

How do I ...

spray-top to reduce annual weeds in pastures?

The issue:	Growth from annual grasses can be considerable, especially during autumn and winter, but it is not without downsides. These include impacted legume growth and production of sharp seed heads, which can be detrimental to livestock. Spray-topping with herbicide is an effective tactic to reduce annual grasses, but its success is dependent on even seed head emergence and timing of application.
The impact:	Spray-topping helps lower the annual grass seedbank, resulting in less seed available to germinate and compete with perennial grasses and sub-clovers. With the right follow-up management, spray-topping can support increased populations of desirable grasses and sub-clover.
The opportunity:	Effective spray-topping can improve our perennial grass and sub-clover content, extend the productive life of a sown pasture and reduce seed injuries to stock.

What is spray-topping?

Spray-topping uses a sublethal dose of herbicide to sterilise seed while it is being formed. Disrupting a plant's ability to set viable seed dramatically reduces seed carryover. As a result, there is less seed available to germinate when the season breaks and, therefore, less weeds the next year.

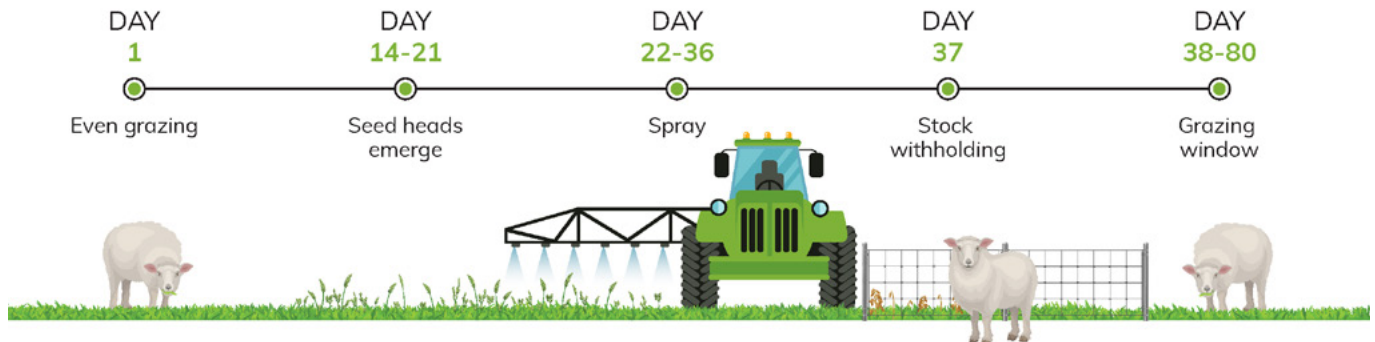
Control of up to 95% in target weeds can result from well-timed spray-topping. Numerous trials have recorded typical reductions of above 85% in annual plants the following year.^{1,2,3} The herbicides commonly used are glyphosate (Roundup®) and paraquat (Gramoxone®). Spray-topping is commonly regarded as essential to establishing new pastures, as well as a means of maintaining existing pasture productivity.



Spray-topped pasture containing barley grass and capeweed (right) versus untreated (left).

Photo courtesy of Department of Primary Industries and Regional Development, WA

The process of spray-topping



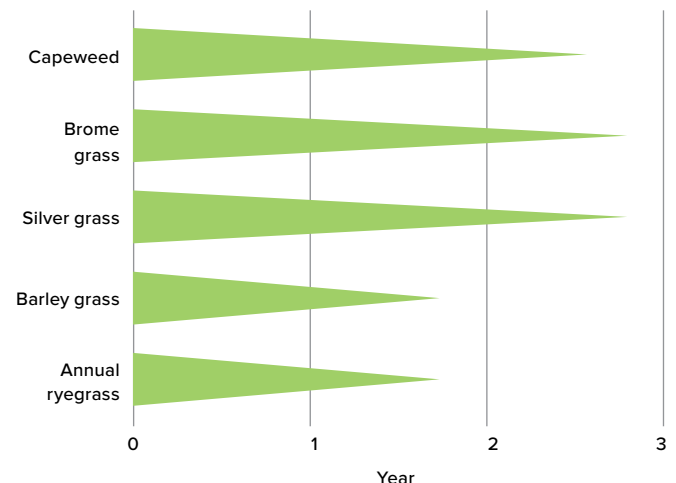
What plants does spray-topping target?

