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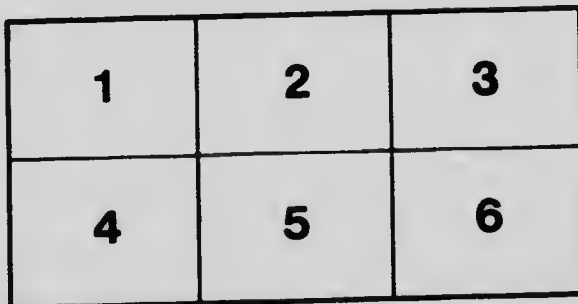
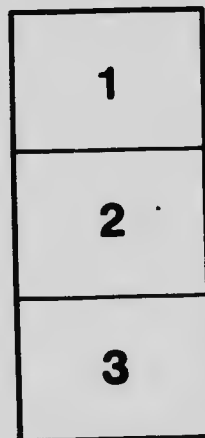
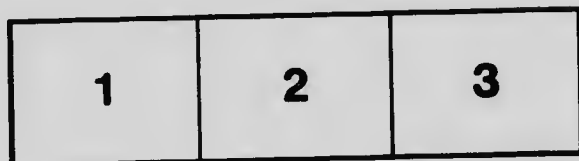
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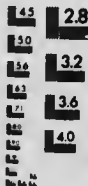
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ONTARIO AGRICULTURAL COLLEGE

Hay and Pasture Crops Grasses, Clovers, etc.

By C. A. Zavitz and W. J. Squirrell

INTRODUCTION.

Pasture and hay crops occupy more than one-half of the farm lands of Ontario. The market value of the hay and clover of the Province has amounted to upwards of \$40,000,000 annually for the past thirty-six years and the market value in each of the past three years has been almost double that of the average. No statistical information has been obtained for the Province regarding the value of the pasture crops but the areas used for pasture are slightly greater than those used for hay. The following table gives the average number of acres used for pasture, hay, small grain, corn, potatoes and roots in Ontario for the past thirty-five years in periods of five years each:

Periods of Five Years.	Pasture.	Hay.	Small Grain.	Potatoes.	Corn.	Roots.
1884-1888.....	2,759,410	2,265,978	4,671,690	152,568	177,150	130,932
1889-1893.....	2,623,111	2,536,092	4,837,700	150,483	247,613	156,092
1894-1898.....	2,693,586	2,467,264	5,200,107	174,029	478,579	199,370
1899-1903.....	2,824,080	2,603,804	5,205,050	153,960	541,684	220,300
1904-1908.....	3,290,120	3,111,836	5,020,997	149,315	509,082	203,277
1909-1913.....	3,132,015	3,234,497	4,846,164	163,831	653,962	171,169
1914-1918.....	3,437,299	3,306,604	4,734,976	158,746	701,339	141,458

It will be seen that the maximum areas for pasture, hay and corn occurred in the five years from 1914 to 1918, for small grains and for roots in the five years from 1899 to 1903, and for potatoes in the five years from 1894 to 1898, inclusive. It will be observed that the greatest increases in the farm lands of Ontario in recent years have been with the coarse fodder crops such as pasture, hay and corn. While the pasture and hay crops have been increasing in area it is doubtful if there has been much improvement in the quality of these crops.

DESCRIPTIONS AND DRAWINGS OF HAY AND PASTURE PLANTS.

Twenty-six varieties of grasses, clovers and similar crops are given separately. Following these will be found the results of experiments conducted at the Ontario Agricultural College in the testing of various crops both singly and in combination for the production of hay and of pasture.

Timothy Grass (*Phleum pratense*).

Other common names: Meadow Catstail, Herd's Grass.

HISTORY.—Although this grass is a native of Europe, its agricultural value was first recognized in America. It was introduced from England into the State of Maryland by Timothy Hanson, from whom it takes its name, about 1720. In the New England States it is known as Herd's Grass because of its introduction into New Hampshire by John Herd.

BOTANICAL DESCRIPTION.—Timothy is a hardy perennial grass possessing a short root stalk. The stems which are erect and smooth sometimes grow to a height of four feet. The leaves are short and flat. The inflorescence is in the form of a spike with the spikelets, which are one-flowered, arranged in a dense cylindrical form. The heads of timothy are distinguished from those of Meadow Foxtail by being larger and coarser and having no soft white hairs.

HABITS OF GROWTH.—Timothy is a slow growing grass, starting late in the spring and usually producing little second growth after being cut for hay. It produces flowers early in July and ripens seed about a month later.

SOIL.—Timothy may be successfully grown on a variety of soils but is best adapted to clay loams which contain a good supply of moisture. Sour soils, sandy soils and those soils which dry out badly during the hot part of the summer are not so suitable for growing timothy.

SEED.—Timothy seed, for the best results, should be comparatively large in size, plump, of a bright silvery color, free from impurities and very little hulled. It is one of the best seed producers among grasses; and is ready to cut for this purpose when the spikes turn from green to yellow. Threshing is accomplished with the ordinary grain thresher, although the best seed on the market is flail-threshed. The legal weight per measured bushel is 48 pounds.

SEEDING.—Owing to its weight and shape, timothy is easily sown. In Ontario, timothy is successfully sown with cereal crops both in the autumn and spring of the year. From 12 to 15 pounds is used per acre when this grass is not seeded in combination with clovers and other grasses.

AGRICULTURAL VALUE.

Timothy is the best known and the most widely grown of all the grasses in Ontario. It is essentially a hay grass producing a large amount of stems and a small amount of leaves. Its popularity is justly due to its many good qualities. (1) Its seed is comparatively cheap and readily obtainable. (2) The seed is less likely to contain weed seeds than most of the other grasses. (3) The crop is easily cut and cured. (4) There is less danger of the hay spoiling from being over-ripe before cutting than there is with other grasses. (5) It produces a large yield of hay of good quality. (6) On account of suitable digestibility, timothy is a favorite grass for work horses and for livery horses which are required to work immediately after feeding. For the best results in making hay, timothy should be cut when the plants are in bloom. It is one of the easiest of all the grasses to cure and wastes little in handling and in transportation. Because of its late start in the spring and its inability to stand the hot dry weather of the summer, timothy is only a fair pasture grass. This grass shows a great deal of variation in the individual plants and much improvement is possible by selection.



TIMOTHY GRASS.
(*Phleum pratense*).

Orchard Grass (*Dactylis glomerata*).

Other common names: Cocksfoot, Rough Cocksfoot.

HISTORY.—This grass is a native of Europe, its common name, "Orchard," being derived from the success attending its growth in shady places. It has been cultivated in America since about 1760. After Timothy and Kentucky blue grass, it is probably the most cultivated grass in Ontario.

BOTANICAL DESCRIPTION.—Orchard grass is a long-lived perennial, having a very short root stalk. The heads are branching and the spikelets borne in dense clusters on the branches. The spikelets may contain from two to five flowers, each of which is enclosed within two strongly keeled and sharply pointed glumes. The stems grow erect and sometimes reach a height of three feet. The leaves are long, broad, flat, not as coarse in texture and more abundant than in timothy. This grass has a tendency to grow in close tufts, and forms one of the best examples among cultivated grasses of a "bunch" grass.

HABITS OF GROWTH.—Orchard is a quick growing grass, starting early in the spring, producing a large amount of growth during the summer and continuing to grow vigorously into the late autumn. It shoots up very quickly after being cut for hay. The flowering period is in the latter part of June and it reaches the hay condition about the same time as red clover.

SOIL.—While Orchard grass is best suited for growing on a rich, well-drained, clay loam soil, it will succeed on soils with a lesser moisture supply than is required for timothy.

SEED.—Orchard grass seed is somewhat boat shaped, about one-quarter of an inch in length and possesses short awns. Good seed is of a bright straw color, free from weed seeds, other seeds and dirt. It is ready to cut for seed about three or four weeks after it has flowered and when the seeds are straw colored. The legal weight per bushel is 14 pounds.

SEEDING.—On account of its light weight Orchard grass seed is more difficult to sow than timothy seed. It may be sown successfully either in the autumn or spring with cereal grains. From 25 to 30 pounds is sown per acre, when this grass is not seeded in combination with clovers and other grasses. The method of seeding is usually to sow it broadcast by hand.

Agricultural Value.

Orchard grass is grown both for hay and pasture but its chief value lies in its use for pasture. Close pasturing does not seem to injure Orchard grass and lessens its habit of growing in bunches. Grass and clover mixtures grown in Ontario with the object of producing pasture will nearly always be improved by the inclusion of Orchard grass. Orchard is one of the very best grasses in withstanding drought. The palatability of the grass is almost equal to that of timothy but it loses its palatability with age much more rapidly than this grass. When it is grown for hay, it should be cut early, not later than the commencement of bloom. After this period, it deteriorates in quality, soon becoming woody. Like timothy, Orchard grass is quite variable in its individual plants, showing great differences in height, coarseness of stem and leaf, leafiness, earliness, etc. There would appear to be almost as great a chance for improvement by selection with this grass as with timothy.



ORCHARD GRASS.
(*Dactylis glomerata*).

Tall Oat Grass (*Arrhenatherum elatius*).

Other common names: Meadow Oat Grass, Tall Meadow Oat Grass, Oat Grass, False Oat Grass.

HISTORY.—Like many of the most important economic grasses, Tall Oat is a native of Europe. It was first cultivated in Southern France. In Ontario up to the present time, it has been little grown. In experiments conducted at Guelph which have extended over a period of several years, it has proven to be one of the most promising grasses tested.

BOTANICAL DESCRIPTION.—Tall Oat is a long-lived perennial with a short root stalk. The heads are in the form of a spreading panicle and somewhat resemble those of oats. The stems grow fairly erect but there is a greater tendency to droop in this grass than is found in either timothy or orchard. The leaves are long and broad, rather soft in texture, and of a yellowish-green color. This grass frequently grows in bunches or tufts but this peculiarity is less marked than in the case of Orchard grass.

HABITS OF GROWTH.—Tall Oat starts growth early in the spring and provides a large amount of green material throughout the summer and autumn. It flowers about the same time as Orchard grass and also reaches the hay condition at about the same period as this grass. In mixtures where Kentucky Blue and Canadian Blue grasses do not gain admission, Tall Oat will last for many years.

SOIL.—The most suitable soils for Tall Oat are rich, moist loams with a good supply of lime. It will, however, give good results on other types of soil where there is a good supply of moisture, and is noted for its ability to give good returns on poor soils.

SEED.—The seed of this grass is straw-colored, about three-eighths of an inch in length, has long twisted awns, and in shape resembles hullless oats. The seed which shatters easily should be cut as soon as the panicles turn yellow. The weight per bushel is 12 pounds.

SEEDING.—On account of its light weight and twisted awns, Tall Oat is a difficult grass to sow. This difficulty of seeding is one of the chief reasons why it is not more extensively grown. In order to obtain an even distribution of seed, it is often mixed and sown with the grain used as a nurse crop. From 30 to 35 pounds of seed is used per acre when this grass is not seeded in combination with clovers and other grasses.

Agricultural Value.

Tall Oat is both a good hay and pasture grass and gives its best returns when sown in mixtures. In its resistance to drought, Tall Oat is the equal, if not the superior, of Orchard grass. When grown for hay, it should be cut at the commencement of bloom. If left later than this stage it soon becomes woody and unpalatable. In Ontario this grass will frequently produce two good crops of hay in a season. This hay is not much more difficult to cure than timothy. Its earliness of growth and the large quantity produced, along with its ability to stand tramping, make it one of the most valuable of pasture grasses. Tall Oat grass is possessed of a certain bitterness of taste which animals do not at first like. When they become accustomed to it, however, they will eat the grass quite readily.



TALL OAT GRASS.
(*Arrhenatherum elatius*).

Yellow Oat Grass (*Trisetum flavescens*).

Other common names: Golden Oat, Yellow False Oat.

HISTORY.—This grass which is also a native of Europe is only of secondary importance in the agriculture of that continent. In both England and France, it is used as a minor grass in permanent pasture mixtures. Its agricultural value is very little known in Ontario.

BOTANICAL DESCRIPTION.—Yellow Oat is a perennial grass, possessing a short root stalk. The heads of this grass are smaller and finer than those of tall oat. From a green color in the immature grass the heads change to a golden yellow at the period of flowering. The stems which are short and fine in texture are covered with hairs. The leaves also, because of their covering of soft hairs, are fine in texture.

HABITS OF GROWTH.—Under suitable conditions of soil and climate, Yellow Oat grass quickly becomes established. It flowers at about the same period as does Orchard grass.

SOIL.—A well drained clay loam soil is the best suited to its growth. Yellow Oat gives poor results on soils which dry out badly in the hot time of summer and on soils which contain excessive moisture.

SEED.—The seeds of Yellow Oat resemble those of Tall Oat but are much smaller in size. They are of a golden yellow color, about three-sixteenths of an inch in length, and have long and very fine awns. The seed is often very impure, usually being obtained from mixtures where Yellow Oat is one of the ingredients. The weight per bushel is about 6 pounds.

SEEDING.—Because of its light weight, it is very difficult to obtain an even distribution in seeding this grass. When sown it is usually mixed with the seed of the grain used as a nurse crop and is even sometimes mixed with sand. From 20 to 25 pounds of seed is sown per acre when this grass is not seeded in combination with clovers and other grasses.

Agricultural Value.

The chief use of Yellow Oat grass is as a minor grass in permanent pasture mixtures and for growing in lawn mixtures. Where this grass has been included in permanent pasture mixtures tested at Guelph, it has proven to be one of the most persistent grasses used. The palatability of Yellow Oat grass is high. All classes of stock like it and cattle will eat it nearly as readily as Kentucky Blue grass. As a lawn grass, it possesses considerable value, forming a fine turf if kept closely cut.



YELLOW OAT GRASS.
(*Trisetum flavescens*).

Meadow Fescue Grass (*Festuca elatior*).

Other common names: English Blue Grass, Randall Grass, Evergreen Grass.

HISTORY.—Meadow Fescue is a native of Europe and is one of the most highly prized of English grasses. It is widely grown in some sections of the United States and Canada and is quite well known in some parts of Ontario.

BOTANICAL DESCRIPTION.—Meadow Fescue is a perennial grass lasting many years. The heads are in the form of a spreading panicle and are distinctly nodding. The stems, which sometimes reach a height of three feet, are slender and smooth. The leaves are flat, broad and thick, and of a glossy dark green color.

HABITS OF GROWTH.—Meadow Fescue is a slower growing grass than either Orchard or Tall Oat. It is ready to cut for hay a few days later than Orchard grass and usually produces a good second growth.

SOIL.—It gives its best results on rich moist soils and may be successfully grown on sandy soils where there is a sufficient supply of moisture available.

