SDSU Extension

iGrow Wheat

BEST MANAGEMENT PRACTICES

Chapter 25: Weed Management in Spring and Winter Wheat

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Introduction

The objective of this chapter is to discuss general weed management options and strategies for spring and winter wheat. Wheat, when planted in rotation with corn and soybeans, can be used to reduce selection for herbicide resistant weeds. The early emergence of spring or winter wheat enables wheat to gain an early season growth advantage relative to many common weed species. This can help suppress weeds that escape herbicide treatments. In addition, the introduction of new herbicides and herbicide-tolerant wheat varieties have made weed management more effective. In this chapter, weed management strategies will be described based on the weed species present and application timing.

Challenging weed species

Despite wheat's competitive ability, there are many weed species that can persist and multiply in small grains. The potential for a weed species to flourish in small grains depends on its emergence time, ability to grow quickly, and its seed production potential. Table 25.1 includes some of the most common weed species in South Dakota wheat.

Table 25.1. Common grass and broadleaf weed species in South Dakota wheat[1].

Grass weed species
1. Brome or "cheatgrass" (downy or Japanese brome)
2. Foxtails (green or yellow)
3. Wild oats
4. Barnyardgrass
5. Witchgrass

Broadleaf weed species
1. Kochia
2. Wild buckwheat
3. Prickly lettuce
4. Common ragweed
5. Mustard species

[1]*Weeds are not arranged in order of frequency across the state.*

Perennial weed species

Although perennial weeds can be very competitive in wheat, there are several management options. Noxious perennial weeds, such as Canada thistle and field bindweed (or creeping Jenny), are particularly problematic in seed production fields where noxious weed seed is prohibited. Both of these species can be suppressed with 2,4-D. Clopyralid (found in WideMatch®) may be more effective than 2,4-D on Canada thistle. Since these perennial weeds will often continue growth after wheat harvest, a fall glyphosate application in wheat stubble can effectively reduce densities in subsequent crops.

Figure 25.1. Canada thistle growing in wheat.

Figure 25.2. Field bindweed flowers and leaves.

Perennial grass weed species can also be a problem. Perhaps one of the most problematic perennial grass weed species is foxtail barley. Foxtail barley is most prevalent in wet, alkaline soils in no-till fields. It can be difficult to control because it matures early (approximately late May), at which time herbicides are no longer effective. In addition, herbicides registered for foxtail barley control, such as those containing propoxycarbazone (Olympus® and Rimfire®), may only provide suppression. In one study conducted in eastern South Dakota, no post-emergence grass herbicide had activity on foxtail barley. Consequently, it may be critical to control foxtail barley with a burndown application of glyphosate prior to spring wheat emergence.

Figure 25.3. Foxtail barley at maturity.

Like many other perennial weeds, foxtail barley may also be controlled with fall glyphosate applications in the wheat stubble. In some cases, both spring and fall glyphosate applications are necessary for optimum control (Blackshaw et al. 1999). Other perennial grass weed species, such as quackgrass, are usually not

 

Figure 25.4. Young foxtail barley plant that may be present at the time of the burndown herbicide application prior to spring wheat planting. May be identified by the clasping auricles, or finger-like appendages, at the base of the leaf (right). Quackgrass also has similar leaf characteristics, but foxtail barley is a clump-type perennial with fibrous roots whereas quackgrass has thicker, "cord-like" rhizomatous roots.

very problematic in wheat, but including wheat in crop rotations can increase the potential for quackgrass establishment and increased densities in subsequent crops. Some herbicides that are active on downy brome, such as propoxycarbazone, sulfosulfuron, or pyroxsulam, may also suppress quackgrass.

Winter annual weed species

Winter annual weed species, such as brome or "cheatgrass" (downy or Japanese brome) and mustards, can be a problem because they emerge at approximately the same time as winter wheat in the fall and resume growth with wheat in the spring. Consequently, properly timing herbicide applications can be difficult because weather conditions can be challenging in the fall because it can be difficult to distinguish brome seedlings from wheat seedlings. Brome can mature rapidly in the spring making them less susceptible to many herbicides.

