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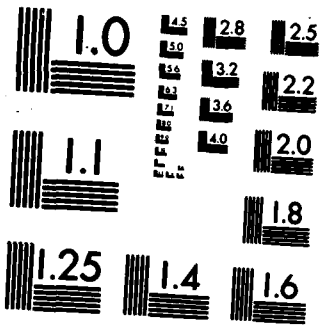

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ALFALFA (*Medicago sativa*)

Section 7.3.1, US ARMY CORPS OF ENGINEERS WILDLIFE RESOURCES MANAGEMENT MANUAL

by

Clinton H. Wasser

Colorado State University
Fort Collins, Colorado 80523

and

Phillip L. Dittberner

US Fish and Wildlife Service
Fort Collins, Colorado 80526

and

Wilma A. Mitchell

Environmental Laboratory

DEPARTMENT OF THE ARMY
Waterways Experiment Station, Corps of Engineers
PO Box 631, Vicksburg, Mississippi 39180-0631

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A plant materials report on alfalfa (*Medicago sativa*) is provided as Section 7.3.1 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 for alfalfa include description, distribution, habitat requirements, wildlife value, establishment, maintenance, and cautions and limitations.

Alfalfa is considered one of the most important forage species in North America, and plants provide food and cover for a variety of wildlife. Distinguishing characteristics of alfalfa are given, and ecotypic variation and growth forms are noted. Habitat adaptations are discussed, and soil and moisture requirements are specified. Benefits of managing alfalfa for big game mammals, upland game birds, waterfowl, and nongame species are discussed. Specifications are provided for establishment, including site selection, site (Continued)

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Fort Collins, CO 80526;
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preparation, propagule selection, and planting methods. Preestablishment and postestablishment maintenance requirements are discussed, and tolerances to grazing, mowing, irrigation, and disease and insect damage 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. Wilma A. Mitchell, Wetlands and Terrestrial Habitat Group (WTHG), Environmental Laboratory (EL), US Army Engineer Waterways Experiment Station (WES). Mr. Chester O. Martin, Team Leader, Wildlife Resources Team, WTHG, 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. Review and comments were provided by Mr. Martin, 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 (PGAD). Drawings were prepared by Mr. David R. (Randy) Kleinman, Scientific Illustrations Section, PGAD, under the supervision of Mr. Aubrey W. Stephens, Jr.

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 7.3.1 in Chapter 7 -- PLANT MATERIALS, Part 7.3 -- LEGUMES, 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.

ALFALFA *(Medicago sativa)*

Section 7.3.1, US ARMY CORPS OF ENGINEERS
WILDLIFE RESOURCES MANAGEMENT MANUAL

Alfalfa is considered one of the most important forage plants in North America (Ditterline et al. 1976, Hanson and Barnes 1978, Wasser 1982). Plants are palatable and nutritious to most herbivores and provide good cover for many birds and small mammals. Alfalfa is used for grazing on rangelands and farm pastures and serves as winter forage in the form of hay or silage. Leaves contain most of the nutrients and are processed into a variety of feedstuffs high in protein, minerals, and carotene. This species is widely adaptable and can often be grown on apparently unsuitable sites if properly cultured.

DESCRIPTION

Alfalfa is a long-lived, herbaceous, perennial legume composed of numerous stems 2 to 3 ft (6 to 9 dm) tall and 0.06 to 0.12 in. (1.5 to 3.0 mm) in diameter (Fig. 1). The stems originate from a woody root crown located near the soil surface and develop into either a reclining or broad upright growth form. Taproots grow from 10 to 30 ft (3 to 9 m) long and bear nodules that manufacture nitrogen from atmospheric sources when plants are inoculated with nitrogen-fixing bacteria.

