Northern IWM fact sheet

Feathertop Rhodes grass

A weed best management guide

Figure 1. *Fallow paddock heavily infested with feathertop Rhodes grass. Chemical control at this growth stage can be very difficult*

Figure 2. *Feathertop Rhodes infestation in sorghum in Central Queensland*

Key messages

- Feathertop Rhodes (FTR) grass requires an integrated and intensive management approach; there are no silver bullets for easy management.
- Seed set must be stopped or minimised to break the life cycle and reduce future weed burdens.
- Large weeds (›10 cm, tillering or with seed heads) are very difficult to kill with knockdown herbicides.
- Small, actively growing weeds (‹5 cm, pre-tillering) should be targeted when using post-emergence herbicides.
- The double-knock tactic is very effective, particularly with a Group A herbicide followed by a Group L herbicide. The knock interval should be at least 7 days for maximum effectiveness; adding residual herbicides to the second knock may improve the Group L knockdown.
- The effectiveness of pre-emergence herbicides (residuals) can be maximised by applying them when the soil surface has very little or no weed cover.
- Escapes and survivors should be monitored and spot treated as soon as possible.
- Strategic tillage, to bury seed or control large plants, has a role to play but may not suit all situations.
- Competitive crops and cultivars should be planted, and narrow row spacings and high crop populations used where possible.
- Crops that allow the use of the grass-active Group A ('fops' and 'dims') herbicides offer alternatives to glyphosate and allow for herbicide group rotation; the fops appear to better than the dims.
- Crops should be planted into weed-free soil and pre-emergence herbicides used. Weeds should be treated in-crop with post-emergence herbicides (over-the-top or shielded boom) or inter-row tillage if required.

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Queensland Government

Where and why is feathertop Rhodes grass a problem?

Feathertop Rhodes (FTR) grass is a major weed in broadacre cropping systems in Central Queensland (CQ), the Darling Downs and Western Downs regions of southern Queensland, and in northern New South Wales. A recent scoping study of coastal and northern Queensland cropping revealed FTR to be a main weed in those farming systems as well. Interstate inquiries indicate it is also a problem in the vineyards and orchards of South Australia, and in parts of the Western Australian grain region. FTR has proven very difficult to control.

Previously a weed of roadsides, fence lines and wasteland areas, FTR has now become an issue in cropping country, particularly where minimum or zero tillage has been practiced for several years. It is not overly susceptible to glyphosate herbicide, particularly after the early tillering stage. The prolonged use and reliance on glyphosate in the fallows of these cropping systems has assisted with a species shift towards this grass. For the same reason, FTR has also recently become an issue in glyphosate-tolerant cotton systems. With minimal disturbance, the seed remains in the upper soil surface, which is ideal for emergence and perpetuation of the weed. Dry conditions have made management difficult, allowing seed bank build-up. Very wet seasons have been associated with substantial field population increases. While FTR has a preference for lighter textured soils, it will also survive on heavier clay soils.

Know the enemy

Description

FTR (*Chloris virgata* Sw.) is a tufted annual grass up to 1 m tall with erect and semi-prostrate branched stems capable of rooting at the joints. Leaf blades are bluish green, 5 to 25 cm long and 3 to 6 mm wide. The seed heads or panicles have 7 to 19 feathery, white-silver spikes that are 3 to 9 mm long. The feathery appearance comes from the stiff white hairs and awns arising from the seeds. Unlike common Rhodes grass, FTR panicles tend to remain unsplayed and pointing upwards. Seedlings are erect but with flattened stem bases, and this flattening becomes more obvious in older tillers. Leaf blades have tufts of hairs along the margins and where the blade joins the sheath. The stem joints are hairless and sometimes very dark. In the early growth stages, FTR can be easily confused with awnless barnyard grass (*Echinochloa colona*).

Figure 3. *Early tillering FTR plants (approximately 5 cm tall). Note the stem bases have a flattened appearance*

Figure 4. *Mature FTR plants*

Seed behaviour

Being an annual in most situations, FTR's dynamics are driven through the seed. Manage the seed production and recruitment, and effective control will eventuate.

