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Mobile is better.

The role and function of the systemic molecule, Xemium.
By: Glen Forster

The value.

Growers are aware of the potential damage diseases can inflict on their crops. Fungal pathogens are mobile; they move throughout the plant tissue to gradually colonize the entire crop. So, if pathogens can move within the plant, shouldn't your fungicide? This is precisely the reason why growers look for fungicides with systemic activity. Systemic fungicides move into and towards new growth within the plant to prevent or halt fungal growth. A major group of systemic fungicides are the SDHI fungicides or succinate dehydrogenase inhibitors. These fungicides act by inhibiting a crucial enzyme in the mitochondria or the powerhouse of the fungus. This shuts down the fungal cell's energy supply and prevents the production of essential building blocks needed for growth. Fungi are particularly sensitive to fungicides that target mitochondria because this is where the cell's fuel for survival is produced. A particularly unique SDHI fungicide called Xemium® has been a valuable compound for several years now and it's changing the way we think about mobility.

The power.

Xemium is a third generation carboxamide, also known as fluxapyroxad. First and second generation carboxamides had a limited disease and application spectrum (FRAC 2016), whereas Xemium has a much broader spectrum across a host of different pathogens. Unlike most other SDHI chemistries, Xemium targets multiple stages of the fungus providing preventative, post-infection and residual efficacy (**Figure 1**). For example, it can inhibit both spore germination and mycelial growth in developing fungi. It provides control from early infection to later growth and future infection, giving growers greater application flexibility and efficacy. Like other SDHI fungicides, Xemium targets fungal mitochondria. But unlike the others, it reaches these mitochondria using its unique mobility characteristics. More specifically, Xemium can rearrange its chemical structure to maneuver through different types of plant tissue and fungal barriers. There are two forms of the molecule, the hydrophilic or "water loving" form that can move through cell walls and the plant's vascular system and the hydrophobic or "water repelling" form that can adhere to and move through waxy layers and membranes of the plant.

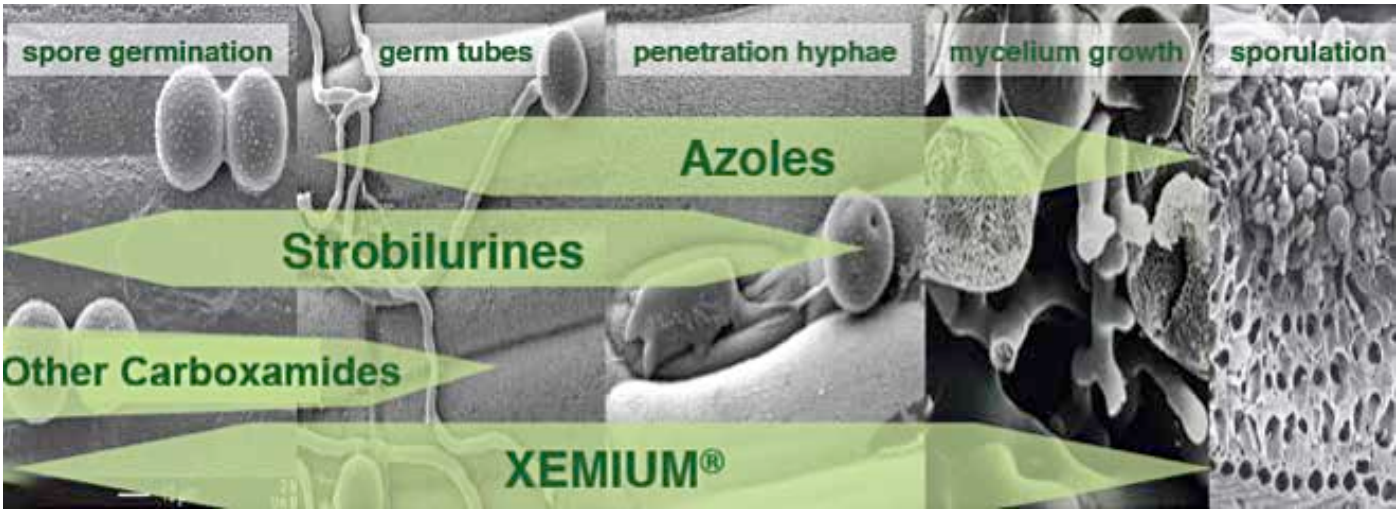

Figure 1. Xemium demonstrates activity at multiple stages of fungi.

