Pacific Seeds

Growing possibilities

HYOLA CT STEWARDSHIP GUIDE

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NEW

World's first Clearfield® + Triazine dual tolerant canola hybrid from Pacific Seeds

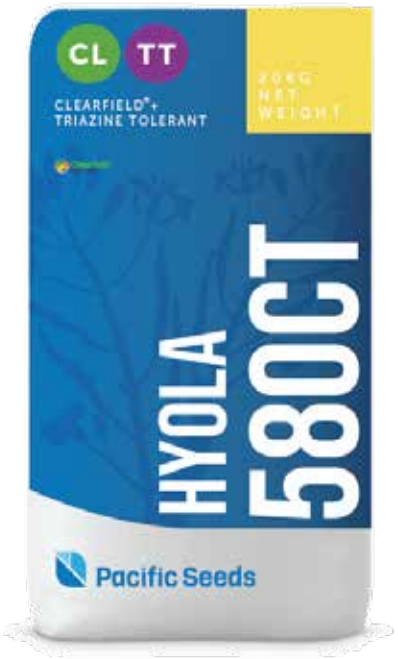
CLEARFIELD®
+ TRIAZINE TOLERANT

Clearfield Production System

HYOLA® CT TECHNOLOGY

Pacific Seeds has developed and released a world first non-GM dual tolerant canola technology system for Australian canola growers, branded as Hyola® CT Canola. Hyola® CT Canola is a combination of Triazine Tolerance and the BASF Clearfield® (Imidazolinone) herbicide technology within the same hybrid canola plant. This process was undertaken without using genetic modification or editing, and therefore has no restrictions with regards to the moratoriums in place in certain Australian states on the production of GM canola.

This guide has been prepared to provide an understanding of the benefits and limitations of Hyola® CT Technology canola. It also provides industry guidelines for the best management practices (BMP) and stewardship of Hyola® CT Canola. The agronomic performance and variety characteristics of current Hyola® CT varieties are available on www.nvtonline.com.au.



THE HYOLA® CT TECHNOLOGY SYSTEM

Hyola® CT technology was developed in full consultation with leading Australian weed and herbicides scientists as well as agronomic input from key agronomists right across Australia. The value behind the development was to provide the industry with an additional canola herbicide technology option that utilised 2 powerful knockdown + residual weed control herbicide chemistries (Triazine & Imidazolinone), in a package that was not genetically modified and therefore not restricted by some state government legislation about where it could be grown, or have any potential limitations in marketing of the grain due to GM status.

Given that around 55-60% of Australia's canola production area is Triazine tolerant (TT), and around 10-15% is Clearfield® canola production, it was logical to investigate and develop canola combining the 2 technologies, as they were already well established and understood in Australian canola farming practices.

Pacific Seeds canola breeders were able to successfully breed and integrate the TT and CL traits into the one hybrid, a hybrid that exhibited all the necessary yield and agronomic attributes required for dual herbicide tolerant Australian Canola production. No genetic modification or gene editing was required for this herbicide trait stack, therefore this event would be approved by the Office of Gene Regulator (OGTR) as "Non-GM". The CT hybrid then underwent stringent testing by Pacific Seed's Canola Technology Development team to ensure that it was compliant and fully tolerant of both Clearfield® (Intervix®) and Triazine (Atrazine) herbicides, both individually as per the respective herbicide labels for such products*.

Hyola® CT technology has passed the necessary testing to be registered as a Clearfield® hybrid, so all label plant back restrictions and spray rates applicable to straight Clearfield® hybrid apply to Hyola® CT Canola. Whilst there is no formal trait testing regime required for TT canola, Pacific Seeds also undertook due diligence to ensure the required tolerance was met to commercial rates of Triazine (Atrazine) herbicides.

*Please note that currently there is no APVMA registration for tank mixing of Clearfield® and Triazine (Atrazine) herbicides together over the top of Hyola® CT Canola. For further information regarding tank-mixing please consult with your local Pacific Seeds or BASF representative. Approved label instructions for each product must always be followed, in particular application timings, application rates, approved tank mix partners, withholding periods and plant back periods.

HYOLA® CT TECHNOLOGY KEY FEATURES

TT canola production system:

• The ability to grow a CT canola in a TT winter cropping system that can sustain no yield loss when faced with group B Imidazolinone herbicide carry-over (as per the Clearfield® label). This is increasing important in certain areas with certain crop rotations which may include other CL crops (CL Wheat, Barley, Lentils, Corn, Sorghum, Legume Pastures etc.), and that have soil types and/or low rainfall that required long plant-back periods to Imidazolinone herbicides).

• The ability to use Imidazolinone chemistry in crop if required for increased residual control of certain weed species (providing they are susceptible to group B herbicides), such as wild radish, Brome grass, Barley grass, wild mustards etc. (as per Intervix® Label).

Clearfield® Production System:

The ability to use another mode of action (group C) in combating group B resistant weeds and reducing the future selection pressure on Imidazolinone resistant weeds increasing.

THE CLEARFIELD® SYSTEM AND STEWARDSHIP

Clearfield® and Clearfield® Plus crops are highly valuable tools for Australian growers to optimise production in several grain crops such as barley, canola and wheat varieties. Herbicide-tolerant Clearfield® and Clearfield® Plus crops simplify control of hard-to-kill weeds with high yielding varieties.

The Clearfield® and Clearfield® Plus Production Systems combine:

- High yielding, herbicide-tolerant varieties from Australia's leading plant breeders and seed companies.
- Custom-designed Clearfield® herbicides for knockdown and residual weed control.
- Clearfield® stewardship program.
- Clearfield® canola varieties: tolerant to and registered for OnDuty® herbicide & Intervix® herbicide.

These registrations enable growers to control over 40 weed species including annual ryegrass, brome grass, barley grass, volunteer cereals, climbing buckwheat and wild oats.
Hyola® CT technology contains BASF's Clearfield® technology and is therefore managed under the Clearfield® stewardship program..

BASF is committed to delivering a high-quality Clearfield® Production System that helps deliver maximum yield potential and remains effective for the long term. Stewardship guidelines exist for both the seed and chemistry, ensuring high seed quality and purity, as well as adequate crop tolerance to Intervix® herbicide.

Clearfield® crops were introduced into Australia in 2000, with Clearfield® canola being the first crop. Since then, Clearfield® wheat, Clearfield® maize, Clearfield® Plus wheat and Clearfield® barley have been added to the portfolio of crops.

With the growing of Clearfield® Production System crops comes the responsibility of all parties (BASF, seed breeders, Clearfield® agencies, Clearfield® accredited agronomists and growers) to manage the sustainability of the Clearfield® Production System.

