UNIVERSITY OF IDAHO
AGRICULTURAL EXPERIMENT STATION

Department of Agronomy

Farming Practices for the Cut-over Lands of Northern Idaho

By
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and
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*In cooperation with U. S. Department of Agriculture.

SUMMARY

In Northern Idaho there are large acreages of cutover lands suited to agriculture. The difficulties experienced in bringing forest lands to a satisfactory state of production are due to the presence of forest debris and the lack of certain plant foods. Nitrogen, organic matter and sulphur are found to be the materials most needed by these soils.

Summer fallowing after clearing of freshly logged land tends to destroy the injurious effect of forest debris.

The raising of legumes presents the only feasible method of supplying nitrogen to the soil.

The application of gypsum to legumes, either at the time of seeding or after the legumes are established, has proven to be the most profitable material to add to these soils.

The cut-over lands are best suited to a diversified system of farming in which legumes should occupy about one-half the cleared portion of each farm.

Sufficient livestock should be maintained on each farm to consume a considerable portion of the legumes raised.

Sweet clover and alfalfa are well adapted to the upland portion of the cut-over lands.

Logged-off lands can be made to produce satisfactory crops under proper management.

FARMING PRACTICES FOR THE CUT-OVER LANDS OF NORTHERN IDAHO

G. R. McDole and J. H. Christ

In the northern counties of Idaho there is a large area of logged-off land, some of which is under cultivation and producing very satisfactory crops. Much of this land is still waiting for someone to clear it and put it into crops. Difficulties have arisen when attempting to put this land under cultivation and bring it to a satisfactory state of production. It is the intent of this bulletin to point out the practices that will enable the farmer, located on logged-off land, to bring his land under cultivation as rapidly and economically as possible.

The greatest areas of cut-over land suited to agriculture are found in Boundary, Bonner, Kootenai, Benewah, Latah, Lewis and Nez Perce counties. Cut-over land is also found in Shoshone, Clearwater and Idaho counties, but a much smaller percentage of the cut-over land of these counties is suited to agricultural purposes.

The results given in this bulletin are obtained from the experiments conducted at the Sandpoint Substation and from the experience of farmers of this region. The methods recommended have been tested thoroly under farm conditions.

CLIMATE

This region represents an area of considerable variation in elevation and this means a decidedly varied climate. In consideration of this factor, topography of the land is of more importance as it relates to the distribution of temperature, than is latitude. In some of the lower valleys temperatures are exceptionally mild; in the more elevated sections the winters are rather long and cold, but on the whole the climate of the section is not as severe as its altitude and latitude might lead one to expect. It lies in the belt of prevailing westerly winds and the mountains on the east protect the region from the cold waves that move down into the United States from Canada.

There also is a wide variation in precipitation, this being heavier in the eastern portion and in the more mountainous localities, decreasing in the western portions and in the lower valleys. Precipitation over the entire section is well distributed throughout the year. The

months of lightest rainfall are July and August, and the months of heaviest precipitation are November, December and January.

In Tables I, II, III and IV, the mean monthly and annual precipitation, annual rainfall from 1912 to 1924, the elevation and mean monthly temperatures, and the frost-free period from some of the stations located within this district, are given.

Table I

MEAN MONTHLY AND MEAN ANNUAL PRECIPITATION

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
Moscow	2.86	2.13	2.17	1.59	2.33	1.31	.68	.73	1.28	1.62	3.08	2.47	22.24
St. Maries	3.28	2.47	2.81	1.70	2.55	1.57	1.01	.84	1.38	2.03	3.81	3.47	26.92
Coeur d'Alene	3.59	2.39	2.38	1.83	1.91	1.45	.71	.57	1.35	1.68	3.36	3.48	24.70
Sandpoint	3.42	2.16	2.22	1.98	2.47	1.79	1.01	1.17	1.80	1.78	4.29	3.42	27.51
Priest River	3.79	2.96	2.77	2.18	2.55	2.00	1.34	1.30	1.96	2.28	4.30	3.63	31.06
Porthill	2.75	1.82	1.44	1.09	1.91	1.61	1.08	.89	1.76	1.65	3.07	2.63	21.43

NORMAL PRECIPITATION DURING GROWING SEASON (Apr. 1 to Sept. 1)

						Total
Moscow	1.59	2.33	1.31	.68	.73	6.64
St. Maries	1.70	2.55	1.57	1.01	.84	7.67
Coeur d'Alene	1.83	1.91	1.45	.71	.57	6.47
Sandpoint	1.98	2.47	1.79	1.01	1.17	8.42
Priest River	2.18	2.55	2.00	1.34	1.30	9.37
Porthill	1.09	1.91	1.61	1.08	.89	6.58

