University of California
Agriculture and Natural Resources

COOPERATIVE EXTENSION SAN LUIS OBISPO COUNTY
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805-434-4106 Phone 805-434-4881 Fax

SEEDING INFORMATION:

RANGE AND PASTURE MANAGEMENT

Table of Contents:

INFORMATION FOR HOMEOWNERS (NON-COMMERCIAL):

Information specifically geared for the homeowner or large property owner (non-commercial). The University of California Master Gardeners volunteer their time to offer educational material for all aspects of gardening and pests, including weed management.

University of California Master Gardeners: http://groups.ucanr.org/slomg/

Contact the Master Gardeners:

San Luis Obispo
2156 Sierra Way, Suite C
Mon & Thurs 1pm- 5pm
805-781-5939

Templeton
350 N. Main Street, Suite B
Weds 9 am- noon
805-434-4105

Arroyo Grande
810 W. Branch Street
Weds 10am- noon
473-7190

Other Helpful Resources:

UC IPM WEEDS: http://www.ipm.ucdavis.edu/PMG/menu.weeds.html

UC WEEDS RESEARCH INFORMATION CENTER: http://wric.ucdavis.edu/

California Invasive Weeds: http://cal-ipc.org/

UC Publications: http://anrcatalog.ucdavis.edu

Yellow Starthistle Management Guide: http://www.cal-ipc.org/ip/management/yst.php

GENERAL RESOURCES:

WEBSITES:

UC IPM Weeds: http://www.ipm.ucdavis.edu/PMG/menu.weeds.html

UC WEEDS RESEARCH INFORMATION CENTER: http://wric.ucdavis.edu/

California Invasive Weeds: http://cal-ipc.org/

UC Publications: http://anrcatalog.ucdavis.edu

California Rangelands: http://californiarangeland.ucdavis.edu/

Cover Crop Resource Page: http://www.sarep.ucdavis.edu/ccrop/

Yellow Starthistle Management Guide: http://www.cal-ipc.org/ip/management/yst.php

"Behave" - Behavioral Education for Human, Animal, Vegetation and Ecosystem Management: http://www.behave.net/

UC PUBLICATIONS: http://anrcatalog.ucdavis.edu

Dryland Pastures: Establishment and Management in the Intermountain Region of Northern California Publication # 8163 Free download. 24 pages

Seeded Range Plants for California Publication # 21344 $2.50 each. 24 pages

Establishing and Managing Irrigated Pastures for Horses Publication # 21164 $1.50 each. 8 pages

Guidelines for Residual Dry Matter (RDM Management) # 8092 Free download. 6 pages

Seed Companies

The following seed companies are listed as a reference for those without internet access. Many seed companies are available online. No endorsement of named products and/or companies is intended, nor is criticism implied of similar products and/or companies which are not mentioned.

Albright Seed Co.
PO Box 1275
Carpinteria, CA 93014
805-684-0436
www.albrightseed.com

Clyde Robin Seed Co.
3670 Enterprise Avenue
Hayward, CA 94545
800-647-6475

Conservaseed
PO Box 455
Rio Vista, CA 94571
916-775-1676

California Native Plant Society
Native Plant Nurseries Listing
http://cnps.org/cnps/horticulture/nurseries.php

Farm Supply Co.
1108 Paso Robles St.
Paso Robles, CA 93446
805-238-1177
805-543-3751

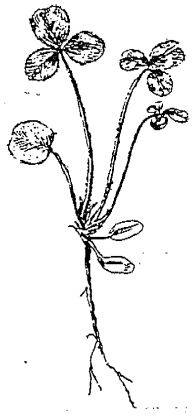
Kamprath Seed
205 Stockton Street
Manteca, CA 95336
800-466-9959

L.A. Hearne
512 Metz Road
King City, CA 93930
831-385-5441
www.hearneseed.com

Rana Creek
35351 East Carmel Valley Rd.
Carmel Valley, CA 93924
831-659-3820
www.ranacreeknursery.com

S&S Seeds
PO Box 1275
Carpinteria, CA 93013
805-484-0551
www.ssseeds.com

Western Farm Service
2502 Oakwood Street
Paso Robles, CA 93446
805-238-3825
www.westernfarmservice.com



Range Management Fact Sheet

for San Luis Obispo County

University of California • Cooperative Extension
2156 Sierra Way, Suite C
San Luis Obispo, CA 93401
(805) 781-5940

By Bill Weitkamp, Farm Advisor

May 1993

Planting and Managing Range Legumes and Grasses in San Luis Obispo County

Range Seeding Yields Long-Term Results

Although the seeding of rangeland with annual legumes and perennial grasses may seem expensive, a successful seeding, when properly grazed, will last indefinitely. So the increased forage yield and protein content during the long life of a range seeding should make it a wise investment for the livestock producer. In addition, these plants will provide good vegetative cover which reduces soil erosion. Consider also that this practice may quality for cost sharing through the federal Agricultural Conservation Program.

As with any dryland agriculture, however, variable factors such as weather, soil and management cause results to vary. If the weather is very dry the first year, seedling establishment may be disappointing or even a failure. Usually, however, if proven recommendations are carefully followed, some establishment will be made the first year and the stand will improve in following years.

Following are some comments about plant species and a step-by-step list of seeding and management recommendations. For more details, contact the livestock and range farm advisor in your county.

Benefits of Seeded Plants

Annual Legumes. Through the process of nitrogen fixation, legumes in symbiosis with root nodule bacteria called rhizobia use elemental atmospheric nitrogen to make proteins. Annual legumes, such as medics and rose and subterranean clovers, thereby increase forage protein content directly and, when their roots break down, they also contribute nitrogen compounds to the soil for other plants. A dense, vigorous stand of legumes therefore eliminates the need for nitrogen fertilization.

Rose clover derives its name from its upright, round rose-colored blossoms. Subterranean (sub) clover, as its name implies, buries part of its seed-producing burs, thus protecting the seed from close grazing. The annual medics are not true clovers but are members of the Medicago genus which includes bur clover and alfalfa. Their dry seed pods provide protein in the summer for livestock.

Some varieties of these legumes are adapted to areas which receive 8 or more inches of annual rainfall while other varieties require 15 to 20 inches.

Perennial Grasses. Berber orchardgrass, Palestine orchardgrass, Hardinggrass and Perlagrass, which has greater seedling vigor but more expensive seed than Hardinggrass, extend the green season and increase forage production on ranges with 15 or more inches of annual rainfall. They are especially beneficial during dry years because they are perennial plants with long roots that extract deep soil moisture. This was demonstrated on Hardinggrass range east of Arroyo Grande where annual cattle gains of 100 to 160 pounds per acre were recorded over a seven-year period which included dry as well as wet years.

