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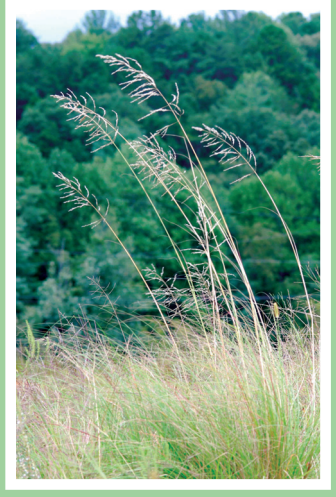
Field Guide for Managing Lehmann and Weeping Lovegrasses in the Southwest



Forest Service

Southwestern Region

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Cover Photos

Top right, Lehmann lovegrass: John M. Randall, The Nature Conservancy, Bugwood.org
Left, Lehmann lovegrass: Joseph M. DiTomaso, University of California, Bugwood.org
Lower right, weeping lovegrass: James H. Miller, USDA Forest Service, Bugwood.org
Lower left, weeping lovegrass: Forest and Kim Starr, U.S. Geological Survey, Bugwood.org

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Lehmann lovegrass (*Eragrostis lehmanniana* L.)
Weeping lovegrass (*Eragrostis curvula (*Shrad.) Nees. var. *curvula*)

Grass family (Poaceae), Chloridoideae subfamily, Eragrostideae tribe

Lehmann and weeping lovegrasses are introduced forage and soil protection grasses that are becoming invasive in southwestern states. They are now listed as noxious weeds in Arizona and portions of New Mexico. This field guide serves as the U.S. Forest Service's recommendation for management of Lehmann and weeping lovegrasses in forests, woodlands, rangelands, desert, and desert scrub associated with its 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

Lehmann lovegrass (synonym: African lovegrass) and weeping lovegrass (synonyms: Boer lovegrass, curved lovegrass, Catalina lovegrass) are hardy, drought-tolerant bunchgrasses originally from South Africa. Both grow in dense tufts and have seed heads that grow as an open panicle with lax or drooping branches. Weeping lovegrass is slightly taller than Lehmann lovegrass and has longer, narrower, drooping blades with fine, soft hairs on the sheaths near the base of the stem. Lehmann lovegrass has smooth sheaths, and newer shoots near the outer edge of the tuft tend to grow in a more prostrate form (lying on the ground).

Weeping lovegrass has been widely planted and is more broadly distributed across the United States than Lehmann lovegrass. During the 1980s and 1990s, weeping lovegrass was the most common grass planted on thousands of acres held under the Conservation Reserve Program in New Mexico, Oklahoma, and Texas. The two lovegrass species were introduced into the Southwest because of their desirable qualities in reducing soil erosion and providing forage. However, some of the traits that allow these grasses to thrive in arid areas have also caused them to be highly invasive and unwanted within native plant communities. In the Southwest, these grasses have been planted since the 1930s and were included in seed mixes used for range and agricultural land restoration, after wildfires, highway construction, and other ground-disturbing activities. Both lovegrasses have been widely planted along highway rights-of-way and for range restoration/soil conservation efforts in the Chihuahuan and Sonoran Deserts.

