DOMINION OF CANADA
DEPARTMENT OF AGRICULTURE
DOMINION EXPERIMENTAL FARMS

EXPERIMENTAL SUB-STATIONS

BEAVERLODGE, ALTA.
FORT VERMILION, ALTA.
GROUARD, ALTA.
FORT SMITH, N.W.T.
FORT RESOLUTION, N.W.T.
SWEDE CREEK, YUKON.
SALMON ARM, B.C.

Interim Reports of the Experimentalists in Charge

FOR THE YEAR 1921

Printed by authority of the Hon. W. R. Motherwell, Minister of Agriculture, Ottawa, 1922

OTTAWA
F. A. ACLAND
PRINTER TO THE KING'S MOST EXCELLENT MAJESTY
1922

EXPERIMENTAL SUB-STATION, BEAVERLODGE, ALTA.

REPORT OF THE SUPERINTENDENT, W. D. ALBRIGHT

SEASONAL NOTES

The season of 1921 was the third successive one at Beaverlodge characterized by copious rainfall during the maturing stage of the grain-production period. The year 1920 was humid both early and late, but the current season, like 1919, was dry in the early months, with the bulk of the April to September precipitation occurring after the middle of July.

Taking it by months, the summer precipitation was as follows:—

	Inches
April	0.03
May	1.65
June	2.04
July	1.89
August	2.51
September	2.69
October	0.67
Total	11.48

Of this, 8.12 inches occurred during the five months April to August, but only 4.54 inches prior to the middle of July. Spring opened early, April being dry and rather warmer than usual. Over some parts of Grande Prairie seeding commenced near the beginning of April, but on the Station the first plots were sown on the 18th. One effect of the dry, early summer was to handicap severely any fields that had been depleted of moisture and nitrates by the production of a heavy crop of grain or grass in 1920, and, conversely, to confer an unusual percentage of advantage upon summer-fallow.

Striking confirmation of this was furnished by three blocks of Liberty, Ottawa, 480, Hulless Oats. One area, seeded in April on well-prepared spring ploughed land of good natural quality, where sixty-four bushels per acre of these oats had been harvested in 1920, yielded, this year, only twenty-five bushels and six pounds. An inferior piece of land, which had also produced hulless oats last year, was spring-disced, then later ploughed and seeded on May 21, yielding thirty-four bushels and twenty-seven pounds per acre. Two acres of summer-fallow of natural soil quality similar to the second piece of stubble ground, were seeded April 28 and yielded seventy-five bushels of hulless oats per acre, more than twice as much as the later-sown piece of spring-ploughed stubble and practicaly three times as much as the early-sown area of stubble. These results are the more remarkable when it is remembered that heavy precipitation in the latter part of 1920 had accumulated an unusual reserve of subsoil moisture. They tally, however, with a large amount of other data recorded at this Station and suggest the question whether soluble nitrogen (nitrates) may not, along with moisture, be a very important limiting factor in Grande Prairie crop production. Whilst the soil is rich in the elements of plant food and capable of producing enormous crops when thoroughly worked in such a way as to bring sufficient nutrients into available form, the period during each summer when there is sufficient heat and moisture in the upper soil layers for nitrification to proceed rapidly is doubtless comparatively brief. Sometimes when the soil is warm enough there is lack of moisture and again at other times when moisture is present the temperature is too low.

On the other hand, the rather moderate annual precipitation here, and the steadily frost-bound conditions of the land throughout most of the dormant season, probably go far to ensure retention over winter of a goodly proportion of such nitrates

as may be accumulated by a summer's tillage. It is not to be expected that leaching of these accumulated nitrates would occur to anything like the same extent as in the Maritime provinces, the coast regions of British Columbia, or even Ontario.

These considerations offer a plausible explanation in part.

(1) Summer-fallow or hoe-crop ground commonly produces about twice as heavy grain crops as stubble ground, however treated, always provided that the crops on the former stand up and ripen.

(2) Stubble land generally throws a much ranker crop of straw from a medium-late than from a very early sowing.

(3) Late breaking of sod yields quite inferior returns as compared with properly worked early breaking, even in cropping seasons of ample precipitation such as 1917 and 1920, the sod plainly not rotting in time to feed the crop properly.

(4) Sod of inoculated legumes is followed by much better yields of grain than is grass sod.

(5) Broadcast Rape (which, according to investigation reported by the Dominion Chemist in 1900, is a crop demanding considerable soil nitrogen in the first six weeks after germination) grew only three or four inches tall when sown May 6th this year on spring-ploughed land that had produced a hundred bushels of oats per acre in 1920, where as on well-prepared fallow, or as a cover crop in the orchard, rape always thrives nicely at Beaverlodge.

(6) Alfalfa, where inoculated, yielded in 1921 far more abundantly than western rye grass in a ley of three years' standing.

(7) Broadcast legumes, when not inoculated, do well enough the first year if seeded alone on properly prepared land, but frequently fail conspicuously thereafter except on the margins along cultivated paths, where tillage insures an extra supply of soil nitrates. (Inoculated legumes are nearly as good in the centre of the plots as along the margins.)

(8) Manure is slow in its action, producing in the experiment conducted here to date much better results in the third and fourth than in the second season following its application.

Summer Temperature Records

Accurate meteorological records have been registered at Beaverlodge for the past six years, 1916 to 1921. Examination of these brings out the following averages and means of monthly temperature:

Month	Six year average maximum temperatures	Six year average minimum temperatures	Six year mean of maxima and minima
	° Fahr.	° Fahr.	° Fahr.
April	47·20	26·39	36·79
May	57·40	34·30	45·85
June	65·48	41·81	53·64
July	70·93	46·29	58·61
August	68·10	44·74	56·42
September	60·44	36·98	48·71
October	46·76	27·51	37·13

While these records of atmospheric temperatures do not establish the soil temperatures, they are worthy of attention as bearing inferentially upon the question of nitrification. Soil thermograph records, which it is proposed to keep henceforth, should throw further light on the subject.

SEASON FAVOURED LATE VARIETIES

The seasonal data discussed above will readily indicate that late-maturing crops and late maturing varieties possess, this year, an undue advantage in yield comparisons, especially since autumn low temperatures held off until September, the first hard, killing frost occurring on the night of September 8. There were irregular occurrences of local light frosts early in July, which cut potato tops in some localities, including one portion of the Station area, and injured a few scattering pieces of grain in the blossom. The spring rye plots on the Station were apparently affected to some extent in this way. In the main, however, the cropping season was a remarkably good one throughout the Peace River District, the best since 1915 for summer-fallow and breaking, though crops on fall and spring ploughing were distinctly below normal, on Grande Prairie, at least. At widely scattered points, both north and south of the Peace, there were credibly attested field yields running around sixty bushels and over of wheat and one hundred bushels and upwards of oats. Eighty bushels of barley was also claimed by one Grande Prairie farmer.

From causes that will be specifically explained, the cereal plot yields on the Station do not compare so well as usual with the general average of commercial production. Still they are creditable. The variety comparisons are more accurate and instructive than ever before. Unlimited pains are taken with all the work and no reasonable effort spared to arrive at trustworthy conclusions.

TABLE of Meteorological Observations taken at Beaverlodge, Grande Prairie, Alberta, from April 1, 1921, to March 31, 1922, giving the maximum, minimum, and mean temperature, the highest and lowest for each month with date of occurrence, also rainfall, snowfall, and total precipitation.

Months	Maximum	Minimum	Range	Mean	Highest	Date	Lowest	Date	Rainfall	Snowfall	Total Precipitation	Number of days Precipitation	Heaviest in 24 hours	Date
	°	°	°	°	°	°	°		in.		in.			
April	50·13	28·93	21·20	39·53	64·0	11th	18·0	rd	0·03	.....	0·03	1	0·03	14th
May	59·67	36·69	22·98	48·18	77·0	19th	27·0	4th	1·65	.....	1·65	7	0·56	26th
June	68·16	41·63	26·53	54·89	75·0	5th	31·0	1st, 2nd, 3rd	2·04	.....	2·04	10	0·59	25th
July	70·77	44·96	25·80	57·86	77·0	15th, 25th, 27th 30th,	34·0	7th	1·89	.....	1·89	13	0·46	25th
August	66·25	44·33	21·91	55·28	80·0	1st & 14th	35·0	5th & 10th	2·51	.....	2·51	11	0·56	8th
September	56·41	34·68	21·73	45·54	73·0	15th	21·0	12th	2·69	.....	2·69	7	1·15	1st
October	52·19	32·90	19·29	42·54	70·0	11th	20·0	6th	0·67	.....	0·67	6	0·32	8th
November	23·26	9·90	13·36	16·58	50·0	9th	−17·0	18th & 21st	0·45	4·60	0·91	7	0·31	2nd
December	26·77	8·54	18·22	17·65	51·0	4th	−30·0	19th	.....	6·00	0·60	4	0·20	14th & 23rd
January	22·67	5·03	17·64	13·85	42·0	12th & 13th	−29·0	22nd	.....	17·50	1·75	10	0·30	19th & 29th
February	9·21	−8·82	18·03	0·19	40·0	28th	−30·0	8th & 12th	.....	17·50	1·75	6	0·50	6th
March	26·87	5·70	21·16	16·28	47·0	1st	−20·0	11th	.....	12·00	1·20	5	0·60	21st
									11·93	57·60	17·69	87	.....	.....

FORAGE CROPS

SECTION I.—INTRODUCTORY

Over twenty acres of land were devoted to experiments with forage crops. The work is treated under ten sections:—

I. Introductory.
II. (Subsections *a* and *b*) The Nurse Crop Experiments.
III. Grass and Clover Mixture Experiments.
IV. Thickness of Seeding Test with Grasses.
V. (Subsections *a* and *b*) Special Alfalfa Experiments.
VI. Inoculation Tests with Legumes.
VII. Legume Root Penetration of Hard Sub-soils.
VIII. Grasses and Clovers for Seed Production.
IX. Variety Tests with Corn and Sunflowers.
X. Field Roots.

Among a number of valuable phases of the work with forage crops, the results with legumes stand easily first. Inoculation has changed failure into a moderate success. This statement is based not upon one bit of evidence, or two, or half a dozen, but upon scores of facts ascertained through many hundreds of plots. The clear light of definite knowledge has been thrown upon the subject. It has been shown that numerous failures with clover and alfalfa which had been ascribed to impervious subsoil, lack of moisture and other causes have been more largely due to lack of inoculation.

Alfalfa roots fourteen months old have been dug up out of hard-clay subsoil showing a measured average penetration of 42·3 inches, with the attenuated ends going still deeper. Corresponding measurements have been made of the roots of sweet clover, alsike and common red clover.

In the dry, early summer of 1921 when yields of all gramineous hays were particularly light, various inoculated plots of the legumes yielded more heavily than the grasses and in a certain three-year-old stand of alfalfa and Western rye grass, irregular areas where alfalfa had become naturally inoculated and had, in consequence, no doubt, persisted, yielded fully twice the crop of hay that grew on areas where the alfalfa had died out and only the rye grass remained. The persistent patches of alfalfa grew above a subsoil so hard that it could not easily be dug with a mattock.

Until 1921 there was never a nurse-crop seeding of clover or alfalfa worth leaving for hay. None had been inoculated and all had failed. But in 1920, in a certain supplementary experiment, a plot each of alfalfa, sweet clover, common red clover and alsike were seeded with oats, it being the third successive cereal crop following breaking. The seed this time was treated with nitro-culture. The same legumes had been seeded here the previous season without inoculation and had failed. The 1920 seeding reversed all previous experience. Excepting the alsike, which headed prematurely, as it is prone to do in dry seasons, they yielded in 1921 about twice as much hay per acre as brome, western rye or timothy alongside, seeded at the same time and under the same conditions.

Certain un-inoculated plots of alfalfa and clovers were sown alone in 1920 as check ranges in the nurse crop test. They "caught" well and were kept clean, yet in 1921 yielded but a few hundred pounds of hay per acre. Some raked up nothing at all. Even the sweet clover was almost a complete failure. A hundred rods from these, on similar land, less perfectly prepared, were plots of the same legumes sown a little later in the season with nitro-culture-treated seed. These produced in 1921 an even, healthy growth, averaging a foot high in the case of alsike, a foot and one-

half in the case of red clover, two feet in the case of alfalfa and three to four feet in the case of sweet clover. The respective yields were 1,142 pounds per acre of alsike, 2,631 pounds of common red clover, 3,364 pounds of alfalfa, and 4,708 pounds of sweet clover, and these in one of the most unfavourable seasons for hay on record.

It is true that common red clover is not satisfactorily hardy and that neither it nor alsike—but particularly alsike—stands dry weather well. In a droughty season they head too low. It is true also that alfalfa does not mature much seed at Beaverlodge, though it pods abundantly. Remained to find a legume that would be hardy, would mature seed reliably and not be easily dwarfed by unfavourable weather into a precocious heading out. It looks as though this may have been found in the late Swedish clover, distributed from the University of Alberta under the name of Altaswede. A very small-scale test at Beaverlodge affords ground for encouragement. If it fills the bill it will be worth untold millions to the future of the Peace River country. If it fails we can still make advantageous use of the legumes mentioned above.

In one of the earlier reports from this Station the statement was ventured that this should be a great country for legumes. It was based largely upon the prevalence and luxuriance of the wild species of *Leguminosae.* Subsequent experience with the domesticated species threw cold water upon the hope. It was found that in favourable growing seasons they would do fairly well but in adverse seasons the only growth worth mentioning was on the borders of the plots. Nurse crop seedings failed outright. It is now clear that in the absence of inoculation they were stunted not merely by lack of moisture but as much, or more, by lack of an adequate supply of nitrogen, for inoculated plots are nearly as good in the centre of the areas as on the margins bordering cultivated paths; this, too, whether the season be wet or dry.

These conspicuous facts not only emphasize the importance of inoculation in order to make the legumes thrive, but equally emphasize the importance of introducing inoculated legumes into the rotation in order to enrich our soils in soluble forms of combined nitrogen, for the lack of an abundant supply of which it is always difficult to get two heavy crops of grain or grass in annual succession on the same land even though moisture be plentiful. The soil is rich enough, but after the land has produced one heavy crop of grain or grass there is liable to be a lack of available nitrogen in the early part of the next season. Hence legumes, important as they are in every agricultural country, seem likely to be especially important in a region with a cool, rather dry climate, resulting in a short season for nutrification. We need them badly to enrich our soils, increase our feed production and balance our live stock rations. We shall need them still more as time goes on. It is a matter of vast satisfaction that we are learning to grow them with a measure of success. Inoculation has proven to be a *sine qua non.*

In addition to the work conducted under direction of the Division of Forage Crops a fertilizer experiment with alfalfa under direction of the Division of Chemistry was seeded in duplicate in 1921. Basic slag, wood ashes, nitrate of soda, lime and manure are being tried singly and some in combination.

SECTION II—THE NURSE CROP EXPERIMENTS

Promising ultimate results of considerable value in several directions, the experiments under way to ascertain the most advantageous method of laying land down to meadow have already brought out a few facts of prime importance. Fairly comprehensive in scope, the seedings are being repeated year by year and very minute office records are kept with a view to determining at the end of a reasonable period such points as the following:—

(*a*) Whether it is more profitable to seed down with or without a nurse crop;

(*b*) In using a nurse crop, how much tonnage of hay one sacrifices in order to obtain a certain number of bushels of grain;

(*c*) Comparison of the total crop, weight of sheaves plus hay in the one case with the total weight of hay in the other;

(*d*) If using a nurse crop of cereals, what one is best and what rate of sowing of the nurse crop is desirable;

(*e*) Whether, when seeding without a nurse crop, a very early or a medium early date is preferable;

(*f*) Whether, when seeding alone it pays to clip and cure the crop offering in the year of seeding;

(*g*) Whether seeding alone and pasturing the new seeding may be depended upon to keep down weeds satisfactorily without disastrously impairing the stand of "seeds";

(*h*) Whether, when using a nurse crop, it is necessary to seed down with the first crop after summerfallow or whether a subsequent grain crop may be used to seed with;

(*i*) How the ten leading grasses and clovers compare one with another, as hay crops and how they, respectively, react to the various conditions and methods of treatment suggested above;

(*j*) How drought and other seasonal vagaries affect the various points under investigation.

SUBSECTION (*a*)—THE MAIN NURSE CROP EXPERIMENT

The fourth successive seeding of the main nurse crop experiment has now been made. It is so-called to distinguish it from the stubble nurse crop experiment, described in subsection *b*. The main nurse crop experiment has always been located on land that was either broken, summerfallowed, or hoe-cropped in the preceding season. The first two years' seedings were on breaking; the next on fallow, the fourth after a somewhat diverse preparation, but chiefly fallow and hoe cropping.

PLAN OF EXPERIMENT

In 1918 three acre-blocks of cereals, viz., wheat, oats and barley were each divided into four quarter-acre strips sown at various rates. Crosswise of the twelve quarter-acre strips of cereals, ten kinds of grasses and legumes were sown and harrowed in. These strips of clovers and grasses extended beyond the grain to provide a check range (A) seeded without any nurse crop. Range B was a second check, duplicating A only sown about a week later. At the end of August the south halves of the plots in both check ranges were clipped with the mower bar set high, and the clippings were cured into hay, which was weighed.

In the 1919 seeding the same general plan was followed, but, in addition, a quarter-acre of oats for green feed was sown May 21st and the hay seedings were extended across this, affording ten meadow plots more than in the year before.

The same plan was followed in the 1920 repetition of the seeding though, unfortunately, an infestation of shepherd's purse compelled the ploughing up of fifteen plots.

In 1921 the only departure made was in substituting for the green feed strip of oats a range where the grasses and clovers were seeded alone, to be pastured later, with a view, especially, of keeping down weeds. Space did not allow the inclusion of a green feed nurse crop under comparable conditions after this grazing test was allotted.

RATES OF SOWING AND OTHER DETAILS

The nurse crops in this experiment have not always been sown quite so thickly as the plan called for. The prescribed rates have been:—

Barley at 4, 6, 8 and 10 pecks per acre.

Wheat at 5, 6, 7 and 8 pecks per acre.

Oats at 10, 12, 14 and 16 pecks per acre.

The oats for green-feed were drilled in 1919 at five pecks per acre on one side of the strip, gradually thickened to ten pecks at the other.

The ten grasses and legumes were sown in 1918 at the following rates per acre:—

Alfalfa, red and sweet clover, 10 pounds each.

Alsike and white Dutch clover, 5 pounds each.

Timothy and western rye grass, 6 pounds each.

Meadow fescue, Kentucky blue and brome, 12 pounds each.

In 1919 the quantities of hay seed were increased 50 per cent practically all round. In 1920 the same rate was maintained for all except the timothy, which was dropped back to the original rate of six pounds. In 1921 the rye grass was increased to 12 pounds. These various changes have been made in quest of the optimum rate of each kind.

Particulars as to dates of sowing of both grain and grass in the first three years' seedings of this experiment were detailed in the 1920 report. Particulars concerning the cereals employed as nurse crops in the 1921 seeding may be found in section I of the current report on field husbandry at Beaverlodge. It is noted in said report that the 1921 seeding of the test was unavoidably marred by lack of equality in previous conditions of cropping, etc. Fortunately, the conditions under which the two check ranges of grasses and clovers were seeded are identical with conditions prevailing on the adjoining block of oats and nearly similar to the conditions on the wheat block. Not as much can be said of the relative conditions afforded each of the ten kinds of grasses and clovers under test. For instance, in the check ranges, in the oat blocks and part of the wheat block, the alsike and red clover strips were located on land that had produced hoe crop in 1920. The brome, Kentucky blue grass and part of the meadow fescue followed potatoes, while most of the remaining strips were on land fallowed in 1920. It was conspicuous that after turnips the initial year's growth of either clover or grass was far less rank than after summerfallow. The grains used as nurse crops were sown April 19 and 20. The grasses and clovers April 26. except check range B and the pasturing test which were not sown till May 7.

Some Points Already Established

For the most part, the figures presented in the accompanying tables should be regarded merely as a report of progress—a carrying of the records down to date—and the casual reader is advised not to bestow much attention upon any except the summaries, found in tables 6 and 7. Even these cover but two seedings in each case and since some variation in both natural and artificial conditions is liable to occur, it is unsafe to draw fine conclusions from anything less than the full cropping data of at least five years' sowings. Nevertheless, the work has already revealed some fundamental points. The most important one of all has been brought out incidentally. Along with other tests, the work under present review has demonstrated:—

(*a*) That is is usually a waste of money to sow the seed of clover or alfalfa without attending to inoculation. This is especially true if seeding with nurse crops is practised.

(*b*) The inoculated legumes are badly needed to maintain soil productiveness as well as to increase the yield and quality of hay mixtures and probably improve their profitable producing duration.

(*c*) That with inoculation insured, the legumes can be advantageously used to some extent at least.

Some Detailed Evidence Showing the Need for Inoculated Legumes

In the first and second years' seedings of the main nurse crop experiment, the alfalfa and clovers were sown without inoculation. Good germination occurred but by

autumn the stand of every legume was exceedingly weak and thin and by the following spring there was nothing really worth leaving for hay. From the 1918 seeding a very thin stand of sweet clover was cut and a few pounds of hay might have been taken from the other legumes where sown with the two thinnest seedings of barley. But "failure" was the word written in capital letters all across the first two attempts at seeding legumes with nurse crops and this despite the fact that copious precipitation in the fall of 1919 and the spring of 1920 afforded abundance of moisture to bring on the "seeds," in the case of the second attempts. Full stands of the grasses were secured on both occasions and while their yields of hay in the year following the grain were very light, nothing at all from Kentucky blue—still they occupied the ground and with one explainable exception, did considerably better in their second cropping season than in their first.

Moisture not the Only Factor Controlling Meadow Yields

The lightness of the hay crops succeeding grain has not always been due to lack of moisture. This is evident from the fact that in 1920, when both soil and sub-soil were thoroughly saturated in the spring and had their moisture supply liberally renewed by timely rains, the nurse-crop seedings, though carrying a full stand of plants, started very slowly indeed and made disappointingly light yields *especially in the hollows,* where the best hay usually grows. The most arresting illustration in this connection was furnished by the brome grass, which, after nurse crops, turned off in August only about half a ton of hay per acre, whereas the brome in the check ranges was much more forward and being mown at the end of July yielded three and a half tons of hay per acre, besides having furnished a ton in the year of seeding. In the next year the check plots yielded rather less than the nurse-crop seedings but the aggregate three years' yield of the checks was still more than three times the two-year aggregate of the plots seeded with nurse crops—11,430 pounds against 3,236. Similar contrasts, varying only in degree, were afforded by the other grasses under trial. This digression, touching upon the grasses, goes to indicate the need of legumes as components in our seeding-down mixtures.

Inoculated With Broadcast Soil—But Too Late

In 1920 the alfalfa and clovers in the main nurse crop test again had to be sown without inoculation, the nitro-culture requisitioned not having arrived in time. Late in the autumn, however, inoculated soil was scattered over the strips of new seeding, including check ranges A and B. It was too late for inoculation to confer its full benefit but decided advantage was apparent, *especially among the nurse-crop seedings.*

On the check ranges (no nurse crop) a first-class catch had been obtained in 1920 as is usual with this method of seeding, but by autumn the vigor had greatly diminished and the colour had faded, indicating that the cloven plants were suffering for lack of nitrogen. The ground here was by this time quite solid and it is conceivable that the inoculating soil spread late in the autumn did not readily find its way down to the roots of the growing clovers. At all events the benefit here was very tardy and irregular in manifesting itself the next spring, though it gradually spread in area and increased the vigor of growth throughout the summer, being far more general in the aftermath than in the first cutting. It is worthy of note that the sweet clover in these checks was a miserable failure, cutting in July but a very few pounds of hay per plot and nearly all of that from the few spots where inoculation had first taken effect. For some reason the alfalfa in these check ranges showed earlier and more general evidence of inoculation than did the clovers or melilot (sweet clover).

Inoculation Took Effect Sooner On The Nurse-Crop Areas

In the corresponding seedings among the grain, the alfalfa and clovers had "caught" splendidly at first, as usual, and then, as before, had languished sadly during the later stages of the growth of the cereals, notwithstanding a copious rainfall throughout most of the later part of the summer of 1920. By the time of scattering the inoculated soil late in October the legume seedlings, though somewhat in evidence among the stubble, were extremely weak and unpromising. Upon the opening of spring, however, they gradually revived and, contrary to all previous experience, promised to outyield the ranges seeded alone. Examination, both superficial and radical, indicated that inoculation had taken effect more thoroughly and readily among the grain-stubble plots than in the check ranges. The only hypothesis the Station staff can offer is that the grain stubble, perforating the soil (clay loam) may have provided orifices through which the inoculating material found its way down to the root systems of the legumes. It was greatly desired to leave these nurse-crop seedings of clover for hay but in the grain of 1920 and in the slow-starting legumes of 1921 too many weeds had become established, especially the pestiferous shepherd's purse, which exhibits incredible prolificacy in Grande Prairie. Hence the nurse-crop seedlings in this main test had once more to be ploughed up.

Plenty of Nodules Forming

In ploughing, a close watch was kept for nodules, which were found quite generally distributed, though by far the most numerous on the roots of patches which were becoming strong and green. On plants not yet noticeably invigorated it was common to find a few nodules forming. Under the more forward patches big compound clusters of healthy tubercles were always in evidence. A great many roots were carefully observed, and few, if any, were the exceptions to the rule as stated.

1921 Seeding Inoculated With Soil at Sowing

Directly after the 1921 seeding of clovers and alfalfa was completed, inoculated soil was broadcasted over the various strips at sundown and promptly harrowed in. Examination made among the check plots indicated that the method was fairly effectual.

The Best Nurse Crop

Reference to table 7 suggests the superiority of wheat and barley over oats as nurse crops. It will be noticed that so far the barley ranks second to the wheat. It has been a matter of surprise throughout the progress of this test to date how little advantage has been shown in favour of thin as compared with thick sowings of the nurse crops. By way of partial explanation it may be said that in yields of grain comparatively little difference has been found within the limits of this experiment since thin seedings largely make up by stooling and rank development for the thinness of their stand at germination. The difference in effect upon the grass seeding is correspondingly slight. A lodged nurse crop has been found particularly detrimental to the success of the seeding.

Nurse Crop Versus Seeding Alone

Under Grande Prairie conditions a so-called "nurse crop" is in reality a strangle crop. Rather more perfect "catches" and far heavier crops of hay have been obtained by seeding alone. Which method is the more profitable is another question. The decision will probably hinge finally upon the question of weed control. Grasses and clovers seeded without nurse crops become very weedy in the first season and clipping would not be effectual in preventing the seeding of such as lambs quarter, wild buckwheat and shepherd's purse. The test plots, of course, are hand-weeded but this would be out of the question on a field scale. A nurse crop holds weeds in check in the year

of seeding but in the weak slow-growing hay crop of the next year the weeds make up for lost time. So it is a case of which and t'other. A method practised by some farmers is to seed the grasses alone in June, July or August on land kept as clean as possible up to that time. If necessary, the mower is used afterwards to clip back weeds. Another method now under severe test at the Station is to seed alone in May and pasture closely thereafter to keep succulent weeds from seeding. This was tried in 1921 in a special pasturing range located on land badly infested with our most troublesome weed, shepherd's purse. A milch cow failed to keep this weed down in patches surrounding her droppings so three sheep were turned in to the paddock in August. Even these while grazing much that the cow had left, failed to clean off the weeds immediately fringing each lump of cow droppings. Everything else was sheared off pretty closely by the end of August and the remnants were then chopped off with a hoe. Had sheep been depended upon from the beginning they would probably have kept the weeds from seeding. As it was, a considerable amount of seed was produced and if the method of treatment proves effectual in this instance in producing a good crop of hay it will go far to vindicate the system.

A Comparison of Five Grasses

Study of table 6 will show that Western Rye grass and brome are the two heaviest yielders, followed by timothy, meadow fescue and Kentucky blue in order of mention. In 1921 Meadow fescue showed up better than usual and timothy not so well. The timothy did not do at all well in the second crop from the 1919 seeding. This shortcoming may have been partly due to the fact that in 1919 the timothy was sown at 9 pounds per acre, which is quite too much for this country, resulting speedily in a sod-bound condition. It is noteworthy in the case of the 1919 seeding that plots where the best "catches" had been obtained (notably the check ranges and, after these, the plots seeded with barley and with oats for green-feed) produced relatively disappointing yields of timothy. For instance, the plots seeded alone and clipped in the year of seeding gave in 1921 less than a quarter of a ton per acre. This emphasizes one of last year's observations that thick seedings tend quickly to become sod-bound.

What is "Sod-bound."

It might be well to arrive at a clear-cut definition of the term sod-bound. Having in mind the desire of British stockmen to establish century-old pasture bottoms comprising a large number of species of grasses and clovers originally laid down with a heavy seeding per acre, the writer has found it difficult to understand fully why, under Grande Prairie conditions, a six-pound seeding of timothy would become sod-bound and unproductive by the third year. He noted that when seeded alone on well-prepared land the timothy grew fast, producing a thick stand with short heads and generally cutting a ton and a half of cured hay in the year of seeding. Unless sown extremely thinly, it would very soon lose the tufted habit of growth characteristic of timothy in Ontario and develop instead, a lawn-like sod. If sown with a heavy-growing nurse crop the condition might be a year later in developing to the same degree. The nurse-crop seeding would give a very small crop in the first year after the grain, amounting to from one half to a ton per acre, but by the third hay-cropping season it, too, would be sod-bound, if not before. In a region capable of throwing from one hundred to a hundred and thirty-five bushels of oats per acre, this was puzzling. Why would a six-pound seeding (considered light in more humid countries), showing such precocity in its initial season, so soon become unproductive? Did its very precocity tend in this direction by quickly establishing a condition analogous to that where a quantity of grain is spilled; resulting in very fine-strawed plants which crowd one another to the point where none amount to much? If so, then what might be the factors stimulating this precocity? Is it the alleged rapid growth supposed to be produced by long hours of sunshine in high latitudes? That seemed improbable since an altitude of 2,400 feet

appeared to more than offset the effect of latitude, resulting not in a rapid but on the contrary in a protracted growing period and a delayed maturity of most crops. Why would such an environment act differently upon timothy than upon grain? Might the apparent precocity be attributable to the large store of available plantfood which summer-fallow accumulates for the crop to be sown on it? But when the timothy was sown with nurse crops or on land which had grown grain the previous season, the phenomenon was still substantially the same, only a little delayed. Plainly none of these suppositions met the case fully. Some information of hypothetical value is afforded by certain lysimeter experiments at Cornell University. Through these it was shown inferentially that nitrification proceeds very slowly in a soil laid down to timothy as compared, for instance, with the rate of nitrate production on corn land. This alleged tendency of timothy to depress nitrate formation, taken in conjunction with what we know of local precipitation and temperature conditions, would go to explain why in a ley of two or three years duration a crop like timothy would likely be handicapped, especially in a dry early summer, for the lack of both moisture and plant food. The writer, then, ventures to define a sod-bound condition as one in which too thick a stand of meadow plants exists to be adequately supported by the amount of moisture and plant food available. As to why a six-pound seeding of timothy will so quickly result in such a condition he is still unsatisfied.

Nurse Crop Table 1

Comparing yields of hay per acre from various grasses and clovers in the Nurse Crop Test.

Three years' results from the 1919 seeding.

Crop	Seeded without Nurse Crop							Seeded with Nurse Crop		
	Average yields S. halves, Ranges A. and B. clipped in 1919. lbs. per acre				Average yields N. halves Ranges A. and B. not clipped, 1919. lbs. per acre			Average yields following nurse crop. lbs. per acre		
	1919	1920	1921	Agg'te. 3 years	1920	1921	Agg'te. 2 yrs.	1920	1921	Agg'te. 2 yrs.
Alfalfa	800	1,520	.....	.....	1,480	.....	.....	.....	.....	.....
Alsike clover	800	1,160	.....	.....	480	.....	.....	.....	.....	.....
Common red clover	740	480	.....	.....	400	.....	.....	.....	.....	.....
Sweet clover	600	2,869	.....	.....	2,205	.....	.....	.....	.....	.....
White Dutch clover	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Timothy	2,480	3,675	360	6,515	2,875	500	3,375	1,263	1,260	2,523
Western rye	1,080	5,520	1,760	8,360	3,450	2,160	5,610	1,356	1,970	3,326
Meadow fescue	440	3,920	1,120	5,480	4,475	1,160	5,635	873	1,548·3	2,421·3
Kentucky blue	.....	3,595	480	4,075	2,855	640	3,495	.....	1,106·6	1,106·6
Brome	1,880	7,450	2,100	11,430	6,650	1,680	8,330	991	2,245	3,236
Totals grasses only	5,880	24,160	5,820	35,860	20,305	6,140	26,445	4,483	8,130	12,613
Averages grasses only	1,176	4,832	1,164	7,172	4,061	1,228	5,289	897	1,626	2,522·6

Notes.

(1) The clovers and alfalfa in the Nurse crop seedings were plowed up before any crop was obtained; in the check range after the 1920 crop was removed.

(2) All the plots left cut quite a clean crop, save the Kentucky blue. The yields of this, as recorded, are after an estimated deduction for weeds, chiefly yarrow.

(3) Low spots were noticed to have, in nearly all cases, a considerably heavier cutting than high spots, whereas the previous year in not a few instances, the knolls seemed rather heavier. This latter result was unusual.

NURSE CROP TABLE 2

Comparing various cereals and rates of sowing of them as nurse crops; also seeding with nurse crops versus seeding alone, etc. Average yields of hay from five grasses.

Three years' results from the 1919 seeding.

Designation	1919 Crop (Year seeding)	1920 Crop	1921 Crop	Aggregate yield
	Lbs. per acre	Lbs. per acre	Lbs. per acre	Lbs. per acre
Average 5 plots seeded with—				
Barley at 4 pecks per acre		882	1,244	2,126
" 6 "		799	1,744	2,543
" 8 "		860	1,956	2,816
" 10 "		829	1,740	2,569
Mean of all barley plots		842	1,671	2,513·5
Average 5 plots seeded with—				
Wheat at 5 pecks per acre		804	1,892	2,696
" 6 "		831	1,908	2,739
" 7 "		1,017	1,400	2,417
" 8 "		1,261	1,444	2,705
Mean of all wheat plots		978	1,661	2,639
Average 5 plots seeded with—				
Oats at 10 pecks per acre		1,184	1,532	2,716
" 12 "		1,034	1,376	2,410
" 14 "		622	1,552	2,174
" 16 "		641	1,724	2,365
Mean of all oat plots		870	1,546	2,416
Average of 5 plots—				
S. halves Range A (seeded alone)	1,248	5,478	1,312	8,038
S. halves Range B (seeded alone)	1,104	4,186	1,016	6,306
Mean of 10 plots S. halves Ranges A and B	1,176	4,832	1,164	7,172
Average of 5 plots—				
N. halves Range A (seeded alone)		4,140	1,360	5,500
N. halves Range B (seeded alone)		3,962	1,096	5,058
Mean of 10 plots N. halves Ranges A and B		4,051	1,228	5,279
Average of 5 plots seeded with oats May 21 for Greenfeed		960	1,256	2,216

Nurse Crop Table 3

Comparing yields of hay per acre from various grasses and clovers in the Main Nurse Crop Test.

Two years' results from the 1920 seeding.

Crop	Seeded without nurse crop				
	Average yield S. halves Ranges A and B (clipped in year of seeding Lbs. per acre			Average yield N. halves Ranges A and B (not clipped year of seeding) Lbs. per ac.	Average yield after nurse crops Lbs. per ac.
	1920	1921	Two years crop	1921	1921
Alfalfa	1,600	760	2,360	1,160	Plowed up
Alsike clover	800	200	1,000	740	"
Common red clover	660	0	660	0	"
Sweet clover	1,400	200	1,600	440	"
White Dutch clover	0	0	0	0	"
Totals, Legumes only	4,460	1,160	5,620	2,340	.....
Average, Legumes only	892	232	1,124	468	.....
Timothy	1,040	2,040	3,080	2,480	1,086
Western rye grass	1,320	4,120	5,440	4,840	2,102
Meadow fescue	.....	3,060	3,060	3,200	1,226
Kentucky blue	.....	1,240	1,240	1,880	0
Brome grass	1,160	2,820	3,980	5,020	1,106
Totals, Grasses only	3,520	13,280	16,800	17,420	5,520
Average, Grasses only	704	2,656	3,360	3,484	1,104

NOTES

(1) *Preparation*—In 1919, summer-fallow. The 1920 nurse crops were sown May 20 and 21. Grasses and clovers in the nurse crop blocks and in check range A were seeded May 24. Range B seeded June 3.

(2) Weeds necessitated ploughing up the grasses in the two thinnest seedings of barley.

(3) Clovers and alfalfa were sown without inoculation owing to the nitro-culture not having arrived in time. In late October, inoculated soil was broadcast over the seedings but this proved too late for good results. Weeds compelled the ploughing up in 1920 of all the nurse crop seedings of legumes. Inoculation was then found to be quite generally commencing. It was much slower in taking effect on the check ranges and produced little effect on the crop of these, which was, in consequence, extremely poor. All the plots represented in the table were mown July 23 and weighed July 26.

Nurse Crop Table 4

Comparing various cereals and rates of sowing of them as nurse crops. Also seeding with nurse crops versus seeding alone, etc.

Average yields of hay from five grasses.

Two years' results from the 1920 seeding.

Designation	1920 Crop (Year seeding)	1921 Crop	Aggregate yield
	Lbs. per acre	Lbs. per acre	Lbs. per acre
Average 5 plots seeded with—	Ploughed	up on accoun	t of weeds.
Barley at 4 pecks per acre	"	"	"
" 6 "	.....	960	.....
" 8 "	.....	1,212	.....
" 10 "	.....	.....	.....
Mean of all barley plots	.....	1,086	.....
Average 5 plots seeded with—			
Wheat at 5 pecks per acre	.....	1,388	.....
" 6 "	.....	1,332	.....
" 7 "	.....	1,436	.....
" 8 "	.....	1,252	.....
Mean of all wheat plots	.....	1,352	.....
Average 5 plots seeded with—			
Oats at 10 pecks per acre	.....	844	.....
" 12 "	.....	908	.....
" 14 "	.....	980	.....
" 16 "	.....	728	.....
Mean of all oat plots	.....	865	.....
Average of 5 plots—			
S. halves Range A seeded alone	960	2,608	3,568
S. halves Range B seeded alone	448	2,704	3,152
Mean of 10 plots S. halves Ranges A and B seeded alone	704	2,656	3,360
Average of 5 plots—			
N. halves Range A seeded alone	.....	3,472	.....
N. halves Range B seeded alone	.....	3,496	.....
Mean of 10 plots N. halves Ranges A and B seeded alone	.....	3,484	.....

NURSE CROP TABLE 5

SHOWING yields of hay per acre from the Check Ranges in the Main Nurse Crop Test. 1921 Results from 1921 Seeding.

Crop	South halves of check ranges		Averages of both ranges
	Range A. Seeded April 26	Range B. Seeded May 7	
	Lbs. per acre	Lbs. per acre	Lbs. per acre
Alfalfa	1,040	2,240	1,640
Alsike clover	480	1,760	1,120
Common red clover	660	1,320	990
Sweet clover	2,160	2,640	2,400
White Dutch clover	0	100	50
Totals, Legumes only	4,340	8,060	6,200
Averages, Legumes only	868	1,612	1,240
Timothy	1,360	1,760	1,560
Western rye grass	1,040	1,360	1,200
Meadow fescue	0	0	0
Kentucky blue	0	280	140
Brome grass	180	960	570
Totals, Grasses only	2,580	4,360	3,470
Averages, Grasses only	516	872	694
Grand Totals	6,920	12,420	9,670
Grand Averages	692	1,242	967

NOTES

(1) Part of the alsike and red clover plots followed hoe crop, chiefly turnips, after which the growth was much less rank than after fallow. The brome, Kentucky blue and meadow fescue followed hoe crop, chiefly potatoes, while the remaining plots were on land fallowed in 1920.

(2) Range A was seeded April 26. Range B on May 7.

NURSE CROP TABLE 6

SUMMARY comparing yields of hay per acre from five grasses in the Nurse Crop Test. Average results from the 1918 and 1919 Seedings.

Crop	Seeded without Nurse Crop						Seeded with Nurse Crop		
	Average yields S. halves A and B. clipped in year of seeding lbs. per acre			Average yields N. halves not clipped in year of seeding lbs. per acre			Average yields following Nurse Crop lbs. per acre		
	3 years crop 1918 seed	3 years crop 1919 seed	Average 2 seedings	2 years crop 1918 seed	2 years crop 1919 seed	Average 2 seedings	2 years crop 1918 seed	2 years crop 1919 seed	Average 2 seedings
Timothy	8,820	6,515	7,667·5	7,160	3,375	5·267·5	3,020	2,523·0	2,771·5
Western rye grass	8,380	8,360	8,370·0	7,840	5,610	6,725·0	3,659	3,326·0	3,492·5
Meadow fescue	5,200	5,480	5,340·0	4,600	5,635	5,117·5	2,722	2,421·3	2,571·6
Kentucky blue	2,840	4,075	3,457·5	2,000	3,495	2,747·5	1,443	1,106·6	1,274·8
Brome	7,440	11,430	9,435·0	7,640	8,380	7,985·0	3,071	3,236·0	3,153·5
Totals 5 grasses	32,680	35,860	34,270·0	29,240	26,445	27,842·5	13,915	12,613·0	13,264·0
Averages 5 grasses	6,536	7,172	6,854·0	5,848	5,289	5,568·5	2,783	2,522·6	2,652·8

Nurse Crop Table 7

Summary comparing various cereals and rates of sowing of them as nurse crops; also results of seeding with and without nurse crops, etc.

Average yields of hay from five grasses. Total results to date from the 1918 and 1919 seedings covering three crops from the check plots clipped in the year of seeding (south halves ranges A and B); in all other cases two crops only.

Designation	Total crop from 1918 seeding	Total crop from 1919 seeding	Average total crop from both seedings
Average 5 plots seed with—			
Barley at 4 pecks per acre	2,960	2,126	2,543·0
" 6 "	2,832	2,543	2,687·5
" 8 "	2,940	2,816	2,878·0
" 10 "	2,800	2,569	2,684·5
Mean of all barley plot seedings	2,883	2,513·5	2,698·25
Average 5 plots seeded with—			
Wheat at 5 pecks per acre	2,928	2,696	2,812·0
" 6 "	3,728	2,739	3,233·5
" 7 "	2,656	2,417	2,536·5
" 8 "	2,728	2,705	2,716·5
Mean of all Wheat plot seedings	3,010	2,639	2,824·6
Average 5 plots seeded with—			
Oats at 10 pecks per acre	2,360	2,716	2,538·0
" 12 "	2,456	2,410	2,433·0
" 14 "	2,488	2,174	2,331·0
" 16 "	2,528	2,365	2,446·5
Mean of all oat plot seedings	2,458	2,416	2,437·1
Average of 5 plots—			
South halves Range A (seeded alone)	6,216	8,038	7,127·0
South halves Range B (seeded alone)	6,856	6,306	6,581·0
Mean of 10 plots—			
South halves Ranges A & B (seeded alone)	6,536	7,172	6,854·0
Average of 5 plots—			
North halves Range A (seeded alone)	5,712	5,500	5,606·0
North halves Range B (seeded alone)	5,984	5,058	5,521·0
Mean of 10 plots—			
North halves Ranges A and B (seeded alone)	5,848	5,279	5,563·5

Subsection (*b*).—The Stubble Nurse Crop Test

From the ashes of Failure Success has arisen in the stubble nurse crop test.

In 1919 the ten kinds of grasses and clovers employed in the main nurse crop experiment were sown in a supplementary test with a nurse crop of late oats for green-feed on a piece of spring-ploughed stubble ground, which had produced a heavy stand of wheat the year before. All the seeds caught nicely, but the legumes, being sown without inoculation, failed as usual before autumn and by spring were principally conspicuous from their absence. The five grasses yielded light crops but at least occupied the land and made a full stand while the block where the clovers has been seeded had to be ploughed up. On June 16, 1920, this block was again drilled with oats for green-feed and the ten grasses and legumes tried out the year before were seeded in half-width plots. This time the seed of alfalfa, sweet clover, common red clover and alsike was inoculated with nitro culture received from the Division of Botany, Ottawa. The seed was sown and harrowed in after sundown, the Superintendent (who had arisen that morning at 4.45 to seed grass plots) personally attending

to these and about a dozen other inoculated plots the same night, concluding at 3.30 a.m. one of the longest and most important day's work he ever did. He was determined that if inoculation failed it would be through no fault of his. This time the clover seedings were a comparative success. It is true the season of 1920 was a particularly favourable one for seeding down but it is equally true that the early summer of 1921 was particularly unfavourable for hay crops and furthermore it should be explained that these new seedings were considerably mutilated from being used as a headland on which the breaking plough was turned. The significant fact is that, in this instance, for the first time in three years' work, comprehending a great many hundred plots, the nurse-crop seedings of legumes were worth leaving for hay. Indeed the average yield of the four fully doubled the average yield of the four best grasses alongside seeded under identical conditions. In view of the previous experience with grasses and clovers at the Station, this fact must be regarded as of incalculable importance to the agriculture of the North Country, raising hope, as it does, that nurse-crop seedings may yet be profitable when inoculated legumes constitute a proportion of the seeding-down mixture.

STUBBLE Nurse Crop Test, 1920 Seeding, 1921 Crop

Kind.	Yield per acre lbs.
Alfalfa	1,530
Alsike	700
Common red clover	1,335
Sweet clover	1,945
Brome	705
Kentucky Blue	0
Meadow fescue	553
Western rye grass	750
Timothy	745
Average 4 legumes	1,379
Average 4 best grasses	688

NOTE: During August the legume hays, which were rather tough at the first weighing, were stored under cover and re-weighed on August 31 when thoroughly cured. Following are the percentage losses in weight that occurred, the decrease except a few leaves being in moisture.

Sweet clover lost 20 per cent of its original weight.
Alfalfa lost 12 per cent (nearly) original weight.
Red clover lost 12 per cent (nearly) original weight.
Alsike lost 12 per cent (fully) original weight.
The yields are calculated from the final weighings.

