

# HERBICIDE APPLICATION FACT SHEET



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## Effective Double Knock herbicide applications

By using a Double Knock approach in fallow paddocks, growers have a reliable technique to control difficult weeds while also assisting in the management of herbicide resistance.

### KEY POINTS

- Double Knock herbicide strategies are critical to reducing weed seed banks.
- May delay the selection for glyphosate resistance, where Double Knock applications are routinely introduced before resistance is present.
- Optimal timing between applications is dependent upon the herbicides used and the weeds being targeted.
- Where possible, always target small weeds to ensure reliable performance.
- Attention to herbicide application parameters will improve consistency of results.

### What is a Double Knock?

A Double Knock (sometimes called sequential applications) is where growers apply two different weed control tactics to a single flush of weeds to stop any survivors from the first application setting seed. The tactics do not need to be herbicides. Cultivation, heavy grazing or fire could also be used as a second knock.

The most common Double Knock approach is to apply a systemic herbicide (for example Groups A, I or M are frequently used) when conditions are favourable for maximum translocation, and then follow it with a contact herbicide such as the bipyrindyls (Group L).

Table 1 represents some herbicide products used for Double Knock applications. This is not intended to be an exhaustive list of available options.

Always refer to the registered product label.

### Why use a Double Knock application?

Growers have adopted the Double Knock approach for the following reasons:

- to achieve very high levels of weed control that are required to stop seed set and drive down weed seed banks;
- to delay the onset of herbicide resistance; however, this will only occur if growers implement the strategy well before resistance has developed in that field;
- to provide improved levels of control of difficult-to-control weeds such as feathertop Rhodes and windmill grass, fleabane and sowthistle; and
- to overcome physical or biological incompatibility of certain herbicide mixtures.

**TABLE 1** Examples of some herbicides suitable for Double Knock applications.

Herbicide group	Active ingredient (primary registered brand name)
A	haloxyfop (Verdict®); propaquizafop (Shogun®); quizalofop (Targa®)
G*	butafenacil (B-Power®); carfentrazone-ethyl (Hammer®); flumioxazin (Valor®); oxyfluorfen (Goal®); saflufenacil (Sharpen®)
I	2,4-D (Amicide®); clopyralid (Lontrel®); dicamba (Cadence®); fluroxypyr (Starane®); fluroxypyr + aminopyralid (Hotshot®); halauxifen + fluroxypyr (Pixxaro®); picloram + 2,4-D (Tordon® 75-D); picloram + triclopyr (Grazon® DS); picloram + 2,4-D + aminopyralid (FallowBoss® Tordon®); picloram + triclopyr + aminopyralid (Grazon® Extra)
L*	paraquat (Gramoxone®); paraquat + diquat (Spray.Seed®)
M	glyphosate (Roundup®)
N*	glufosinate (Basta®)
Q	amitrole (Amitrole T)
Q+L*	amitrole + paraquat (Alliance®)

\*Herbicide groups G, L, N and Q+L have Modes of Action that work by rapid contact activity, so they are normally preferred as the second application when used in a Double Knock program. Haloxyfop (PER12941 – QLD only), quizalofop (PER13460 – NSW only).

Fleabane at an ideal stage to commence a Double Knock herbicide program.



PHOTO: BRUCE WILLSON



PHOTO: MARK CONGREVE, ICAN



PHOTO: MAURIE STREET, GRAINS ORANA ALLIANCE

Do not let fallow weeds get out of control. In addition to robbing the fallow of soil moisture, weeds such as these large sowthistle have already started to return seed to the seed bank and will be very difficult to control, even with a Double Knock application.

Poor control of fleabane, where boom height was too low for full spray coverage of a paraquat application.

## How to maximise the performance of Double Knock applications

To obtain the high levels of weed control required in a fallow, the first herbicide application must be able to achieve a robust level of control in its own right. Therefore weeds targeted by the first knock should ideally be small (pre-tillering for grass weeds and still in the rosette stage for broadleaf weeds) and not suffering from stress (for example, frost, too hot, too wet, too dry or damaged by insects or grazing). Robust application rates and good coverage are required to achieve the maximum performance on difficult-to-kill weeds.