CQ research trials and growth cabinet studies examining germination, field emergence, persistence (viability and dormancy over time) and the effect of burial depth on fresh FTR seed have shown that:

- Germination occurs across temperatures of 20 to 30 °C but a preference is shown for 25 °C and above with exposure to light.
- Seed has an innate dormancy, requiring an after-ripening period of approximately 6 to 10 weeks. While pre-chilling assists in breaking dormancy, it is not essential.
- Approximately 25% of seed produced is non-viable (dead or incomplete), but this may vary and be influenced by growing conditions before and at seed maturation.
- Seed appears to be short-lived (about 7 to 12 months) irrespective of burial depth, suggesting short field persistence (Figure 5); seed exhumed from depth after being buried for 12 months did not germinate even after several dormancy-breaking mechanisms were applied.
- The majority of field germinations occur from the 0 to 2 cm seed burial depth; over 12 months 47% of seed buried near the surface germinated, compared with 5% at 5 cm and 0% at 10 cm depths.
- The cumulative germination of the seed bank at or near the surface over a 12 to 18 month period (total recruitment or emergence) ranged from 25% to 50% in three separate studies, with the majority of the recruitment occurring within the first 7 months (Figure 6).

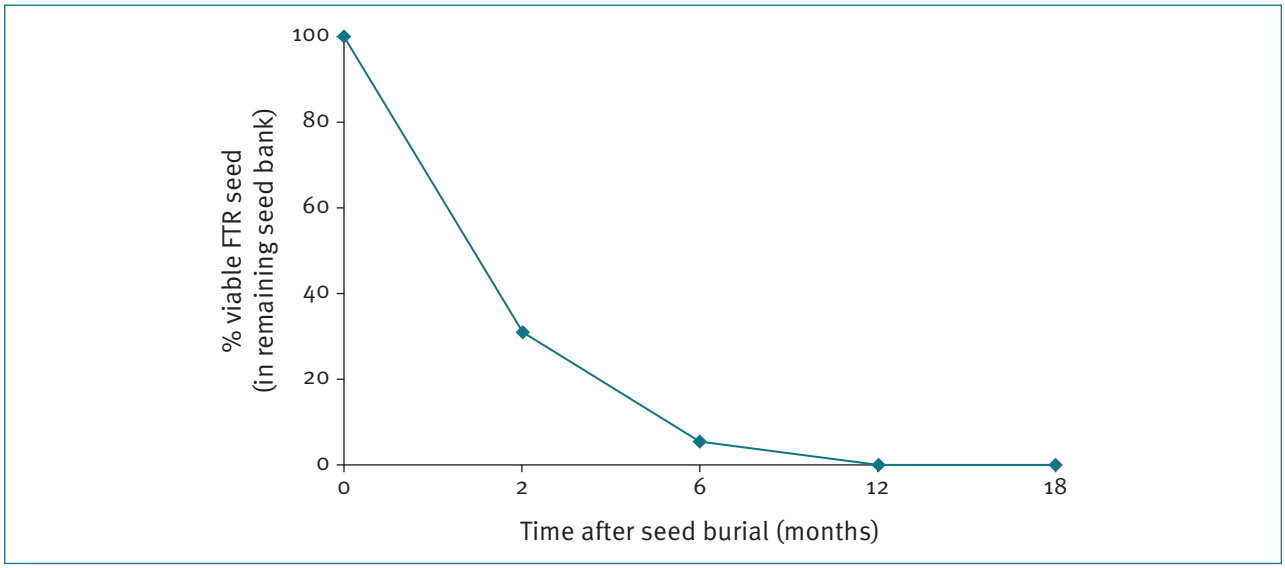

Figure 5. *FTR seed bank viability over time in the CQ environment*

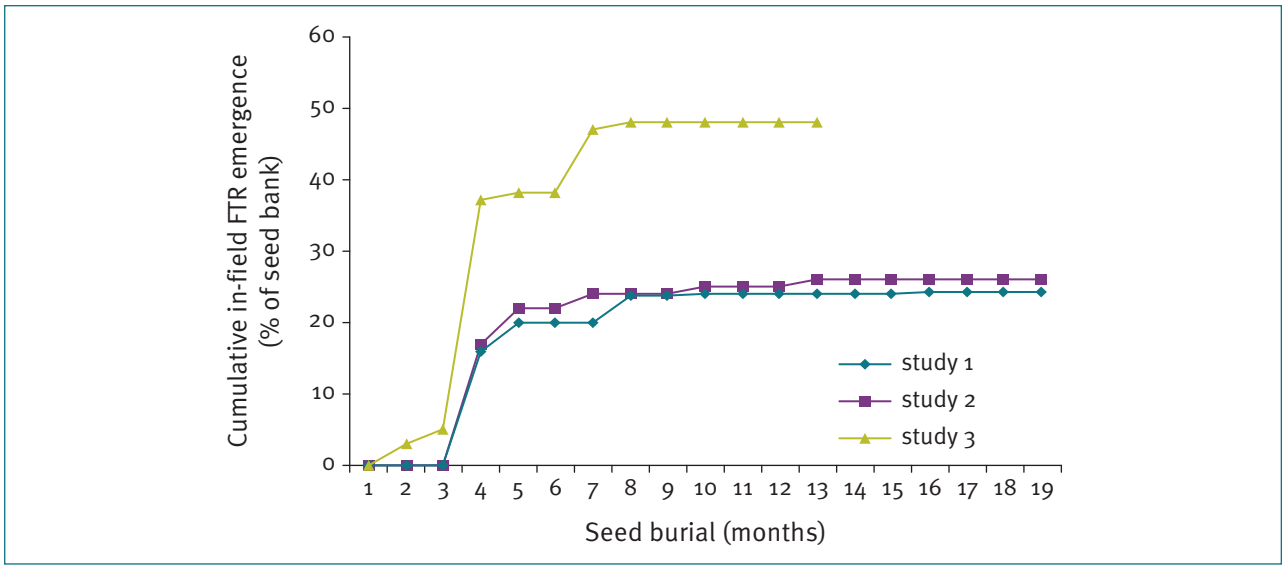

Figure 6. *Cumulative in-field emergence of FTR (expressed as a percentage of the seed bank) from seed buried in the surface 2 cm of soil (studies 1 and 2 used seed from the same source; all studies started at the end of summer)*

Implications for management

Be prepared and consider the following when developing a management plan for FTR (based on CQ research):

- FTR's very shallow or surface germination requirement means it will most likely be a problem in zero-till paddocks compared to disturbed paddocks.
- FTR is likely to germinate year-round in CQ but with preference for the period between spring and autumn. Mild wet winters will also produce recruitments in CQ.
- There should be limited immediate recruitment from freshly shed seed due to the after-ripening requirement, although the condition of the mother plant during seed set may determine dormancy levels and after-ripening requirements.
- Seed shed during late autumn will receive immediate pre-chilling (going into winter) thus breaking dormancy and allowing germination on the first spring rains.
- Burying the seed deeper than 5 cm and leaving it deep and undisturbed for at least 12 months will stop seedling emergence and will significantly reduce the seed bank as the viability of seeds deteriorates.