THE SEEDING OF 1919

The 1919 seeding in this sub test had included besides plots of the ten grasses and legumes sown separately, good-sized blocks of two mixtures, one representing a medium-thick and the other a rather thin rate per acre. In both the resultant crops the thin mixture has given the better results of the two and for some unexplained reason the two-year yield of either is much heavier than the yield of any of the grasses grown singly. If this difference had occurred only in 1921 it might have been attributed to the factor mentioned in connection with the 1920 seedings, viz., trampling by teams which turned mostly on the small plots when breaking some adjoining land. But the disparity was almost equally marked in the first year's crop, which had been subjected to no such prejudicial treatment. As the soil and contour seemed well night uniform, this feature of the results is perplexing and does not accord with the deductions from other tests bearing upon the question.

These plots had been sown at the end of May on oats drilled a few days earlier at about two bushels per acre by weight. The grasses were sown at the following rates:

Timothy and western rye grass each at 9 pounds per acre. Meadow fescue, Kentucky blue and brome each at 18 pounds. The thin mixture comprised seeds of grasses and clovers, the grasses consisting of a blend of timothy, western rye, meadow fescue and Kentucky blue—of the whole 10⅜ pounds per acre. The thick mixture comprised the same grasses plus a little Red Top, amounting in all to 16 pounds of grass seed per acre. There were also 6 pounds of clover seed but the clovers failed in this as in all other Nurse Crop areas of the 1919 seeding.

NURSE CROP TABLE 9.—Stubble Nurse Crop Test. Two years yield of hay from the 1919 seeding of grasses.

Designation	Fraction of acre	Net yield per acre 1920 (less weeds)	Net yield per acre 1921	Two years aggregate yield
			lbs.	lbs.
Timothy	1/8	1,200	360	1,560
Western rye grass	—	640	736	1,376
Meadow fescue	—	640	552	1,192
Kentucky Blue	—	0	384	384
Brome	—	784	920	1,704
Thin Mixture	¾	1,713	1,826	3,539
Thick mixture	⅞	1,168	1,680	2,848

NOTES

(1.)—Note the effect on the second crop of timothy from an original seeding of 9 pounds per acre.

(2.)—The western rye grass seed, being chaffy, was probably not sown thickly enough for best results. Its stand was rather uneven.

SECTION III.—GRASS AND CLOVER MIXTURE EXPERIMENT

This experiment, like the nurse crop test, (Sec. II) has been carried the length of a fourth annual seeding, the first one having been ploughed up in August of 1920 after the third crop of hay had been taken from the areas clipped in the year of seeding and the second crop from areas not clipped in the initial year.

The primary purpose of the experiment is to compare various combinations of legumes and grasses. So far as the former are concerned the object has been largely defeated by lack of inoculation. Nevertheless results of distinct value have been obtained and now that, in the case of the 1921 seeding, inoculation has been attended to, it will be useful to check the average returns from the first two or three years seeding against those from the seedings of 1921 and subsequent years. Already the experiment has supplied certain links in the long chain of irrefutable evidence establishing the need of legumes in seeding-down mixtures and the need of artificial inoculation to make them an early success. Many others points are also being brought out.

OUTLINE OF EXPERIMENT

Early in June of each year 48 fortieth-acre meadow plots have been sown in three series representing mixtures of certain grasses with three leguminous bases, viz., alfalfa, common red clover and a blend of red clover with alsike. Each series consists of two ranges, one (range A) sown at a fairly heavy rate per acre, and the other (range B) at a reduced rate, usually just two-thirds that of the first. In each range there are thus, 48 divided by 6 equals 8 plots, six of which, constituting a complete quota in themselves, have always been sown without any nurse crop, while the seventh and

eighth plots of each range repeat the sixth, being sown, however, on a strip of grain drilled early as a nurse crop. The principal idea of this supplementary seeding has been to compare, in a general way, the outcome of seeding down in June, by which time the nurse crop was well up, with the results of sowing the small seeds directly after the grain was drilled, as practised in the main nurse crop experiment (See Sec. II). As the two experiments have always been laid out on adjoining land, usually quite similar in nature and preparation, this incidental nurse-crop comparison has been instructive. Thus far, results decidedly favour sowing the grass and clover seeds directly after the grain is drilled rather than after it has come up. The less head start the nurse crop has the less it strangles the "seeds." This has been more particularly true of the clovers, which until 1921, have failed almost completely under the system of deferred seeding.

In 1921 the nurse-crop strip was an extremely thin stand of Ruby wheat and the inoculated legumes presented reasonably good promise in the autumn.

Apart from the twelve plots seeded each year on the nurse-crop strip along one side of the block, there are always 36 plots which lend themselves to fair averaging and computation. Hence the various tables comprehend these only, with foot notes where necessary, giving the yield from such of the twelve "nursed" plots as may have been left for hay. So far as the primary objects of the experiment are concerned the thirty-six plots are complete in themselves. The usual plan has been to clip the south half of each plot in the year of seeding, curing and weighing the product. The north halves are never clipped the first year. In the second and third seasons the two halves are weighed separately so that the tables of yield represent virtually 72 eightieth-acre plots. The only exceptions are the tables presenting returns from the 1919 seeding, which was not accomplished in time to produce anything worth cutting in that year.

Preparation

In 1918 this experiment was laid out on well worked breaking of the previous year; in 1919 on breaking back-set in May prior to the sowing of the plots; in 1920 on summer-fallow and in 1921 principally on land that had been devoted to green-feed in 1920 after variety grain plots the year before. There was a slight exception, however. The nurse-crop strip and half of each plot next it followed potatoes, while on the other side of the block the first plot in each case followed land where drills of sunflowers and oats had been inter-cultivated in 1920. In both cases the growth of clover and grass was much more prolific than after oats grown broadcast. The plots thus unduly favoured were the plots of legumes only and the plots of legumes plus five grasses. Otherwise the comparisons are not affected.

Rates of Seeding

In each year except 1919 the rates of seeding have been as follows:—

Taking for example the alfalfa series, we would have in range A a plot of alfalfa only sown at 12 pounds per acre; a plot of alfalfa 10 pounds plus timothy 8; a plot of alfalfa 10 plus western rye grass 8; of alfalfa 10 plus meadow fescue 15; of alfalfa 10 with the above three grasses combined at the rates of 5, 5 and 9, and sixthly, alfalfa 10 plus five grasses, viz., the three named at 4, 4, and 7 as well as 4 pounds each of red top and Kentucky blue.

Range B duplicates A but is laid out in reverse order to check up on soil variation. Except in 1919 it has been sown with two-thirds the quantity of seed used in A. In the year mentioned the quantities of alfalfa were the same in corresponding plots of each range but the quantities of grass seeds were reduced by one-half in range B, the object being to give the legumes a better chance. In the absence of inoculation this amendment proved ineffectual and was discontinued.

The other two series are laid out on the same model as the alfalfa ranges, a necessary difference being that in the case of the red clover and alsike series the amounts of clover seed were 10 pounds of red and 4 of alsike for the first plot in range A with 8 in red and 2 of alsike in those plots of that range where grasses occurred.

Cereals Employed as Nurse Crops

For the nurse crop strip the cereals used have been Marquis wheat in 1918, Ruby wheat and Abundance oats in 1919, Liberty hulless oats in 1920 and an extremely thin stand of Ruby wheat in 1921.

Inoculation

Inoculation was not practised at all the first two years. The third year the nitro culture arrived on the eve of seeding, after the grass and clover seeds had been mixed and weighed out, so that there was opportunity to treat only the seed in the plots where the legumes occurred unmixed with grasses. In 1921 all the clover and alfalfa seed was treated with soil applied by the glue method.

Findings to Date

Though it were premature to form many definite conclusions, it cannot be amiss to draw attention to a few points that stand out from the work thus far.

Table 7 brings out the extremely poor performance of the legumes as sown without inoculation in 1918 and 1919. Observe by table 11 their much improved showing, relative to the grass mixtures, in the 1920 seeding, even although the stand of some in the latter instance was very incomplete from imperfect distribution of sticky seed, sown in a poor light. The alfalfa was particularly handicapped by this cause.

Comparing the three leguminous bases, alfalfa makes the best general showing in the legume-only plots. That it does not seem to carry this lead throughout all the grass combinations is probably due to the fact that the alfalfa layout has always to date occupied the highest and driest area of the three series and on such soil the grasses, which have, as yet, furnished the bulk of the total crop, do not yield so heavily as on the slightly lower slopes where the other two series have been paid out.

Eight years' observation has convinced the Superintendent that of the three legumes involved alfalfa is distinctly the most suitable to local conditions save for one drawback. It does not mature any seed worth mentioning while the others do. This means repeated importation with high cost and perpetual danger of fresh weed infestation.

The extremely poor results from seeding clovers and grasses—particularly the former—in June on early-sown nurse crops has already been pointed out, but will bear emphasis.

In this experiment as in those covered by section II, western rye proves easily the highest-yielding grass. That it fell down slightly in the 1920 seeding was probably due to an uneven stand, the seed having been somewhat chaffy.

Timothy and Meadow fescue rank about equal. The former did more poorly than usual in 1921 and the latter relatively better than usual. This was remarked before haying in respect to the crop of both the 1919 and 1920 seedings. Reason unknown.

The extent to which hay yields are affected by slight differences in soil quality and contour is repeatedly demonstrated, emphasizing the advantage of extensive systems of plots such as the experiment affords. From such a plan of seeding, repeated a number of years, fairly trustworthy deductions should ultimately be derived.

Grass and Clover Mixtures Experiment—Table 1

Seeded June 11, 1919—Two years' results

—	1920 Crop Pounds per acre			1921 Crop Pounds per acre			Two years crop Range A	Two years crop Range B	Two years crop. Average both ranges
	Range A	Range B	Average 2 ranges	Range A	Range B	Average 2 ranges			
							Lb.	Lb.	Lb.
Alsike and Red Clover Series—									
Clovers only	1,080	560	820	1,000	.....	500	2,080	560	1,320
Clover and timothy	2,520	2,920	2,720	1,120	1,220	1,170	3,640	4,140	3,890
Clover and western rye	3,080	2,680	2,880	2,200	2,320	2,260	5,280	5,000	5,140
Clover and meadow fescue	3,080	2,360	2,720	920	1,900	1,410	4,000	4,260	4,130
Clover and three grasses	3,840	2,520	3,180	1,140	1,820	1,480	4,980	4,340	4,660
Clover and five grasses	3,600	2,920	3,260	1,240	1,780	1,510	4,840	4,700	4,770
Averages	2,867	2,327	2,597	1,270	1,506·6	1,388·3	4,137	3,833·6	3,985·3
Red Clover Series—									
Clover only	720	760	740	1,200	.....	600	1,920	760	1,340
Clover and timothy	2,520	2,960	2,740	1,460	1,460	1,460	3,980	4,420	4,200
Clover and western rye	2,400	2,840	2,620	3,000	2,620	2,810	5,400	5,460	5,430
Clover and meadow fescue	2,440	2,120	2,280	1,880	1,720	1,800	4,320	3,840	4,080
Clover and three grasses	3,080	2,680	2,880	1,580	1,640	1,610	4,660	4,320	4,490
Clover and five grasses	2,840	2,800	2,820	1,160	1,720	1,440	4,000	4,520	4,260
Averages	2,333	2,360	2,346	1,713·3	1,526·6	1,620	4,046·3	3,886·6	3,966·5
Alfalfa Series—									
Alfalfa only	1,520	1,760	1,640	960	1,120	1,040	2,480	2,880	2,680
Alfalfa and timothy	2,280	2,640	2,460	1,180	1,320	1,250	3,460	3,960	3,710
Alfalfa and western rye	2,280	4,000	3,140	1,860	2,180	2,020	4,140	6,180	5,160
Alfalfa and meadow fescue	3,240	2,680	2,960	1,400	1,260	1,330	4,640	3,940	4,290
Alfalfa and three grasses	2,560	3,400	2,980	940	1,340	1,140	3,500	4,740	4,120
Alfalfa and five grasses	4,120	3,920	4,020	1,860	1,280	1,570	5,980	5,200	5,590
Averages	2,666	3,066	2,866	1,366·6	1,416·6	1,391·6	4,032·6	4,482·6	4,257·6
Grand averages	2,622	2,584	2,603	1,450	1,483·3	1,466·6	4,072	4,067·6	4,069·8

Supplement to Table 1

Yields five-grass mixtures after nurse crops—1920 crop only. Plots broken after one cutting of hay

Designation	Red and Alsike plus 5 grasses	Red Clover plus 5 grasses	Alfalfa plus 5 grasses	Averages
After Ruby wheat	1,440	1,040	1,240	1,240
After oats for green feed	1,000	520	1,240	920
	1,220	780	1,240	1,080

Note.—(1). The land where this experiment was located was high and rolling with a thin layer of black loam. It was backset deeply and seeded June 11, 1919, and not cut in the year of seeding.

(2). The nurse crop strips were ploughed up in 1920 and two clover plots in range B early in 1921.

GRASS AND CLOVER MIXTURES—TABLE 2

Comparing two years' crop from three leguminous bases. Grass and Clover mixtures, seeding of 1919

Designation	Pounds hay per acre		
	1920 Crop	1921 Crop	Aggregate two crops
Average of 12 plots red clover and alsike series	2,597	1,388·3*	3,985·3*
" 12 plots red clover series	2,346	1,620 *	3,966·5*
" 12 plots alfalfa series	2,866	1,391·6	4,257·6
" 36 plots, all 3 series	2,603	1,466·6	4,069·8

GRASS AND CLOVER MIXTURES—TABLE 3

Comparing Ranges A (full seeding) with Ranges B (about two-thirds seeding). Two years' crop from 1919 seeding

Designation	Average pounds Hay per acre					
	Ranges A			Ranges B		
	1920	1921	2 years	1920	1921	2 years
Alsike and red clover series	2,867	1,270	4,137·0	2,327	1,506·6	3,833·6
Red clover series	2,333	1,713·3	4,046·3	2,360	1,526·6	3,886·6
Alfalfa series	2,666	1,366·6	4,032·6	3,066	1,416·6	4,482·6
Average three series	2,622	1,450	4,072·0	2,584	1,483·3	4,067·6
Average advantage or disadvantage of thicker seeding	38	−33·3	4·3			

NOTE.—For the reason explained in the foot note under Table 2 the thin seeding was unfairly handicapped. Could the two clover-only plots in ranges B have been left for cropping in 1921 they would, if they had produced anything at all, have thrown the net balance of the two-years' aggregate yield in favour of the thinner seeding.

GRASS AND CLOVER MIXTURES—TABLE 4

Comparing the three legumes one with another and the averages of the three grown singly with the averages of the various grass mixtures in which they have been respectively combined. Two years' crop from the 1919 seeding.

Designation	Pounds Hay per acre		
	1920	1921	2 years
Red clover and alsike only	820·0	500·0	1,320·0
Red clover only	740·0	600·0	1,340·0
Alfalfa only	1,640·0	1·040·0	2,680·0
Average of legumes plus timothy	2,640·0	1,293·3	3,933·3
" " western rye grass	2,880·0	2,363·3	5,243·3
" " meadow fescue	2,653·0	1,513·3	4,166·3
" " three grasses	3,013·0	1,410·0	4,423·0
" " five grasses	3,366·6	1,506·6	3,873·3

* These four averages have suffered slightly by reason of the ploughing up of the two clover plots in Ranges B before haying in 1921, this being expedient owing to the thin, weak stand affording weeds a chance to grow. At the most, the two starred averages in the third column may thus have been pulled down a hundred pounds each ; probably much less, however, for the two plots in question promised very little crop.

Grass and Clover Mixtures—Table 5

Comparing aggregate crops to date from three leguminous bases, seedings of 1918 and 1919. (In the case of the 1918 seeding South halves only (clipped in year of seeding) are considered. The 1919 seeding was not clipped in the initial season.)

Designation	Pounds of Hay per acre from		
	3 crops of 1918 seeding	2 crops of 1919 seeding	Average of both seedings
Average yield 12 plots.			
Red clover and alsike series	7,213	3,985·3	5,599·1
Red clover series	6,929	3,966·5	5,447·7
Alfalfa series	6,746	4,257·6	5,501·5

Grass and Clover Mixtures—Table 6

Comparing thick versus thin seeding ranges A and B. Total crops from seedings of 1918 and 1919. (*See* heading of Table 5.)

Designation	Ranges A. Full seeding			Range B. Thin seeding		
	3 crops 1918 seeding	2 crops 1919 seeding	Aggregate crop both seedings	3 crops 1918 seeding	2 crops 1919 seeding	Aggregate crop both seedings
Alsike and red clover series	7,240	4,137·0	11,377·0	7,186	3,833·6	11,019·6
Red clover series	7,106	4,046·0	11,152·3	6,733·0	3,886·6	10,619·6
Alfalfa series	7,053	4,032·6	11,085·6	6,440·0	4,482,6	10,922·6
	7,133	4,072·0	11,205·0	6,786·3	4,067·6	10,853·9

Net mean advantage from all series of thick over thin seeding 351 pounds hay per acre, or say 70 pounds per acre per annum.

Grass and Clover Mixtures—Table 7

Comparing the three legumes with each other and the averages of the three grown singly with the averages of the several grass mixtures in which they have been combined. Results from seedings of 1918 and 1919.

Designation	Hay, pounds per acre				
	Total 3 years' crop from S. halves of 1918 seeding (clipped in initial year)	Total 2 years' crop from N. halves of 1918 seeding (not clipped in initial year)	Total 2 years' crop from 1919 seeding (not clipped in initial year)	Total 2 years' crop from 1919 seeding and 3 years' crop S. halves 1918 seeding	Total 2 years' crop from 1919 seeding and 2 years' crop N. halves 1918 seeding
Red clover and alsike only	4,080	1,960	1,320·0	5,400·0	3,280·0
Red clover only	3,240	2,560	1,340·0	4,580·0	3,900·0
Alfalfa only	4,480	2,440	2,680·0	7,160·0	5,120·0
Average of 3 legumes plus—					
Timothy	8,040	5,493	3,933·3	11,973·3	9,426·3
Western rye grass	9,013	7,520	5,243·3	14,256·3	12,763·3
Meadow fescue	6,386	5,510	4·166·3	10,552·3	9,676·3
Three grasses	7,680	7,160	4,423·0	12,103·0	11,583·0
Five grasses	6,706	5,920	3,873·3	10,579·3	9,793·3

Grass and Clover Mixtures—Table 8

Presenting yields of hay to date in pounds per acre from the 1920 Seeding

Designation	South halves (clipped in year of seeding)							North halves (not clipped in year of seeding)		
	Range A full seeding			Range B two-thirds seeding			Average two two ranges two crops	Range A full seeding 1921	Range B two-thirds seeding 1921	Average two ranges 1921
	1920	1921	Two year agg'te.	1920	1921	Two-year agg'te.				
Alsike and Red Clover Series—										
Clovers only	320	1,360	1,680	560	760	1,320	1,500	1,880	1,280	1,580
Clover and timothy	1,360	1,280	2,640	1,280	1,840	3,120	2,880	1,960	1,120	1,540
Clover and western rye grass	1,120	1,800	2,920	1,280	2,600	3,880	3,400	2,120	2,920	2,520
Clover and meadow fescue	1,200	2,320	3,520	1,520	2,120	3,640	3,580	2,200	2,520	2,360
Clover and three grasses	720	1,840	2,560	1,760	2,120	3,880	3,220	2,080	2,560	2,320
Clover and five grasses	1,200	2,160	3,360	2,240	2,280	4,520	3,940	2,040	2,120	2,080
Averages	986·7	1,793·3	2,780	1,440	1,953·3	3,393·3	3,086·6	2,046·6	2,086·6	2,066·6
Red Clover Series—										
Clover only	560	2,400	2,960	320	1,640	1,960	2,460	2,520	3,120	2,820
Clover and timothy	2,400	2,440	4,840	800	1,160	1,960	3,400	1,600	1,600	1,600
Clover and wsstern rye grass	80	1,960	2,040	1,040	1,960	3,000	2,520	1,480	3,000	2,240
Clover and meadow fescue	720	2,440	3,160	720	2,400	3,120	3,140	2,840	2,520	2,680
Clover and three grasses	1,760	1,640	3,400	880	2,880	3,760	3,580	1,360	2,160	1,760
Clover and five grasses	1,840	1,800	3,640	1,200	2,160	3,360	3,500	1,280	1,560	1,420
Averages	1,226·7	2,113·3	3,340	826·7	2,033·3	2,860	3,100	1,846·6	2,326·6	2,086·6
Alfalfa Series—										
Alfalfa only	560	760	1,320	2,160	2,080	4,240	2,780	1,440	2,240	1,840
Alfalfa and timothy	1,120	2,120	3,240	1,840	1,680	3,520	3,380	1,880	2,280	2,080
Alfalfa and western rye grass	880	1,880	2,760	1,760	2,280	4,040	3,400	1,640	2,640	2,140
Alfalfa and meadow fescue	1,040	2,360	3,400	960	2,040	3,000	3,200	2,320	2,880	2,600
Alfalfa and three grasses	2,000	2,280	4,280	1,040	1,840	2,880	3,580	2,920	3,200	3,060
Alfalfa and five grasses	1,840	3,200	5,040	1,440	1,280	2,720	3,880	3,720	2,320	3,020
Averages	1,240	2,100	3,340	1,533·3	1,866·7	3,400	3,370	2,320	2,593·3	2,456·6
Grand averages three series	1,151	2,002·3	3,153·3	1,266·6	1,951·1	3,217·7	3,185·5	2,071	2,335·5	2,203·2

Legumes and five grasses after nurse crop of hulless oats (only 3 plots left for hay).
In Range B of the red clover and alsike series.....1,080 lbs. hay per acre
In Range B of the red clover series..... 900 lbs. hay per acre
In Range B of alfalfa series.....1,060 lbs. hay per acre.

Grass and Clover Mixtures—Table 9

Comparing the three leguminous bases in Grass and Clover mixtures. Yield in pounds of hay per acre from seeding of 1920

Designation	S. halves both Ranges, clipped in year of seeding			N. halves both Ranges not clipped in year of seeding	Averages both N. and N. halves
	1920	1921	Aggregate 2 crops		
Average yield of 12 plots.					
Red clover and alsike series	1,213·3	1,873·3	3,086·6	2,066·6	2,576·6
Red clover series	1,026·7	2,073·3	3,100·0	2,086·6	2,593·3
Alfalfa series	1,386·7	1,983·3	3,370·0	2,456·6	2,913·3

GRASS AND CLOVER MIXTURES—TABLE 10

Comparing the South Halves of Ranges A (full seeding) with Ranges B (two-thirds seeding). Results to date from seeding of 1920

Designation	S. halves clipped in year of seeding		N. halves not clipped in year of seeding		Average results, both halves	
	Ranges A Aggregate 2 crops	Ranges B, Aggregate 2 crops	Range A, 1921	Range B, 1921	Range A, full seeding	Range B, 2-thirds seeding
Alsike and red clover series	2,780·0	3,393·3	2,046·6	2,086·6	2,413·3	2,740·0
Red clover series	3,340·0	2,860·0	1,846·6	2,326·6	2,593·3	2,593·3
Alfalfa series	3,340·0	3,400·0	2,320·0	2,593·3	2,830·0	2,996·6
Average three series	3,153·3	3,217·7	2,071·0	2,335·5	2,612·2	2,776·6
Mean advantage of thinner seedings	.....	64·4	.....	264·5	.....	164·4

GRASS AND CLOVER MIXTURES—TABLE 11

Comparing the three legumes one with another and these with the respective averages shown by the various grasses with which they have been combined. Results to date from the 1920 seeding.

Designation	Total 2 years' crop from halves clipped in year of seeding	Crop 1921 from halves not clipped in year of seeding
*Red clover and alsike only	1,500·0	1,580·0
*Red clover only	2,460·0	2,820·0
*Alfalfa only	2,780·0	1,840·0
Average of three legumes plus:—		
Timothy	3,220·0	1,740·0
Western Rye grass	3,106·6	2,300·0
Meadow fescue	3,306·6	2,546·6
Three grasses	3,460·0	2,380·0
Five grasses	3,773·3	2,173·3

* The legume-only plots were seeded by lantern light with nitro-culture-treated seed, sticky with the sweetened-skim-milk medium. Several of them, notably the alfalfa plots, had the seed very imperfectly distributed.

SECTION IV.—A THICKNESS OF SEEDING TEST WITH GRASSES

For the purpose of obtaining more exact information than seemed likely to be furnished by other experiments as to the quantities of seed per acre of the leading grasses which it was advisable to use when seeding down, a thickness-of-seeding test with grasses was commenced in 1919 and the seeding has now been twice repeated.

The most prominent lesson suggested to date is the unwisdom of drawing hasty conclusions. Despite elaborate care to select and maintain uniform conditions of soil and treatment, unexpected discrepancies will creep in. Sometimes it is a shock of grain standing too long on a certain new-seeded plot; sometimes an unsuspected difference in soil. These little things often affect plot yields rather seriously. The work must be repeated and continued.

This much may be said safely. When seeding is done without nurse crops and weeds are held in check by pulling, very thin grass seedings, evenly distributed, will sometimes give excellent crops. On account of weeds, however, the lower limit should not be too closely approached in field practice. On the other hand, the six-

pound seedings of timothy, while giving a good enough crop in 1920, produced a very short fine hay in the second cropping year. A medium course is best—five pounds of timothy seems about right.

A very interesting comparison lies between the 1919 timothy plots seeded with versus without nurse crop. The former plots produced small crops in 1920 but consistently better ones in 1921. The latter cut heavy crops in 1920 but fell off badly in the next season. The two-year aggregate yields, however, were much heavier from the plots seeded alone.

A similar tendency was exhibited by the rye grass, only the falling-off in the case of the no-nurse-crop plots was not nearly so marked.

The behaviour of both grasses in the respects noted is substantially in accord with previous experience at Beaverlodge.

THICKNESS OF SEEDING—TABLE 1

Presenting, in pounds of hay per acre, two years' results from 1919 seeding.

Designation	Seeded without Nurse crop			Seeded with Nurse crop		
	1920	1921	Aggregate two crops	1920	1921	Aggregate two crops
Timothy at 2 lbs. per acre	5,440	1,548	6,988	880	1,940	2,820
" 3 "	5,360	980	6,340	1,520	2,280	3,800
" 4 "	5,600	980	6,580	1,680	2,160	3,840
" 5 "	5,200	1,056	6,256	2,320	2,880	5,200
" 6 "	4,640	980	5,620	2,240	2,440	4,680
Western rye at 4 lbs. per acre	4,000	3,128	7,128	800	3,700	4,500
" 5 "	4,160	3,168	7,328	1,120	3,280	4,400
" 6 "	3,680	3,384	7,064	1,200	3,520	4,720

NOTES

(1) *History of area.*—1917 land broken; 1918 cereal plots east and west; 1919 spring-ploughed in May and harrowed twice, seeding in 1919 at rates specified, in plots north and south, crosswise of the cereal plots. North half of each plot was seeded with a nurse crop of 3 bushels of oats per acre, the two north swaths of which were cut for hay when oats were in the milk, yielding 6,240 pounds oat hay per acre.

(2) Land apparently uniform except that thickest seeding of rye grass was located on rising ground, especially the part seeded without nurse crop.

THICKNESS OF SEEDING—TABLE 2

Presenting results to date in pounds of hay per acre from the 1920 seeding

Designation	Seeded without Nurse crop			Seeded with Nurse crop
	1920	1921	Aggregate two years	1921
Timothy at 2 lbs. per acre	1,600	2,720	4,320	1,960
" 3 "	1,760	3,200	4,960	1,880
" 4 "	1,440	3,600	5,040	1,900
" 5 "	2,400	3,600	6,000	2,200
" 6 "	2,400	3,600	6,000	2,040
Western rye at 6 lbs. per acre	1,920	5,520	7,440	2,120
" 8 "	1,120	6,720	7,840	2,480
" 10 "	1,120	4,480	5,600	2,440

NOTES

(1) Location abutting the 1919 seeding.

(2) 1917 broken; 1918 cereal plots (east and west); 1919 summer-fallow; 1920 seeded May 31 to grasses as noted on chart, plots north and south, crossing previous

plots of cereals. North 2 rods of each plot seeded with a nurse crop of oats (cut in milk) and beardless, hulless barley cut very short when grain was nearing maturity. South rod of each plot seeded without nurse crop.

(3) Soil appeared reasonably uniform although the thickest seeding of rye grass was handicapped by being on rising ground.

THICKNESS OF SEEDING—TABLE 3

Presenting first season's crop from the one-eightieth acre plots seeded without nurse crop and cut high about August 24. 1921 seeding

Designation	Yield per acre from 1921 seeding
Timothy at 2 lbs. per acre	1,200
" 3 "	1,680
" 4 "	1,800
" 5 "	1,880
" 6 "	1,320
Western rye grass at 6 lbs. per acre	1,120
" 8 "	1,160
" 10 "	880
" 12 "	720
" 14 "	520
Red top at 6 lbs. per acre	160
" 8 "	200
" 10 "	400
" 12 "	500
" 14 "	280

NOTES

(1) Location: South of 1920 seeding of this test.

(2) History of area. Broken 1917; cropped in 1918 to cereal plots running east and west; summer-fallowed in 1919; cereal plots same direction in 1920; spring-worked and spring-plowed in 1921 and seeded to this test with plots running north and south.

Several western rye plots, particularly those seeded at 12 and 14 pounds, and more particularly the latter, were mutilated and reduced in yield by the necessity of pulling and clipping volunteer oats where rows of oat stocks had stood on the variety plots of 1920.

(3) From the two strips of oats grown as a nurse crop across the north halves of these ranges a good quality of green-feed was cut about September 12, amounting to 5,500 pounds per acre. The area might be roughly classed as three-fifths stubble ground and two-fifths summer-fallow, after the scuffled paths between the previous season's grain plots. Growth on the paths was about twice as heavy as on the stubble strip.

SECTION V.—SPECIAL ALFALFA EXPERIMENTS

Some exceedingly important data, though on lines other than contemplated when the work was planned, have been furnished by a couple of special alfalfa experiments seeded in 1918 on well-prepared breaking of the previous year. Two distinct soil types were represented.

At the front of the grounds, facing the highway, was a willowy raw clay knoll showing but two or three inches of black loam when broken. In the spring of 1918 this loam was turned under by deep back-setting, done to make sure of exterminating all native perennials. On this land were laid out duplicate ranges of a variety test, comprising six well-known hardy kinds of alfalfa in each range. The seed of these six varieties was treated with nitro culture and a supernumerary plot in each range was sown with untreated seed. There were thus two ranges each consisting of seven fortieth-acre plots with paths between. Sown June 13 on a fine seed bed, they made an even, healthy growth and went into winter with six to ten inches of top. The next spring opened dry and cold, with extremely unfavourable growing conditions in the early part. Though little winter killing had occurred in the alfalfa plots, the growth was extremely tardy and disappointing. After a time the margins of the plots next cultivated pathways began to show up pretty well and by haying were nearly two feet tall with abundance of bloom. Interiorly the plants maintained a weak, pale appearance and when cut in July the new shoots were scarcely taller than the old bottom. Indeed, the crop of 1919, small as it was, consisted largely of the old bottom plus the vigorous growth from the narrow strips bordering the paths. After haying, the south range was double-disced, the north range being left untouched.

The fall of 1919 and the spring of 1920 were characterized by extreme precipitation, the subsoil everywhere being saturated. Yet the behaviour of these plots was no better than it was the year before, barring certain scattered areas of irregular shape and size where the growth and colour began to improve markedly, the plants soon attaining a height of twelve to twenty inches, with green colour, while the surrounding areas, five or six inches in height, were pale, stunted and gradually yielding up the ghost to grass. Examination revealed nodules unvaryingly present on the good areas and never on the others. The inoculated patches were quite as noticeable on the check plots at the west end of the ranges as they were on the plots that had been sown with treated seed, from which fact it is deducted that the nitro culture used must for some reason have been ineffectual. The areas which showed chance inoculation in 1920 were considerably more extensive on the south range than on the north one. This may have been due in part to the discing of the south range after haying in 1919 and in part to distribution of the bacteria by water traversing a slight "draw" which after crossing an inoculated patch in a corner of the west plot of the north range, spread across some portion of every plot in the south range. In this depression inoculation was fairly general, though not universal.

RIVALLING THE CONTRASTS OF POT EXPERIMENTS

In his study of agricultural literature the writer has never encountered an instance where a single factor in plant nutrition, other than moisture, has produced in field work such a great contrast as was shown by these nodule-supplied plants when compared with uninoculated ones around them. It was nearly as great as the difference between inoculated and uninoculated legumes in pot-culture experiments where these are grown in pure quartz sand supplied with all the elements of fertility except nitrogen. And just here it is interesting to note parenthetically that similar contrasts were found during the same season in plots of alsike and common red clover seeded in 1918 on a distant part of the Station without any attempt at artificial inoculation and no known chances of accidental inoculation.

SPREADING THE "ANT-HILLS"

During the summer of 1920 these inoculation contrasts were pointed out to many visitors, one of whom insisted that the vigor of growth on the good patches was due

to the fact that ant-hills must have been ploughed up here. Why the ant-hills had not manifested their effect more promptly he omitted to explain, nor did he venture to account for the steady expansion of the good areas. With a view to further extending the activity of the "ants" in question, loam from a well-inoculated plot of sweet clover was broadcasted over the twelve alfalfa plots which had been originally sown with treated seed, keeping the extreme west plot of each range still as a check. This inoculated soil was applied on July 24, 1920, during a steady rain. The plots were mown August 2 and on August 4, after the hay was removed the seven plots in the south range were again double-disced. Towards the close of summer, some of the plots in both ranges improved decidedly in colour and vigour of growth, but a few in the north range manifested little or no improvement. The soil here was quite a compact clay and the alfalfa plants had already been starved nearly to death. Certain experience detailed in an earlier section of this report (see section 2) raises the question whether the symbiotic bacteria found their way down to the roots in this tenacious soil before being killed by sunlight. However this may be, it is noteworthy that soon after the inoculated soil was broadcast, every treated plot in the south (disced) range showed decided improvement over the greater portion or in some cases the whole of its area, so much so that in early September the better half of the range was cut and the aftermath cured into hay. This cutting was too late to admit of a third growth for winter protection and considerable dormant injury occurred on this late-clipped half of the range. Weights of the two halves taken separately in 1921 revealed the effect of this abuse.

In 1921 the north range, which had become quite grassy and weedy and was still very incompletely inoculated, was ploughed up before haying, the south range after haying. The idea was to prepare the land thoroughly and reseed alfalfa under favourable conditions on, at least, part of the area.

A FOUR-TO-SIX-HUNDRED PER CENT INCREASE BY INOCULATION

Figures sometimes indicate, sometimes magnify and sometimes minify the lessons of experimental plots. In the accompanying table they fail to enforce the conclusions as strongly as did simple observation of the growing crop. Their trend, however, is clear enough. Despite the fact that 1921 was quite as unfavourable a season for hay as 1919 had been; that the 1921 crop was not augmented by any old bottom to speak of; that the stand had been impaired by encroachment of weeds and grass before inoculation took effect, and that, even at the last, inoculation was not yet completely general, the 1921 crop of the south range was nevertheless 76 per cent heavier than the 1919 crop of the same range, and if we were to consider only the half of this range that was not adversely affected by too late clipping in 1920—which was until then the poorer half by far—we should have an increase of 115 per cent of the third over the first crop. Under strictly field conditions, where there would be no scuffled paths to furnish an extra quota of nitrogen from organic sources to the plants growing on the borders of the plots the percentage of increase due to inoculation would be far greater still. Indeed, it is safe to say that on this clay type of soil inoculated areas produced in 1921 four to six hundred per cent more top growth than did uninoculated areas in any of the three cropping years. This estimate, if anything, errs on the side of being over-conservative. It is borne out, too, by plenty of other evidence at the Beaverlodge Station. Romance pales before this illuminating record of fact. Who can estimate its import to the future of the vast Northland?

ALFALFA—TABLE 1

Comparing yields of disced and undisced ranges of the alfalfa variety test plots seeded in 1918. Also comparing the 1921 crops of the two parts of the south range.

one-half of which had been cut in September, 1920, and consequently winter-injured. Yields hay in pounds per acre.

Designation	South Range disced each year after haying and also traversed by a draw where running water seemed to help spread inoculating bacteria.	North Range not disced after haying
1919 crop	1,119	1,079
1920 crop	1,748	1,515
Aggregate 2 crops	2,867	2,594
1921 crop	1,971	Ploughed up
1921 Crop from that portion of South Range clipped in September, 1920	1,531	
1921 crop from that portion of South Range whose 1920 aftermath was left for winter protection	2,411	
Difference	880	

SPECIAL ALFALFA EXPERIMENTS

SUBSECTION (*b*).—CULTURAL TESTS WITH ALFALFA

Whereas the variety test discussed under subsection (*a*) was located on a raw heavy soil on a knoll at the front of the farm, another series of plots designed to compare drills versus broadcast seeding and also different quantities of seed per acre, were laid out at the rear of the farm on land with a deeper black loam top and a varying but generally more open sub-soil, some of it quite friable to a depth of twenty inches while other parts ran quickly into a medium-hard chocolate clay. Being due North of the variety test, this land was broken not merely in the same year but on exactly the same days as the land devoted to the variety test and its subsequent cultivation was the same except that it was not all back-set before seeding. It was sown four days later with an Ottawa strain of seed, which occurred also in the variety test, and the seed was treated with nitro culture from the same source as that used in the other test. The same men performed all the work, which was very carefully attended to in every detail. The broadcast area here behaved at first much the same as did the variety plots—growth good in the season of seeding, but very disappointing the next. It was not quite so poor, though, for notwithstanding the larger area of this plot, with its correspondingly lower percentage of path-bordered margins, the 1919 yield was 1,243 pounds of hay per acre as against ten to eleven hundred in the average of the variety plots. Apparently in the absence of inoculation the greater depth of black loam was of advantage. Also, it was conspicuous that inter-cultivated rows, where not sown too thickly, yielded far more heavily at first than the broadcast area. One plot of 30 inch drills seeded at 2 pounds per acre yielded at the rate of 3,120 pounds of hay, which, however, was coarse, hard and stemmy. In the broadcast area considerable evidence of inoculation was noticed in the autumn of 1919, a good deal more in the early part of 1920 and by the time of cutting the 1920 aftermath it had become pretty general, the result being a very encouraging and fairly even growth with a profitable second cutting of hay taken early in September. This was too late for the good of the stand, as was revealed by a degree of impairment in vigour noticed

the ensuing spring. However, two cuttings of hay were again obtained in 1921, the first on July 14 and the second August 24. Even this was too late to allow an adequate third growth for winter protection. Had the first cutting been taken off sooner, as it might have been only for being deferred a few days awaiting the visit of the Dominion Agrostologist, the second might possibly have been secured in time to make a moderate third growth before the winter. As it is, this piece has now cut two crops per season for two years in succession, amounting to a ton and a half per acre in 1920 and two tons in the less favourable season of 1921. Nor should it escape attention that in the second and third years of cropping, the broadcast area, now fully inoculated, is rather outyielding the drills. Considering that part of the broadcast area is traversed by a bad seepage draw leading from a neighbouring pond and that this area is rather soddy with a comparatively inferior growth of alfalfa, the average of the whole broadcast area to date is encouraging, particularly when one considers the tardiness with which inoculation took effect. In those portions of the drill plots where the growth was best during the year after seeding, examination discovered a rich looking and friable subsoil to a depth of eighteen or twenty inches. It appears probable that where the alfalfa plant has to depend upon soil nitrogen, a rich, open, friable type of soil and subsoil affords it the best chance. When fully inoculated, it thrives conspicuously on some of the hardest, waxiest types of clay, as the writer well knows from extensive experience in southern Ontario and more limited experience recently at Beaverlodge. It would also seem plausible that the symbiotic bacterial occurring sporadically in initial seedings are more readily distributed through the friable soil than through an impervious clay. At all events, close watch during the summer of 1920 showed that the evidence of inoculation spread much more rapidly and thoroughly in the broadcast area of these cultural plots than in the variety plots dealt with in subsection (*a*). Strange to say, also, the broadcast area appeared, from the rather inadequate observation bestowed upon this particular point, to have inoculated more readily than the drills. Both areas were double-disced after haying in 1919 but the drills had been scuffled occasionally as well, which should have assisted materially in distributing the bacteria. Whether the comparative adequacy of soil nitrogen available to the inter-cultivated drills enabled them to resist the symbiotic bacteria is a nice point of speculative interest to bacteriologists. Probably the examination in respect to this detail should have been more elaborate.

Excavation at one corner of the plot discovered a fairly stiff chocolate sub-soil, permeated to a depth of about three feet with strong branching roots well supplied with nodules on their upper six inches.

Analysis by the Division of Chemistry, Ottawa, revealed that this soil showed a slightly alkaline reaction.

In the accompanying table attention is directed to the fact that while the plot of 30 inch drills seeded at two pounds per acre has given a greater three-year aggregate yield of hay than the broadcast area, this lead was obtained in the first crop before the broadcast area was benefited by inoculation. Since then the latter has been progressively improving, its 1921 yield being substantially greater than the corresponding cuttings of the alfalfa in rows.

ALFALFA—TABLE 2

Presenting yields of hay in pounds per acre from alfalfa plots in the cultural test. *1918 Seeding* North (only remaining) Range

Designation	Yield 1919 1 cutting only	Yield 1920			Yield 1921			Total crop three years
		First cutting	Second cutting	Total 2 cuttings	First cutting	Second cutting	Total 2 cuttings	
30 inch drills at 2 lbs.	3,120	1,980	840	2,820	2,520	1,035	3,555	9,495
30 inch drills at 4 lbs.	2,400	1,260	720	1,980	1,800	1,065	2,865	7,245
24 inch drills at 2·5 lbs.	1,320	1,740	1,440	3,180	1,920	1,620	3,540	8,040
24 inch drills at 5 lbs.	960	1,200	1,320	2,520	1,860	1,140	3,000	6,480
Broadcast—average several rates.	1,243	1,250	1,775	3,025	2,634	1,431	4,065	8,333

Section VI.—Inoculation Tests With Legumes

Though the whole work with forage crops, in so far as it relates to alfalfa and clover, furnishes one conclusive chain of evidence in favour of inoculation, it has been thought well to clinch the matter with an annual succession of specific tests upon this point. A cursory review of these is in order, prefaced by the preliminary experience.

EARLY EXPERIENCE—A CHRONOLOGICAL RECORD

In 1914 alfalfa and common red clover were first sown at the Beaverlodge Station. In 1915 and thereafter annual seedings were made. Until the latter part of 1919, no nodules, or practically none, were ever observed on the roots of clover or alfalfa and the cropping result ranged from medium to poor except in 1915, when alfalfa that had been seeded in inter-cultivated rows the year before grew about three feet tall. In the same year, which was an exceptionally luxuriant one for growth, the remnant saved from a broadcast area of Red clover seeded the year before attained a barely medium growth, but ripened seed in August.

The 1915 seedings, of both clover and alfalfa were all broadcast and without nurse crops. Cut worms destroyed the first stand and the plots were reseeded on July 24. The land was summer-fallow in excellent tilth. Promising stands were obtained by reseeding but barely a dozen Red clover plants survived the winter. The alfalfa, both Liscombe and Grimm, came through fairly well but made little growth until the summer rains and the crop was quite "spotty." It cut a ton to the acre, weighed in rather a tough condition.

In 1916 the experimental work, which until then had been prosecuted on rented land, was moved to its present location on a farm owned by the Superintendent. The fact is mentioned to explain that if any chance inoculation had taken place in the initial years its residual effect would necessarily have been lost to the subsequent seedings. In May and June respectively, of 1916, duplicate plots of alfalfa, Red clover and alsike were seeded broadcast and without nurse crops. Rye grass, timothy and meadow fescue were sown at the same time. The season was dry except for one deluging rain early in July. The land was well-prepared breaking of the year before. Good catches were obtained but no crop taken in the year of seeding. The latter half of May and the first half of June 1917 were characterized by extraordinary precipitation and the legumes did moderately well, the red clover, which had suffered some winter injury, yielding nearly two tons and the alfalfa and alsike over two and a quarter tons of cured hay per acre. This, however, was much less than the yield of the western rye grass, which amounted to almost four tons. Furthermore, it is recollected, and crude photographic records show, that decidedly the best growth of legumes, even in that wet season, was on the margins bordered by scuffled paths. Also, it is significant that scarcely a plant among the plots of alfalfa and clovers survived the ensuing

winter although some of the alfalfa was mulched with manure. No doubt the grazing of horses had much to do with this result but the complete disappearance of the alfalfa was hardly expected.

NO NODULES IN 1917

It must be admitted that until the 1917 cropping year, no systematic search for nodules was ever attempted at the Station. In that year, examination was made, with the result of discovering hardly a nodule. In fact there were none whatever which the supervisor could decide to his positive satisfaction were caused by the symbiotic organisms. In view of subsequent discoveries it is probable that there were few or none in the earlier years' seedings, either.

The 1917 seedings were made late on an early-sown nurse crop, and, the weather turning dry, complete failure was the result. Thus far, no attempts at artificial inoculation had ever been made.

INOCULATION EXPERIMENTS COMMENCED IN 1918

In the 1918 seedings of alfalfa an inoculation experiment was dove-tailed into the variety test, with results elsewhere described (see section 5, subsection a). In that year the inoculation failed to take effect, whether from lack of vitality of the culture or from some more obscure cause is not known. When at last some inoculation did occur it was as prevalent on the check plots as on the others. Against this one failure with nitro culture, may now be set three successive years' unqualified success.

Even in a Good Season Inoculation Doubled Yield

On June 16, 1919, twelve fortieth-acre plots of red clover, alfalfa and sweet clover, were sown on a piece of well-prepared summer-fallow. Unfortunately, through a misunderstanding, the inoculated plots adjoined the uninoculated so that considerable overlapping occurred. During the season of seeding no difference was noticed between inoculated and uninoculated areas, but as the first crop of 1920 came on, the growth of the former was uniformly green, healthy and prolific while the middle of the uninoculated strips of red clover and alfalfa was in every instance yellowish and comparatively weak. On these areas the crop was, according to observation only about half what it was where inoculated. The benefit of inoculation was equally or even more apparent in the aftermath. For some reason the contrast in the case of the sweet clover was not nearly so marked. Possibly the checks were accidentally inoculated from alfalfa seeded in their vicinity in 1916. When the plots were ploughed up in September nodules were found plentifully and uniformly distributed on the roots of the red clover and alfalfa plants sown with treated seed. Under the pale, weak-growing plants they were extremely sparing or absent. The Superintendent personally paid very close attention to this point. From all the legumes in this test two cuttings were obtained in 1920, the inoculated areas yielding approximately a ton per acre of red clover, two and a half tons of alfalfa and nearly three tons of sweet clover.

