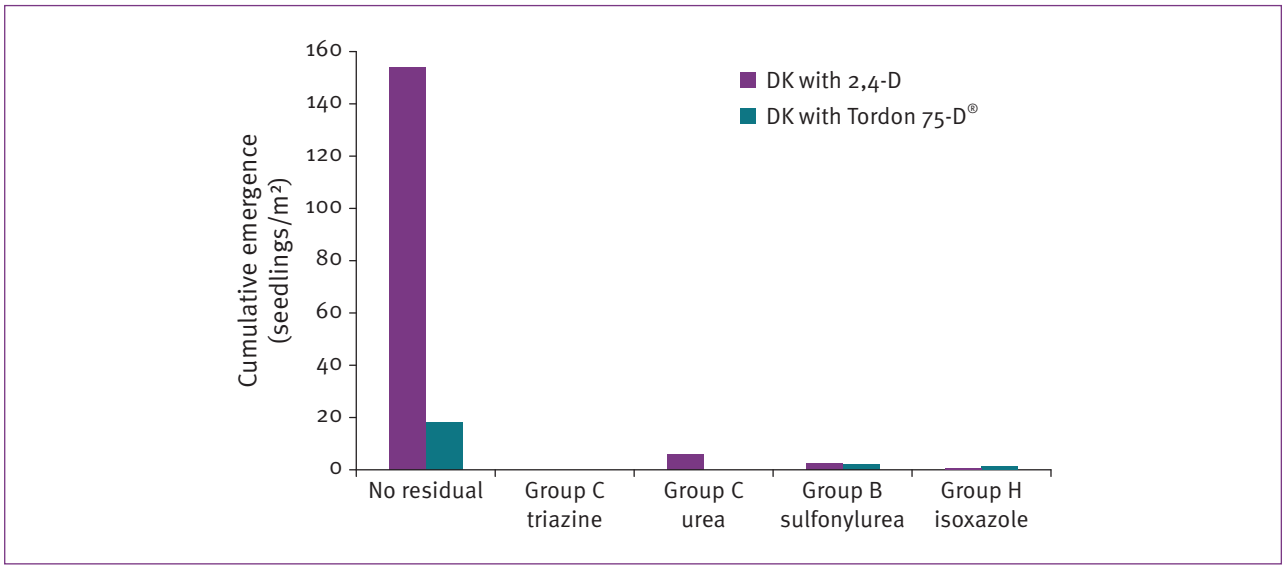

Figure 6. *Cumulative emergence of flaxleaf fleabane over 6 months following application of a double knock (DK) using glyphosate + 2,4-D or glyphosate + Tordon 75-D® followed by a residual mixed with Spray.Seed® in the second knock 7 days later*