The movement.

Once Xemium is applied, a portion quickly penetrates the leaf and moves into the plant's water transport system, or the xylem, for quick movement to the tips of the leaves. It's able to travel to portions of the plant that were not reached during spraying and eventually spreads throughout the entire cross-section of the leaf. The portion of Xemium that wasn't taken up immediately, binds firmly to the waxy layer of the leaf. And thanks to its water-repelling properties, some of the active will remain on the leaf surface in waxy depots. These Xemium depots or deposits continuously release the active due to moisture or stress-related events. In other words, the plant is protected as it grows (**Figure 2**).

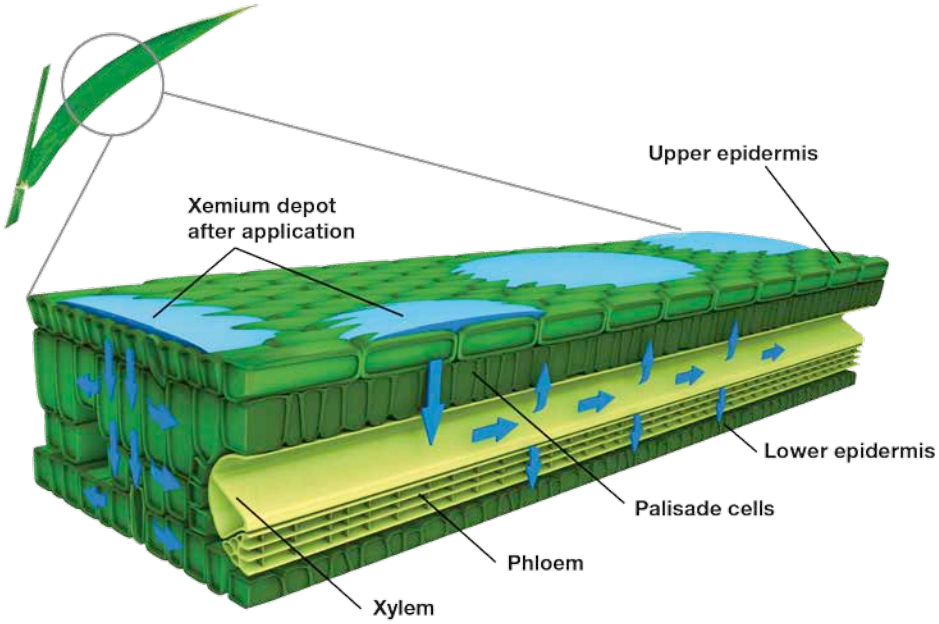

Figure 2. The distribution of Xemium throughout the plant tissue.

Systemic seed treatments make a difference.

Achieving a healthy, consistently emerged stand is key to a successful crop. Using a systemic seed treatment, particularly for pulses, protects the entire seedling during the critical growth stages and ensures that your crop gets that strong start. Seed treatments with Xemium move throughout the entire seedling providing superior disease control to young crops. Many seed treatments will move into the roots but not the shoots, so there is little efficacy on the aboveground portion of young plants. Xemium moves downward into the roots but it also moves toward new growth for improved germination and emergence (**Figure 3**). Overall, you'll get protection from key seed- and soil-borne diseases in pulses like ascochyta, anthracnose, fusarium, rhizoctonia and pythium.

Figure 3. Xemium (shown in blue) travels from the seed throughout the seedling to provide consistent and continuous protection. Source: BASF internal study, Germany, 2012.

Extended foliar disease protection.