Downy and Japanese brome must be treated with herbicides in the fall for optimal control. These brome species are often incorrectly referred to as "cheatgrass." Fall herbicide applications can result in nearly complete control whereas spring herbicide applications may result in 50 to 70% control. Herbicides applied in the spring must be applied early (late April to early May) to increase their effectiveness. If fall moisture is adequate or winter wheat is planted late, it may be possible to control early emerging brome populations with a fall glyphosate burndown application, but this is not a standard recommended practice.

Generally, ALS-inhibiting herbicides such as propoxycarbazone (Olympus®), sulfosulfuron (Maverick®), or pyroxsulam (PowerFlex®) are applied in the fall (early to mid-October) after the winter wheat and brome species have emerged. SDSU trials have demonstrated that these herbicides often result in similar control, so people may select products based on price and rotation restrictions. One common challenge with fall applications is that cold weather can injure the brome species (causing purple discoloration or necrosis), which can reduce its susceptibility to herbicides (Figure 25.7). Nevertheless, fall applications generally result in more consistent control than spring applications.

Another concern regarding brome control is herbicide resistance. Since current standard brome herbicides are a similar mode of action, resistance to one product would result in resistance to all amino acid synthesis (ALS) inhibitor mode of action herbicides. ALS herbicides include Olympus®, Maverick®, PowerFlex®, Everest/PrePare®, and Beyond®.

Herbicide-resistant brome biotypes have been identified in Kansas and could occur in continuous winter wheat fields in South Dakota. Consequently, it is important to include crop rotations with winter wheat to enable the use of alternative herbicides, which will minimize selection for herbicide-resistant brome biotypes. Since brome seed is usually relatively short-lived in the soil (approximately three years), crop rotations are an effective component of brome management programs (Chepil 1946; Rydrych 1974; Wicks 1997).

Feral rye and jointed goatgrass are also winter annual weed species that can be difficult to control with herbicides partially because they have similar genetic characteristics as wheat. Herbicide-resistant wheat varieties, such as ClearField wheat, are necessary to control these weeds species. ClearField wheat technology protects the plant from some ALS herbicides, such as imazamox (Beyond®). Plants in this

Figure 25.5. Downy brome seedlings can be differentiated from wheat seedlings as downy brome has soft hairs covering the entire plant. In addition, many brome species will have slightly twisted leaves.

Figure 25.6. Downy brome (top) can be distinguished from Japanese brome (bottom) by the long awns on the tips of the downy brome seed heads, which gives a more "feathery" appearance. This distinction can be important for selecting future herbicide programs because downy brome is generally more difficult to control than Japanese brome.

Figure 25.7. Downy brome injured by cool temperatures in the fall, which can reduce its susceptibility to herbicides.

category are herbicide resistant and are not classified as genetically modified organisms. Additional information on using this technology effectively is available at http://www.agproducts.basf.com/products/research-library/cl-wheat-stewardship-tib-2010.pdf.

Feral rye can be a problem in several areas in central and western South Dakota, whereas jointed goatgrass is generally a problem in a few locations in southwestern South Dakota.

There are also several problematic winter annual broadleaf weed species, such as wild mustard, field pennycress, bushy wallflower, and tansymustard. These species can also grow as annual weed species by germinating in the spring. The most effective herbicides for these species are generally 2,4-D or ALS-inhibiting herbicides such as thifensulfuron (Harmony®), tribenuron (Express®), metsulfuron (Ally®), and others.

Several of the ALS-inhibiting herbicides used to control downy or Japanese brome will also control several winter annual weed species in the mustard (Brassicaceae) plant family, which includes the weed species mentioned above. As with the winter annual grass weed species, crop rotations can disrupt the life cycle of these weeds species, which can help reduce the weed seed banks.