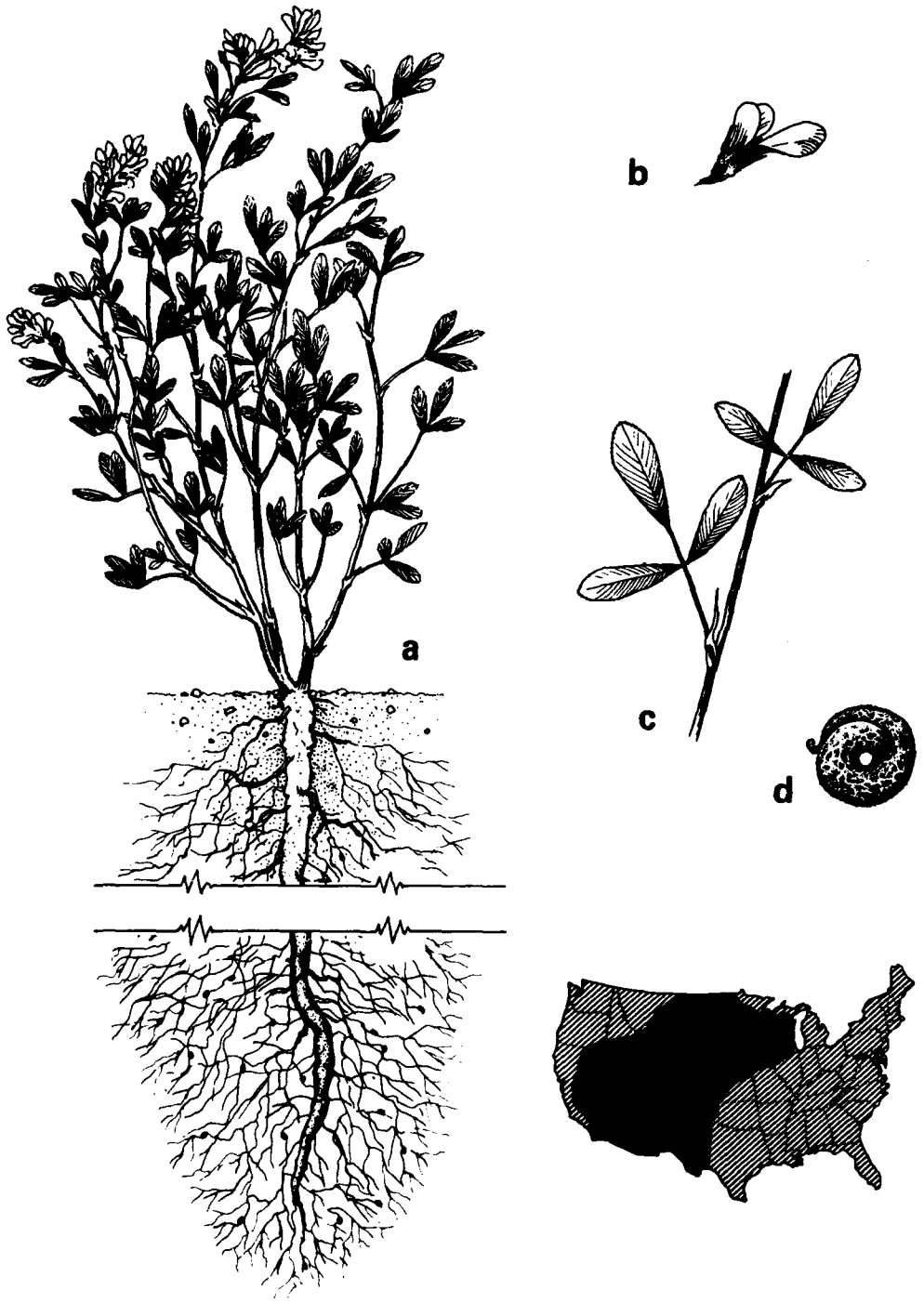

Figure 1. Distribution and characteristics of alfalfa *(Medicago sativa)*: (a) entire plant showing elongated taproot, (b) flower, (c) leaves, and (d) seed. The map shows the overall species distribution (diagonal lines) and region of greatest management use (crosshatching)

The alternate, compound leaves of alfalfa crowd the upper portions of the stems. Each leaf is composed of 3 denticulate leaflets that are 0.4 to 1 in. (1 to 2.5 cm) long and 0.1 to 0.4 in. (3 to 10 mm) wide, obovate to oblanceolate in shape, smooth and hairy, and dark green on the upper surface. The infloresence is a loose, subglobose to cylindric, spike-like raceme 0.4 to 1.5 in. (1 to 4 cm) long and 0.4 to 0.8 in. (1 to 2 cm) wide. Small pea-like flowers range in color from pale blue to purple but are occasionally white or variegated (Radford et al. 1968); some varieties also possess yellow flowers. The mature seedpod is spirally coiled in 1 to 3 turns and contains several kidney-shaped seeds. Plants resume growth in early to mid-spring and flower and seed throughout the summer.

