CIS 1076

Quackgrass Control with Maverick & Other Herbicides

in Dryland Wheat Production Systems in Northern Idaho

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Quackgrass (*Elytrigia repens* (L.) Nevski) is a perennial grass infesting cropland throughout the northern United States and southern Canada. Infestations of quackgrass pose serious problems to agriculture throughout Idaho. This publication, however, focuses on quackgrass control in dryland cropping systems in the northern parts of the state. In a 1998 statewide survey, Idaho wheat growers reported quackgrass as their main weed concern. An extensive system of thick underground rhizomes and rhizome buds allows quackgrass to spread rapidly in a field, once established. The rhizomes have a large carbohydrate food reserve, which increases their ability to persist in a field.

History & taxonomy

Quackgrass, a native of the Mediterranean, found its way into New England and Quebec prior to 1700. The species spread westward along with settlements, likely through the transportation of quackgrass-contaminated hay and straw and the sowing of contaminated bromegrass seed. Quackgrass first attracted serious attention as a weed in the United States about 1837. It is closely related to the western wheatgrasses, such as Western and Intermediate wheatgrass, commonly grown on rangeland. Although quackgrass can be one of the preferred species growing in range, its occurrence in field crops can reduce yields significantly. Also, it is designated a noxious weed in the Federal Seed Law.

Identification

Positive identification of quackgrass during the vegetative stage can be difficult. While many of the vegetative characteristics are similar to those of wheat, quackgrass leaves may be a slightly darker shade of green and slightly wider than those of wheat. One of the easiest ways to identify young quackgrass shoots is to note the hairy or downy base of the plant, and the clasping auricle (figure 1). However, while the auricle distinguishes quackgrass from other grass weeds, it does not always do so for quackgrass in wheat. Pulling up a quackgrass shoot will reveal the rhizome system, which is not present in wheat. At the vegetative stage, the shoot crown will usually have two or three rhizomes forming (figure 2).

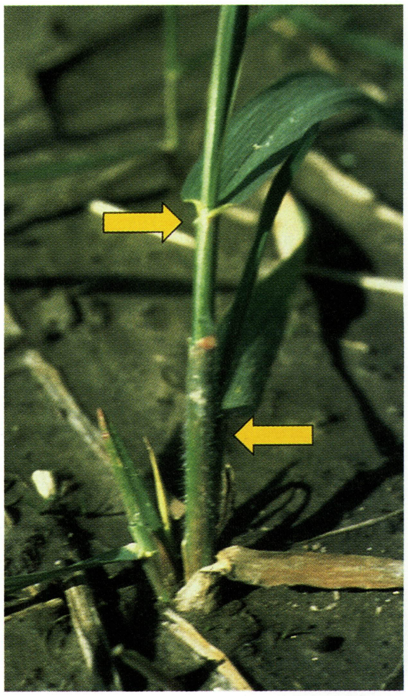

Fig 1. Young quackgrass shoot showing the clasping auricle (top arrow) and downy base (bottom arrow).

These rhizomes are off-white to cream colored, with sharply pointed tips. Quackgrass plants also may have a pronounced chevron, or constriction, on the tips of newer leaves (figure 3), while this is less common in wheat. Quackgrass is easily recognized at heading (figure 4), or maturity, by the dense green or blue-green spike it forms. The spikelets are about 1/2-inch long and form rows on opposite sides of the rachis, or stem axis. The spikelets are arranged close to the axis so that the opposite rows are parallel to one another.

Ecology

Quackgrass grows in a wide range of habitats throughout Idaho. Although it is more commonly found in areas with moderate to high moisture levels, such as low-lying fields or valleys, it also can grow in dryer areas. Quackgrass is found in soils ranging from pH 4.5 to 8.0, although more vigorous plants grow at soil pH 6.5 to 8.0. Additionally, this species has a high salt tolerance (70 to 95 mg salt/ 100 g soil), and can grow in saline soils.

Reproduction occurs by sexual and vegetative means, but vegetative reproduction by rhizome growth is the primary means of persistence. Only about 25 viable seeds are produced per plant per year. In contrast, a dense quackgrass sod can have more than 700 lb/a of rhizome dry matter and more than 1,300 rhizome buds/ft^2. Quackgrass shoot growth begins in the fall when rhizome buds begin to form shoots. New rhizome growth occurs in the spring when each shoot produces two or three primary rhizomes. During the summer, these will differentiate into numerous horizontal rhizomes so that each plant may form as many as 50 rhizomes during the growing season.

