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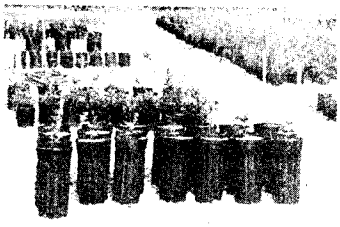

ENVIRONMENTAL IMPACT RESEARCH PROGRAM

TECHNICAL REPORT EL-86-38

YELLOW SWEETCLOVER (*Melilotus officinalis*)

Section 7.3.4, 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 yellow sweetclover (*Melilotus officinalis*) is provided as Section 7.3.4 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 for yellow sweetclover include description, distribution, habitat requirements, wildlife value, establishment, maintenance, and cautions and limitations.

Yellow sweetclover is a bushy, cool-season, biennial legume that is widely used in agriculture and provides food and cover for a variety of wildlife species. Diagnostic features of yellow sweetclover are described, and the species distribution and region of greatest potential management use are shown. Habitat preferences and soil and moisture requirements are discussed. Benefits to wildlife, primarily upland game birds and big

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Fort Collins, CO 80523;
2625 Redwing Road,
Fort Collins, CO 80526;
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game mammals, are described. Specifications are given for establishing sweetclover stands for wildlife; topics addressed include site selection, site preparation, propagule selection, and planting methods. Planting mixtures are recommended for several habitat types. Maintenance requirements and cautions and limitations 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.; 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, and Ms. Jennifer Shoemaker, WELUT, prepared the original drawings. 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.

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 7.3.4 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.

YELLOW SWEETCLOVER *(Melilotus officinalis)*

Section 7.3.4, US ARMY CORPS OF ENGINEERS
WILDLIFE RESOURCES MANAGEMENT MANUAL

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Yellow sweetclover is a bushy, cool-season, biennial legume that is widely used for hay, silage, cover crops, temporary pasture, green manure, erosion control, and soil improvement. The species is not native but is considered naturalized in many areas of the United States. Yellow sweetclover provides food and cover for a variety of wildlife species, especially upland game birds and big game mammals, and is a valued nectar producer for honey (Grange and McAtee 1934, Gorz and Smith 1973, Smith 1975).

DESCRIPTION

First-season growth of yellow sweetclover is entirely vegetative and produces a leafy, branched, central stem (Fig. 1). During the second season numerous coarse stems arise from rootcrown buds, grow erect or spreading, and reach heights of 2 to 6 ft (6 to 18 dm). Plants have large fleshy taproots with many lateral roots. Each compound leaf consists of 3 oval to oblong leaflets with minutely toothed edges. Small, yellow, pea-like flowers are located near the ends of bushy stems and are borne in elongated, loose racemes from 2 to 6 in. (5 to 15 cm) long. The small, wrinkled, oval-shaped seedpods are brown to black when mature and contain 1 or 2 laterally grooved seeds (Wasser 1982).

In northern and central latitudes, yellow sweetclover usually initiates growth in early spring, flowers in late spring or early summer, and reaches

