

Field Guide for Managing Jointed Goatgrass in the Southwest



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Jointed Goatgrass (*Aegilops cylindrica* Host; *A. cylindrical rubiginosa* Merr; *Cylindropyrum cylindricum* Merr; *Triticum cylindricum* Merr)

Grass family (Poaceae), Triticeae tribe

Jointed goatgrass is a common weed that has spread into wildlands from winter wheat croplands. It is listed as a noxious weed in Arizona and New Mexico while in Texas and Oklahoma it is identified as a troublesome/common agricultural weed. This field guide serves as the U.S. Forest Service's recommendations for management of jointed goatgrass in woodlands and rangelands associated with the Southwestern Region. The Southwestern Region covers Arizona and New Mexico, which together have 11 national forests. The Region also includes four national grasslands located in northeastern New Mexico, western Oklahoma, and the Texas panhandle.

Description

Jointed goatgrass (synonyms: jointgrass) is an introduced, cool season, annual grass that is closely related to winter wheat. It is native to western Asia and eastern Europe and is now found in Chihuahua, Mexico, and nearly every state of the continental U.S. Jointed goatgrass can be introduced as a contaminant in winter wheat seed as current technology is typically unable to separate these two grass seeds effectively. The inflorescence stem (rachis) of jointed goatgrass shatters at maturity resulting in the spikelet falling away from the inflorescence. The unit that falls away is called the joint, which contributes to its name. Joints present on the ground help identify this grass species.

Growth Characteristics

- Introduced, cool season, tufted, annual bunchgrass; 15–30" tall.
- Plants resemble winter wheat, but seedlings have fine hairs along leaf margins, sheaths, and auricles. The first leaf to emerge on seedling jointed goatgrass is reddish to brownish-green; whereas wheat tends to emerge as a whitish-green leaf.
- Stems are hollow and may be upright, slightly laying down, or abruptly bent near the base. Stems branch at the base; the stems that branch off the main stem are called tillers.

- Mature plants have fine, evenly spaced hairs along margins of alternately arranged flat blades, 0.07–0.11 inch wide and 1–6 inches long; fine hairs may also be present on the upper and lower blade surface.
- Ligule is membranous but has a fringe of fine hairs above the membrane.
- Cylindrical-shaped spike inflorescence (2–4 inches long) with one spikelet per node. Spikelets are positioned alternately along the rachis giving a zigzag appearance. Inflorescence shatters into joints (a floret with a portion of the rachis) at maturity. The presence of these joints upon the soil surface is a positive identifying characteristic.
- Each spikelet has 2–5 florets with 0.20-inch-long awns present on the lemma of the terminal floret; lower lemmas tend to have a very small awn, more like a point.
- Reproduction is solely by seed, which remain viable for 3–5 years. Each plant can produce greater than 100 spikes, which may contribute approximately 3,000 seeds per plant. However, jointed goatgrass tends to average only 130 seeds per plant when found within a wheat crop. Compacted soil favors germination, thus jointed goatgrass is likely to emerge in the tracks between rows.

Ecology

Impacts/threats

Jointed goatgrass is a primary concern within or near winter wheat fallow production areas where the weed species can contribute to reduced yield, loss of profitability, and degraded land values. In wildland situations, it may go unnoticed until the infestation becomes quite severe. It is often found where wheat has been planted as a cover crop during wildland restoration efforts, such as reseeding after fires. Jointed goatgrass is difficult to control selectively within wheat fields or in wild grassland areas.

Location

Jointed goatgrass is found mainly in wheat fields or other cropland areas including alfalfa fields and pastures. It escapes to waste areas and is found along roadways, railroad tracks, and other rights-of-way. It prefers areas with 10–20 inches of annual precipitation, between 820 and 6,500 feet in elevation.

Spread

Prominent awns on fertile florets insure transport and dispersal of seed by adhering to clothing, fleece, and animal fur. Seeds may be carried by wind, water, or by small rodents and is very likely to be a contaminant in grain, especially in winter wheat seed. Seed can germinate on the soil surface, although germination is enhanced by compacted soil conditions, as is present between crop rows. Seedlings can emerge from seed buried to a depth of 4 inches.