Foliar diseases can significantly lower both the yield and quality of your pulses, so protecting the health of pulse crops is essential. The unique mobility properties of Xemium can help control foliar diseases like mycosphaerella in field peas, anthracnose in lentils and ascochyta blight in lentils and chickpeas. Because of the continuous redistribution and slow release of the active, the plant is protected for longer periods of time (**Figure 4**). But remember, just because Xemium provides extended protection to new growth, it won't control disease that develops on older plant tissue. So as always, coverage is key.

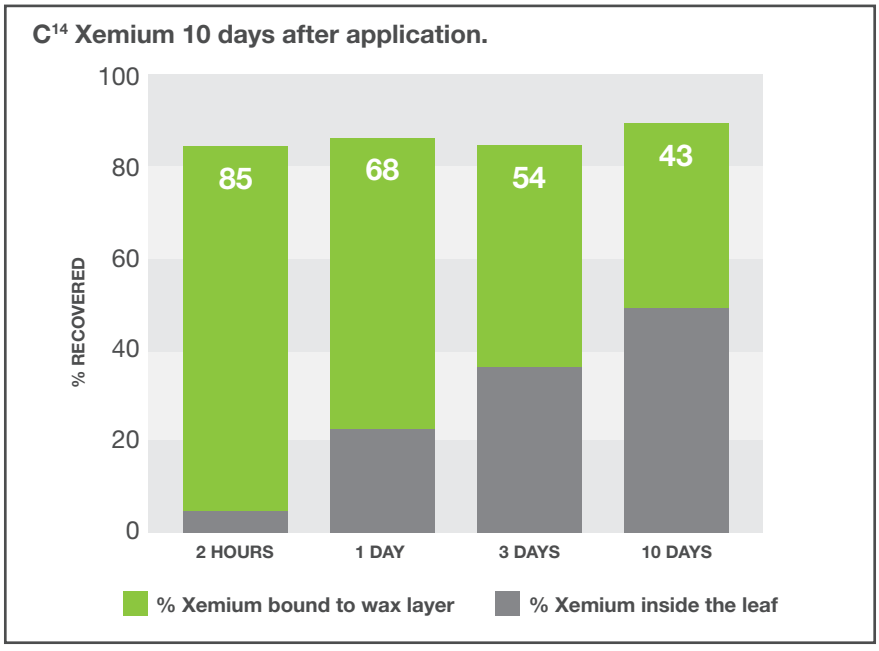

Figure 4. Continuous release of Xemium over several days.

Future Innovations.

Xemium is a key active ingredient for several crops around the world, including wheat. In 2013, Smith et al. reported that Xemium showed stronger efficacy against key foliar diseases in wheat (septoria, tan spot and stripe rust) compared to other actives. They also found that plants treated with Xemium demonstrated greater water use efficiency, meaning the amount of water needed to produce the same amount of grain per hectare was significantly reduced compared to other fungicides. In Canada, a new research product called Nexicor™ is in the process of being registered. Nexicor combines three active ingredients, one of which is Xemium, to deliver superior leaf disease control in cereals. Research trials have demonstrated that Nexicor provides more consistent and continuous disease control for increased growth efficiency and greater yield potential.

Sources

FRAC 2016. SDHI fungicides. http://www.frac.info/working-group/sdhi-fungicides

Smith J, Grimmer M, Waterhouse S, Paveley N. 2013. Quantifying the non-fungicidal effects of foliar applications of fluxapyroxad (Xemium) on stomatal conductance, water use efficiency and yield in winter wheat. Communication Agriculture Applied Biological Science. 2013;78(3):523-35.

Always read and follow label directions.

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Managing volunteer canola in tight rotations.

The benefits of alternating herbicide-tolerant systems.
By: Colleen Redlick

Maximizing canola production in tighter canola rotations requires planning that includes managing volunteer canola. A volunteer is any canola plant that grows from the seed of a previous crop. They can be viable for a couple of years in soil and a single volunteer can produce over 500 seeds.

