USDA
United States Department of Agriculture

Field Guide for Managing Buffelgrass in the Southwest

Forest Service
Southwestern Region
TP-R3-16-03
Revised June 2017

Cover Photos

Upper left: Buffelgrass clump – Travis Bean, Univ. Arizona

Upper right: Buffelgrass collar with hairs – Southern Arizona Buffelgrass Coordination Center, buffelgrass.org

Lower left: Buffelgrass infestation – USDI National Park Service

Lower right: Buffelgrass inflorescences – Southern Arizona Buffelgrass Coordination Center, buffelgrass.org

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Buffelgrass (*Cenchrus ciliaris* L., synonym: *Pennisetum ciliare* L.)

Grass family (Poaceae), Paniceae tribe

Buffelgrass is an introduced forage grass that has become invasive in southwestern States. Due to its threat to the Sonoran Desert ecosystem, buffelgrass has been listed as a noxious weed in Arizona.

This field guide serves as the U.S. Forest Service's recommendations for management of invasive buffelgrass in forests, woodlands, rangeland, 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 administers 4 national grasslands that are located in northeastern New Mexico, western Oklahoma and the Texas panhandle.

Description

Buffelgrass (synonyms: anjangrass, African foxtail grass, zacate buffel) is a drought-tolerant bunchgrass originally from African savannah that was introduced into the U.S. for forage and erosion control. However, many of the traits that make buffelgrass desirable as a forage grass also cause it to be highly invasive in native plant communities.

Buffelgrass has a number of cultivars and is variably classified across two very closely related grass genera – *Cenchrus* and *Pennisetum*. Key characteristics useful for buffelgrass identification include a bottlebrush-like inflorescence and light-colored hairs that occur near the junction (collar) where leaves meet the stem. Buffelgrass is similar in appearance to fountain grass (*Cenchrus setaceus*, syn. *Pennisetum setaceum*), which is an escaped ornamental grass. However, buffelgrass is generally shorter (1 to 1.5 feet tall) than fountain grass (3 to 4 feet) and has shorter, thicker inflorescences (1.5 to 5 inches long) compared to fountain grass (4 to 14 inches).

Growth Characteristics

- Tussock-forming perennial grass; typically 1 to 1.5 feet in height but can grow to over 3 feet. Knotty and branching at base; tillers often have secondary branching that give plants a subshrub-like (chaemaphytic) appearance.
- Normally warm season and intolerant to cold temperatures but at lower elevations can grow in moderate temperatures during winter after rainfall. Shade tolerant; shade may promote growth on some sites. Generally requires summer moisture to thrive.
- Rapid growth; germinates from seed, matures, and flowers within 6 weeks after rainfall of at least 0.75 inches and a period of moist soil lasting 3–5 days.
- Flat leaf blades (3–12 inches long, 0.1–0.3 inches wide), scabrous or with long, soft hairs; sheaths open, keeled, glabrous to having sparse, long, soft hairs; collar region with sparse, whitish, straight hairs about 0.2 inches long.
- Purplish to reddish, bottlebrush-like inflorescences (0.8–5.1 inches long); spikelets in clusters of 2–4, each with 2 flowers (lower floret reduced); spikelets tan, beige, or slightly orange at maturity; spikelets fall off whole from the rachis.
- Reproduces from apomictic (asexually formed) seed; seed usually lies dormant 3 to 18 months and is viable for at least 3–5 years.

Ecology

Impacts/Threats

Although buffelgrass is used as forage for livestock, it is an unwanted weedy invader in many arid regions of the world. Buffelgrass is a particularly serious threat to the Sonoran Desert in Arizona and the lower Rio Grande Valley in Texas. It can out-compete native vegetation for soil nutrients and moisture. In addition, infestations of buffelgrass alter fire regimes in native plant communities by changing fire frequency and intensity through an increase in fuel loading and connectivity. Buffelgrass re-grows quickly following wildfire; however, fire can kill or injure nearly all native plant species in Sonoran Desert communities. As a result, buffelgrass has the potential to displace native plant communities and change ecologically rich areas into near-monocultures of buffelgrass with decreased diversity, cover, and densities of native plants.

Site/Distribution

Buffelgrass is spread widely across disturbed and undisturbed areas in the Southwest, which includes urban areas, roadsides, rangeland, old fields, and desert plant communities. It is commonly found on rocky, south-facing slopes in Arizona uplands. The species has been planted as a forage grass on re-seeded rangeland in certain parts of Texas and Mexico.