Chemistry stewardship is equally important and we recommend four key agronomic good practices be followed for all Clearfield® crops. Clearfield® Production Systems provide a clear route to high-yielding, high-quality and ultimately, more profitable crops. We look forward to a rewarding industry partnership with Clearfield®.

Four key agronomic practices for your Integrated Weed Management of Clearfield® Production Systems:

- Utilise crop rotation.
- BASF recommends that no more than two (2) Group B herbicides are applied in any four (4) year period on the same paddock as this is an important component of the stewardship program, and where possible, care should be taken to avoid applications of Group B herbicides in consecutive years unless at least two years' previous good weed control has been achieved with methods other than Group B herbicides. Keep accurate records of all herbicide usage.
- Properly manage weeds in crop-fallow rotation.
- Properly control volunteer Clearfield® plants.

Pacific Seeds advocates the preservation of Australia's canola herbicide production systems through the correct selection and application of canola production systems. Part of any sustainable farming practice involves good stewardship, and adapting to new farming practices and technologies, especially with regards to integrated weed management (IWM).

The stewardship principles for Hyola® CT Technology fully align with the broader Clearfield® Stewardship System, with further details provided in the sections below of this guide.

Pacific Seeds also recommends that no more than two (2) Group B herbicides are applied in any four (4) year period on the same paddock as this is an important component of the Clearfield® stewardship program, and where possible, care should be taken to avoid applications of Group B herbicides in consecutive years unless at least two years' previous good weed control has been achieved with methods other than Group B herbicides. Pacific Seeds also encourages any person applying pesticides to keep accurate records of all herbicide usage.

Reducing the weed burden can increase yields, reduce production costs, protect the integrity of Australia cropping systems, protect grain from marketing risks both domestically and export (i.e. weed seed contamination), and increase the sustainability of grain production in Australia.

Through Pacific Seeds leadership in developing new and novel canola herbicide technologies, we can provide our growers with increased options and flexibility..."more tools in the tool box" so to speak...during the canola phase of their cropping rotation. This aligns well with the industry WEEDSMART's "The Big 6" basis for an IWM program (https://weedsmart.org.au/the big-6/), which can be summarised as followed:

1. ROTATE CROPS AND PASTURES: Use double break crops, fallow and pasture phases to drive the weed seedbank down over consecutive years.
2. DOUBLE KNOCK – TO PRESERVE GLYPHOSATE: Follow glyphosate with a high rate of paraquat to control survivors in a fallow or pre-sowing situation.
3. MIX AND ROTATE HERBICIDES: Rotate between herbicide groups; Use different groups within the same herbicide mix; Always use full rates.
4. STOP WEED SEED SET: Crop top canola, pulses and feed barley (APVMA APPROVAL NO.: 62723/114765) in weedy paddocks; Consider hay, brown manure or long fallow in high-pressure paddocks; Spray top/spray fallow pasture prior to the cropping phase.
5. CROP COMPETITION: Adopt at least one competitive strategy (but two is better), including reduced row spacing, higher seeding rates, east-west sowing and competitive varieties.
6. HARVEST WEED SEED CONTROL: Capture weed seed survivors at harvest using chaff lining, chaff tramlining, chaff carts, narrow windrow burning or integrated weed seed destructors.

HYOLA® CT HERBICIDE APPLICATIONS & TIMINGS

Clearfield® herbicide applied in the CT canola:
Apply to canola crop at the 2 to 6 leaf stage. Apply to actively growing weeds in the 3-leaf to 2-tiller stage and broadleaf weeds in the 2 to 6 leaf stage.

DO NOT apply Clearfield® after 6 leaf stage.

It is important that Intervix® herbicide is applied as per the label recommendations to ensure weed species are either controlled or suppressed. To achieve the best result with Intervix® herbicide the following is recommended:

- Apply only to actively growing weeds which are not stressed.
- Apply in a minimum water volume of 70L/ha.
- Apply as early as possible within the application window to maximise efficacy (see Application Timings).

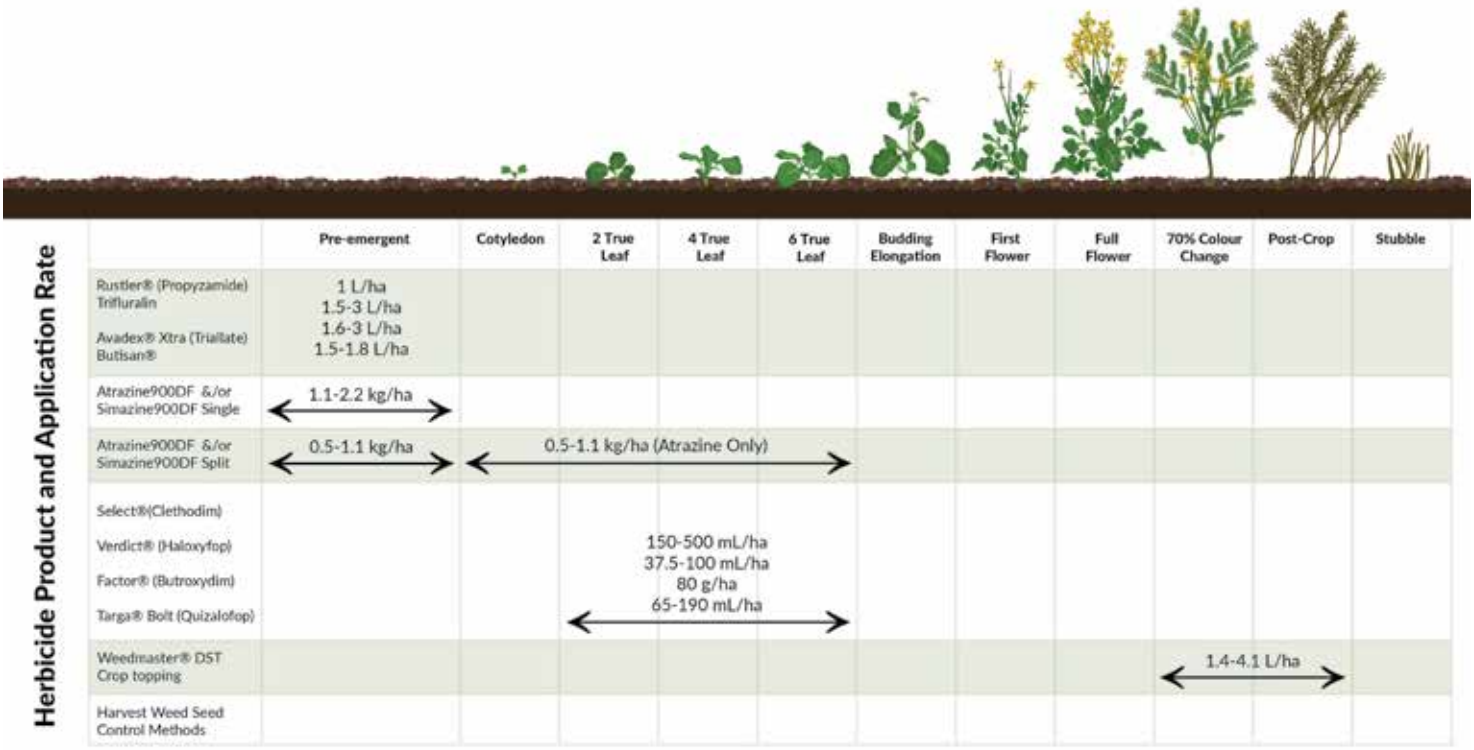
HYOLA® CT HERBICIDE APPLICATIONS - TT SYSTEM

