Red clover

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Cover photo: A field of red clover.

Note. This publication is intended to be used as a guide for farmers and extension workers for growing and managing red clover in areas in Canada where this crop can be grown. Special regional recommendations should be obtained from Agriculture Canada research stations, provincial departments of agriculture, or universities.

Recommendations for licensed cultivars, mixtures, management practices, fertilizer requirements, and chemical control for insects and weeds are not listed in detail, because they change periodically. Updated recommendations are continually being published by the federal and/or provincial departments of agriculture.

Red clover

by
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DISTRIBUTION AND ADAPTATION

Red clover, *Trifolium pratense* L., is widely grown in Canada for herbage and seed production and for use in rotations for soil improvement. The crop is best adapted to areas where summer temperatures are moderately cool to warm and adequate moisture is available throughout the growing season. However, unlike alsike clover, *Trifolium hybridum* L., it is not adapted to low, poorly drained soils. In contrast to alfalfa, *Medicago* spp., red clover will grow on moderately acid soils, but maximum yields are obtained when calcium (Ca) is adequate and the pH is 6.0 or higher.

Red clover is a biennial, or a short-lived perennial, and all the cultivars grown in Canada are classified into two groups—the late-flowering or single-cut cultivars and the early flowering or double-cut cultivars. Single-cut cultivars usually produce one hay crop plus an aftermath each year. In the establishment year few flowering stems are formed; thus seed is produced only in the second and subsequent years. Single-cut cultivars are hardy and are usually grown in the parkland areas of the Prairie Provinces and in northern areas of British Columbia, Alberta, Ontario, and Quebec. Double-cut cultivars usually produce two or three hay crops a year. These cultivars are capable of rapid spring growth. In some instances, a first cut is taken in early spring and the second crop is left for seed. Double-cut cultivars are not winter hardy and are usually grown in Eastern Canada, the Atlantic Provinces, and the southern coastal region of British Columbia. Performance of some licensed cultivars is documented in Table 1.

Diploid red clover cultivars have 14 chromosomes in the nuclei of their cells. Tetraploid cultivars have been artificially produced by doubling the chromosome number to 28 by chemical means. Both single-cut and double-cut tetraploid cultivars have been produced. Tetraploid cultivars are usually larger and in some regions have higher forage yields than diploid cultivars. Pollen from diploid plants can be used in the pollination of tetraploid plants, but the seed, if formed, is predominantly nonviable. Hence, an adequate isolation of two types is necessary if the crop is grown for seed.

MORPHOLOGY

The growth habit of red clover varies from erect to decumbent. Numerous leafy stems arise each year from a crown. The leaves are large and consist of three leaflets on one petiole. There are two stipules at the base of each

TABLE 1 Performance of some licensed red clover cultivars

Cultivars	Alberta (Peace River region)[1]			Atlantic Provinces[2]		Ontario[3]
		Yield kg/ha		Herbage yield kilograms per hectare		Herbage yield kilograms per hectare
	No. data years	Herbage	Seed	One cut	Two cuts	One cut
Arlington	3	1043	141	—	—	7981
Altaswede	6	3212	365	5497	—	—
Dollard	12	1001	154	—	—	—
Florex	3	2863	227	—	7836	8288
Hungarpoli	3	273	108	—	—	—
Lakeland	10	910	231	—	7711	8023
Norlac	6	3247	357	5643	—	—
Ottawa	15	910	168	—	6559	7403
Pacific	3	1327	198	—	—	5846
Prosper I	—	—	—	—	7789	8083

Source:

1. Elliott, C. R.; Howe, G. M. 1979. Northern Research Group Publ. 79-16A-1979. Agriculture Canada Research Station, Beaverlodge, Alta.
   Elliott, C. R., et al. 1981. Northern Research Group Publ. 81-16B-1981. Agriculture Canada Research Station, Beaverlodge, Alta.
   Najda, H. G.; Howe, G. M. 1982. Northern Research Group Publ. 82-16B-1982. Agriculture Canada Research Station, Beaverlodge, Alta.
2. Choo, T. M. 1981. 1981 data from four locations—two in Nova Scotia, one in Newfoundland, and one in New Brunswick. Agriculture Canada Research Station, Charlottetown, P.E.I.
3. Ontario Forage Crop Investigations. 1982. Report on forage crop trials. Data from six locations. Report available from Secretary, Ontario Forage Crop Committee, Ontario Ministry of Agriculture and Food, c/o Crop Science Department, University of Guelph, Guelph, Ont.