Spread

Seed is spread by wind, water, animals, and vehicles. Whenever buffelgrass becomes established near roads and ditches, the opportunity for spread is increased.

Invasive Features

Buffelgrass spreads aggressively by seed and grows in dense stands that can double in cover every 2–3 years. The species is highly adaptable and grows on many soil types including soils that are heavy, sandy, or overlying limestone. It is often more effective at capturing soil moisture than native plant species, thereby contributing to its invasiveness.

Management

Buffelgrass is a major threat across large areas of the Southwest, particularly in the Sonoran Desert and lower Rio Grande Valley. To undertake effective buffelgrass control at this scale, collaboration among affected stakeholders is essential, especially stakeholders managing pathways (road systems, utility corridors, etc.) by which buffelgrass can invade. A major emphasis for stakeholders should be to reduce buffelgrass fuel loads and connectivity thereby diminishing the likelihood of wildfire. Another management emphasis should be to maintain or restore the resiliency of native plant communities. Indications of treatment success during restoration include the return of native plant species and an increase in species diversity.

Long-term planning, integrated management, and follow-up monitoring are necessary to control buffelgrass effectively. The following actions should be considered when developing a management approach for buffelgrass:

1. Develop a specific action plan to meet goals and objectives for infested areas, which may include eradicating new buffelgrass infestations in sensitive sites or controlling buffelgrass in managed landscapes, e.g., wildland-urban interface (WUI) areas.
2. Evaluate infested sites to determine which treatment methods (or combination of methods) are most effective for buffelgrass control. Chosen methods should focus on stopping seed production and mitigating impacts from fire. A combination of various treatment methods and repeated treatment will often improve effectiveness.
3. Give priority to early detection of buffelgrass and eradication of new infestations in otherwise healthy sites. For established infestations, the perimeter and any satellite populations should be treated first to prevent further encroachment.
4. After treatment, implement monitoring and follow-up treatment for missed plants and seedlings. To deplete the buffelgrass seed bank, treatments need to be repeated annually for several years and can be repeated within a growing season if rainfall causes regrowth and green-up. Also, monitor recovery of desirable native plants following control efforts.
5. Limit disturbance and maintain healthy plant communities that can 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.
6. Detect, report, and map buffelgrass populations that have spread out over large areas. Also map presence and condition of native vegetation. Keep annual records of reported infestations. Identify priority areas for treatment by using records, maps, and other information sources such as known habitat for Threatened & Endangered species, travel corridors, seed pathways, etc.

Table 1. Management options*

Site	Physical Control	Cultural Control	Biological Control	Chemical Control
Wildland-urban interface (WUI) areas	Use hand pulling, grubbing, or hoeing on small patches but minimize soil disturbance. Remove the entire root mass to prevent re-sprouting. Transport removed buffelgrass in plastic bags to a sanitary landfill or leave plants onsite by using the "pile-and-rock" method or by spreading plants over disturbed soil and placing rocks over them. Revisit treated sites to remove new buffelgrass seedlings and previously missed plants.	Avoid using buffelgrass for erosion control. For disturbed areas with supplemental irrigation or adequate moisture for germination, consider reseeding with native species. Avoid undue soil disturbance.	None available	Use backpack or hand-held sprayers for small patches. Broadcast spraying with vehicles may be used for larger patches. **Special Note**: Protect non-target plants from spray drift, runoff, or residue movement in soil plants. Revisit treated sites to spray new seedlings, missed plants, and regrowth on previously sprayed plants.
Roadsides	Mowing or grading along roadsides should be used with caution to prevent seed spread. Cut buffelgrass before seed stalks are developed. Use hand pulling, grubbing, or hoeing on small patches but minimize soil disturbance. Remove the entire root mass to prevent re-sprouting. Transport removed buffelgrass in plastic bags to a sanitary landfill or leave plants outside of the right-of-way by using the "pile-and-rock" method. Revisit treated sites to remove new buffelgrass seedlings and previously missed plants.	Avoid using buffelgrass for erosion control. Implement sanitary requirements for vehicle operations in buffelgrass-infested areas and require new infestations along roadsides to be reported. Gravel and other road materials transported into un-infested areas should be free of buffelgrass seed. Consider reseeding disturbed roadsides with native species during periods of adequate moisture. Avoid undue soil disturbance.	None available	Use ground spraying with backpack sprayers, ATVs, trucks, or tractor-towed equipment. Wash underneath vehicles after spraying to prevent spread. Revisit treated sites to spray new seedlings, missed plants, and regrowth on previously sprayed plants.
Rangeland	Use hand pulling, grubbing, or hoeing on small patches but minimize soil disturbance. Remove the entire root mass to prevent re-sprouting. Transport removed buffelgrass in plastic bags to a sanitary landfill or leave plants onsite by using the "pile-and-rock" method or by spreading plants over disturbed soil and placing rocks over them. Revisit treated sites to remove new buffelgrass seedlings and previously missed plants.	Avoid using buffelgrass for erosion control. Consider reseeding disturbed areas with native species during periods of adequate moisture. Avoid undue soil disturbance. Avoid moving livestock through infested areas. Inspect and remove attached inflorescences and seed from clothing, livestock, and vehicle surfaces before moving to un-infested areas.	Consider using prescribed grazing as part of an integrated management approach.	Use backpack spraying, ground broadcast spraying, or aerial spraying depending on accessibility of infested areas. Wash underneath ground equipment after spraying to prevent spread. Revisit treated sites to spray new seedlings, missed plants, and regrowth on previously sprayed plants.