Hyola® CT technology aims to increase the flexibility and spray options over standalone TT or Clearfield® canola production systems. The ability to use an extra mode of action (Group C for a CL grower, or Group B for a TT grower) may increase the weed control level and importantly reduce the number of weed species survivors, and consequently the ability for that species to produce weed seeds for further generations. This is all provided that the resistance status of the targeted weed species is susceptible to the herbicides being applied.

Results from collaborative efficacy research studies with Adelaide University show that weed control was greatly improved by tank mixing either Intervix® or Atrazine with Clethodim against applying Clethodim standalone. Below are some different herbicide options in which this tank mixing can be utilized within the Hyola® CT production system. (Please note: Tank mixing Intervix® with Clethodim is currently not registered).

These scenarios are provided as examples, and are not exhaustive, so please consult your agronomist or advisor and the latest herbicide product labels for the most up to date information.

Figure 1: Example of Hyola® CT used as a TT production system only. (Plant-back scenario)



HYOLA® CT HERBICIDE APPLICATIONS & TIMINGS

Scenarios for growing Hyola® CT as a TT only canola could include restricted crop options due to Imidazolinone herbicide residue from the previous Clearfield® crop, including CL Wheat, CL Barley or Pulses such as Imidazolinone Lentils or legume pastures. It may be desirable to grow Hyola® CT instead of a straight CL hybrid as a conventional type canola for several factors:

1. Allowing the Imidazolinone plant back period to pass whilst still using canola in the rotation and utilising a residual herbicide technology in Triazine to help combat hard to control weeds like annual ryegrass. Growing a CL canola in this scenario would be relying solely on Group A herbicides for post-emergent ryegrass control in-crop. CT would allow Atrazine + Group A's to be used in-crop, increasing the control levels and thus reducing the weed seed burden.
2. Using Triazines to control certain broadleaf weeds like wild radish and mustards.
3. Using Triazines to control or suppress broadleaf weeds like capeweed and Sow thistle, without relying on the use of Lontrel® (clopyralid). Lontrel® may have plant back issues in some regions with regards to following pulse crops or pastures.
4. Using CT as part of a "double-break" crop in the crop rotation, following an Imidazolinone-pulse crop where Clearfield® herbicides where applied e.g. Hurricane Lentils.
5. Provides great crop safety in relation to over the top spraying and boom hygiene, especially if other Clearfield® crops are grown on farm during the same season

Care must be taken to understand the carry-over restrictions that can occur on some soil types with Triazine herbicides like Atrazine and Simazine. Please consult your agronomist or refer to herbicide to labels regarding cropping plant-back restrictions post the use of Triazine herbicides and refer to the section in this guide regarding herbicide residues.

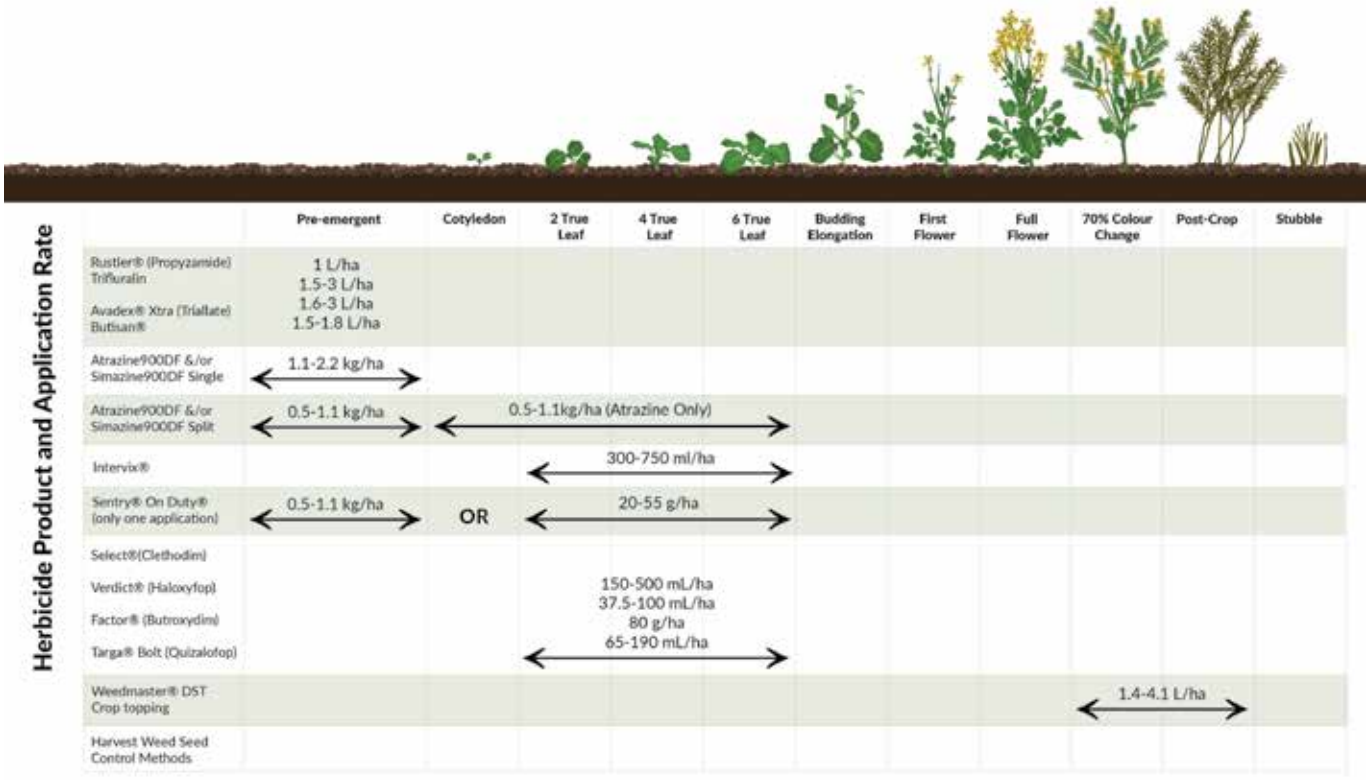
HYOLA® CT HERBICIDE APPLICATIONS - CT SYSTEM