Hardinggrass and Perlagrass can become clumpy and unpalatable if not grazed enough while in a young stage of growth. The orchardgrasses have finer stems and therefore are less likely to become clumpy.

Since annual legumes and perennial grasses thrive under similar management, they complement each other well in a range seeding.

Preparations before Seeding

Range seedings should be made before November 1 in order to catch the early rains and allow for germination before cold weather begins and competing resident plants begin to grow. Seed and fertilizer should be ordered well in advance since some items may be in short supply. Applications for costsharing from the Agricultural Conservation Program must be approved before work begins in order to qualify for payment. If a range drill or other seeder is going to be borrowed or rented, it is advisable to reserve it in advance.

Recommended Seed Mixtures

Since plant species and varieties vary in season of maturity and their adaptability to different sites, it is advisable to initially seed a broad mixture of species. In later years, it may be more economical and effective to select fewer varieties based on previous results and/or use different mixtures on different sites.

Here are three seed mixtures of varieties adapted to San Luis Obispo County. The rates are in pounds of raw seed (before inoculation) per acre.

On clay-loam soils where annual rainfall is 15 inches or more (most coastal areas):

1	Hykon rose clover
1	Wilton rose clover
2-3	Rosedale, Northam, and/or Nungarin sub clover
2	Seaton Park sub clover
1-2	Mt. Barker sub clover
2-4	Jemalong, Sephi, Serena and Sava medics
2-4	Berber or Palestine orchardgrass (can substitute Perlagrass or Hardinggrass)
11-17	Total pounds per acre for broadcast seeding (Can be reduced to 6-10 pounds per acre for seedings made with a range drill because the seed is concentrated in rows.)

On gravelly or sandy soils and/or where annual rainfall is 10 to 15 inches:

1	Hykon rose clover
0-1	Kondinin and/or Wilton rose clover
2	Rosedale, Northam and/or Nungarin sub clover
1-2	Seaton Park sub clover
2-4	Jemalong, Sephi, Serena and Sava medics
6-10	Total pounds per acre for broadcast and range drill seedings

For areas where soil pH is neutral or basic and annual rainfall is down to 8 inches:

4-8	Jemalong, Sephi and Serena medics
0-1	Rosedale, Northam and/or Nungarin sub clover
0-1	Hykon rose clover
4-10	Total pounds per acre, preferably seeded with a range drill

Legume Inoculation

Legume seeds should be inoculated with the proper nitrogen-fixing bacteria for the species. This is important because many soils lack the appropriate root nodule bacteria for the legumes being seeded.

A recommended do-it-yourself inoculation method is a system called Pelinoc-Pelgel. It is easy to apply, inexpensive and very effective. Six pounds of Pelinoc-Pelgel materials and 2 quarts of water are added per 100 pounds of seed. The seed should be inoculated just before planting.

Seed can also be purchased that has already been pellet–inoculated with peat inoculum coated with calcium carbonate – both held to the seed with an adhesive such as gum arabic.

Seedbed Preparation and sowing

An ideal seedbed is a stubble field that has been farmed to oat hay or cereal grain using good weed control practices. Legumes and grasses may be sown directly into the stubble with a range or grain drill or a Brillion seeder which drops the seed between two ring rollers.

Seeding in the ash of recent burns or on fuelbreaks made with bulldozers or disks can be effective too. Herbicide application may be needed the following spring, after the legume seeds have matured, to reduce brush regrowth.

For broadcast seedings on tilled, loose soil, seed loss to birds and rodents is reduced and germination is more successful if the seed is covered with about 1/4 inch of soil by using a ringroller. Seed shouldn't be buried deeper than 1/2 inch or germinating plants may be unable to reach the soil surface.

Seedings can also be made in established grassland using only a range or grain drill. The low-growing legumes, such as sub clover, respond well to this method if livestock grazing is used to reduce competition from other plants.

Fertilization at Seeding

The amount of fertilizer to be applied at seeding time depends on the available soil phosphorus which can be determined in a commercial soil testing laboratory by the sodium bicarbonate extraction soil test. If this test shows that phosphorus is less than 10 parts per million (ppm), broadcast seedings should be preceded by an application of 50 to 100 pounds of P_2O_5 (phosphoric oxide) per acre. If a drill seeder is used and the fertilizer is placed in a row with the seed, rates of only 20-40 pounds of P_2O_5 per acre are adequate for establishing vigorous legumes. Sulfur application at about one half the P_2O_5 rate is also recommended, so compare fertilizers for sulfur content.

Grazing Management the First Season

Competition from nonseeded plants should be reduced by grazing which keeps the faster-growing weeds and grasses from overtopping the legumes. As a rule, when the soil is not too soft and muddy, a new field should be grazed to about 2 inches until April or May when the legumes are flowering and the annual grasses have headed out. At that time, livestock should be grazed in other fields until the legume seeds are dry and hard.

In the case of sub clover seedings in established grassland, however, livestock grazing throughout the season will control grass competition without harming the low-growing sub clovers. This allows seeding on ranges where livestock removal is impossible or inconvenient.

Grazing and Fertilizing Established Stands

After the first year, graze early each growing season to control competition and later as the forage is needed. Legumes are good dry forage because of their high protein content and palatability.

More stands of clover are lost because of too little grazing rather than too much grazing. So, if a good stand is established the first year and the seed matures, it is usually not necessary to restrict spring and early summer grazing in later years. Seed production in stands of rose clover or medic can be encouraged, however, by restricting grazing when the plants are in bloom and until the seed hardens.

Although legumes provide their own nitrogen, they are dependent on phosphorus and sulfur from the soil. Soil tests can be used to detect phosphorus deficiency but are not reliable indicators of sulfur deficiency. Where phosphorus levels are less than 10-20 parts per million, fertilizing with 50-75 pounds of P_2O_5 and 25-50 pounds of sulfur per acre every three years will usually increase production. Before fertilizing large acreages, trial applications should be made to see if the results justify the cost. A Cooperative Extension farm advisor can suggest the correct way to do this.

Bloat and Estrogen Problems

Although bur clover can cause bloat, problems have not been reported with rose and sub clovers or seeded medics.

Sub clovers contain varying amounts of pigments that can have estrogenic effects on animals. In Australia, estrogen levels of some sub clover varieties in nearly pure stands have reduced lambing percentages. This has not been a problem in California because sub clovers usually are not over 50 to 60 percent of the stand even in the best pastures and varieties high in estrogen have not been widely used.