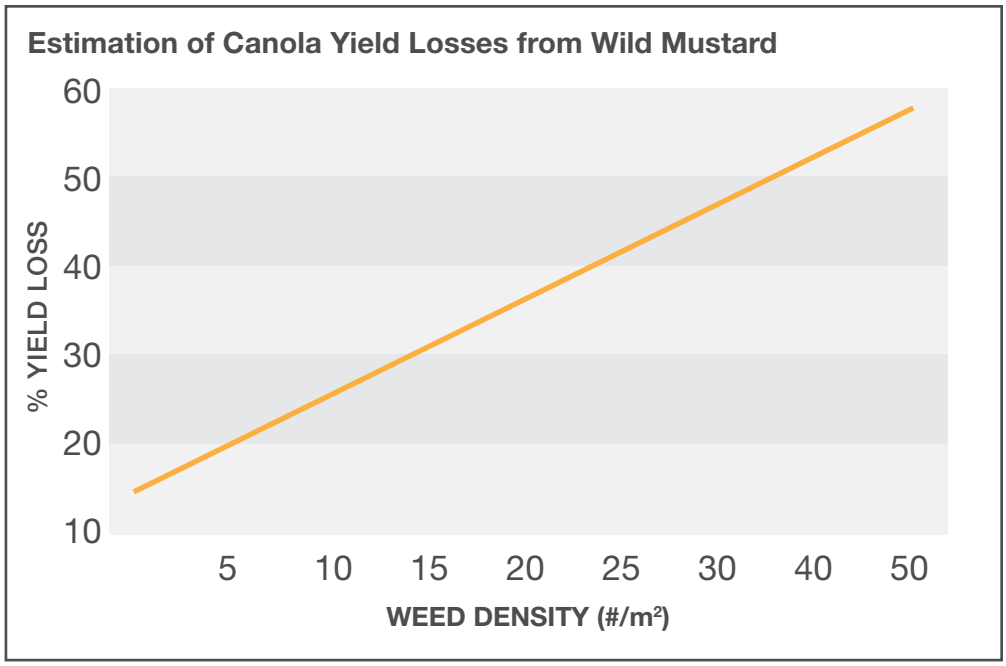
Left unmanaged, volunteer canola can reduce a crop's yield potential and have negative effects on both quality and integrity.

Decreased yield potential

- Volunteers do not have the same genetic yield potential. Second generation seed can yield as much as 13% less that the original hybrids.
- Volunteers compete with the crop for nutrients, water and light, reducing the crops yield potential during early development.
- Emerged canola volunteers can provide a refuge for flea beetles, which can damage a seeded crop regardless of whether a seed treatment was used.
- Volunteer seed that has been sitting in the soil can harbour diseases (blackleg, clubroot and sclerotinia), subsequently infecting the crop.

Quality and integrity

In addition to consequences in yield potential, volunteers can also introduce undesirable traits through cross pollination and seed contamination (Canadian Seed Trade Association, Fact Sheet). Left unmanaged, the persistence of canola volunteers that are not from the crop can also impact marketability of the harvested seed. (Canola Council, Canola Export Ready program)



Source: Canola Council of Canada, Canola Grower's Manual, 2011.

Using wild mustard (a similar species to canola) as a stand-in for volunteers gives an idea of yield reduction based on volunteer density. At 5 wild mustard plants per m^2, canola can lose 15% of its yield.

Volunteers can be introduced to a field in a number of ways:

- Losses of seed through the combine at harvest can be up to 20 times the seeding rate for a crop.
- Pod shatter during swathing and heavy wind or hail impact on a standing crop can add seed to a field.
- Full tillage and the burying surface seed left after harvest can keep volunteer seed viable for years (dormancy).
- Volunteer seed can also be transported field-to-field via equipment.

Scouting for volunteer canola.

