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PRODUCING RED CLOVER SEED IN ONTARIO

S.R. Bowley and R.A. Upfold,
Crop Science Department, University of Guelph,
and H. Wright, Plant Industry Branch

Red Clover is a widely adapted forage legume that has excellent quality and is easy to establish (Figure 1). It is more tolerant of variable drainage and is more productive at a lower soil pH (5.0-6.0) than alfalfa. However, it does poorly under dry, sandy or gravelly conditions.

Red clover is especially useful as a one or two-year "break" crop for rotation on cash-crop farms. It fits well into such rotations because it improves soil structure, supplies nitrogen to succeeding crops, and helps break disease and insect cycles. In addition, seed can be produced for an additional source of income.

SEEDING

Red clover is frequently seeded with a companion crop such as barley or winter wheat. Broadcast seedings into winter wheat should be made in late March to early April. Seed may be applied with the nitrogen application on wheat, or as a separate application using a broadcast seeder. With spring cereals, early seeding at the same time as the cereal is preferred, although summer seeding (August) can sometimes be successful. Fall plantings of red clover rarely are successful. In situations where underseedings often fail, direct seeding of red clover (*i.e.*, without a companion crop) is recommended. *Rhizobium* inoculant may be worthwhile, especially in fields that have not had red clover for a number of years.

Seed may be sown with a grain drill equipped with a small seed box, by a cyclone seeder, or by a billion-type seeder.

Care should be taken to prevent undue competition from the companion cereal crop. The companion crop should be removed from the new seeding as soon as possible to reduce competition and to give the young clover plants a better chance of survival. Although as little as 3 kg/ha of red clover seed can produce high seed yields, it is desirable to sow 8-10 kg/ha on most farms to ensure a good stand.

WEED CONTROL

Weed control can be achieved using a number of herbicides. MCPA will give good control of common mustard and many broadleaf weeds in cereals seeded down to red clover. Note that red clover will be damaged by 2,4-DB. Consult OMAF Publication 75, *Guide to Chemical Weed Control* for recommended herbicides and rates.

DISEASES

During the late spring and summer, northern anthracnose [*Kabatiella caulivora* (Kirch) Karak] and powdery mildew [*Erysiphe polygoni* DC] may infect red clover.

Northern anthracnose causes small, darkened lesions



Figure 1. Red clover is easy to establish, provides excellent quality feed, and will produce a seed crop.



Figure 2. Northern anthracnose is a major disease that causes stems to droop and die. Recommended varieties have good tolerance to the disease.

on the stems and petioles. These lesions grow larger and take on a dark brown-black appearance as the affected parts die. The plant takes on a wilted, droopy appearance (Figure 2). Northern anthracnose is most often found on the first growth especially in damp, cool seasons.

Powdery mildew appears as a whitish growth on the leaves (Figure 3). The fungus forms a cobweb of mycelium on the leaflet surface and sends feeding structures into the leaf cells. The surface of the leaves take on a white,



Figure 3. Powdery mildew is prevalent during periods of moderate temperature and moist conditions.

powdery or dusty appearance. The disease weakens the plant but seldom kills it.

Both northern anthracnose and powdery mildew are most prevalent in periods of moderate temperature and moist conditions. Recommended varieties of red clover (see OMAF Publication 296, *Field Crop Recommendations*) have good tolerance to both diseases. Common seedlots will not necessarily have resistance to these diseases.

Root and crown rots will seriously deplete or eliminate the stand after a couple of years. Organisms associated with root rot include *Fusarium* sp., *Rhizoctonia* sp., *Gliocladium* sp., and *Sclerotinia* sp. The plants may die during the dry summer period or are killed during the winter. Varieties with significant tolerance to these diseases are not presently available.

INSECTS

The clover seed chalcid (*Bruchophagus platyptera* Walker) is one of the most damaging insects to clover seed. The adult is a jet-black, wasp-like insect about 2 mm in length. The females lay their eggs in the developing seed pods. The eggs hatch into larvae and these then eat the inside of the seed leaving a thin outer shell. Infested plants will not show visible damage. Close examination of the seeds, however, will show many of them with empty shells or parts of such shells. The insect has been found to be extremely difficult to control. Destruction of chaff and screenings, and maintaining clean fields help to reduce damage from the chalcid.

The clover bud weevil, also called the lesser clover-leaf weevil (*Phytonomus nigrirostris* F.) can also attack the developing seed head. The beetles are about 3 mm long, blue-green in color, with small black heads. Infested plants show a deadening of the leaves and reduced growth, particularly in dry seasons. Just above the axils of the stem, small slits, where eggs have been deposited, will be found cut in the stem. The developing larvae feed on the newly forming buds and cause the flower heads to appear stunted and mishapen. No satisfactory method of control has been found. In most years, the weevil is not a problem in Ontario.

MANAGEMENT

Although it is possible to produce seed of red clover in the year of seeding (direct seedings only), this is not a recommended practice. The seed yield will be lower and

undesirable annual types of red clover are likely in flower at that time. These annual types will reduce the persistence of the stands obtained when the harvested seed is planted. Because of this, pedigreed seed fields of double-cut red clover must be managed to prevent setting of seed in the year of seeding unless special permission has been obtained from the Canadian Seed Growers Association (CSGA).

Optimum seed yields of double-cut red clover are obtained from the second harvest of the first full crop year (Table 1). The stand is thinner, the weather is more favorable, and bee populations and movement tend to be higher compared to the first growth. The first crop should be harvested (as hay or silage) as soon as possible once the plants have reached the early bloom stage. If harvest is delayed, the forage will be of lower quality and seed yields from the second cut will be reduced considerably. Seed production of double-cut red clover is often not economical in the second full production year. **Note:** Seed from the single-cut red clover must be taken from the first crop because the aftermath will not flower.

