Fumitory (Fumaria spp.)

Fumitory (Fumaria spp.) is an annual herbaceous weed found across the Murrumbidgee catchment. It has been an increasing problem in annual cropping systems over the past 20 years due to possessing most of the inherent characteristics of an ‘ideal weed’. This enables it to successfully compete with coexisting vegetation, including crop plants, causing significant yield losses. (Figure 1)

Figure 1. Fumaria spp. infestation

KEY POINTS

- Fumitory is a widespread and successful weed found across the Murrumbidgee catchment.
- Correct identification of the individual species is essential for effective control.
- Strategic tillage operations can be used to deplete the fumitory seed bank.
- Spread can be prevented by ensuring introduced crop and pasture seed is not contaminated with fumitory seed.

Legislation

Fumitory is not declared noxious in the Murrumbidgee catchment under the Noxious Weeds Act 1993.

Taxonomy

Fumitory species comprise the genus Fumaria which belongs to the Fumariaceae family. The accepted common name is fumitory but it is also known as carrot weed, beggary, fume-of-the-earth, fumiterre, fumusterre, God’s fingers and thumbs, snapdragon and wax dolls. There are around 50 species worldwide, 7 of which are naturalised in Australia: Fumaria parviflora, F. officinalis, F. densiflora, F. muralis, F. bastardii, F. indica and F. capreolate (Norton 2003).

Origin and Introduction

Fumitory originated in Morocco and on the Iberian Peninsula and is now found on all continents except Antarctica. It was introduced into Australia via human trade and travel.

Distribution

All of the 7 fumitory species naturalised in Australia are found in the Murrumbidgee catchment (Figure 2). Fumitory distribution depends mostly on soil texture and autumn rainfall. Most species prefer medium to heavy textured soils and high April rainfall but some species have adapted to other soil types in the Murrumbidgee catchment. Generally, fumitory populations consist of multiple species.

Figure 2. Distribution of Fumaria spp. in New South Wales.

- F. densiflora The most adaptable species, growing over a range of soil types and rainfall zones. Along with F. bastardii it is the most common and widespread fumitory species in agricultural areas of NSW.
- F. bastardii Found on a number of soil types in regions where April rainfall is high.
- F. parviflora Prefers heavy soils uncommon in the Murrumbidgee catchment. It is the only species that is pH sensitive preferring neutral to alkaline soils.
- F. muralis Prefers heavy soils and high April rainfall.
- F. indica Well adapted to low rainfall environments.
- F. capreolate Rare, found predominantly in non-agricultural areas.
- F. officinalis Rare.
Fumitory distribution is also influenced by agricultural practices such as crop rotation, tillage, crop and cultivar choice and the movement of seed and fodder. The expansion of canola crops and improved pastures that incorporate sub clover has escalated the spread of fumitory due to the difficulty in removing fumitory seed from crop and pasture seed. It is likely fumitory was introduced into large scale cropping regions via contaminated clover seed.

**Biology and Ecology**

Fumitory is a widespread and successful coloniser due to:

- extensive genetic variability giving rise to different biotypes within species that ensure survival in a range of environments
- self-pollinating flowers guaranteeing fertility and a stable population
- a high level of phenotypic plasticity, i.e. the environment has a strong influence on the physical expression of traits, guaranteeing survival in a range of environments
- strong competitive ability due to its semi-climbing habit and exudation of allelo-chemicals
- highly persistent seeds (up to 20 years) attributed to morpho-physiological dormancy
- a wide temperature window for germination
- long and short range dispersal of seeds by human and ant activity
- the similarity of the Murrumbidgee catchment’s climate to fumitory’s native environment, i.e. hot, dry summers followed by cool, moist winters
- a lack of pests and diseases that target fumitory in Australia
- a diversity of ant species similar to fumitory’s native environment with which the plant has a mutually beneficial relationship; and
- an increase in the area sown to canola. Fumitory control options are limited in canola and canola seed acts as a major dispersal mechanism.

**Identification**

**Mature plant:** Semi-erect to sprawling with a climbing habit, slender, herbaceous, freely branching and between 30-70cm tall (Figure 3).