Table II

ANNUAL RAINFALL IN INCHES

Year	St. Maries	Coeur d'Alene	Sandpoint	Priest River	Moscow	Porthill
1912	27.98	——	31.47	37.05	25.66	18.75
1913	——	——	26.61	26.97	30.17	17.14
1914	——	24.70	29.46	34.31	19.22	21.99
1915	——	22.75	24.69	30.51	19.16	19.82
1916	33.37	28.23	28.13	32.81	21.96	17.99
1917	26.41	23.96	25.76	27.25	20.71	15.77
1918	18.11	19.75	27.48	29.13	17.84	17.53
1919	17.64	21.48	27.61	29.72	20.40	16.41
1920	21.49	——	27.53	31.24	23.71	16.87
1921	27.58	24.03	26.37	23.83	25.37	16.40
1922	19.97	18.86	27.52	25.71	15.69	13.69
1923	26.13	24.19	26.39	25.66	24.93	18.63
1924	22.84	21.04	27.00	24.23	17.15	17.90

Table III

ELEVATION AND MONTHLY MEAN TEMPERATURES

	Elevation	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
Moscow	2748	28.4	31.3	37.7	46.0	52.0	58.3	66.5	65.7	57.7	48.1	37.6	31.0	46.6
St. Maries	2155	28.7	32.4	39.2	46.8	53.6	60.3	66.0	64.6	57.0	48.2	37.9	31.2	47.2
Coeur d'Alene	2157	28.3	32.0	37.0	46.8	54.2	61.0	67.8	68.2	58.2	48.4	36.7	31.2	47.6
Sandpoint	2100	25.6	29.0	36.6	45.6	51.6	58.4	64.6	63.0	54.6	45.0	35.4	28.6	44.9
Priest River	2380	23.3	27.0	33.4	42.8	49.2	56.8	62.7	61.7	52.8	42.4	32.8	25.0	42.5
Porthill	1665	23.4	26.8	35.0	45.4	53.0	59.0	65.6	63.6	53.9	44.8	33.7	27.4	44.3

Table IV

FROST FREE PERIOD FOR NORTHERN IDAHO STATIONS

Dates of Killing Frosts

	St. Maries			Coeur d'Alene			Sandpoint		
	Last	First	No. Days	Last	First	Days No.	Last	First	No. Days
1912	4-26	10-6	163	No Record			6-3	9-16	105
1913	No Record			5-2	10-25	176	5-4	9-19	138
1914	No Record			4-26	11-15	203	5-29	9-1	95
1915		10-6		4-21	10-6	168	4-21	9-13	145
1916	4-24	9-14	144	5-23	10-4	134	5-14	9-10	119
1917	5-1	10-6	158	5-17	10-17	153	5-30	9-30	123
1918	5-27	10-8	134	5-26	10-22	149	6-3	10-8	127
1919	6-12	9-21	101	6-12	9-28	108	6-12	9-21	101
1920	5-31	10-16	138	6-2	10-23	143	6-2	16-16	136
1921	5-3	9-10	130	5-28	9-10	105	5-12	9-10	121
1922	5-23	10-30	160	5-9	10-29	173	5-23	10-12	142
1923	5-3	9-24	144	5-3	9-24	144	5-15	9-17	124
1924	6-6	8-30	185	6-8	10-6	120	6-26	8-30	164
		Average....136			Average....148			Average....118	

	Priest River			Moscow			Porthill		
	Last	First	No. Days	Last	First	No. Days	Last	First	No. Days
1912	5-3	9-14	134	4-15	10-7	175	5-1	9-27	149
1913	5-4	9-25	144	4-23	9-23	153	5-6	9-24	141
1914	5-29	10-21	145	4-28	10-20	175	5-28	10-21	146
1915	5-30	9-20	113	4-21	9-12	144	4-22	9-12	143
1916	7-26	9-10	46	5-13	10-2	142	5-14	9-28	137
1917	7-29	9-29	62	5-15	10-16	154	5-5	10-17	165
1918	6-29	8-28	60	5-25	10-21	149	6-1	10-8	129
1919	6-13	9-21	100	5-3	9-20	140	6-1	9-29	120
1920	6-24	8-19	56	5-30	10-13	136	5-20	10-15	138
1921	5-28	9-10	105	4-30	9-10	133	5-12	9-10	121
1922	5-13	9-21	131	5-22	10-21	153	5-10	10-6	149
1923	6-18	9-6	80	4-30	10-23	182	5-3	9-19	139
1924	7-7	8-30	54	4-27	10-25	161	6-8	9-26	110
		Average.... 93			Average....154			Average....137	

SOILS

A great variety of soils are found in the cut-over districts, varying from those that are admirably suited to cultivation, both on account of their texture and topography, to those too rough and mountainous or too coarse in texture for farming operations. The soils are of many different origins, ranging from the organic peat and muck to all classes of mineral soils. A discussion of the cultivation of peat lands will be given in a later bulletin.

The principal soils are derived from glacial deposits, wind-blown material and those of a residual nature. The surface soil has been modified in many places by recent deposits of wind-blown material. While the mineral soils are of many different origins, a number of things are common to all logged-off lands when considered from the standpoint of putting them under cultivation. While the hardwood forest soils of the central states are very productive, the soils of the Northwest which have supported the coniferous type of forest growth are found to be lacking in some of the elements essential to plant growth.

These soils are usually found to be very deficient in nitrogen and organic matter. Until this deficiency is cared for, they cannot be brought up to a satisfactory state of production. In addition, many of them are found to be acid or lacking in some of the minerals necessary to plant growth. The addition of sulphur in some form has produced marked increases in yields of leguminous crops.