Cooperative Extension Publications with More Details

Annual Medics for Range and Grain Lands, Range Science Report No. 9

Management of Clovers on California Annual Grasslands, Leaflet 2661

Range-Legume Inoculation and Nitrogen Fixation by Root-Nodule Bacteria, Bulletin 1842

Range Plants Seeded in San Luis Obispo County

Seeded Range Plants for California, Leaflet 21344

Pasture Management Fact Sheet

for San Luis Obispo County

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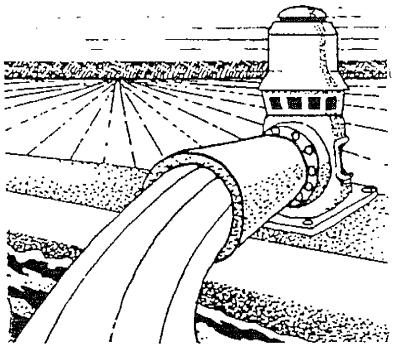


By Bill Weitkamp, Farm Advisor

December, 1993

Irrigated Pastures in San Luis Obispo County

The purpose of this fact sheet is to explain how to overcome the most common problems involved in establishing and managing irrigated pastures in San Luis Obispo County. Additional pasture information can be found in the University of California Cooperative Extension publications listed at the end of this fact sheet.

Assets of Irrigated Pasture

An irrigated pasture can be a valuable source of feed for livestock either as the only forage or as a supplement to seasonal dryland range or other feeds. Its most economical use is as a replacement for more expensive feeds such as hay or protein supplements. This is usually the way it is used in a livestock operation where the main forage is dryland range. Here, irrigated pasure is used either when there is not enough dryland forage or when it is too low in protein such as during the summer and fall.

If it is to be used as the only feed, it will take about a half acre of excellent irrigated pasture to support a mature horse or cow or five mature sheep during the best part of the growing season which is March through October. Additional feed will be needed the rest of the year. Part or all of this supplemental feed requirement can be met by feeding hay or silage made from early-season irrigated pasture growth.

Establishing a New Pasture

Preparing a weed-free seedbed, correctly seeding the pasture and irrigating it adequately (if rainfall is insufficient) for maximum seedling establishment are three critical steps in producing a good pasture. Mistakes made in these practices are difficult to correct later and may lead to reseeding.

Seedbed Preparation

Weed control is a major consideration. Land grading, where feasible, will increase irrigation efficiency and reduce weed and mosquito problems caused by low spots. If the land has not been farmed or in irrigated pasture, it should be farmed to one or more crops such as oat hay, cereal grain or sudan grass in order to clean up the weeds. A weed spray can be used in these crops to control broadleaf weeds if present. After the crop is harvested, the field can be disked (cultivated) and then rolled with a ringroller or cultipacker. It may pay to irrigate after the crop is harvested, and then disk and roll after a new crop of weeds has germinated.

The Idea is to have a firm seedbed so the seed can be pressed in with a roller to a depth no deeper than 1/2 inch, preferably 1/4 inch.

Seed and Seeding

Seed represents a small part of the investment, so insist on high germination and purity. Certified seed will assure this. Be certain also that legume seeds are freshly inoculated, preferably with a pelleting process. This will insure that the legumes will have the bacteria which fix nitrogen from the air for use by the plants.

The seed can be sown with a broadcast seeder, a drill, an airplane or a ringroller with a seeding attachment. Any method that applies the seed uniformly without burying it too deep is acceptable. Ringrolling or cultipacking should follow the seeding operation to cover the seed and to firm the soil around the seed for maximum moisture retention. Rolling, seeding and a second rolling can all be accomplished in one operation by using a seeder with a sowing attachment located between two ringrollers.

Sample Seed Mix for Cattle, Sheep and Horses

	Lbs. seed/acre
Salina strawberry clover	4
Dallisgrass (for hot climates)	0 or 4
Perennial ryegrass and/or festulolium	4
Orchardgrass (Akaroa)	4-6
Total	14-16

Moisture and Seedling Establishment

Fall seedings can be established with little or no irrigation provided winter rains come regularly and hot spells are not a problem. It is safest, however, to have the irrigation system ready to go at seeding time in case the rains start and then discontinue. To reduce the amount of irrigation and yet not subject the new plants to cold winter weather before they are big enough to take it, the best time to seed is September or October.

For spring plantings, frequent irrigations are often essential to allow the plants to grow through the critical period from germination until a good root system is established. Irrigating 2 or 3 times a week may be necessary during hot weather in order to keep the seed and root zone moist.

Irrigation of Established Pastures

Once the pasture is established, a very important management practice in keeping it productive is irrigation. The timing of irrigations and the amount of water to apply must be based on a knowledge of the moisture in the soil and the plant requirements for water. A water supply of at least 6 gallons per minute for each acre is necessary for sprinkler irrigation. The seasonal requirement will be 2 1/2 to 4 1/2 acre-feet per acre.

During the summer, it is usually necessary to apply 3 inches of water every 7 to 14 days. The more frequent intervals are required in the hotter areas whereas the coastal pastures need less frequent waterings.

In the spring, it is important to begin irrigating before the soil has dried out. Don't wait until May to start the pump if the last rain was in February. Spring should be a very productive season for an irrigated pasture if it has enough moisture. Fall can also be a productive season if adequate moisture is available.

An inexpensive soil sampler available in farm catalogs is very useful in finding how deep the moisture is present in the soil. Keep in mind that clovers can use moisture down to a depth of 2 feet and grasses down to 3 to 4 feet. Since both legumes and grasses are in the pasture, adequate soil moisture should be maintained throughout the entire root zone of all plants. This means irrigating often enough to keep the shallow-rooted clovers growing vigorously and deep enough

for the long grass roots.

Livestock should not be put on the pasture until after the surface has dried because the soil may become compacted which will reduce water penetration, lower production and may require deep plowing for correction.

Fertilization

Like irrigation, the fertilization program has a lot to do with the production of the pasture and the relative abundance of grasses and legumes. Keep in mind that all legumes (clovers, trefoils and alfalfa, for example) thrive on phosphorus and sulfur but will supply nitrogen for themselves and associated grasses if phosphorus, sulfur and the correct nitrogen- fixing bacteria are present.

Grasses, on the other hand, cannot provide their own nitrogen so they depend on nitrogen fertilizer or associated legumes for this element. It is cheaper of course to let the legumes provide the nitrogen rather than to buy it.

The objective should be, therefore, to establish about a 50:50 ratio of grasses and legumes, correct phosphorus and sulfur deficiencies if indicated by soil or plant analysis, and allow the legumes to provide the nitrogen.

