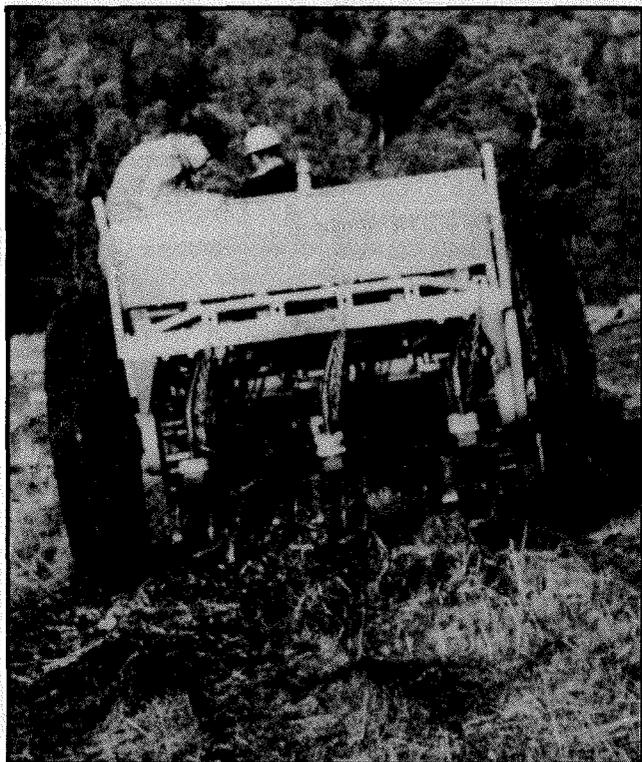




SEEDED RANGE PLANTS FOR CALIFORNIA



Cooperative Extension
Division of Agricultural Sciences
UNIVERSITY OF CALIFORNIA

LEAFLET 21344e



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Seeded Range Plants for California

This leaflet is intended for ranchers, range managers, and land reclamation contractors. It describes the grasses and legumes currently used for range reseeding and disturbed land reclamation in California, and is intended to inform the reader of alternative plants for seeding and their respective environmental requirements and management needs. Most of these species are readily available in the seed trade.

The authors are Melvin R. George, Agronomist; Theodore E. Adams, Jr., Wildlands Specialist; and W. James Clawson, Range Specialist, all of Cooperative Extension, Davis. Photographs were supplied by Jack K. Clark, Peter B. Sands, Alfred L. Smith, and the Soil Conservation Service Plant Materials Center.

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ANNUAL RYEGRASS

(*Lolium multiflorum*)

Importance

Emergency revegetation following brush fires is the most important use of annual ryegrass (also called Italian ryegrass) on California rangeland. Because of its availability, relatively low cost, and rapid seedling development it has been the first choice for erosion control following wildfire. To persist, annual ryegrass requires high levels of nitrogen and consistent, late season rains.

Annual ryegrass can provide quick cover for early grazing in irrigated pastures. It can provide an early forage crop on dryland pastures with fertilization and early fall rains or supplemental irrigation. It has also been used as a cover crop for orchards and crop land.

The crude protein content of immature annual ryegrass can exceed 20 percent but it decreases to 5 percent or less as plants dry and die during the summer.

Annual ryegrass residue leachates can have an adverse effect on germination of associated species. Also, residues decompose slowly and can interfere with seedling emergence of future crops.

Occurrence

Annual ryegrass is native to southern Europe, Asia Minor, and north Africa. It is found growing in the New England states west to Iowa, south to Florida and Texas, and throughout California and Oregon. It is generally not abundant on California rangelands.

Annual ryegrass is best adapted in coastal areas with long seasons of cool, moist weather and annual rainfall in excess of 12 inches. The variety Wimmera 62 is recommended for areas of marginal rainfall or soil fertility.

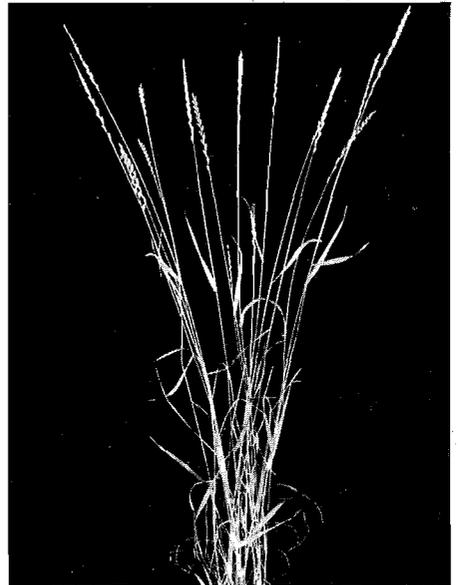
Annual ryegrass grows on sandy loam to clay soils but medium to heavy textured soils with high fertility are required for high yields of seed or forage and persistence. Acid to moderately alkaline soil pH's are tolerated.

Description

Annual ryegrass is a cool season, short lived annual that may grow to a height of 2 to 3 feet (60 to 90 cm). It is generally robust with flat leaf blades and 20 or more flattened seed spikes. Spikelets are several-flowered, solitary, and placed in alternate depressions along the rachis.

A number of characteristics distinguish annual ryegrass from perennial ryegrass. Annual ryegrass has awns on the spikelets whereas perennial ryegrass usually has no awns. The stems of annual ryegrass are usually cylindrical while perennial ryegrass stems tend to be flattened. The leaves of annual ryegrass are rolled from the bud while those of perennial ryegrass are folded. Also, the basal parts of annual ryegrass tend to be yellowish green while those of perennial ryegrass tend to be reddish.

Two varieties of annual ryegrass are used on California rangelands. Common annual ryegrass is produced in Oregon and is readily available. This common type is frequently used in post-fire reseeding, in lawns, and for erosion control.



A second variety, Wimmera 62, is the product of natural selection and roguing for 13 generations at the USDA Soil Conservation Service Plant Materials Center. The original source was naturalized ryegrass from Victoria, Australia. This variety is possibly a hybrid between *Lolium rigidum* and *L. multiflorum*. It is an awnless, deep bright green, erect, early maturing annual. It is uniform in appearance and leafy, with numerous culms. It matures up to 3 weeks earlier than common annual ryegrass. It has no advantage over common ryegrass in areas of high humidity or on fertile soils where rainfall exceeds 12 inches annually. However, in inland areas of low rainfall below 2,500 feet elevation, it may provide more effective erosion protection. It tends to lodge the first season, covering soil more completely.

Management

Annual ryegrass can be seeded in fall or early spring, with fall seedings being more successful in the temperate regions. When moisture and fertility are not a limiting factor, it makes an excellent hay and may be cut twice during the growing season.

When used for temporary cover, annual ryegrass should be prevented from setting seed by plowing under, discing, mowing, or using nonpersistent contact herbicides. These operations are usually carried out during early bloom.

In suitable environments, if permitted to set and drop seed, annual ryegrass will continue to reseed itself for many years. It may persist almost indefinitely in pastures, orchards, vineyards, wildlife areas, and critical areas managed to assure natural reseeding each year. In California's annual grasslands, annual ryegrass rarely persists.

Ryegrass should be cut no later than early bloom for high quality hay. Strips of uncut forage should be left to produce seed if another hay crop is to be taken the following year. About 3 tons of hay per acre per year can be produced on fertile soils where moisture is adequate up to crop harvest. Continued heavy production of hay or pasture will require 75 to 100 pounds of nitrogen each fall.

SOFT CHESS

(*Bromus mollis*)

Importance

Soft chess is an important and valuable constituent of California winter annual rangelands. It matures later than other less desirable annual bromes and is characterized by its soft seed head. The absence of barbed awns and sharp pointed fruits, and the retention of seed in the head after maturity allows palatable and nutritious grazing beyond the period when most associated annuals are dry, low in nutrients, and unpalatable.

