

# Sweetclover production in Western Canada



Agriculture  
Canada

Publication 1613/E



630.4  
C212  
P 1613  
1984  
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Canada

**PUBLICATION 1613**, available from Communications Branch,  
Agriculture Canada, Ottawa K1A 0C7

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Cat. No. A53-1613/1984E ISBN: 0-662-13432-X

Printed 1977 Revised 1984 10M - 9:84

Également disponible en français sous le titre:

*Le mélilot dans l'ouest du Canada*

Cover photo

The two most commonly cultivated species of sweetclover grown in Canada. *Left*, white blossom, *Melilotus alba* Desr. *Right*, yellow blossom, *M. officinalis* (L.) Lam.

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# Sweetclover production in Western Canada

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## Introduction

Sweetclover is a native of Asia Minor. In the 1700s, it was introduced into North America where it was considered to be a weed for nearly 200 years. Since 1875, it has been recognized as a valuable forage crop.

Sweetclover is a fast-growing legume that is valuable for soil improvement, silage production, and nutritious pasturage. It is also a source of nectar and pollen for honey production. It is a biennial, that is, it lives through only one winter so it is useful in short rotations. Sweetclover is drought resistant and is particularly well adapted to the drier areas of Western Canada.

Sweetclover has some disadvantages as a crop. It is susceptible to infestation by the sweetclover weevil, which often destroys new seedlings. It is highly sensitive to 2,4-D herbicide drift and although it is not killed, its leaves and stems become distorted and it may shed its leaves and flowers. Livestock find sweetclover less palatable than other legumes and they may develop "sweetclover or bleeding disease" when fed an improperly cured sweetclover forage for 3 weeks or more. Volunteer sweetclover plants may develop on land sown to sweetclover because seeds are often too hard coated to germinate in the first season and they remain in the soil for many years.

## Characteristics

Sweetclover is a sweet-scented, upright, broad-leaved legume. The plants have many stems and branches. The leaves are 1.3–2.5 cm long and consist of three leaflets, which are mostly saw-toothed along the edges. In the seedling year, plants develop to a height of 30–91 cm. In the 2nd year, growth develops from the base and at maturity plants average 1.2–1.5 m in height. Also in the 2nd year, flower racemes grow from the axils of the leaves and produce many florets, each of which may develop a seed pod containing one and sometimes two seeds.

There are two common types of sweetclover, white-flowered and yellow-flowered. The yellow-flowered sweetclover is shorter, finer stemmed, and finer leaved than the white-flowered type. It flowers earlier and has spreading growth and purple-flecked seeds.

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\*Deceased June 1979.

## Adaptation

Sweetclover is winter-hardy and grows throughout Western Canada. It is most productive on fertile, well-drained clay and clay loam soils. However, it can be successfully grown on sandy loams and heavy clay soils, and on Gray Luvisol soils. It can also be grown on saline "white alkali" soils, which are unsuitable for cereal crops. Sweetclover frequently thrives along roadside ditches where there is a good moisture supply, and it reseeds itself when left uncut or ungrazed.

Sweetclover should not be sown on land that is subject to flooding or on acid soils.

## Varieties

### Polara

A white-blossomed, biennial variety of *Melilotus alba* Desr., Polara, was developed by the Research Station, Saskatoon, and licensed in 1970. It contains only trace amounts of coumarin, whereas all other varieties of sweetclover grown in Canada have high levels of the potentially harmful substance. The low-coumarin variety Polara produces forage with no danger of causing sweetclover or bleeding disease in farm livestock, which is discussed in this publication under the heading of "Sweetclover disease."

### Yukon

This yellow-blossomed, biennial variety of *Melilotus officinalis* (L.) Lam., Yukon, was developed by the Research Station, Saskatoon, and licensed in 1970. Yukon is a winter-hardy strain of Madrid sweetclover. It was developed by natural selection from an original introduction of Madrid in 1950, which was grown through consecutive generations in northern Saskatchewan. As a general-purpose variety it has excellent seedling vigor for easy establishment, is winter-hardy, and produces high yields of forage and seed.

