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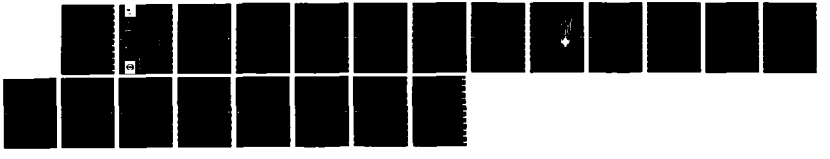

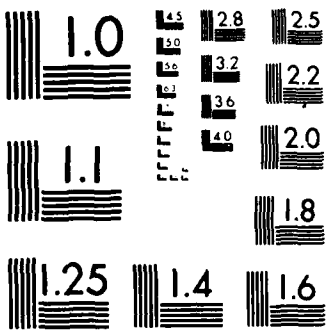
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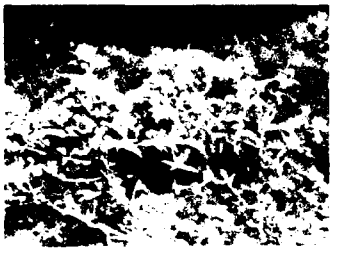

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ENVIRONMENTAL IMPACT RESEARCH PROGRAM

TECHNICAL REPORT EL-86-26

WINTERFAT (*Ceratoides lanata*)

Section 7.5.2, US ARMY CORPS OF ENGINEERS WILDLIFE RESOURCES MANAGEMENT MANUAL

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19 ABSTRACT (Continue on reverse if necessary and identify by block number)

A plant materials report on winterfat (*Ceratoides lanata*) is provided as Section 7.5.2 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 wildlife and habitat development programs. Major topics covered for winterfat are description, distribution, habitat requirements, wildlife value, establishment, maintenance, and cautions and limitations.

Winterfat is a native perennial shrub that occurs in extensive rangelands in the West. Diagnostic characteristics and ecotypic variation in winterfat are described, and the species distribution is given. Habitat adaptations are discussed, and soil and moisture requirements are described. Benefits of planting winterfat for wildlife are addressed. Guidelines are provided for site selection, site preparation, propagule selection, and

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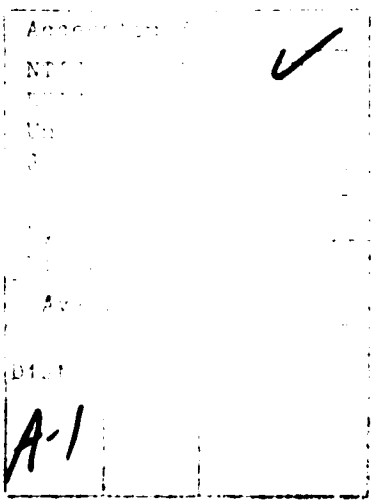
planting methods. Seeding techniques for rangeland plantings are described, and components of seed mixtures are given. Tolerances to grazing, browsing, burning, and competition are discussed.



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., and Dr. Phillip L. Dittberner, US Fish and Wildlife Service, Western Energy and Land Use Team (WELUT), Fort Collins, Colo. Mr. Chester O. Martin, Team Leader, Wildlife Resources Team, Wetlands and Terrestrial Habitat Group (WTHG), Environmental Laboratory (EL), US Army Engineer Waterways Experiment Station (WES), was principal investigator for the work unit. The original report was prepared by WELUT under an Interagency Agreement with WES. 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 7.5.2 in Chapter 7 -- PLANT MATERIALS, Part 7.5 -- WOODY SPECIES, 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.

WINTERFAT *(Ceratoides lanata)*

Section 7.5.2, US ARMY CORPS OF ENGINEERS
WILDLIFE RESOURCES MANAGEMENT MANUAL

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Winterfat is a native, cool-season, half-shrub that occurs in extensive rangelands of the West. The species is palatable and nutritious to livestock, especially in winter, and provides preferred browse for pronghorn (*Antilocapra americana*), mule deer (*Odocoileus hemionus*), and elk (*Cervus elaphus*). Stands can be extensively damaged by overgrazing, and the species is considered a key indicator of grazing pressure on dry sites. Plants are drought resistant, long lived, easily established, and are valuable in stabilizing disturbed soils in arid regions. Winterfat is in the goosefoot family (Chenopodiaceae). Other common names are white sage, lamb's-tail, and sweet or winter sage.