The second application in a Double Knock program is then applied to further increase levels of control, ensuring there are no survivors. Often the Double Knock approach will use a systemic herbicide for the first application and a fast-acting contact herbicide for the second application. Where a systemic herbicide is used for the first application, it is important to allow a few days for the first herbicide to move throughout the weed before applying the subsequent contact herbicide that will quickly shut down any further possibility of herbicide translocation. Contact products, such as a Group L bipyridyl herbicide, do not

move easily through the plant. They are therefore best targeted at small plants only, and they must have a high level of coverage to achieve good results.

## What is the best application timing?

It is important to plan to Double Knock. To obtain maximum performance when using two different herbicides as a Double Knock, growers will generally apply the second application before the full effect of the first application is evident.

Poor results are regularly seen where growers only apply the second knock as an afterthought or when they have delayed application until the first application is showing signs of recovery.

*Most advisers recommend that if rain is forecast, it is usually preferable to apply the second application a day or two earlier than the ideal timing, rather than risk the possibility of being kept off the paddock for an extended period of time due to wet conditions. This is especially important when using Group L products as the second knock, as these cannot be applied by air.*

Poor control with the second knock is often due to the weeds becoming too large or too stressed or not having enough photosynthetic material to allow bipyridyl herbicides to work effectively.

If climatic conditions have prevented application of the second application for an extended period and plants have started to regrow, then the use

**TABLE 2 Suggested minimum spray volumes for bipyridyl (Group L) herbicide application.**

Spray quality	Recommended water volume
Fine	Avoid using due to the risk of spray drift.
Medium	Spray volume of 50 to 75L/ha will normally give acceptable results.  Use water rates at the lower end of the range on small weeds and in situations where coverage is ideal (i.e. low populations with minimal shading).
Coarse	Spray volume of 75 to 100L/ha will normally give acceptable results.  Use water rates at the lower end of the range on small weeds and in situations where coverage is ideal (i.e. low populations with minimal shading).

of a non-chemical Double Knock tactic, such as cultivation or fire, may be more successful in achieving the objective of preventing seed set.

The interval between herbicide applications will affect the efficacy of the Double Knock. The ideal interval depends upon a number of factors, which include:

- the type of herbicide being used for each application (systemic or contact herbicides);
- the species being targeted (generally shorter intervals for grasses than broadleaf weeds);
- the size and age of the weeds; and
- temperature and available moisture.

As a general rule, the smaller the weed, the less time it will take for the first systemic herbicide product to translocate throughout the plant. Employ intervals at the shorter end of the range.

### Application parameters when using contact herbicides as the second knock

Contact herbicides require excellent plant coverage to achieve good results as they are not translocated within the plant. Historically growers achieved this coverage by using smaller spray droplets in the fine to medium range. With the increased focus on spray drift reduction, fine droplets are no longer recommended. When using medium to coarse spray quality for contact herbicides applied as the second knock, increase the spray volume to ensure that there are enough spray droplets for effective coverage (Table 2).

Nozzle orientation may also assist in improving coverage of contact herbicides. Both forward and backward facing nozzles have been shown to give an increased level of control under some situations when compared to standard vertical nozzle arrangement. However, for forward facing nozzles to perform correctly and to avoid excessive drift with backward facing nozzles, growers need to optimise boom height and operating speeds should be less than 20 kilometres per hour.

With contact herbicides, boom height is critical as the herbicide will only act on the part of the plant that makes contact. In advanced stages, taller

