Managing Smooth Scouringrush and Field Horsetail in Dryland Cropping Systems

Abstract

Smooth scouringrush and field horsetail are members of an ancient, spore-bearing vascular plant group that arose about 400 million years ago. They are perennial plants that can be troublesome in no-till, dryland cropping systems. Although neither species competes strongly with fall-sown crops, thick stands of either species can significantly reduce yields of spring-sown crops. Their presence in the field at harvesttime can result in high sickle bar wear and discoloration of chickpea seed. Both species are toxic to livestock, particularly horses. This publication discusses the biology and management of these two *Equisetum* species in dryland cropping systems of eastern Washington.

Introduction

Equisetum species belong to an ancient, spore-bearing vascular plant group that arose about 400 million years ago and was likely one of the main and preferred food sources for Sauropod dinosaurs during the Jurassic period (Pickrell 2019). The genus *Equisetum* is divided into two subgenera, *Equisetum* and *Hippochaete*, commonly referred to as horsetails and scouringrushes, respectively. Horsetails have stems that are short-lived, softer, and with a tendency to regularly branch out, whereas the stems of scouringrushes are mostly long-lived, harder, fibrous, and unbranched or irregularly branched (Hauke 1963, 1969). The term "scouringrush" comes from North American settlers who used the stems, which have a high silica content, for washing dishes and polishing wood (Scagel et al. 1984).

Three species of scouringrushes are commonly found in or near croplands in the inland Pacific Northwest. These are:

1. Smooth scouringrush (*Equisetum laevigatum* A. Braun)
2. Scouringrush (*Equisetum hyemale* L.)
3. Intermediate scouringrush (*Equisetum ×ferrissii* Clute)

The stems of smooth scouringrush are hollow, jointed, and deciduous; that is, they die back each fall and reemerge in the spring. They appear wispy, have a single black band visible at the tip of the sheath around each node (Hitchcock and Cronquist 1976), and a rounded spore-bearing cone, botanically known as a strobilus, at the tip of fertile stems (Figure 1). Smooth scouringrush can be found on drier sites than the other common *Equisetum* species. It is the *Equisetum* species that is most likely to be found growing in drier areas of crop production fields. The stems of scouringrush are more robust than those of smooth scouringrush. The stems of scouringrush do not die back in the winter and remain green year-round, for the most part. Two dark bands are usually visible on each sheath—one at the tip and another near the base of the sheath at each node—and the spore-bearing cone at the top of fertile stems has a pointed tip (Figure 2) (Hitchcock and Cronquist 1976). Scouringrush tends to grow in locations that are frequently wet or flooded, such as roadsides and roadside ditches (Figure 3). In places where both smooth scouringrush and scouringrush grow, a natural, sterile hybrid, intermediate scouringrush, can occur. The lower stem of intermediate scouringrush remains evergreen while the upper stem dies back in the winter. One black band below each node is visible on the stems of intermediate scouringrush.

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Figure 1. Smooth scouringrush has a single black band at the tip of the sheath at each node on the stem and a rounded, spore-bearing cone at the top of the stem. Photo provided by Drew Lyon.

Field horsetail (*Equisetum arvense* L.) produces two types of stems, both of which die back each year and reemerge in the spring. Fertile stems emerge in the early spring and reach a height of about one foot (Figure 4). They are tan-colored and end in a spore-bearing cone that may be up to four inches long. These stems die back shortly after spores are shed. The sterile, vegetative stems emerge after the fertile stems and may reach two feet in height. A whorl of branches are produced at the nodes to form a bushy plant that resembles a horse's tail or small pine tree (Figure 5).

Equisetum species spread primarily by rhizomes, a system of horizontal and vertical underground stems that can produce shoots and roots from the nodes. The rhizome system of a colony of field horsetail was found to have five successive horizontal layers of rhizomes connected by vertical rhizomes in the top seven feet of soil (Golub and Whetmore 1948). This tiered rhizome system may be unique, as other rhizomatous plants generally have only a single layer of horizontal rhizomes. The underground biomass of most *Equisetum* species far outweighs their aboveground biomass. The extensive rhizome systems of *Equisetums* can store plant sugars (carbohydrates) that sustain a well-established colony for multiple years, which can make control efforts challenging.