Many soils in this county are deficient in phosphorus. A phosphorus soil analysis by a reputable laboratory will tell you if you should apply a phosphorus fertilizer. Pastures with a content of less than 10 parts per million available phosphorus in the soil will usually respond well to phosphorus fertilizer. Contact a farm advisor for information on soil sampling and how to interpret test results.

If the soil test shows a phosphorus deficiency, 20-40 pounds of P_2O_5 (phosphoric pentoxide) per acre may be needed annually to provide satisfactory growth of legumes and grasses. Sulfur application at about one half the P_2O_5 rate is also recommended, so compare fertilizers for sulfur content.

In pastures where few or no clovers are present and they can't be increased without disking or plowing and reseeding, nitrogen fertilization will probably be required for maximum grass growth. Under average conditions, a single application of 30 to 40 pounds of nitrogen will be effective for only about one month. Fertilizing with 150 to 200 pounds of ammonium sulfate or 70 to 90 pounds of urea every month during the growing season will keep grasses well-supplied with nitrogen. Such stimulation of grass growth, however, can crowd legumes out of the pasture, especially if grazing pressure is light, soil moisture is low or phosphorus and sulfur levels aren't maintained.

Weed Control in Established Pastures

If the seedbed has been prepared as recommended in this fact sheet, it will be much easier to control weeds later. After a new pasture has reached a height of 10 inches or more, it should either be grazed or mowed to keep the annual weeds from competing with the slower-establishing pasture perennials. If the pasture is irrigated, grazed and fertilized so that the seeded perennials become well-established and are maintained for high production, they will then usually keep out most annual weedy species. Perennial weeds such as dock and sedge, however, may persist and require improved drainage or herbicide application for control.

Mowing

Mowing can be beneficial in both new and mature fields in reducing weeds and promoting even cropping and full utilization of forage which in turn enhances pasture quality. Removing coarse stalks and seedheads of vigorous grasses greatly improves utilization. Surplus growth is usually available in the spring

which can be used for hay or silage. The type of machinery available for mowing will partly determine the height of cutting, but about 3 to 6 inches of stubble is suitable.

Harrowing

Pastures can be harrowed regularly to spread the droppings of cattle and prevent bunchy growth around manure clumps. Harrowing for this purpose is especially effective after an irrigation. A flexible type of springtooth harrow does a better job than a rigid harrow of breaking up and spreading the manure.

Grazing Mangement

Two main considerations in the management of grazing are: 1) to stock the number of livestock which will result in optimum forage production and utilization and 2) to avoid soil compaction by keeping livestock off the pasture when the soil is too wet, a problem which is greater on clay soils than on sandy soils.

It is important to stock enough livestock to keep the clovers from being crowded out by the grasses but not so many animals that the root and leaf systems of the plants are inhibited. By maintaining about a 50:50 mix of vigorous clovers and grasses, maximum forage production and utilization by livestock will result.

Soil compaction can be reduced by moving cattle between two or more fields to avoid grazing during and just after irrigation. Fencing into separate fields also makes it possible to grow hay in one field while grazing animals in another.

You may even decide to follow a grazing plan in which livestock are moved between numerous fields (or paddocks) at intervals that allow for the plants to be grazed only at the stage when they are in the fastest rate of growth. This type of planned grazing is explained in more detail in various publications which can be recommended by your Cooperative Extension livestock farm advisor.

Interseeding with Clover

The preferred method of renovating an old pasture is to plow and crop to an annual before reseeding. However, pastures with a low population of legumes can sometimes be improved by drill- or broadcast-seeding Salina strawberry clover among the established grasses. Seeding 2 to 4 pounds of clover with about 60 pounds of P_2O_5 per acre is recommended. Pastures with many bare spots may only need a broadcast seeding whereas dense pastures should be seeded with a heavy-duty drill when the soil is moist. Grazing to restrict grass competition and applying several frequent irrigations will help the seedlings get started. It takes about one year for the strawberry clover to become well-established since it spreads by creeping stems that root at the nodes.

Bloat

Bloat is a hazard when cattle or sheep are grazed on pastures containing a high percentage of clovers or alfalfa. Ladino clover causes a greater bloat problem than does strawberry clover, although dense, closely-grazed stands of strawberry clover can cause livestock deaths. Bloat is reduced when grasses are allowed to grow tall enough to compete with clovers. This can be achieved by moderate grazing (preferably on a pasture rotation plan), irrigating deeply but not too frequently and, if these practices fail, by nitrogen fertilization.

Molybdenum Toxicity

Some soils in San Luis Obispo County have an excess of the element molybdenum which is taken up by pasture plants and can cause toxic symptoms in cattle, especially when copper levels are insufficient. Severely affected cattle scour, lose weight rapidly and

change hair color. Even with mild toxicity, cattle do not gain as well as they should.

Molybdenum toxicity can be corrected in cattle by administering copper boluses orally with a balling gun. These will maintain copper levels for up to one year. Copper sulfate can also be fed at the rate of 1/2 to 1 gram per head per day in a salt-grain mix, commercial supplement or the drinking water.

Since internal parasites cause symptoms similar to molybdenum toxicity, a veterinarian should be consulted for diagnosis and treatment recommendation.

Gophers

Pocket gophers cause problems in pastures by forming extensive burrowing systems that cause irrigation water loss and reduced forage production. Trapping or baiting the burrows with poison grain can be effective in reducing gophers. On large acreages with an abundance of gophers, the mechanical tractor-drawn gopher bait applicator has replaced the more time-consuming manual methods. More details are found in Cooperative Extension Leaflet #2699 entitled Pocket Gopher Control with Mechanical Bait Applicator.

Other Pasture Publications

The following publications contain additional information related to pasture production. These and other agricultural publications are available from Cooperative Extension offices located in counties throughout California.