Common alfalfa frequently hybridizes with yellow-flowered alfalfa *(Medicago falcata)* in areas where both species are grown. Hybridization has resulted in several spreading types of alfalfa that may be planted where the spreading growth form is particularly beneficial, as in pastures (Plummer et al. 1968, Hanson and Barnes 1978, Rumbaugh 1982). The rhizomatous type has short, semihorizontal rhizomes that develop from crown buds, and the creeping-root type develops adventitious stem shoots from enlarged sections of lateral roots (Hanson and Barnes 1978).

DISTRIBUTION

Alfalfa is thought to have originated in southwest Asia, but it may have developed from centers in China and Siberia (Hanson 1972, Martin et al. 1976). Although introduced to the east coast of the United States in 1736, alfalfa did not become established as a crop until its introduction into California and Minnesota around 1850. It is now grown throughout the United States but has its greatest utilization in the West and Midwest. The leading states in alfalfa production are Wisconsin, Michigan, Minnesota, Nebraska, Iowa, Montana, South Dakota, Colorado, Utah, and California (Graumann and Hanson 1954, Ditterline et al. 1976, Hanson and Barnes 1978).

HABITAT REQUIREMENTS

Through its many varieties, alfalfa is adapted to a wide range of climatic conditions and grows from near sea level in Imperial Valley, California, to 8000-ft elevations in the Rocky Mountains (Hanson and Barnes 1978). Alfalfa can be grown as either a warm or cool season plant, as it can survive

extremely low temperatures; however, frost at any stage of growth can greatly reduce production (SCS 1971). Alfalfa grows best in full sunlight. Both yield and forage quality decline with increasing shade, but no critical levels of shade have been identified.

Soils

Alfalfa will grow on soils of all textures but is particularly well adapted to loams and clayey loams (SCS 1973). It produces abundantly on deep, well-drained soils that contain lime, which is needed for plant nutrition and is utilized by nitrogen-fixing bacteria. Alfalfa is not adapted to acid soils of low lime content; therefore, it requires liberal liming and fertilization when grown on sandy soils in the eastern United States (Graumann and Hanson 1954). The species grows well in a pH range of 6.3 to 7.5 and tolerates moderate alkalinity. Alfalfa is tolerant of a soil salinity of 6 μmhos/cm, especially where irrigation leaches the salts from most of the root zone, but is intolerant of strongly saline and sodic (alkali) soils (Bernstein 1964, Hanson and Barnes 1978).

Moisture

Alfalfa requires 16 to 20 in. of moisture to maintain a satisfactory stand but will produce under a water regime of 12 to 15 in. in cooler or moisture-accumulating habitats (SCS 1973). Only protracted drought will kill plants; they usually become dormant with the onset of drought and recover afterward (Hanson and Barnes 1978). The section on Maintenance provides information on water requirements in arid environments.

Alfalfa is poorly adapted to areas in which the water table fluctuates within the root zone (SCS 1971). It is usually intolerant of water tables that come closer than 5 ft to the soil surface and of flooding that saturates the surface soil for more than a few days (Briggs and Mortensen 1959, Kehr and Moline 1972).

WILDLIFE VALUE

Alfalfa is used for food and cover by a variety of wildlife species (Table 1). Martin et al. (1951) listed more than 25 species of birds and mammals that feed on the seeds, foliage, or stems of alfalfa plants. The species is considered a choice food for mallard, American coot, Canada goose, sage grouse, sharp-tailed grouse, elk, deer, and pronghorn (SCS 1971, 1973). It