SEED.—The seed considerably resembles Orchard grass but is larger in size and not so pointed. It is awnless and of a light brown color. Meadow Fescue should be cut for seed as soon as the panicles of the head have turned brown. If left after this period, it shatters badly. It is a large yielder of seed and, under favorable conditions, has been known to produce seed crops for a period of three years. When it is grown for seed production, it is better not to pasture it in the spring. It may be successfully threshed with the ordinary grain thresher. The seed weighs about 25 pounds per measured bushel.

SEEDING.—Meadow Fescue grass seed is comparatively easy to sow and is usually sown at the rate of from 35 to 40 pounds per acre when not seeded in combination with clovers and other grasses. When it is grown for seed production, 20 pounds of seed is enough to sow per acre.

Agricultural Value.

Meadow Fescue is a very hardy grass, being strongly resistant both against cold and drought. This grass is nearly always sown in mixtures and combines hay and pasture value better than most grasses. It is inferior to timothy in quality and in yield of hay, but is a much better pasture grass. It reaches its best hay condition just before full bloom. After flowering, the stems rapidly become hard and woody and lose much of their nutritive value. Because of its drought-resisting qualities, its ability to stand tramping and the large amount of pasture produced in summer and autumn, Ontario pasture mixtures could usually profitably include this grass.

Tall Fescue is very closely related, botanically, to Meadow Fescue. It shows the following physical differences:—greater height, somewhat coarser texture, later maturity, and a more vigorous second growth. The seeds of this grass can not be distinguished from those of Meadow Fescue.



MEADOW FESCUE GRASS.
(*Festuca elatior*).

Sheep's Fescue Grass (*Festuca ovina*).

HISTORY.—Sheep's Fescue is a native of the Old World and is found growing throughout the most of Europe and Asia and also Northern Africa. While it is also a native of Canada and the United States, many of the cultivated forms of this grass have been obtained by these countries from Europe.

BOTANICAL DESCRIPTION.—Sheep's Fescue is a short-lived perennial which grows in dense tufts. The flowers are produced in a small one-sided panicle. The spikelets which contain three or four flowers are of a green color and have in addition a violet tint. Sheep's Fescue grass produces many slender stems which are somewhat angular in shape. The leaves are very narrow and of a pale green color.

HABITS OF GROWTH.—Sheep's Fescue produces little growth during the year in which it is sown and begins to go back after the third year. When once established, it commences growth early in the spring and continues to grow into the late autumn. It reaches maturity a few days earlier than Kentucky Blue grass.

SOIL.—Sheep's Fescue is especially valuable for growing on poor, sandy, or stony soils, surpassing most other grasses under these conditions.

SEED.—The seed is about one-third of the size of Meadow Fescue grass seed. It is straw-colored and has short fine awns. Commercial seed is nearly all produced in Europe and is comparatively cheap. If over-ripe the seed shatters easily. The crop should be cut when the spikelets break up readily in the hand. The seed weighs about 10 pounds per measured bushel.

SEEDING.—Good catches have been obtained where Sheep's Fescue has been sown in the spring with a nurse crop of barley or of spring wheat. Sheep's Fescue is usually sown in mixtures but, when not sown in combination with clovers or other grasses, from 20 to 25 pounds of seed is sown per acre.

Agricultural Value.

The chief agricultural value of Sheep's Fescue is for growing under those conditions not suitable for successfully growing other grasses. It usually makes a sheep pasture on poor soils where other and more valuable grasses cannot be grown. Opinions differ as to the ability of this grass to stand tramping and close grazing. Some writers claim that it is unsurpassed in its ability to support these conditions, while others hold almost the opposite opinion. In experiments conducted at Guelph extending over a period of years, it has produced less pasture than the average grasses tested and was inferior in its ability to stand tramping and close grazing to a number of the grasses included in the test. The hay produced from Sheep's Fescue is of fairly good quality but the yield is too small to warrant it being grown for this purpose. Sheep's Fescue and other closely related species are frequently included in lawn grass mixtures.



SHEEP'S FESCUE GRASS.
(*Festuca ovina*).

Kentucky Blue Grass (*Poa pratensis*).

Other common names: Blue Grass, June Grass, Spear Grass, Smooth Stalked Meadow Grass.

HISTORY.—Kentucky Blue is a native grass of North America, Europe and Asia. It is one of the most widely distributed and most valuable of the native American grasses. The name given is used to distinguish it from Canadian Blue grass, and also because of the famous blue grass regions of the State of Kentucky.

BOTANICAL DESCRIPTION.—This grass is a long-lived perennial, having extensive creeping root stalks. Its root system and its hardness make it one of the most persistent of grasses. The inflorescence is a panicle, pyramidal in shape and more widely spreading than Canadian Blue grass.

HABITS OF GROWTH.—Kentucky Blue becomes established after seeding comparatively slowly but, after establishment, is one of the earliest grasses in reaching maturity, being several days earlier than Orchard grass. Unlike Canadian Blue grass, which produces heads throughout the season, it heads only once. It produces a very thick uniform sod and is capable of crowding out most other grasses and even weeds. As an enemy to alfalfa, it is only surpassed among cultivated grasses by Canadian Blue grass.

SOIL.—Kentucky Blue gives good results on a wide range of soils. Rich clay loam soils, over limestone formations, which do not suffer from drought in summer are the most suitable. This grass gives only fair results on sandy and on heavy clay soils.

SEED.—The seed, which is harsh to the touch, is awnless and of a light brown color. In length it averages about one-eighth of an inch. The keel and the edges of the seed are covered with very fine silky hairs. Harvesting of seed should be commenced when the panicles have turned yellow in color. A large amount of the commercial seed is produced in the blue grass region of Kentucky. The weight per bushel is 14 pounds.

SEEDING.—It frequently happens that the germination of the seed is injured by heating in the process of curing and emphasis should be put on the advisability of germinating the seed before sowing. About 25 pounds of seed is sown per acre when this grass is not seeded in combination with clovers and other grasses.

Agricultural Value.

This grass is grown both for hay and pasture and as an ingredient in lawn mixtures. It produces a small amount of hay of good quality. The feeding value and palatability of Kentucky Blue grass hay is equaled by few grasses. The best hay is produced if the grass is cut when in bloom. As a pasture grass it ranks high, its palatability for this purpose being unexcelled by few other cultivated grasses. Kentucky Blue grass starts growth early in the spring and gives a fairly large amount of pasture throughout seasons of sufficient rainfall. Its chief weakness as a pasture grass lies in its inability to stand hot, dry summers. It forms a close compact turf which enables it to stand a large amount of tramping and close grazing without injury. Kentucky Blue is used as a basic grass in lawn mixtures. The formation of a fine close turf, its ability to stand tramping and close cutting gives it a position for this purpose unrivalled by any other grass.



KENTUCKY BLUE GRASS.
(*Poa pratensis*).

Canadian Blue Grass (*Poa compressa*).

Other common names: Wire Grass, Flat Stemmed Meadow Grass, Canada Blue Grass, Virginia Blue Grass.

HISTORY.—Canadian Blue Grass is a native of Europe and Asia. It was first discovered in America, growing near Quebec, in 1792. It is now widely distributed throughout southern and central Ontario, and is common in many other parts of Canada.

BOTANICAL DESCRIPTION.—Canadian Blue is a perennial grass with extensive underground creeping root stalks. The flowers are arranged in a panicle which is shorter and not so widely branched as that of Kentucky Blue. The stems, which seldom reach a height greater than two feet, are flattened in shape and knee bent at the joints. This flattened stem characteristic is one of the chief points of difference in distinguishing between this grass and Kentucky Blue. The leaves are few, varying from one to three inches in length and are wiry in texture. In color they are a bluish green.

HABITS OF GROWTH.—This grass reaches maturity several days later than Kentucky Blue. It will stand very unfavorable conditions of soil and climate without injury and is one of the most difficult of grasses to eradicate.

SOIL.—While this grass is very commonly found growing on poor soils, especially gravelly loam soils, it gives good results on clay loams providing they are not too wet. Soils which are poor in quality and deficient in moisture, where most other grasses will not thrive, provide an economic place for Canadian Blue Grass.

SEED.—The seed very closely resembles Kentucky Blue grass, and is often used to adulterate the seed of this grass. The chief points of difference between these two grass seeds are the presence of less prominent veins in the lemma of Canadian Blue grass seed and the slightly darker color of the seed. When grown for seed, it should be cut when the panicles are a deep yellow. The seed of this and of Kentucky Blue grass is threshed in the same way as Timothy. The weight per bushel is 14 pounds.

SEEDING.—Canadian Blue grass usually appears in cultivation spontaneously. From 20 to 25 pounds of seed is sown per acre when this grass is not seeded in combination with clovers and other grasses.

Agricultural Value.

The chief use of Canadian Blue grass is under those conditions where Kentucky Blue does not thrive. It is very little grown for hay because of its light yield per acre. In permanent pasture mixtures, it produces pasture later in the season than Kentucky Blue and of only slightly inferior quality. Like Kentucky Blue grass, it is well able to stand tramping and close grazing, and in this condition is more palatable to stock. It is frequently sown in lawn mixtures, and for this purpose is especially valuable on gravelly and stiff clay soils.



CANADIAN BLUE GRASS.
(*Poa compressa*).

Red Top Grass (*Agrostis alba*):

Other common names: Fiorin Grass, Creeping Bent Grass.

HISTORY.—Red Top is a native of Europe and Asia and, it is thought, also of some of the countries of Northern Africa. In America it has been cultivated for nearly one hundred years. It is a well-known grass in many parts of Ontario.

BOTANICAL DESCRIPTION.—It is a hardy perennial grass with smooth erect growing stems, which sometimes reach a height of four feet. The root system is shallower than that of Timothy. In general appearance Red Top resembles Kentucky Blue but may be distinguished from this grass by the purple color of the panicle their wider branching and also by the fact that in Red Top the spikelets are one flowered, while in Kentucky Blue there are from three to five flowers in a spikelet.

HABITS OF GROWTH.—Red Top commences growth late in the spring but continues to grow until late autumn. It is several days later in blooming than Timothy, and is not at its best when included in a mixture with Timothy and other grasses for hay. Red Top usually provides a good second growth. It is quite resistant to cold.

SOIL.—This grass is adapted to a wide range of soil and climate. It thrives best in moist or even wet soils. The moisture content of the soil seems to be a greater deciding factor in the successful growing of this grass than the type of soil on which it is grown.

SEED.—Red Top grass seed is one of the smallest of cultivated grass seeds. It is from 1-32 to 1-16 of an inch in length and somewhat boat shaped. In color it is a glossy light red and is without awns. Commercial seed usually contains considerable chaff, which lessens its weight per bushel. The seed should be cut when it shells easily in the hand. It may be readily threshed in the same manner as Timothy seed. Seed weighs 14 pounds per measured bushel.

SEEDING.—Red Top may be seeded in the spring of the year with good results, using a nurse crop of cereal grain. Twenty pounds of good seed is sufficient to sow an acre when this grass is not seeded in combination with clovers and other grasses.

Agricultural Value.

This grass is grown for hay and pasture and also as an ingredient in lawn swards. Red Top hay, which weighs heavy for its bulk, is inferior in quality to Timothy. On wet soils, Red Top will outyield most of the other cultivated grasses for hay. On clay loam soils with a good supply of moisture, it is an excellent bottom grass in hay mixtures. Red Top makes sod quickly and nearly equal in quality to the Kentucky Blue grass. Pasture mixtures, both temporary and permanent, when sown on low wet lands, should always include Red Top as one of the grasses sown. It gives its best results in lawns when it is sown thickly and is closely mowed. The individual plants of Red Top show almost as much variation in characteristics as those of Orchard grass, and much improvement is possible by selection.



RED TOP GRASS.
(*Agrostis alba*).

Perennial Rye Grass (*Lolium perenne*).

Other common names: English Rye Grass, Common Darnel.

HISTORY.—Perennial Rye was the first of the perennial grasses to be cultivated as a pure culture. There are records which show that this grass was cultivated in England as early as 1677, which date is many years earlier than we have any record of the cultivation of Timothy. In European countries, Perennial Rye is considered to be one of the most valuable grasses and is widely grown in short rotation mixtures. In Ontario, this grass has not usually been found a profitable one to grow.

BOTANICAL DESCRIPTION.—Perennial Rye is a low growing grass lasting only a few years. It has indications of creeping root stalks and the plants often grow in spreading tufts. The inflorescence is in the form of a spike, with the spikelets set edgewise on the stem. These stems, which in Ontario seldom reach a height greater than two feet, grow erect and are slender and smooth. The leaves are dark green in color and are folded together when in the bud.

HABITS OF GROWTH.—Perennial Rye produces a low strong growth the first year, and its maximum growth during the second year. Even under the most favorable conditions, it is not likely to last more than three or four years. It reaches maturity about the same time as Kentucky Blue grass.

SOIL.—Rich moist loams and clay loam soils and comparatively mild climates are best suited to the growth of Perennial Rye grass. Soils with excessive moisture and poor sandy soils are not well suited for growing this grass.

SEED.—The seed of Perennial Rye is of a light brown color and shows more lustre than is usually found in the seeds of Meadow Fescue. In size and shape and in being awnless these two seeds resemble each other, but Perennial Rye seed is flatter and blunter at the ends. Perennial Rye is one of the largest seed producers among grasses. The seed is taken from the second crop when it becomes tough and leathery, which period is usually about one month after flowering. Good seed weighs about 25 pounds per bushel.

SEEDING.—Where the winters are mild enough, Perennial Rye is sown in the autumn to insure a crop the next season. Spring sown seed rarely produces a crop worth cutting the same year as sown. The seed is almost as easy to sow as that of Timothy. From 25 to 30 pounds of seed is sown per acre when this grass is not seeded in combination with clovers and other grasses.

Agricultural Value.

In Europe and those sections of America where Perennial Rye is grown, it is used for both hay and pasture. Its chief value, however, is as a pasture grass. When grown for hay it should be cut when in full bloom, and is cured in the same manner as Timothy. On account of the rapidity with which it becomes established, it is used in temporary pastures, permanent pastures and even in lawns. In permanent pastures it provides pasture during the period when the other and more valuable grasses are becoming established. It stands tramping and close cutting without injury. Its feeding value is inferior to that of Timothy.



PERENNIAL RYE GRASS.
(*Lolium perenne*).

Italian Rye Grass (*Lolium multiflorum*).

HISTORY.—This grass is said to have been first cultivated in Northern Italy. It has been grown in France and England for nearly one hundred years and is considered of more value in these countries than elsewhere in Europe. In Ontario and other parts of Canada, it has been little grown in cultivation.

