CIHM
Microfiche
Series
(Monographs)

ICMH
Collection de
microfiches
(monographies)

Technical and Bibliographic Notes / Notes techniques et bibliographiques

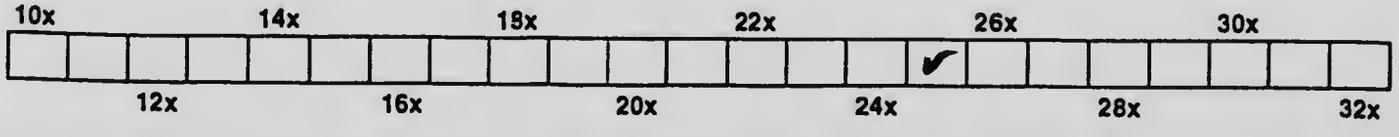
The Institute has attempted to obtain the best original copy available for filming. Features of this copy which may be bibliographically unique, which may alter any of the images in the reproduction, or which may significantly change the usual method of filming are checked below.

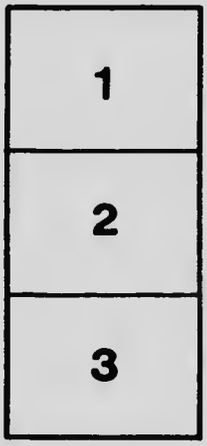
- [x] Coloured covers / Couverture de couleur
- [ ] Covers damaged / Couverture endommagée
- [ ] Covers restored and/or laminated / Couverture restaurée et/ou pelliculée
- [ ] Cover title missing / Le titre de couverture manque
- [ ] Coloured maps / Cartes géographiques en couleur
- [ ] Coloured ink (i.e. other than blue or black) / Encre de couleur (i.e. autre que bleue ou noire)
- [ ] Coloured plates and/or illustrations / Planches et/ou illustrations en couleur
- [ ] Bound with other material / Relié avec d'autres documents
- [ ] Only edition available / Seule édition disponible
- [ ] Tight binding may cause shadows or distortion along interior margin / La reliure serrée peut causer de l'ombre ou de la distorsion le long de la marge intérieure.
- [ ] Blank leaves added during restorations may appear within the text. Whenever possible, these have been omitted from filming / Il se peut que certaines pages blanches ajoutées lors d'une restauration apparaissent dans le texte, mais, lorsque cela était possible, ces pages n'ont pas été filmées.
- [ ] Additional comments / Commentaires supplémentaires:

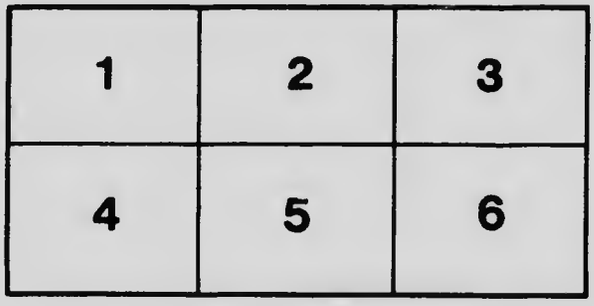
L'Institut a microfilmé le meilleur exemplaire qu'il lui a été possible de se procurer. Les détails de cet exemplaire qui sont peut-être uniques du point de vue bibliographique, qui peuvent modifier une image reproduite, ou qui peuvent exiger une modification dans la méthode normale de filmage sont indiqués ci-dessous.

- [ ] Coloured pages / Pages de couleur
- [ ] Pages damaged / Pages endommagées
- [ ] Pages restored and/or laminated / Pages restaurées et/ou pelliculées
- [x] Pages discoloured, stained or foxed / Pages décolorées, tachetées ou piquées
- [ ] Pages detached / Pages détachées
- [x] Showthrough / Transparence
- [ ] Quality of print varies / Qualité inégale de l'impression
- [ ] Includes supplementary material / Comprend du matériel supplémentaire
- [ ] Pages wholly or partially obscured by errata slips, tissues, etc., have been refilmed to ensure the best possible image / Les pages totalement ou partiellement obscurcies par un feuillet d'errata, une pelure, etc., ont été filmées à nouveau de façon à obtenir la meilleure image possible.
- [ ] Opposing pages with varying colouration or discolourations are filmed twice to ensure the best possible image / Les pages s'opposant ayant des colorations variables ou des décolorations sont filmées deux fois afin d'obtenir la meilleure image possible.

This item is filmed at the reduction ratio checked below / Ce document est filmé au taux de réduction indiqué ci-dessous.







THE CANADIAN PACIFIC RAILWAY COMPANY.

DEPARTMENT OF NATURAL RESOURCES.

AGRICULTURAL AND ANIMAL INDUSTRY BRANCH.

ALFALFA

Its adaptation and value as a food for all classes of live stock, its beneficial effect upon the soil, and how to best plant, inoculate, grow and harvest the crop, with an appendix on

MIXED PASTURE GRASSES

By

DON H. BARK

Chief of Irrigation Investigation Division.

THE CANADIAN PACIFIC RAILWAY COMPANY.

DEPARTMENT OF NATURAL RESOURCES.

AGRICULTURAL AND ANIMAL INDUSTRY BRANCH.

ALFALFA

Its adaptation and value as a food for all cla es of live stock, its beneficial effect upon the soil, and how to best plant, inoculate, grow and harvest the crop, with an appendix on

MIXED PASTURE GRASSES

By

DON H. BARK

Chief of Irrigation Investigation Division.

Harvesting Alfalfa at Strathmore, 1914.

INDEX

ALFALFA

ITS ADAPTATION AND VALUE AS A FOOD FOR ALL CLASSES OF LIVE STOCK, ITS BENEFICIAL EFFECT UPON THE SOIL, AND HOW TO BEST PLANT, INOCULATE, GROW AND HARVEST THE CROP.

As a forage plant alfalfa excels all other crops in yield, low cost of production, feeding value and beneficial effect upon the soil. It has now been grown successfully for a sufficient number of years in this portion of Alberta to demonstrate its hardiness, yielding capacity and general adaptability to the locality, and it is believed that if more Alberta farmers realized (1) the ease with which this crop can be grown, (2) its value as a food for all classes of live stock, and (3) its beneficial effect upon the soil, the acreage devoted to the crop in the Province would be rapidly increased.

With the view of throwing more light upon the value of this crop and of furnishing authentic dependable information for the use and guidance of those who may be interested in the subject, the data contained herein have been carefully selected and compiled from the various sources indicated, all of which we have reason to believe are reliable.

In order to assist in the interpretation of the first two tables following, and to throw a little light upon the main reason for the increased value of alfalfa over the other common foods, it is thought best to say a few words concerning the principles of feeding which have been derived from the results of feeding experiments and study.

The chief functions of food are to furnish a sufficient supply of the necessary ingredients to replace the body tissues of the animal, which are gradually breaking down, and enough in addition to maintain the body heat and also permit of growth and increase in weight or milk production as the case may be.

These body tissues consist of certain compounds that bear a more or less definite or constant relationship to one another in practically all classes of animals. It is evident that an animal must secure all the repairs for its system through its food and that this food, in order to be economical, must contain digestible nutrients in sufficient quantities and in at least approximately the proper proportions if the animal is to make the best and most economical use of its food.

The valuable part of all feeding stuffs or foods can be divided into three principal parts, namely, protein, carbohydrates and fats. The protein is that portion of the food containing nitrogen and is often designated as the "flesh-forming" constituent.

The carbohydrates and fats are those parts of the foods which do not contain nitrogen and are used by the animals for the purpose of producing heat and keeping the body warm and for storing up fat.

It is believed that, to at least a certain extent, the fats and carbohydrates of food can take the place of each other, but none can take the place of the protein. This must be in the food itself. Now, as has been said before, a ration, to be economical, must contain certain definite proportions of the above digestible nutrients. This has been found by actual test to range from one part of protein to from four to eight parts of

carbohydrates and fats. If the animal is fed food containing more than these proportions of carbohydrates and fats, it will have to eat so much to secure the necessary amount of protein that too much fats and carbohydrates will be taken into its system. This will necessitate that the excess be thrown off in the manure and urine of the animal, which is both a drain on the animal's system and a direct waste of food, both of which are economically bad. The same proposition holds true when feeds too rich in protein are fed.

The discovery of the necessity for certain definite proportions of ingredients in food resulted in the adoption of the term "balanced rations," which means, roughly, the combining of foods so as to contain approximately the four to eight parts of fats and carbohydrates to each part of protein.

It is a well demonstrated fact that most of the common forage crops grown and fed, such as timothy and prairie hay, green feed, corn fodder, etc., do not contain enough of the protein, and hence, cannot become an economical ration, either for the animal fed or for the feeder's pocketbook. Alfalfa, clover hay and most other legumes, however, always contain an excess of protein, and so can be fed very profitably, either alone or along with other feeds that are deficient in this food, for it has been found that a ration had better contain too much than too little protein, provided the excess is supplied from alfalfa hay when this is produced at a reasonable price. Bearing these fundamental feeding principles in mind, the feeding value of alfalfa and the other feeds as given in the following tables can be readily understood, and appreciated.

VALUE OF ALFALFA AS FEED

The following table has been compiled from a special bulletin issued by the Wisconsin State University, covering experiments actually made, the value of timothy hay on the farm being assumed to be $2.50 per ton:

TABLE No. 1.

CROP.	Yield Per Acre Tons	Comparative Weight Green	Per Cent Hay Protein	POUNDS PROTEIN		Comparative Value Per Acre Based on Protein
				Per Ton	Per Acre	
Alfalfa	5.4	100	18.17	363.4	1962.3	$51.75
Red Clover	2.5	50	13.28	265.6	664.0	17.51
Timothy	2.3	33.3	4.74	94.8	218.0	5.75
Brome Grass	1.3	20.0	6.07	121.4	157.8	4.16

Bearing in mind that the quantity of protein in a feed is the factor which usually fixes its value as a ration it will be seen from the above table that if timothy is valued at $2.50 per ton, alfalfa, on the basis of the amount of protein contained, would be worth $9.58 per ton, or $51.75 per acre. While the values given by the above table are accurate for the time and place indicated, these values would, no doubt, vary somewhat in the different localities. There would, however, be practically the same comparative difference in our own locality.

The composition of a large variety of feeding stuffs is also given in United States Department of Agriculture Bulletin No. 22, and again in Kansas Experiment Station Bulletin No. 115, and the following extracts from them should furnish a fairly clear idea of the comparative value of some of Alberta's feeding stuffs, for this table represents the average of a large number of analyses.