Table 1. Management options* (cont.)

Site	Physical Control	Cultural Control	Biological Control	Chemical Control
Wilderness and other natural areas	Use hand pulling, grubbing, or hoeing on small patches but minimize soil disturbance. Remove the entire root mass to prevent re-sprouting. Transport removed buffelgrass in plastic bags to a sanitary landfill or leave plants onsite by using the "pile-and-rock" method or by spreading plants over disturbed soil and placing rocks over them. Revisit treated sites to remove new buffelgrass seedlings and previously missed plants.	Avoid using buffelgrass for erosion control. Consider reseeding disturbed areas with native species during periods of adequate moisture. Avoid undue soil disturbance. Avoid moving livestock through infested areas. Inspect and remove attached inflorescences and seed from clothing, pets, and livestock before moving to un-infested areas. Post signs warning visitors to inspect and remove attached inflorescences and seed from clothing, pets, and livestock when leaving an infested area.	Consider using prescribed grazing as part of an integrated management approach.	Use backpack sprayers for small infestations. Broadcast spraying by aerial or ground methods may be used on larger stands if permitted. Wash underneath ground equipment after spraying to prevent spread. Revisit treated sites to spray new seedlings, missed plants, and regrowth on previously sprayed plants.

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

Table 1 summarizes some management options for controlling buffelgrass in various situations. Further details on these management options are explained below. Choice of individual control method(s) depends on many local factors including the extent and density of buffelgrass infestation, current land use, and site conditions (terrain, accessibility, microclimate, presence of flora and fauna, etc.). Other important considerations include treatment effectiveness, overall cost, and amount of time needed to achieve control. More than one control method may be needed for a particular site.

Physical Control

Physical methods usually have to be repeated and must often be timed properly to be effective. Both manual and mechanical methods of buffelgrass removal may facilitate further invasion through soil disturbance, erosion, or seed spread. To help reduce buffelgrass establishment, soil disturbance should be kept to a minimum.

Manual Methods

Hand-pulling, grubbing, or digging – Mature buffelgrass has a tough root crown and a dense, fibrous root mass that makes manual removal difficult. Hand-pulling, grubbing, and hoeing buffelgrass are effective (but demanding) methods for control. Hand removal is easiest when the soil is moist, temperatures are cool, and plants are in their early growth stage. Simple digging tools (digging bar, hoe, shovel, Pulaski tool, etc.) may be used to aid root removal. Regardless of method, the root crown must be completely removed. To prevent seed dispersal, removed plants should be placed in plastic bags, which can then be taken to a sanitary landfill for disposal. In areas too remote to transport plastic bags, removed buffelgrass plants may be left onsite by (1) putting the plants into a pile and then placing rocks over them, i.e., pile-and-rock, or (2) spreading the plants out over the disturbed soil and then placing rocks over them to hold them in place. With the latter method, the removed buffelgrass plants should be distributed in a thatched pattern by layering the plants in rows with the lower part of each

plant and its roots left exposed. The rows should be oriented such that the tops of plants are pointed upslope. At the topmost layer, the inflorescences should have rocks placed over them as an anchor. The shading effect of this method will help prevent buffelgrass seeds from germinating. Sites undergoing buffelgrass removal should be revisited after rainfall, and any missed plants or newly emerged seedlings should be pulled up or spot sprayed. Several consecutive years of hand removal may be required to eliminate an infestation completely.

