Production of Subterranean Clover Seed in Western Oregon

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INTRODUCTION

Subterranean clover (*Trifolium subterraneum* L.), or subclover, is a winter annual pasture legume adapted to much of the hill-land pasture region west of the Cascades. Native to the Mediterranean and western European regions, it has been successfully cultivated in Australia since the late 1800s as a pasture crop with seed being produced there commercially since 1906.[2]

Subclover was introduced into the United States from Australia in the 1920s. The first plantings in Oregon were in 1922 on the Agricultural Experiment Station at Corvallis.[3] Some of the earliest commercial plantings for pasture were in the late 1920s in Douglas County. Some stands of those early plantings are still there—a credit to the persistent nature of this plant.

The first commercial seed fields of subclover in Oregon were planted in 1943,[3], with production reaching a peak in 1951 with 2,400 acres. The average yield at that time was 82 pounds per acre. The main areas of production were in the Willamette Valley with a small amount in the lower river valleys of south central Oregon.[4] Acreage for seed production fell to less than 50 acres between the late 1950s and mid-1970s, but increased to approximately 300 in 1980 and more than 500 in 1981. Most of this increased acreage has shifted from the traditional seed-producing areas in the Willamette Valley to the Umpqua River valleys in Douglas County, but there is some production in Lane County.

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[2] Hill, R. 1936. Subterranean clover — its history in South Australia. Australian Journal of Agriculture 40:322-330.

[3] Rampton, H. H. 1945. Growing subclover in Oregon. Oregon State College Experiment Station Bulletin 432.

[4] Oregon State College. 1954. Oregon's grass and legume seed crops: 1936-53. Federal Cooperative Extension Service and USDA Extension Circular 573.

Description

Subclover seed germinates and plants become established in the fall after the first effective rainfalls. Characteristically, it has a large percentage of hard seed and seed with dormant embryos. These characteristics insure that stands will be established if early season rainfall is followed by dry periods.

Subclover growth rate depends on the severity of winter temperatures. Rapid growth occurs between March and late May if moisture is adequate and temperatures are high enough. Growth slows and terminates with the decline in spring rainfall.

Subclover grows in a rosette form during the winter. Main basal runners, which form and elongate in the spring, may form lateral runners. The flowering period, highly variable, depends on temperature. Active flower development requires adequate moisture. Flowers develop at the stem nodes toward the ends of the basal runners and along most of the lateral runners. They are formed in clusters of three or four rather than in dense heads as in other clovers. The flowers can be observed by looking through leaves near the ground. In some varieties cream-colored petals show red markings. Subclover is self-pollinated and requires no bee pollinators. A bur develops which contains two to four purple-colored seeds. On very sandy soils, the burs are often buried, somewhat like peanuts; on heavier soils, the burs usually are on the soil surface. The earlier maturing varieties are more likely to have buried burs.

The varieties best adapted to Oregon conditions, in order of maturity from latest to earliest, are: Tallarook, Nangeela, Mt. Barker, and Woogenellup. These varieties have the potential to produce more than 1,000 pounds of seed per acre.

SEED PRODUCTION

Precautions

Most subclover seed used in the United States is imported from Australia. Readily available markets have not been developed outside Oregon so nearly all seed produced in the

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state is sold in local markets. Inquiries should be made to determine the proper variety to grow and how to secure a buyer before planning a subclover seed crop.

A new stand should not be established in a field where another variety has been grown recently because of contamination from hard seed of the previous variety.

Some consideration also should be given to the method and equipment of seed harvest. Most conventional methods of clover seed harvest are not adequate for subclover because of the difficulty in picking up burs from the soil surface.

Field Preparation

The field should be as smooth as possible. This benefits stand establishment and greatly improves harvest since ridges in the soil surface make the pickup of burs more difficult.

Time of Planting

Subclover germinates at relatively low temperatures. It is best to establish first-year fields in mid-September or early October before heavy rainfall begins. Planting in a moist and smooth seedbed which has been well worked is best. Early planting is possible if sprinkle irrigation is used to establish the crop. However, spotted cucumber beetles have attacked early established fields in the Willamette Valley.

Inoculation[5]

The seed should be inoculated just before planting. Mixing the inoculant with the seed a day or more before planting may result in unsatisfactory inoculation. Only inoculant specific for subclover should be used since general clover and alfalfa inoculants give inferior results to those of the subclover inoculants. Buy fresh inoculant (not outdated) that has been stored in a cool, dark place. The package should not be opened until planting. Planting seed in a dry seedbed may result in the death of the inoculum and ineffective nodulation.