TABLE No. 2.

Showing per cent. of dry matter, of **digestible** food ingredients, and nutritive ratio of common feeding stuffs:

FEEDING STUFF.	Total Dry Matter. Per Cent	Protein. Per Cent	Carbo-hydrates Per Cent	Fat. Per Cent	Nutri-tive Ratio
Alfalfa Hay	91.6	10.58	37.33	1.38	1:3.8
Red Clover	84.7	7.38	38.15	1.81	1:5.7
Alsyke Clover	90.3	8.15	41.7	1.36	1:5.5
Oat Hay (green feed)	84.0	4.07	33.35	1.67	1:9.1
Timothy Hay	86.8	2.89	43.72	1.43	1:16.2
Orchard Grass	90.1	4.78	41.99	1.4	1:9.4
Prairie Grass (Kansas)	51.5	0.61	46.9	1 97	1:84.2
Wheat Straw	90.4	0.37	36.3	0.4	1:100
Rape Pasture	14.3	2.16	8.65	0.32	1:4.3
Turnips	9.5	.81	6.46	0.11	1:8.3
Wheat Bran	88.5	12.01	41.23	2.87	1:4.0

The three middle columns of this table show only the percentage of the **digestible** ingredients, the total per cent. being from 50 to 100 per cent. higher in each case. By nutritive ratio is meant the proportion of protein to carbohydrates and fats, the amount of fats being multiplied by 2¼ and added to the carbohydrates on account of the greater energy contained in the fats. The amount of protein is represented by 1 in each case. It will be seen from this table that under conditions similar to those in the States, which are identical to those of Alberta in so far as these factors are concerned—alfalfa and the clovers head the list of forage crops in percentage of digestible protein and that timothy and prairie grass are much inferior, thus emphasizing the fact that alfalfa has a far greater feeding value per ton than any other forage crop that we can raise.

The above table shows simply the amount or percentage of the **digestible** food ingredients in the different feeding stuffs, which simply indicates but does not demonstrate their comparative value. But fortunately there are also the results of many experiments to prove both the comparative and actual worth of these feeds in growing, maintaining and fattening the various kinds of live stock common to Alberta, and it will also be seen from these that alfalfa and clover again always head the list, which demonstrates that they should be an important part of the ration for all classes of live stock if profitable gains are to be made.

The following table is taken from Bulletin No. 99 of the Nebraska Experiment Station, and gives the results of feeding three lots of 17 hogs each, each experiment running for 98 days:

TABLE No. 3.

KIND OF FOOD.	No. of Days Fed	Average Gain per Hog		Grain Fed Per 100 Lb. Gain
		Total	Per Day	
Alfalfa pasture and ½ lb. corn per 100 lbs. of hog per day	98	27	.28	124
Alfalfa pasture and 1½ lbs. corn per 100 lbs. of hog per day	98	36	.37	222
Alfalfa pasture and 2½ lbs. corn per 100 lbs. of hog per day	98	48	.51	332

The hogs used in this experiment were light weight hogs and the results secured show that alfalfa pasture is at least a maintenance ration for hogs, and that with even a very small allowance of grain per day very cheap gains can be made, but that if rapid gains are desired the grain allowance per day must be increased.

Bulletin No. 147 of the Nebraska Experiment Station on Pages 6 and 7 shows that 10 old sows were kept over winter from early in November until early in March, a total of 121 days, on 9.9 bushels of corn and 86 pounds of alfalfa hay apiece, and that the sows gained enough in weight with corn at 47 cents per bushel to show a profit. The sows showed an average gain of 93 pounds each at a total cost for feed of $5.29 each, the alfalfa hay being estimated, worth $8 per ton.

Twenty to 25 young sows were wintered each year for five consecutive years for periods ranging from November 10 to from March 14 to April 1 on chopped alfalfa hay and grain, and it was found that it required an average of 477 pounds of grain and 181 pounds of alfalfa per sow to produce 100 pounds of gain at a cost of $5.30 per 100 pounds.

The same bulletin on Pages 9, 10 and 11 shows that by an actual test with 18 old sows each winter for four winters it cost $2.11 each for feed enough (both alfalfa and grain) to produce a 50 pound pig on grain and alfalfa pasture when food for the sow from November 1 the fall before until the pigs reached a weigh of 50 pounds each was also taken into consideration.

Fig. 1. Hogs Pasturing on Alfalfa Near Strathmore.

Also that a test of the average cost of producing a 50 pound pig from 24 young sows each winter for five consecutive years, with corn at 47 cents per bushel, showed that the cost of the food for a 50-pound pig was $1.68, the cost of keeping the mothers from November 1 of the fall before till the pigs reached 50 pounds in weight being again considered as with the old sows. This same bulletin also gives the record of 1345 pigs fed during the summer on alfalfa pasture and various grain rations, with the following average results:

TABLE No. 4.

KIND OF FOOD.	Daily Gain Pounds	Grain Required Per 100 Lb. Gain.
Alfalfa pasture plus 2 lbs. grain per 100 lbs. of hog.....	.56	260
Alfalfa pasture plus 2.5 lbs. grain per 100 lbs. of hog....	.73	312
Alfalfa pasture plus 3.0 lbs. grain per 100 lbs. of hog....	.90	389

During the winter of 1913-1914, 7 lots of 10 pigs each were fed various grain rations with alfalfa hay in racks for 98 days in order to test the comparative value of the various feeds.

It was found that grinding the wheat increased its efficiency 21 per cent., or that 1 bushel of ground wheat made as much gain as 1.21 bushels of whole wheat; also that the ground wheat produced the fastest gains and that soaking the ground wheat increased its feeding efficiency about 4 per cent.

One bushel of ground wheat produced the same gain as 1.2 bushels of shelled corn.

One bushel of shelled corn produced slightly more gain than one bushel of whole wheat.

All were fed alfalfa hay in racks and with corn 47 cents, wheat 70 cents, rye 50 cents per bushel and hogs at $5.90 per hundred, the following results were secured ranking the feeds according to the gain and profit per pig.

TABLE No. 5.

RATION.	Cost Per 100 Lbs. Gain	Profit Per Pig
Shelled corn (dry)	$3.97	$2.11
Ground wheat (soaked)	4.84	1.46
Ground wheat (moistened)	5.00	1.21
Whole rye (soaked)	5.51	.34
Whole wheat (soaked)	5.92	loss
Whole wheat (dry)	5.99	loss

The above prices are somewhat under the normal Alberta prices for these products, but the following table in which the same results are tabulated in the order of the economy of gain and profit per pig with corn 65 cents, wheat 70 cents and rye 50 cents per bushel, and with hogs at $7.75 per hundred, is more nearly comparable with our normal conditions here.

TABLE No. 6.

RATION.	Cost of 100 Lbs. Gain	Profit Per Pig
Alfalfa hay in racks plus. Ground wheat (soaked)	$4.84	$4.02
Ground wheat (moistened)	4.99	3.70
Shelled corn (dry)	5.47	2.49
Whole rye (soaked)	5.50	1.97
Whole wheat (soaked)	5.92	1.91
Whole wheat (dry)	5.98	1.80

It will be noted in the above table in which the costs and values of products are more nearly comparable with Alberta conditions the ground wheat ranks ahead of all other feeds, both in low cost of gain and in profit made per animal. Grinding the wheat and soaking it as compared with feeding whole wheat soaked decreased the cost of 100 pounds of gain $1.08, increased the profit per pig $2.11, and raised the price received for one bushel of wheat 21 cents.

Missouri Agricultural Experiment Station Bulletin No. 110 gives the results of tests made by this station on the value of different pastures for pork production, with pork valued at both 6 cents and 8 cents per pound.

TABLE No. 7.

Summary of results of Missouri pasture tests with hogs.

KIND OF PASTURE.	Number Years Tested	Pounds of Pork Per Acre of Pasture	VALUE OF PORK PER ACRE OF PASTURE	
			Pork 6c Per Pound	Pork 8c Per Pound
Alfalfa	1	591.8	35.51	47.34
Clover	2	567.7	34.05	45.41
Rape, oats and clover	3	414.6	24.87	32.50
Rape	1	392.8	23.57	31.42
Corn	7	365	21.79	29.39
Blue grass	5	324.6	19.47	25.96
Cowpeas	5	152.7	9.16	12.22
Rye grain	5	211.7	12.70	16.93
Soy beans	4	117.6	7.05	9.40

The above table is based on actual tests and shows strikingly that alfalfa and clover pasture for hogs will produce remarkable returns, even with pork as low as 6 cents per pound.

Fig. 2. Pure Bred Duroc Jersey Sow Pasturing on Alfalfa.

On Page 301 of Kansas Experiment Station Bulletin No. 155, it is stated that in a test at that station some years ago a gain of 800 pounds of pork was made from a ton of alfalfa, and a little less tha' that amount of gain was made from an acre of alfalfa pasture. In another test an acre of alfalfa produced $20.20 worth of pork, while an acre of rape fed to a similar lot of hogs returned $10.05 worth of pork, also that in a later experiment 100 pounds of alfalfa hay saved 96 pounds of corn.

It is believed that a careful perusal and study of the above tahles and data that have been gathered from so many different and thoroughly reliable sources will throw much light upon the value of alfalfa as a hog feed, and that they will prove to anyone that there should be much profit in hogs in Alherta during normal years with a normal price for grain.

It will be noted and must be borne in mind, however, that although the experiments cited have demonstrated that alfalfa has more value as a pasture for hogs than any other forage and that good alfalfa hay gives excellent results as a part ration, alfalfa alone is not adapted as a ration for hogs. When, on account of shortage of grain, it is absolutely necessary to do so, full grown hogs may be carried for short periods or even wintered on nothing but alfalfa, but with such practice little or no gain can be expected.

In all cases cited where alfalfa has been fed with grain, the smaller the grain ration the less grain there has been required for 100 pounds of gain. The rate of gain, however, is always much slower than where larger amounts of grain have been fed, which indicates that the feeders will find on account of risk, interest on investment, markets or necessity for turning off hogs before bad weather sets in ,etc., that in many cases it will he more profitable to feed a larger grain ration along with the alfalfa in order to secure the more rapid gains.

Bulletin No. 146 of the Illinois Experiment Station on Page 138 quotes the results of a test made with 16 cows for the purpose of determining the relative values of alfalfa and timothy hay for milk production. The following table shows the results secured in tabular form for different values of milk:

TABLE No. 8.

