Biology and management of the top weeds in spring wheat

May 22, 2019

Dr. Charles Geddes
Research Scientist – Weed Ecology and Cropping Systems
Lethbridge Research and Development Centre
Agriculture and Agri-Food Canada

Green foxtail, wild oat and wild buckwheat are the three most abundant and problematic weed species in spring wheat in the Canadian Prairies. Unmanaged, these weeds can cause large yield losses, and contribute copious amounts of seed to the soil seedbank. Since the 1970s, these weeds have remained the top three most abundant mid-season weeds in the western Canada among all field crops. The unique and species-specific characteristics of these weeds have allowed them to persist in our cropping systems for several decades. Early identification and implementation of targeted management strategies can go a long way in helping reduce the impact of these weeds on crop yields, and reduce their persistence throughout crop rotations.

Spring planting is quickly coming to an end, and crop scouting will soon become a vital component of weed control programs and management decisions. This article will outline and discuss some of the best tricks for identification and management of green foxtail, wild oat and wild buckwheat before they become an issue in your fields.

Refer to Figure 1 for visual representation of grass characteristics used for identification.

Figure 1. Example diagram of grass characteristics used for identification. Source: http://agron-www.agron.iastate.edu/~weeds/Ag317-99/id/GId.html
**Green foxtail (Setaria viridis L.)**

**Description and identification**

Also known as **green bristlegrass or wild foxtail millet.**

**Green foxtail** is the most abundant weed in spring wheat in the Canadian Prairies following in-crop weed management. Not surprisingly, this weed is also the most abundant mid-season weed among all field crops in western Canada. Green foxtail is found in about 38% of spring wheat fields in the Canadian Prairies, often occurring at densities averaging about 24 plants per square metre.

Green foxtail is an annual grass species that reproduces by seed and often emerges late in spring. This weed tends to be most abundant in Manitoba and Saskatchewan, and to a lesser extent, Alberta.

Green foxtail seedlings can be identified most easily by a **rough leaf surface** with fine upward pointing barbs, a **ligule composed of a short** (1.5 to 2.0 mm) **fringe of hairs**, and **absence of auricles**. The sheath is smooth, and often has short hairs along the margins. The seed head is composed of densely grouped spikelets in a green elongated and compressed panicle that resembles a small bottle brush.

**Biology and habitat**

Seeds of green foxtail require warm temperatures to germinate, which results in later emergence periodicity than many other weeds in western Canada. Emergence of green foxtail declines with increasing depth of burial, indicating that deeper tillage could help manage this weed in the short-term. This weed is known for rapid growth and development, and phenotypic plasticity, which allows the weed to adapt to a wide range of environmental conditions. The ability for green foxtail to readily adapt to its environment can result in rapid...
production of seed, allowing green foxtail to complete multiple generations in a single growing season.

Green foxtail is most competitive in crops seeded in late-spring, and the competitive ability of this weed is enhanced under high temperatures and levels of light. This weed is also competitive for nitrogen, especially when nitrogen fertilizer is broadcasted rather than band.

**Herbicide resistance**

Herbicide-resistant green foxtail is present throughout the Canadian prairies. In Alberta, populations of green foxtail have been found with resistance to acetyl-CoA carboxylase (ACCase)-inhibiting (**group 1**), acetolactate synthase (ALS) inhibiting (**group 2**), and microtubule assembly inhibiting (**group 3**) herbicides in separate populations. Populations with two-way resistance to ACCase and microtubule assembly inhibiting herbicides (**groups 1 & 3**) have been confirmed in Saskatchewan and Manitoba, while two-way resistance to ACCase and ALS inhibiting herbicides (**groups 1 & 2**) was recently confirmed in Manitoba.

**Management**

Several herbicides are effective for management of herbicide-susceptible populations of green foxtail; however careful consideration must be given to herbicide selection when herbicide-resistant populations are present. Most commonly, group 1 and 2 selective in-crop herbicides are used for post-emergence grassy weed management in the Canadian Prairies. These herbicides also have the greatest potential to select for herbicide resistance. Best management practices regarding herbicide use include rotation of group 1 and 2 selective herbicides, as well as chemical classes within these groups, with non-selective pre-emergence herbicides. Even though group 1 and 2 herbicides have high efficacy for weed management, it is recommended to rotate away from these groups rather than rotate or alternate among them.