Seeding Rate and Planting

Subclover has a larger seed than other clovers. Therefore, seeding rates or 10 to 20 pounds per acre are desirable. The grain drill should be set to plant no deeper than one-half inch.

Fertilization[6]

Nitrogen (N) is not required as a fertilizer since this nutrient is supplied by nitrogen-fixing bacteria in the root nodules. Soils which have a low pH test value prevent effective root nodulation. If the pH in the top 2 to 3 inches of soil is below 5.5, apply 1 to 2 tons per acre of lime.

Phosphorus (P) should be banded 1/2 to 1 inch to the side or below the drilled seed row of new seedings. Otherwise, broadcast applications can be used for new stands. P can be applied to established stands by broadcasting in the fall. P should be applied in the following amounts if OSU test values are:

Phosphorus	Apply this amount of P_2O_5
ppm	lbs/acre
0 to 10	60 to 90
10 to 20	40 to 60
20 to 30	30 to 40
over 30	0

Potassium (K) should be broadcast in the fall before seeding new stands or if required in established fields. On new or established fields, K should be applied in the amount shown for the following OSU soil test values:

Potassium	Apply this amount of K_2O
ppm	lbs/acre
0 to 75	60 to 100
75 to 150	40 to 60
over 150	none

Sulfur (S) should be applied annually to furnish 20 to 30 pounds per acre. On the "Red Hill" soils, 40 to 50 pounds per acre of S every three years gives good results.

Boron (B) responses are not always apparent in subclover. B should be broadcast if needed and never banded. B should be applied in the amount shown for the following OSU soil test values:

Boron	Apply this amount of B
ppm	lbs/acre
0 to 0.5	1 to 2
0.5 to 1.0	1
over 1.0	none

All these figures are based on forage responses. No data are available for specific responses for seed production.

Forage Management

Sheep grazing may increase seed yields as much as 50 percent, depending on the year and the time of the grazing treatment. Experiments in Oregon and Australia have shown that without some grazing, seed yields are reduced. Light grazing with two to three ewes per acre before flowering to early bur formation gives maximum seed yields. Sheep grazing should be terminated in time for the crop to fully recover from the defoliation. Limited rainfall after grazing may reduce regrowth and seed yields.

Excessive grazing, grazing during bur formation, or grazing very early in the season also may reduce seed yields. Intense grazing may stimulate bur burial which makes seed harvest more difficult. Consideration should be given to the trade-off between added income from grazing fees and the possible reduction in seed yields from heavy grazing.

Mechanical defoliation has not increased seed yields in experimental plots.

Weed Control[7]

Next to harvest loss, weed control is the major concern in producing subclover seed. Not only do the weeds compete with the crop for light, mineral nutrients, and water, but they also reduce the efficiency of the seed harvest.

Winter annual grasses and broadleaf weeds pose the main problem in subclover seed fields. Ripgut brome, wild oats, rattail fescue, dogtail grass, small quaking grass, and Italian (annual) ryegrass are a few of the annual grassy weeds. Common annual broadleaf weeds are filaree, common chickweed, galium (bedstraw), black medic, vetch, Italian thistle, mustard, and mayweed (dogfennel).

Some perennial weeds commonly found in subclover seed fields include Kentucky bluegrass, bulbous bluegrass, perennial ryegrass, bentgrass, St. Johnswort, and sheep sorrel.

Annual grasses and volunteer cereals can be controlled with EPTC (Eptam) before planting or with propham (Chem-

[5] For further details, see Inoculating Alfalfa and Clover Seed, Oregon State University Extension Bulletin, EC 1055, January 1981.

[6] All fertilization recommendations are based on those for subclover-grass pastures. For further details, see the Oregon State University Fertilizer Guide for Subclover-Grass Pastures, FG 4, June 1979.

[7] All weed control recommendations are based on those given in the Oregon Weed Control Handbook, January 1981, for Crimson and Subterranean Clover, pp. 50, 51.

Hoe) or pronamide (Kerb) after crop emergence (at least three trifoliolate leaves). EPTC should be applied at the rate of 3 pounds per acre active ingredient and incorporated into the soil immediately after spraying. Propham should be applied at 4 pounds per acre active ingredient; pronamide should be applied at 0.75 to 1.0 pound per acre active ingredient.