The farmers often attribute their difficulty in obtaining satisfactory crops from freshly logged land to the presence of turpentine or other poisonous materials in the soil. While the nature of such materials has not been definitely established, the department of bacteriology of the Idaho Experiment Station has shown that the presence of forest debris in the soil has a depressing effect upon bacterial activities. In addition, the agricultural chemistry department has isolated* a resinous material from the soil small quantities of whcih have proven toxic to wheat seedlings. Farm practice has shown that this difficulty is largely overcome if the land is summer fallowed the first year after clearing. Winter wheat is the most satisfactory first crop to use when this practice is followed.

CLEARING

The first operation necessary to the putting of logged-off land under cultivation is to clear it sufficiently to put in the desired crop. Clearing costs vary according to the size and number of stumps per

*Unpublished data.

acre and the amount of debris left after the logging operations. Another factor is that of the length of time elapsing between the completion of logging operations and the clearing of the land. Estimates have placed the cost of these operations at from $10.00 per acre to over $100.00 per acre.

Immediate System of Clearing

Where it is desired to clear a piece of ground as rapidly as possible, all down stuff is burned and the stumps removed either by pulling or blasting. Blasting or pulling is done more ecenomically either

Logged-off Land

early in the spring or late in the fall when the soil is moist. The land is then prepared and put in crop as soon as conditions will permit. This method is used to secure land for cultivation or to seed down for meadow.

Delayed System of Clearing

This system, as the name implies, consists of delaying the time of the removal of the stumps. All second growth timber is removed or slashed and allowed to dry, the down stuff is collected into piles and all the debris burned. The better the burn, the better the land is suited for the operations that are to follow. The burning operations can be conducted at any time when the material is sufficiently dry.

If the stumps are not too numerous the ground can be prepared by disking for the seeding of some grass that will furnish pasture. Where the stumps will not permit of disking, very satisfactory stands of grasses have been obtained by seeding in the spring either on a light covering of snow, or when the ground is honey-combed by the frost. Good stands also have been secured by seeding immediately after burning or in the late fall. Red and alsike clover and timothy are well adapted to seeding under these conditions. It is more difficult to obtain stands of sweet clover and alfalfa on unprepared ground.

As soon as the grasses are sufficiently established, the field may be pastured. Where this system is used it is found that the stumps rot out quite rapidly and, after a delay of several years, the final cost of clearing is materially reduced. In addition to the value of the feed obtained by this method, the improvement of the soil is often of even greater value. The presence of a legume is necessary if any addition is to be made to the nitrogen content of the soil. A few years of pastureage (5-6) usually will increase the nitrogen and organic matter of the soil to the point where, when it is broken, the field is practically as fertile as cleared land that has been in a legume for several years. The cost of clearing also is materially reduced by this method. Green stumps require a relatively large amount of powder to blast them out, while the older stumps blow much easier. In many places the land quickly becomes overrun with second growth timber if left undisturbed after logging. This greatly increases the final cost of clearing. In some cases, the second growth becomes more of a problem than that of caring for the original materials left after logging.

Treatment of Cleared Land

Cleared land that is not productive, the kind that farmers refer to when they say that the land is full of turpentine, presents a special problem. Experience has shown that if this type of land is summer fallowed for one season, following the removal of the stumps, a very satisfactory crop of winter grain can be obtained the first year. If cropping is continued the yields soon run down to the point where they are not profitable. When this condition occurs the farmer recognizes that there are certain deficiencies in his soil which must be met before profitable production can be maintained.

Delayed Clearing

Any system of handling the logged-off land that will secure a stand of grasses among the stumps to be used either as pasture or to be cut for hay comes under the delayed system of clearing as ex-

plained in the earlier pages of this bulletin. If the stumps are not too thick, the land can be plowed and planted to crop and the stumps removed later by blasting or burning. If the land has been in clover and grass for a number of years, usually no difficulty is experienced in getting any other crop to grow.

LAND IN SECOND GROWTH TIMBER

Where second growth timber has been allowed to grow, the condition of the soil is similar to that of freshly logged land. When the second growth is slashed and burned, it is considered advisable to sow all that is not to be cleared at once to a mixture of grasses containing a large percentage of clover. The secret of obtaining a good stand lies in getting a good burn.

Nitrogen

So much has been written concerning the addition of nitrogen to the soil through the medium of legumes that it is not considered necessary to more than mention a few things in this connection. There is no source of nitrogen available to the farmer that will supply this element more economically than by the use of legumes. Two years of sweet clover have been found to furnish as much nitrogen as could be obtained from the application of 25 to 50 tons of barnyard manure. If it were necessary for the farmer to purchase this nitrogen in the form of sodium nitrate or other high grade fertilizers, it is doubtful if anyone could afford to put cut-over land under cultivation. The legumes, besides furnishing a supply of nitrogen and organic matter, pay their way in the supply of pasturage or forage obtained during the time the land is being built up for other crops. One of the chief difficulties which has confronted the farmers on the cut-over lands has been that of getting a satisfactory stand of legumes. The following methods are recommended for securing stands of legumes as a result of four years' experimentation at the Sandpoint Substation and on various farms thruout the cut-over district.