Table 1. Wildlife species known to use alfalfa as food and/or cover

Species	Use	
	Food	Cover
Mammals		
Mule deer *(Odocoileus hemionus)*	X	
White-tailed deer *(O. virginianus)*	X	
Elk *(Cervus elaphus)*	X	
Pronghorn *(Antilocapra americana)*	X	
Jackrabbits *(Lepus* spp.)	X	
Cottontail rabbits *(Sylvilagus* spp.)	X	X
Muskrat *(Ondatra zibethicus)*	X	
Pocket gophers *(Thomomys* spp.)	X	
Ground squirrels *(Spermophilus* spp.)	X	X
Prairie dogs *(Cynomys* spp.)	X	
Meadow mice *(Microtus* spp.)	X	X
White-footed mice *(Peromyscus* spp.)	X	X
Marmots *(Marmota* spp.)	X	
Raccoon *(Procyon lotor)*	X	
Birds		
Sandhill crane *(Grus canadensis)*	X	
Canada goose *(Branta canadensis)*	X	X
Mallard *(Anas platyrhynchos)*	X	X
Blue-winged teal *(A. discors)*		X
Northern shoveler *(A. crecca)*		X
Gadwall *(A. strepera)*		X
American wigeon *(A. americana)*	X	X
Wood duck *(Aix sponsa)*		X
American coot *(Fulica americana)*	X	X
Sage grouse *(Centrocercus urophasianus)*	X	X
Greater prairie-chicken *(Tympanuchus cupido)*		X
Sharp-tailed grouse *(T. phasianellus)*	X	X
Ring-necked pheasant *(Phasianus colchicus)*	X	X
Northern bobwhite *(Colinus virginianus)*	X	
Gambel's quail *(Callipepla gambelii)*	X	
Blue grosbeak *(Guiraca caerulea)*	X	

also provides nesting cover for waterfowl, ring-necked pheasant, and greater prairie-chicken.

Alfalfa is commonly included in mixtures sown for big game habitat improvement in the West. Yoakum (1978, 1979) and Yoakum et al. (1980) found that pronghorns were more productive on Oregon sagebrush ranges that were reseeded with a grass-forb-browse mixture containing Nomad alfalfa. Plummer et al. (1968, 1970) tested alfalfa in mixtures used for seeding thousands of acres of big game restoration projects in Utah; these seedings were made primarily for deer but also received use by elk at higher elevations and by pronghorn at lower elevations. In Montana, white-tailed deer use alfalfa in spring and summer, and mule deer forage it in fall (Allen 1968, Martinka 1968). Elk at Jackson Hole, Wyoming, utilize forbs heavily in summer, feeding on alfalfa in cottonwood - spruce *(Populus angustifolia - Picea pungens)* and agricultural habitats (Martinka 1969).

Grass-alfalfa mixtures have been used to attract nesting upland game birds. Kirsch et al. (1973) showed that habitat for greater prairie-chickens could be developed on cultivated land by planting mixtures of alfalfa and smooth brome *(Bromus inermis)* or sweet clover *(Melilotus officinalis)*. Bartmann (1969) demonstrated that lands seeded to alfalfa and crested wheatgrass *(Agropyron cristatum)* produced a high percentage of successful pheasant nests on a dryland study area in northern Utah. In an intensively farmed area of Illinois, road edges seeded with Vernal alfalfa and smooth brome also increased the reproductive success of pheasants (Joselyn and Tate 1972). Sage grouse in central Montana use alfalfa fields in late summer, chiefly because of the overall availability of forbs and not specifically for alfalfa (Peterson 1970, Wallestad 1971, Wallestad et al. 1975).

Alfalfa produces excellent nesting cover for waterfowl in the midwestern prairies. In a 3.13-square-mile circular study area in South Dakota, 269 pairs of breeding puddle ducks were found on idle lands seeded to grass-alfalfa mixtures (Duebbert and Kantrud 1974). Of 206 duck nests examined over a 5-year period in the rainwater basin of Nebraska, 33% were in alfalfa cover (Evans and Wolfe 1967); during a 4-year period at Union Slough National Wildlife Refuge in Iowa, 37% of recorded duck nests were located in alfalfa fields (Burgess et al. 1965). On Lower Souris National Wildlife Refuge, North Dakota, 5.5 puddle duck nests per 10 acres were found in alfalfa and summer fallow fields (Martz 1967). Alfalfa is also used in the Pacific Northwest for

the development of Canada goose brood pastures; irrigated pastures in Washington have been planted with a mixture of orchard grass *(Dactylus glomerata)*, clover *(Trifolium spp.)*, and Ladak alfalfa (Habermehl 1984).