Soft chess crude protein content is highest at 23 percent in mid to late winter when forage is immature. It declines through the spring to about 9 percent in June. Crude protein in dry summer forage is about 4 to 5 percent.

Blando brome is a commercially available cultivar of soft chess and is reliable and consistent in forage and seed production from year to year. In comparison to other strains, Blando brome is medium-early in maturity, suberect in growth habit and has strong seedling vigor. In good years the strain was not outstanding in comparison to others tested at the USDA Soil Conservation Service nurseries in Pleasanton and San Fernando. In low rainfall years, however, Blando brome outperformed all others.

Occurrence

Soft chess is a cool season, annual grass from Europe that is widely distributed in the annual ranges of California, including the Sierra foothills, the range areas bordering the Sacramento-San Joaquin Valley and the Salinas Valley, and the high mountain chaparral ranges of southern California. Soft chess requires good drainage and does best on neutral or slightly acid to slightly alkaline soils. Under very droughty conditions when little plant growth occurs, seed will usually be produced insuring perpetuation.

Blando brome was selected by the USDA Soil Conservation Service Plant Materials Center in California from seed collected in 1940 from annual rangeland near San Ramon, California.

Description

Soft chess is an annual with stems 3 to 18 inches (7.5 to 45 cm) tall. The foliage, especially the leaf sheaths, is covered with fine, soft, short hairs. The panicles are dense, usually 2 to 4 inches (5 to 10 cm) long, but sometimes reduced in size in nonvigorous plants. The spikelets are 1/2 to 3/4 inch (1.25 to 2 cm) long and borne on somewhat spreading or erect branches. The florets may be hairy or smooth and are 1/4 to 1/3 inch (0.5 to 0.75 cm) long with a straight or curved awn arising just below the apex.

Management

Good stands are obtained from fall broadcast seedings made in the ashes of brush burns or from drilling on prepared seedbeds. Blando brome will respond to nitrogen fertilization or association with nitrogen fixing legumes.

In the late 1950s the Soil Conservation Service reported highly favorable results from the use of blando brome in rotations with row crops for soil improvement. Blando brome is also used as a cover crop in orchards and vineyards and for seeding of critical areas to control erosion.

Soft chess does not germinate in summer and seeds in the soil are not a potential source of weeds in summer irrigated crops.



ANNUAL FESCUE

(*Festuca megalura*)

Importance

Zorro annual fescue is primarily used in road bank stabilization, mine spoil revegetation, and for orchard and vineyard cover crops in a Mediterranean climate. It does not produce highly desirable forage except when very young and, therefore, would generally not be seeded for forage purposes.

Zorro annual fescue produces a quick ground cover that can persist on steep, shallow-soiled, infertile, barren, disturbed slopes. It also adapts to acid soils and to the highly variable winter rainfall pattern characteristic of southern California and other regions of annual grassland. Zorro annual fescue is a self-reseeding grass that occurs naturally on many California rangelands.

Occurrence

The origin of this plant is in dispute but specialists believe it was brought into California along with livestock by settlers. It is probably the same as *Vulpia myuros* found in Europe, North and South America, Hawaii, Japan, and Australia. It is a common grass on dry slopes below 6,000 feet elevation in plant communities of the Mediterranean climate.

Early tests in northern California along newly constructed highways showed Zorro annual fescue to be superior to barley or ryegrass on many shallow, low fertility, low pH soils. This superiority was expressed in better stand establishment, cover development, and reseeding ability.

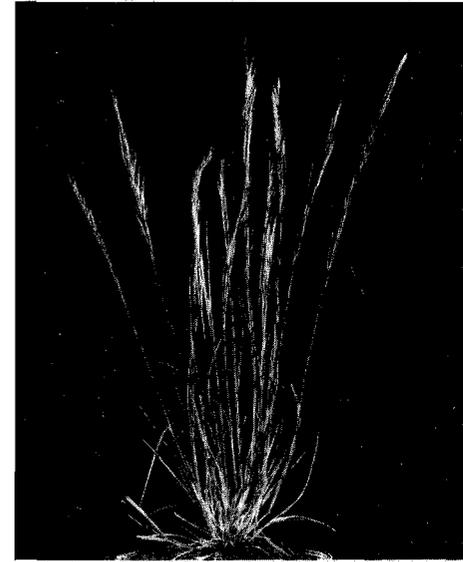
Description

Zorro is a selection from a wild grass population made by the USDA Soil Conservation Service Plant Materials Center, California. It is a commercially available cultivar of foxtail fescue, which occurs throughout the annual grasslands of California. Variety selection and tests on Zorro began in 1970. It was released to nurseries and seed producers in early 1977.

Zorro annual fescue is an early maturing, short, annual grass that has many fibrous roots. This grass has small seedlings with excellent vigor that emerge in the fall very soon after the first rain.

Management

Because Zorro annual fescue reseeds itself, does not require fertilization, and is unpalatable to livestock during most of its life cycle, no standard management practices are necessary for its persistence.



HARDINGGRASS AND PERLAGRASS

(*Phalaris tuberosa*)

Importance

Hardinggrass and perlagrass are perennials that were developed to improve annual range. Typically, they produce no more forage than native range, but they provide forage earlier in the season and stay green longer. With adequate moisture, both grasses can add about 1 month to the green feed period in spring and they often send up leafy shoots before the fall rains. They are both extremely drought tolerant and very long lived.

Both grasses are useful for improving Sierra foothill and coast rangelands. They are also used following brushland burns. Successful seedings can be found from Shasta County in the north to San Diego County in the south.

Occurrence

Hardinggrass and perlagrass are adapted to the Mediterranean climate zone below 2,500 feet elevation where frost heaving is not a problem. They will grow in areas with 16 inches of annual rainfall if there is adequate soil waterholding capacity. Moisture holding capacity of the soil becomes less critical as rainfall increases or where there is a coastal influence. Both grasses will survive in California with 10 to 60 inches of rain, but they prefer at least 16 inches.

Hardinggrass is presumed to be native to the Mediterranean region, but was first noticed in 1902 in Australia. It has been under observation by the California Agricultural Experiment Station since 1914. Perlagrass is native to Morocco.

Description

Hardinggrass (*Phalaris tuberosa* var. *stenoptera*) is a cool season, long lived bunchgrass with a loose branching, weakly rhizomatous base. It grows to a height of 2 to 3 feet (60 to 90 cm) and has many blue-green leaves that tend to wrap around the stout stems. It has a dense, spikelike, compressed seed head.

Hardinggrass reproduces poorly from seed except along the central coast. It spreads by producing tillers or short rhizomes extending from the base of its flat crown. The plant prefers heavier soils, at least 3 feet (90 cm) deep. It cannot withstand severe competition the first year, but once established it is very persistent if properly managed. It is highly drought tolerant, but produces much less forage during periods of drought than under favorable conditions.

Perlagrass (*Phalaris tuberosa* var. *hirtiglumis*) is a tall, robust, rapidly developing, perennial bunchgrass. In general appearance it resembles hardinggrass. However, it has bigger seeds, much greater seedling vigor, yellow-green leaves, hairy glumes, and more vigorous rhizomes. It establishes easily, grows well during cold winter months, and readily reproduces from seed under proper management. During years when springs are droughty, perlagrass can produce more forage than hardinggrass because it matures about 3 months earlier.

Perlagrass has replaced hardinggrass for range improvement in California because of its greater seedling vigor, ease of establishment, better survival, and increased winter growth.



Management

New stands of hardinggrass and perlagrass should not be grazed until the first season's growth is complete, except as a weed control practice. At the end of the green feed period, dry forage can be grazed if the plants are large enough to resist pulling by livestock. An average stubble height of 3 to 4 inches (7.5 to 10 cm) should be maintained.