SEEDING LEGUMES

Seedbed Preparation

Plowing may be done either in the fall or spring but fall plowing is preferable. If fall plowed, the ground is left rough until spring at which time it should be worked down to a fine seedbed by disking and harrowing. If spring plowed, it should be plowed as early as possible, working the ground into a good seedbed as soon as practicable by disking and harrowing. The disking should be thoro in order to pack the soil and to re-unite the plowed portion with the undisturbed

subsoil. Five or six inches has been found to be the most satisfactory depth of plowing. No pains should be spared in making a well prepared seedbed. Legume seeds are small and require a fine, well prepared seedbed for their germination.

Innoculation of the Seed

In portions of the cut-over districts the soils are found to contain the bacteria needed for the innoculation of the clover. However, unless it is definitely known that clover grew on the land, it is better to inoculate to make sure that the plants are supplied with the necessary bacteria. Alfalfa and sweet clover **always** should be inoculated where sown for the first time as the cut-over areas are found to be lacking in the bacteria needed by these plants. In general, it is desirable to inoculate any legume seed when sown for the first time on cut-over land. The cost is too small to neglect this important part of the operation. It is impossible to secure satisfatcory growth of any of the legumes without proper inoculation.

Time and Method of Seeding

The time and method of seeding of the various legumes has considerable influence on these crops. It has been found that red clover, alsike clover and timothy and other grasses can be seeded with good results in the late fall, in the winter on the snow and also in the spring on honey-combed ground. The most satisfactory time, however, is in the spring on a well prepared seedbed, after danger from heavy frosts is past. This is generally during April and the fore part of May. Seedings can be made at later dates, providing moisture conditions are satisfactory. It is generally a poor practice to attempt to get a catch of alfalfa and sweet clover from seedings made after the first of September, for on many of the soils of this region the plants do not get sufficiently established to prevent their being heaved out by the action of frosts in the fall and spring. Red and alsike clovers are better adapted than alfalfa and sweet clover for seeding at this time.

The following number of pounds per acre have been found to be suited to the cut-over regions:

Red Clover	10-12	Sweet Clover	12- 15
Alsike	6- 8	Vetch	30- 60
Alfalfa	8-12	Peas	90-120

On the lighter types of soil, greater success is obtained by broadcasting than by drilling the seed. It is difficult to adjust a drill for shallow seeding on light and uneven soils. The following table

illustrates the difference resulting from different dates of seeding and also gives a comparison of drilling and broadcasting.

Table V

EFFECT OF DATE AND METHOD OF SEEDING UPON THE YIELD OF ALFALFA AND SWEET CLOVER—(SANDPOINT SUBSTATION) 1923

Date of Seeding	Method of Seeding	Yield Pounds Per Acre	
		Alfalfa	Sweet Clover
(1) March 21	Broadcast	5508	5112
(2) April 2	Broadcast	4320	5796
May 17	Drilled	6264	6840
May 17	Broadcast	6300	10404
(3) July 8	Drilled	3600	4968
July 8	Broadcast	7632	6048
Sept. 11	Drilled	Killed	Killed
Sept. 11	Broadcast	Killed	Killed

(1) Sown on top of ten inches of snow.
(2) Sown on honey-combed ground.
(3) Sown after rain.

After broadcasting, it is necessary to cover the seed with a light drag. A smoothing harrow with the teeth set at an angle of about 30 degrees is suitable for this purpose.

Use the Roller

Owing to the light nature of many of these soils it is essential that they be packed after seeding. Various types of packers, cultipackers and light rollers are on the market and may be used for this purpose. The home-made log roller also has been used to advantage for this operation. Rolling the land at seeding time assists in keeping the moisture near the surface until the young plants have become firmly established. It also permits a more uniform germination and promotes a greater early growth. On sandy soils having a tendency to blow, a corrugated roller should be used.

NURSE CROPS

Seedings made at the Sandpoint Substation using nurse crops have proved unsatisfactory. In practically every case where a nurse crop was used there was a total loss of stand. In years of abnormally high rainfall, satisfactory stands have been obtained using a nurse crop, but even in such years the legumes received a setback that was evident the second year of growth. On the upland portions of the cut-over lands the use of a nurse crop is not considered advisable. While many farmers have obtained stands with nurse crops in wet years, the loss of stands in dry years more than offsets such gains.

The feeding vlaue of the legumes is so much higher than any nurse crop that can be used that it is more profitable to seed legumes alone. On some of the river bottoms and lower ground, a nurse crop can be safely used. In general, it is permissible to use a nurse crop in any place where there is ample moisture thruout the entire growing season. This also will hold true if the farmer has a stream from which he can irrigate his fields during the dry portion of the year.

THE FIRST YEAR CROP

Where the weed growth is heavy, it sometimes is desirable to clip the crop the first year. The best time to do this is when the soil is moist. At that time there is less injury to the plants from the use of the team and machinery. If the growth is heavy, it is well to rake the weeds and remove them from the field; otherwise they will be picked up in the crop the following year and spoil the appearance and value of the hay.

