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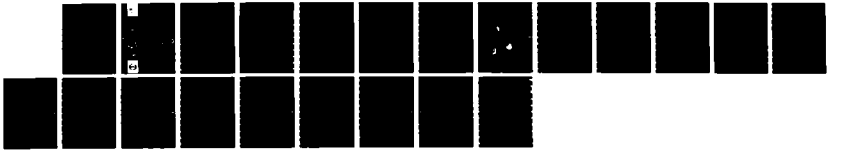

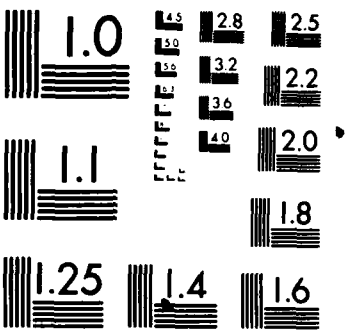

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ALKALI SACATON (*Sporobolus airoides*)

Section 7.1.4, US ARMY CORPS OF ENGINEERS WILDLIFE RESOURCES MANAGEMENT MANUAL

by

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US ARMY ENGINEER WATERWAYS EXPERIMENT STATION

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A plant materials report on alkali sacaton (*Sporobolus airoides*) is provided as Section 7.1.4 of the US Army Corps of Engineers Wildlife Resources Management Manual. The report was prepared as a guide to assist the Corps District or project biologist with the selection, cultivation, and management of suitable plant materials for development of wildlife habitat. Topics covered include description, distribution, habitat requirements, wildlife value, establishment, maintenance, and cautions and limitations.

Alkali sacaton is a large, warm-season bunchgrass native to the western United States. The species is most beneficial to wildlife in the restoration of habitat on disturbed sites. Distinguishing characteristics of alkali sacaton are given, and the species distribution and region of maximum abundance are shown. Habitat requirements are discussed, and soil and moisture tolerances are specified. Benefits of the seed and foliage to wildlife are
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discussed. Specifications for establishment, including site selection, site preparation, propagule selection, and planting methods, are given. Species recommended for planting with sacaton are listed for several habitat types. Maintenance requirements and tolerances to fertilization, irrigation, mechanical treatment, grazing, burning, and competition are described.

PREFACE

This work was sponsored by the Office, Chief of Engineers (OCE), US Army, as part of the Environmental Impact Research Program (EIRP), Work Unit 31631, entitled Management of Corps Lands for Wildlife Resource Improvement. The Technical Monitors for the study were Dr. John Bushman and Mr. Earl Eiker, OCE, and Mr. Dave Mathis, Water Resources Support Center.

This report was prepared by Mr. Clinton H. Wasser, Professor Emeritus, Range Science Department, Colorado State University, Fort Collins, Colo.; Dr. Phillip L. Dittberner, US Fish and Wildlife Service, Western Energy and Land Use Team (WELUT), Fort Collins, Colo.; and Dr. Donald R. Dietz, US Fish and Wildlife Service, Habitat Resources, Grand Junction, Colo., under an Interagency Agreement with the US Army Engineer Waterways Experiment Station (WES). Mr. Chester O. Martin, Team Leader, Wildlife Resources Team, Wetlands and Terrestrial Habitat Group (WTHG), Environmental Laboratory (EL), WES, was principal investigator for the work unit. Ms. Cathy Short and Ms. Pam Hutton, WELUT, assisted with manuscript preparation, and Ms. Jennifer Shoemaker, WELUT, prepared the original drawings. Review and comments were provided by Mr. Martin and Dr. Wilma A. Mitchell, WTHG, and Mr. Larry E. Marcy, Texas A&M University.

The report was prepared under the general supervision of Dr. Hanley K. Smith, Chief, WTHG, EL; Dr. Conrad J. Kirby, Chief, Environmental Resources Division, EL; and Dr. John Harrison, Chief, EL. Dr. Roger T. Saucier, WES, was Program Manager, EIRP. The report was edited by Ms. Jessica S. Ruff of the WES Publications and Graphic Arts Division.

COL Allen F. Grum, USA, was the previous Director of WES. COL Dwayne G. Lee, CE, is the present Commander and Director. Dr. Robert W. Whalin is Technical Director.