In established stands of both grasses, the first fall rains trigger significant growth. Time of range readiness and amount of growth vary with precipitation, temperature, location, and soil fertility. Mature stands of perlagrass should be 6 to 8 inches (15 to 20 cm) high and ready for grazing by late fall or early winter with early, consistent fall rains. Late rains and cool temperatures can delay range readiness until midwinter. Hardinggrass is usually ready for grazing 3 to 4 weeks later than perlagrass. Both grasses can be grazed at range readiness without harm to the plants so long as the ground is firm and not so wet that damage from trampling might occur. Grazing of these ranges should stop when fertilized annual range is ready for use or when average stubble height is 3 inches (7.5 cm). Lack of moisture or poor growing conditions may require earlier termination. Infrequently, when abundant rainfall occurs in late winter, grazing can continue through mid-March.

Vigorous perlagrass and hardinggrass stands can usually be grazed earlier and longer than nonvigorous stands, but these perennials must be rested following winter grazing to allow recovery and regrowth. Vigorous stands occur where climate, site, and fertility are suited to these grasses. Both grasses have been seeded on many marginal sites, and their stand density and vigor have never reached satisfactory levels.

By the time the annual range is dry, perlagrass and hardinggrass will have recovered, produced seed, and stored food reserves in their roots. The leaves of the perennial grasses will still be green and will remain green for about 1 month after the annuals are dry. This palatable forage can be grazed heavily until the average stubble height is 3 inches (7.5 cm).

At the end of this grazing period many plants will be heavily grazed and others only partially grazed, and there will be numerous seed stalks left. To promote more uniform use and retain some high protein feed, perennial grasses can instead be harvested for hay. The areas mowed should be alternated each year, and a 3- to 4-inch (7.5 to 10 cm) stubble should be maintained.

These grasses will respond to nitrogen fertilizer if phosphorus and sulfur are not limiting. Cold tolerance is improved by inclusion of phosphorus with nitrogen during fall fertilization. Interseeding annual legumes, especially subterranean clover, into established hardinggrass stands can improve forage quality and improve nitrogen fertility if phosphorus and sulfur are not limiting.

ORCHARDGRASS

(Dactylis glomerata)

Importance

There are two types of orchardgrass, irrigated and dryland. They were developed primarily for forage purposes. The dryland varieties have the same growing season as hardinggrass and perlagrass but are generally less productive. For this reason the dryland orchardgrasses have not received much use on California annual range, but these summer dormant varieties have been used in roadside revegetation for erosion control.

Immature orchardgrass protein content is about 20 percent, declining to 9 percent at mid-bloom. In dry, dead foliage protein is less than 5 percent.

Occurrence

Orchardgrass is a native of Europe and the Middle East and was introduced into this country before the American Revolution. The irrigated varieties or those requiring summer rain were widely grown, especially in states along the Mason Dixon Line. Where adapted, these varieties continue to be important forage plants.

In California orchardgrass has traditionally been thought of as an irrigated pasture grass. However, the University of California and the USDA Soil Conservation Service cooperated to develop two varieties of dryland orchardgrass. The variety Palestine was increased at the University of California, Davis from an accession received in 1947 from G.L. Stebbins. The seed had been collected near Samaria, Palestine. This nonirrigated, strong winter grower has drought resistance but little winter hardiness.

In the 1970s a new variety of dryland orchardgrass, Berber 80, was received from Australian researchers. It is superior to Palestine in persistence and productivity.

Description

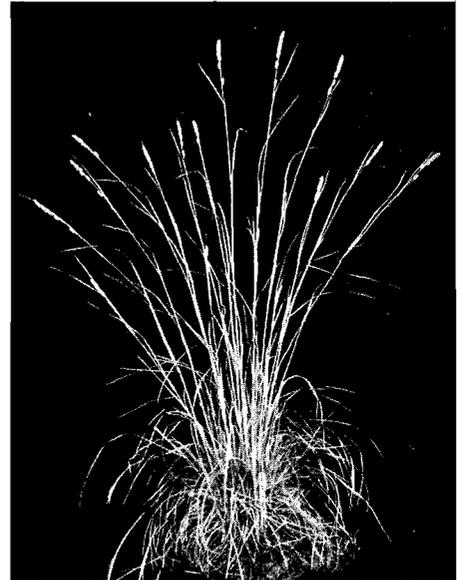
Orchardgrass is a long lived perennial that may reach a height of 2 to 4 feet (60 to 120 cm). It is a bunchgrass with dense growth near the ground. It begins to grow with the first fall rains and remains green until soil moisture is depleted in late spring or early summer. The leaves are broad and flat, about 1/2 inch (1.25 cm) wide, and rough to the touch. The leaf sheaths are strongly flattened. The spikelets, crowded in one-sided clusters, are easy to recognize in the strongly flattened leaf sheaths, a striking characteristic of orchardgrass.

Management

The management of dryland orchardgrasses is similar to that of perlagrass. Winter grazing is followed by a rest period during the annual grassland growing season. Additional grazing in early summer removes the standing residue.

Dryland orchardgrasses respond to nitrogen fertilization and to sulfur and phosphorus fertilization where these nutrients are deficient.

Dryland orchardgrass varieties should not be used in irrigated pasture. Suitable irrigated varieties include Akaroa, Potomac, or Latar. The latter is often included in alfalfa grass mixes for hay.



VELDTGRASS

(Ehrharta calycina)

Importance

Veldtgrass is primarily useful for grazing cattle and big game in the rangelands of the central and southern coast areas. It grows well when sown on brush burns in this region. It is also useful for soil erosion control, as well as stabilization of light soils in sandy, beach areas and adjacent to airport runways. It spreads by reseeding and gradually becomes part of the landscape.

Occurrence

The veldtgrass variety Mission is adapted to the old mission trail region along the coast from San Diego to San Francisco where annual rainfall is 10 inches or more, where the soils are light and sandy, and where the climate is relatively mild.

Description

Mission veldtgrass is a fine stemmed, densely tufted, perennial bunchgrass, varying in height from 12 to 24 inches (30 to 60 cm). The collar is usually dark red or purple. Mission is readily distinguished from other varieties by its panicle which appears contracted or compact because of its short branches. The seeds of Mission veldtgrass are larger, heavier, and darker brown than the older varieties, and they do not shatter readily at maturity.

Management

Mission veldtgrass is easily established and long lived, and reseeds well. A seeding rate of 3 to 4 pounds per acre is adequate. As with most slow starting perennials, dryland veldtgrass seedings may need to be mowed or grazed for a brief period early in the spring following seeding to help control competition from more rapidly growing annuals. That first year, stock should subsequently be removed until after seed maturity. Following establishment, grazing should be managed to allow an annual rest period in spring before the end of the growing season.

In the central coast area, perennial veldtgrass always responds well to applications of nitrogen. Sulfur with nitrogen appears to produce an added response in some locations.



SMILO

(Oryzopsis miliacea)

Occurrence

Smilo is a hardy, drought resistant, long lived, palatable, perennial bunchgrass well adapted to much of California's foothill areas. It is native to the mountains of southern Europe and the Mediterranean area where it grows on dry soil on the borders of woods. Smilo was first tested by the California Agricultural Experiment Station in 1879 and again in 1914.

Smilo is slow to germinate and has extremely poor seedling vigor. The seedlings are subject to severe damage by frost heaving and, as a result, smilo establishes more readily on rocky soils that are not so subject to heaving or where it receives some protection from fallen logs or brush "staubs". As with wild oats, germination is delayed for a high percentage of smilo seeds which is an important factor in establishing a stand where severe winter conditions follow the seeding period.

Smilo can be used below 3,000 feet elevation where annual rainfall is in excess of 16 inches. It is best suited to well drained soils and is not recommended for use where soils become waterlogged. It grows well on a wide variety of soils ranging from sands through clays to the thin, poor soils associated with brushlands in the Sierra Nevada and coast range foothills. It has become part of the landscape in the coastal mountains from Santa Barbara County south to San Diego.



