

INTRODUCED BLUESTEM GRASSES: Management on Native Lands

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Early land managers introduced nonnative grasses to Texas for use as groundcovers or as forage for livestock. As with many new ventures, the drawbacks of bringing new plants to an area are often unknown until the damage has been done.

At least 27 species of bluestems grow in Texas, only six of which are nonnative (Table 1). The remaining 21 are native to Texas and can provide valuable forage for livestock and/or habitat for wildlife as a member of a diverse plant community.

Examples of common native species are big bluestem, broomsedge bluestem, bushy bluestem, little bluestem, and silver bluestem.

Bluestems in general are neither “good” nor “bad” because the species vary greatly. Land use goals often contribute to their value, especially if the land is used for cattle grazing only or for both cattle grazing and wildlife habitat.

Introduction of nonnative bluestems

King Ranch (KR) bluestem originated in China and was brought to California as early as 1917. The first Texas introduction was in 1924 at the Angleton Agricultural Research Service Substation, a division of the U.S. Department of Agriculture (USDA).

In 1939, the Texas Agricultural Research Service named the plant yellow beardgrass and released the seed for commercial production in 1949.

The grass was used in rangelands and pastures and for erosion control and revegetation (Fig. 1).

Between 1924 and 1937, the plant was introduced to the KR, where the Soil Conservation Service (now USDA–Natural Resources Conservation Service) increased it for distribution; it is likely the source

of present seed. KR bluestem and yellow beardgrass are indistinguishable and considered to be the same plant.

Kleberg bluestem originated in South Africa. In 1939, it was found growing with KR bluestem on the King Ranch. A Soil Conservation Service nursery in San Antonio, Texas, increased the seed and released it around 1944.

Kleberg bluestem was developed for pasture forage, hay production, and range reseeding.

Each ecotype of KR (Fig. 2) or Kleberg bluestem may have been favored for traits such as cold or drought tolerance, forage yield, general stand persistence, soil adaptability, or precipitation requirements for optimal growth.

Distinguishing between the species

In the field, it is extremely difficult to differentiate between KR and Kleberg bluestem species, much less their ecotypes:

Table 1. Bluestems introduced in Texas

SCIENTIFIC NAME	COMMON NAME(S)	ECOTYPES
<i>Bothriochloa bladhii</i> (Retz.) S. T. Blake	Australian bluestem Caucasian bluestem	WW-BDahl bluestem
<i>Bothriochloa ischaemum</i> (L.) Keng	King Ranch bluestem KR bluestem Yellow bluestem	Ganada bluestem Plains bluestem WW-Iron Master bluestem WW-Spar bluestem King Ranch bluestem
<i>Bothriochloa pertusa</i> (L.) A. Camus	Pitted bluestem	—
<i>Dichanthium annulatum</i> (Forssk.) Stapf	Kleberg bluestem Ringed bluestem	T-587 (PMT-587) bluestem Pretoria 90 bluestem
<i>Dichanthium aristatum</i> (Poir.) C.E. Hubb.	Angleton bluestem Awned dichanthium	Gordo bluestem Medio bluestem
<i>Dichanthium sericeum</i> (R. Br.) Camus	Silky bluestem	—

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Figure 1. King Ranch bluestem. *Source: Meagan Lesak*



Figure 2. Kleberg bluestem. *Source: Meagan Lesak*

- Although Kleberg generally grows taller than KR bluestem, management practices such as mowing can alter plant height and productivity.
- Kleberg bluestem has hairy stem joints (nodes) and more leaf material than does KR bluestem. But KR bluestem can also have hairy nodes, and the amount of its leaf material varies.
- Kleberg bluestem is typically found in Central Texas and in South Texas along the Gulf Coast (Fig. 3), is air salinity tolerant and does best on loamy to clay soils. KR bluestem is common throughout Texas (Fig. 4), even in drier regions, and it grows well on rocky limestone hills and shallow or clay soils.
- Although both species' response to management appears to be similar, the application of management practices may vary on different ecological sites.

As with many introduced grass species, KR and Kleberg bluestems often grow in monocultures (Fig. 5) or thick stands with only one or very few plant species present (Fig. 6). For livestock producers, a solid stand of introduced bluestems was appealing, especially given their ability to withstand heavy grazing and unfavorable weather.

Unfortunately, many introduced bluestems—including KR and Kleberg bluestems—do not always provide adequate nutrition for livestock.