Propham is degraded rapidly by soil micro-organisms so application should be delayed until soil temperatures are lower. December applications are often more effective than earlier applications, but propham should be applied when the grasses are still small.

Pronamide is more effective on seedling than on established grasses, but requires rainfall or irrigation to move it into the root zone of the weeds. Conditions usually are favorable for pronamide by late November. Later applications may require the higher rate of herbicide.

Perennial grasses such as bentgrass are controlled by EPTC at a rate of 3 pounds per acre active ingredient or by pronamide at 1.5 pounds per acre active ingredient. Time of application is the same as for annual grasses.

Product label directions should be followed closely for best performance of the herbicide.

These herbicides primarily control grasses, but also control some broadleaf weeds such as chickweed. However, they usually are not adequate for general broadleaf weed control.

There are no registered herbicides for the control of broadleaf weeds in subclover seed fields. Weeds such as filaree and black medic grow more frequently in later years of a subclover stand. Starting with a clean field and rotation with such crops as small grains may help reduce the incidence of these weeds in subclover seed fields.

Irrigation

Most seed is produced without irrigation and no experimental information is available concerning the effects of irrigation on subclover seed production in Oregon. Irrigation can be used to help establish stands in early fall and may be of some benefit during droughts. However, information from Australia indicates that late irrigation during bur filling may lower seed yields. Even though moisture stress is avoided, seed yields can be reduced by rotting of the seed. Excess watering also produces large amounts of vegetative growth which hinders seed harvest.

Seed Harvest

Harvest loss severely limits seed yields since 50 percent of the seed crop can be lost during harvest. There is no fully effective harvest procedure which easily recovers all the seed.

All varieties are ready for harvest at about the same time, when active growth ceases and the plant has dried. Large amounts of vegetative growth may delay drying by shading the soil surface and preventing the burs from drying.

There are several ways to harvest subclover. The Horwood-Bagshaw vacuum harvester is the most commonly used machine. When it is used correctly,much of the potential seed yield can be obtained. However, the harvester, a sizeable investment, can be used only for subclover.

Before using the harvester, conventional hay-making equipment must be used to clear the field of dried stems and leaves which cover the seed burs lying near the ground. Once the hay crop has been removed, the field is allowed to dry further or is prepared for the vacuum harvester. Preparation for harvest involves dragging equipment, such as a spike-toothed harrow which has been turned over or a length of cyclone fencing, through the field several times. This process breaks the stems and burs from the crown of the plant, but care must be taken not to shatter too many seeds from the burs. The number of passes over the field and the time of day regulate the effectiveness of this process. Since a vacuum is used to pick up the burs, it is important that the field be flat and free of mounds and ridges. Rough ground, weed residue, and stems still attached to the crown prevent the burs from being picked up by the harvester.

The vacuum harvester is pulled through the field with the vacuum set to pick up whole burs and not individual seeds. Because the Horwood-Bagshaw harvester has an operating speed of approximately one-half acre per hour, it usually is not economical to make more than two passes over a field unless a portion of the field is especially full of burs. This machine is not well suited to steep slopes.

Another method of harvesting seed is to use a windrower with conventional guards on the mower bar. The mower bar can be tilted 12 to 15° below horizontal to cut close to the ground. The windrow is then picked up with a combine as in other seed crops. This method is much faster than the vacuum harvester and uses standard seed harvesting equipment. However, seed losses can be high and the field must be fairly flat to insure even cutting of the standing crop.

The Murphy Pickup has been used to pick up additional seed after the windrow method of harvesting. This attachment is mounted on a conventional combine instead of the header. Rotating rubber flails create a vacuum that is capable of picking up any burs left on the soil surface.

Field Preparation for Following Year's Crop

Most harvest methods leave more than 20 percent of the seed crop in the field. This means that in a field which had the potential of producing 1,000 pounds of seed per acre, 200 pounds of seed remain. Not all this seed will germinate immediately since much of it is dormant, but more than enough is present to reestablish the crop.

Harvest operations tend to leave the seed unevenly distributed throughout the field. For this reason, it is probably best to harrow or lightly disc the field sometime before germination in the fall. This distributes the seed throughout the field and allows better contact between the seed and the soil, improving stand establishment.

Since subclover is an annual crop, soil amendments and fertilizers can be applied at this time if needed.