Description

Smilo's most distinguishing feature is its solid culm. Smilo is readily recognized by its bright green leaves with a reddish tinge and slightly scorched appearance, the tufted growth of leaves from the nodes or joints of the stem, and its loose wavy or flowing seed head. Its seed stalks are tall, reaching a height of 30 inches (75 cm) or more. In new seedings it can be most readily found growing from under fallen logs or clumps of burned or fallen brush, or from cracks in rocks.

Smilo is drought resistant with about the same climatic adaptation as hardinggrass, but it does better on lighter or fractured soils. It is difficult to obtain stands except in ash of brush burns or on very light soils. It is less palatable than veldtgrass or hardinggrass.

Management

Seeds are small (about 1 million in a pound) and must be planted carefully to avoid getting them too deep. Successful stands can frequently be obtained when seeds are sown in ashes resulting from brush burns. This may be due to softening of the hard, outer coat by caustic action of chemicals in the ashes, but the most important factor is lack of competition from fast-growing, winter annual grasses. When unburned areas are seeded, the seed must be treated with bleach to insure germination. Excellent stands have been obtained on land bulldozed out of brush.

Smilo should be sown in October, November, or early December. Smilo grows slowly the first year and becomes fully established the second year. Once established it is a persistent and hardy grass that reseeds itself readily. Because of differences in palatability, it should not be seeded with other perennial grasses.

CRESTED WHEATGRASS

(Agropyron desertorum)

Importance

Crested wheatgrass, a perennial bunchgrass, plays an important role by providing forage 2 to 4 weeks earlier than the native rangelands in the intermountain west. The young foliage may have a crude protein content of 23 percent. At full bloom protein content is about 10 percent, declining to 3 percent when tops are dry. Crested wheatgrass is also used extensively for roadside erosion control, for seeding with dryland alfalfa, and in rotation with wheat. Many acres of the intermountain west have been improved for livestock by planting crested wheatgrass by itself. However, in California it is not as important as intermediate wheatgrass. Crested wheatgrass is considered very winter hardy, drought tolerant, and long lived.

Occurrence

Crested wheatgrass was introduced into Oregon from Siberia where it is the native bunchgrass on many millions of acres. It has been used for seeding rangelands throughout the intermountain west where annual rainfall is 10 to 15 inches. It does not tolerate long snow cover or very wet conditions.

Description

Crested wheatgrass is a strong growing bunchgrass, usually 18 inches (45 cm) tall. It is very long lived with a large, deep root system. The light green leaves, some rough on the upper side, are usually less than 1/2 inch (1.25 cm) wide and taper to a long, sharp point. There are many basal leaves, but stems are also well covered with leaves.

The flower heads or spikes are not branched. They are 2 1/2 to 3 inches (6.25 to 7.5 cm) long and very flat on each side. The spikelets grow flat against the main stalk (rachis) as in a wheat head. Each spikelet tends to break off as a whole and contains a group of eight or ten seeds, each of which has a very short beard and resembles a small oat. The leaves and stems of the plant remain green as the head ripens, the stems becoming tough, somewhat like broom straws.

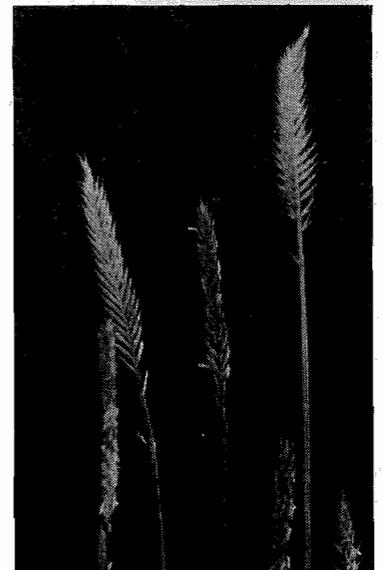
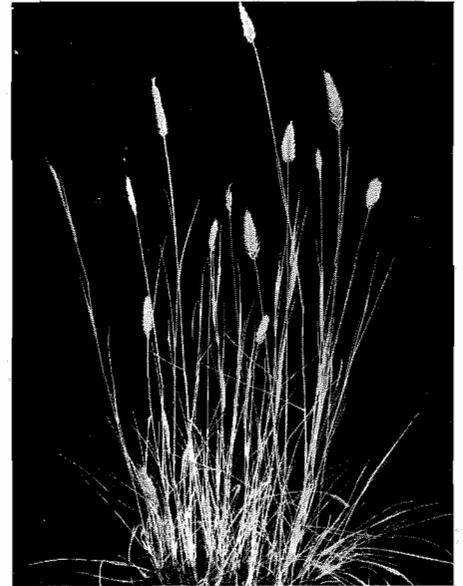
The recommended variety of crested wheatgrass is Nordan, an improved variety that was selected by the USDA Soil Conservation Service for its superior seedling vigor, uniform stand appearance, broad leaves, and longer, nearly awnless heads.

Management

Crested wheatgrass pastures are planted in the fall except where frost heaving is a problem, in which case spring seeding is recommended. The seedlings become established slowly, but the well established plant grows vigorously. Crested wheatgrass grows best in the early spring.

Crested wheatgrass has been seeded with alfalfa. However, this mixture may produce lower yields than if alfalfa is planted separately.

The grass is palatable and nutritious and tolerates heavy grazing. Pastures under good management that have been protected from prolonged flooding have been productive for more than 30 years.



PUBESCENT WHEATGRASS

(*Agropyron trichophorum*)

Importance

Because of its drought resistance and sod forming growth pattern, pubescent wheatgrass is an important range reseeding species in the intermountain west. Its primary uses are for range reseeding, forage production on abandoned farm lands, dryland waterway seeding, or as grass/alfalfa plantings in dry areas at the lower limits of alfalfa production. Under dryland conditions, pubescent wheatgrass is superior to intermediate wheatgrass in persistence, rate of spread, production, and adaptability to low fertility, eroded, or alkaline soils. It will also grow at higher elevations than intermediate wheatgrass. The crude protein content of pubescent wheatgrass is similar to that of intermediate wheatgrass at the same stage of maturity.

Occurrence

Pubescent wheatgrass was introduced from Eurasia. It is recommended for planting in dryland conditions where minimum annual rainfall is at least 11 inches per year. It is more drought tolerant than intermediate wheatgrass and has been used successfully in reseeding projects mostly above 3,000 feet in the Sierra Nevada and southern California mountains and in the intermountain area.

On poorer sites, the production and persistence of pubescent wheatgrass is better than that of intermediate wheatgrass. Pubescent wheatgrass is well adapted to medium and fine textured, well drained soils in the eastern portion of Oregon and Washington, in the intermountain areas of the Pacific northwest, and in the northern Great Plains. It is moderately tolerant of salt.

Description

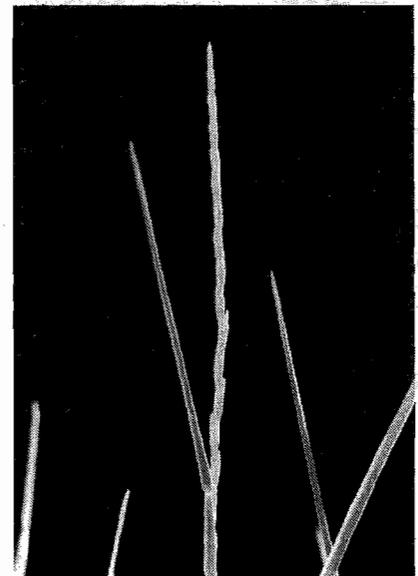
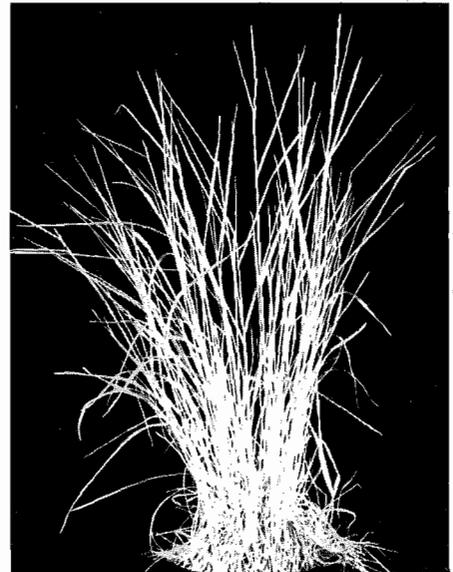
Pubescent wheatgrass is quite similar to intermediate wheatgrass. It is a cool season, drought tolerant, late maturing, long lived, perennial, sod forming grass.