Invasive Features

Jointed goatgrass seedlings emerge with favorable soil moisture mostly from September to early November. The plant has an overwinter dormant period and then produces new seed in the spring, usually before winter wheat inflorescences emerge. The seed has a long anthesis (flowering) period which allows it to take advantage of favorable weather conditions and to compete with wheat and native grasses for sunlight, soil moisture, and soil nutrients. Jointed goatgrass tolerates drought better than winter wheat and other annual grasses.

Management

Preventing the introduction of jointed goatgrass should be the key objective when managing this weedy species. The best way to prevent introduction is to always use certified weed-free seed from a reliable seed source when planting winter wheat in any wildland situations.

Once jointed goatgrass is established, it spreads solely via seed. Control strategies should focus on removing seed production and reducing the opportunity for germination

of seed already present in the soil. In most cases, several years of treatment are necessary to control jointed goatgrass. Anticipate 1–2 years of monitoring and implementing further measures to control emergence of new plants from the seed bank. The following actions should be considered when planning an overall management approach:

- Check seed stock, hay, straw, and mulch for presence of weed seed before using them in weed-free areas; certified weed-free hay or pellets should be fed to horses used in back country areas.
- Practice crop rotation to maintain healthy winter wheat crop communities; plant sunflower, corn, or sorghum one season and leave fallow the next so as to allow an interval of 3–4 years between each crop of winter wheat.
- Detect, map, and eradicate new populations of jointed goatgrass as early as possible, especially in areas adjacent to grain croplands. Keep annual records of reported infestations.
- Implement monitoring and a followup treatment plan for missed plants or seedlings;
- Remove grazing animals from infested areas before jointed goatgrass seed heads mature. If an infested area has been grazed, confine animals in a holding area for a period to allow contaminated waste to pass before moving to an uninfested area. Check animals for presence of seed within fur or fleece. Monitor animal trails for seed spread in areas of known infestation.
- Encourage use of spray washing stations to reduce seed spread when mechanized equipment is utilized inside or near an infestation.
- Combine mechanical, cultural, biological, and chemical methods for most effective control.

Table 1 summarizes some management options for jointed goatgrass control under various situations. Choice of control method depends on the current land use and site conditions; accessibility, terrain, and climate; jointed goatgrass

Table 1. Management options*

Site	Physical Methods	Cultural Methods	Biological Methods	Chemical Methods
Roadsides, fence lines, and noncrop areas	Mow before inflorescence has emerged from the sheath, if possible. Repeat mowing if necessary Moldboard plow or V-blade sweep (see below).	Avoid excessive disturbance. Implement requirements for vehicle operations and for reporting infestations along roads. Clean mechanized equipment after use in infested areas or areas suspected of being infested.	No classical biological control agents have been approved for use by USDA.	Use truck or tractor spraying equipment. Wash underneath to prevent spread.
Rangeland or pasture areas	Deep moldboard plowing or V-blade sweeping may be used in suitable areas. The moldboard plow is not recommended on slopes highly susceptible to soil erosion.	Use certified weed-free seed and hay. If animals have grazed in an infested area, confine before moving to a new area.	Consider high intensity grazing with cattle during winter and early spring followed by herbicide treatment of remaining plants after cattle have been removed.	Use ground broadcast sprayer; or for areas difficult to access, use backpack sprayer.
Wilderness, other natural areas, and/or small infestations	Manual methods, such as hoeing or hand pulling, in localized areas are effective if roots are pulled. Acceptable to leave pulled plants to air dry in situ.	Post signs warning visitors to remove seeds.	No classical biological control agents have been approved for use by USDA.	Use backpack sprayer; broadcast spraying by other methods may be used on thicker stands, if allowed.

* Choice of a particular management option must be in compliance with existing regulations for land resource.

density and degree of infestation; and nontarget flora and fauna present. Other considerations include treatment effectiveness, cost, and the number of years needed to achieve control. More than one control method will likely be needed for each site.