- If seed set is stopped (no further deposits are made into the seed bank), FTR problems should be diminished quickly since the existing seed bank is short-lived.

Repeated field observations suggest that peak or major flushes of emergence occur if good rain (›50 mm) falls over several consecutive days, particularly in spring. These major flushes can exhaust the majority of the non-dormant viable seed bank and offer an ideal management opportunity. Sporadic and smaller rain events facilitate a number of smaller sequential germinations, making effective control via a single management application more difficult.

Figure 7. *A germinating FTR seed*

Figure 8. *Peak flushes of FTR, just after emergence (top), and well established in close proximity to senesced mother plant (bottom)*

Management strategies

Research and industry experience have shown that successful management of FTR requires an integrated approach, with attention given to both fallow and in-crop phases. Important management considerations and principles that apply across all farming system phases include the following.

- No single weed management application will effectively control FTR—use a variety of tactics in combination and over time (across rotation phases).
- Aim to stop seed set to halt the perpetuation of this grass problem.
- Use the density and distribution across paddocks to determine treatment type—boom, spot sprayer, aerial, or expansive versus spot tillage.
- For scattered or occasional FTR infestations, make a concerted effort to prevent these from becoming bigger problems using whatever spot treatment is necessary or available.
- Target small, non-stressed and actively growing plants to improve the chances of good control. Spraying small FTR seedlings as soon as possible after rain is likely to provide best control, and aerial application should be considered if it stays too wet to use ground sprayers (as the soil profile dries, plant stress levels increase).
- Use good herbicide application techniques to maximise coverage—appropriate nozzles, boom heights, water volumes and speed for the intended spray job.
- Closely monitor the results of all management applications and spot treat survivors as soon as possible.
- When using residual herbicides, the soil surface needs to have less than 50% weed or stubble cover. Ideally no weeds should be present to maximise the amount of herbicide reaching the soil surface.
- If using tillage to control existing plants, ensure the depth and type of tillage is sufficient to uproot the grass without subsequently transplanting it. The rooting depth will depend on the season—roots will be shallow in dry seasons.
- If using tillage for seed burial, ensure the depth of soil inversion is at least 10 cm to guarantee burial below the depth at which the weed can germinate.
- Manage outbreaks along roads, fences and around sheds as these will be a continuing seed source for paddocks.