Milk Per 100 Lbs.	Value of Alfalfa Per Ton Above Timothy	Value of Alfalfa Per Acre Above Timothy When Timothy is Worth $10 Per Ton. (Alfalfa 4 T. Per Acre; Timothy 1½ T. Per Acre.)
$1.00	$ 8.36	$58.44
1.10	9.19	61.7[illegible]
1.20	10.03	65.12
1.30	10.86	68.44
1.40	11.70	71.80
1.50	12.54	75.16
1.60	13.38	78.52
1.70	14.21	81.84
1.80	15.06	85.24
1.90	15.88	88.52
2.00	16.72	91.88

The conditions under which this experiment were carried out, and the yields and prices assigned to the products are quite similar to Southern Alberta conditions, and there is no reason to doubt but that approximately the same difference in the feeding values of the two crops would be found. The table is, of course, based on an actual test, and shows that when milk is worth $1.30 per hundred, an acre of alfalfa that yields 4 tons is worth $68.44 more for milk production than an acre of timothy is worth that produces 1½ tons per acre. This bulletin also stated that the alfalfa fed cows were in much better condition at the end of the experiment than were the timothy fed cows.

Wyoming Experiment Station Bulletin No. 85 on Page 8 states that in a feeding experiment with lambs during the winter of 1909-10 it was found that 20 per cent. less hay or 30 per cent. less grain was required per hundred pounds gain where alfalfa replaced native hay in the ration.

Bulletin No. 152 of the New Hampshire Experiment Station states that in a sheep feeding test each 100 pounds of gain cost $7.66 with a ration of grain, turnips and clover hay, while the cost with native hay turnips and grain was $12.40 per hundred. The feeds in this experiment were worth: Clover, $18 per ton; native hay, $20; corn, $1.40 per hundred weight, and oats 54 cents per bushel. This test again shows the value of leguminous hay over native hay. The author of the bulletin states on Page 14 that

alfalfa would be preferable to clover if the same could be secured at a reasonable price. It will be noted that the clover was worth fully twice, if not three times as much in the above experiment as it could be produced for in Alberta.

Indiana Experiment Station Bulletin No. 162 on Page 681 gives the costs of fattening lambs on shelled corn and timothy, and shelled corn and clover, where clover hay was valued at $15 per ton, timothy $18 per ton and corn from 56 cents to 63 cents per bushel. The results of the test showed the cost per hundred pounds of gain to be $8.86 for the timothy and $6.48 for the clover, a saving of $2.38 per nundred by using clover instead of timothy. It will again be noted that the values given for the hay are fully twice those of the same crops in this locality.

Henry and Morrison's well-known text book on "Feeds and Feeding," page 314, states that alfalfa hay furnishes the sole roughage for horses upon tens of thousands of farms and ranches in the West, but that for best results not over 1.2 pounds per day per 100 pounds live weight should be fed.

Wyoming Bulletin No. 98, on Page 4, states that in a horse feeding test of 6 horses for 10 months, the horses showed a total gain of 203 pounds while fed on alfalfa, while during an equal period on native hay there was a total loss of 84 pounds.

Kansas Bulletin No. 155, on Page 302, states that alfalfa will not only pasture more horses per acre, but it will produce horses of greater weight, larger bones and stronger muscles than any other grass.

On Page 441 of the Report of the Dominion Experiment Farms of Canada for 1914 under the Division of Animal Husbandry, is given a table showing an average of the results secured from a three-year lamb feeding experiment, where it is stated that if cost price is charged for the feeds which supplemented the alfalfa hay rations and all cost of labor is omitted, thus crediting all of the profit to the alfalfa hay, the average price received for all hay for all three years and would have been $19.49 per ton.

Nebraska Experiment Station Bulletin No. 93, a bulletin devoted to steer feeding experiments states on Page 23 that "alfalfa hay is pronouncedly superior to prairie hay for beef production and the more rapid the extension of the area of land devoted to the production of alfalfa supplanting the less valuable and lower yielding native hay, the more rapid will be the production of wealth from our soil."

Henry and Morrison in discussing steer feeding state on Page 466 of their last work on Feeds and Feeding "that on account of their richness in protein and also because of their palatability, the legume hays are the most valuable of dry roughages and that even when a ration of corn and such carbonaceous roughages as timothy hay, prairie hay, or corn fodder is properly supplemented by linseed or cottonseed meal or some other protein-rich concentrate, smaller gains will nearly always be produced than when the ration consists of corn and legume hay." Also on Page 467 that "only when silage, appetizing as well as nutritious, is fed is it possible to provide a ration which will be equal to one where the roughage is legume hay."

The following table showing the results from an experiment at North Platte, Nebraska, with three lots of 20 steers each, is given on Page 467 of Henry and Morrison's Feeds and Feeding, the concentrate consisting of two parts corn and one part oats.

AVERAGE DAILY ROUGHAGE ALLOWANCE	Average Daily Gain Lbs.	FEED FOR 100 LBS. GAIN	
		Concentrates	Roughage
Lot 1, alfalfa hay, 12.3 lbs.....	1.2	162	1000
Lot 4, prairie hay, 10.9 lbs.....	0.7	305	1676
Lot 5, alfalfa hay, 7.5 lbs., prairie hay, 7.5 lbs	1.1	174	1315

The foregoing discussions and citations concerning the feeding value of alfalfa for beef and dairy cattle, as well as for sheep, hogs and horses, selected from and based on actual experiments in New Hampshire, Illinois, Missouri, Kansas, Nebraska, Colorado, Idaho, Wyoming, Indiana and Alberta, cover a wide range of conditions and are almost universal in their praise of the feeding value of alfalfa. There are many other references and citations that might well be given, all illustrating the wonderful feeding value of this plant for practically all classes of farm live stock, but it is believed that sufficient have been given and that they cover wide enough diversity of conditions (both humid and arid climates) to demonstrate to any one the great feeding value of this plant.

VALUE OF ALFALFA AS A FERTILIZER

Although alfalfa, as has been pointed out, has more feeding value than any other forage crop we can produce, its production has many other advantages for the grower. Its importance as a fertilizer or soil rejuvenator is second only to that of its feeding value.

In order to produce profitable and maximum crops year after year one needs to give thought to the maintenance of the fertility of the soil. It should be remembered that there are about ten essential elements of plant food, each of which is of equal importance to the crops grown, for if plants are deprived of any one of these ten essential elements it is impossible for them to develop and mature. Carbon has no market value as plant food, because the plant obtains carbon in the form of carbon dioxide, a gas which is present everywhere in the atmosphere, and which the plant inhales through its leaves. One need not concern himself about either hydrogen or oxygen, as they are the elements which comprise water, a liquid compound which plants absorb through their roots. The same holds true with calcium, magnesium, iron and sulphur, because they are present in practically all soils in abundance as compared with the amounts required in plant growth. The three elements, nitrogen, phosphorous, and potassium, however, are present in most soils in rather limited amounts, and are of extreme importance, for they are required by plants in very considerable quantities. Whenever the available supply of either nitrogen, phosphorous or potassium becomes too much reduced in a soil the yield of the crops is inevitably very much reduced also. Western soils of the arid and semi-arid belt, however, as they have never been leeched by the rains of centuries as have the humid soils are more liable to contain a sufficient supply of both potassium and phosphorous, the nitrogen being the only highly important element in which they are liable to be deficient.

Nitrogen being the chief element, the maintenance of which concerns the farmer on both arid and semi-arid soils, it is considered that the farmer who can produce good yields of alfalfa is indeed fortunate, for he not only secures the profits from the feeding of the crop, but, in addition, maintains and even increases the nitrogen content and fertility of his soil so as to be enabled to produce far larger crops after plowing up the alfalfa than he is able to produce on adjoining lands where the alfalfa or other legumes have not been grown.

Alfalfa adds to the fertility of the soil and increases crop production in two different ways: (1) the decay of the multitude of thick, fleshy alfalfa roots, which have penetrated deeply into the soil improves both the nitrogen content of the soil and its mechanical condition as well, and (2) the nitrifying bacteria which have been actively at work during the life of the alfalfa have taken an immense amount of nitrogen from the soil air, and have worked it over into nitrates and stored it in the soil as such, in which form it is readily available as plant food for the crops that follow.

The foregoing discussion of plant food and soil fertility clearly indicates the reason for the beneficial effect of alfalfa on arid and semi-arid soils, and while fewer actual tests of this factor have been made than of the feeding value of the crop, there are sufficient on record to demonstrate the great fertilizing value of the plant.

United States Department of Agriculture Bulletin No. 339, on Page 32, statea that alfalfa increased the yield of Irrigated crops in Wyoming at the following rates: Potatoes, $16 per acre; oats, $16 per acre, and wheat, $8 to $12 per acre.

United States Department of Agriculture, Farmers Bulletin No. 215, on Page 28, states that In sugar-beet growing districts the effect of alfalfa has been shown by increased yields for four years.

Bulletin No. 44 of the Wyoming Experiment Station, states that oats gave an increased yield of 48 per cent. and wheat an increase of 60 per cent. on alfalfa sod, over the yield on other similar land.

Bulletin No. 78 of the Idaho Experiment Station, on Page 26, shows that barley produced 84.87 bushels per acre on alfalfa sod as against 33.02 bushels per acre on raw, unfertilized soil adjoining.

Fig. 3. Six Year Old Alfalfa Roots from Strathmore.

(Showing the development of the root and crown which illustrates the strength, vitality, long life and yielding capacity, as well as fertilizing value of alfalfa as grown in Southern Alberta.)

The Twin Falls (Idaho) Experiment Station during 1915 produced 87.3 bushels of barley per acre on red clover sod, as against 37.8 on land that had never been in either clover or alfalfa, showing a gain by reason of the clover sod of 130.9 per cent. The same year the yield of oats on the same station was increased from 53.5 to 92.8 bushels per acre on alfalfa sod, though the land had been planted to alfalfa for only eight months during 1914.

The above are in reality only a few of the results that might be tabulated to show the wonderful increase in yields of other crops that are made by the plowing under of alfalfa sod. The concensus of opinion seems to be that the greatest good is only secured after the alfalfa has been planted three or four years, and then only provided the alfalfa has been well inoculated, and with a good thick uniform stand.

Southern Alberta is certainly pre-eminently a live stock country, and as alfalfa is surely pre-eminently adapted to the feeding of this stock, it is believed that if more farmers could only realize and appreciate the great value of alfalfa, both for the feeding of live stock and from its beneficial effect on the soil, the acreage of this valuable crop in the Province would be very much increased during the next few years. The growing

of this crop, together with pasture and other hay grasses, provided they can be fed on the farm is surely less hazardous than even grain growing on summer-fallow or any other profitable type of agriculture that can be engaged in, for there is less danger from frost, hail and rain, as well as from hard times, fluctuating prices, or depleted soil fertility and the consequent low yields.