**Cotyledons:** Spear shaped with a pointed apex and hairless (Figure 4).

**Leaves:** Triangular and deeply lobed, soft, hairless, green or blue-green in colour, arranged alternately (Figure 4).

**Stems:** Unevenly five-angled, green, smooth, succulent and weak.

**Flowers:** Occur in clusters of 10 to 40 flowers, 6-12mm long, white, pink or red depending on the species.

**Root system:** Fumitory has a strong tap root.

Correct identification of fumitory species is extremely important for management as herbicide susceptibility varies between species (Table 1). There is also a lot of within species variation with several variants, or bio-types, identified for five of the seven fumitory species in Australia. The varying behaviour of these bio-types may account for why some species are found across a range of environments and why control of fumitory is often unpredictable and variable.
Table 1. Distinguishing characteristics of the seven *Fumaria* species naturalised in Australia (Bowcher & Condon 2005).

<table>
<thead>
<tr>
<th>Species</th>
<th>Flower colour</th>
<th>Leaves</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>F. parviflora</em></td>
<td>Light-mid pink</td>
<td>&lt; 1mm wide</td>
</tr>
<tr>
<td><em>F. indica</em></td>
<td>Light-mid pink</td>
<td>1-2mm wide, 10mm long</td>
</tr>
<tr>
<td><em>F. densiflora</em></td>
<td>Dark pink</td>
<td>1-2mm wide, 5mm long</td>
</tr>
<tr>
<td><em>F. officinalis</em></td>
<td>Dark pink</td>
<td>&gt; 2mm wide</td>
</tr>
<tr>
<td><em>F. muralis</em></td>
<td>Mauve</td>
<td>&gt; 2mm wide</td>
</tr>
<tr>
<td><em>F. bastardii</em></td>
<td>Mauve</td>
<td>&gt; 2mm wide</td>
</tr>
<tr>
<td><em>F. capreolata</em></td>
<td>White</td>
<td>&gt; 2mm wide</td>
</tr>
</tbody>
</table>

**Seed dormancy and germination**

Fumitory seeds are highly dormant due to an immature embryo and seed covering structures that limit oxygen infusion into the embryo (morpho-physiological dormancy). The embryo matures following high temperatures and then a cold, moist period. Seed positioned less than 5cm below the soil surface lasts three to five years but at depth (15cm) in heavy, undisturbed agricultural soil seeds can persist for up to 20 years (Norton 2003). Ants can assist with longevity by carrying seed to ‘safe sites’ well below the soil surface.

Fumitory will germinate all year round if there is adequate moisture however it occurs mostly between May and August in response to rainfall events. The optimum temperature range for germination is 10-15°C but it can occur anywhere between 5 and 22°C. Germination is stimulated by tillage undertaken during daylight providing the required ‘light effect’. The tillage effect overrides the temperature requirements for germination. Germination is not influenced by nitrogen application.

**Seedling establishment**

Fumitory emergence patterns vary according to species, season, soil type (texture, organic matter and nitrogen status), seed burial depth and soil disturbance. Emergence is greatest in disturbed clay soils from seeds less than 2.5cm deep. Seeds at 2-3cm deep also benefit by assisting each other to break through the surface crust. Seeds on the soil surface usually have poor emergence due to a weak radicle (root) which can not penetrate the surface.

Fumitory has a slow growth rate at low temperatures. It does not establish well in wetter seasons but thrives in seasons with good opening rains and slightly lower than average growing season rainfall.

**Flowering**

Flowering occurs between September and November. The flowers are self-pollinating and although outcrossing can occur, it is less than 1% of the time because the anthers are in close contact with the stigma. (Figure 5)

**Seed production and dispersal**

Each fumitory plant can produce up to 22,500 seeds which mature about three weeks after the first flowers are visible. An after-ripening period is then required before the seeds will germinate. Seeds range from 1.75mm to 3.75mm in diameter, depending on the species.

Fumitory can be spread via clothing, boots, vehicles, tillage and harvest machinery, crop and pasture seed and forage. In practice, insufficiently cleaned crop seed, especially canola and sub-clover seed, is the most common method of long distance dispersal.

Seeds are also spread up to 10m by ants who are natural dispersal agents. Ants have a mutually beneficial relationship with fumitory: the seed coating is a food source for the ants and the ants collecting habits benefit the seed by depositing it in ‘safe sites’. Fumitory seed may also be moved by water along creeks and rivers.