These species were also seeded to decrease soil erosion along dams, spillways, and highway rights-of-way and in depleted rangelands. They were very effective for this purpose.

However, these bluestems can quickly disperse seed into nearby pastures, especially on exposed soil or during a drought. They establish quickly and crowd out other species. Because of incidental seed movement and the grasses' invasive nature, introduced bluestems are

common in many areas where they were never seeded intentionally.

Management theories

Three main approaches are used to manage invasive grasses on native lands: eradication, diversity management, and passive management.

Eradication

Eradicating KR or Kleberg bluestem is difficult unless the grass was introduced only recently and in small amounts. To eradicate these grasses from even a single pasture, a land manager would have to begin intensive control efforts, replant, apply follow-up treatments continually, carefully choose the hay brought onto the property, and protect pasture borders.

To reduce the likelihood of these grasses returning to the property, the manager would need to allow only clean equipment or vehicles to enter the property, request a “weed wash” of equipment that had been on introduced grass fields, and carefully monitor for introduced bluestems along pasture roads.

Diversity management

Another approach is to manage the land to encourage plant diversity and reduce the dominance of KR or Kleberg

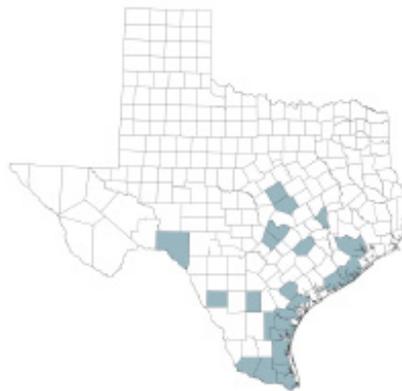


Figure 3. Kleberg bluestem distribution in Texas by county. *Map source: Amanda Anderson*

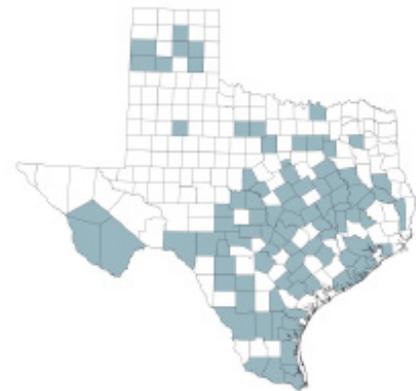


Figure 4. King Ranch bluestem distribution in Texas by county. *Map source: Amanda Anderson*



Figure 5. KR bluestem monoculture. *Source: Meagan Lesak*



Figure 6. Introduced bluestem field. *Source: Meagan Lesak*

bluestem. Native wildlife species generally do best in diverse plant communities.

These diverse plant communities are superior in providing all wildlife needs, including food, protection from predators, and areas for nesting and brooding young.

This approach is not a “one and done” endeavor. To enable native plants to compete with KR or Kleberg bluestem, retreatments must be timely, repeated, and well planned.

Passive management

The final option is to do nothing. Although it can be difficult to watch an invasive grass species invade a once-diverse native site, some managers cannot provide proper follow-up treatments to keep these grasses suppressed.

Research has confirmed that many management techniques disturb plants and soils, which encourages the further spread of KR and Kleberg bluestem. KR bluestem has been observed to decrease in density on coarse (sandy) and drier soils when the land is left alone.

Rather than creating a disturbance and encouraging these invasive grasses, there are situations where it may be best to leave the area alone and put effort into protecting areas that have not yet been invaded.

Management options

Practices that benefit nonnative bluestems

Many traditional practices to combat nonnative plants—such as mowing, plowing, disking, and fire (winter or summer)—have increased KR and Kleberg bluestem. The techniques provided only short-term suppression and ultimately failed to reduce these grasses.

As introduced grasses mature, they often shade ground where native plants would have otherwise been able to germinate and grow. Removing this top growth is often thought to give native plants a temporary competitive edge.

Unfortunately, several studies have found that the invasive grasses not only grow back within months, but they actually become more vigorous than before and out-compete the native plants.

A characteristic of introduced bluestems that makes them particularly difficult to manage is their large and persistent seedbanks. To achieve long-term control, a

manager must address existing plants as well as their seedbanks.

Traditional disturbance practices to prevent invasive grasses from going to seed often fail because the plants can seed out within 2 weeks post disturbance. Applying the technique continuously often results in grass plants that produce seed at shorter heights, as we see in home yards that are mowed often.

The additional disturbance can also harm desirable native plants in the area.