### Norgold

Norgold is a low-coumarin, yellow-blossomed, biennial cultivar of sweetclover. It was licensed in 1981 by the Research Station, Saskatoon. It is the first low-coumarin cultivar of yellow-blossomed sweetclover to be developed. Because the plants contain only trace amounts of coumarin, as in Polara, use of this cultivar avoids any potential problem of the hemorrhagic condition known as sweetclover disease. Farmers and ranchers in North America have shown a strong preference for yellow-blossomed sweetclovers, and Norgold is typical of this species with its finer stems, finer leaves, and earlier flowering than the white-flowered cultivars. Also, Norgold has been found to be substantially higher in forage and seed yield than Polara, the only other low-coumarin cultivar available.

Therefore, Norgold is expected to replace Polara and serve as a low-coumarin equivalent of the yellow-blossomed cultivar Yukon.

## Seeding

Use only pedigreed seed of a variety recommended for your area. The use of pedigreed seed ensures high-quality seed that has good germination and is free from weed seeds. Choosing a recommended variety provides maximum yields and economic returns on your investment.

Sweetclover has a hard seed coat, so that only a few seeds germinate each year when it is growing naturally. Unless this seed coat is chipped or otherwise broken, moisture cannot enter and the seed does not germinate. Sweetclover seed must be scarified before seeding. Seed companies sell only scarified sweetclover seed. Sweetclover produced and sold by a farmer can be scarified with a grain crusher by adjusting the plates so that only a very small amount of seed is ground.

Sweetclover should be seeded on clean, summerfallow land. Before seeding, harrow the land once or twice to ensure a firm, well-packed seedbed. The seedbed must be firm to ensure shallow seeding, and also to provide better moisture conditions near the soil surface. The seed should be sown at a depth of less than 2.5 cm. Depth control attachments are particularly useful to ensure shallow seeding. One of the most common causes of failure in new seedings results from seeding too deep (Table 1).

**Table 1. The effect of seeding depth on emergence and establishment of a sweetclover stand**

Depth of seeding cm	Emergence %	No. of days for emergence	Characteristics of stand
1.3	98	4	very uniform, strong stand
2.5	88	5	very uniform, fairly strong stand
3.8	46	6	fairly uniform, weak stand
5.0	20	7	uneven, very weak stand
6.3	2	9	very uneven, seedlings yellow and spindly
7.5	0	—	no emergence

For purposes of hay, silage, or soil improvement, seed sweetclover at a rate of 9.0–11.2 kg/ha and in rows 15–20 cm apart. Seeds may be broadcast if moisture conditions are excellent. However, this practice is not recommended because the surface soil seldom remains moist long enough for the seeds to germinate and become established. For seed production, seed at a rate of 3.4–4.5 kg/ha in rows 61–91 cm apart.

Purpose of crop	Row spacing cm	Seeding rate kg/ha
Hay, silage, soil improvement	15–20	9.0–11.2
Seed	61–91	3.4–4.5

Seed sweetclover as early as possible in the spring. Early seeding takes advantage of favorable moisture conditions and allows the sweetclover seedlings to emerge and become established before weed growth begins. **Fall seeding of sweetclover is not recommended.**

Using a companion crop is up to your own judgment. Keep in mind that a better and stronger seedling stand usually results when a companion crop is not used. However, if you do plant a companion crop, sow it at one-half or less the normal rate as a first operation; this further packs and firms the soil. Then seed the sweetclover at the required shallow depth, either crosswise or in alternate rows, to minimize competition between the more vigorous companion crop seedlings and the delicate forage seedlings.

The greatest obstacles to successful seedling establishment of sweetclover are weeds and weevils, which are discussed in detail later in this publication.

Inoculate each new seeding to provide the proper nitrogen-fixing bacteria. Sweetclover and alfalfa use the same type of inoculant, culture A.