Although seed can be obtained from the first growth, excessive forage and/or grass growth often reduces seed yield and causes harvesting problems. A practice that is often used in southern Ontario is to take a silage harvest the first week of June or to clip the stand and leave a 30-40 cm stubble the third week of May. This reduces the vegetative growth thereby increasing seed yield and reducing harvesting problems.

Highest seed yields are obtained from short, sparse growth. Plants in wide rows (30 cm vs. 15 cm) will give greater seed yield; however, weeds are often a problem (in wide rows) and this may pose a management problem for production of quality seed.

Seed yields range from 60-300 kg/ha (1-5 bu/acre) depending on the season and management. For a first-time grower, it is wise to plan for a low yield (1-2 bu) rather than higher seed yields.

INSECT POLLINATION

Red clover must be cross-pollinated to set seed. Although bumblebees and other wild bees are very effective pollinators, their numbers are sometimes low. One to two hives per acre of honeybees in or near the field should increase seed yield provided there is no adjacent crop in flower that is more attractive to the honeybees. Don't place the hives in the field too early before flowering, otherwise the bees will set up a pattern of feeding elsewhere. Caution should be exercised when using insecticide on or near the seed field. If the bees are killed or their activity reduced, seed production will drop dramatically.

Red clover is ready to harvest when most of the seed-heads have turned brown or black (Figure 4). As a rule of thumb, 30 seeds per head indicate about 2 bu/acre (130-150 kg/ha). Red clover can be direct-combined or swathed and then combined. Direct combining can be facilitated if a chemical desiccant such as Diquat is applied to the stand 5-7 days prior to combining. If the crop is swathed and raking is necessary, it should be done when the material is still tough, as this prevents shatter of seedheads.

Optimum threshing of seed will be obtained if the seed-heads are dry and combine settings are as recommended by the manufacturer. If the correct settings are not known, a suggested starting point is to use a 3/32 bottom



Figure 4. Harvest red clover for seed when most seedheads have turned brown to black.

screen with the wind shut right down. The cylinder should be tightened down ($\frac{1}{8}$ "), run at 900 rpm and contain blanks. Because there is a lot of chaff to handle, ground speed should be as slow as possible. Unsatisfactory seed harvest is often the result of too fast a ground speed or combining when the material is too wet.

CLEANING AND STORAGE

If the seed is damp or green material is present, the seed will heat in the bin after combining which will reduce the germination and quality of the seed. In this situation the seed should either be dried by forced, unheated air or spread in a thin layer on a dry floor and stirred frequently until dry.

Seed should be cleaned to remove dockage such as weed seeds. A top screen of 1/15 with a bottom screen of 6 × 22 or 6 × 24 will remove many contaminants. Weed seeds that remain are best removed by a well-equipped seed cleaning plant that has equipment such as velvet rolls, magnetic, spiral, and gravity separators. Keep in mind that every time the seed is processed, the loss of some good seed will result.

The field and not the bin is the best place to remove the weeds. Chemical control, cultivation, roughing by hand, and combining around patches of weeds will reduce the weed content and increase the quality and profitability of seed production.

PEDIGREED SEED

The usage of pedigreed red clover seed has been steadily increasing in Ontario. Pedigreed varieties are desired because they have better production than common seed and are true to type. Often, common seed is a mixture of single and double-cut types or may be susceptible to a number of diseases. The use of pedigreed seed is the only way to ensure that a productive stand will be obtained.

Some growers incorrectly assume that yellowish rather than reddish seed is indicative of a single-cut type of red clover. This is not the case, as seed color bears no relationship to the growth habit of red clover. Indeed, one double-cut variety marketed in the United States has the identifying characteristic of being primarily yellow seed.

To grow pedigreed seed, the grower has to be specialized and be a member of the Canadian Seed Growers Associa-

tion (CSGA). Strict regulations are in force to maintain varietal purity. Regulations and information about pedigreed seed production can be obtained from the Canadian Seed Growers Association, Box 8455, Ottawa, Ontario K1G 3T1.

For production of certified red clover seed from a planting of foundation seed, the field must not have had red clover in the preceding two years unless the grower has taken chemical control measures approved by the CSGA. Manure cannot be applied the year previous to seeding or during the life of the stand. The field must be isolated from all other red clover by at least 50 m. When the crop is established with foundation seed, seed can be harvested for two years and classified as certified. As mentioned before, double-cut red clover must be prevented from setting seed in the year of seeding unless special permission is obtained from the CSGA.

CONTRACT SEED

A number of varieties of red clover are proprietary, that is, owned exclusively by one or more companies. Often, seed production of these varieties will be contracted out to various seed growers. In these situations, a binding contract is made between the grower and the company. The grower agrees to purchase foundation seed, produce a crop according to the rules of CSGA, pay the costs involved, and deliver all seed to the company plant. The company agrees to purchase the entire crop, pay a base fee at delivery, and final settlement payment by some set future date. Information regarding contract pedigreed seed production can be obtained by writing to the company concerned.

ADDITIONAL INFORMATION

Further information regarding red clover can be obtained from (1) OMAF Publication 221, *Red Clover for Feed, Seed and Soil*; (2) OMAF Factsheet, *Red Clover in Ontario*; (3) CSGA Circular 6, *Regulations and Procedures for Pedigreed Crop Production*; and (4) CSGA Publication, *Pedigreed Forage Seed Production*.

Table 1. Effect of time of harvest on red clover seed yields, Elora

	Clean seed (kg/ha)	Range
Seed harvested from first growth	153	80-200
Seed harvested from second growth	181	105-280