Mechanical Methods

If using machinery to manage buffelgrass, equipment and clothing should be cleaned after use to prevent movement of seed into un-infested areas.

Tillage – Properly timed and repeated tillage with a plow or disc may be used to reduce buffelgrass in cropland or pasture areas; however, tillage when used alone as a treatment may actually increase buffelgrass establishment under certain conditions. Tillage is most effective during hot, dry weather that greatly stresses plants, although soil moisture must be adequate for tillage. Tillage will exhaust carbohydrate reserves stored in roots but will not eradicate seeds. Therefore, tillage should probably be combined with herbicide control in most cases.

Mowing and grading – Mowing or grading with heavy equipment may suppress buffelgrass growth and seed production. However, these treatments often favor re-establishment and increased dominance. In general, mowing should be discouraged as a standalone method since buffelgrass can set seed at low heights.

When mowing or grading, buffelgrass should be cut before seed stalks are developed. Herbicide application or hand-grubbing should be used as follow-up treatments, particularly after significant rainfall. Dense buffelgrass stands in accessible areas such as graded roadsides can be mowed to stimulate growth and ensure that all plants are at a similar growth stage prior to herbicide treatment. Allow at least 25% of the original plant height or foliage to recover from mowing before spraying. In certain situations, mowing buffelgrass 2 to 4 weeks before herbicide application has been shown to be an effective sequence for control. Use vehicle or trailer-mounted sprayers to apply herbicide during active growth, as indicated by the appearance of shiny, bright green leaves.

Prescribed Fire

Fire is generally not recommended as a control method for buffelgrass. The species re-grows quickly after fire, and buffelgrass stands may return at greater densities than before. In addition, most native vegetation in the Sonoran Desert is not fire-adapted. However, a strategy of prescribed fire-herbicide-reseeding is currently being researched for restoration of highly disturbed areas such as abandoned agricultural fields.

Cultural Control

Buffelgrass seed should not be planted for forage or erosion control. Areas disturbed by fire, road construction, overgrazing, etc., may be reseeded with native species to help prevent buffelgrass encroachment. In southern Arizona, native species adapted to lower elevations such as Arizona cottontop (*Digitaria californica*), plains bristlegrass (*Setaria macrostachya*), sideoats grama (*Bouteloua curtipendula*), and sprucetop grama (*B. chondrosioides*) may be used. However, soil disturbance associated with reseeding may actually encourage emergence of buffelgrass seedlings.

Various sanitary measures may be implemented as part of an overall management program to prevent buffelgrass spread. Gravel and other road materials transported into un-infested areas should be free of buffelgrass seed. Livestock should not be moved through infested areas if possible. Inspect and remove attached inflorescences and seed from animal hides, clothing, and vehicle surfaces before moving from infested areas to un-infested areas. Signs may be posted in sensitive areas to warn visitors to remove attached inflorescences and seed from clothing, vehicles, livestock, and pets after leaving an infested area.

To manage buffelgrass on a landscape scale, land-owning stakeholders and the public must be educated

about buffelgrass and its impacts. The media should be used when possible to focus public attention on prevention, early detection, and long-term commitment to buffelgrass removal. Citizen volunteer groups may be enlisted to monitor and manually remove buffelgrass from residential neighborhoods and along roadways. Collaboration among diverse stakeholders should also be encouraged. In southern Arizona, various agencies and organizations regularly collaborate on buffelgrass management, including the hosting of community events such as *Beat Back Buffelgrass Day* to remove the invasive grass from roadsides and sensitive areas. In regions where buffelgrass is an integral part of the livestock industry, culturally sensitive collaboration may be necessary to prevent buffelgrass from spreading beyond areas where it is used as forage.

Biological Control

Grazing

Buffelgrass is moderately palatable to livestock as a forage grass, and livestock grazing of buffelgrass may play a role in reducing fuel loads and wildfire threats. However, grazing alone will not control buffelgrass and should only be used for buffelgrass management as part of an integrated management approach. Intensive grazing may be used to stimulate plant growth prior to herbicide application during the actively growing stage. Monitor sites previously grazed and treated after substantial warm season rains and provide follow-up treatment by hand pulling or spot spraying emergent seedlings.

Research shows that buffelgrass seed does not germinate after passing through the rumen of cattle thereby precluding buffelgrass establishment from seed in manure. The same inability for seed to germinate after digestion may apply to other ruminants (sheep and goats). However, inflorescences and seed on livestock hides should be removed before moving them from infested areas to un-infested areas.