Pubescent wheatgrass can be distinguished from intermediate wheatgrass by the short, stiff hairs on its seed head and seeds, and by its generally blue-green color that contrasts with the bright green of intermediate wheatgrass. It has culms 24 to 40 inches (60 to 100 cm) tall with leaf sheaths and blades that are more or less hairy. The spikes are stiff and 4 to 8 inches (10 to 20 cm) long and the spikelets are ordinarily hairy.

The pubescent wheatgrass varieties Topar and Luna were developed by the USDA Soil Conservation Service Plant Materials Center. Luna is the newer and preferred variety in California.

Management

Pubescent wheatgrass plantings should be limited to areas where it is too dry or infertile for intermediate wheatgrass. Unlike intermediate, pubescent is not greatly affected by frost heaving. Fall plantings are as successful as spring plantings. It should be planted on a well prepared seedbed.



INTERMEDIATE WHEATGRASS

(Agropyron intermedium)

Importance

Intermediate wheatgrass, a perennial sod forming grass, is vigorous and easily established, and spreads rapidly to give a dense, leafy ground cover the second year. It is used for pasture and hay, for binding soil, and, in combination with alfalfa, for seeding rangelands. It starts growing early in the spring, stays green long into the summer, and matures late. Early growth is high in crude protein, declining to less than 5 percent in dead, dry forage.

Occurrence

Intermediate wheatgrass is adapted to the western slopes of the Sierra Nevada mountains above 4,000 feet elevation, to northeastern California, and to the eastern portions of the Pacific northwest.

It performs well on fertile, medium textured soils that are well drained and have sufficient moisture (more than 12 inches annual rainfall). With adequate water and nutrients, it reaches a height of 40 inches (105 cm) or greater. Intermediate wheatgrass will not tolerate saline or alkaline conditions.

Description

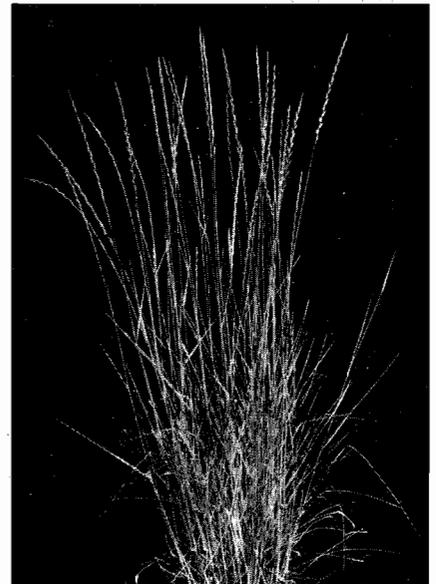
Intermediate wheatgrass is a sod forming grass closely related to pubescent wheatgrass. The leaves along the seed stalks are both basal and divergent. It is similar in appearance to pubescent wheatgrass but lacks the short hairs on the leaf blades (pubescence). It is bright green in contrast to the blue-green generally characteristic of pubescent wheatgrass. Its seed heads are generally more compact than those of pubescent wheatgrass and are not so spikelike. In addition, the seeds have no beards (awns) and are not covered with short hairs (pubescent).

Intermediate wheatgrass is less drought tolerant and winter hardy than pubescent wheatgrass. The variety Oahe is generally higher yielding but less palatable than the variety Greenar.

Management

Intermediate wheatgrass is usually planted in the fall, or early spring if frost heaving or weed control is a problem. It is readily grazed in the spring and makes excellent hay when cut in early flowering.

This grass is long lived and resistant to disease and frost. It requires more moisture than crested wheatgrass but less than smooth brome. It generally produces more forage than either of these two grasses on favorable sites. However, intermediate wheatgrass pastures should be well managed or the stands will diminish.



SUBTERRANEAN CLOVER

(*Trifolium subterraneum*, *T. yanninicum*, and *T. brachycalycinum*)

Importance

Subterranean clover, or subclover, furnishes excellent forage for all kinds of livestock when interseeded into existing annual grassland or sown with perennial grasses. It is particularly valuable where winter and spring grazing is heavy. Properly managed, subterranean clover improves soil fertility and increases the productivity of associated grasses by fixing and making available atmospheric nitrogen.

Subterranean clover and other annual legumes significantly improve the quality of annual rangelands. Lamb production per acre is frequently increased two to fourfold with greater increases documented less frequently. Protein content of young foliage is greater than 20 percent and declines to about 8 percent in the dry, mature foliage which shatters rapidly providing little dry summer feed.

Occurrence

Subterranean clover originated in the Mediterranean region, but was introduced into California from Australia. Several varieties have been widely planted in the state.

Subterranean clover is adapted to elevations below 3,000 feet in the Mediterranean climate zone where annual precipitation of 10 or more inches occurs. It is better adapted to heavy, acid soils than burclover, tolerating a soil pH as low as 4.5. It is not well suited to even moderately alkaline soil. Forage production is best when the pH is between 6 and 7.

Subterranean clover germinates on annual range in cold fall weather, but not as well as annual grasses. It performs best when fall rains occur while the weather is still relatively warm, enabling the subterranean clover to germinate and compete with annual grasses.

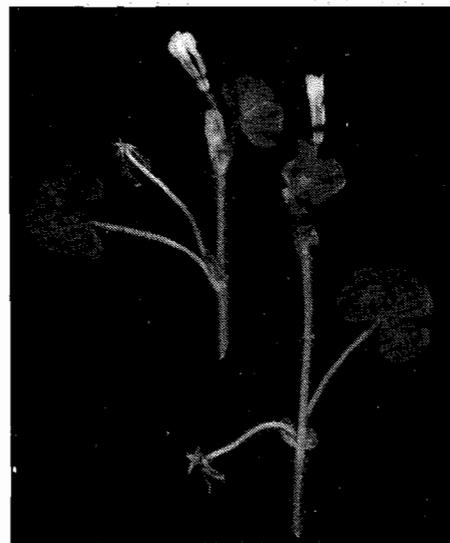
Subterranean clover dominates other clovers on moist sites. However, the varieties Yarloop, Trikkala, and Larisa are particularly well adapted to poorly drained soils.

Subterranean clover provides increased winter and spring feed on annual range. On high potential range sites, mixtures of perennial grasses and subterranean clovers provide green feed earlier in the fall and later in the spring. Planting these dryland pastures, in addition to fertilizing native range, provides an effective range improvement program.

Description

Subterranean clover is an annual legume with prostrate stems. The leaves have three heart-shaped leaflets, each usually having a whitish crescent across it and frequently having scattered black flecks. Both stems and leaves are covered with short hairs.

The creamy white or pinkish flowers are inconspicuous, occurring in groups of four in heads at the ends of short stalks. After flowering, the stalks supporting the heads bend toward the ground, and the mature flowers turn backwards. At the tip of the flowering stalks a series of stiff, forked bristles develop. If the head is in contact with the soil the bristles pull the seed head into the soil.



There are early, midseason and late maturing varieties of subterranean clover. The early maturing varieties are stemmy and poor forage producers, but they are able to grow where rainfall is light. Late maturing varieties require a longer rainy period and are high forage producers. Midseason varieties are intermediate in production. Frequently varieties representing the three types are sown in mixtures to obtain the advantages of each.