HOW TO PLANT, GROW AND CARE FOR ALFALFA

TYPE OF SOIL REQUIRED

Alfalfa will grow and do well on a very large variety of soils. It, however, has its preference, and usually does better on the lighter soils, consisting of the sandy, sandy loam and clay loam. Even in districts having the heavier soils most farms contain one or more classes of soil, and in such cases the alfalfa should be planted on the lighter or more sandy soil. One should not hesitate, however, to plant alfalfa even though his farm consisted of all heavy soil. The one thing that alfalfa will not stand is wet, soggy soil. Though it requires considerable precipitation or irrigation water throughout the season it prefers a well drained soil. If those desirous of planting alfalfa on heavy soils will select the higher and better drained portions of their farm for this crop, but little difficulty will usually be experienced. Never plant alfalfa in the bottom of a depression that does not have surface drainage.

Fig. 4. Irrigated Alfalfa on Government Experimental Plots, Strathmore.

ALFALFA ON DRY LAND.

The yield of alfalfa is always largely dependent on the amount of moisture available. Provided the season is warm enough the yield usually increases within reasonable limits as the available supply of moisture is increased. Alfalfa is pre-eminently adapted as an irrigated crop for this reason. It can, however, be produced successfully in the more humid portions of Alberta and the adjoining provinces without irrigation, but the yield produced will be very largely dependant upon the amount of moisture available. On account of its great feeding value and its remarkable ability to replace nitrogen and humus in the soil it is probable that the dry farmers will find that its production is profitable even when a yield of only 1 to 1½ tons can be produced, and it is, therefore, believed that at least a small area should be devoted to it wherever land suitable for its production can be found, even if it is not possible to provide irrigation for the crop. It will be found, however, that the crop will

almost invariably respond to and pay good returns upon the time and expense involved in its irrigation wherever such is possible.

The same care should be used in the planting and inoculating and the same methods of curing, etc., should obtain as with the irrigated alfalfa.

PREPARATION OF GROUND FOR IRRIGATION.

There are two types of irrigation systems adapted to alfalfa in this and the adjoining provinces, namely: free flooding and flooding between borders, though the furrow or corrugation system might be used to some advantage in certain districts. Free flooding consists of flooding water between more or less parallel head ditches, spaced from 50 to 200 feet apart. With this system, as with all others, if efficient irrigation is desired, all knolls and depressions must be removed so that water can be run uninterruptedly without pooling up from one head ditch to the next one below it. The larger knolls and depressions should first be smoothed off with a fresno scraper, as this tool, where the haul is short will move dirt quicker and cheaper than any other implement in common use. After the larger knolls and depressions have been smoothed off with the scraper, a rectangular leveller should be run over the ground, both lengthwise and crosswise of the field. This type of a leveller is well illustrated in Figs. 6 and 7, and should be used on every farm, for there is no better or cheaper method of levelling

Fig. 5. Levelling Down Larger Knolls With Fresno Scraper.

down the smaller irregularities than by the use of this tool. The best farmers in all of the older irrigated districts invariably run this type of leveller over their land at least once and sometimes twice before planting each and every crop, for they well realize that no farm can be too evenly graded for irrigation and that no tool will remove the smaller irregularities so cheaply and efficienly as the rectangular or float leveller.

The head ditches with free flooding the same as with practically all other systems should be .un on a rather flat uniform grade of from 0.1 to 0.3 foot fall per 100 feet. This grade will ensure sufficient fall to give the ditches ample capacity, but will not give enough velocity to cause scouring and consequent trouble. Where these ditches have too much fall and velocity, irrigation is rendered difficult, as the canvas dams are not only easily washed out, but the cuts that are made here and there in the ditch banks give far more trouble than where flatter grades are used. The above applies more especially to the "head" or "feed" ditches, the main farm lateral or distributary supplying water to the various head ditches may have as much grade as the nature of the

soil will stand without undue erosion. It must be borne in mind that all ditches should be built good and strong and of ample capacity and that the flatter the grade the larger the cross section of the ditch must be.

The head ditches should be installed more or less parallel to one another, the proper distance between them depending somewhat upon the topography and nature of

Fig. 6. Rectangular Leveller for Smoothing Smaller Irregularities.

the soil. From 50 to 200 feet apart has been found to be the proper spacing for this section. The more porous the soil and the flatter the slope the closer should be the spacing of the ditches.

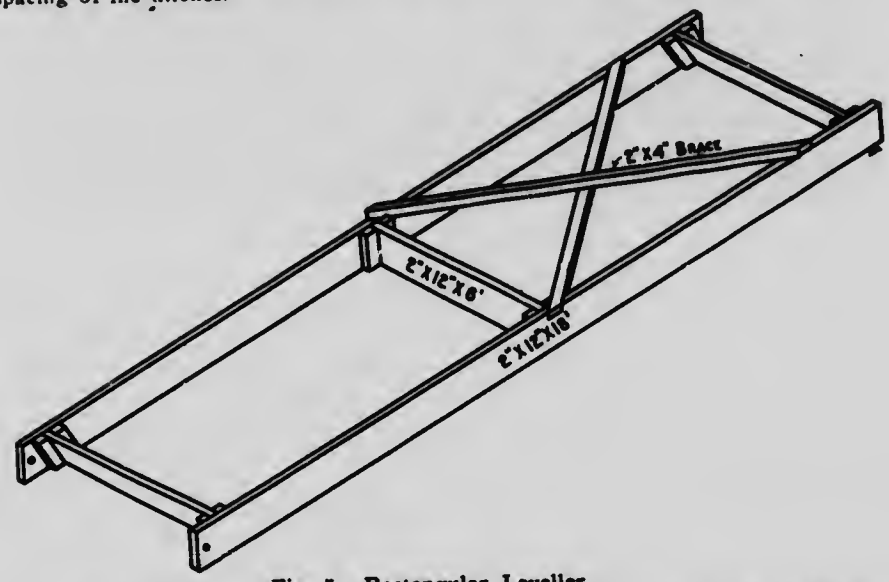


Fig. 7. Rectangular Leveller.

(This type of leveller should be run over every field in preparing it for irrigation, no matter how smooth it seems, for it will cut off and smooth over many small irregularities that are not even perceptible to the eye.)

The irrigation should be begun at the upper end of the field, one ditch being used at a time, the water being dammed up at frequent intervals by canvas dams and turned out into the field through notches cut with the shovel in the lower ditch bank by the irrigator. If the levelling has been carefully done and the irrigator gives the water careful attention, very efficient irrigation can be accomplished by this system. There should not be much waste water, but whatever water is wasted should be caught up in the next ditch below and used for the irrigation of the next strip. In order to prevent chance runs of water from flooding the road or a neighbor's field, a substantial waste ditch should be constructed across the lower end of the field. This should lead to some drainage channel or to some small reservoir.

FLOODING BETWEEN BORDERS.

This system is probably best adapted for alfalfa on practically all of the various types of soil found in Alberta. So far as topography is concerned, it can be used on all but the steeper grades, slopes, equivalent to approximately 150 feet per mile being the maximum slope with which it should be used for alfalfa. The head ditches with this system are constructed in about the same manner and about the same or a little greater distance apart as with the free flooding system.

Fig. 8. "A" or "V" Ditcher (for conatructing field ditches).

The only essential difference between this system and the free flooding system is that more or less parallel border guiding dykes are constructed 30 to 60 feet apart between the head ditches and more or less at right angles to them. The smaller the head of water that is to be used, the rougher the land, and the flatter the general slope, the closer should be the spacing of the border dykes.

The water is checked up in the ditch with canvas dams as before, and is flooded between the border guiding dykes to the next head ditch below, the dykes guiding and controlling the water in a much more efficient manner than with the free flooding, where the water is unconfined, and requires careful attention from the irrigator. To be ideally laid out for irrigation by this system the side fall should be taken out of each strip; in other words it should be made approximately level crosswise throughout its length. In actual practice the side fall is seldom all eliminated, but the more nearly this is accomplished the easier it will be to secure an even distribution of the irrigation water which is so necessary if the best results are to be obtained. It is, however, not necessary to make the lenghtwise slope uniform, it simply being necessary, the same as

with the free flooding system to smooth off the knolls and depressions sufficiently so that the water will run uninterruptedly from one head ditch to the next one below. In actual practice where the land is not too steep, these parallel border guiding dykes usually run down the greatest slope, for this is the direction the water will naturally run with the least attention. There will also be less side fall in each strip than as if the border dykes angled down the slope. These dykes are usually constructed at the time the levelling is done, the dirt being deposited on the location of the dykes by the fresno. Where but little fresno work is necessary the dykes are made by plowing a back furrow consisting of two or four furrows on the proposed location of each dyke. The dykes are afterwards gone over by a ridger, which is run lengthwise of the back furrow.

Fig. 9. Ridger for Making Border Dykes.

This ridger consists essentially of two 2x12 planks, 16 to 18 feet long, placed on edge with a spread in front of from 12 to 14 feet, and only approximately 3 feet behind. The wide end is pulled ahead, thus gathering a shallow layer of dirt from quite a wide area on each side of the backfurrow, the dirt being pulled against the side of the back furrow by the sloping sides of the ridger. These ridges are afterwards smoothed down and rounded over by harrowing them lightly, the alfalfa being planted across the top of the ridges in the same way and at the same rate as between. If the ridges are constructed in this manner they will be high enough to control the water, yet broad and low enough so that alfalfa will grow on the tops of them and the wagons and hay tools can cross them with no inconvenience whatever.

Fig. 10. The Right and Wrong Way to Build Border Dykes.

The ridges when completed should be from 6 to 9 inches high in the centre and from 2 to 3 feet broad at the base. In practice the water is turned into the head of each

strip at two or more places and spreads quite uniformly between the two guiding dykes, as it advances across the strip. The irrigator should cut it off and turn it into the next strip below as soon as the water has advanced far enough so that the quantity in the strip will advance to the lower end and thereby thoroughly irrigate the bottom portion. This system is a very efficient one for not only alfalfa, but all other grasses, and provided the ground is properly prepared for it at the start, it will be found that the water will actually require less attention and that more acres can be irrigated in a day with less water and less work than by means of any other system.