Cultural tools used to enhance management of green foxtail include banding fertilizer rather than broadcast application, enhanced crop seeding rates, early seeding of summer-annual crops, or rotating to winter-annual or perennial crop life cycles. Shallow tillage should be avoided.

*For more information, visit:* https://www.farmingsmarter.com/weed-wisdom-march-2018/

**Wild oat** (*Avena fatua* L.)

**Description and identification**

**Wild oat** is the second most abundant mid-season weed in spring wheat in western Canada, and arguably the most problematic weed in the Canadian Prairies overall. This weed is common
throughout the Prairie Provinces. Wild oat is found in about 50% of spring wheat fields following in-crop weed management, where it occurs at densities averaging 8 plants per square metre, but ranging up to 450 plants per square metre.

Like green foxtail, wild oat is an annual grass species that reproduces by seed. The seedlings are identified most easily by a *counter-clockwise twist in the leaves* when viewed from above, a *large membranous ligule* (somewhat irregularly toothed), *absence of auricles*, and *hairs on the leaf margins*. The leaf blades are rough on both sides, the sheath is split, and the seed head is a loose, open, and drooping panicle with *long twisted awns*. In early growth stages, the seed often remains attached to the root system when the seedling is plucked from the soil, making seedling identification rather easy.

**Biology and habitat**

Wild oat prefers cool temperate climates, moist soil conditions, and is most abundant in zero-tillage systems. Emergence of wild oat tends to coincide with seeding and emergence of most spring-seeded crops in the Canadian Prairies. However, emergence of wild oat also can occur throughout the growing season. Wild oat remains one of the most difficult-to-manage weeds due to prolonged seedbank persistence (about 4 to 5 years) facilitated by seed dormancy, irregular germination throughout the growing season, and herbicide resistance. Several studies in Saskatchewan have shown wild oat-induced yield loss in spring wheat ranging from 10% to 60% depending on crop cultivar, plant density, agronomic management and environmental conditions.
**Herbicide resistance**

Heavy reliance on the highly efficacious selective ACCase- and ALS-inhibitor in-crop herbicides have resulting in selection pressure for herbicide resistance in wild oat. Herbicide resistance in wild oat has become a major problem in the Canadian Prairies, where different populations have been found with resistance to ACCase-inhibitors (group 1), ALS-inhibitors (group 2), lipid synthesis-inhibitors (group 8), protoporphyrinogen oxidase (PPO)-inhibitors (group 14), very-long chain fatty acid (VLCFA) biosynthesis-inhibitors (group 15), and ary lam inopropionic acids (group 25). Recently, a population with five-way resistance to groups 1, 2, 8, 14 and 15 was identified in Manitoba. Two-way resistance to in-crop selective herbicide groups 1 and 2 is becoming more common, and blanket resistance to these two herbicide modes of action can drastically limit options for post-emergence management using herbicides in cereal crops, like spring wheat.

**Management**

Integrating non-chemical weed management practices with non-selective herbicides applied pre-plant and post-emergence, with less-frequent use of in-crop selective herbicides and a diverse crop rotation is the an optimal strategy to mitigate selection pressure for herbicide resistance in
wild oat. The most consistent non-chemical tool for management of wild oat is increased crop seeding rate. Tall cereal cultivars, crop rotation, and breaking up crop life cycles with either two years of a winter cereal or perennial forage are among some of the most effective tools for management of wild oat populations. Placement of fertilizer in a band rather than broadcasting can also promote a competitive crop and reduce the response of wild oat to fertilization. Historically, delayed seeding following a stimulation of wild oat germination via shallow tillage and a subsequent management pass, was used for management of wild oat, however this approach can promote a flush of later-emerging weeds like green foxtail.

A proactive approach is important for management of wild oat because once wild oat seedlings are present in cereal crops, few effective management options remain, aside from using an in-crop selective herbicide. Continual and sustained use of these herbicides, however, should be limited to mitigate selection pressure for herbicide resistance. Other potential management tools include clipping wild oat seed heads above the crop canopy, mowing dense wild oat patches prior to seed production, or some form of harvest weed seed control. Seed shatter of wild oat can create difficulties for management using harvest weed seed control because the plant tends to lose about 60% to 70% of its seed prior to crop maturity and harvest.