Herbicide registrations

The few herbicides specifically registered for the control of FTR are atrazine, butroxydim (e.g. Factor®), clethodim (e.g. Select®) and Arsenal Xpress® (imazapyr + glyphosate for non-crop land uses only), while clorthal-dimethyl (Dacthal®) is registered for control of *Chloris* spp. in cotton. Paraquat (e.g. Gramoxone®) has a registration for control of annual grasses in general.

A recent 'minor use' permit has been issued to cover FTR control in fallows prior to mungbean cropping using the double-knock technique (permit 12941). It allows haloxyfop 520 g ai/L formulations (e.g. Verdict® 520) to be applied at 78 to 156 g ai/ha with Uptake™ spray oil additive (0.5 % v/v) which then must be followed 7 to 14 days later with paraquat (e.g. Gramoxone®) applied at 400 g ai/ha on to 3-leaf to early tillering FTR growing on fallow land that will be next cropped to mungbean.

CQ research over the past 6 years has demonstrated several promising herbicides for the control of FTR both in fallow and in-crop. While the majority of the herbicides are registered for use in the respective situations, they do not currently have FTR listed on their labels. Current development trials being undertaken by the regional Grower Solutions groups will supply further data to support new FTR registrations.

Control tactics

To effectively control problem weeds such as FTR, all phases of the life cycle must be attacked using a range of chemical and non-chemical methods. The aim is to deplete the seed bank, control seedlings and small plants, stop seed set and prevent new seeds entering from outside the system.

Seed bank depletion

Residual herbicides (fallow and in-crop)

Fallow and crop rotation trials in CQ have shown several residual herbicides to be very effective on FTR. For in-crop situations these residuals were applied either pre-plant during the fallow or post-plant prior to crop emergence. In fallow, they were applied alone or as part of a double-knock strategy, with best results most often occurring when applied with a Group L bipyridyl herbicide in the second knock (weed cover has been reduced by first knock and the Group L of the second knock assists with rapid plant matter desiccation and disintegration).

The residual herbicides act on the germinating seeds of sequential flushes, often stopping establishment and thus depleting the seed bank as each cohort attempts to emerge or establish. The number of cohorts affected (length of residual activity) is determined by the herbicide rate applied, soil type, the ensuing climatic conditions and location of the seed relative to the herbicide (root/shoot accessibility).

When using residuals it is important that the herbicides reach the soil surface, so application is best made to bare soil that is weed and stubble free. Rain should be received within 14 days of application to allow incorporation below the surface into the seed zone and to minimise the amount lost to ultraviolet degradation. The best time to apply is prior to the sowing rain (herbicide will control FTR plants emerging with the crop). Applying immediately after sowing is an alternative, but this tends to be less effective if follow-up rain is not received soon after. Application water volumes should be kept high (80 to 100 L/ha) for best results. Re-cropping opportunities may be limited where residuals have been used so consult herbicide labels to determine the plant-back periods.

Fallow

Effective residuals applied in the fallow (often as part of a double-knock strategy) have included a Group C triazine mixed with a Group K chloroacetamide, and a Group B imidazolinone (see Table 1). Six years of CQ research data on FTR have also shown that the Group C and K herbicides are more effective and long-lasting when mixed together than when either is applied alone. The same research has shown that when these herbicides are applied in fallows during the cooler months, the duration of control is several months longer compared to fallow use in summer.

In-crop

The FTR-effective residual herbicides applied immediately pre-plant, at planting or post-plant pre-emergence in CQ research trials have included:

- sorghum: Group C triazine + Group K chloroacetamide
- wheat: Group B sulfonylurea; Group K chloroacetamide; Group D dinitroaniline (see Table 1)
- chickpea: Group K chloroacetamide; Group C triazine + Group F isoxazole
- mungbean: Group D dinitroaniline; Group B (1) and (2) imidazolinones (see Table 1)
- sunflower: Group C triazine; Group D (1) and (2) dinitroanalines; Group K chloroacetamide (see Table 1).