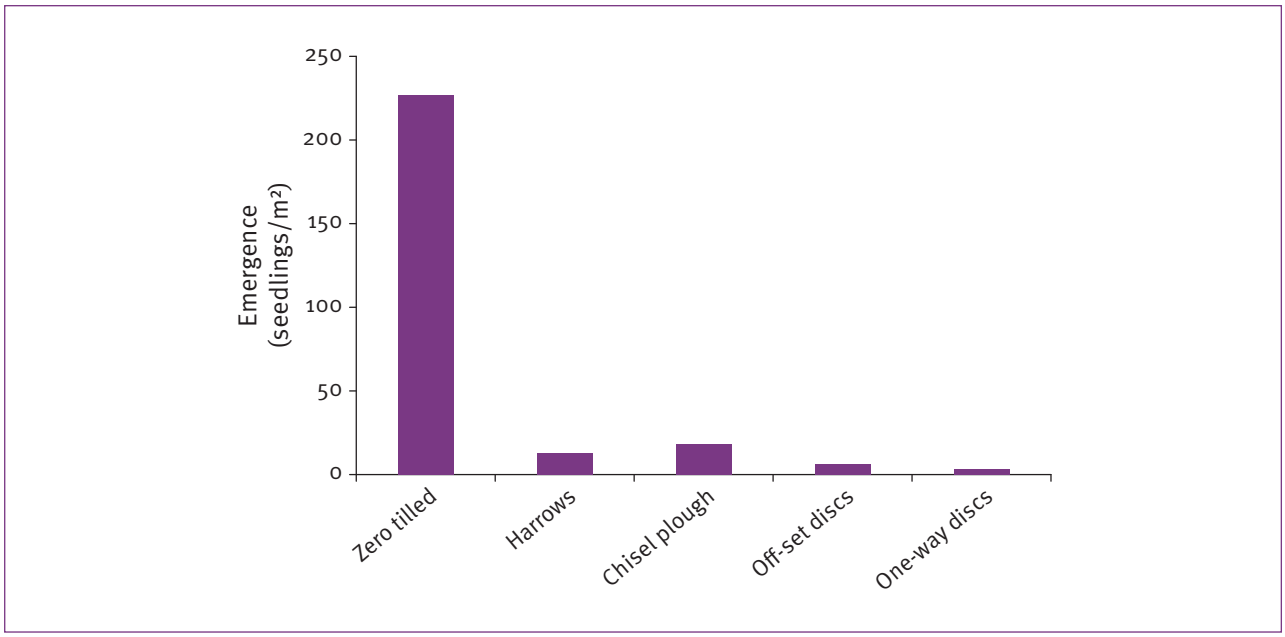

Figure 7. *Impact of different tillage operations on subsequent emergence in field*

Rosette control in fallows

Several herbicides, mixes and sequential applications (double-knock) provide good seedling control, but herbicide performance depends largely on weed size, age, density and growing conditions at spraying. Several herbicides, such as Amitrole®, are slow acting, with visual symptoms appearing as late as 1 month after application and death at 6 to 8 weeks.

Correct timing of herbicide application is essential for effective flaxleaf fleabane control. It is crucial to apply herbicides when the plant is a small rosette, preferably 5 cm in diameter or smaller, and definitely prior to stem elongation, as control efficacy declined as plants mature. Table 1 includes the range of registered herbicides and shows that overall efficacy was reduced from 92% on 1-month-old weeds to 77% on 3-month-old weeds. Figure 8 shows that control was reduced with glyphosate mixes when 2-month-old weeds were treated, but improved control was achieved using the double-knock. Best control was achieved by applying the double-knock tactic to younger plants.

The commonly used treatment of glyphosate + 2,4-D provided good control of young rosettes, but efficacy was variable. Research by the Northern Grower Alliance showed that a short (2 hour) split between the glyphosate and 2,4-D applications reduced efficacy significantly. However, the addition of an oil-based adjuvant to the glyphosate + 2,4-D mix increased efficacy on flaxleaf fleabane, although this reduced grass control due to the antagonism from mixing the 2,4-D with the glyphosate.

The most consistently effective treatments were the double-knocks (sequential application), particularly with glyphosate + Tordon 75-D® followed 7 days later with Spray.Seed® (paraquat + diquat).

For these fallow treatments to be effective, robust rates are needed (as well as high water volumes of around 100 L/ha for paraquat products), particularly for dense populations and high stubble levels.

Optimum follow-up times for Spray.Seed® and paraquat products are 5 to 10 days after glyphosate application. A shorter interval is likely to result in reduced efficacy resulting from insufficient time for the first knock to move and act within the plant. The adverse impact of a longer interval may be compensated for by increasing rates of the second knock.

Full control of flaxleaf fleabane throughout the winter fallow can greatly minimise infestations in following spring-sown crops.

Table 1. *Efficacy of knockdowns in four winter fallow field experiments, measured at 6 weeks after treatment, when applied to 1- and 3-month-old weeds. The range of efficacy across the experiments is in brackets.*

Herbicide	Weed control (%)			
	1-month-old weeds		*3-month-old weeds*	
Glyphosate + 2,4-D	84	(62–100)	76	(63–96)
Glyphosate + Tordon 75-D®	93	(86–99)	84	(62–98)
Glyphosate + 2,4-D fb Spray.Seed®	96	(93–100)	93	(87–97)
Glyphosate + Tordon 75-D® fb Spray.Seed®	99	(97–100)	97	(92–100)
Glyphosate + 2,4-D fb Alliance®	96	(92–99)	90	(78–100)
2,4-D fb Spray.Seed®	97	(97–98)	83	(68–97)
2,4-D#	88	(81–95)	53	(48–57)
Amitrole®#	90	(84–95)	96	(95–97)
Spray.Seed®#	84	(78–89)	22	(13–30)
Mean	**92**		**77**	

fb = followed by a 7-day interval
 # = applied in only two of the four field experiments