Growth Characteristics

- Both species are perennial bunchgrasses; normally warm season but low winter temperatures may cause these lovegrasses to act as annuals or short-lived perennials.
- Rapid growth; weeping lovegrass grows mostly in summer and is slow to regrow after it is grazed; Lehmann lovegrass actively grows in spring, summer, and fall; it has a moderate growth rate following use.
- Weeping lovegrass grows erect in bunches, 24 to 60 inches tall; Lehmann lovegrass grows semi-erect in bunches 15 to 30 inches tall and tends to root at nodes (weakly stoloniferous).
- Leaf blades flat to slightly rolled under along margins (weeping lovegrass 5 to 20 inches long; 0.04 to 0.11 inch wide and Lehmann lovegrass 0.8 to 5 inches long; width same), Lehmann lovegrass blades are glabrous to slightly scabrous; weeping lovegrass may have long, soft hairs near the base; ligules are ciliate (Lehmann lovegrass ligule is shorter than weeping lovegrass ligule).
- Open, greenish, rebranching panicle (weeping lovegrass inflorescence is 6 to 14 inches long; Lehmann lovegrass inflorescence is 2.75 to 7 inches long); spikelets have 3 to 12 florets each (lower floret reduced); spikelets yellowish at maturity; weeping lovegrass blooms in mid-spring; Lehmann lovegrass blooms in late spring.
- Both reproduce from seed; Lehmann lovegrass seeds require a ripening period before germination; dry heat and a certain level of red light improve the likelihood for germination. Weeping lovegrass does not require fertilization to produce seed; it is an obligate apomitic

species. Neither of these lovegrasses reproduces vegetatively; however, Lehmann lovegrass may root at nodes.

Ecology

Impacts/threats

Lehmann lovegrass is more likely than weeping lovegrass to move beyond planted areas into native plant communities; however, both grasses are expanding their range. The natural fire regime in desert communities has been altered as these species have increased, resulting in more intense wildfires that occur with greater frequency. Both species are not highly preferred by livestock and wildlife for grazing in comparison to native grasses, which has allowed them to become increasingly dominant in many native plant communities.

Location

In southeastern Arizona, Lehmann's lovegrass is commonly found growing away from planted areas, especially on course soils at moderate elevations of 3,000 to 4,500 feet. Weeping lovegrass tends to not move far from planted areas and grows in Arizona from 4,900 to 6,500 feet.

Spread

Lehmann and weeping lovegrass both produce huge quantities of small-sized seed that accumulate in the soil seed bank. Seed is spread by wind, water, animals, and vehicles. Lehmann lovegrass seed is initially dormant and requires 6 to 9 months of after-ripening. Shading inhibits germination since the seed also requires exposure to red light to propagate. In southeastern Arizona, the spread of Lehmann lovegrass is related, in part, to the amount and distribution of summer rain and soil type (spread is more likely in loamy sand or sandy loam soils). Newly emerged weeping lovegrass must have dependable moisture to survive as dry soils will quickly desiccate seedlings.

Invasive Features

Lehmann lovegrass establishes quickly, produces high quantities of viable seed during its first season of growth, and can spread at a rate of 175 m/year. While weeping lovegrass is less likely to escape boundaries of planted areas, it is very persistent and long lived.

Management

Considerable information has long been available regarding how best to plant and manage lovegrasses for various beneficial purposes including grazing, soil erosion conservation, roadside stabilization, and mine site reclamation. Conversely, there is much less experience and information available concerning how best to control these grasses in areas where native grass restoration is a primary management objective. To achieve this goal, there is general agreement that such an effort will require several steps taken over a long time horizon. In many situations, it may be impractical to replace lovegrasses where they have become widespread and well established in native plant communities. Rather, accepting lovegrass as a minor component in the vegetation mix may be a more practical management strategy. In any case, control and restoration efforts will require long-term planning, integrated management, and followup monitoring. The following actions should be considered when planning a management approach for these two lovegrasses:

- Maintain healthy plant communities to help prevent or limit new infestations. This may involve using improved grazing management practices to prevent excessive grazing and/or reseeding areas with desirable native grasses and forbs after disturbance.
- Detect, report, and map known Lehmann and weeping lovegrass populations. Keep annual records of reported infestations.
- Develop a specific action plan to meet goals and objectives for infested areas, which may include eradication of new populations of Lehmann lovegrass in sensitive sites, such as those areas known to be habitat for threatened and endangered species, travel corridors, seed pathways, etc.