BOTANICAL DESCRIPTION.—Italian Rye is a short-lived perennial which considerably resembles Perennial Rye grass. The inflorescence is in the form of a spike with the spikelets set edgewise on the stems. These spikelets contain a greater number of flowers than do those of Perennial Rye grass. The stems are more slender, usually grow taller, and have the upper part more roughened than those of Perennial Rye. The leaves, which are of a bright green color, are comparatively broad and soft in texture.

HABITS OF GROWTH.—Italian Rye grass is even shorter-lived than Perennial Rye, few plants living after the second year. This grass starts growth early in the spring, reaches maturity early, and, where conditions are favorable, may be cut three or four times in a season.

SOIL.—Italian Rye gives good results on rich sandy loam and rich clay loam soils. A good supply of lime in the soil favors its growth. It is not suited for growing on poor soils and on soils where water remains stagnant for any length of time.

SEED.—The seed much resembles that of Perennial Rye, but may be distinguished from the latter by its long slender awn, and its blunter and flatter appearance. It is also somewhat lighter in color and has less lustre than the seed of this grass. Italian Rye grass seed is usually cut in the late dough stage, as it shatters badly if over-ripe. Like Perennial Rye, it is a large seed yielder and is just as easily harvested and threshed. Seed weighs from 20 to 25 pounds per measured bushel.

SEEDING.—In mild climates fall seeding is usually considered to give the best results with Italian Rye grass. In Ontario fair results have been obtained where the grass has been seeded in the spring of the year along with a nurse crop of barley or of spring wheat. It is more often sown alone than in mixtures, when as much as 35 pounds of seed is sown per acre.

Agricultural Value.

The chief value of Italian Rye grass lies in its rapid growth and in the quickness with which it recovers after being cut for hay. Where the grass has been irrigated and where liquid manures have been applied, it has produced large yields. Experiments have shown, however, that, under the average conditions of Ontario, it is decidedly less valuable than such grasses as Timothy or Orchard. It produces a fair amount of pasture early in the spring and a medium amount of hay of about the same quality as Perennial Rye. The hay should be cut when the plants are in full bloom and may be cured in much the same way as Timothy.



ITALIAN RYE GRASS.
(*Lolium multiflorum*).

Meadow Foxtail Grass (*Alopecurus pratensis*).

HISTORY.—Meadow Foxtail is a native grass of Europe, Asia and Africa. It is one of the oldest and most commonly cultivated grasses in Great Britain and in other European countries having a moist climate. It is considerably grown in the Eastern United States and in some parts of Central and Eastern Canada.

BOTANICAL DESCRIPTION.—Meadow Foxtail is a long-lived perennial which grows in loose tufts and produces many basal leaves. The inflorescence is in the form of a spike which much resembles Timothy. The spikelets are covered with long soft hairs which give to the spike a softness to the touch not possessed by Timothy. The stems, which grow erect and are smooth, usually do not reach as great a height as Timothy. The leaves are smaller and finer than those of Timothy.

HABITS OF GROWTH.—This grass is the earliest of the cultivated grasses in reaching maturity and is frequently in full head before the first of June. It recovers quickly after being cut for hay and usually produces a good second growth.

SOIL.—Rich clay and clay loam soils with a plentiful supply of moisture suit its growth the best. It is not partial to dry weather nor to soils where the water lies stagnant the greater part of the time.

SEED.—The seed is straw-colored, comparatively short, soft, fluffy and possesses fine medium-length awns. It ripens early but rather unevenly, which makes it difficult to harvest and to cure. The unevenness in maturing seed seems to be the explanation of the lack of vitality in much of the seed. Seed weighs about 5 pounds per measured bushel.

SEEDING.—Meadow Foxtail is one of the most difficult grasses to sow and obtain an even distribution of seed. Successful seeding is only possible where the grass seed is mixed with the grain sown as a nurse crop or with sand or other soil. From 20 to 25 pounds of seed is sown per acre when this grass is not seeded in combination with clovers and other grasses.

Agricultural Value.

Meadow Foxtail produces hay of a quality nearly equal to Timothy, but is a much smaller yielder per acre. Owing to the fact that it requires from two to three years to become established it is very seldom sown in short rotation mixtures. It is cut for hay when in bloom. Its chief value lies in its use in permanent pasture mixtures. For this purpose its earliness gives it a value possessed by no other cultivated grass, as it provides considerable pasture at a period when stock have little to graze upon.



MEADOW FOXTAIL GRASS.
(*Alopecurus pratensis*).

Awnless Brome Grass (*Bromus inermis*).

Other common names: Brome Grass, Smooth Brome Grass, Hungarian Brome Grass, Austrian Brome Grass, Russian Brome Grass.

HISTORY.—Awnless Brome, which is a native of Europe and western Asia, has been cultivated in Europe for about one hundred and fifty years. It was introduced into America about 1882 by the California Experiment Station and into Canada shortly after this date. It is now widely distributed throughout Canada and especially in the Prairie Provinces.

BOTANICAL DESCRIPTION.—This grass is a very long-lived perennial, and is one of the hardiest of the cultivated grasses. Its extensive system of creeping root stalks forms a firm deep sod which is difficult to break up. The panicle, which is large, spreading and drooping, becomes contracted after flowering. The spikelets, which are often nearly an inch long, turn a brownish red color with maturity. The stems are stout and smooth. The leaves, which are quite numerous, are long, broad and smooth.

HABITS OF GROWTH.—Awnless Brome grass grows slowly the first year and does not reach its full growth until the third year. After becoming established, it produces a fairly large amount of material early in the spring, during the summer and into late autumn. It is such an extensive stooler that the soil has been known to become sod bound, necessitating reseeding to maintain the yield. It matures a few days earlier than Timothy.

SOIL.—It seems best adapted to dry and rather poor soils, and is especially suited to those regions where the climate is cold and the rainfall light during the summer.

SEED.—The seed is light brown in color, about three-eighths to one-half of an inch in length, and in shape resembles that of Meadow Fescue. It differs from this grass, however, in being larger, natter, and having blunter ends. Commercial seed is grown chiefly in the north-western States, Manitoba and Saskatchewan. This seed usually contains considerable quantities of chaff and broken stems. When grown for seed, Awnless Brome should be cut when the spikes have turned brown. The seed is less likely to shatter through being over ripe than that of most other grasses. It is harvested and cured in much the same manner as cereal grains. Good seed weighs 14 pounds per measured bushel.

SEEDING.—Spring seeding, using a nurse crop of cereal grain, gives good results with Awnless Brome grass. This method of seeding is especially suitable where it follows dry autumns and winters with a small amount of snowfall. Fifteen pounds of good seed is sufficient to sow an acre when this grass is not seeded in combination with clovers and other grasses.

Agricultural Value.

Awnless Brome grass is grown for both hay and pasture. It is resistant against both cold and drought. When grown for hay, it should be cut just as soon as it reaches full bloom. The quality of hay produced is not equal to that of Timothy and, owing to greater leaf growth, it is more difficult to cure and is more easily injured by unfavorable weather conditions than the hay of this grass. It is of greater value for pasture than for hay. The pasture is readily eaten by stock and it stands close tramping well. Its extensive root system enables it to give fair returns for pasture.



AWNLESS BROME GRASS.
(*Bromus inermis*).

Fringed Brome Grass (*Bromus ciliatus*).

HISTORY.—Fringed Brome is a native of the North American continent, but has been very little grown in cultivation. In experiments conducted at Guelph, extending over a period of six years, this grass has given promising results, standing third in yield of hay among fourteen varieties of grasses tested, and giving returns above the average for pasture.

BOTANICAL DESCRIPTION.—It is a long-lived perennial having short root stalks and growing in loose tufts. The panicle is broad, spreading and drooping. The spikelets, which are nearly all carried at the end of the panicles, are long and from five to nine flowered. The stems are tall, rather slender and covered with stiff hairs on the lower parts. The leaves are broad and soft in texture, being covered on both sides with soft short hairs. In color the grass is a decidedly light green.

HABITS OF GROWTH.—This grass is less hardy than Awnless Brome and greater difficulty is experienced in obtaining a good stand. When once established, however, it maintains itself almost as well as Awnless Brome. It commences growth slowly in the spring and recovers slowly after being cut for hay. Fringed Brome is one of the latest grasses in reaching maturity and is ready to cut for hay about three weeks later than Timothy.

SOIL.—It gives the best results on rich moist soils and is well adapted to growing in shady places.

SEED.—With the exception that it is hairy, it much resembles Awnless Brome seed in appearance and weighs about the same per measured bushel.

SEEDING.—Good results have been obtained when Fringed Brome has been sown in the spring with a nurse crop of barley or other cereal grain. Fifteen pounds of good seed is sufficient to sow an acre when it is not sowed in combination with clovers and other grasses.

Agricultural Value.

The value of Fringed Brome as a cultivated grass is very little known in Ontario. Experiments, conducted at Guelph, indicate that it is worthy of more attention than has hitherto been given to it. In these tests, it surpassed Timothy in yield of hay per acre. The hay, however, was more difficult to cure and was coarser and less palatable than that of Timothy. Fringed Brome, in order to make its best quality of hay, should be cut when it reaches the period of full bloom. In tests conducted at Guelph, where it was grown for pasture, it produced slightly more per acre than Awnless Brome grass and stood tramping equally well. The quality and palatability of the grass, however, was inferior to that of Awnless Brome.



FRINGED BROME GRASS.
(*Bromus ciliatus*).

Western Rye Grass (*Agropyron tenerum*).

Other common names: Slender Wheat Grass, Bald Wheat Grass.

HISTORY.—Western Rye is a native American grass which is widely distributed throughout Canada and the Pacific coast states. Although Western Rye has been cultivated less than forty years, it is already highly esteemed in many parts of western Canada. It combines hay and pasture value better than most grasses which have been under test at Guelph.

BOTANICAL DESCRIPTION.—This grass is a long-lived perennial with somewhat of a branching habit of growth. The roots are long and fibrous and have not the extensive, creeping, underground system of Couch grass. The inflorescence is in the form of long narrow spikes, and much resembles that of Couch grass. The spikelets, which have awn pointed glumes, differ from those of Perennial Rye by being attached flatwise to the stems. The stems grow tall and erect and are more slender than those of Couch grass. The leaves are long and softer in texture than those of this grass.

HABITS OF GROWTH.—After seeding, this grass quickly becomes established, and in favorable seasons will often produce heads in the autumn of the year. It reaches its maximum growth the third year after sowing. Western Rye matures hay ten to twelve days later than Timothy and usually produces a good second growth.

SOIL.—Western Rye grass does best on rather dry soils and in climates where there is a comparatively limited rainfall. Its deep root system enables it to stand prolonged drought without serious injury. It produces poor results on flooded land areas.

SEED.—The seed, which is of a bright straw color, is from three-eighths to one-half of an inch long and somewhat resembles small oat grain. These seeds have short straight awns. Western Rye, which is one of the easiest of the grasses to harvest and thresh for seed, should be cut when the spikelets become straw colored. The seed weighs about 20 pounds per measured bushel.

SEEDING.—It is one of the easiest grasses to sow, and usually gives good results when sown in the spring with a nurse crop of cereal grain. An even distribution of seed may be obtained by seeding broadcast by hand or with the grass seeder attachment on the grain drill. Fifteen pounds of good seed is sufficient to sow an acre when this grass is not seeded in combination with clovers and other grasses.

Agricultural Value.

Western Rye is one of the best grasses cultivated in its resistance to cold and drought. It produces good results for both hay and pasture when sown alone or in mixtures with clovers and other grasses. In variety tests, which were conducted at Guelph over a period of six years, it stood first in average yield of hay per acre and was third in pasture value. It makes its best quality of hay if cut just when the heads are fully out of the sheath. The quality of hay produced is not quite the equal of Awnless Brome. This grass, like Timothy and Orchard, is quite variable in its individual plants, showing great differences in height, in stooling qualities, in vigor of growth, and in color. Systematic plant selection would much improve Western Rye grass.



WESTERN RYE GRASS.
(*Agropyron tenerum*).

Bearded Wheat Grass (*Agropyron caninum*).

Other common name: Awned Wheat Grass.

HISTORY.—This grass, which is a native of Europe, is now quite common in the Prairie Provinces of Canada. In experiments conducted at Guelph it has given only fair results for hay and pasture.

BOTANICAL DESCRIPTION.—Bearded Wheat in general appearance resembles Western Rye, but is coarser in texture and may be distinguished from this grass by the long awn of its flowering glumes and the arrangement of the flowers in a one-sided spike. It often grows in tufts, sometimes reaches a height of three feet, and droops at maturity.

HABITS OF GROWTH.—Bearded Wheat commences growth slowly in the spring of the year and reaches its maximum growth the third year after sowing. It is late in maturing, reaching the hay condition two or three weeks later than Timothy. It usually produces a fairly good second growth.

SOIL.—Unlike Western Rye grass, it is not partial to dry soils, but prefers rich moist loam soil.

SEED.—The seed resembles Western Rye grass seed, but is not quite so long and has slightly greater width. One of the chief points of distinction between this seed and Western Rye lies in the long stiff-awned characteristic of Bearded Wheat. This grass is seldom listed by seedsmen, but seed is sometimes obtainable in small quantities through the experiment stations of Western Canada. The seed weighs about 7 pounds per measured bushel.

SEEDING.—Because of its light weight and long stiff awns, Bearded Wheat is a very difficult grass to seed successfully. This is only possible by mixing the grass seed with the grain sown as a nurse crop or by mixing it with sand. About 15 pounds of good seed per acre is the amount used when the grass is not seeded in combination with clovers and other grasses.

Agricultural Value.

Bearded Wheat is a very hardy grass, standing cold as well as Western Rye grass, but being more susceptible to injury from drought. Although it has given fair yields of hay and fair results for pasture in experiments conducted at Guelph, it is unlikely, on account of the difficulty of seeding it evenly, its lack of palatability and its general coarseness, that it will ever be much cultivated in Ontario.



BEARDED WHEAT GRASS.
(*Agropyron caninum*).

Virginia Lyme Grass (*Elymus virginicus*).

Other common names: Lyme Grass, Terrell Grass.

HISTORY.—Virginia Lyme is a native of the North American continent and is found throughout Canada from Nova Scotia to the Rocky Mountains. It is more common in the Maritime Provinces than in any other part of Canada. Very little attention has so far been given to the cultivation of this grass.

BOTANICAL DESCRIPTION.—It is a long-lived perennial grass with a tendency to grow in dense tufts. The flowers are produced in a spike-like inflorescence which is nearly as large as the spike of wheat. The stems, which sometimes grow to a height of four feet, have a purplish tinge, are smooth, rather slender and leafy to the top of the plant. The leaves are quite broad and abundant, the lower ones usually being dead at flowering time.