In cutting for hay the first year, the cutting bar of the mower should be left higher than is usually done in mowing older stands. This leaves a stubble that is more effective in retaining the snow. This especially is desirable in localities where the snow drifts badly.

USING MIXTURES

Under ordinary conditions the use of various legumes in a mixture for seeding is not recommended. The dates at which each is best suited to cut for hay show a wide variation and while a certain date would be satisfactory for one particular kind of hay, it would not be suitable for another.

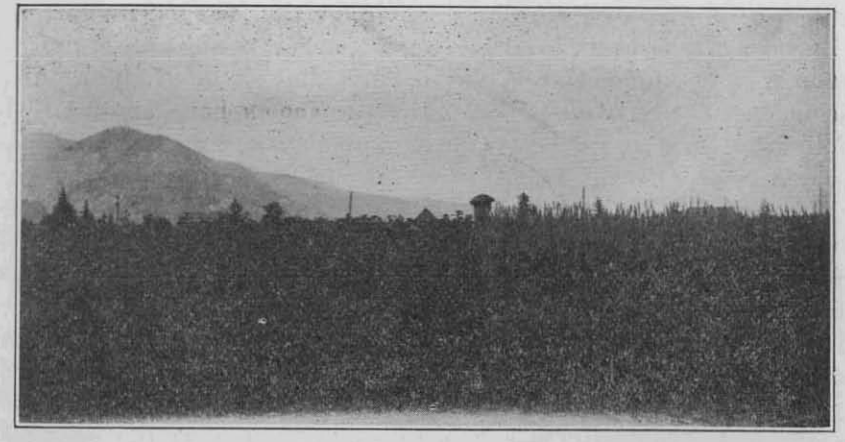
Under Sandpoint conditions, sweet clover is usually ready to cut by June 25, alfalfa by July 1, red and alsike clovers and timothy by July 10, and mammoth red clover about July 15. For second cuttings, alfalfa can be cut about the middle of August, sweet clover at approximately the same time and red clover near the last of August. With suitable weather conditions, a third cutting of alfalfa generally can be obtained by the last of September.

SWEET CLOVER

In work done at the Sandpoint Substation, the biennial white sweet clover has far out-yielded the biennial yellow. The yellow sweet clover makes a slightly greater growth early in the season, but this is not sufficient to make up for the difference in tonnage secured from the white species. Hubam clover also has been tried but the results secured have not been satisfactory.

A few points in the handling of sweet clover differ from other

clovers, and from alfalfa, and should be familiar to the grower. One of the chief differences is that of height of cutting. With sweet clover, it is possible to practically kill out the crop by mowing too close to the ground. The second growth of the plant is made from the lower buds on the stem and not from the crown, as is the case of alfalfa and red clover. It is necessary therefore, to leave a stubble from six to eight inches in height. The next difference is that of time of cutting. With the other clovers cutting usually takes place after full bloom. It is important that sweet clover be cut considerably before that time. The time when a good quality hay can be obtained is when the plants have made a growth of about 30 inches. At that time the stems are fine and succulent and if let go much beyond that point become hard and woody. The prejudice of some



Crops on Cleared Land

farmers against the use of sweet clover as a hay crop usually is found to be due to their letting the crop get too old before cutting. It is never difficult to get stock to eat well made sweet clover hay, even tho some refuse it the first time it is fed.

Sweet clover as a pasture crop is unexcelled among the crops for the cut-over lands. It has been shown that the carrying capacity of sweet clover is from two to three times greater than the mixed pastures of clover and timothy or bluegrass. This is due not only to its greater growth early in the season, but also to the fact that it continues its growth through the dry summer months. Some of the experiment stations have found that sweet clover makes a very satisfactory silage crop.

ALFALFA

Alfalfa is one of the most promising hay crops for the upland portion of the cut-over section. Its deep root system enables it to penetrate to a great depth in search of moisture and plant food. This extensive feeding area enables it to withstand the drought of midsummer far better than any of the true clovers. It is adapted to a variety of soils of this section and when once well established proves an abundant yielding plant. It is not recommended for peat lands and has not proved satisfactory on poorly drained mineral soils, but where drainage on upland soils is good alfalfa does well.

When to Cut for Hay

The best indication of the time to cut alfalfa for hay is the appearance of the shoots which develop for the following crop. The development of shoots from the crown for the production of another crop is very different from the methods of growth of the ordinary legumes. If delayed too long after the shoots have appeared, the following crop is severely set back and no new growth will be observed for some time. If cut before the shoots appear the chances are that the crop will not have reached its maximum development. Some recommend cutting when the crop is in full bloom, but under North Idaho conditions this delays the growth of the next crop from two to three weeks and when practiced only allows of two cuttings a year.