If rhizomes are cut or separated into pieces by mechanical tillage, for example, each piece containing a node can grow into a new plant. Tillage is one way that *Equisetum* species may spread in agricultural fields. Rhizomes store nutrients and enable the plants to survive during unfavorable conditions and successfully recover after major disturbances. Field horsetail was the first vascular plant to emerge from burial under volcanic ash following the eruption of Mount St. Helens in 1980 (WNPS 2025).

All *Equisetum* species contain an enzyme that destroys thiamine (vitamin B1), which then leads to thiamine deficiency in livestock. Field horsetail is the species that is most often consumed by livestock. It is particularly toxic to horses. Symptoms include weakness, particularly in the hind quarters, lack of coordination, and difficulty turning. Appetite remains normal until just before death. Removal of contaminated forage in the early stages of poisoning can result in rapid recovery. Field horsetail consumption by cattle or sheep is rarely fatal but results in a loss of condition, like, weight loss, muscle wasting, or an emaciated appearance.

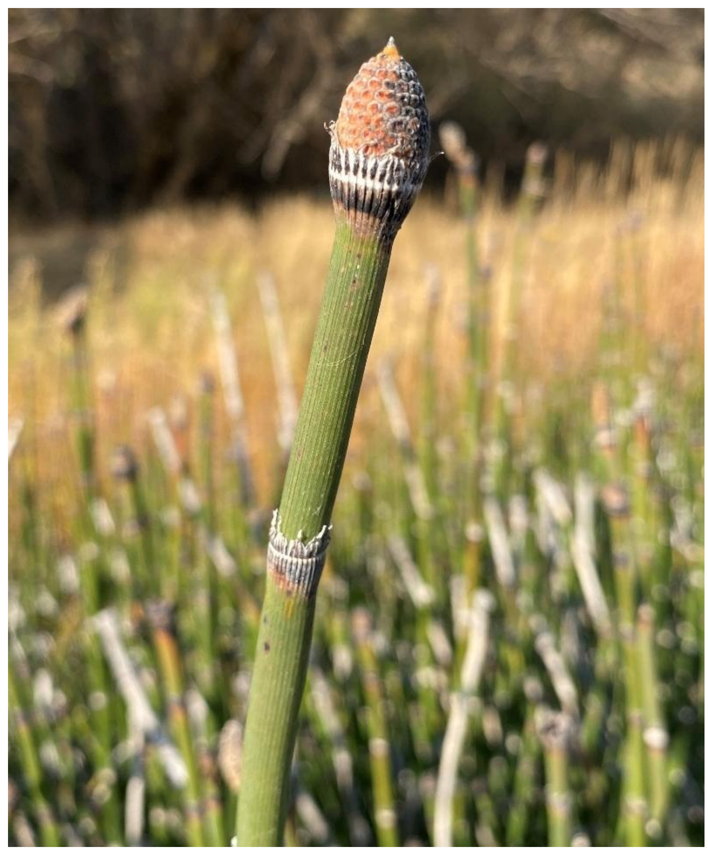

Figure 2. Scouringrush has two dark bands at each node—one at the tip and another lower on the sheath—and the spore-bearing cone at the top of fertile stems has a pointed tip. Photo provided by Drew Lyon.

Figure 3. Scouringrush tends to grow only in locations that are frequently wet or flooded; for example, it is commonly seen growing along roadsides and in roadside ditches. Photo provided by Drew Lyon.

Figure 4. Fertile stems of field horsetail emerge in the early spring and reach a height of about one foot. They are tan-colored and end in a spore-bearing cone that may be up to four inches long. These stems die back shortly after spores are shed. Photo provided by Marija Savic.

Figure 5. The sterile, vegetative stems of field horsetail emerge after the fertile stems and may reach two feet in height. A whorl of branches are produced at the nodes to form a bushy plant that resembles a horse's tail or small pine tree. Photo provided by Drew Lyon.

Smooth Scouringrush Management

Smooth scouringrush is the *Equisetum* species that infests the most cropland in eastern Washington. In addition to being found in low lying wet areas of fields, it is also commonly seen growing on dry hillsides and upper portions of fields. It is suspected, although not confirmed, that the extensive and deep rhizome system is able to access water from perched water tables in these apparently dry areas of the field. A perched water table is defined as "a local zone of soil water saturation held above the main body of groundwater by an impermeable layer or stratum (usually clay) and separated from the main body of groundwater by an unsaturated zone" (USDA-NALT 2024).