Table 1. Management options*

Site	Physical Methods	Cultural Methods	Biiological Methods	Chemical Methods
Roadsides, fence lines, or noncrop areas	Disk or plow in agronomic areas. Repeated mowing is a suppression option along roadways.	Consider native grass species when reseeding rights-of-way. Avoid driving vehicles and equipment through infested areas.	As of yet, classical biological control methods are not available.	Use truck or tractor-mounted spraying equipment to broadcast treat. Wash underneath vehicle after applicxation to prevent seed spread.
Rangelands, pastures, or riparian corridors	Burning alone is not recommended since it will likely result in increased densities; consider burning in combination with herbicide spraying.	Use certified weed-free seed and hay. Use pellets for horses in back-country areas. Where feasible, consider reseeding areas with native grasses following control actions.	Graze in the winter or spring when livestock will select nonnative lovegrasses over native grasses to reduce biomass and fuel load.	In areas difficult to access, an ATV-mounted sprayer or backpack unit may be the most practical application methods.
Wilderness, other natural areas, and/ or small infestations	Hand pulling or digging may aid in control. Wear gloves for pulling; pull when soil is moist and remove as much root stock as possible.	Same as above.	Same as above.	Use backpack or hand-held sprayers. Broadcast spraying with ground 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.

- Combine mechanical, cultural, biological, and chemical treatment methods for most effective control of these two lovegrass species.
- Implement a monitoring and followup treatment plan for missed plants and seedlings. Also, monitor recovery of desirable native plant species following control efforts.

Choice of control method(s) for Lehmann and weeping lovegrasses depends on many local factors including primary species present, degree of infestation, current land use, and site conditions (terrain, accessibility, climate, nontarget flora and fauna present, etc.). Other management considerations include treatment effectiveness, cost, and the number of years needed to achieve control and whether the management objective is eradication or containment. Table 1 summarizes some management approaches for common situations involving these two lovegrass species. A slightly different approach may be needed depending on which species is primarily present and more than one control method may be needed for a particular site.

Physical Control

Physical methods used to control lovegrass should focus on minimizing plant spread and mitigating adverse impacts from fire. These methods usually have to be repeated and must be timed properly to be effective.

Manual Methods

Hand removal – Mature weeping lovegrass develops a dense mat of roots that fills the soil space between plants; mature Lehmann lovegrass develops dense crowns that root at nodes, making it difficult to distinguish one plant from the next. Hand pulling, grubbing, and hoeing can be effective (but difficult) year-round methods for control. Hand removal is easiest when soil is moist, temperatures are cool, and plants are in their early life stage. Simple digging tools (digging bar, hoe, shovel, Pulaski, etc.) may be used to aid root removal. To prevent seed dispersal, plants that have been pulled up should be placed in plastic bags and properly disposed of in sanitary landfills. For areas too remote for transport with plastic bags, pulled up weeping and Lehmann lovegrass plants may be left onsite by putting them into a

pile and then placing rocks over them. Sites undergoing lovegrass removal should be revisited after rain, and any seedlings that have emerged should be pulled up or spot sprayed. Several consecutive years of hand removal will be required in order to eliminate an infestation completely.

Mechanical Methods

Tillage and mulching – Both weeping and Lehmann lovegrasses respond to light and are less likely to thrive under shaded conditions. To remove lovegrass from previously seeded cropland or rangeland areas, till with a deep plow or disc. Cultivation is most effective in hot, dry weather that greatly stresses plants. Tillage will exhaust carbohydrate reserves stored in roots but will not eradicate seed in the soil. Leaving tilled vegetation on the surface or adding a layer of gravel or litter mulch will further decrease the likelihood for seedlings to germinate and survive. Reseed tilled areas with a mixture of native seed that is adaptable to the local area.

Mowing – Since weeping lovegrass stores carbohydrates primarily in its crown, it is especially susceptible to repeated close cutting. Where feasible, cut to a height below 2 inches and leave clippings in place as a mulch. Mowing causes the highest mortality in weeping lovegrass when conducted from September through November. For Lehmann lovegrass, mowing is more effective in combination with a follow up pre- or post-herbicide application. See the "Combined Strategies" section for more information.

