

The Adaptation, Cultural, and Management Requirements of Cascade Lotus

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CASCADE LOTUS is a special strain of broad-leaved birdsfoot trefoil, *Lotus corniculatus* L., a popular new forage legume. It has become popular because of its adaptation to shallow acid soils, high forage production over a long period of time, palatability, and high feeding value.

With proper cultural and management practices, Cascade lotus can be grown successfully on much of the nonirrigated, low-capability land in western Washington and northwestern Oregon. It is long-lived and therefore more economical to use than the short-lived, red clover-grass mixture now used extensively in this area.

Birdsfoot Trefoil in Western Washington and Northwestern Oregon

Broad-leaved birdsfoot trefoil came to this country by accident—no one knows just when. It spread along New York highways where farmers discovered the value of it for both pasture and hay. As a legume, it became the subject of intense study by New York agricultural workers in 1934.

However, the use of birdsfoot trefoil in western Washington and northwestern Oregon is relatively recent. The eastern and imported varieties had little success here, due primarily to weak seedling vigor and low forage yields. The Cascade variety has characteristics that overcame these limitations. It has strong seedling vigor, has good recovery after cutting, is persistent, and produces high yields of forage. It was selected from three European-imported lots in 1944. The most vigorous plants were selected and grown in an isolated block for seed increase.

Cascade lotus was released jointly in 1949 by the Bellingham Soil Conservation Service Nursery and the Washington State Agricultural Experiment Station (Chapin, Hafenrichter, and Law, 1951). Cascade lotus has been registered under the cooperative agreement between the Field Crops Research Service, United States Department of Agriculture, and the American Society of Agronomy (Hollowell, 1954).

This legume was introduced in the field through field-sized planting trials established on the farms of soil conservation district cooperators. Trials were

established in Clark, Cowlitz, Grays Harbor, Kitsap, Lewis, Pierce, Snohomish, Thurston, and Whatcom counties in western Washington and in Marion and Multnomah counties in northwestern Oregon. Through these trials, Cascade lotus was further evaluated under actual-use conditions where additional information was obtained on its adaptation to major soil types and its cultural and management requirements.

The first field trial of Cascade lotus was established in 1948 in Lewis County. To date more than 1,800 acres have been seeded on farms and ranches of Clark, Lewis, and Thurston counties. Additional plantings have also been made in a number of adjacent counties.

Plant Description

The Cascade variety, like other varieties of the erect, broad-leaved birds-foot trefoil, resembles a fine-leaved, fine-stemmed alfalfa. It is a perennial legume usually growing to a height of 20 to 40 inches. Old plants may have 50 to 100 stems from a single crown. The pea-like flowers are larger than those of alfalfa, with four to eight flowers in a cluster. Flowers are from bright orange-yellow to lemon-yellow in color. Flowers are self-sterile, and for seed production cross-pollination must be done by bees.

Adaptation

Cascade lotus is climatically adapted to all of western Washington and northwestern Oregon. Preliminary results from experiments now being conducted indicate that it is superior to other varieties for use in some areas in eastern Washington and northern Idaho.

It has wide soil tolerance and grows under conditions of wide variations in soil acidity, fertility, and moisture. It is highly recommended for use on the moderately to well-drained, medium to heavy-textured surface soils with clay subsoils or restricting layers occurring at a depth of 24 to 40 inches. These soils are not suited to alfalfa production. Cascade lotus has done well on the deep, well-drained bottom and hill soils, but, where the pH and fertility levels are satisfactory, alfalfa has been more productive.

It will make good growth on acid soils on which alfalfa won't succeed. It should not be substituted for big trefoil, *Lotus uliginosus* Schkuhr, on wet lands.