HABITS OF GROWTH.—Virginia Lyme starts growth slowly in the spring and usually does not produce much of a second crop after being cut for hay. It reaches the hay condition at a period intermediate between Western Rye and Fringed Brome grasses and is at least two weeks later in maturing than Timothy.

SOIL.—Virginia Lyme is quite adaptable in its soil requirements. It gives good results on moist loam soils and has been successfully grown on light dry soils where other grasses do not thrive.

SEED.—Virginia Lyme grass seed is one of the largest of the cultivated grass seeds, often reaching a length of one-half inch or more. It is very broad, with wide projecting smooth glumes, which have very short awns. The seed weighs about 12 pounds per measured bushel.

SEEDING.—It is not a difficult grass to sow. It may be seeded successfully in the spring of the year with a nurse crop of barley or other cereal grain or sown broadcast by hand. About 15 pounds of seed is sown per acre when this grass is not seeded in combination with clovers and other grasses.

Agricultural Value.

Virginia Lyme produces a large amount of hay, the quality of which, because of its coarseness and lack of palatability, is poor. It makes its best hay if cut when the heads are just out of the sheath. If left later than this period, it soon becomes woody and unpalatable. If used for pasture, it is usually not cut for hay. The best pasture results are obtained when the grass is pastured closely.



VIRGINIA LYME GRASS.
(*Elymus virginicus*).

Canadian Lyme Grass (*Elymus canadensis*).

Other common names: Nodding Wild Rye, Common Wild Rye.

HISTORY.—Canadian Lyme grass, which is a native of Canada and the United States, is common in some parts of the Canadian West, but, so far, has been little grown in cultivation in Ontario.

BOTANICAL DESCRIPTION.—It is a leafy perennial, with deep fibrous roots, and shows a decided tendency to droop as the grass approaches maturity. The spike is long and densely flowered, the spikelets having long bent awns. The stems are stouter than those of Virginia Lyme, but do not grow to as great a height. The leaves are short, broad and somewhat coarse in texture.

HABITS OF GROWTH.—Canadian Lyme grass starts growth slowly in the spring and does not reach its full growth until the third year. Under favorable conditions, it produces a better second growth than does Virginia Lyme grass. It reaches the hay condition about the same time as this grass.

SOIL.—It is best suited to growing on sandy loam soils and is less adaptable to different soil types than is Virginia Lyme grass.

SEED.—The seed of Canadian Lyme grass, while about the same length, is more slender than the seed of Virginia Lyme. Its color varies from straw to a light brown. The glumes of the seed are hairy and the awns are long and bent. Seed is usually not obtainable through commercial sources. Small amounts, however, may sometimes be had from experiment stations. The seed weighs about seven pounds per measured bushel.

SEEDING.—Owing to its light weight and to the awn characteristic of the seed, it is difficult to sow the seed evenly. The most even stands are obtained when the grass is seeded with the grain used as a nurse crop or when mixed with sand. At Guelph, the best results have been obtained from spring sowing and the use of a nurse crop of barley or of spring wheat. About 15 pounds of seed is sown per acre when this grass is not seeded in combination with clovers or other grasses.

Agricultural Value.

Owing to the scarcity of seed, its low vitality and the difficulty of obtaining an even distribution of the seed in sowing, it is doubtful if this grass will ever be of much agricultural importance in Ontario. In the experiments which have been conducted at Guelph, over a period of six years, Canadian Lyme grass has given better results for pasture but less hay per acre than Virginia Lyme. The hay produced was of inferior quality to that furnished by Virginia Lyme grass. The best quality of hay of Canadian Lyme is obtained when the grass is cut early, soon after the heads are out of the sheath. The best pasture results are obtained when the grass is pastured at an early stage of growth.



CANADIAN LYME GRASS.
(*Elymus canadensis*).

Common Red Clover (*Trifolium pratense*).

Other common names: June Clover, Meadow Clover, Broad-Leafed Clover, Meadow Trefoil.

HISTORY. Red Clover is a native of Europe, northern Africa, Siberia, and south-western Asia. The history of its cultivation is much older than that of any of the grasses. There are records of its use as a cultivated plant at least two thousand years old.

BOTANICAL DESCRIPTION. Red Clover is mainly a biennial, a few plants being short-lived perennials. It has deep branching tap roots, which enable it to withstand drought and which have an excellent mechanical effect on the soil. The inflorescence is in the form of a dense head, which is, when full, grown, nearly an inch in diameter, and may be bright red, or purple, in color. The flowers are cross-fertilized chiefly through the agency of bumble bees. The stems grow erect and vary much in height. The leaflets, which are larger than those of Alsike or White Clover, have distinct V-shaped white markings.

HABITS OF GROWTH. In the year in which it is seeded, Red Clover produces little more than its root system and sufficient growth to protect itself over winter. In the second season, it reaches the hay condition from ten days to two weeks earlier than Timothy and usually produces a good second growth after being cut for hay.

SOIL. Red Clover is adapted to growing on various types of soil, the most suitable soils being well-drained clay loams with a fair amount of lime and plenty of humus. Red Clover does not grow successfully on poor or water-logged soils. An open subsoil is almost as necessary for successfully growing Red Clover as is the required surface soil.

SEED. Red Clover seed is about one-sixteenth of an inch long and varies in color from a yellow to a dark violet or purple. The presence of deadish brown shrunken seeds indicates immature seed and seed of low vitality. Seed is usually obtained from the second crop, which is cut when the heads turn brown and when the stems are drying up. The legal weight is 60 pounds per measured bushel.

SEEDING. Red Clover seed may be successfully sown in the spring with a nurse crop of barley or other cereal grain. Good results are also obtained by seeding Red Clover on winter wheat in the early spring on a fresh fall of snow. About 10 to 12 pounds of seed is sown per acre when this clover is not sown in combination with grasses or other clovers.

Agricultural Value.

Red Clover is one of the most important fodder plants grown. It has a high feeding value, especially for young growing animals and milk cows. It is one of the best improvers of the mechanical condition of the soil and is highly valuable as a green manuring crop. Besides its use for hay and pasture and as a green manure, it is also grown for soiling and as a silage crop. Red Clover should be cut for hay when just past full bloom and when the heads are beginning to turn brown. The leaves are the most valuable part of the hay crop and the method of curing adopted should insure the saving of the highest percentage possible of this part of the plant. Red Clover is sometimes pastured the first autumn, but care should be taken that it is not pastured too closely, or too late. Mammoth Red is an important strain of Red Clover. It is larger, coarser, and several days later in maturing than Common Red Clover. Unlike Common Red Clover, it only produces one good cutting of hay in a season.



RED CLOVER.
(*Trifolium pratense*).

Alsike Clover (*Trifolium hybridum*).

Other common name: Swedish Clover.

HISTORY. Alsike Clover, which was first cultivated in Sweden, about one hundred and fifty years ago, takes its common name from a parish in that country. In the last fifty years, it has been extensively grown throughout Europe. In Canada, its growth is largely confined to the eastern provinces and chiefly to Ontario. The city of Toronto is one of the principal Alsike Clover seed markets of the world.

BOTANICAL DESCRIPTION. Alsike is a perennial which, on good soils, frequently lasts from four to six years. Its root system is less deep and more branching than that of Red Clover. The heads are smaller and grow on longer stalks than those of Red Clover. In color they vary from a white to a pinkish rose. The flowers are cross-fertilized chiefly through the agency of honey and bumble bees. The stems, which are smooth, grow erect and usually do not reach a height greater than two feet. The leaflets are smooth, and are shorter and comparatively broader than those of Red Clover. They have no V-shaped white markings.

HABITS OF GROWTH. Alsike commences growth later in the spring than Red Clover. It blossoms later than this clover and does not reach the hay condition until just before Timothy. Alsike produces less second growth than Red Clover.

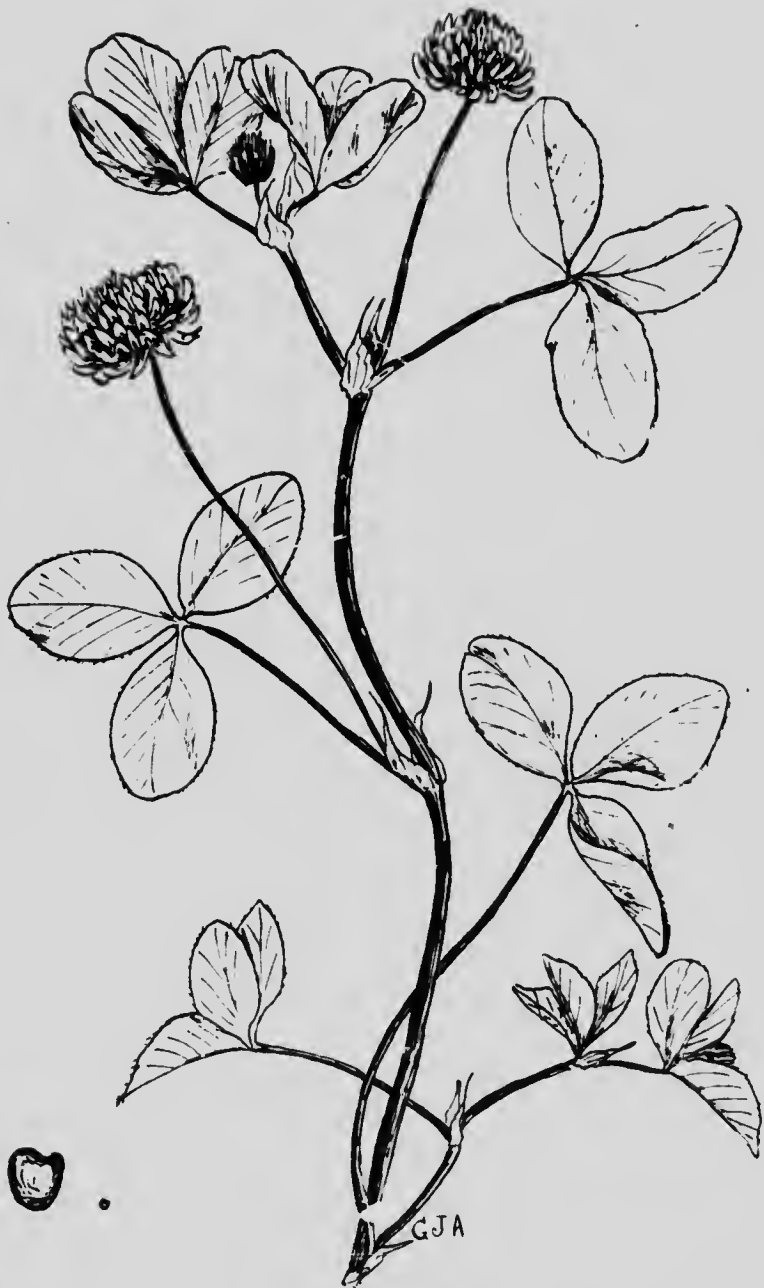
SOIL. The most suitable soils for Alsike are moist clay and clay loams, although it gives good results on other types of soil where there is a good moisture supply. Alsike may be successfully grown on soils which are too wet for Red Clover.

SEED. Alsike seed is about one-half the size of Red Clover and is heart-shaped. It varies in color from a light green to almost a black. The seed is obtained from the first crop, which is often pastured for a time in the spring. Plants should be cut for seed when the heads have turned brown. The seed shells easily and, to prevent loss, the plants are often cut in the early morning when they are wet with dew. The legal weight per measured bushel is 60 pounds.

SEEDING. Alsike may be successfully sown in the spring of the year with a nurse crop of barley or other cereal grain. Good results are also obtained when it is sown on winter wheat in the early spring on a fresh fall of snow. From 6 to 8 pounds of seed is sown per acre when this clover is not sown in combination with grasses or other clovers.

Agricultural Value.

In total value, Alsike is not the equal of Red Clover. It, however, surpasses this clover in being more perennial in character, in being a better pasture clover under most conditions, and in being a better hay plant on soils too wet to successfully grow Red Clover. It should be cut for hay when the plants are in full bloom or a small percentage of the heads have turned brown. It remains green and succulent longer than Common Red and is not injured as much when cut over-ripe for hay as is this clover. Alsike seldom produces more than one crop of hay in a season. The hay is cut and cured in the same manner as Red Clover. Alsike is a valuable clover in permanent pasture mixtures, especially on low land. It is one of the most valuable of honey plants. There is less variation in the individual plants of Alsike than is found in Common Red and there are no recognized varieties or strains.



ALSIKE CLOVER.
(*Trifolium hybridum*).

White Clover (*Trifolium repens*).

Other common name: Dutch Clover.

HISTORICAL. This clover is a native plant of Europe, Russia in Asia, and northern Africa. Although widely distributed in both the United States and Canada, it is not thought to be a native of either of these countries. It was first cultivated in Holland, which fact gave rise to the common name "Dutch Clover."

BOTANICAL DESCRIPTION. White Clover, which is a low growing, creeping plant, is one of the most perennial of the clovers. It is shallow rooted and differs from Alsike in that the solid stems creep on the ground and easily take root. This characteristic enables it to stand much mowing and rather close grazing. The heads, which are white in color, are produced from the lower part of the stem and are smaller in size than those of Alsike. The flowers are cross-fertilized chiefly through the influence of honey bees. The stems are smooth. These are so close to the ground that when they are cut for hay, the crop is nearly all flower-stalks and leaves. The leaves are smaller and more nearly rounded than those of Alsike. They have white markings, smaller but otherwise similar to those on Red Clover.

HABITS OF GROWTH. When sown in the spring, the plants often produce blossoms in the autumn. When White Clover becomes well established, its creeping stems enable it to spread over the ground rapidly. The seed which reaches the ground retains its vitality for a long period and aids in the persistency of this clover.