From statistics collected on the Lethbridge project it has been found that the average amount applied per application to the different crops in that locality is approximately 0.75 acre feet per acre. This amount of application is in reality more than should be applied at any one time. With the border system well laid out it will be found that these same soils may be evenly irrigated with much less water per application, say from six acre inches to as low as three acre inches per application. The average irrigation head that has and will be used in this section is approximately two second feet, which will deliver a sufficient quantity in 24 hours to cover four acres one foot in depth or four acre feet. Hence it will be seen that with the border system it will be possible to irrigate eight acres each 24 hours with a six inch application or 16 acres with a three inch application.

PREPARATION OF SEED BED.

The preparation of a proper seed bed for alfalfa is very important. Alfalfa has a small seed, and the plant for the first two or three months is rather weak and puny. It, therefore, requires a rather firm, well cultivated seed bed in order that each seed can come into intimate contact with the adjacent soil grains. A good stand cannot be secured if the alfalfa seed is planted in rough, cloddy ground. Alfalfa plants are quite spindling and grow so slow during the first two or three months of their growth that the weeds in a very weedy field will sometimes either partially or entirely crowd out the alfalfa. It is, therefore, best to plant alfalfa on a tract of land that is as free from weeds as possible. Land that has been summer-fallowed the previous year, or that has produced potatoes or other rowed crops is best adapted for alfalfa, as it will be the freest from weeds. Grain land that is fairly free from weeds is also well adapted for alfalfa, provided it has been in cultivation long enough to disintegrate the sod. Do not plant alfalfa on new breaking, as the prairie and other grasses will not permit the alfalfa to secure a quick start.

INOCULATION.

As has been mentioned earlier, alfalfa has the power of supplying nitrogen to the soil, and it is a good thing that nature provided the plant with this power, for if it did not have it there would be but few soils sufficiently rich in nitrogen to grow the crop for any length of time. This same thing would probably hold true to a somewhat lesser extent with the other leguminous crops, for they all contain a large amount of nitrogen or protein. They therefore must be able to secure a large amount of it from the soil. The manner in which alfalfa and the other legumes supply nitrogen to the soil is through the bacteria, which live in and upon their roots. These bacteria are not originally present in all soils, for these particular bacteria cannot live indefinitely without legumes, nor can the legumes live for any length of time without the bacteria, the principal reason being that the legume is such a greedy feeder upon nitrogen that unless the basteria are present, it soon exhausts the available nitrogen in almost any soil. While all legumes harbor basteria of much the same nature, it has been found that there are certain kinds that prefer each particular leguminous plant. This is probably due to the fact that these particular basteria have adapted themselves to this plant.

These bacteria are so small that they can scarcely be seen with a microscope of the highest power, and it is consequently somewhat difficult to study them. It is believed that they are absorbed by the minute root hairs along with the water, and that after

being absorbed, irritate the roots to such an extent that plant juices are automatically thrown out at the spot, thus forming the little appendages called nodules in which the bacteria live. These nodules vary with alfalfa from small whitish lobes the size of a pin head to clusters of these lobes one-half inch in diameter arranged somewhat like a bunch of grapes.

Nodules on Alfalfa Roots
(Note size, shape and arrangement)

These bacteria, after becoming domiciled in the nodules attached to the roots multiply at an extremely rapid rate and are able to absorb the free nitrogen found in the air spaces of the soil and to work it over into nitrates, a definite chemical compound and a plant food of the highest value, in which shape the alfalfa itself or any other plant can utilize it. These bacteria, therefore, are very essential to alfalfa, no matter where it is grown. In the soils of certain districts throughout the West it seems there are enough of these alfalfa bacteria, or other bacteria of a similar nature that can readily adapt themselves to the alfalfa plant, so that their multiplication is sufficiently rapid after the alfalfa is planted to take care of the plants needs for nitrogen, in which case it is unnecessary to inoculate the alfalfa at the time of planting. Such is not the case here, however, though the continued planting of alfalfa on our irrigation projects may in time develop enough of these bacteria so they will become so widely scattered throughout the soil that it will be found unnecessary to supply them artificially.

The best method found to date of supplying these bacteria to our alfalfa fields is to secure surface soil to a depth of 9 or 12 inches from an old, well established alfalfa field that has become well inoculated, and to scatter this soil evenly at the rate of from 200 to 400 pounds per acre upon the field after it has been prepared for alfalfa and immediately before seeding. Failure to do this and to take the proper precautions after it has been done has probably been the cause of a greater number of failures with alfalfa in Alberta and the adjoining Provinces than all other causes taken together. These bacteria can stand very low temperatures, even 30 to 50 degrees below zero will not kill them, but either bright sunlight for a few moments or a continued temperature for a few hours of 100 or more degrees Fahrenheit will kill them very readily. It is, therefore,

very necessary to secure the original soil in a fresh condition, to keep it in a comparatively cool place free from sunlight and to spread it promptly and evenly upon the field to be planted, after which it should be immediately harrowed in, so as to cover the bacteria deep enough and quick enough so that they cannot be killed by sunlight. If these precautions are taken but little trouble will be experienced with the soil transfer method of inoculation. Care should be used to secure soil as free from weeds as possible, but do not leave it in piles and let the chickens scratch through it for weeks and thoroughly expose every particle of it to the sunlight and still expect results.

There is one other method of inoculation that is coming into quite general use. This is inocu' tion with pure cultures.

The various provincial or state agricultural departments usually are prepared to furnish these cultures, either free of charge or at a nominal cost to residents of their districts. They are also put up and sold by various laboratories throughout the country, being delivered to the consumer in small bottles, each bottle containing millions of the proper kind of bacteria. The directions for using these cultures differ slightly, but should be strictly followed. They usually state that the contents of the bottle should be emptied into a gallon of water that has previously been boiled and cooled so as to kill all other and possibly harmful bacteria, to which is added a little sugar or beef broth, after which the mixture is placed for 48 hours in a moderately warm place to enable the bacteria to grow and multiply, about the same as a housewife sets her yeast. After these bacteria have been developed a little more water is added, after which the alfalfa seed itself is thoroughly sprinkled with the solution containing the bacteria. The seeds are then thoroughly mixed so as to become uniformly moistened with the solution, after which they are allowed to dry in a moderately cool, dark place, after which they should be immediately planted. If the culture is good when secured and directions are strictly followed out a sufficient number of bacteria are usually attached to the alfalfa seed to thoroughly inoculate the whole field. After the small plants start to grow the bacteria are absorbed by the roots and the process previously described is carried out. The bacteria not only furnish sufficient nitrogen in an available form for the growth of the plant, but an excess supply for the crops which follow, after the alfalfa is plowed up.

The soil transfer method of inoculation, where soil free from weeds can be secured, is, however, probably the cheapest, surest and best method for the farmers of this section, and if directions are carefully carried out there will be but few failures. The principal precautions that are necessary are (1) to procure fresh soil from a field that you are sure is well inoculated, (2) to apply it immediately, and (3) to harrow it in without delay.

When alfalfa is well inoculated it will be noticed that the plants are vigorous and of a dark green color, while the plants not inoculated are liable to be spindling and of a light or yellowish green color. The lack of inoculation, however, should be determined by a careful examination of the roots for nodules, as too much soil moisture also causes alfalfa to be light or yellowish green in color. The inoculation frequently takes well on only a portion of the field. If these spots are well scattered over the field they will probably spread over the entire field during the second year. If they show up only on part of the field it would be well the second spring to put more inoculated soil on that portion about the time the plant starts to grow, and to disc it in lightly at once. Irrigation water spreads the inoculation much better than rainfall, as some of the bacteria seem to be carried in suspension in the water. Some have inoculated their fields by spreading a strip of inoculated dirt below the ditch and irrigating immediately, the water carrying sufficient bacteria from this dirt to inoculate the field. This method is not recommended, however, except during the second year, and then only in cases where the inoculation has not become well established from the original inoculation.

TIME OF PLANTING.

A study of the rainfall records of that part of Alberta lying between Calgary and Medicine Hat shows that there is usually sufficient rain during May and June to start

alfalfa and these are the best months to start it, not only because of the rainfall, but as the plants are not particularly hardy until they attain a height of at least six inches, it is desirable to secure as much growth as possible before winter sets in. Alfalfa, therefore, should not be planted late in the season, probably not later than July 15, the latter half of May and the month of June being undoubtedly the best time. It is considered of considerable advantage to have rainfall enough to start the alfalfa, for the seeds are so small that if one was compelled to irrigate freshly harrowed soil to start the seeds, some of them would be bound to be washed away. This section is especially fortunate in this regard, for in many alfalfa growing districts it is neeessary to irrigate the seed up.

VARIETY OF SEED.

Though the original home of alfalfa centuries ago was in Asia in a climate more like that of California than that of Alberta, it has since spread to the far corners of the globe and it is now raised to a greater or lesser extent in practically every country under the sun. This shows the wonderful adaptibility of the plant. There are said to be between 50 and 100 species of alfalfa but not over six of these have ever become of much economic importance and these are all much alike in appearance. The chief difference between the many strains now grown in America is in their hardiness or ability to resists cold winters. The extra hardiness of some strains has been brought about by the severity of the winters under which they have been grown. The longer the plant has been grown under rigorous conditions the more hardy it becomes, for the less hardy plants gradually kill out leaving the seed to be borne by those that have proven themselves to be the most hardy.

The two best strains for Alberta are undoubtedly Grimm and Turkestan, for these have both been grown under climatic conditions similar to those obtaining in this Province for many years. Both of these strains have done well here, and should be recommended for planting, although almost any northern grown Montana seed should give good results, provided it has been produced from stock that has been grown under rigorous conditions for some years. No matter what variety of seed is used one should be sure that it has been grown in a region of cold winters for a considerable time, that it is of good vitality and free from weeds.

RATE OF SEEDING.