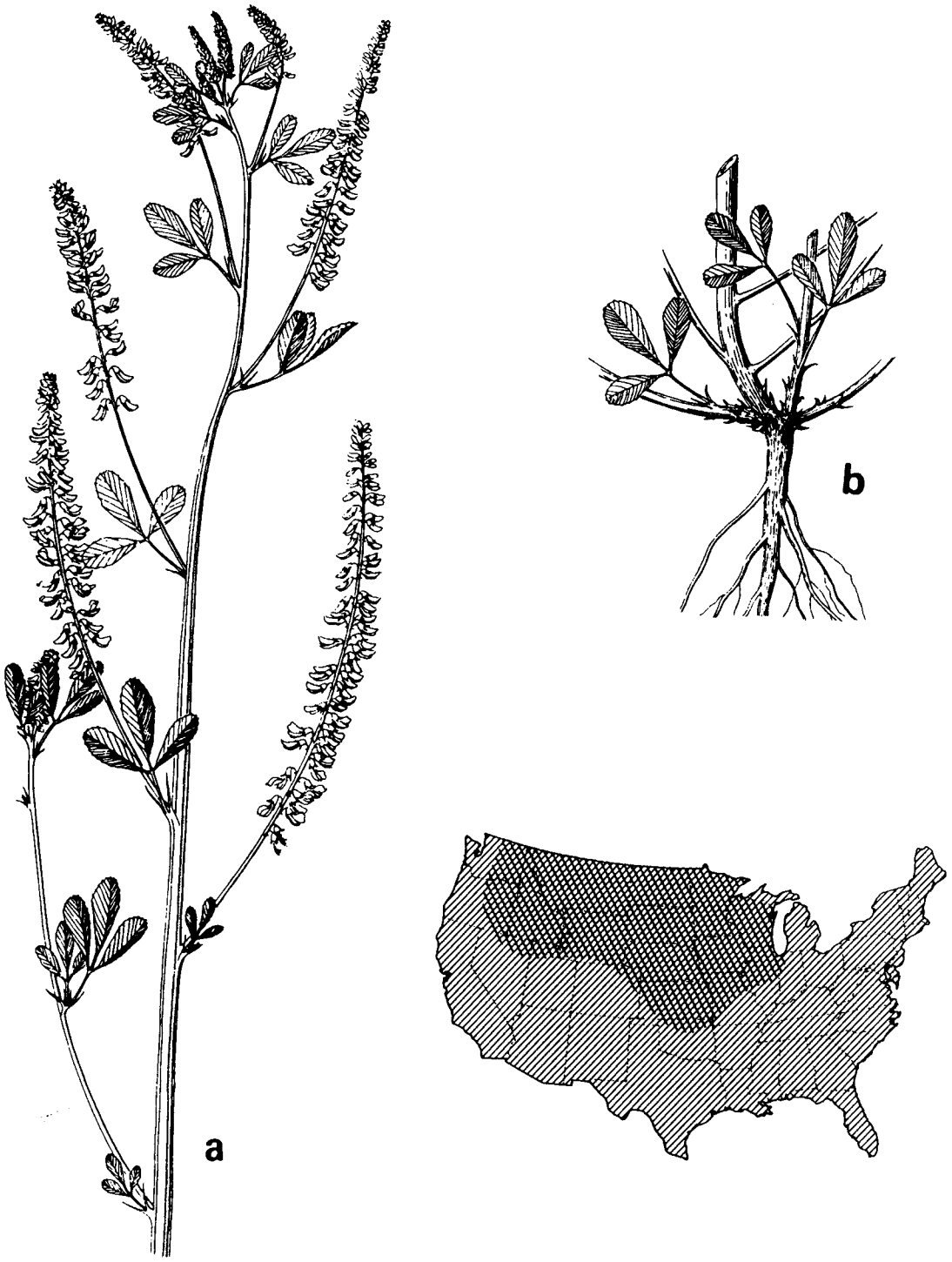

Figure 1. Distribution and characteristics of yellow sweetclover (*Melilotus officinalis*): (a) flowering branch, and (b) roots (from Wasser 1982). The map shows the overall species distribution (diagonal lines) and region of greatest management use (crosshatching)

maturity by midsummer. In southern latitudes, however, growth may begin during mild winters, thereby resulting in earlier maturity. Although the seeds shatter soon after they mature, most plants remain intact over winter and provide protective cover for soil and wildlife. Plants die after reproducing; therefore, persistence of the species beyond the second year depends upon natural or artificial reseeding.

DISTRIBUTION

Yellow sweetclover is an introduced species that probably originated in southwestern Asia. It now occurs in all 50 states (Fig. 1) and has become naturalized in many areas (Johnson and Nichols 1970, Gorz and Smith 1973, Smith 1975). Sweetclover grows from sea level to subalpine elevations in the western mountains; it is usually not found above 6500 ft in northern mountain regions or above 8500 ft in southern sections of the Rocky and Cascade/Sierra-Nevada Mountains (Short 1943, Pickford and Jackman 1944, Cornelius and Talbot 1955, Hull and Johnson 1955, Lavin and Springfield 1955).

Yellow sweetclover was considered a weed in the United States until about 1850, when its value as a crop was realized. It is planted chiefly in the Northern Great Plains, Great Lakes States, Corn Belt, interior Pacific Northwest, and the limey uplands of eastern Texas, northern Mississippi, and northwest Alabama (Gorz and Smith 1973). Yellow sweetclover is widely used in the West for range seeding and for soil improvement and stabilization of disturbed lands (Smith 1975, Vogel 1981, Thornburg 1982, Wasser 1982).

HABITAT REQUIREMENTS

Yellow sweetclover is more cold tolerant than alfalfa (*Medicago sativa* and *M. falcata*) or white sweetclover (*Melilotus alba*). It grows well in partial shade or open woodlands but is sensitive to dense shade and loses its lower leaves when shaded by its own thick second year's foliage (Plummer et al. 1968, Smith 1975).

