PUBLICATION 693 ISSUED MARCH, 1940
FARMERS' BULLETIN No. 93 FIRST PRINTING
DOMINION OF CANADA—DEPARTMENT OF AGRICULTURE

Improved Pasture Crops and Pasture Practices for Central Alberta

BY

F. H. REED

AND

G. E. DELONG

DOMINION EXPERIMENTAL STATION
LACOMBE, ALBERTA

›re intensely interested in how to improve the quality and carrying capacity of their pastures.

EXPERIMENTAL FARMS SERVICE

ublished by authority of the Hon. JAMES G. GARDINER, Minister of Agriculture,
Ottawa, Canada

EXPERIMENTAL FARMS SERVICE

PERSONNEL

DIRECTOR, E. S. ARCHIBALD, B.A., B.S.A., LL.D., D.Sc.

ASSOCIATE DIRECTOR, E. S. HOPKINS, B.S.A., M.S., Ph.D.

Dominion Field Husbandman ..... E. S. Hopkins, Ph. D. (Acting)
Dominion Horticulturist ..... M. B. Davis, B.S.A., M.Sc.
Dominion Cerealist ..... L. H. Newman, B.S.A., D.Sc.
Dominion Animal Husbandman ..... G. W. Muir, B.S.A.
Dominion Agrostologist ..... T. M. Stevenson, Ph.D.
Dominion Poultry Husbandman ..... George Robertson.
Chief, Tobacco Division ..... N. T. Nelson, B.S.A., M.S., Ph.D.
Dominion Apiarist ..... C. B. Gooderham, B.S.A.
Chief Supervisor of Illustration Stations ..... J. C. Moynan, B.S.A.
Economic Fibre Specialist ..... R. J. Hutchinson.

ALBERTA

Superintendent, Experimental Station, Lacombe, F. H. Reed, B.S.A.
Superintendent, Experimental Station, Lethbridge, W. H. Fairfield, M.Sc., LL.D.
Superintendent, Experimental Sub-station, Beaverlodge, W. D. Albright.
Superintendent, Experimental Sub-station, Fort Vermilion, A. Lawrence.
Officer in Charge, Range Experiment Station, Manyberries, H. J. Hargrave, B.S.A.

BRITISH COLUMBIA

Superintendent, Experimental Farm, Agassiz, W. H. Hicks, B.S.A.
Superintendent, Experimental Station, Summerland, R. C. Palmer, M.S.A.
Superintendent, Experimental Station, Windermere, R. G. Newton, B.S.A.
Superintendent, Experimental Station, Sidney, E. M. Straight, B.S.A.
Officer in Charge, Experimental Sub-station, Smithers, K. McBean, B.S.A.

MANITOBA

Superintendent, Experimental Farm, Brandon, M. J. Tinline, B.S.A.
Superintendent, Experimental Station, Morden, W. R. Leslie, B.S.A.

SASKATCHEWAN

Superintendent, Experimental Farm, Indian Head, W. H. Gibson, B.S.A.
Superintendent, Experimental Station, Rosthern, F. V. Hutton, B.S.A.
Superintendent, Experimental Station, Scott, G. D. Matthews, B.S.A.
Superintendent, Experimental Station, Swift Current, L. B. Thomson, B.S.A.
Superintendent, Experimental Station, Melfort, M. J. McPhail, B.S.A.
Superintendent, Forest Nursery Station, Indian Head, N. M. Ross, B.S.A., B.F.
Superintendent, Forest Nursery Station, Sutherland, James McLean.

NEW BRUNSWICK

Superintendent, Experimental Station, Fredericton, C. F. Bailey, B.S.A.

NOVA SCOTIA

Superintendent, Experimental Farm, Nappan, W. W. Baird, B.S.A.
Superintendent, Experimental Station, Kentville, A. Kelsall, B.S.A.

PRINCE EDWARD ISLAND

Superintendent, Experimental Station, Charlottetown, J. A. Clark, M.S.A., D.Sc.
Superintendent, Experimental Fox Ranch, Summerside, G. E. Smith, B.A.Sc., D.Sc.

ONTARIO

Central Experimental Farm, Ottawa.
Superintendent, Experimental Station, Kapuskasing, S. Ballantyne.
Superintendent, Experimental Station, Harrow, H. F. Murwin, B.S.A.

QUEBEC

Superintendent, Experimental Station, Cap Rouge, C. E. Ste Marie, B.S.A.
Superintendent, Experimental Station, Lennoxville, J. A. Ste Marie, B.S.A.
Superintendent, Experimnetal Station, Ste Anne de la Pocatière, J. R. Pelletier, B.S.A., M.S.
Superintendent, Experimental Station, Normandin, A. Belzile, B.S.A.
Superintendent, Experimental Station, Farnham, R. Bordeleau, B.S.A.
Superintendent, Experimental Station, L'Assomption, J. E. Montreuil, B.S.A.
Officer in Charge, Experimental Sub-station, Ste Clothilde de Chateauguay, F. S. Browne, B.S.A.

TABLE OF CONTENTS

9—6500—1½

Foreword

The recommendations made in this publication are based on information gained in compiling data connected with pasture experiments, and on observations made and experience gained in the management of pasture crops for the live stock maintained at the Dominion Experimental Station, Lacombe, Alberta, over a twenty-year period.

The reader should keep in mind the fact that the Lacombe Station maintains large herds and flocks of all classes of live stock which utilize pasture crops. For this reason, feed, both in the form of winter fodder and summer pasture, is always a vital problem, and any crop, method of management or pasture practice which shows promise in an experimental way is at once given the acid test of practical production under actual farm conditions.

It is also advisable for the reader to keep in mind the fact that the Station is situated in the park belt of Alberta where the average annual precipitation is approximately eighteen inches. While the rainfall in the park belt is more than is received in the short grass prairie areas, nevertheless dry years occur in the park belt during which growth conditions are similar to the marginal prairie areas; hence data compiled and problems encountered during such dry seasons are applicable to those areas. Likewise, the data compiled during wet seasons are applicable to portions of Alberta with a more abundant rainfall such as the grey wooded soil area. While the recommendations made in this publication are specific for central Alberta, many of the principles included in the recommendations have a much wider application.

Since this is the first publication on pasture crops available from this Station, some of the fundamentals of modern pasture management which are not based on experimental evidence compiled at this Station are included in the general recommendations. It is believed that such general remarks and recommendations will prove useful to farmers who wish to improve their pastures.

Improved Pasture Crops and Pasture Practices for Central Alberta

By F. H. Reed and G. E. DeLong

Introduction

Pasture is an important and essential part of any successful farming scheme that involves the maintenance of live stock.

A combination of live stock and crop farming forms the basis of a more permanent and superior system of agriculture than where either grain or live stock is produced singly. Live stock enables the farmer to profitably utilize coarse grains and forage crops which of themselves are of secondary importance, but which are necessary in implementing approved crop rotations and agricultural practices. The return of fertility to the land through the medium of manure is an important factor in establishing a permanent agriculture.

Good forage, including pasture, is the foundation of efficient live stock production. Good pasture is an important source of feed, including such nutrients as vitamins, minerals, proteins, carbohydrates, and other nutrients, for all classes of live stock including swine and poultry.

Importance of Pasture Crops in Alberta

The importance of pasture crops in maintaining live stock in Alberta is indicated by the following statistics furnished by the Alberta Department of Agriculture. The numbers of live stock and poultry in Alberta in 1938 totalled 648,800 horses; 440,900 milch cows; 920,700 other cattle; 833,800 sheep and lambs; 707,000 hogs; and 6,920,600 head of poultry—all of which utilized pasture and grazing land to a greater or less extent.

The 1936 Quinquennial Census, the latest for which figures are available, showed the acreage of land in pasture in Alberta as 517,841 acres. Adding to this the 22,176,571 acres of unimproved farm land which constitutes a part of the acreage of the 100,358 occupied farms of Alberta, most of which is used for grazing farm flocks and herds, the importance of improving pasture crops can be appreciated.

Surveys have shown that in many areas of the short grass prairie, at least fifty acres of grazing land is required to carry a cattle beast throughout the pasture season, that ten acres of wild land is required in park belts, and that the carrying capacity of the bush land of the grey wooded soil area and the foothills is dependent on the amount of open glades in any given area. At best the carrying capacity in the latter area is very low.

The possibility of improving the carrying capacity of cultivated and wild-land pasture is suggested by data compiled on pasture projects conducted at this Station; and by observations made in operating the main farm at this Station where pastures seeded with suitable varieties of suitable crops of proved pasture mixtures have a greater carrying capacity than one animal per acre in a season with normal precipitation. There is no doubt that the use of suitable pasture crops and approved management and pasture practices would materially increase the carrying capacity of pastures in central Alberta.

96500—2

Farmers were encouraged to break and bring under cultivation large areas of land of questionable value for grain production in the grazing areas of the short grass prairie while high grain prices prevailed during the European war of 1914-18. Later agricultural developments showed that this land should be put back into grass. Wider use of this land for grazing would reduce the production of cereal crops on marginal land that is not a safe grain-production area. The wider use of grass crops on the farms of Alberta would reduce over-production of cereals in normal times, conserve the fertility of the soil, reduce soil erosion, preserve soil resources, protect water storage reservoirs, make agriculture a safer and more pleasant livelihood, and probably increase net returns from the land.

The Experimental Station flock of breeding ewes on wild land pasture. Sheep graze on low shrubs and brush as well as grass and thus make land clearing much easier. This type of pasture is inferior in quality and has a low carrying capacity.

Large tracts in the grey wooded soil area of the province are so unsuitable for agricultural purposes that they are not fit for settlement. These areas, which are rough in topography and low in fertility, should be made into forest reserves or parks where live stock might be grazed under a controlled policy. Somewhat comparable conditions prevail in the drought area of the province where land utilization policies should be put into effect which set aside such areas for community pastures and thus facilitate progressive pasture and live stock improvement programs.

Alberta in general, and central Alberta in particular, has possibilities of development into an almost ideal diversified farming area. It is possible to produce large tonnages of grasses and legumes for winter feed, and an abundance of succulent and nutritious pastures throughout the entire grazing season. It has been observed, however, that farmers as a whole have been rather tardy in adopting a live stock production policy which gives proper attention to the question of pasture management and improvement.

Nutritive Value of Pasture

Fresh green pasture grown on fertile soil, provides in a palatable form most of the substances required for animal nutrition. It is rich in protein, minerals and vitamins, and is valuable in maintaining health and productivity of live stock. An abundance of luscious, succulent pasture permits the animals to replace the stores of minerals and vitamins which have become exhausted during the winter, and enables them to lay up a reserve for use during a subsequent period of inadequate nutrition. A clean pasture not only provides natural conditions for live stock, but it reduces the cost of caring for the stock and also reduces the danger of mineral and vitamin deficiencies.