The following table separates subterranean clover varieties according to minimum rainfall requirement, flowering date, and estrogen level.

Variety	Minimum rainfall (inches)	Flowering date	Estrogen level
<i>Early season</i>			
Nungarin	10	Late February	Low
Northam	10	Early March	Low
Geraldton	10	Early March	High
<i>Early midseason</i>			
Daliak	12	Mid March	Low
Yarloop*	18	Mid March	Very High
Seaton Park	18	Mid March	Low
Trikkala*	18	Mid March	Low
<i>Midseason</i>			
Dinniup	18	Late March	Very High
Esperance	20	Early April	Low
Woogenellup	20	Early April	Low
Howard	20	Early April	High
Clare†	20	Early April	Low
<i>Late season</i>			
Mt. Barker	25	Late April	Low
Larisa*	25	Late April	Low
Nangella	30	Late April	Low
Tallarook	35	Early May	High

* For waterlogged conditions (*T. yanninicum*).

† For neutral soils (*T. brachycalycinum*).

Management

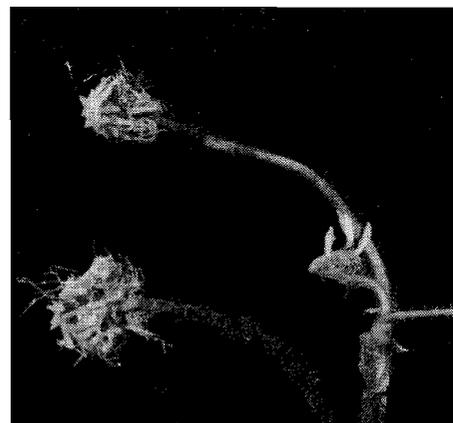
Subterranean clover grows on a wide variety of soil types, but, unlike most other clovers, it is best adapted to acid soil conditions. Fall planting is best because the young plants can then take advantage of early season rains.

Seed should be inoculated with nitrogen fixing *Rhizobium* before sowing to insure the development of nitrogen fixing nodules. Where proper strains of *Rhizobium* are not present in the soil, inoculation can make the difference between stand failure and good forage production.

Once established, subterranean clover has excellent reseeding capability due to its high seed production and its mechanism for burying seeds in the soil. A large proportion of its prolific seed production is hard seeds which germinate over a period of time, producing a stand even if seedlings appearing after the first fall rains die from drought or frost.

Subterranean clover can withstand heavy grazing and, in fact, reseeds itself better if grazed. Heavy winter and spring grazing favors subterranean clover by keeping down taller, competing vegetation.

Subterranean clover responds well to fertilization with phosphorus. In sulfur deficient soils, addition of this element improves clover production. Fertilization can produce significant increases in both yield and quality of forage.



Subterranean clover seed burs.

ROSE CLOVER

(*Trifolium hirtum*)

Importance

Cattle, sheep, and deer graze rose clover even when it is dry. Dove and quail also feed on the plant. Young, green foliage has a crude protein content of about 25 percent, declining to about 12 percent when plants are in flower and to 8 percent when they are dead and dry.

Rose clover has been used successfully for roadside revegetation. It often spreads naturally to roadsides from adjacent rangelands.

Occurrence

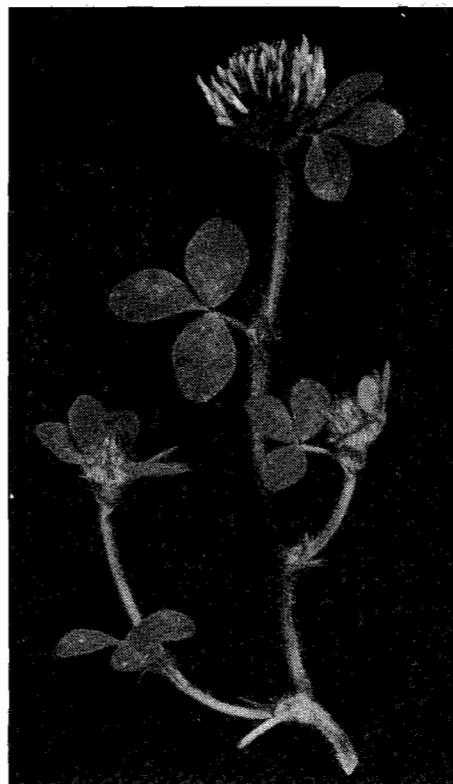
Rose clover was introduced from Turkey and has been widely sown in California. It grows well below 3,000 feet elevation where annual rainfall is more than 10 inches but it has been known to spread to 4,000 feet. It is adapted to a wide range of soil types, but performs best on well drained, slightly acid soils. Rose clover is frequently included in seed mixes used to revegetate roadsides, abandoned fields, and brush burns, and to seed annual rangeland. It grows better on droughty sites than do most other annual legumes.

Description

Rose clover is an annual legume with stems 3 to 18 inches (7.5 to 45 cm) tall. The numerous, spreading branches are densely covered with short, coarse hairs. The compound leaves have three leaflets with hairs on both surfaces. Usually there is a reddish mark a little above the center of the leaflet and a white mark flaring to the leaflet margins. The flowers are grouped in compact, rounded heads about 3/4 inch (2 cm) across and densely hairy. The rose-colored flowers appear from April to May.

In every crop of seed, there is a high percentage of hard seeds that will not germinate after the first fall rains. Some of these remain dormant for as long as 20 years, providing additional insurance against loss of stand by killing droughts or frost.

Four varieties of rose clover have been used in California: Olympus, Hykon, Kondinin, and Wilton. Availability often determines the varieties recommended. Kondinin and Wilton bloom later than do native clovers and other annual legumes, extending the green feed period. The following table presents the minimum rainfall requirement, flowering date, and estrogen level of the four rose clover varieties.



Variety	Minimum rainfall (inches)	Flowering date	Estrogen level
Olympus	10	February	Low
Hykon	12	February	Low
Kondinin	12	March	Low
Wilton (common)	15	April	Low

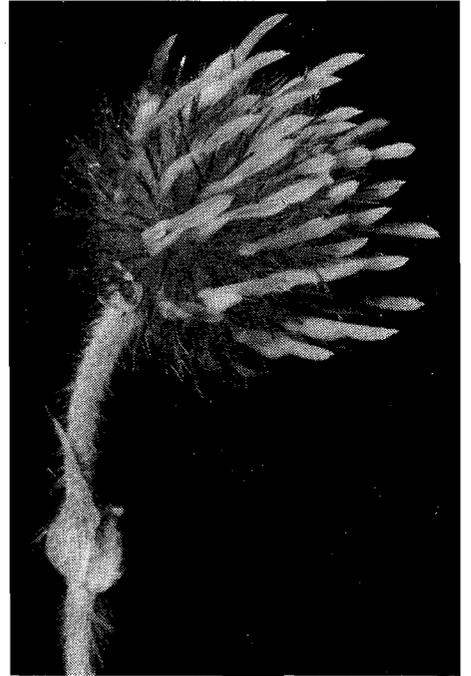
Management

Rose clover seeds should be inoculated before sowing to insure development of root nodules necessary for nitrogen fixation. Nitrogen produced symbiotically by root bacteria improves forage quality and soil fertility.

Fall sowing is best for this plant because the seeds will germinate after the first fall rains, insuring adequate time to produce a seed crop. One seeding will usually establish the plant since it is a prolific seed producer. Once established it reseeds itself, increasing in density and production.

Heavy winter and spring grazing, followed by removal of livestock while enough soil moisture remains to produce a seed crop, is favorable for rose clover. This is especially important the first year. After seed set, summer grazing will shatter the seed and trample it into the soil. Under this grazing system the maturing rose clover uses up moisture that would otherwise be available for undesirable summer weeds.