The Contrast Afforded by a Poor Hay Year

In June 16, 1920, one plot each of alfalfa, sweet clover, red clover and alsike was sown with seed treated with nitro culture, supplied, as before, by the Division of Botany, Ottawa. The land was summer-fallow which had run together considerably as the result of its clay texture, the wet weather and the tramping of stock and teams. This was particularly true of the area where the alfalfa and sweet clover were sown. In fact on this portion the disc and harrow had to be run several times to get enough loose earth for a seed bed. All the seed was sown after sundown on the evening of the day it was treated and harrowed in before dawn. First-class catches were obtained save on one corner of the very hardest trampled ground where there was no proper

covering for the seed. Part of each plot was cut in September producing a heavy yield. Approximate yields are given in the accompanying table for all except the alfalfa, to which a suckling foal helped itself rather freely before the coils were weighed up. His Equine Lordship recommended this tender alfalfa hay very highly. The portions of the plots clipped thus late did not winter nearly so well as the unclipped portions, the common red and sweet clover suffering most and the alfalfa perhaps the least. The unclipped portion of every plot wintered almost perfectly save for a small proportion of the red clover. The alfalfa was the first to show growth in the spring and the sweet clover about the last.

In the light of subsequent developments it is especially regrettable that the space near the buildings where these plots were laid out did not admit of contiguous check plots. The fact is, they were sown rather as specimen than as test plots. Comparison is afforded, however, by certain plots occurring in the nurse crop test, 1920 seeding. Though situated at a distance of about fifty rods, the latter were likewise sown on summer-fallow, the land in each case having been broken in 1916 and thereafter cropped identically the same except that in 1917 the one area grew grain instead of potatoes. The natural soil quality would appear quite similar and the plots we are now regarding as checks had the advantage of a somewhat mellower seed bed. They were sown thirteen days earlier but this should not have handicapped them, although not being inoculated, they lost colour before autumn. In all essential respects the comparison is thought to be substantially a true one. Except this: these plots we are now considering as checks had inoculated soil broadcast over them late in 1920 and while this was slow in taking effect it did appear to produce some betterment, especially in the alfalfa, as the summer of 1921 wore on. The effect was to considerably reduce the disparity that would otherwise have been shown. But the contrast is still marked enough, as the table of yields brings out. Could the actual contrast have been photographed in plots located side by side, it would have rivalled in graphic effect any camera records of pot-culture experiments that have ever come under the writer's notice.

In the inoculated plots, particularly on the areas not clipped in the year of seeding, the growth was beautifully level, practically as high in the centre as on the margins. In uninoculated plots this has never been the case. The centre of such would, in favourable seasons, be perhaps three-fifths the height of the margins while in adverse seasons the middle would be not more than one-fifth the height of the margin. Could anything more conclusively prove that with uninoculated legumes nitrogen, rather than moisture, is the predominant limiting factor?

TABLE COMPARING YIELDS OF INOCULATED AND UNINOCULATED PLOTS OF FOUR DIFFERENT LEGUMES

Designation	Crop from areas clipped in year of seeding						1921 crop from areas not clipped in year of seeding	
	Inoculated			Checks				
	1920	1921	Aggregate two years	1920	1921	Aggregate two years	Inoc.	Check
Alsike	3,840	428	4,268	560	80	640	1,142	400
Common red clover	2,880	1,282	4,162	320	0	320	2,631	0
Alfalfa	1,360	–	–	1,600	560	2,160	3,364	1,120
Sweet clover	3,520	*2,140	5,660	1,360	160	1,520	4,708	480

*Incomplete.

NOTE

In this table all the figures are accurate except those in the first column (1920 yield of inoculated plots). Those yields were rather roughly taken. Unfortunately the complete yield of alfalfa from the inoculated area clipped in year of seeding is

not available. Part of its 1920 crop was consumed before weighing and the 1921 crop was confused in raking. Both crops were good—far superior to the corresponding yields from the check plots. For an initial season's crop the 1920 yields of hay from the inoculated areas were wonderful. Inoculation plus copious moisture makes legumes grow luxuriantly, amply fulfilling the anticipation ventured in our 1919 report.

A CONTRAST APPARENT THE FIRST SEASON IN 1921 SEEDINGS

The 1921 seeding of the inoculation experiment was located on a hill at the rear of the premises to guard, if possible, against the chance of the check plots being accidentally inoculated through the agency of wind or water carrying bacteria from some area where inoculated legumes were already growing, or had previously grown. In sowing and covering seed, the check plots, of course, were attended to first. Three plots each of sweet clover, alfalfa and alsike were sown on June 2 and 3. The highest plot of each was a check, the next a plot whose seed has been inoculated with soil applied by the glue method, while the third and lowest plot of each legume was sown with seed treated with nitro culture supplied by the Division of Botany, Central Experimental Farm, Ottawa. In the case of the soil-inoculated plots some loose inoculated soil was broadcasted over each plot to supplement what adhered to the seed.

The land where this test was located had been broken in 1915, cropped two years to cereals, fallowed in 1918, drilled to variety plots of cereals in 1919 and grew potatoes in 1920. On the crown of the hill where the check plots occurred the soil was rather thin and hard. It gradually improved descending the slope. Poorest soil conditions were thus unavoidably afforded to the check plots and best soil conditions to the plots sown with nitro-culture-treated seed. This fact will have to be kept in mind when comparing results. Good catches were obtained. The plots were weeded and the first few weeks' growth was very satisfactory on all plots. Sweet clover made the strongest growth, attaining finally a height of two and a half feet on the inoculated plots. The alfalfa was next highest and the alsike much the shortest of the three. For the first few weeks there was no difference between the inoculated and uninoculated areas but by early August the check plot of sweet clover was noticed to lose colour somewhat and evince a diminished rate of growth as compared with its fellows. A week or two later the same phenomenon was observed in the alfalfa plots, and thence forward until winter the contrast became increasingly marked in both legumes. The contrast was too straight-edged and abrupt to be attributed to any factor but the one under investigation. Late into November and even winter the top growth of the inoculated areas maintained its dark green shade while the uninoculated were by contrast pale, faded and thin looking, besides being shorter. That the sweet clover showed the contrast earlier in August than the alfalfa is attributed to the fact that its ranker growth more quickly depleted the stock of available soil nitrogen. That the alsike did not show any striking contrast at all may have been due in part to the fact that its much lesser growth had not reduced the soil nitrogen to the point of paucity.

NITRO CULTURE RATHER SUPERIOR TO SOIL INOCULATION

In the case of both alfalfa and sweet clover the nitro-culture plots seemed rather more vigorous than the soil-inoculated. Examination at successive dates showed that in the case of all three legumes nodules were formed soonest, most generally distributed and most plentifully on the nitro-culture plots. Indeed, here as in the 1919 seeding the evidence of inoculation left nothing to be desired. Good results were also obtained by the soil method though not quite so good as from the nitro culture. The check plots showed very few nodules until the last examination, when

quite a few roots were found with the tubercles commencing to develop on them. As to how the nitrogen-gathering bacteria got there, the Station staff are unable to offer a confident opinion, but their occurrence may be expected to modify next summer's contrast in growth.

INOCULATION OF PEAS AND VETCHES

Biologists group the wild pea-vine, wild vetch, common field pea and common vetch as plants belonging to a group among which cross inoculation will occur, but with this theory Beaverlodge evidence to date does not fully accord. Both wild vetch and wild pea-vine are indigenous to the locality, being well distributed and very prolific where shade, wind-shelter and other conditions favour. They were originally prevalent on all the Station area.

In 1921 there were on the Station small plots of Arthur field peas, grass peas, common vetches and hairy vetches, all side by side. Nodules were abundant on the roots of all but the field peas; nor were any to speak of found on field peas growing on other portions of the grounds.

In 1921 inoculation tests were made with peas and common vetches. The principal test with peas was incidental to the variety test, two or three kinds being sown with both treated and untreated seed. The nitroculture came from the Division of Botany, Ottawa. No particular results were obtained in the crop yields and it must be acknowledged that in the absence of superficial evidence, radical examination was not so thorough as it perhaps should have been.

Another test was made on very rich land in the garden, manured twice and summer-fallowed as well during 1920. Arthur field peas and common vetches were sown in inter-cultivated rows with and without nitro-culture treatment. Growth was extremely rank, as might be expected under such conditions, but it could not be positively said that the inoculated was ranker than the uninoculated. After the peas were pulled the roots were dug up and examined, some being sent to the Division of Botany. Neither lot of peas showed any nodules worth mentioning and even on the vetch roots they were not nearly so numerous as in 1920. This, however, may have been due to the richness of the soil. In Marshall's Microbiology it is stated:—

> "When an abundance of available nitrogen compounds is supplied, tubercle formation may be largely or wholly suppressed. In that case the plants secure their nitrogen from the soil and are not only independent of the bacteria but are strong enough to resist their entrance."

Why the plants should be disposed to "resist" the entrance of so beneficient an organism, is a riddle concerning which we should like further light from the scientists.

Summing up the findings to date, these facts stand out in bold relief:—

1. Seedings of alfalfa, red clover, alsike and sweet clover have never been a real success at Beaverlodge without inoculation, either artificial or through natural agency. This is true even of areas seeded without nurse crops. With nurse crop seeding, there has never been a plot of any of these legumes worth leaving for hay until inoculation was resorted to. Then, in the very first instance, the clovers nearly doubled the hay yield of the grasses.

2. In the absence of inoculation, much the larger yields are usually obtained from inter-cultivated rows and on deep, rich, loamy soils with porous sub-soils. With inoculation general, broadcast seedings have, in the limited experiments to date, surpassed the drills in yield of hay, and excellent crops have been grown broadcast on trampled clay land.

3. Where sown without a nurse crop on any reasonably good seed bed, the legumes always start nicely and look promising until the supply of soil nitrogen rendered available by the preparatory tillage becomes deficient. If the land is rich and seeding has been deferred until June, little or no difference may be noticed the first season between inoculated and uninoculated plots. But if the soil is only moderately rich or if seeding has been done early in May the uninoculated plots are likely to evince

diminished growth and a bleached colour before autumn. Uninoculated seedings in nurse crops usually winter-kill and in any case are failures for hay production.

4. In the second season, uninoculated plots produce satisfactory growth only on the margins bordering cultivated paths. The plants massed in the body of the plots will be, depending upon soil and season, from three-fifths down to only one-fifth the height of the plants on the margins, except where sporadic inoculation takes place and on such spots the growth more or less closely approaches that of the margins.

5. Fully inoculated plots grow vigourously from first to last. They go into the winter with a strong growth and dark green shade of leaves and stems and in the second season come along promptly with a prolific growth which, so far as yet observed, is nearly as tall in the centre as on the path-bordered margins of the plots.

6. Lack of inoculation is responsible for many of the failures that have been erroneously attributed to hard subsoil and other causes.

7. For best results hay crops need copious moisture but drouth alone has never yet caused complete failure of inoculated legumes at Beaverlodge.

A CO-OPERATIVE EXPERIMENT IN INOCULATION

About thirty good farmers, well distributed throughout the Upper Peace River country, are co-operating with the Beaverlodge Station in an inoculation experiment, the majority working with alfalfa. Seed for both check and inoculated plots was sent out through the Beaverlodge Station, inoculation being first applied by the glue method.

Nearly all the plots were seeded in June on well-prepared summer-fallow or garden soil, and with few exceptions they seem to be well looked after. Satisfactory preliminary reports have been received from the majority. When examining in September, some of the experimenters reported no nodules on either plot; others found them on both, while a few discovered them plentiful in the inoculated but sparing or absent in the checks. In one or two of the latter cases the growth seemed to have been conspicuously improved by inoculation even in the year of seeding.

SECTION VII—LEGUME ROOT PENETRATION OF HARD SUBSOILS

Along the north edge of the inoculated plots of legumes seeded June 16, 1920, and discussed under section VI, trenches were dug in August last in order to permit of excavating and measuring typical roots of each of the four legumes represented. The findings were very interesting. Beneath the alfalfa and Sweet clover plots the subsoil was found to be a very tough hard clay to a depth of over six feet. Skipping a rod the workers sunk another trench-pit at a point where the Red clover and Alsike plots adjoined, there being no paths dividing any of these plots. Here the subsoil was the same to a depth of three and one-half to four feet, at which level sand was encountered. The clover roots had not reached the sand however. From the sides of the trenches, representative (i.e. average) roots of fourteen-months old plants were picked out and measured with the following result:—

Kind of crop	Number of Roots measured	Average length (vertical penetration)	Extreme length
		inches	inches
Alfalfa	7	42·3	47
Sweet clover	11	34	39
Common red clover	8	26·1	35
Alsike clover	10	26·1	37

NOTE.—The actual penetration was deeper than shown for the fine ends were unavoidably broken off in the hard soil.

The average height of the top growth when photographed and cut on July 14 was as follows, the figures applying to the areas not clipped in year of seeding:—

	Inches
Alsike clover	12
Common red clover	18
Alfalfa	24
*Sweet clover	36-48

*Sweet clover not fully headed.

The weakness of Alsike is here brought out. Though winter hardy and very productive in wet years, it heads prematurely in dry seasons, just as potatoes have been observed to blossom at six inches in height, whereas with favourable growing conditions the same varieties would have attained a height of two feet or more. Common red clover, though less winter hardy than alsike, is not quite so prone to premature blossoming in a dry season, albeit inclined to the same defect. Much is hoped for from the Late Swedish or perennial red clover (Altaswede) which, being a later-maturing crop, should be more likely to continue growing past the period of early summer drouth into the season of the June rains.

SECTION VIII—GRASSES AND CLOVERS FOR SEED PRODUCTION

In a region where transportation charges whittle the net returns from heavy products down to the vanishing point, it is good business to seek out lines of effort where the freight factor will be minimized. A hundred dollars' worth of wheat may require forty dollars to lay it on the market, when a hundred dollars' worth of clover seed could be shipped for perhaps a tithe of that cost. That grass and clover seeds can be successfully grown on Grand Prairie has been repeatedly demonstrated at the Beaverlodge Station, while a few enterprising farmers have also taken certain of these lines up in a commercial way, with very satisfactory returns as to cropping and with pecuniary outcome depending largely upon the enterprise exercised in advertising and finding customers. Some degree of initiative is usually required of those who would reap extra profits by avoiding the beaten track.

THREE SUCCESSIVE SEED CROPS FROM WESTERN RYE GRASS

About a quarter-acre of western rye grass was seeded without nurse crop in 1918, part of it home-grown seed sown alone and the balance purchased seed, sown mixed with alfalfa. The alfalfa grew reasonably thick in the bottom but for lack of inoculation amounted to little until 1921 when a number of patches of it came on strong, quite over-topping the grass. The area of the piece had been reduced in 1920 to a fifth-acre in preparation for other tests. For three successive seasons the field has been cut for rye grass seed, the alfalfa not maturing seed in the time allowed. Heavy losses from shattering and imperfect separation occurred in the first and second crops, particularly that of 1919. This past year dry weather cut down the crop and alfalfa crowded it badly in spots. Yields follow:—

YIELD of Western Rye Grass seed—Pounds per acre.

Year	Yield	Remarks
1919	303	Over-mature and shattering.
1920	409	Over-mature and shattering.
1921	255	Much chaff still to be cleaned out.

ARCTIC SWEET CLOVER

On July 9, 1920, a row of Arctic sweet clover was sown on high rolling land with seed supplied by the University of Saskatchewan. This seed had been scarified and inoculated by the soil method. The row wintered perfectly and made a tall branching growth in 1921, some plants exceeding six feet in height. They proved enormously fecund in the production of seed though, unfortunately, a good deal of this was shattered by high winds. After cutting, the stooks were more than once blown down and each time it happened very heavy wastage occurred.

After all this, the yield of seed was still heavy but the coarse hard stalks nearly wrecked the small separator through which they were passed. Hulling and cleaning were rather imperfectly accomplished but the gross production as at present ascertained was 34 pounds from a row 24 rods long. Calculating the row as occupying a width of one yard, the yield per acre would be 1,246 pounds, or 20 bushels and 46 pounds. Of course, further separation of hulls and immature seed will reduce this very materially but on the other hand the excessive shattering must be borne in mind. No wonder sweet clover soon lines the roadways of a province.

ALSIKE, COMMON RED AND ALTASWEDE

In June, 1920, a row each was sown of alsike clover, common red and the perennial red clover distributed from the University of Alberta under the name of Altaswede. All the seed was treated with nitro culture and sown after sundown. The seed being sticky from treatment, a rather uneven distribution occurred, especially of the Altaswede, the supply of which was limited. The alsike was the fullest-seeded row and the Altaswede the most irregularly sown. In the year of seeding, the new clover made a small top growth but this was learned to be its habit.

In respect to winter hardiness the Alsike came through best of all with the Altaswede a very good second and common red a very poor third. Thanks, no doubt, to scuffling, the alsike grew rather taller here than in any of the broadcast plots. It blossomed freely and set a large quantity of seed, which ripened at the end of August. Situated close to a cattle lane, the Altaswede was somewhat set back in sections by cattle reaching through the fence, until this was noticed and stopped by woven wire. In spite of this and imperfect seeding, it made an encouraging growth and ranked second to alsike in productioon of seed. With an equally good stand it might possibly have done as well.

The comparison between Altaswede and common red was in every respect much to the advantage of the Altaswede.

Both the red clovers were cut for seed on September 8. At date of inditing this report all these small seeds await the arrival of cleaning apparatus. The three in question, however, are already reasonably clean and a sample of the Altaswede tested in the Seed Laboratory at Ottawa germinated 62 per cent in four days and 75 per cent in ten days. As at present cleaned, yields compare thus:—

Alsike, about	7	bushels	per	acre.
Altaswede, nearly	5	"	"	"
Common red, about	4	"	"	"

ALFALFA RIPENS LITTLE SEED

Alfalfa has never ripened any seed worth mentioning at Beaverlodge. In 1921 it bade fair to do so but very little yellow seed came through the separator, little green either for that matter. It podded almost as profusely as the Arctic sweet, but the season is too short for maturity.

OTHER SEEDS

White Dutch clover, seeded two years ago on a pond embankment where seepage was abundant in early summer, flourished well in 1921, some stalks being nearly a foot and a half long. Some of these heads were plucked and shelled out a very nice sample of seed.

Common vetch grown in inter-cultivated rows on rich garden soil yielded at the rate of fifteen bushels per acre of seed, most of it good, but some a trifle green.

A series of clover and grass plots were seeded in 1921 for the special purpose of seed production. The grasses were probably sown too late to winter, but the legumes got an excellent start. Wild sanfoin was included in the series, but promises little.

Several of Dr. Malte's selections of western rye grass were seeded in comparative rows.

ANNUAL SWEET CLOVER

A small quantity of Hubam or annual sweet clover was seeded in the garden on July 8 against the white-flowered biennial. It was, of course, too late to give Hubam a fair test and some seed was reserved for early sowing in 1922. By winter the biennial had made the larger growth of the two.

SECTION IX.—VARIETY TESTS WITH CORN AND SUNFLOWERS

Seven strains of sunflowers and eleven kinds of field corn were compared on well-prepared spring-ploughed land where variety plots of cereals had been grown in 1920. Each plot consisted of a row 22 rods long, amounting to one-fortieth of an acre. The test with sunflowers was in duplicate. As the rows of corn and sunflowers crossed the stubble of the grain plots, quite fair conditions were provided, especially for the sunflowers. There were some irregularities in the stand of corn, but in so far as the leading varieties are concerned the results in tonnage correspond pretty closely with appearances prior to harvest. That is to say, the best kinds of corn compare in yield much as they did in maturity and development.

Contrary to general experience at Beaverlodge, the corn and sunflowers were killed by frost on the same day, September 9. Cutting commenced at once. The corn was weighed the next day but the sunflowers not until the 12th. The result was surprising until explained by data from other stations going to show that rapid loss in weight from wilting takes place after cutting. The sunflowers looked twice as heavy as the corn when growing in the field, but the latter, being scaled in a much sappier condition, recorded fully as great a weight as the sunflowers. This relative discrepancy as between actual and recorded weights did not interfere materially with the purpose of variety comparisons.

Reference to the table of corn yields will show that Twitchell's Pride led with a crop of twelve tons, followed by Quebec 28 and Longfellow in order of mention. The first two of these, but particularly the former, led all through the summer and were the most advanced at harvesting. Canada Yellow was slightly more nearly mature than Longfellow and its lower yield is at least partly attributable to its having only sixty per cent of a full stand, whilst Longfellow had eighty per cent, Twitchell's Pride seventy-five per cent, and Quebec 28 sixty-five per cent. Speaking broadly, it is probable that the suitability of the various varieties will be more reliably judged from their relative maturity than from their standing in respect to yield.

In addition to the eleven varieties tabulated there were some Howes' Alberta Flint grown in the garden, its seed having been received too late for field trial. Sown June 11 on very rich land, this corn attained an average height of only three feet but had ears forming when caught by the early September frost.

TABLE CORN YIELDS

Weights and Measurements of Field Corn Variety Test

Variety	Yield per acre	Tallest stalk	Average stalk	Per cent stand	Remarks
	pounds	inches	inches		
Twitchell's Pride	24,040	67	56	75	100% tassels, 60% silk, 40% ears (a few well formed).
Quebec 28	23,200	60	45	65	95% tassels, 42% silk, 2% ears.
Longfellow	19,200	62	45	80	70% tassels, no ears.
North Dakota	17,680	46	38	75	2% tassels, no ears.
Northwestern Dent	14,480	42	33	45	5% tassels, no ears.
Compton's Early	14,440	57	36	85	1% tassels, no ears.
Wisconsin No. 7	14,400	46	40	60	5% tassels, no ears.
Canada Yellow	13,800	66	45	60	80% tassels, standing. 5% ears just forming.
Leaming	11,280	56	46	70	1% tassels, no ears.
*White Cap Yellow Dent	10,420	71	48	80	38% tassels.
Bailey	2,000	30	25	40	No tassels, no ears.

*Figures for the White Cap Yellow Dent are the average of two rows, one in a drill and one in hills. Results with this cultural test were too erratic to be at all trustworthy and it is questionable whether the figures should be included in the variety report.

EARLY SUNFLOWERS

Previous experience having shown that the Giant Russian variety of sunflowers was too late to mature safely at Beaverlodge, inquiry has been made for earlier sorts. The 1921 list included three early kinds grown in Saskatchewan and obtained through the agency of the Rosthern Experimental Station. These have been respectively distinguished as R. No. 1, Friesen, and Burns. Then there were three lots of seed presumably representing three strains bred or selected by Dr. Charles E. Saunders, Dominion Cerealist. One called Early Ottawa 76 was received from Dr. Saunders direct; another, designated Dr. Saunders' Early, from the Dominion Horticulturist, and one called "Saunders' Selection," which had been worked with by Dr. Saunders for a number of years but of which the Division of Forage Crops had produced a quantity of seed in 1920. The Mammoth Russian seed was obtained through a commercial source. There was also an Alberta variety, but unfortunately the seed of it was not received in time for a proper comparative sowing.

Of the seven sorts given a fair duplicate trial the best yield was made by the strain of Dr. Saunders' Selection received through the Forage Crop Division, though it did not differ very markedly from the other two Saunders strains.

Without full information concerning the best stage at which sunflowers should be cut for ensilage it is impossible to appraise accurately the relative worth of different sorts. Possibly it may be found that the Early Ottawa, though yielding a little less than the other sort, will be more desirable. The Mammoth Russian again proved itself too late to be recommended for the district. The Saskatchewan varieties proved rather interesting. All quite early, they varied in degree of precocity. On July 24 a number of blooms were noticed on the Friesen rows and a few on the R. No. 1. These two kinds might be classed as dwarfs. The Burns comes nearest of the trio to filling the bill as a silage crop. Though not quite so early as the other two, it grew and decidedly outyielded them. It was 95 per cent in bloom at harvest. Early Ottawa 76 was the next earliest kind.

It is likely that the dry, early summer followed by more ample rainfall in the latter part of the season exaggerated the spread in periods of maturity as between the late and early kinds. Certain it is that after heading out normally, the earliest kinds developed a secondary inflorescence with a large number of branching heads on many stalks, so that their yield compared far better with that of the late kinds than might have been expected from their relative height. On a basis of dry matter per acre, they would probably have shown up better still. In comparing yields of

forage crops there is ever the likelihood of representing well matured kinds to their disadvantage. Analysis of dry matter and comparison upon that basis would be instructive. Bearing in mind that one year's work cannot suffice for conclusions, the Superintendent inclines to favour tentatively the Burns and Early Ottawa 76 varieties for the purpose of ensilage in Grande Prairie.

TABLE OF SUNFLOWER YIELDS

Weights and Measurements of Sunflowers in Experimental Plots, 1921

Variety	Average yield per acre wilted weight	Tallest plant	Average plant	In head (buds or bloom)	In bloom	Diameter largest head	Stalks with branching heads
	lbs.	ins.	ins.	%	%	ins.	%
Saunders Selection	23,340	82	61	100	35	6	.....
Mammoth Russian	22,180	73	58·5	92·5	5	4	.....
Early Ottawa 76	20,220	75	55·5	100	92·5	6·5	0·5
Burns	20,100	66	52·5	100	95	9·5	6
Saunders Early	19,740	83	60·5	100	57·5	8·5	.....
Friesen	15,480	45	37	100	100	9	30
R. No. 1	14,540	46	39·5	100	92·5	10	62·5

Yields of field roots were the best ever harvested from the plots at Beaverlodge. Early seeding on summer-fallow land gave them a good start, while reasonably prompt attention in thinning and cultivation enabled them to take full advantage of the growing season.

Land of naturally poor quality, showing something like three inches of black loam when broken in 1918, was cropped to flax in 1919. Rock had prevented a clean job of ploughing, hence to destroy the perennial grasses which are the usual legacy of imperfect breaking of prairie sod, the land was summer-fallowed in 1920, being ploughed twice that summer. No manure or fertilizer was applied. Seven varieties of turnips, three of sugar beet, one of mangels and one of field carrots were sown, most of them in triplicate. Yields have been calculated from but one row of each. From the weight of the fresh-pulled crop, ten per cent has been deducted as an allowance for dirt. This still leaves a yield of 21 tons 669 pounds for the Monarch Swede, while the long, mangel-shaped turnip, Boitfelden, achieved a production of 28 tons 1,073 pounds per acre. In point of quality this appeared to be rather superior to the Greystone, which was eaten very reluctantly by the cattle in the winter of 1920 and 1921.

FORAGE CROP TABLE—FIELD ROOTS

Kind	Variety	Sown	Harvested	Yield per acre
				lbs.
Mangel	Yellow Intermediate	May 6	Oct. 5	18,567
Sugar beets	Waterloo	May 6	Oct. 6	15,444
"	Chatham (home grown)	May 6	Oct. 6	15,147
"	Chatham	May 6	Oct. 6	14,206
Field carrots	Danish Champion	April 30	Oct. 13	13,290
Turnips	Monarch	April 30	Oct. 13	42,669
"	Greystone	April 30	Oct. 13	55,885
"	Suttons Champion	April 30	Oct. 13	31,977
"	Ditmar's Swede	May 21	Oct. 13	38,709
"	Boitfelden	May 21	Oct. 13	57,073
"	Ostersundem	May 21	Oct. 13	46,777
"	Rund Stubbom	May 21	Oct. 13	42,025

A DATE OF PLANTING TEST WITH MANGELS AND SWEDES

Monarch Swede turnips and yellow Intermediate mangels were included in the date-of-planting test with garden vegetables. The land was a very rich summer-fallow, manured both before and after ploughing in 1920. The mangel test was at the better end of the garden. This fact, together with an irregularity in the stand of the fourth seeding of turnips, explains why, for once, mangels have outyielded turnips at Beaverlodge. As a rule it has been decidedly the other way. The yields obtained show that whilst Grande Prairie is not particularly well adapted to root culture, yet in some seasons creditable crops can be secured by the use of sufficient labour and manure.

In the garden test the plots were necessarily small, each sowing of turnips being represented by a 20-foot section of a row, amounting to one-seven hundred and twenty-sixth of an acre, and each sowing of mangels by a 15 foot section amounting to one nine hundred and sixty-eighth of an acre. Naturally, with such small plots there will be irregularities in yield, but the trend shows that fairly early planting insured the largest yields, though the turnips from the first sowing were coarse and unsuitable for table use. Taking one year with another, the fore part of May has been indicated as the best time for seeding field root crops, though results vary according to the seasons.

GARDEN DATE-OF-PLANTING TEST, 1921

Designation	Sown	Turnips Harvested Oct. 19	Mangels
		lbs. per acre	lbs. per acre
1st date	April 20	72,600	55,176
2nd date	" 27	68,244	64,856
3rd date	May 5	52,272	55,176
*4th date	" 12	29,040	55,176
5th date	" 19	48,642	49,368
6th date	" 27	48,642	43,560
7th date	June 3	34,122	39,688
Averages		50,509 (25 tons, 509 lbs.	51,857 (25 tons, 1,857 lbs.

*Yield of 4th sowing of turnips reduced by a very incomplete stand.

SUMMARY OF SEVEN YEARS' EXPERIMENTS WITH FIELD ROOTS

Notwithstanding the large yields of roots which it is sometimes possible to secure by intensive methods, it must be admitted that field root culture in Grande Prairie on a commercial scale is fraught with difficulties. To obtain a full crop it is usually necessary to sow medium-early and when this is done, difficulty is often experienced in establishing a good braird. Growth is liable to be very slow in May and early June, laying the crop open for a prolonged period to the attacks of insects, the encroachment of weeds and the lashing of high winds, which occur in some seasons. Uncertain weather in autumn calls for early harvesting, often before the crop is fully grown. Mangels are particularly liable to have their crowns injured by an unusually hard frost which may occur in September or may not arrive until November. Seeding, thinning and harvesting come at a busy time when help can ill be spared from other work. Finally, the storage and winter feeding, in a climate which is at times severe, present difficulties that are particularly trying under pioneer conditions. In order to feed roots to advantage throughout the winter one requires a root cellar opening into a reasonably warm stable, so that the storage will not be chilled unduly by daily entrance nor the roots frozen while being handled and

fed. Such storage can certainly be provided but the cost per unit of capacity is rather high.

From the records of variety tests of field roots at Beaverlodge a table has been prepared comparing the yields of the several classes of roots year by year and also presenting four-year and two-year averages. The marked irregularity in yields according to season is brought out, also the low averages. To be sure, the variety plots have seldom had a taste of manure but they have had quite as good preparation as the land which yielded hundred bushel averages of oats and forty to fifty bushel averages of wheat. It is clear, therefore, that if field roots are to become an important crop it must be by specially favoured treatment, in which good wind shelter will probably be found an important factor in some years.

FORAGE CROP TABLE

Summarizing seven years' experiments with field roots, Beaverlodge, 1921

Year	Swede Turnips Average all varieties		Mangels Yellow Intermediate		Sugar Beets Average all varieties		Field Carrots Average all varieties		Greystone Turnips	
	tons	lbs.	tons	lbs.	tons	lbs.	tons	lbs.	tons	lbs.
1915	18	666	15	1,680	.....	.....	10	1,000		
1916	.....	.....	3	1,260	.....	.....	2	1,321		
1917	12	386	8	1,312	.....	.....	5	1,937		
1918	21	540	13	300	10	40	11	1,338		
1919	5	1,777	9	0	3	1,466	Frozen in ground Oct.			
1920	13	346	7	1,342	7	1,342	5	1,141	23	802
1921	20	689	9	567	7	932	6	1,290	27	1,885
Averages 4 years, 1918-1921	15	338	9	1,552	7	445	5	1,942		
Averages 2 years, 1920-1921	16	1,517	8	954	7	1,137	6	215	25	1,343

FIELD HUSBANDRY

SECTION I.—THICKNESS OF SEEDING EXPERIMENT

Inaugurated in 1918, and serving a dual purpose, being intended to compare different thicknesses of grain seeding as to their results in grain production and at the same time to provide nurse crops for a seeding-down test, this experiment has now run through its fourth season.

An acre each of wheat, oats and barley is divided into four quarter-acre strips 10 x 16 rods, the intended rates of seeding on these being as follows:—

Wheat at 5, 6, 7 and 8 pecks per acre

Oats at 10, 12, 14 and 16 pecks per acre

Barley at 4, 6, 8 and 10 pecks per acre

It is difficult to regulate the seedings precisely and usually the actual rate falls a little short of the intended. It was thus in 1921; and, besides, the germination of all three grains was very badly impaired by using the dry-formaldehyde treatment for smut, too much solution being applied for the limited quantities of grain employed. The germ of the wheat was almost destroyed and all the grains in the test came up very slowly indeed. Harvest was accordingly delayed. In view of the handicap, it was remarkable what good yields of wheat were obtained, the average turnout of the four strips being 57 bushels 5 pounds per acre. The average of the four seedings of oats was 98 bushels 10 pounds per acre, and of three seedings of barley 46 bushels 32 pounds, the returns from the thickest sown and probably the best block of this cereal having been confused at threshing time.

THE TEST MARRED BY LACK OF UNIFORM CONDITIONS

Steady expansion of the experimental work to a scale beyond what was definitely provided for when the Station was established has rendered necessary the bringing in of certain areas not presenting a parity of previous cropping conditions. It was so, of necessity this year, with the area occupied by the experiment under discussion. In the preceding season the land had been partly in garden vegetables and potatoes, partly in field roots, partly in summer-fallow and partly in grass and clover plots ploughed up in September. The oats were probably the only grain of the three which had closely comparable conditions for all the four rates of sowing. Conditions for the wheat strips were probably not very unequal save that the six-peck and seven-peck seedings were evidently favoured by the leachings and litter from a rotting manure heap adjacent. This, by the way, not only perceptibly benefited the grain near by but greatly stimulated the clover seeded amongst it. The barley was located on land quite unevenly treated in advance.

SOME INFERENCES

The Superintendent hesitated to include this year's outcome in the long-term averages but finally decided to tabulate the wheat and oats, throwing out the caution that from several unavoidable causes the results of this experiment to date are much less dependable than the results of other experiments under way at the Station and are to be accepted with reserve. The work is of some value nevertheless. It confirms the earlier conclusion that on well prepared fallow or breaking fairly thick seedings of oats ripen earlier than thin ones, the gain, within the limits of this test, being about a day for each extra half bushel of seed. So far as yield is concerned, the result seems to vary somewhat according to the variety employed. With the Victory and Ligowo oats used in the earlier years the thicker seedings gave the larger yield. With the Banner, introduced in 1921, the largest yield was obtained from the thinnest seeding, notwithstanding the set-back from injudicious seed treatment. Soil variation may possibly have been a factor but certain it is that the straw decidedly decreased in length and stoutness as one progressed from the thinnest to the thickest seeding. With the Huron wheat and O. A. C. No. 21 barley these differences were not so marked as with the oats.

LEGUME VERSUS GRASS SOD FOR BARLEY

The space devoted to the acre of barley comprised garden land of 1920, land where four-year-old stands of western rye grass, timothy and meadow fescue had been ploughed up and land where some sweet clover, alfalfa and red clover, all sown in 1918 for an inoculation test, had been broken in September following the removal of the 1920 aftermath of hay. These plots of legumes were broken on the same day as the grass swards and the subsequent treatment was the same in each case. An extremely valuable opportunity for observation was thus afforded. While the rye grass had cut only 2,477 pounds of hay per acre in 1920 and the other grasses less than half a ton, the growth of barley after all the grasses was very thin and short, whereas after the clovers and alfalfa it was strong and good, notwithstanding that from the sweet clover plots had been taken in one season two cuts of hay totalling two and three-quarter tons; from the alfalfa two and one-quarter tons and from the red clover 1,700 pounds per acre. Casual examination discovered no striking difference between the barley following sweet clover and that following red clover. If moisture were the all-important limiting factor, one would have looked for a much larger crop of barley after 1,700 pounds of red clover than after 5,600 pounds of sweet clover.

SUMMER-FALLOW VERSUS HOE-CROP PREPARATION

There was afforded a conspicuous comparison of summer-fallow with various kinds of hoe crop preparation. Each strip of oats and wheat crossed a strip of 1920 fallow, two strips of turnip land, a strip where table carrots had grown and a strip

of potato ground. The heaviest straw grew on the fallow land, the next heaviest after carrots, then after potatoes, while after 15 to 24 tons of turnips per acre the straw was fully six inches shorter than after fallow, and much finer. In respect to maturity the converse order applied.

RATIO OF GRAIN TO TOTAL CROP

All the grain was cut slightly on the green side and was stacked for some weeks. At threshing the thoroughly cured out product of each quarter acre was weighed before separation. From the data resulting some interesting ratios of grain to total crop are figured out. Men who buy and sell bundles will also be interested in the average weight of a sheaf. In cutting, the binder had been set to tie small-size bundles. The straw, however, was of good length.

TABLE 1.—Presenting Results Thickness of Seeding Test 1921. All plots one-quarter Acre in Area

	Count of sheaves per plot	Weight total crop per plot at threshing	Weight grain per plot	Per cent grain to total crop 1921 (only)	Grain per acre 1921	Aggregate yield grain —3 years	Average yield of grain— 3 years
		lb.	lb.		bush. lb.	lb.	bush. lb.
Wheat— Variety 1921 Huron, seeded April 19, harvested Sept. 3 and 5—							
5 pecks per acre	155	1,856	840	45·25	56 0	8,407	46 42
6 pecks per acre	164	1,925	890	46·23	59 20	8,399	46 39
7 pecks per acre	165	1,913	870	45·47	58 0	8,635	47 58
8 pecks per acre	158	1,875	825	44·00	55 0	8,967	49 49
Totals wheat	642	7,569	3,425			34,398	
Averages wheat				45·25	57 5		47 47
Oats— Variety 1921 Banner, seeded April 20, harvested Aug. 22.							
10 pecks per acre	145	1,620	880	54·32	103 18	9,186	90 2
12 pecks per acre	137	1,530	823	53·78	96 28	9,211	90 10
14 pecks per acre	137	1,565	840	53·67	98 28	9,871	96 26
16 pecks per acre	127	1,500	799	53·26	94 0	9,707	95 5
Totals Oats	546	6,215	3,342			37,975	
Averages, Oats				53·77	98 10		93 2
Barley— Variety O.A.C. 21, seeded April 20, harvested Aug. 13.							
4 pecks per acre		1,262	540	42·79	45 0		
6 pecks per acre			550		45 40		
8 pecks per acre		1,055	590	55·92	49 8		
10 pecks per acre		1,160					

NOTE.—Column headed "Aggregate yield grain 3 years" is not supposed to be published as it would be superfluous and confusing. It is included here for convenience in future computations.

TABLE 1A.—Summarizing some deductions from Table 1.

	Days to mature	Count of sheaves one acre 1921	Weight crop on one acre 1921	Weight grain on one acre 1921	Ratio grain to total crop 1921	Average weight bundle at threshing	Three years average yield
			lb.	lb.	%	lb.	bush. lb.
Wheat	139	642	7,569	3,425	45·25	11·78	47 47
Oats	124	546	6,215	3,342	53·77	11·38	93 2

SECTION II.—MANURING EXPERIMENT

In 1918 a fairly level whitish-clay knoll-top at the rear of the Station area was summer-fallowed, the east half being enriched with about twenty tons per acre of barnyard manure. The west half was left unfertilized. Though the manure was

well incorporated by tillage, under conditions that might have led one to expect good results in the ensuing crop, there was only a 17 per cent advantage indicated by the 1919 yield of winter wheat, a difference that could not, with certainty, be recognized by the eye. In the spring of 1920 the land was ploughed late and sown to oats, rather meagre preparation being given. In this second crop the advantage from manuring was 27 per cent in total weight at threshing and 32.7 per cent in the weight of grain. Even this considerable benefit, though noticeable to the eye, would not have been fully appraised by inspection alone.

In the spring of 1921 the land was again ploughed and drilled to Eureka barley (beardless and hull-less). Not only was the manured half perceptibly more vigorous but it headed out and ripened two or three days sooner than the unmanured part. This difference was sharp and unmistakable. Slight irregularities in the line of application could be traced. At harvest there were 38 per cent more sheaves from the manured than from the unmanured half. It was observed, however, that the heads of the latter were a little larger and the kernels seemed better filled. This may have been partly due to the peculiar nature of the season, which afforded more favourable weather to late-maturing kinds. As the crop was allowed to become almost dead ripe the odds, if any, were thrown to the unmanured, which possibly crinkled less, being less over-mature. At threshing it was found that the manured area showed an advantage of 28.8 per cent in total weight of crop and 24.3 per cent in weight of grain alone. The measurements were exact. Before reaping, a path was cut through, dividing the two halves. The yield, in each case, was calculated from an area 16½ by 3 rods—49.5 square rods.

The results are important in bringing out the deferred action of manure in this cool, comparatively dry climate. Presumably, after three successive crops of grain a considerable residual benefit must still remain. Taking the three crops to date, however, and ignoring the straw, we have from this one twenty-ton application of manure a gain of:—

5 bush. 36 lbs. wheat	at 50c bush.	$2 80
15 bush. 30 lbs. oats	at 20c bush.	3 17
5 bush. 20 lbs. hulless barley	at 40c bush.	2 17
		$8 14

At the low prevailing prices of grain used in this estimate there has already been recovered a return in grain alone of 40.7 cents per ton of manure. Add what the straw may be worth, as feed, allow for the residue which undoubtedly remains to benefit many succeeding crops in diminishing ratio, note the effect of the manure in promoting early maturity of the barley, and, after allowing for the extra twine and labour required by the heavier crop, consider whether it pays to let manure waste while poor knolls go hungry.

TABLE 2.—Manuring Test, 1921

A—1919 RESULTS, WINTER WHEAT

Designation	Area	Yield total crop per acre-lbs. at stacking	Yield grain per acre	Yield grain per acre	
	sq. yds.		lbs.	bush.	lbs.
Manured	1,729		2,309	38	29
Unmanured	1,729		1,973	32	53
Difference			336	5	36
Per cent			17%		

TABLE 2.—Manuring Test, 1921—*Concluded*

B—1920 RESULTS, OATS

Manured	1,729	6,718	2,191	64	15
Unmanured	1,729	5,290	1,651	48	19
Difference		1,428	540	15	30
Per cent		27%	32·7%		

C—1921 RESULTS, BARLEY (HULLESS AND BEARDLESS)

Manured	1,497·4	2,424	1,328	27	32
Unmanured	1,497·4	1,881	1,068	22	12
Difference		543	260	5	20
Per cent		28·8%	24·3%		

NOTE.—Area of grain trimmed to 1,497·4 sq. yds. in 1921. Yield total crop represents weight at threshing in 1921.

D—THREE YEARS' RESULTS COMBINED

Manured			5,828
Unmanured			4,692
Difference			1,136

Advantage to date in favour of manuring—24·21 per cent.

SECTION III.—FALLOW VS. EARLY AND LATE SEEDED STUBBLE GROUND

Though not designed as an experiment there were on the Station farm three differently prepared areas seeded to multiplying blocks of hulless oats, which furnished some very instructive comparisons. These areas had, for different reasons, been left over when the season's experimental work was plotted and varied in size from an acre and a quarter up to slightly over two acres, being thus representative of field conditions. The area of each was exactly measured at harvest and yields carefully weighed, with an allowance of one pound per bushel for good measure, though the grain was pretty cleanly fanned. Essential details are presented in table III.

There were three distinct conditions:—

(*a*) Naturally good land spring-ploughed and seeded early;

(*b*) Naturally poor land spring-ploughed and seeded late;

(*c*) Naturally poor to medium land fallowed in 1920 and seeded early.

It will be observed that the summer-fallow yielded twice as much grain per acre as the late-seeded stubble of similar natural quality and practically three times as much as the early-seeded stubble, though the black loam here was considerably deeper than on the fallowed area.

It is true there were complicating factors, such as difference in the degree of maturity when harvested but after making full allowance for these the results are still significant and suggestive. They are all the more suggestive when it is known that there was a considerable reserve of sub-soil moisture carried over from 1920.

Without further and more absolutely conclusive evidence the Superintendent does not feel warranted in advancing for publication all the inferences which these comparisons invite, but he does consider it quite safe to deduce that at least one

important factor besides moisture is involved. The desirability of having an accumulation of nitrates to give the newly-sown crop a prompt and vigorous vegetative development is indicated. In the Grande Prairie climate, summer-fallowing insures this, though a complete season of bare fallowing may be ultimately wasteful of fibre and fertility. Looking into the future, it is easy to glimpse the practical importance of manure, legumes and such modified forms of cultivation practice as will minify waste of fertility while, at the same time, providing sufficient soluble plant food to give the early-sown crop a proper start. Part-season fallowing and hoe-cropping may be necessary to this end.

TABLE 3.—Results with Liberty Hulless Oats—Commercial Crop, 1921

Designation	Preparation	Date seeding	Date harvest	Days between seed and harvest	Total crop per acre	Grain per acre	Per cent grain to total crop
					lb.	bush. lb.	
1. Early seeded stubble	Naturally good loam, broken in 1915. Cropped to three successive crops cereals. Summer-fallowed in 1919. Cropped to hulless oats in 1920 yielding 64 bushels per acre	April 27	Aug. 15	110	2,060	25 6	41·55
2. Late seeded stubble	Naturally poor land. Broken in 1918. Hoe-cropped in 1919. Hulless oats in 1920. Disked in 1921. Spring-ploughed late and floated and drilled	May 21	Sept. 8	120	.....	34 27	.....
3. Summer-fallow	Naturally a medium to rather poor soil. Broken in 1918. Cropped to cereals 1919. Fallowed 1920	April 28	Aug. 19	114	6,475	75 14	39·6

SECTION IV.—SEEDING WINTER RYE WITH SPRING GRAIN

In 1920 a 1 by 16 rod strip of barley and a 1 by 4 rod strip of oats were crossed-drilled to winter rye at five pecks per acre. Spring seeding was late that year so that the barley was not sown until May 21 and the oats a few days later. The rye was crossed-drilled on June 17, the spring grain being then well up. The single-disc drill mutilated the latter rather badly but at harvest careful sampling revealed 6.4 per cent more total crop and 4 per cent more threshed grain from the areas seeded to rye than from other areas not thus mutilated. The apparent increase may have been due to chance but certainly observation at harvest revealed no detrimental effect attributable to the rye seeding. The barley in these blocks yielded 55 bushels per acre and the oats heavily also. An excellent "catch" of rye was obtained and in the very wet autumn of 1920 it grew a long, thick mat in the barley stubble. Jointing was feared and would, under other conditions, have been prevented by fall pasturing, but grazing was not feasible on this experimental area.