petiole. Each leaflet usually bears a horseshoe-shaped mark. The stems and leaves may be hairy or glabrous, depending on the cultivar. On average, there are 125 flowers densely crowded in each ovoid raceme (Fig. 1), subtended from an annual stem by a leaf-like bract. Petals are purplish red (occasionally white), and form a long basal (corolla) tube. Flowers are predominantly self-sterile and must be pollinated by bees to produce seed (Fig. 2). Pods are short and single seeded. There are about 600 000 seeds per kilogram.

Red clover has a thick tap root from which emerges numerous fine lateral roots. The tap root grows to a length of 60–90 cm. Lateral roots are mainly concentrated in the top 10 cm of the soil. Numerous small ovoid, pinkish white nodules are found on the lateral roots.

SOIL FERTILITY, INOCULATION, AND SEEDING

Soil tests are required for proper assessment of soil nutrient availability. Liming is essential on soils with a pH below 5.0. Lime makes the soil less acid and promotes the nitrogen-fixing activity of nodule bacteria. Table 2 shows estimates of nitrogen fixation in red clover and other legumes. All the important nutrients should be replenished in depleted soils on the basis of a soil test.

Major elements are required in large quantities for optimum growth and yield. Nitrogen (N) is essential for seedling establishment and a minimum of 11 kg/ha is recommended. Atmospheric nitrogen (N_2) is fixed by well-nodulated plants after stand establishment. However, excess N fertilizer reduces nodulation and substitutes for the atmospheric nitrogen, which would otherwise have been fixed by the nodule bacteria *(Rhizobium trifolii)*. On acid soils with a pH less than 5.5, nodulation is suppressed and fertilizer nitrogen should be supplied for growth.

The phosphorus (P) content in the dry matter (DM) of red clover should be between 0.2% and 0.4% if yield is not to be limited by P deficiency. Thus, for an annual maximum dry matter yield of 10 000 kg/ha, the P requirement is between 20 and 40 kg/ha per year.

The critical content of potassium (K), below which red clover suffers from K deficiency, is estimated to be 1.8% in the DM; therefore for an annual dry matter yield of 10 000 kg/ha, red clover requires 180 kg/ha per year. Many soils can supply this amount of K.

Sulfur (S) is deficient on some luvisolic (gray-wooded) soils, and fertilizers such as 16-20-0 will provide the necessary S. Table 3 shows the average and critical concentrations of major and minor elements in clovers compared with alfalfa and grasses, and Table 4 lists the symptoms of some major element deficiencies in red clover.

A number of elements essential for plant growth are required in extremely small amounts and are referred to as trace elements. They play just as important a part in plant nutrition as the major elements. For instance, boron (Bo) is required in protein synthesis and is associated with increased seed set. Copper (Cu) plays an important part in respiration and reproductive growth and molybdenum (Mo) is required in N fixation. However, unlike the major elements, the availability of trace elements is more dependent on soil pH, water

Fig. 1 Red clover raceme

Fig. 2 Pollination of red clover by honey bees
(Photo: Courtesy of D. L. Nelson)

TABLE 2 Estimates of nitrogen fixation in five legumes*

Legume crops	Nitrogen fixation (kilograms per hectare) in two soils	
	Gray Luvisol (Beryl)	Black solod (Landry)
Red clover	334	250
Alfalfa	442	171
Sweet clover	214	125
Alsike clover	303	152
Bird's-foot trefoil	190	145

* Nitrogen fixation was determined by measuring the nitrogen in the herbage and in barley crops following the legumes on two soils for 2 years after establishment.

Source: Adapted from Rice, W.; Hoyt, P. 1980. Crop rotation: The role of legumes. Northern Research Group Publ. 80-2. Agriculture Canada Research Station, Beaverlodge, Alta.

availability, soil structure, and the ratio of other nutrients. The optimum range in concentration of trace elements is usually quite narrow, and small increases above the optimum can have toxic effects.