Rose clover responds to phosphorus and sulfur fertilization where these elements are deficient in the soil. Both forage production and forage quality may be increased severalfold through the use of fertilizers.



ANNUAL MEDICS

(*Medicago polymorpha* and *M. truncatula*)

Importance

Annual medics (burclover and the three barrel medic varieties) have proved to be valuable additions to California rangelands. They are outstanding in nutritive value at all stages of growth. Crude protein content is 20 percent or more up to the bloom stage, decreasing to about 15 percent when the plants are dry. Calcium and phosphorus contents are adequate. Digestibility is high even when the plants are dry, and animals can make good weight gains on dry burclover. In fact, animals may graze the plants only lightly when green but graze them heavily when dry. The dried burs, which are high in protein, are especially attractive to livestock and they will seek them out and lick them up before turning to other forage. In the summer and fall when other annuals are dry, burs in abundance can take the place of supplements because they are not affected by leaching and retain their high nutritive value.

Occurrence

Burclover was introduced from southern Europe and is now found throughout California west of the Sierra Nevada below 3,000 feet elevation. It seems to be most abundant on adobe soils and shales. It is usually not abundant on sandy or acid soils. Barrel medics, closely related to burclover and imported from Australia, do best on neutral to moderately alkaline soils.

Description

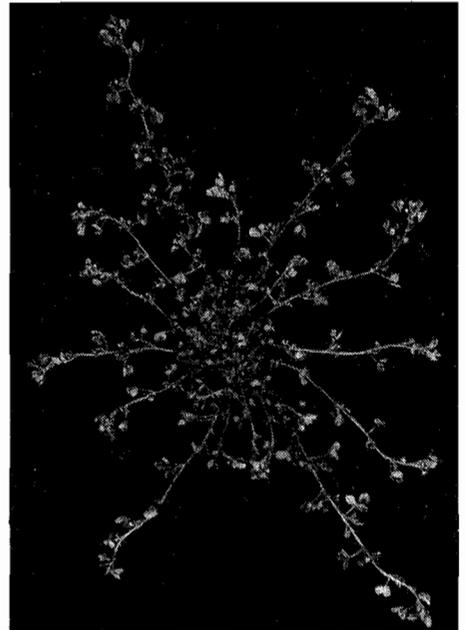
Four medic varieties representing two species are currently recommended in California for seeding into annual range. They are burclover and the barrel medic varieties Harbinger, Hannaford, and Jemalong.

Burclover is an annual legume with prostrate stems branched from the base and 4 to 12 inches (10 to 30 cm) long. Compound leaves are borne on stems $\frac{3}{8}$ to $1\frac{1}{2}$ inches (1 to 3.75 cm) long. Each leaf has three leaflets, the stalk of the central leaflet being longer than the other two. The leaflets are rounded and $\frac{3}{8}$ to $\frac{3}{4}$ inch (1 to 2 cm) long, with a sharp indentation at the top. The foliage is smooth and hairless.

From March to June irregular pealike flowers with yellow petals are borne in groups of two to nine on short stems. The seed pods are coiled and have two or three rows of hooked spines. Several varieties are botanically identified by the length of the spines.

The barrel medics are semiprostrate and normally 6 to 12 inches (15 to 30 cm) in height. The leaflets are $\frac{3}{16}$ to $\frac{25}{32}$ inch (0.5 to 2 cm) long and hairy on the upper and lower surfaces. The flowers are yellow as are those of burclover. The seed pods have short, unhooked spines.

Annual medics germinate after the first fall rains and develop slowly until spring when rapid growth occurs. All four varieties require a minimum of 10 inches of rainfall annually. The seedlings are very sensitive to frost and the plants do best in mild winters or frostfree localities. Abundance of the plant fluctuates widely from year to year.



The following table presents the flowering date and seeds per pound for the four varieties.

Variety	Flowering date	Seeds per pound
Burclover (<i>M. polymorpha</i>)	February	145,000
Barrel Medics:		
Harbinger (<i>M. truncatula</i>)	January	190,000
Hannaford (<i>M. truncatula</i>)	February	110,000
Jemalong (<i>M. truncatula</i>)	February	110,000

Management

Since the burs are valuable forage, management may be directed toward producing a large crop of burs. This is best accomplished by deferring grazing during the period when burs are setting and maturing.

After the burs are dry, heavy grazing favors annual medics because many seeds pass through the intestinal tract of cattle and sheep and are trampled into the soil by the grazing animals. The young plants thrive in soil disturbed by livestock. Thus, grazing spreads medics over the range. Medics decrease in abundance under very light grazing.

Annual medic seed should be inoculated with the proper nitrogen fixing *Rhizobium* to insure proper development of nitrogen fixing nodules. The medics respond to phosphorus and sulfur fertilization, as do other legumes.

Medics are not without problems. Burs sometimes collect in the fleece of sheep, decreasing the value of the clip. Also, alfalfa weevils are becoming a problem in burclover and the barrel medics.



Annual medic seed burs.

CRIMSON CLOVER

(*Trifolium incarnatum*)

Importance

Crimson clover is useful as a hay crop and for grazing. It is often sown along with other clovers in rangeland revegetation and the plant is readily eaten by livestock, deer, and other wildlife. It is similar to rose clover in crude protein content, with about 25 percent in young growth, declining to 8 percent in dead and dry plants. Because of its colorful flower, it is included in wildflower seeding recommendations for erosion control and beautification.

Occurrence

Crimson clover was introduced from Europe and has been widely planted in the southeast and in California. Many varieties have been developed. In California it grows best below 3,000 feet elevation in areas where rainfall is more than 15 inches yearly. Seedling establishment success and forage production will increase as rainfall increases. Crimson clover is not as persistent in range seedings as other adapted annual legumes.

Description

Crimson clover is an annual legume with upright stems 6 to 30 inches (15 to 75 cm) high. Each leaf has three leaflets that are broadly rounded at the tip and narrow at the base. Leaves and stems are covered with soft hairs.

The bright crimson flowers are borne at the ends of the stems in cylindrical, pointed heads about 2 inches (5 cm) long. When seed is mature, it is easily harvested.

Seedlings grow rapidly after the fall rains, forming a rosette of leaves. In spring the erect, hairy flower stems develop with many nodes from which leaves are produced.

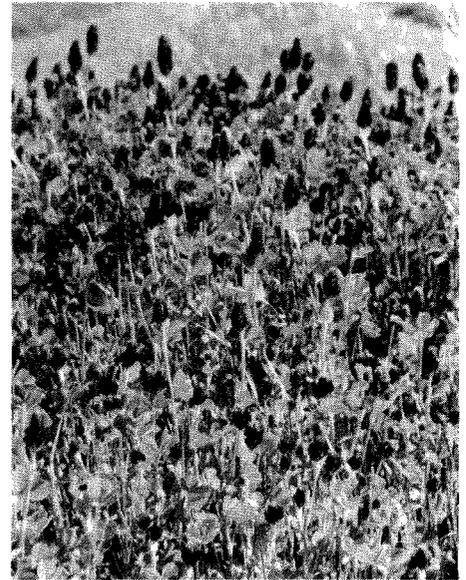
Most of the selected varieties of this clover produce abundant seed, most of which is hard. The hard seeds do not germinate until after a period of dormancy, helping to insure against stand loss from drought and frost.

Management

Fall sowing of crimson clover is best. The seed should be inoculated before seeding to insure proper nodule formation.

When crimson clover is used as a range plant, it is favored by heavy spring grazing followed by a period of nonuse while seed is setting and maturing. Continuous grazing eliminates the plant, but once seeds are mature, summer grazing helps to shatter the seed and trample it into the soil. Forage yield and quality can be greatly increased by fertilization with phosphorus and/or sulfur.