Good pasture appears to be a perfect feed for cattle, horses, and sheep except those giving large quantities of milk, or being fattened rapidly, or doing hard work. When grass is new, it contains a high percentage of moisture; hence, an animal would get a relatively small amount of dry matter for each 100 pounds of fresh green forage eaten. It can readily be seen why this soft feed is not satisfactory for horses doing heavy work. As the plant matures the percentage of protein decreases and the carbohydrate and dry matter increases. The dry-matter content of the forage of many grasses late in the fall may be as high as 50 per cent.

A dairy cow on full ration requires approximately thirty pounds of dry matter in 24 hours. Succulent herbage containing 15 per cent dry matter would necessitate the consumption of 200 pounds of green material per day. This degree of succulence in a sole ration has a very laxative effect on animals, and for that reason, its continued use over a long period might have a very undesirable effect on the digestion of the animal.

The protein of young grass is highly digestible. It has been estimated that immature forage is so high in protein that an animal would receive sufficient protein to meet its requirements if one-half its ration consisted of forage from immature plants.

Since green grass is high in minerals as well as protein, animals on fresh luscious pasture require very little, if any, mineral suplement, unless they are grazing on land known to be deficient in certain minerals such as phosphorus or iodine. The dry matter of immature grass may contain about four times as much mineral as cereal grains, and as much as the best legume hay.

Pastures produce food for live stock at a minimum of expense and labour requirement. After a permanent pasture is established all the labour involved in maintenance is that necessary to keep up fences, apply fertilizer, and occasionally clip weeds and brush. No cost is involved in harvesting the crop. The only additional costs are taxes and interest on investment.

A comparison of yields of dry matter per acre produced by pasture and harvested crops such as hay indicates that pasture crops do not usually yield quite so much as harvested crops. In other words, more land is required to carry stock on pasture than is required to carry the same number of animals if the feed is harvested as hay and fed to the stock.

While the yield of pasture crops in central Alberta is lower than that produced by harvested fodder crops, the herbage grazed by stock has a much higher nutritive value. In fact, the dry matter of the herbage produced by close grazing is really a high-protein concentrate. Because of the higher digestibility of the nutrient content of the forage produced by pasture, this crop produces nearly as much digestible nutrients as the same crop utilized as hay. Forage produced by close grazing has feeding qualities similar to high-protein concentrates such as oil-mill by-products. It is also well supplied with minerals and vitamins.

96500—2½

Since immature grass and legume forage is richer in protein and is more digestible than the best mature hay, much interest has centered around its preservation for use in winter. Such grass, dried by artificial heat, usually retains its green colour and agreeable odour, and has proved a satisfactory substitute for oilmeal and other oil-mill by-products. The low cost of high quality roughage and concentrates in Alberta has retarded the development of this phase of feed production.

The production of grass silage has not proved very satisfactory for the reason that immature grass does not contain the carbohydrates necessary to produce a desirable form of fermentation. Better silage is produced from immature grass and legumes when molasses is added at the rate of forty pounds to each ton of green forage. Since molasses costs approximately two cents per

Farmers' mares, many with foals at foot, sent from different parts of the province to be bred to one of the stallions standing at service at the Dominion Experimental Station, Lacombe. These horses are grazing on an annual pasture mixture of two bushels of oats and one bushel of winter rye per acre. These mares gained over one hundred pounds each during the six weeks they were grazing on this pasture.

pound in central and northern Alberta, this would add approximately one-third to the cost of preserving grass for winter use by the silage method. It is doubtful if farmers would give favourable consideration to this increase in the cost, except where relatively higher prices of agricultural produce prevailed.

The whole question of efficient pasture management rests upon the maintenance of the plants which constitute the pasture in that condition of growth in which their protein and mineral content is at its maximum. The protein content is governed largely by the stage of maturity of the plant, being high in immature plants and decreasing as the plants approach maturity.

Soil and climatic conditions under which a pasture crop is produced also exert an important influence on the mineral content of the forage produced. Mineral absorption by plants, particularly phosphates, is lowered during periods of drought and where plants are grown under very moist conditions. Feeder cattle and lambs from the grey wooded soil area where the soil is leached by a

heavy rainfall, and from the drought areas where lack of moisture retards mineral absorption by the plants, frequently show abnormal appetites for phosphorus and other mineral supplements when placed in the feed lot.

It is believed by some research men that most of the live stock breeding troubles in Alberta are attributable to malnutrition resulting from mineral deficiencies in the forage constituting the summer pasture and the winter feed provided for the animals. Pasture crops, like other crops, are deficient in those mineral elements that are deficient in the soil.

High nutritive value of pasture is associated with a high mineral content. The possibility that the mineral constituents may be as important as the energy-producing constituents in calculating the value of forage is given support by the fact that farmers are spending large sums each year in purchasing mineral supplements as feed for their live stock. Furthermore, it has been observed that live stock, grazing on marshy, muskeg or peaty lowland, where a soft grass, known to have a relatively low mineral content constitutes the principal forage produced, always come off the pasture in the fall in relatively low flesh.

Aberdeen Angus herd on stubble pasture at the Dominion Experimental Station, Lacombe. Stubble fields frequently develop a heavy fall growth that provides excellent grazing suitable for carrying beef cattle, horses, or sheep for considerable periods during the fall and early winter.

The amount of mineral nutrients in the soil influences both the yield and the composition of the forage produced. The phosphorus content of pasture produced on phosphorus-deficient soil may be only 25 per cent of that from fertile pastures, and may be much below normal. There may be a wide variation in the mineral content of rich and poor pasture which may be reflected in increased gains in favour of the stock grazed on pasture produced on fertile soil.

Pasture from young green plants is rich in vitamins. Immature grass and legume plants are rich in vitamin A and also contain an abundant supply of vitamins B and C. Since vitamin A promotes growth and increases resistance to disease, early spring pasture from young succulent green plants is one of the best tonics live stock can receive.

Pasture Management Practices

Rotation grazing is the practice of grazing two or more pastures in regular order or rotation. One pasture is grazed down closely before the stock is transferred to another area. After being grazed down, the pasture is allowed a rest and recovery period during which new fresh growth is produced.

This new fresh growth, in addition to being more nutritious, is much more palatable than similar forage of advanced maturity. For that reason, stock should not be allowed to range over an area so large that they cannot keep it grazed down, or they will leave areas untouched. These ungrazed portions of the field become less nutritious and less palatable as the plants in them approach maturity. It is a much better plan to divide the pasture, and confine the animals on smaller areas and practice rotational grazing so that the pasture will all be grazed down uniformly in one paddock or field before transferring them to another.

Rotation grazing has the advantage over continuous grazing in that the stock is kept on young, succulent, palatable and nutritious pasture. If a larger acreage is kept for pasture than is required to carry the stock, one or more of the fields or paddocks can be left ungrazed and harvested for hay or some other type of forage.

It frequently happens that two or more classes of stock can be used to advantage in rotation grazing. Two classes of stock, such as cattle and sheep, or cattle and horses, make better use of pasture than either alone. Where one class of stock follows another, such as sheep after cattle, areas left by one group are cleaned up by the other. In the case of dairy herds, the highest producing members are allowed first choice of the new fields, while dry cows and breeding stock and young cattle follow the milking stock in cleaning up the fields.

Rotation grazing can be accomplished by arranging fields and crops so that one kind of pasture will follow another. It is possible to start off in the spring with fall rye and follow with such crops as brome, sweet clover, alfalfa, oats and rye, rape, etc., all of which may be arranged to follow each other in natural sequence.

Rotation grazing has an advantage over continuous grazing in that the live stock used on rotated pastures, because of improved sanitary conditions, are less subject to infection from pathological diseases and less apt to pick up internal parasites than stock left continuously on the same pasture. Most bacteria which cause disease, as well as numerous internal parasites, are voided in the animal droppings and urine, and contaminate the pasture. The rest period in rotation grazing makes it possible for the weather to act as a sterilizing agent in reducing the vigour of contaminating organisms.

Live stock do not graze more than one-third of the time when pastures are reasonably good, the remainder of the time being spent lying down, or standing in the shade or water fighting flies. Hence much of the manure of grazing animals is not voided on the land that produced the forage and as a result the fertility of the pasture field tends to gradually deteriorate. Manure voided on pasture should be scattered at different times during the season. This is most important on land with a high carrying capacity where so much manure may be voided that uniform grazing may be interfered with. A lever harrow, with the teeth lying flat on the ground, is an excellent implement to use for scattering the piles of manure on pastures.

Since all the manure resulting from forage produced by a pasture is not voided on the land which produced it, the lowering of the fertility of old pastures is an important pasture management problem. The importance of phosphate and other mineral fertilizers in pasture management is discussed in other portions of this publication. Many farmers have large tonnages of manure spoiling which could be applied on their pasture fields to advantage.

Renovating Old Pastures

Many farmers are interested in renovating old pastures. Experience and experiments indicate that it is difficult to renovate old pastures by reseeding, by cultivation, or by an application of commercial fertilizer. It is usually better to plough and prepare a suitable seed-bed and reseed the land with a good pasture mixture.

Weeds in pasture fields can usually be controlled by mowing once or twice each year. Best results are obtained when the weed to be controlled is mowed when in bloom. Brush which springs up on pastured land can be best controlled by cutting when the tree or shrub is in bloom.

Burning over pastures should be practised only in occasional years when there is an excess amount of old grass and refuse of the previous season's growth, ensuring quick and uniform burning of the pasture. Burning does least injury when done in the late fall or early spring when there is plenty of moisture in the soil. Late fall burning is frequently effective in eradicating some species of weeds and brush. Burning late in the spring after growth has started seriously injures the pasture plants and materially reduces their productiveness.

Holstein herd grazing on the aftermath on meadows at the Dominion Experimental Station, Lacombe. Such supplemental pasture is useful during periods when permanent grass and legume pastures are relatively unproductive.

Insects such as grasshoppers, June bugs, etc., and rodents such as gophers, moles, groundhogs, etc., frequently consume a lot of forage and seriously lower the carrying capacity of grazing land. Approved pasture management policies involve the control of these pests. Literature giving information concerning the control of such pests is available from both the Dominion and Provincial Departments of Agriculture.

Need for Supplementary Pastures

Most of the grasses used for pasture crops develop a vigorous spring growth which is followed by a more or less dormant period during the heat of the summer and after the formation of the seeds. Permanent pastures exhibit this tendency to a greater extent than annual pastures. It is therefore advisable,

if good pasture is to be provided throughout the season, to have supplementary pasture during midsummer. Rape, oats and rye, second growth alfalfa or sweet clover, and the aftermath on meadows, all make excellent supplementary pastures.