In good haying weather alfalfa can be mowed one day, raked and bunched the day following and after a few days of field curing put directly into the barn. If placed in small cocks about the size that can be handled in one fork full, there is less shattering of the leaves in handling and more rapid curing. If weather conditions are extremely dry and the stems and leaves wilt and dry out quickly, it may be raked and bunched the same day it is cut. Alfalfa or other hays should not be put in the barn when wet or damp with external moisture such as heavy dew or rain, because of danger of spontaneous combustion from excessive heating. There also is danger of producing a poor, dusty grade of hay by mildewing and bleaching. If grown in mixture with other hay crops a longer time should be allowed for field curing, as practically all the other hay crops require a longer time to remove the moisture from the plant.

MEDIUM RED AND MAMMOTH RED CLOVER

There is very little difference between the handling of medium red and mammoth red clover as a hay crop. One of the chief objections to these clovers is that they are not as satisfactory in years of low rainfall as the deeper rooted plants such as alfalfa or sweet

clover. The hay produced from these clovers is of good quality and a very satisfactory feed for cattle and sheep. The best quality hay is obtained when cut in full bloom. The palatability and digestibility decrease when the hay is cut at later stages. Medium red clover usually furnishes one good cutting and in years of high summer rainfall a second. Medium red clover usually is considered a biennial and mammoth red a short-lived perennial but evidences are at hand on farms of the cut-over district that these clovers have persisted over much longer periods. In some cases they have maintained themselves over periods ranging from 10 to 20 years.

ALSIKE CLOVER

Alsike clover finds its best adaptation to the low, wet lands. It also is more tolerant of acid conditions than most of the other clovers. Under North Idaho conditions alsike usually runs out after three or four years. It also is more susceptible to drought than red clover under upland conditions. In wet years it has a tendency to lodge and make a coarse, stemmy hay. It should be cut just after full bloom but if it appears that the crop is going to lodge prior to that time, an earlier cutting is more satisfactory. Alsike clover rarely makes sufficient growth for a second cutting.

VETCH

Vetch has produced satisfactory crops in the years it has been tested at the Sandpoint Substation, but it is doubtful if it will ever be grown to any great extent on the cut-over lands. The fall sown varieties are much more suitable than those seeded in the spring. For best results vetch should be seeded between the first and middle of August. Hairy vetch and Hungarian vetch are two varieties most suitable for fall planting. When cutting for hay the crop should not be left past the full bloom stage. The second growth of the plant, in some instances, furnishes considerable hay and pasture. As yet no insect pests have proven troublesome to this crop on the cut-over lands.

FIELD PEAS

Peas often are used alone and in mixture with grain as a hay crop. They are one of the most satisfactory annual hay crops adapted to these lands. When peas are grown alone, they should be cut before the pods begin to ripen. The same holds true with a mixture of peas and oats. The most satisfactory rate of seeding for peas and oats has been—peas, 90 pounds and oats, 50 to 70 pounds per acre. Since there is a considerable difference between dates of maturity of varieties of peas and oats, it is necessary to use two varieties that

mature at practically the same time. White Canada peas and Idamine or Silvermine oats have been found satisfactory from this standpoint.

TIMOTHY AND CLOVER

A mixture of timothy and clover makes a very satisfactory hay for the first two or three years after sowing. After this time the clover gradually disappears, leaving only timothy. The greatest difficulty from the standpoint of the soil lies in the fact that after the clover disappears the timothy uses the supply of nitrogen left by the clover.

The use of timothy alone is to be discouraged as the timothy plant removes large amounts of plant food and adds nothing to the soil, leaving it as badly depleted as if wheat had been grown. It is only when grown with clover that any plant food is added to the soil. A mixture of timothy and clover should be plowed before the clover has run out. The crop should be cut when the clover of the mixture is passing the full bloom stage.

FERTILIZERS

In May, 1921, a series of plots were laid out on the Sandpoint Substation farm for the purpose of testing the effect of certain fertilizers on various legumes. The following crops were seeded: Alfalfa, alsike, medium red clover, sweet clover, a mixture of legumes and non-legumes, peas and vetch. With the exception of the peas and vetch, the seed was sown broadcast, covered with a smoothing harrow and rolled with a corrugated roller. These plots were treated with phosphorous, gypsum and lime. The phosphorous was applied in the form of treble super-phosphate at the rate of 125 pounds per acre. The gypsum was applied at the rate of 200 pounds per acre and lime at the rate of one ton per acre. All applications were made to the soil before seeding and thoroly mixed with the soil by disking and harrowing. These applications were made just previous to seeding in 1921 and nothing has been added since. A record of the results is contained in Table VI. From Table VI. it is seen that the effect of gypsum is much greater on biennial and perennial legumes than on the annuals, such as peas and vetch. This effect is also reflected in the yield of sunflowers following these annual legumes. In years of normal or abnormally high rainfall, the improved condition of the gypsum plots was very apparent. In years of low rainfall, the gypsum plots were the only ones producing a satisfactory second cutting.

The outstanding increases in yield have been obtained thru the use of the gypsum. While phosphorus and lime have produced some increase in production, the gypsum has proved to be the most profit-

able material to use. The greatest increase in tonnage has been secured on alfalfa, with sweet clover second. The relative profitableness of these applications is made more apparent in Table VII. in which the increase over the cost of materials is compared. The cost of materials is as follows: Phosphorus, $60.00 per ton; gypsum, $15.00 per ton; lime, $8.00 per ton. These prices, as well as those assigned to the crops, are about the average at Sandpoint for these commodities.