**Competitiveness**

Fumitory’s semi-climbing habit allows it to outgrow and smother smaller plant species. In addition, allelopathic interference is exhibited by clusters of individual plants.

The competitive impact of fumitory depends on crop species and cultivar, time of fumitory emergence and density of the infestation. Fumitory can reduce wheat yields by up to 40% and canola yields by up to 36% (Norton 2003).
**Nutrition**

Fumitory thrives in soils that have a high nutrient status and growth of the plant increases following nitrogen applications. Growth also increases following lime applications as fumitory prefers neutral to alkaline soils.

**Management**

**Chemical options**

There are a number of herbicides available for fumitory control. For a full list of registered products, refer to *Weed Control in Winter Crops* at http://www.dpi.nsw.gov.au/agriculture.

The method of herbicide application (eg incorporation method and droplet size) is important and can affect herbicide efficacy. Always read and follow directions for use (on the herbicide label) thoroughly to obtain optimum results.

Following are the results from a fumitory herbicide tolerance trial conducted at Wagga Wagga in 1999 by Dr Gertraud Norton. Each herbicide was applied at 0.5, 1, 2 and 4 times the recommended label rate to the species *F. bastardii*, *F. muralis*, *F. densiflora* and *F. officinalis* (Bowcher & Condon, 2005).

- Trifluralin (Treflan®) and pendimethalin (Stomp®)- All species showed some tolerance to both herbicides, even at higher rates. *F. bastardii* and *F. muralis* showed the greatest tolerance. *F. densiflora* resistance was detected and attributed to repeated applications to the population over time.
- Simazine- Most seedlings died except at half the recommended rate. Some survivors were recorded at the recommended rate (mostly *F. densiflora*) which may have been due to resistance to this chemical.
- Triasulfuron (Logran®)- Survivors of all species were recorded at the recommended rate but they had stunted growth. No survivors were recorded at double the recommended rate. Late emerging seedlings appeared unaffected. *F. muralis* and *F. bastardii* were slightly more susceptible.
- Terbutryn (Igran®)- 90-95% control was recorded at the recommended rate and 100% control at double the recommended rate.
- MCPA- Unsatisfactory control was observed at all rates despite some initial symptoms, eg leaf distortion.
- Bromoxynil (Bromicide®)- Good control was recorded in *F. bastardii* only although there were still some survivors at the recommended rate.

Other trials have shown Bromonil M® to be the most effective herbicide with the least effect on the crop (Table 2). Additionally, Ally® + MCPA (tank-mixed) and Agtryne have shown excellent results in the Murrumbidgee catchment (B. Haskins pers. comm.).

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Table 2. Results from a herbicide efficacy (*Fumaria* spp.) and crop tolerance (Amery wheat) trial in Western Australia in 1997 (Madin 1998).

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Weed control rating (0= no control, 10= excellent control)</th>
<th>Wheat yield (t/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control- untreated</td>
<td>0</td>
<td>2.43</td>
</tr>
<tr>
<td>Logran® 15g + oil</td>
<td>9</td>
<td>3.50</td>
</tr>
<tr>
<td>Glean® 15g + WA</td>
<td>8</td>
<td>3.61</td>
</tr>
<tr>
<td>Igran® 500mL + MCPA 500mL</td>
<td>8</td>
<td>3.25</td>
</tr>
<tr>
<td>BromonilM® 500mL + Glean® 10g</td>
<td>10</td>
<td>3.78</td>
</tr>
<tr>
<td>Jaguar® 750mL</td>
<td>8</td>
<td>3.52</td>
</tr>
<tr>
<td>Barrel® 1000mL</td>
<td>9</td>
<td>3.21</td>
</tr>
<tr>
<td>BromonilM® 1000mL</td>
<td>9</td>
<td>3.28</td>
</tr>
</tbody>
</table>

Selected herbicides were evaluated by growers at a fumitory management workshop held at Coolamon in 1999 (Table 3). The herbicides which gave the best control were Glean®, OnDuty® (Clearfield® system) and Bromoxynil.
Table 3. Management techniques rated by fumitory management workshop participants in 1999 at Coolamon, NSW (Moerkerk 1999).

NB: This information was supplied by workshop participants on their experiences only and is not a recommendation.