Late Fall and Winter Pastures

One of the principal problems in pasture management is that of extending the grazing season in order to reduce the quantity of harvested feed required to carry animals over the winter. The cost of winter feed for a six-month period is usually two to four times as much as the cost of summer grazing. Late fall, winter and early spring grazing for breeding stock can be provided for by leaving areas of permanent and annual pasture, stubble or meadows ungrazed in the summer. Long growth is best for winter pasture so that stock can graze by uncovering the snow from a minimum area. Horses paw the snow and thus can graze through deeper snow than any other class of live stock. Sheep paw the snow and graze in winter more efficiently than cattle.

Late fall and winter pasture is utilized to a much greater extent than is generally appreciated. Thousands of head of cattle, horses and sheep pick much of their fall and winter sustenance on stubble fields, old meadows and on the open range. If planned in advance, pasture crops of hardy grasses such as the blue grasses, fescues, crested wheat, etc., the forage of which is not seriously damaged by low temperatures, can be used to advantage in bringing live stock through the winter in good condition in portions of the province where depth of snow does not make it too difficult for animals to graze. A stack of straw for live stock to run to for shelter and supplemental feed is always a decided advantage.

Removing the surplus growth from pastures and hay meadows by winter grazing after the ground has frozen up does not damage the plants to any appreciable extent. Experiments have shown that this fall growth, so necessary for the development and storage of a reserve food supply by perennial plants such as alfalfa, may be removed after growth ceases in the autumn without seriously harming the plant. In general, it is much safer to winter graze than to graze meadows between August 20 and October 1. Stock should be taken off such meadows before the frost goes out of the land in the spring and when the ground is muddy.

Succulence in Pasture Crops

Succulence refers to the moisture content of the crop being used for grazing. The moisture content of pasture influences its palatability, its nutritive value, its resistance to drought and frost damage, etc.

In spite of the laxative effect on the digestive tract produced by the forage of young grass, cereals, legumes and rape, these succulent forages have a stimulating effect on the general health of the animal and, if sufficient dry feed is fed to balance the ration, they are particularly valuable in promoting growth and the production of milk and meat. Where animals are on heavy feed for either milk or meat production, it is almost impossible to put the animal off its feed if a reasonable proportion of the ration consists of herbage from one of the succulent pasture crops.

In general, the more succulent or the higher the moisture content of forage, the more palatable it is. This does not mean that the forage from blue grass which is low in moisture content is less palatable than that of winter rye or rape which has a high moisture content, but that the young succulent leaves of blue grass with a high moisture content are more palatable than the forage from mature blue grass in the late fall when the moisture content is relatively low.

While succulent pasture crops are among the very best pasture crops, caution must be exercised in grazing them with certain types of live stock, or bloating may result. If animals are permitted to gorge themselves on the forage produced by broad-leaved plants, such as alfalfa, the clovers and rape, digestive disturbances may be set up and bloating result. Danger from bloating can be lessened by giving the stock access to a stack of straw or hay or other dry feed or forage, and by growing legumes for pasture in mixtures carrying at least 50 per cent proportion of grass, such as is the case with the better mixtures mentioned in this publication.

Palatability of Pasture Crops

Palatability tests have been conducted with different pasture crops. Strips of pure species were seeded and grazed by different classes of stock. In general, stock prefer the forage and kind of crop which is most luscious and has the lowest dry-matter content. So many factors affect palatability that differences of opinion exist concerning the palatability of different pasture crops. For that reason it seems unwise to attempt to rate grasses and legumes in the order of their palatability for horses, cattle and sheep. Observations indicate that hogs prefer grass to cereals—with little preference for peas, wheat, barley, oats or the first year's growth of winter rye; that they will not eat winter or spring rye after it is headed out, that they will almost starve before they will eat sweet clover, that they have to learn to eat alfalfa, and that they will not eat rape until all the grass along the fence lines and all the grain growing in the same field with the rape has been grazed down to the bare ground.

Weed Control by Pasture Crops

There is a great variation in the ability of different pasture crops to control weeds. The dandelion is possibly the worst weed which infests pastures in central Alberta. It has been observed that the dandelion and other weeds have great difficulty establishing themselves in stands of grasses with creeping roots—such as Kentucky blue grass, creeping red fescue, brome, or reed canary grass; and that weeds start much more quickly in pure seedings of the bunch grasses such as rye grass, timothy and crested wheat. Crested wheat is better than either timothy or rye grass in its ability to hold weeds in subjection in the park belt; and because of its greater resistance to drought, is better than the creeping-rooted grasses in this respect in the drier portions of the open prairie. Western rye grass is of least value in controlling weeds for the reason that it is a short-lived perennial, and its weakened plants gradually lose vigour and are replaced by more vigorous plants of weeds or creeping grasses.

Full stands of legumes are excellent weed-control crops. The biennials such as alsike and sweet clover, and the short-lived perennials such as red clover, cannot be expected to control weeds for periods longer than their life. Alfalfa, which is a deep-rooted, long-lived perennial, is an excellent weed-control crop as long as a full, healthy stand persists. If the stand or the vigour of the alfalfa plants is reduced, it may be necessary to fertilize the crop or plough it up and establish a new stand.

Pasture Experiments

The first systematically arranged pasture project undertaken at the Dominion Experimental Station, Lacombe, Alberta, was laid down in 1931. In all the pasture experiments conducted and referred to in this publication each treatment or crop was replicated so that it was represented four times each season. Since each experiment was under way five years, each treatment or crop reported has been repeated twenty times under a wide range of climatic conditions.

The forage produced by the different crops, mixtures and treatments was clipped and carefully harvested by hand, and the yield and other data recorded.

Where mixtures were grown, the forage produced was separated into the different species constituting the mixture. In this way the competition between species was easily ascertained, and the contribution each species made to the mixture determined.

The different crops seeded during the latter part of June, 1931, made so much growth the year they were seeded, that it was considered advisable to clip them and record the yields produced. The late fall cutting of the first year's growth resulted in most of the legumes, particularly the alfalfa and sweet clover, being winter-killed. Adjacent legume plots which were not clipped back showed no winter-killing. Since winter-killing was so pronounced in the autumn-clipped legume plots it was assumed that there is a critical period in the autumn during which legumes such as alfalfa and sweet clover should not be clipped back or grazed. Later investigations proved this to be true.

Shorthorns grazing on mixed sweet clover, timothy and crested wheat grass pasture at the Dominion Experimental Station Lacombe. This pasture is productive, luscious and nutritious.

The serious winter-killing which occurred in the 1931 seeding as a result of clipping in the fall made it necessary to reseed the project in 1932, and also suggested the necessity of finding out more about the effect the autumn clipping had on both grasses and legumes. The 1932 seeding was therefore divided into three series: Series "A" was clipped on August 29, 1932; Series "B" was clipped on October 5, 1932; after the season's growth was completed; and Series "C" was permitted to go into the winter with the first season's growth intact.

The average yield of dry matter and protein produced per acre showed that late fall clipping was preferable to the early clipping, and that the yield produced the following year by any of the fall-clipped plots did not equal the yield of those which went through the winter with the first season's growth intact.

The foregoing statement applies particularly to legume crops such as alfalfa and sweet clover, and mixtures containing these crops. In the case of these crops, and mixtures containing these crops, plots clipped in the early fall did not yield as well as those clipped in the late fall, nor did the late-fall-clipped plots yield as well as the plots which were not clipped at all. On the other hand, the grasses, such as brome, rye grass, crested wheat, timothy and Kentucky blue appeared to respond better to early fall clipping than to late fall clipping; but did better if let go into the winter with the autumn growth intact.

In the case of grasses, if they are to be grazed in the autumn it would seem advisable to have this done during the late summer and remove the stock early enough in the fall to permit the grass to make three or four inches of growth before freeze-up. The legumes, however, if grazed in the fall, should not be grazed until after freeze-up. Since the legumes may suffer damage from fall grazing to a greater extent than grasses, mixtures of grasses and legumes should be fall grazed so that least damage will be done to the legumes.

It frequently happens that unclipped plots give considerable quantities of refuse in the second season's growth. On the other hand, there seldom is sufficient of this refuse material to justify the trouble and expense involved in removing it in the spring. In actual farm practice, it would seem advisable to remove the autumn growth in the fall after freeze-up from new seedings which make a very heavy growth the first year, but new seedings with less than a foot of growth should be let go through the winter without the autumn growth being harvested or grazed off. Grazing seems to do less damage than clipping with the mower.

The high yields produced by the 1931 and 1932 seedings of brome, timothy, alfalfa, sweet clover and the mixtures containing these crops, indicated the possibility that new and improved pasture mixtures might be evolved by using these crops as a base.

The fact that these crops outyielded the drought-resistant crops, such as rye grass and crested wheat, indicated that where sufficient moisture is available to produce these crops to advantage, as is the case in the park belt of Alberta, pasture mixtures should not contain a high percentage of drought-resistant crops.

The 1932 seeding also left unanswered many questions connected with injury to legumes resulting from fall clipping or grazing, and also suggested the necessity of finding out more about the relation of autumn clipping of legumes to winter-killing. For this reason, a series of alfalfa plots were seeded in June and clipped at regular intervals in the autumn to find out the most critical period in the growth of the plant.

The damage attributable to autumn clipping increased until September 1 and gradually tapered off until freeze-up. The period August 15 to September 15 apparently is the most critical period in the autumn growth of alfalfa during which harvesting or grazing does most damage to this crop.

The old recommendation that the autumn growth should be left on alfalfa to hold the snow and protect the crowns is refuted by the results produced by the cutting taken late in the fall after the ground froze up. Removing this autumn growth after growth ceased in the fall did not reduce the yield the following year. Apparently this autumn growth is necessary to the alfalfa plant, making it possible for it to store up a reserve of plantfood in the root from which it develops the early growth the following year. The following year's growth appears to be reduced in proportion to the extent to which the plant is prevented from storing up these plantfood reserves by the removal of the autumn growth. Cutting or grazing during this critical period prevents the storage of the plantfood referred to, and further complicates matters as it appears to force the plant to exhaust its reserves in an endeavour to produce more autumn growth. In actual practice, legumes such as alfalfa and sweet

96500—3½

clover should not be grazed heavily during the latter part of August or September; but little or no harm is done to these crops if grazed after low temperatures have stopped further growth in the late fall.

A seeding of different grasses, and mixtures of grasses and legumes was made on June 28, 1933. This project was divided into four series. One was clipped on September 7, one on September 22, one on October 13 after growth had ceased in the autumn, and one was let go through the winter with the first season's growth intact.