In the spring of 1921 the rye came up nicely, despite dry weather, producing an average yield of grain of 30 bushels 43 pounds per acre against 47 bushels 8 pounds from the Variety Test plots seeded in August on summer-fallow. The only cost of the secondary crop was the rent of the land, the value of five pecks of rye and the work of drilling it in. As a means of economizing labour this system has much to recommend it. None of the grasses seeded under the same conditions as this winter rye produced nearly as large a total weight of crop.

Rye is hardy and a gross feeder. On summer-fallow it often produces excessive straw and is difficult to harvest. Seeded with spring grain it gives a more moderate but quite sufficient length of straw and was comparatively easy to handle.

On May 7 a mixture of western rye grass and timothy was drilled in among the growing rye, the single-disc grain drill being run several times over the land to

insure even distribution of the small amount of seed weighed out for the test. A good germination of grass seed resulted, but it remains to be seen what the yield of hay will be.

THE RYE SEEDING REPEATED IN 1921

The experiment of seeding rye among the spring grain was repeated in 1921, but with a slight variation. Oats at six pecks per acre were drilled April 5 on spring-ploughed stubble. Winter rye was cross-drilled June 21 at five pecks. A stand of rye was again obtained but owing to less favourable preparation, a drier early summer and a longer lapse between the sowing of the two grains, the growth of rye was not nearly so strong as it was in 1920.

RYE MUST BE SEEDED LATER THAN THE SPRING GRAIN

It may be recalled that in 1919 rye was seeded with oats at the time of sowing the oats. This was not a success for the rye cut the yield of oats nearly in half and even when the headed rye was counted in with the oats the total 1919 yield was reduced by 35 per cent. Some of the rye having headed out, it was not surprising that considerable winter killing occurred. It seems that for best results the rye should be sown about a month after the spring grain.

SECTION V.—DATE OF SEEDING EXPERIMENTS WITH CEREALS

In 1918, 1919 and 1921 some very interesting observations have been afforded by plots of the leading cereals sown on different dates. No such successive seedings were attempted in 1920 because spring that year opened later than the date at which the final sowing would ordinarily occur. Irregularity in the opening of the seasons, combined with the frequent necessity of harvesting certain plots in advance of maturity to forestall frost, makes it difficult to tabulate instructive averages

Table 4 brings out the fact that the first sowing produced the largest crop of wheat, it being more fully matured. The best yields of oats and barley obtained were from the second seedings. The third seeding of barley surpassed the first while the third seeding of oats nearly equalled the first. None of these tests were in duplicate and too positive conclusions must not be drawn. It is rather surprising that the third seeding of oats and barley did not show up better in comparison with the second. Otherwise the results agree substantially with former findings and go to support the conservative observations presented in the report of two years ago which, with a few additions, are repeated thus:—

1. Early seedings produce the earliest but not always the largest crops.

2. As compared with very early seedings, medium ones commonly mature in fewer days.

3. Medium to late seedings frequently make the heaviest tonnage of total crop, especially in the case of stubble ground.

4. The sooner one can seed after the fields are arable the surer he is of producing a good grade of wheat and a high-germinating sample of oats and barley.

5. In the average season best yields of wheat will probably be obtained by seeding as soon as practicable after the middle of April.

6. As a rule, the best crops of feed oats will be secured from medium rather than from extremely early sowings.

7. Very late sowings of oats sometimes produce excellent crops but do not usually have time to ripen fully.

8. In eight years' experiments with oat and barley plots located side by side the effect of late-spring frosts has appeared to be little more severe upon the barley than upon the oats. Even when the barley was flattened out by frost on June 1, as has happened twice, it has recovered rapidly.

9. Frost after heading out affects the sample and yield of wheat and barley much more readily than it affects the sample and yield of oats, though the germination of the latter may be badly affected when the sample does not reveal it to casual inspection.

10. Flax will stand successive light frosts in the early stages of growth but on two occasions has been wiped out by a hard late-spring frost. Seeding around, or before the middle, of May seems safest, however, since if the flax is destroyed by a spring frost the land may be re-sown to oats for green-feed.

11. Field peas, like wheat, stand frost well while young, but not well after blossoming. Hence they should be sown early.

12. Summer-fallow should usually be drilled ahead of stubble ground. The first reason is that the summer-fallow crop needs more days to reach maturity. The second is that the summer-fallow has moisture and nitrates in readiness to support a prompt early growth.

13. Approximate maturity is essential to high yields but easy-shattering cereals will often lose more in a windy climate through being left to ripen fully than they will from being cut on the green side.

14. On the majority of farms the most advantageous order of seeding of the leading grains will probably be: 1st, wheat; 2nd, peas; 3rd oats for seed production; 4th, barley; 5th, oats for feed; 6th, green-feed. Flax, if sown, will probably work in between the barley and the feed oats.

15. Striking variations from the foregoing conclusions may occur in particular seasons; and what is sound practice for the higher lands may not always hold true on lower and frostier levels. Also, what works out with one variety will not necessarily with another requiring a longer or shorter period in which to mature. The preceding comments apply to standard sorts. In shaping one's course mature experience is called for and no set of rules can substitute it.

TABLE 4.—DATE OF SEEDING—CEREALS

Designation	Date of seeding	Date of cutting	Time to mature fully (estimated)	Yield grain per acre	Remarks
			days	bush. lbs.	
Marquis Wheat—					
After hoe-crop—					
First seeding	April 18	Sept. 8	143	55 52	Reasonably mature.
Second seeding	" 28	" 8	138	51 42	Not fully mature when harvested but hard frost impending.
Victory Oats—					
On August-ploughed sod-					
First seeding	April 19	Aug. 29	134	100 5	Cut when fairly ripe.
Second seeding	" 28	Sept. 2	129	104 14	In good condition.
Third seeding	May 12	" 8	123	98 20	Cut when not overly ripe.
O.A.C. No. 21 Barley—					
On August-ploughed sod-					
First seeding	April 20	Aug. 18 & 20	124	51 20	Only moderately mature
Second seeding	" 28	" 20	118	65 8	Cut when rather green.
Third seeding	May 12	" 29	112	54 8	Reasonably mature.

SECTION VI.—BROADCAST ENSILAGE CROPS, ALSO RAPE AND MILLET

On an area of wheat and oat stubble where heavy crops of grain had been produced in 1920, after summer-fallow, the oats having yielded 100 bushels per acre, there were laid out a series of plots to compare oats only with oats and common vetches; oats and hairy vetches; oats, peas and vetches (o.p.v. mixture); oats and

sunflowers sown together broadcast; Siberian millet, and Dwarf Essex rape. Of the oats only, there were triplicate plots; of the o.p.v. mixture, ditto, while of the other crops there was but a single plot in each case. The lay out was such as to afford the fairest possible comparison between the oats and the o.p.v. mixture. The other comparisons should also be substantially, though perhaps not minutely, reliable.

PREPARATION

In the spring of 1921 the land was first double-disced, then ploughed, harrowed, floated with a log drag, again harrowed and left a week or so before drilling. There was a considerable accumulation of subsoil moisture resulting from the wet summer and autumn of 1920 and the seed bed was apparently in good condition.

SEEDING

The whole area (excluding the portion reserved for rape and millet) was, on May 5, drilled lengthwise to Ligowo oats at about 1½ bushels per acre. With this as a basis the various one-eighth acre plots were then cross-drilled directly afterwards with kinds and quantities of seed as follows:—

Designation of plot	Cross-drilled with seed per acre
Oats only	1 bushel.
Oats and hairy vetches	36 pounds vetches.
Oats and common vetches	36 pounds vetches.
O.P.V. plots	40 pounds Arthur peas and 18 pounds common vetches.
Oats and sunflowers	Sunflowers in alternate runs only.

Growth in all cases was moderate to poor owing to dry weather. Although dry weather was the only apparent cause of the low yields, it does not follow that moisture was the sole limiting factor, for there was an unusual supply of subsoil moisture. Since the seed bed was good and germination prompt it is hard to account fully for the outcome without taking into account the depletion of soluble plant food by the rank crop of the year before.

PEAS AND VETCHES DWARFED BY THE OATS

Some very interesting and important facts were observed. It was conspicuous that the peas and both kinds of vetches were hopelessly dwarfed and insignificant where occurring in the oats. This was very clearly brought out by carefully separating the components of two typical binder sheaves of the o.p.v. mixture, with results as indicated.

Oats	94.9%
Weeds	3.5%
Peas	1.1%
Vetches	0.5%

This is the more surprising when it is known that the vetches roots were well supplied with nodules and that in 1920 both hairy and common vetches, as well as grass peas, made a very rank crop, being grown alone in each case and on summerfallow land. It seems that the wild legumes inoculate freely for these three crops but at Beaverlodge have not seemed to inoculate readily for the common field pea, which is of a different genus, though generally supposed to be susceptible to cross inoculation with the wild peavine, it seemed that, under the conditions of the 1921 test, inoculation was of slight advantage to the vetches, presumably because the oats had them dwarfed before the nodule bacteria could confer much benefit upon them. So far as the field peas are concerned it may be observed that the result this year agrees with previous tests, it having always turned out here that oats alone gave a

larger yield than oats and field peas mixed. It would be very interesting to learn, another season, whether this general result might be changed by inoculating the peas and by sowing both peas and vetches somewhat earlier than the oats so as to give them a head start of the vigorous growing cereal. There is reason to suspect that legumes are gravely handicapped in their initial stages of growth by a lack of soluble nitrogen in the soil. The best "catches" of clover are obtained on rich land.

All the plots, except the rape and millet, were cut with a binder on September 5, Averaging the triplicate comparison of oats and o.p.v. mixture we find:—

Kind of Crop	Yield per acre pounds ripe crop at harvest
Oats only	3,740
O.P.V. mixture	3,384
Difference in favour of oats	356
Per cent of difference	9·5%

There was no important difference between the yields of the two kinds of vetches in mixtures, the actual figures being 2,920 pounds per acre for the common vetch mixture and 2,824 for the hairy vetch plot. The small difference might have been due to experimental error.

The sunflowers in the oats grew slender and short. A few of them headed out but none amounted to much except along the margins of the plots where some grew four to four and a half feet tall and comparatively stout, most of them heading out.

AN INTERESTING STUDY IN RAPE

A very significant comparison lay between the oats and rape, with the millet intervening. Though sown on uniform land uniformly prepared and on practically uniform dates, the contrast between the rape and oats was striking. The rape seemed stunted from the commencement and a peculiar fact was that even the lambs quarter in this plot grew rather weak and diminutive. The weeds were later pulled, leaving the rape sole possession of the ground, yet from May to October it achieved a height of not over three or four inches, except where it bordered a cultivated path and possibly overlapped a path of 1920. Here in a strip two or three feet wide it grew twelve to eighteen inches in height and was strong and vigorous. Except on this path there was no yield to cut. In fact, it was only about tall enough for a sheep to graze. Yet the millet alongside grew twelve to fifteen inches high and the oats in the next plot about two feet tall. The millet, by the way, was so badly injured by frost on September 9 that it was not harvested. It has proven itself an unsuitable crop for the district.

Reverting to the case of the rape, it is recalled that whenever this crop has been sown at Beaverlodge on rich land, as in the orchard for a cover crop, it has made a healthy, vigorous growth. When sown on late breaking it has done poorly and on ploughed stubble still more poorly, though never in any previous season was it quite such a dismal failure as on the spring-ploughed stubble of 1921. Inasmuch as there was not only a substantial reserve of subsoil moisture to commence with but 8·12 inches of rainfall during the five months, April to August (the bulk of it occurring, however, the latter part of the period) it is pretty difficult to explain the result on an hypothesis of moisture only. Does it not rather suggest that the rape was stunted in its early growth by a lack of moisture in the surface stratum, by a lack of soluble plant food or, more probably, by both?

The conspicuously unsatisfactory behaviour of the rape in this test indicates scope for further experimentation, though important light is thrown upon the subject

by some investigations into the chemistry of rape reported by Dr. Frank T. Shutt in the Experimental Farms Report of 1900, from which we quote:—

> "The fact that the assimilation of the soil plant food elements takes place chiefly during the first six weeks of growth points to the benefit to be derived from a thorough preparation of the soil.
>
> "Compared with other forage crops, rape, although it possesses a large percentage of water, takes a high place, owing to its comparatively speaking, large percentage of nitrogenous constituents (albuminoids).
>
> "The assimilation of nitrogen from the soil by the plant goes on more rapidly during the first month or six weeks than later."

SECTION VII.—INTER-CULTIVATED ENSILAGE CROPS

Cultural experiments with sunflowers included a thinning test in triplicate and a date of planting test, the latter being duplicated on a small scale in the garden.

A THINNING TEST WITH SUNFLOWERS

The thinning test was laid out on a piece of land that had been broken in 1918, cropped to potatoes the next year and to variety plots of grain in 1920. The land then lay until spring when it was double-disced, ploughed, and the greater part of it top-dressed with rotted manure. It was then harrowed, floated, disced and floated making a first-class seed bed. The sunflowers were put in on May 6 with a grain drill, in rows running north and south, thus crossing the stubble of the grain plots and giving to all rows an equal length of manured land.

Thinning was accomplished in July but as the stand was not sufficiently thick to admit of precise spacing the best that could be done was to allow a certain number of plants per lineal yard. The late date of thinning may go to explain, in part, the reduced yield of the more open spacings. In the rows intended to be spaced four and five inches respectively, there were insufficient plants to allow the required number per yard. The deficiency was estimated at eight and five per cent of the desired rates.

The test was made with drills both 30 inches and 36 inches apart. The former comparison was in duplicate, two varieties being employed, viz: Mammoth Russian and a selection of Dr. Charles E. Saunders'.

The sunflowers were killed outright by a hard frost on the morning of September 9, the tops quickly turning dark. They were cut with a hoe September 10. Before cutting all rows were trimmed off to a length of twenty-two rods, which, in the case of the 36-inch drills, amounted to a fortieth-acre per row, or plot. Sunday intervening, it was not practicable to weigh these plot yields until September 12, two days after cutting and on the fourth day after the frost. They wilted very considerably during the interval and, judging from some trial weighings at other Stations, probably lost a very substantial percentage of their weight. The comparisons will not have been very materially affected, however. The main point is that with prompt cutting and weighing the tonnage of all the plots would have been shown very much heavier than it appears.

The growth was slow but steady during the dry, early summer. It was conspicuously greater on the cultivated paths between the 1920 grain plots than it was where the grain had grown, averaging at harvest from one to two feet higher. The yields may therefore be considered as representing an area of about one-third fallow and two-thirds stubble. If the manure produced any benefit in the sunflower crop it was not noticeable. Little or none was expected. It was applied with a view to benefiting future crops and destroying weed seedlings, with the cultivation given the sunflowers.

As to the point under investigation it must be admitted that the results are not very consistent. The extra-large yield of the four-inch spacing seems freakish and may be due in part to accident of stand and in part to ample moisture at the end of the season, favoring to an unwonted extent a thick stand in point of tonnage.

Without venturing any very definite conclusions, it may be observed that on the whole the medium spacings show up well.

The seven rows of Mammoth Russian in 30-inch drills averaged 1,011 pounds per acre more crop than the corresponding seven rows of the same kind in 36-inch drills. This might conceivably be due to some other factor than the width of spacing. The figure stands to check against future trials.

The higher yield of the Saunders' selection as compared with the Mammoth Russian agrees with results in the variety test.

TABLE 5.—Thinning Test with Sunflowers, 1921

Designation	Mammoth Russian 36″ drills	Mammoth Russian 30″ drills	Saunders Selection 30″ drills	Average 2 kinds 30″ drills
Thinned to 10″	18,080	18,864	20,352	19,608
Thinned to 9″	17,960	19,296	22,272	20,784
Thinned to 8″	18,040	18,672	22,944	20,808
Thinned to 7″	20,080	22,416	29,568	25,992
Thinned to 6″	24,160	22,176	26,400	24,288
Thinned to 5″	21,840	20,544	24,480	22,512
Thinned to 4″	22,760	28,032	25,728	26,880
Averages	20,417	21,428	24,534	22,981

DATE OF PLANTING TEST WITH SUNFLOWERS

Adjoining the thinning experiment with sunflowers and on land identically prepared, was a date-of-planting test the variety used being Dr. Saunders' selection mentioned above. These plantings were made on successive dates with a small garden seeder. As this experiment was located on the east side of the field, an extra, or flanking row was sown on the same date as the first-date-of-seeding row. It is interesting to compare the yields of these two rows sown on the same day. The flanking row is much the heavier. In the work at Beaverlodge care is taken never to include such outside rows in the area from which comparative computations are made, other than the incidental one just now suggested. The first planting was made on May 6; the others at weekly intervals. From the table appended it will be seen that the first and second dates gave nearly equal yields. The former, however, showed the earlier heads and the larger percentage of bloom. The crop was cut September 10 and weighed two days later.

Designation	Yield per acre (wilted weight)		
	lbs.	tons	lbs.
Flanking row.....seeded May 6	33,320	16	1,320
First-date row..... " " 6	23,680	11	1,680
Second-date row ..... " " 13	23,400	11	1,400
Third-date row..... " " 19	22,360	11	360
Fourth-date row..... " " 27	19,360	9	1,360

In seeding this fourth-date row a skip occurred which was not filled in soon enough to give it a fair chance. The other and more important comparisons are believed to be reasonably accurate.

A GARDEN TEST IN DATES OF PLANTING SUNFLOWERS AND CORN

The field test on this point was duplicated in the garden on an extended scale as to dates but on a very small scale as to area, the rows here being only about a rod

long. The variety used was one called Early Ottawa, 76, also brought out by Dr. Saunders. The land for this garden experiment was an exceedingly rich piece of summer-fallow, two applications of manure having been given during 1920, one ploughed under and the other top-dressed.

It was conspicuous that the first-date row and its flanking row sown at the same time headed out fully in August, developing very large blooms but not growing very tall, perhaps seven feet on the average. The first blooms on these rows were noticed on August 3 and on that date the second sowing was already the taller. The difference in precocity was so marked as to raise the question whether a mistake might have been made by sowing different kinds of seed. The gardener was sure, however, that no error had occurred. Before the other rows commenced to bloom a period of showery weather set in and the plants shot up in height very much taller than the first-date row but blooming was long delayed and even at harvest none but the first-sowing could be said to be in full bloom. Corresponding comment applies to the third and later sowings. The third and fourth-date sowings in this series grew the tallest of all, both height and yield falling off slightly toward the final dates. The tallest stalks were somewhere around ten feet and they were very stout.

Considering the smallness of the plots, in which a stalk more or less makes a substantial difference in the per-acre yield, it must be acknowledged that the results are fairly consistent and agree substantially with appearances prior to harvest. Harvesting was not attended to promptly following the frost but, after cutting, weights were taken directly. The yields indicate what heavy tonnage is possible with this crop when plenty of moisture and plant food is available.

In the table below are given the yields from these successive seedings and also, the comparative yields of corn from corresponding seedings. As the tests with these crops adjoined, the sunflowers in each case continuing on from where the corn left off in the rows, the comparison is a useful one.

TABLE 6.—Comparative Yields Sweet Corn and Sunflowers in garden date-of-planting Test, 1921

Designation	Corn: Sweet Kloochman			Sunflowers Early Ottawa, 76		
	Yields per acre			Yields per acre		
	lbs.	tons	lbs.	lbs.	tons	lbs.
First date, April 20	15,488	7	1,488	42,592	21	592
Second date, " 27	21,296	10	1,296	78,408	39	408
Third date, May 5	25,168	12	1,168	77,440	38	1,440
Fourth date " 12	25,168	12	1,168	89,056	44	1,056
Fifth date, " 19	22,264	11	264	65,824	32	1,824
Sixth date, " 27	29,040	14	1,040	63,888	31	1,888
Seventh date, June 3	35,816	17	1,816	75,504	37	1,504
Averages	24,891	12	891	70,387	35	387

In connection with the table it may be pointed out that the weights given are of green crop. Compared on a basis of dry matter content, the showing of the earlier-sown plots would doubtless be relatively improved.

From the standpoint of tonnage the later dates of planting were relatively more favourable to the corn than to the sunflowers, though the earliest plantings of corn gave the only usable ears. The last sowing of corn gave the tallest stalks and the first and second the shortest ones.

Confirming previous experience, the results suggest that from the standpoint of maturity and tonnage combined it is probably best to plant sunflowers early in

May, while corn, too, may often with advantage be planted in the fore part of that month, providing one keeps a supply of seed for a second planting if needed, as it sometimes may be. Practice must vary with location, however.

SECTION VIII.—SUNFLOWERS VERSUS OATS

An interesting comparison between oats broadcast and sunflowers in drills was afforded by an area of commercial crop grown to fill the silo and not designed as an experiment at all. At one end of a stubble field was a certain neck of ground across which manure was spread early in spring and the land afterwards ploughed for sunflowers. Owing to shortage of seed, only half the width was reserved for this crop, the remainder being drilled to oats. Some of the sunflowers were sown on May 6 and the balance on May 12. Two lots of seed were used, one called Mammoth Russian and one Giant Russian—Tweedledum and Tweedledee. Both sunflowers and oats grew much ranker here than on unmanured land adjacent. The oats were cut with a binder on September 5, being nearly matured and heavy in the head. Their green weight was 2,618 pounds from an area amounting to 1,418/3,960 of an acre. After being weighed they were shocked and on September 12 weighed again and hauled to the silo, partly cured. The second weight was 1,910 pounds, the week's loss in curing having amounted to 27 per cent of the original. The sunflowers were cut with a hoe on September 12 or 13 several days after being killed by frost. They were quite wilty and had evidently lost considerable sap. They weighed 5,515 pounds, this from an area which happened to be exactly that of the oat block to a square foot, a fair margin around the outside of each plot being counted as part of the measurement on which computations were based. Yields are low owing to the season and the partially-cured condition of each crop. The comparison is not absolute, but reduced to an acre basis it stood:

Sunflowers (wilted), 15,401 pounds per acre.
Oats (first weight), 7,311 pounds per acre.

SUNFLOWERS NOT SAFE IN ALL SITUATIONS

Small plots of sunflowers have been tried by not a few farmers in Grande Prairie with fairly encouraging results. However, the Superintendent of the Station proved to his own satisfaction that for frosty districts they are scarcely so safe as oats. To test it he sowed a few hills on a low lying (but not wet) field representative of the coldest level in the district. Both early and late they appeared more susceptible to frost than the oats beside and among them.

SECTION IX.—EXPERIMENTAL UNDERDRAIN

On the rolling land of the Upper Peace River region are many hollows or "draws" in which deep snow accummulates in winter and down which much surface water flows in spring, keeping them wet many days after the knolls are fit to cultivate. While the present stage of development scarcely warrants underdraining as a commercial proposition it has been thought well, looking to the future, to ascertain the cropping gain, if any, that might result from underdraining such hollows. Consequently a twenty-one-rod drain made of poplar poles covered with willow brush was laid during the summer of 1921 through the middle of a broad, flat "draw" of this character where seepage had always been particularly persistent and troublesome in spring. The lower end of the drain was diverted through a slight rise more nearly typical of upland field conditions, thus broadening the basis of observation.

In the "draw" proper the subsoil was found to be of two types, sand in the one case and hard chocolate clay in the other.

Over the hard subsoil patches of alfalfa seeded three years earlier in a mixture with western rye grass were found growing very vigorously, well inoculated and with strong roots extending to the bottom of the trench. Some were followed down and one was dug up measuring four and a half feet vertical penetration. The soil here was so hard and dry that it could with difficulty be dug with a mattock. Great cracks showed in it at places. In these patches where the alfalfa had persisted it had quite got the better of the rye grass. Practically no sandy subsoil was encountered in that portion of the drain running through the rye grass-alfalfa-mixture sod. All the alfalfa patches were underlaid with the tough hard soil, which crumbled, however, upon exposure after excavation.

CEREALS

SECTION I.—SPRING WHEAT

SOURCE OF SEED, ETC.

Six well-known varieties of wheat were compared in regular plots, besides small samples of Black Durum and Kubanka grown in rows in the garden alongside Marquis for comparison. The soil being very rich, all three did remarkably well and grew enormous heads, but the Marquis was the only kind that was reasonably mature on September 8th. The Black Durum, though shrunken, made a medium grade. Kubanka was the least mature of any. Samples of all three pulled on September 8 and put under cover turned out far superior to corresponding samples pulled the next day, after a night temperature of 26°.

The varieties and sources of seed were as follows:—

Ruby from Ottawa in 1918; Red Bobs from Wheeler in 1919; Marquis, pure strain from Ottawa, 1920; Huron from Ottawa in 1916; Kitchener from South Western Saskatchewan in 1920; Early Red Fife from Ottawa in 1920. All varieties since their receipt have been propagated annually at Beaverlodge.

PREPARATION

Land of good average quality was broken in 1915, cropped to grain the next two years, fallowed in 1918, seeded with variety plots of cereals (chiefly oats and barley) in 1919, devoted to hoe crop (chiefly potatoes) in 1920, left untouched until spring, double disced and harrowed the second week in April and harrowed again just before drilling on April 18. This very moderate amount of tillage, following clean cultivation of the hoe crop, in 1920, prepared an excellent seed bed. No manure or fertilizer had been applied to this area since its breaking. The plots of cereals crossed the 1920 strips of hoe crop, conferring as uniform conditions as possible.

SEED WHEAT INJURED BY TREATMENT

Pressure of spring work and lack of convenient facilities for drying numerous small lots of wet grain induced the Superintendent to depart from his customary policy of caution and treat the wheats by the "dry formaldehyde" method, which consists in spraying the seed with a strong solution prepared by diluting formalin with its own bulk of water. This new method, recommended by some authorities for oats, is not advised for wheat, owing to danger of injuring the germ. Even with oats, care is needed to apply exactly the right quantity of solution per bushel. When treating small lots for plot seeding, the quantity was difficult to guage and the matter was decidedly overdone, the germ of a large percentage of kernels in some varieties

being destroyed while all were extremely slow in sprouting. Huron, Kitchener and Red Bobs were the varieties most seriously affected. A germination test confirming careful field observations, one range of plots was resown on May 2 with a light supplementary seeding of untreated wheat, the south or duplicate range being left as a check. Yields are calculated from the north range only.

THIN VERSUS FULL STANDS

It was surprising to note how thin, ragged stands, such as might have resulted from less than a peck of good seed per acre, would gradually thicken up, developing broad stoles, stout stalks and very large heads with a final yield equal to more than half what was obtained from full-seeded plots. This was brought out very clearly by two plots of Ruby in a certain cultural test. The seed for these two plots was treated separately from that in the variety test and was injured as badly as that of any kinds sown in the variey test. Yet at harvest the better of these two Ruby plots cut twenty-two sheaves as against twenty and one-half from the full-seeded plot of Ruby in the North range of the variety test.

Allowing for the fact that the straw in the thin-standing cultural plot was green and coarse, not packing closely in the sheaf, the comparison is still remarkable. Both plots were harvested on the same day and although the cultural plot was considerably greener it yielded eighty-eight per cent as much grain. The heads were as large as normal heads of Marquis. In the variety test the duplicate, or south plot (which had not been re-seeded) actually yielded two bushels per acre more grain than its fellow and was only two or three days behind it in ripening. Soil variation may have had something to do with this and another factor, no doubt, was more favourable weather for heading and filling. On top of all this it is evident that very thin seeding does not always handicap a plot so much as might be supposed.

The Red Bobs, Huron and Kitchener were doubtless set back more by seed treatment than the Ruby, although, on the other hand, it must be said that the Red Bobs in the North range was closer than usual to the Ruby in heading out. By harvest the spread had widened. There are puzzling vagaries in the relative behaviour of different varieties from year to year, due, no doubt, to seasonal reactions.

Injury from treatment of the seed delayed the start and therefore the ripening of several kinds, running their harvest into the wet weather and the risky temperatures of early September, necessitating cutting on the green side and subjecting their samples to damage in stock by the succession of hard frosts which occurred during the second week of that month. So far as yield of these is concerned it is probable that it was fully as good, despite immaturity at harvest, as it would have been if vegetative and seed development had occurred wholly in the earlier and drier weather, but neither yield nor sample were equal to what they would have been if dependable weather had contined a week longer; and certainly the sample of none, except, perhaps, the Ruby, was equal to what would have been reaped if the crop had got away to an unimpeded start.

HURON STILL LEADS IN YIELD

For the seventh successive season Huron has distanced Marquis, in plots always located side by side. Renewing the supply of Marquis seed in 1920 did not change the result. In the seven-year average Huron now leads by over eight and one-half bushels, the bulk of its margin having been obtained in years of frost, with the single exception of 1915, when chance favoured it in location. Though no earlier than Marquis, it is hardier. The 1921 yield was 64 bushels 1 pound. Despite its showing, farmers are disinclined to take up with it for fear of being penalized on grade at the elevator because of its somewhat inferior bread-making quality. By the way, Huron is often confused with Preston in popular parlance.

A PLACE FOR RUBY

For a large number of farmers in the brush country Ruby is the best available variety, despite its grave fault of shattering too easily. With a limited acreage this is less serious than it would be on a large wheat farm. The question of its yield is worthy of some discussion. Taking the past four years' average we find the following interesting comparison:—

Huron	50	bushels	7	pounds	per acre.
Marquis	44	"	27	"	" "
Ruby	33	"	34	"	" "

In other words the Ruby was outyielded thirty-two per cent by Marquis and forty-nine per cent by Huron. Or, expressing the percentage the other way, the Ruby fell twenty-four per cent short of the Marquis and thirty-three per cent short of the Huron.

On the other hand, Ruby is the only variety of the three which can be reasonably depended upon one year with another to give a good grade. It is a high-quality wheat and so far as can be judged from the few baking trials with Beaverlodge harvests, it makes a distinctly better showing than any other variety grown here. Even on the high lands of the Experimental Station Ruby is much the safest wheat and this is much more emphatically true for the bulk of the area surrounding the Station. Furthermore, while Ruby has not yielded so well as the later kinds, its four-year average of thirty-three bushels and thirty-four pounds of high-grade wheat would be counted creditable for Marquis in many renowned wheat-growing regions. This average yield has not been produced by any extravagant methods. No fertilizer of any kind was applied, the soil has been in some years rather sub-standard and the preparatory tillage very moderate. As emphasizing this point, it may be recorded that in 1921 a sixty-acre field of Ruby grown on highly-prepared summer-fallow in the Red Willow District yielded thirty-five bushels per acre, despite premature cutting from fear of frost on the rather low-lying flat land.

The fact of the matter is that thanks to fertile soil, fairly clean land, comparative freedom from diseases and pests and a slow maturing season, favourable to filling, Peace River farmers can take precocious varieties of grain like Ruby and attain higher yields than are secured on the worn lands farther south, where drought, hail, rust, weeds, gophers, insects and other evils beset the crop. This superior result can be reliably secured; however, only by pursuing a policy of safety first. Gambling with late and therefore risky varieties is as bad business with wheat in the wheat belt as with corn in the corn belt or with fruit in the Niagara Peninsula.

Another point: By advancing the harvest a week or ten days, Ruby enables the farmer to do his fall ploughing early enough to promote some nitrification in autumn, thus preparing the land for a good crop the next year and compensating in a large measure for its own deficiency in average yield as compared with later sorts.

All things considered, therefore, the case for early varieties is strong. If Ruby did not shatter so easily it would be almost a perfect wheat for the Peace River region.

OTHER VARIETIES

Red Bobs, Kitchener and Early Red Fife have not been grown long enough at Beaverlodge to determine accurately their value.

The two first-named show up better in yield than at some other Western Stations, but the element of chance has always to be recognized. It is doubtful whether Kitchener will surpass Marquis on a long-term average. Early Red Fife seems to have nothing to recommend it above Marquis, and it shatters rather easily. The three kinds, Kitchener, Huron and Marquis ordinarily mature in about the same period. Red Bobs is about three days earlier than these and is a wheat of considerable promise. Though irregular in length of straw it seems to run reasonably true to

type in other respects. Mutation is common to all varieties. Persistent, timely roguing combined with repeated re-selection seem necessary to maintain true type by avoiding, or at least minifying, accidental hybridization and eliminating mutants. The work of the plant breeder will never end.

A few field notes may be appended:—

May 14: As judged by present appearance, best germination of wheats occurred in Early Red Fife, Ruby and Marquis, Red Bobs coming slowly, Huron and Kitchener very poor.

July 9: Wheats heading in order as follows: Ruby, Red Bobs, Marquis. Red Bobs perhaps three or four days ahead of Marquis.

September 2: Cut the north range plots of Red Bobs, Marquis and Early Red Fife, all being green enough that sap could be readily squeezed out of the kernels. A very little shelling had taken place in the Red Bobs and Early Red Fife. Red Bobs seemed a trifle more mature than the others, but not much. Perhaps the Red Fife was a shade riper than the Marquis.

September 7: In a drizzle, turning later to rain, cut north range plots of Kitchener and Huron, though still quite green of straw in places. Both lodging a little, Huron rather more than Kitchener. Huron looked a shade the riper, but may not really have been. These two plots each yielded well over seven hundred small-to-medium sized sheaves per acre.

TABLE 1.—SPRING WHEATS, BEAVERLODGE, 1921

Variety	Date of Cutting	Time to mature fully	Yield per acre, 1921	Yield per acre, 7-year average 1915-1921	Yield per acre, 4-year average 1918-1921	Yield per acre, 3-year average 1919-1921	Yield per acre, 2-year average 1920-1921
		days	bush. lbs.	bush. lbs.	bush. lbs.	bush. lbs.	bush. lbs.
Early Red Fife	Sept. 2	137	51 2	.....	.....	.....	49 45
Huron	Sept. 7	142	64 1	46 44	50 07	53 29	57 05
Kitchener	Sept. 7	142	62 28	.....	.....	.....	58 20
Marquis	Sept. 2	137	56 32	38 01	44 27	49 42	51 26
Red Bobs	Sept. 2	137	55 26	.....	.....	51 29	54 43
Ruby	Aug. 26	130	36 57	.....	33 34	36 55	38 23

SECTION II.—SPRING RYE

Tried for the first time at Beaverlodge, spring rye of two varieties was sown April 23 on land adjoining the spring wheat plots and prepared the same. The two varieties were Saunders' Select obtained from the Dominion Cerealist and O. A. C. No. 61, from Dr. C. A. Zavitz, Guelph, Ontario. There being insufficient seed of the latter for a full-size plot, both kinds were sown in half-width plots. Though between six and seven pecks per acre was used, the stand did not appear to be very thick. Owing, perhaps, to occurrence of showery weather while filling was in progress, the grain ripened unevenly. At harvest, some kernels were found to have ripened early and shrivelled, some were just right for cutting while others were swollen to a very great size and milky. Empty glumes occurring in quite a few heads led to the surmise that some of the blossoms had probably been caught by the early July frosts. Both kinds matured in 128 days, being cut August 29. Saunders' Select outyielded O. A. C. No. 61 by 6 bushels and 7 pounds per acre. The comparison stands:—

Saunders' Select—43 bushels 7 pounds.

O. A. C. No. 61—37 bushels 0 pounds.

SECTION III.—OATS

PREPARATION; OATS AFTER SOD; SMALLER YIELDS FROM PLOT THAN FROM COMMERCIAL BLOCK

Eleven prominent varieties of oats were compared in one-twenty-second-acre plots on land which had been broken in 1917 and seeded the next year to experimental mixtures of grasses and clovers, the sod of which was broken about the first of August, 1920, and double-disced before winter. Wet autumn weather prevented the killing of all the grass by this method and the sod had not time to rot properly so that conditions for the 1921 oat plots were by no means ideal. This will be apparent from the fact that while the Test plot of the Liberty Hull-less yielded 65 bushels 12 pounds per acre, a two-acre multiplying block on summer-fallow yielded 75 bushels, though cut much greener than the Test plot. The latter was hand-weeded while the larger block lacked this advantage. There was a difference in the dates of seeding, the larger block having been sown on April 28 and cut August 19 while the Test plot was sown April 19 and cut August 26, having thus sixteen days more in which to mature. This extra time to mature was undoubtedly of decided advantage to the plot and helped to reduce the lead which the summer-fallow would otherwise have had. The straw in the multiplying block was much longer and stouter than in the plot. The detailed comparison is important in showing the handicap our oat plots sustained as compared with what they would have done under summer-fallow or hoe-crop conditions. On the other hand, it is important to know what can be expected in the way of grain production after partial fallow subsequent to the removal of a hay crop, for this is a system of cropping that may be depended upon to conserve fibre and fertility. From the mere standpoint of achieving phenomenal yields, the complete summer-fallow or hoe crop is unchallenged. Indeed, it is so easy by this means to produce fifty bushel yields of wheat and hundred bushel or better crops of oats that the game is almost devoid of zest. The securing of good paying yields by annual cropping under a system which maintains or increases fertility is not quite so easy for this touches one of the real problems of Peace River agriculture.

Although the sod of the experimental hay plots afforded rather uneven conditions for the 1921 grain plots, the laying out of the latter *across the ranges of the preceding hay crops* assured practically equal conditions for the eleven kinds of oats under test. If there was any disparity at all it could not have been very great.

The lay-out did, however, afford opportunity to compare the residual effect of certain hay crops. It was conspicuous that wherever a heavy grass sod had been turned under, the grain crop was comparatively light and it seemed—though often we cannot be too positive—as though the lightest grain yields of all occurred where timothy had been the predominant grass in the preceding hay plots. Timothy appeared to give more trouble from volunteering in the grain than did western rye grass or meadow fescue. Much heavier growth occurred where one or two plots slightly overlapped a path between the preceding grass ranges. Plainly, a tough grass sod in a raw condition was unfavourable to the securing of a heavy crop of grain.

SOURCE OF SEED, ETC.

Victory, Ligowo and Daubeney from Central Experimental Farm, Ottawa, in 1916 and 1917; Abundance from a neighbouring farmer in 1917; Liberty Hull-less from Central Experimental Farm in 1918; Banner from Central Experimental Farm in 1919; Gold Rain from Lacombe in 1920; Leader from Winnipeg Seed House in 1920 (Harris McFayden); O. A. C. No. 3 from Guelph, Ont. in 1920; Alaska from Central Experimental Farm in 1921; Great Lizo from a Winnipeg Seed House in 1921 (Steele Briggs). All since their receipt as noted have been propagated successively without interruption at the Beaverlodge Station.

In addition to the eleven varieties listed above, three interesting introductions have been grown on plots too small to afford a trustworthy comparison, for which

reason their yields are excluded from the table. The O. A. C. No. 72 was received from Guelph. The German Heath oat was received from Major S. G. Freeborn, of the Dominion Live Stock Branch, who had obtained it through an interesting experience in Germany, where it was supposed to have been bred for the heath lands. Curiously enough, the tag on the sack was inscribed "Garton's Abundance x Sixty-day". The last of the three introductions referred to was a black winter oat, a row of which was sown in the garden in Spring. It grew rank but did not very fully mature its grain, owing, in part, to late seeding, in part to the method of culture in rows and in part, perhaps, to its adaptability to the habit of a winter annual. A row of this was sown on August 20 to test its behaviour in this capacity.

The seed oats this year were not treated with chemicals but the seed being quite clean, little or no smut was found in the crop.

The intended rate of seeding was about three bushels per acre but bad harvest weather in 1920 accounted for some rather tardy germination. Notes taken on May 14 indicated that best germination had occurred in the Alaska, whose drills could then be sighted most of the way through the plot; after that in approximate order were Great Lizo, Gold Rain, Ligowo, Liberty, Banner, Abundance, O. A. C. No. 3 and Daubeney. The Leader was very slow as it was also in 1920.

On July 5 the following notes were made: "German Heath oat about as far advanced as the Liberty and just emerging from the sheath. Alaska, O. A. C. No. 3 and Daubeney all nicely out of shot blade and nearly equal but a shade of advantage lying in order of mention. Remainder of oats heading approximately in this order: Abundance, Ligowo, Great Lizo (probably earlier because of superior seed), Banner, Gold Rain, Victory, Leader. Last four showing little sign of heading."

MULTIPLE HEADED OATS

An interesting novelty noticed this year was multiple heading of oats. This is not to be confused with the suckering which often occur from the base of an oat stole. Specimens of this irregularity were found in the plots of practically all the fourteen varieties under test, occurring most frequently in the outside drills of the plots, bordered by cultivated path-ways. Scores of stalks were found showing a second and third head of this character; but one stalk of Leader oats had five—the main head and four others. As a rule, these extra heads were relatively small, but certain of the secondary heads exhibited several dozen glumes each.

It is not supposed that this unusual development is of interest, otherwise than as a novelty, but as such it is worthy of attention. The most plausible cause suggested is that a period of exceptionally good growing weather following a season of more restricted vegetative development, impelled the plants to put forth renewed efforts to reproduce. In this connection it is interesting to record that some of the earlier kinds of drawf sunflowers grown on the Station, after developing one good head per stalk, branched out into a profusion of secondary inflorescence, one sunflower stalk being found with eighteen distinct heads varying from the bud to the blossom stage.

It is also interesting to note in connection with the oats that one normal head was found measuring 14½ inches in length.

A FEW VARIETY COMPARISONS

Victory vindicates its name by heading not only the 1921 list but every average column except the three-year, where it is exceeded slightly by Banner which, whether by chance or merit, did phenomenally well in 1919 though not quite so well as usual in 1921. The Victory is a splendid oat, but is rather late to be a dependable cropper in all parts of Grande Prairie. Ligowo is a good medium-early oat, but Abundance is still by far the leading oat in Grande Prairie, its earliness and plump

type making it a dependable cropper and a good seller. The great majority of buyers do not criticize its thick hull. Among the three extra-early oats, the shorter plumper kernel of the Alaska may probably commend it to the public over Daubeney and O. A. C. No. 3. None of these compared as well in yield with the Standard kinds as they would in the average season. Great Lizo did not yield according to its promise. Leader showed a marked tendency to a breaking up in the type of its head. From the normal cluster type there were many departures varying to the ordinary branching or spreading head. Perhaps five per cent or more of the Leader heads were rogued with a view to eliminating these off-type heads. This considerably reduced the yield. It seems to be a prolific sort but is late and in 1920 showed a marked tendency to lodge.

The Liberty oat has a well assured place in northern Alberta. From a four-pound sample received from Ottawa four years ago has been propagated a crop which must by this time be in the neighbourhood of 5,000 bushels. Last year the station manager, from the harvest of his multiplying blocks, shipped Liberty oats in two-bushel lots all over northern Alberta, from Pouce Coupe and Spirit River down to Olds, as well as to Saskatchewan, Ontario, the States of Washington, North Dakota and Ohio. From many quarters of Alberta favourable reports have come. The hull-less character is a valuable asset for pig feeders in a district where barley is not so safe a crop as oats. Earliness, strong straw, resistance to shattering and good yield are other important considerations. The four-year average gives the Liberty a yield of meat content equal to almost 96 per cent that of Abundance and over 91 per cent that of Victory. Allowing the Liberty to mature extra well in 1921 improved its position as compared with the previous showing. As noted above, two acres of fallow, of barely medium soil quality, on the Station farm, threshed 75 bushels per acre in 1921. A neighbour had an even heavier crop on five or six acres of naturally better soil. This latter crop being allowed to stand longer, matured more fully and according to bin estimate yielded 70 bushels per acre. If the whole crop had been weighed it would probably have exceeded 80 bushels. But take the known yield of 75 bushels: This would be equal to the meat in 107 bushels of ordinary oats. A country which can raise such feed crops has little to worry about if it cannot grow corn.

TABLE 3.—OATS

Variety	Date of Cutting	Time to mature fully	Yield per acre, 1921	Yield per acre 6-year average, 1916-1921	Yield per acre 5-year average, 1917-1921	Yield per acre 4-year average, 1918-1921	Yield per acre 3-year average, 1919-1921	Yield per acre 2-year average, 1920-1921
		days	bush. lbs.	bush. lbs.	bush. lbs.	bush. lbs.	bush. lbs.	bush. lbs.
Abundance	Aug. 26	128	97 24	.....	99 33	108 1	106 28	104 17
Alaska	" 13	116	62 26	.....	.....	.....	.....	.....
Banner	" 29	132	94 10	.....	.....	.....	118 18	111 11
Daubeney	" 13	116	71 0	77 33	80 28	84 1	78 12	74 31
Gold Rain	" 26	130	93 0	.....	.....	.....	.....	107 25
Great Lizo	" 26	130	90 31	.....	.....	.....	.....	.....
Leader	" 29	134	92 12	.....	.....	.....	.....	107 21
Liberty O. 480 (H'less)	" 26	128	65 12	.....	.....	72 18	70 8	69 12
Ligowo	" 26	130	92 29	101 7	103 26	111 11	107 21	104 17
O. A. C. No. 103	" 13	116	69 8	.....	.....	.....	.....	77 17
Victory	" 29	134	99 22	105 24	107 3	113 22	117 29	116 32

SECTION IV.—BARLEY

Adjoining the range of oat plots and on land identically prepared, were eleven kinds of barley. Rather, there were ten distinct varieties and one plot of a Duke's Mixture supposed to be Marriot, and obtained on the recommendation of a local institution. It was the only discreditable grain plot on the Station.

For some undetermined reason the barley plots on this sod land appeared to ripen very little earlier than the oats, though sown but one day later. For instance, the Daubeney oat, which usually ripens with O. A. C. No. 21 barley when seeded simultaneously, was this year cut a week ahead of it.

TREATMENT, SEEEDING, GERMINATION, ETC.

