



Jointed Goatgrass

Aegilops cylindrica Host.

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Jointed goatgrass (*Aegilops cylindrica* Host.) is a winter annual grass weed that was introduced into the United States in the late 1800s. It is found throughout the continental United States and is most common in the winter wheat (*Triticum aestivum* L.) production areas of the Pacific Northwest and central Great Plains. Jointed goatgrass is most commonly observed growing between wheat rows (Figure 1). It also is found in pastures and along roadsides, fencerows, field access roads, and other disturbed areas (Figure 2).

Identification

Seedling stage

Jointed goatgrass and wheat are closely related species, and it can be difficult to distinguish between them in the seedling stage. The most effective way to identify jointed goatgrass seedlings is to dig up a plant and look for a *spikelet* still attached to the roots (Figure 3). The hulls of jointed goatgrass do not separate from the seed as they do in wheat. The jointed goatgrass *coleoptile* is extremely narrow and often crimson or purple. Wheat coleoptiles are wider and green. Jointed goatgrass seedling leaves are

narrower than wheat leaves and a darker shade of green, and they have evenly spaced hairs at 90-degree angles to the leaf margins and culms.

Vegetative stage

As the plant matures, jointed goatgrass follows a life cycle very similar to that of winter wheat. Specific growth stages are distinguished by changes in



Figure 1. —A mature jointed goatgrass plant can be spotted easily growing between wheat rows.



Figure 2.—Jointed goatgrass growing in a Conservation Reserve Program field along a fence near Nye, Oregon.

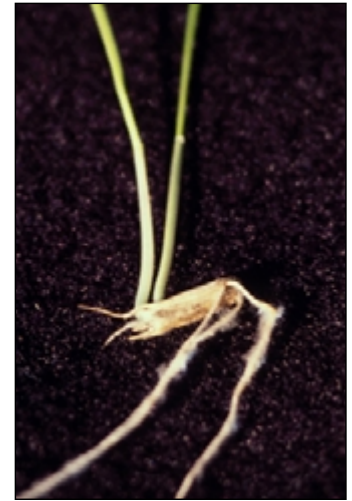


Figure 3.—A jointed goatgrass seedling can be identified by the spikelet still attached to the roots. The hulls of jointed goatgrass do not separate from the seed as they do in wheat.

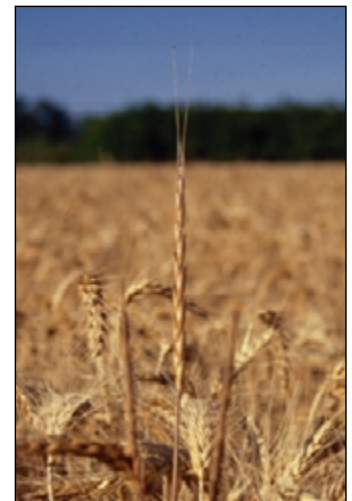


Figure 4.—Hybrid and jointed goatgrass spikes grow to the top of the wheat canopy or slightly above it. The hybrid (center) shows spikelet characteristics that are a blend of wheat and jointed goatgrass traits.

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vegetative appearance. Jointed goatgrass typically emerges and begins tillering in the fall, with tillers continuing to form through late fall or early spring. It enters the jointed stage (begins erect growth) in March or April and passes through final reproductive stages similar to those of wheat.

Without competition, jointed goatgrass can produce up to 135 tillers and grow approximately 18 to 25 inches tall. In wheat fields, jointed goatgrass may have fewer tillers and can grow to the top of the wheat canopy or slightly above it (Figure 4).

Reproductive stage

Jointed goatgrass *spikes* are similar to wheat spikes but are slender and cylindrical. The spike typically is 3 to 5 inches long and made up of 5 to 10 spikelets or "joints," with *awns* at the top of each spike.

Jointed goatgrass spikelets are similar in appearance to wheat straw fragments. Individual spikelets are 0.3 to 0.5 inch long and contain two to five flowers. Spikelets may contain anywhere from zero to three viable seeds.

One jointed goatgrass plant has the potential to produce up to 135 spikes, 15 spikelets per spike, and 2 seeds per spikelet—more than 4,000 seeds.

Seed

Jointed goatgrass generally ripens before wheat, and spikelets turn from green to dark crimson, purple, or several shades of brown. When separated from the tight *glumes*, *lemma*, and *palea* of the spikelet, jointed goatgrass seed resembles a small wheat kernel. Like feral rye or wild oats, jointed goatgrass spikelets typically shatter before grain harvest and land on the soil

surface near the base of the plant. Spikelets typically are found on the soil surface or within the top inch of soil but can be buried in tillage systems.