Smooth scouringrush is primarily found in dryland crop production fields under no-till management. Tillage likely damages the shallowest layer of rhizomes from which the stems emerge. The extensive rhizome system likely allows smooth scouringrush colonies to survive for an extended period with little to no aboveground stem establishment.

Over an extended period of time, tillage that prevents stem emergence will deplete the food reserves in the rhizomes and result in the death of the colony. However, tillage can also spread rhizomes to uninfested areas of the field. To minimize this risk, tillage is best done when the soil is dry, when rhizome pieces are likely to desiccate and die.

Unfortunately, the use of frequent tillage in dryland cropping systems results in increased soil erosion, diminished soil quality, and reduced soil water storage for subsequent crop growth. Consequently, reduced- and no-tillage cropping systems have been adopted by many dryland crop producers in eastern Washington. Without frequent tillage, growers are limited to cultural and chemical practices for the management of smooth scouringrush.

Herbicides

Chlorsulfuron, the active ingredient in Glean XP and one of the active ingredients in Finesse Cereal and Fallow, provides effective control of smooth scouringrush for multiple years. In several multiyear field studies conducted in the low and intermediate rainfall zones of eastern Washington, smooth scouringrush was effectively controlled when Finesse Cereal and Fallow was applied in the summer fallow year of winter wheat–fallow or winter wheat–spring wheat–fallow rotations. We conducted these studies over two cycles of the respective crop rotation, and control was not adequately maintained in the second cycle if Finesse Cereal and Fallow was not applied in the second summer fallow season. The herbicides applied during the wheat production year or years did not affect control.

Unfortunately, chlorsulfuron can remain active in the soil for extended periods of time, limiting crop rotation flexibility. The rotation intervals to dry pea and lentil are 24 and 36 months, respectively, if soil pH is 6.5 or lower and cumulative precipitation since application equals or exceeds 36 inches for dry pea or 50 inches for lentil. A field bioassay is required before planting dry pea or lentil if the soil pH is greater than 6.5. A field bioassay is also required before planting any other noncereal crop. Growers who want to grow crops other than cereals will need to limit their use of herbicides containing chlorsulfuron.

Glyphosate is quickly bound to clay and organic matter, resulting in no soil residual activity except in soils with very low clay or organic matter content. Glyphosate applied at higher rates has provided good to excellent control of smooth scouringrush for one to three years, depending on the site. Lyon and Thorne (2022) found that high rates of glyphosate (3.3 lb of the acid equivalent or ae/acre) applied alone or with an organosilicone surfactant provided effective control of smooth scouringrush one year after application compared to the nontreated check. Addition of an organosilicone surfactant improved glyphosate efficacy one and two years after treatment compared to glyphosate applied alone (Figure 6). Although no benefit was observed for adding glyphosate to Finesse Cereal and Fallow for smooth scouringrush control for the first two years after application, the duration of control was increased in the third year after application at upland field sites when glyphosate at 2.2 or 3.3 lb ae/acre and an organosilicone surfactant were added as tank mix partners (Lyon and Thorne 2025).

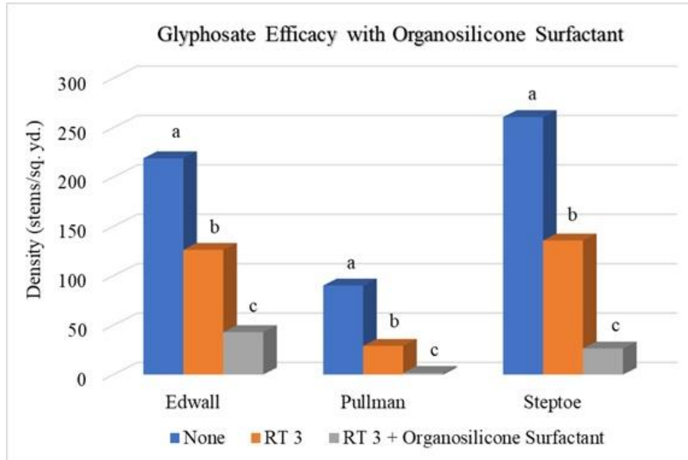

Figure 6. Smooth scouringrush stem densities averaged over four application timings (May, June, July, and August) following three treatments at three eastern Washington locations. RT 3 (glyphosate) applied at 96 fl oz/acre; organosilicone surfactant (Silwet L77) applied at 0.25% v/v. Columns with the same letter are not statistically different at the 95% confidence level.