Mowing: Although mowing shortens the plants greatly, KR and Kleberg bluestem respond quickly after top removal. This trait is one of the reasons it was originally introduced for livestock grazing.

Continuous mowing causes the plants to shift their growth form from bunch to prostrate, in which the stems begin to grow parallel to the ground.

Along many highway rights-of-way are examples of mowing that has led to the dominance of introduced bluestems. In areas mowed twice annually, introduced bluestems typically dominate, whereas the nearby rights-of-way generally left unmown have more native grasses and greater plant diversity, especially late in the growing season.

Plowing: In crop production systems, a field is often plowed to rid the area of unwanted plants before replanting. Deep plowing can uproot invasive grass plants, allowing their roots to dry out and die.

Plowing can also potentially bury some introduced grass seed to prevent it from germinating as readily.

However, if plowing is used as a single treatment, KR and Kleberg bluestem can recover within months with rainfall, using their large seedbanks to take over the exposed soil.

Disking: Especially in winter, disking (Fig. 7) has been used to promote forb growth in early spring. Though this practice does not control these grasses long-term, repeated disking may increase forb availability for wildlife on some soil types.

However, disking can also expose soil, further promoting the spread of KR or Kleberg bluestem with time.

As with any treatment, the success of disking depends on the soil moisture conditions before and after disking. In drier soils, invasive grass root crowns may not re-root as easily



Figure 7. Disking implement. *Source: Robert Lyons*

following a disking event, whereas moist soils could promote quick reestablishment.

Coarse (sandy) soils are more easily manipulated with mechanical equipment and may allow invasive grass root crowns to dry out before they can reestablish, although long-term control with few treatments is not realistic.

Fire: Prescribed fire techniques (Fig. 8) are often used to increase nutrient cycling on rangelands and to produce new plant growth, as many of our native plant species have thrived with fire. However, research has found dormant-season burns increase the presence of introduced bluestems.

Summer fire was thought to be harsh enough during the plant's active stages of growth to control many introduced bluestem plants. Generally, summer fire has been found to reduce the amount of introduced bluestems on a site for up to a year, but plant crown survival and new seedlings eventually increase until their coverage meets or greatly surpasses pretreatment densities.

The rate of return can be influenced by soil type and rainfall received both before and after the burn.

Use extreme caution when burning a field where pockets of KR or Kleberg bluestem grow or where it is found next to a burn plot. Fire spreads introduced bluestems and is highly unlikely to produce long-term reductions in introduced bluestem populations.

Grazing: During the early growing stages of KR and Kleberg bluestems, the leaves may provide decent cattle forage, but the plants mature at rapid rates, becoming high in unpalatable stem material very quickly as compared to other forage grasses.

It is difficult to assign a specific nutritional value of these grasses for livestock because they decrease in both crude protein and digestibility as the plant matures. They also can vary widely depending on the ecoregion and plant cultivar in question.

Livestock avoid these plants when mature and in turn increase grazing pressure on other desirable native plant species such as little bluestem (Fig. 9), big bluestem, yellow indiagrass, and switchgrass. Overgrazing these preferred, highly palatable plants will eventually cause them to die and allow the further spread of introduced bluestems.

To reduce the possibility of overgrazing, maintain light to



Figure 8. Summer prescribed burning. *Source: Meagan Lesak*

moderate stocking rates. Be especially cautious of grazing pressure on desirable grasses during drought and certain periods of the year, such as the fall, when the native grasses grow best. The introduced grasses will already be mature, and livestock will avoid them.

Management combinations for suppression

If single-treatment applications are ineffective, what about combining some treatments to give these tough invasive grasses a one-two punch? Managers and researchers have tried combinations and repetitions of mowing, glyphosate (Roundup), fertilizing, plowing, and prescribed fire on native pastures.

At best, even combinations of management techniques reduce KR or Kleberg bluestem only short-term. After most



Figure 9. Little bluestem is native to Texas. *Source: Meagan Lesak*

management combinations, these bluestems generally return to pretreatment levels within 2 years, but more often after 3 to 6 months.

Plowing combinations yield the longest-lasting results, but in most cases, some type of subsequent planting will be needed because most plants present will be uprooted and many seeds buried.

Treatment combinations last for varying periods, depending on the technique, timing, soil type, seed bank in the soil, surrounding plant cover, and weather.

To increase the chances of success, apply mechanical or prescribed fire treatments when conditions are dry. However, at some point, KR or Kleberg bluestem will reinvade and the management combination will need to be repeated. Although the recovery period will vary, any management plan to reduce KR or Kleberg bluestems will be a multi-year, multi-treatment approach.

