Quackgrass
Management on Organic Farms

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Photo: E. Gallandt

Introduction

Quackgrass (*Elytrigia repens* (L.) Nevski), previously named *Agropyron repens* (L.) Beauv., is a widespread, cool-season perennial grass. The specific epithet "repens" means "creeping," a reference to the prolific rhizome (underground stem) growth. Quackgrass is one of the foremost perennial weed problems on organic and diversified vegetable farms in New England. Although known by some as "witchgrass," quackgrass should not be confused with *Panicum capillare*, an annual grass species.

Quackgrass is not native to North America, and probably traveled from the Mediterranean in alfalfa seed during the mid-1600s. It is now well established in temperate areas of Canada and the Northern U.S., where infestations may reduce crop yield and the quality of forage and harvested seed[1].

Biology

Morphology

Quackgrass is a tall, slim grass, 1 to 4 feet high. Although the stems and upper leaves can be somewhat hairy, the undersides of leaves are smooth. It resembles other members of the genus *Elytrigia*, but related species lack the extensive rhizome and root system of quackgrass (see Identification).

Identification

Quackgrass spikes resemble those of Italian rye grass, but the two species can be distinguished by simply rolling their inflorescences between thumb and forefinger; quackgrass spikes feel round whereas Italian rye grass spikes feel flat.

Quackgrass has distinctive clasping auricles which grasp the stem at the base of each leaf.

The distinctive rhizomes of quackgrass offer conclusive identification.

Reproduction

Seeds contribute to long distance quackgrass dispersal, however, local infestations persist and spread by prolific rhizome growth. White rhizomes with conspicuous nodes at 2 to 4 cm intervals spread horizontally in the top six inches of the soil and can be up to a meter long. These rhizomes, in addition to the fibrous root system, comprise 60 to 70% of total plant biomass[2]. Each node contains meristematic cells which may form buds and eventually new plants, particularly when rhizomes are separated from the mother plant, as by digging or tillage. New plants started from rhizomes are more vigorous than those started from seed.

Quackgrass is wind-pollinated but self-sterile. Thus, the amount of seed production in a given stand will depend on the proximity of other members of the species that are not genetically identical. A single quackgrass plant will both produce seed and spread by rhizomes. Plants at the edge of a patch may therefore be pollinated and produce seed, but plants in the middle will only continue to spread by rhizomes[1]. Rhizomes may grow more than an inch per day, extending 10 feet or more from the mother plant[3]. Buried seed may survive four years before germinating.

Life Cycle

Quackgrass is a perennial, storing sugar in roots and rhizomes in the late summer and fall to ensure winter survival. In the following spring the plant has a ready supply of energy, giving it a competitive advantage over many crops that start from seed. It is most vulnerable just as the shoots are emerging, when sugar from the roots is being expended in the new growth but the leaves are not photosynthesizing at full capacity, so no sugar is being sent back to the roots.

Growth Habit

Because it is a cool season grass, the annual cycle of quackgrass starts as early as the end of March. Even following repeated disturbance throughout the summer, if soil moisture is adequate, quackgrass may begin to flourish in the fall after most crops have been harvested or have died back[4]. During the hot part of the summer its above-ground growth is limited[5], but rhizome production is greatest in June, July and August. Each of the rhizomes form numerous lateral rhizomes in July. In autumn, the aerial shoot of the parent plants die off and the rhizomes stop growing horizontally, forming a primary aerial shoot and emerging from the soil[5]. As a consequence of this growth habit, quackgrass thrives in undisturbed cropping environments, including forage crops, winter or year-long cover crops, and perennial crops such as asparagus and strawberries.

Killing quackgrass does not immediately alleviate its effects. Toai and Lindscott[6] found that quackgrass is allelopathic, releasing phytotoxic constituents during decomposition that inhibit the germination of alfalfa by almost one-third. Their study showed that phytotoxicity is maxi-

mal 7 to 10 days after being cut, and in relatively warm weather, allelopathic effects cease to be detrimental after about three weeks.

Management

Quackgrass management requires an integrated approach, involving prevention, tillage, grazing or mowing to deplete the sugar stores in the rhizomes, followed by a competitive crop to keep surviving rhizome buds from flourishing.

Tillage

For a small, recently established patch of quackgrass, hand digging, a mulch such as a fabric weed barrier, and careful monitoring may be sufficient[2]. Disruption of the root system will cause the grass to re-sprout profusely, because dormant rhizomes have been activated. The new plants must be dug again before they have more than three leaves, but several repetitions of this process will kill the stand.

For larger stands of quackgrass, repeated tillage with a spring or spike-tooth harrow beginning in the hottest, driest part of the summer is often recommended. The goal is to expose the roots and rhizomes to the sun, causing them to dry out. Rhizomes that have adapted to drought like conditions will be harder to kill in this manner. The disruption will, of course, separate rhizome buds from their parent plants and cause them to sprout, so tillage must be repeated before the new plants put out three leaves. Rhizome fragments buried in the top 10 cm of soil tend to sprout in synchrony, making the shoots easier to eradicate at the correct stage, so tillage methods should be designed to keep rhizomes as close to the soil surface as possible[7]. Tillage must be repeated every time new shoots come up, through late fall, until the quackgrass becomes dormant for the winter. Very cold temperatures after a summer of repeated tillage may contribute to dormant bud mortality and help to control the grass.