Growing Hyola® CT and utilizing both Clearfield® + TT herbicide systems within the crop could be used to benefit an IWM program in some of the following ways:

1. Tackling problematic grass weeds such as brome grass, barley grass, that Group A selective herbicides may not be effectively controlling on those weed species on their own. Using the strategy of tank-mixing different mode of action groups to get better efficacy and reduce herbicide resistance selection pressure.
2. Provide additional control for certain hard to kill broadleaf weeds like Wild radish & Marshmallow, by combining the use of Triazine and Imidazolinone chemistry within the crop period.

Care must be taken to understand the carry-over restrictions that can occur on some soil types with Triazine & Imidazolinone herbicides Please consult your agronomist or refer to herbicide to labels regarding cropping plant-back restrictions post the use of Triazine and/or Imidazolinone herbicides and refer to the section in this document regarding herbicide residues.

Figure 2: Example of Hyola® CT used as a Clearfield® & TT production system.



RESISTANCE MANAGEMENT & IWM CONSIDERATIONS

To preserve the effectiveness of any herbicide a good resistance management approach is recommended. Intervix® herbicide is a Group B herbicide. Other group B (ALS inhibitors) include sulfonylureas, and triazolopyrimidines (sulphonamides). To assist with resistance management, rotate Clearfield® winter crops with spring crops to break the cycle of winter annual weeds and allow the use of alternate site of action herbicides. If winter cropping is rotated with a fallow season, control weeds before they set seed and use alternate mode of action herbicides. ALS-inhibiting herbicides should not be used more than 2 out of 4 years.

The rapid development of more Imidazolinone-tolerant crops over the past 25 years, has seen the application and use of Imidazolinone herbicides become very widespread. Winter crops such as wheat, barley, canola, and lentils have been bred to be tolerant to Imidazolinone herbicides, as well as summer crops including maize, newly released grain sorghum, and soon to be released sunflowers.

On top of this are naturally tolerant legume crops and pastures such as Field peas, mung beans, faba beans, chickpeas, peanuts, soybeans, Lucerne, serradella and subterranean clover. With such a wide use possibility, the possibility for widespread weed resistance is very real for Imidazolinone herbicides. Combined with the fact that weeds that are resistant to other Group B chemistry such as the sub-group Sulfonyl Ureas (Glean®, Logran®, Ally® etc.) can become cross-resistant to the sub-group Imidazolinone without being exposed to those herbicides.

In order to protect the integrity of Imidazolinone herbicides and reduce the risks of resistance developing, BASF recommends that Group B herbicide use is limited to twice in every four-year period per paddock, and to thoroughly control any surviving weeds.

In conjunction with this, a sound IWM strategy utilizing alternative modes of action across pre-emergent, post emergent and fallow application in different crops should be adopted, along with non-herbicide control measures such as harvest weed seed control (chaff carts, seed destructors, narrow windrow burn, chaff lining, Chaff baling etc.). Also consider a tank mix with non-ALS mode of action herbicide at full label rates for in-crop weed control.

IMI GROUP B - RESISTANCE MANAGEMENT CYCLES

Group B herbicides are very handy tools in the weed control toolkit, but weeds can evolve resistance relatively quickly to their mode of action.

To keep these herbicides as an option, and to maximise the benefits of imi-tolerant crops, it is essential they be used correctly within farming systems.

BASF suggests that it is easy for growers to get caught up in the imi-cycle of using imi-tolerant crops to avoid plant-back issues with imi residuals in the soil. The problem arises when an imi-tolerant crop is sown to avoid imi residues from the previous crop or fallow, but then the grower also wants to use the imi chemistry in the crop,

This leads very quickly to over-use of the imi herbicides, and research has shown that as few as four applications of group B herbicides (to which imi herbicides belong) to the same population of weeds can result in the selection of resistant individuals, so resistance can evolve within a very short period of time.
In Australia there are four imidazolinone or 'imi-type' active ingredients registered to control a variety of grass and broadleaf weeds in crops and fallow.

These actives are imazamox (e.g. Intervix®*, Raptor®), imazapic (e.g. Bobcat I-Maxx®*, Flame®, Midas®*, OnDuty®*), imazapyr (Arsenal Xpress®*, Intervix®*, Lightning®*, Midas®*, OnDuty®*) and imazethapyr (Lightning®*, Spinnaker®).

The other types of herbicides in Group B are the pyrimidinylthiobenzoates, sulfonylureas (SUs) and triazolopyrimidines herbicides. They all inhibit the plant's production of specific essential proteins.
Use the WeedSmart Big 6 to develop an integrated weed control program that keeps Group B herbicides as a viable option well into the future.

How do Group B herbicides work?

Short answer: The Group B herbicides, including the imis, interfere with the activity of the ALS enzyme that is used in the production of certain essential plant proteins.

Longer answer: The Group B mode of action is to inhibit the production of the acetolactate synthase (ALS) enzyme in the plant cells. This enzyme is needed to produce essential plant proteins. By inhibiting ALS production, a foliar herbicide application causes the plant to deplete its supplies of the essential proteins and the plant will slowly die, often taking about three weeks. Group B herbicides with residual activity inhibit the production of amino acids so the plant uses up the reserves in the seed as it germinates and is exhausted before it breaks through the surface of the soil.

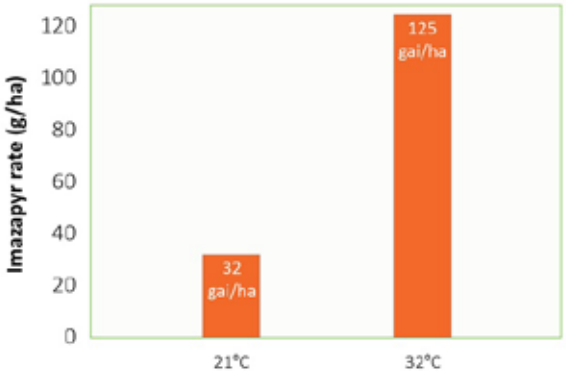
Whether using Group B herbicides as a pre-emergent, or post-emergent application; consider the use of registered tank mixes with herbicides from other modes of action.