ESTABLISHMENT

Site Selection

The northern Intermountain region of the Northwest has ideal sites for the establishment of alfalfa to improve big game range. These sites are characterized by large size, deep porous soils, and vegetation consisting predominantly of basin big sagebrush *(Artemisia t. tridentata)* over 2 ft tall with a thin herbaceous undercover. If range is being improved for pronghorn, selected sites should have an existing population or contain potential pronghorn habitat, which consists of large open areas with a gradient of less than 30% within 2 to 4 miles of water (Yoakum 1978, Kindschy et al. 1982). Other vegetation types suitable for alfalfa establishment in the northern and central Intermountain region are mountain big sagebrush *(A. t. vaseyana)*, mountain shrub *(Cercocarpus montana)*, juniper - pinyon *(Juniperus* spp. - *Pinus edulis)*, aspen *(Populus* spp.) openings, open aspen-conifer, subalpine herbland, and meadow types that lack desirable forage plants but are needed as big game winter range. Sites that should be excluded are meadows and drainageways in sage grouse habitat and those located within 2 miles of grouse breeding grounds or winter concentration areas (Braun et al. 1977).

Alfalfa can be planted for small game cover on farmlands in the U.S. Soil Conservation Service land capability classes 1 through 7 (USDA 1961). Although its use is beneficial on top-quality land, it is more advantageous on lower class lands that are eroding and need the protection, tilth, and fertility that alfalfa imparts (Bennett 1939, Graham 1944). Alfalfa, mixed with a dense sod-forming grass, can be used to stabilize road edges and improve pheasant habitat in farming districts where less than 3% of the total area contains suitable nesting cover. Selected roadsides should not be along heavily traveled highways or major secondary roads. Roadside borrow pits should provide good drainage to prevent ponding or high water tables, which reduce the longevity of alfalfa (Grange and McAtee 1934, Bennett 1939, Troeh et al. 1980).

Site Preparation

Plot design. Projects designed to improve sagebrush range for pronghorns should be less than 1000 acres in size (Kindschy et al. 1982) and exclusive of critical habitat for sage grouse (Braun et al. 1977). The most satisfactory plots are composed of elongated strips, no wider than 100 ft, alternating with untreated sagebrush strips of the same size. Irregular perimeters are preferred because they reduce adverse visual impacts and increase edge effect. Whenever possible, perimeters should conform to the natural landscape. This can often be achieved by leaving untreated rocky ridges, streams, drainageways, and some areas that have desirable forage and cover (Williamson and Currier 1971, Fish 1972). If sage grouse are not present on the range, areas accessible to ground equipment can be treated on the contour for erosion control.

Wildlife may also benefit from alfalfa fields used in agricultural crop rotation. These fields, usually totaling 20% to 25% of the cropped area, can often be modified into elongated strips worked on the contour and designed to provide concealment cover between forage and nesting or roosting areas.

Mechanical treatment. On pronghorn range, plant competition must be reduced to safe levels for seeding; however, up to 15% of sagebrush cover, mostly plants 30 in. tall, should be preserved. Vegetation can be thinned by chaining or cabling; this operation should follow the contour whenever possible. Brushland plots or one-way disk-plows can be used on rock-free slopes of low gradient, but a pipe harrow may be required on steep, rocky slopes (Plummer et al. 1968, Yoakum 1978). Scalper-seeders are usually more effective on lesser slopes when most of the vegetative competition is grass. The above techniques are also applicable to mountain shrub, juniper-pinyon, open aspen-conifer, and subalpine types of vegetation.

Seedbeds prepared for planting alfalfa in croplands are usually plowed unless seeding follows an intertilled crop (Graumann and Hanson 1954). To be effective, tillage should precede or be done concurrently with planting (Joselyn and Tate 1972). The seedbed can be disked and smoothed far enough in advance to allow the soil to settle and may then be firmed by cultipacking before and after planting. Land under irrigation should be smoothed as needed to obtain even distribution of water (SCS 1971). Seedbeds for roadside plantings of alfalfa can be prepared the same way as for croplands.

Soil amendments. Rangeland seedings of alfalfa do not usually include fertilizer; however, soils should be tested to identify site-specific nutrient needs. Alfalfa will produce adequate nitrogen for its use if seeds have been inoculated with the proper bacterial culture, but nitrogen may be required to establish stands on disturbed lands lacking topsoil or on land that has not been previously seeded with alfalfa. Mountain meadows utilized for emergency winter forage can also benefit from nitrogen application; the response may be considerable if legumes compose less than 50% of the total forage (Delaney and Bonnelli 1980).

Lime will be required for acid soils and, except in limestone regions, will be needed on most soils east of the Mississippi River. Phosphates will likely be needed in the Southeast and on some sites in the West; treatment is most effective when phosphates are applied to the root zone (Ditterline et al. 1976, Hanson and Barnes 1978). Potassium and micronutrients such as sulfur and boron may also be required. Fertilizers may be applied before or during seedbed preparation or just after seeding (SCS 1973).