Management of Small Pastures
LE 2906

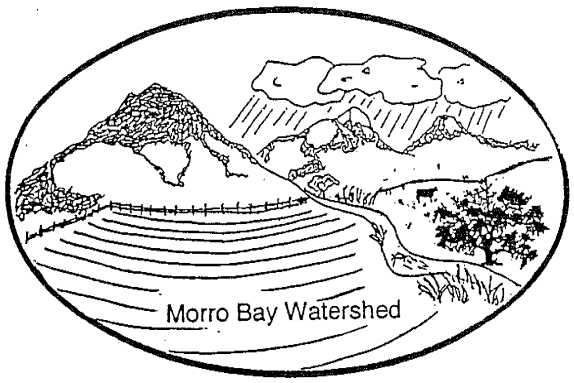
Establishing & Managing Irrigated Pastures for Horses
LE 21164

Permanent Sprinklers for Hilly Pastures
LE 2662

Irrigation Costs
LE 2875

Pocket Gopher Control with Mechanical Bait Applicator
LE 2699

Grading Land for Surface Irrigation
LE 2692



Native Plants

Watershed Educational Program

for San Luis Obispo County

FACT SHEET

University of California • Cooperative Extension
2156 Sierra Way, Suite C
San Luis Obispo, CA 93401
(805) ~~549-5940~~ 781-5940

No. 7 February 1992

Native Plants for Erosion Control on the Central Coast

Botanical Name	Common Name	Comments
Trees and Shrubs.		
Alnus rhombifolia	White Alder	1, 2
Acer macrophyllum	Big Leaf Maple	1, 3
Acer Negundo var. californicum	Box Elder	4
Artemisia californica	California Sagebrush	5, 12, 26
Baccharis pilularis var. consanguinea	Coyote Brush	12, 27
Ceanothus cuneatus	Buckbrush	5, 6, 12
Cornus glabrata	Creek Dogwood	1, 16, 18
Hazardia squarrosa	Goldenbush	6
Heteromeles arbutifolia	Toyon	5, 12, 28
Myrica californica	Bayberry (Wax-Myrtle)	1, 16
Plantanus racemosa	California Sycamore	1, 16
Populus trichocarpa	Black Cottonwood	1, 16
Querus agrifolia	Coast Live Oak	5, 12, 17, 27, 28
Rhamnus californica	Coffeeberry	5, 10, 28
Rhamnus crocea	Redberry	5
Ribes divaricatum	Wild Gooseberry	8
Ribes Menziesii		8, 24
Ribes Menziesii var. Hystrix		8, 20
Ribes speciosum	Fuschia flowered Gooseberry	8
Rosa californica	Wild Rose	1
Rubus ursinus	California Blackberry	1, 9, 20
Salix lasiolepsis	Arroyo Willow	1, 16, 18, 22
Salvia mellifera	Black Sage	5, 6, 26
Salvia spathacea	Hummingbird Sage	20
Sambucus mexicana	Blue Elderberry	1, 5, 11, 12, 28
Umbellularia californica	California Bay California Laurel	2, 5, 12, 16, 24
Forbs and Grasses		
Artemisia Douglasiana	Mugwort	1, 5, 24
Aster chilensis	Wild Aster	1, 11

Botanical Name	Common Name	Comments
Bloomeria crocea var. aurea	Golden Stars	25
Conyza canadensis	Horseweed	1, 13
Cryptantha sp.	Cryptantha	6
Cyperus eragrostis	Umbrella Sedge	1
Delphinium sp.	Larkspur	6, 28
Eleocharis palustris	Common Spikerush	1, 16
Elymus glaucus	Blue Wildrye	5, 12, 15, 20, 27
Elymus triticoides	Creeping Wildrye	5, 12, 15, 19, 22, 27
Epilobium Watsonii	Willow Herb	1
Equisetum Telmateia	Giant Horsetail	1, 11, 28
Eschscholzia californica	California poppy	5, 6, 23
Festuca megalura	Annual Fescue	5, 6, 12, 15, 19, 23
Galium Aparine	Bedstraw	11, 20
Helianthus annuus	Sunflower	
Hordeum brachyantherum	Meadow Barley	15, 19, 23
Hordeum californicum	California Barley	14, 15, 23
Lotus purshianus	Pink Deer-Vetch	6, 12
Lupinus albifrons	Bush Lupine	5, 6, 28
Lupinus succulentus	Lupine	14, 15, 28
Microseris sp.		6
Mimulus cardinalis	Scarlet Monkey Flower	1, 16
Mimulus guttatus	Monkey Flower	1, 16
Montia perfoliata	Miner's Lettuce	16, 17
Phacelia distans	Phacelia	6
Poa scabrella	Pine Bluegrass	5, 12, 23
Psoralea macrostachya	Leather Root	1, 18
Scirpus americanus	Threesquare Bulrush	1, 19
Scirpus microcarpus	Small Flowered Bulrush	1
Selaginella Bigelovii	Spike Moss	6, 25
Spergularia Sp.	Sand Spurrey	19
Stachys bullata	Hedge-Nettle	1, 20
Stipa cernua	Nodding Stipa	5
Stipa pulchra	Purple Needle Grass	5, 6, 12, 14, 23, 27
Tillaea erecta	Pygmy Weed	6
Typha augustifolia	Narrow Leaved Cat-Tail	1, 24
Verbena robusta	Verbena	1, 25
Vicia americana	Vetch	20

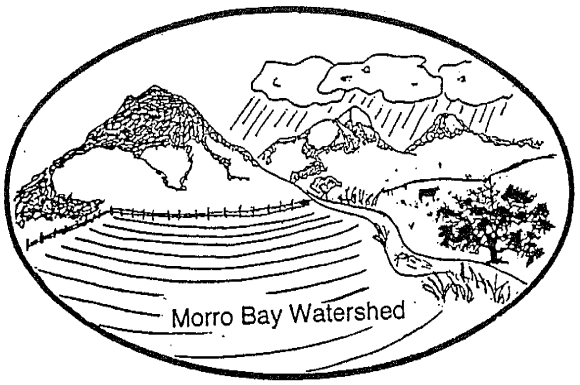
Comment KEY

1.	Prefers moist areas	2.	Tolerates winds
3.	Resistant to Oak Root Fungus	4.	Messy, attaracts pests
5.	Drought resistant	6.	Dry, sandy, or rocky areas
7.	Needs irrigation	8.	May not be available in nurseries
9.	Seldom a good crop of fruit	10.	Better with some summer water first year
11.	Invasive root system	12.	Good wildlife cover
13.	Common weed	14.	Heavier soils
15.	Good on fresh cut/fill	16.	Not for dry areas
17.	Not for saline areas	18.	For stream beds
19.	Can handle saline/alkalai	20.	Shaded woody areas
21.	Can not tolerate wind	22.	Spreads rapidly
23.	Open hills and plains	24.	Canyons
25.	Will grow in serpentine soils	26.	Keep on dry side
27.	Not in standing water	28.	Some species may have poisonous parts

References: San Luis Obispo County; Soil Conservation Service, "The Cover Up Story of SLO County"; ConservaSeed seed list; Vascular Plants of San Luis Obispo County, California by Robert F. Hoover.