<table>
<thead>
<tr>
<th>Crop</th>
<th>Herbicide</th>
<th>MOA</th>
<th>% control</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Treflan®</td>
<td>D</td>
<td>0-50</td>
</tr>
<tr>
<td></td>
<td>Bromoxynil 2L/ha</td>
<td>C</td>
<td>99</td>
</tr>
<tr>
<td></td>
<td>Glean® 25-30g/ha</td>
<td>B</td>
<td>90-100</td>
</tr>
<tr>
<td>Canola</td>
<td>Jaguar® 1L/ha</td>
<td>C, F</td>
<td>90+</td>
</tr>
<tr>
<td>TT canola</td>
<td>On Duty® 40g/ha</td>
<td>B</td>
<td>90-100</td>
</tr>
<tr>
<td>Wheat</td>
<td>Simazine 2L/ha + Atrazine</td>
<td>C</td>
<td>90</td>
</tr>
<tr>
<td></td>
<td>Igran® 500ml/ha + MCPA 500ml/ha</td>
<td>C, I</td>
<td>95</td>
</tr>
<tr>
<td>Wheat</td>
<td>Logran® 35g/ha</td>
<td>B</td>
<td>95+</td>
</tr>
<tr>
<td>Wheat</td>
<td>Igran® 100ml/ha + Jaguar® 800ml/ha</td>
<td>C</td>
<td>95+</td>
</tr>
<tr>
<td>Pasture</td>
<td>Broadstrike® 25g/ha</td>
<td>B</td>
<td>80</td>
</tr>
<tr>
<td>Pasture</td>
<td>Tigrex® 500ml/ha</td>
<td>F, I</td>
<td>95+</td>
</tr>
<tr>
<td>Peas</td>
<td>Sencor® 450ml/ha</td>
<td>C</td>
<td>50</td>
</tr>
</tbody>
</table>

Treatments considered a failure by participants of the workshop include:

- Spraygrazing- controlled capeweed but not fumitory which was possibly due to low grazing pressure.
- Sencor® in field peas- possibly dependant on fumitory species.
- Group D herbicides including trifluralin- failed possibly due to resistance and species variation or problems associated with applying trifluralin in no-till systems.
- Grazing- plants will recover and set seed after stock removal.
- Spraytopping- the reduction in seed production was rated as unsatisfactory. Fumitory is a poor target for selective spray topping due to its low growing habit and rapid maturity and senescence.

- Resistance note: Herbicide resistance in fumitory was first reported in NSW in 1999 and there are now approximately 50 resistant populations in grain cropping regions of southern Australia (Preston 2004). All of these are resistant to Group D herbicides (trifluralin).

**Local demonstration**

A local demonstration site was established in 2006 to show the efficacy of post-emergent herbicides for the control of fumitory in wheat and barley. Treatments were applied in 2006 and 2007 (on different areas of the site).

**Aim**

To show the efficacy of 3 post-emergent herbicide mixes for the control of fumitory in wheat and barley.

The treatments applied and their approximate cost per hectare excluding application costs are:

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Cost ($/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Control (no herbicide)</td>
<td>0</td>
</tr>
<tr>
<td>2 Agtryne MA (1L/ha)</td>
<td>11.75</td>
</tr>
<tr>
<td>3 Ally® (5g/ha) + MCPA 500 (1.4L/ha) + non-ionic surfactant</td>
<td>10.70</td>
</tr>
<tr>
<td>4 Bromicide® MA (1.4L/ha) + Glean® (20g/ha) + non-ionic surfactant</td>
<td>25.05</td>
</tr>
</tbody>
</table>

Treatments were applied on 4th July 2006 and 7th July 2007. Treatments were applied using a 15L backpack sprayer with a 1.5m hand held boom, flat fan nozzles and 3 bar of pressure. A water rate of 133L/ha was used. The crop was at growth stage Z13-Z22 and the fumitory was cotyledon to rosette.