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NOTE TO READER

This report is designated as Section 7.1.4 in Chapter 7 -- PLANT MATERIALS, Part 7.1 -- GRASSES, of the US ARMY CORPS OF ENGINEERS WILDLIFE RESOURCES MANAGEMENT MANUAL. Each section of the manual is published as a separate Technical Report but is designed for use as a unit of the manual. For best retrieval, this report should be filed according to section number within Chapter 7.

ALKALI SACATON *(Sporobolus airoides)*

Section 7.1.4, US ARMY CORPS OF ENGINEERS
WILDLIFE RESOURCES MANAGEMENT MANUAL

Alkali sacaton is a large, warm-season bunchgrass native to the western United States. The species is widely distributed in subirrigated or flooded valleys and basins, usually on sites with salty soils. Sacaton is managed primarily for livestock grazing and hay but is also used for game range improvement and soil conservation purposes (Flory and Marshall 1942, Hafenrichter et al. 1968, Plummer et al. 1968, Aldon 1978).

DESCRIPTION

Alkali sacaton is a native, long-lived, perennial grass. It grows in tough, large-diameter tufts with numerous creamy and slick sheaths at the base (Fig. 1). Culms are mostly 1.5 to 3 ft (45 to 90 cm) tall. Leaves are most numerous at the base of plants; the blades are flat when young and actively growing but involute on drying. They taper from a medium-width base to a narrow, thread-like tip. Ligules are composed of a fringe of dense, fine hairs, with longer hairs at the throat. Alkali sacaton has the unique characteristic of producing salt crystals on its leaf surfaces (Pohl 1954). The