Red clover seed should be inoculated just prior to seeding. The inoculum is a culture of living *Rhizobium* bacteria, and should be applied to the seed with a sticking agent. Pre-inoculated seed should be kept in a cool, dark place. Exposure to sunlight or fertilizers will kill the *Rhizobium* bacteria. Seed as early in the spring as possible into a warm, moist, firm seed bed at a depth of 1 to 2 cm. Seeding rates will vary, depending on the area of cultivation, cultivar(s) used, soil type, and intended use of crop—for forage seeded alone or in a mixture, or for seed production. Fertilizer, cultivar, and management recommendations are specified in federal and provincial publications.

HERBAGE PRODUCTION, STORAGE, AND UTILIZATION

Red clover is capable of providing a large yield of nutritious forage with high intake characteristics. It is a palatable, high-protein crop. For herbage production it can be seeded alone or in a mixture with grasses. It is frequently used as one of the legume components in pasture mixtures. A companion grass reduces the risk of complete loss due to disease or winterkill and the presence of grass will cushion the red clover crowns against wheel damage of tractors and implements used in herbage production. Red clover should be cut when 25% of the flower buds are showing color. At this stage, the digestibility of the dry matter varies between 65% and 70%. Digestibility decreases after this stage because the stems contribute significantly to yield.

Three of the predominantly used methods for utilizing red clover for herbage are hay, silage, and grazing. Table 5 shows the nutritive value of red clover compared with alfalfa and other grasses.

TABLE 3 Concentrations of major and minor elements in the vegetative growth of clovers in comparison with those in alfalfa and grasses

	Concentrations of elements														
	Major elements (percentage)							Minor (trace) elements (parts per million)							
	N	P	K	S	Mg	Ca	Na	Fe	Al	Mn	Ba	B	Cu	Zn	Mo
Clovers															
Average	3.15	0.34	2.35	0.25	0.28	1.55	0.04	65	60	45	12	30	11	34	2.0
Critical	—	0.14	0.85	0.14	0.11	0.40	—	25	—	25	—	15	5	11	0.7
Alfalfa															
Average	4.3	0.38	2.6	0.28	0.40	1.8	0.03	95	85	60	35	44	11	35	2.2
Critical	2.5	0.15	1.4	0.10	0.18	0.85	—	25	—	25	—	20	5	13	0.6
Grasses															
Average	4.3	0.55	5.4	0.48	0.42	1.5	0.15	120	85	120	12	32	14	45	0.8

Source: Adapted from *Soil and plant analysis*. Memphis, TN: A & L Agricultural Laboratories. c. 1974.

TABLE 4 Symptoms of some major element nutrient deficiencies in red clover

Deficient element	Symptoms of deficiency	Cause
Nitrogen (N)	Causes older leaves to gradually become chlorotic and drop off.	Inability to fix N, probably caused by a lack of nodulation
Phosphorus (P)	Retards growth, resulting in dwarf, spindly plants with dark green or bluish green leaves. Delays bloom and maturity.	Inability to utilize and transfer carbohydrates
Potassium (K)	Results in leaf margins turning yellow. Yellowed areas gradually cover most of the leaf surface; it then shrivels and dies.	Usually an imbalance between Ca and K in a well-limed soil
Sulfur (S)	Causes younger leaves to gradually become chlorotic and drop off.	Poor nodulation and a low rate of N fixation
Magnesium (Mg)	Results in leaf margins turning inward. Leaves gradually turn yellow, then bronze.	Lack of chlorophyll synthesis
Calcium (Ca)	Causes small chlorotic dots to form on older leaves. These dots gradually become gray, the leaf petioles collapse, and the leaf droops, but there is no immediate wilting of leaf blades. Leaves gradually wilt and die. Petioles of new leaves do not elongate and the leaves form a clump at the crown.	Insufficient Ca to strengthen cell wall formation

During haymaking, the leaves of red clover dry relatively quickly, become brittle, and are prone to shattering before the stems are cured. The stems are difficult to dry. A crimping or conditioning attachment should be used at the time of cutting to hasten crop drying. Store the hay under cover as quickly as possible to minimize spoilage.