The average yields of individual plots indicated that the grasses respond to fall clipping differently than legumes such as alfalfa and the sweet clovers. Grasses appear to benefit by early fall clipping, but clipping late in the fall has a harmful effect. In the case of grasses the late fall clipping leaves the ground bare with no vegetation to hold the snow and protect the roots; with the result that there is a loss of vigour and a certain amount of winter injury following the late fall clipping, which in turn results in reduced yields the following season.

Five-Year Average Per Cent of Protein and Yield of Forage per Acre of Perennial Pasture Crops

Plot No.	Crop and Rate of Seeding	Per cent Protein	Yield of Dry Forage in Tons
	(Seeded in 1932)		
1	Brome 15 lb	17·72	1·23
2	Western Rye 15 lb	17·30	0·64
3	Crested Wheat 15 lb	16·60	1·06
4	Timothy 8 lb	12·64	1·02
5	Kentucky Blue 12 lb	12·62	0·87
6	Reed Canary Grass 15 lb	22·62	0·49
7	Yellow Sweet Clover 20 lb	*23·88	2·62
8	White Sweet Clover 20 lb	*25·88	2·27
9	Alfalfa 15 lb	20·94	1·22
10	Brome 10 lb., White Sweet Clover 10 lb	18·63	1·09
11	Western Rye 7 lb., Timothy 2 lb., White Sweet Clover 10 lb	15·33	0·88
12	Western Rye 10 lb., Alfalfa 10 lb	23·42	1·40
13	Timothy 5 lb., Red Clover 4 lb., Alsike Clover 2 lb	14·71	0·93
14	Western Rye 7 lb., Timothy 2 lb., Alfalfa 10 lb	18·82	1·26
15	Western Rye 5 lb., Timothy 2 lb., Alfalfa 5 lb., Kentucky Blue 4 lb., Alsike Clover 2 lb	17·59	1·09
16	Kentucky Blue 10 lb., White Dutch Clover 4 lb	13·94	0·75
	(Seeded in 1933)		
1	Grazier Western Rye 25 lb	16·57	0·37
2	Brome 25 lb	17·86	0·93
3	Crested Wheat 25 lb	16·32	0·76
4	Western Rye 12 lb., Crested Wheat 12 lb	16·03	0·59
5	Brome 12 lb., Crested Wheat 12 lb	17·35	0·70
6	Timothy 8 lb., Crested Wheat 12 lb	15·23	0·74
7	Western Rye 6 lb., Brome 6 lb., Timothy 3 lb., Crested Wheat 10 lb	17·63	0·83
8	Western Rye 6 lb., Brome 6 lb., Timothy 3 lb., Alfalfa 5 lb., Crested Wheat 10 lb	15·96	0·81
9	Timothy 8 lb., Red Clover 8 lb., Alsike Clover 2 lb., Kentucky Blue 5 lb., White Clover 2 lb., Yellow Trefoil 1 lb	14·56	0·67
10	Timothy 8 lb., Red Clover 8 lb., Alsike 2 lb., Red Fescue 5 lb., White Clover 2 lb., Yellow Trefoil 1 lb	13·66	0·60
11	Orchard Grass 10 lb., Timothy 4 lb., Red Clover 6 lb., Alsike Clover 2 lb., White Clover 2 lb., Yellow Trefoil 1 lb	13·87	0·75
12	Timothy 3 lb., Orchard Grass 6 lb.. Meadow Fescue 4 lb., Red Clover 4 lb., Alfalfa 4 lb., Alsike Clover 2 lb., White Clover 2 lb., Yellow Trefoil 1 lb	16·96	0·75
13	Creeping Red Fescue 25 lb	13·86	0·54
14	Creeping Red Fescue 15 lb., White Clover 5 lb	14·03	0·50

* One year only.

The data compiled in this experiment, when interpreted in pasture management practices emphasize the advisability of removing stock from closely grazed pasture not later than the middle of September so that the grass will have the opportunity to develop three to four inches of growth before winter sets in. Grazing after September 15 would not be particularly harmful if the growth is several inches or a foot high, and if the stock is not allowed to graze off all the forage and leave the ground bare. In other words, stock should not be permitted to "eat it into the ground." Pasture fields should always have three to four inches of growth left above ground for winter protection.

Discussion of Different Biennial and Perennial Crops and Mixtures for Pasture

Brome.—Brome has given a higher yield per acre than any of the other grasses.

Brome has a certain amount of drought resistance as indicated by the fact that it was the only grass included in the 1932 seeding, other than crested wheat, which produced an appreciable amount of forage in the dry season of 1937; a year in which old stands of other grasses and legumes remained unproductive from a variety of causes such as dry weather, winter-killing, weed competition, and damage by pocket gophers.

In addition to being one of the most productive crops under test, brome has other valuable features as a pasture grass. It makes a quick strong growth the year it is seeded, and will continue to produce new leafy growth after being grazed off, provided there is sufficient moisture and plantfood available.

Brome has creeping root stalks, forms a comparatively dense sod, and stands tramping well. When the turf of brome is injured by stock, such as the rooting of hogs, its creeping root system is a decided advantage as it quickly fills in and produces new growth on any open space which may develop. Its creeping root system makes it one of the most efficient grasses tested for holding weeds in control.

Brome is the most succulent and contains the highest moisture content of the different grasses included in the test. While succulence is a valuable characteristic of certain pasture crops, it may be objectionable for the reason that some crops with a high moisture content are easily damaged by frost. One of the chief objections to brome as a pasture is that it is damaged by early fall frosts and is of little value for fall, winter or very early spring grazing.

Western Rye Grass.—Western rye grass produces good yields for one or at most two years. It makes a quick strong growth when seeded, but remains productive only to the end of the second year. Being a short-lived perennial, it cannot compete with other longer-lived perennial pasture plants or weeds. It renews itself slowly when grazed off and, like most drought-resistant grasses, tends to go into a dormant stage or rest period during the heat of the summer when it makes little or no growth, and during which dormant period weeds or other more aggressive grasses may gain ascendency over it.

Rye grass lacks the lush, leafy growth typical of a good pasture plant, and as a consequence is somewhat unpalatable to live stock. The autumn growth is not resistant to frost damage, and when frozen, becomes dry and lacking in palatability and nutritive value. The forage of this grass has little value for late fall, winter or early spring grazing.

When used as a pasture crop, this grass did not produce yields of either dry matter or protein equal to the better pasture crops. It has some value as a drought-resistant grass, but in this respect, it is inferior to crested wheat. When

all the foregoing objectionable features are taken into consideration, it will be seen that there appears to be no reason to justify using this grass for pasture purposes.

Crested Wheat Grass.—Crested wheat grass produces a somewhat harsh growth that is not relished by live stock as much as some other grasses. Where ample rainfall occurs, it will not give as high yields of either dry matter or protein as the softer grasses such as brome or timothy, but will outyield them in very dry years, or in areas where its drought resistance is an advantage.

This grass makes an earlier growth in the spring and a later growth in the fall than most grasses and for that reason is valuable in mixtures for the park belt. It has a further advantage in that its growth is not seriously damaged by moderately low temperatures and is therefore suitable for late fall, winter, and early spring grazing. For these reasons, a few pounds of seed of this grass might be used to advantage in pasture mixtures for central Alberta.

While crested wheat is reported as being an excellent weed controlling grass in the drier areas, its tendency to go into a dormant stage or rest period in the heat of the summer, even when an abundance of moisture is available, gives certain perennial weeds, such as dandelions, a chance to establish themselves.

It is believed that this grass will find its greatest usefulness as a pasture crop in the drier areas of the Prairie Provinces.

Timothy.—Timothy has proved an excellent pasture grass where sufficient moisture is available. Provided sufficient plantfood and moisture are available, timothy will continue to produce succulent, leafy foliage throughout the pasture season, and after each successive cutting. New seedings of timothy on fertile soil containing an abundance of moisture will yield particularly well.

Because of its succulence and high moisture content, timothy produces a forage that is easily damaged by low temperatures; hence it is not a good pasture for late fall, winter or early spring. Furthermore, late fall clipping seriously reduced the yield the following year, indicating that this plant should not be grazed off too close late in the fall.

Observations revealed the fact that timothy is damaged by winter injury to a greater extent than is generally appreciated. The effect of winter-killing is revealed in the yields produced by the timothy plot in the 1932 seeding when timothy, following severe winter damage in 1933-34 dropped from one of the highest to one of the lowest yielding grasses. Similar conditions occurred in the winter of 1936-37, when timothy disappeared from most of the mixtures included in the 1933 seeding as a result of winter injury.

Being a moisture-loving plant, and being an excellent pasture plant when grown under favourable conditions, timothy is one of the best pasture grasses for the grey wooded soil area and the foothill country where sufficient moisture is usually available to grow it satisfactorily. It also does well around the margins of non-alkaline sloughs and along creek bottoms.

Timothy is a low-protein grass, and for that reason it is particularly important that it should not be seeded alone but should always be seeded in a mixture with legumes. Since the area for which it is well suited will also grow red clover, alsike clover, sweet clover and alfalfa satisfactorily, there is no justification for seeding pastures with pure timothy. Pure stands of timothy soon become unproductive, and the forage low in nutritive value.

Kentucky Blue Grass.—Blue grass is an excellent pasture grass to use on rich loam soils and where sufficient moisture is available to develop it. It has a creeping root system and develops a thick tough sod which stands tramping well. Provided sufficient rainfall occurs, it develops a luscious growth of herbage that is relished by all classes of live stock. It has the additional advantage that the moisture content of the leaves is lowered in the autumn so that the forage is

High producing dairy cows grazing on pure alfalfa. This is one of the highest quality and highest producing perennial pasture crops tested. No losses from bloating have been experienced over a twenty-year period. The supplementary feeding given to these high producing cattle lessens the danger from bloating. Access to dry forage such as hay or straw, lessens the danger of bloat.

The mixture of two bushels of oats and one bushel of winter rye constitutes an ideal annual pasture for milch cows. It yields well, and is both palatable and nutritious. These cattle can get a mouthful anywhere they drop their heads.

not injured by low temperatures. For this reason this grass makes excellent grazing during the late fall, winter and early spring. Unfortunately, blue grass requires more moisture than is usually available in central Alberta. It quickly becomes sod bound and unproductive. Moist seasons such as 1935 bring this grass back to productivity.

In spite of the fact that it is not so productive as some of the other grasses, this grass has a high protein content, and is highly nutritious; and it is believed that a mixture of grasses and legumes for seeding permanent pastures in central Alberta should include one or two pounds of blue grass seed per acre. A thin scattering of blue grass in the pasture forms a bottom grass and gives quality to the pasture. When used in this way, the blue grass is not thick enough to get sod bound quickly, and does not appear to compete with or reduce the yield of the other plants included in the pasture mixture.

Since this grass does not thrive under dryland conditions, its use in pasture mixtures should be confined to the more humid areas of the province.