## Weed control and fertilizers

Sweetclover is very susceptible to all the known herbicides used for control of broad-leaved weeds. Hence, every effort should be given to minimize weed growth and competition by cultural methods, as described previously. The following well-established practices will give the sweetclover seedlings maximum opportunity to establish and develop vigorous seedlings before the spring flush of weed growth occurs:

- Seed on clean summerfallow land.
- Prepare the seedbed well and firm the soil by packing.
- Seed shallow, less than 2.5 cm.
- Seed as early as possible in the spring.

If considerable weed growth occurs or if a companion crop has been used, it should be mowed off or otherwise harvested early (no later than July) to remove the top growth and allow the sweetclover to grow vigorously until the fall frosts occur. In widely spaced rows for seed production, weeds can be controlled by cultivation.

Some weeds, such as green foxtail and wild oats, can be successfully controlled by herbicides. Please consult your local agricultural authority for specific recommendations concerning herbicides.

Although no postemergence herbicides have been found for control of broad-leaved weeds in sweetclover, the writers have found some preemergence herbicides to effect good weed control without harming the sweetclover seedlings.

Sweetclover is a legume and obtains its nitrogen requirements by nitrogen fixation in the root nodules. However, in certain areas it may be necessary to apply phosphorus, potassium, or sulfur. For more specific recommendations, have your

soil tested and consult your nearest Agrolgist representative. Most provinces prepare and distribute an annual bulletin on the most recent fertilizer and weed control recommendations.

## Crop uses

### Seed production

Sweetclover can be grown for seed on either dry or irrigated land. Spaced rows or solid stands may be used. For pedigreed seed production, spaced rows are preferred to permit easier roguing of weeds and off-type plants.

Honey bees are essential for pollination to assure seed setting. Three to five colonies are needed for each hectare. If you depend on natural pollinators, the yields may be 56–112 kg/ha, whereas if you use honey bees the yields can be 560–785 kg/ha (Fig. 1).