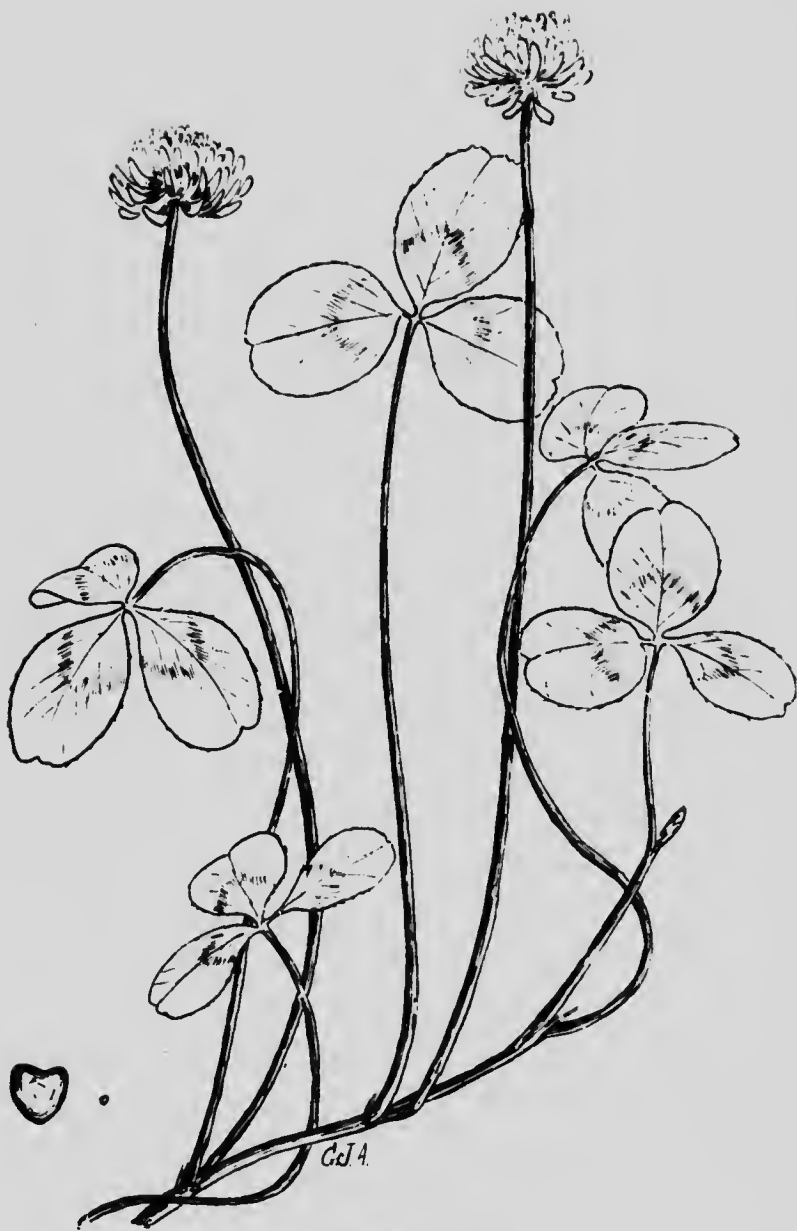
SOIL. White Clover may be grown successfully on a variety of soils, but prefers a rich moist loam, well-drained, and which contains considerable lime. White Clover is not suitable for growing on poor or on wet soils.

SEED. The seed is much the same shape as that of Alsike, but is slightly smaller in size. In color it varies from a yellow to an orange red. It is usually obtained from the first crop which, like Alsike, is often pastured for a time in the spring. Seed is ready to cut when the heads have turned a dark brown. The seed shatters easily and requires the greatest care in harvesting. White clover will naturally reproduce itself from seed if not too closely pastured. The legal weight per measured bushel is 60 pounds.

SEEDING. White Clover may be successfully sown in the spring of the year with a nurse crop of barley or other cereal grain. Good results are also obtained when it is sown on winter wheat in the early spring on a fresh fall of snow. From 6 to 8 pounds of seed is sown per acre when this clover is not sown in combination with grasses or other clovers.

Agricultural Value.

The chief value of White Clover consists in its use as a lawn clover, its use in permanent pasture mixtures, and its use as a honey plant. As a lawn clover, it is unequalled among clovers, withstanding considerable tramping and mowing without serious injury. Its perennial character, and its ability to stand tramping and close grazing make it one of the most valuable of clovers for use in permanent pasture mixtures. Here, its chief function is that of a bottom grass. With suitable soil and moisture requirements, it provides pasture much relished by all classes of stock and lasting from early spring until late summer. It produces a good quality of hay but an amount so small as to prohibit its general growth for this purpose.



WHITE CLOVER.
(*Trifolium repens*).

Crimson Clover (*Trifolium incarnatum*).

Other common names: Italian Clover, German Clover, French Clover, Scarlet Clover.

HISTORY. Crimson Clover is a native of southern Europe and attains its greatest perfection in the countries of this region. In the United States, it has been successfully grown in the middle and south Atlantic States. In Ontario, it has so far been but little cultivated, due largely to unfavorable climatic conditions. The small amount of this clover grown is confined almost entirely to the Niagara Peninsula and to south western Ontario.

BOTANICAL DESCRIPTION. Crimson Clover is a short, erect growing annual or winter annual, with strong branching tap roots. The flowers are in a spikelike head which is longer, narrower and more pointed than that of Red Clover. These cone-shaped heads are scarlet or crimson in color. The stems, which sometimes reach a height of three feet, are soft in texture and covered with soft hairs. The leaflets are shorter and broader than those of Red Clover and, like the stems, are covered with soft hairs.

HABITS OF GROWTH. Where the climate is favorable, Crimson Clover will, if sown in the spring, often produce seed in the autumn. Where it is fall sown, if it survives the winter, it will produce a hay crop earlier in the following season than any other clover grown in Ontario.

SOIL. It is best suited to rich sandy soils and gives good returns on lighter soil types than those which best suit the growth of Red Clover.

SEED. The seed is somewhat egg-shaped and almost twice the size of Red Clover seed. Good seed has a uniform pinkish color. Old seed is of a brownish color and generally shrunken. In harvesting, the seed easily shatters if over-ripe and care should be taken to see that the crop is cut in the early morning when the plants are wet with dew. The legal weight per measured bushel is 60 pounds.

SEEDING. In climates which are well suited to its growth, Crimson clover is usually sown in the early autumn. In Ontario it is usually spring sown and makes such rapid growth that a nurse crop is seldom used with it. About 15 pounds of seed is sown per acre when this clover is not sown in combination with grasses or other clovers.

Agricultural Value.

Crimson Clover is grown for hay and pasture, as a cover crop in orchards, and for its use as a soiling crop. It is cut for hay when the lower leaves of the most matured plants have faded. The stiff hairs on the plants in their later stages of development are known to have caused injury to stock and Crimson Clover, therefore, should not be cut for hay later than the commencement of bloom. In Ontario, Crimson Clover is occasionally used as a hog pasture, sometimes alone and sometimes in combination with other crops. As a cover crop, it possesses value because of its rapid growth and the early period in the spring at which it may be ploughed under. In numerous experiments conducted at the Ontario Agricultural College, Crimson Clover from autumn seeding has winter killed badly and from spring seeding has not equalled Common Red Clover when sown under similar conditions for pasture or for hay.



CRIMSON CLOVER.
(*Trifolium incarnatum*).

White Sweet Clover (*Melilotus alba*).

Other common names: Bokhara Clover, Melilot, Sweet Melilot, Melilotus.

HISTORY. This plant, which is a native of Europe and also of Asia, was first cultivated in western Asia. It was introduced into the United States by the early settlers and is now widely distributed throughout that country and also throughout Canada.

BOTANICAL DESCRIPTION. White Sweet Clover is a biennial plant, having a deep tap root system and producing a very strong vigorous growth. The flowers, which grow in long racemes, are white in color and ripen seed very unevenly. The stems, which frequently grow to a height of five feet or even more, are much branched and spreading. The leaves resemble those of alfalfa but are less numerous. The characteristic fragrance of this plant is responsible for the name, "Sweet Clover."

HABITS OF GROWTH. It grows slowly the first year and does not bloom or produce seed. In the second season, its growth is rapid and it reaches the hay condition several days earlier than alfalfa. The second year's growth of White Sweet Clover is less leafy and more stemmy than that of the first year.

SOIL. It is adapted to growing on many types of soil and gives especially good results on rather poor and on wet soils. A plentiful supply of lime in the soil favors its growth. In order to grow it successfully the presence of the proper bacteria is as necessary as for the successful growing of alfalfa. These bacteria are thought to be identical with those of alfalfa.

SEED. The seed is shorter, usually slightly smaller and less kidney-shaped than that of alfalfa. In color it is a darker yellow and has less lustre than this seed. White Sweet Clover seed may be distinguished from the yellow seed of Red Clover by a more distinct notching near the end of the seed and by its characteristic odor. The seed weighs 60 pounds per measured bushel.

SEEDING. The ease with which Sweet Clover establishes itself on roadsides and in waste places has led to the mistaken belief that it is very easy to get a good catch of this crop. Experiments have shown that it is almost as difficult to secure a good stand of White Sweet Clover as it is to obtain a good stand of alfalfa. The seed may be successfully sown in the early spring, using barley or some other cereal grain as a nurse crop. Good results have also been obtained where the seed has been sown on winter wheat in the early spring after a fresh fall of snow. Sweet Clover seed often contains a considerable percentage of "hard seeds," the germability of which is poor. The percentage of germination of these seeds may be increased by scarifying the seed. About 20 pounds of seed is usually sown per acre when this legume is not sown in combination with grasses or other legumes.

Agricultural Value.

Its chief importance in agriculture lies in its suitability for growing on those soils where alfalfa does not thrive, in its value as a soil renovator, and in its ability to improve the mechanical condition of the soil. When grown for hay, it should be cut just before blossoming. After the most suitable period for cutting hay is past, it quickly becomes woody and unpalatable. In cutting, care should be taken to cut the first crop sufficiently high above the ground so as not to injure the second growth. Its peculiar "odor" is generally distasteful to stock. On poor soils and on poorly drained land, it produces more pasture than alfalfa. As a bee plant it possesses considerable value. The individual plants of White Sweet Clover differ much in height, in percentage of leaf to stem, and in coarseness of leaf and stem. Much improvement, therefore, is possible by selection.



WHITE SWEET CLOVER.
(*Melilotus alba*).

Yellow Sweet Clover (*Melilotus officinalis*).

(Other common name: Melilot.)

HISTORY. This plant is a native of Central Asia and has been cultivated in this region for many centuries. In Ontario it is much less common than White Sweet and its agricultural value is but little known.

BOTANICAL DESCRIPTION. Yellow Sweet Clover is a biennial with a smaller tap root system than that possessed by White Sweet Clover. The flowers resemble those of this plant but are smaller and yellow in color. The stems do not grow so tall and are finer in texture than those of White Sweet. The leaves resemble those of this legume but are somewhat deeper notched and more numerous.

HABITS OF GROWTH. The plants of Yellow Sweet are smaller and are more decumbent the first year than those of White Sweet. The second season this legume grows very rapidly and is ready to cut for hay several days earlier than White Sweet Clover. It maintains itself on roadsides and in waste places chiefly through its habit of reseeding itself.

SOIL. It grows successfully on different types of soil and will produce good results on poor soils. A plentiful supply of lime in the soil favors its growth. Inoculation of the seed with the proper bacteria in soils lacking in these organisms materially assists its growth.

SEED. The seeds in shape, size and color much resemble those of White Sweet and usually cannot be distinguished from those of this species. Occasionally, however, they are slightly mottled with purple, when they may be identified. The seed weighs 60 pounds per measured bushel.

SEEDING. Yellow Sweet Clover may be successfully sown in the early spring of the year, using barley or some other cereal grain as a nurse crop. Success has also been attained where this seed has been sown on winter wheat in the early spring after a fresh fall of snow. Twenty pounds of seed is sufficient to sow an acre when this legume is not sown in combination with grasses or other legumes.

Agricultural Value.

Yellow Sweet Clover produces less hay per acre than White Sweet Clover, and its value as a soil improver is less because of its smaller root system and its generally smaller growth. Some farmers, however, prefer it to White Sweet on account of its production of a finer quality of hay and because of its greater palatability. It should be cut for hay just before blossoming. If left later than this period, it soon becomes woody and fibrous, although this condition is reached less quickly than with White Sweet. It apparently stands pasturing as well as White Sweet Clover and the pasture seems to be more relished by stock. Yellow Sweet Clover has considerable value as a bee plant and, in some sections, is sown especially for this purpose.



YELLOW SWEET CLOVER.
(*Melilotus officinalis*).

Alfalfa (*Medicago sativa*).

Other common name: Lucerne.

HISTORY. Alfalfa is one of the oldest of fodder plants and has been cultivated in Europe and Asia for nearly twenty-five hundred years. It has been cultivated in Ontario for about sixty years. For years after its introduction into this province, its cultivation was confined largely to a few individual farmers in the counties of Haldimand, Welland and Lincoln. In the last few years, its merits have been more generally recognized and the area devoted to growing it has been largely increased.

BOTANICAL DESCRIPTION. It is a long-lived, deep-rooted perennial legume with a typical tap root. The part of the tap root showing above ground is known as the crown. The flowers of Alfalfa are produced in clusters and are usually purplish in color. The stems are generally smooth and are less branched than those of Sweet Clover. The leaves consist of three leaflets which are narrow and sharply toothed in the upper part.

HABITS OF GROWTH. Alfalfa usually does not produce sufficient growth in the year in which it is seeded to provide a crop of hay or pasture. In the second year, it commences growth early in the season and is ready to cut for hay several days before Red Clover.

SOIL. Alfalfa is very particular in its soil requirements, and failures to secure good stands are often due to unsuitable soil conditions. Definite soil types seem less necessary to success in growing this crop than does the presence of the other proper conditions. The best results are obtained where the sub-soil is open, where the drainage is good, where a good seed bed has been provided, where the proper bacteria are present in the soil, and where a plentiful supply of lime exists.

SEED. Alfalfa seed is kidney-shaped, about one-third larger than Red Clover seed and is yellow in color. The presence of many deadish brown seeds indicates seed of low vitality. Seed is usually obtained from the second crop. Alfalfa should be cut for seed when about one-half of the pods have turned brown. The legal weight per measured bushel is 60 pounds.

SEEDING. The following methods have given good results in seeding Alfalfa: 1. Sowing on winter wheat in the early spring on a fresh fall of snow; 2. Sowing in the early spring with a nurse crop of barley or other cereal grain; 3. Sowing alone about July 15th on well prepared land where a good supply of moisture exists. About 20 pounds of seed is sown per acre when Alfalfa is not sown in combination with grasses or other legumes.

Agricultural Value.

Alfalfa is chiefly valuable as a hay crop, but is also grown for pasture, as a soiling crop, for silage, and for its use as a green manure. When grown for hay it should be cut at the commencement of bloom or at the beginning of the second growth. It makes hay of excellent quality but the greatest care is necessary to preserve the leaves of the plants. In average seasons in most parts of Ontario, three cuttings of hay are produced. Alfalfa is only a fair pasture plant and should never be pastured too closely, too early in the spring, or too late in the autumn. Many failures in growing Alfalfa have been due to the sowing of tender strains. The most suitable strains of Alfalfa for growing in Ontario are Grimm, Ontario Variegated and Baltic.