Table VI
EFFECT OF PHOSPHORUS, GYPSUM AND LIME ON YIELDS OF LEGUMES AND SUCCEEDING CROPS—(SANDPOINT SUBSTATION, 1922-1924)

Seeded 1921 (1)	No Treatment Pounds per acre	Phosphorus Pounds per acre	Gypsum Pounds per acre	Lime Pounds per acre
1922 Yields				
Alfalfa	1560	1635	1455	1370
Alsike	1000	1200	1050	1090
Meadow Mixture	1345	1360	1575	1250
Sweet Clover	1090	1120	1130	1160
Red Clover	1720	1830	2450	2050
Peas (2)	-------	-------	-------	-------
Vetch (2)	-------	-------	-------	-------
1924 Yields				
Alfalfa	4790	5640	8320	6150
Alsike	3600	3720	5510	5080
Meadow Mixture	4370	4740	6430	5130
Sweet Clover (3)	1770	1910	2480	2200
Sunflower (4)	9160	10320	14740	10980
Peas	1740	1660	2260	2240
Vetch	2500	2200	2700	2440
1923 Yields				
Alfalfa	2090	2750	5530	2530
Alsike	980	1130	1740	1080
Meadow Mixture	1620	1640	2400	1460
Sweet Clover	2470	3640	7020	4350
Spring Wheat (5)	11.5 bu.	16.9 bu.	17.7 bu.	13.2 bu.
Sunflowers (6)	6420	7860	8750	10340
Sunflowers (7)	6060	5320	5200	6780

(1) No yields obtained in 1921.
(2) No yields obtained because of drought.
(3) Clipping, first year's seeding.
(4) Following red clover.
(5) Plot in red clover in 1922, sunflowers in 1923.
(6) In peas in 1923.
(7) In vetch in 1923.

It will be noticed in the 1922 yields that red clover was the only crop which gave a marked increase from the use of gypsum. The

diffreence between the yield of the gypsum plot and the unfertilized area was 730 pounds. In 1923 all of the gypsum plots gave considerable increase over checks, the lime plots a favorable increase and the phosphorus plots only slight increases. The greatest difference was found where gypsum was applied to alfalfa. The difference in that particular case was 3530 pounds per acre. An average of all the hay crops shows that phosphorus increased the production 6.9 per cent, lime 23.7 per cent and gypsum 47.5 per cent. Sunflowers following the red clover showed the benefit of the greater growth of clover and this also was reflected in the yield of spring wheat in 1924.

Table VII
INCREASE PER ACRE OVER THE COST OF MATERIALS PRODUCED BY APPLICATION OF PHOSPHORUS, GYPSUM AND LIME

Crop	Net Increase Over Check		
	Phosphorus	Gypsum	Lime
Alfalfa	$8.14	$49.99	$4.08
Sweet Clover	6.30	38.25	2.85
Meadow Mixture	(1)— .71	21.53	(1)— 4.21
Wheat)	(1)— .23	18.89	4.53
Alsike			
Red Clover)	4.22	18.55	(1)— 1.09
Sunflowers) (2)			

All hay crops valued at $15.00 per ton.
Sunflowers valued at $3.00 per ton.
Wheat valued at $1.00 per bushel.
(1) Loss.
(2) Total for rotation.

The year 1924 was much drier during the summer months than the same period in 1923 and the effect of the gypsum during that year is far more strikingly shown than in the preceding years. The average of all the hay crops during the 1924 period shows that phosphorus produced an increase of 27.9 per cent, lime 31.5 per cent and gypsum 133.0 per cent. From a consideration of these yields it is evident that there is sufficient justification for the use of gypsum on the cut-over areas of North Idaho.

In order to fully appreciate the value of gypsum in increasing the production of legumes, one should make a careful study of Table VII. The data in this table were obtained by comparing the total production from the plots to which phosphorus, gypsum and lime had been applied with yields of the check plots. For example, in the case of alfalfa, the total production for the three years was 8440 pounds from the check, 10,025 pounds from the phosphorus plot, 15,305 pounds from the gypsum plot and 10,050 pounds from the lime

plot. The increase over the check amounted to 1585 pounds for phosphorus, 6865 pounds for gypsum and 1610 pounds for lime. The total value of the increased production at $15.00 per ton amounts to $11.89 for phosphorus, $51.89 for gypsum and $12.08 for lime. The net value of the increase was obtained by deducting the cost of materials from the value of the amount produced above the yield of the check. This leaves a net gain of $8.14 for the application of phosphorus, $49.99 for the application of gypsum and $4.08 for the application of lime. These values are not to be taken as the maximum that may be obtained from those materials because out of the three years included in the results two were abnormally dry. It is not known how much longer the treatments may affect production. The results reported may be considered as a minimum rather than a maximum. Some farmers have reported greater increases than given here from applications of gypsum, but unfortunately the yields were not carefully compared with check plots.