Spray-topping is a useful technique on annual grasses, and some broadleaf plants, which produce seeds with short seed life, such as barley grass (*Hordeum leporinum*), brome grass (*Bromus* species), annual (Wimmera) ryegrass (*Lolium rigidum*), silver grass (*Vulpia* species) and capeweed (*Arctotheca calendula*) (Figure 1).

Other annual and perennial plants sprayed as a consequence of this treatment may also be affected. However if their seed viability is long and/or the seeds have already fully formed, the technique will be less effective in achieving long-term control. Spray-topping perennials, which often flower later than annuals, will commonly prevent or retard seed head emergence.

For some producers, these plants are a major contributor to the annual feed supply and spray-topping should only be considered if it is part of encouraging other desirable species or as preparation for cropping or resowing.

Figure 1. Longevity of seeds of annual grasses affected by spray-topping. Longer cones indicate greater seed dormancy before germination.



The pros and cons of annual grasses

Annual grasses can be valuable in a pasture. They germinate early, establish fast in autumn and provide high quality feed during winter and early spring.

However, they do have downsides. The primary one is their potential to destabilise pastures by outcompeting sub-clover which, in turn, reduces feed quality, animal intake and nitrogen availability for productive grasses.

They commonly flower early, to ensure seed carryover for next year, which can shorten the length of annual pasture growth. This reduces feed quality and has been recorded to decrease lamb production by 30%.⁴ Dead annual grasses leave trash which is unattractive to grazing livestock. The trash can contain allelopathic toxins which impact the soil and prevent sub-clover seedling emergence.

Some grass seeds lead to animal health problems and can damage and reduce the value of the animal's carcase and/or wool. Annual (Wimmera) ryegrass heads can host an endophyte which causes ryegrass staggers.

Therefore, the decision to spray-top needs to be done on balance, weighing up the pros and cons.

Although spray-topping is a registered use for silver grass and capeweed control, other herbicide application practices are preferred for managing these species. For capeweed this is spray-grazing (see MLA fact sheet: [How do I spray-graze to remove broadleaf weeds?](#)) as it allows other plants, preferably sub-clover, to fill the bare spaces created by the removal of capeweed before the end of the season. Removing capeweed in spring provides insufficient

time for other plants to fill the spaces, which exposes the soil when the capeweed dies over summer.

The preferred method for silver grass is winter cleaning (see MLA fact sheet: [How do I winter clean pastures to remove annual grass weeds?](#)). Silver grass can flower over several months,³ with some seed heads remaining in sheath of the plant.⁵ Similar to capeweed, removing silver grass in the middle of the season enables other plants to fill the bare spaces.

Herbicide effect and use

The two different herbicide types used in spray-topping have different modes of action.

Glyphosate-based herbicides are absorbed by the plant and move through the 'sap system' (translocation). With annual plants, the herbicide is absorbed as the seed is forming, rendering the seed sterile. Even though seed heads may form, the majority of seed will not germinate in the next year.

Glyphosate may also reduce sub-clover seed set by approximately 40%.

Paraquat is a contact grass herbicide which means it must make physical contact with the seed to be effective. Therefore, it is used later in the season when seed heads have emerged. It is not effective on capeweed.

Paraquat is safer on sub-clover seed set than glyphosate because it is not translocated and is effective on grasses only.



A secondary effect of both herbicides is to 'freeze' plant maturity for a short period, meaning the plant retains its quality (energy and protein levels) even though it will appear brown (Table 1). The quality is 'frozen' for about four to six weeks or until heavy rain.⁶ After this time quality declines at a rate similar to non-sprayed pasture.