Propagule Selection

Seed. Alfalfa is usually established from seed, and more than 80 cultivars have been adapted for use in the United States. State lists should be consulted for varieties best suited to specific regions and sites. Those resistant to bacterial wilt are recommended for sites where alfalfa will remain longer than 3 years; Ranger, Buffalo, and Vernal are the more commonly used and widely adapted varieties that have wilt resistance (Hanson 1972, Hanson and Barnes 1978). Spreading varieties are preferred for seeding pastures and rangelands; Nomad, Rambler, Travois, and Teton are generally recommended (Plummer et al. 1968; Yoakum 1978, 1979). When the growing season is short, Ladak is specifically recommended because of its high yield from one cutting and its wide adaptability in the West. Rumbaugh (1982) reported that Grimm, Ladak, Nomad, Ranger, Rhizoma, and Sevelra survived for 25 years in a dryland pasture-grazing experiment in the sagebrush zone and were all reseeding toward the end of that period.

Commonly used varieties are available in commercial quantities, but only registered seed should be selected to ensure getting the desired strain. Selected seed should bear a test tag from the current year indicating at least

99% purity and 90% germination. To avoid delayed germination, seed should contain no more than 10% hard seeds (Wasser 1982).

Seedlings. Offshoots from rhizomes or root cuttings have been used to revegetate very critical sites. The best time to transplant seedlings is during spring, but it can be done satisfactorily any time that adequate soil moisture and suitable temperatures are present (Plummer et al. 1968).

Planting Methods

Time of seeding. The time of planting varies with the climate and elevation. In the West, alfalfa is usually sown in spring and early summer, whereas in the South it is seeded in the fall to reduce vegetative competition. Planting should be done after the danger of frost has passed in the spring or before the first fall frost. Seeding in May and June is recommended for sites above 7000 ft in the West, but alfalfa may be sown in late summer or early fall at lower elevations (SCS 1971).

Seeding. On agricultural lands alfalfa is usually planted as a row crop, and drilling is the preferred method of seeding. Standard equipment includes grain drills or a fertilizer drill that has boxes for drilling large and small seeds separately. Seeds can also be dropped from a seedbox mounted between 2 corrugated rollers that firm and cover the dropped seeds. Packer wheels attached to drills or corrugated rollers pulled behind the drill may be used to firm seedbeds in dry or loose soils but should not be used on moist soils.

The rate of seeding alfalfa in a monoculture varies with region, water regime, and mode of planting. In the Western States, from 2 to 5 lb of seed per acre are recommended for dryland sites, whereas from 6 to 12 lb per acre should be planted on irrigated lands (SCS 1971, 1972b, 1973). From 15 to 20 lb of seed per acre are usually used in the South, where higher rates of seeding are needed to combat weeds and ensure rapid stand establishment (Kimbrough et al., undated). When alfalfa is seeded with a grass for hay or pasture, it should be planted in alternate rows at the rate of 1 to 2 lb per acre on dryland sites and 2 to 6 lb per acre on irrigated sites (SCS 1971, 1973).

Seeds should be inoculated at planting time if seeded into a plot that has not previously supported alfalfa. Ideal depth of planting is 1/2 in. in silty soils; however, it should be altered by 1/4 in. in finer or coarser soils (Martin et al. 1976, Hanson and Barnes 1978).

Alfalfa has also been successfully established by broadcasting seeds on western rangelands. Plummer et al. (1968) obtained better stands by broadcasting than by drilling seeds on big game range in Utah; sites were chained or pipe-harrowed to cover seeds lightly (1/4 in.) either before seedbed preparation or between treatments. On Oregon pronghorn ranges, alfalfa seeds were broadcast from an airplane onto sagebrush lands that had been plowed and drilled with other seeding components (Yoakum 1978). Helicopters are recommended for seeding both sagebrush range inhabited by sage grouse and narrow untreated strips adjacent to meadows and drainages (Braun et al. 1977, Yoakum 1979).