All the barley seed was treated for smut, the hull-less kinds by a special method, the grain of these being dampened before the chemical solution was applied. The intended rate of sowing was two bushels per acre but it probably fell somewhat below this. When the delayed germination report came from Ottawa after seeding it was found that some varieties must have been more adversely affected than supposed by the bad harvest weather of 1920. However, the field observations made as the grain was coming up did not tally very well with the germination report. For instance, though the full-period test in all cases showed percentages running from 83 to 97, the short-term test of the Early Chevalier gave only 6% (poorest) and of the Eureka (hull-less and beardless) 49% (best of any). Yet on May 14 the braird of the Chevalier was second only to that of the Guymalaye, while the Eureka was rather more backward than most. And the new kinds, seed of which was obtained from "outside", showed up little, if any more promptly than the average of the kinds whose seed was taken from our own harvest of 1920. These points are cited not to discount germination tests but rather to emphasize the need of caution in drawing conclusions.

VARIETY NOTES

Albert is early but a very light yielder, is inferior of sample and shells too readily.

Early Chevalier produces a good sample comparatively free of awns but yields only moderately and ties into slithery sheaves.

Eureka (hull-less and beardless) is a good yielding barley whose beardless character is an extremely great advantage. While very resistant to shattering, the heads are too heavy for the straw and many are lost. With hogs to glean the stubble the scatterings might be consumed. Its worst fault as grown here to date is a marked tendency to loose smut, which formaldehyde has failed to control. Nor has early and thorough rogueing of smut heads availed. If this fault could be overcome the Eureka would be, in the Superintendent's opinion, much the best barley to grow.

Guymalaye is a good-yielding barley producing a lot of solid feed but it wastes in harvesting much as does the Eureka and lacks the advantage of the beardless character. It has not been particularly subject to smut.

Hannchen has not done so well here as at the University of Saskatchewan, whence it was obtained. It is rather late.

Manchurian shatters too easily to be valuable. Even when cut decidedly on the green side there is usually a little loss.

"Marriott" proved to be a mixture.

O. A. C. No. 21 still heads the list of the varieties grown for more than one year. Its six-year average of 42 bushels and 37 pounds is six and a half bushels ahead of Manchurian and more than five bushels better than Early Chevalier. It is medium-early. Its worst fault is the beard, which has quite a tendency to adhere to the kernel at threshing unless the crop is well ripened before harvest.

Success is hopeless. Despite extreme care it shattered fearfully both before cutting and while standing in the stook.

Bark's. This new barley introduced into Canada by Don H. Bark, of the C. P. R. Department of Natural Resources, is a promising cropper but late. Its peculiar short compact head has the close-set kernels standing out approaching a right angle with the axis of the head. Though measurements revealed the head to be only about three-fifths as long as that of the O. A. C. No. 21, the number and size of

kernels per head were as great or greater. Its yield of 65 bushels 4 pounds put it second in the 1921 yield column.

The Trebi, a still more recent introduction by Mr. Back, easily headed the list this year in yield though cut four days earlier than the Barks and Hannchen. The head, while compact, more nearly approaches the ordinary six-row type than does the Bark. The straw is of fair length and strength and altogether this promises, so far as can be judged from one year's work, to be the best bearded barley of the eight under trial.

TABLE 4.—BARLEY

Variety	Date of cutting	Time to mature fully	Yield per acre 1921	Yield per acre 6-year average 1916-21	Yield per acre 3-year average 1919-21	Yield per acre 2-year average 1920-21
		days	bush. lbs.	bush. lbs.	bush. lbs.	bush. lbs
Albert (6 row)	Aug. 5...	107	23 18	.....	28 24	29 6
Barks (6 row)	" 26...	128	65 4	.....	.....	.....
Early Chevalier (2 row)	" 20...	122	46 14	37 16	49 20	50 34
Eureka (hull-less and beardless)	" 18...	122	45 7	.....	.....	50 6
Guymalaye (hull-less)	" 18...	120	44 0	.....	48 32	48 21
Hannchen (2 row)	" 26...	127	57 14	.....	.....	58 8
Manchurian (6 row)	" 18...	120	42 30	36 10	50 40	53 31
Marriott (6 row)	" 26...	122	39 28	.....	.....	.....
O.A.C. No. 21 (6 row)	" 20...	122	51 43	42 37	59 39	61 38
Success (beardless)	" 3...	102	17 2	.....	.....	.....
Trebi (6 row)	" 22...	125	72 20	.....	.....	.....

SECTION V.—FLAX

Two seedings of Premost flax were to be compared, but through a misunderstanding of one of the helpers the first was made with some spoiled seed from the harvest of 1919. None of this grew, so that the yield is taken from the second plot, sown May 12, which was too late for best results, since its harvest ran into September frosts. In spite of considerable competition by volunteer timothy, the flax threshed 13 bushels 37 pounds per acre of very good seed. A four-year average yield covering one year of complete failure, amounts to 13 bushels 46 pounds per acre. While not a strictly safe crop, it is probable that flax could be profitably grown on some farms by seeding early in May with a view to re-seeding with oats for green-feed in those occasional years when late spring frosts might destroy the crop.

SECTION VI.—PEAS

At least two kinds of peas adapted to the Peace River country may now be recommended by this Station, with a possible third. Arthur is too late to be safe though it sometimes yields very well. Its seven-year average is 18 bushels and 29 pounds.

The peas were grown this year under substantially the same conditions as the oats, barley and flax. The yields were encouraging.

It having been observed last year that common field peas had very few nodules on their roots, some duplicate plots were sown this year with seed treated with nitro culture. For some reason, no result appeared to follow the treatment although other strains of nitro culture were applied to seed of clovers and alfalfa with very conspicuous benefit. The wild peavine occurring so abundantly on Grande Prairie is of a different genus from the common field pea and does not seem to inoculate the latter —at least not readily. With thorough inoculation it is hoped that the growth and yield of peas may be very greatly improved as the growth of alfalfa and clover already has been.

TWO SMALL WHITE EARLY PEAS

The only two peas raised in 1920 were the Arthur from Ottawa and the Alberly Blue from the University of Alberta. Both matured good seed but its germination was badly impaired by prolonged wet weather while the peas lay on the ground in bunches, hence the 1921 stands were extremely thin, handicapping these two kinds. Alberly Blue is the earlier of the two but Arthur has rather outyielded it in each of the past two seasons.

Two new small white peas that promise well are the Chancellor D, bred by Dr. Saunders, and the White Alberta from the Provincial University. Considering their earliness and the lack of inoculation the yield of both kinds was good. The plots of these were too small, however, to warrant close comparison. They are valuable acquisitions.

TABLE 5.—PEAS

Variety	Date of pulling	Time to mature fully	Yield per acre 1921	Yield per acre 7-year average 1915–1921
		days	bush. lbs.	bush. lbs.
Alberly Blue	Aug. 22...	123	33 0	.....
Arthur	" 25...	126	36 18	18 29
Chancellor D	" 22...	121	42 21	.....
White Alberta	" 22...	120	41 48	.....

SECTION VII.—WINTER GRAIN

GOOD YIELDS OF WINTER WHEAT

Grown in a desultory way on Grande Prairie since the early days of settlement, dating back, at least to 1909, winter wheat has been under trial at the Beaverlodge Station for several years, the first experimental plots being harvested in 1918. Turkey Red and Dawson's Golden Chaff were compared at first but the latter, not proving very hardy, was substituted in the 1920 seeding by the new variety, O.A.C. No. 104, of which there was seed for but a half-size plot. A fair test was afforded, however, as this half-width plot was between two full-size plots of its competitor. The O.A.C. No. 104 is a bald white wheat with an erect head and straight straw which is nice to harvest and ties into a heavy compact sheaf like that of Marquis. The Turkey Red, on the other hand, is a fine-strawed wheat which makes an untidy bundle and at threshing quite a percentage of it is found loose. The dormant period of 1920-21 was not a severe one on winter crops and both varieties came through almost perfectly. The Turkey Red has usually wintered well at Beaverlodge and its four-year average of 32 bushels and 14 pounds should go to dispel misgivings concerning the Peace River climate, while the season's yield of 47 bushels and 28 pounds from the O.A.C. No. 104 is very encouraging. Both wheats ripened well in advance of frost and made good samples. They were grown on a piece of summer-fallow of rather inferior natural quality but had the advantage of some willow scrub shelter. No manure or fertilizer has ever yet been applied to the land where the test plots of winter grain have been grown.

RYE

Adjoining the wheat was the winter rye, the yield of which was somewhat curtailed by reason of the fact that it made most of its development during the unfavourable weather of the early summer, maturing in fewer days than usual. Nevertheless it made a yield of 47 bushels and 8 pounds, which is close to its four-year average. In a small part of one rye plot hairy vetches had been seeded with

the rye in 1920. The rye utterly dwarfed the vetches, as it did the lamb's quarter, which sprang up as the result of a second late ploughing of the summer-fallow. In the wheat adjoining, a great many stalks of these weeds grew to the height of the wheat and seeded. In the rye they were quite insignificant and matured very little seed. The value of rye as a cleaning crop is thus indicated. It is proving quite hardy, productive and has an important place to fill as a forage crop.

TABLE 6.—WINTER GRAIN

Variety	Date seeding	Date harvest	Days to mature fully	Yield per acre 1921	Yield per acre 4-year average
				bush. lbs.	bush. lbs.
WHEAT	1920	1921			
O.A.C. No. 104	Aug. 21...	Aug. 18...	365	47 28	.....
Turkey Red	" 21...	" 18...	364	35 52	32 14
Winter Rye	" 21...	" 13...	357	47 8	48 7

HORTICULTURE

SECTION I.—INTRODUCTORY

Thorough summer-fallow preparation plus liberal manuring both before and after ploughing, the manure being well incorporated with the furrow slice, resulted in good gardens notwithstanding that the early summer was quite too dry for hay or even for heavy crops of cereals on spring and fall ploughing. With a good reserve of moisture and plant food accumulated and with occasional light showers, most vegetables got away to a timely start while of fruits even the strawberries gave quite a nice little crop. Favourable weather in the latter part of the season resulted in luxuriant growth. A twenty-two-pound pumpkin, a democrat load of bush marrow, plenty of beans, a smaller supply of corn and a few tomatoes were among the achievements with the more tender vegetables while all the hardier kinds throve unusually well. The crop of currants was most excellent, flowers abounded and most of the shrubs and trees made satisfactory growth.

It becomes increasingly evident that a considerable variety of species of horticultural plants will be available to embellish the homes of the Peace River country. Some really wonderful results have been already attained by industrious and enterprising private gardeners and there is urgent need to sound the possibilities more fully by experimental work on a broad scale.

SECTION II.—POTATOES

Nearly four acres of potatoes were planted, over an acre and a half of them consisting of experimental plots. The principal area was situated on unmanured land where clovers and grasses had been seeded in 1918. The half devoted to legumes had failed for lack of inoculation and after being run over with the mower in 1919 was ploughed, fallowed and planted to sunflowers in 1920, yielding nearly fourteen tons per acre, wilted weight. The half of the piece seeded to grasses was mown for hay in 1919 and 1920; the sod land was well disked in the spring and floated before planting. Each potato plot consisted of a ten-rod row, which crossed the two strips, giving all rows exactly the same proportion of each preparation. Planting was done mostly by opening furrows with a scuffler, having the side teeth removed. After the sets were dropped they were usually covered by dragging dirt in with the feet. Harrowing was tried but made a poor job. At the last an improved way of covering was hit upon. The scuffler was run through between the drills with the side shovels

throwing out. This not only covered the sets satisfactorily but gave a final ripping-up to the land between the rows.

The potatoes on the sunflower land started more promptly than those after sod, but there was little difference in the crop at digging time.

A FREAKISH STREAK OF FROST

Frost played a peculiar freak. The main patch, described above, was badly singed early in July, the tops of some of the earlier varieties being cut down about fifty per cent. The land being high, with a moderate slope, this was quite unusual, the more so seeing that on many farms in the neighbourhood where frost is ordinarily much more severe than on the Station, the potatoes were almost or quite unscathed. More singular still, the experimental date-of-planting test, which was located in the vegetable garden near the buildings, but not twenty-five rods from the main patch escaped with scarcely a leaf blackened. The land here was lower than that occupied by the larger patch, though it had the advantage of a sharper slope. As to whether the proximity of the buildings or the heavy manuring given to the land in the garden were protective factors, it might be unwise to speculate in this report. Suffice to say that the yields in the garden were heavy, while those in the larger patch were not at all up to the average. The more forward rows suffered most since they were more advanced when the frost struck them. This distinctly handicapped early varieties and those methods of treatment designed to produce an early crop. In this July-frosted patch, some late-planted Early Rose yielded much more heavily than the early-planted. This is an exceptional result, for potatoes at Beaverlodge seldom suffer from mid-summer low temperatures. It illustrates once more that Jack Frost is no slave to Precedent.

SUBSECTION (A)—VARIETIES

To the nine varieties grown in 1920 there were added six each from Lacombe, Alberta, and Scott, Saskatchewan. From each source a sample of Empire State was obtained but part of the Scott seed of this kind was overlooked at planting, resulting in a thinly planted row and a slightly reduced yield. The variety did well in both cases.

For reasons explained in the introduction, the yields of all kinds are light and some of the precocious sorts, such as the Early Rose, were particularly set back by the July frost, never fully recovering. Some of the later kinds, such as Irish Cobbler and Table Talk, not being so forward when the frost occurred, were very much less affected and consequently show up better than usual in the tables, all of which emphasizes anew the unwisdom of risking everything on a single throw; also the need of long-term averages to supply data for trustworthy conclusions. It is not considered that four years' trial is nearly sufficient to warrant final judgment upon the relative merits of potato varieties, but a few tentative observations may be ventured:—

Early Norther, a prolific medium-early red variety, heads the list in average yield but shows a marked and apparently increasing tendency to red discoloration of flesh and its quality is not so well thought of as it was in the first two years experience.

Country Gentleman is an excellent pink-skinned but white-fleshed sort, medium-early and an excellent cropper of nice-quality tubers, one of the very best general-purpose kinds.

Gold Coin is the favourite white potato at Beaverlodge Station. Skin creamy white, flesh white. Medium-early, reasonably smooth, good quality and a satisfactory cropper.

Early Rose is a reliable standby for the North, being quite early, a fair yielder and of excellent quality save for red discoloration of flesh, a defect which effort is being made to eliminate by selective work.

Irish Cobbler, though liked by some growers on Grande Prairie, is not a favourite at the Station. It is scarcely early enough for the conditions and hardly so mealy or good-flavoured as some other kinds and exhibits a tendency to an overly large number of rather small tubers.

Table Talk is probably a variety of high quality where it fully matures but is too late for dependable results at Beaverlodge. Even more than the Cobbler it distributes its tubers with unrestrained abandon all through the surface soil so that it takes about twice as long to fork out a row of these as a row of Early Rose.

Wee McGregor is a high-quality white potato but has not yielded so well as some other kinds.

The above seven varieties were tried in 1921 in a triplicate test, as was also American Wonder. Early Ohio was in duplicate only. Of the new introductions there was seed for but a single plot each. Of the newer introductions comments as follows were made on certain kinds after a single cooking test of each:—

Carman No. 1.—Somewhat immature but colour texture and flavour excellent.

Morgan Seedling.—Excellent, though perhaps scarcely equal to Carman No. 1.

Early Bermuda.—Small and dark.

Epicure.—Good but badly cracked.

Everitt Rose.—Very red inside and did not cook well.

Early Ohio.—Quality and flavour good but flesh not quite so white as that of Gold Coin and Wee McGregor.

American Wonder.—Good. Much like Wee McGregor.

Empire State.—White, good flavour and cooking quality.

Though the potatoes were quite clean when lifted an allowance of ten per cent has been made for moisture and dirt.

Besides the twenty kinds represented in table 1 there was a trial of three British varieties, seed of which was kindly furnished by Norman Johnston of Pouce Coupe District. These arrived too late for the main test but were planted in the garden on May 27 against check rows of Country Gentleman. They were McKurry (purple) Windsor Castle and Iron Chief both white. The latter was the only one of the three that outyielded the Country Gentleman. The McKurry had a large number of small potatoes, thirty-five being counted in one hill. With earlier planting the results of all three kinds will no doubt be better. Iron Chief gave the best satisfaction in the cooking test, McKurry being distinctly at a discount.

In connection with the general topic of potato varieties it may be mentioned that in the season of 1921, many, if not all, of the red varieties showed a decided tendency to deep checks, even on tubers that were not scabby. The question has been raised whether this was due to abnormally good growing conditions following a season of restricted growth.

TABLE 1.—STANDING OF VARIETIES.

Varieties grown four years arranged in order of their four-year averages. Others follow according to their 1921 showing.

Variety	Yield 1921	Four-year average
	bush. lb.	bush. lb.
Early Norther	273 17	335 17
Country Gentleman	220 58	301 25
Gold Coin	246 24	298 13
Early Rose	181 52	280 13
Irish Cobbler	270 50	276 38
Table Talk	285 1	267 33
Wee McGregor	218 2	256 4
Empire State (Lacombe)	275 44	
Houlton Rose (Lacombe)	266 56	
*Empire State (Scott)	264 0	
American Wonder	252 45	
Early Ohio (Edmonton)	226 36	
Early Hebron (Lacombe)	224 24	
Bovee (Scott)	218 32	
Morgan Seedling (Scott)	218 32	
Everitt (Scott)	218 32	
Green Mountain (Lacombe)	208 16	
Carman No. 1 (Scott)	190 40	
Extra Early Eureka (Lacombe)	178 56	
Epicure (Lacombe)	178 56	
Early Bermuda (Scott)	154 0	

*Thinly planted.

SUBSECTION (*b*).—THE DATE-OF-PLANTING TEST.

In 1918 a date-of-planting test with potatoes was made by planting seven rows at weekly intervals, commencing April 27. With but one slight variation the yield showed a marked diminution according to the date of planting, ranging from 412 bushels per acre from the first down to 173 bushels from the last planting made on June 7. Analysis by the Division of Chemistry, Ottawa, revealed a corresponding, although not equally pronounced, diminution in the percentage of dry matter, as per table 2.

TABLE 2.—Yields of potatoes from different dates of planting in 1918.

Date planting	Yield per acre	Per cent dry matter	Dry matter per acre
	bush. lb.		lb.
April 27	412 54	20·57	5,096
May 4	332 45	19·64	3,921
" 10	317 37	18·42	3,510
" 17	208 43	18·49	2,307
" 23	231 24	18·28	2,537
" 31	176 47	17·16	1,820
June 7	173 53	17·01	1,774

The test was repeated in 1919 but the season was one which favoured late plantings inasmuch as the weather was extremely adverse in the early months but exceedingly favourable in the latter half with a fairly open fall. Hence it was not surprising to find little or no advantage from early planting in that year although there was some falling off in the plantings made after the middle of May, the June planting showing a decided reduction. Mischance marred the formal test in 1920 but the general results from it and many incidental comparisons in that year distinctly favoured early planting.

In 1921 the test was expanded as follows:—

On the day when the first planting was made (April 22) a quantity of Country Gentleman seed potatoes was put upstairs to sprout in a light though none too warm place in the Experimental building. Thereafter, each week one row would be planted with this sprouted seed and one row with the same run of seed taken direct from the bin in a fairly cool, dark root cellar. The experimental rows were three feet apart and 170 feet long. Yields are calculated to a per-acre basis. There was an extra flanking row on each side of the patch. The soil was a good black loam, well summer-fallowed in the previous season and very heavily manured for garden work. Yields were excellent, running up to 538 bushels per acre.

From the resulting crop, samples for analysis were sent the Dominion Chemist, Dr. Frank T. Shutt, whose determinations are included in the table of yields. Unfortunately a few rows had been weighed and dumped before it was remembered about collecting samples.

TABLE 3.—Presenting total yields and weight of dry matter from the Date-of-Planting Test, 1921. Variety, Country Gentleman.

Date planting	Condition of seed	Yield per acre	Per cent dry matter	Dry matter per acre
		lb.		lb.
1st—April 22	Not sprouted	29,638	20·13	5,966
2nd— " 29	Not sprouted	29,808	19·71	5,875
2nd— " 29	Sprouted 1 week	29,552	19·59	5,789
3rd—May 6	Not sprouted	28,527	19·34	5,517
3rd— " 6	Sprouted 2 weeks	30,833	20·29	6,256
4th— " 13	Not sprouted	27,588	19·76	5,451
4th— " 13	Sprouted 3 weeks	29,125	20·69	6,025
5th— " 20	Not sprouted	25,196	18·36	4,625
5th— " 20	Sprouted 4 weeks	28,954	20·89	6,048
6th— " 27	Not sprouted	25,196	17·70	4,459
6th— " 27	Sprouted 5 weeks	27,844	No analysis	
7th—June 4	Unsprouted	25,709	"	
7th— " 4	Sprouted 6 weeks	32,285	"	

From the table it will be noticed that the average yields from the late plantings made with sprouted seed fully equal the yields from the first plantings made with unsprouted seed, but that there is a distinct falling off in yield when the unsprouted seed only is considered. That this difference was not more marked may be reasonably attributed to the character of the season, which somewhat resembled 1919 in being much more favourable to growth in the latter months. In all cases the vine growth was much heavier from the late plantings than from the early ones. Indeed it is almost invariably better and if the late plantings had time to mature a full nest of tubers they could be depended upon to give the larger yields. In the fact that they seldom have time to mature their bottoms lies the argument for early planting in districts with short seasons. The argument has special force when late-maturing sorts are grown and when autumn frosts come early.

A fairly consistent correlation is exhibited as between total tonnage and percentage of dry matter. When these are multiplied together so as to give the total weight of dry matter per acre the advantage from sprouting is the more emphatically brought out.

SUBSECTION (*c*)—SIZE OF SET

The third year's work under this head was conducted in duplicate, the results agreeing substantially with earlier findings, save that one plot planted with large tubers cut to three eyes fell much below its fellow in yield, pulling the average two-year yield below that produced by the two-eye sets. Though positive proof of ex-

perimental error is lacking, it is supposed that a mistake in weighing or else careless work in digging must be responsible for the deficiency. The consistency of the outcome otherwise is satisfactory.

In the first two years' work it was remarked that while small potatoes planted whole often produce as large a crop as sets cut from medium to large tubers, yet there was a tendency for the resultant crop to show an undue percentage of small potatoes. Accordingly, at digging time in 1921 a half bushel composite sample of each run was sacked separately and set aside to be counted and weighed at a more convenient season. The result was presented in the fourth column of Table 4. This table shows that the smallest crop (excepting the three-eye sets, where a probable error marred the test) but the largest average sample was obtained from the one-eye sets. The smallest average sample resulted from planting very small whole potatoes, with the medium-small whole proving a trifle better. All the sets cut from full-sized potatoes gave a larger average sample than did the small whole sets. Whether this is owing to the fact that the small whole potatoes have too many eyes in proportion to their substance or whether hereditary tendency comes into play may be determined by future work. The practical lesson to date is that a settler in straitened circumstances may sometimes, if lacking other seed, plant such as are too small to eat; but, pending further data, he will be well advised to plant also a few well selected tubers to furnish seed stock for the following year.

TABLE 4.—Size of set test, 1921.—Variety, Early Rose—Presenting results in yield and average weight of tubers from planting different sizes of whole potatoes and cut sets.

Designation	Yield in pounds per acre			Average weight per tuber
	First Range	Second Range	Average both ranges	
				ozs.
Very small whole potatoes	13,552	13,464	13,508	3·25
Medium small whole potatoes	17,952	15,840	16,896	3·396
Large potatoes cut to one eye	13,024	12,760	12,892	5·157
" " two eyes	13,640	13,816	13,728	4·7
" " three eyes	14,696	10,912*	12,804	3·892

*It is believed that this figure must be erroneous, due possibly to some mistake in the field. It is the only important inconsistency occurring in three years' work under this head. In 1920 three-eye sets yielded better than two-eye sets as they did in the First range this year.

TABLE 5.—Size of Set Test—Presenting results from three years' work.

Designation	Aggregate 3 years	Yield per acre in pounds		
		Average 3 years	Aggregate 2 years	Average 2 years
Very small whole potatoes	50,674	16,891	30,008	15,004
Medium small whole potatoes	56,484	18,828	34,296	17,148
Large potatoes cut to one eye	42,338	14,112	25,542	12,771
" " two eyes	51,139	17,046	29,128	14,564
" " three eyes	.....	.....	28,354	14,177

*See footnote preceding table.

SUBSECTION (*d*) REMOVING VERSUS LEAVING ALL EYES BUT ONE PER SET

In the duplicate test in 1919 whole potatoes with all but one eye gouged out before planting gave a thirty per cent larger yield than whole potatoes with all eyes left. The reverse result was obtained in 1920 from a triplicate test employing three

varieties, the average loss in yield from the removal of the eyes being 14·75 per cent. In 1921 a single test was made with the Country Gentleman variety with results as follows:—

Whole potatoes sprouted, all eyes left	19,448 lb. per acre
Whole potatoes sprouted, one eye left	19,096 "
Loss from the operation	352 "
Per cent of loss	1·8

SUBSECTION (*e*)—POTATO SPROUTS

Perhaps the most important and practical line of work with potatoes which has been accomplished at Beaverlodge to date is that relating to various phases of the sprouting question.

THE ADVANTAGE OF LEAVING WHITE SPROUTS ON SETS

A duplicate experiment in 1915 resulted in an advantage of 15 per cent in yield from leaving the cellar sprouts on potatoes at planting as compared with breaking them off. A similar experiment in 1919 gave an advantage of 18·4 per cent. In 1920, when planting was much belated and the cellar sprouts in consequence were extra long and strong, the advantage from leaving them on worked out to 33·8 per cent as the average of a duplicate test. In that year many incidental comparisons confirmed the formal trial. Furthermore, in that season the Superintendent grew a long row of tolerably good crop from sprouts broken off some potatoes reserved for table use.

In 1921 a single trial only was made on this particular point. The variety was Early Rose and as the test was located in a patch injured by July frost it would not have been surprising if the more forward condition of the row planted with seed retaining its sprouts should have resulted in a reversal of previous experience. But again, the row with sprouts broken off yielded exactly 21 per cent less than the row with cellar sprouts left on. The average result for the four years is thus 22·05 per cent in favour of leaving the cellar sprouts on.

GREEN SPROUTS VERSUS WHITE SPROUTS VERSUS NO SPROUTS

When it was found through preliminary trials that the long white cellar sprouts were of so much advantage, several new questions were suggested. Would green sprouts be better than white ones? Or would it be better to keep the potatoes from sprouting at all, thus conserving their vitality until they were committed to the ground? Two years' data are now available with which to answer these questions. Both years' results agree in general tenor although a conspicuously and unaccountably large yield from one of the 1921 plots planted with sets having white sprouts attached throws the balance of advantage in this particular year's work in favour of the white as compared with green sprouts. It is noteworthy that among the twelve plots representing two years' work, every plot planted with seed tubers having either green or white sprouts has outyielded any plot of the same season that was planted with unsprouted seed. Thus another year's evidence goes to support the conclusion that either a green or a white sprout is of advantage in forwarding maturity. (See also the Date of Planting Test, subsection (*b*). The main trouble with white sprouts is that they are liable to be broken off in handling. For this reason, if for no other, it is desirable to bring the tubers up out of the cellar in advance of planting and let them form tough green sprouts in a light warm place.

One reason why the green sprouts do not show up better against white sprouts in the 1921 test is that the former were formed in too cool and airy a building so that by planting time they were much less developed than the white sprouts on the corresponding lot of seed put in the warm house cellar on the same date.

TABLE 6.—No Sprouts versus White Sprouts versus Green Sprouts

Designation	Yield in pounds per acre		
	1920 crop	1921 crop	Average two years crop
No sprouts. Tubers kept in cool dark storage till planting	16,700	12,012	14,356
Sets with white sprouts formed in cellar storage	18,800	16,104	17,452
Sets with green sprouts formed in a light upstairs room	20,500	14,652	17,576
Adv. white sprouts over no sprouts	2,100	4,092	3,096
Adv. green sprouts over no sprouts	3,800	2,640	3,220
Percent adv. white over no sprouts	12·5	34	21·6
Percent adv. green over no sprouts	22·7	21·9	22·4

BREAKING OFF VERSUS LEAVING CELLAR SPROUTS WHEN PUTTING UPSTAIRS TO SPROUT

Supposing one wishes to develop green sprouts on his potatoes before planting, is it advantageous to break off any white sprouts that may be formed or is it better to leave the white sprouts on to green up and toughen in the light? A single test on this point in 1921 confirmed the results of a quadruplicate test in 1920, favouring the leaving of the white sprouts attached.

TABLE 7.—Breaking off versus Leaving Cellar Sprouts when Putting Upstairs to Sprout

Designation	Yield in pounds per acre		
	1920 results	1921 results	Average two crops
Cellar sprouts left on when tubers put upstairs to form green sprouts	20,375	18,040	19,207
Cellar sprouts broken off when tubers put upstairs to form green sprouts	18,900	17,864	18,382
Disadvantage of breaking off sprouts	1,475	176	825
Per cent	7·2	1	4·3

N.B.—As the white sprouts were very small when the lots were put upstairs the percentage loss from breaking them off was much less than in 1920.

TREATING WITH FORMALDEHYDE BEFORE VERSUS AFTER SPROUTING

When following the practice of sprouting potatoes before planting, is it preferable, in case treatment with fungicides is called for, to apply the treatment before or after putting the seed upstairs to sprout? A quadruplicate test in 1920 gave a net advantage in yield of 1,700 pounds per acre or 8·1 per cent in favour of treating with formaldehyde before sprouting rather than after. It was noticed that a certain percentage of the treated tubers were bad, and the rejection of weakened sets from the lot treated in advance may have explained the results. In 1921 the experiment was repeated in triplicate with results at variance with those of the year preceding. Table 8 presents a summary of the two years' data. The variety used in 1920 was Early Norther; in 1921 the Early Rose.

TABLE 8.—Presenting results of treating seed potatoes with formaldehyde before versus after sprouting

Designation	Yield in pounds per acre		
	1920 crop	1921 crop	Average two crops
Treated before sprouting	22,525	13,434	17,979
Treated after sprouting	20,825	14,696	17,760
Advantage (+) or disadvantage (−) of treating before sprouting	+1,700	−1,262	+219
Per cent advantage or disadvantage of treating before sprouting	8·1	−8·6	1·2

N.B.—As the seed used was pretty clean there was slight opportunity to study relative efficacy in disease control. The experiment hinges upon the effect of the chemical upon the viability of the seed tubers.

SUBSECTION (*f*).—HEEL EYES VERSUS SEED END EYES

At the suggestion of one of the helpers, a single experiment was planted to compare sets cut from the seed ends of the potatoes with those cut from the heel ends. The experiment was on too small a scale to be regarded as conclusive, but favoured the seed-end eyes.

Designation	Yield pounds per acre
Seed-end eyes	17,424
Heel-end eyes	15,576
Difference in favour of seed-end eyes	1,848
Per cent difference	11·8

SUBSECTION (*g*)—FRESH CUT VERSUS DRIED SETS

A quintuplicate comparison of fresh cut versus sundried sets confirmed in every instance the conclusion from a duplicate test in 1920. In that year two varieties were employed, whilst three different ones were used in 1921. Furthermore, there were several supplemental comparisons in 1921, all going to support the same conclusion, but since these latter were not under strictly comparable conditions they were withheld from the tabular computations. The table below summarizes the results from seven accurate comparisons comprehending five distinct varieties and two successive seasons' work. The findings agree, too, with those of some less carefully conducted tests in earlier years and show an average disadvantage of 16·4 per cent against sun-drying sets to the point where they lose approximately half their weight. In these experiments no dust or other styptic has been applied to the cut surfaces.

TABLE 9—Comparing Fresh-Cut with Sun-Dried Sets

Designation	Yield in pounds per acre		
	1920	1921	Average two years
Fresh-cut sets	20,400	18,304	19,352
Sun-dried sets	16,500	15,840	16,170
Disadvantage of drying	3,900	2,464	3,182
Per cent of difference	19·1	13·4	16·4

HILLING VERSUS LEVEL CULTURE

In 1919 a duplicate test of hilling versus level culture showed a 6·8 advantage in yield in favour of level culture, though hilling was of benefit in protecting the tubers from fall frosts, reducing sunburn and slightly reducing the amount of red discoloration in the Early Rose.

The experiment was omitted in 1920 but recommenced in 1921, a triplicate trial being provided for. Unfortunately the records do not make it absolutely clear whether the hilling was attended to in each of the three cases. It was done in one instance on July 27 and this row showed a slight reduction in yield from the level rows on either side. In the other instances the yields were nearly equal but since there is a slight uncertainty in the records, these are excluded from the table and only the single test is counted.

TABLE 10—Showing Effect of Hilling Versus Level Culture

Designation	Yield in pounds per acre		
	1919 Country G. and E. Rose	1921 Early Rose	Average two years
Level culture	21,746	13,596	17,671
Hilled	20,265	12,584	16,424
Loss in yield by hilling	1,481	1,012	1,247
Per cent loss	6·8	7·4	7

Despite this result, moderate hilling is still practised with the general crop for the reasons set forth above.

DEEP OR SHALLOW PLANTING

Deep planting was compared with shallow by opening alternate drills with a single and a double passing of the scuffler (arranged as described before by removal of the side teeth). A single stroke opened a furrow about four inches deep into which some loose earth fell back so that the sets were covered only an inch or so. A double stroke with pressure on the handles opened a furrow about six or seven inches deep and by pressing the sets into the bottom of this and drawing the dirt in level, the sets here were covered to a depth of at least four inches. The result of such planting was a tardy start and a substantial reduction in the yield.

In 1920 a similar test was undertaken but running water washed out some of the seed potatoes resulting in a quite inordinate advantage in favour of shallow planting, so that it hardly seems fair to carry those results into the tabulations. What was believed to be a truer comparison for that year was afforded by some alternate deep and shallow hills planted in the furrow opened out about a foot deep for planting trees. The deep hills were planted near the bottom of this furrow and well covered with earth. The intervening ones were planted on top of a mound of soil drawn into the furrow, the sets being then lightly covered with earth. The results of this accurately conducted test are recapitulated in Table 11.

Notwithstanding the undoubted fact that very shallowly planted tubers may be depended upon to start much more promptly and usually to produce the larger yield, yet extremely shallow planting is not advised as a general practice, since the potatoes grow too close to the surface, sunburn readily, in spite of hilling, and suffer too extensively by autumn frosts in advance of digging. It is also thought that the cooking quality is scarcely so good while certain red kinds such as Early Rose and Norther appear to be rather more liable to discoloration of flesh. A medium course is preferred.

TABLE 11—Comparing Deep Versus Shallow Planting

Designation	Results from an equal number of hills—1920 (not calculated to acre basis)	Yield pounds per acre 1921
Shallow planting	310	17,811
Deep planting	270	15·312
Advantage shallow over deep	40	2,499
Per cent advantage	14·8	16·3

HILL SELECTION

Between fifty and sixty strains representing hill selections made at various dates were grown under comparative trial. A large proportion of these were Early Rose and Early Norther and one of the important objects in view is to determine the extent to which the red discoloration of flesh of these varieties is hereditary and the extent to which it may vary with cultural conditions such as soil, season, depth of planting, earliness and depth of moulding. Cooking trials are also made to compare flavour with mealiness. So far as the work has yet progressed it leads to the belief that the red discoloration is inherent in varying degree in different strains but that environment probably affects somewhat the degree to which it may be exhibited. However, the data on the subject are not yet extensive enough to be conclusive.

It is sought to isolate a strain of Early Rose that will be white-fleshed, mealy, good-flavoured and of high-yielding propensity. The combination is not easy to secure. Strange as it may seem, sampling previous to 1921-1922 failed to discover a strain of Rose that was both perfectly free of discoloration and yet of superior table quality. The best quality in this variety seemed always to be associated with a certain degree of redness.

From the crop of 1921, however, a few isolations have been tested which promise the desired combination of attributes. But, of course, further work is needed to decide the fixity of the apparent characteristics.

SECTION III.—FRUITS

CURRANTS.—Out of fifty-four bushes of red, white, and black currants set out at the Beaverlodge Station in 1916, fifty-three are still living and healthy. Two black and three red varieties are proving almost perfectly hardy. An annual crop with a rapidly-increasing ratio of production has been obtained from the reds since 1917 and from the blacks since 1918. Highest yield to date has been obtained from six bushes of New Red Dutch, which, after extensive sampling by visitors, yielded over 72 pounds of beautiful fruit—only nine pounds behind the Canadian Experimental Farms' record for reds as reported by the Dominion Horticulturist in his bulletin on bush fruits. It is just possible that this variety has a slight advantage in location over the other reds, but such is not definitely known to be the case.

None of the currant bushes have been laid down for winter with the exception of one-third the bushes in the fall of 1917. In the ensuing winter there was practically no winter killing of any of the bushes and the practice of laying down has been discontinued.

TABLE 1

RED CURRANTS

—	New Red Dutch	Cumberland Red-O. 492	Victoria Red	Fay Prolific	Wilder
	lb.	lb.	lb.	lb.	lb.
Aggregate yield 1917-19	30·5	39·0	27·5	0·2	0·0
Yield—1920	42·0	29·0	37·0	1·5	0·0
Yield—1921	72·25	55·25	62·75	13·2	3·5
Totals	144·75	123·25	127·25	14·9	3·5

BLACK CURRANTS

—	Topsy O. 568	Collins Prolific
Aggregate yield 1917-19	18·4	14·3
Yield—1920	38·0	26·0
Yield—1921	37 3	33·4
Totals	93·7	73·7

WHITE CURRANTS

—	Large White O. 551	White Cherry O. 550 5 bushes only
Aggregate yield 1917-19	7,75	4·4
Yield—1920	1·0	5·0
Yield—1921	5·25	12·5
Totals	14·00	21·9

RASPBERRIES.—From fourteen plants which survived shipment and transplanting in 1916 a very large number of raspberries have been propagated and considerable distribution has taken place. The present plantation at the Station now comprises two rows twelve to fourteen rods in length, mostly the Herbert variety. These are succeeding fairly well, but usually sustain a certain amount of winter injury when not laid down. During the last two winters laying down of the bulk of the canes has been practised. Despite late spring frosts, the fruit prospect in 1921 was particularly good but was greatly curtailed by a serious attack of red spider, which seems to have been the only troublesome pest to date. Nevertheless the following pickings were obtained, besides the usual amount of sampling out of hand:—

	Pounds
August 11	21.0
" 15	40.5
" 18	24.25
" 22	15.5
" —	9.0
" 27	25.0
" 31	10.0
Total for season	145.25

STRAWBERRIES.—Both the ordinary and the everbearing strawberries have proven satisfactorily winter-hardy, but the latter have, so far, been very scant croppers at the station. Of the regular class, a variety, locally obtained and thought to be the Early Dakota has been found satisfactory and of good quality, with a rich, if some-

what tart, flavour. A seventeen-rod row of these was planted in August, 1918, with 100 plants, ninety of which struck root. By 1920 these widely-spaced plants had fairly well filled up their row and gave a small to moderate yield. By the spring of 1921 this row was well filled and perhaps two and one-half to three feet wide. It was kept clean and before picking time a mulch of clean straw was spread along each side of the row. Spring frosts killed some blossoms, but there was plenty left, and the set of fruit was excellent. Notwithstanding the dry, early summer, this row yielded 88½ imperial quarts of fruit. If the row were computed as occupying a width of five feet this would figure out to 85 bushels per acre. It happens that by chance rather than by intention this row has never been mulched for winter protection, and it is gratifying to record that little or no winter injury has been observed. It has the advantage of good snow protection, however. In 1920 two twelve-rod rows planted in August of the previous year were devoted to a comparison of hills versus matted-row culture. In one case the runners were all cut off, leaving merely the parent plants. In the other case the runners were trained to form a continuous row. In 1921 results were greatly in favour of the row. The question is raised, however, whether the outcome from the hill system might not be improved by resorting to spring planting.

Table 2 presents the results of this experiment as well as the crop from the seventeen-rod row planted in August, 1918. It will be noted that the latter greatly outyielded the younger row trained to the same system. It rather appears from present experience as though a Grande Prairie strawberry plantation, if kept clean, is liable to give a bigger crop in the third than in the second season. Possibly the number of early-struck, strong-rooted plants is larger.

TABLE 2

TABLE 2—Strawberries, 1921

	12-rod hill row, planted August, 1919 (all runners in 1920 cut off)	12-rod matted row, planted August, 1919 (runners trained to form continuous row)	17-rod matted row, planted August, 1918
	quarts per row	quarts per row	quarts per row
July 15	....	....	4
" 16	....	....	4
" 18	....	....	6
" 19	1	....	10·5
" 21	1	1·75	14·5
" 23	....	....	13·5
" 25	0·5	1	10·5
" 26	....	1	....
" 27	0·5	1	13·5
" 29	....	0·5	8·5
" 31	0·5	1·25	....
Aug. 1	....	0·75	3·5
" 15	....	1	....
	3·5	8·25	88·5

APPLES.—Most of the apples set out in 1916 still survive and made considerable headway in 1921. A few of them have attained a moderately encouraging growth, but it is not expected that these can really succeed until the wind-break is grown larger. Mrs. Mary Thompson, the celebrated pioneer horticulturist who resides southeast of Bear Lake, had the honour of maturing in 1921 what are supposed to be the first apples grown in Grande Prairie. Being the product of ungrafted seedlings, the fruit was not much larger than haws, but the fact that some dozen or so of fruits ripened warrants hope for greater triumphs in the future.

WILD FRUITS.—Wild gooseberries, wild cherries, wild currants, wild strawberries, wild raspberries and native saskatoons have all been successfully transplanted, though with the exception of the saskatoon and possibly the cherry, it is doubtful whether results will justify attention to the wild species where hardy domesticated varieties are available.

In the autumn of 1920 seeds of three probable acquisitions were received from W. J. Boughen, horticultural explorer for the Dominion Government. These were the Manitoba wild grape, the Sand cherry, and the Myra wild plum. Rooted plants of the Sand cherry were also received and though not stored under the best condition during winter, many of them grew when planted, as did quite a large number of seeds of all three fruits.

SECTION IV.—ORNAMENTALS AND SHELTER BELTS

The shelter belt material is progressing nicely. The Manitoba maples set out in 1916 have been allowed to develop a thick, brushy habit of growth to give bottom wind protection to small fruits in the lee of it. Most of these maples are from eight to twelve feet in height. Russian poplar cuttings set out in 1920 are from four and a half to seven feet high. Native spruce and Scotch pine are getting vigorously established. Chinese lilac and caragana are thriving well and blooming profusely. The former are over six feet in height. Some of the more tender ornamentals such as spiraea are still alive and give some bloom but are not yet a great success. Tartarian honeysuckle promises well. All the bushes of it set out in 1919 bloomed abundantly in 1921. Wild honeysuckles transplanted from an adjacent pasture blossomed prettily and promise to be worth while. A good many more of these were secured during the summer. They may be moved at blossoming time if the top be pruned back and reasonable care observed in transplanting. Other wild species transplanted to the grounds in 1921 or heeled in for spring planting are the dwarf birch, the tamarack, wild clematis, dwarf hazelnut, high bush cranberry and mountain ash. The three last-named were obtained on Saskatoon mountain, a big hill five to eight hundred feet high, on the top and slopes of which the flora evince a climatic character somewhat modified as compared with that on surrounding areas.

A lawn was very successfully seeded on June 1 with a mixture of Kentucky blue grass, red top and white Dutch clover. By autumn, growth in places was nearly a foot high and the clover in fragrant bloom.

SECTION V.—VEGETABLES

The following notes on vegetables and flowers have been prepared by Mr. P. Flint, who has had special charge of the gardening operations and deserves credit for their success:—

The 1921 season, with the exception of a short, dry spell just after seeding, was favourable throughout. On May 26 everything was covered with snow an inch deep but it was soon gone. On May 27 the ground was frozen stiff in some places. Ice formed on water, still no serious damage was done. On May 30 another frost occurred when the young corn was touched considerably. Later frosts were not severe until September 8. This allowed most vegetables to mature and made 1921 the banner year at this Station for quality and quantity.

ARTICHOKES.—Some of our own tubers, which are of a white variety, received from Ottawa in 1918, and also a red variety received this year were planted. Results from the former were nearly double those of the red variety.

ASPARAGUS.—The results here are not great but sufficient to show that this desirable vegetable can be raised in this climate and soil. A new quantity of seed Washington (Stokes) sown May 9 made a good appearance and was transplanted to fill out the old row on November 2.

BEANS.—Six varieties of garden beans were sown on May 17, Early Red Valentine (Rennie); Early Model (Wills); Refugee (Carters); Stringless Green Pod (Rennie); Round Pod Kidney Wax (McDonald); Wardwell Kidney Wax (McDonald). Each variety gave good returns, but Wardwell Kidney Wax, Early Valentine and Stringless Green Pod were a long way the best and were about equal to each other in yield. Refugee was far behind. Frost put an end to the bearing on September 8.

BROAD BEANS.—Seventeen varieties were sown on May 17. All made splendid progress, developing fine pods, but the frost of September 8 and succeeding nights, while not destroying the plants, yet rendered the beans in the pod soft and thus ruined them. They demonstrated production and considerable hardiness but few persons cared for them as a table vegetable.

BEETS.—Six varieties were sown on May 10. The land was not perfect owing to the presence of a short, loose litter in the surface soil, and the dry time succeeding sowing but rains caused good development and every variety produced excellent roots. Yields as follows:—

Variety	Yield per acre		
	lb.	tons	lb.
Detroit Dark Red, O. 200	30,354	15	354
Early Wonder (McDonald)	18,585	9	585
Crosby Egyptian (Harris)	28,074	14	74
Early Model (D. & F.)	28,750	14	750
Eclipse (McDonald)	28,256	14	256
Black Red Ball, O. 245	21,739	10	1,739

The yield was nearly, though not quite equal to that of the preceding year. Detroit Dark Red takes the lead as in the previous season.

BRUSSELS SPROUTS.—It is seldom the sprouts have become fully mature at the Station but this past year there were six plants out of twenty-five which produced fully matured sprouts. The Dalkeith failed to mature.