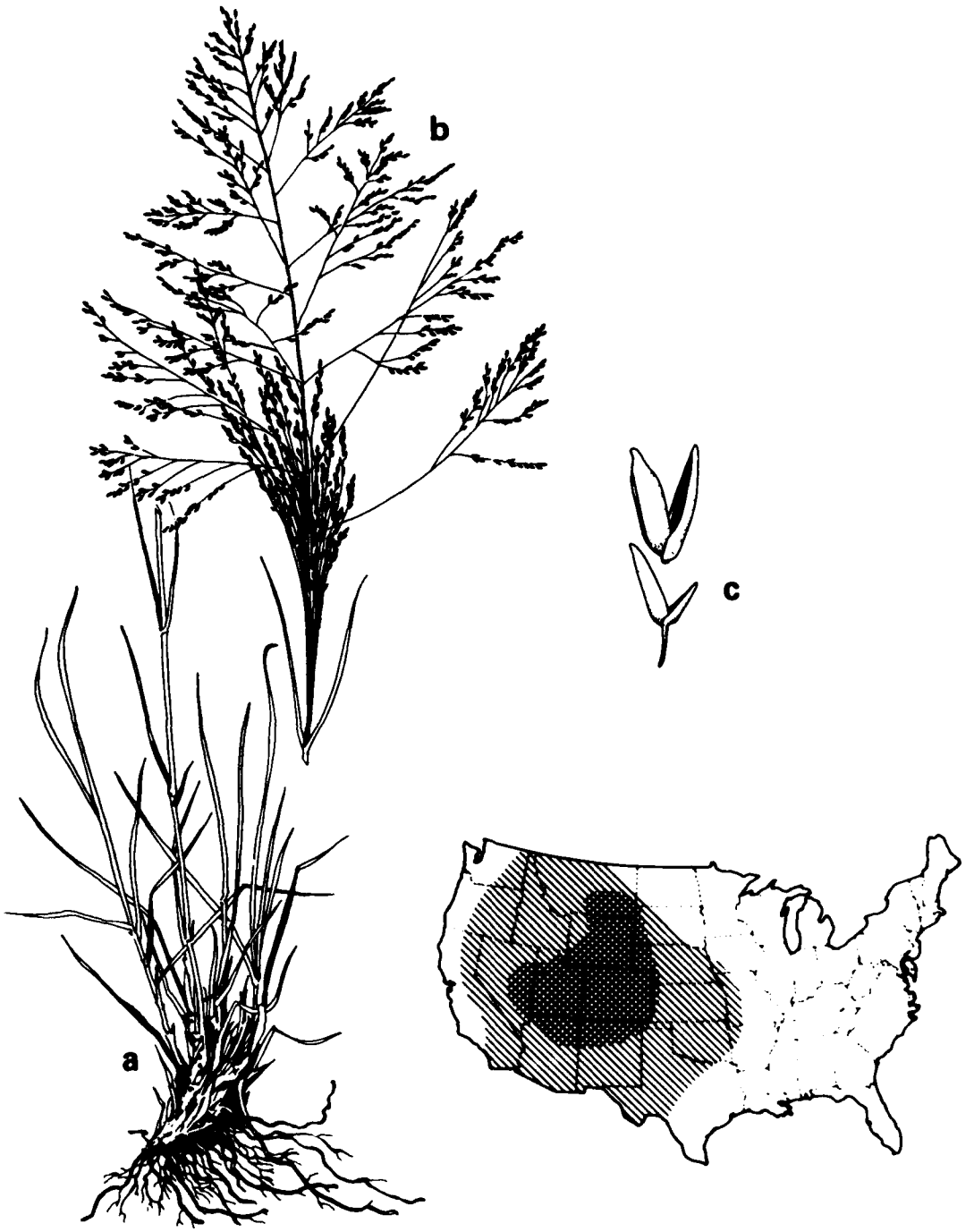

Figure 1. Distribution and distinguishing characteristics of alkali sacaton (*Sporobolus airoides*): (a) culms, (b) panicles, and (c) floret and glumes (after Hitchcock and Chase 1950, Gould 1975, Wasser 1982). The map shows the species distribution (diagonal lines) and region of maximum abundance (cross-hatching)

roots are coarsely fibrous, tough, and deep, often reaching capillary fringes of moderately deep water tables.

The inflorescences of alkali sacaton are open, and the pyramidal panicles are 12 to 16 in. (30 to 40 cm) long, with their basal branches often partially enclosed in the sheaths. Small spikelets are borne near tips of the panicle branches. They contain miniature, deciduous, papery glumes and pointed lemmas, which partly envelop small seeds (caryopses) about the size and shape of sand grains. Plants begin growth in late spring to summer, and seeds mature in late summer or fall. There is some variation among regional and edaphic ecotypes, but little published information is available on their differences.

DISTRIBUTION

Alkali sacaton occurs from Missouri, the Dakotas, and Texas to eastern Washington and southern California (Fig. 1) and in Mexico as far south as San Luis Potosi (Gould 1975). Major centers of distribution appear to be in the western Great Plains, the Southwest, and the central and southern Great Basin (Flory and Marshall 1942, Johnson and Nichols 1970). Cronquist et al. (1977) recorded a disjunct population of the species in South Carolina. *Sporobolus wrightii*, also referred to as alkali sacaton, is a similar species occurring in Oklahoma, Texas, northern Mexico, and westward to southern California (Gould 1975).

HABITAT REQUIREMENTS

Sacaton often occurs in nearly pure stands, particularly in saline sites where water accumulates at some time during the growing season. Plants often grow intermixed with western wheatgrass (*Agropyron smithii*), inland saltgrass (*Distichlis stricta*), alkali cordgrass (*Spartina gracilis*), and switchgrass (*Panicum virgatum*) in saline meadows. In the Intermountain region, it also occurs with several species in distinct plant communities dominated by black greasewood (*Sarcobatus vermiculatus*), shadscale saltbush (*Atriplex confertifolia*), blackbrush (*Coleogyne ramosissima*), and inland saltgrass. The species grows from near sea level to approximately 8000 ft in intermountain parks. Plants are fairly shade tolerant but grow best in full sunlight (Harrington 1964, Vallentine 1971, Shaw and Cooper 1973).

Soils

Alkali sacaton will grow in soils of all textures except unstable sands. Plants thrive on medium-textured soils that are sandy to slightly clayey (Thornburg 1982) and also grow well in deep, alluvial soils. The species is highly tolerant of alkaline, saline, sodic (alkali), and saline-sodic soil conditions. Duke et al. (1976) reported alkali sacaton as occurring on soils with a pH range from 4.8 to 7.4.