Prepared by Billie Rae Knittel

This fact sheet is part of a program funded by the U.S. Department of Agriculture to reduce the flow of sediment and other pollutants into Morro Bay. In addition to an educational program conducted by Cooperative Extension, the Soil Conservation Service provides landowners with technical assistance in implementing practices that are part of a conservation plan and the Agricultural Stabilization and Conservation Service assists landowners by costsharing those practices. Leadership, coordination and public information for the program are provided by the Coastal San Luis Resource Conservation District.



Drought Tolerant Plants

Watershed Educational Program

for San Luis Obispo County

FACT SHEET

University of California • Cooperative Extension
2156 Sierra Way, Suite C
San Luis Obispo, CA 93401
~~(805) 549-5940~~ (805) 781-5940

No. 8 February 1992

Some Drought Tolerant Plants for Direct Seeding

Often it is less expensive to plant seed than seedlings purchased from a nursery. The natives of San Luis Obispo County listed below are excellent candidates for direct seeding. For more choices, see Leaflet 2577 listed at the end of this fact sheet.

Baccharis pilularis (coyote bush)
Ceanothus species (wild lilac)
Fremontodendron californicum (flannel bush)
Heteromeles arbutifolia (toyon)
Quercus agrifolia (coast live oak)
Quercus Douglasii (blue oak)
Quercus lobata (valley oak)
Rhamnus californica subsp. tomentella (chaparral coffeeberry)
Salvia leucophylla (purple sage)
Sambucus mexicana (Blue elderberry)

Fall seeding is preferable for all of these. Of this list, only the ceanothus seeds need pretreatment. They should be placed in a volume of hot (170 - 212° F) water 4 to 5 times the volume of the seeds, then allowed to cool 12-24 hours and planted immediately after cooling.

Do not collect seeds on private or public property without permission. Contact a plant nursery or the California Department of Forestry and Fire Protection for the names of seed dealers.

Direct Seeding Procedure

Dig hole 4 inches deep or, if gophers are a threat, dig a hole 12-18 inches deep and put a cylinder of 1/2 inch mesh poultry wire in it prior to planting.

Apply slow release fertilizer at 4 inch level – 3 teaspoons per hole. If soils in your area require sulfur, add 1/4 tsp. of potassium sulfate.

Consult chart on next page for additional information about seeding.

Number of Seeds per Hole, Depth of Seeding Depression, Soil Depth Over Seed, and Depth of Depression for Moisture Accumulation.

Seed Diameter (inch)	Seeds # Per Hole (number)	Depth of Seeding Depression Below Surface (inch)	Depth of Soil Over Seed (inch)	Depth of Depression For Water (inch)
< 1/16	20	1/4 to 3/8	1/8	1/8 to 1/4
1/16 to 1/8	10	3/8 to 1/2	1/8 to 1/4	1/4
1/8 to 1/4	5	1/2 to 3/4	1/4 to 3/8	1/4 to 3/8
1/4 to 1/2	3	7/8 to 1	1/2	3/8 to 1/2
Oak Acorns	3	2 to 2.5	1	

#Based on approximately 50 percent germinability.

Refill hole, tamp firmly to correct level for the seed you are planting and add seeds.

Cover the seeds with pulverized soil according to the depth specified in the above chart. Firm soil by hand or trowel, leaving a depression of the depth specified above. Water in to settle soil well and to provide ample moisture for seed germination.

Protect seeds and seedlings from birds and rodents by constructing a cage of 1/2 inch mesh poultry wire. Stake the cage down.

Control weeds until seedlings are big enough to compete. A layer of mulch 2 inches deep and kept 2 inches away from the seedlings on all sides will help. Extend mulch to at least a one-foot radius. Oaks should have a 2-foot radius of mulch cover. Be careful not to disturb seedlings when weeding.

Most of these plants will grow without irrigation, but they will get a better start if they are watered their first year.

Trees should be thinned to one per hole by **cutting** off all but one of the trunks level to the ground. Do not pull out the extras, as this will disturb roots. Wild lilac, flannel bush, and purple sage shrubs will do fine with two plants remaining in each hole.

Fertilize the winter after the first growing season with two times the amount of nitrogen used at planting. Put the nitrogen in two 5-inch holes or spread it in a 4-12 inch wide band around the plant. Keep it 4" from the plant.

Reference: "Direct Seeding Woody Plants in the Landscape", University of California Cooperative Extension Leaflet 2577, 1979.

For additional information on planting oak acorns, contact your local University of California Cooperative Extension office.

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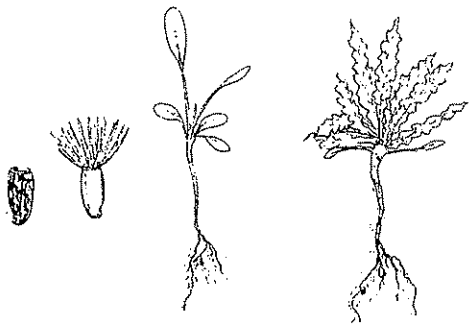

Range Management Fact Sheet

for San Luis Obispo County

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January 1994

Controlled Grazing on Annual Grassland Decreases Yellow Starthistle

From an article in the November-December 1993 issue of California Agriculture by Craig Thomsen, William A. Williams, Marc Vayssieres, Fremont L. Bell and Melvin R. George

Livestock grazing in late spring and early summer resulted in large reductions of yellow starthistle, Centaurea solstitialis, on infested annual grasslands. Grazing in the bolting stage before spines developed reduced starthistle's canopy size, seed production and thatch accumulation and enhanced native plant diversity. Properly timed grazing effectively manages starthistle on a seasonal basis but does not eliminate populations.

These are the findings from grazing trials with cattle on a ranch in Colusa county for 3 consecutive years and sheep for 2 years followed by goats for 1 year at the UC Davis Agronomy Farm. To determine whether grazing starthistle suppresses its growth and reproduction, UC researchers compared short-duration, high-intensity grazing with no grazing.

Timed to specific stages of starthistle growth, grazing initially was targeted at either the rosette or the bolting, pre-spiny stage. The duration of grazing varied from 8 to 52 hours according to the amount of biomass present and the number of animals present. Animals were removed from the paddocks when plants had been heavily defoliated and there was insufficient forage left, or when animals showed no more interest in grazing. New Zealand-style electric fencing was used to enclose and subdivide the experimental pastures.

Cattle Grazing Methods

Cattle grazing periods at the Arrowhead Ranch in Colusa County were inititated in late spring (May 25) and two to three biweekly follow-up grazings were used to consume the regrowth. Stock densities were 18 cow-calf pairs per half acre. Initial grazing periods ranged from 12 to 24 hours per paddock and declined to 8 hours or less for the last grazing period.