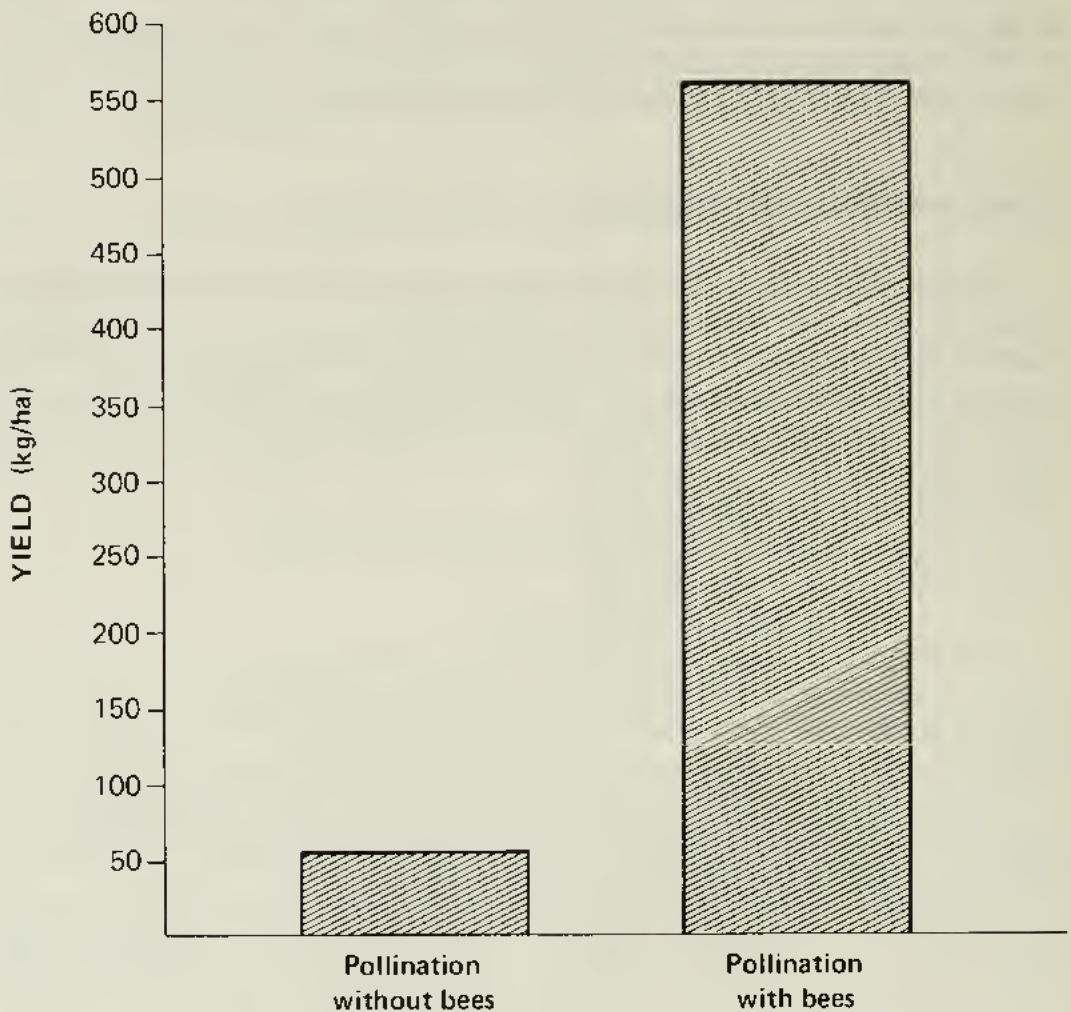


Fig. 1. The effect of honey bees on seed yields of sweetclover. *Left*, with no bees, the yield was 56 kg/ha; *right*, with pollination by bees, the yield was 560 kg/ha.



Sweetclover is especially sensitive to some herbicides. Flower drop results from herbicide drift of spray or dust. Growing tips of branches become distorted at higher concentrations of herbicide drift. Plants may flower after such damage but the seed crop may be too late to mature.

Seed pods turn brown, dark gray, or white when mature. It is critical to swath when two-thirds of the seeds are mature. Within a week most of the immature pods ripen in the swath, so that the crop can be picked up with a combine. Seeds drop faster as they mature and a crop may be lost by delayed swathing or by a wind storm. The swath is usually very fluffy and may not feed well into the combine. Swath and pick up the seeds when they are damp such as in early morning, to lose fewer seeds from pod drop. Use a slow cylinder speed and wide clearance of concaves to avoid shelled or broken seed and to obtain maximum seed yields. The hulls should also be left on because this makes cleaning the seeds easier (Fig. 2).



Fig. 2. The hull should remain on the seed in properly harvested sweetclover. *Left*, properly harvested; *right*, improperly harvested; arrows point to seeds without hulls.

## Silage

Sweetclover should be cut for silage at the 10–20% bloom stage of flowering. Moisture content should be from 65–72%. Sweetclover should be conditioned and lie in the swath for 2 or 3 hours on a sunny day, or longer on a dull day, before cutting with a forage harvester. When the silage pieces are 1.3 cm long and a squeezed handful slowly breaks apart when hand pressure is released, it is ready for ensiling. If the squeezed handful falls apart when pressure is released it is too dry, and if it stays in a firm ball it is too wet. Silage needs firm packing as soon as it is placed in the silo to eliminate air, to assure rapid fermentation, and to avoid spoilage. The silo should be filled as quickly as possible to limit spoilage. The surface layer should be of another forage that is less susceptible to mold than

sweetclover. Place a plastic cover over the silo as soon as it is filled. Spoilage of sweetclover silage is dangerous because of the problem of sweetclover or bleeding disease, which is discussed later in the section on "Sweetclover disease."

## Soil improvement

Sweetclover is one of the best legumes for soil improvement. The widely branched, deeply penetrating taproots open up the subsoil. The roots use nutrients not available to plants with shallow roots. When sweetclover plants decay, the nutrients in the roots are released for use by other crops.