Moisture

Alkali sacaton grows best in the 10- to 20-in. mean annual precipitation (MAP) zone but also occurs where there is as little as 8 in. and as much as 30 in. of precipitation (Thornburg 1982). It is tolerant of poor drainage, frequent flooding, shallow water tables, inundation for up to 24 days, and moderate sedimentation (Shaw and Cooper 1973, Aldon 1977). The species is rated poor in responsiveness to irrigation (Shaw and Cooper 1973), but it reportedly maintains excellent sods on very salty soils with only 2 irrigations per year in Idaho (SCS 1972). Plants tolerate moderately severe droughts once they are well established; this is probably due to the deep penetrating root system and the xeric nature of the species. Seedlings are intolerant of drought conditions.

WILDLIFE VALUE

Alkali sacaton is most beneficial to wildlife in the restoration of habitat on harsh sites, especially in disturbed saline valleys and on reclaimed mine spoils of the Southwest (Plummer et al. 1968, Aldon 1978). When properly managed, stands can provide dense, persistent cover and can withstand drought, extensive grazing, flooding, and sedimentation (Hickey and Springfield 1966, Aldon and Garcia 1967). Sacaton can also provide important cover and can help retard erosion in riparian habitats of the Southwest (Aldon 1975).

The seeds and foliage of alkali sacaton are eaten to some extent by big game species, cottontail rabbits (*Sylvilagus* spp.), rodents, songbirds, upland game birds, and geese (Monson 1941, SCS 1972). In a Colorado study, the forage value of the species was rated high for cattle and horses; moderate for sheep, elk (*Cervus elaphus*), pronghorn (*Antilocapra americana*), and small mammals; and low for deer (*Odocoileus* spp.), upland game birds, and songbirds (Dennis and Antonio 1980). Plants are palatable and moderately nutritious

while actively growing but are poor in nutritional quality after maturity (Wasser 1982). Morrison (1956) suggested that alkali sacaton was not an especially high quality feed but that it could be a valuable supplement on harsh sites where other forage was scarce.

ESTABLISHMENT

Site Selection

Sites suitable for restoration with sacaton include areas that have formerly supported good range stands but have deteriorated to poor condition by overuse. Better seeding responses can be expected on sites that have deep, medium-textured soils with gradients of less than 5%. Stand establishment is more likely on sites that receive one or more flood irrigations or some runoff water accumulation (Hafenrichter et al. 1968, Aldon 1978).

Sites considered for improvement by waterspreading (a water diversion system consisting of dams and dikes designed to intercept runoff from natural drainage areas and convey the water at low gradients across the land surface) should have extensive, nearly flat land surfaces that parallel intermittent streams with enough watershed area to have 1 or 2 nondestructive floods per year (Stokes et al. 1954). Experiments with diverting floodwaters from gullies in the Southwest resulted in marked improvement in cover and production of alkali sacaton (Hubbell and Gardner 1950). Waterspreading is considered infeasible in areas with less than 8 in. mean annual precipitation (Bennett 1939).

Alkali sacaton is one of the most successful species planted for soil stabilization of mine spoils in the Southwest (Aldon 1978). The species is often useful for seeding bare and disturbed areas, where stands will provide some wildlife benefits. Surface disturbed sites, such as abandoned roads and power and utility rights-of-way, may be secondary sites for reestablishment of sacaton (Aldon 1978).

Site Preparation

Plot design. Long, narrow plots with irregular borders adjacent to preferred foods and protective cover are most desirable for wildlife habitat development. Plots should be oriented with their length approximately paralleling the contour (Leopold 1933, Bennett 1939). Road, utility, and pipeline rights-of-way often have suitable edge conditions and some degree of

interspersion and make favorable sites for treatment. Waterspreader site designs are set largely by engineering limitations, and major plot design alterations generally are infeasible. They usually include one or more detention and diversion dams and a series of low-gradient dikes that distribute water to irrigate suitable sites. Plots often encompass areas about 1/4 to 1/2 mile wide and are located a mile or more downstream from dams (Stokes et al. 1954).