DESCRIPTION

Winterfat is a bushy perennial that usually grows from approximately 1 to 3 ft (3 to 10 dm) tall (Fig. 1). The numerous semiherbaceous twigs arise from a woody base and form hemispherical or nearly cylindrical crowns. Plants have a deep taproot and an extensive fibrous root system capable of stabilizing soil. The leaves are simple, alternate, mostly linear, revolute-margined, and are from 0.4 to 1.2 in. (1 to 3 cm) long; they are gray-green, finely pubescent, and appear silvery to whitish from a distance.

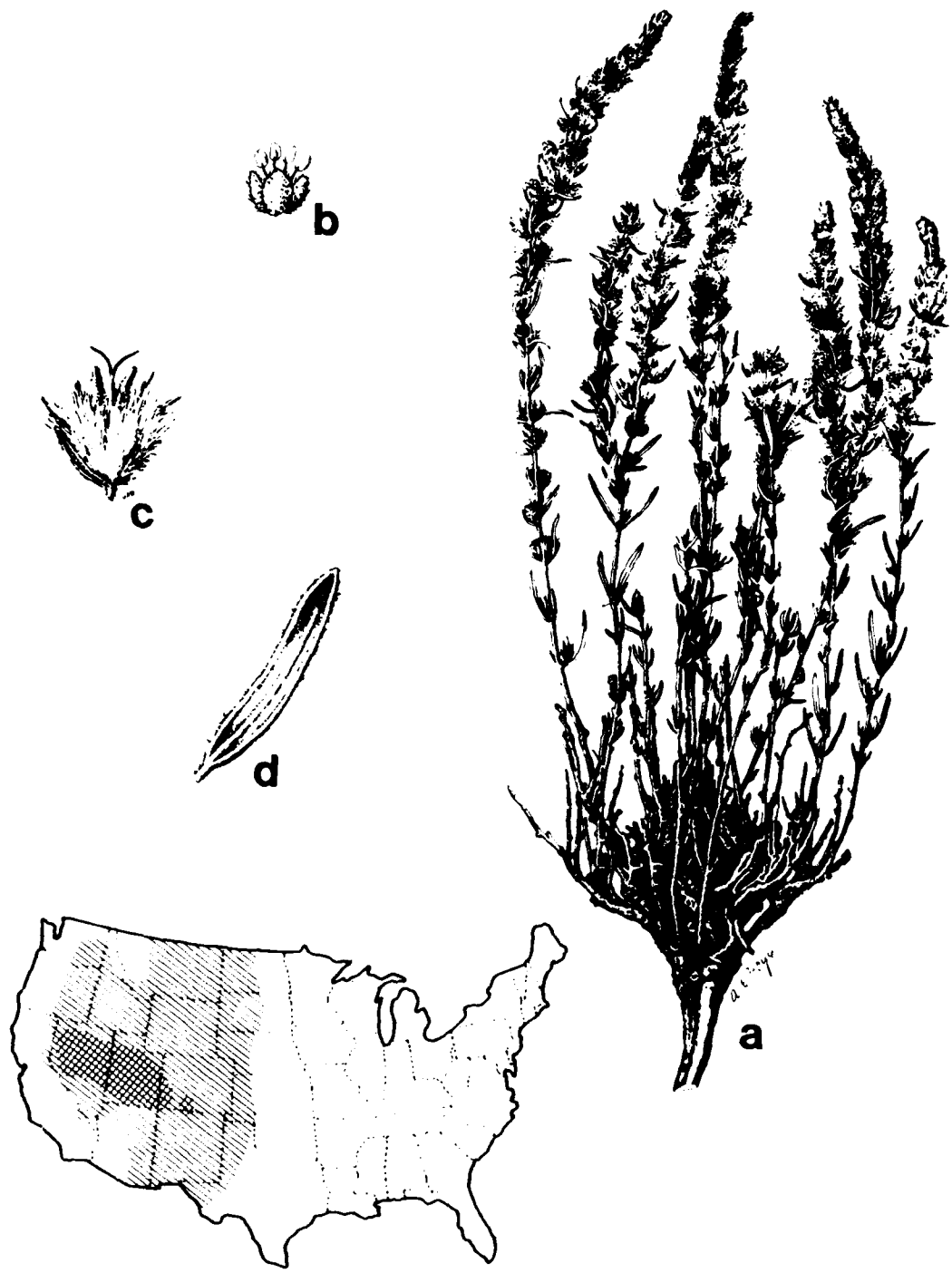

Figure 1. Distribution and distinguishing characteristics of winterfat (*Ceratoides lanata*): (a) plant, (b) staminate flower, (c) pistillate flower, and (d) leaf. The map shows the overall species distribution (diagonal lines) and region of maximum abundance (crosshatching)