When using glyphosate for the control of smooth scouringrush, glyphosate rate and surfactant choice play an important role. Smooth scouringrush control improves as glyphosate rate increases from 1.1 lb ae/acre to 3.3 lb ae/acre. Additionally, both the level and consistency of control with glyphosate are improved by adding an organosilicone surfactant or a blend of an organosilicone surfactant plus a nonionic surfactant (Savic et al. 2023). The exception to this finding is that the use of an organosilicone surfactant can reduce efficacy when temperatures are high, humidity is low, or plants are experiencing water stress.

Organosilicone surfactants aid in droplet spread. It is believed that this spreading effect promotes the entry of glyphosate and other herbicides through open stomata (pores) in the stem, increasing the amount of herbicide that can enter the plant. However, spread-out droplets evaporate more quickly. Consequently, under hot, dry conditions, the herbicide may not be able to enter the plant either because the droplet evaporates, the stomata are closed to conserve water, or a combination of both droplet evaporation and closed stomata. An organosilicone surfactant should not be used when temperatures are expected to exceed about 85°F after application or late in the season when plants are more likely to be experiencing water stress. In one field study we conducted, the addition of an organosilicone surfactant to Finesse Cereal and Fallow resulted in slightly increased control of smooth scouringrush compared to adding a nonionic surfactant.

Cultural Practices

Winter wheat competes strongly with smooth scouringrush. Winter wheat is typically growing rapidly in May when smooth scouringrush is just emerging. The shading provided by a good stand of winter wheat limits the growth of smooth scouringrush. Establishing a good stand of vigorously growing winter wheat is an excellent cultural practice to help manage smooth scouringrush. Poor wheat growth in portions of a field could be due to several factors, such as low soil pH, poor water drainage, or soil compaction. Determining the cause for poor wheat growth and correcting the underlying issue or issues will aid in the management of smooth scouringrush. Smooth scouringrush does not respond to nitrogen fertilization, so a nitrogen fertility plan that promotes wheat growth and optimizes grain yield and quality can be an effective management approach.

Spring-planted crops are less competitive with smooth scouringrush than fall planted crops. It is particularly important when planting spring crops to do everything you can to promote vigorous early growth and establish solid stands that will shade the ground as quickly as possible. Spring crops should be planted as soon as recommended soil temperatures are reached. Starter fertilizer may also help with early growth. Narrow row spacing will reduce the time necessary to shade the ground. Selecting cultivars that emerge quickly and rapidly shade the ground is also helpful.

Field Horsetail Management

Field horsetail tolerates wet soil conditions and may be spread by flooding, which favors its establishment in areas that are frequently flooded, such as roadside ditches and low-lying flats (Pratt et al. 2024). In addition to an extensive rhizome system, field horsetail also produces tubers, which contribute to its abiotic stress tolerance. The management of field horsetail is like that discussed above for smooth scouringrush. Providing drainage to poorly drained areas may help with the management of field horsetail, although tile drainage often becomes plugged by the extensive rhizome systems of field horsetail (Bastiene et al. 2006).

Herbicides

Field horsetail management with herbicides is slightly different than for smooth scouringrush. Field horsetail has proven to be difficult to control with herbicides, as the deep root systems and energy-storing tubers contribute to its resilience following disturbance. Previous herbicide research on field horsetail with single-season, in-crop applications has focused on burning down aboveground biomass to reduce interference with the crop, but the research did not evaluate long-term control (Soltani et al. 2015). However, several herbicides have been reported to reduce stem density in years following application (Pratt et al. 2024). Control of 50% and 65% one year after treatment was observed with MCPA applied at 0.3 lb active ingredient per acre and 0.5 lb active ingredient per acre, respectively (Hoyt and Carder 1962). Ainsworth et al. (2006) observed reduced stem density one year after treatment with a sponge-applied, undiluted glyphosate product. It is important to note that the labeled rate of glyphosate applied through a wiper-type device is 33% to 75% and that this type of application is not labeled for use in all crops. In non-crop areas, imazapyr (currently registered as Imazapyr 4 SL) applied in two consecutive years resulted in nearly 100% control of field horsetail for at least four years after the initial application (Torstensson and Börjesson 2004).