Soils

Yellow sweetclover will grow in soils of all textures; however, medium-textured, sandy to clayey soils are optimal (Shaw and Cooper 1973, Thornburg 1982). The species grows vigorously on limey soils with abundant calcium, phosphorus, and potassium, but is poorly adapted to strongly acidic soils

(Gorz and Smith 1973). Plants tolerate soils that are sodic, moderately acidic (lower limit pH = 5.5), or strongly saline (EC = 8 to 12 μmhos/cm^2) (Bernstein 1964, Shaw and Cooper 1973, Vogel 1981).

Moisture

Yellow sweetclover is moderately drought tolerant but responds well to increased seasonal precipitation. It is most productive in areas that receive more than 15 in. mean annual precipitation if the moisture is available during the growing season. The species also grows in the 10- to 15-in. precipitation zone, particularly on the more fertile and wetter sites (Thornburg 1982). Mature plants can withstand 7 to 10 days of early spring flooding, but response to irrigation is only fair (Shaw and Cooper 1973).

WILDLIFE VALUE

Stems, leaves, seeds, and whole sweetclover plants are eaten by several wildlife species (Martin et al. 1951). Grange and McAtee (1934) noted that sweetclover furnishes food for a number of bird species and makes excellent cover for pheasants and other game. Upland game birds that consume the seeds include the sharp-tailed grouse (*Tympanuchus phasianellus*), greater prairie-chicken (*T. cupido*), gray partridge (*Perdix perdix*), ring-necked pheasant (*Phasianus colchicus*), Gambel's quail (*Callipepla gambelii*), and California quail (*C. californica*). Muskrats (*Ondatra zibethicus*) and cottontails (*Sylvilagus* spp.) eat the foliage and stems, and small mammals such as ground squirrels (*Spermophilus* spp.) feed on the seedpods and leaves.

Big game species, including pronghorn (*Antilocapra americana*), elk (*Cervus elaphus*), mule deer (*Odocoileus hemionus*), and white-tailed deer (*O. virginianus*), consume all parts of the plant. Elk show preference for yellow sweetclover during summer and fall in the Rocky Mountains (Kufeld 1973), whereas mule deer in the same area prefer it throughout the year (Kufeld et al. 1973). Mackie (1970) noted that both deer and cattle showed a marked preference for volunteer sweetclover in the Missouri River breaks of eastern Montana, and Crawford et al. (1969) reported its use by cattle, deer, and ring-necked pheasants in the Ozark Mountains.

Yellow sweetclover is widely used in western game range restoration from the foothill shrublands/woodlands to the intermountain basins (Plummer et al. 1955, 1968). The species is sometimes planted between shelterbelts in South

Dakota as winter food and cover for pheasants (Kimball et al. 1956) and is occasionally seeded as a monoculture in pine (*Pinus* spp.) and aspen (*Populus* spp.) openings for wildlife habitat improvement (Yoakum et al. 1980).

ESTABLISHMENT

Site Selection

A variety of sites are suitable for planting yellow sweetclover. Big game winter rangelands that have deep alkaline soils with gentle to moderate gradients (preferably less than 15%), receive more than 10 in. mean annual precipitation, and are deficient in desirable forage should be considered for range seedings or type conversions. Range types usually suitable for improvement practices using sweetclover are juniper - pinyon (*Juniperus* - *Pinus* spp.), mountain shrub (*Cercocarpus* spp.), black greasewood (*Sarcobatus vermiculatus*), inland saltgrass (*Distichlis stricta*), and sagebrush (*Artemisia* spp.).

Potential agricultural sites include fields that are eroding or marginal in crop productivity and declining in fertility, tractor turnaround areas, field edges, waterways, gullies, and noncropped dryland fields. Poor-condition pastures or sodbound grass stands that need renovation can benefit from sweetclover seedings. In these areas sweetclover can be used as green manure; a cover crop; permanent pasture or cover in set-aside conservation acreages; or temporary pasture, hay, or silage in a crop rotation program.