Alfalfa seeds are quite small but usually have very good vitality. It has been found by actual count that if 10 pounds of seed are scattered uniformly over an acre, 52 seeds would be placed upon each and every square foot. As it is indeed a poor farmer who cannot make at least half the seeds planted grow, it can be seen that planting at the rate of 20 pounds per acre is unnecessary, for this would place 104 seeds upon every square foot or nearly one to each square inch. From carefully conducted experiments on a government experiment station in South Idaho, where all conditions were ideal, including a very fine seed bed, it was found there was no difference in the yield during a three-year period from alfalfa seeded at the rate of 4, 8, 12, 16 or 20 pounds per acre. It is not possible nor practicable, however, for the farmer to manufacture such a good seed bed upon large areas as was secured on this government experiment station, and it is, therefore, recommended that from 12 to 20 pounds, and no more, of good alfalfa seed be planted. It should be borne in mind that a careful preparation of the seedbed pays good returns on the investment, for the better the preparation the less will be the amount of seed required. Do not make the mistake of planting too deep. Alfalfa seed is small and cannot, like peas, wheat or potatoes, come up through three or four inches of soil. During fairly moist weather one-half inch in depth is sufficient, while in dryer weather from one to one and one-half inches would be somewhat better. If alfalfa is planted on stubble ground during or after a dry spring it is always advisable to irrigate the ground before planting the crop. In any case do not plant alfalfa deeper than one and one-half inches. It does not matter much whether alfalfa be planted in drills or whether it be

sown broadcast as long as the proper distribution and depth of planting is secured. In planting it broadcast on top of well-prepared ground, a fairly light harrowing after seeding usually places most of the seeds at about the right depth. Drilling the seed is probably preferable in this section, for if careful attention is given to the drill all of the seeds may be placed at the proper depth. It is well to bear in mind the fact that the better the seed-bed is prepared, the freer it is from weeds, and the more favorable the moisture conditions the less seed there will be required per acre. Too much emphasis cannot be placed upon the necessity for a thorough preparation of the seed-bed.

NURSE CROP.

There is no question but that a better stand of hardier alfalfa will be secured if it is planted without a nurse crop. Alfalfa prefers lots of sun, which cannot be secured when it is planted with oats, wheat or barley. There is no possible advantage in planting a nurse crop with alfalfa, except that a year's use of the ground is not lost. Considering the extra hardiness of the plant and the thicker stand that is secured without a nurse crop, however, it is hardly probable that it will pay in the long run to plant alfalfa with a nurse crop.

If alfalfa is intended as hay for either hogs or cattle or a pasture for hogs, it is preferable to plant it alone. It is, however, much improved as a horse hay, both in yield and feeding value if some other grass is planted with it. A grass to form the best mixture with alfalfa should do well in the shade, mature at about the same time as the alfalfa and be comparatively rich in carbo-hydrates, instead of protein, in order to form a more nearly balanced ration. The very best grass that can be planted with alfalfa to accomplish this purpose is orchard grass. It is perfectly hardy in this climate, it does well in the shade, matures more nearly at the same time as the alfalfa than any other grass, is relished by stock, and has a good feeding value. Liverymen that have once fed this type of hay to their horses will pay from $1 to $2 more for it than for straight alfalfa. Where orchard grass will grow and do as well as it does here, never plant timothy as a mixture with alfalfa. Eight pounds of orchard grass and ten pounds of alfalfa seed per acre should be planted, the inoculation being applied in the same manner as if the alfalfa were planted alone.

IRRIGATION OF ALFALFA.

The irrigation of alfalfa or any other plant is easy and simple, providing the land is sufficiently level and properly prepared at the outset. (See "Preparation of Ground for Irrigation" and "Flooding Between Borders.") Too much emphasis can hardly be placed upon the preparation of the land for the irrigation of alfalfa. Water cannot be run up hill and it is absolutely imperative, if good success is to be obtained with alfalfa, that all knolls and hollows be so levelled down at the outset before the alfalfa is planted that the water can be made to run uninterruptedly from one head ditch to the next one below it. There is much more reason for careful levelling of the land before planting alfalfa, pasture, or other permanent crops, than there is with grain, for the same trouble will be experienced with every little hill and hollow every time the alfalfa is irrigated every year, while where grain is planted there is an additional opportunity of doing more levelling on the land each spring.

WHEN TO IRRIGATE ALFALFA.

Careful experiments have been made during the last few years to determine at what stage of growth alfalfa needs irrigation, and it has been found that it needs a practically constant uniform supply of moisture throughout the season.

This condition can only be brought about where irrigation is possible, yet, owing to the variation in the precipitation of this section, no hard and fast rule can be laid down, either as to the number of irrigations required or the stage of growth at which they should be applied. Much will depend on the type of soil and the amount of rainfall received during the season. Every irrigator should learn to study the needs

of his own particular soil and crops, and then apply his irrigation water at .ch times and in such amounts as will maintain the necessary constant uniform moisture supply in the soil. Alfalfa should never be allowed to become too dry, and above all, water should never be allowed to stand on it during irrigation for over 12 hours at a time. Neither should it go into winter quarters in a very wet, muddy condition, as winter killing may result. During normal years in this section alfalfa will probably require from two to three irrigations during the season.

AMOUNT OF WATER REQUIRED.

Alfalfa is a gross feeder, and grows luxuriantly throughout the season, there being a large amount of leaf surface exposed to the sun and wind from which an unusual amount of transpiration takes place. Alfalfa, therefore, requires considerably more water than almost any other crop we can produce, all other conditions being uniform. A long series of careful, exhaustive experiments were conducted by the writer for the United States government for the purpose of determining the water requirements of alfalfa, and these experiments demonstrated that where all other conditions are similar alfalfa

Fig. 11. Flooding Alfalfa at Strathmore, 1915.

requires twice as much irrigation water during a season as grain. Where grain does best with one acre foot per acre, alfalfa requires two acre feet, and where grain requires one and one-half acre feet, alfalfa requires three acre feet, and has a tendency to produce the most crop where the most water is supplied, though care must be taken not to over-saturate or waterlog the soil, for alfalfa will not stand "wet feet."

GENERAL TREATMENT FIRST AND SUCCEEDING YEARS.

After planting alfalfa there is nothing to be done with it until it has reached a height of from 6 to 10 inches, except to see that it has the proper supply of moisture. At from 6 to 10 inches in height, no matter whether the field is weedy or not, it should be clipped, in order to strengthen the crowns and thicken up the growth. If the season has been favorable enough and the initial planting early enough there may yet be time to secure one crop during that season, though in the majority of cases even in much milder climates no crop at all is expected the first year. Mr. H. Lausen, of Carsland, during the season of 1915, secured about as large a yield from alfalfa for the first season is ever seen, even in the mild climates of Colorado, Utah or Idaho. Mr. Lausen planted two acres during the latter part of May, 1915, and in August harvested one and

one-third tons of cured hay per acre. This is really phenomenal. If the initial planting of alfalfa has been done so late in the season that clipping when it has reached from 6 to 10 inches in height will force it to go into winter quarters with less than four inches of growth, it should not be clipped at all, for alfalfa, in order to be able to withstand the winter in the best possible shape, should have some amount of growth at the time the ground freezes up. This holds particularly true for the first season. In the subsequent years alfalfa requires no unusual treatment, except that care must be used that it has a proper supply of moisture, that water does not stand upon it, and that the crops are cut and cured properly.

DISCING ALFALFA.

The tramping of stock, the passage of wagons and harvesting machinery, and the action of the irrigation water causes the surface of the soil on alfalfa fields to become very compact after a few years of cropping, consequently alfalfa needs cultivation fully as much as many other crops. Discing and loosening up of the surface each spring, after about the third year, has been found to be very beneficial in many localities, particularly if the soil is heavy and weeds or grass has a tendency to creep in. This should be done after the frost is out and about the time the alfalfa starts growth, and only when the surface soil is comparatively dry. Under these conditions discing every spring will be advised here. If done at this time one need not be afraid of killing off or thinning out the alfalfa, provided too much slant is not given to the discs. The discing, in fact, has a tendency to thicken up the stand by splitting the crowns, and at the same time kills out the more shallow rooted grasses. Cultivation is not usually advised, however, until the second spring, at which time the alfalfa is well able to withstand it.

Fig. 12. Cutting and Curing Alfalfa in the Crowfoot District Near Strathmore.

The severity of the discing in any case should he gauged by the compactness of the soil, the number of weeds present and more particularly by the strength and hardiness of the alfalfa. Other tools, such as the spring tooth or spike tooth harrows and various specially designed alfalfa renovators are frequently used with good results for the cultivation of alfalfa.

TIME TO CUT.

Alfalfa is pre-eminently adapted as a hay crop, for no other forage recuperates so quickly after cutting. Parts of Southern Arizona and the Imperial Valley, California,

which are easily the hottest portions of the United States, cut alfalfa as often as nine times a year. In order to secure the largest possible crop of the highest possible feeding value, alfalfa must be cut at the proper stage. This is at the time that the little basal shoots or the sprouts of the next crop start, which is usually when the crop is about one-tenth in bloom. If the crop is left until one-half or in full bloom these basal shoots will have grown so long that the mower will clip their tops, thus retarding the following crop, while, if it is cut at the proper time, just as the basal shoots start up around the crowns near the ground the next crop will come on and begin growth immediately, provided the necessary amount of moisture is available in the soil at the time.

CURING ALFALFA.

In order to secure the best appearing alfalfa hay of the highest possible feeding value, and a product that will always command the highest market price, alfalfa hay must not only be cut at the proper stage of growth but should be cured in such a way as to retain, not only its leaves, but as much as possible of its bright green color as well. In order to obtain this class of product it should be placed in the stack at the first possible moment after it is sufficiently cured, for exposure to the sun, wind and rain causes it to lose, not only a percentage of its feeding value, but also its bright green color, which makes it so attractive.

The leaves of alfalfa hay contain more feeding value pound for pound than the stems of the plant—so great care must be used in harvesting the plant to insure the

Fig. 13. Cocking Alfalfa in the Crowfoot District near Strathmore.

saving of as large a per cent. of the leaves as possible. The proper curing of alfalfa, however, is not a difficult problem, provided favorable weather conditions can be secured. No hard and fast rule can be laid down that will fit all conditions equally well, for the methods of handling in each case will always depend largely upon the weather.

Normally, alfalfa should be cut in the forenoon after the dew is off and raked up into windrows while still quite green, either late the same afternoon or not later than the following afternoon, for the longer it is left in the swath, the more it will become bleached and discolored from the sun. If the weather is dry there is but little danger of placing it in the windrows too green. It should be left in the windrows from one to two days, or until half dry, and then placed in small or medium-sized cocks or piles, where it is to be left until it is sufficiently cured to permit of stacking.

The main principle to be observed in the curing of alfalfa should be to dry it out sufficiently for stacking with as little exposure to the sun and elements as possible. If this principle is borne in mind and the plan outlined carried out it is possible to dry it out sufficiently for stacking and still retain its bright green color—always provided the weather is good. Rain during harvest time is, of course, a serious drawback in the curing of alfalfa and one of the hardest factors to guard against. In the New England and Middle Atlantic States, where alfalfa is highly prized for its feeding value, it is being more widely grown each year, but is harvested and cured with difficulty. Some growers in these districts place the piles of hay on small "stools," with slatted bottoms, the stools being constructed of 1 x 4 inch lumber, and elevated on short legs about six inches from the ground, after which each pile or cock is covered with a canvas cover until the hay is thoroughly cured and ready for the stack, but this method is expensive from the standpoint of both equipment and labor. The covers used cost about 50 cents each. Whatever the condition of the weather or the method of curing, it should be borne in mind that water on the hay from either dew or rain is more liable to cause trouble than moisture in the hay. Hay is ready to stack when no moisture can be twisted out of a bunch or wisp by twisting in the hands.