The flowers are borne in either axillary or terminal spike-like clusters; terminal clusters are often as much as 12 in. (30 cm) long and become cottony white as fruits develop. Staminate and pistillate inflorescences may be produced on the same or different plants. Stamens are produced within miniature flowers having only 4 small sepals. Pistillate flowers lack both sepals and petals and have 2 small pubescent lance-shaped bracts within which a small, 2-horned utricle fruit develops. Conspicuous hairs on the flowers and fruit distinguish winterfat from the closely related saltbushes (*Atriplex* spp.). Plants initiate growth in early to late spring, flower between March and July, and produce seed from September to November; timing varies with environmental conditions (Harrington 1964, Blauer et al. 1976).

The species is polymorphic, with short ecotypes present on valley floors and tall ecotypes most common in mountainous terrain. Tall and dwarf forms tend to retain their characteristics even when cultivated away from the original site (Workman and West 1969). Blauer et al. (1976) noted ecotypic differences in seed production and size, seedling germination and vigor, fruit pubescence, and tolerance to soil pH. Bush winterfat (var. *subspinosa*) is a distinct form that has somewhat woody, spreading branches with spiny tips.

DISTRIBUTION

Winterfat is found from the western edge of the Great Plains and west Texas to eastern Washington, Oregon, and California (Fig. 1). The center of maximum abundance is the Great Basin of Utah and Nevada. The species also occurs from Manitoba to the Yukon Territory in Canada and south into Sonora and Chihuahua, Mexico (Blauer et al. 1976, Stubbendieck et al. 1981). The species grows from near sea level in Death Valley, California, to approximately 9850 ft in central Utah (Stevens et al. 1977). Bush winterfat occurs at the southern edge of the species range and extends from southern Utah into Arizona, southern California, and Mexico (Kearney and Peebles 1942, Blauer et al. 1976).

HABITAT REQUIREMENTS

Winterfat is broadly adapted to arid to subhumid precipitation zones and is remarkably drought tolerant. Plants show good cold tolerance when fully established but are somewhat frost sensitive in early seedling growth stages (Wasser 1982). The species is relatively intolerant of shade (Dayton 1931,

Woodmansee and Potter 1971) and often suffers a loss in vigor at shade levels of 25% to 35%. Plants are highly tolerant of fire and moderately tolerant of grazing (see sections on maintenance and on cautions and limitations).

Soils

Winterfat is adapted to a wide range of soil textures (Wasser 1982). The species may occur on shallow rock outcroppings (especially the variety *subspinosa*), and on sandy loam, silty, and clayey soils. Plants are usually more productive on finer textured soils. The species grows well on alkaline and calcareous soils, preferring a pH range of 7.4 to 8.0, but is intolerant of acid soils (Woodmansee and Potter 1971). Some ecotypes can tolerate weak to moderate soil salinity.

Moisture

The species is fairly common in regions with 5 to 20 in. mean annual precipitation but generally grows in zones of 10 in. or less. Although it extends into zones with as little as 3.9 in. of precipitation, plants are usually reduced in stature and production (Dayton 1931, Stevens et al. 1977). The deep taproot and extensive lateral root system are thought to be responsible for its tolerance to drought (Holmgrem and Hutchings 1972, Blauer et al. 1976). Winterfat is intolerant of flooding and suffers from oxygen deficiencies when growing in standing water or saturated soil.

Plant Associates

Winterfat often occurs in nearly pure stands on valley floors and plains, especially within its zone of maximum abundance. Stands may be extensive but are often invaded by weedy or less palatable species. Winterfat is also found in open desert shrub, juniper - pinyon (*Juniperus* spp. - *Pinus edulis*), and other woodland types. Common plant associates include shadscale saltbush (*Atriplex confertifolia*), Gardner saltbush (*A. gardneri*), black greasewood (*Sarcobatus vermiculatus*), spiny hopsage (*Grayia spinosa*), Douglas rabbitbrush (*Chrysothamnus viscidiflorus*), black sagebrush (*Artemisia nova*), big sagebrush (*A. tridentata*), galleta grass (*Hilaria jamesii*), Indian ricegrass (*Oryzopsis hymenoides*), and bluebunch wheatgrass (*Agropyron spicatum*) (Wasser 1982). Winterfat grows more commonly in association with other woody species than with herbaceous species.