Biology

Seed production, germination, and longevity

Because it is an annual, jointed goatgrass reproduces only by seed. A *vernalization period* will accelerate the onset of the reproductive phase in jointed goatgrass. Typically, vernalization occurs when plants overwinter, but spring-emerged jointed goatgrass may vernalize if temperatures are cool. Studies have shown that increasing the vernalization period decreases the number of days to seed set. Consequently, cold winters may cause jointed goatgrass to flower earlier in the growing season compared to short winters.

Jointed goatgrass seed germination usually is stimulated by rain and ground disturbance from mid-September through November and again in late spring. Although seed germinates at temperatures from 40° to 95°F, the optimum temperature range usually is 60° to 70°F. About 90 percent of the seedlings emerge from the top inch of soil, 10 percent emerge from 1 to 3 inches deep, and very few emerge from more than 4 inches deep.

Adequate soil moisture increases seed germination and reduces seed longevity in the soil *seed bank* (most likely through increased rates of decay) as well as seed *viability*. At Moscow, Idaho (23 inches of recorded annual precipitation during the study period), the viability of jointed goatgrass seed declined more rapidly and to a greater extent than at Lind, Washington (10 inches of

recorded precipitation). After 3 years of burial, no viable seed remained at Moscow, and after 5 years about 0.1 percent of the seed remained viable at Lind.

Genetics

Jointed goatgrass and wheat are genetically related, and both have the "D" *genome*. They occasionally cross to produce a *hybrid* that is intermediate in appearance (Figure 4). Hybrids are male sterile, but Bob Zemetra, a University of Idaho cereal breeder, has shown that partially or fully fertile *backcross* offspring can be produced artificially and can occur naturally at very low levels.

Competition

Jointed goatgrass reduces winter wheat yields and lowers grain quality. Winter wheat yield loss is greatest when jointed goatgrass emerges with or shortly after the crop (Table 1). Oregon field competition studies showed that five jointed goatgrass plants per square foot reduced winter wheat yield by 25 percent. Jointed goatgrass has a competitive advantage over winter wheat, especially under hot, dry conditions. The recent release of several herbicides to control downy brome may result in increased jointed goatgrass populations, since jointed

Table 1.—Jointed goatgrass emergence early in the growing season has a detrimental effect on wheat yield.

Emergence (days after wheat emergence)	Wheat yield loss (%)
No jointed goatgrass	0
0 (emerges with wheat)	27
14	20
28	20
42	17
160	7

goatgrass may expand into now clean areas of fields.

Winter wheat harvest causes unshattered jointed goatgrass spikes to break apart and contaminate grain. These spikelets often result in serious dockage losses. Some elevators will not buy wheat heavily infested with jointed goatgrass. A high number of jointed goatgrass spikes also may reduce grain test weight and lower the grade.

Current standards for certified wheat seed have a zero tolerance for jointed goatgrass contamination. Only one jointed goatgrass plant in a field prevents the whole field from being certified.

Management

Jointed goatgrass and winter wheat have similar photosynthetic rates, optimum temperatures for growth, and other physiological characteristics. Thus, management strategies designed to improve the health and vigor of winter wheat often benefit jointed goatgrass.

The following recommendations should be considered as part of a long-term management strategy, and no one technique should be used alone. Some techniques are suited more for fencerows, field access roads, and roadsides than for wheat fields and pastures.

Prevention

A good weed management program includes regular scouting. Do not allow jointed goatgrass to spread to uncontaminated fields. Always buy and plant certified wheat seed. Be aware of neighboring infestations of jointed goatgrass and potential paths and methods for introduction. If uncovered grain trucks drive by uncontaminated fields, or livestock and deer pass through, specifically watch

these areas and promptly remove jointed goatgrass plants.

Crop rotation

Cultural practices for managing jointed goatgrass should include crop rotation. The benefits of crop rotation increase with the length and diversity of the rotation and are not limited to weed control. Rotations break up the life cycle of jointed goatgrass and may permit the use of grass-specific herbicides and other management strategies. Jointed goatgrass seed longevity studies suggest that small grain crops should not be grown on contaminated fields for 3 to 5 years.

Planting date

The winter wheat planting date can be delayed to reduce the competitive ability of jointed goatgrass. Early fall rain and cool temperatures stimulate jointed goatgrass germination so that tillage and planting operations kill the seedlings or significantly reduce populations. However, the risk of exposing young winter wheat to frost and disease must be balanced with the benefits of delayed planting.