Mechanical treatment. Black greasewood stands can be thinned by brush-breaking tools to prepare a seedbed for alkali sacaton. Thinning can be done by disking with a heavy offset disk or a brushland plow. Double chaining and pipe-harrowing in reverse directions thins brush, scarifies the soil, and leaves mulch on the soil surface, which reduces soil crusting that can impede seedling emergence (Plummer et al. 1968). Anchor chaining is effective in thinning blackbrush sites, but dense stands may require weighting the chain links with short pieces of railroad iron for adequate thinning (Plummer et al. 1968). Dense stands of inland saltgrass can be prepared by moldboard or disk plowing; these sites should be plowed 4 to 6 in. deep during the dry season. Two to 3 treatments may be necessary to adequately reduce saltgrass competition for the successful establishment of sacaton.

Dryland sites, particularly in shadscale saltbush and blackbrush cover types, require the use of a pitting disk plow, an eccentric one-way plow, or a combination dozer, pitter, and seeder equipped with a conveyor that scatters brush back on the site as mulch (Plummer et al. 1968, Abernathy and Herbel 1973); this equipment is needed to prepare a seedbed with pits that concentrate and conserve critical soil moisture. Narrow rights-of-way, roads, and similarly disturbed areas can be prepared and seeded in one operation with a rotaseeder (Joselyn and Tate 1972). Surface-mined coal lands should be leveled, graded, and backfilled with topsoil (Aldon 1978, Vogel 1981). Where soil compaction and crusting is a problem, the soils may also need to be scarified or ripped by disking with a heavy-duty offset disk or by tilling with a chisel plow.

Soil amendments. Soil samples from disturbed areas should be analyzed for needed amendments. Soils of dryland sites that have not been significantly disturbed do not usually require amendments, nor will they be cost effective. Experiments on southwestern mine spoils have indicated that placing about 1/2 in. of mulch in a moist seedbed immediately after planting results in much better stand establishment (Aldon 1969b, 1978).

Propagule Selection

Alkali sacaton is primarily established by seed, but commercial supplies are limited and seeds are produced irregularly in native stands. Transplants can be used on critical sites. There are currently only informal strains of alkali sacaton. Willcox is a leafy selection being tested and grown in southern Arizona. Other strains being field tested are P-15616 selected for shallow upland sites in New Mexico, and PM-ND-264 from saline bottomlands in North Dakota (Wasser 1982).

Seed selection. Seed quality is not well standardized but should test 85% purity, 80% germination, and at least 68% pure live seed (PLS). There are about 1,750,000 seed per pound and 1,200,000 PLS per pound in quality seed (Wasser 1982). When commercial seed is used, it should come from areas with similar site conditions and within 300 miles north to 200 miles south of the seeding site. It is preferable to obtain seed from sites north of the planting site. Seed can be harvested from native stands by combining or by threshing seed-containing hay. Little further cleaning should be necessary with properly set equipment, but fanning is sometimes done.

Germination and vigor. Most alkali sacaton seed germinates in 5 to 10 days under ideal conditions, but dormancy sometimes results in late germination. Hafenrichter et al. (1968) and Stefferud (1948) reported germinative capacity of 80%. Researchers recommend using large seeds that are 1 year old because fresh seeds require some afterripening or pretreatment before being used in plantings (Aldon 1969a). Soaking fresh seed in a 1% KNO_3 solution for 24 hours and drying 48 hours before use is recommended (Akamine 1944). Germination takes place in 21 days after 5 days of prechilling treatment in the soil (Akamine 1944, Shaw and Cooper 1973). Good germination occurs at constant temperatures of 85° F or by alternating temperatures between 77° and 89° F (Akamine 1944, Aldon 1969a). Seedling vigor is fair. Stands may develop fully by the end of the second season under favorable conditions but normally take from 3 to 5 years (Wasser 1982).

Planting Methods

Time of seeding. Late fall, winter, and early spring seeding dates are used in big game range restoration in Utah. Workers suggest that plantings be delayed until December in areas where rodents are troublesome, especially in the blackbrush cover type (Plummer et al. 1968). Aldon (1970) recommended

delaying planting until there is an 80% chance of rain or flooding within 15 days in the Southwest because emergence and seedling development take place only when soil moisture is at field capacity. Such conditions usually occur in late July or August. In the western Great Plains, seeds are usually planted in early spring when soil moisture is most abundant.