Reed Canary Grass.—Reed canary grass has not shown up to advantage as a pasture crop, being the lowest yielding grass included in the 1932 seeding. This project was seeded on upland soil, and the natural habitat of reed canary grass is around the margins of non-alkaline sloughs and creeks where an abundance of moisture is available. Under such moist conditions, this grass grows shoulder high, while under upland conditions it develops a rather short stunted growth.

Reed canary grass produces a coarse herbage that is not as attractive to live stock as the finer-leaved grasses. It is considered the least suitable for upland locations of the different grasses tested, and it is believed that its production should be limited to moist locations such as old peaty slough and creek bottoms.

This grass has a creeping root system, and develops a very tough sod that requires about two years summer-fallowing to break down. It is not injured by the tramping of live stock and under conditions which favour its development, can hold its own in competition with other plants.

Creeping Red Fescue.—Creeping red fescue appeared to be the best of the different fescues for pasture purposes. It has a dark green foliage and is attractive to live stock. It has a creeping root system and is similar in habit of growth to blue grass. It is not a very productive grass, becoming sod bound after it has been down for a few years. Like blue grass, it forms a dense sod that stands tramping well, and is very persistent in competition with weeds and other pasture plants. Its forage is not injured by low temperatures, hence this grass makes an excellent late fall, winter and early spring pasture crop. Creeping red fescue has a high protein content and is highly nutritious. It should not constitute the sole grass in a pasture because of its low yield, but one or two pounds per acre could be used to advantage in a mixture for seeding permanent pastures in the same manner and under the same conditions as recommended for blue grass. Since blue grass and creeping red fescue are similar in many ways, nothing would be gained by including both grasses in a pasture mixture. Comparable pasture data on these two grasses are not available, but since creeping red fescue gives larger yields than blue grass when harvested as hay, it is believed that the fescue should have preference over the blue grass for inclusion in pasture mixtures for central Alberta.

Orchard Grass.—Orchard grass made no contribution to the mixtures in which it was included. This grass is not hardy when grown under conditions which prevail at the Lacombe Station. Different strains and selections have been seeded repeatedly without isolating a strain with sufficient hardiness to warrant growing this crop on a large scale.

Suckling pigs leave their mothers in the piggery and roam in search of green pasture. Even these young pigs know what is best for them. Sunshine and green forage will correct anemia and many of the other ills which afflict suckling pigs.

Meadow Fescue.—Meadow fescue was included in the project seeded in 1933 to provide a comparison with the creeping red fescue. The meadow fescue is lacking in winter hardiness and did not produce any growth in 1934 and the following years. It has no agricultural value in central Alberta.

Red Top, Blue Joint, Etc.—Red top, blue joint, lyme grass, and other miscellaneous native grasses were not included in these pasture projects for the reason that data recorded in other experiments indicated that these grasses made a relatively stunted growth when grown on high land away from their natural environment which is in low, wet, positions such as around the margins of non-alkaline sloughs and along creek bottoms. In locations where these grasses grow naturally to advantage, it is doubtful if it would be advisable to break the land and reseed with other cultivated grasses and legumes.

Alfalfa.—Alfalfa proved to be one of the best pasture crops tested. When grazed, it sends up new growth quicker than either white or yellow blossom sweet clover. New growth starts from buds which form on the crowns before the flowers open; and if grazing is done about the time the buds begin to form, the new growth develops very quickly.

Alfalfa suffered less from late fall clipping than either of the sweet clovers, and proved hardier in many ways. Alfalfa plants which had their vigour reduced by fall clipping fully recovered the following summer.

Alfalfa has an advantage over red and alsike clover as a pasture plant to be grown on high land in that it will produce good yields under conditions where sufficient moisture is not available to grow either red or alsike clover to advantage. Furthermore, alfalfa is a much longer lived perennial, and for that reason is a much more permanent pasture plant than white or yellow blossom sweet clover or red or alsike clover.

Alfalfa outyields other legumes and grasses in both dry matter and protein. Since alfalfa is superior in numerous ways to other legumes for pasture purposes in central Alberta, it would seem advisable to make alfalfa the legume base around which a legume—grass mixture is built up for use in the park belt and marginal prairie portions of Alberta.

Yellow Blossom Sweet Clover.—Yellow blossom sweet clover proved superior to white blossom in winter hardiness, in its ability to produce under pasture conditions higher yields of both dry matter and protein, and to recover after close grazing or close cutting. Since the yellow blossom sweet clover sets seed very freely, it is believed it would tend to reseed and re-establish itself more readily, and thus constitute a more permanent pasture crop than the white blossom type.

The question of the palatability of sweet clover is not a serious problem. No difficulty has been experienced with horses, cattle or sheep in having them refuse sweet clover as pasture or hay. It is believed that, when sweet clover is seeded in a mixture with grasses and other legumes, and stock turned on it early in the spring before it makes too much growth, no difficulty will be met with as regards lack of palatability. While horses, cattle and sheep ate sweet clover readily, sweet clover has not proved a satisfactory pasture for hogs. Pigs are usually short-lived animals, and they frequently go to market before they have acquired the taste for sweet clover.

It is believed that sweet clovers, either yellow or white blossom, can be used to advantage in many pastures. In fact the most promising method of rejuvenating old pastures tested to date involves seeding ten to fifteen pounds of sweet clover seed per acre each spring until a stand of sweet clover has been developed; after which the sweet clover tends to reseed itself and thus maintain a fair stand without any further treatments.

White Blossom Sweet Clover.—White blossom sweet clover proved less suitable as a pasture crop than alfalfa. The plants, when grazed close to the ground, make a slower recovery for the reason that new growth starts from buds which form at the crown of the roots, and considerable time may elapse before new growth develops sufficiently for grazing. This applies to a less degree to the yellow blossom.

While white blossom sweet clover has objectionable features for pasture purposes as compared with alfalfa, it nevertheless is an excellent pasture plant in many ways. It produces high yields of luscious forage that is high in protein content and is relished by live stock when they once acquire the taste for it. The low cost of the seed and other commendable features make it one of the best legumes to combine with grasses for pasture purposes where it is the intention to leave the pasture for two years only. Its use for pasture purposes should be limited to the park belt and open prairie where there is not sufficient moisture to grow red clover to advantage. In the grey wooded soil area where red clover is a reasonably sure crop, farmers would be well advised to use red clover instead of sweet clover for pasture purposes.

Red, Alsike and White Clover.—No pasture plots were seeded with pure stands of these legumes for the reason that there is not sufficient rainfall in the park belt to grow them to advantage. The only locations in the park belt where these plants thrive is in non-flooding moist locations around the margins of non-alkaline sloughs and creek bottoms. They all thrive in moist areas in the park belt and give particularly good returns under the climatic conditions which prevail in the grey wooded soil area, and should be included in pasture mixtures designed for use in that area.

These clovers are productive in the park belt if seeded without a nurse crop on partially summer-fallowed land so that they have the use of more than one season's available moisture. Under such conditions they have produced reasonably good yields of hay and pasture but seldom produce the second successive crop except in very wet seasons. Under favourable conditions in the grey wooded soil area, both red and white clovers persist for several years, but are much shorter lived perennials at the Lacombe Station. It is believed that differences in precipitation and available moisture are responsible for this difference in the longevity of these crops as grown in these different areas. If not pastured too closely so that some of the heads will mature seed, these clovers will persist for years in a pasture field.

Yellow Trefoil.—The yellow trefoil seeded in 1933 winter-killed and made no contribution to the yield produced by these plots. This crop has been seeded at different times in the forage crop nursery at the Station and has never given promising returns. It is believed that the purchase of seed of this crop to be sown for pasture production would be a waste of money.

Grass and Legume Mixtures.—A mixture of ten pounds each of brome and white blossom sweet clover did not yield as much dry matter per acre in 1933 as did the pure brome. The sweet clover, being a biennial, produced for one year only after which the plants died and the roots acted as a fertilizer for the plants which remained in the plot. The beneficial effect of the sweet clover is reflected in the increased yields produced in the following years 1934-35-36-37 when the brome from the brome–sweet clover plot outyielded that from the plot where brome alone was seeded.

The mixture of seven pounds western rye grass, two pounds timothy and ten pounds sweet clover did not produce as well as timothy alone during the same period. The western rye grass apparently added very little to the mixture. It is a short-lived perennial and persisted in the mixture for three years only.

The sweet clover, being a biennial, made a contribution to the mixture only for the first year. The mixture did not live up to expectations as it was not superior to timothy seeded alone in any of the five years the project was under way.

A mixture of ten pounds western rye grass and ten pounds alfalfa was used extensively for a number of years for hay production in Western Canada. It was felt that it might prove a useful pasture mixture as well. The rye grass made very little contribution to the mixture and being a short-lived perennial, produced for four years only. While this mixture yielded well, the alfalfa was largely responsible for the high yield produced. The plot containing this mixture exhibited one of the objections to alfalfa which gave no yield in 1937. Pocket gophers, which are particularly destructive to alfalfa in central Alberta, started in this plot in the late fall and had cut off the roots of all the alfalfa plants before they were observed. This mixture emphasizes the importance of alfalfa as a pasture plant for central Alberta.

The mixture of five pounds timothy, four pounds red clover, and two pounds alsike is in general use for hay purposes in districts suitable for this crop such as the grey wooded soil area. The Lacombe district does not receive sufficient rainfall to grow red and alsike clover to advantage. When seeded without a nurse crop, as was the case with these plots, and with approximately two seasons' rainfall available for one crop, the clovers live through one winter and give a good account of themselves in yield; but unless a wet season follows, they make no further contribution to the crop. These clovers made little or no contribution after the first year. Small amounts harvested in later years originated from hard seeds which did not germinate along with the main crop. This mixture would give a good account of itself in the grey wooded soil area or in moist locations in the park belt.

The growth produced by the mixture of western rye seven pounds, timothy two pounds, and alfalfa ten pounds demonstrated the importance of having a high-producing grass such as timothy combined with a high-producing, long-lived perennial, such as alfalfa, in a pasture mixture. The data compiled in this experiment and observations made with actual farm crops on the Station indicate that a suitable combination of timothy and alfalfa constitutes one of the best pasture mixtures for use in central Alberta. Under farm conditions, the western rye grass in the mixture dies out, and unless there are enough other cultivated plants to take its place, it is replaced by persistent perennial weeds such as dandelions.

The mixture of five pounds western rye grass, two pounds timothy, five pounds alfalfa, two pounds white Dutch clover, and four pounds Kentucky blue grass appears to have very little to commend it. The western rye grass and white clover made little contribution to the mixture at any time during the five-year period. The Kentucky blue grass, because of its creeping root stalks, tended to thicken up as the stand became older. It choked out other crops and became sodbound and unproductive in the last years of the experiment.