When properly inoculated, sweetclover contributes considerable organic matter and nitrogen to the soil. When plowed under in the year after seeding, the succulent top growth and the fleshy, heavy roots decay rapidly. This improves aeration, drainage, and the general physical condition of the soil.

Plow under when sweetclover plants are about 15 cm high in the year after seeding. Late plowing adds more organic matter, but if the growth is heavy the surface soil may dry out and the organic matter may break down slowly. Release of nitrogen to the succeeding crop requires activity of the soil microflora and late breaking will not allow adequate time for decomposition and nutrient release. Heavy growth of sweetclover, when plowed under, may form an insulation layer that prevents root penetration and good establishment of the crop following the sweetclover.

## Saline "white alkali" soils

These problem soils have a high soluble-salt content and usually poor surface drainage; they require soil-improving crops such as sweetclover. High-phosphate fertilizers are needed to assure establishment and good production by the sweetclover, which is plowed under in its 2nd year to add organic matter and nitrogen as discussed previously under "Soil improvement." One or two cereal crops may be harvested before sweetclover is seeded again on the less saline areas. The highly saline areas should be sown permanently with the high salinity-tolerant forages such as tall wheatgrass or slender wheatgrass.

## Bee pasture

Sweetclover is an excellent source of nectar and pollen for honey bees. It produces good yields of high-quality honey. To assure continuous blossom for bees, management is required. By using Yukon, an early blooming variety, and Polara, a later-blooming variety, you can extend the period of flower and nectar available for bees. Also, by cutting back early growth you can delay onset of flowering and extend the nectar-producing capability of the crop.

## Pasture

When properly managed, sweetclover supplies high yields of nutritious, succulent legume pasturage with little or no danger of bloat. Some legumes are more palatable and more productive and can withstand grazing better than sweetclover. Plants that are 25–38 cm high provide good pasturage, whereas taller plants become coarse, woody, and unpalatable. Plants that are less than 25 cm high should not be grazed; production would be severely limited because regrowth does not develop from the base, but only occurs from the branches of developed stems.

## Hay

When sown in early May on fallow or on adequately fertilized stubble in areas of sufficient rainfall, sweetclover provides more nutritious feed in the seedling year than any other legume or perennial forage. Second-year production is not adversely affected if a hay harvest is taken in late September of the seedling year.

Sweetclover, however, is not considered a good hay crop. When cut just before blossoms appear and if properly cured, it makes a fairly good hay, but at this time the stems are succulent, high in water, and hard to dry sufficiently for safe storage. The mowed or swathed hay requires treatment with a conditioner attachment. When hay is left for the stems to dry out to a safe moisture level, the leaves dry, become brittle, and shatter badly. If you delay cutting, the proportion of coarse stems to leaves increases and feeding value decreases. Such plants are tough, woody, and rather unpalatable to livestock.

## Diseases and insects

Sweetclover grown in Canada is fairly free from serious disease problems.

The sweetclover weevil is the main insect pest of sweetclover grown in Western Canada. Damage is most severe in the spring in new seedling stands, particularly in dry years when growth is slow and establishment is difficult. A light weevil infestation at this time can severely thin or completely destroy a stand. Frequently when a companion crop has been used the farmer may be unaware that a stand has been destroyed by weevils until after the companion crop has been harvested. Check for weevil damage to the seedlings growing under a canopy, as well as in early spring when the most severe damage may occur. In late summer or early fall, new adult-generation weevils may move into seedling stands from 2nd-year stands that have been harvested for seed or plowed under after a hay crop. In this case damage is most noticeable along field margins. In 2nd-year stands of sweetclover, damage from the weevil (Fig. 3) is generally small because the plants grow so vigorously. Only a very heavy infestation of weevils can thin and stunt them. Because of the potential movement of weevils from 2nd-year stands, sow new stands as far away as possible from 2nd-year stands.