ALFALFA.
(*Medicago sativa*).

Sainfoin (*Onobrychis sativa*).

Other common name: Esparsette.

HISTORY. This plant is said to have been first cultivated in France more than four hundred years ago. Since that date it has been extensively grown in other countries of Europe, notably England. In Europe it added an important fodder crop asset because of its ability to grow on dry barren calcareous soils. It was first introduced into America about one hundred years ago, but has never attained any great agricultural prominence. It is not to be compared with alfalfa in fodder value.

BOTANICAL DESCRIPTION. Sainfoin is a long-lived perennial plant with a deep, woody, much branched tap root system. The flowers, which are rose-colored, are contained in a spikelike inflorescence. The stems grow erect and seldom reach a height greater than two feet. The leaves are compound and consist of many leaflets. The seed pods are one-seeded and are brown in color.

HABITS OF GROWTH. Sainfoin commences growth early in the spring and reaches the hay condition about the same time as alfalfa. When once well established on suitable soil, it lasts for many years.

SOIL. The most suitable soils are friable clay loams with a plentiful supply of lime.

SEED. On account of low vitality of commercial seed, it is often difficult to obtain a good stand of Sainfoin. It is sold both as shelled and unshelled seed. The unshelled seed is cheaper and occurs in much greater quantity in commerce than shelled seed. The unshelled seed or seed-pods are flattened and somewhat bean-shaped, the surface being covered with a fine, mesh-like netting. The outer edge of the seed pod has strong sharp teeth. Shelled seed is kidney-shaped, about three-sixteenths of an inch long, and of an olive brown color. Shelled seed weighs 60 pounds per measured bushel.

SEEDING. Sainfoin may be successfully seeded in the early spring of the year with a nurse crop of barley or other cereal grain, or in the early spring on winter wheat on a fresh fall of snow. From 50 to 60 pounds of shelled seed is sown per acre when this legume is not sown in combination with grasses or other legumes.

Agricultural Value.

Sainfoin excels alfalfa in agricultural value only in its ability to grow on poor soils and to stand close pasturing. It should be cut for hay when the plants are about one-third in bloom. After this period it rapidly becomes woody and loses much of its feeding value. In favorable seasons, it will produce two crops in the one year. It is ready to pasture fully as early in the spring as alfalfa and will stand pasturing by sheep better than this plant. It is considered a valuable bee plant.



SAINFOIN.
(*Onobrychis sativa*).

VARIETIES OF GRASSES FOR HAY PRODUCTION.

Comprehensive and numerous experiments have been conducted at the Ontario Agricultural College in comparative tests of different varieties of grasses for hay production. The different experiments have varied somewhat in the varieties used. It has been found very difficult to get a perfect stand of all varieties under similar conditions and, at the same time, to have all kinds growing pure in the plots without mixtures of other grasses, clovers, or certain weeds. Some varieties give one and some varieties two cuttings in the same season. This adds to the difficulty in getting accurate results of cured hay from a large number of varieties and in different years. The following table gives the comparative results of sixteen varieties of grasses grown under similar conditions in each of six years:—

Varieties of Grasses.	Date When in Full Head (Average 4 Years).	Average Results for 6 Years.	
		Height of Crop (ins.).	Total Yield of Hay per Acre per Annum (tons).
Western Rye	July 13th	30	3.98
Virginia Lyme.....	July 21st	31	3.65
Fringed Brome.....	August 2nd	33	3.39
Timothy	July 5th	34	2.84
Bearded Wheat.....	July 21st	32	2.83
Canadian Lyme.....	July 22nd	28	2.76
Tall Oat	June 21st	42	2.75
Orchard.....	June 23rd	33	2.16
Awnless Brome.....	July 2nd,	22	1.82
Canadian Blue.....	June 22nd	18	1.71
Meadow Fescue.....	June 26th	30	1.53
Meadow Foxtail.....	June 6th	30	1.42
Red Top.....	July 13th	20	1.23
Kentucky Blue.....	June 17th	23	1.20
Yellow Oat.....	June 27th	27	1.19
Perennial Rye.....	June 18th	19	.76



A few varieties of grasses, showing the comparative average height. From the left: Tall Oat, Timothy, Orchard, Meadow Fescue, Western Rye, Meadow Foxtail, Kentucky Blue, Awnless Brome, Red Top, Perennial Rye, and Canadian Blue.

Five out of the six of the highest yielding grasses are all native of Canada, and especially of the Western Provinces. Timothy occupies a relatively higher place when used for hay than it does when used for pasture. The Tall Oat and the Orchard grass are suitable for either hay or pasture production. The Awnless Brome grass, which was strongly advertised a few years ago, has not given very satisfactory results in Ontario. Of the varieties under test, Meadow Foxtail is the earliest and Fringed Brome the latest. All of the sixteen varieties are comparatively hardy. The results here presented should furnish some good information as a basis for making certain selections and combinations when it is desirable to grow different grasses in mixtures.

VARIETIES OF TIMOTHY.

There is no variety of grass which is used so extensively in Ontario for hay and for pasture as Timothy. As a pasture crop, however, it gives very poor results in a hot, dry time in the summer, when pasture is needed the most. Such crops as Orchard grass, Tall Oat grass, Meadow Fescue, Tall Fescue and Meadow Foxtail will usually give a fairly good green growth in a time of drought when the timothy makes practically no growth.

Several years ago, Dr. Hopkins, formerly of the Agricultural Experiment Station at Morgantown, West Virginia, carried on some extensive work in starting new strains of timothy from selected plants. From the very large number of selections which Dr. Hopkins made, he finally chose three of the very best for fulfilling certain requirements. Some of the seed of each of these special strains was obtained. The different strains were sown in comparison with the Common timothy on a duplicate set of plots. After they became established the first season, they were cropped in each of four successive years, the following being the average results in yield of hay per acre:—

Varieties.	Tons of Hay per Acre. Average 4 years.
Common Timothy	1.35
Early Timothy	1.50
Stewart's Mammoth Timothy.....	1.34
Pasture Timothy	1.63

It will be seen from the results here presented that two of the selected strains of timothy gave greater yields of hay than the Common timothy of Ontario.

In the spring of 1915, seed of each of ten strains of specially selected timothy was obtained from Cornell University, Ithaca, N.Y. These selected strains resulted from a large amount of investigational work extending over a series of years. As the result of three years' testing, an average annual return varying from 2.65 to 3.32 tons per acre was obtained. The highest return resulted from the strain No. 1777 of Cornell University. Unfortunately, no common timothy was included in this test as a basis of comparison.

VARIETIES OF CLOVER FOR HAY PRODUCTION.

A number of varieties of clover have been under test for the production of hay but it has been difficult to get the results of a large number of varieties of clover under uniform conditions for a series of years. The following table gives the yield per acre, in tons of hay per annum, for each of three varieties of clover in each of seven years:—

Varieties.	1892.	1897.	1898.	1900.	1902.	1907.	1916.	Average 7 Years.
Mammoth Red.....	2.81	1.36	2.84	3.20	2.55	2.95	4.88	2.94
Alsike.....	2.31	2.24	2.64	3.00	2.85	1.90	4.80	2.82
Common Red.....	1.89	3.08	2.92	3.10	2.05	2.25	4.25	2.79

Mammoth Red gave the highest yield of hay per acre in each of four years, Common Red in each of two years, and Alsike in one year. Although the Alsike gave a slightly higher average yield of hay per acre than the Common Red, it will be seen that the latter surpassed the former in hay production in each of four out of the seven years. In the seven-year period, there were two cuttings of Red clover in each of four years, of Mammoth clover in each of two years and of Alsike clover in one year.

In each of three years comparative results were obtained from alfalfa, White or Dutch clover and Yellow Trefoil, in addition to the three clovers previously reported. The following table gives the number of tons of hay per acre per annum for each of these six varieties of crops in each of three years:—

Varieties.	1900.	1907.	1916.	Average 3 Years
Alfalfa.....	4.60	4.00	4.15	4.25
Mammoth Red.....	3.20	2.95	4.88	3.68
Alsike.....	3.00	1.90	4.80	3.23
Common Red.....	3.10	2.25	4.25	3.20
Yellow Trefoil.....	1.40	1.63	3.95	2.33
White or Dutch.....	1.80	1.06	2.70	1.85

It should be understood that alfalfa does not receive its full development until the third year, and under favorable conditions should produce crops for many years in succession. The alfalfa does not even reach its maximum returns by the time that the life of most of the clovers has passed.



Weighing grasses grown on the experimental plots.



An eleven-acre field of Ontario Variegated Alfalfa grown on the College farm.



Loading Alfalfa in a thirty-acre field on the College farm.

ALFALFA FOR HAY.

In each of the past twenty-three years, experiments were conducted on growing alfalfa in the experimental grounds at Guelph. The results for 1899 and for 1905 were not recorded in sufficient detail to permit of their being reported. For the other years, however, accurate determinations were made. A number of different seedings are represented. Each seeding took place in the spring of the year by sowing from 18 to 20 pounds of alfalfa seed per acre which was usually sown in combination with a grain crop, such as barley, at the rate of one bushel per acre. The following table gives the yields per acre of the different cuttings of green alfalfa and of cured hay produced in each of twenty-one years:—

Years.	Green Crop.					Hay.				
	First Cutting.	Second Cutting.	Third Cutting.	Fourth Cutting.	Total.	First Cutting.	Second Cutting.	Third Cutting.	Fourth Cutting.	Total.
1896....	9.96	6.47	4.06	2.06	22.55	3.08	1.91	1.29	.65	6.93
1897....	12.04	5.61	4.42	....	22.08	3.59	1.56	1.23	....	6.38
1898....	9.71	5.85	2.64	....	18.20	2.30	1.75	.63	....	4.68
1900....	11.93	6.00	1.60	....	19.53	2.33	1.47	.80	....	4.60
1901....	9.70	2.20	7.49	....	19.89	2.03	1.00	1.50	....	4.53
1902....	13.35	8.69	2.96	....	25.00	2.50	2.02	.54	....	5.06
1903....	13.10	8.53	2.75	....	24.38	2.50	2.09	.67	....	5.25
1904....	12.45	9.35	4.00	....	25.80	3.40	2.50	1.08	....	6.98
1906....	9.78	6.60	4.85	....	21.23	2.55	1.13	.58	....	4.26
1907....	14.55	3.95	....	....	18.50	2.95	1.05	....	....	4.00
1908....	9.70	6.75	3.73	....	20.18	2.50	1.15	.75	....	4.40
1909....	8.68	4.56	.84	....	14.08	2.52	1.40	.14	....	4.06
1910....	15.08	3.88	4.76	....	23.72	2.94	.80	1.32	....	5.06
1911....	8.00	1.80	1.36	....	11.16	1.76	.34	.30	....	2.40
1912....	9.48	4.68	4.72	....	18.88	2.08	.99	.56	....	3.63
1913....	9.00	2.96	2.33	....	14.29	2.66	.88	.68	....	4.22
1914....	7.64	1.61	4.28	....	13.53	2.32	.54	1.02	....	3.88
1915....	10.63	6.06	6.92	....	23.61	3.07	1.31	1.53	....	5.91
1916....	13.29	6.86	2.40	....	22.55	3.10	1.60	.83	....	5.53
1917....	12.04	5.54	2.60	....	20.18	2.40	1.50	.90	....	4.80
1918....	2.38	1.98	2.00	....	6.36	.64	.60	.66	....	1.90
Average 21 Years.	10.59	5.23	3.37	.10	19.30	2.53	1.31	.81	.03	4.69

In each of nineteen years, the alfalfa gave three cuttings per annum. In 1907, two cuttings, and in 1896, four cuttings were produced in the one season. The spring of 1896 opened up very early and that of 1907 very late.

The yield of alfalfa hay per acre amounted to over six tons in each of three years, between five and six tons in each of five years, between four and five tons in each of nine years and less than four tons in each of four years.

The results show that, on the average, the first crop of the season was about double the yield of the second crop and that the second was nearly double that of the third crop. In some years the yields of alfalfa per acre were more than twice as much as those of other years. The average annual production of alfalfa for the twenty-one year period was nearly twenty tons of green crop and nearly five tons of hay per acre. The green alfalfa furnished on an average 24.3 per cent. of its weight as dried hay. The average dates of cutting for the twenty-one years were June 22nd for the first, July 30th for the second and September 17th for the third.

MIXTURES OF GRASSES, ALFALFA, AND CLOVERS FOR HAY PRODUCTION.

Six separate yearly tests have been obtained from growing, under uniform conditions, sixteen mixtures of grasses and clovers for hay production. Alfalfa, Common Red clover, Mammoth Red clover, and Alsike clover were used in combination with Timothy, Orchard grass, Tall Oat grass, and Tall Fescue grass. Each mixture consisted of a grass and a legume. The mixtures produced either two or three cuttings each season, the third cutting resulting from the mixture containing alfalfa. Seed mixtures were sown with a grain crop in every case. No crop was obtained in the same year in which the seed was sown. The cuttings were made, in every instance, from the second and the third years after seeding took place. Two or three separate weighings were made of the hay from each plot in order to make accurate determinations. The following table gives the average annual yield of green crop and of hay per acre per annum for the six separate tests of each of sixteen mixtures:—

Mixtures.	Green Crop.	Hay.
Tall Oat and Alfalfa.....	18.17	5.20
Orchard and Alfalfa.....	18.56	4.85
Timothy and Alfalfa.....	17.24	4.64
Tall Fescue and Alfalfa.....	18.81	4.57
Tall Oat and Mammoth Red	12.90	4.08
Tall Oat and Common Red	12.18	4.02
Timothy and Mammoth Red.....	13.41	3.91
Tall Fescue and Mammoth Red.....	13.77	3.86
Orchard and Mammoth Red.....	12.57	3.75
Tall Fescue and Common Red	12.88	3.47
Orchard and Common Red	11.17	3.46
Tall Oat and Alsike	10.22	3.41
Timothy and Common Red	12.02	3.40
Orchard and Alsike	9.52	2.98
Tall Fescue and Alsike	9.70	2.86
Timothy and Alsike	9.02	2.64

It will be seen, that in high production, the dominating influence resulted from the alfalfa of the legumes, and from Tall Oat of the grasses. The Timothy and the Alsike clover seemed to exert greatest influence towards low production. It is interesting to note that the Tall Oat grass and the alfalfa are both very hardy, start early in the spring, are ready to cut at about the same time, withstand hot dry weather in the summer, and form good growth in the autumn. It is a mixture which not only gives a large yield of hay, but should form excellent pasture, providing the alfalfa is not eaten down closely so that the animals would destroy the crowns of the roots and thus kill the plants.