Other sites to be considered are shelterbelts, unvegetated strips, road edges, and gravel pits. Waste places are especially important because of the opportunities to provide relatively permanent wildlife cover. Empty lots, utility line rights-of-way, and drainageways may also be suitable for establishing yellow sweetclover. Grange and McAtee (1934) concluded that yellow sweetclover:

> ... may be planted: (1) next to corn that is left standing; (2) next to any good natural cover; (3) along roadsides newly graded; (4) around or in old gravel pits; (5) in eroding gullies, washes, and wind drifting soils; and (6) in other places on the farm that are not being cropped and that are not intended for trees, windbreaks and hedges. Sweetclover is sometimes planted with corn, left in the field through the winter and plowed under in the spring; this is excellent for wildlife during the most critical season of the year.

Site Preparation

Plot design. The most desirable plot designs in big game restoration projects have irregular margins and islands of woody vegetation with plot length roughly parallel to land contours (Williamson and Currier 1971). Areas in tall shrublands and woodlands that are opened during site preparation for yellow sweetclover should not be more than 200 yd from cover suitable for deer and elk (Reynolds 1962). The USDA Forest Service (1969) guidelines suggest that: (1) clearings up to 120 acres in the juniper-pinyon type are preferred for elk and deer in the Northwest; (2) 15% of the wooded area should be left untreated; (3) 5% of live juniper crowns, cliffrose (*Cowania mexicana*), and other valuable browse plants should remain standing; and (4) northern exposures should not be treated. Kindschy et al. (1982) set a maximum of 1000 acres for projects designed to improve pronghorn range. These authors suggested that no more than one-third of pronghorn winter range be treated and approximately 20% of the sagebrush be retained within the treated area.

Kimball et al. (1956) suggested that shelterbelt plantings for pheasants in South Dakota consist of 7-acre tracts spaced at 3-mile intervals. These should be planted to adapted trees and shrubs in belts separated by herbaceous cover of sweetclover and other suitable species. Plantings should be made on the contour at right angles to the prevailing winds but far enough from fields, homesteads, and other structures to prevent undesirable snowdrifts.

Sweetclover plots in agricultural areas should be developed with respect to land suitability classes, soil types, and land contours; however, interspersion of food and cover should be the major objective. Suitable habitat for a variety of game species can be developed by using small fields or pastures (minimum of 5 acres) with diverse crops, cover types, stubble heights, and plant densities. Strips of yellow sweetclover at least 50 ft wide can be planted adjacent to standing corn shelterbelts for pheasants and other upland game birds (Grange and McAtee 1934, Kimball et al. 1956).

Mechanical treatment. There are several alternatives for rangeland site preparation. Firm, weed-free seedbeds on nearly level, rock-free sites, such as abandoned fields, can be prepared by moldboard or disk plowing, disk harrowing, and/or rolling, as is done in croplands. Moldboard and disk plowing are effective in relatively rock-free areas of low brush on slope gradients of less than 15%; brushland plows are recommended for areas with taller brush or somewhat rocky slopes of 10% to 20% gradient. Areas of tall shrubs and open

woodlands with little rock outcrop can be cleared by chaining. Burning is sometimes feasible on carefully selected sites with nonsprouting woody plants.

Soil amendments. Soils should be tested to determine site-specific fertilizer needs. Croplands and pastures in humid zones with acidic soils will probably require lime. Phosphate fertilizers are commonly added when sweetclover is seeded alone or is the dominant element in a seed mixture (Potts 1955). After establishment, sweetclover will supply its own nitrogen needs through nitrogen fixation if the seeds have been inoculated with the proper strain of bacteria or if alfalfa or a sweetclover was recently grown on the site (Gorz and Smith 1973, Smith 1975).

Propagule Selection

Cultivars. There are 3 cultivars of yellow sweetclover. Madrid from Spain has good seedling vigor, frost resistance, and excellent seed production. Goldtop, developed in Wisconsin, has excellent seedling vigor and produces higher yields, better forage, and larger seeds than Madrid; it also matures 2 weeks later. Yukon, a Canadian variety, produces an equal or higher yield of both forage and seeds than does Madrid, from which it was developed (Gorz and Smith 1973).

Seed selection. Yellow sweetclover is established only from seed. Wasser (1982) stated that good quality seed should test 95% purity, 90% germination, and 85% pure live seed (PLS). Seed weights reported for yellow sweetclover range from approximately 258,000 to 262,000 seeds per pound (Redente et al. 1982, Wasser 1982). Scarified seeds should be used in cropped fields. These seeds have been treated to hasten germination and may be obtained from commercial sources; however, seeds planted in the fall will become scarified by natural processes. Seeds should be inoculated with appropriate strains of *Rhizobium* bacteria to induce nitrogen fixation, which will be beneficial to both sweetclover and associated vegetation (Harrington 1964, Johnson and Nichols 1970).