Chlorsulfuron has not been well researched for controlling field horsetail in crops, but preliminary results from a study we conducted suggest that it may be an effective tool in certain situations. Finesse Cereal and Fallow applied to actively growing stems in September following spring canola harvest resulted in 91% reduction of field horsetail the following year in winter wheat, but only 5% two years after application (Figure 7). However, in the same study when Finesse Cereal and Fallow was applied to bare soil where field horsetail stems had been removed, control was only 36% the year after application and 0% two years after application. This suggests that herbicides with chlorsulfuron are active on field horsetail for up to one year after application, but only if applied to foliage.

Herbicide applications in a growing crop are subject to label restrictions in relation to the crop stage of growth. Herbicides such as Finesse Cereal and Fallow or MCPA may have limited efficacy if applied when the field horsetail is small or has not yet emerged. Applications following harvest may be more effective provided the field horsetail is still green and actively growing.

Soil persistence limits the use of chlorsulfuron in rotations with pulse or canola crops; however, field horsetail tends to be limited to patchy areas and one strategy may be to grow cereal crops that tolerate chlorsulfuron or use chemical fallow in infested areas and then apply chlorsulfuron in subsequent years when stems reemerge until it is evident that an acceptable level of control has been reached. Finesse Cereal and Fallow can be applied to wheat after the one-leaf stage but before the boot stage and can also be applied to fallow, but check the label for rates and timing.

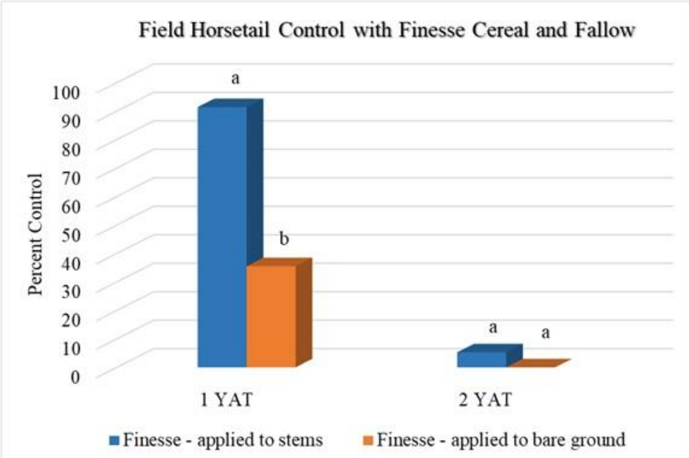

Figure 7. Field horsetail control one and two years after treatment (YAT) to green and healthy stems or to bare ground where stems had been removed. Applications were made following canola harvest in September at a location near Pullman, Washington. Finesse Cereal and Fallow was applied at 0.5 oz product per acre preplant with an organosilicone surfactant at 0.25% v/v. Columns with the same letter at each YAT are not statistically different at the 95% confidence level.

Cultural Control

Field horsetail is reported to be most problematic in reduced tillage and no-till systems (Pratt et al. 2024); however, it also persists in tillage systems where soil moisture is high, either on floodplains or near drainage ditches or creeks (Figure 8). Tillage can control aboveground stems, but new stems will arise from where the rhizomes were cut (Cloutier and Watson 1985). Furthermore, tillage equipment can spread rhizomes, which will develop into new plants if there is adequate soil moisture. Cloutier and Watson (1985) determined it would take 15 years for field horsetail to completely spread over one hectare (2.5 acres) of uninfested farmland if only two fragments were established at 10 sites across the hectare. But it would take only five years if the number of established fragments were increased to 10 at each of the 10 sites. This research assumed a one-time introduction; however, multiple tillage operations can occur each year, thus increasing the number of introductions over time. Management efforts need to focus on reduction of patch size and stem density over the long run without spreading rhizomes to new areas.

Figure 8. Field horsetail in a field of chickpeas and in a drainage ditch. The infested part of the field is low lying and is often saturated during early spring. The field is managed using a reduced-tillage system. Photo by Mark Thorne.

Summary

Smooth scouringrush and field horsetail can be troublesome weeds in eastern Washington dryland cropping systems. These plants have been around for a very long time and will likely be here for much longer. As with most perennial weed species, management requires a sustained effort. Herbicides chlorsulfuron and glyphosate can be effective if applied appropriately, but complete control will not be achieved with just a single application. The extensive rhizome systems of smooth scouringrush and field horsetail make them formidable foes, but by using good cultural practices that promote competitive crop growth, applying herbicides wisely, and, in some situations, tillage, these weeds can be successfully managed.

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