Table 1. Feed quality differences in mid-November of untreated and spray-topped (mid-October) annual ryegrass pasture at Rutherglen, Victoria.⁷

Treatment	Stem digestibility (%)	Leaf blade digestibility (%)	Seed head digestibility (%)
Unsprayed	25	76	52
Spray-topped with glyphosate	51	74	64

For annual plants, there is usually no recovery after 'freezing' as the plants will be in their reproductive growth stage. For perennial plants they will recover.

If significant late rain occurs before full plant maturity, this can stimulate annual grasses to rapidly produce new tillers after spraying has occurred.

Spray-topping also helps reduce the amount of annual grass litter which would otherwise be unattractive for grazing due to sharp seed heads and declining feed value.

Spray-topping is different to hay freezing. Hay freezing uses a higher rate of herbicide and is done to maintain quality of standing dry feed. Both paraquat and glyphosate can be used but care should be taken to avoid inadvertently damaging desirable species.

On the left is an early spray-topping application just prior to seed head emergence, showing plant recovery with viable seed heads emerging and, on the right, the browning effect of spray-topping done at milky dough seed stage.

Preparation pays off

Successful spray-topping relies on achieving even seed head emergence. Heavy grazing in winter and early spring and then spelling the paddock for two to three weeks before the anticipated spraying time, allows the seed heads to emerge at once. Low stocking rates and selective grazing will result in uneven and staggered seed head emergence and seeds of different maturities.

Heavy grazing will also delay seed head emergence by slowing plant development. This is advantageous, as it keeps high quality vegetative growth for longer.



Unsynchronised seed head emergence as a result of uneven grazing.

Timing

Time of spraying is critical and varies with plant species and soil moisture. Common annual weeds usually mature in the following sequence:

Capeweed ➡ Barley grass and silver grass ➡ Brome grasses ➡ Annual ryegrass

The ideal time of spraying for glyphosate application is at flowering for annual ryegrass and capeweed, and at or just before milky dough stage on barley, brome and silver grasses (see page six).

Beyond the milky dough stage, seed will be soft but no milk will be released. The seed heads will appear lighter green to light brown and start to 'hay off'. At this stage paraquat is the preferred herbicide.

There is typically a two-week period where seeds are at ideal maturity for spraying.

There is no advantage in spraying early (before heading) as the loss of pasture growth will be large and plants may produce late seed heads from residual soil moisture or late-season rain.

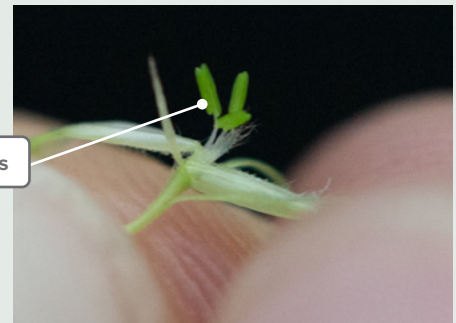
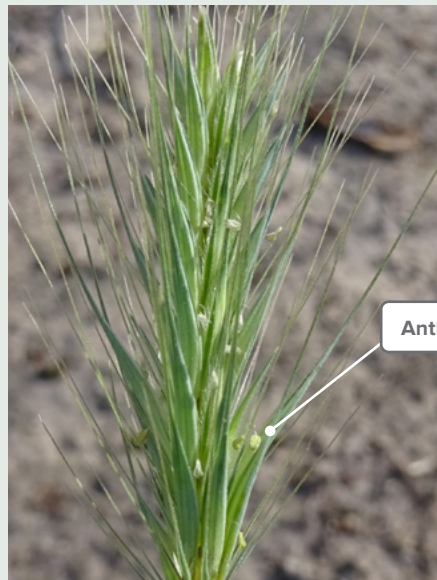
Sometimes multiple annual weeds are present with different ideal spraying times. If this is the case, manage spraying for the weed causing most concern.

For information on timing to minimise risks to annual clover seed set, refer to the section on reduction in legume population.