It's always recommended to scout early before seeding the crop to look for early germinating volunteers. Look for seedlings that are emerging between the rows; these will likely be volunteers. An easy way to confirm is to dig it up and look at the seed. If there is no coloured seed coat it means it's untreated and therefore a volunteer.

Volunteer canola emerges early and can harbour flea beetle and seedling diseases.

Source: BASF video, Scouting for volunteer canola

Integrated management plan for volunteer canola

There are several things you can do to reduce the presence of canola volunteers in your field:

- Keep records of the herbicides used, including years when canola is not being grown.
- Manage your harvest, especially with respect to swathing timing and combine settings. Aim to reduce any canola seed returned to the field.
- Promote the germination of any seed left on the soil after harvest. Germinated seed will not survive.

Rotating your HT canola system

If you have volunteer canola or anticipate having it in a canola sequence, the best recommendation is to rotate to a canola system that uses an alternative-mode-of-action system herbicide. The three main herbicide-tolerant (HT) canola systems use herbicides from three different group chemistries.

- glyphosate (Group 9)
- glufosinate (Group 10)
- imidazolinones (Group 2)

Rotating between these three systems will help ensure volunteer canola can be controlled by the alternative in-crop system herbicide.

Including Clearfield® in your rotation

The **Clearfield** Production System for canola with Ares® herbicide provides an alternative mode of action for control of volunteer canola from the Group 9 and Group 10 herbicide-tolerant canola systems. Including it in the rotation can provide other benefits as well:

- High-performance hybrids designed for competitive yields
- Superior standability and harvestability for straight-cutting ease
- Different maturities, resistance to disease and lodging along with other agronomic traits suitable for your operation
- Pod-shatter resistance for better straight-cutting performance with newer varieties being developed
- Consistent, reliable post-emergent weed control, including subsequent flushes of weeds like cleavers and wild mustard
- Improved control of wild buckwheat, wild oats and lamb's quarters

Tightened canola rotations require all growers to have an integrated management plan for reducing the losses in yield due to volunteers. Scouting early to keep a handle on any problems that may be present in your fields and planning to include all possible HT systems in your sequence can go a long way to helping maximize the success of your canola crops.

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Finding the right partner for your glyphosate application.

Strategies for managing glyphosate-resistant weeds.
By: Andrew Reid

It's no secret that crops grow best in a clean field, and the best way to achieve that is with a pre-seed/pre-emergent burndown. Since its introduction in 1974,[1] glyphosate's broad weed spectrum has made it the herbicide of choice for many growers. But with the continued spread of glyphosate resistance, an effective burndown calls for more than glyphosate alone.

Resistance impacts your yield early on.

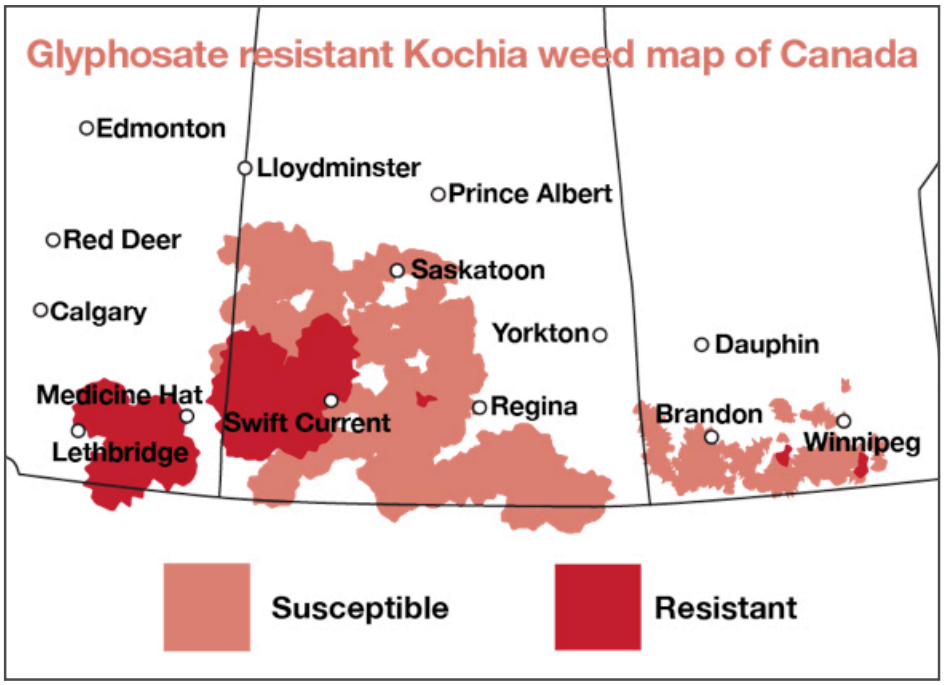
Volunteer canola and kochia are known weeds with resistance to glyphosate in Western Canada. They compete for nutrients, sunlight and water during the early stages of crop development, robbing your crop of its yield. If not managed properly, resistant weeds can continue to spread and limit your cropping options. Repeated applications of a herbicide with a single mode of action can continually select for resistance – worsening the problem in the long run. Plus, weeds can harbour diseases even in non-crop years, diminishing the benefits of your crop rotations.