Classical Biological Control

Classical biological control involves the beneficial action of introducing insects, parasites, or pathogens to manage pests and mitigate their damage. A spittlebug (*Aeneolamia albofasciata*), leaf spot (*Cochliobolus australiensis*), and fungal blight (*Magnaporthe grisea*) have the potential to injure buffelgrass stands. This grass reproduces vegetatively or asexually and has low genetic diversity, which suggests that it is unlikely to develop natural resistance to leaf spot or blight. However, no classical biocontrol agent has been approved by the USDA for use against buffelgrass.

Chemical Control

The primary herbicides used to control buffelgrass are glyphosate and imazapyr (table 2). These broad spectrum chemicals are non-selective and will impact non-target species. This includes most woody and broadleaf species; however, imazapyr is typically more active against woody species than glyphosate. Herbicides selective for grass species (e.g., clethodim or fluazifop) are generally ineffective against established buffelgrass plants, but they will kill seedlings.

Glyphosate and imazapyr have many trade names. These products are often formulated differently and have unique requirements and restrictions. Thus, it is very important to read the herbicide label carefully and follow all instructions when mixing and applying either herbicide. Aquatically approved formulations of glyphosate (e.g., Rodeo® and Aquamaster®) and imazapyr (e.g., Habitat®) must be used in or near water. When using these formulations, a surfactant approved for aquatic use must also be added to the spray mix.

Herbicide Application

Precautions should be taken to protect non-target plants (particularly woody species) from both direct spray and spray drift of glyphosate and especially imazapyr. Also, imazapyr may kill or injure non-target plants through runoff, movement in soil, or root exudation from treated plants. Therefore, imazapyr should not be used in residential, urban, or wildland-urban interface (WUI) areas where ornamental vegetation or turf grass may be affected.

For foliar applications with glyphosate, buffelgrass plants should be at least 50% green before spraying. Better control will be obtained when plants are actively growing and are more than 80% green. This generally occurs within 2 to 6 weeks following heavy summer rains. However,

Table 2. Herbicide recommendations

Common Chemical Name (active ingredient)	Product Example(s)[1]	Broadcast Treatment (rate per acre)	Spot Treatment (spray solution)[2]	Time of Application	Remarks
Glyphosate	Roundup Pro Roundup Ultra Rodeo Aquamaster Accord Kleenup Pro [many others available]	Use 3 quarts per acre for formulations with 3 lbs. ai per gallon (e.g., Roundup Pro) or 2.25 quarts per acre for formulations with 4 lbs. ai per gallon (e.g., Rodeo). A 1% w/w addition of ammonium sulfate or other acidifier may be necessary to adjust water to a neutral pH.	2 to 5%	Spray when buffelgrass is actively growing as indicated by bright green and glossy leaves. At least 50% of plant should be green.	A rate of 2.25 lbs. ai per acre is recommended when broadcast spraying. Read label carefully to mix the proper rate of application. Immobile in soil. This herbicide is a non-selective amino acid inhibitor and will kill desirable vegetation. It is more active on grasses than herbaceous forbs or broadleaf plants and is least active on woody species.
Imazapyr	Arsenal Habitat Chopper Stalker Assault [many others available]	Use 2 quarts per acre (with formulations of 2 lbs. ai per gallon) Methylated seed oil may increase effectiveness of imazapyr applications.	To protect non-target plants during IPT, a reduced spray solution of 0.5 to 1.5% is recommended. Otherwise, higher solution rates listed on product labels may be used if impacts to non-target plants are secondary considerations.	Foliar or crown-directed applications may be made at any time while buffelgrass is growing.	Apply in a spray solution of at least 15 gallons per acre when broadcast spraying. Herbicidal activity may be slow. This herbicide is a non-selective amino acid inhibitor and will kill desirable vegetation, including forbs and woody species. In addition to spray drift, non-target plants may also be killed or injured by imazapyr through runoff, residue movement in soil, or root exudates from treated plants. Therefore, imazapyr should not be used in residential, urban, or wildland-urban interface (WUI) areas where ornamental vegetation or turf grass may be affected.

[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 buffelgrass.