The mixture of ten pounds Kentucky blue grass and ten pounds white Dutch clover gave the lowest yield of any of the mixtures. It is believed that there is not sufficient moisture available in central Alberta to grow either of the crops included in this mixture to advantage. This need of an abundance of available moisture by the clover was reflected in the first year's yield when the clover produced 68·4 per cent of the yield, followed by zero in 1934 and 15·5 per cent and 20·7 per cent in the two years following when more rainfall occurred. This mixture is not recommended for use on the higher land of central Alberta. Its value for pasture purposes in any part of Alberta would be very limited.

The mixture containing twelve pounds western rye grass and twelve pounds crested wheat grass has nothing to commend it. These two grasses are both drought-resistant and produce vegetation very similar in appearance.

Since the western rye grass is a short-lived perennial, it disappears and is replaced by the crested wheat which, in this case, was seeded heavily enough to make a full stand. Nothing appeared to be gained by adding a grass such as western rye to crested wheat. This is one of the lowest yielding mixtures in the test.

The mixture of twelve pounds brome and twelve pounds crested wheat provides an interesting study of the ability of these two grasses to compete with each other. The per cent of the yield produced by each of the two crops indicates that brome tends to smother out the crested wheat. Under soil and climatic conditions which prevail in central Alberta, it would seem that a bunch grass, such as crested wheat, cannot compete with a grass with creeping root stalks, such as brome. Since this mixture did not yield as much as pure brome, and no more than pure crested wheat in the same experiment, the addition of crested wheat apparently reduced the yield of the mixture below that produced by pure brome, hence the addition of crested wheat to brome for use as a pasture crop in central Alberta would not seem advisable.

The mixture of eight pounds timothy and twelve pounds crested wheat grass indicated that these two grasses are about equal in their ability to compete with each other under the soil and climatic conditions which prevail in central Alberta. The percentage of crested wheat increased in the fifth year, as a result of winter injury suffered by the timothy. This mixture contains a drought-resistant and a moisture-loving grass, and, while it is not outstanding from the standpoint of yield, the inclusion of the crested wheat in the mixture makes it continue to produce forage from early spring until late fall. It would therefore seem advisable to use this mixture for pasture purposes where the pasture will be left down for two to three years.

The mixture of six pounds brome, three pounds timothy, ten pounds crested wheat, and six pounds western rye grass includes the four principal cultivated grasses used for hay purposes in central Alberta. It is interesting that the percentage of brome continued to increase after the first year, thus indicating its ability to compete with the other grasses and its superiority for pasture purposes. There would seem to be little to be gained by adding either timothy, rye grass or crested wheat to brome for pasture.

The mixture of six pounds western rye, six pounds brome, three pounds timothy, ten pounds crested wheat, and five pounds alfalfa is very similar to that of the preceding plot, except that alfalfa is added. The addition of alfalfa to the mixture did not increase the yield per acre of either dry matter or protein. In comparing the competition between the crops in the mixture it is interesting to note that the percentage of brome and alfalfa tended to increase, that timothy held its own, and that western rye and crested wheat could not hold their own in competition with the other crops in the mixture. Apparently the addition of western rye and crested wheat grass made no improvement in the mixture.

The mixture of eight pounds timothy, eight pounds red clover, two pounds alsike clover, five pounds Kentucky blue grass, two pounds white clover and one pound yellow trefoil gave a relatively low yield per acre. This mixture yielded well while the timothy was young and growing vigorously, but the yield dropped when the blue grass got thick enough to choke the timothy. The clover in the mixture made very little contribution to the yield. Apparently clover cannot compete with the grasses for the limited available moisture. The yellow trefoil in this and other plots in this project added nothing to the value of the mixture. This mixture is not recommended.

The mixture of eight pounds timothy, eight pounds red clover, two pounds alsike clover, five pounds creeping red fescue, two pounds white clover and one pound yellow trefoil is similar to that in the previous plot except that creeping red fescue replaces the Kentucky blue grass. The fescue behaved much like blue grass in the mixture. These two grasses are similar in type and

habit of growth, and there is little to choose between them as far as production is concerned. This mixture is one of the lowest yielders included in the test, hence is not recommended.

A mixture of ten pounds orchard grass, four pounds timothy, six pounds red clover, two pounds alsike clover, two pounds white clover, and one pound yellow trefoil was also tested. The orchard grass and yellow trefoil winter-killed and the clovers did not yield very much, hence this plot was almost pure timothy with a sprinkling of clover in it. It is believed that soil and climatic conditions are too cold and too dry to make it possible to grow this mixture to advantage in central Alberta.

Another mixture which combines four pounds meadow fescue, four pounds red clover, 2 pounds alsike clover and one pound yellow trefoil with two of the best pasture crops, three pounds timothy and four pounds alfalfa, was grown. The meadow fescue proved to be a short-lived perennial and the white clover and yellow trefoil contributed little to the yield produced by the mixture. In other words, the timothy and the alfalfa gave most of the crop and it is doubtful if the additional cost involved in adding the meadow fescue and the other legumes to the mixture is justified.

A pure seeding of fifteen pounds creeping red fescue proved to be one of the lowest yielding plots in the test. This grass is not recommended for pasture purposes unless a dense turf that will stand tramping and control weeds is more desirable than a crop or mixture that will have a higher carrying capacity.

A mixture of fifteen pounds creeping red fescue and five pounds white clover developed into a plot of pure fescue for the reason that the white clover winter-killed. This mixture is not recommended as it has been found that white clover is not hardy, except where moisture is more plentiful than on high land in the park belt of central Alberta.

Protein Content of Pasture Crops

The protein content of a feed indicates to a marked degree its nutritive value. The protein content of different feeds varies over a wide range; and the proteins of various feeds differ in nutritive value. The fact that young cattle, colts and lambs can make good growth on succulent pasture following the weaning period indicates that the protein produced by such pasture has a high nutritive value.

The analyses reported in the following paragraphs indicate that pasture crops as grown in central Alberta are high-protein feeds. The protein content of the low-protein pasture crops is higher than bran, a feed considered rather rich in protein. The high-protein pasture crops produce forage with a protein content nearly as high as some of the high-protein oil-mill concentrates. Since concentrates with a high protein content such as oilcake meal are the most expensive to purchase, it would seem that most economical feeding operations can be accomplished only when full advantage is taken of the use of succulent pasture in providing the protein essential in an animal's diet.

The average protein content of the project seeded in 1932 was 20·78 per cent in 1933, 18·74 per cent in 1934, 16·36 per cent in 1935, 13·11 per cent in 1936, and 12·80 per cent in 1937, thus indicating that pastures may become less productive and less nutritious as the stands become older. The average protein content of the project seeded in 1933 showed the same trend, but the annual decrease was less consistent.

The broad-leaved legume crops, as a class, have a higher protein content than the grasses. The advisability of having a high-protein long-lived legume such as alfalfa included in a permanent pasture cannot be over-emphasized. It is equally important that pastures intended to be left down for one or two years should contain a legume of some kind in the mixture in order to maintain a high

protein level in the forage produced, and it is suggested that sweet clover should be used for this purpose in the park belt and marginal prairie; and that red and alsike clover should be used in the grey wooded soil area.

The protein content varies in different grasses. The drought-resistant grasses such as crested wheat and brome have a higher protein content than the less drought-resistant grasses such as timothy. It is also of interest that the higher protein grasses include those most resistant to frost injury. Fortunately the most important pasture grasses for the marginal and open prairie are high-protein grasses, while the area for which timothy, a low-protein grass, is recommended will also grow legumes to advantage. A mixture of timothy and alfalfa or one of the clovers will produce forage with a high protein content and nutritive value in the grey wooded soil area.

The greater nutritive value of drought-resistant grasses is borne out in actual grazing results. Stock from the marginal and open prairie, where only drought-resistant grasses can thrive, make larger annual gains and come off the grass with a better finish than stock grazing on the native grasses of the grey wooded soil area, where the rainfall is greater and where the native grasses apparently have a low dry-matter and protein content and are more subject to damage by freezing temperatures.

The protein content of the different annual pastures was determined. Results showed that the annual pastures as a class produce forage with a higher protein content and therefore a higher nutritive value than the biennial and perennial pasture crops and mixtures other than alfalfa and the clovers. It is surprising to find some of these annual pastures with as high protein content and therefore as high nutritive value as biennial and perennial legumes such as alfalfa and the clovers.

While all the annual pasture crops and mixtures are high in protein content, rape and the first season's growth of winter rye are outstanding in this respect; both being equal or superior to the legumes.

Seasonal Variation in Quality of Pasture

The nutritional value of pasture varies throughout the autumn, due in part to frost damage. The accompanying table shows the changes in protein and dry-matter content which takes place between early September and freeze-up.

* Seasonal Variation in Protein and Dry-Matter Content of Pasture

	Date of Cutting		
	Sept. 7	Sept. 22	Oct. 13
Average Protein Content	20·18	16·43	13·68
Average Dry-Matter Content	30·42	34·58	49·45

* Average of 200 samples.

The low nutritive value of pasturage in the late fall as indicated by the low protein content of the forage collected on October 13, after low temperatures stopped further growth and development, is appreciated by stockmen who find that their animals make little or no gains when grazed after the middle of September. Stock seldom do more than maintain body weight if grazed after that date.

Annual Pasture Crops

Crops used for annual pasture include the cereal grains, rape, millets, etc., which are seeded and grazed the same season.

Annual pasture crops are becoming increasingly important. They are used more extensively with each successive year as their merits become better known and the knowledge concerning their production increases. Their greatest use is as supplemental pastures for cattle, horses and sheep; and they are the best for, and should constitute the principal cultivated pasture crops for hogs and poultry.

Most annual pasture crops suitable for and in general use in central Alberta are succulent, palatable, nutritious and very attractive to live stock. The principal objection to annual pasture crops is that their production involves a greater expenditure on labour, etc., than is the case with biennial and perennial pastures.