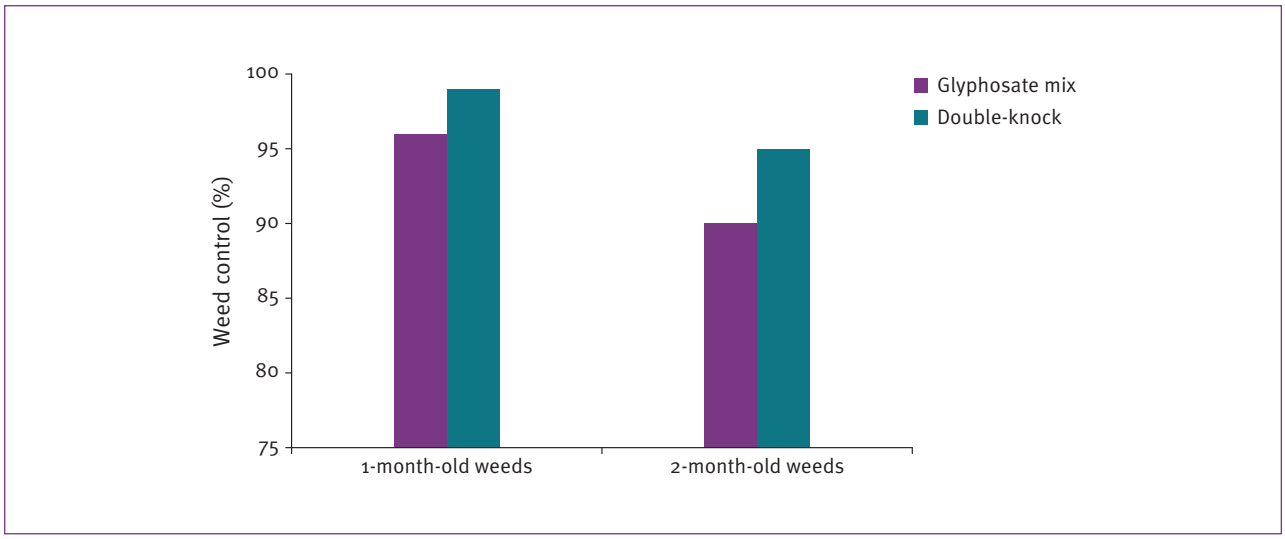

Figure 8. *Impact of weed age and sequential application of second knock of Spray.Seed® following four different glyphosate mixtures on flaxleaf fleabane efficacy as measured at 4 weeks after treatment*

Rosette control in-crop

Good in-crop control of flaxleaf fleabane will also greatly reduce the problem in the following fallow.

Research has shown that flaxleaf fleabane is susceptible to 2,4-D and several other Group I (phenoxy and pyridine) and Group B (sulfonylurea) herbicides, which are used in wheat. These would be useful for controlling the late autumn and early winter flushes.

In a pot experiment, the Group I herbicides gave excellent control (95–100%) when small or young weeds were treated under optimal soil moisture conditions. Efficacy tended to be reduced by an average of 8% when young weeds were moisture stressed at spraying. However, when treating older weeds, particularly moisture-stressed ones, control was reduced to 57% (Figure 9).

Similarly, in the field, overall efficacy of 11 Group I and Group B herbicides was reduced from 87% to 48% control by delaying spraying by 2 weeks due to increased weed age and moisture stress (Table 2).