All of these herbicides are registered for use in the respective crops (except Group B (2) imidazolinone in mungbean) but not for the control of FTR. Further development work with these herbicides is continuing.

Strategic tillage alone or in combination with residual herbicides (fallow)

Since FTR germinates at or very near the soil surface, burying the seed below 5 cm will place the seed too deep for germination. Strategic tillage can be used to do this, and CQ research has shown that deep inversion (25 cm) tillage completely stops FTR emergences for as long as 9 months after implementation. Other tillage types provided a range of control from 1% to 89% for the same period. Application of a residual herbicide with tillage can also be beneficial in reducing the seed bank (see Figure 9).

Harrows and Kelly chains can be used to 'tickle' the upper 5 cm of soil to create an ideal seedbed for FTR germination. Several field observations have been made in CQ that show these tickle tillage operations facilitate peak flushes of FTR emergence. These flushes virtually exhaust the seed bank and present excellent opportunities for early post-emergence management.

Table 1. *Impact of residual herbicides used in various crops on FTR dynamics measured in a replicated research trial at Biloela Research Station*

Crop and residual herbicide	FTR reduction (%)
Wheat (50 cm wide rows)	
no herbicides	72
Group B sulfonylurea	100
Group D dinitroanaline	94
Group K chloroacetamide	91
Wheat (25 cm wide rows)	
no herbicides	100
Group B sulfonylurea	100
Group D dinitroanaline	75
Group K chloroacetamide	100
Sunflowers	
Group D (1) dinitroanaline	100
Group K chloroacetamide	100
Group D (2) dinitroanaline	100
Group C triazine	100
Mungbeans	
Group D dinitroanaline	100
Group B (1) imidazolinone	100
Group B (2) imidazolinone	100
no residual only post-emergence knockdowns	100
Fallow	
double-knock: Group M followed by Group L + Group B imidazolinone	100
3 sequential double-knocks (Group M followed by Group L) without residuals	100