Fig. 3. Typical symptoms of damage from sweetclover weevil.

Control of the sweetclover weevil can be carried out by certain agronomic practices and by insecticides:

- Sow high-quality, scarified seed into a firm, moist seedbed at a depth of less than 2.5 cm.
- Locate your new seedling stand as far as possible from 2nd-year stands.
- Watch for signs of weevil damage in the spring and then in mid-summer, and apply a recommended insecticide as required.
- Shallow-cultivate, plow, or till 2nd-year fields as soon as harvested to destroy the new population of weevils in the soil.

Occasionally damage to seedling stands may also occur from cutworms and grasshoppers. Cutworm damage can be detected when the seedlings wilt and die because they have been cut off below ground or at the surface, or completely eaten off above ground. Grasshopper damage is easily detected by observing large numbers of grasshoppers in the field. In either case, if the infestation is damaging the stand, apply the recommended insecticide as required.

### **Sweetclover disease**

In poorly preserved sweetclover hay or silage, coumarin may change to dicoumarol, a potent anticoagulant. When eaten by farm livestock, dicoumarol in spoiled sweetclover forage interferes with normal blood clotting and causes an often fatal condition called sweetclover disease. The blood of affected animals loses its normal ability to clot and livestock may bleed to death from the slightest injury, either internally or externally.

Although most sweetclover forage is safe for feed, improperly cured and moldy forage should be used with caution. Samples from such forage should be sent to the nearest Feed Testing Laboratory for a chemical analysis of dicoumarol content. Sweetclover hay or silage containing dicoumarol should not be fed to farm livestock. However, if this represents a large economic loss, you may lessen the danger of loss of animals from bleeding by feeding the sweetclover for 10 days, followed by 10 days with some other forage. Also, severely spoiled parts of sweetclover forage should be removed and disposed of in a safe place away from farm animals.

If you find sweetclover disease in your herd, immediately stop feeding with sweetclover forage and consult your nearest veterinarian. He may alleviate the condition by massive doses of some K vitamins.

The use of low-coumarin varieties of sweetclover, such as Polara and Norgold, eliminates the problem of sweetclover disease. They contain only trace quantities of coumarin, the precursor of the anticoagulant dicoumarol. Hence no degree of spoilage or improper curing can lead to sweetclover disease from such low-coumarin forage.

## CONVERSION FACTORS

Metric units	Approximate conversion factors	Results in:
<b>LINEAR</b>		
millimetre (mm)	x 0.04	inch
centimetre (cm)	x 0.39	inch
metre (m)	x 3.28	feet
kilometre (km)	x 0.62	mile
<b>AREA</b>		
square centimetre (cm <sup>2</sup> )	x 0.15	square inch
square metre (m <sup>2</sup> )	x 1.2	square yard
square kilometre (km <sup>2</sup> )	x 0.39	square mile
hectare (ha)	x 2.5	acres
<b>VOLUME</b>		
cubic centimetre (cm <sup>3</sup> )	x 0.06	cubic inch
cubic metre (m <sup>3</sup> )	x 35.31	cubic feet
	x 1.31	cubic yard
<b>CAPACITY</b>		
litre (L)	x 0.035	cubic feet
hectolitre (hL)	x 22	gallons
	x 2,5	bushels
<b>WEIGHT</b>		
gram (g)	x 0.04	oz avdp
kilogram (kg)	x 2.2	lb avdp
tonne (t)	x 1.1	short ton
<b>AGRICULTURAL</b>		
litres per hectare (L/ha)	x 0.089	gallons per acre
	x 0.357	quarts per acre
	x 0.71	pints per acre
millilitres per hectare (mL/ha)	x 0.014	fl. oz per acre
tonnes per hectare (t/ha)	x 0.45	tons per acre
kilograms per hectare (kg/ha)	x 0.89	lb per acre
grams per hectare (g/ha)	x 0.014	oz avdp per acre
plants per hectare (plants/ha)	x 0.405	plants per acre

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