Prescribed Fire

Lehmann and weeping lovegrasses regrow quickly after a fire and may return at greater densities than before. Thus, fire is not recommended as a single or stand-alone control method. Studies in central Arizona have shown decreased weeping lovegrass in areas protected from fire and grazing, which is believed to be due to suffocation of new growth by older stands.

Cultural Control

Public education about the use of nonnative grasses, such as Lehmann and weeping lovegrasses, and its impacts on ecosystems is an essential component for changing restoration practices. Since weeping lovegrass has become an integral part of roadside reseeding and erosion control on mine spoils, culturally sensitive collaboration may be required to encourage the use of native species for reseeding areas that have been disturbed by mining, fire, overgrazing, or road building. Species such as Arizona cottontop (*Digitaria californica*), plains bristlegrass (*Setaria macrostachya*), sideoats grama (*Bouteloua curtipendula*), sprucetop grama (*Bouteloua chondrosioides*), and other native species adapted to lower elevations in southern Arizona may be considered.

To help limit the spread of Lehmann or weeping lovegrass beyond areas where they are used as forage, landscape disturbance should be minimized. Gravel and other road materials transported into uninfested areas should be weed free. Always wash mowing and other equipment used along roadsides when moving from infested areas to areas free of invasive lovegrass.

Biological Control

Grazing

Grazing is often the most practical means for reducing lovegrass fuel loads and lowering wildfire threats. However, grazing alone will not eliminate future lovegrass spread and should be used as part of an integrated management approach. Lehmann and weeping lovegrasses are moderately palatable forage grasses, especially in the winter and spring when native grasses are not yet green. Consider using intense grazing over a short period of time in the winter, spring, and fall when cattle are most likely to select these grasses. Use a mineral supplement to enhance livestock consumption and nutrition. Reduce grazing pressure in summer to avoid excessive use of preferred native grasses.

Fall grazing contributed highly to winter mortality of weeping lovegrass in Oklahoma-based studies. In this region, it is recommended that grazing cease 6 weeks before frost when freezing temperatures turn grass straw colored. By deferring grazing during this time, weeping lovegrass

foliage and regrowth provides its own germination suppressing shade. Precaution should be taken when moving animals from an infested pasture to one free of invasive lovegrass; consider a 10-day quarantine to prevent seed introduction.

Classical Biological Control

No classical biological control agents are available for use against Lehmann or weeping lovegrass.

Table 2. Herbicide recommendations

Common Chemical Name (active ingredient)	Product Example[1]	Product Example Rate per Acre (broadcast)	Backpack Sprayer Treatment Using Product Example[2]	Time of Application	Remarks
Glyphosate	Roundup, Roundup Ultra, Rodeo, Accord, others available	0.75–1 pint	2–5% solution	Fall or spring when lovegrass is actively growing as indicated by bright green and glossy leaves. Best results if lovegrass is at least 50% green.	Glyphosate is a nonselective amino acid inhibitor and is formulated as a product with either 2 lb or 4 lb active ingredient per gallon. Certain brands require addition of a NIS3. Read label carefully to mix the proper rate of application. Do not add ammonium sulfate when spraying rangelands. Also, consider tank mixes of both glyphosate and imazapyr for increased control. See herbicide label for details. Glyphosate may also damage desirable vegetation, including forbs and woody species. Preferred time to spray is when desirable grasses are dormant but lovegrass growth is suitable for spraying.
Imazapyr	Habitat, Arsenal, others available	2–3 pints	1–3% solution	Fall or spring when lovegrass is actively growing as indicated by bright green and glossy leaves, but desirable grasses are dormant.	Imazapyr is a nonselective amino acid inhibitor. For perennial grasses, it is best used as a postemergent control, which requires the use of a 0.25 NIS or 1% MSO[4]; follow label instructions. Nontarget plants including desirable forbs and woody species may also be killed or injured by root transfer of imazapyr between intertwined root systems. Herbicidal activity may be slow. Allow two full growing seasons before followup treatment.
Sethoxydim	Poast, Vantage, Ultima160	1.5–2.5 pints	1–1.5% solution	Warmer days of spring or fall, preferably when less than 6–10” high.	Sethoxydim is a selective metabolic inhibitor that targets most grasses; it is absorbed by foliage and translocated to growth points in roots and shoot. Addition of 1% MSO[4] increases activity; see label for details.