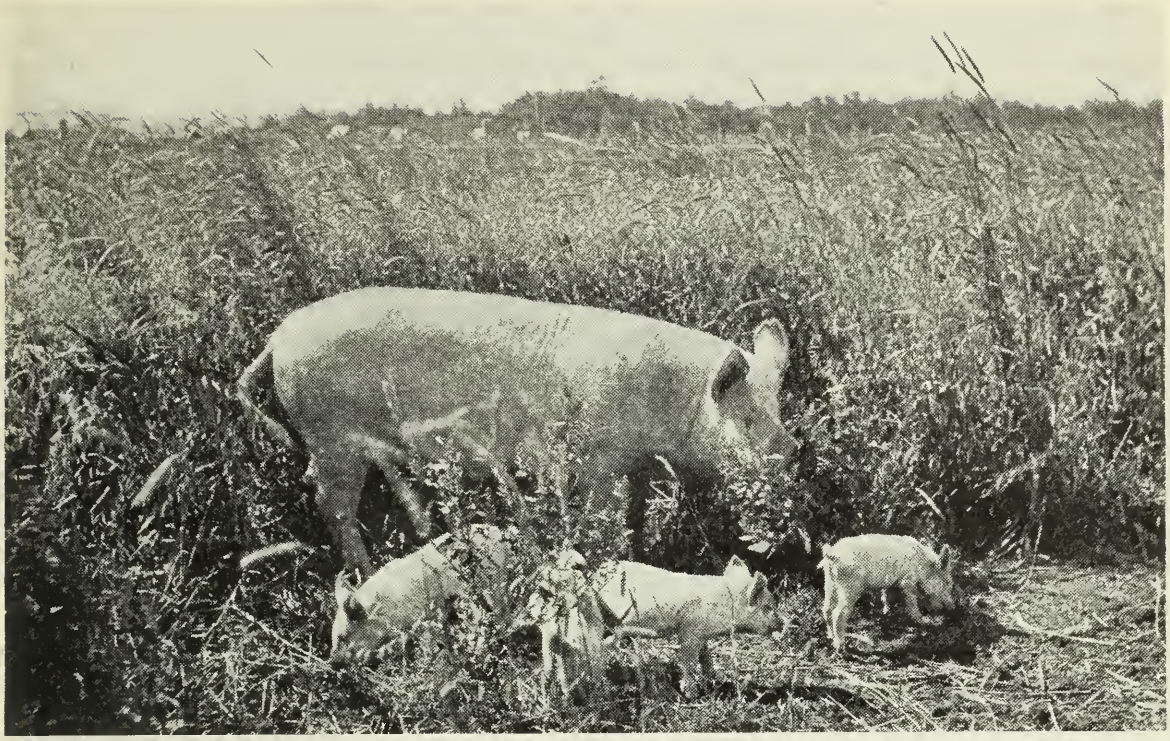
Five-Year Average Per Cent of Protein and Yield per Acre of Annual Pasture Crops

Plot No.	Crop and Rate of Seeding	Per cent Protein	Yield of Dry Forage in Tons
1	Colsess Barley 1½ bu	24·08	0·83
2	Garnet Wheat 1½ bu	22·49	0·66
3	Colsess Barley 1 bu., Garnet Wheat 1 bu., Banner Oats 1 bu	22·45	1·20
4	Banner Oats 2½ bu	22·69	1·45
5	Victory Oats 2½ bu	21·82	1·44
6	Legacy Oats 2½ bu	20·87	1·25
7	Alaska Oats 2½ bu	21·24	0·95
8	Gopher Oats 2½ bu	20·40	1·44
9	Victory Oats 2 bu., Early Blue Peas 1 bu	22·75	1·29
10	Alaska Oats 2 bu., Rape 10 lb	24·91	1·36
11	Banner Oats 2 bu., Winter Rye 1 bu	24·14	1·54
12	Winter Rye (Seeded in the Spring) 1½ bu	26·93	1·05
13	Spring Rye 1½ bu	23·11	0·82
14	Rape 3 lb	26·08	1·14
15	Siberian Millet ½ bu	20·51	1·17
16	Hog Millet ½ bu	22·96	0·88

Annual pastures are particularly well suited for intensively grazed areas such as hog pastures, sheep and cattle paddocks, poultry runs, etc. The intensive grazing on such areas tends to leave patchy stands at the end of the season. If such pastures were seeded with perennial crops, the pastures would continue to be patchy the following year, but when annuals are used as the pasture crop, they are reseeded each year and new stands established.

The cultivation necessary in preparing the seed-bed for annual pasture crops is a decided advantage from the standpoint of sanitation, particularly in the case of intensively grazed areas such as hog pastures and poultry runs. Such pastures usually have the soil firmly packed by tramping and become badly polluted by the droppings of the stock. The ploughing necessary in seed-bed preparation not only opens up and aerates the soil, but buries the droppings and filth which may contain disease germs and larvae of internal parasites. When the land is ploughed in preparing a seed-bed, such contaminating material is buried so deeply that its chances of infecting grazing animals are reduced; at the same time it is converted into an excellent fertilizer which increases the yield of the pasture. The fresh soil which is brought to the surface by ploughing provides a reasonably clean, fresh grazing area for the stock.

In comparing the yields produced by annual pasture crops with those produced by perennial pasture crops during the five-year period, 1933-38, it was observed that the annual pasture crops tended to produce higher yields per acre of both dry matter and protein.



Yorkshire sow and part of her litter in pasture of oats and winter rye. Most farmers make the mistake of including too small an area in their hog pastures. If too large an area is seeded with this mixture it can be harvested for grain or greenfeed, or the hogs will hog it down when ripe without any loss of grain, or other live stock may be used to graze off the areas which get ahead of the pigs.

Brome is the best grass to use for hog pasture. It is palatable, productive and nutritious. Its creeping root system quickly fills in any areas rooted out by the pigs. It is one of the best early spring pasture crops. No hog pasture in Central Alberta is complete without a certain area devoted to this grass.

Colsess, the most productive of the beardless barleys, outyielded Garnet wheat, but in turn was outyielded by all other crops and mixtures except spring rye. It produces a high quality forage that is very succulent, and has a higher protein content than wheat or oats. The only advantage to be gained by using beardless barley in place of oats for pasture purposes would be that of having a certain amount of variation in the animal's ration which would result from the use of more than one annual pasture crop. It is doubtful if it would be advisable to grow barley as an annual pasture if seed oats were available.

Garnet wheat proved very inferior as an annual pasture crop, being low in yield of both dry matter and protein. It is believed that the longer-strawed, later-maturing varieties might give a higher yield per acre as a pasture crop, but it is doubtful if even the later-maturing varieties would prove as satisfactory for pasture purposes as other cereals. Wheat is not recommended for annual pasture for central Alberta if seed of other cereals is available. On the other hand certain varieties of wheat have exhibited greater drought resistance than barley and oats, and it is possible that they would prove more valuable than the coarse grains for use as annual pasture in the drier areas of the open prairie.

The mixture of one bushel each of Colsess barley, Garnet wheat and Banner oats did not produce as large a yield of either dry matter or protein as the plots seeded with oats alone. Since neither barley nor wheat yielded as well as oats, the inclusion of these two crops in a mixture with oats could not be expected to result in an increase in the yield of either dry matter or protein. Since this mixture is outyielded by a number of other crops it is not recommended for general use in central Alberta.

Banner oats proved to be one of the best annual pasture crops tested at the Station. The fact that there is a relatively small margin of difference between the yield of protein and dry matter produced by Banner and Victory would indicate that the later-maturing varieties of oats such as the above make excellent annual pasture crops.

Legacy oats, being a medium early-maturing variety, is not so productive of either dry matter or portein as the later-maturing sorts. It should not be used as an annual pasture crop if seed of later-maturing sorts is available.

Alaska is one of the very early-maturing varieties of oats. Since it produces a very low yield of both dry matter and protein, it should not be used as a pasture crop if seed of later-maturing sorts is available.

Gopher oats produced high yields of dry matter and low yields of protein. Like other early oats, the variety does not make as satisfactory an annual pasture as do the later-maturing varieties.

The mixture of two bushels of Victory oats and one bushel of Early Blue peas gave a fair yield of high-protein forage. The addition of the peas to the oats slightly increased the protein content and slightly reduced the total yield per acre of both the dry matter and protein. While this mixture might prove satisfactory for certain special pastures, it is believed that it would not give the general satisfaction resulting from the use of some of the other annual pastures. The peas furnished only 9·25 per cent of the forage produced by the mixture, and produced very little growth after the second cutting.

A mixture of two bushels of Alaska oats and ten pounds of rape is an excellent annual pasture. It produced a good yield of high-protein forage. The oats provide the forage grazed off in the early summer, and the rape comes on and provides the grazing in the late summer and fall after the oats have progressed beyond their period of maximum growth and production. The rape produced 16·5 per cent of the forage. This mixture is suitable for cattle, sheep and hogs, but would not be as suitable for horses or poultry as some of the other annual pasture crops.

Alfalfa is one of the best legume pastures for hogs. Some hogs do not find it palatable. If it is grazed closely, hogs tend to root it out, and, since alfalfa cannot renew itself in the same way as brome, it tends to become patchy.

Rape is one of the best late summer, fall and early winter pastures for hogs, sheep and cattle. It is high in protein and is not seriously damaged by freezing.

The mixture of two bushels of Banner oats and one bushel of winter rye produced the highest yield of both dry matter and protein of any of the annual pasture crops tested. While the protein content of the forage produced by this mixture was not equal to that of winter rye or rape, it was higher than that produced by pure oats, barley, wheat or millet. The oats produce the spring and early summer pasture and the rye produces the late summer and fall grazing. The winter rye produced 28·25 per cent of the forage. This mixture is considered the best all-round annual pasture mixture included in the test, and is suitable for and has been used extensively for all classes of live stock and poultry at the Station. It has constituted the main pasture crop and has been used almost exclusively for hog and poultry pasture at the Station during the past twenty years.

Feeder lambs grazing on rape. Some farmers in central Alberta grow over one hundred acres of rape for lamb feeding. If feeder lambs are available by the middle of September, they can be finished on rape with little or no grain. Where sufficient moisture is available, an intertilled crop of rape grazed off by sheep constitutes an excellent summer-fallow substitute.

Winter rye seeded in the spring proved a much better annual pasture than was expected when the test was started. It produces a fair yield of high-quality, nutritious and palatable forage. The protein content of the winter rye forage was the highest of any of the crops included in the test. This crop has an advantage over many others, in that it can be grazed the year it is seeded and unless grazed too closely late in the fall, will live through the winter, and the second year's growth can be used for pasture, green feed, or grain production. It is believed that winter rye seeded early in the season could be used to advantage as a pasture crop on many farms.

Spring rye is not so good for annual pasture purposes as winter rye. It does not produce such high yields per acre of forage, nor is the protein content so high as that of the winter rye. Since it does not yield as much dry matter or protein as barley, wheat, or oats, and since it is less palatable and attractive to live stock

than either of these crops, there would seem to be little to warrant using spring rye for pasture purposes. The forage produced by spring rye would be similar to the second year's growth of winter rye.

Rape is one of the best and most useful special-purpose annual pastures. The protein content of the forage is second only to the first season's growth of winter rye, and the yield of dry matter and protein is reasonably good. It is one of the best annual pastures available for late summer and fall grazing for swine, sheep, poultry and certain classes of cattle. Some farmers of central Alberta grow as much as one hundred acres of rape in rows for fattening feeder lambs. Since its nutritive value is not seriously injured by low temperature it makes a particularly valuable late fall pasture for sheep and swine.