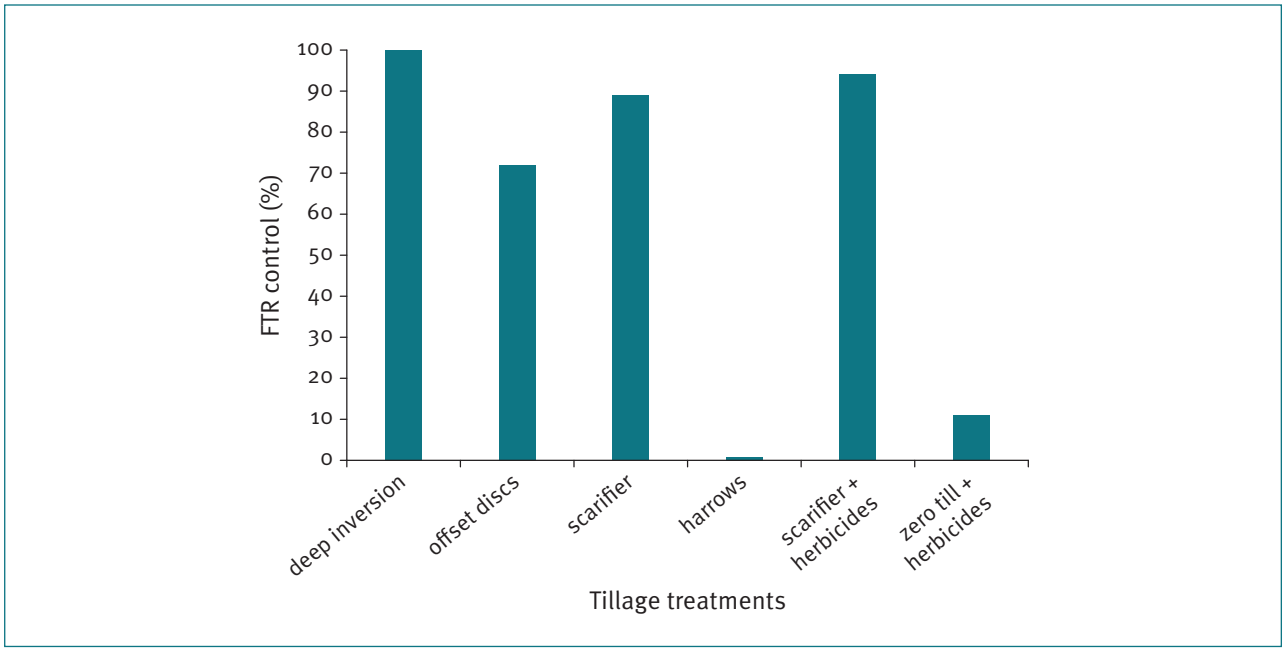

Figure 9. *Impact of different tillage types, some with residual herbicides included, on the control of FTR at 9 months after application after receiving >200 mm rain*

Seedlings and small plant control

Post-emergence herbicides (in-crop and in fallow)

Fallow

FTR does not appear in the lists of weeds controlled on the labels of any fallow-registered knockdown herbicide. However as noted previously, minor use permit 12941 allows a double-knock of Verdict® 520 (Group A) followed by paraquat (Group L) but only in fallows that will be planted to mungbean.

Research in CQ has shown that once FTR is past early tillering stage, a Group M (glycine) herbicide used alone becomes ineffective, but if a Group L bipyridyl herbicide is applied sequentially, control approaches 100%. This double-knock tactic (see Figures 10 and 11) has proved to be the most consistently effective across a range of growth stages and plant stress conditions. The same research has also shown that the addition of residuals (particularly Group B) to the second knock enhances the knockdown of the Group L herbicide (Figure 12).

Figure 10. *Double-knock on FTR in fallow (Group M herbicide followed 10 days later with Group L mixed with Group C and K residual herbicides)*

Figure 11. *Untreated FTR (top) compared to the success of the double-knock (Group M herbicide followed 11 days later by Group L mixed with a Group B residual herbicide) (bottom)*

Since the double-knock is a sequential application of herbicides, the interval between knocks is important to overall efficacy. For many weeds, the interval is short (3 to 4 days) but for FTR, a minimum of 7 days is necessary when using a Group M as the first knock. This is probably due to an antagonism that occurs inside the plant and is specific to FTR. Research conducted by the Northern Grower Alliance discovered this anomaly (Figure 13), which is being investigated further by researchers in the newly funded Grains Research and Development

Corporation (GRDC) project 'Improving IWM practices in the Northern Region'.

Current field trials conducted by the CQ Growers Solutions project are showing that the double-knock tactic of a Group A herbicide followed by Group L with residuals (particularly Group B) is far superior to the double-knock where a Group M herbicide is applied as the first knock. These trials are also showing that as FTR density increases, the rate of the Group A first knock needs to increase to maintain good efficacy.

Ideally, a herbicide-based double-knock tactic works best when applied to small, actively growing weeds, and rates for both knocks should be kept robust. Costs of the double-knock can be reduced by applying the second knock as a spot spray (density dependent) or using weed detection technology if available. Spot tillage may also be an option. In some instances the second knock may be a tillage operation instead of herbicide.