**Wild buckwheat** (*Fallopia convolvulus* L.)

**Description and identification** Also known as black-bindweed, climbing bindweed, corn bindweed, or *Polygonum convolvulus*.

In western Canada, wild buckwheat has been the third most abundant mid-season weed species in spring wheat for decades. Like wild oat, this weed is found throughout the Canadian Prairies. Wild buckwheat is an annual species that reproduces by seed. This vine-like weed climbs crop plants in search of light and tangles the crop canopy together, causing problems at harvest. A wild buckwheat-infested crop often takes longer to harvest because the vine tends to wrap around the combine header, which can damage mechanical components if the weed is not removed. Among the Prairie Provinces, wild buckwheat is found in 48% of spring wheat
fields, where it occurs at an average density of about 4 plants per square metre.

Wild buckwheat seedlings can be identified most easily by a *slender stem* often red in color, *slender linear cotyledons*, and *simple alternate heart-shaped leaves*. The stem has long smooth internodes and an ocrea at each node (not shown). Initially, the *seedling grows erect*, but *later grows prostrate* in a twining or creeping manner. The vines can grow between 5 cm and 200 cm in length and wrap around neighboring plants. The seed head includes small greenish clustered perfect flowers in the leaf axils or at the tips of branches or short racemes. Wild buckwheat flowers indeterminately throughout the growing season and produces hard, black, triangular-shaped seeds.

**Biology and habitat**

Wild buckwheat is found in both cultivated and non-cultivated habitats and populations of wild buckwheat can persist for several years or even decades. In the soil seedbank, wild buckwheat seed can persist for 6 to 10 years. The hard, relatively impermeable seed coat requires damage or scarification to allow for germination, which can result in unpredictable emergence patterns. The seed can germinate and emerge from up to 20 cm below the soil surface; however most seedlings emerge from less than 5 cm depth. In western Canada, wild buckwheat begins to germinate in April, and continues to germinate throughout the growing season. Wild buckwheat can produce up to 12,000 seeds per plant and result in about 12% yield loss in cereal crops at densities of about 5 plants per square metre.

**Herbicide resistance**

Most wild buckwheat populations in the Canadian Prairies have avoided selection for herbicide resistance. The first cases of wild buckwheat resistant to the ALS-inhibitor (group 2) herbicides florasulam, thifensulfuron, and tribenuron in western Canada were confirmed in Alberta in 2007.
To the best of our knowledge, wild buckwheat has not evolved resistance to any other herbicide modes of action. However, wild buckwheat is naturally tolerant to several herbicides including MCPA, 2,4-D, or even glyphosate and lower label rates.

**Management**

Many products remain effective for control of wild buckwheat, including: bromoxynil, clopyralid, dicamba, glufosinate and sulfonyleurea herbicides. Bromoxynil tends to be the most efficacious and recommended choice for control of wild buckwheat in cereal crops, and application at earlier growth stages results in improved management. This contact herbicide burns the leaves of the plant, resulting in eventual starvation. Tolerance of wild buckwheat to systemic herbicides is dependent on the stage of the plant at the time of application. If systemic herbicides like glyphosate or the ALS-inhibitors are used, it is best to apply prior to the 4-leaf stage of wild buckwheat. Beyond this stage, herbicide efficacy may be reduced.

Effective non-chemical tools for management of wild buckwheat include shallow tillage to promote germination, followed by subsequent tillage or harrow passes and late-seeding of summer annual crops. Crop rotation to perennial forage production, including forage harvest or grazing by livestock at multiple times throughout the growing season also can help manage wild buckwheat populations.


Green foxtail, wild oat and wild buckwheat have remained the top three weed species among field crops in the Canadian Prairies since the 1970s. Clearly these weeds are difficult to manage in contemporary cropping systems. However, diligent scouting efforts, early detection, swift action, and a proactive approach to herbicide resistance management can go a long way to reduce weed pressures in your fields. An integrated weed management program including both chemical and non-chemical management tools is important for management of current weed populations as well as mitigation of selection pressure for herbicide resistance; allowing for sustained crop yields and production of world-leading crops, like spring wheat, in the Canadian Prairies.