Physical Control

Physical methods to control jointed goatgrass require proper timing and may need to be repeated to reach an acceptable level of control. Focus on removing plants and preventing seed production. Improving the competitiveness of desired species or planting adaptable species should always be considered in combination with mechanical control.

Manual Methods

Hand removal – This method is an acceptable, although often difficult, option for sparse or low density populations. Hand pull, cut, or hoe before the seed head exits the sheath in late winter or early spring to prevent plants from

maturing and reaching seed production. Several return visits to a site may be required to eliminate new plants. Remove as much of the root as possible and allow pulled plants to dry in place upon the soil surface.

Mechanical Methods

Tillage – Where appropriate, deep tillage with a moldboard plow or V-sweep (6–8 inches deep) can effectively deter seed germination and emergence. Soil must be fully inverted and should cover all surface material to a minimum depth of 4 inches. Subsequent plowing (e.g., for purposes of planting crops) should be shallow so as not to return seeds to soil surface. If possible, avoid plowing for 2 years following deep tillage so as to allow time for buried seeds to decay. Tillage on wildlands should always be considered in combination with reseeding of desirable perennial species.

Mowing – Timing is critical for use of this method. Ideally, mow in late winter to early spring when inflorescence is

formed, but still within the sheath. If performed too early, extensive tiller production will result. If performed after the inflorescence has emerged from the sheath, viable seed may be spread. Expect the need to follow up with a secondary method—such as herbicide spraying—for most effective control.

Prescribed Fire

Postharvest burning of winter wheat stubble is often used to reduce germination of jointed goatgrass seed lying on the soil surface. However, opportunities for using a planned burning program for jointed goatgrass control on range or noncrop lands are generally limited. A broadcast burn may be used to eliminate dried out, standing leaf and seed material but anticipate that in later years jointed goatgrass will return. Expect to implement a second or third year management strategy in combination with burning, such as herbicide spraying followed by reseeding with desired species. Other issues to consider are the loss of nitrogen when burning and the conversion of phosphorous to a form unavailable to plants which may require increased fertilization.

Cultural Control

Vehicles, humans, and domestic animals should be discouraged from traveling through areas infested with jointed goatgrass. Spread on restoration projects can be minimized by: (1) sowing jointed goatgrass-free seed wheat; (2) thoroughly cleaning machinery before moving from infested to noninfested areas; (3) processing contaminated grain before feeding to livestock; and (4) preventing the use or transportation of contaminated straw bales into noninfested areas. Some additional management tips from the agricultural sector that may be applicable to certain restoration projects in wildland areas include:

Crop Rotation – In cultivated fields, crop rotation has been found to be a highly effective way to significantly reduce jointed goatgrass seed and presence. One crop rotation approach commonly used includes planting a fall seeded crop, such as winter canola, after harvest. Another approach is treating the area with glyphosate or tilling which is then

followed up by planting sorghum, sunflower, or corn in the spring.

Nutrient Management – Applying nitrogen in ways that increases the amount available to wheat and decreases the amount available to jointed goatgrass is sometimes used as a means of reducing jointed goatgrass. There are two primary approaches to manipulate nitrogen levels: (1) “banding” high rates of nitrogen adjacent to and below the seed during planting time, or (2) using a water diluted nitrogen solution as the carrier when applying herbicide. The herbicide will control the jointed goatgrass and allow the nitrogen to be available for desired plants.

Seed Selection Strategies – There are many recommendations with regard to size, quality, cultivar selection, and competitiveness of wheat seed. Seeding rate guidelines should fit the local environment and are available through the Cooperative Extension Service.

Biological Control

Grazing

A combined approach called “graze-out plus glyphosate” has been used with some success in active wheat-growing areas or when doing intensive reclamation. With this method, an area is grazed at high intensities by using aggressive stocking rates, and then cattle are removed early in the spring while jointed goatgrass is still green and actively growing. Glyphosate herbicide is applied by broadcast spraying to provide nonselective grass control. Grazing alone rarely provides complete jointed goatgrass control since livestock prefer to graze wheat and other grasses first.