CARROTS.—Six varieties were sown on May 7. Here also an excess of coarse litter in the surface soil affected the stand considerably so that this cannot be considered a perfect test. However, the yields were:—

CARROTS

Variety	Yield per acre		
	lb.	tons	lb.
Early Scarlet Horn (D. & F.)	11,927	5	1,927
Hutchinson (Gregory)	27,916	13	1,916
Chantenay (O. 246)	19,743	9	1,743
Scarlet Nantes (D. & F.)	17,701	8	1,701
Chantenay (McDonald)	15,402	7	1,402
Oxheart (Steele)	18,333	9	333

CELERY.—Seven varieties were sown in hot-bed on April 27, which is probably too late for best results. It seems difficult to secure an even growth in the hot-bed. Here the Golden Yellow was almost an entire failure. These varieties were set out in two rows, one on the level, the plants when grown being boarded up, the other in a trench dug one foot deep filled with rotted manure five inches and then four inches

of top soil. These were all taken up October 28 and it was seen that the results from the trench were far better than those from the level row. Lack of moisture militated against the level culture. The trench system retained moisture better. On the level Giant Pascal, Evans Triumph and Winter Queen gave fair plants with stalks twelve to fourteen inches high, while these same in the trench gave stalks sixteen to twenty-four inches high. French Success was very poor on the level but in the trench the stalks were eighteen inches long. These were packed upright in the root cellar in earth above the roots and here most of the blanching was done.

CITRON.—In most years these are an entire failure, but this year there was one specimen four inches in diameter and another three inches and many others smaller. Some hope for the future.

CUCUMBER.—There has not been very much success with this vegetable, but this year it was better than usual. From a Giant Pera vine left in the hot-bed, specimens were taken six inches long and from a specially prepared hill in the open, Improved Long Green (McDonald) the largest was eight and one-half inches long. Quite a number of cucumbers were gathered from Early Russian (Burpee) suitable for pickling.

CORN.—Sown May 14. Ten varieties. Soil was fine and moist. Early frost checked them somewhat. Of the ten varieties sown only one gave mature ears, the Pickaninny O. 8716, a dwarf corn. All others attained a good height, but in Howling Mob and Sweet Squaw ears scarcely formed, while Early Fordhook, Malakoff, Early Dakota and Pocahontas formed ears but they did not mature. The Sweet Assiniboine had nearly usable ears and the earliest plantings of Sweet Kloochman in the date of planting test had a few that were good enough to boil.

CABBAGE.—Fifteen varieties in the test were sown in the hot-bed on April the 18th. These were thinned on May 12 by transplanting to the cold frame. The plants left in the hot-bed made good growth and were ready first, being transplanted to the open on June 1. Those from cold frame were not transplanted until June 14. The soil for this test was in good condition with a top dressing of well rotted manure. The season was extra well suited for cabbage giving the greatest number of uniformly solid heads raised at this Station in one year. There was little difficulty with insects. Root maggots destroyed a number of plants. Sections of the cabbage plot were treated twice with a solution of corosive sublimate (1 oz. to 8 gallons water). Other sections were not treated. This was not a year to show conclusively the benefits of this treatment, but as it stood the portion treated was almost entirely immune, while that not treated showed more the ravages of the maggot. The plants taken directly from the hot-bed gave much better results than those which were first transplanted into the cold frame, yet both were excellent. On August the 15th nice specimens of Jersey Wakefield, Copenhagen Market and Enkhuizen Glory were used. The latter two run almost evenly for first place in yield—25 heads averaging 10½ pounds. Jersey Wakefield and Early Paris Market are early and uniformly good heads but both are more subject to root maggot than any others. Ex Amager Danish Ballhead O. 105-15 is a fine winter variety, twenty-five heads giving an average of eight pounds each. Flat Swedish, Marblehead Mammoth and Improved Brunswick, for which our seasons are usually too short, gave good solid heads averaging 6½ pounds apiece. Kildonan and Succession averaged seven pounds. It is difficult in this locality to get good heads of red cabbage, but Delicatesse and New Danish Delicatesse yielded firm, fine heads. Good results also from Savoy.

CAULIFLOWER.—Two varieties were sown in the hot-bed on April 18 and transplanted to the open on June 1. Early Snowball (McDonald) and Early Dwarf Erfurt (McDonald). Thus far, there is little to choose between these varieties but this year the Erfurt gives somewhat better results. After setting these out the weather was rather dry and hot, consequently many flowered prematurely, the heads being much smaller than usual.

HORSE RADISH.—Roots were divided and the row extended. All show the usual vigorous growth.

KOHL RABI.—Three varieties were sown. All were a success, the purple samples rather the best.

MUSK MELON AND WATER MELON.—No bloom again this year.

LETTUCE.—Nine varieties, all developed fine heads, except Salamander which was a failure here for the second successive season.

PEAS.—Thirteen varieties were sown on May 7. The earliest picking was from Thos. Laxton on July 21st, but English Wonder (0.8929), Gregory Surprise and Early Morn (McDonald) followed closely on July 23, while Little Marvel, Carter Eight Weeks and American Wonder were first gathered July 26th. Danby Stratagem and McLean Advancer are later, August 3rd and 8th respectively. The later varieties were the heavier yielders this time, the season being exceptionally favorable to late varieties. The Gradus seed was all used in the Date-of-Planting Test and this kind was not compared with other varieties in 1921.

ONIONS.—The plot sown July, 1920, which made a good showing last fall was badly winter-killed, though well mulched. It presented a very poor stand in the spring. While there were some very good samples and these mature, yet from thirty-two-foot rows of Southport Red Globe, Southport Yellow Globe and Yellow Globe Danvers, only six pounds each were taken and these were the best rows. A row of Dutch Sets gave fine, large mature samples, many of them four inches in diameter.

VARIETY TEST—SEED ONIONS

Rows 50 feet long, 18 inches apart

	Pounds	
Yellow Globe Danvers, O. 49-54	22½	
Yellow Globe Danvers, Graham	21½	
Southport Yellow Globe, Ewing	31	
Southport White Globe, Graham	23	
Southport Red Globe, Graham	36½	
White Barletta, McDonald	5½	(poor stand)
Giant Prizetaker, Graham	27	
Australian Brown	23	
Ailsa Craig, Graham	26	
Ex. Early Flat Red, McDonald	13	

It will be seen that Southport Red Globe leads, while Southport Yellow Globe and Yellow Globe Danvers are not far behind. Thick neck developed considerably.

PARSLEY.—Champion Moss Curled had magnificent growth and was an ornament as well on each side of the path to the garden.

PARSNIP.—Hollow Crown (0.104-5) withstood all frosts and produced at the rate of 18,360 pounds or 9 tons and 360 pounds per acre.

PEPPERS.—Harris' Earliest (0.879) bloomed this year and small fruit formed. The largest, however, was not over one inch in diameter.

RADISH.—Fine, early radishes were secured by sowing in hotbed on April 18, White Icicle (D. & F.). The best results in the open were secured from White Icicle, while two strains of Scarlet Turnip White Tip (Lennoxville and D. & F.), gave fine returns.

PUMPKIN.—Connecticut Field (McDonald) was the only variety giving any appreciable returns. The largest was from a hill made similar to the squash hills. This weighed twenty-two pounds and by covering at night from September 8th and subsequently and uncovering during the day it was fully ripened. King of the Mammoth and Small sugar were comparative failures even in this favorable year.

SPINACH.—Carter's Victoria (McDonald) and New Zealand (McDonald). The first came along early and was fully equal to the previous year. New Zealand (a new variety here) was long in germinating but made a perfect growth. It would

be too late for most years. We are not enthusiastic over the taste but this may be from lack of knowledge how to serve.

SQUASH.—The attempt to set out vegetable marrow from the hot-bed resulted in failure, while those sown in the open scored the best success to date. On May 10th four varities were sown, English Vegetable Marrow, Delicious, Hubbard and Golden Hubbard. From the English Vegetable Marrow was gathered the finest marrow ever grown here, the longest two feet. From Delicious no fruit. Golden Hubbard gave small specimens, the largest being 5½ inches in diameter. The Hubbard was no better. On May 11th one hill of English Vegetable Marrow and one of Long White Bush Marrow (McDonald) were planted. For these holes were dug one foot deep half filled with rotted manure and the rest with top soil. Excellent fruit was gathered from each, but the White Bush Marrow more than doubled the yield from the English Vegetable Marrow. From the Long White Bush Marrow in the Vegetable Date of Seeding Test a splendid crop was harvested. Every year this variety gives a good account of itself.

SWISS CHARD.—Lucullus, 1919 seed, sown on May 10th was never better.

TOMATO.—On April 18th six varieties were sown in hot-bed, viz. Wibolts, Bonny Best, Alacrity, Earlibell, Alacrity X Earlibell, and Chalk's Jewel. On June 20th two plants of each were transplanted to the open. They were good and vigorous and about to bloom. All were pruned to a single stem. They were not, however, tied up though a supporting stake was placed to each. None of the fruit was large and all green when the frost came. Alacrity X Earlibell gave the best yield, though that was only 1 pound 14 ounces for the two plants. Wibolts and Earlibell were nearly equal. The tomato vines have never been loaded at this Station. Some plants left in the hot-bed produced a few ripe samples.

VEGETABLES—DATE OF PLANTING TEST

To ascertain the best average date for planting is an important matter in this country and to accomplish it the Date-Of-Planting Test has been conducted now for four years. The results for 1921 are here given.

The land was well manured and summer-fallowed. The season on the whole was very favourable for germination and growth. All the common vegetables are included in this test, eighteen in number. There were seven dates of planting beginning with April 20, then April 27th, May 5th, May 12th, May 19th, May 27th and June 3rd. The date on which the highest yield occurs is rated 100%, all others reckoned in proportion.

DATE-OF-PLANTING TEST, VEGETABLES

Kind	1st date, April 20	2nd date, April 27	3rd date, May 5	4th date, May 12	5th date, May 19	6th date, May 27	7th date, June 3
*Beans	.....	.....	.....	100	.....	.....	.....
Beets	94	100	86	75	70	71	61½
Cabbage	62	45	38	56½	88	100	63
Cauliflower	100	33	25	77	54½	68	54
Carrot	72	100	81½	88½	76½	79	86
Corn	100	90	70	50	40	20	10
†Lettuce	.....	100	.....	.....	.....	.....	.....
Mangel	86	100	86	86	77	62½	67½
Onion	73	100	97	79	79	79	30½
Parsnip	81	100	77½	89	77½	63	70
Parsley	80	95	100	100	100	90	75
Peas	.....	100	100	.....	.....	.....	.....
Pumpkin	27	63	46½	100	34	43	20
Radish	100	100	100	100	100	100	100
Salsify	81	100	61	69	55	38	54
Squash	48	15	42	59½	78	86	100
Turnip	100	93	72	60	67	67	46½

* Fourth date best. † All good, first date earliest.

It will be seen that half these vegetables, nine out of fifteen, gave the best results on second date, while four others were best on the first date, showing the advisability of getting some seed in for the hardy vegetables around or before May 1st, if the ground is ready. Great variation occurs, however, from year to year. Beans and pumpkins and most of the squash, of course, should usually be planted not before the middle of May. The cabbage gave the largest returns from the sixth date, May 27th, but this was an unusual year and other elements likely enter. Best results are usually obtained by early planting.

SECTION VI—FLOWERS

The season for flowers proved considerably better than 1920. With very little exception every species, whether annual or biennial, throve and bloomed abundantly.

Asters, Phlox, Calendula, Ten Week Stocks, Petunias, Candytuft and Verbena all presented a perfect development; Sweet Peas, in abundance and variety. A quantity designed for raising seed was caught before maturity by the frost.

Pansy.—A multitude of plants from this year's seed bloomed through all the hard frosts till the first week in November, a few blooms occuring well on in that month.

Antirrhinum (or Snapdragon), too, proved exceedingly hardy, retaining its dark-green foliage to November 1st and even later, blooming nearly all the time.

Butterfly.—A few plants attracted special attention on account of the beauty of their bloom.

Nasturtiums, until frosts came on September 9, were exceedingly rich in colour.

Sweet Alyssum, the beautiful border plant, is hardy and of richest perfume.

Hollyhock was sown and made a good growth for the first year.

On October 17 seven hundred bulbs, Hyacinth, Narcissus and Tulip, were planted. Part of the area was well mulched late in the fall and part left without mulching.

SECTION VII.—EFFECT OF FROST ON VARIOUS FLOWERS AND VEGETABLES

Some notes on the effect of frosts from September 9 to 13 may be of general interest. There were taken after Fahrenheit registers as follows: September 9, 26° F.; September 10, 28° F.; September 11, 25° F.; September 12, 21° F.; September 13, 26° F. Undoubtedly on the ground where the flowers and vegetables grow the temperature would be a few degrees lower.

Seedlings of Myra plum and Sand cherries grown from pits sown this year, seemed not affected, while those of the grapes and of New Zealand whattle from seed sown this year were killed entirely by the first frost. Two of the whattle seedlings taken to the house flourished throughout the winter, graceful as maiden hair fern. The seed for these were brought from New Zealand by a neighbour, Mrs. A. Haszard. The California poppies were injured but not killed. Some blossoms were still unfolding. The poppy buds were all killed and plants almost gone. Verbena shows no sign of frost. Schizanthus (or Butterfly) frozen down. Linaria only slightly hurt. Balsams, of course, entirely gone. Nasturtiums, the first frost got them. Phlox affected somewhat. Ten Week Stocks hurt considerably but not killed. Godetia ruined. Sweet Alyssum affected but not destroyed. Pansies, the beautiful faces looking up sweetly as ever. Aster, worst in appearance but some not frozen. Antirrhinum, little hurt by all the frosts or even by harder ones later and bloomed almost to November 1. Sweet Peas, blossoms all gone. Vines badly hurt but the lower parts were green later on. Candytuft looks up clean and bright as ever. Calendula considerably injured but not destroyed. Hollyhock, uninjured.

EFFECTS ON THE VEGETABLES

The tender vines, although covered, were almost entirely destroyed. Some squash and pumpkin (thanks to heavy covering of straw) matured their fruit. A few tomatoes were ripe before the frost and some green ones were picked, but all the rest were

injured. Swiss chard little hurt. Parsley shows no sign of frost. New Zealand spinach entirely killed. Cabbage family shows very little injury. Beets, the tops injured somewhat. Peas, green, frozen completely. Mangels, parsnip, salsify and carrots show no effect. Potato tops entirely destroyed. Corn, of course, badly injured and growth arrested. Beans, common varieties, all gone. Broad beans, plants not destroyed but the beans in the pod were rendered soft and thus ruined.

ANIMAL HUSBANDRY

ENSILAGE FEEDING EXPERIMENT, 1920-1921

With the object of testing the feasibility of the silo and ensilage under Peace River conditions and, at the same time, gaining some experience preliminary to the conduct of a formal experiment in 1921-1922, a twelve by twenty-six-foot stave silo was erected in the autumn of 1920 at the Dominion Experimental Sub-station, Beaverlodge, Alberta. It being in the nature of a rush order, with a desperately trying condition of roads and weather to contend with, plus a very high rate of wages and a lack of workers experienced in silo construction, the cost was abnormally high, totalling $606.70, of which $361.85 was for material (including mill-work and blacksmithing). Teaming accounted for $63.20 of the balance. This total cost could now be halved by a farmer planning ahead and doing his team work in advance. If he chose to throw in his time and count the cash outlay only, the cost would be still more moderate.

Appendix I gives details of the cost complete. The figure of $606.70 covers several appurtenances such as chute, feed chest, silage cover, etc.

On October 11 and 12 the silo was filled with the crop from two acres of sunflowers, plus some partially cured oats and partially cured barley, the cereal crop and sunflowers being put in, for the most part, load about. The barley, which was purchased from a neighbouring farm, was very smutty and contained but little kernel, having been sown very late and frosted in the blossom. The Giant Russian sunflowers, delayed in development by wet weather after planting, were less than five per cent in bloom, though unscathed by frost until late in September and showing the lower half of their foliage green when the crop was harvested early in October. They were allowed to lie about a week before filling and weighed as hauled to the silo.

On October 29 the silo was refilled with nearly nine tons of very late sown oats which, like the barley, had been frosted in the blossom, but were still quite sappy when bound about the 10th of October. Left lying on the ground, they retained much sap and being saturated by a rain the day before the refilling, they went into the silo in excellent condition, curing into a very pleasant flavoured silage which the cattle seemed rather to prefer to the sunflower silage fed later.

Very nearly sixty tons, all more or less wilted and part of it more than half cured, were thoroughly tramped into a silo whose nominal capacity would be fifty-five tons of corn.

Feeding commenced immediately after refilling and no wastage occurred, except a little at first when only a few head of cattle were being fed. A very slight amount of mould developed in a few of the driest layers of barley. The contents consisted of:

26 tons sunflowers,

18 tons green oats,

11½ tons shocked barley (produce of 4½ acres spring ploughing),

808 bundles shocked oats (not all weighed).

Appendix II gives further details. The cost of filling was enhanced by the necessity of hiring at high rates an engine which was unable to run the cutting box at full capacity. Wages were also very high.

To consume the silage it was desired to finish a bunch of two-year-old steers, but on a falling market it was found difficult to purchase a satisfactory quality at a justifiable price. In the end ten yearling steers, mostly good grade Shorthorns, were picked up at various dates at prices ranging from $32 to $52.90; and fifteen calves, all but one supposedly sired by a Hereford bull, were bought late in November.

The cattle, in two age lots, were fed in a straw-covered pole shed, windtight on three sides but entirely open on the south. A central raised manger, divided with a longitudinal partition, bisected the shed area, extending forward from the silo chute at the rear. Water was nearly always conveniently available in a tank warmed with a coal-burning cast-iron heater, which served to supplement the scanty water supply by melting much snow.

To the few yearlings first purchased, silage feeding commenced shortly after refilling, and before any waste had occurred at all, but there were not head enough to avoid some waste later. The freshly ensiled oats gave particularly good satisfaction, the odor being like that pervading a brewery. Cattle put on silage at this stage take to it greedily, never missing a feed.

The first evening that sunflower silage was fed there was solemn silence in the shed. The animals stood back with an injured air as if to say: "We ask for bread and you give us a stone." A few nibbled at the stuff for a moment and then stood back in disgust, making it unanimous. Only by baiting with chop could any be induced to eat it. By the fourth feed they took to it pretty readily and thereafter ate it with zest, though never with quite the same relish as they did the oat silage. The family cow in the stable consumed for a time fifty pounds a day, and, often after a heavy feed, exhibited symptoms which suggested slight intoxication. This was observable chiefly at milking and was the more conspicuous from the fact that she always was previously and has since been a particularly gentle animal.

Incidentally, it may be remarked that this cow and her spring calf, kept in the stable beside her, seemed to manifest a larger appetite both for roots and silage than did any of the cattle fed outdoors. This was particularly true as regards the Greystone turnips.

Whether because of the smut, the beards, or both combined. the cattle did not relish the barley ensilage, though they always cleaned it up. Several of the calves developed small abscesses on their jaws (not actinomycosis) which broke and finally healed. The trouble was, at first, attributed to barley beards, but may have been due to something else, as it was reported from many other herds in the neighbourhood. However this may be, it is confidently believed that much better results would have been obtained had the silage been made altogether from oats and sunflowers.

GAINS DURING A HUNDRED-DAY MID-WINTER PERIOD

The cattle purchased at varying dates were not all weighed upon receipt, but gains were recorded between early January and the middle of April, covering the coldest part of the winter. During this time the calves received per diem approximately twelve pounds apiece of silage with one feed of second quality rye grass and blue joint hay and one feed of straw. On the silage was sprinkled about two pounds per head of ground feed wheat, the quantity being considerably tapered off toward the last. Oats would have been preferred, but the wheat was used because it was available. A very few turnips were also fed, but as the most of these were Greystones, the cattle ate them indifferently and in very spare amounts. Block salt was constantly before them.

The yearlings received daily about twenty pounds of silage and a pound of ground wheat with oat straw *ad libitum* and half a tubful or so of turnips divided daily among the ten head. Seven of the ten yearlings were dehorned after the January weighing.

It will be understood that no attempt was made to fatten any of these cattle. The aim was simply to carry them through the winter in thrifty condition. Considering that the inferior barley silage was fed from about the middle of February, alternating with layers of sunflowers, the gains made and the condition of the cattle must be regarded as quite satisfactory. With legume hay to balance the ration results should have been much better.

The average weight of the fifteen calves on January 4 was 446 pounds; on April 14, 505·06 pounds, gain of almost three-fifths of a pound per head per day. The average weight of the yearlings on January 5 was 830·3 pounds; on April 15, 900·2 pounds, a gain of practically seven-tenths of a pound per head per day. A local co-operative shipper stated in May that some of these steers were equal in quality and condition to the best he had recently seen offered on the Edmonton market, and according to his estimate they would have commanded in May, a price about sufficient to recoup the expense of wintering. In a district where it is more common for store cattle to lose than to gain weight during the winter months, this was pleasant to hear. One of the calves, proving a ridgeling, was sold for beef on June 1, and dressed 294 pounds of nice meat. He was not better than the average of the bunch.

It is true that the winter was a mild one, and that in an ordinary year considerable trouble from freezing might occur, particularly with sunflower silage. As it was, the silage never froze more than about a foot in from the outside, and not a pound was lost as a result of freezing, nor was there a symptom of indigestion. The bulk of the frozen silage was left until a chinook came, when it would be thawed out and used. Had some care not been exercised, the outcome might have been different. However, a few precautions were observed that are worth passing on. In the first place, straw was piled around the silo to one-half to two-thirds its height. This seemed to help a little. A well-insulated feed-chest was provided at the bottom of the chute and on very cold days a can or two of hot water was set in here and the lid closed down. Best of all was a hinged cover of rough lumber, with a ply of tar-paper battened on. This cover lay flat on top of the silage in the silo and extended to within a foot of the perimeter. One day the east side would be lifted and laid back on the leg provided to protect the hinges, and the day's supply of silage would be thrown out from this side. The next day the other side would be lifted, and so on. Very little freezing ordinarily occurred under this cover, and it might well be made a little larger than it was, though there ought to be several inches clearance between it and the wall.

When spring opened the cattle continued to eat silage until the end of May, roaming as well a native pasture, and gaining steadily. Two or three feet of silage were carried over. In all, twenty-seven head ate silage all winter and till the end of May, the quantity consumed by the two head of personal property being balanced against the roots supplied. In June they were put in a shady, well watered pasture where they made excellent gains until the grass failed in September. During the latter half of October the grass was supplemented with twenty to thirty oat bundles per day and the cattle have come into winter quarters in good condition, none of the ten heifers having been bred, so far as can be judged. No autumn weights have been taken at date of inditing this report. The cattle are now on a home pasture (native grass) and eating oat straw with a noon feed of perhaps 18 to 20 pounds per head of pulped roots, the supply of which is nearly exhausted. So far this winter they have been watered once daily at a neighbouring pond.

ENSILAGE IN 1921

About four acres of sunflowers were grown in 1921, chiefly on spring ploughed stubble. Hard frost on the morning of September 9, with other severe frosts following, cut the corn and sunflowers alike. The sunflowers were of several varieties and varied in maturity from full head to five to ten per cent in bloom. Filling com-

menced on September 13, so that most of the sunflowers were considerably wilted. The material was cut very fine and packed surprisingly. When it became apparent that there would be insufficient sunflowers to fill the silo, ripe, well headed, oat bundles which had been ten days in shock were hauled up, stacked by the silo and mixed in with the last half of the sunflowers, a very few having gone into the lower half also. On top of about two and one-half feet of old silage there was blown in 73,281 pounds, or say 36½ tons of sunflowers, corn and horse beans (chiefly sunflowers) valued at $2.50 per ton, or $91.25; and 19,759 pounds ripe, shocked oats, or say 9¾ tons at $4.50 per ton, amounting to $43.88, the total value of the material being $135.13. The precise wheat ensiled in 1921 was 93,040 pounds, or say 46½ tons, raising the level of the silo from about 2½ up to 21 feet, since settled to about 16 or 17 feet. As mentioned before, the nominal capacity of this silo for corn would be only 55 tons, if filled from bottom to top. It is evident that a silo will hold very many more tons of sunflowers than of corn. The fact must not be overlooked that the sunflowers ensiled in 1921 had lost much sap and the oats most of theirs. With the same material ensiled green, the tonnage capacity would be far greater still. Some juice has run from the lower half of the silo.

After filling, a foot of cut straw was blown into the silo and the silage cover laid on top of this. The material next the wall was tramped daily for some time after filling. The straw under the cover became wet and half rotten with some oats growing in it. No moisture but vapour and rainfall had wet it. Beyond the perimeter of the board cover the cut straw remained dry on top.

Appendix V gives the cost of ensilage in 1921, though allowance should be made for the fact that nearly two acres of the crop consisted of test plots, the cutting and weighing of which involved a great deal of extra time.

APPENDIX I

Cost of Silo, 1920

90 staves 2x6x26 at $50 per M.	$117 00	
4 standards 4x6x30 at $50 per M.	12 00	
Millwork	43 00	
Sheet-iron connections for joints	2 75	
Floor—		
Material for form and template ring (5 pieces 2x10x12)	4 50	
10½ sacks cement	25 20	
Hoops—		
Material and blacksmith work	93 00	
Hardware—		
Nails, hinges, etc.	5 30	
Feed Chute—		
Material	15 50	
Exterior Insulation—		
Tar paper and lath	1 70	
Silage cover and hinges for same	5 50	
Flat roof, including hinges, etc.	18 25	
Guying—		
Wire, bolts, eyebolts	9 50	
Scaffold—		
Poles, etc.	8 65	
Total material, including millwork and blacksmithing		$361 85
Teaming of lumber	36 70	
Teaming of two loads gravel (not all used)	12 00	
Teaming of poles for scaffold	5 00	
Teaming of cement	9 50	
Total teaming		63 20
Labour—		
Skilled, 15 hours at 80c	12 00	
Skilled, 45½ hours at 75c	34 10	
Unskilled, 271 hours at 50c	135 55	
Total, 331½ hours		181 65
Grand total material and labour		$606 70

APPENDIX II

Cost of Ensilage, 1920

Labour—		
Cutting sunflowers, filling and refilling silo, 225 hrs. at 50c per hr.		$112 50
Team hire, 4 days at $7.40		29 60
Engine hire, first filling		39 30
Engineer, refilling 1 day		6 40
Gasoline and oil, refilling		5 50
Ensilage Material—		
26	tons sunflowers at $2.50 as per acct. rendered	65 00
18	tons green oats at $4.50	81 00
4½	acres bound barley at $13 per acre	58 50
293	oat bundles purchased at 6c delivered	17 58
515	oat bundles purchased at 4c	20 60
	Total	$435 98

Weight of ensiled material, approximately 60 tons.
Weight of cured ensilage, allowing for spoilage, etc., estimated roughly at 50 tons.
Cost of silage per ton, $7.79.

APPENDIX III

Ensilage Feeding Experiment. List of Calves, with record of weights and gains to April 14, 1920.

No.	Sex	Description	Weight, 15-12-20	Weight, 4-1-21	Weight, 14-4-21	Gain in 100 days	Gain in 120 days
1	Heifer...	White face, two red ears, white top neck	463	497	506	9	43
*2	Steer....	White face, red marks eyes to nose, white spot top of withers	418	429	506	77	88
3	Steer....	White face, red marks both eyes, two red spots over nose	398	425	520	95	122
4	Heifer...	Light roan (bigger of two)	512	524	552	28	40
5	Heifer...	Red, small star	455	469	510	41	55
6	Steer....	White face, red ears	380	425	490	65	110
7	Heifer...	Smaller light roan	385	400	450	50	65
8	Steer....	Red, triangular, white forehead, white fleck tail head	456	471	540	69	84
9	Heifer...	Wild, four red spots on white face	356	360	386	26	30
10	Heifer...	Big dark roan	468	460	550	90	82
11	Heifer...	Clear, white face, spots top neck and withers	394	405	480	75	86
12	Heifer...	Black	540	539	612	73	72
13	Steer....	White face, white top neck to withers	400	421	488	67	88
14	Heifer...	Red, rangy type	388	370	434	64	46
15	Heifer...	Red, white face, red spot under left eye, white on brisket	455	495	552	57	97
		Totals	6,468	6,690	7,576	886	1,108
		Averages	431·2	446	505·06	59·06	73·86

* Sold June 1, 1921.
N.B.—No. 4 developed lump under jaw, apparently as a result of beards in barley silage. Barley silage was fed from about middle of February and was eaten reluctantly.

APPENDIX IV

RECORDS Ten Yearling Steers to April 15, 1921

Tag No.	Name	Seller	Price	Date of delivery	Weight delivery	Weight 5-1-21	Weight 15-4-21	Gain in 100 days	Total gain recorded
16	Red Bobs	Robt. Stone	33·25	Nov. 5	.....	908	966	58	58
17	Roan Bobs	Robt. Stone	33·25	Nov. 5	.....	808	966	75	75
18	Moyer	Gordon Moyer	50·00	Nov. 2	870	972	1,040	68	170
19	Johnson	Arnold Johnson	40·00	Nov. 19	785	723	826	103	41
20	Rd. Linglel	E. W. Lingrell	33·00	Dec. 9	.....	696	758	62	62
21	Sptd. Lingrel	E. W. Lingrell	32·00	Dec. 9	.....	638	712	74	74
22	O'Connell	J. O'Connell	44·00	Nov. 27	800	835	886	51	86
23	Dark Roan H	D. C. Hume	52·90	Dec. 8	920	983	1,030	47	110
24	Lt. Roan H	D. C. Hume	50·03	Dec. 8	870	973	1,054	81	184
25	Carrell	Carrell Bros.	42·20	Jan. 3	767	767	847	80	80
	Totals	.....	.....	.....	.....	8,303	9,002	699	
	Averages	.....	.....	.....	.....	830·3	900·2	69·9	

Average daily gain per head during 100-day period, 0·699.

Immediately after weighing on January 5 seven of the steers were dehorned, and this, judging from two comparative weighings on February 21, at the time of a short course in stock judging, set them back somewhat.

The steers, which were hornless when purchased were Nos. 19, 24 and 25.

During the latter half of the 100-day period the silage fed consisted of barley and sunflowers ensiled in layers load about. The barley was badly smutted and the barley silage was eaten without evidence of relish, though always cleaned up. Besides silage, the steers had oat straw ad libitum and about a pound per head per day of ground wheat. The steers are in fair flesh, thrifty, and their hair shows satisfactory lustre. For past three weeks they have eaten little straw but have filled up daily on prairie pasture. Silage is always cleaned up.

APPENDIX V

COST of Ensilage Put up in 1921

Material—		
36½ tons sunflowers, etc., at $2.50 per ton	$91 25	
9½ tons shocked oats at $4.50 per ton	43 88	
		$135 13
Labour—		
Cutting sunflowers, etc., 57 hours	17 35	
Hauling, 52 hours at 30c per hour	15 60	
Filling, etc., 132 hours	42 55	
		75 48
Gas and oil		24 00
		$234 61

Average cost per ton of material ensiled, $5.04.

NOTE.—While no allowance is made for the use of machinery, this is offset by the high labour cost of harvesting and weighing experimental crops. The cost of overhauling the engine and putting it in condition for a season's threshing has all been charged to the silo filling.

Several minor mishaps of an unusual nature retarded operation and ran up costs. Short cutting increases costs but is believed to improve results.

EXPERIMENTAL SUB-STATION, FORT VERMILION, ALBERTA

REPORT OF THE SUPERINTENDENT, ROBERT JONES

THE SEASON

The winter of 1920-21 was the mildest that has been experienced here for thirty years, while the growing season of 1921 was practically all that could be wished for, with its moderately warm weather after the end of May and the abundance of precipitation following the first week in June.

No snow fell at all until November 22, 1920, and then only a very light fall—one-half inch. At the end of the month there were only one and a quarter inches on the ground, so that wheels could still be used With this extremely light snowfall and no very cold weather, range cattle were able to feed out on the range until the end of the month, and, when rounded up, were found to be in the very finest condition. Many horses were allowed to winter out, and when taken up in the spring were found to be in fair condition. With a little extra feed they were soon in good shape for spring work. During this winter, too, abundance of feed for all stock was available throughout the district. Losses from any cause were practically nil. On fifteen days during the month of November the temperature dropped to below zero, the lowest recorded (25th) being 29.5 F.

December was an average month, comparatively mild, no severe wind storms being experienced and no extreme drop in temperature. Sufficient snow fell during the first part of the month to make fair sleighing, which enabled the farmers of the district to get at their hauling, of both hay and wood, and to market their surplus wheat, which commanded a fair price. All surplus wheat grown in this district is made into flour by the local mills, this flour being used by the large trading companies in trade with the Indians and trappers. Besides this local supply, many hundreds of sacks are imported annually. It snowed on seven days during December, and at the end of the month there were six and a half inches on the ground. The minimum temperature was well below zero, with the exception of two mornings during the month. The lowest temperature reached was recorded on the morning of the 26th, when it was —48.9 degrees.

January opened rather mild, and remained so until the 6th, when the weather suddenly turned cold, and from that date on it was well below zero for the remainder of the month. There was practically no wind, however, and bright sunshine, so that work went on as usual. Horses and cattle were allowed out each day for exercise. Snow fell on five days, and at the end of the month there were fourteen and a half inches on the ground. The heaviest fall at any one time occurred on the 3rd, when two and a half inches fell.

March was, on the whole, a pleasant month, comparatively free from storms. There was a light snowfall, of half an inch, on the 1st, and this was the total precipitation throughout the month. The mercury remained below zero except on three occasions,—45.0 F. being the lowest point touched (on the 13th). There was no trouble in keeping the roads in good condition, there being freedom from winds. An abundance of feed remained on hand for all stock, which latter kept in excellent condition.

Winter weather continued throughout the early part of April, no work being done on the land until the 27th. On this date the first variety plots were commenced. Seeding, however, was not general until May 1, when field work was begun. The hotbeds were got under way by the 21st, on which date the first seed was sown. Sowing continued, at intervals, until the end of the month. The limited snowfall of the winter quickly disappeared, the frost being out of the ground sufficiently to start ploughing on the 20th; but the water from the spring thaw did not provide sufficient

moisture for rapid germination of seed. The lowest minimum temperature for the month was recorded on the 4th, when the thermometer registered —8 degrees. Birds and waterfowl put in their appearance much earlier than usual, the river being free of ice on the 26th. Young stock were out on the range by the end of the month. The total precipitation was only 0.14 of an inch, this amount being in the form of melted snow.

May opened rather cool. Seeding was general throughout the district on the 1st, the land being in good condition for working, though the higher land was somewhat dry. The mean temperature for the month was around normal. Frost was recorded on all mornings but six, the lowest temperature touched being 17.2 degrees, on the morning of the 28th. All grains and garden stuff suffered from this severe frost, but luckily the six preceding nights had been comparatively warm, or more damage would have been done. Very little rain fell during the month, the total precipitation being only 0.39 of an inch, which fell on four different occasions. The period between the 4th and the 25th was so free from hindrances in the matter of weather conditions that spring work proceeded rapidly. By the latter date the land had become quite dry, and with the frequent frosts and lack of moisture crops were beginning to show the effects; but the timely light showers of the 25th, 29th and 31st soon revived the young plants; and with the later rains of June all crops made excellent headway. A small proportion of the transplanting was accomplished during the final days of the month, the tomatoes being left until after the beginning of June, in anticipation of the usual frost, which occurred in due course and did considerable damage, as usual.

June, after the 4th, was a moderately warm month. The nights were unusually warm, as high as 51.5 being noted. The maximum temperature was also high; 84.1 was touched, and it was usually well above the 70 mark. With this warmth and the frequent showers the growth of all crops was remarkable. On the 6th 0.19 of an inch of rain fell, followed by 0.61 of an inch the next day. This precipitation effected a wonderful change in all crops, but more especially with the newly transplanted plants which were showing the effects of the drought and frost. By the 15th early sown wheat was fully fourteen inches high, and on the 27th it measured twenty-nine inches. By the end of the month the tomatoes and other plants which had been transplanted on the 6th and subsequently were fine large plants. The tomatoes were in full bloom, with some fruit set. Much summer-fallow was done during the latter part of the month; also a fair amount of new breaking in readiness for next season's crop.

July also was a warm month, with a fair rainfall distributed well over the entire district. Both minimum and maximum temperatures were unusually high. Haying commenced on the 25th, when blue joint, red top and vetch were fully three feet high. Frequent showers slightly delayed haying operations during the latter part of the month. On the 20th 0.42 of an inch of rain fell, and this heavy shower was accompanied by a very high west wind which caused many of the plots of grain to lodge, a condition from which they really did not recover, as they were kept beaten down by the later rains in August. By the 20th of July these plots of grains had reached a height of forty-two inches, at which they could not withstand the heavy rain and high wind. While the rains caused some damage to grain crops they were beneficial to the gardens and to the root crops. Much garden stuff was in use by the middle of the month, and by the end it had reached a fair size. All varieties of perennial flowers were in bloom in the early part of the month, and many of the annuals by the 15th. They all made a fair showing and added greatly to the beauty of the surroundings.

August was warm, no frost being recorded. There was an unusual amount of precipitation, rain falling on sixteen days. On the 24th, 1.07 inches fell in sixteen hours, while there were many heavy showers prior to this date. The plots of grain, and any large fields of somewhat rank growth looked as though rollers had passed over them. Some difficulty was experienced in harvesting them. These conditions, however, made for abundance of fodder, and were regarded as very favourable by men who had moved in from drier districts further to the south. The moisture was

beneficial to the root crops and to any late sown grain crops, though it caused considerable delay in haying and harvesting operations, haying extending well into September. The extra moisture caused a second growth to spring up in most of the grain plots, more especially oats; and in the early sown crops the heads did not mature. The amount of straw harvested was greatly in excess of what it otherwise would have been. Harvesting of the early maturing varieties of wheat commenced on August 6, the very early maturing varieties of oats and barley having been cut during the latter part of July. The earliest date on which any grain was cut at this Station was July 23 (barley). The wheat straw was fifty-four inches in length, some varieties of oats fifty-nine, and barley forty-eight. The potato crop was very heavy, and all vegetable gardens throughout the district were good.

September also was fairly warm, with bright sunshine and a moderate rainfall, occurring on six different occasions. The period 7th to 18th was quite free from rain, and during this spell of fine weather all work was pushed forward rapidly. Haying was completed by the early part of the month, ample hay for all stock being put up throughout the district. The binders were kept busy until well towards the end of the month. A bumper, fully matured crop was harvested. The 19th and 20th were showery, followed by another fine period from the 21st to the 30th. The first frost was recorded on the morning of the 8th, frost being recorded on eight mornings altogether during the month. The lowest temperature occurred on the 12th, when the mercury dropped to 21.5. The period September 13-October 2 was free from frost. Many flowers continued to bloom until the end of September, and the root and potato crops were harvested between the 15th and 30th. These gave a larger yield than had been anticipated, not only at the Station, but throughout the whole district, despite that many of the gardens were new breaking. September was a hurry-up month at the Sub-Station.

October was, on the whole, extremely pleasant. Freedom from unfavourable weather conditions permitted much work to be done which otherwise would have been left over until the next year. Ploughing continued until the 21st before it was too hard frozen to continue the operation. During the early part of the month the stacks were removed. Manure was applied to the different grain plots, and the land deeply ploughed. This land is to be used for experimental work with roots, corn and potatoes during 1922. The balance of the sod land that was broken in the early spring of 1921 was kept well cultivated during the season. It was given a liberal application of well-rotted barnyard manure and thoroughly disced in just before the freeze-up. The sod land on which the different varieties of corn were planted in the spring of 1921, which proved a failure on account of the seed being destroyed by wire worms, was reploughed in the latter part of June, and was kept thoroughly cultivated during the balance of the season. It was given a light application of manure and reploughed just before the freeze-up, in order to destroy as many of the worms as possible. The rainfall for the month was very light, there being only six showers. The first snow of the season (one inch) fell on the 31st. The highest maximum temperature for the month was 73.5, on the 12th, and the lowest minimum, on the 10th, was 19.0 degrees.

November was considered a fine month for the north. It furnished further opportunity for finishing up more of the autumn's work and for the completion of threshing, a large proportion of which had been left over for November. It has been carefully estimated that 35,000 bushels of grain were threshed in the district immediately around the Station, 18,000 of this being wheat of the finest quality. The balance was oats and barley, both very good, and the former weighing as high as 38 pounds to the bushel. The mercury was well below zero on seventeen different occasions during the month, the lowest point touched being on the 21st, when a temperature of 33 degrees was recorded. Snow fell on five occasions, and by the end of the month there were six inches on the ground. This did not prevent young stock from grazing out during most of the month. During the year quite a number of new settlers have arrived in the Fort Vermilion district, and a fairly large acreage of new breaking has been done in readiness for next season's crop.

TABLE of Meteorological Observations taken at Fort Vermilion, Peace River District, Alberta, from April 1, 1921, to March 31, 1922, showing maximum, minimum, and mean temperature, the highest and lowest for each month with date of occurrence, also rainfall, snowfall, and total precipitation.

Months	Maximum	Minimum	Range	Mean	Highest	Date	Lowest	Date	Rainfall	Snowfall	Total Precipitation	Number of days Precipitation	Heaviest in 24 hours	Date
	°	°	°	°	°		°		in.	in.	in.			
April	51·86	18·01	33·84	36·93	68·0	16th	−8·0	4th	0·51	3·90	0·90	2	0·81	24th
May	62·28	30·22	32·05	46·24	83·5	20th	17·2	28th	0·39	.....	0·39	4	0·18	4th
June	70·25	38·96	31·29	54·60	84·4	8th	17·9	2nd	3·46	.....	3·46	13	1·02	15th
July	74·60	47·31	27·28	60·95	85·5	16th	37·5	6th	2·10	.....	2·10	10	0·95	9th
August	65·89	43·18	22·70	54·53	80·5	14th	32·5	12th	3·63	.....	3·63	16	1·07	25th
September	60·13	32·39	27·74	46·26	74·5	16th	21·5	12th	1·47	.....	1·47	6	0·70	20th
October	47·56	28·83	18·72	38·19	73·5	12th	19·0	10th	0·68	1·00	0·78	8	0·27	18th
November	13·65	− 4·50	18·16	4·58	39·0	2nd	−33·0	22nd	.....	5·00	0·50	5	0·15	2nd & 4th
December	13·40	−13·33	26·74	0·04	43·5	9th	−43·9	19th	.....	1·50	0·15	2	0·10	10th
January	7·82	−17·33	25·16	−4·75	40·5	13th	−50·0	22nd	.....	1·25	0·12	1	0·12	1st
February	4·73	−23·23	27·97	−9·25	28·5	25th	−48·0	7th	.....	2·75	0·27	3	0·15	7th
March	18·75	−13·19	31·95	2·78	50·0	3rd	−43·0	26th	.....	5·00	0·50	3	0·20	15th & 16th
									12·24	20·40	14·27	73		

SOME Weather Observations taken at Central Experimental Farm, Ottawa, as compared with those taken at Fort Vermilion, Peace River District, Alberta.

—	Mean temperature	Highest temperature	Lowest temperature	Total precipitation	Heaviest in 24 hours	Total hours sunshine	Average sunshine per day
	°	°	°	in.	in.		
April—							
Ottawa	46·85	78·0	18·9	2·43	0·50	201·0	6·70
Fort Vermilion	36·93	68·0	−8·0	0·90	0·81	246·5	8·21
May—							
Ottawa	59·90	94·8	36·0	2·73	1·87	315·3	10·17
Fort Vermilion	46·24	83·5	17·2	0·39	0·18	245·1	7·90
June—							
Ottawa	67·45	98·4	42·0	3·82	1·36	334·0	11·13
Fort Vermilion	54·60	84·4	17·9	3·46	1·02	230·5	7·68
July—							
Ottawa	75·50	99·6	52·8	2·50	0·82	282·9	9·12
Fort Vermilion	60·95	85·5	37·5	2·10	0·95	309·8	9·99
August—							
Ottawa	66·70	89·0	46·6	2·69	0·87	276·9	8·93
Fort Vermilion	54·53	80·5	32·5	3·63	1·07	166·3	5·36
September—							
Ottawa	63·18	91·8	40·0	1·71	0·76	231·1	7·72
Fort Vermilion	46·26	74·5	21·5	1·47	0·70	218·1	7·27
October—							
Ottawa	45·85	70·8	24·0	4·57	1·22	122·6	3·95
Fort Vermilion	38·19	73·5	19·0	0·78	0·27	99·1	3·19
November—							
Ottawa	28·36	62·4	9·2	3·06	0·53	62·3	2·07
Fort Vermilion	4·58	39·0	−33·0	0·50	0·15	55·4	1·84
December—							
Ottawa	17·55	43·5	−14·2	2·71	1·03	78·3	2·52
Fort Vermilion	0·04	43·5	−43·9	0·15	0·10	59·8	1·92
January—							
Ottawa	11·49	36·8	−20·0	1·68	0·65	122·4	3·94
Fort Vermilion	−4·75	40·5	−50·0	0·12	0·12	66·7	2·15
February—							
Ottawa	14·57	39·4	−22·4	2·42	0·55	117·8	4·20
Fort Vermilion	−9·25	28·5	−48·0	0·27	0·15	139·0	4·96
March—							
Ottawa	27·82	49·2	− 4·8	2·07	0·86	195·8	6·31
Fort Vermilion	2·78	50·0	−43·0	0·50	0·20	167·7	5·40

RECORD of Sunshine at Fort Vermilion, Peace River District, Alberta, from April 1, 1921, to March 31, 1922

Months	Number of days with sunshine	Number of days without sunshine	Total hours sunshine	Average sunshine per day
April	30	0	246·5	8·21
May	28	3	245·1	7·90
June	27	3	230·5	7·68
July	31	0	309·8	9·99
August	24	7	166·3	5·36
September	27	3	218·1	7·27
October	20	11	99·1	3·19
November	14	16	55·4	1·84
December	21	10	59·8	1·92
January	20	11	66·7	2·15
February	20	8	139·0	4·96
March	30	1	167·7	5·40

FORAGE CROPS

ENSILAGE CROPS

VARIETY TESTS WITH INDIAN CORN

Indian corn has been tested for a number of years at this Station, but has not produced sufficient yield to warrant the growing of it for ensilage. The reasons for failure to produce profitable ensilage from Indian corn are the liability to late spring frosts, short growing season and cool nights. Variety tests were again conducted this year, but owing to the poor germination of the seed, and to attack by insects, all plots were so seriously damaged that they were ploughed up. The following varieties were planted: North Western Dent, Leaming, Longfellow, White Cap Yellow Dent, North Dakota, Compton's Early, Wisconsin No. 7, Twitchell's Pride, Canada Yellow and Quebec No. 28.