**TABLE 3 Suggested intervals for some common Double Knock herbicide combinations.**

Weed	First application	Second application	Recommended timing	Comments
<b>Broadleaf weeds</b>				
Most broadleaf weeds	glyphosate	Group L (for example, paraquat)	7 to 21 days. Optimal timing is generally 10 to 14 days	
Difficult to control broadleaf weeds such as fleabane ( <i>Conyza bonariensis</i> )	Group I (for example, Amicide <sup>®</sup> , Advance, Tordon <sup>®</sup> , herbicides) with or without glyphosate	Group L (for example, paraquat) with or without saflufenacil (Sharpen <sup>®</sup> )	7 to 21 days. Optimal timing is generally 7 to 10 days	If interval is greater than 14 days, use maximum label rates of Group L herbicide
Difficult to control broadleaf weeds such as sowthistle/milkthistle ( <i>Sonchus oleraceus</i> )	glyphosate	2,4-D	2 to 4 days	Recommended to split applications due to biological incompatibility between 2,4-D and glyphosate. As both products are systemic, the interval needs to be short.
	glyphosate	Group L (for example, paraquat) with or without saflufenacil (Sharpen <sup>®</sup> )	7 to 21 days. Optimal timing is generally 7 to 10 days	Only target small rosettes
<b>Grass weeds</b>				
Most grass weeds including: Annual ryegrass ( <i>Lolium rigidum</i> ), Barnyard grass, ( <i>Echinochloa colona</i> & <i>E. crus-galli</i> )	glyphosate	Group L (for example, paraquat)	4 to 14 days. Optimal timing is generally 5 to 7 days	This strategy may not be effective on glyphosate resistant populations.
Feathertop Rhodes grass ( <i>Chloris virgata</i> )	propaquizafop (Shogun <sup>®</sup> )	Group L (for example, paraquat)	7 to 14 days. Optimal timing is generally 7 to 10 days	Target small, actively growing weeds for 3 leaf to early tiller. Refer to Shogun <sup>®</sup> label.
	haloxyfop	Group L (for example, paraquat)	7 to 14 days. Optimal timing is generally 7 to 10 days	Refer to APVMA permit PER12941 (expires 31 July 2024)
Windmill grass ( <i>Chloris truncata</i> )	quizalofop	Group L (for example, paraquat)	Within 7 days	Refer to APVMA permit PER13460 (expires 31 March 2022)

plants such as fleabane, sowthistle and some grasses can be too tall for effective coverage without raising boom height, and hence increasing drift.

Dense foliage, stubble shading and wind direction can also reduce coverage with contact herbicides, limiting their effectiveness.

When applying coarse or larger droplets at travel speeds above 20 kilometres per hour, droplets will leave the nozzle with forward momentum, resulting in a 'shadow' behind obstructions such as large weeds or standing stubble. Orientating nozzles 10° to 15° backwards may assist in larger droplets falling closer to vertical, which may increase coverage in these situations.

## PROJECT CODES

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## MORE INFORMATION

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## FREQUENTLY ASKED QUESTIONS

### I have seen excellent results from Double Knock application reported in trials, however, my field results are sometimes variable. What is happening?

When using a contact herbicide such as paraquat-based herbicides, pay careful attention to weed size, spray volume and application conditions. Double Knock trial results show consistently high performance when applied to small weeds (prior to tillering for grass weeds and prior to stem elongation for broadleaves) and where applications are applied on time with correct application set-up and climatic conditions. Results from research trials targeted at large weeds or where the Double Knock application is applied under less than ideal conditions also show variability in performance.

### How am I going to be able to get across my whole farm twice within a two-week period?

Lack of adequate spray capacity is one of the biggest constraints preventing successful adoption of Double Knock applications. Added to this, using contact-based herbicides as the second knock generally requires higher water rates and slower travelling speeds, and the climatic conditions for good application often mean the spray window is narrow.

Strategies that have been adopted by some growers include investment in additional spray capacity, use of contractors or the use of aerial application for the first pass. If spraying capacity is limited, ensure that the most critical paddocks are given priority and look towards other strategies for less critical paddocks, for example, apply a residual herbicide to some paddocks in order to take the pressure off the need to Double Knock the whole farm.

Access to an optical sprayer (for example WEEDit or WeedSeeker®) can greatly improve the time efficiency of the second pass, especially in situations of lower weed densities.

### I have applied the first knock, but rain has delayed my ability to apply the second knock. What should I do?

Sometimes climatic conditions prevent the ideal timing of Double Knock applications. Table 3 provides information on the preferred spray intervals for various weed and herbicide combinations that have shown to be the most successful in trial and commercial applications. Every circumstance is slightly different, so often there is a range of timings where acceptable, even if not optimal, Double Knock control can still be achieved.

Should the second application be delayed to the point where plants are showing signs of regrowth, then it may be more successful to wait until weeds 'freshen up' before starting again with the first knock. However, the important message is to prevent seed set and not to allow new seed to replenish the seed bank.

Bear in mind that weeds that have started to regrow will be bigger, have a more established root system and less leaf area to target and will almost always be harder to kill than younger weeds.

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