Control

Methods of suppressing quackgrass, such as use of herbicides and tillage, focus on the depletion of its rhizome carbohydrate food reserve. To successfully control quackgrass it is necessary to understand the seasonal fluctuations of this reserve.

Throughout the year, in cultivated fields, carbohydrate reserve in quackgrass rhizomes varies, accounting for 45 to 55 percent of the total rhizome dry matter (figure 5). During the winter, reserves remain fairly constant, from 48 to 50 percent. With warming temperatures in March and April, rhizome carbohydrate food reserve drops quickly, as rapid shoot growth begins. Above-ground biomass increases throughout the late spring and summer, and carbohydrate levels of the rhizomes also increase, because the products of photosynthesis are transported downward from the shoots and deposited in the rhizomes. The carbohydrate level in rhizomes is highest, 50 to 55 percent, from August to October, during which time the mature plants are able to partition into the rhizomes large amounts of carbohydrates produced from photosynthesis. The single greatest period of downward translocation of carbohydrates from the shoots to the rhizomes occurs immediately following the first frost in late summer or early fall. Quackgrass shoots respond to frost by rapidly mobilizing the carbohydrates in the foliage and increasing the translocation of these carbohydrates downward into the rhizomes.

The effect of downward translocation of carbohydrates has important implications for control of quackgrass with chemicals and tillage.

Tillage Shallow tilling of quackgrass sod brings some of the rhizomes to the soil surface. Quackgrass rhizomes are very susceptible to drying and will die within two to three days (figure 6).

Preventative control It is essential to clean machinery between different fields, especially after tilling a field infested with quackgrass. Rhizome fragments can catch on the tillage equipment and be deposited in noninfested areas of a field, or in different fields. New quackgrass shoots can develop from small rhizome pieces. Similarly, rhizome pieces can be dragged through the field into noninfested areas. It is a good idea to work areas with quackgrass separately, after working the rest of the field.

Fallow Including a fallow period in crop rotation can be an effective method of reducing the extent of a quackgrass infestation through tilling or use of herbicides. Repeated shallow tilling of quackgrass

Fig 2. Shoot crown area of a quackgrass plant showing rhizome formation.

Fig 3. Young quackgrass leaf with chevron visible on the leaf tip.

Fig 4. Quackgrass spike at heading.

sod can cause a depletion of the rhizome carbohydrate food reserve, and lessen the extent of an infestation. However, it is essential to repeat tillage every ten days, before the new shoot growth from rhizome buds is photosynthetically active; otherwise, this shoot matter will return carbohydrates to the rhizomes.

The disadvantage with a conventional, tilled fallow is that this practice increases soil erosion and compaction, and lowers soil organic matter. Because of this, a tilled fallow may be practical only if the extent of the infestation is severe or if the infested area is small and can be contained. A chemical fallow, in which quackgrass in the fallow area is treated with a broad-spectrum systemic herbicide, may be more economically and environmentally acceptable, because of reduced potential for soil erosion.

Chemical control When using herbicides, a good strategy is to use a systemic compound that will be transported downward by the plant, into the rhizomes. This reduces subsequent shoot regrowth. A nonselective herbicide such as Roundup (glyphosate) can be used before planting a crop, throughout the rotation. The drawback with this treatment is that quackgrass should be 6 to 8 inches high when Roundup is applied. This requirement can delay crop planting. Roundup also can be applied in the fall after harvest. An application on the day following the first frost will increase control as long as the quackgrass is not drought stressed. During the first hours after a frost, plants will mobilize the carbohydrates in the shoots and partition them downward into the rhizomes to be stored over winter. This increased translocation of carbohydrates also results in increased translocation of herbicide.