[1] Trade 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 information and appropriate use with lovegrass.

[2] Herbicide/water ratio - As an example, a 3 percent mixture for a gallon of spray water is made by adding a sufficient volume of water to 4 ounces of liquid herbicide until a volume of 1 gallon is reached (4 oz ÷ 128 oz/gal = 0.03 or 3 percent).

[3] NIS is used as an abbreviation for nonionic surfactant.

[4] MSO is used as an abbreviation for methylated seed oil.

Chemical Control

The primary herbicides used for Lehmann and weeping lovegrass control in the United States are glyphosate and imazapyr. All herbicides listed in table 2 will provide lovegrass control when properly applied. However, these are nonselective herbicides and may also impact nontarget species. Therefore, caution should be taken if nontarget plants (including woody species) need to be protected. Each herbicide product has different requirements and restrictions. Thus, it is important to read the label carefully and follow all instructions and guidelines when mixing and applying any herbicide.

When spraying Lehmann or weeping lovegrass, the foliage should be at least 50 percent green; however, better control is obtained when plants are actively growing and are more than 80 percent green. Lovegrass tends to green up 2 to 4 weeks before native grasses in the spring and often stays greener later into the fall and winter. This offers a narrow opportunity for spraying lovegrass while minimizing damage to other desirable species. However, each site scheduled for treatment must be closely evaluated before spraying to determine if the potential harm to the surrounding plant community is acceptable.

To limit impacts to desirable plants from spraying, a backpack or hand-held sprayer may be used to spot spray lovegrass directly. Since herbicide uptake and activity occur mainly through the foliage, enough spray should be used to wet leaves but avoid dripping off the plant. Adding a blue or red dye to the solution will aid in identifying treated plants. A team of applicators walking together side-by-side (about 10 feet apart) is an effective way to spray a defined area systematically; this method is particularly effective for treating smaller, less dense infestations. For large infestations, it may be more practical to use an ATV or UTV sprayer or a conventional boom sprayer that is pulled or mounted to a truck or tractor. After careful evaluation, an aerial application may also be considered as a method for controlling large, monocultural tracts of lovegrass on a landscape basis. Before spraying, always consider the need for reseeding with desirable native grasses following herbicide application.

Control Strategies

When planning a strategy to manage either Lehmann or weeping lovegrass, it is important to understand why and how these grasses where originally planted and how they have since spread into areas where they are unwanted. In the Southwest, they have been planted over the past 75 years across a wide range of ecological sites, often for different reasons. Lehmann lovegrass is of greater concern than weeping lovegrass with respect to how these grasses have spread into desert communities and other nonagricultural areas in the Southwest. From a practical standpoint, Lehmann and weeping lovegrasses have become so well established in many areas that it may be unrealistic to seek their elimination as a management goal. A more realistic goal may be to direct efforts toward reducing their dominance in a local area. The following strategies for combined treatments should be considered to contain and reduce lovegrass dominance:

- **Manual–chemical strategy** – For smaller or isolated populations of lovegrass on otherwise healthy sites, remove by hand using simple tools such as a hoe, shovel, digging bar, or Pulaski. Take care to remove as much of the root as possible. While hand removal can be done at any time of the year, it is easiest when soil is moist, temperatures are cool, and plants are in their early growth stage. Monitor previously treated sites following significant warm season rains and provide followup treatment by hand pulling or spot spraying emerging seedlings with a 2 percent mix of Roundup.
- **Mechanical–chemical strategy** – Tilling with a deep plow is especially suited as a control method in areas previously planted with lovegrass, such as old fields or pastures. Mowing during hot, dry weather and then spraying the regrowth at a later time is suited for roadsides and rights-of-way. Monitor previously

treated sites following significant warm season rains and use truck- or ATV-mounted sprayers to apply herbicide during active growth in the fall (as indicated by the appearance of bright green, shiny leaves).