GRASSES, ALFALFA AND CLOVERS SOWN IN THE FALL AND IN THE SPRING WITH AND WITHOUT NURSE CROPS.

On three different occasions an experiment was conducted in the experimental grounds in sowing three varieties of grasses, two varieties of clover and one variety of alfalfa in the autumn with winter wheat and without winter wheat, and in the spring with oats and without oats. The cropping took place in 1898, in 1901 and in 1906. The fact of having this experiment conducted in three separate periods covering different seasons adds value to the results. The same quantities of seed were used for the three different seedings. The crops, when in the proper stage,

were cut and weighed in the green condition and then carefully cured into hay and were weighed three times, leaving several hours between each two weighings in order to secure accurate and reliable information.

The tabulated results here given represent the average yield of hay in tons per acre for each crop sown under each of the conditions of the experiment. The figures in every case represent the average of three distinct experiments:—

Crops.	Autumn Sowing.		Spring Sowing.	
	Winter Wheat as Nurse Crop.	No Nurse Crop.	Oats as Nurse Crop.	No Nurse Crop.
Orchard Grass	3.26	3.60	4.05	3.13
Meadow Fescue	2.44	2.86	3.52	2.94
Timothy	3.26	3.18	3.68	3.63
Common Red Clover.....	2.86	1.16	3.32	3.35
Alsike Clover.....	2.51	.90	2.57	2.39
Alfalfa or Lucerne	3.56	1.24	4.11	3.97
Average 3 Grasses	2.99	3.05	3.75	3.24
Average 3 Legumes	2.98	1.1"	3.35	3.24

It will be seen that the figures given in the tabulated results represent the yields per acre for only one year which was the second summer after the seeding took place. In the first experiment the Orchard grass, the Meadow Fescue and the Timothy, which were sown in the autumn without a grain crop, produced hay in the next summer as follows:—Orchard grass, 3 tons per acre; Meadow Fescue, 4.6 tons per acre; and Timothy, 4.6 tons per acre. In the second experiment these same three grasses which were sown in the autumn without winter wheat also produced hay the following year, the yields being as follows: Orchard grass, 1 ton per acre; Meadow Fescue, 1.1 tons per acre; and Timothy, 2.1 tons per acre. Each of the grasses and the clovers sown in the first experiment without a grain crop in the spring of the year produced the following yields of hay per acre in the first summer after the seed was sown: Orchard grass, 2.2 tons; Meadow Fescue, 3.2 tons; Timothy, 1.7 tons; Common red clover, 1.9 tons; Alsike clover, 2.1 tons; and Alfalfa, 1.5 tons. These were the only crops which were of sufficient quantity to cut and weigh in the first summer after sowing.

It will be observed from the figures given in the table here presented that the amount of hay produced from sowing the clover and the alfalfa in the autumn of the year without any grain crop was very small. In both the first and the third experiments the alfalfa and clovers which were sown alone in the autumn made a good growth before the winter started, but were badly winter killed before spring. Although the clovers and alfalfa which were sown alone in the autumn in the second experiment did not fare as badly as those of the first and the third experiments, still the results were poor in comparison with those of other seedings. The grasses, the clovers and the alfalfa gave good results when sown in the spring, either with or without a grain crop. The grasses also gave fairly good results when sown in the autumn either alone or with winter wheat. In studying these results, it must be remembered that where the grass and clover seed has been sown with either winter wheat or with oats, there is a great advantage in having the grain crop which is likely to be more valuable, in most instances, than the increase in the yield of the grasses or the clovers when sown by themselves.

GRASSES GROWN SINGLY FOR PASTURE.

It is, indeed, a difficult matter to make an exact determination of the amount of pasture produced from a number of different kinds of grasses when pastured by farm stock. In the experiments conducted in connection with the Royal Agricultural Society at Woburn, England, as well as at other places, it was found unwise to attempt to compare different grass lands by having the crops pastured by sheep unless at least three acres were used in each plot. If cattle were used, even larger plots than these would be necessary. It will, therefore, be seen that if it is desirable to make a comparison of fifteen or twenty kinds of grasses by pasturing them separately with sheep or cattle, a very large amount of land would be required. It was thought, however, that some valuable information might be obtained by using smaller plots of land and by cutting, weighing and removing the crops from the land instead of pasturing them with farm stock. An experiment was conducted, therefore, for four years in succession by cutting, weighing and



Sheep do wonderfully well on pasture lands, and are very effectual in eradicating weeds.

removing the crop produced from each of sixteen varieties of grasses at that time in the spring when the earliest varieties were ready for pasturing, and then by repeating this process at each time during the summer when the more vigorous varieties had produced a sufficient growth for furnishing a good pasture crop. In the average of the four years, the crops were cut on the six dates as follows: May 28th, June 18th, July 9th, July 30th, August 20th and September 16th. It will be seen that the growth was somewhat slower between the last two dates than in the earlier periods.

In one year during which an experiment was conducted there were two sets of grass plots containing sixteen varieties each. These two sets were fenced separately. They were pastured three times during the summer, one by a herd of cattle and one by a flock of sheep. The sheep were turned on the pasture on May 19th, July 3rd and September 14th and the cattle on May 27th, July 13th and September 22nd. In each instance the animals were on the pasture about one week.

Careful notes were taken of the amount of pasture removed from each plot at the end of the first and of the last day of each period. This experiment was conducted in order to glean information regarding the palatability of the different grasses as pasture for cattle and for sheep.

The following table gives the average yields of the four years' results of each of sixteen varieties of grasses at each of six different cuttings, as well as the total number of tons of pasture material per acre per annum, and the comparative palatability of the different grasses:—

Varieties of Grasses.	Percentage Palatability determined by pasturing cattle and sheep. 12 determinations		Tons of Green Pasture per Acre per Annum from each of Six Cuttings. (Ave. 4 years).						
	Cattle	Sheep	1st.	2nd.	3rd.	4th.	5th.	6th.	Total Cuttings
Tall Oat	77	80	5.93	.93	1.59	1.23	1.33	.87	11.70
Orchard	100	80	4.34	1.71	.92	1.30	1.05	1.40	10.72
Western Rye.....	37	20	4.82	1.28	.93	1.58	.89	.64	10.14
Canadian Lyme.....	67	77	3.67	1.81	1.01	1.82	1.01	.73	10.05
Bearded Wheat.....	41	48	3.18	1.78	1.03	1.89	1.11	.79	9.78
Meadow Fescue.....	68	53	4.60	1.72	.69	1.09	.84	.61	9.55
Virginia Lyme.....	43	49	4.13	1.32	.87	1.65	.86	.62	9.45
Tall Fescue.....	55	55	4.70	1.75	.78	.87	.74	.59	9.43
Timothy.....	87	92	4.87	1.71	.58	1.11	.62	.49	9.38
Fringed Brome.....	59	58	4.27	.80	1.09	1.55	.98	.58	9.27
Awnless Brome.....	81	80	4.53	.96	1.04	1.26	.63	.62	9.04
Perennial Rye.....	40	42	4.10	1.49	.61	.78	.90	.80	8.68
Meadow Foxtail.....	88	75	3.81	1.32	.72	.95	.53	.37	7.70
Kentucky Blue.....	69	87	3.76	1.04	.73	.78	.58	.58	7.47
Rhode Island Bent.....	59	66	3.17	1.17	.66	.91	.52	.40	6.83
Red Top.....	63	68	2.71	1.03	.62	.67	.44	.37	5.84

It will be seen that the Tall Oat grass produced the largest amount of pasture crop per acre, the average for the four years being nearly twelve tons per annum. It gave decidedly the largest yield at the first cutting, held out well in the middle of the summer and furnished a fairly large amount of pasture crop in the autumn of the year. The Orchard grass was especially strong in the autumn, producing the greatest quantity of pasture crop at the last cutting of any of the sixteen varieties of grasses under experiment. Although the Western Rye, Canadian Lyme and Bearded Wheat have all given comparatively high results in yield of pasture crop per acre, a study of the experiment shows that when these crops are cut six times during the summer the plant vitality becomes greatly exhausted and the crops are apt to be quite inferior in the following season. In the case of Tall Oat, Orchard Grass, Meadow Fescue and Tall Fescue, however, the vitality of the plants does not seem to be injured to any great extent by frequent cutting. The results of this experiment are very suggestive and furnish some valuable information regarding the special characteristics of different varieties of grasses when grown with the object of pasture. The results of the individual tests help to form a basis for procuring different mixtures of grasses to be sown for the production of pasture.

CLOVERS AND SIMILAR CROPS GROWN SINGLY FOR PASTURE.

An experiment was conducted for three years by cutting each of eight varieties of clover and somewhat similar crops at six different times during the growing season, in order to ascertain the amount of pasture crop produced by each variety throughout the summer. The first cutting was made as soon as the earliest varieties had furnished sufficient growth to afford a good pasture. Each of the other five cuttings were made at such times as the most vigorous growing varieties had produced sufficient growth for pasture purposes. As each cutting was made, the crop was weighed immediately in order to ascertain the exact yield of pasture crop produced by each variety.

In order to glean information regarding the palatability of the different varieties, each of two sets of plots was enclosed with a hurdle fence. When the majority of varieties were in the best condition for pasture, a herd of cattle was turned on one set and a flock of sheep on the other set. The animals were allowed to roam over the plots. Careful notes were taken on the evening of the first and on the evening of the last day of the pasture period, which lasted nearly a week. This process was repeated three times during the season. The average amount of pasture crop removed from the plots in the six observations for each class of farm stock, when worked out in the form of percentages, furnishes information regarding the comparative palatability of the different varieties when pastured by cattle and by sheep.

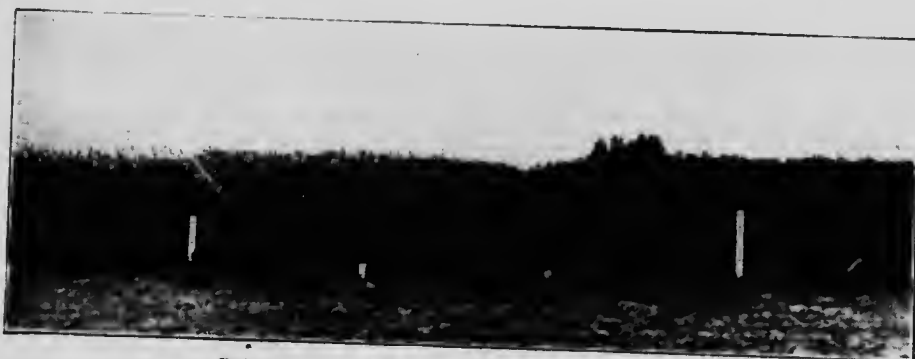
The following table gives the average results for three years of each of six cuttings per annum of each variety, and also the palatability of the different varieties of pasture crops, as determined from six observations made in the one season when cattle and sheep were allowed to pasture on the plots:

Varieties.	Percentage Palatability as determined by pasturing cattle and sheep. 12 Determinations.		Average of Three Years' Results in Yield of Green Pasture Crop per Acre from each of Six different cuttings (tons).						
			1st.	2nd.	3rd.	4th.	5th.	6th.	Total 6 Cuttings
	Cattle.	Sheep.							
Alfalfa	93	83	8.73	3.06	2.70	3.62	1.56	1.27	20.94
Common Red.....	99	88	10.88	1.10	2.37	3.39	1.52	1.15	20.41
Mammoth Red.....	100	100	10.55	1.02	1.99	2.83	1.19	1.19	18.77
White or Dutch.....	86	93	7.35	2.35	1.95	1.91	2.08	1.63	17.27
Alsike.....	98	96	8.22	.28	3.06	1.41	2.56	.98	16.46
Yellow Trefoil.....	..	..	5.07	.19	2.59	2.18	2.10	1.02	13.15
Sainfoin	88	74	4.64	.67	1.78	2.73	1.19	.79	11.80
Burnet	88	69	2.64	1.39	1.05	1.52	.59	.41	7.60

The foregoing tabulated results show that those crops which were the least relished as pasture were Sainfoin and Burnet, by sheep, and White or Dutch clover, Sainfoin and Burnet, by cattle. The Mammoth Red clover proved to be very palatable to both classes of farm stock.

It will be seen that upwards of twenty tons per annum of green pasture crop per acre were produced by Alfalfa and by Common Red clover. Alfalfa produces a large amount of pasture material, but unfortunately animals in tramping over a field composed entirely of Alfalfa often destroy the plants by eating off the

crowns of the roots. This is particularly true if any heaving has taken place. The White or Dutch clover has also made a high return. Although the plants do not grow to a great height, the crop is apt to be very compact and generally yields more than its appearance would indicate. The results which are here presented should be considered in connection with the figures previously reported for the grasses grown singly for pasture.



Sainfoin to the left and Alfalfa to the right.

In each of two years an experiment was conducted at the College in comparing the amount of pasture crop produced by sweet clover, by Alsike clover and by Common red clover. The yields per acre were determined at each of six cuttings in each of the two years. Three weeks were allowed between each two cuttings. The results are very interesting in furnishing definite information regarding these three crops in the production of green clover, which would correspond pretty closely to the relative amounts of pasture produced. The following table gives the average of the two years' experiments in tons per acre of green pasture crop:

Varieties.	1st.	2nd.	3rd.	4th.	5th.	6th.	Total 6 Cuttings.
Common Red Clover.....	13.3	1.4	2.9	4.6	2.0	1.6	26.0
Alsike Clover.....	11.0	.2	4.0	1.7	3.4	1.1	21.4
White Sweet Clover.....	11.0	1.5	2.5	3.0	1.9	.9	20.8

The results show that, with one exception, in the average of the two years the Common red surpassed the sweet clover in yield of pasture crop per acre at each of the cuttings. In the total amount of pasture per acre per annum, the Common red clover surpassed the sweet clover by fully five tons or by about twenty-five per cent., and the Alsike surpassed the sweet clover by about one-half ton.

MIXTURES FOR ANNUAL PASTURES.

Owing to various circumstances, stock farmers sometimes realize in the spring of the year that the amount of pasture for the season is likely to be deficient for maintaining the farm stock throughout the coming summer. Experiments were started at the Agricultural College with the object of gleaned information regarding the most suitable varieties of crops to sow in the spring, either separ-

ately or in combination, to produce pasture satisfactorily in the same season in which the crops are sown. Fourteen different crops were selected, and after some preliminary work definite experiments were planned. These crops were sown on twenty-eight plots, which were uniform in size and shape. One set of fourteen plots was used for determining the comparative earliness, drought resistance, quick and persistent growth and yields of the different crops, and the other for determining the palatability of the crops when being pastured by farm stock.