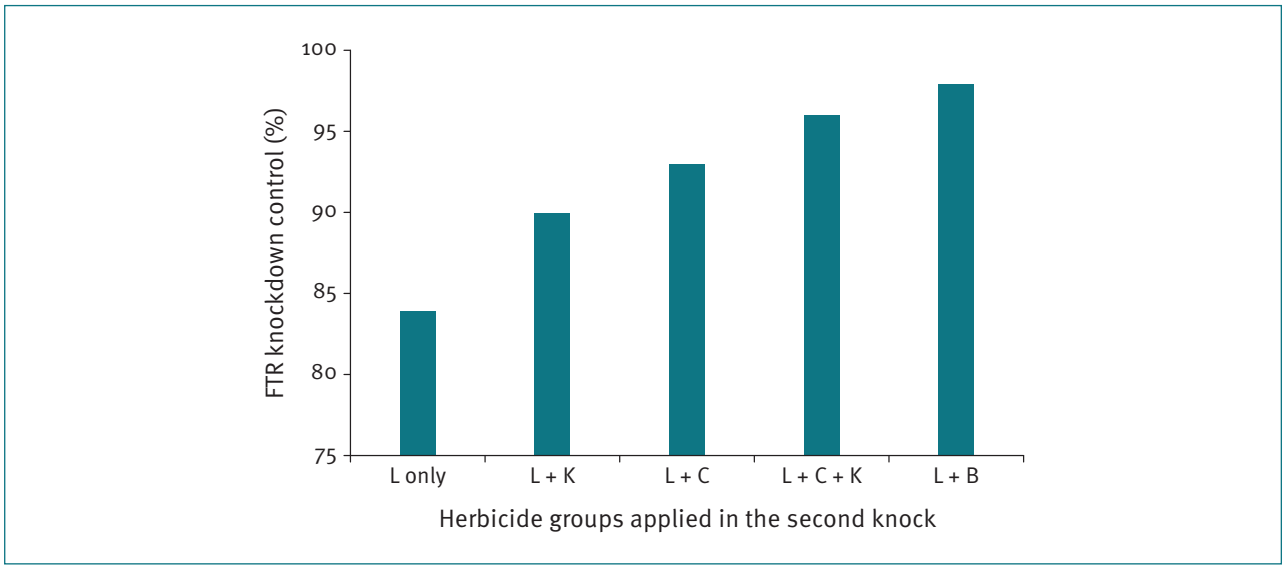

Figure 12. *Impact of the residual herbicides (Groups K, C and B) with Group L in the second knock of a double-knock tactic on the knockdown control of FTR. The first knock was a robust rate of a Group M herbicide. Data are the means of three CQ trials*

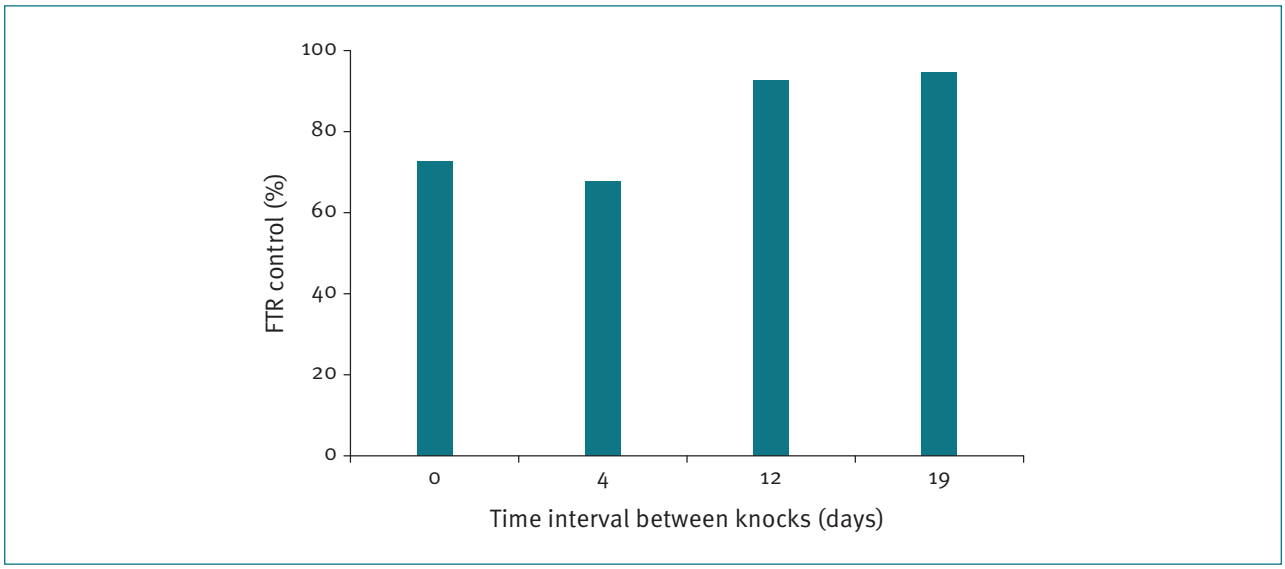

Figure 13. *Effect of time interval between the first (Group M herbicide) and second knocks (Group L herbicide) of the double-knock tactic on control of FTR in a southern Queensland trial. The '0' day treatment only received the first knock (data source: Northern Grower Alliance)*

In-crop

In-crop management of FTR will be limited by the crop chosen and the herbicides that can be safely used with those crops. For post-emergence control in-crop, shielded sprayers may be required (Group L and M herbicides in most crops, and Group A herbicides in some grass and cereal crops). Local research has shown that several of the grass-selective Group A herbicides have good efficacy on FTR, and the 'fop' chemistry appears to better than the 'dims' and 'dens', although butroxydim and clethodim are the only Group A herbicides registered in-crop for FTR control.