Annual grass weed species

The most common annual grass weed species in South Dakota spring wheat include green foxtail, yellow foxtail, barnyardgrass, and wild oats. Although annual grass species may not be highly competitive in spring wheat, their populations can become high enough to cause measureable yield loss (Peterson and Nalewaja, 1991 and 1992). If not properly managed, spring wheat crops can facilitate increases in the seed banks of annual grass weed species as some can continue growing and produce seed after wheat harvest.

There are several herbicide options to control annual grass weed species, but it is important to correctly identify the grass species as herbicide options and rates can vary among weed species. Some ALS-inhibiting herbicides, such as mesosulfuron (e.g., Silverado® and Rimfire®) intended for grass control may be very effective on wild oats, but not foxtail species. Several herbicides intended for foxtail control are more effective on green foxtail than yellow foxtail so rates may need to be adjusted when controlling these species. Fenoxaprop (e.g., Puma®) is an example of an herbicide that has different recommended rates for green foxtail, yellow foxtail, and wild oats.

Persian darnel may be a relatively new annual grass weed species of concern in South Dakota. Persian darnel is established in several locations in North Dakota and eastern Montana, and now there are reports of this weed in northwestern South Dakota. Due to its relatively short stature, it can be difficult to detect in wheat. However, high densities can result in 80% spring wheat yield loss (Holman et al. 2004). Some effective herbicides may include pinoxaden (Axial®), propoxycarbazone (Rimfire®), and imazamox (Beyond®, for ClearField wheat only).

Annual broadleaf weed species

In many cases, it is necessary to use more than one herbicide chemistry to control all broadleaf weed species present in wheat fields. Kochia is likely one of the most common weed species found in wheat. It can be difficult to control since most populations are now resistant to ALS-inhibiting herbicides. Fluroxypyr (e.g., Starane® and several others) is a growth regulator herbicide that is likely the most effective herbicide for kochia control, but it is not highly effective on many other broadleaf weed species.

Bromoxynil (e.g., Buctril® and several others) is a photosynthesis-inhibiting herbicide that is not as effective on kochia as fluroxypyr, but it has activity on wild buckwheat and several other annual broadleaf weed species. Consequently, these are likely among the most commonly used herbicides and they are a component of several premixed herbicide products.

Wild buckwheat is also controlled with some ALS-inhibiting herbicide products or growth regulator herbicides such as clopyralid (found in WideMatch®) or dicamba. The presence of other broadleaf weed species may influence the need for additional herbicide tank mix partners. For example, prickly lettuce control may require including a growth regulator herbicide such as 2,4-D, dicamba, or clopyralid.

Pigweed species, common lambsquarters, and mustard species may be best controlled with ALS-inhibiting herbicides (Harmony®, Express®, Affinity®, Ally®, and several others) or growth regulator herbicides such as 2,4-D. Premixed herbicide products are becoming more common for controlling mixtures of several

Figure 25.8. Yellow foxtail may be distinguished by the relatively long hairs at the leaf base, whereas other areas on the shoot are hairless.

Figure 25.9. Green foxtail can be distinguished by the lack of hairs on the leaves or stems. Like other foxtail species, green foxtail has fringed ligule or collar at the leaf base. Wild oats has a longer membranous ligule.

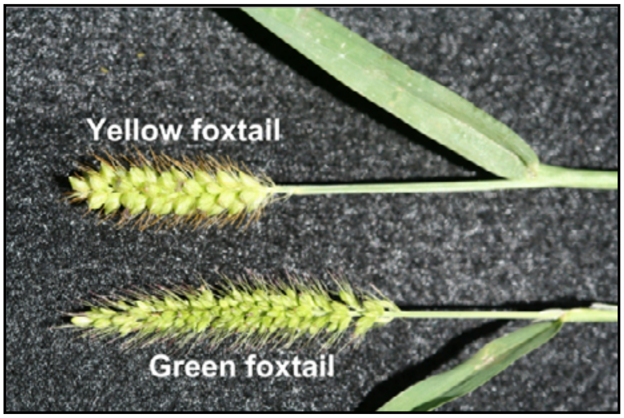

Figure 25.10. Foxtail species may also be distinguished by their seed as yellow foxtail has much larger seeds than green foxtail.

different broadleaf weed species or grass and broadleaf weed species. In some cases, MCPA or 2,4-D may be added to these premixes as a relatively inexpensive way to improve the control of difficult weeds and provide protection against many minor broadleaf weed species.