A good potential exists for utilizing red clover for silage. Excellent results can be achieved by feeding red clover silage to dairy or beef cattle. However, the high protein content of the crop presents problems in making silage. It is beneficial to wilt the crop to a dry matter content of 25–35% (65–75%

TABLE 5 The nutritive value of red clover versus alfalfa and grasses

Crop during different stages of growth	Dry matter (DM)	Digestible organic matter in DM	Crude protein (CP) in DM	Crude fibre in DM	Metabolizable energy MJ/kg	Digestible CP in DM
	%	%	%	%	DM	%
Red clover						
Early flower	19	57	23.7	23.2	9.0	15.2
Very good hay	85	61	18.4	26.6	9.6	12.8
Good hay	85	57	16.1	28.7	8.9	10.3
Poor hay	85	50	13.1	34.0	7.8	6.7
Damaged hay	85	46	14.1	39.4	6.9	7.3
Silage	22	56	20.5	30.0	8.8	13.5
Alfalfa						
Early flower	24	54	17.1	30.0	8.2	13.0
Hay, before flowering	85	54	19.3	32.1	8.3	14.3
Hay, half-flower	85	55	22.5	30.2	8.2	16.6
Hay, full-flower	85	51	17.1	35.3	7.7	11.6
Silage	25	52	16.8	29.6	8.5	11.3
Grasses — General						
High digestibility hay	85	61	10.1	32.0	9.0	5.8
Moderate digestibility hay	85	57	8.5	32.8	8.4	3.9
Low digestibility hay	85	51	9.2	36.6	7.5	4.5
High digestibility silage	20	67	17.0	30.0	10.2	11.6
Moderate digestibility silage	20	58	16.0	34.0	8.8	10.2
Low digestibility silage	20	52	16.0	38.0	7.6	9.8

Source: Adapted from Nash, M. J. 1978. Crop conservation and storage in cool temperature climates. Permagon Press.

moisture) in the field to minimize undesirable fermentation after ensiling. Silage additives such as organic acids may be particularly useful in ensuring a desirable pattern of fermentation. Red clover grown in a mixture is easier to handle and can facilitate a desirable type of fermentation in the silo. This also dilutes the concentration of substances that cause bloat.

Grazing a pure stand of red clover is not recommended because the plant cannot withstand high or prolonged grazing pressure. Furthermore, bloat may occur in cattle grazing on immature red clover. However, this is not a major problem with sheep. To utilize the full yield potential of red clover, it should be defoliated infrequently. This is best accomplished by zero grazing (green chopping). This method of utilization also readily lends itself to the addition of bloat-control additives, for example poloxalene, at feeding time.

A reduction in fertility of ewes grazing red clover or fed red clover silage before or during mating has been reported. Reproductive disturbances are apparently caused by oestrogenic isoflavones and can be reduced by growing red clover in mixtures with grasses. To date, there is no evidence of red clover causing reduced fertility in cattle.

Generally, the seeding rate of red clover for a pure stand of hay is 7.5–8.0 kg/ha; for pasture mixtures the rate is 2–2.5 kg/ha.

Follow the recommendations for seeding rates and choice of cultivars and mixtures in your area.

SEED PRODUCTION

Early spring seeding and low seeding rates are recommended for red clover seed stands. Seeding rates vary from 2 to 4 kg/ha, although stands seeded at a rate as low as 1 kg/ha have produced good seed yields on weed-free soils. Row spacing may vary from 15 to 46 cm. Check the recommendations for management practices and suitable cultivars for your area. Information on pedigreed seed production can be obtained from the following publications of the Canadian Seed Growers' Association: Circular 6, *Regulations and procedures for pedigreed seed crop production*, and *Pedigreed forage seed production*.

Red clover must be cross-pollinated to produce seed. Cross-pollination, or the transfer of pollen from the anthers of one plant to the stigma of another plant is done primarily by bees. Flowers are pollinated when bees are collecting pollen or nectar. A bee forces its proboscis down the corolla tube, causing the stamens and pistil to protrude from the interior of the floret. The body of the pollinator is then brought in close contact with the upper ends of the stamens and pistil, and it becomes covered with pollen. Since the pistil of the red clover floret protrudes a little beyond the stamens, it is more likely to come in contact with the pollen from other plants already deposited on the body of the pollinator than with the pollen of its own flower. This cross-pollination must occur for seed set, because red clover is self-sterile, that is, the pollen is unable to successfully fertilize the pistils of the plant on which it is produced. Unlike other legumes, the flower structure of red clover provides a greater opportunity for cross-pollination—after each visit

by a pollinator the pistil and stamens move back to their original position. A second or third visit by an insect will have the same effect and the chances of the pistil being properly fertilized will last as long as it remains in a condition to receive pollen.