Cattle Grazing Results

Grazing significantly reduced starthistle flowerhead densities in all 3 years (Table 1), and there were decreases in canopy densities of more than 90% in 2 of the 3 years. Grazed plants that were not killed outright were severely stunted (6 to 12 inches). The ungrazed paddocks supported

mature starthistle that formed dense spiny thickets 2 to 3 feet tall with flowerhead densities 4 to 11 times greather than in grazed paddocks.

Initial heavy grazing resulted in some starthistle mortality, but most plants regrew from basal and axillary buds. The regrowth also flowered, so it was essential to closely monitor and regraze them before spines appeared. For best results, this window between grazings lasted between 2 and 3 weeks. A longer period of nearly a month between first and second grazings in 1991 accounted for the high flowerhead densities that year.

Table 1. Yellow starthistle flowerhead densities for plots grazed by cattle (3x,4x,3x) and ungrazed treatments in 1989, 1990 and 1991, Colusa County

Treatment	1989	1990	1991
	flowerheads/sq. meter		
Grazed	82 a	23 a	192 a
Ungrazed	558 b	255 b	843 b

Means followed by different letters are significantly different ($p<.05$).

Sheep Trial

In the tiral at the UC Agronomy Farm, a pilot study was conducted in 1989 with lambs to determine the feasibility of using sheep. The next year, intensive sheep grazing (40 ewes per 0.1 acre) started on March 23 -- 2 months earlier than in the cattle trial. The second grazing was 3 weeks later and the third from May 3 to 5 (both periods with 20 ewes per 0.1 acre). The sheep uniformly grazed the vegetation and the yellowstar recovered more rapidly from defoliation than associated plants. This had the negative effect of greater yellowstar flowerhead densities and vegetative regrowth in the grazed paddocks than in the ungrazed.

Goat Trial

In spring 1991, 17 goats grazed the same paddocks used by sheep in previous years. As in the cattle experiment, initial grazing was timed to starthistle's bolting stage (May 15). Although there were many plants still in the rosette stage, the goats selectively grazed the upright, bolted plants. Regrowth of the grazed stalks was slow because of the drought and the ungrazed vegetative rosettes remained moisture-stressed.

Table 2. Densities of yellow starthistle flowerheads (A) after sheep grazing (3x) initiated in the rosette stage in 1990, and (B) after goat grazing (2x) in the bolting stage in 1991, UC Agronomy Farm

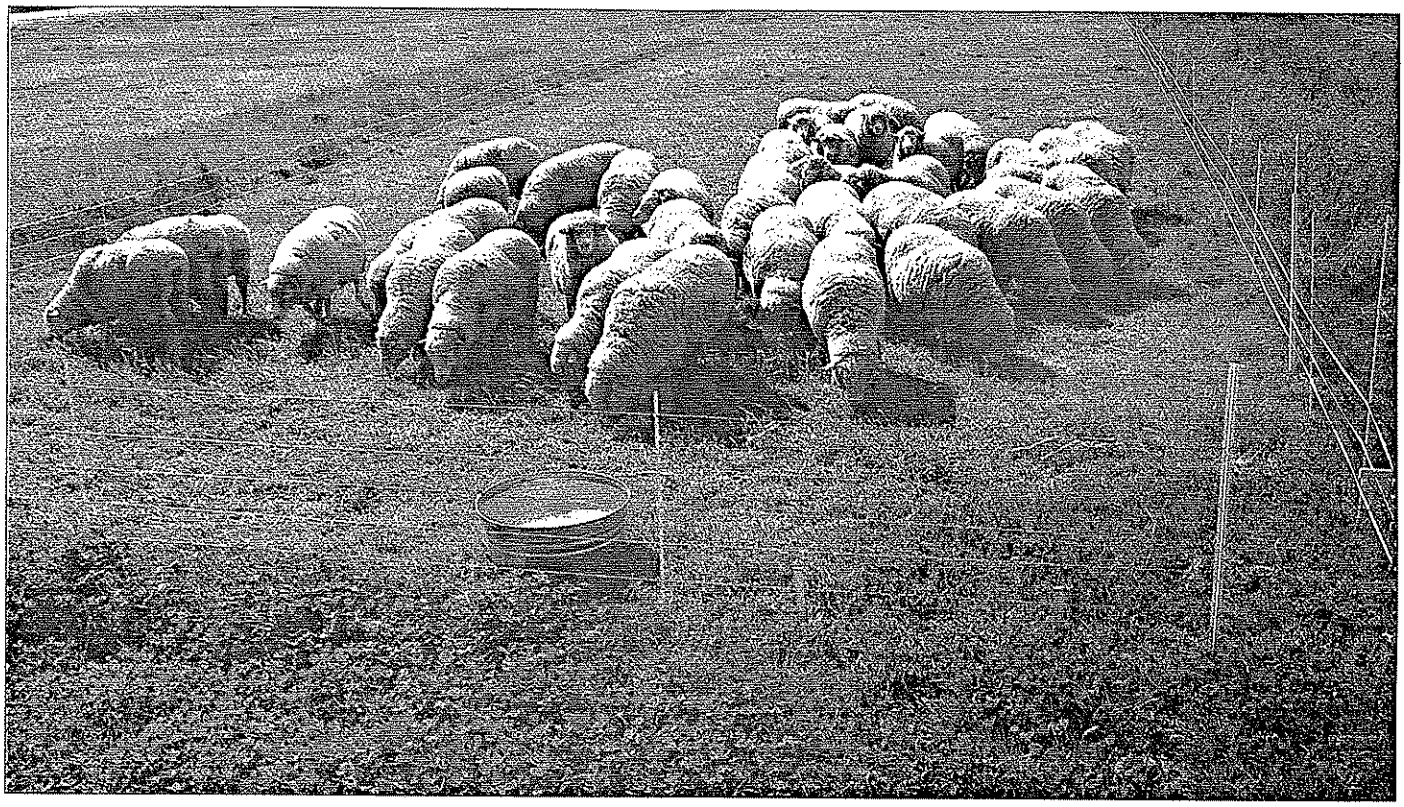
	A	B
	Sheep	Goats
Treatment	1990	1991
	flowerheads/sq. meter	
Grazed	226 a	27 a
Ungrazed	172 b	374 b

Means followed by different letters are significantly different ($p<0.5$).