It is difficult to pinpoint a percent coverage of the introduced grasses to look for before re-treating—say, 20 percent, 30 percent, or 40 percent. Regardless, after the invasive grasses start to grow back, they will increase coverage steadily until they have met or surpassed the previous levels.

After rainfall, KR and Kleberg bluestems can quickly rebound from a disturbance, often moving into areas where native plants thrived before. To maximize control, take care of reinvasions early and often.

Replanting the pasture

When introduced bluestems become a monoculture in a pasture, the options are to learn how to live with it or start over. Land managers often try to control as much of the existing plants as possible and replant the pasture with more desirable seed.

Unfortunately, the introduced bluestem seed will be present in the soil, and no data is available on how long these seeds remain viable for germination. A soil seed sterilizer is not recommended because it will also sterilize any desirable seed planted later.

Even after replanting an entire pasture, managers will face the same challenges as with introduced bluestem

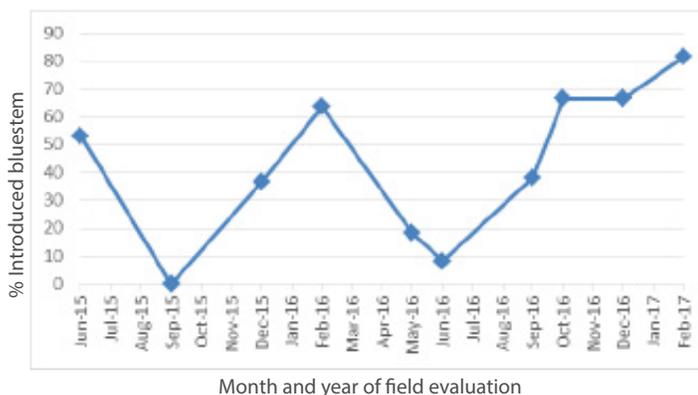


Figure 10. Average percentage of introduced bluestem cover in plots plowed (September 2015), sprayed with glyphosate (June 2016), and reseeded with natives (September 2016) in Kleberg County, Texas. Adapted from Lesak, 2016.

eradication—the need to watch vigilantly for introduced grasses moving in, protect the borders of the pasture, and maintain control over vehicles and hay brought onto the property.

The reseeding process involves plowing or disking the field in combination with applying glyphosate herbicide and then reseeding the pasture with a diverse native mix.

Studies have shown difficulty in recuperating planting and high maintenance costs with cattle income alone. But if the property goals include the enjoyment or recreational value of diverse wildlife species, converting a monoculture to a mixed native plant community could be viewed as an investment in the property instead of the cattle operation.

Mechanical treatment

The first step in converting an introduced bluestem field to natives is often a mechanical treatment (plowing or multiple disking) to dry out the plant roots and try to kill a large percentage of the invasive grasses. These mechanical treatments also may bury some seed, giving newly planted seed a chance to become established.

If you plow in the fall at least a full year before native seeding, you may be able to add more mechanical and chemical applications to new seedlings or difficult-to-control plants if needed.

EVERYTHING BUT THE KITCHEN SINK!

Lesak (2016) conducted a study in South Texas across six sites to determine how long combination treatments on King Ranch and Kleberg bluestems would suppress or control the invasive grasses.

She researched combinations of summer fire, glyphosate applications, and Pastora® applications (labeled for coastal bermudagrass pastures only) with plowing, mowing, plowing followed by native plant reseeding, fertilizing, and each technique on its own.

The findings:

- All treatment combinations temporarily reduced the amount of introduced bluestems, but they typically increased in coverage steadily over the course of a year until it met or substantially surpassed the density before treatment or until dry conditions decreased total plant material.
- Although introduced bluestems decreased on summer burn sites, significant crown survival and new seedlings led to an eventual increase in coverage until it reached pretreatment densities well within a year.
- Plowing combinations were best at reducing the introduced bluestems. But when plowing was used as a single treatment, King Ranch and Kleberg bluestem recuperated within months with rainfall to take over the exposed soil using their large seedbanks.
- Introduced bluestems can be killed by plowing, applying glyphosate, and replanting with native seed. But without follow-up management practices, the nearby introduced bluestem plants repopulated within 1½ years (Fig. 10).

Proper seedbed preparation will increase the likelihood of a successful reseeding. The average cost for plowing with a 4-inch-deep chisel is \$13.50 per acre.