WILDLIFE VALUE

Winterfat was named for its superior value as winter browse. Chemical analyses have shown that the forage is moderately high in crude protein content year long, and particularly so in winter, when compared with most other native range plants. Total carbohydrate content is relatively high during spring, summer, and winter. Winterfat is consistently above average in palatability to large herbivores but is preferred most when actively growing (Stevens et al. 1977).

Pronghorns, mule deer, elk, bighorn sheep (*Ovis canadensis*), and jackrabbits (*Lepus* spp.) are known to consume winterfat forage. Pronghorns and rabbits show high preference for the species year-round (Stevens et al. 1977), and Dayton (1931) considered it one of the more important winter browse plants for elk in northwestern Wyoming. Sampson and Jesperson (1963) rated winterfat browse fair to good for deer, good to excellent for cattle and sheep, fair to excellent for goats, and fair for horses. The species also provides cover for mourning doves (*Zenaida macroura*), ground-dwelling birds, and a variety of small mammals. Rodents use plant parts for nesting material (Stevens et al. 1977).

ESTABLISHMENT

Site Selection

Winterfat plots can be valuable in depleted salt desert and sagebrush-dominated pronghorn and desert bighorn range and where juniper-pinyon and sagebrush-invaded rangelands are being managed for habitat improvement. Winterfat is useful in seed mixtures designed to restore deer and elk winter habitat, particularly in juniper-pinyon types. It is often a part of seed mixtures used to stabilize disturbed minelands, roadsides, and abandoned croplands.

Rangeland revegetation programs utilizing winterfat should be on sites that formerly supported vigorous winterfat plants. Plant establishment will be more successful if the following site criteria are met: (1) the terrain should be nearly level with less than 10% slope; (2) soils should be deep and fertile; (3) soil moisture should be up to field capacity; and (4) stands of competing woody and herbaceous species must be sparse. Before seeding, it should be determined that existing winterfat plants are too sparse or

unthrifty to reproduce naturally and restore an adequate stand with proper management. Impacts responsible for the initial decline of winterfat must be controlled before new seedings occur. Test plots should be used in areas where there is no previous experience with winterfat seeding success.

Site Preparation

Plot design. Winterfat plots should preferably be in strips or narrow, rectangular units with irregular boundaries in order to maximize edge and accessibility for wildlife and to minimize negative visual impacts (Williamson and Currier 1971, USDA Forest Service 1977, Kindschy et al. 1982). Plantings on slopes should be contoured, particularly when site preparation and seeding are done by mechanized equipment. Areas of juniper-pinyon and sagebrush that will be managed to support more winterfat and other wildlife browse species should not exceed 1000 acres per project.

Mechanical treatment. Competing vegetation should be reduced to ensure satisfactory seedling establishment. Annual weedy growth can be turned under with a one-way disk plow on rock-free sites or with a brushland plow on rough, rocky terrain. The brushland plow can effectively reduce black greasewood and shadscale saltbush when winterfat is planted in these habitat types. Black greasewood will be suppressed but not killed by this treatment. Direct seeding without site preparation can be done in former croplands that are seeded the year they are abandoned.

Herbicidal treatment. Registered contact and cleanup-type herbicides can be used to control weedy growth and as a chemical fallow treatment into which direct seedings can be made. Herbicides can also be used to chemically scalp strips of cheatgrass (*Bromus tectorum*) and other annual grasses prior to drilling or broadcasting (Vallentine 1971).

Soil amendments. Winterfat does not usually respond to fertilization because western rangeland sites often have an excess of soil nutrients in relation to moisture supply. However, fertilizers may be useful where topsoils of critically erosive and disturbed sites have been removed and the subsoils are infertile. Soil test information and guides can be used to identify the deficient nutrients before seeding. Providing topsoil for the site is too costly unless the site is drastically disturbed. Adequate litter or other cover is needed on sites during the establishment period. Straw or similar

mulches are helpful in obtaining better stands in arid regions and on steeper slopes and critically erosive sites (Springfield 1972).

Propagules

Winterfat can be established from seeds or transplanted seedlings. Seedings usually require 3 to 5 years to mature and supply dependable forage, compared with 1 to 2 years for transplants. However, establishing transplants is more costly and labor intensive and can only be justified for depleted critical winter game ranges or disturbed areas in need of immediate soil stabilization. Neither seeds nor seedlings are consistently available in commercial quantities, but propagules can be collected or obtained through contract with seed collectors or native plant nurseries.