Volunteer canola

Not only do canola volunteers detract from your yield, they also emerge throughout the season. Without residual activity, a glyphosate-only burndown is unlikely to provide adequate control. And if canola volunteers happen to be of the glyphosate-tolerant variety, then a tank-mix partner is needed for your pre-seed/pre-emergent application. Note that canola volunteers can be outcrossed with other systems, leading to individuals with stacked herbicide-tolerant traits.

Glyphosate-resistant kochia

Research has shown that nearly 80% of kochia emerges before your crop does,[2] hence the importance of a pre-seed/pre-emergent burndown. Due to overreliance on Group 2 chemistry, all kochia in Western Canada is now considered Group 2-resistant. Combined with the rise in glyphosate resistance, kochia management requires at least two additional modes of action during that season for effective control.



Source: 2014 IPSOS brochure

Wild oats

No instance of glyphosate-resistant wild oats has been reported yet, but wild oats has shown resistance to multiple Group chemistries already. Many are resistant to Groups 1, 2 and 8, and researchers say it could be the next weed to adapt to glyphosate.[3]

As both broadleaf weeds and grasses develop resistance to more and more chemistries, the cost of incorporating additional herbicides will only get higher.

How to choose an additional mode of action. Or two.

To reduce the impact of early emerging weeds and glyphosate-tolerant biotypes, we need to take an integrated approach that includes an additional mode of action in your pre-seed/pre-emergent burndown. This will help manage existing resistant biotypes, as well as prevent the onset of resistance in other weeds. Here's what you should look for in a suitable tank-mix partner:

Residual activity

Glyphosate only works on emerged weeds. To control flushing weeds such as volunteer canola, cleavers or wild oats, choose a tank-mix partner with residual activity. If you're using a herbicide-tolerant system, this will also help take the pressure off your in-crop herbicide later on.

Group chemistry differs from your in-crop herbicide

In-crop herbicide choices tend to be limited, so make sure you use a different mode of action for burndown. This will help manage weeds not targeted by your in-crop herbicide.