Herbicide treatment

Applying glyphosate after some plants regrow helps clean the seedbed before planting. Glyphosate (trade name of Roundup®) is a common herbicide tool used to control introduced grasses and prepare land for reseeding. Keep in mind that glyphosate is active on green, leafy material, so it is not plant selective and does not sterilize seed in the soil.

The rate for broadcast applications of glyphosate must be high (3.3 quarts per acre) with the knowledge that most grasses and forbs will also be controlled if they are green at the time of spray.

The ideal time to treat with glyphosate is in the spring after the plants green up. If needed, consider a second glyphosate treatment just before planting in the fall.

A single glyphosate treatment for renovation costs about \$36 per acre, based on \$90 for a 2.5-gallon container of glyphosate product and a \$7 per acre application fee.

Sometimes, especially when the soil is wet, more KR and Kleberg bluestem may be controlled if you apply a high rate of glyphosate before plowing or multiple disking.

Burning or mowing the invasive bluestem before spraying can help remove standing dead material and expose shorter, green regrowth to take in the herbicide. Although burning or mowing is not necessary to achieve control with glyphosate, the green leaves must be covered well during the growing season to enable the chemical to do its job.



Figure 11. Native grass seed mixture. *Source: Meagan Lesak*

Reseeding

Native seeding often occurs in spring or fall when good growing conditions, including rainfall, are expected. Ideally, native seed (Fig. 11) would be planted in a clean, firm seedbed after the previous fall's plowing and spring glyphosate application, at a minimum.

For the planting to be successful, the native seed mix must be diverse and contain seeds of specific plant varieties adapted to the area.

A typical native seeding costs \$107 per acre, which includes \$82 for a 22-native seed mix and \$25 to broadcast

and pack seed.

All seeding efforts are risky because their success depends highly on timely rainfall. To increase the chances of success, support native plantings by spot spraying any returning invasive grass species as they emerge. Use a glyphosate mix at a 1.5 percent rate.

The chemical would cost only \$0.54 per gallon of mix, well worth it to protect the investment of plowing, glyphosate applications, and seeding, which could top \$150 per acre.

Prevention

If your property has no KR or Kleberg bluestem, some best management practices can reduce the likelihood of their invasion:

- Learn to identify invasive plant species in your area. Routinely check pastures for these plants so you can remove them before they become established.

Introduced bluestem can invade from roads, livestock working areas, hay distribution points, and residential areas.

- Spot spraying any new invasive grass recruits with glyphosate may help reduce these grasses' ability to invade your pasture. **Remember:** Although spot treatments with glyphosate are easy to apply, it will affect any green plants it contacts.
- Be careful when bringing equipment or vehicles onto the property. Equipment used where these invasive grasses grow can easily transport seeds and scatter them on your land.

Ask pipeline companies, professional hay balers, hunters, and others who need access on your property to clean their equipment and vehicles before bringing them into your pastures. Introduced bluestems are well established along most public roadways, and seeds can readily be transported onto a ranch by any vehicle traveling public roads.

- Maintain buffers along fence lines next to introduced grass fields.

If KR or Kleberg bluestem is found in neighboring fields or along road ditches, pay careful attention to the land nearest these sites. Avoid exposing the soil because it creates prime opportunity for invasive grass seeds to blow in and establish. Do not disturb the vegetation along these fences with fire, mowing, or disking, and maintain proper stocking rates to avoid overgrazing, which also opens up bare ground.

Where many invasive grasses are threatening a once-clean pasture, some landowners have tried to maintain buffers by regular plow and glyphosate treatments as they would when installing fireguards on pasture perimeters. Before starting such a rigorous maintenance program, be sure that you can keep it up long-term. Otherwise, you may make the problem worse.

Take-home message

Like many invasive grass species, introduced bluestems love disturbance. Although a single mowing, burning, plowing, or disking will temporarily decrease the amount of KR or Kleberg bluestem present, these species will respond aggressively.

Applying any of these disturbance practices appears to reduce all plants equally. But because KR and Kleberg bluestem can crowd out native vegetation, they are often back to their original density within a few months. In some cases, they surpass the coverage present before the practices. The land would be better left alone and the landowner would save the cost of the management practice.

Even with advanced technologies, land managers struggle with complex management issues. The first steps to effective management are to understand these invasive species and learn how to reduce their footprint.

Adopting management practices that further the ultimate goal for the property can bring success, even among the presence of difficult-to-control grass species such as introduced bluestems.

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