The grass-selective knockdown herbicides are widely used in the broad-leaved crops such as mungbean, chickpea, cotton and sunflower (see Figures 14 and 15). Growing these crops in the rotation plays an important role in managing FTR and also in managing herbicide resistance for other high-risk summer grasses. There are also certain Group A herbicides used in wheat and barley that provide good post-emergence efficacy on FTR, so winter cereals should be considered as an option in the development of an integrated weed management (IWM) plan.

Figure 14. *Group A herbicide applied in sunflower to control FTR*

Figure 15. *Group A herbicide applied over the top of mungbean to effectively control FTR*

Tillage

Cultivation, including inter-row tillage, is an alternative option to control emerged FTR in fallows and in-crop. However for the latter, crop rows need to be wide enough and the crop short enough to facilitate passage of the implements without sustaining damage to the crop. In many cases inter-row tillage is only an option in the early crop growth stages. Tillage is best performed when soil conditions are dry to avoid the possibility of transplanting.

Success of tillage for FTR control during the fallow hinges on plant size and type of cultivation undertaken. Small FTR plants are easily removed, particularly if moisture stressed and shallow rooted, by Kelly chains or similar equipment. The experiences of a few growers suggest that the use of a fallow knockdown herbicide followed several days later by a shallow tillage (another example of a double-knock tactic) with a Kelly chain works best when the FTR is no larger than the early tillering stage. As mentioned previously, tickle tillage can be used to promote peak flushes of emergence that can then be targeted with the herbicide-based double-knock tactic.

When FTR plants are large and clumped, tillage that uproots and chops the material is best—tandem offset discs and chisel ploughs should be considered. If FTR densities are low and plants are scattered, spot tillage (e.g. a single-tined sweep) may be a minimum tillage option.

Stopping/reducing seed set

All of the herbicide and tillage tactics described so far, when applied using best management principles, should provide good control of FTR and significantly reduce seed production. Most weed control tactics rarely achieve 100% control, so escapes or survivors will be present. For difficult-to-control weeds that perpetuate through the seed, it becomes critical to stop seed set in these survivors; otherwise the problem will continue. Post-treatment monitoring of all weed management practices is paramount to the success of any IWM plan as it allows for the detection of survivors. These should then be re-treated by spot tillage, spot spraying including weed sensor spray technology, or manual removal as soon as possible to stop any further seed set.

Growing competitive crops will also assist in reducing seed production. Using manipulative agronomy to maximise crop competition allows the crop itself to become an adjunct weed management tool. This involves:

- selecting the most competitive crop (traditionally, barley is more competitive than wheat, maize is more competitive than sorghum)
- selecting the most competitive cultivars
- sowing into a clean seedbed to give the competitive advantage to the crop
- aiming to establish the highest crop population according to the cultivar and region
- keeping row spacings to the minimum for the cultivar and region
- ensuring good crop nutrition and crop protection practices (insect and disease control).

If you are unable to take advantage of crop competition and crops are being grown on wide rows, it becomes very important to use in-crop FTR management practices (see Figure 16). Take advantage of the wide-row spacing to utilise inter-row tillage or shielded spraying (summer cereals). The wide inter-row space also facilitates easier and greater herbicide penetration below the crop canopy, which is ideal for the Group A grass-selectives applied in broad-leaved crops.

Pre-harvest desiccant sprays can also be utilised (where registered) to contribute to the control of late in-crop FTR emergences or the survivors of earlier management practices. Observations made on local research trials have noted that applications of Group M herbicide (which is also a common pre-harvest herbicide) causes FTR seed shed within 2 to 3 days of spraying. This is particularly valuable if the seed being shed is not physiologically mature at the time.

Figure 16. *Dense infestation of FTR in a CQ wide-row wheat crop that has not received any in-crop grass management*

Preventing new seeds entering from outside

FTR plants growing along farm tracks and paddock verges, on fence lines and around sheds and buildings are a seed source for nearby paddocks since the seed can be dispersed short distances by wind, and carried on animal fur and on vehicles and farm equipment that pass through the areas. Ideally, these areas should be kept FTR-free but not bare since FTR (and fleabane) are among the first plants to colonise bare areas. Sturdy, non-invasive, low-growing ground covers should be encouraged in these areas.

More information

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