Establishing Stands

Cascade lotus should be seeded in the spring on a well-prepared, firmed seedbed. Seeding during late April and May has given good results. Fall seedings of nearly all adapted perennial legumes have done poorly. Cold

weather and frost heaving are primarily responsible for failures of establishing legumes from dryland fall seedings. Work done at Cornell University (Smith and Broadbent, 1955) has indicated that cold temperatures prevent nodulation and nitrogen fixation of birdsfoot trefoil. This may partially account for the failures and near failures of establishing Cascade lotus from fall seedings. The seed from Cascade lotus should be inoculated with its own special inoculant just prior to seeding. It is suggested that skim milk be used to adhere the inoculant to the seed.

Mixtures

Highest forage yields are obtained when Cascade lotus is seeded with a grass. Mixtures containing a grass are also freer of low-grade, weedy grasses. Cascade lotus is compatible with either orchardgrass or tall fescue, but the amount of grass in the mixture should be kept at a minimum in order to avoid excessive competition to the lotus during establishment. Mixtures of five pounds of Cascade lotus and five pounds of orchardgrass or eight pounds of tall fescue have been highly successful.

Seeding

Cascade lotus should be seeded only on well-firmed seedbeds, as planting is generally too deep on loose, poorly firmed seedbeds. Drill seedings have given better results than broadcast seedings.

The most successful way of establishing Cascade-grass mixtures has been by the alternate-row method of seeding. This is a new technique which is easily accomplished by making simple alterations on standard grain drills. This method of establishment reduces competition and results in more uniform stands.

Control Weeds during Establishment

The control of weeds in new, birdsfoot trefoil-grass seedings is desirable. This can be accomplished by either clipping or by means of a chemical weed killer.

Work done at the Northwest Washington Experiment Station (Johnson, Peabody, and Wolfe, 1955) has shown that many of the annual weeds can be controlled without injury to grasses and legumes by using a chemical weed killer, dinitro amine. This chemical should be applied soon after the legume reaches the first true leaf stage of growth.

Management of Stands

Cascade lotus is ideal for silage and hay production, and it will persist for years under this system of management. This gives it very distinct advantage

over red clover, a short-lived legume, which is commonly used for these purposes on the shallow, nonirrigated soils.

The yields of Cascade lotus-grass mixtures under dryland conditions vary from three to four tons of hay and are obtained in two cuttings. It is equal to alfalfa hay in feed value (McKee and Schoth, 1941).

When Cascade lotus is used in seedings primarily for pasture, careful grazing management is necessary to maintain stands. This is especially true during the first three years following seeding. When strip grazing is practiced, which allows about a three-week recovery period, it makes an ideal pasture legume and can be grazed without danger of bloat. It is sometimes substituted for Ladino clover in irrigated pastures because of the nonbloat hazard, although it is only about 75 per cent as productive. The higher yield is sacrificed to prevent the risk of losing valuable animals.

Fertilization

The application of barnyard manure supplemented with phosphate has been beneficial in stimulating growth of both lotus and grass and in maintaining a desirable lotus-grass balance.

Applications of commercial nitrogen and phosphate have given good responses, but care must be taken not to overfertilize with nitrogen in the spring. Heavy applications of nitrogen at this time will stimulate the growth of the grass to the extent that the competition will be detrimental to the lotus. Applications of 30 pounds of actual nitrogen and 60 pounds of available phosphate have given good returns on many seedings.

Liming is recommended if soil pH is below 5.6.

Seed Production

Cascade lotus is being used rather extensively in Lewis, Thurston, and Clark counties. There are many other counties where it is recommended, but seed supplies are limited.

Several farmers have attempted to produce Cascade lotus seed west of the Cascades, but weed competition, insect damage, seed shattering, and unfavorable climatic conditions during harvest have discouraged most of them. However, chemical weedicides, insecticides, and desiccant sprays have been little used by these producers.

Production presently comes from a few fields that are harvested when seed set and climatic conditions appear favorable.

The method most commonly used in western Washington has been to seed Cascade lotus in rows spaced 28 to 36 inches apart. Seed harvest has been

accomplished by mowing and windrowing, letting the crop wilt in the windrow, and combining. This method has resulted in seed yields of from 50 to 300 pounds of seed per acre, depending on degree of shattering prior to windrowing, and weather conditions following windrowing.