The much greater profit derived from a small initial investment makes the use of gypsum very attractive. As a result of other experiments conducted on practically every soil type in Northern Idaho, sufficient increases have been secured to warrant recommending the use of gypsum on legumes on the soils of Northern Idaho. If doubt is felt regarding the value of gypsum, it should be tried first experimentally on a small area.

GYPSUM AS A FERTILIZER

Gypsum is used as a fertilizer in these experiments and as such furnishes sulphur to the soil. Sulphur is used by legumes in considerable amounts and is one of the elements essential to plant growth. Much the same results are obtained in some of the Northwestern states by the use of commercial sulphur. Under the climatic conditions in Northern Idaho, gypsum is found to be more satisfactory than sulphur on account of becoming available to the plants more quickly. Gypsum also acts as an indirect fertilizer in that it renders available certain of the other minerals, especially potassium and phosphorus.

It will require additional experiments to determine the amount and frequency of applications of gypsum that will be the most profitable. From the experiments already conducted it is quite evident that the effect of one application of 200 pounds of gypsum at the time of seeding will produce a marked effect the fourth year after its application.

The effect of gypsum does not always become apparent the first

year. If the season is dry, a much more marked effect will be shown the second year after its application. The beneficial effect often does not become apparent on new ground until the second or third year after its application, as there is sufficient sulphur in many of the Northern Idaho soils to meet the needs of legumes for the first few years. It is on old alfalfa fields that the most striking effect often is shown the first year, especially if the application is made in the fall.

When to Apply Gypsum

Gypsum can be applied at any time one can get on the land. It should not be placed on the snow, as much will be lost when the snow melts. For new seedings it is desirable to apply it before seeding, working the gypsum into the soil by disking or harrowing. For established stands of legumes it is desirable to apply it in the fall, as a much greater benefit will be obtained the first year. If it is impossible to apply in the fall, spring applications will usually produce some benefit the first year, provided the rainfall is normal.

Does Gypsum Injure the Soil?

Gypsum is added to the soil to make up a deficiency of sulphur which exists in many of the soils of the Northwest. The amounts recommended for use are not sufficient to have any injurious effects on the soil.

Amount of Gypsum to Apply

On most soils that show a benefit from applications of gypsum it is recommended that 200 pounds be added at the time of seeding, or the same amount be used on a top dressing to establish stands of legumes. Subsequent applications at intervals of from two to four years will furnish all the sulphur needed by the crops. In some sections it is a general practice to apply 100 pounds per acre of gypsum every year to old stands of alfalfa. This may be a heavier application than is necessary.

Method of Application

The most satisfactory implement for spreading fertilizer is a fertilizer drill. Where this is not available, it can be either applied by hand or by a manure spreader. Grain drills have not proved satisfactory for distributing gypsum as there is a tendency to clog the machine and the lack of agitators in the drill prevents the material from working thru freely.

ROTATIONS

No attempt will be made in this bulletin to set forth rotations suited to all conditions in North Idaho. The type of rotation used will be governed by the need of the farm furnishing products for the family, the livestock and the market. If the major activities of the farm consist of some form of livestock production, the choice of

crops will be somewhat different than where only a small amount of livestock is maintained. Because of the natural deficiencies of these soils, it is necessary that the rotation be build upon legumes. For the first few rotation periods the land should be in legumes the same number of years it is occupied by other crops. The most satisfactory type of rotation is founded upon the biennial type of legumes. This gives a four-year rotation in which the land is in a legume two years and in other crops for the same length of time. If alfalfa is used in place of the biennial legumes, the rotation period necessarily will be longer, but it does not follow that the land should be in other crops for the same period that it has been in alfalfa. A cultivated crop should be included in the rotation to permit clean cultivation for the control of weed growth.

Examples are given below showing the manner in which rotations will work, using biennial legumes.

Rotation I	Rotation II
1st year, Sweet clover	Red clover
2nd year, Sweet clover	Red clover
3rd year, Winter grain	Potatoes or other cultivated crop
4th year, Potatoes, corn or sunflowers	Spring grain

The program as outlined in the preceding pages would mean that on the farms in the cut-over areas one-half the land would be in legumes and one-half in other crops. This would increase the acreage of hay crops very materially in some sections and continue to increase the acreage in hay as more land is cleared and put under cultivation. As the acreage of hay increases it probably will cease to be a profitable crop. Even tho this condition does arise, the farmer should not reduce his acreage of legumes but should seek a market thru livestock. Livestock farming fits into a soil building program for these lands better than a system in which the crops are sold off the farm. By a system of pasturing and feeding of materials raised on the farm a greater amount of fertility produced by the legumes can be retained on the farm.

CONCLUSION

The cut-over lands of Northern Idaho present excellent opportunities for some form of diversified farming.

The chief difficulty experienced by the farmers on the cut-over lands has been that of bringing their land into a satisfactory state of production. The results presented in this bulletin show that by the proper use of legumes and gypsum these difficulties can be overcome at a cost that is within the reach of every farmer.

The maintenance of correct rotations, the proper selection of crops and the use of livestock are considered essential to profitable farming of the cut-over lands.