- **Grazing–chemical strategy** – In pasture and rangeland settings, graze Lehmann or weeping lovegrass intensively to eliminate top growth and to stimulate new plant growth. Follow with a chemical treatment during the active growth stage, preferably before seed set. Monitor treated sites after significant warm season rains and provide followup treatment by pulling or spot spraying emerging seedlings.
- **Prescribed burn–chemical strategy** – In areas with a near monoculture of Lehmann or weeping lovegrass, consider a prescribed burn to eliminate top growth and litter. After rain and with 4 to 6 inches of new green growth, use a broadcast herbicide treatment. Monitor and use followup treatments on the burned area. Where feasible, consider reseeding with adaptable native species.

Any approach designed to control these grasses and restore native plants in specific communities must be adapted to local conditions. While information in the literature is limited, there is agreement that two or more steps taken over a relatively long time horizon will be needed to control and replace Lehman lovegrass with desirable native plants in areas where it now occurs. A study in Arizona suggests that lovegrasses should be treated first (such as burning) to force the expression of the seed bank which can then be followed up with an additional treatment (such as herbicide treatment) to kill seedlings and adult regrowth. If needed, areas may be reseeded at a later time with adaptable desired native species. Treated areas should always be monitored for several years to control emerging lovegrass seedlings.

Adaptive Management

Available information and research currently underway suggest that there probably will not be one overarching process or method for effective control of Lehmann or weeping lovegrass. Therefore, an adaptive management strategy should be used in most cases to control these grasses with the overall goal of restoring desirable native vegetation to the greatest extent possible. 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,
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

Biedenbender, S.H., B.A. Roundy, and L. Abbot. 1993. Replacing Lehmann Lovegrass with Native Grasses. In Roundy, B.A.; McArthur, E.D.; Haley, J.S.; Mann, D.K., comps. 1995. Proceedings: wildland shrub and arid land restoration symposium; 1993 October 19-21; Las Vegas, NV. Gen. Tech. Rep. INT-GTR-315. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station.

Cox, J.R., M.H. Martin, F.A. Ibarra, J.H. Fourie, J.F.G. Rethman, and D.G. Wilcox. 1988. Influence of Climate and Soils on the Distribution of Four African Grasses. Journal of Range Management 41(2):127–139

Cox, J.R., G.B. Ruyle, and B.A. Roundy. 1990. Lehmann Lovegrass in Southeastern Arizona: Biomass, Production and Disappearance. Journal of Range Management 43(4):367–372.

Cumming, K.J. 1989. Lehmann Lovegrass and Simple Time Control Grazing. Rangelands 11(4):150–153

D'Antonio, C.M. and P.M. Vitousek. 1992. Biological Invasions by Exotic Grasses: the Grass/Fire Cycle and Global Change. Annual Review of Ecology and Systematics 23:63–87.

Devoe, N., B. Nowak, and S. Florence. 2009. Effective Management of Invasive Plants. Rangelands 31(3):21–24. Available at http://www.srmjournals.org/doi/full/10.2111/1551-501X-31.3.21 (accessed Feb. 2010)

Freeman, D. 1979. Lehmann Lovegrass. Rangelands 1(4):162–163.

Gucker, C. L. 2009. Eragrostis curvula. In Fire Effects Information System (Online). U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available at http://www.fs.fed.us/database/feis/ (accessed November 2011).