Herbicide Application Timing

Post-emergence applications

Proper herbicide application timing is critical to avoid wheat injury and maximize weed control. The targeted application period for many post-emergence herbicides is from wheat tillering to jointing, which is the time when stem nodes become visible. Timing dicamba (between 4- and 6-leaf spring wheat) or 2,4-D (5-leaf stage to jointing) applications is particularly important as late applications can injure developing reproductive tissue and cause wheat head deformities.

Many 2,4-D labels suggest it may be applied in wheat until the early boot stage (immediately prior to head emergence), but the risk of wheat injury increases if 2,4-D is applied after jointing. The targeted application period can vary among herbicide products, so it is important to be aware of the application directions on the herbicide labels and to be aware of wheat development in the field in order to make well-timed herbicide applications.

Burndown or pre-emergence applications

Non-selective herbicides, such as glyphosate or paraquat (Gramoxone®), may be applied prior to wheat emergence to control emerged weeds. It is recommended to apply these herbicides immediately prior to wheat planting. People occasionally plan to apply these herbicides after seeding, but prior to emergence. In some cases, adverse weather conditions can delay the herbicide application, which produces an environment where wheat emerges before the herbicide is applied (Figure 25.11). This creates a very challenging situation because the weeds may be much larger than the wheat and the new wheat seedlings are too small to tolerate many common post-emergence herbicides.

Some herbicides are available for tank-mixing with glyphosate to increase control of difficult weed species and provide soil residual activity to suppress or control weeds emerging after crop emergence. Flucarbazone (PrePare®) is one herbicide that may be applied prior to weed emergence to provide residual control of grass species such as green foxtail or wild oats. Flucarbazone also has foliar activity to help

Figure 25.11. Emerging wheat may be sensitive to many burndown herbicides.

control mustard species or downy brome that may be emerged prior to wheat planting. In addition, flucarbazone may also be applied after wheat emergence.

Saflufenacil (Sharpen®) may only be applied prior to wheat emergence to provide residual broadleaf weed control. Saflufenacil also has foliar activity to help control emerged broadleaf weed species at the time of application.

Herbicides are being developed for application prior to winter wheat emergence that will provide residual control of downy or Japanese brome. Therefore, residual herbicide options are increasing which may improve weed management flexibility in winter and spring wheat.

Pre-harvest applications

Herbicides are occasionally applied immediately prior to harvest if the weeds are still present at levels that will inhibit combining, or if the grain is intended to be sold as certified seed. Pre-harvest herbicide options include 2,4-D (ester or amine), dicamba (Clarity®), metsulfuron (Ally®), carfentrazone (Aim®), or glyphosate. Glyphosate is an appealing option because of its price and the large number of weeds it controls. However, pre-harvest glyphosate applications are not recommended for fields intended for seed production because it can inhibit wheat germination and seedling vigor if applied too early (when wheat seed moisture is greater than 30%).

In SDSU trials, glyphosate application at 50% seed moisture did not greatly reduce wheat seed germination. However, the resulting seedlings were noticeably stunted or deformed. All pre-harvest herbicides should be applied after the hard dough stage, which is approximately the time when wheat seed moisture is less than 30%.

At the hard dough stage, most of the maturing wheat plants will be necrotic (dead) and the stem nodes (joints) will have lost nearly all green color. This is the time when the wheat plants have reached maturity and grain fill is nearly complete. Since the herbicides will be applied to a dense canopy, it may be beneficial to increase the water carrier rate as much as possible. Labels for several of these herbicides suggest that carrier rates may be as low as ten gallons per acre, but 15–20 gallons may provide more consistent results.