In coastal areas, crimson clover is affected by sooty blotch, a foliage disease that causes leaf loss during blooming and lowers forage value. It is also susceptible to pea aphids and spotted alfalfa aphids.



LANA VETCH

(Vicia dasycarpa)

Importance

Lana vetch can be used for range seeding, hay, and cover crops. Depending on stage of maturity, crude protein content varies from 10 to 20 percent. Lana vetch is exceptionally valuable for wildlife both for food and cover. Mourning doves have been observed concentrating on many seedings of this species. Several hunting clubs have increased their quail population by planting Lana vetch.

Occurrence

Lana vetch is easy to establish, tolerant of early frost, and a dependable forage producer. It reseeds better than purple vetch. It is adapted to moderately acid and moderately alkaline soils below 3,000 feet elevation in areas receiving 10 inches or more annual rainfall.

Lana vetch was selected from plants introduced in 1937 from Turkey, and was developed at Pleasanton, California, by the USDA Soil Conservation Service Plant Materials Center in cooperation with the Agronomy Department of the University of California, Davis.

Description

Lana vetch, a variety of woollypod vetch, is a self-seeding, cool season, annual legume similar in appearance to other annual and perennial vetches. Woollypod vetch varieties are similar in general appearance to hairy vetch, though the flowers are a little smaller and the seeds tend to be oval instead of nearly round. The flowers are borne in long clusters called racemes. Each raceme usually has 5 to 15 flowers which are pinkish purple in color, compared with the reddish purple of purple vetch. The leaves are compound, usually with 10 to 20 narrowly oval, pointed leaflets.

Lana vetch is semiprostrate with trailing stems up to 3 feet (90 cm) long. It will climb on any available support, including brush or the stiff stems of grass and grain.

Management

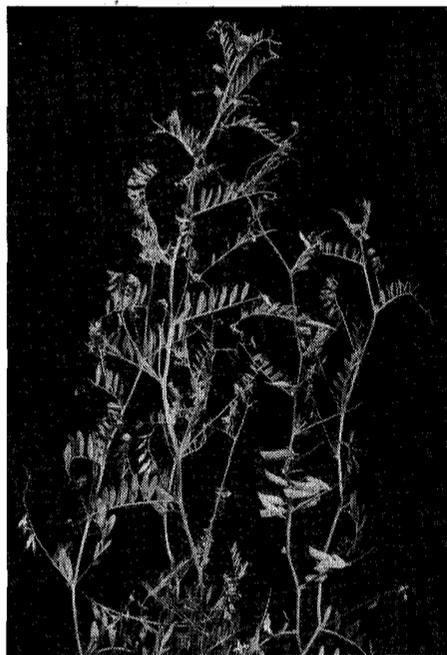
In range seedings, this legume can be broadcast by plane on the ash of brush burns and on annual rangelands where there is adequate residue to provide protection for germinating seed. Seedbed preparation such as discing is helpful. The best stands are produced from drilled seedings on prepared seedbeds. The seed should be inoculated at the time of planting.

October is the best month for planting vetch over most of the area to which it is adapted. Midwinter plantings are likely to be only moderately successful, even during mild winters. Fertilizing in the fall with phosphorus and sulfur will increase production.

Where there is competition from annual grasses, newly planted areas should be grazed as soon as annual grasses and weeds are ready for grazing. Vetch plantings should be grazed to a uniform height of about 3 inches (7.5 cm) for no longer than a month. A weed-free brush burn planting becomes better established if stock are kept off the first season until seed is ripe. Grazing should not be permitted while the soil is saturated, or the plantings will suffer from trampling.

Stock should be removed from established stands well before spring moisture is depleted so the vetch seed crop can mature. Summer grazing is safest and provides a source of high quality feed. Cattle will avoid vetch during the green season if other feed is available but will graze dry vetch readily.

For medusahead control, it is essential that Lana vetch be fertilized with superphosphate to avoid stimulation of this and other undesirable grasses.



DRYLAND ALFALFA

(*Medicago sativa* and *M. falcata*)

Importance

The presence of alfalfa in dryland pastures can improve forage yield and quality. Like all legumes it will fix atmospheric nitrogen that is unavailable to the general plant community. The fixed nitrogen will encourage increased productivity and protein content of the associated grasses, and the increased quality and quantity of forage will increase livestock production per acre.

A study in northern Utah indicates that several dryland alfalfa varieties planted in the summer of 1956 were still surviving in the summer of 1977. Similar results have been observed in Modoc County in northeastern California.

Occurrence

Dryland alfalfas have been most valuable when planted with wheatgrasses in the intermountain region. Originally these alfalfas were interseeded with crested wheatgrass. Oahe and Greenar intermediate wheatgrass have replaced crested wheatgrass in recent plantings. The wheatgrasses are not adapted to dryland seeding in the Mediterranean areas of California below 3,000 feet elevation.

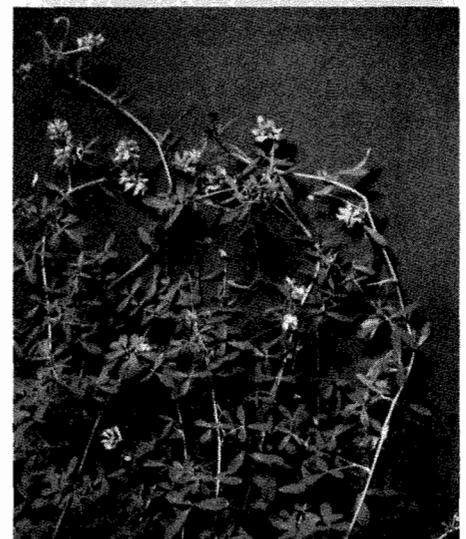
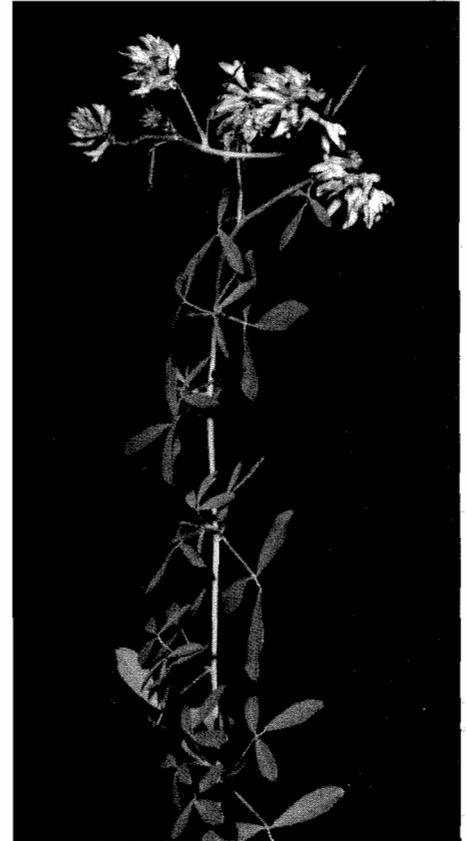
Description

The alfalfa varieties Vernal, Ladak 65, Rambler, Norseman, Drylander, Rangelander, and Victoria may be seeded with varying degrees of site preparation in dryland pastures. These varieties are winter hardy and capable of surviving arid conditions. In addition, some of these varieties, such as Rambler, have rhizomes that help the plants spread vegetatively.

Management

Good grazing management of dryland alfalfa requires periodic resting of the plants during the grazing season to allow regrowth and replenishment of carbohydrate reserves. The associated perennial grasses also need a rest period for regrowth and replenishment of reserves.

As long as alfalfa is adequately maintained in the dryland pasture it can "fix" atmospheric nitrogen, eliminating the need for nitrogen fertilization. However, alfalfa productivity and nitrogen fixation can be improved by addition of other nutrients such as phosphorus, sulfur, and potassium if they are deficient. When dryland alfalfa-wheatgrass stands lose alfalfa plants, alfalfa can be re-established by interseeding.



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