Seed selection. No minimal seed quality standards exist for winterfat, but seed used for broadcasting should test 50% purity, 90% germination, and 45% pure live seed (Plummer et al. 1968). Seeds vary from 111,000 to 210,000 per pound. Large seeds germinate more rapidly than do smaller seeds.

When selecting seed from a native stand, it is important to locate a current year's supply from an ecotype or local strain shown to be well adapted to the site. When local ecotypes have not been adequately tested, use seed from nearby locations or from slightly more northern sites or higher elevations with similar soil characteristics (Plummer et al. 1968, Blauer et al. 1976, Stevens et al. 1977, Wasser 1982). Seed from a taller ecotype should be used when planting at higher elevations, such as on juniper-pinyon range. Seed from bush winterfat is usually not available and is difficult and expensive to collect.

Winterfat seed can be collected by hand-stripping into collecting containers or with mechanized seed strippers after the seed is fully mature and beginning to shatter. Vacuum harvesting has also been used, and portable vacuum equipment is being tested (Plummer et al. 1968, Springfield 1974, Vories 1981). After carefully drying, bulk seed may be cleaned to drillable quality either in fanning mills or by hammermilling, or both (Vories 1981, Springfield 1974). However, seed that has been hammermilled or cleaned to a high purity is very costly, and the process may injure some seed. Bulk material collected from native stands is usually satisfactory for broadcast seeding.

Germination and vigor. Winterfat seed loses considerable germination capacity in 1 year and most of its capacity within 2 years. Seeds undergo afterripening for several weeks following harvest and maturity. Room temperature appears to be satisfactory for storage during afterripening, but chilling and freezing the seed may hasten the process and permit earlier germination (Vories 1981). Alternating temperatures between 8° and 18° C is optimal for germination (Springfield 1974, Vories 1981).

Planting Methods

Seeding. Seeds should be broadcast or drilled no deeper than 0.5 in., and preferably between 0.1 and 0.25 in. Seeding rates for drill-seeding techniques should be 2.7 to 4.5 lb/acre; broadcast rates are 50% to 100% higher, depending on soil moisture, competition, seed placement capabilities, and land use.

The best season for planting has not been determined, but late fall, winter, and spring seedings have been used or recommended. It is usually better to seed before the season of highest moisture if surface soils are not saturated for more than 2 weeks (Wasser 1982). Time of seeding is especially critical in the Intermountain region because the soil moisture dissipates soon after the winter snows melt, and germination is near zero once the surface soil becomes dry. Planting in spring or early summer in moist soil with a straw mulch on top increased germination and seedling establishment in field tests near Santa Fe, New Mexico (Springfield 1972).

Direct seeding can be done with a Hansen scalper-seeder, which simultaneously removes existing vegetation in strips and plants seed. Crawler tractors, used to pull disks or disk-plows, can be equipped with seed dribblers mounted above the track wheels. The seed is planted under the tracks, which then press the seed slightly into the soil. Planting in miniature furrows or depressions made by lister or pitting equipment may increase planting success in more arid zones. Furrows and pits, however, should not be used on sandy and erosive soils because the depressions soon fill in by soil sloughing and the seed is covered too deeply. A combination tractor-dozer, equipped with a pitter and seeder-packer rig, is recommended for seeding extensive areas in depleted brushlands (Herbel 1972).

Seeds may be broadcast aerially or from mechanized or hand-driven equipment such as fertilizer or bait spreaders and cyclone seeders (Plummer et al.

1968). Vories (1981) recommended that seeds be broadcast in front of a drill seeder because the seeds are fluffy and require a shallow planting depth. After seeds are broadcast, the seedbed should be prepared by chaining, cabling, or pipe-harrowing for defoliation and thinning of competing vegetation. This also scarifies the soil and covers the broadcast seed. Broadcast seed should be covered no more than 0.25 in.

Transplants. Seedlings are usually planted only on critically disturbed and eroded sites that require immediate stabilization. One- or 2-year-old stock, grown in greenhouses or cold frames, is transplanted into furrows or dug holes. Container and bare-rooted stock are both used; bare-rooted stock must be kept damp after lifting and should be planted in early spring while still dormant. Wild stock can be dug or pulled when soil is saturated with moisture in the spring and transplanted like bare-rooted nursery stock.