Classical Biological Agents

None available

Chemical Control

Because of the genetic similarity between jointed goatgrass and wheat, no currently registered herbicide product is available that will selectively control jointed goatgrass in wheat or related annual grass. Rather, complete plant control using a nonselective herbicide—such as

glyphosate—has been the primary option relied upon for effective treatment of jointed goatgrass in agronomic or wildland situations. Glyphosate can be used both as a spot treatment or as a broadcast spray. An advantage of glyphosate compared to other nonselective herbicides is that it has limited soil residual activity which allows reseeding shortly after spraying. Sulfometuron methyl is another nonselective herbicide that is effective on annual grasses, including jointed goatgrass, within a rangeland or noncrop setting. Sulfometuron methyl is a broad-spectrum, urea-based herbicide that inhibits cell division in the growth regions of stems and roots; it may be used pre- or post-emergent. ALS-inhibiting herbicides such as imazamox, imazapic, or imazapyr are also effective in controlling jointed goatgrass; however, these products have longer acting soil activity than glyphosate. Imazamox herbicides such as Beyond™ or Clearmax™ should only be used on Clearfied™ wheat. It is important to closely consult the herbicide label for application options.

Herbicides may be applied in several ways including backpack, ATV or UTV sprayers, or conventional boom sprayers that are pulled or attached to a tractor or truck. For sparse populations, one person or a small team can spot spray jointed goatgrass with an adjustable spray nozzle attached to a hand-held or backpack sprayer. The foliage should be sprayed to wet without dripping. Ideally, apply glyphosate in the spring when jointed goatgrass is fully tillered but before the inflorescence has emerged from the sheath.

Numerous herbicides have been examined for jointed goatgrass control in winter wheat fields, and control success is well described in the literature (i.e., see Donald and Ogg 1991). Herbicides listed in table 2 are mainly intended for use in rangeland or noncrop situations. These products will effectively control jointed goatgrass when properly applied, although all are nonselective and will also impact nontarget species. Therefore, caution should be taken if desirable plants, including woody species, need to be protected. Each herbicide product will have different requirements and restrictions. Thus, it is important to read the label carefully

and follow all instructions and guidelines when mixing and applying chemical herbicides. Consult the registrant if you have questions or need further detail.

Control Strategies

Management of jointed goatgrass in a noncrop/rangeland setting begins with identifying and mapping the infestation. Consider carefully the area occupied by jointed goatgrass and the intended land use and objectives. Develop a plan for controlling the weed that is practical to implement and envisions the end result. The plant density and size of the infested area should also be considered when determining an appropriate approach for weed control.

In general, a combination of control methods should be used when managing jointed goatgrass. Initial treatment should attempt to eliminate as many live plants and disrupt as much seed production as possible. Secondary treatments should aim to prevent seed formation and increase competition from desirable perennial plants. For a large, dense infestation, consider treating the perimeter first to reduce further spread. For confined or isolated patches where jointed goatgrass occurs in high densities, consider broadcast spraying with glyphosate in the spring and then follow up by reseeding native perennial plants. Prevent the spread of low density jointed goatgrass populations from disturbed areas such as oil well pads, field edges, access roads, rights-of-way, etc. by hand pulling, hoeing, or spot spraying with glyphosate.

If possible, invest in a major reclamation effort for heavily infested areas whereby the site is prepared for seeding through use of glyphosate. A successful reseeding project on range or noncropland following jointed goatgrass control can be challenging, especially when precipitation is low and there are few adaptable species choices for planting purposes. Thus, anticipate that treatments may need to be repeated in later years. If reseeding is not planned, then encourage growth of desirable native plants that will directly compete for soil moisture, light, nutrients, and space. In a rangeland or other noncrop setting, suppression or removal of jointed goatgrass will often enable the natural return of