[2] Spray solution is the herbicide/water ratio in a spray mix that may be used for spot treatment with backpack or hand-held sprayers. The amount of product applied during an annual growing season must not exceed the maximum application rate per acre as specified by the product label – refer to the product label for the site type and application.

green-up of buffelgrass sufficient enough for glyphosate application may not occur during seasons when rainfall is insufficient. Re-treatment of buffelgrass previously treated with glyphosate is generally necessary to ensure that all plants are completely killed.

Use of imazapyr potentially provides greater flexibility for buffelgrass control as compared to glyphosate since imazapyr may be applied when buffelgrass green-up is less than 50%. With a half-life of up to 142 days in soil, some imazapyr residues may remain in the soil beyond the normal green-up period. Imazapyr may be applied foliarly during green-up as an individual plant treatment (IPT) at a 0.5 to 1.5% v/v rate. Higher rates listed on product labels may be used if impacts to non-target plants are secondary considerations. To protect desirable trees or shrubs, do not apply imazapyr within twice the drip line (canopy edge) distance. For desirable cacti, imazapyr should not be applied closer than at least twice the extent of their lateral root system. Applications of imazapyr on land should include methylated seed oil (MSO) at a rate of 1% v/v rate (i.e., 1.28 fl. oz. per gallon of water).

To limit impacts to non-target plants during herbicide application, a backpack or hand-held sprayer may be used to spray small buffelgrass infestations. Backpack or hand-held sprayers should be calibrated so that a known amount of spray material will be applied per plant or given area. With both glyphosate and imazapyr, enough spray should be used to moisten the leaves, but not so much that spray drips off the plant. Adding a blue or red dye to the solution will aid in identifying treated plants. A team of applicators walking together in a line about 10 feet apart is most effective for spraying a defined area systematically. This method is particularly effective for treating smaller, less dense infestations. For large infestations on accessible lands, it is generally more practical to use calibrated ATV or UTV sprayers or boom sprayers that are tractor-pulled or mounted on a truck. Aerial applications of glyphosate are currently being used in Arizona to control buffelgrass over large landscape areas, especially those with rough terrain.

If using backpack sprayers for IPT with imazapyr, special attention should be given to controlling the amount of imazapyr applied to each plant since excessive amounts of the herbicide increase the risk of off-target movement. A standard period of time should be set for spraying individual buffelgrass plants such that the foliage is sufficiently wet but runoff is avoided. To minimize small driftable spray droplets, drift reduction nozzles such as air induction nozzles should be used as well as a flow control valve that regulates pressure at the nozzle head. Spray drift may also be reduced by delivering a crown-directed spray of relatively large droplets within the inner 70% portion of a buffelgrass plant. Exterior spraying of buffelgrass foliage is more effective than crown-directed applications; however, exterior spraying may result in greater spray drift or the spraying of non-target plants.

Management Strategies

In areas of the Southwest where buffelgrass is not already established, early detection and rapid response (EDRR) should be used to eradicate new infestations at the earliest stages. When eradication is no longer feasible, a combination of physical and cultural control methods, chemical treatments, and possibly grazing should be used as part of an integrated management strategy to control or slow the colonization process. Buffelgrass seed production should be disrupted as much as possible, and the biomass, density, and viability of live buffelgrass plants should be decreased.

In most cases, at least 2 or more consecutive years of field treatments will be necessary to eliminate or substantially reduce buffelgrass infestations and seedbanks. Since it is ordinarily useless to treat an area only one time without retreatment, sufficient resources must be allocated for the area where control is attempted. Only an area that can be retreated successfully should receive initial treatment so that resources are available to respray or retreat as necessary. Previously treated areas should always be continuously monitored and retreated when necessary to control recovering buffelgrass patches. Failure to

perform follow-up management may result in a return of the infestation to pretreatment levels.

Adaptive Management

Current experience and research suggest that there will not be one overarching process or set of tactics for controlling buffelgrass consistently. Therefore, realistic goals and objectives should be established to manage buffelgrass infestations occurring broadly across a given landscape. To improve long-term success, consider using an adaptive management approach with overall goals of reducing fires and maintaining or 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 and measures,
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 approach is 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.

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Suggested Websites

Arizona-Sonora Desert Museum: https://www.desertmuseum.org/buffelgrass/

For information about calibrating spray equipment: NMSU Coop. Ext. Serv. Guide #A-613 Sprayer Calibration. Available at: http://aces.nmsu.edu/pubs/_a/A-613.pdf

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For more information or other field guides, contact:

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

Or visit the Southwestern Region's website for invasive species:

http://www.fs.usda.gov/goto/r3/invasivespecies