Pre-harvest herbicide applications should be viewed as a rescue treatment in seed fields as the use of any product may reduce wheat seed viability. After harvest, wheat germination should be checked if the seed is intended for planting.

Post-harvest applications

Several weed species may continue to grow after wheat harvest and produce seed that may increase future weed populations. To prevent this, non-selective herbicides, such as glyphosate, may be applied to control weeds prior to weed seed production. This is also a good time to control perennial weeds such as dandelions, field bindweed, and Canada thistle. Sometimes 2,4-D or dicamba may be applied alone or together for general broadleaf weed control or with glyphosate to improve perennial weed control.

However, opportunities to use 2,4-D or dicamba can be limited due to the risk of off-site droplet or vapor movement to neighboring susceptible broadleaf crops such as soybeans, sunflowers, or alfalfa.

Herbicide tank mixes

When applying herbicide mixtures, it may be important to check the labels for tank-mixing compatibility. Mixing herbicides may reduce activity or increase the risk of crop injury. For example, high rates of bromoxynil can reduce the activity of grass herbicides such as fenoxaprop.

Mixing herbicides with similar modes of action can occasionally increase the risk for crop injury, particularly among sensitive varieties. For example, mixing two ALS-inhibiting herbicides (one for broadleaf and one for grass control) can increase the risk of temporary crop discoloration. However, in some cases, tank mixtures can be utilized to reduce the risk for crop injury. For example, tank-mixing 2,4-D with tribenuron (Express®) can reduce the risk of temporary crop yellowing that can occasionally be caused by tribenuron.

Although negative interactions among herbicides may be less common now than in the past, always check label guidelines for compatibility when mixing herbicide chemistries. In addition, it may be important to be aware that increasing the number of chemical mixes increases the probability of an unexpected and undesirable outcome.

Unexpected injury can also occur when herbicides are mixed with other pesticides. For example, tank-mixing bromoxynil herbicides with fungicides formulated as emulsifiable concentrates can occasionally cause temporary leaf necrosis. This interaction may be most common when weather conditions are cool at the time of application. Although injury may initially appear harmful, wheat often quickly grows out of the injury symptoms without a yield loss (Wiersma et al. 2005).

Herbicide Carryover

Wheat injury from herbicide carryover

Most herbicides used in corn, soybeans, or sunflowers do not restrict rotations with wheat. However, atrazine carryover after corn could potentially cause wheat injury. Generally, wheat may tolerate up to 0.15 lbs/A atrazine in the upper three inches of the soil surface. This tolerance will vary among soil types as the carryover risk may be greater on coarse texture, low organic matter (less than 2%), and high pH soils (greater than 7).

For most fields, atrazine is not a risk to spring wheat because research suggests that under normal growing conditions 90% or more of the applied atrazine is depleted over a year. However, the same may not be true for high risk soils. We recommend that in high-risk soils, atrazine be avoided for the year preceding wheat.

Carryover of wheat herbicides

Including wheat in crop rotations can help reduce weed populations, but it is important to select herbicides that do not persist and risk injury to subsequent crops. Herbicide carryover is particularly problematic when the wheat crop is unexpectedly lost due to severe weather, such as hail, and an alternative crop may be planted. Metsulfuron is an example of an herbicide that is effective on several broadleaf weed species and is relatively inexpensive, but it has a relatively high risk for carryover injury to crops such as sunflower and safflower.

Many herbicides used to control downy or Japanese brome have a potential to cause carryover injury to field corn, particularly if the herbicides are applied in the spring as a rescue treatment. Therefore, it is important to check for rotational crop restrictions when selecting appropriate herbicides for weed control.

Cover crops

Labels are generally vague or do not specify rotation restrictions for cover crop species that may be planted in wheat stubble. The risk of herbicide injury to cover crops may increase in coarse texture soils, soils with low organic matter, or high soil pH. Perhaps the herbicides with the greatest carryover risk include

Figure 25.12. Wheat leaf tip necrosis caused by bromoxynil.

metsulfuron (e.g., Ally®) or several herbicides used for downy or Japanese brome control. Table 25.2 provides estimates of the potential risk associated with different herbicides on different cover crop species. Additional information on cover crops is available in Chapter 7.