**Methodology**

The demonstration site is located approximately 30km south east of Narrandera, NSW. The paddock has been in pasture for several years and was sown to Sunstate wheat in the first week of May, 2006 and to barley in 2007. Fumitory (*Fumaria bastardii*) is the predominant weed species present in the paddock.
Results and Discussion (2006)

Agtryne MA and Bromicide M + Glean provided very similar control levels of fumitory. In 2006, Agtryne gave slightly better control with 98% reduction in the fumitory population compared with 92% for Bromicide M + Glean. In 2007 the order was reversed with Bromicide M + Glean giving 99% control and Agtryne MA 91%. Ally + MCPA was provided the lowest level of control in 2006 and 2007 with 61% and 77% respectively.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>2006 Plants/m² Prior to treatment</th>
<th>2007 Plants/m² Prior to treatment</th>
<th>% Control</th>
<th>% Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>159</td>
<td>308</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Agtryne MA</td>
<td>153</td>
<td>376</td>
<td>98</td>
<td>91</td>
</tr>
<tr>
<td>Ally® + MCPA</td>
<td>245</td>
<td>411</td>
<td>61</td>
<td>77</td>
</tr>
<tr>
<td>Bromicide® MA + Glean</td>
<td>268</td>
<td>473</td>
<td>92</td>
<td>99</td>
</tr>
</tbody>
</table>

Agtryne MA resulted in total plant death except for some cotyledons which appeared unaffected. These may have germinated after the treatments were applied thus escaping treatment. Excellent control is being achieved with this herbicide in other areas of the Murrumbidgee catchment (Haskins pers. comm.).

Bromicide® MA + Glean® also had a high rate of plant death with some cotyledons appearing unaffected. Previous work by Dr Gertraud Norton found that although bromoxynil provides poor control of some fumitory species, it provides good control of *Fumaria bastardii*, the species present at this site.

Ally® + MCPA resulted in a lower rate of plant death however the remaining plants were severely wilted and discoloured and were unlikely to be competitive with the wheat crop. Dr Norton also found all species of fumitory to be relatively tolerant to MCPA with poor control obtained at 1, 2 and 4 times the recommended rate.

Transient crop yellowing was initially seen for two of the treatments- Ally® + MCPA and Bromicide® MA + Glean® however it was not noticeable 28 DAT.
Economic Analyses

To evaluate the economic benefit of different herbicides you need to consider the weed population, percent control achieved, potential wheat yield, yield loss, actual yield and cost of the herbicide. Below is an example of how to estimate your gross margin (looking at weed control only).

<table>
<thead>
<tr>
<th>Treatment</th>
<th>% Control (2006)</th>
<th>Fumitory population (plants/m²)</th>
<th>% Yield loss</th>
<th>Actual yield (t/ha)</th>
<th>Income ($/ha)</th>
<th>Herbicide cost ($/ha)</th>
<th>Gross margin ($/ha) (weed control only)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>0</td>
<td>159</td>
<td>30</td>
<td>2.8</td>
<td>560</td>
<td>0</td>
<td>560</td>
</tr>
<tr>
<td>Agtryne MA</td>
<td>98</td>
<td>3</td>
<td>0.6</td>
<td>3.976</td>
<td>795.2</td>
<td>0</td>
<td>782.2</td>
</tr>
<tr>
<td>Ally® + MCPA</td>
<td>61</td>
<td>96</td>
<td>18</td>
<td>3.28</td>
<td>656</td>
<td>10.97</td>
<td>645.03</td>
</tr>
<tr>
<td>Bromicide® MA + Glean®</td>
<td>92</td>
<td>31</td>
<td>6</td>
<td>3.76</td>
<td>752</td>
<td>24.25</td>
<td>727.75</td>
</tr>
</tbody>
</table>

From the gross margin above, we can see that Agtryne MA gives the highest return per hectare out of the three herbicides due to the high level of weed control obtained (98%). When deciding on herbicide options, other factors such as crop tolerance, plant back periods, withholding periods, fumitory variety present, other weed species present, damage to non-target species (environmental damage) and herbicide use history (resistance risk) also need to be considered.

Conclusion

This demonstration gave similar results in both years it was carried out (2006 in wheat and 2007 in barley). Agtryne MA gave 98% and 90% control respectively, Bromicide® MA + Glean® gave 92% and 99% control and Ally® + MCPA gave 61% and 76%. Due to the high cost of Bromicide MA + Glean ($25.05/ha) Agtryne MA is likely to be more economical at $11.75/ha. Ally® + MCPA is the cheapest at $10.70/ha but gives significantly poorer control than the other two treatments.
**Cultural options**

**Cultivation**

Cultivation promotes fumitory emergence due to improved gas exchange in the soil and a light effect when carried out during daylight (Figure 5). As a consequence, cropping systems that use no-till for wheat and then conventional cultivation for the following canola crop exacerbate the fumitory problem. Fumitory numbers will be low during the cereal crop where there is no cultivation and high in the following canola crop when full cultivation is used and where control options are limited.