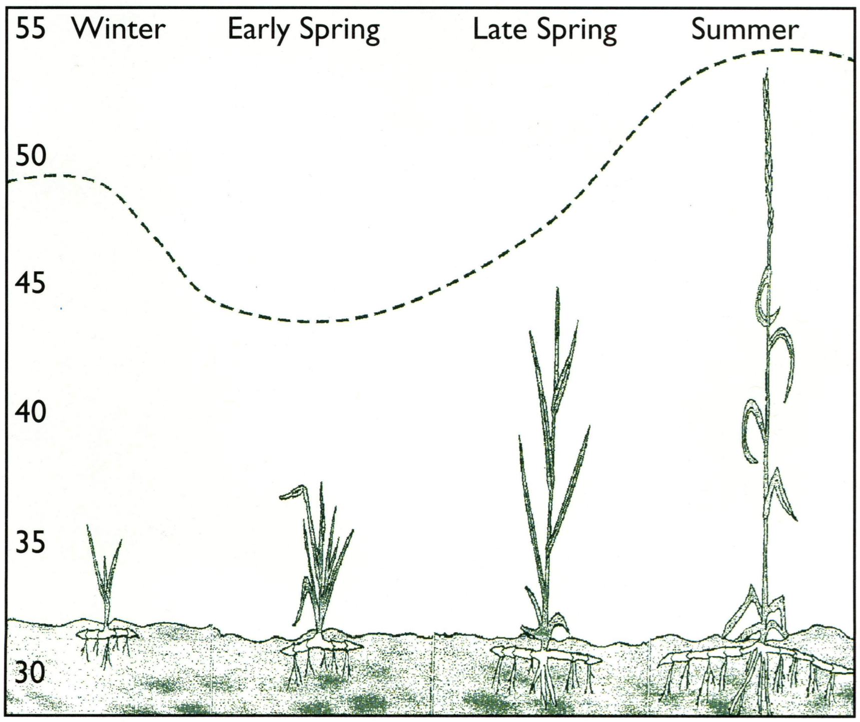

Fig 5. Percentage seasonal flux of rhizome carbohydrate reserve in quackgrass.

Selective chemical control of quackgrass in northern Idaho can be obtained in wheat, and in many crops grown in rotation with wheat, such as peas, lentils, chickpeas, alfalfa, canola, and bluegrass.

Wheat Roundup can be applied to a wheat crop at or after the hard dough stage. In addition to weed control, this treatment is also a harvest aid, because green quackgrass shoots can plug combine harvesters and contaminate harvested grain.

Maverick (sulfosulfuron) is a new herbicide developed by Monsanto to control grasses in wheat. Quackgrass is included among the targeted weed species. Quackgrass studies with Maverick were conducted in naturally infested winter wheat fields near Potlatch and Bonners Ferry, Idaho (tables 1 and 2). Maverick was applied at the 3- to 5- and 6- to 8-leaf stages of quackgrass. Three rates, including the proposed use rate of 0.37 oz a.i./A, were compared to an untreated control. Visual quackgrass control and winter wheat yield were assessed. Visual control with Maverick applied at the 3- to 5-leaf stage of quackgrass at 0.37 oz a.i./A ranged from 75 to 91 percent. Lower control at Bonners Ferry may have been due to increased weed pressure at that location. Average densities for this study were 5 shoots/ft^2 at Potlatch and 8 shoots/ft^2 at Bonners Ferry. Yield with Maverick applied at 0.37 oz a.i./A ranged from 2,721 to 3,055 lb/A at Potlatch (variety "Rely"), and from 2,849 to 3,423 lb/A at Bonners Ferry (variety "Hill 81").

Peas/lentils/chickpeas For quackgrass suppression, apply either Poast (sethoxydim) when quackgrass shoots are no more than 8 inches high, or Assure II (quizalofop) when shoots are 6 to 10 inches.

Roundup can be applied as a spot treatment (10 percent or less of a field) to control quackgrass. The herbicide, applied at the heading stage of quackgrass, will kill the crop. Roundup also can be applied as a broadcast spray at the hard dough stage of the seed (see wheat section).

Alfalfa Poast applied in one application or two sequential applications when quackgrass is no more than 8 inches high will suppress its growth in alfalfa. Kerb (pronamide, a restricted-use herbicide) can be applied to quackgrass either preemergence or early postemergence. Note restrictions on the labels of both herbicides regarding application timing, harvesting, and grazing.

Canola Poast applications when quackgrass shoots are no more than 8 inches high, and Assure II applications when

Fig 6. Tilled quackgrass sod showing desiccated rhizomes.

Table 1. Quackgrass control and wheat grain yield near Potlatch, Idaho with Maverick herbicide.

Rate	Quackgrass growth stage			
	3 to 5 leaves	6 to 8 leaves	3 to 5 leaves	6 to 8 leaves
	Quackgrass control		Wheat grain yield	
oz a.i./Acre	%		lb/Acre	
0.26	43	45	3,206	2,827
0.37	91	47	3,055	2,721
0.51	95	88	3,393	2,755
0	—	—	2,213	1,844

Control: $LSD_{rate*timing} = 53$

Yield: $LSD_{rate} = 435$, $LSD_{timing} = 307$

Table 2. Quackgrass control and wheat grain yield near Bonners Ferry, Idaho with Maverick herbicide.