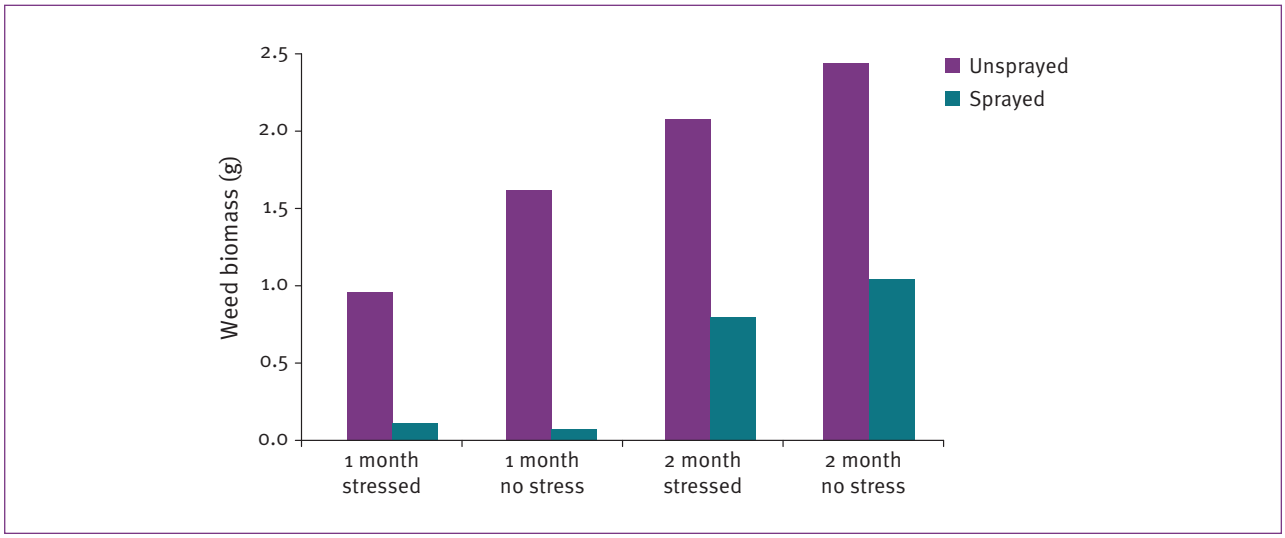

Figure 9. *Impact of weed age (1- and 2-month-old weeds) and soil moisture (40% and 80% of field capacity) on efficacy on wheat selective herbicides in a pot experiment*

Table 2. *Weed control with a Group B (sulfonylurea) and several Group I (phenoxy and pyridine) herbicides in wheat when applied at two weed ages in two field experiments. Means with range in brackets are presented. Most are currently not registered for flaxleaf fleabane control, apart from Amicide Advance 700® (2,4-D amine)*

Herbicide	Weed control (%)			
	Age 1 (4 weeks)		*Age 2 (6 weeks)*	
2,4-D amine	90	(82–98)	87	(83–91)
Sulfonylurea	82	(76–87)	38	(4–72)
Group I (i)	92	(89–95)	46	(0–92)
Group I (ii)	89	(85–93)	47	(6–88)
Group I (iii)	75	(62–87)	85	(78–92)
Group I (iv)	81	(77–84)	53	(44–62)
Group I (v) + sulfonylurea	84	(82–86)	56	(35–77)
Group I (i) + Group I (v)	84	(76–93)	60	(50–70)
Group I (ii) + Group I (v)	74	(71–77)	69	(57–80)
Group I (iii) + sulfonylurea	83	(82–84)	85	(73–96)
Group I (iv) + 2,4-D amine	84	(83–86)	57	(28–86)
Mean	**83**		**62**	

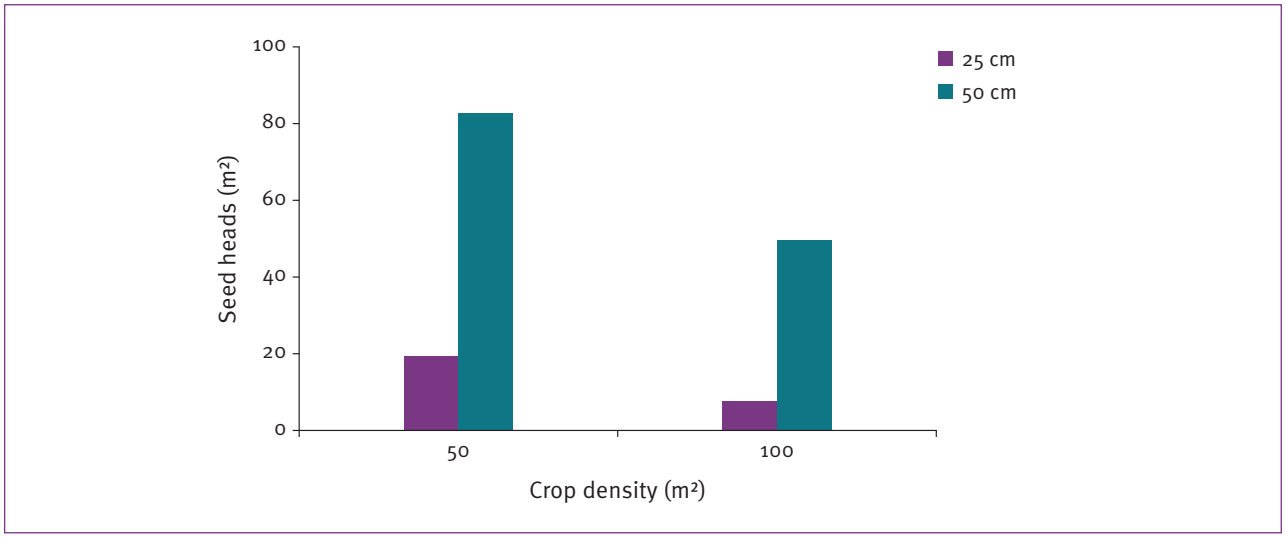

Figure 10. *Impact of crop competition on the number of flower heads in wheat at two row spacings and two crop populations*