Where the round baler is used, the crop is windrowed, allowed to wilt, and baled. After the bales are dry, they are opened and fed through a combine. But there are disadvantages to this method, as it requires more hand labor than other methods, and the forage may heat and lower seed germination.

A new technique was used in Cascade lotus seed production during the 1956 harvest at the Pullman, Washington, Soil Conservation Service Plant Materials Center. The green material was removed from the field and spread 18 to 24 inches deep on plastic sheeting to wilt. All shattered seed was saved. This technique resulted in seed yields of 300 pounds of clean seed per acre from a newly established field.

The Lygus bug has reduced seed yields in this area when fields are not dusted. This insect can be controlled by dusting with DDT or by spraying with toxaphene. As a general rule, dust or spray the plants just as they begin to bloom. As these chemicals are injurious to bees that are necessary for pollination, all dusting or spraying after the plants are in bloom should be done in the early morning before the bees are in the field or late in the evening after they have left. Forage that has been sprayed or dusted with toxaphene or DDT should not be fed to dairy cattle.

Work done in Iowa (Thompson and Metcalf, 1955) has indicated that the first crop should be used as seed. Mowing or grazing trefoil in the spring greatly reduced seed yields.

The time to harvest trefoil is difficult to determine, as it does not flower uniformly. Flowers and green, brown, black, or shattered pods may occur on a single plant at the same time. The pods may break open and shatter seed soon after they are ripe, but they usually don't shatter until they are dark brown or black.

From the results of the Iowa study (Anderson, 1955) it may be concluded that higher seed yields may be obtained if birdsfoot trefoil is harvested when the maximum number of pods are light green to light brown. Pods will not shatter as profusely as at more mature stages. They reach this stage at Ames, Iowa, from 25 to 28 days after full bloom.

Work done by the Iowa State College Seed Testing Laboratory (Wiggins, Metcalf, Thompson, and Buchele, 1956) has indicated that the use of chemical desiccants offers considerable promise in harvesting trefoil seeds. The plants dry rapidly, and direct combining is practical.

Dinitro, at a rate of two pints in five gallons of diesel oil per acre, and pentachlorophenol, at the rate of four quarts in 20 gallons of diesel oil per acre, have been the most promising chemicals. These chemicals gave satisfactory results even in cool and humid weather. Endothal, at three gallons in 40 gallons of water per acre, desiccated the forage rapidly only when the weather was hot and dry.

The cost of such desiccant sprays averaged around \$5.00 per acre, although actual cost varied with the chemical used and the rate of application.

These chemicals killed the upper or foliage parts of the plants on contact. They acted like artificial frost drying the leaves and plant tops. These desiccants have not affected seed germination or the stand of the crop the following year.

Combining must follow the sprays application within from 36 to 48 hours to prevent excessive shattering.

Summary

The main factors involved in establishing and managing Cascade lotus for a forage crop or producing profitable seed yields of this new legume are:

1. Drill seed on a smooth, well-firmed seedbed.
2. Seed only in the spring—late April or early May.
3. Use equal amounts of Cascade lotus and grass. A mixture of five pounds of Cascade lotus and five pounds of Akaroa orchardgrass per acre is recommended.
4. Alternate row seedings give best results.
5. Cascade lotus is well adapted to soils having a claypan-restricting layer at 24 to 40 inches below the surface.
6. Cascade lotus is an excellent plant to grow for silage and hay.
7. Cascade lotus can be used for pasture, but rotate grazing for high production.
8. Applications of manure supplemented with phosphate have always been beneficial. Lime, nitrogen, and phosphate have been economical where the soil was deficient in these elements.
9. For seed production, Cascade lotus should be seeded in spaced rows and cultivated.
10. Lygus bug must be controlled for high seed yields.
11. Bees are need for pollination.
12. The most common method of seed harvest is to mow, windrow, allow forage to wilt, and combine.
13. Chemical desiccants appear as promising seed-harvest techniques.

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