How to pick optimal flowering time

In grasses, flowering is indicated by anthers appearing in the spikelet and, in capeweed, flowering is indicated by yellow anthers appearing on the black disc.

Flowering barley grass.
Note: flowers hanging off
the spikelet (left) and
close up of flower (right).



Flowering capeweed (left)
and close-up of anthers
covered in yellow pollen (right).



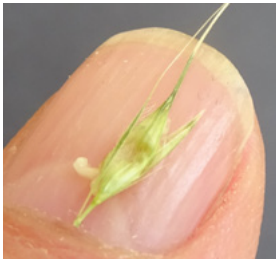



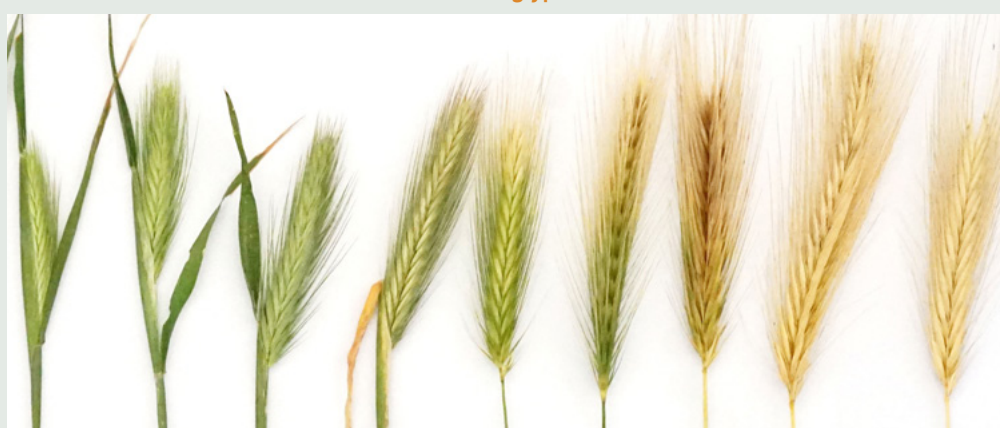
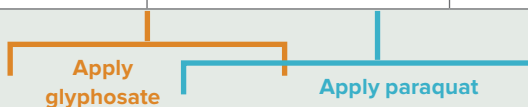
How to test for grass seed maturity

Step 1: Extract seeds from the middle of the seed head and squeeze seed between thumbnail and finger.



Step 2: Look for the following features to indicate the seed development stage.⁷ Glyphosate is commonly recommended to be used at milky dough, which includes stages 2 to 3, and paraquat between stages 3 and 4.

1. Watery ripe	2. Milk stage	3. Dough stage	4. Ripening
<p>The seeds release sappy liquid.</p> <p>(Cells which store starch are being formed).</p>	<p>The seeds release white liquid.</p> <p>The thickness indicates early, middle and late milk stages.</p> <p>(Indicates starch is being deposited).</p>	<p>The seed is cloggy but still soft and like dough.</p> <p>The soft dough stage changes to the hard dough stage when hardly any moisture is left in the seed. However, even at the hard dough stage the seed will still compress when squeezed.</p>	<p>Ripened seed barely compresses when squeezed and the colour is yellow/ brown.</p> <p>It is now too late to get control. Seed has reached maturity.</p>
			



Barley grass plants starting to 'hay off' indicated by lightening in colour (apply paraquat) and 'hayed off', seed heads have gone light brown (too late to spray).



Application and herbicide rate

Herbicide rates are provided on the labels. The higher rates are recommended for denser infestations. While higher rates can increase the level of control, use the minimum where possible to reduce the herbicide effects on desirable species.

Adding a wetter or surfactant to glyphosate will depend on the product formulation and the target weeds. Refer to the herbicide label for details.

The boom height may need to be raised compared to other spraying times to achieve double overlap at the height of the seed head.



Light and heavy infestation of silver grass, which would require different rates of herbicide.

Grazing after treatment

Stock can be introduced once the required withholding period has been reached, however the 'freezing' of quality in the pasture means grazing can be delayed. Other untreated pastures that are maturing can be grazed first.