Seeding. On greasewood sites, Plummer et al. (1968) preferred broadcasting alkali sacaton by aerial or hand-seeding methods; broadcasting was followed by anchor chaining or pipe-harrowing so that the scattered plant debris served as mulch to counteract soil crusting. These methods also are useful in rocky sites of the blackbrush cover type. The rangeland drill or deep-furrow type drill works satisfactorily on rock-free sites. These drills also work well for seedbeds prepared in the saltgrass type and for seeding directly into shadscale. Interseeders equipped with 16-in.-wide scalpers effectively seed into thin saltgrass sods and in cheatgrass (*Bromus tectorum*) undercover in the shadscale saltbrush type (Plummer et al. 1968).

Drills equipped with small seedboxes work well in planting the very fine seeds of alkali sacaton. Ordinary grain drills that lack small seedboxes can be used by mixing 2 bushels of rice hulls with each pound of sacaton seed. The mixture flows smoothly through the grain box and does not let the fine seed settle to the bottom and run out too rapidly (SCS 1972). Cultipacker seeders are useful in making strip seedings. Rangeland drills work satisfactorily in seeding mine spoils (Joselyn and Tate 1972, Aldon 1978).

Drilling is usually done in 6- or 12-in. rows with variations of 1 or 2 in. for different spacings of drops in commercial drills. Plummer et al. (1968) recommended the use of browse seeders equipped with 12-, 16-, or 24-in.-wide scalpers for seeding mixtures applied on shadscale and saltgrass range. These authors also recommended planting browse plants in alternate rows with other species. Alkali sacaton is usually planted at a depth of 1/4 in. in bare soil, or 1/2 in. of vermiculite mulch is used to cover the seed (Aldon 1969b).

The SCS (1972) recommended drilling in 6-in. rows, using 3 to 4 lb/acre of alkali sacaton seed on irrigated lands. In New Mexico, Merkel and Herbel (1973) recommended using 0.5, 1.0, and 1.5 lb/acre, respectively, for drilling, broadcasting, and broadcasting on critical sites. Plummer et al. (1968) did not specify a rate and listed alkali sacaton as a substitute species, probably due to the uncertainty of available seed supplies.

Transplanting. Container-grown transplants of alkali sacaton may also be used to revegetate depleted wildlife and livestock grazing areas. Field planting should be done when soil moisture is high. Western wheatgrass is often an associated species in the field transplanting process (Aldon 1973, Aldon et al. 1975).

Planting mixtures. The species is recommended as a substitute or additive ingredient in seed mixtures used to restore big game ranges in the black greasewood, shadscale saltbush, blackbrush, and inland saltgrass vegetation types in Utah (Plummer et al. 1968) (Table 1). It can also be used on sites where saline or alkaline soils are prevalent and where other conditions are suitable. Plummer et al. (1968) suggested planting Belvedere summer cypress (*Kochia scoparia*), fivehook bassia (*Bassia hyssopifolia*), yellow sweetclover (*Melilotus officinalis*), or a mixture of these 3 species as an interim crop in unusually dense and competitive stands of saltgrass. This interim crop provides competition for the saltgrass, weakening its competitive ability and increasing the probability of establishing a successful stand of alkali sacaton.

MAINTENANCE

Fertilization

Sacaton stands are moderately responsive to fertilizers, but fertilization is usually not cost effective on unirrigated sites (Bernstein 1964, Shaw and Cooper 1973). Annual nitrogen fertilization may be economical on dense stands of sacaton that are irrigated and harvested for hay. Hafenrichter et al. (1968) reported examples where forage yields were increased 28 lb for every pound of nitrogen added. Disturbed sites may need fertilizers to correct nutrient deficiencies identified in soil tests. A greenhouse experiment in northwestern New Mexico showed that both nitrogen and phosphorus added at a rate of 80 lb/acre increased seedling yields 2 to 3 times that of unfertilized plots, but response to fertilization was not significant when either element was added alone (Aldon 1976).