What conditions do Group B herbicides need to work best?

Short answer: Small weed size is critical for effective foliar application. Imis will not kill older weeds, so applying these herbicides to large weeds is a waste of money.

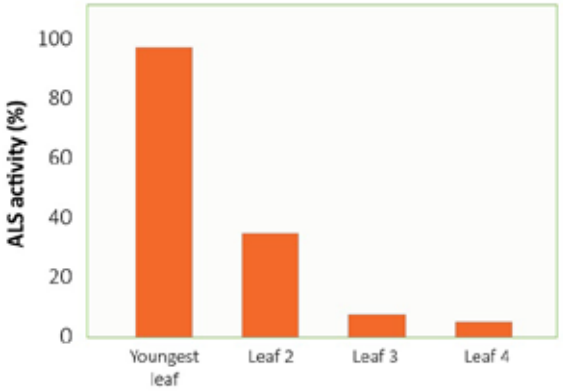
Longer answer: ALS concentration is highest in young plant tissue and so Group B herbicides are most effective when plants are small and actively growing. When plants are moisture-stressed there will be reduced uptake and translocation of foliar-applied imis. Uptake of imis is very sensitive to high temperatures. In summer, temperatures in the 30s will require much more active ingredient for the same level of control achieved at lower temperatures. Follow the label instructions.

There is a wide range of soil characteristics and environmental conditions that affect the efficacy of soil-applied Group B herbicides.



Affect of temperature on efficacy

- Environmental conditions such as temperature and relative humidity are the most significant factors affecting efficacy.
- Hot, dry conditions are the biggest influence, causing more rapid drying of the spray deposit and will also impact on the potential translocation.
- The chart shows that the rate required to give the same level of control (90% control if Cyperus) was significantly higher at 32°C than that at 21°C.



Importance of weed size

- Imidazolinone activity inhibits the ALS enzyme
- Control is better in younger, more rapidly growing plants.
- If the herbicide doesn't reach the growing points, activity is reduced.

Source: The Imidazolinone Herbicides (Shaner and O'Conner) 1991

GROUP B USE PATTERNS & PLANT-BACK REQUIREMENTS

What are recommended Group B use patterns?

Short answer: Apply no more than two (2) Group B herbicides in any four (4) year period on the same paddock and choose the right product for the situation.

Longer answer: A Group B herbicide application in either a summer crop or summer fallow is equivalent to a winter crop pre-emergent application, so no further Group B applications should be made in that paddock, that year. Use Group B herbicides strategically, if you use imazapic (Flame) in the summer fallow and Ally, Logran, Atlantis or Intervix (for imi-tolerant cereals) over the top of your cereal crop in the winter, you then need to wait three years before using any other Group B chemistry in that paddock.

If you are planting imi-tolerant varieties to get around an imi residue problem, do not use imi chemistry over the top – it's not good practice for resistance management and you will get stuck in the imi-cycle!

Always read and follow label instructions.

GROUP B HERBICIDE PLANT-BACK REQUIREMENTS

What are my options if there's sufficient planting rain but the plant-back requirements for the Group B herbicide haven't been met?

Short answer: Consider planting a Clearfield or imi-tolerant crop but try to avoid using imis or other Group Bs in-crop. Imazapic (e.g. Flame) applied in a summer fallow is cheap and effective, but it will have implications for crop rotation flexibility.

Longer answer: Imis have a broad range of soil binding characteristics and the period of residual decay varies markedly. Microbial activity is the primary mechanism for breakdown of soil-applied imis.

Consequently, soil moisture and temperature play an extremely important role in how long the herbicide remains effective in the soil and when it is safe to plant a sensitive crop.

Even if the residual has not broken down sufficiently to safely plant sensitive crops, there may be poor weed control due to sub-lethal amounts of herbicide remaining in the soil. This scenario represents a serious risk of partially resistant weeds setting seed. Other weed control options must be set in place to control weed escapes.

While Clearfield and imi-tolerant crops are the most tolerant crops available, there are several non-Clearfield crops, such as chickpea, field pea, mungbean, peanut and soybean that have a degree of natural tolerance to imi herbicides.

Look for a safe option that also enables the use of non-Group B herbicides and or cultural methods to manage weeds in-crop. If you need to use a pre-emergent, be sure to choose from an alternative herbicide MOA group.

Source: WeedSmart

MANAGING HERBICIDE CARRYOVER EFFECTS

Some herbicides can remain active in the soil for weeks, months or years. This can be utilised to a grower's advantage as it can provide greater long term weed control. However, if the herbicide stays in the soil longer than intended it may create issues for future crops or pastures that may be sensitive to those herbicide residues in subsequent years.

A common example is group B Sulfonyl Urea ("SU") or Imidazolinone ("Imi") is used in wheat or barley (CL Wheat or CL Barley for Imi), it can remain active in the soil for several years and damage non-tolerant legumes and oilseeds, particular in low rainfall farming regions, and high pH soils for SU's (pH>7), and low pH soils for Imi's (pH<7).

A problem for growers can be identifying the amount of residue that is remaining prior to planting the following crops, as the processes for herbicide breakdown can be a complex interaction of soil biology, soil pH, sunlight, rainfall and time.

Often commercial soil residue testing procedures can be too time consuming, expensive, are not able to accurately predict the amount of residue. Often the best to way to test a paddock is to take a small sample of soil from an area that would have been treated with a residual herbicide the previous season, and also take a sample from an area that was not treated with herbicide.

Keep these 2 samples separate in pots and plant some seeds of the intended crop into the pots and observe if there are any differences in establishment and early growth. This can take a few weeks so needs to be done well in advance of planting the paddock, and is not totally reliable as there are other factors that could be affecting the outcomes:

- The 'untreated' sample, whilst from the same field, may have been taken from outside the 'normal' planting/sprayed area, so may have different soil fertility, pH etc to the treated area, which may affect early plant growth of the test crop
- Rainfall/ moisture levels may be uneven across a paddock, there breakdown of herbicides may have occurred un-evenly across the paddock, so test samples may not show potential problem areas.
- On large farming operations, the collecting of multiple samples and growing in pots could become a time-consuming project.