Immediate heavy grazing does have the advantage of enabling seed heads to be eaten before they become brittle. If any heads have avoided herbicide contact, these can also be removed.

What are the risks and possible solutions?

Reduction in perennial grasses

The growth of perennial grass may be temporarily retarded by spray-topping, although the timing of application is usually late spring when pasture production is at its highest for the year. Plants commonly brown but recover if moisture is available. Glyphosate, a translocated herbicide, may result in greater reductions in future growth than paraquat.⁸

Reduction in annual grasses

The impact on annual grass production can be severe. Early spray-topping (mid-October, two weeks prior to flowering) of an annual pasture at Rutherglen, Victoria,

with glyphosate reduced spring growth by 4t DM/ha, or 45%, compared to the untreated area.⁶

If annual grasses are the base of a pasture, it would be wise to avoid using spray-topping, as the effect will be carried over to subsequent years.

Reduction in legume population

Glyphosate application during sub-clover flowering damages seed development and reduces initial levels of hardseededness.⁹ The resulting seeds will be smaller, with implications for seedling vigour, which makes them more susceptible to false breaks. Using paraquat instead of glyphosate is an option to reduce this damage.

Studies on other legumes such as balansa, serradella and gland clover have also reported reductions in viable seed after the application of paraquat.⁹

Unfortunately, optimum timing of spray-topping annual grasses with glyphosate often coincides with flowering of mid to late sub-clover varieties. If possible, avoid spraying until the seed is firm dough stage (may still be green) as this will result in less damage.

To test pull the burr or pod apart with your fingernails and feel the firmness of the seed between your fingers.



Firm sub-clover seed.

In the following year graze to maximise seed set to restore the sub-clover seedbank (see MLA fact sheet: [How do I manage grazing to maximise sub-clover seed set?](#)).



Spray-topping would best be avoided in years of spring feed shortage, unless it is part of a re-sowing preparation phase.

Viable weed seeds remaining

Rarely does spray-topping achieve complete reduction in viable weed seeds. There is also likely to be some residual seed in the soil from previous years. The technique will have reduced, but not eliminated, the weed seedbank.

Annual grasses and capeweed are prolific seeders, meaning populations can return quickly if they have the opportunity. Competition from other desirable pasture species is an essential part of capturing the benefits from spray-topping. Applying further weed control actions such as fodder conservation, mowing or additional herbicide techniques will enhance the effect (see MLA fact sheet: [How do I use hay and silage production to remove annual grasses?](#)).

Herbicide resistance

Strategic use of spray-topping in long-term pastures is unlikely to lead to herbicide resistance issues, due to a low incidence of resistant plants in a population. However, spray-topping can lead to an increased incidence of resistant weeds if there has been:

- prolonged use of the same herbicide mode of action
- an existing level of resistant weeds in a population
- incorrect application of herbicide – either low rates or poor coverage of target plants due to inadequate boomspray set-up.

If herbicide-resistant weeds are already suspected (or confirmed through resistance testing), spray-topping with the same mode of action will not be effective at preventing seed set.

Alternating herbicide modes of action (glyphosate and paraquat) and using non-herbicide control methods, such as silage, will be effective tactics for preventing herbicide-resistant weeds developing.

General spray-topping rules

- Use the lowest rate possible for the desired control, as the goal is to make the seed unviable without killing the plant or surrounding desirable species.
- Early application provides more time for perennial grasses to recover.
- Avoid spray-topping pastures less than 12 months old.
- Only use wetters and surfactants if recommended on the herbicide label.

References and more information

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9. Douglas A and Ferris D (2020) Effect of spray-topping on pasture legumes. DPIRD, WA. Online (verified Aug 2020) <https://www.agric.wa.gov.au/pasture-management/effect-spray-topping-pasture-legumes>

The herbicide label provides all the critical comments and precautions for the safe and responsible use of herbicides using the described techniques. Always read the label and only use as directed.

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