Fig. 14. Loading Alfalfa Hay at Strathmore Irrigation Headquarters, 1915.

STACKING.

More alfalfa is undoubtedly ruined by improper stacking than from any other cause. It is almost impossible to stack it properly by hand labor alone, unless one goes to the expense of stacking it on a false bottom of straw or lumber, and then covers it with a waterproof cover. The hand built stacks after settling has taken place are usually so low that they are about all bottom, sides and top, and present too great a percentage of exposed surface.

A high, well drained spot should be selected for the stack location, and if they are properly built of sufficient size and well tramped and topped out, and at least 20 feet in height after settlement has taken place, hay can be carried through the winter in uncovered stacks in this climate with very little deterioration. Alfalfa stacks do not shed water as well as those of some other hays, and their keeping qualities can frequently be improved by topping them out with straw or slough hay. The points to be kept in mind are (1) to make the top as nearly waterproof as possible, (2) to keep the bottom dry, and (3) to make them large enough and high enough so as to have as small a per cent. of hay exposed as possible.

In order to accomplish this purpose and be enabled to construct the proper size and height of a stack, and at the same time do it cheaply, either a home-made pole derrick stacker or a patent stacker is necessary. The derrick stacker consists essentially of a home-made derrick with a vertical pole at least 40 feet in height, the same being constructed largely of round cedar or fir poles, and mounted on skids, so that it can be moved from place to place on the farm. With this stacker the hay is drawn in from the cocks on "slips," consisting of from six to eight 1" x 12s" nailed together in the form of a barn door and drawn flatwise on the ground. The hay is drawn up and swung on the stack from the slip by a team hitched to a wire cable, the slip load of hay being held by "rope slings," which are spread out on the slip before the hay is pitched on from the cocks. Three men and teams with slips with a man and team operating the stacker, and two men on the stack, should stack from 30 to 40 tons of hay per day with this outfit, under favorable conditions, at a cost of from 40 to 60 cents per ton. This type of stacking outfit complete with rope, slings and slips, costs from $60 to $125, depending upon local conditions.

Fig. 15. Stacking Hay With Automatic Stacker and Sweep Rakes.

A still cheaper method of stacking hay, and one in which the hay is never touched by hand until it reaches the top of the stack, is by means of sweep or buck rakes, and an automatic patented stacker. With this method the hay is bunched and later, after being cured, pushed to the stacks and on to the stacker with these rakes, which work ahead of the horses. The stacker in turn lifts the hay from the ground and deposits it on top of the stack. Two men and teams with sweep rakes, and one or two men on the stack, with one man and a team operating the stacker, will stack from 40 to 50 tons of hay per day with this equipment, at from 35 cents to 50 cents per ton.

The equipment for stacking hay with this method, including two sweep rakes and stacker complete, would cost from $250 to $350. Of the two equipments the home made derrick is probably preferable for Alberta conditions for, although the hay can be stacked cheaper with the sweep rakes and automatic stacker, the cost of the equipment is much higher. Better and higher stacks can also be made with the home-made apparatus.

FEEDING ALFALFA.

By far the greater part of alfalfa hay used is fed whole, though some of the experiments show that clipping or grinding it increases the returns secured. Wherever possible it should be fed in racks so as to prevent as much waste as possible—the racks

in each case being especially built and adapted to the kind of stock being fed. Cattle, sheep and horses, will usually eat almost any alfalfa, provided it is of reasonable quality. The better results, of course, are always secured from first-class hay. Hogs, however, should only be fed the best of hay if they are expected to make good use of the hay consumed.

HARDINESS AND VITALITY OF ALFALFA.

There is no doubt of the adaptability of the hardier varieties of alfalfa to Alberta conditions. It has been grown successfully at Lethbridge, Alberta, for at least 15 years. Many of the original fields have never yet been plowed up, and they are still, to all appearances, producing very profitable returns. It has now been grown to a considerable extent at Strathmore for six years, and scores of fields have already passed through two and three winters successfully.

During the past season samples of alfalfa 7 feet 9 inches tall and also five alfalfa roots that totalled 7 feet across the crowns (see fig. 3) were secured in this vicinity. It is doubtful whether either Southern California or Asia herself, the original home of the alfalfa plant, can beat this record for height of plant or size of crowns. Considering the records that have already been made on the thousands of acres now in the Province it is believed that there can be no doubt either as to the strength, vitality or hardiness of alfalfa as grown in Alberta or as to its feeding and fertilizing value.

ALFALFA SEED.

Alfalfa has been grown for seed for the past 25 years with varying degrees of success in almost every Western State. It is not so sure to bear seed as the grains or clover. In fact, the production of alfalfa seed is considered a very uncertain undertaking —some growers secure very excellent crops three years out of five, while none has been able to make it pay every year. There is evidently much yet to be learned about the management of the crop for seed production. Some think their difficulty lies with the soil, and some with the moisture supply, while others lay their failure to the vagaries of the climate or to lack of bees, when, as a matter of fact, their failure is no doubt due to a combination of these causes.

The author has made a considerable study of this subject, and on account of the many failures that have come under his observation, would not as yet advise any one to try alfalfa seed production on a large scale in Alberta. It may yet, however, be grown at a profit, and for the benefit of those who may decide to engage in the enterprise, it is suggested (1) a thin stand is to be desired, (2) the first crop should be saved for seed, (3) that irrigation water should be applied rather sparingly after the alfalfa has begun to bloom, (4) that the presence of bees and insects to assist in pollination are desirable, (5) that it requires twice as long for a seed crop to mature as for a hay crop, (6) that the seed crop should be cut when most of the seed pods have turned brown, and (7) that great care should be used in harvesting and in handling the crop afterward, in order to shatter and lose as few of the seed pods as possible.

An inability on the part of Alberta farmers to grow profitable crops of seed should not, however, discourage them in the growing of the crop for pasture and forage, as with good seed at the present prices, the cost of the seed can work no particular hardship upon any one who is desirous of planting the same.

RULES FOR MEASURING HAY.

There are several rules in use for the determination of the tonnage of hay in a stack, the principle involved in each one being the determination of the cubical contents of the stack, which is divided by the number cubic feet there is supposed to be in a ton. There is none of these rules, however, that will give accurate results for all classes, sizes and shapes of stacks, for an arbitrary rule can neither accurately determine the cubical contents of so many different shapes of stacks, nor determine their comparative density. Hay is not usually sold by measure until 30 days after stacking, at which time

512 cubic feet is usually assumed to equal a ton. If the stacks are comparatively high and well built, 422 cubic feet should equal a ton after being stacked 90 days, and 350 cubic feet after being stacked from six months to one year.

The most common rule in general use is to determine, the average "over top" of the stack in two or more places by measuring with a tape from the ground on one side over the top of the stack and down to the ground on the opposite side. The bottom width is then subtracted from the over top, and this result is then divided by two, giving the average height of the stack. The height of the stack is then multiplied by the average width and average length in feet, which gives the contents of the stack in cubic feet. The tonnage of the stack is then found by dividing the cubical contents by the number of cubic feet in a ton.

DON'TS IN REGARD TO ALFALFA.

(1) Don't plant alfalfa on soil that is naturally wet and soggy or in a depression without natural drainage.

(2) Don't plant alfalfa earlier than May or later than July.

(3) Don't plant it in very weedy soil.

(4) Don't fail to prepare a good seed bed and level down all irregularities.

(5) Don't fail to inoculate your alfalfa, and if the soil transfer method is used, don't fail to secure good soil and harrow it in immediately.

(6) Don't clip or pasture it too close late in the fall.

(7) Don't fail to secure seed from hardy strains and be sure it is free from weeds and has good vitality.

(8) Don't expect much, if any crop the first season—clip it when it has reached a height of 10 inches.

(9) Don't fail to make large, high stacks, and top them out well.

(10) Don't sell your alfalfa; feed it.

CONCLUSION.

There are hundreds of writers and experimenters advocating the growing and feeding of alfalfa under conditions varying from the humidity of the North Atlantic coast to the irrigated deserts of the Southwest. Enough has been said, it is hoped, to show every reader the great value of alfalfa as a feed for all classes of live stock, and its effect in introducing nitrogen and humus into the soil. The experience in this part of Alberta indicates conclusively the hardiness and yields that may be expected from properly prepared alfalfa fields. Alfalfa responds particularly well to irrigation and produces its highest yields and development on irrigated land. With yields of from 2½ tons to 4½ tons of cured hay per acre, and with the relatively low priced irrigated lands that are awaiting development in Alberta, it is easy to predict prosperity and an appreciating value for the land in all this great district.

Too much emphasis, however, cannot be given to the necessity for thorough preparation of land which is to be planted to alfalfa and irrigated throughout a series of years. This initial work of levelling and smoothing the land for irrigation, though it will give ample returns for the amount spent upon it, is a capital expenditure and prohibits the handling of large areas without large financial backing. Live stock is the basis of successful permanent agriculture in any country, and a study of conditions on irrigated lands shows the necessity for mixed farming on moderate sized farms. This type of agriculture gives the farmer unusual advantages, not only from the increased production that will be induced by the proper systems of rotation, but the possibility of having succulent forage from alfalfa, pasture grasses, etc. during the entire growing season, permits him to make maximum profits from dairying and the production of hogs and other kinds of live stock.

The production of alfalfa hay for market has been profitable in Southern Alberta, but as the area of alfalfa on the irrigated lands is increased, only a small portion of the hay can be disposed of in this manner. Except for a few growers near shipping stations,

live stock production should keep pace with the alfalfa production. This will place the marketing as well as the whole system of farming on a sure basis, where hail, frosts and the other drawbacks of the single crop system of farming are largely eliminated. With a cropping system for grains and roots based on an alfalfa rotation, the wonderful fertility of our soils will be maintained, and the present high standard for maximum yields of all the small grains and roots of a quality surpassed nowhere in the world, can be kept up indefinitely.

In short, it has been the aim of this pamphlet to prove not only the inherent value of alfalfa, but to point out that in connection with the raising of live stock it is the basis for the most scientific practical and profitable system of farming that can be engaged in, particularly on the irrigated lands of the Western Prairie Provinces.