MANAGING HERBICIDE CARRYOVER & GRAIN MRL'S

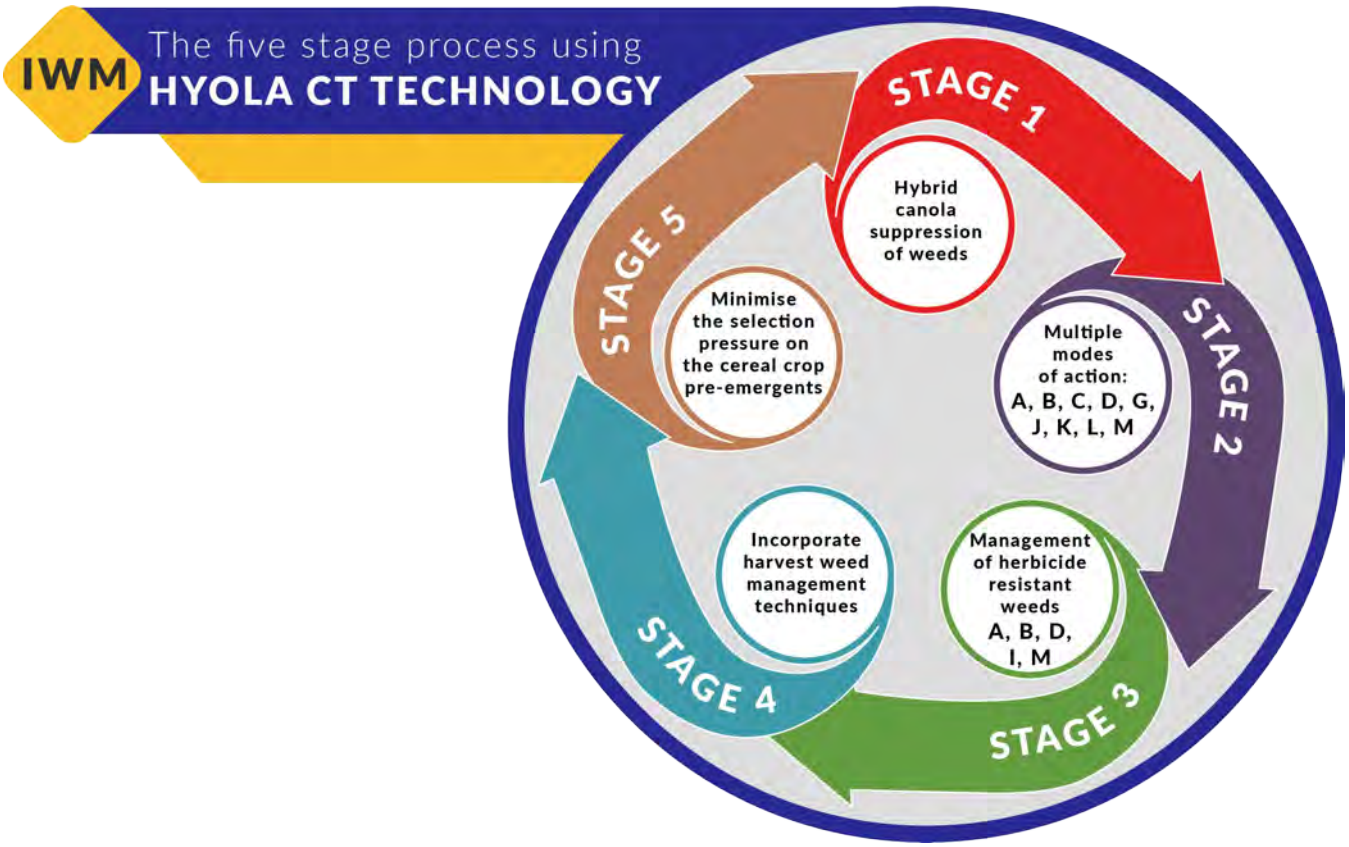
Another issue can develop after a crop has been planted, in that it can be difficult to identify residue issues confidently as other issues could be present such a nutrient deficiencies, disease or pests. Also, to further complicate the matter, the herbicide residues could actually be the primary issue and it is overlooked, as secondary issues are identified as plant nutrient deficiencies, diseases or pest damage, but the secondary issues are caused by the plant's stress tolerance being tested by the herbicide residues.

Intervix® herbicide can be used with confidence in Clearfield® barley, Clearfield® Plus wheat and Clearfield® canola.

Maximum Residue Limits (MRLs) in export destinations may be different to those in Australia. In some countries, in the absence of an established MRL a default of 0.01ppm is established. The use of Intervix® herbicide according to the label provides confidence for MRL compliance. Always use the registered product in accordance with the approved label.

Every country registers chemicals under their own regulations and according to their domestic use pattern and therefore differences between Australia and overseas MRLs may occur.

HYOLA® CT INTEGRATED WEED MANAGEMENT



TT variety significantly affected by soil Imidazolinone herbicide carryover

Hyola® CT variety unaffected by soil Imidazolinone herbicide carryover

INDUSTRY RESEARCH - RIGHT RATE TO REDUCE RESIDUES

• Weed management for hard-to-kill weeds is a significant issue for grain growers
• Uptake of Imidazolinone-tolerant varieties is becoming more common, especially when farmers are working to manage brome and barley grass, which have limited chemical control options
• Imidazolinone herbicide rates must be carefully manage to reduce the risk of residue build-up in the soil, especially in dry years
• Residues can affect plant vigour and growth of non-tolerant crops
• Incorrect use can lead to resistance so careful management is required

Correct use of Imidazolinone-tolerant technology is essential to avoid negative impacts in subsequent seasons, such as herbicide residues in soil which can impair growth in non-tolerant varieties. Rural Directions, in collaboration with growers from South Australia's Lower North and with support from the Grains Research and Development Corporation, led a project which looked at the effect of imi residues in cropping systems.

"Due to the dry spring and autumn, herbicide residues were likely to show up in the 2013 growing season, providing us with a great opportunity to investigate the effects of tolerant versus intolerant varieties of wheat, barley, canola and lentils," Rural Directions' Brendan Wallis said.

The trial investigated Imidazolinone herbicide efficacy on weeds by applying over two consecutive years at varying rates. Mr Wallis said the research was of particular interest as more growers incorporated Imidazolinone-tolerant varieties into their cropping systems to combat hard to kill weeds. He believes this use must be carefully assessed, particularly in low rainfall areas.

"Results showed there were no significant differences in the establishment of tolerant versus non-tolerant varieties. However, Imidazolinone residues were found to reduce plant vigour, with non-tolerant plants showing stunted root growth plus some yellowing of leaves.
We also found that the tolerant varieties out yielded non-tolerant varieties by 5 percent in wheat, 4 percent in barley, 34 percent in canola and 13 percent in lentils."

Source: Brendan Wallis, 08 8525 3000, bwallis@ruraldirections.com https://grdc.com.au/news-and-media/news-and-media-releases/south/2014/04/imidazolinone-residues

MANAGING CLEARFIELD PLANTBACK STEWARDSHIP

Unfavourable Conditions:

If there is little or no rainfall following the use of Intervix®, consult your local BASF representative before planting non-Clearfield cereals.