Overlapping activity on your weed spectrum

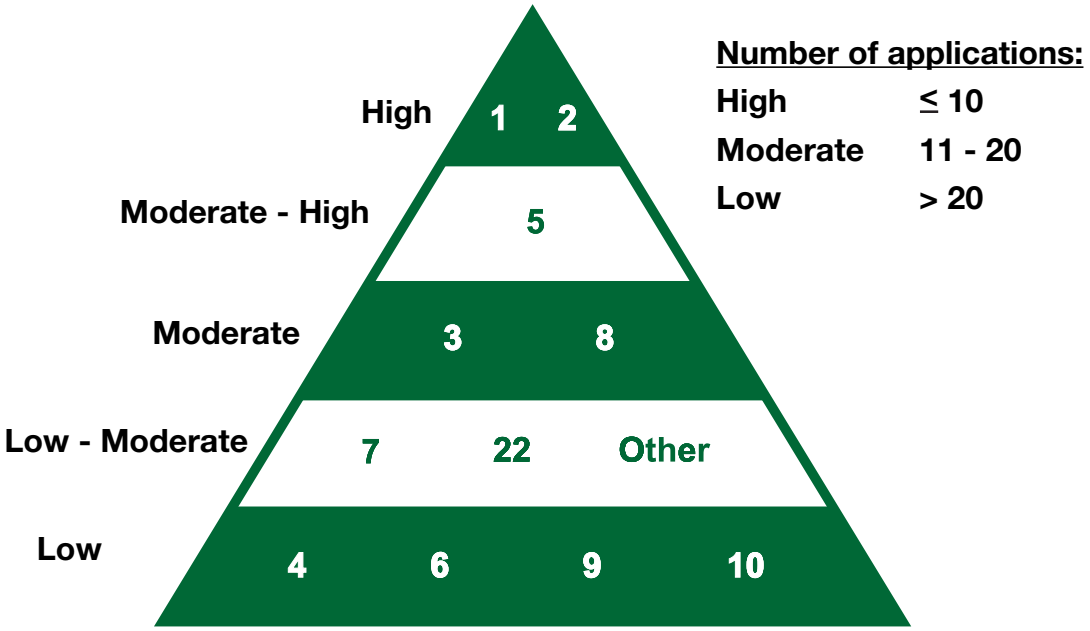
Know which weeds are growing in your fields and choose chemistries that target them. All kochia is now considered Group 2-resistant, so if you have glyphosate-resistant kochia, avoid tank mixing glyphosate with a Group 2 herbicide. Many wild oats are resistant to Groups 1 and 2. Use active ingredients with overlapping activity to avoid placing selection pressure on a single chemistry.

Suitability for your crop

Ensure that any tank-mix partners won't cause harm to your crop. Some broadleaf herbicides have residual activity that can lead to canola damage. Double check the herbicide label to confirm.

Unique chemistries

Repeated use of some chemistries are more likely to lead to the onset of resistance than others, such as Groups 1 and 2. This is in part due to the complexity of resistance mechanisms involved. Wherever possible, use chemistries that have a lower risk for resistance and/or have fewer reported incidents of herbicide resistance such as Groups 14 and 15.



Source: Adapted from Beckie, 2006 as appeared in Grainews[4]

Speak to your retailer about solutions that fit your needs. Some good pre-seed tank-mix partners include Group 14 and Group 6 chemistries for managing glyphosate-tolerant volunteer canola, as well as Group 14 chemistry for managing kochia.[5] Some Group 15 herbicides are also good options for application ahead of canola.

Once you've selected an appropriate tank-mix partner or two, take full advantage of your tank-mixed glyphosate application by applying these best practices:

- Use full label rates to minimize weed escapes and the spread of weed seeds
- Keep fields clean when the impact to yield is greatest
  - For cereals: emergence up to early jointing
  - For canola: emergence up to the 4-leaf stage
- Apply when weeds are actively growing and when overnight lows are above 3°C to 5°C
- If you miss the pre-seed application window, take note of environmental conditions to determine your timing for a pre-emergent application
- Use a sprayer meant for that type of herbicide; double check the label or contact your local representative

Integrate non-herbicidal practices into your approach.

While using multiple modes of action is a good strategy, the best approach to managing resistance includes non-herbicidal practices as well. Increase the competitiveness of your crop by selecting varieties suitable to your field's growing conditions. Plant at more shallow depths and sow at higher seeding rates to outcompete weeds. Rotate your crops to take advantage of different chemistries. Even rotating into a different herbicide-tolerant system will help manage volunteers and delay resistance. Be sure to use clean equipment to prevent the spread of resistant weed seeds. And most importantly, keep good records of your weeds, the management strategies taken and their outcomes.

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