Rate	Quackgrass growth stage			
	3 to 5 leaves	6 to 8 leaves	3 to 5 leaves	6 to 8 leaves
	Quackgrass control		Wheat grain yield	
oz a.i./Acre	%		lb/Acre	
0.26	69	80	3,250	3,080
0.37	75	80	3,423	2,849
0.51	80	83	3,423	2,801
0	—	—	2,139	2,151

Control: LSD_{rate} = not significant, $LSD_{timing} = 1$

Yield: $LSD_{rate} = 393$, $LSD_{timing} = 278$

quackgrass shoots are 6 to 10 inches, will suppress quackgrass growth in canola. Roundup will control quackgrass in ***Roundup Ready Canola*** varieties.

Bluegrass Beacon (primisulfuron) applied when the weed is 4 to 8 inches can control quackgrass in Kentucky bluegrass.

Rotation of herbicides to prevent selection of herbicide-resistant weeds Weeds develop herbicide resistance (see PNW Bulletin 437, revised) because of the natural genetic variability of species. In a field with quackgrass, for example, there might be a small percentage of these weeds resistant to the herbicide being applied that year. These survive and produce herbicide-resistant seed, or vegetatively reproduce from rhizomes; thus, there will be a slightly larger population of resistant plants the second year. Resistance of quackgrass (or other weeds) to herbicides can be prevented by spraying with herbicides that have different modes of action, the following year. If, however, the weed is sprayed with the same herbicide, or one with the same mode of action, these resistant plants will again reproduce and the population of resistant weeds will increase dramatically.

A planned and diverse herbicide rotation should be incorporated into the overall production system for quackgrass control. For example, in the Palouse region of north central Idaho, herbicides with different modes of action can be used on winter wheat/spring wheat, canola, peas, lentils or chickpeas. For quackgrass control, sulfosulfuron may be applied to a winter or spring wheat crop. However, a wheat crop treated with sulfosulfuron cannot be followed with barley, canola, mustard, chickpeas or lentils, due to the risk of injury from herbicide carryover. Roundup may be applied to winter and spring wheat, peas, lentils, and chickpeas, either after the hard dough stage, or postharvest. In peas, lentils, chickpeas, and canola, Poast or Assure II may be applied. These two herbicides will suppress wild oats as well.

In northern Idaho, a crop rotation may consist only of cereals. However, this rotation is not recommended since it promotes cereal-borne diseases, and also limits the choice of grass herbicides that can be applied. A crop rotation that contains only cereals increases the quackgrass, and other grass weed problems. Incorporation of canola, peas, or lentils into the rotation can aid in the control of grass weeds since Poast and Assure II can be applied.

Listed here are some quackgrass herbicides and their modes of action.

ACCase inhibitors These herbicides inhibit the enzyme ACCase (acetyl-coenzyme A carboxylase), stopping lipid biosynthesis. Root and shoot growth stops and susceptible plants become chlorotic and necrotic. ACCase inhibitors do not control broadleaf weeds, but do control many grasses.

Examples include:
- Assure II
- Poast

ALS inhibitors These herbicides inhibit the enzyme ALS (acetolactate synthase, also known as AHAS), stopping the plant's ability to produce key amino acids. Root and shoot growth rapidly ceases, anthocyanin formation may occur in which plants turn a reddish color, and the terminal bud dies.

Examples include:
- Maverick
- Beacon

Aromatic amino-acid inhibitors These inhibit the biosynthesis of key amino acids, causing a cessation of growth in the meristem, initially. The most notable example in this class of herbicides is Roundup.

For current registered herbicide uses and in-depth information about managing quackgrass in specific crops, consult the *Pacific Northwest Weed Control Handbook*, or contact a local extension agent. Remember always to read the herbicide label entirely and follow directions for proper use.

About the authors

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All photos are by Suzanne M. Sanders.

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Further readings

Herbicide-Resistant Weeds and Their Management. 1999. PNW 437. University of Idaho, College of Agriculture.

Pacific Northwest Weed Control Handbook. Current year's edition. Oregon State University.

Pesticide Residues — These recommendations for use are based on currently available labels for each pesticide listed. If followed carefully, residues should not exceed the established tolerances. To avoid excessive residues, follow label directions carefully with respect to rate, number of applications, and minimum interval between application and reentry or harvest.

Groundwater — To protect groundwater, when there is a choice of pesticides, the applicator should use the product least likely to leach.

Trade Names — To simplify information, trade names have been used. No endorsement of named products is intended nor is criticism implied of similar products not mentioned.

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