In addition to variety tests, there were sown three 1/80th acre plots of mixed corn, the crop being fed to stock as green feed. This material was very much relished. These plots were sown on well cultivated land free from insects and were hand-cultivated during the growing season. Yields obtained were as follow:—

YIELDS OF CORN

Plot	Date of planting	Date of harvest	Height of plants	Yield per acre
			ft. in.	tons lbs.
1	May 17	Sept. 11	7	10 700
2	" 10	" 3	6 10	9 1,730
3	" 17	" 5	7 2	9 630
Average				9 1,020

TEST OF SUNFLOWERS

Although sunflowers have been successfully grown in the garden for a number of years, this was the first year that they were grown under field conditions at this Station. The land selected for this test was in roots last season, and no fertilizer was applied for the sunflowers. It may be noted that sunflowers were at no stage

of their growth affected by light or severe frost, although corn was seriously affected, with consequent lessening yields.

Plots were sown of different varieties, at different dates and with varying distances between rows. No thinning was done, and plants were about 4 inches apart in the row. The following table gives yields obtained from sunflower plots:—

YIELDS OF SUNFLOWERS

Variety	Planted in drills	Size of plot	Date sown	Date cut	Height	Yield per acre
		acre			ft. in.	tons lbs.
Mammoth Russian	24 inches apart	1/60	May 16	Sept. 5	9 6	30 1,320
"	26 "	1/60	" 17	" 6	10	28 920
"	22 "	1/60	" 16	" 5	9	25 1,600
Early Ottawa 76	20 "	1/60	" 7	" 3	8 6	18 360
Seed from G. H. Hutton	10 "	1/60	June 7	" 8	7	14 1,220

Weight taken seventy-two hours after cutting.

The first blooms appeared August 1, on the Early Ottawa 76. Some plots did not come into bloom until August 18, but all plots were, at harvest, sufficiently matured to make excellent ensilage. At harvest, seed of Ottawa 76 was in firm dough, whilst other varieties were in the soft dough stage.

NOTE.—Seed received from G. H. Hutton was seeded on land previously sown to millet which failed to germinate owing to the seed being uncovered by high winds. In sowing the sunflowers some of this seed was recovered, and germinated, with the result that a fair growth of millet appeared in the sunflowers. This millet was left, no cultivation being given this plot. This, with the closeness of the sunflower rows, no doubt influenced to a considerable extent the yield of sunflowers from this plot.

HAY MIXTURES

To ascertain the clovers, including alfalfa, and grasses which alone, or in combination, will produce the most profitable crops in this district, a series of plots was sown with clovers alone and in combination with grasses.

The land selected for this experiment was part of a wheat field that was taken into the experimental area in 1920. A liberal application of barnyard manure was applied, and the land ploughed in the fall of 1920. In the spring it was thoroughly disced and harrowed and an excellent seed bed obtained. All plots were sown broadcast and covered with the smoothing harrow. The land was then rolled to break any remaining lumps of earth, to cover any uncovered seed and for the conservation of moisture. All plots were sown with a nurse crop, with the object of utilizing it for fodder and so obtaining hay crops from this area the same year as sown. A very favourable growth was obtained, both of the nurse crops and the clover and grasses, alfalfa and clovers being quite noticeable. All plots were cut July 21, and gave a fair yield of fodder, as indicated in the following table, this year the hay being, of course, principally of the nurse crop. All plots were again cut September 2 by which time the hay mixtures were doing well, particularly clovers and alfalfa. The second cutting was left on the ground as a winter protection, and will be removed in the spring when danger of thawing and freezing has passed. The following tables give seeding, and yield per acre of first cutting 1921.

Yields from Hay Mixtures

SERIES 1.—Basic legume, Red Clover. Sown May 27 with nurse crop of Banner oats. First cutting July 21. Size of plots $\frac{1}{16}$-acre.

No. of plot	Seeding	Rate of seeding per acre	Rate of seeding nurse crop per acre	Yield per acre first cutting	
		lbs.	bush.	tons	lbs.
1	Red clover	12	2	2	1,500
2	Red clover	10			
	Timothy	8	1¾	2	1,500
3	Red clover	10	1¾	2	1,000
	Western rye	8			
4	Red clover	10	1¾	2	1,000
	Meadow fescue	15			
5	Red clover	10			
	Timothy	5	1½	2	
	Western rye	5			
	Meadow fescue	9			
6	Red clover	10			
	Timothy	4			
	Western rye	4	1	2	
	Meadow fescue	7			
	Kentucky blue	4			
	Red top	4			

SERIES 2.—Basic legume, Alfalfa. Sown May 27 with nurse crop of Banner oats. First cutting July 21. Size of plot $\frac{1}{16}$-acre.

No. of plot	Seeding	Rate of seeding per acre	Rate of seeding nurse crop per acre	Yield per acre first cutting	
		lbs.	bush.	tons	lbs.
1	Alfalfa	12	2	2	1,000
2	Alfalfa	10			
	Timothy	8	1¾	2	1,000
3	Alfalfa	10			
	Western rye	8	1¾	2	500
4	Alfalfa	10			
	Meadow fescue	15	1¾	2	500
5	Alfalfa	10			
	Timothy	5	1½	2	
	Western rye	5			
	Meadow fescue	9			
6	Alfalfa	10	1¾	1	1,500
	Timothy	4			
	Western rye	4			
	Meadow fescue	7			
	Kentucky blue	4			
	Red top	4			

SERIES 3.—Basic legumes Red Clover and Alsike. Sown May 28 with nurse crop of Success Barley. First cutting July 23. Size of plots $\frac{1}{16}$-acre.

No. of plot	Seeding	Rate of seeding per acre	Rate of seeding nurse crop per acre	Yield per acre first cutting	
		lbs.	bush.	tons	lbs.
1	Red clover	10			
	Alsike	4	1½	3	
2	Red clover	8			
	Alsike	2	1½	3	
	Timothy	8			
3	Red clover	8			
	Alsike	2	1½	2	1,500
	Western rye	8			
4	Red clover	8			
	Alsike	2	1½	2	1,500
	Meadow fescue	15			
5	Red clover	8			
	Alsike	2	1½	2	1,000
	Timothy	5			
	Western rye	5			
	Meadow fescue	9			
6	Red clover	8			
	Alsike	2	1	2	
	Timothy	4			
	Western rye	4			
	Meadow fescue	7			
	Kentucky blue	4			
	Red top	4			

ALFALFA

Alfalfa has been grown with varying success at this Station for a number of years, the cause of failures being chiefly winter-killing. In 1919 a series of alfalfa plots were sown which, due to light snowfall during the winter of 1919-1920 and consequent lack of protection, were so badly winter-killed that they were useless for further record. These plots were ploughed under and the land prepared for a further series of alfalfa plots in 1921, with the object of ascertaining the most satisfactory methods and rate of seeding. Plots of Grimm Alfalfa were seeded on May 27 and, as germination was good and rainfall abundant during June, all plots made a most satisfactory growth. On July 23, the growth being thick, even vigorous and to a height of about 12 inches, a cutting was made and utilized as hay. Growth was excellent after first cutting, and a second cutting was made September 6. This cutting was left to act as a hold for snow and as a mulch to protect the plants from alternate thawing and freezing in the spring of 1922. The following table gives methods and rates of seeding and yield per acre of first cutting.

ALFALFA YIELDS

No. of plot	Method of seeding	Rate per acre	Yield per acre first cutting
		lbs.	lbs.
1	Broadcast	20	1,800
2	"	15	1,775
3	"	10	1,700
4	"	5	1,400
5	In drills 6 inches apart	20	1,600
6	" 6 "	15	1,575
7	" 6 "	10	1,500
8	" 6 "	5	1,450
9	In rows 24 inches apart	5	1,625
10	" 24 "	2·5	1,570
11	" 30 "	4	1,375
12	" 30 "	2	1,300
13	" 36 "	3·3	1,225
14	" 36 "	1·67	1,175

ANNUAL HAY CROPS

Several kinds of crops were grown for annual hay during 1921. The land used had been previously sown to millet. Owing, however, to June frosts and prevailing high winds experienced during the latter part of May and early June the millet plots made no stand, and consequently the land was reworked and seeded again to millets and other crops for hay.

CEREALS AS ANNUAL HAYS

A number of one-sixtieth-acre plots were sown with mixtures of cereals which were cut for hay. The following table gives yields, etc., of these plots:—

YIELDS OF CEREALS FOR HAY

Mixture seeded	Date of seeding	Date cut	Length of straw	Yield per acre	Maturity when cut
			ins.	tons lb.	
Spring rye and Arthur peas	June 9	Aug. 12	49	5 1,700	Spring rye in soft dough stage. Peas well formed.
Banner oats and Arthur peas	June 9	Aug. 12	58	5 1,540	Oats in milk stage. Peas quite green.
Success barley and Prussian Blue peas.	June 7	Aug. 13	48	5 800	Oats in soft dough stage. Peas well formed.
Ligowo oats and Prussian Blue peas,	June 10	Aug. 12	56	5 500	Oats in firm dough stage. Peas nearly formed.
Spring rye, Success barley, Banner oats and Arthur peas.	June 12	Aug. 15	48	5 80	Rye green, barley firm dough; oats in early milk stage; peas well formed.

With the very favourable growing season of 1921 these made excellent growth, a second growth was noticed in them before cutting which no doubt added materially to the yield. They were weighed when green. Harvesting operations were delayed somewhat by unfavourable weather.

VARIETY TESTS WITH MILLETS

The first seeding of millets was done on May 4 and 6, but, this seeding being totally destroyed, the plots were reseeded during June. The following table gives varieties tested, yields per acre and other data in connection with the test of varieties of millets, all plots one-thirtieth of an acre.

YIELDS OF MILLETS

Variety	Date re-sown	Date cut	Height	Yield per acre	
			inches	ton	lb.
Common	June 10	Aug. 13	49	3	120
Japanese	June 10	Aug. 12	50	3	30
Hungarian	June 9	Aug. 12	48	2	1,550
Siberian	June 9	Aug. 12	56	2	1,370

HORTICULTURE

The season opened comparatively early and the first seeding in the vegetable garden was done on April 27. May was somewhat dry and cool, but very favourable for the progress of the work. June also was cool and rather dry until after the 10th. July and August were favourable to the growth of the vegetables. Late summer and fall brought plenty of rain for all late crops. The period free from killing frosts was fairly long; from June 31 to September 25. The land on which the vegetables were grown this season was land that was summerfallowed during the season of 1920, and in a good state of tilth, manure being applied at the rate of fifteen wagon loads per acre, this being added after the land was ploughed in 1920 and worked into the soil with the disc harrow during the season. It was lightly cultivated in the spring of 1921 in preparation for the seed.

ASPARAGUS, COLUMBIA

The asparagus was slow in getting started this season, and was first ready for use on June 10, which was considerably later than usual, the old bed yielding a good crop of shoots.

RHUBARB, VICTORIA

This was in use on June 1; the ground seemed to remain cold for sometime after the mulch was removed, and the plants were slow in getting started.

On this date the plants were of a fair size, a considerable quantity were picked during the season, and they eventually became quite large.

VARIETY TEST WITH POTATOES

A number of varieties of potatoes were under test again this season. The test was conducted on land that was in summer-fallow during the season of 1920. This land had grown a number of crops of cereals prior to 1920. Just before being ploughed in June, 1920, it was given an application of twenty wagon loads of barn-yard manure per acre. It was thoroughly cultivated during the balance of the season, to help germinate any weed seeds and destroy them, to incorporate this manure with the soil, and to conserve the moisture for the crop to follow. It was cross ploughed in the spring of 1921 and harrowed, and was in excellent condition for the potato crop.

As the planting was done comparatively early in the season, the drills were ploughed not quite deeply a day or so previous to the seed being planted, this being done to allow the soil in the bottom of the drills to warm up somewhat, before the planting was done. The seed was carefully cut, and any tubers that were foreign to the variety or showed any signs of disease were discarded; the sets were planted in rows three feet apart, and dropped ten inches apart in the rows. These potatoes were kept thoroughly cultivated and free from weeds. At the first appearance of any of the latter the drag harrow was started cross-ways of the drills. The plots were given three harrowings, on May 20, June 9, (on this date the plants were first showing above the ground) June 5.

On June 28 the horse cultivator was started, and a second cultivation was given on June 28. The plots were gone through and slightly hilled up with hand hoes on July 5, and at this date the growth of tops was good. The plots were ½-acre in size. The following were the dates planted, dates when first ready for use, and date harvested, with yield obtained.

VARIETY TESTS WITH POTATOES

Variety	Planted	Fit for use	Harvested	Yield per acre	Marketable	Unmarketable	Size	Colour
				Bush. lb.	Bush. lb.	Bush. lb.		
Rochester Rose...	April 30	July 18	Sept. 15	420 40	355 0	65 40	Large.....	Pink
Early Rose.....	May 4	" 23	" 15	381 40	300 0	81 40	Med. large..	Pink
Carman No. 1.....	April 30	" 30	" 15	394 0	334 0	60 0	Very large..	White
Gold Coin.....	May 3	" 28	" 15	336 0	286 0	50 0	Medium....	White
Irish Cobbler.....	April 30	" 26	" 16	330 0	285 0	45 0	Medium....	White
King Edward.....	May 3	" 29	" 16	361 20	300 20	61 0	Fairly large	Russet

POTATOES IN FIELD PLOTS

Several varieties of potatoes were planted in field plots of one quarter acre each, on May 18. The land used for this experiment was ploughed out of brome grass sod during the season of 1920. After being ploughed twenty wagon loads of well rotted barnyard manure were applied, this manure being thoroughly incorporated with the soil by the use of the disc harrow during the balance of the season of 1920. The land was again thoroughly disced in the Spring of 1921, previous to the drills being made.

The same cultural methods were used with all experiments with potatoes.

The following were the results obtained from these varieties:—

POTATOES IN FIELD PLOTS

Variety	Planted	Yield per acre	Harvested	Size
		bushels		
Rochester Rose.....	May 18	212	Sept. 20	Medium
Gold Coin.....	May 18	200	Sept. 20	Fair
King Edward.....	May 18	218	Sept. 20	Quite large

Two varieties were planted in large field plots of one-half acre each. The seed was planted in land that was in summer-fallow the previous season. These plots were planted on May 5, and were harvested on September 23. The following were the yields obtained from the two varieties,—

Rochester Rose, 389 bushels per acre, good sized tubers.

King Edward, 401 bushels per acre, tubers very large.

Some small experiments were carried out this season with uncut large seed, and the results obtained were satisfying and proved without a doubt that with the larger seed there is less liability of failure should frost occur during the late spring, which is often the case in this north land, and should the tops be cut down there is still sufficient plant food left and a good strong root system established to carry the crop along to successful harvest. It has been proved in the past that small seed was the reason of partial failure of the potato crops in this north land, with its liability to early and late spring frosts. Two drills thirty-three feet long, three feet apart, sets dropped twelve inches apart in the drills, were planted on May 5.

The smoothing harrow was used on the plot three times, the horse cultivator passed through the drills twice, and hand hoeing was done once.

The following varieties were under test, all being harvested on September 28, and the following yields were obtained from the two drills of each variety. In all cases the tubers were large, there being practically no small ones.

Rochester Rose.—Yield from 2 drills, 318 pounds.

Early Rose.—Yield from 2 drills, 264 pounds.

Gold Coin.—Yield from 2 drills, 274 pounds.

Irish Cobbler.—Yield from 2 drills, 284 pounds.

Carman No. 1.—Yield from 2 drills, 295 pounds.

King Edward.—Yield from 2 drills, 279 pounds.

LETTUCE

With the precipitation of the early season, all varieties of lettuce remained in use for a longer period than usual.

VARIETY TESTS WITH LETTUCE

Variety	Seed	Sown	Fit for use	Quality
Iceberg	McDonald	April 27	June 2	Very crisp, fairly large heads.
Crisp as Ice	Wills	April 27	May 28	Very fine, fairly large heads.
Grand Rapids	C. E. F.	April 28	June 1	Very good, medium sized heads.
Cos or Romaine	Dupuy & Ferguson.	April 27	May 30	Very fine variety.
Simpson Black Seeded	Ewing	April 27	June 3	Good flavour, crisp and fine.
Later Seeding				
Grand Rapids (O-775)	C. E. F.	May 6	June 6	Very good quality.
Hanson	McDonald	May 18	June 20	Very crisp and fine.
May King	McDonald	May 18	June 15	Medium quality.

RADISHES

Although the early sown plots of radishes were somewhat thinned out and destroyed by the severe frost of the latter part of May, the remaining plants came along fairly well, and produced a fair crop. The following varieties were under test this season. In each test the drills were twenty inches apart:—

VARIETY TESTS WITH RADISHES

Variety	Seed	Sown	Fit for use	Quality
Scarlet Turnip, white tipped, O-9347	C. E. F.	April 27	May 25	Fair
Scarlet Turnip, white tipped, O-8903	C. E. F.	April 27	June 5	Very fine.
Scarlet Turnip, white tipped	Thorburn	April 27	June 18	Poor
LATER SOWING				
Icicle	McDonald	May 6	June 16	Very fine.
S. T. W. tipped	McDonald	May 18	June 14	Very good
White Icicle	McDonald	May 18	June 8	Fine

With the ample rainfall of the latter part of June the radishes remained fit for use for a longer period than usual.

TABLE CARROTS

Six varieties of table carrots were grown in uniform plots of 1/60 acre each.

The plots were sown from April 27 to May 10, they were thinned out from June 15th to the 20th, to ten inches apart in the rows, all being harvested from September 13th to the 20th. The results obtained were as follows:—

VARIETY TESTS WITH CARROTS

Variety	Seed	Fit for use	Quality	Yield
				Bush.
Chantenay, O-8885	McDonald	June 8	Very good	348
Danvers Imp	Kentville	June 28	Fair	295
Nantes Half Long Scarlet	Dupuy & Ferguson	July 5	Very good	305
Earliest Shorthorn	Dreer	July 10	Very large, rough, and inclined to crack	352
Early Scarlet Horn	McDonald	July 12	Medium	345
Chantenay	McDonald	July 12	Large, very fine quality	495

TABLE BEETS

Six varieties and strains of garden beets were tested this season. The plots were 1/60 of an acre in size, and the drills twenty inches apart, the seed being sown with a Planet Junior seeder.

The germination of the seed was very timely and growth good, the different plots were thinned out on June 24th, the plants being left to six inches apart in the drills. With the ample precipitation of the early summer and autumn, the roots grew to a fair size, all being harvested on September 21st.

The following are the results obtained:—

VARIETY TESTS WITH BEETS

Variety	Seed	Sown	Fit for use	Quality	Yield
					bush.
Detroit Dark Red O-9520	C.E.F.	April 30	July 17	Very fine table..	458
Crimson Globe	McDonald	April 30	July 10	Very good	462
Crosby Egyptian	Harris	May 6	July 14	Fine	12 ton 1,320 lb.
Eclipse	McDonald	May 7	July 16	Fair	493
Detroit Dark Red O-9520	C.E.F.	April 27	July 10	Very fine	498
Detroit Dark Red B. O-8886	C.E.F.	April 27	July 11	Very good	494
Early Marvel	C.E.F.	April 29	July 11	Fine, very smooth.	494

PARSNIPS

Two strains of the Hollow Crown variety were under test this season in plots 1/60 of an acre. The plots were sown on April 28 and 29, the drills being twenty-four inches apart. A test to determine the best distances apart to thin the young plants was made; the two plots were thinned out to three and four inches apart, respectively. The plot that was thinned out to four inches gave the best yields. 0-9335 was spaced to three inches; 0-8888 spaced to four inches. The plots were harvested on September 15 with the following results:—

VARIETY TESTS FOR PARSNIPS

Variety	Seed	Sown	Fit for use	Quality	Yield
Hollow Crown O-9335.....	C.E.F.....	April 28	July 8	Good, smooth, medium size.	470
Hollow Crown O-8888.....	C.E.F.....	April 29	July 10	Good, smooth, large....	492

KOHL RABI

Only one variety was under test this season, Large Green. Four drills were sown on May 16, drills twenty-four inches apart, the seed being sown with the hand seeder. The plants were thinned out to six inches apart on June 27, were fit for use on August 18, and were of a fair size. A satisfactory yield was obtained when taken up on September 26.

SPINACH

The Victoria variety of spinach, 0-8910 C.E.F. seed, was under test this season, being sown on April 29 in drills twenty inches apart, germination of the seed being timely and growth rapid during the early summer. This was fit for use on June 2, and owing to the frequent showers of rain, it remained in use for a longer period than usual.

PARSLEY

Three varieties of parsley were sown April 28 and 29 in drills twenty inches apart, the plants being thinned out to five inches apart in the drills, and when taken up on September 28 they were very large. In each case the growth was rapid. Two drills of each variety were sown, drills being thirty-three feet long.

The following were the varieties grown, and results obtained:—

No. 1 Double Curled, 0-9373 C.E.F. seed.
Fit for use, June 1.
Eighteen pounds picked September 28.

No. 2 Champion Moss Curled. Ewing & Co. seed.
Fit for use, June 6.
Sixteen pounds picked September 26.

No. 3. Triple Curled. Ewing & Co. seed.
Fit for use, June 10.
Twenty-one pounds picked September 28.

Part of this was distributed during the autumn, balance dried for winter use.

SALSIFY

Two varieties of salsify were tested this season. Four drills of each variety were grown, the seed was sown in the open ground on April 29 and 30, growth was very

good and both varieties were fit for use July 1. The roots were harvested on September 26 and the following yields obtained, the preference being given to the Long White as being more free from side shoots:—

No. 1. Mammoth Sandwich Island. 0-8271. C.E.F. seed.
Seventy-five pounds harvested.

No. 2. Long White. 0-8891. C.E.F. seed.
Ninety-one pounds harvested.

ONIONS

A number of varieties and strains of onions were grown this season, in uniform test plots, the seed being sown from April 27 to May 7 in drills twenty inches apart. They were thinned out to two inches apart in the drills, the thinning out being done in most cases as used. All the plots were thinned out by July 25th and from this date the tops were kept rolled down during the balance of the season, to check their growth. The seeding was done with a Planet Junior seeder, the germination of the seed being very good. The plots were thoroughly cultivated and kept free from weeds during the growing season, the growth was very good and the bulbs were quite large when harvested on September 20th.

Owing to the excessive rains of the late summer and early autumn an excessive and continuous growth was maintained, which caused considerable difficulty in harvesting and bringing these crops to maturity. The tops continued to grow and were quite green when pulled. As a slight frost occurred during the last few nights previous to the crop being harvested, it was supposed that this frost may have penetrated into the bulbs. A large percentage of the onion crop was lost later through this supposed cause. This difficulty with the onion crop seems to have been the case throughout the district, as many of the farmers in the district have enquired the reason for it.

Below in each case the size of plot or number of drills is given with number of bushels per acre.

VARIETY TESTS WITH ONIONS

Variety	Seed	Sown	Fit for use	Quality	Yield
Large Red Wethersfield	McDonald	April 27	June 27	Very large	499
Yellow Globe Danvers	Graham	April 27	July 2	Very large	490
Ex. Ey. Flat Red	McDonald	April 28	July 6	Fair	333
Yellow Globe Danvers O-9290	C.E.F.	April 30	July 11	Medium	339
Large Red Weathersfield	McDonald	May 6	July 5	Medium	363
Australian Brown	McDonald	April 29	July 23	Fair	238
Giant Prize Taker	Graham	May 7	July 26	Fair	247
Ailsa Craig	Graham	April 30	July 28	Medium	209
Southport White Globe	Graham	April 30	July 26	Large	358
Southport Red Globe	Graham	April 29	July 22	Large	361
White Barletta	McDonald	May 6	July 29	Medium	210
Yellow Globe Danvers	McDonald	May 6	July 4	Large	345
Mixed (2 plots)		May 7			Plot 1—353 Plot 2—351

ONION SETS

The onions grown from the sets did mature much earlier than those grown from the seed. Those grown at the station this season were fully matured when taken up on September 20, and the same precaution was taken in the drying of these onions with the other varieties. No difficulty was experienced in the keeping of these bulbs.

Plot No. 1. Seed from the Dominion Horticulturist.
Size of plot, 2 drills, 33 feet long, and 2 feet apart.
Sets were planted 6 inches apart in the drills. May 12th.
Yields from the 2 drills, 72 pounds.
Yield per acre, 360 bushels.
Bulbs very large.

Plot No. 2. Kenneth McDonald. Sets Ottawa.
Size of plot, 2 drills, 33 feet long, and 2 feet apart.
Sets were planted 6 inches apart in the drills. May 12th.

Yield from the 2 drills, 78 pounds.
Yield per acre, 340 bushels.
Bulbs quite large.

Plot No. 3. Local Sets.
Size of plot, 2 drills, 33 feet long, and 2 feet apart.
Sets were planted 6 inches apart in the drills. May 12th.
Yield from the 2 drills, 70 pounds.
Yield per acre, 350 bushels.
Bulbs large.

BUSH BEANS

Twelve varieties of Bush beans were under test this season. These were planted on land similar to that on which the corn was planted. The germination of the seed was very slow, and much of it was destroyed by the wire worms, while many of the plants were cut down by the frost which occurred during the latter part of May and the early part of June, so that the plots were quite thin. The remaining plants on the plots were kept carefully cultivated during the balance of the growing season. A fair amount of green pods were picked. Owing to the late summer and early autumn frost none of the varieties came to maturity. The size of the plots was 1/60th acre each, the distance apart in hills being 2½ feet x 2½ feet. The following were the varieties under test, with dates of seeding and date in use.

VARIETY TESTS WITH BUSH BEANS

Variety	Seed	Planted	Fit for use	Length of Pod
				inches
May Queen O–8954	C.E.F.	May 17	Aug. 1	4
Masterpiece O–8955	C.E.F.	May 17	July 29	5½
Plentiful French O–8957	C.E.F.	May 18	July 28	5
Ex. Ey. Red Valentine	Rennie	May 17	Aug. 2	4
Refugee	Carter	May 18	Aug. 20	4½
Round Pod Kidney	McDonald	May 18	Aug. 4	5
Stringless Green Pod	Rennie	May 18	July 27	5
Kentucky Wonder Wax	Rennie	May 18	Aug. 19	4½
Davis White Wax	McDonald	May 18	July 27	5
Pencil Pod Black Wax	McDonald	May 20	July 28	4
Wardwell Kidney Wax	McDonald	May 20	Aug. 10	5
Fordhook Favourite	McDonald	May 20	Aug. 12	4½

GARDEN PEAS

Several strains and varieties of garden peas were under test this season. The planting was done at intervals between April 29 and May 18. The method of planting has been to plant two drills very closely, then a spacing of 2 feet and two more drills of seed, the planting of the two drills closely together being done to form a support, as no sticks are used, time not allowing of this.

Frequent cultivations were given the plots during the growing season, and in each cultivation the soil was hilled towards the two closely planted drills. With this

method a fairly upright stand was obtained. With the frequent rains at the time of ripening considerable difficulty was experienced in getting the peas sufficiently dried previous to threshing. The following were dates of seeding, date when any of the varieties were fit for use, dates of ripening and number of pounds of ripe seed harvested, in each case this being after the plots had been used liberally during the season.

Four drills of each variety were planted.

VARIETY TESTS WITH GARDEN PEAS

Variety	Seed	Planted	Ready for use	Ripe	Length		Number of peas in pod	Size	Seed harvested
					Vine	Pod			
					in.	in.			lb.
Thos. Laxton	McDonald	April 29	July 9	Aug. 2	48	3	7	V. L.	18
McLean Adv.	C.E.F.	May 6	July 15	Aug. 20	38	3	8	M.	14
Gradus	Carter	April 30	July 28	Aug. 31	30	2½	6	M.	10
Stratagem	McDonald	April 30	July 11	Aug. 22	40	3	7	L.	13
Eng. Wonder A. O-9384	C.E.F.	April 29	July 6	July 29	36	3	8	M.	9
Surprise	Gregory	April 29	July 13	Aug. 11	34	2½	7	S.	8
Eight Weeks	Carter	May 7	July 15	Aug. 13	20	3	8	M.	9
Blue Bantam	Ewing	April 30	July 14	Aug. 2	38	3	8	M.	7
Early Morn	Gregory	April 29	July 18	July 30	54	3	7	V. L.	11
Pioneer	Gregory	May 7	July 25	Aug. 16	41	3	8	M.	6
Little Marvel	Graham	April 29	July 30	Aug. 23	39	3	7	L.	8
Notts Excelsior	S. Briggs	May 7	July 18	Aug. 9	38	2½	6	V. L.	5

NOTE.—S. Small. M. Medium. L. Large. V.L. Very large.

The three varieties that are most suited for a general farm garden in this northland, with regard to earliness, productiveness and length of season, are English Wonder, Thomas Laxton, and Gregory Surprise.

Two small plots of mixed varieties were sown on May 18, in soil similar to that in which the other varieties were sown. These came into use on July 22, gave a fair yield, and remained in use until well into the autumn.

CABBAGE

Several varieties of cabbage were under test this season. The seed was sown in the hot-beds on April 21, this being a number of days earlier than usual. The germination of the seed was very timely, the plants made good headway and were fine large plants when transplanted to the open ground on May 25. They were somewhat retarded in growth by the frost which occurred during the latter part of May and the beginning of June, but with the later showers and more favourable weather they soon recovered from the effects of the frost, made good growth and became fine large heads. Frequent cultivation was given the plants, which helped to their progress.

The following were the varieties used, dates when ready for use, and average weight per head when harvested on September 24:—

VARIETY TESTS WITH CABBAGES

Variety	Seed	Ready for use	Weight of head when harvested	Quality
			lb.	
Early—				
Jersey Wakefield	McDonald	July 28	8	Very solid.
Selected Jersey W.	McDonald	July 26	7½	Very firm.
Medium—				
Succession Savoy	Ewing	Aug. 8	10	Large but loose; not suitable to climate.
Perfection Drumhead Savoy	Ewing	July 30	18	
Late—				
Danish Ballhead O-9257	C.E.F.	July 29	21	Good winter keeper.

CHINESE CABBAGE

A packet of Chinese cabbage seed was obtained locally. This was sown in the open ground on May 7, in two drills, was ready for use on July 1, and produced an abundance of greens. The plants came into bloom during the late summer and continued to bloom until the late autumn. Much nectar was gathered by the bees from these blooms.

BRUSSELS SPROUTS

Only one variety was under test this season. This was sown under glass on April 22, and transplanted to the open ground on May 26. It was affected by the late frosts. The plants made good headway during the late season, and some sprouts of a fair size were picked.

It would appear that the climate here is not suited to this vegetable, the season being too short.

CAULIFLOWERS

Test of Varieties

The different varieties of cauliflowers were sown in the hot-beds on April 22 and transplanted to the open on May 26. These made very good growth after recovering from the effects of the late May and early June frosts, and with the abundant precipitation of the late season the growth was rapid, the heads becoming very large. The following were the dates when ready for use. The remaining heads that were left, after a season's use, were harvested on September 17.

Variety Tests with Cauliflowers

Variety	Seed	Ready for use	Weight per head when harvested
			lb.
Early Snowball	McDonald	July 22	9½
Early Snowball	McDonald	July 26	10½
	Cultural.		
Ex. Early Dwarf Erfurt	McDonald	July 24	10
	Cultural.		

PEPPERS

Test of Varieties

The peppers were started in the hot beds on April 23, and germination of the seed was very good. They were not transplanted to the open ground until June 6, after all danger of spring frost had passed and at this date the plants were quite large. Twenty plants of each variety were set out, and with the favourable weather conditions and ample rainfall of the season, the plants made fine growth, and produced an abundance of green peppers. While a small percentage ripened out of doors, the greater part were taken inside to ripen. Of the two varieties under test Harris Early appeared to be the earlier of the two varieties.

The following were the two varieties under test, and the amount of fruit picked on September 5. The reason for the early picking was the fear of frost.

Harris Early. 945. Summerland seed.

Six pounds picked. A large percentage very large.

Neapolitan. 944. Summerland seed.

Five and a half pounds picked. Of a medium size.

One drill was sown in the open ground on May 7, and did not produce any fruit.

CELERY

Test of Varieties

Four varieties of celery were under test this season with very good results. The seed was sown in the hot beds on April 21, the germination of the seed being quite timely. The transplanting to the open was done on June 6, one row 44 feet long of each variety being planted.

A trench was dug to the depth of fourteen inches, three inches of manure being placed in the bottom of the trench. This manure was packed down quite firmly. Three inches of soil was placed on top of the manure, and into this soil the young plants were set. As they grew the soil was replaced in the trench, and as the plants reached the top of the trench the soil was hilled up around the plants. This hilling up continued during the season, at intervals, as required. It has been found at this station that the best blanched celery was secured from the plants hilled up with earth and protected from the early autumn frosts. The rows were six feet apart, this being sufficient space to give ample room and plenty of soil for the hilling up of the plants. A fair crop was obtained.

Variety Tests with Celery

Variety	Seed	Ready for use	Size	Quality	Weight of one dozen heads when harvested	Length of whole plant
					lb.	in.
White Plume	Graham	Aug. 20	Medium	Good, tender	16	24
Paris Golden	Graham	Aug. 24	Fairly large	Fine	18	22
Winter Queen	Graham	Aug. 29	Large	Fine	17½	25
Giant Pascal	Graham	Aug. 17	Large	Earliest, tender	19	26

EXPERIMENTS WITH PUMPKINS, SQUASH, CITRON, MELONS AND CUCUMBERS

It is almost impossible in the north to grow any of the cucurbitaceous plants outside without some protection during the spring. Very good results have been obtained at this Station by using small hot beds, the size of the frames used for cucumber, melon and citron being ten by twelve inches, and those for the pumpkin, squash and vegetable marrows being thirty by thirty-six inches. As these frames are without bottoms, they are removed after all danger of frost is passed. After the removal of the frames the plants are thinned out to the required number.

The holes for these hot beds are dug in the previous autumn in readiness for the spring planting, then at planting time in the spring these beds are partly filled with heated manure, the small frames being then put into position and four inches of soil placed over the manure with some soil hilled up around the frames to prevent the escape of the heat. The glass is then placed in position and left for a day or so to allow the soil to become thoroughly warmed up before the seed is planted. Great care must be taken not to allow the beds to become over-heated after the seeds are planted. This can be prevented by removing the glass during a part of the day, should the sun be shining brightly. It was noticed this season that all plants grew to a very great length before bloom of any kind appeared. Therefore, it was somewhat later than usual before any fruit was set. This being the case with all plants, a very rank growth of vines and tops. This was probably due to the very large amount of precipitation during the late spring, this being the general complaint of the many gardeners throughout the district.

The following were the varieties tested, number of hills of each variety, and distance apart, with results obtained:—

VARIETY TESTS WITH PUMPKINS

Variety	Seed	Planted	Number of hills (6 x 6 ft. apart)	Ready for use	Harvested	Number picked	Av. weight	Quality
							lb.	
Connecticut Field.	McDonald..	May 4	4	Aug. 20	Sept. 6	18	30	Fully matured.
King of the Mammoths.	McDonald.. C.E.F.	May 4	4	Aug. 27	Sept. 6	15	34	Partly matured
Small Sugar...	McDonald..	May 6	4	Aug. 17	Sept. 10	46	12	Fully matured.

VARIETY TESTS WITH CITRONS

Variety	Seed	Planted	Number of hills (6 x 6 ft. apart)	Harvested	Number picked	Av. weight	Quality
Green Seeded O-9799..	C.E.F....	May 6	3	Sept. 6	11	6½	Not fully matured.
Red Seeded.....	C.E.F....	May 4	4	Sept. 6	20	7	Fully matured.

VARIETY TESTS WITH SQUASH

Variety	Seed	Planted	Number of hills (6 x 6 ft. apart)	Harvested	Number picked	Av. weight	Quality
Mammoth Whale.....	McDonald..	May 4	2	Sept. 10	4	33½	Matured red
Long White Bush Marrow....	McDonald..	May 4	4	Sept. 6	22	12	Fine.
Eng. Veg. Marrow.....	McDonald..	May 4	4	Sept. 6	48	14	Matured.
Giant Summer Crookneck...	McDonald..	May 4	2	Sept. 6	12	10	Matured.

MELONS

Musk Melon EX. Ey. Hackensack. McDonald seed. Planted May 4. Two hills 5 feet by 5 feet apart. These were not a success. Six small, immature fruit picked on September 6.

VARIETY TESTS WITH CUCUMBERS

Variety	Seed	Planted	No. of Hills (5 x 5)	Ready for use	Harvested	Aver'ge Weight	Number	Quality
						oz.		
Davis Perfect.....	McDonald.... C.E.F. seed.	May 6	3	Aug. 3	Sept. 6	14	44	Fine
Boston Pickling.....	McDonald, C.E.F. seed...	May 6	4	Aug. 5	Sept. 6	12	60	Good
Giant Pera.....	McDonald, C.E.F. seed...	May 6	4	Aug. 8	Sept. 6	16	36	Fine

WEST INDIA GHERKIN

This variety was under test and the results obtained were very unsatisfactory, little or no fruit being obtained.

The pollination of the bloom was very timely for the bees this season, and sure.

TABLE OR SUMMER TURNIPS

Three varieties of Turnips were tested this season sown in drills 33 feet long. Very good yields were obtained from all the three varieties. It was found that after mid-summer they became of a very strong flavour, and when taken up were not relished by the stock. The following were the varieties tested, dates sown, dates ready for use, and yield per acre when harvested during the latter part of August. The thinning was done on June 24, plants thinned out to six inches apart in the drills, and the drills twenty-four inches apart.

VARIETY TESTS WITH TURNIPS

Variety	Seed	Sown	Ready for use	Taken up	Yield per acre
					tons lbs.
Early Snowball	McDonald	May 7	July 8	Aug. 25	25 400
Red Top Strap Leaf	"	May 7	July 10	Aug. 25	24 1,500
Ex. Early Purple top Milan	"	May 8	July 12	Aug. 26	22 1,900

At this date of harvesting, these crops were fed to the stock.

TOMATOES

Test of Varieties

Several varieties of tomatoes were under test this season, and very fine crops were harvested from the plots. With the exception of Danish Export and Red Plum, they were sown in the hot beds on April 21, the two former being sown on May 10, so that even with the late planting of the Danish Export and Red Plum the results obtained from all the varieties were quite satisfactory, and more ripe fruit was picked this season than any other season since this station was started in 1908. In comparing pruned and unpruned plants it was found that while the unpruned plants produced the heavier yields, the pruned plants produced more ripe fruit, and in the north, with its short season, a system of pruning must be followed if any ripe fruit is to be obtained. More ripe fruit was obtained from the plants pruned down to a single stem. A comparison was also made between tying the plants to stakes and tying to cross wires. It was found that with the wires there was more liability of the plants being cut and damaged by their own weight and by being blown about with the wind, as with the stake the plants could be tied in several places, if needed, and thus be prevented from being blown about.

The pruning of the plants was commenced on July 21 and two clusters of bloom or small fruit were left on each stem. The pruning continued throughout the balance of the season, and all lateral branches removed so as to produce an upright plant.

Ripe fruit was picked from Alacrity, Strain 201.A. on August 12, followed by Alacrity, Strain A 1.1918 on August 16. A goodly percentage of the fruit was ripened, after being picked, in the windows, all fruit being picked on September 5. All had been covered quite a few nights prior to being picked, as by September 5 the nights were getting quite cold and some light frosts had been experienced.

The following were the varieties under test, and the yield obtained from both ripe and green fruits. Twenty-four plants of each variety were transplanted to the open ground from June 2 to June 10. All plants were set three feet apart each way.

VARIETY TESTS WITH TOMATOES

Variety	Seed	Ripe	Harvested partly Ripe	Green	Total	Size and quality
Alacrity	C.E.F. 201A	20	14	76	110	Very large and smooth.
Alacrity	1918 C.E.F.	18	17	57	92	Medium size, smooth, fine.
Langdon Earliana	Summerland	15	12	57	84	Smooth and good.
Chalk's Early Jewel	Carter	12	10	47	69	Medium size, fine.
Red Head	Langdon	10	22	68	100	Large, smooth, fine.
Danish Export	C.E.F.	11	12	46	69	Medium, excellent.
Red Plum	McDonald	.....	.....	38	38	Quite small, good quality.

All were harvested on September 5.

BROAD BEANS

The following Broad Windsor beans, seed from the Horticultural Division of the C.E.F., were under test this season. The seed was sown on May 10 and 11. This being at a time when the land in which the seed was planted was at its driest, as it was rather soddy, having been ploughed out of brome grass the previous season. Germination of the seed and growth of the plants were slow up to June 10, when the dry spell was broken by timely rains. An abundance of precipitation occurred after June 10, and during the balance of the season the plants made good growth. All varieties eventually became very large plants and produced a fine crop of green beans during the late summer and autumn. Owing to the severe frost of the late autumn none of the varieties reached the full stage of maturity. All were taken up on September 12, tied together and hung over poles to dry out, and on that night the mercury dropped to 21.5, making 10.5 degrees of frost, with fatal results to the beans. The date of first appearing of any of the plants above ground was June 11, date of coming into bloom June 28, and into use from July 29 to August 20.

The following were the varieties under test:—

Early Mazagan, Dwarf Fan Bog. or Cluster, Beck Green Gem, Long Pod Green, Taylor Windsor, Long Pod Early, Windsor Harlington Green, Green Windsor, Long Pod Johnson Wonder, Windsor Common, Long Pod Bunyard Exhibition, Long Pod Aquadulce, Long Pod Conqueror (Sharpe), Windsor Harlington, Long Pod Seville, Long Pod Masterpiece, Windsor Giant 4 Seeded.

The different varieties of currant bushes have recovered somewhat from the winter-killing of 1919, and a fair growth has been made during the past summer. Some fruit of a good quality was obtained, the total yields being, however, very much below the average.

A fair yield was obtained from the raspberries. As they have become rather overgrown it was the intention to remove them to another plantation, but through the press of other work this was not carried out. In the coming season an effort will be made to do so.

The yields from the old strawberry beds were only fair. The plants were transplanted out into two new beds in the latter part of August, these new beds being made on land that has become available through the thinning out of the shrubbery.

The native Spruce was thoroughly pruned and the tops taken off to cause a thicker and bushier tree, which added greatly to their appearance, as well as making it more convenient for the use of the horse cultivator.

ORNAMENTALS

SHRUBS

All shrubs and evergreens came through the winter of 1920-21 in good condition and considerable work was done among them this season in the way of cultivation and thinning out.

The following were the varieties of shrubs in bloom, with dates.

Shrubs

Caragana, *arborescens.*—In bloom June 1. This variety also formed the hedge around flower garden.

Caragana, *grandiflora.*—In bloom June 4.

Caragana, *frutescens.*—In bloom June 9.

Caragana, *pygmaea.*—In bloom June 14.

Syringa villosa, common lilac.—In bloom June 13.

Lilac, Emile Lemoine.—In bloom June 14.

Lilac, Chas Joly.—In bloom June 15.

Lilac, Congo.—In bloom June 18.

Lilac, Michel Buchner.—In bloom June 20.

Lilac, Japanese Tree.—In bloom June 30. This variety made a remarkable showing of bloom again this season.

Lonicera, *alpina.*—In bloom June 15.

Lonicera, *mundeniensis.*—In bloom June 15.

Lonicera, *tatarica virginalis.*—In bloom June 16.

Lonicera, *sullivanti.*—In bloom June 16.

Spiræa, *billardii.*—In bloom June 28.

Spiræa, *sorbifolia.*—In bloom June 28.

Spiræa, *arguta.*—In bloom June 29.

Ribes aureum, Missouri Yellow or Flowering Currant.—In bloom July 15.

Many collections of ornamental shrubs and small fruit bushes were distributed from the station during the season.

ROSES

The rose bushes made very good growth during the past season, all having come through the winter of 1920-21 without any winter-killing.

All the varieties bloomed very luxuriously and remained in bloom until the late autumn.

The following are the names of the varieties and dates when first coming into bloom:—

Rose, *Delicata.*—In bloom July 1.

Rose, *rugosa* double.—In bloom July 3.

Rose, *rugosa* single—In bloom July 1.

Rose, Japanese.—In bloom July 4.

PERENNIALS

The perennials grown at the Station this season have made a very good showing. These varieties were mixed generally with the annuals throughout the flower garden.

It is the intention to remove them into permanent beds this coming spring and making a flower border on each side of the path leading from the office to the road. In order to fill these beds a number of varieties of perennials, bulbs and a few choice roses have been ordered.

These perennials with the annuals caused much comment to by the many visitors to the station, especially those from the south who expressed suprise at the luxurious growth of all flowers and shrubs at a point so far north.

The following are the names of the varieties and dates when coming into bloom.

Perennials

Pansies, year-old plants.—In bloom May 15.
Pansies from seed.—In bloom July 28.
Poppies, Iceland.—In bloom June 2.
Poppies, Oriental.—In bloom May 29.
Lychnis, Burning Star.—In bloom June 24.
Dictamnus or Gas plant.—In bloom June 18.
Paeony White.—In bloom July 18.
Dianthus or Pinks—
Chinensis.—In bloom June 30.
Heddewigii.—In bloom June 28.
Imperialis.—In bloom June 26.
Hesperis matronalis.—In bloom June 15.
Delphinium, Larkspur,
Seedling Blue.—In bloom June 28.
Aquilegia, Columbine.—In bloom June 11.
Achillea.—In bloom July 10.
Arabis.—Rock cress.—In bloom June 26.
Cerastium.—Snow in summer.—Bloom June 26.
Digitalis.—Fox glove.—In bloom July 11.
Gallardia—
Crimson and Gold.—In bloom July 6.
Dark Red Centre.—In bloom July 9.
Dwarf.—In bloom July 14.

ANNUAL FLOWERS

Each year extensive tests are made with the annual flowers, and some success was obtained with the many varieties this season.

The more tender varieties were sown in hot beds from April 21 to the 28. These seeds germinated very quickly and became good strong plants before they were transplanted to the open beds, June 3rd to 15th, great care was taken in protecting the young plants from the spring frosts that were so prevalent this season.