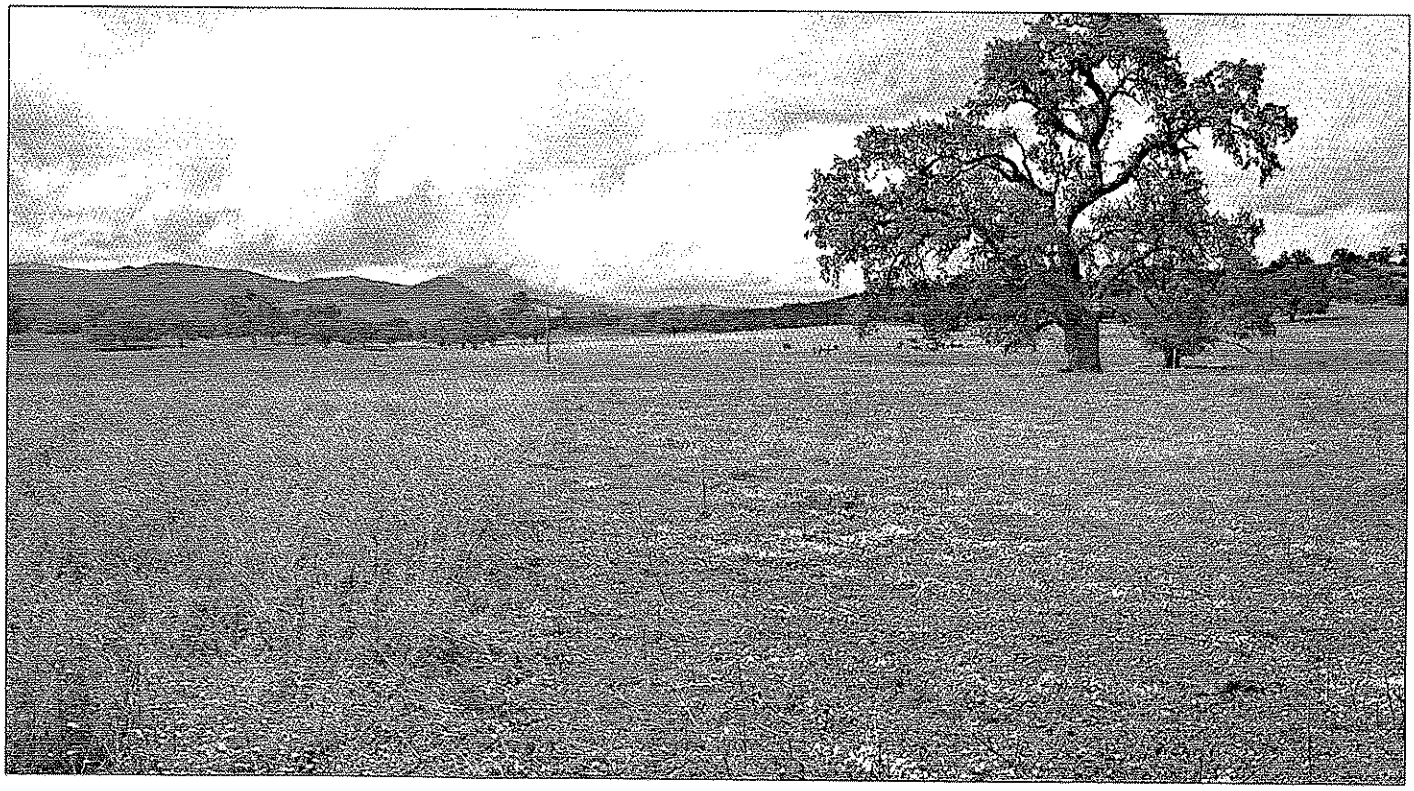
When the goats were returned 3.5 weeks later they showed little interest in grazing and only nibbled at the unspiny regrowth and the rosettes, avoiding the few plants with spines. In spite of this sparse second grazing, a 14-fold reduction in flowerhead densities resulted (Table 2). This was in spite of the fact that starthistle seedling densities sampled before the goat grazing were 3 times higher in the grazed paddocks than in the ungrazed paddocks. The fewer number of grazings required with goats compared with cattle was associated with the drought's severity.

Palatability Differences

Differences in animal acceptance of starthistle could not be quantified because of differences in sites, timing of grazing, animal numbers, origin and age of animals and their dietary history.



Flock of 40 ewes graze yellow starthistle during rosette stage of growth, UC Agronomy Farm, March 1990.



Left, yellow starthistle skeletons in ungrazed paddock.
Right, cattle-grazed paddocks with meadowfoam, *Limnanthes douglasii*, April 1992.

Nevertheless, the following observations were noted:

1. The cattle readily grazed early stages (rosette), late stages (bolting, pre-spiny stalks) and the regrowth from bolting plants.

2. No conclusion could be drawn from this trial about sheep acceptance of starthistle in late stages of growth, but these researchers reported observations at many other localities of routine grazing by sheep late in the season that effectively reduced dense stands.

3. Unlike sheep, the goats showed strong preference for bolting plants and ignored plants in the rosette stage. During the second grazing, they showed little interest in the regrowth and the previously ungrazed plants.

4. In general, animal acceptance of starthistle decreased after bolting plants had been grazed, with cattle being the most willing to heavily defoliate the recovered plants. In one year of the cattle study, they grazed starthistle 4 times between May 15 and July 3.

Timing

Yellow starthistle's ability to regrow following defoliation during much of its life cycle surpasses that of most, if not all, herbaceous plants in California annual grasslands. Starthistle recovers after grazing because of its basal buds and its deep roots which extract moisture better than associated plants. This explains why it is such a successful weed on grazing lands (and on hay stubble) and it explains why only repeated grazing during the most vulnerable growth period can effectively manage infestations.

Under a later grazing regime, starthistle usually recovers somewhat, but decreasing soil moisture and high air temperatures dry it out. After a second or third grazing, many plants no longer have sufficient reserves to continue normal growth and either die or become markedly suppressed.

The timing of grazing also had an effect on the residual dry matter (RDM) that remained on the soil surface. RDM is used as a basic measure of range health because it protects the soil and enhances forage production the following growing season. With early grazing, associated plants were grazed, along with starthistle, and little RDM was left, resulting in a bare, exposed soil surface. With late-season grazing, animals preferred grazing starthistle to grazing the dried annuals, and sufficient residue -- well above the recommended minimum -- was maintained on the soil surface.

Summary

Grazing between mid-May and early July resulted in major reductions in plant biomass canopy size and seed production, but sufficient seed was produced or already existed in the soil seedbank for some new plants to establish in subsequent years. Properly-timed grazing effectively managed infestations and made use of starthistle as forage, but additional control measures are necessary to futher reduce populations. There is no practice that is certain to eradicate well-established starthistle infestations on rangelands, and long-term management of starthistle requires use of these or other practices on a more or less permanent basis.

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