Lemieux, Cloutier and Leroux[7] found that while a significant number of quackgrass rhizomes can be killed in the first year of management, at least two years of tillage are required to completely eradicate it. If the quackgrass stand remains relatively thick and verdant after the first year, tillage must be continued until the middle of the summer.

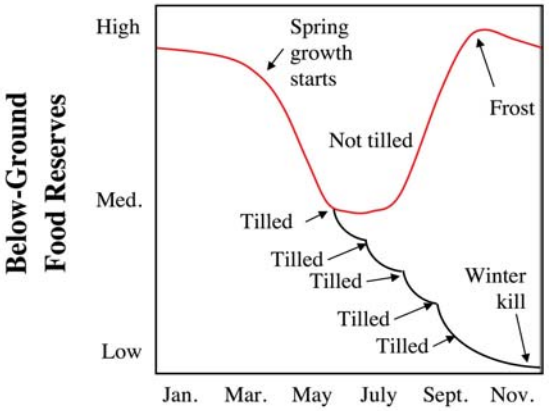
The amount of cultivation needed to eradicate quackgrass can vary slightly with soil type. On lighter soils, two to three rounds of cultivation may be sufficient, while it may take as many as six on heavier clays.

Mowing / Grazing

Quackgrass can be managed by mowing or allowing animals to intensively graze the leaves and shoots. Mowing at the soil level is more effective at reducing new rhizome growth than keeping the grass at 2cm[5]. Intensive grazing that encourages the animals to eat the shoots down to the soil level would have a similar effect. Horses and

Timing of Tillage[8]

In the absence of tillage, quackgrass relies on below-ground food reserves (carbohydrates) to support early-season vegetative growth. If young quackgrass plants are allowed to grow three or four leaves, they will begin to send out new rhizomes, and also reach sufficient photosynthetic capacity to begin accumulating new stores of sugar in the roots.



Tillage should begin in the spring, when carbohydrate reserves have been expended on new growth, but before they are rebuilt through new photosynthetic activity. Each tillage operation removes the new shoot growth and forces the plant to sprout again, until its below-ground food reserves are completely exhausted.

The Nordell's System

Photo: E. Gallandt

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Quackgrass rhizome biomass was measured in soil samples collected in May 2005, following two years of red clover (2-Yr. CC) and compared to the amount following a year of vegetable production and a subsequent year of annual cover cropping/summer fallowing (Alt.-Yr. CC).

Quackgrass thrived in the perennial cover crop system and was rarely found in fallow-based, alternate year cover crop system (Alt.-Yr. CC) which is based on strategies developed by Eric and Anne Nordell of Trout Run, PA. (Nordell, 1993).

	Rhizomes (Lbs. dry wt. per acre)
2-Yr. CC	2
Alt.-Yr. CC	290

cattle enjoy eating rhizomes, and pigs will root through the soil to find them[5].

Crop Competition

Following a sequence of repeated tillage, throughout the summer, fall cover crops could then be planted anytime in August. Some examples of overwintering cover crops include winter rye and hairy vetch. Another option is to plant a winter killed cover crop like oats or oats and peas. To prevent reinfestation, competitive fall cover crops such as cereal rye should be planted after harvested crops whenever possible[2].

If, in the spring, the stand appears to be greatly reduced or even gone, the site should nevertheless be planted to a competitive crop (e.g., forage or feed corn), to keep competitive pressure on any surviving plants. Dyke and Barnard[9] conducted a three-year experiment, finding that barley or beans undersown with either clover or Italian rye grass reduced stands of quackgrass by about half, without the aid of any physical disruption.

Prevention

Quackgrass tends to spread from weedy field edges into fields, where occasional tillage actually encourages it to spread by separating buds from the parent plant[5]. Field margins should be mowed regularly, because this causes the same sort of reduction in reserves as repeated digging.

Because it is important to prevent re-establishment, tillage equipment should be thoroughly cleaned following work in infested fields as rhizomes may be easily moved from an infested area to a clean one.

Conclusions

- Periodic fallowing of field edges should be performed to reduce movement of rhizomes into fields.

- Effective quackgrass management requires well timed tillage, generally repeated when regrowth reaches 3-4 leaves.

- Harrows with S- or C-shaped spring shanks are particularly useful for lifting rhizomes to the soil surface where they will dessicate.

Designing Crop Rotations to Reduce Quackgrass

After Cash Crop	Late Spring/Early Summer	Late Summer/Early Fall
Plant Winter Rye	Plow in Rye, Start Summer Fallow	In August, Plant Fall Cover Crop

- Be sure to plow the Rye in and start the summer fallow as soon as the ground is dry enough to be worked.
- Till approximately once a month† during the summer fallow using appropriately aggressive tillage.
- The Fall Cover Crop can be either a winter killed crop, like peas or oats, or a winter hardy crop, like winter rye. With a winter killed crop, you will have thicker fall growth, which can do a better job of out competing the quackgrass, but there will be nothing there to compete with the quackgrass's early spring growth.
- The key with either type of fall cover crop is to establish a good, competitive stand. This means you would want a seeding rate of 2 to 2.5 bushels per acre of oats, for example.
- Once your perennial weed problems are under control, the length of the summer fallow can usually be shortened
- If taking your land out of production every other year isn't an option, you could try doing a summer fallow every four years.

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