![Figure 5. The effect of cultivation on fumitory numbers in a Central West Farming Systems trial at Merriwagga, NSW, in 2004 (Haskins 2004, unpublished).](image)

Light cultivation (to promote germination) and subsequent control using a knockdown herbicide prior to sowing cereals can reduce the seedbank and in-crop numbers. Soil moisture must be sufficient to enable germination and establishment of fumitory.

There is some evidence to suggest cultivating in the dark to avoid the light effect makes germination more temperature dependant. When followed by immediate sowing, the crop will have a head start and it may outcompete fumitory.

In addition, stubble retention seems to impede fumitory emergence.

**Crop rotation**

An extended pasture phase may not reduce the fumitory seed bank due to its persistence under no-till situations. Fumitory also thrives in pastures due to limited chemical options and bare ground which it readily colonises.

Fumitory is a significant problem in pulse crops such as lupins and field peas. Sowing these crops in paddocks of known high fumitory pressure should be avoided. A common practice is to sow a triazine tolerant (TT) canola variety as the first crop after pasture as the triazine herbicides give good fumitory control.

**Competitive crops**

Grow the most competitive crop suited to your region and choose a variety with high seedling vigour. Use a high seeding rate and good agronomy practices to promote a healthy crop. This will help create a thick canopy which can reduce the impact of weeds and ultimately reduce weed seed set. Fumitory thrives in pulse crops due to their poor competitive ability, but will struggle in well tillered cereal crops. In canola crops, fumitory will have average growth but will still set seed.

**Grazing**

Sheep will graze fumitory plants only when it is in the vegetative state so grazing is a poor control option.

**Burning crop residues**

Burning crop residues is unlikely to be effective due to buried seeds escaping the fire. Fire may also stimulate germination by increasing seed-coat permeability and seed maturation due to changes in the soil thermal properties.

**Mowing/Slashing**

Mowing and slashing can prevent seed set but timing is critical and the cut needs to be low because of fumitory’s growth habit.
Hygiene

Seed cleaning can not effectively remove all fumitory seed from crop seed, particularly in small seeded crops like canola. For this reason, select fumitory free paddocks for seed and harvest them prior to those with fumitory present (to avoid contaminating the header and grain handling equipment). This will reduce the risk of introducing fumitory into new areas.

When purchasing seed always ask for a seed analysis report and check for the presence of fumitory and other unwanted weeds. Do not purchase seed contaminated with weed seeds.

Biological options

Fumitory hosts a range of fungal pathogens including *Peronospora affinis* and *Alternaria radicina* which are both potential biological control agents. The first is host specific however the second attacks cruciferous and umbelliferous crops and therefore cannot be used as a control measure where these crops are grown.

Although ants attack the outer seed coat of fumitory, the seed remains viable therefore they are not considered a biological control agent.

Prevention

Preventing dispersal and reintroduction is necessary to stop fumitory populations from spreading and to reduce seedbank numbers. Pay attention to all mechanisms of seed dispersal and introduction, especially crop seed and fodder. Monitor paddocks closely and control new infestations before they spread to become a whole paddock (or farm) problem.

References


Disclaimer

The information contained in this publication is based on knowledge and understanding at the time of writing (2008). However, because of advances in knowledge, users are reminded of the need to ensure that information upon which they rely is up to date and to check currency of the information with the appropriate officer of New South Wales Department of Primary Industries/Murrumbidgee Catchment Management Authority or the user’s independent adviser.

The product trade names in this publication are supplied on the understanding that no preference between equivalent products is intended and that the inclusion of a product name does not imply endorsement by NSW Department of Primary Industries or Murrumbidgee CMA over any equivalent product from another manufacturer.

ALWAYS READ THE LABEL

Users of agricultural chemical products must always read the label and any Permit, before using the product, and strictly comply with directions on the label and the conditions of any Permit. Users are not absolved from compliance with the directions on the label or the conditions of the permit by reason of any statement made or omitted to be made in this publication.

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