Table 2. Herbicide recommendations

Common Chemical Name (active ingredient)	Product Example ¹	Product Example Rate per Acre ¹ (broadcast)	Backpack Sprayer Treatment Using Product Example ²	Time of Application	Remarks
Imazamox	Beyond, Clearmax	4 oz + surfactant and liquid nitrogen fertilizer	0.25–1.5 percent + surfactant	Fall or early spring during active growth, but before maximum plant size is reached. See label for specific number of leaves/tillers.	Only labeled for crop areas planted with Clearfield wheat variety. Broad spectrum; residual; amino acid inhibitor; affects growth regions in roots and stem. Liquid fertilizer solution should be at least 50 percent water before use as carrier.
Glyphosate	Roundup Pro, Rodeo, Accord	2.5–3 pints	0.5–2 percent	Apply to actively growing plants emerged before boot state.	Nonselective amino acid inhibitor; will kill desirable vegetation, including forbs and woody species; quickly inactivated in the soil. Foliar application only. Use as a spot treatment or for chemical fallow.
Imazapic	Plateau	0.063–0.188 pounds per acre	2 percent + surfactant	Apply pre-emergence for best results.	Use lower rates for dry climates and low leaf litter. Use higher rates as moisture increases and/or litter increases. Higher rate may suppress cool season grasses.
Sulfometuron Methyl	Oust	Oust: 1.3–2 ounces	NA	Apply late fall or winter before jointed goatgrass is 3 inches tall. Best if applied right before rainfall.	A broad-spectrum, urea-based herbicide that blocks cell division in growth region of stems and roots; may also damage nontarget vegetation. Can provide pre-emergence and postemergence control. Read product label carefully before applying.

¹Trade names for products are provided for example purposes only, and other products with the same active ingredient(s) may be available. Individual product labels should be examined for specific mixing information and appropriate use with jointed goatgrass.

²Herbicide/water ratio - As an example, a gallon of spray water with a 3 percent mixture is made by adding a sufficient volume of water to 4 ounces of herbicide until a volume of 1 gallon is reached ($4 \text{ oz} \div 128 \text{ oz/gal} = 0.03$ or 3 percent).

native plants without undergoing the added expense and difficulties associated with reseeding.

Adaptive Management

Jointed goatgrass is an introduced naturalized species commonly found throughout the western U.S. and controlling it across broad areas may be impractical. Therefore, realistic goals and objectives should be established to manage jointed goatgrass infestations occurring extensively throughout a given landscape. To improve long-term success in controlling jointed goatgrass,

consider using an adaptive management strategy with the overall goal of restoring desirable plant communities. The stepwise process for adaptive management involves:

1. Assessment of the overall weed problem,
2. Establishing management goals and objectives,
3. Implementation of control strategies,
4. Monitoring the effectiveness of management actions,

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5. Evaluating actual outcomes in relation to expected results, and
 6. Adjusting practices as necessary.

Steps of this process should be repeated in sequence as part of a continuous learning cycle that improves management planning and strategy by learning from the outcomes of previous management actions. In general, an adaptive management strategy may be considered to be successful if:

1. Stakeholders are actively involved and remain committed to the process;
2. Monitoring and assessment are used to adjust and improve management decisions; and
3. Management goals and/or objectives for the resource are being achieved.

References and Further Information

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Suggested Web Sites

For jointed goatgrass project information:

<http://www.jointedgoatgrass.org/>

For information on invasive species:

<http://www.invasivespeciesinfo.gov/>

<http://www.invasive.org/weedus/index.html>

For information about calibrating spray equipment:

NMSU Cooperative Extension Service Guide

A-613 Sprayer Calibration at http://aces.nmsu.edu/pubs/_a/A-613.pdf

Herbicide labels online:

<http://www.cdms.net/LabelsMsds/LMDefault.aspx>

Noxious Weed List for New Mexico:

[http://nmdaweb.nmsu.edu/animal-and-plant-protection/noxious-weeds/noxious20weed memo list.pdf](http://nmdaweb.nmsu.edu/animal-and-plant-protection/noxious-weeds/noxious20weed%20memo%20list.pdf)

Noxious Weed List for Arizona:

<http://www.azda.gov/PSD/quarantine5.htm>

**For more information
or other field guides, contact:**

USDA Forest Service
Southwestern Region
Forest Health
333 Broadway Blvd., SE
Albuquerque, NM 87102

Or visit:

<http://www.fs.usda.gov/main/r3/forest-grasslandhealth/invasivespecies>

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