Stopping seed production and seed rain in fallows and crops

All knockdown or selective in-crop treatments do not give 100% control consistently. As prevention of seed set on survivors is essential for an IWM plan, follow-up actions are therefore needed.

As mentioned earlier, the sequential application of Spray.Seed® or paraquat products as part of the double-knock tactic can be highly effective on controlling rosette survivors in the fallow. This tactic can achieve close to 100% weed control, thus significantly reducing the impact on following crops.

Crop competition is another useful tactic to suppress flaxleaf fleabane growth and seed production of sprayed survivors, particularly in a winter cereal. Figure 10 shows the 90% reduction in number of flaxleaf fleabane heads when wheat was grown in narrower rows and higher population densities.

However, it is very difficult to control well-established flowering plants, and thus stop seed production. These situations result from ineffective control of weeds at the rosette stage as well as delays in applying treatments. Also, late flushes in a winter crop can flourish under wet spring conditions and may flower prior to harvest.

Research undertaken by the Northern Grower Alliance has not identified any reliable fallow knockdown treatment, with control of only 40% to 80% achieved when applied to flowering flaxleaf fleabane. Again, follow-up action was needed with the second knock, although full control was not achieved.

Weed detection spray technology has an important role in enabling growers to apply knockdown herbicides and the double-knock tactic using robust rates to isolated plants and survivors. A range of herbicides is now registered for this technology in New South Wales and may be available in Queensland soon.

Preventing new seeds entering from outside

It is important to control flaxleaf fleabane in areas surrounding cropping paddocks as some seeds can move several hundreds of metres. The same control tactics used in fallows, double-knocks followed by residual herbicides at robust rates, have been shown to be very effective to keep fence line areas weed-free for a season.

Further reading

Journal papers

Walker SR, Bell K, Robinson G and Widderick M (2011) Flaxleaf fleabane (*Conyza bonariensis*) populations have developed glyphosate resistance in north-east Australian cropping fields. *Crop Protection* 31, 311–317.

Werth JA, Walker SR, Boucher LR and Robinson GR (2010) Applying the double knock technique to control flaxleaf fleabane (*Conyza bonariensis*). *Weed Biology and Management* 10, 1–8.

Wu H, Walker S, Robinson G (2008) Chemical control of flaxleaf fleabane (*Conyza bonariensis* (L.) Cronquist) in winter fallows. *Plant Protection Quarterly,* 23, 162–165.

Wu H, Walker S, Robinson G and Coombes N (2010) Control of flaxleaf fleabane (*Conyza bonariensis* L. Cronq.) in wheat and sorghum. *Weed Technology* 24, 102–107.

Wu H, Walker S, Rollin M, Yan D, Robinson G, Werth J (2007) Germination, emergence and persistence of flaxleaf fleabane (*Conyza bonariensis*). *Weed Biology and Management* 7, 192–199.

Proceedings of national workshops

Department of Primary Industries and Fisheries (2007) *Management of flaxleaf fleabane: proceedings of a workshop held at DPI&F in Toowoomba in 2007*, DPI&F, Brisbane ‹http://tools.cotton.crc.org.au/Assets/PDFFiles/WEEDpak/Fleabano7.pdf›.

Department of Primary Industries and Fisheries (2007) *Fleabane: proceedings of a workshop held at DPI&F in Toowoomba 25th February 2004*, DPI&F, ‹http://pandora.nla.gov.au/pan/64168/20080620-0000/www.weeds.crc.org.au/documents/fleabane_proceedings%20_mar_04.pdf›.

Other references

Other articles and reports on flaxleaf fleabane can be downloaded from the GRDC website ‘Weedlinks’ ‹www.grdc.com.au/director/events/linkpages/weedlinks?shortcut=1#Flaxleaf%20fleabane›.

More information

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