Planting Mixtures

Winterfat is usually planted as one component of a shrub and herb seed mixture designed to produce a stand of usable forage species. Planting a few fast-developing shrubs and grasses helps retard invasion of exotic annuals and other aggressive weeds. Usually no more than 1.5 lb/acre of winterfat seed is drilled or 3.0 lb/acre broadcast in a total mixture seeded at 7 to 18 lb/acre (Plummer et al. 1968).

Usually 3 to 5 perennial grasses, 2 to 6 forbs, and 2 to 4 other shrubs are seeded in mixtures with winterfat. These complex mixtures speed up vegetation establishment and stability, repel aggressive weedy invaders, and provide a greater diversity of vegetation, while supplying a better year-round nutritional balance for domestic and wild animals. Alfalfa (*Medicago sativa*) or one or more clovers (*Trifolium* spp.) are included in these mixtures to provide protein and soil nitrogen. The mixture usually includes both native and introduced species. More native seedstocks are currently available than in years past when these mixtures were first formulated. The seed mixture shown in Table 1 is recommended for shadscale saltbush sites; similar mixtures have been developed for other vegetation types in big game range restoration projects (Plummer et al. 1968).

Table 1. Example of winterfat seed mixture

Species	Application, lb/acre	
	Broadcast	Drilled
Grasses		
Russian wildrye (*Elymus junceus*)	1½	1
Fairway crested wheatgrass (*Agropyron cristatum*)	1½	1
Standard crested wheatgrass (*A. desertorum*)	1½	1
Indian ricegrass (*Oryzopsis hymenoides*)	1½	1
Forbs		
Gooseberry leaf globemallow (*Sphaeralcea grossulariaefolia*)	1½	1
Alfalfa (*Medicago sativa*)	1½	1
Shrubs		
Winterfat	1½	1
Fourwing saltbrush (*Atriplex canescens*)	1½	1
Total	12	8

MAINTENANCE

The main concern during seedling establishment is to ensure that weedy plants do not suppress the normal growth and development of winterfat and other seeded species. Mowing and rotobeating above the height of the winterfat seedlings to suppress weeds are feasible only when winterfat is the sole seeded species or dominant of an otherwise nonshrub mixture. Mowing weeds should be done during their period of rapid stem growth. If the seedbed has been thoroughly prepared, competition is usually suppressed for 1 or 2 years, after which the vigorously developing stand is not as subject to weed encroachment. Well-established winterfat and its perennial associates usually persist for 25 to 50 years if the stand is carefully managed.

During the first 2 years of a winterfat restoration program, herbivores should be kept at low population levels, especially during the spring and summer growing seasons when winterfat is most vulnerable. Revegetated rangeland should be monitored and management actions taken as needed to prevent overuse of the plants (Holmgren and Hutchings 1972).

Intensive browsing and prolonged droughts or periods of cold, wet weather may shift the stand composition toward grasses, unpalatable shrubs, or

strongly competitive species that can suppress winterfat. In this case, control measures, such as reduced grazing pressure or increased hunting limits, may be needed. If an undesirable vegetative composition continues to persist, prescribed fire or mechanical manipulation may be needed to restore the cover to the desired balance; artificial seeding may also be required. Winterfat sprouts vigorously after burning and responds well to a deferred rotation grazing system (SCS 1971).

CAUTIONS AND LIMITATIONS

Winterfat is a choice forage plant for livestock as well as big game species. Where livestock grazing threatens the productivity of winterfat range and its value for wildlife, grazing should usually be eliminated or confined to the dormant growth period, which is usually from mid-November to mid-February.

The current year's twig growth comprises over half of winterfat's standing crop and biomass. Although this increases forage value, plants are more vulnerable to physical and physiological damage from browsing. Plants can withstand removal of only about 25% of current annual twig/leaf growth during the rapid stem elongation period. A greater removal rate results in a reduction of the carbohydrate supply in the stem bases and roots, which is needed to initiate growth and support production the next year. Winterfat may tolerate up to 40% removal of current annual growth during growth phases other than stem elongation. Removal of current growth during fall and winter dormancy should not exceed 60%.

Winterfat is tolerant of planned burning and sprouts vigorously after a fire (Wright and Bailey 1982). However, considerable loss in vigor and some loss in stand density may occur in juniper-pinyon wildfires, particularly where litter has accumulated.

Rabbits and rodents are known to damage stands of winterfat and may destroy seedlings. Grasshoppers, Mormon crickets, and a variety of plant-sucking insects are commonly present but usually do not cause extensive damage. Minor plant pathogens include leaf rusts and stem infectors (Wasser 1982).

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