Variety choices and seeding

Used together, wheat variety, seeding rate, and row spacing can increase the ability of winter wheat to compete with jointed goatgrass. Tall wheat varieties are more competitive than shorter varieties. Rapid, early shoot and root growth also increases the competitiveness of wheat. Wheat seeding rates in contaminated fields should never be less than recommended rates.

Narrow row spacing also can increase the competitiveness of crops against weeds, although the response depends on

environmental conditions. A paired-row planting strategy, compared to a single row, can reduce jointed goatgrass spikelet production by 19 to 35 percent.

Fertilization

Fertilizer timing can be manipulated to affect the competitive relationship between wheat and jointed goatgrass. Because jointed goatgrass competes vigorously with winter wheat for nutrients, apply nitrogen in the spring of the fallow season or when winter wheat is planted. Since nitrogen is leached deep into the soil profile, this timing ensures the ability of the wheat, which has deeper roots than jointed goatgrass, to utilize nitrogen.

In paired-row plantings, a deep band of fertilizer between the paired rows may make wheat more competitive.

Tillage

For tillage to be effective, the soil must be dry and air temperatures warm when the soil is tilled. It is difficult to control moderate to dense infestations of jointed goatgrass with tillage

Use herbicides safely!

- Wear protective clothing and safety devices as recommended on the label. Bathe or shower after each use.
 - Read the herbicide label—even if you've used the herbicide before. Follow closely the instructions on the label (and any other directions you have).
 - Be cautious when you apply herbicides. Know your legal responsibility as a pesticide applicator. You may be liable for injury or damage resulting from herbicide use.
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alone. Tillage kills only the germinated jointed goatgrass, and soil disturbance usually prompts additional seed to germinate. Sweep tillage immediately after harvest improves seed-to-soil contact for optimum jointed goatgrass germination and better control.

Preventing jointed goatgrass from producing seed during the fallow period is critical. Sweep or rodweed during the summer, using additional tillage as needed to control weeds and prepare a seedbed.

Other techniques

When jointed goatgrass populations are sparse, hand roguing can be used to stop further spread. Hand roguing should be done early, before spikelets break apart and scatter seed. Remove plants from the field because they can reroot in moist soil.

Spraying small, isolated patches with glyphosate, preferably before the weed pollinates, can control jointed goatgrass. Timing is critical to this management strategy because many grass weeds form viable seed soon after pollination. If a spikelet has already formed on jointed goatgrass, the herbicide application may only accelerate plant dry-down and seed production.

Postharvest burning of wheat stubble during dry field conditions has killed 90 percent or more of jointed goatgrass seed lying on the soil surface. Burning should be restricted to small, isolated infestations.

Jointed goatgrass may be managed early in its life cycle with frequent mowing.

However, if the plant has begun to tiller, mowing initiates the formation of new tillers, and the result may be a more competitive plant.

Glossary

Awn—Slender, bristlelike projection extending from the glumes. Also known as a beard.

Backcross—A new plant developed from pollination of a hybrid by either winter wheat or jointed goatgrass.

Coleoptile—The first leaf of a grass.

Culm—A grass stem.

Genome—A complete set of an organism's genetic material.

Glumes—The hull. Located at the base of each spikelet, they enclose the flower.

Hybrid—The first generation produced from a cross of winter wheat and jointed goatgrass.

Leaf margin—The edge of a leaf.

Lemma/palea—A fine, protective chaff, enclosing the flower and, subsequently, a seed.

Seed bank—All of the viable seed in and on the soil.

Spike—A type of seed head on grass plants.

Spikelet—Individual units on a seed head; composed of two glumes, a lemma, palea, and flowers or seed.

Tiller—An additional stem or sprout that grows from the base of a plant.

Vernalization period—The cold period necessary to stimulate seed development.

Viability—A measure of a seed's health. A viable seed is able to germinate if environmental conditions are suitable.

Management summary

- Prevent new introductions of jointed goatgrass.
 - Eradicate jointed goatgrass along field edges and roadsides.
 - Use tarps to cover trucks when hauling contaminated grain.
 - Thoroughly clean combines and other farm machinery before moving them from a contaminated field.
 - Hand rogue scattered plants or use nonselective herbicides to kill small patches of jointed goatgrass before it produces viable seed.
- Use crop rotations that extend the interval between small grain crops.
- Select tall, fast-growing varieties of wheat.
- Plant certified wheat seed.
- Use high seeding rates for wheat and plant in narrow rows.
- If possible, delay seeding in the fall and use tillage or nonselective herbicides to kill jointed goatgrass seedlings before planting.
- Maintain healthy, vigorously growing wheat.
- Burn wheat stubble to kill most of the seed lying on the soil surface as a one-time event in a long-term management strategy.