In calculating rainfall received, place greater emphasis on rain received from application up to the end of Spring and less emphasis on seasonal break and summer rains.

If single isolated heavy summer, autumn falls and break rains are required to achieve rainfall targets, it may not be safe to sow non-Clearfield cereals within 10 months of application. Consult your local BASF representative for advice.

Normally safe residue levels may still affect follow crops when soil nutrition is low or marginal, when cold and very wet soil conditions prevail, or when soil pathogens or nematodes are present. As environmental and agronomic factors make it impossible to eliminate all risks associated with this product, rotational crop injury is always possible.

Managing Clearfield Plantback:

When sowing a Plantback crop soon after its minimum re-cropping interval, ensure the following steps are taken to help minimise potential crop damage:

• Conduct a root disease test
Crop effects will be magnified in the presence of root disease.

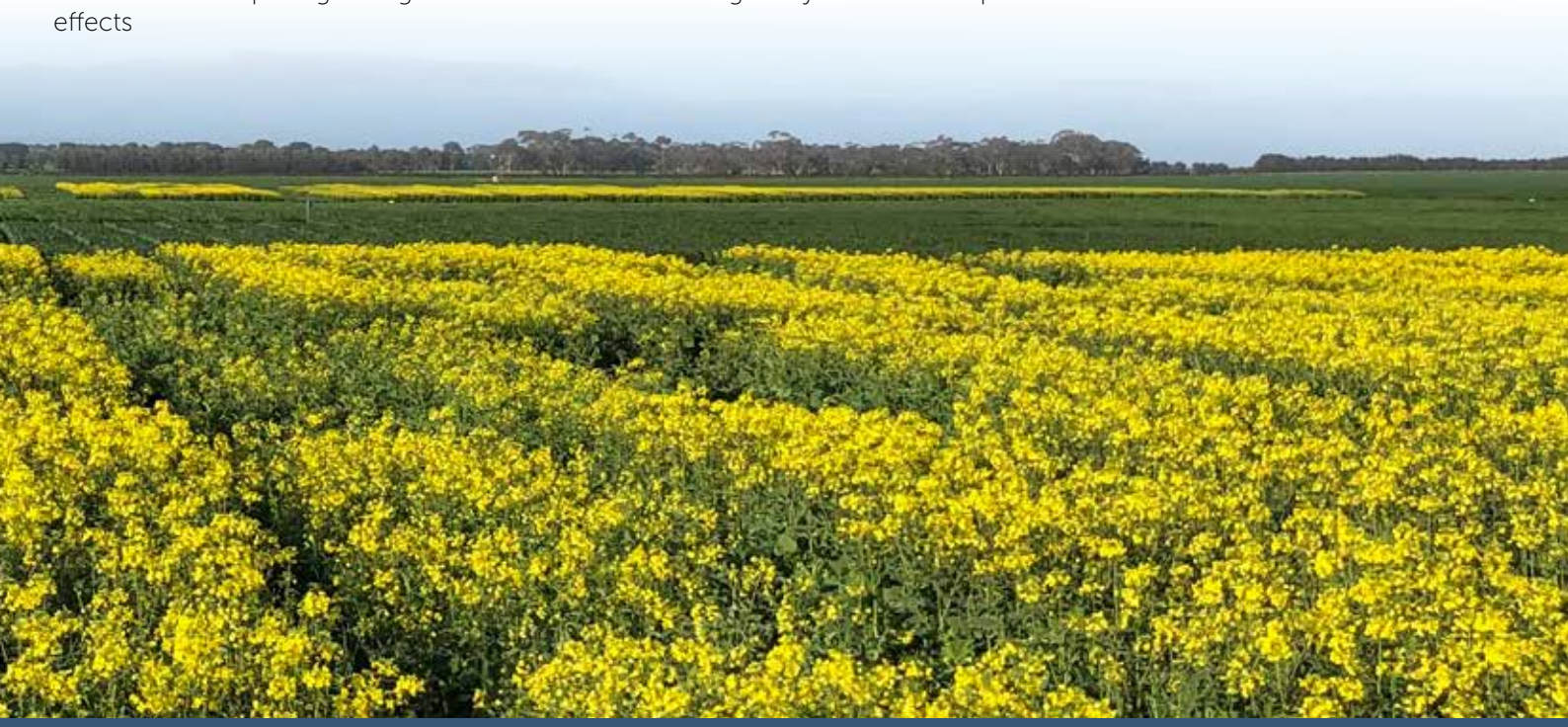
• Apply zinc to the seed
Available zinc promotes early root development.

• Delay seeding
Allowing more time will maximise potential breakdown.

• Sow at the right depth and ensure there is adequate nutrition
Promoting rapid germination and emergence will minimise risk.

• DO NOT use another Group B herbicide in the Plantback crop
Rotating modes of action reduces the potential of compounding herbicide effects.

• Avoid stress during the growing season
Stresses such as poor growing conditions or insect damage may make the crop more vulnerable to residual herbicide effects



MANAGEMENT STRATEGIES FOR CANOLA VOLUNTEERS

Using canola to control weeds as part of a balanced crop rotation can be an integral part of on farm integrated weed management (IWM).

There are several different canola herbicide technologies available to growers, and continual research means more will be become available in the future. Currently Australian canola growers have access to Triazine Tolerant, Clearfield®, Conventional, Glyphosate tolerant systems (State dependent) (Roundup® Ready and the new TruFlex®) and combinations of 2 or more technologies, such as RR+TT.

For 2019, new technologies from Pacific Seeds; Clearfield® + Triazine (CT) and TruFlex® + Triazine (XT), can be added to this list. One important factor to keep in mind, is that with new novel herbicide tolerances and combinations of tolerances, is the ability to control any volunteer canola that may germinate in subsequent crops, pasture and fallow areas.

Being aware of what herbicides are affective at controlling canola is essential in ensuring the volunteer canola doesn't become part of the weed burden.

The Australian Oilseeds Federation has published a comprehensive document on controlling canola and other brassica weeds in 2014. There are 4 key topics covered in this document that can be summarized as below:

1. Understanding volunteer canola and where it can come from: Seeds split or lost during harvest processes, incorrect use of herbicides when trying to control canola in a non-canola crop or fallow, seed movement around the farm from spillage, stock, rainwater runoff, and Low-Level Presence (LLP). LLP is where a trace amount of herbicide technology seed is found in the seed/paddock of a different herbicide technology canola.