Halvorson, W.L. and P. Guertin. 2003. Eragrostis curvula Factsheet. In USGS Weeds in the West Project: Status of Introduced Plants in Southern Arizona Parks. Available at: http://sdrsnet.srnr.arizona.edu/data/sdrs/ww/docs/eragcurv.pdf (accessed December 2011)

Halvorson, W.L. and P. Guertin. 2003. Eragrostis lehmanniana Factsheet. In USGS Weeds in the West Project: Status of Introduced Plants in Southern Arizona Parks. Available at http://sdrsnet.srnr.arizona.edu/data/sdrs/ww/docs/eraglehm.pdf (accessed December 2011)

Humphrey, N. 1994. History, Status and Management of Lehmann Lovegrass. Rangelands 16(5):205–206.

James, D. 1995. The Threat of Exotic Grasses to the Biodiversity of Semiarid Ecosystems. Aridlands Newsletter No. 37. Available at http://ag.arizona.edu/OALS/ALN/aln37/james.html (accessed Nov. 2011)

McClaren, M.P. and M.E. Anable. 1992. Spread of Introduced Lehmann Lovegrass Along a Grazing Intensity Gradient. Journal of Applied Ecology 29:92–98.

Meat and Livestock Australia. 2009. 3D Weed Management: African Lovegrass. Available at http://images.wool.com/pub/3D_Weed_Guidelines_AfricanLovegrassJune2009_lowresFINAL.pdf (accessed December 2011)

Morisawa, T. 2000. Weed Alert: Cenchrus ciliaris L. The Nature Conservancy. Available at http://www.invasive.org/gist/moredocs/cencil01.pdf (accessed Feb. 2010)

Northam, E., W. Meyer, J. Arnold-Musa, E. Carrillo, K. Egen, and M. Hershdorfer. 2009. Non-Native Invasive Plants of Arizona. Produced by Conservation Districts and RC&D Areas of Arizona and the University of Arizona Cooperative Extension. pp. 8–9. Peer reviewed publication AZ1482. Available at http://cals.arizona.edu/pubs/natresources/az1482.pdf (accessed Feb. 2010)

Pope, L. and L. Ayres. 2010. African Lovegrass Management. Primefacts 927. Industry and Investment NSW. New South Wales, Australia. Available at http://www.actnrmcouncil.org.au/files/African-lovegrass-management.pdf (accessed December 2011)

Ruyle, G.B. and D.J. Young, eds. 2002. Arizona Range Grasses (Original edition by R.R. Humphrey). Cooperative Extension and University of Arizona. Available at http://cals.arizona.edu/pubs/natresources/az1272/ (accessed Nov 2011)

Tiedmann, A.R. and J.O. Klemmedson. 2004. Responses of Desert Grassland Vegetation to Mesquite Removal and Regrowth. Journal of Range Management 57(5):455–465.

Tu, M. 2002. Cenchrus ciliaris L. The Nature Conservancy: Wildlands Invasive Species Team. Dept of Vegetable Crops and Weed Sciences University of California Davis. Available at http://www.imapinvasives.org/GIST/ESA/esapages/documnts/cenccil.pdf (accessed Feb. 2010)

Uchytil, R.J. 1992. Eragrostis lehmanniana. In Fire Effects Information System, [Online]. USDA, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available at http://www.fs.fed.us/database/feis/ (accessed November 2011).

USDA, NRCS. 2011. The PLANTS Database. National Plant Data Team, Greensboro, NC. Available at http://plants.usda.gov (accessed 8 November 2011).

Williams, B.K., R.C. Szaro, and C.D. Shapiro. 2009. Adaptive Management: The U.S. Department of the Interior Technical Guide. Adaptive Management Working Group, U.S. Department of the Interior, Washington, DC. Available at http://www.doi.gov/initiatives/AdaptiveManagement (accessed April 2011)

Suggested Web Sites

For information about calibrating spray equipment:

NMSU Cooperative Extension Service Guide A-613 Sprayer Calibration http://aces.nmsu.edu/pubs/_a/A-613.pdf

Herbicide labels online:

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

Invasive Plant Atlas of the United States:

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

For more information or other field guides, contact:

USDA Forest Service
Southwestern Region
Forest Health
333 Broadway Blvd., SE
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Or visit:

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