Irrigation

Areas seeded to alkali sacaton should be irrigated or have a saturated soil at the time of seeding (Aldon 1970). The soil needs to be kept moist by frequent precipitation or irrigation during the first growing season. Once

Table 1. Species recommended for planting with alkali sacaton on black greasewood, blackbrush shadscale, and inland saltgrass sites (Plummer et al. 1968)

Species	Approximate Seeding Rate (lb/acre)
Grasses	
Fairway crested wheatgrass (*Agropyron cristatum*)	½ - 3
Great basin wildrye (*Elymus cinereus*)	1 - 2
Indian ricegrass (*Oryzopsis hymenoides*)	1 - 1½
Intermediate wheatgrass (*Agropyron intermedium*)	½ - 1
Pubescent wheatgrass (*A. trichophorum*)	½ - 1
Reed fescue (*Festuca arundinacea*)	0 - 2
Russian wildrye (*Elymus junceus*)	1 - 4
Sand dropseed (*Sporobolus cryptandrus*)	½ - 1
Standard crested wheatgrass (*Agropyron desertorum*)	1 - 1½
Tall wheatgrass (*A. elongatum*)	½ - 3
Forbs	
Alfalfa (*Medicago sativa*)	1 - 2
Gooseberryleaf globemallow (*Sphaeralcea grossulariaefolia*)	½ - 1½
Pacific aster (*Aster chilensis*)	½ - 1
Small burnet (*Sanguisorba minor*)	1½ - 3
Strawberry clover (*Trifolium fragiferum*)	0 - 2
Yellow sweetclover (*Melilotus officinalis*)	1 - 4
Shrubs	
Fourwing saltbush (*Atriplex canescens*)	½ - 5
Gardner saltbush (*A. gardneri*)	½ - 3
Rubber rabbitbrush (*Chrysothamnus nauseosus*)	¼ - 1
Winterfat (*Ceratoides lanata*)	0 - 3

established, the species maintains satisfactory stands on suitable sites without irrigation. However, 1 or 2 irrigations per year, usually in spring and fall, maintain better cover (Hafenrichter et al. 1968, SCS 1972).

Flood detention dams, diversion ditches, and waterspreading dikes need to be maintained to stay effective and prevent the creation of gullies and damage from uncontrolled flows on waterspreading projects. Breaks in structures must be corrected promptly, and supplemental dikes or diversion ditches may need to be installed to prevent ponding and to spread the water more uniformly over grassy flats (Stokes et al. 1954).

Mechanical Treatment

Mowing when weeds are in the stem elongation to flowering stages is recommended for controlling weedy invaders in mixtures of alkali sacaton,

broad-leaved forbs, and browse plants. Two or 3 mowings may be necessary the first season, and 1 mowing may be needed the second year. Occasional mowing is justified in mature stands that are being invaded by herbaceous weeds. Undesirable brushy weeds or mixtures of herbs and shrubs may be controlled by chaining, cabling, pipe-harrowing, or railing with drags made of rails. Any treatment should be done in a way that permits alkali sacaton to go into fall dormancy with at least a 4-in. stubble (SCS 1972). Weed control efforts may not be cost effective under dryland conditions.

Grazing

Sacaton generally maintains thrifty stands when no more than 50% of current annual growth is removed by grazing during the growing season or 60% during the dormant season. It reportedly responds well to a deferred rotation grazing system. Grazing should be withheld from new seedings during the first 2 growing seasons or until the plants produce some seed. Light grazing may be possible at the end of the first season if exceptional stand development has occurred, but this is rare (SCS 1972).

Burning

Alkali sacaton is moderately tolerant of controlled burning. It can be burned during the dormant state with minimal damage or at the start of growth to remove excess accumulations of unused herbage and encourage more uniform use by herbivores. Burning may control certain nonsprouting weeds, including undesirable shrubs, after they have initiated growth in moist sites such as swales and meadows (Wasser 1982).

CAUTIONS AND LIMITATIONS

Seedlings of alkali sacaton are vulnerable to competition, particularly during the first growing season and when the site is dry. Dense, established stands of alkali sacaton can usually be maintained by reasonable management; however, concentrations of animals around water or salt licks, trails, bare spots, and thin sods may result in the invasion of other, less desirable species. Herbicides are often more effective agents in the control of weeds on relatively pure grass swards, but they may be destructive to broad-leaved species in mixed stands of grasses and legumes, forbs, or shrubs. Expert advice should be sought in formulating any herbicide weed control program.

Grasshoppers, rabbits, and rodents often damage new seedlings and may thin stands and forage in established stands. Ants create mounds that are enlarged by silting and interfere with mowing and uniform waterspreading. No serious diseases are known to affect alkali sacaton (Wasser 1982).

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