The Experimental Station flock of sheep cleaning up the fence lines and roadways before being moved out to summer range. A farm flock will pay its way in the good they do in controlling weeds along fence lines and on summer-fallows.

Neither Siberian nor Hog millets have proved very satisfactory annual pasture crops. Neither the yield nor the quality of the forage produced by millets is equal to that produced by oats and some of the other annual pastures. Millets are very subject to damage by freezing temperatures and the forage is very unattractive to live stock after being frozen. In addition, the millets make very little growth in cool, damp weather typical of part of the growing season in central Alberta. For these reasons, it is doubtful if millets will ever fill a very large place as annual pasture crops under conditions which prevail in central Alberta.

Recommended Pastures

The following recommendations are based on data recorded in definite pasture experiments, observations made in supervising such experiments and producing forage for the large herds and flocks kept at the Station, and on observations made in the large agricultural area throughout central Alberta that is served by this Station.

The portion of Alberta served by this Station consists of four principal zones, the short grass prairie, the marginal prairie, the park belt and the grey wooded soil area or the timber belt, in which different soil and climatic conditions prevail. Different pasture crops are recommended for the different zones.

Short Grass Prairie.—The short grass prairie is situated in that portion of the province which is visited by very dry years and is frequently referred to as the drought area. For that reason, only drought-resistant crops should be used for pasture purposes in this area. Experience to date indicates that crested wheat grass is the most promising of the perennials, and has the widest application of any pasture crop in that area. However, there may be certain depressions where moisture tends to concentrate and where crops such as brome grass

White Wyandotte cockerels on alfalfa pasture. Alfalfa is one of the best permanent pasture crops for poultry, Feed hoppers, etc., should be moved frequently as the alfalfa is grazed down near them and may be killed out unless they are moved at frequent intervals.

and alfalfa will give a reasonably good account of themselves. In many locations biennial crops such as sweet clover and winter rye will provide a lot of feed and, if not over grazed, will reseed themselves and help round out the pasture season. Spring rye and wheat constitute the best annual pastures for use in this area. Broad-leaved pasture crops such as rape require more moisture than is usually available for crop production in this area.

Marginal Prairie.—The marginal prairie is situated between the short grass prairie and the park belt. It also is visited by very dry years which lend a certain amount of hazard to crop production. On the other hand, rainfall in this zone is frequently more abundant than in the short grass plains area. The recommendations for the short grass prairie also apply in this zone to a large extent, but perennial pastures such as brome and alfalfa, biennials such as sweet clover, and annuals such as winter rye and rape can be grown more satisfactorily in this area. The oat and winter rye annual pasture mixture will give a reasonably good account of itself throughout this zone. Locations in this area where moisture tends to concentrate will produce successfully the crops which do well on the higher land of the park belt.

Park Belt.—A great variety of pasture crops can be grown successfully in the park belt where a dark fertile soil and moderate rainfall make conditions particularly well suited for diversified farming. In this area, some of the land is quite rolling, and it has been observed that recommended farm practices for the marginal prairie are applicable to the higher land of the park belt, and farm practices recommended for the grey wooded soil area are applicable to the low land of the park belt.

In very few cases is it advisable to seed pure stands of either grasses or legumes for perennial pasture crops in the park belt. In this area, a mixture of five pounds crested wheat grass and eight pounds of alfalfa per acre is recommended for the higher sandy locations intended for permanent pasture. A mixture of five pounds brome grass and eight pounds alfalfa is recommended for the better type of high land permanent pastures, or a mixture of three pounds timothy and eight pounds alfalfa for the better types of high land intended to be

Brome grass on left and crested wheat grass on right showing their ability to control weeds as indicated by infestation of dandelions. Creeping rooted grasses, like Brome, Kentucky Blue grass, Creeping Red Fescue, etc., effectively control weeds, while bunch grasses like Crested Wheat grass, Timothy, Western Rye grass, etc., are less effective in their ability to control weeds than the creeping rooted grasses.

left in grass for periods of three to six years. A mixture of five pounds timothy and ten pounds sweet clover is recommended for good land that does not flood and that is intended to be left in pasture for one to two years. A mixture of four pounds each of timothy, red clover and alsike clover is recommended for the low moist locations such as the margins of non-alkaline sloughs and creek bottoms. The addition of a few pounds of red top or reed canary grass to this last mixture will improve it for low wet areas of peat land that remain flooded for varying lengths of time. Annual pasture mixtures of two bushels of oats and one bushel of winter rye per acre; or one bushel of oats and ten pounds rape; or one and one-half bushels of winter rye; or three pounds of rape in rows thirty to thirty-six inches apart will give good results in this zone.

Grey Wooded Soil Area.—The grey wooded soil area, or the timber belt, is characterized by an abundant rainfall and a rather infertile grey soil covered with considerable timber and brush. The limitations of this zone make it necessary for its inhabitants to practice diversified farming in order to secure a livelihood.

In this area, the crested wheat, brome, timothy combinations with alfalfa could not be expected to give as good satisfaction as in the park belt, but the mixtures of brome and alfalfa or timothy and alfalfa could be expected to be reasonably satisfactory on the higher land if properly fertilized. The most generally satisfactory grass—legume mixture for the grey wooded soil area is four pounds each of timothy, red clover and alsike clover, with a few pounds of either red top or reed canary grass added for low peat land which remains flooded for varying lengths of time in the spring.

It is considered advisable to prevent or prohibit the seeding of sweet clover in the grey wooded soil area for the production of either pasture, hay or seed, for the reason that the area will produce as high yields of red clover as of sweet clover. The introduction of sweet clover into the area might result in the sweet clover becoming a weed, and thus interfere with the production of red and alsike clover seed which is fast becoming a profitable phase of agricultural production in this area.

Legumes for pasture, hay or seed production in the grey wooded soil area will usually produce enormous yields if they are fertilized with suitable fertilizers, but may give disappointing returns if they receive no fertilizer treatment. Fertilizer treatments which have given best results to date include barnyard manure, marl, sulphur, ammonium sulphate and ammonium phosphate. Information concerning the most suitable fertilizer to use, and the cost, rates of application, etc., should be secured from the nearest District Agriculturist, Experimental Station, School of Agriculture, or University.

Methods of Seeding Pastures

The methods of seeding pastures varies with each soil and climatic zone in the area served by the Station. It is believed that lack of information on the best method of seeding to secure good stands of pasture crops has been an important factor in retarding pasture improvement programs.

In the open plains or short grass prairie zone of the province the range has been improved by drilling crested wheat into the soil in September or in the late fall or in a period of light snow covering during the winter. Strips the width of a seed drill have been seeded at intervals of *four to ten* rods on abandoned farming land; the idea being to let this grass go to seed and permit the wind to scatter the shattered seed over the intervening space between the seeded strips. In this dry area it is advisable to sow the crested wheat grass seed in a trash cover of refuse left by weeds or some cereal crop. Fields seeded solid have made good stands of grass much more quickly than when seeded in strips and the method is preferable if sufficient seed is available. Where seeding has been followed by very dry periods, the grass seed has lain in the ground for two to three years before germinating, and it has then made an excellent stand when a period with abundant rainfall occurred.

In the marginal prairie area where more moisture is received and where there is usually sufficient moisture from winter snow to germinate the seed, good stands have been obtained by sowing the seed in the stubble in the late fall or winter. While grass seeds such as crested wheat or brome may be seeded in the early fall with good results, as they will come through the winter in good condition if they germinate before winter sets in, the same does not hold good for legumes such as sweet clover and alfalfa, the seedlings of which are sure to be

winter-killed if they do not make a certain amount of growth before winter sets in. Late summer or early fall is too late to seed any of the legumes. If fall seeded, the seeding should be late enough to make sure the seed will not germinate before freeze-up.

If grass and legumes are seeded on cultivated land in the marginal prairie, the seeding should be done early in the season without a nurse crop. The small grass and clover seedlings cannot compete with the ranker-growing cereals for the limited moisture available in this zone. It is necessary for the grass and legume seedlings to make a certain amount of growth before the intense heat of July and early August occurs or the young seedlings may be killed by the high temperatures of the surface soil during such periods of high temperature. For this reason, spring seedings should not be made later than the first week of June.

Seeding Sweet Clover, Timothy, Alfalfa and Brome in wheat stubble. Jan. 10th, 1938.

Fall seeding does not always prove satisfactory in the park belt or in the grey wooded soil area for the reason that moisture is more abundant in these areas and this abundant moisture causes a crust to form on the surface of the soil. The small seeds and seedlings are bound up in this hard crust so tightly that seedlings are usually killed and seed germination is retarded until weeds have got a big start on any surviving grass and legume seedlings. Seeding during the second or third week of June without a nurse crop has given best results in the park belt over a period of years.

Experience at the Experimental Station has shown that seeding with a nurse crop entails a certain proportion of failures. It usually happens that seedings made with a nurse crop are failures two to three years out of five and that seeding without a nurse crop is the surest way of establishing good stands of grasses and legumes in the park belt. Seeding without a nurse crop is advisable particularly when expensive seed such as alfalfa is being used. If cheap seed such as timothy and sweet clover is being seeded, the grower is justified in taking the risk involved in seeding with a nurse crop.

The grey wooded soil area is usually blessed with more abundant rainfall than any other part of the province. Seeding with a nurse crop of grain gives good results in this area in normal seasons.

Different grasses and legumes have been seeded at Lacombe on the first of the month throughout the entire season for several years. Hardy grasses such as crested wheat and brome may be seeded any time in the year with good results. Other grasses such as timothy, blue grass, etc., do best if seeded between early spring and the third week in June. Many grasses do well if seeded during August on land that is free from weeds and carrying sufficient moisture to cause quick germination of the seed. Seedings made on summer-fallow or clean stubble at that season give seedlings in the third- or fourth-leaf stage by freeze-up. The seedlings of the hardier grasses, such as crested wheat, brome, rye grass and timothy, which have developed to this stage come through the winter with a low percentage of winter-killing and make a good growth the following year. Alfalfa and sweet clover seldom winter unless seeded before July 1. Red, alsike and white clovers frequently make a good showing if seeded as late as August 1.

Acknowledgments

The co-operation of the Dominion Experimental Station, Swift Current, Saskatchewan, in making the dry-matter determinations; and the Division of Chemistry, Science Service, Dominion Department of Agriculture, Ottawa, in making the analyses for protein content on forage collected in connection with the pasture projects reported herewith is gratefully acknowledged. The writers also wish to express appreciation of the excellent work done by A. D. McFadden and other graduate and undergraduate students who did most of the routine field work connected with these projects.

OTTAWA
J. O. PATENAUDE, I.S.O.
PRINTER TO THE KING'S MOST EXCELLENT MAJESTY
1940