APPENDIX.

MIXED PASTURE GRASSES

It is believed that if the farmers of Alberta could realize and appreciate the true worth of a conveniently located mixed pasture plot, one would be installed at a very early date on a majority of the Alberta farms. Such a tract, if well fenced, conveniently located and planted to the proper type of grasses so as to make a maximum yield, will be found profitable even where there is still vacant land, not only in the direct returns secured, but also in the convenience it affords, for such a pasture can always be used to advantage either for the dairy cows at night or the calves, colts and idle horses, even where there still remains vacant unfenced land in the neighborhood. The necessity for pastures on the farm will also rapidly increase as the territory settles up and the available free range disappears.

Although alfalfa is unsurpassed in feeding value as a hay for all classes of live stock, and as a pasture for hogs and horses, it is not adapted as a pasture for either cattle or sheep on account of its liability to cause bloat and loss. Furthermore, alfalfa does not form a sod or turf as do the natural grasses and, hence, cannot stand the excessive tramping without damage, that an ideal pasture planted strictly for pasture purposes must do.

For strictly pasture purposes no single grass can make maximum returns unless it be alfalfa as a hog pasture. A mixture of grasses (the more the better) has many advantages over any single grass for pasture purposes for many reasons. No single grass will be at its best throughout the entire growing season, nor will it do equally well on all classes of soil. A mixture to give maximum returns should contain not only enough grasses that spread by means of creeping root stalks to form a tough sod, but also sufficient other grasses that tend to grow in clumps or tufts so that the mixture will not become sod bound, for such a condition materially reduces production. It should also contain some deep rooted and some shallow rooted grasses, some should prefer lots of sun and some should do well in the shade, some should be able to grow on sour land, while some should be able to withstand a reasonable amount of alkali, some should be rich in carbohydrates, while others should be rich in protein, and some should require lots of water, while some should be good drought resisters. Some grasses in the mixture should start early in the spring, while others should be at their best at the end of the season and care should be used to have all of the grasses equally hardy if possible.

There being hundreds of cultivated grasses to pick from, it is comparatively easy to design a mixture that will come up to these specifications. This has already been done and demonstrated by the writer in several different localities and it is truly remarkable how much returns can be secured from an acre, particularly under irrigation. The proper mixture starts early in the spring and continues making a maximum growth on every square foot of the pasture throughout the season, for no matter whether it be hot or cold, wet or dry, or whether the soil consists of clay or sand, some one grass is always bound to find just the very condition it prefers or can withstand.

The large number of grasses contained in the mixture also adds greatly to the attractiveness and palatability of the ration for the different classes of stock which, in itself, is quite a factor when the gains secured from the stock are taken into consideration.

The mixture recommended for irrigated lands in this district is as follows:

Kentucky Blue Grass	8 pounds per acre
Western Rye Grass	4 pounds per acre
Orchard Grass	4 pounds per acre
Timothy	4 pounds per acre
Meadow Fescue	4 pounds per acre
White Clover	2 pounds per acre
Total	26 pounds per acre

These grasses in nearly these proportions, plus a small amount of Red Top and Brome Grass, were planted by the writer on a Government Experiment Station in South Idaho. The second year after planting, a measured acre kept two milch cows throughout the entire growing season, but the entire acre had to be mowed once to keep it down, the yield of hay being 1,000 pounds of cured hay in addition to what the cows ate. The following year the same acre kept three grown cows throughout the season, but it was not necessary to mow it. Four two-year-old steers were also kept on one acre of a similar mixture during the season of 1914, an equivalent of 373 days for one steer, and, although the steers were in very good flesh to begin with, their total gain from the pasture and ditch water was 500 pounds.

Pasture grasses, in order to produce maximum returns in almost any climate, must be irrigated. This is evidenced by the necessity for the artificial watering of lawns in practically every city on earth, no matter what the amount of the annual precipitation, for the distribution of the precipitation is almost never just right for maximum growth, which is so necessary if the lawns are to retain their best possible appearance.

Cows Feeding on Irrigated Mixed Pasture Grasses.

Where it is desired to plant pasture grasses on land that cannot be irrigated in that section of Alberta lying between Calgary and Medicine Hat only drought resistent grasses of known hardiness should be planted. It is rather doubtful if white clover would persist under these conditions, much as it is necessary in a mixture. The mixture recommended for dry land pastures in the above-named district is as follows:

Brome Grass	8 pounds per acre
Western Rye Grass	8 pounds per acre
Orchard Grass	8 pounds per acre
Total	24 pounds per acre

In order to show the characteristics that adapt them for pasture purposes, a short description of each grass recommended is given below.

Kentucky Glue Grass is undoubtedly the best of all pasture grasses where it can be given a reasonable and continuous supply of moisture. It forms a good sod, does well on a large variety of soils, has a high feeding value, is perfectly hardy and does well, both very early and very late in the season. It starts very slow the first season, but

produces well the second year. This grass requires considerable moisture to produce maximum results.

Western Rye Grass produces less forage than Kentucky Blue Grass, but is a good drought resister, perfectly hardy and will stand more alkali than any other grass in the mixture.

Orchard Grass, commonly called Cock's Foot in England, is perfectly hardy in this climate, and is a good yielder as well as a fairly good drought resister. It does well in the shade, starts growth very early in the spring and continues growing vigorously throughout the season. It recuperates rapidly after being cut or eaten off, and has good feeding value. This grass does not form a dense sod like Kentucky Blue or Brome Grass, but is more inclined to grow in tufts or bunches.

Timothy is so well known that it needs no description. It is perfectly hardy, makes a good sod, and requires lots of water for maximum production.

Meadow Fescue, sometimes called English Blue Grass, does not have the marked tufted habit of Orchard Grass, nor the strongly stoloniferous or creeping habit of Kentucky Blue Grass, but stands with Timothy somewhere between the two extremes. This grass is adapted to a wide range of soils, and though it will withstand fairly moist soil and requires considerable moisture for maximum production, it is also a fairly good drought resister. This plant is perfectly hardy here and has good feeding value.

Brome Grass has many advantages as a pasture grass. It reproduces itself both from seed and strongly stoloniferous underground stems, and is one of the most hardy and persistent grasses that can be planted—so much so, in fact, that although the writer has always advised planting it in irrigated pasture grass mixtures in the drier districts of Idaho, Colorado, Utah and Wyoming, he hesitates to recommend it here for irrigated lands on account of possible danger of its spreading, and the difficulties that might be found in killing it out. It forms a tough sod and has good feeding value, starts earlier in the spring than any other grass, recuperates quickly after being eaten off, is an excellent drought resister and will do well on almost any class of soil.

Red Top is particularly adapted to light, wet, sour soils, but will not withstand any appreciable amount of alkali. It starts comparatively late in the spring, but when once growing it keeps on until late in the fall. It is liked by all kinds of live stock and stands tramping well. It might well be included in any pasture mixture for irrigated lands, but the writer has not included it in the mixture recommended for this class of lands here, as under normal conditions it cannot compete with the other grasses in the mixture recommended.

White Clover is strongly perennial in nature, being unquestionably the hardiest of the clovers. Unlike most clovers, it spreads to a certain extent from the creeping root stems that root at the joints, which especially adapts it as a pasture plant. It requires considerable water for maximum production, and has a good feeding value, being rich in protein, which helps to balance the ration. This plant being a legume, has the characteristic nitrogen fixing bacteria associated with it, which introduce nitrogen into the soil, not only for the clover, but for the other grasses, thus providing for a maximum yield of them all. Experience seems to indicate that this clover will not need inoculation here. This clover is much better adapted for pasture than any of the other clovers. It is hardier, stands tramping better, makes a very fine succulent forage close to the ground, and is not so liable to cause bloat as the other clovers.

Pasture grasses should be planted early in the spring, preferably during the months of May and June, and in order to secure good results, a well cultivated but firm and compact seed-bed is necessary. The seeds of these different grasses vary greatly in size and density and should preferably be sown separately, though fairly good results can be secured by separating the various grasses into two or three classes, placing those of the same size and density in a class, and sowing each class by itself after a thorough mixing. Pasture grasses sold already mixed by seed-houses are not recommended because of the impossibility of securing an even distribution of all the grasses in the sowing. And then, too, if the seed-house is not perfectly reliable, a large per cent. of

the mixture is liable to consist of cheap or inferior grasses. It is always best to buy your grasses separately and mix them yourself before sowing. The seeds should preferably be sown broadcast, after which they should be given a light harrowing.

The same methods of preparing the ground and in irrigating will apply as with alfalfa. Pastures, even after they are well established, are comparatively shallow-rooted and not only require fully as much water as alfalfa during the season, but will require it oftener if maximum returns are to be expected. While some may think the mixture recommended is rather heavy seeding and consequently expensive, it has been found that the best results cannot usually be secured with less seed. Thorough preparation of the seed-bed is absolutely necessary in starting a grass pasture. The majority of failures to secure a satisfactory stand of grass are directly due to either a poor seed-bed or an insufficient moisture supply. Grass seeds are small, and the tiny rootlets that are sent out must be able, to not only come into intimate contact with the soil grains, but also to secure a ready supply of moisture. This cannot be done in rough, cloddy ground.

Very little grazing can be done on the pasture during the first season, but if it is lightly grazed during the first fall some growth should be left on as it goes into winter quarters. It can be grazed comparatively heavy during the second year, and if a good stand has been secured will become better and more productive up until the third or fourth season. In order to secure the largest returns from a pasture, it had best be fenced into two or three equal parts, so that one part can be pastured while one is being irrigated and the other is growing and recuperating. Though pastures do best and produce most only on the best of soils it can readily be seen that they are adapted to and will give very good production on a much wider range of soils and under a much wider range of conditions than alfalfa, provided the proper mixture of grasses is planted.

If the foregoing instructions are followed out it is believed that pastures can be secured on both the dry and irrigated lands of Alberta that will equal, if not excel, in the net profits that can be produced from any other crop that can be grown, all other conditions being similar. It should be borne in mind that a pasture does not need re-seeding each spring; that it is one of the easiest crops to irrigate, and that the animals themselves do all of the harvesting. Also that it is a sure crop, for it is less affected by either rain, drought, hail or frost, than any other. In the opinion of the writer, the farmers of Alberta cannot be too strongly urged to select a conveniently located tract on their farms and to prepare and plant it to mixed pasture grasses, for it is believed that no other similar area on the farm will exceed it in net returns, provided there are sufficient stock on the farm to utilize it to advantage.

April, 1916.