It was decided to cut each crop in one set at the end of six, nine, twelve, fifteen and eighteen weeks after the seed was sown, thus making five cuttings for each crop. By weighing the green material obtained in each instance, immediately on its being cut, information could be gleaned regarding the approximate amount of green pasture material from each crop throughout the season. The experiment was repeated in each of five years.



A section of the experimental grounds showing, in the foreground, a field of Annual Pasture Mixture on which cattle are grazing, and some grass plots beyond.

The other set was sown in exactly the same way as the one already described, but the crops were pastured by a small herd of cattle instead of being cut and weighed every three weeks. When the crops were in their best condition for pasture, the cattle were turned on and allowed to roam freely over the plots. Notes were carefully taken of the approximate amount of pasture eaten from each plot at the end of the first day and of the last day of the pasture period, which lasted about a week. This was repeated from two to three times each season in each of three years and furnished some valuable information regarding the palatability of the crops for pasture purposes.

The following table gives the average percentage of palatability as determined by pasturing cattle and also the production of pasture material obtained from the different cuttings of each of fourteen crops:

Varieties.	Percentage Palatability as determined by pasturing Cattle 3 years. 16 Determinations.	Average of Five Years' Results in Yield of Green Pasture per Acre from each of five different Cuttings (tons).					
		1st.	2nd.	3rd.	4th.	5th.	Total 5 Cuttings.
Oats	100	3.61	2.73	1.16	.72	.51	8.73
Red Clover.....	67	.05	2.15	2.70	1.97	1.73	8.60
Hairy Vetches.....	67	1.04	3.85	1.17	1.30	.89	8.25
Sorghum or Sugar Cane.....	82	.11	2.00	3.20	1.43	.94	7.68
Pasture Rape.....	90	.61	3.98	1.08	.97	1.01	7.65
Crimson Clover.....	66	.04	2.49	2.48	1.05	1.57	7.63
Spring Rye.....	22	5.54	.71	.37	.51	.28	7.41
Barley.....	89	3.91	1.55	.58	.33	.43	6.80
Hungarian Grass.....	58	1.01	2.98	1.24	.97	.33	6.53
Common Vetches.....	62	1.54	2.31	1.01	.92	.66	6.44
Grass Peas.....	63	1.56	2.78	.77	.38	.24	5.73
Flint Corn.....	96	.77	2.31	1.72	.64	.01	5.45
Goose Wheat.....	74	2.18	1.62	.78	.27	.33	5.18
Soy Beans.....	52	.64	1.26	1.05	.69	.41	4.05

Those varieties of pasture crops which were eaten most readily by the animals were in the following order: oats, flint corn, pasture rape, barley, sorghum and goose wheat. Other crops which held an intermediate position in palatability were red clover, hairy vetches, crimson clover, grass peas and common vetches. The Hungarian grass, soy beans and spring rye were the least relished as pasture crops. The spring rye grew rapidly and soon became unpalatable.

In total amount of pasture per acre per annum the oat crop heads the list with 8.73 tons. It furnished its largest crop early in the season. In comparison with this, red clover furnished a larger amount of pasture material than any other crop at both the 4th and the 5th cuttings. The hairy vetches and pasture rape gave the highest yields of pasture crop at the 2nd cutting, and the sorghum or sugar cane furnished the largest amount of pasture material at the 3rd cutting. Sorghum stools considerably when pastured down and thrives comparatively well in the time of drought. Barley gave considerably less pasture material than oats. If any of the barley plants come into head, they are objectionable for pasture purposes, owing to the presence of beards. Goose wheat is comparatively low in both yield and palatability and the seed is expensive.

In the fourth year of the experiment, emmer was added to the list of crops. In total production and in palatability of pasture it is almost identical with Hungarian grass. In distribution of pasture material throughout the season, however, it corresponded more closely with barley.

Realizing that for pasture purposes greater satisfaction would probably result from the annual crops grown in mixtures rather than grown separately, an experiment was conducted by using six different combinations of three crops each. These six mixtures were tested in duplicate in each of five years. Each mixture was cut at the end of six, nine, twelve, fifteen and eighteen weeks after the seed was sown, thus making five cuttings of each crop in the season. The following table gives the amount of pasture material obtained from the different cuttings of each of the six mixtures:

Mixtures.	Average of Five Years' Results in Tons of Green Pasture per Acre from each of five different Cuttings. (10 tests).					
	1st.	2nd.	3rd.	4th.	5th.	Total 5 Cuttings
1. { Oats	2.95	3.73	1.84	1.14	1.01	10.67
{ Sorghum						
{ Hairy Vetches.....						
2. { Oats	2.92	3.54	1.74	1.21	1.00	10.41
{ Hairy Vetches.....						
{ Crimson Clover.....						
3. { Oats	2.78	3.13	1.18	1.18	.85	9.12
{ Sorghum						
{ Red Clover.....						
4. { Emmer	2.46	2.28	1.06	1.10	.66	7.56
{ Hungarian Grass						
{ Red Clover.....						
5. { Emmer	2.30	2.09	1.14	1.12	.72	7.37
{ Sorghum						
{ Red Clover.....						
6. { Spring Rye.....	4.43	1.06	1.06	.55	.22	7.32
{ Emmer						
{ Hungarian Grass						

In selecting the mixtures in each case the aim was to have a natural succession of crops and a continuous supply of pasture in the autumn and in the hot, dry summer, as well as in the earlier part of the season. Any one of the first three mixtures has produced a good yield of pasture material, which has been well relished by the animals.

As a result of testing the different crops, both singly and in combination, it was decided to make use in a more extensive way of a mixture of oats, sorghum and red clover as an annual pasture. For this purpose, the following quantities were used:

Oats	51 pounds per acre.
Sorghum	30 " "
Red Clover	7 " "
Total	88 " "

The oats and the sorghum were mixed together and were sown from the grain box of the seed drill, and the clover seed was sown from the grass seed box placed in front of the tubes of the drill.

Fully eight acres sown with this mixture have been used for pasture purposes in the Department of Field Husbandry in each of eleven years. The seeding has generally taken place about the end of the first week in May and the crop has usually been ready for pasturing from the 15th to the 20th of June. The crop was pastured with milch cows for three years, with heifers for three years, and with steers for five years. When steers were used they were weighed once a month and were removed from the pasture at no other time. In the average of five years in which careful records were kept, it was found that on the average one steer

would require four-fifths of an acre, or five steers would require four acres for the season. The increase in live weight of the animals was 2.6 pounds per head per day. The annual pasture crop was not supplemented by any other kind of feed. In no instance was there any trouble from bloating, and the animals kept in excellent health and in fine condition when on the pasture. The tramping did not injure the soil to any appreciable degree and all three crops in the mixture withstood the tramping of the animals satisfactorily. In ten out of the eleven years, there was a good catch of clover, while in the other season the clover crop was only fair. The clover, when sown in this way, forms a good matting over the ground in the autumn and is in a satisfactory condition to be left over winter to furnish hay, pasture or seed in the following season if desired.

As the seed of the Early Amber Sugar Cane was scarce and expensive in 1917, the mixture was composed of one bushel each by weight of oats, barley and wheat, and seven pounds of red clover seed per acre, and in 1918 the mixture consisted of two bushels by weight of oats, one bushel of barley, and seven pounds of red clover



Cows pasturing on the Annual Pasture mixture.

per acre. In all our results up to date we have not obtained as good satisfaction from either wheat or barley as we have from oats.

In each of the past two years an experiment has been conducted in testing different quantities of different varieties of oats with red clover as an annual pasture. The results so far indicate good returns from eight to ten or twelve pecks of a good stooling oat in combination with seven pounds of Common red clover, providing there is not a drought in July or August. Such crops as Early Amber Sugar Cane and Hairy vetches, however, help the pasture greatly in a hot, dry summer.

In the experiments of the past two years winter wheat, winter rye, winter emmer and winter barley, when sown in the spring, have not given very satisfactory results as pasture crops.

MIXTURES FOR TEMPORARY PASTURES

Grasses and clovers may be used singly or in combination for the production of hay or pasture to meet the requirements of the individual farms. In some instances Common red clover, Mammoth clover or sweet clover may be sown with a grain crop, with the object of producing either hay or pasture in the following

year, after which the land is again brought into cultivation. A legume of this kind is suitable for a three years' rotation such, for instance, as a cultivated crop, a grain crop and a hay or pasture crop. In the majority of cases, however, farmers sow a mixture of one or more varieties of grasses and one or more varieties of clover. The mixtures are usually used according to the length of time that the farmers intend to leave the land in sod. A mixture of timothy and Common red clover is probably used more extensively than any other combination and is generally suitable for two years of hay and pasture. Unfortunately, however, in recent years when labor has been scarce many farmers seed their grain with timothy and Common red clover, and after taking off one crop of hay use the land for pasture for a number of years. The clover soon disappears and the timothy forms a comparatively poor pasture, especially in dry seasons. If it is the intention to use the crop for pasture for a series of years, it is frequently wise to add to the mixture a quantity of some of the hardier grasses which usually give a fairly good green



Grass and Clover plots, showing a mixture of Tall Oat grass and Alfalfa in the foreground.

growth, even in a summer when the season is comparatively hot and dry. The following are suggested combinations of grasses and clovers suitable for shorter or longer rotations in which the amount of seed per acre of each variety is indicated:

Common Red Clover	8	} 12 pounds of seed per acre.
Timothy	4	
Common Red Clover	6	} 12 pounds of seed per acre.
Alsike	2	
Timothy	4	
Common Red Clover	6	} 18 pounds of seed per acre.
Alsike	3	
Timothy	3	
Orchard Grass	3	
Meadow Fescue	3	

Alfalfa	4	} 25 pounds of seed per acre.
White or Dutch Clover	1	
Timothy	4	
Orchard Grass	8	
Meadow Fescue	8	

Each of the first two mixtures would be suitable for two years, the third mixture for a longer period, and the fifth mixture would even be suitable, in some instances, as a permanent pasture.

If the land is low and comparatively wet such varieties as Red Top, Blue Joint and Alsike can often be used to advantage.

A nurse crop of grain may be used satisfactorily with any one of the foregoing mixtures. The seed, in all cases, should be sown in front of the tube drill. The clover and the timothy can be sown from the grass seed box and the Orchard grass and the Meadow Fescue by hand. The crop could be used for hay in the following year and for either hay or pasture afterwards.

MIXTURES FOR PERMANENT PASTURES.

Land which can be spared from the regular rotation of the farm can often be seeded with a permanent pasture mixture to excellent advantage. Fields lying remote from the buildings and which are inconvenient for cultivation, or fields which are unsuitable for some of the other crops, can frequently be converted into permanent pasture, especially for the use of cattle, sheep, or growing stock. It is also convenient to have some small sections of permanent pasture near the farm buildings and which are suitable for turning on the milch cows.

A large amount of experimental work has been done in testing varieties of grasses and clovers, both singly and in combination, within the past thirty years. The grasses and the clovers have been carefully seeded and much information has been gleaned regarding their value for permanent pasture. In the earlier days of the College it was found that some of the grasses, such as Sweet-scented Vernal, Crested Dog's Tail, and Italian Rye grass, proved to be unsuited for Ontario's conditions. After about twenty grasses had been sown on two or three occasions and their characteristics and hardiness studied, a permanent pasture mixture was recommended in 1885 by the late Prof. Wm. Brown. In 1893, after eight years of additional experimental work, during which time the writer was closely connected with the operations of the Experimental Department, another mixture was recommended, containing a lesser number of varieties and containing a smaller amount of seed per acre. The grasses and clovers recommended in 1893 have proven themselves to be particularly valuable in the formation of a permanent pasture mixture. They are all hardy varieties and, when grown together, furnish a large amount of pasture. A definite experiment was started by sowing a plot of the mixture which was recommended in 1885 and a plot of the mixture which was recommended in 1893. It was impracticable to use farm stock for pasturing the crops. It was also desirable to glean information in regard to the relative productiveness of the two mixtures. Each crop was, therefore, cut and weighed from two to three times each year and, in a period of eleven years during which this experiment was conducted, no less than twenty-six cuttings were obtained. The relative yields were reckoned as freshly cut green material, and the average annual returns for the eleven-year period are as follows:

Class of Crop.	Varieties in Mixture.	Amount of Seed Sown per Acre.		Average tons of Green Pasture Crop per acre per annum 11 years. (26 Cuttings).
		Pounds Single Varieties.	Pounds Total Mixture.	
1885.				
Grass	Meadow Fescue	6	35.	12.9
..	Meadow Foxtail	3		
..	English Rye	2		
..	Timothy	3		
..	Canadian Blue	4		
..	Orchard	3		
..	Red Top	2		
..	Yellow Oat	2		
Alfalfa	Alfalfa	4		
Clover	White or Dutch	2		
..	Alsike	2		
..	Red	1		
Legume	Yellow Trefoil	1		
1893.				
Grass	Orchard	4	24	15.7
..	Meadow Fescue	4		
..	Tall Oat	3		
..	Timothy	2		
..	Meadow Foxtail	2		
Alfalfa	Alfalfa	5		
Clover	Alsike	2		
..	White or Dutch	1		
Legume	Yellow Trefoil	1		

The foregoing table shows that the mixture of 24 pounds of the hardy and vigorous growing grasses and clovers gave a higher average yield of material per acre than the other mixture composed of 35 pounds and containing a few of the smaller-growing varieties.

In the eleventh year after the permanent pasture plots were seeded they were carefully examined, and it was found that 88 per cent. of the larger and 90 per cent. of the smaller mixture was composed of the original grasses. In the larger mixture, the English Rye grass, the White or Dutch clover and the Alsike clover had entirely disappeared, and in the smaller mixture there was not even a trace of the Alsike or the White or Dutch clover. Those varieties which proved to be the hardiest were the Tall Oat grass, the Yellow Oat grass and the Orchard grass.

These two mixtures of permanent pasture should have been kept for a number of years longer but, unfortunately, they were ploughed by mistake.

It is now considered unwise to use Yellow Trefoil in a permanent pasture mixture in Ontario.

The seed of a permanent pasture mixture can be sown in the early spring, either with or without a grain crop. It is better to follow some cultivated crop which has been carefully looked after during the previous season. If the seed is sown alone, the tops of the plants should be cut occasionally during the summer and allowed to lie on the ground as a mulch. If a nurse crop is used, about one bushel of barley or of wheat per acre is recommended. As a rule, oats do not form a good nurse crop for a permanent pasture mixture. If, however, they are used they should be sown thinly. The seed for the permanent pasture should be sown in front and not behind the tube drill. Some of the finer seeds can be sown from the grass seed box and the others by hand.

The most desirable combination of hardy grasses and clovers, when once well established on suitable land, should produce a good pasture, appetizing to the animals, excellent in quality, abundant in growth and permanent in character.

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