2. Identifying and controlling volunteer canola: most canola seeds will germinate within the nest season but can germinate up to around 3 years later. Check all possible areas for volunteer canola emergence and aim to control them while they are small (prior to 4 leaf stage). In non-crop areas grazing, mowing, grading and herbicides can be used to control herbicides. Prior to crop establishment use appropriate knockdown herbicides (be aware that glyphosate is not registered to control canola) or cultivation. Within a crop, use appropriate registered herbicides.

3. Machinery hygiene and harvest management: Cleanliness of sowing equipment, trucks, harvesters, chaser bins, field bins etc. can largely prevent the distribution of canola seed beyond the paddocks it was grown. Correct timing of windrowing and harvest, as well as correct harvester set-up and operating speed, are essential to ensuring minimal harvest loss.

4. Summary: Most canola volunteers emerge the following year post a canola crop, and following canola with a cereal maximises the number of herbicide options available both pre-sowing and in-crop for effective volunteer control. Glyphosate alone may not control volunteers. Target early control (<4leaf) and use full rates of the appropriate herbicides.

To read the full report, download the article from the AOF website http://www.australianoilseeds.com/__data/assets/pdf_file/0018/9261/Canola_volunteer_control_guide_-_2014.pdf

Table A: Herbicide options to control volunteer Hyola® CT# canola in summer fallow and non-cropping situations*			
Herbicide Tolerance	Herbicide Product		
HYOLA CT#	Common Trade Names	Active Ingredient	Mode of Action
REGISTERED FOR USE	Amicide® Advance 700	2,4-D amine	I
REGISTERED FOR USE	Estercide® Xtra 680	2,4-D LVE ester	I
REGISTERED FOR USE	Spray Seed®, Revolver®	Paraquat + Diquat	L
REGISTERED FOR USE	Gramoxone® 360 PRO, Shirquat® 250	Paraquat	L
REGISTERED FOR USE	Agritone® 750, Polo® 570 LVE	MCPA	I
REGISTERED FOR USE	Amitrole T	Amitrole	Q
REGISTERED FOR USE	Alliance®	Amitrole + Parquat	L+Q
REGISTERED FOR USE	Sledge®	Pyraflufen-ethyl	G
REGISTERED FOR USE	Amitrole® T	Amitrole + ammonium thiocyanate	Q

* Product label claims for control of canola volunteers in specific crop situations. ** Always refer to the product label directions of use.
# Group B herbicide options or in combination with Triazine herbicides may not control Hyola CT canola volunteers in following rotation crops.
*Glyphosate herbicide used as a standalone option is not registered for control of canola volunteers.

Table B: PRE-PLANT herbicide options to control Hyola® CT# canola volunteers in winter crop situations			REGISTERED FOR USE					
Herbicide Product			Winter Crop Situation*					
Common Trade Names	Active Ingredient	Mode of Action	Wheat & barley	Other cereals, Triticale & Durum	Other cereals, Oats	Field peas and / or lupins	Chickpeas	Faba beans and / or lentils
Spray Seed®, Revolver®	Paraquat + Diquat	L						
Gramoxone® 360 PRO, Shirquat® 250	Paraquat	L						
Amitrole T	Amitrole	Q						
Alliance®	Amitrole + Paraquat	L+Q						
Balance® 750 WG **	Isolxaflutole	H						
Sharpen® WG	Saflufenacil	G						
Below registered Tank-mix options with the addition of Glyphosate (M) or Paraquat (L) #								
Amicide® Advance 700	2,4-D amine	I						
Estercide® Xtra 680	2,4-D LVE ester	I						
B-Power®	Butafenacil	G						
Sledge®	Pyraflufen-ethyl	G						
Hammer®, Nail®	Carfentrazone ethyl	G						
Terrain®, Valor®_500 WG	Flumioxazin	G						
Sharpen® WG	Saflufenacil	G						

* Product label claims for control of canola volunteers in specific crop situations. ** Always refer to the product label directions of use.
# Group B herbicide options or in combination with Triazine herbicides may not control Hyola CT canola volunteers in following rotation crops.

Table C: POST-EMERGENT herbicides to control volunteer Hyola® CT# canola in winter crop situations			REGISTERED FOR USE						
Herbicide Product			Winter Crop Situation*						
Common Trade Names	Active ingredient	Mode of Action	Wheat & barley	Other Cereals, Triticale & Durum	Other cereals, Oats	Field peas and / or lupins	Chickpeas	Faba beans and / or lentils	Pasture
EARLY POST EMERGENCE									
Eliminar® C	Bromoxynil + picolinafen	C + F							
Jaguar®, Bentley®	Bromoxynil + diflufenican	C + F							
Bromicide® MA	Bromoxynil + MCPA	C + I							
Broadside®	Bromoxynil + MCPA + dicamba	C + I							
Ecopar® + Agroxone® 750	Pyraflufen ethyl + MCPA	G + I							
Unity® + Agritone® 750	Carfentrazone ethyl + MCPA	G + I							
Agritone® 750, Polo® 570 LVE	MCPA	I							
Tigrex®, T-Rex®	MCPA + diflufenican	I + F							
Velocity®	Pyrasulfotole + bromoxynil	H + C							
Precept®	Pyrasulfotole + MCPA	H + I							
Triathlon®	MCPA + bromoxynil + diflufenican	F + C + I							
Paragon®	Picolinafen + MCPA	F + I							
Flight® EC	Picolinafen + bromoxynil + MCPA	C + F + I							
LATE POST EMERGENCE									
Amicide® Advance 700	2,4-D amine	I							
Estercide® Xtra 680	2,4-D LVE ester	I							
Agritone® 750, Polo® 570 LVE	MCPA	I							

* Product label claims for control of canola volunteers in specific crop situations. ** Always refer to the product label directions of use.
# Group B herbicide options or in combination with Triazine herbicides may not control Hyola CT canola volunteers in following rotation crops.

Pacific Seeds™

Growing possibilities

SUPPORTING RESOURCES

Resistance Management
CropLife Australia-Industry Stewardship-Resistance Management Website: www.croplife.org.au

Clearfield® Production System
Clearfield® Stewardship Best Management Practice,
Website: www.crop-solutions.basf.com.au

Weedsmart - Every Weed, Every Seed, Every Farm, Every Year The 'Big 6' of the WeedSmart plan
Website: https://weedsmart.org.au/the-big-6/

Australian Oilseeds Federation Website
Website: http://www.australianoilseeds.com/

Australian Oilseeds Federation Canola Volunteer Control guide Website:
http://www.australianoilseeds.com/__data/assets/pdf_file/0018/9261/Canola_volunteer_control_guide_-_2014.pdf

FOR MORE INFORMATION AND TO FIND YOUR LOCAL TERRITORY MANAGER, PLEASE VISIT

pacificseeds.com.au