Bumble bees (*Bombus* spp.) are excellent pollinators of red clover. Colonies of native bumble bees can be built up by providing nesting areas and spring flowering plants that commence bloom before red clover does. Surrounding bush and abandoned nests of small mammals or birds are often chosen as locations for colonies. Some species choose underground sites, whereas others prefer sites that are on the surface but concealed in a depression or under a tuft of grass. However, for consistent and reliable seed yields, colonies of honey bees must be introduced to seed fields during the blooming period.

Good seed yields of some red clover cultivars are produced when honey bees, *Apis mellifera* Linnaeus, are introduced to the field at two colonies per hectare. However, in some cultivars the honey production potential is usually low, presumably because the long corolla tubes and/or nectar levels in the tubes of these cultivars make nectar collection difficult for the bees. Alfalfa leafcutting bees (*Megachile rotundata* (Fabricius)), although known to be capable of pollinating red clover, have not yet been used successfully on a field scale.

For seed production, diploid and tetraploid cultivars must not be mixed and must be grown in isolation from each other. Seed yields of tetraploid types are severely reduced when they are pollinated by diploid pollen. Tetraploids invariably produce lower seed yields than diploids under similar conditions, because they produce fewer flower heads as compared to diploids; also floret fertility may be lower.

Seed production of Canadian licensed cultivars is encouraged because of superior adaptation. However, a limited opportunity exists for production of seed of some foreign cultivars. The seed is grown under contract for a particular member country of the Organization for Economic Cooperation and Development (OECD). Such contracts are negotiated between the individual producer and the particular seed firm responsible for delivery of the seed to the country involved. A number of countries participate in this scheme, and prospective producers should make all arrangements and contracts with the seed firms of their choice prior to going into production of foreign unlicensed cultivars.

Red clover should be cut and swathed when 80–90% of the heads are brown, unless the crop is defoliated by chemical means or a severe frost. The swaths should be left to dry and may be threshed in 7–10 days. If wet weather persists, a side delivery rake can be used to turn the swath for drying with minimal seed loss.

Straight combining of the standing crop may be necessary where winds disturb the swathed fields. The crop should be chemically defoliated 7–10 days in advance (or harvested after a killing frost in northern areas). A concave clearance of 2.4–4.8 mm with a cylinder speed of 800 rpm is suggested.

Use a slow forward speed, because overloading the machine can cause serious seed losses.

Seed obtained from threshing or combining should be dried if the moisture content is too high for storage (in excess of 14%). Specialized machines, usually found in seed-cleaning plants, may be required for further processing.

RED CLOVER FOR SOIL CONSERVATION

A red clover crop can also be used as green manure. This practice is sometimes referred to as plowdown. The crop is allowed to grow to the blossom stage and is then incorporated into the soil. This is done with either a moldboard plow or a disk. Single- or double-disk harrows followed or preceded by heavy-duty cultivators can effectively incorporate the green crop into the soil. The operation should be performed before the crop gets too thick to handle.

Using red clover as a green manure crop in a rotation helps to conserve the soil and, in most instances, it is preferable to summer fallow because red clover prevents wind and water erosion and increases the organic matter content of the soil. The increase in organic matter of the soil is of particular advantage on heavy-textured or clay soils, which require large quantities of organic matter for proper tilth. The green crop plowed under contains nitrogen (N) and this adds to the N content of the soil. Thus, the amount of commercial fertilizer added for the succeeding crop can be decreased. An increase in yield and quality has been observed in cereal crops that were subsequently grown on land where red clover had been used as green manure. Red clover or other forage legumes in a rotation can also be effective in controlling diseases and insects that may build up under continuous crop production.

WEEDS

In strong, vigorous stands of red clover annual weeds are not usually a problem, because the crop can compete strongly with weeds. Persistent perennial weeds, however, sometimes become a problem in established stands. Weeds occurring in patches in established stands can be isolated from the rest of the field and destroyed by cultural means or recommended herbicides.