Germination and vigor. Scarified seeds usually germinate within 7 days, but unscarified seeds take much longer. Thornburg (1982) and Wasser (1982) reported strong to excellent seedling vigor, and Wasser (1982) indicated that good cover is usually established the first season. Yellow sweetclover seedlings are strong competitors and tend to suppress weaker grass seedlings when sweetclover and grasses are sown together (Blaser et al. 1956). In the more

humid zones sweetclover reproduces well through natural reseeding (Johnson and Nichols 1970, Gorz and Smith 1973, Smith 1975, Vogel 1981). In some areas, such as eastern Montana, climatic conditions are unpredictable and natural reseeding is too sporadic for yellow sweetclover to be considered a key species in management programs (Mackie 1970).

Planting Methods

Time of seeding. Sweetclover seeds usually germinate faster and establish fuller stands when sown in early spring; time of seeding is usually before April in southern regions and before May in northern states. However, establishment is better in the Southwest if seeds are sown in late June prior to summer rains. Sweetclover is a secondary component in most rangeland mixtures sown in late fall or winter in the Intermountain West (Plummer et al. 1968) and is used in hay and pasture mixtures sown in late summer in regions with dependable rainfall (Potts 1955). In irrigated areas sweetclover can be seeded at other times but should be in the ground at least 6 weeks before fall frosts (Garver and Kiesselbach 1947, Turelle and Austin 1967).

Seeding. Seeds of yellow sweetclover can be drilled or broadcast. Drilling requires less seed because of uniform distribution and can often be combined with firming the seedbed. On farmlands sweetclover may be sown with an alfalfa-type drill or with a cultipacker seeder, which has seedboxes arranged to drop seeds between a double set of corrugated rollers (Gorz and Smith 1973). A grain drill equipped with a legume seedbox can be used to sow sweetclover alone or to plant grass-sweetclover mixtures in alternating rows. Rangeland drills should be used on ranges with moderate gradients that contain stumps or rocky terrain, and scalper-seeders or interseeders may be used in grassy areas to plant rows of seed in a manner similar to drilling (Plummer et al. 1968).

Seeds can be broadcast by airplane or tractor-mounted devices in brushland areas that have been plowed, chained, or pipe-harrowed. To ensure thorough seed coverage, broadcasting should be done between the first and second passes over an area during site preparation. Natural settling of the soil or the weight of snow will firm these seedbeds (Plummer et al. 1968).

Good stands of yellow sweetclover result from seeds planted at 0.5- to 1-in. depths on silty to loamy soils; however, deeper planting may be advantageous in dry, sandy soils. Good establishment occurs with seeds placed 1 to

2 in. deep, but plants require a longer emergence period (Smith and Graber 1948, Wasser 1982). Seeds should be planted at the rate of 20 to 30 PLS per square foot or 3 to 5 lb per acre to establish full stands in semiarid zones (Wasser 1982). Seeding rates should be increased in subhumid zones, on harsh sites, and for hay production. If sweetclover is sown for temporary pasture or green manure, rates may vary from 8 to 16 lb per acre, with the higher rates applicable in humid zones (Garver and Kiesselbach 1947, Gorz and Smith 1973).

Planting mixtures. Yellow sweetclover is commonly sown in mixtures with grass, forb, or shrub components. It may be seeded with a harvestable small grain, such as oats, for temporary pasture or establishment in cropland fields. Sweetclover is frequently included in seed mixtures recommended for pastures in regions outside the South. When used for hay or pasture in crop rotation, it is mixed in approximately equal proportions with 1 or more grasses and seeded at a rate that varies regionally from 4 to 12 lb of seed per acre (Stefferud 1948). The grass components will be determined by site and cultural conditions, such as availability of irrigation. Grasses used in humid to semiarid zones include timothy (*Phleum pratense*), orchardgrass (*Dactylis glomerata*), smooth brome (*Bromus inermis*), and wheatgrasses (*Agropyron* spp.). Bunchgrasses are generally less competitive than sodgrasses when sown with sweetclover.

Yellow sweetclover is sown in legume mixtures for renovation of poor-condition or sodbound pastures (Peterson and Hughes 1947). Mixed with red clover (*Trifolium pratense*) and alsike clover (*T. hybridum*), it is used to renovate bluegrass (*Poa* spp.) pastures in the Midwest. Seeding rates are 5 to 8 lb of sweetclover seed per acre in a total mixture of 10 to 13 lb of legume seed per acre.