Planting mixtures. Complex mixtures of grasses, forbs, and shrubs are recommended for different range types and site conditions. Mixtures sown to improve pronghorn range in Oregon and Utah are composed of 6 grasses, 6 forbs, and 6 shrubs. Alfalfa comprised 10% of the seed mixture and maintained approximately 10% composition for 6 years in the established stands (Yoakum 1979). On Illinois roadsides, Vernal alfalfa and smooth brome were each planted at the rate of 12 lb/acre to increase ring-necked pheasant nesting cover (Joselyn and Tate 1972). This rate can be reduced to 6 lb/acre on plots from central Nebraska westward.

MAINTENANCE

Preestablishment

No grazing should be allowed during the first year of alfalfa establishment in croplands (SCS 1971), and livestock should be excluded for 2 to 3 years from rangeland being restored for big game. However, stands can be mowed to reduce weed competition. The cut material may be removed for hay or left on the ground if there is no danger of smothering the alfalfa plants; at least 4 to 6 in. of stem should remain as stubble (SCS 1972a). Croplands that have been directly seeded without tillage are best treated for weed control by spraying with a suitable herbicide. Impacts on new seedings are minimized with establishment, low populations of big game, or restriction of wildlife from the area.

Alfalfa has a high water requirement and should not be stressed during any phase of growth. The root zone must be kept moist; therefore, irrigation is vital for alfalfa management in arid regions. Plots on well-drained soils

should be irrigated every 5 to 7 days until seedlings are 2 in. tall; irrigation intervals can then be lengthened as plants grow larger. On less well-drained soils, water must be carefully regulated to prevent prolonged surface soil saturation (SCS 1972b, 1973).

Postestablishment

In farmlands, livestock grazing may be gradually restored during the second growing season. The nonrhizomatous alfalfas should be grazed only after plants are 10 in. tall and should not be grazed below an average height of 4 in. (SCS 1972b). Alfalfa requires 20 to 40 days for regrowth under favorable conditions; therefore, livestock use necessitates a system of rotational grazing. To sustain high production, rotation schemes should incorporate 30- to 40-day recovery periods and allow grazing to stop at least 30 days before fall frosts (Graumann and Hanson 1954, Ditterline et al. 1976, Hanson and Barnes 1978). Care should be taken when livestock graze alfalfa because bloat is a major risk (SCS 1973).

Alfalfa grown for wildlife use can be managed as hay. For spring-seeded plots, the first cutting should be done when alfalfa is at full bud. For those seeded in fall, alfalfa need reach only 10% to 25% bloom before it is cut in the first spring. Subsequent cuttings can be made when plants are at 10% to 35% bloom or when the crown buds are 1 to 1-1/2 in. long. To allow for regrowth, cutting intervals usually range from 30 to 40 days (SCS 1971, 1973; Kimbrough et al., undated). A flushing bar may be attached to the mower or tractor during harvest (Grange and McAtee 1934). It is best, however, to delay mowing plots used for nesting until the young have left the nest; for pheasants, this is around 1 August (Joselyn and Tate 1972). In alfalfa fields used by prairie-chicken, Kirsch et al. (1973) recommended suspension of mowing and grazing; when stand vigor begins to decline, prescribed burning can be applied to restore habitat quality.

When alfalfa is seeded with a small grain, it should be monitored so the grain can be harvested as soon as the alfalfa shows signs of wilting or suppression. Stands developed in alternate strips for pronghorn use need continual evaluation to determine when the untreated strips can be treated. In sage grouse areas, the alternate strips should not be planted until the alfalfa stands provide effective cover (Braun et al. 1977).

CAUTIONS AND LIMITATIONS

Alfalfa is susceptible to damage caused by a variety of organisms. Bacterial wilt will kill and thin nonresistant varieties of alfalfa by the third year. If this disease is a health problem in an area, wilt-resistant varieties, such as Ranger or Buffalo, should be used to sustain long-term production. Crops throughout the United States, particularly in the South, are vulnerable to alfalfa weevil larvae. Only semiresistant varieties exist; therefore, insecticides should be applied early in the season to prevent severe damage. Lygus bugs and alfalfa seed chalcids affect seed production but are controllable by insecticides. The pea aphid and spotted alfalfa aphid weaken plant vigor and secrete a mold-attractant that lowers hay quality. Leaf spot, root rot, and the stem nematode cause damage to nonresistant varieties of alfalfa. Varieties resistant to aphids and nematodes do exist and should be used if these organisms produce significant damage in the project area. Because alfalfa is highly susceptible to disease, resistance is being bred into the newer varieties (Ditterline et al. 1976, Hanson and Barnes 1978).

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