Red clover is most susceptible to injury from weeds during the establishment phase. Red clover seedlings are generally weak and are poor competitors. Aggressive annual weeds can reduce the vigor of the crop during the year of establishment, causing poor establishment of red clover seedlings, and reduced yields in subsequent years. To reduce losses from annual weeds, use pedigreed seed and plant only on clean land. If the land is infested with weeds it should be cleaned up by cultivation or other means before seeding the red clover crop. Herbicides can be useful in controlling weeds in seedling stands. Recommendations for herbicide use are contained in provincial bulletins.

Fig. 3 Northern anthracnose
(Photo: Courtesy of W. B. Berkenkamp)

DISEASES

Diseases are caused by fungi, bacteria, viruses, mycoplasma, nematodes, and mineral deficiencies or excesses. Of these, fungi are the most important causal factors, because they attack foliage, roots, and crowns (Fig. 3). Preventing or minimizing diseases is more economical than curing them. Crop losses caused by most diseases can be reduced by proper management to maintain a vigorous stand. Use clean seed of recommended cultivars and resistant cultivars where available. Rotate with non-legumes. If serious diseases develop, get professional diagnoses. Lengthen the rotation interval between legumes. Avoid contaminating healthy fields by farming diseased fields last, and/or by disinfecting farm machinery after using it on infected areas. Table 6 lists some common diseases of red clover.

TABLE 6 Some diseases of red clover

1. Crown and root rot — Winter crown rot or snow mold, *Coprinus psychromorbidus*.	The fungus is active only at near-freezing temperatures. Damage occurs in late winter and causes irregular patches of dead plants. Remnants of white fungal threads can sometimes be detected at the edge of melting snow. This fungus infection can be avoided or controlled by sound management practices and frequent rotations with non-legumes.
Root rot, *Fusarium* spp.; brown root rot, *Plenodomus meliloti*.	Progressive rotting of tap and lateral roots, often involving the crown; with brown root rot, plants become yellow and stunted in the spring and may show small, round, black fungus bodies on dead roots. Stresses such as frequent cutting, nutrient deficiency, and insect or nematode injury or wounding during cultivation increase root rot. Use proper management.
2. Stem rot, blight — northern anthracnose, *Kabatiella caulivora* sp.	Elongated brown sunken lesions appear on stems and petioles and a characteristic shepherd's crook bend occurs below leaves and flower heads. Plant parts above infected areas wilt, die, and easily break off. Control disease by rotation or use resistant cultivars.
Black stem, *Phoma trifolii*.	Black or dark brown lesions appear on stems and other aboveground plant parts. Burning of stubble in the spring before growth, removing infected plant material, and rotating with non-legumes are effective control measures.
Black patch, *Rhizoctonia leguminicola*.	Dark brown spots appear on leaves. Feeding livestock with infected material causes slobbers' disease. Cut early to minimize losses. Lengthen rotation intervals with non-legumes.

INJURIOUS INSECTS

Insects that affect forage yield and quality, and seed yields are leafhoppers, root borers, lygus bugs, thrips, clover seed chalcids, and clover seed midges. Occasionally, grasshopper outbreaks occur in red clover areas. Treat the crop with specific insecticides when necesssary and follow the recommendations for your area.

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CONVERSION FACTORS

Metric units	Approximate conversion factors	Results in:
LINEAR		
millimetre (mm)	x 0.04	inch
centimetre (cm)	x 0.39	inch
metre (m)	x 3.28	feet
kilometre (km)	x 0.62	mile
AREA		
square centimetre (cm^2)	x 0.15	square inch
square metre (m^2)	x 1.2	square yard
square kilometre (km^2)	x 0.39	square mile
hectare (ha)	x 2.5	acres
VOLUME		
cubic centimetre (cm^3)	x 0.06	cubic inch
cubic metre (m^3)	x 35.31	cubic feet
	x 1.31	cubic yard
CAPACITY		
litre (L)	x 0.035	cubic feet
hectolitre (hL)	x 22	gallons
	x 2.5	bushels
WEIGHT		
gram (g)	x 0.04	oz avdp
kilogram (kg)	x 2.2	lb avdp
tonne (t)	x 1.1	short ton
AGRICULTURAL		
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