Herbicide resistance

Few weeds in wheat have been identified as herbicide resistant. Kochia resistance to ALS-inhibiting herbicide has become widespread and is likely present in most wheat fields. In many wheat fields, approximately half the kochia population may be resistant to ALS-inhibiting herbicides.

Wild oat resistance to fenoxaprop has been identified in central and eastern South Dakota. These biotypes may be controlled with ALS-inhibiting herbicides, such as mesosulfuron (Silverado® or Rimfire®).

There is one field in central South Dakota, however, where it is suspected that the wild oat population may be resistant to ACCase-inhibiting herbicides, such as fenoxaprop (Puma®), and ALS-inhibiting herbicides. Consequently, there may be no other herbicide options for controlling wild oats in that scenario. In this particular field, wheat has been grown continuously for several years. This demonstrates the importance of crop and herbicide rotation to minimize the risk of selecting for herbicide-resistant weed biotypes.

Downy and Japanese brome are two weed species that would be particularly problematic if resistant biotypes were selected since only one herbicide mode of action registered in South Dakota is effective on these weed species. Biotypes resistant to ALS-inhibiting herbicides have been identified at several locations in Kansas. In these fields, there are no other registered herbicides that may be effective for downy brome control. Therefore, it is critical to rotate herbicides, crop species, and apply herbicides at appropriate rates, times, and with appropriate adjuvants to help prevent selection for herbicide resistant weed biotypes.

Table 25.2. Potential risk estimates using different herbicides on different cover crop species. Months required between wheat herbcide applications and cover crop planting[1]. (Source: M. Moechnig, SDSU)

Carryover risk[1] Low = ☐; Moderate = ☐; High = ☐

Herbicide	Application timing	Forage legumes (Alfalfa, clover, vetch)	Pulse crops (peas, dry beans, lentils)	Seed mustards (canola, rapeseed)	Root mustards (turnips, radish)	Small grains (rye, wheat, trificale, millet)	Other grasses (sorghum, sudan)	Oilseeds (sunflower, safflower)	Other broadleaf crops (flax, buckwheat)
Maverick (sulfosulfuron)	Fall	22	22	22	22	3	22	22	22
Olympus Flex (propoxycarbazone + mesosulfuron)	Fall	24	12-24	12	12-24	4	12	12	24
Rimfire (propoxycarbazone + mesosulfuron)	Spring	10	10	10	10	0-4	12	10	10
PowerFlex (pyroxsulam)	Fall	9	9	9	9	1	9	9	9
GoldSky (pyroxsulam + florasulam + fluroxypyr)	Spring	9	9	9	9	1	9	9	9
Everest (flucarbazone)	Spring	24	9-24	9-24	9-24	4-11	11-24	9	11-24
Beyond (imazamox)	Spring	3	3	18-26	9-18	4-9	9	9	9-18
Ally (metasulfuron)	Spring	22	22	22	22	1-10	12	22	22
Harmony (thifensulfuron)	Spring	1-2	1-2	2	2	0	1-2	1-2	1-2
Express (tribenuron)	Spring	1-2	1-2	2	2	0	1	1-2	1-2
Buctril (bromoxynil)	Spring	1	1	1	1	1	1	1	1
Huskie (pyrasulfotole + bromoxynil)	Spring	9	9	9	9	0-4	4	9	9
WideMatch (clopyralid + fluroxypyr)	Spring	11	18	4	4	0	11	18	4
Starane (fluroxypyr)	Spring	4	4	4	4	4	4	4	4

[1]This table is intended to provide general risk approximations. Prior to planting, verify rotation restrictions on the herbicide labels or with the herbicide retailer. Carryover restictions may vary by soil characteristics and precipitation totals. conduct a bioassay if uncertain about the carryover risk.

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