Yellow sweetclover can be sown for wildlife food and cover. It is included in complex forb-shrub-grass seed mixtures in big game restoration projects in Utah and the Intermountain West (Plummer et al. 1968, Yoakum et al. 1980, Kindschy et al. 1982). Yoakum (1979) advocated the use of mixtures containing 6 species of each group for pronghorn range improvement. Recommended rates for seeding big game ranges are 0.5 to 4 lb of sweetclover seeds per acre in 10 to 20 lb of mixture per acre (Plummer et al. 1955, 1968). Species recommended for planting with yellow sweetclover in black greasewood and inland saltgrass types are listed in Table 1.

Table 1. Proportions of species in mixtures used to seed game ranges in black greasewood and inland saltgrass types in Utah (Plummer et al. 1968)* (All units are in lb/acre)

	Rangeland Types and Site Conditions			
	Black greasewood (Moist-wet soils with high water table)		Inland saltgrass (Wetlands)	
Plant Species	Broadcast	Drilled	Broadcast	Drilled
Grasses				
Fairway crested wheatgrass (*Agropyron cristatum*)	1	½	0	0
Tall wheatgrass (*A. elongatum*)	3	1½	2	1
Quackgrass** (*A. repens*)	2	1	0	0
Pubescent wheatgrass (*A. trichophorum*)	1	½	0	0
Intermediate wheatgrass (*A. intermedium*)				
Basin wildrye (*Elymus cinereus*)	0	0	2	1
Russian wildrye (*E. junceus*)	2	1	4	2
Tall fescue (*Festuca arundinacea*)	2	1	2	1
Forbs				
Pacific aster (*Aster chilensis*)	0	0	1	½
Yellow sweetclover (*Melilotus officinalis*)	3	1	4	2
Strawberry clover (*Trifolium fragiferum*)	1	½	2	1
Shrubs				
Fourwing saltbush (*Atriplex canescens*)	1	½	0	0
Gardner saltbush (*A. gardneri*)	1	½	3	1½
Rubber rabbitbrush (*Chrysothamnus nauseosus*)	½	¼	0	0
Total	17½	8¼	20	10

* There are separate recommendations for dry phases of both range types.
** Not recommended for use near agricultural areas.

MAINTENANCE

Yellow sweetclover is moderately tolerant of defoliation. During the first growing season, it may be mowed once, leaving a stubble height of 12 in. Mowing should be done at least 6 weeks before fall dormancy to prevent interference with carbohydrate storage and rootcrown bud development. Second-year production of sweetclover is closely correlated with the amount of carbohydrates accumulated at the end of the first year (Smith and Graber 1948). In the South, stands seeded in the fall can be mowed twice the first year (Potts 1955).

Yellow sweetclover used for pasture may be grazed the first year after fall dormancy. As maintenance of a 12-in. stubble height is necessary for abundant regrowth, grazing should be withheld the second season until the sweetclover is 8 to 12 in. tall. Lush spring growth creates shade sufficient to kill leaves on the lower 8 in. of stem; therefore, little new growth will occur if plants are grazed as low as 6 in. (Stewart 1934). Maintaining a 12-in. stubble height also encourages late-season growth and ensures natural reseeding. Taller stubble provides nesting cover for pheasants and other ground nesters, and stubble left standing overwinter offers concealment cover for small mammals and birds.

CAUTIONS AND LIMITATIONS

When sweetclover is planted with a grain crop to control weedy growth, the companion crop should be harvested before it causes the sweetclover to wilt (Garver and Kiesselbach 1947, Potts 1955). Mowing weeds during rapid stem elongation may be feasible if only a minimal amount of the sweetclover is cut.

Sweetclover contains dicoumarin, which can cause a bleeding disease in livestock when moldy forage is consumed. Legume bloat may result from overconsumption of sweetclover but usually does not occur if the clover is sown in mixtures with grasses.

Animal damage may be a problem to new crops of yellow sweetclover. Pocket gophers infrequently eat legume seeds or seedlings in sufficient quantities to prevent good establishment on both agricultural and range lands. During peak populations, grasshoppers may strip leaves and even decimate first-year stands. County agricultural agents, rodent control specialists,

and pest control officers can provide information on appropriate pesticides and effective control programs.

Guidelines for protecting sage grouse (*Centrocercus urophasianus*) habitat should be observed in site selection for sweetclover plantings; in particular, grouse leks (communal breeding grounds) should be avoided (Braun et al. 1977).

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