The hardier varieties were sown in the open ground from May 18th to 20th. These also germinated very well and made good headway.

The flower garden is surrounded by a Caragana hedge, which protects it from the high winds, therefore very little trouble is experienced in having the plants blown down by wind.

Twelve strains of asters were tested this season, the seed being sown under glass from April 21 to 27. Germination of the seed was very timely, all were transplanted to the open ground on July 11– came into bloom from July 28 to August 6, and remained in bloom until the September frost destroyed them.

An excellent showing of bloom from all varieties was obtained. The following are the names of the strains tested.

Aster. Peerless Pink.—McDonald seed.
Aster. Purity.—McDonald seed.
Aster. Quilled.—McDonald seed.
Aster. Late Upright.—C. E. F. seed.
Aster. Branching Mixed.—C. E. F. seed.
Aster. Mikado Mixed.—C. E. F. seed.
Aster. Suttons Snow Queen.—Sutton seed.
Aster. Vicks Royal Purple.—Vick seed.
Aster. Vicks Sunset.—Vick seed.
Rose Perfection.—Vick seed.

Rose Violet King.—Summerland seed.
Rose Fire King.—Summerland seed.
Antirrhinum. Four varieties.
Sutton Intermediate Yellow.—In bloom July 4.
Int. Carmine Pink.—In bloom July 7.
Summerland, Rosy Queen.—In bloom July 6.
Summerland, Yellow Queen.—In bloom July 5.
Aroclinium. Steele Briggs seed.—In bloom July 28.
Adonis. Steele Briggs seed.—In bloom August 1.
Balsam, Camelia Flowered Sulphur Yellow.—In bloom July 22.
Bartonia Aurea. Sutton seed.—In bloom July 14.
Browallia. Sutton seed.—In bloom July 19.
Clarkia. McDonald seed.—In bloom July 29.
Candytuft Scented. Sutton's seed.—In bloom July 20.
Canary Bird Vine. McDonald seed.—In bloom July 18.
Cosmos. Mixed Ey. Flowering. Summerland seed.—In bloom July 21.
Cosmos Mixed Ey. Flowering. Sutton's seed.—In bloom July 19.
Calendula. Sutton seed.—In bloom July 30.
Coreopsis. McDonald seed.—In bloom August 2.
Cucumber Ornamental. Very strong growth.
Cobaea scandens. These were potted from the hot-bed and kept in the office where they bloomed luxuriously from July 21 to September 10.
Datura Wrightii (neteloides). Suttons seed. In bloom July 4.
Dahlia Double. Paeony Flowered Mixed. Sutton's seed.
The seeds were sown in hot-beds on May 2 and were transplanted to the open ground on June 15 they came into bloom August 8 and remained in bloom until the bulbs were taken up just before the more severe frosts.
Much comment has been made by all who saw the plants in bloom and created a wonder to many that such fine plants could be raised from seed in this far North Land, some of the blooms measurinng 7 inches in diameter.
Eschscholtzia. Sutton seed.—In bloom July 18.
Godetia. Mixed colours. Sutton seed.—In bloom July 25.
Gypsophila elegans. Cape Rouge, P.Q., seed.—In bloom July 4.
Gypsophila. Cape Rouge, P.Q., seed.—In bloom July 15.
Helichrysum. Everlasting flower. Sutton seed.—In bloom July 30.
Hibiscus africanus Major. Sutton seed.—In bloom August 1.
Ipomoea Quamoclit. McDonald seed. Potted out and placed in the office, came into bloom July 21. Very much admired good, showing of bloom.
Jacobea. Double mixed. Sutton seed. In bloom July 25.
Kochia or Summer cypress. McDonald seed. These plants made good growth, and were very attractive.
Leptosiphon Hybrid. Sutton seed.—In bloom July 23.
Lavatera Mixed White and Rose. Sutton seed.—In bloom July 24.
Linaria S. Special Mixture. Sutton seed.—In bloom July 24.
Linaria Crimson Gold. McDonald seed.—In bloom July 22.
Lobelia ramosa. Tenuior Blue. McDonald seed.—In bloom July 29.
Mignonette. Sutton seed.—In bloom July 20.
Malope. Sutton seed.—In bloom July 27.
Nemesia Hybrid. Sutton seed.—In bloom July 21.
Nigella. Sutton seed.—In bloom July 4.
Nicotiana. Sanderae. Hibrid mixed. Sutton seed.—In bloom August 2.
Nicotiana. Sanderae. Summerland seed.—In bloom August 4.
Nicotiana. Sanderae. McDonald seed.—August 7.

Twelve strains of nasturtiums were sown from May 18 to 21 in the open rockeries and produced an abundant display of bloom which commenced on July 11, and continued until destroyed by the September frosts. The plants attained great size.

The following were the dwarf varieties under test:—

Empress of India.—Sutton seed.

The King.—Sutton seed.

Yellow.—Sutton seed.

Cloth of Gold.—Sutton seed.

Spotted.—Sutton seed.

The following were the tall varieties under test:—

Scarlet.—Sutton seed.

Fairy Queen.—Sutton seed.

Prim-Rose Crimson Spotted.—Sutton seed.

Salmon Queen.—Sutton seed.

Sutton Pearl.—Sutton seed.

Sutton Ruby King.—Sutton seed.

Petunia. Single. Sutton seed.—In bloom July 4.

Petunia, S. Giant Leviathan. Sutton seed.—In bloom July 6.

Pentstemon. Mixed colors. Sutton seed.—In bloom July 5.

Poppies, Double. Sutton seed.—In bloom July 2.

Poppies, Snowdrift. McDonald seed.—In bloom July 5.

Poppies, McDonald Suberb Shirley.—In bloom July 3.

Six varieties of phlox were sown under glass April 27, and were set out into the open beds on June 5, all plants made remarkable growth and came into bloom from July 6 to 29, a very fine display of bloom continued during the balance of the season.

The following are the names of the varieties that were under test:—

Phlox D. Livid Scarlet. Summerland seed.

" *D.* Salmon Rose. Summerland seed.

" *D.* Mixed. Brandon seed.

" *D.* Carmine White. Sutton seed.

" *D.* Paeony Flowering, Mixed. Sutton seed.

" *D.* Pure White. Sutton seed.

A collection of Sutton Giant Perfection, 10 weeks stocks were sown under glass from April 21 to 27 and germination was very timely. They were transplanted to the open ground on June 10, came into bloom July 23 and continued to bloom very luxuriously until the autumn.

The following are the colours that were included in the collection:—Crimson, terra cotta, purple, white, light blue, yellow.

Schizanthus. Sutton seed.—In bloom July 14.

Sweet Sultan Giant. Sutton seed.—In bloom July 22.

Salpiglossis Large Flowered. Sutton seed. In bloom July 5.

Salpiglossis Golden Yellow. McDonald seed.—In bloom July 8.

Tagetes Signata. Pumila. Brandon seed.—In bloom July 28.

Verbena. Mixed. Summerland seed.—In bloom July 15.

Verbena Sutton Superb Bedding.—In bloom July 15.

Verbena Sutton Superb Bedding. Blue.—In bloom July 16.

Verbena Sutton Superb Bedding. White.—In bloom July 16.

Zinnia. D. Sutton seed.—In bloom July 16.

Zinnia. Elegans. Summerland seed.—In bloom July 20.

SWEET PEAS

Four collections of sweet peas were sown in the open ground from May 19 to 21, the germination was somewhat slow, owing to the lack of moisture. They came into bloom between July 18 and 29 and continued to bloom abundantly during the balance of the season.

The following were the names that were included in each variety collection:—

Collection No. 1—Best Grandiflora Varieties—Seed from Robert Sydenham, Birmingham, England

Black Knight.—Colour, black.
Miss Willmott.—Colour, Salmon red.
Prima Donna.—Colour, blush pink.
Mrs. Walker Wright.—Colour, rich rosy mauve.
Jennie Gordon.—Colour, carmine, buff bicolour.
Lady Grisel Hamilton.—Colour, lavender self.
Helen Pierce.—Colour, marbled or grained blue.
Prince of Wales.—Colour, deep rose.

Collection No. 2—Good Wave Varieties—Seed from Robert Sydenham, Birmingham, England

Asta Ohn.
Moonstone.
Constance Acombe.—Colour, creamy white, suffused pale mauve.
Charles Foster.—Colour, satiny pink, pale mauve.
Mrs. R. Hallam.—Colour, rich pink on cream.
Queen of Norway.—Colour rosy mauve.
King Manoel.—Colour, red deep maroon.
Lilian.—Colour, pale pink flushed buff.

Collection No. 3—Waved Type—Seed from Robert Sydenham, Birmingham, England

Lady Evelyn Eyre.—Colour, pink.
Margaret Atlee.—Colour, salmon pink on creamy ground.
The President.—Colour, orange scarlet.
King White.—Colour, white self.
Rosina.—Colour, bright rosy heliotrope.
Edith Taylor.—Colour distinct rosy cerise.
Princess Mary.
Maud Holmes.—Colour, the best of sunproof crimsons.

Collection No. 4—Seed from W. Atlee Burpees Co., Philadelphia

Elfrida Pearson.—Colour pink.
Illuminator.—Colour, salmon orange.
Cherub.—Colour, ivory white.
Queen Victoria.—Colour, primrose.
Fiery Cross.—Colour, scarlet.
Blue Monarch.—Colour, dark blue.
Empress Eugenie.—Colour, lavender.
Phantom Blue.—Colour, pale blue.

CEREALS

The season of 1921 was on the whole a very favourable one for the production of good crops of cereals, not only at the Station, but throughout this district. The limited snow-fall of the winter of 1920-21 soon disappeared, leaving very little water lying on the ground. The land was in fine condition to work on April 27, on which date the first variety plots of wheat were sown. Although May was somewhat dry for the rapid germination of the seeds, it was an ideal month for the carrying on of the seeding operations. Growth was rather slow until after June 6th, when some very timely showers of rain occurred, and from this date onwards during the balance of

the growing season the precipitation was above normal, 10·70 inches being recorded for the six growing months from April 1st to end of September. The larger percentage of this amount was recorded during the months of June, July and August, when it was needed. This ample moisture, along with other favourable conditions, gave crops rapid growth. They became eventually a heavy crop both in grain and straw, the straw being very rank. It lodged in the latter part of July, owing to heavy rains and high winds that were experienced at that time. This straw did not recover, but remained in a lodged condition until cut. In consequence the ripening period for all cereals was greatly prolonged.

All cereals were sown this season on the older and more thoroughly cultivated part of the experimental area. This land had grown crops of corn, roots and potatoes the previous season, barn-yard manure having been applied for the crops. No manure was applied for the cereal crop of 1921. The land was ploughed in the autumn of 1920, lightly disced and thoroughly harrowed in spring of 1921, and just previous to seed being sown a light roller was run over the plots. This was done to break up all lumps, and to make a firmer seed bed, as seeding was done with hand seeder in drills seven inches apart. When plants were nicely above the ground the land was given a light cultivation, this being done to break up crust that had formed, to form a mulch, and to prevent evaporation, also kill out any weeds that might have got a start.

The following were the dates of seeding, dates of ripening and yields obtained of the different varieties of cereals, also the yields of both grain and straw:—

VARIETY TESTS WITH WHEAT

Variety	Sown	Ripe	Number of days maturing	Length of straw including head	Length of head	Strength of straw on a scale of ten points	Yield per acre		
							Grain	Straw	Weight per measured bushel after cleaning
				in.	in.		bush. lb.	tons lb.	lb.
Red Fife	April 27	Sept. 1	127	25	3	4 (badly lodged)	58 20	4 700	64·2
Marquis	April 28	Aug. 30	124	54	3½	6 (somewhat lgd.)	52 30	4 400	63·5
Bishop	April 28	Aug. 27	121	53	3	6 (straw down)	66 30	4 880	63·3
Huron	April 29	Aug. 26	120	53	3	7 (partly lgd.)	62 0	4 550	64·8
Prelude	April 29	Aug. 6	99	42	2	8	46 0	3 900	65·2
Ruby Ottawa 623	April 29	Aug. 13	106	47	3	7	48 10	3 1,300	64·0

A plot of one-thirtieth of an acre of Marquis wheat sown under the Influence of Environment Investigation. The seed for this plot was supplied from the Chemistry Division, C.E.F., the source of seed being the same as for this plot on the other Experimental Farm.

Crop Marquis wheat. Size of one-thirtieth of an acre.

Sown April 30. Germination of seed slow.

First plants above the ground, May 10.

Date when 50 per cent above the ground, May 12.

Date when all plants where above the ground, May 16.

Notes made *re* this plot on June 18. Since June 10 when the dry spell was broken by timely showers of rain, the growth of this plot has been very rapid. It has stooled out much more than previous seasons. Therefore, at this date the plants are quite thick. Growth of straw, rank. Colour of plants, a very dark green. Little or no weeds in plot.

Date stooling began, June 8.

Date when 50 per cent of plants stooled, June 13.

Date when all plants where stooled, June 20.

Date when first stem roots appeared, June 24.

Measurements of the height of this plot were taken every seventh day throughout the season, beginning on May 16, when the first measurement was taken.

May 16, 1½ inches.
May 23, 4 inches.
May 30, 5½ inches.
June 6, 9 inches.
June 13, 14 inches.
June 20, 22 inches.
June 27, 29 inches (a very heavy growth at this date).
July 4, 35 inches.
July 11, 42 inches (this was to top of the head).
July 18, 50 inches.
July 25, 52 inches.
August 1 (at this date the grain was in hard dough stage).

Date when first plant began to head out, June 29.
Date when 50 per cent headed out, July 4.
Date when entire plot headed out, July 6.
Date when first anthers visible on the plot, July 9.
Date when visible over the entire plot, July 15.
Date when first kernels reached the milk stage, July 19.
Date when kernels reached the milk over the entire plot, July 26.
Date first plants on plot reached maturity, August 22.
When about 50 per cent of the plants reached maturity, August 27.
Date plot was ready for cutting, August 30.

This plot was badly lodged when cut.

Marquis wheat, sown April 30, ripe, August 30.
Number of days maturing, 123 days.
Length of straw including head, 52 inches.
Strength of straw on points, 7.
Length of head, 3 inches.
Total weight of grain per acre, 3,450 pounds, 57 bushels and 30 pounds.
Weight of straw per acre, 7,650 pounds, 3 tons and 1,650 pounds.
Yield of grain from the plot, 115 pounds.
Weight of straw from the plot, 255 pounds.

Variety Tests with Oats

Variety	Sown	Ripe and cut	Number of days maturing	Length of straw including head	Length of head	Strength of straw on a scale of ten points	Yield per acre		
							Grain	Straw	Weight per measured bushel after cleaning
				in.	in.		bush. lb.	tons lb.	lb.
Banner Ottawa 49	May 3	Aug. 10	99	58	6½	8	62 30	4 1,600	36·3
Daubeney, Ottawa 47	May 5	July 30	86	48	6½	6	34 14	2 1,550	34·2
Eighty Day, Ottawa 42	May 5	July 30	86	46	6	6	35 10	2 800	32·2
Liberty, Ottawa 480	May 3	Aug. 3	92	48	7	10	26 16	2 1,250	
Victory	May 4	Aug. 6	94	54	8	7	61 26	4 250	37·0
Gold Rain	May 5	Aug. 18	105	60	7	4	67 2	5 1,850	32·2
Improved Ligowo	May 6	Aug. 11	97	59	6½	9	56 16	4 1,900	
Garton's Regenerated Abundance	May 6	Aug. 11	97	59	7	6	45 30	5 620	
Liberty Ottawa	May 10	Aug. 10	92	50	7½	10	36 16	4 160	

VARIETY TESTS WITH BARLEY

Variety	Sown	Ripe and cut	Number of days maturing	Length of straw including	Length of head	Strength of straw on a scale of ten points	Yield per acre		
							Grain	Straw	Weight per measured bushel after cleaning
				in.	in.		bush. lb.	tons lb.	lb.
Manchurian, six-rowed bearded	May 5.	July 26.	82	46	3	7	61 12	4 100	47·0
O.A.C. 21, six-rowed bearded	May 5.	July 29.	85	49	3	8	62 24	3 1,320	47·2
Duckbill O. 57, two-rowed bearded	May 6.	Aug. 1.	87	48	3	10	65 0	4 1,000	54·5
Hulless white, beardless and awnless	May 5.	Aug. 1.	88	44	2½	7	65 0	3 1,200	65·0
Success, six-rowed beardless	May 6.	July 27.	82	47	3	6	58 36	3 1,380	43·8
Champion, six-rowed beardless	May 6.	July 29.	84	48	3	5	55 0	3 1,200	43·2
Albert O. 54, six-rowed bearded	May 6.	July 22.	78	44	2½	6	60 0	3 1,800	46·2

The following varieties of cereals were under test this season. All were sown on land similar to that on which the other experiments were carried on, with the same treatment as per after cultivation. The Club and Kubanka wheat were sown this season, as during the winter of 1920-21 a very large number of requests were made to this office for samples of these varieties from farmers in the district. The requests for the Club wheat were made from men who had just moved into the district from the drier districts further south, and they considered the Club wheat the only variety that would thrive and produce a crop under those conditions. This Club wheat was the very first variety of wheat sown in this district thirty-five years ago, but had been largely discarded for the newer varieties of late years.

The Egyptian King wheat was tested more out of curiosity, the seed being on hand, and time available. It may not be a good milling wheat, but it is a good yielder, both in grains and straw. The straw makes a fair fodder as it is very leafy.

The Bark barley and Leader oats were from a very small sample received from the Harris McFayden Seed Co.

TESTS OF VARIETIES OF SOME CEREALS

Variety	Sown	Ripe and cut	Number of days maturing	Length of straw including head	Length of head	Strength of straw on a scale of ten points	Yield per acre		
							Grain	Straw	Weight per measured bushel after cleaning
				in.	in.		bush. lb.	tons lb.	
Club wheat	April 30.	Aug. 27.	120	52	2½	8	59 0	3 1,500	
Kubanka wheat	April 30.	Sept. 2.	125	58	3	7	54 0	3 1,200	62·5
Egyptian King W.	April 30.	Sept. 3.	126	68	3	6	68 0	4 700	61·0
Spelt	May 16.	Sept. 3.	110	48	3	7	74 20	4 700	39·0
Bark barley (seed only for a 15 ft. row, thin).	May 16.	Sept. 5.	112	38	3	10	(from 10 row)	(from 15 row)	46·0
Leader oats (seed only for a 15 ft. row).	May 16.	Sept. 5.	112	46	8	8	(from 7 row)	(from 15 row)	
Silverhull buckwheat	June 10.	Sept. 3.	90	54	.....	.....	49 8	7 400	

Two varieties of flax were under test this season. The varieties were sown on land on which a crop of roots had been grown the previous season. After the root crop had been removed in the autumn of 1920 the land was ploughed and left in that condition for the winter. In the spring of 1921 the land was thoroughly cultivated with disc and smoothing harrow. A roller was then run over the plots to break down any remaining lumps, and make a firmer seed bed, as the seeding was done by hand seeder. No manure was applied for the flax crop. The seed was sown at the rate of three-quarter bushel per acre. The germination of the seed was very timely, but growth was slow until mid-June, when considerable precipitation was

experienced, and from June 18 during the balance of the growing season the growth was quite rapid. These plots were also badly lodged by heavy rain and high winds that occurred on July 22. The plots did not recover from the beating down, as they were kept down by the later rains and high winds. This lodged condition somewhat prolonged the ripening period.

Size of plots, one-sixtieth of an acre.

The following were the results obtained:—

FLAX, TEST OF VARIETIES

No. 1—Premost No. 25, sown May 5. Ripe and cut August 17.
Number of days maturing, 105.
Length of plant, 32 inches.
Straw on points, 7 points.
Total weight of grain per acre, 1,200 pounds 21 bushels and 24 pounds.
Yield of straw per acre, 2 tons and 80 pounds.
Yield of grain from the plot, 20 pounds.
Yield of straw from the plot, 68 pounds.
Weight per measured bushel after cleaning, 54·0 pounds.

No. 2—North Dakota Wilt-Resistant No. 52.
Sown May 5. Ripe and cut, August 13.
Number of days maturing, 100.
Length of plant, 35 inches.
Straw on points, 6 points.
Total weight of grain per acre, 1,320 pounds 23 bushels and 32 pounds.
Yield of straw per acre, 2 tons and 260 pounds.
Yield of grain from the plot, 22 pounds.
Yield of straw from the plot, 71 pounds.
Weight per measured bushel after cleaning, 53·5 pounds.

SPRING RYE

A plot of one-sixtieth of an acre of spring rye was sown on May 5. The seed was sown at rate of one and a half bushel per acre, on land on which a crop of potatoes had grown the previous season, no manure being applied for the rye crop. The land was fall ploughed, lightly disced and thoroughly harrowed in preparation for the seed. Just previous to the seed being sown a roller was passed over the plot, this being done to make a firmer seed bed. The germination of the seed was timely, and growth rapid during the growing period, there being a very rank growth of straw which was lodged during the early part of July by heavy rains and high winds, and was kept down by the later rains. The straw was still lodged and somewhat green when cut. A new growth sprang up, which added to the weight of the straw.

The following were the results obtained:—

Spring rye. Sown May 5. Ripe and cut, August 4.
Number of days maturing, 91.
Length of straw including head, 60 inches.
Strength of straw on points, 9 points.
Length of head, 3 inches.
Total weight of grain per acre, 2,520 pounds 45 bushels.
Yield of straw per acre, 4 tons and 700 pounds.
Yield of grain from the plot, 42 pounds.
Yield of straw from the plot, 145 pounds.
Weight per measured bushel after cleaning, 58·2 pounds.

A large field plot of eight acres of spring rye was sown on May 20. The land on which this seed was sown was Marquis wheat stubble. This plot of land was summer-fallowed in 1919, wheat in 1920, and rye on stubble in 1921. Owing to the

unfavourable weather conditions during the autumn of 1920, and to threshing not being completed until freeze-up, also to press of other work, it was found impossible to have this plot of land ploughed in the autumn of 1920. Also, as this plot was needed, it was decided to carry out the experiment on the stubble.

The land was well disced and thoroughly harrowed just previous to its being sown. It was seeded at the rate of two bushels per acre. This land is somewhat sandy with small gravel, and was rather dry when the seeding was done. Germination of the seed was slow, and growth slow until the rains of mid-June. By June 20 the plot was doing fairly well and making good growth, the balance of the season being very favourable, with its ample rainfall, for this style of land and this method of cultivation, and a fair crop of grain was harvested.

The following were the results obtained:—

Sown May 20, eight acres.

Ripe and cut, August 29. Weight per measured bushel after cleaning, 58.2 pounds.

Number of days maturing, 101.

Length of straw, including head, 46 inches.

Strength of straw on points, 10 points. Straw very erect. (This plot not being effected by the high winds, as it was protected from the prevailing high winds by a heavy growth of poplar.)

Total weight of grain per acre, 1,743¾ pounds, 31 bushels and 7 pounds.

Yield of straw per acre, 2 tons and 1,400 pounds.

Length of head, 2¾ inches.

FALL OR WINTER RYE

The following varieties of fall rye sown during August, 1920, on land that had grown a crop of wheat the previous season. This land was in summer-fallow in 1918, and had grown a number of crops of wheat previous to that year. During the spring of 1920 these plots of land were deeply ploughed; then a liberal application of twenty tons per acre of barnyard manure was given the plots. This manure was thoroughly incorporated with the soil, with the aid of a spring tooth-harrow, during the season. Just previous to the seed being sown, the land was thoroughly harrowed over with a smoothing harrow. The seed was sown broadcast at the rate of one and one-half bushel per acre. Although the seeding was done at about the driest time of the season, the germination of the seed was quite timely, and sufficient growth was obtained to form a good mulch for winter protection. These plots were not pastured down. They came through the winter of 1920-21 in fine condition, with no noticeable winter-killing. With the very favourable growing season of 1921 and its ample rainfall, these crops made wonderful growth, the straw being of an unusual length, as also were the heads. With the very frequent rains of the season, the ripening period was greatly prolonged. These plots were also badly lodged.

The following were the dates sown, dates cut, and yields obtained:—

VARIETY TESTS WITH FALL RYE

Variety	Sown	Ripe and cut	Length of straw including head	Length of head	Strength of straw on a scale of ten points	Yield per acre		
						Grain	Straw	Weight per measured bushel after cleaning
	1920	1921	in.	in.		bush. lb.	tons lb.	lb.
North Dakota 959	Aug. 19	Aug. 8	58	4	8	60 0	4 940	58·1
Saskatoon	Aug. 19	Aug. 9	56	4	8	58 22	4 790	59·0
Mammoth White	Aug. 19	Aug. 12	55	4	6	57 18	4 550	58·5

A large field plot of four acres of fall rye was sown on August, 1920. The land used was land on which a crop of wheat had grown the previous season. The land was ploughed during the latter part of June, 1920. No manure was applied for the rye crop.

The land was thoroughly cultivated in preparation for the seed. This land is somewhat sandy, some gravel and small stone, and owing to the limited moisture in the soil at time of seeding the rye germination of the seed was slow, but with timely rains of the late autumn it made a fair growth. This plot was pastured down very closely in the autumn by cattle and horses, and a large flock of sheep. It was thought at one time that this close pasturing would ruin the plot, but with the heavy snow fall of the latter part of October, it proved otherwise. With the moisture from the winter's snow, the favourable growing conditions of the spring, and the ample moisture of the summer, this plot made very favourable growth and gave a fair yield both in grain and straw.

The plot was ripe and cut on July 26.

Length of straw, including head, 48 inches.

Length of head, 3 inches.

Total yield of grain per acre 2,184 lbs. 39 bushels.

Yield of straw per acre, 2 tons and 1,800 lbs.

EXPERIMENTS WITH FIELD PEAS

Four varieties of field peas were under test again this season. The quantity of seed used per acre varied from two to two and a half bushels per acre, according to the size of the peas, two bushels per acre for the Arthur and Prussian, and two and a half bushels per acre for the Empire and Alberby Blue.

The Arthur seems to be the best adapted to conditions in the Northland, as it matures earlier then the other varieties and gives a fair yield.

The peas were sown on land that was in a root crop in 1920, manure being applied for the root crop, and none for the grain crop.

With the very frequent showers of rain during the latter part of the growing season, the vines grew to a great length and continued growing and remained green for a longer period than usual. Some difficulty was experienced in the harvesting of these crops, on account of the frequent showers.

A loss of about 3 per cent was incurred by the frequent handling of the crops.

The seed was sown on May 3 and 5 in plots of one-sixtieth of an acre.

The following were the results obtained:—

VARIETY TESTS WITH FIELD PEAS

Variety	Sown	Ripe and cut	Length of vine	Length of pod	Number of days maturing, and size	Yield per acre		
						Grain	Straw	Weight per measured bushel after cleaning
			in.	in.		bush. lb.	tons lb.	lb.
Arthur	May 3	Aug. 11	72	2	100 Fair	40 0	3 1,800	
Prussian Blue	May 5	Sept. 2	76	2	120 Medium	39 0	3 1,920	
Empire	May 3	Aug. 13	60	2½	102 Fair	37 30	3 1,200	
Alberly Blue	May 5	Sept. 5	72	2½	123 Large	33 30	4 40	

GENERAL

Some additional building and improvement was done during the year, part being done in November. A lean-to was built onto the new barn that was built during 1920, to house the increase of pigs. This was built out of logs, common lumber being used for the roof, which was covered with three-ply asphalt roofing. The size was 14 feet by 28 feet, and the lean-to was divided into four pens. It will be used largely for breeding purposes or pens. Another large log barn was started in the spring of 1921, but through press of other work it was not completed, although all material is on hand. A cellar was dug 13 by 16 feet 7 feet deep, and over this will be built a residence for the assistant. This cellar may also be used for winter quarters for the bees.

EXPERIMENTAL SUB-STATION, GROUARD, ALTA

The growing season of 1921 was favourable, although dry. On May 4 the following grains were sown:—

Wheat—Ruby, Huron, Prelude, Marquis.
Oats—Hulless, Victory, Daubeney, Banner.
Barley—Hulless, Albert, Duckbill O.A.C. No. 21
May 14—Germination of all of the wheat.
May 17—Germination of all of the oats.
May 25—Germination of all of the barley.
June 27—Ruby headed.
June 27—Daubeney oats headed.
June 27—Hulless barley headed.
June 28—Hulless oats headed.
June 30—Albert barley headed.
July 4—Huron wheat headed.
July 4—Duckbill barley headed.
July 5—Huron wheat headed.
July 7—O.A.C. No. 21 barley headed.
July 8—Victory and Banner oats headed.

RIPE

August 5—Daubeney.
August 6—Prelude.
August 8—Hulless barley.
August 13—Ruby.
August 15—Duckbill.
August 17—O.A.C. No. 21.
August 22—Huron.
August 24—Marquis.

Hulless, Victory and Banner oats destroyed by starlings.

The whole of the grain of good height, and that came well, can be classed as No. 1, even, to judge by a few heads that escaped, the varieties that were eaten by the starlings.

The hulless oats and barley were not inferior to the seed received and sown. Yields are not yet available.

As usual, the garden crops succeeded, with the exception that, owing to drought, turnips and radishes were attacked by small white maggots. No variety of corn reached the dough stage; some did not even ear.

The forage plants gave but mediocre results, the clay subsoil being too hard for roots.

The fodder corn, sown perhaps too thickly, suffered from the drought.

Alfalfa, clovers, alsike, etc., gave a few isolated bunches. The wild grasses come better with moisture. Even Brome grass, Red Top, western rye, etc., yield nothing on dry land. An enormous difference is noticed on the same plot.

EXPERIMENTAL SUB-STATION, FORT RESOLUTION, MACKENZIE DISTRICT, N.W.T.

GENERAL CHARACTER OF SEASON

The year 1921 was, in general, a very good agricultural year. The winter was one of the mildest that can be remembered. Ice bound the Great Slave lake at a very late date in November, 1920. At the close of the winter, the ice was not three feet thick. Also, the ground did not freeze to a great depth. In certain places, under snow banks, for instance, the frost did not reach deeper than six inches. The proof of this is that when seeding was performed, in the spring, the plough uncovered well preserved potato plants. It is the first time so far as can be ascertained that such a thing as been noted here.

Spring was early, most of the snow had disappeared as early as April 15. On April 20 it was possible to take out the 16 head of cattle at the Station, and on that day they found an abundance of feed, so that from then on it was not necessary to feed them inside. This was a happy occurrence, for there was nothing left to feed them with. In previous years, the stock had to be kept in the stable until May 20.

As early as the second week in May the soil was, therefore, dry enough, and it is at that time that most of the seeding was done. There were cold days and heavy night frosts later on.

In general, conditions in the spring were of the best. Everything pointed to a favourable season and excellent results. The year's work would have been fully successful but for the caterpillars, and for the warm periods and droughts in July. The caterpillars or small black worms with white bars, somewhat resembling silkworms, appeared in thousands about May 25. They multiplied and greatly increased in size during three or four weeks, causing serious injury. They exercise their voracity upon all vegetation. Turnips, carrots and beets, after germinating particularly well, were nearly completely devoured. These injurious insects even attacked the hay and the cereals, such as oats and barley. Sweet clover, alfalfa and different kinds of flowers suffered much from them. After eating the small tender leaves, they attacked the roots. They were to be found by tens at the foot of each bunch of grass or of flowers. Some years ago the white maggot was complained of, but the injury caused by the caterpillars is far more considerable. It is their first appearance here and it is a great question whether they will appear next year. In general, everything except potatoes suffered from the caterpillars. However, they did not reduce everything to complete ruin.

In July there was some exceptionally hot and dry weather which was detrimental, especially to the potatoes. Rains, which has been abundant in June, set in again early in August, and from then on the crop, a moment in danger, was assured, and finally was satisfactory.

Variety	Origin	Date sown	Germination	Ready to eat	Maturity	Weight
Turnip white	C. Exp. F.	May 7	May 20	July 19	Sept.	15 bs. 20, 25 lbs.
Rutabaga	Resolution	" 7	" 24	" 25	End Sept.	14, 18 lbs.
Carrot, Shorthorn	C.E.F.	" 7	June 3	" 15	Sept.	1, 2 lbs.
Improv. white	C.E.F.	" 7	" 5			No success.
Chantenay	C.E.F.	July 3	July 10	Aug. 25	End Sept.	Good success.
Parsnip	C.E.F.	May 7				No success.
Beet—						
Detroit dark red	C.E.F.	" 7	June 1	July 30	End Sept.	Good success.
Turnip	"	" 7	July 1	Aug. 5	"	"
Crosby's Egyptian	C.E.F.	" 7	" 1	" 8	"	"
Cabbage—						
Copenhagen Market		" 10	May 18	" 15	"	10 and 12 lbs.
Jersey Wakefield	C.E.F.	" 10	" 18	" 20		From 8 to 15 lb.
Cauliflower, dwf. early	C.E.F.	" 10	" 18			No success.
Tomatoes	C.E.F.	" 7	May 18	Sept.	Not ripe on plant.	
Peas—						
English Wonder	C.E.F.	June 24	June 29	Aug. 20	Sept. 8	Good success.
Thomas Laxton	C.E.F.	" 24	" 29	" 20	Sept. 8	"
Gregory Surprise	C.E.F.	" 24	" 30	" 20	Sept. 8	"
Beans—						
May Queen	C.E.F.	" 24	" 30	Sept. 2	Frosted Sept. 8.	
Round rod kidney wax	C.E.F.	" 24	" 30	" 2	" "	
Corn—						
Early Malcolm	C.E.F.	" 24	June 29	8 in. ear	Not ripe.	
Sweet Squaw	C.E.F.	" 24	" 30	No ear.		
Pickaninny	C.E.F.	" 24	" 30	6 in. ear	Not ripe	
Beet—Detroit dark red	C.E.F.	" 24	July 1	Aug. 25		Good success.
Radish—Scarlet turnip	C.E.F.	" 24	June 30	July 13		"
Lettuce—Sutton's Early prs	C.E.F.	" 24	July 2	July 30		
Onions—						
Yellow Globe	C.E.F.	June 25	" 2	End of Se	pt., size of a nut,	
Large red Wethersfield	C.E.F.	" 25	" 2	for repla	nting in 1922.	
Oats—						
Liberty	C.E.F.	May 19	June 1	Headed June 21	Ripe, Sept. 12	
Barley, Albert	C.E.F.	" 19	July 4		Ripe, Aug. 25	
Daubeney oats	C.E.F.	" 19	July 21		Ripe, Sept. 12	
Prelude wheat	C.E.F.	" 19	" 15		"	
Wheat, Ruby	C.E.F.	" 19	" 15		"	
Potatoes, Early Rose	Resolution	May 11-15	June 15-20	Aug. 5	Sept. 12	

DETAILS REGARDING THE DIFFERENT EXPERIMENTS

Some 13,000 pounds of seed potatoes yielded 70,000 pounds. In proportion, the yield is lower than for previous years. However, the tubers are of better quality, firmer and more mealy.

For a number of years work has been industriously carried on to clear the land, in order to increase the area of fields and to have meadows. But the fine season is so short, and there is so much to do at that time that clearing operations progress very slowly. At present about 30 acres of land are cleared, the greater part of which was seeded this fall.

Experiments have been conducted with different kinds of hay seeds for three years. The conclusion has been reached that rye grass, brome grass and timothy are those that give the best results.

It has been noticed that sweet clover does not succeed very well. Some was sown last summer, germination was good, and roots penetrated deeply into the soil before winter set in. This spring, it was found that frost had killed much of it. Moreover, through the action of the frost, the roots protruded from 1 to 1½ inch out of the soil, as if some one had tried to pull them up. This is the first experiment here with this kind of forage, but it is feared that it will not become acclimatized. Alfalfa is more satisfactory. This spring a small sample of it was sown in dry, well prepared soil. About mid-July it was in full bloom and three feet in height. It is believed that its acclimatization can be obtained, the experiments will be continued next spring.

Below are some details concerning the different kinds of flowers grown on the Station grounds, which are much admired by passersby.

PLANTS AND FLOWERS IN FULL BLOOM

May 27.—Apple trees and lilacs.
June 1.—Phlox and Myosotis.
June 15.—Fox gloves.
June 18.—Sweet William and Blue Bells.
July 1.—Marguerite.
July 3.—Pinks and poppies.
July 6.—Marigolds and Morning glories.
July 15.—Alyssum and Lavatera.
July 20.—Mignonette and sunflowers.
Apple trees blossomed, but did not bear any fruit.

METEOROLOGICAL RECORD FOR 1920-21

Month	Max.	Min.	Snow	Rain
December	+ 340	− 479	3 ins.	
January	+ 326	− 579	3½ "	
February	− 312	− 466	4 "	Shower, Feb. 25
March	− 320·5	− 558·5	14 " 5	
April	+1164·5	+ 632	3 "	2
May	1644·5	1062·5	.....	1·51
June	2037·0	1474·5	.....	1·61
July	2219·0	1658·5	.....	0·40
August	1913·0	1480·5	.....	2·36
September	1596·0	1200·5	.....	0·87
October	1273·5	987	.....	0·47

Other observations:—

April 1.—Crows arrive.
" 7.—Willows start to bud.
" 8.—Snowfall.
" 11.—First ducks.
" 14.—Snow entirely gone.
" 15.—Flies and butterflies.
" 22.—Cranes and gulls.
" 26.—Petite Rivière au Boeuf free from ice.
" 27.—Frogs are heard.
May 1.—Hail.
" 2.—Water appears in bays.
" 6.—Ploughing.
" 7.—Small seeds sown.
" 12.—Great Slave river free from ice.
" 12.—Potatoes planted.
" 19.—Bay free of ice.
" 19.—Bay covered with floating ice.
" 20.—Trees becoming green.
" 29.—Trees becoming covered with leaves.
" 30.—Great lake free from ice.
June 3.—Strawberry plants in blossom.
" 6.—Potato plants appear above the soil.
" 23.—Strawberries beginning to ripen.
Aug. 15.—Heavy white frost.
Sept. 1.—Leaves beginning to turn yellow.
" 5.—Birds migrate.
" 8.—Hail and snowfalls.
" 11.—Ice appears near the shore.
" 12.—Digging of potatoes.
" 16.—Light snow.
" 20.—Trees bared of the leaves.
Oct. 5.—White partridges arrive.
" 13.—Land well covered with snow.
" 15.—Snow disappears.
Nov. 1.—Bay bordered with ice.
" 3.—Skating on bay.
" 3.—Large flights of bustards depart.
" 5.—A few sledges cross the bay.
" 24.—The lake is bound as far as the eye can see.
" 25.—Five sledges leave for Rivière au Foin.

EXPERIMENTAL SUB-STATION FOR THE SWEDE CREEK, YUKON

REPORT OF JAMES R. FARR

The ten acres which have been under soil improvement, and now comprise a three-year rotation scheme, viz., hoed crop, grain, and hay, have this year been planted with hoed crops—mangels, carrots, turnips, and several varieties of potatoes.

The first plot of mangels, carrots, and swede turnips was seeded on May 7, the second crop was seeded on May 15, and the third plot was seeded on May 23. These plots were on bench ground, and owing to the season being unusually dry the growth was poor, the second seeding being better than the others.

Four varieties of fall turnips were seeded on June 8, viz., Rund Stubbiover, Greystone, Bert Felelio, and Osternsunden. All these varieties gave a large yield, the quality of the Bert Fellelio and Osternsunden being excellent.

The potatoes were planted on the days between May 10 and 17. The varieties were Gold Coin, Early Eureka, Agassiz Special, Irish Cobbler, Burpee's Extra Early. Sussex Rose, and Early Ohio. Of these, the yield of Gold Coin, Agassiz Special, and Sussex Rose were the largest, yielding one pound per lineal foot of row. The yield of Irish Cobbler and Burpee's Extra Early was very poor. The quality of all varieties was good.

The two-acre area under soil improvement, which in 1919 was seeded with rye and buckwheat, and in 1920 with oats, peas, and red clover, the red clover being winter-killed, was reseeded with red and sweet clover in the spring. This was ploughed down in August and, considering the dryness of the season, the growth was good.

The second two-acre area under soil improvement, which in 1920 was seeded with rye and buckwheat, and ploughed under in August, was sown with oats, peas, and clover on May 18. This yielded one and one-half tons per acre. The growth of the clover on this plot was very poor, and it is the intention to reseed with clover in the spring.

The third two-acre area under soil improvement was sowed on May 23 with rye and buckwheat and sweet clover. This, being seeded earlier than usual, gave an abundant growth and was ploughed under on July 26 and 27.

The Canadian variegated alfalfa which was sown in 1919 and 1920 withstood the winter; although the growth was good, the seed did not mature.

The alsike seeded on May 20, 1920, did not withstand the winter satisfactorily, and the growth during the summer was very poor.

The plot of white clover seeded on May 20, 1920, was winter-killed.

On May 6 one acre was seeded with timothy and red clover, on bottom land; the growth obtained was very satisfactory.

On May 9 a small area was seeded with each of the following: alfalfa, timothy, and white clover, on bench land. The alfalfa and timothy gave a medium yield, but the white clover was a failure.

On May 4 plots of one-fortieth acre were seeded, each with the following varieties of wheat: Ruby, Prelude, Marquis, and Huron, on the basis of 1⅜ bushels per acre. The Ruby was harvested on August 26 and yielded 81 pounds, or at the rate of 54 bushels per acre, of excellent quality. The Prelude, harvested on August 28, gave a yield of 62 pounds, or 41⅓ bushels per acre, the quality also being excellent. The plots of Marquis and Huron were a complete failure; these were sown with local-grown seed, as was also the plot of Prelude. The plot of Ruby was sown with imported seed.

On May 5 plots of one-fortieth acre were seeded each with Success and Manchurian barley. The Success was harvested on August 1 and yielded 40 pounds, or 33⅓ bushels per acre. The Manchurian, harvested on August 6, yielded 51 pounds, or 42½ bushels per acre.

On May 5 two plots of one-fortieth acre each were seeded with Banner and Victory oats. On August 25 both varieties were harvested, yielding as follows: Banner, 85 pounds, or 100 bushels per acre; Victory, 72 pounds, or 84¾ bushels per acre.

All the above-mentioned plots of grain were sown on bottom land.

On May 9 plots of wheat, oats, and barley, of the above-mentioned varieties, were sown on bench land. Owing to the lack of moisture and also to being sown on land that had not been treated for soil improvement, the crop was so light that it was not harvested with the intention of threshing.

The plots of Marquis and Huron wheat were a complete failure, due probably to native-grown seed.

EXPERIMENTAL SUB-STATION, SALMON ARM, B.C.

REPORT OF THOS. A. SHARPE

During the year 1921 there was only a little less than the usual rainfall, but the rains came mostly in the seasons when they were of the least benefit to growing crops, with the consequence that potatoes and other root crops were below average. Prices also were low, and sales slow for all agricultural products, while labour prices remained practically as high as in 1920.

Months	Temperature				Precipitation			Sunshine	
	Highest	Date	Lowest	Date	Rain-fall	Snow-fall	Total precip-itation	Total hours	Average per day
	°		°		in.	in.	in.		
April	70·0	10th	30·5	28th	0·86	.....	0·86	172·48	5·74
May	83·0	31st	33·0	28th	1·80	.....	1·80	296·42	9·56
June	84·0	3rd	42·0	16th	1·75	.....	1·75	220·06	7·33
July	94·0	14th, 19th, 31st	43·0	2nd	0·36	.....	0·36	328·18	10·85
August	92·0	13th	41·0	25th	0·85	.....	0·85	248·06	8·00
September	72·0	16th	34·0	30th	1·26	.....	1·26	136·24	4·54
October	46·0	24th	28·0	23rd	1·40	.....	1·40	114·48	3·69
November	61·0	11th	4·0	19–20th	0·63	27·50	3·38	40·36	1·34
December	46·0	12th	−12·0	20th	0·72	7·50	1·47	53·24	1·71
January	39·0	9th	−11·0	31st	.....	24·00	2·40	50·12	1·61
February	42·0	7th	−11·0	1st	.....	20·50	2·05	101·30	3·61
March	49·5	29th	13·0	27th	0·46	14·50	1·91	131·54	4·24
					10·09	94·00	19·49		

The apple crop was about an average one, but sales have been slow, and collections very unsatisfactory, owing to poor prices for live stock and grains in the Prairie Provinces.

There is a successful butter factory in the village, which operates throughout the year, and the price for butter has been good.

A great deal of the upland here was burned over by forest fires, and the Sub-station was no exception, as it had most of the large timber burned, and the soil was practically robbed of its humus. On account of the need for humus in agricultural soils, especially in this district of very limited rainfall, efforts have been made to get a crop that would produce a heavy yield in the shortest time, and also furnish a much needed supply of nitrates. This chemical fertilizer had been destroyed when the land was so severely roasted at the time the forest was burned off. A short rotation has been used, with red clover in a three-year course, but it will be possible to get more growth to turn under each year by growing the soy bean, as this makes a strong growth, and if used as stock feed is very acceptable to all classes of stock. The seed, however, is expensive, and the Station has been trying for years to obtain a variety that would give a heavy crop, and, if left to grow all season, would ripen seed. Up to the present the only one of the many varieties secured that ripened seed was too small, being very short in the stem and rather scanty in foliage. Several varieties are being tried this year, and it is hoped to get one that will grow and ripen seed, which can be recommended to orchardists for furnishing both humus and nitrates. A few drills of soy beans between the rows of apple trees, sown during the June rains, could be turned under after the apples were harvested; and this practice, continued for a very

few years, would give a supply of humus to enable the trees to carry the crop through the dry season and mature the fruit as well as the season's growth of wood.

Over one hundred varieties of apples have been fruited, and of these several have been retained for further test. There are three varieties promising enough to try on a more extended scale. Of one of these, the Scarlet Pippin, there are on hand fifty one-year trees, of which a small block will be planted and the remainder distributed to other planters. If they prove meritorious, nurseries will be glad to propagate. The Pinto, one of the Central Experimental Farm seedlings, is doing so well here that it is hoped to be able to bud enough to plant a block and distribute a number to orchardists in the vicinity. The Buckingham, an old eastern variety not known on this coast, has done so well here, and is of such promise, that enough young trees have been secured to plant a small block for further test — although it is only a fall and winter variety. A number of good winter varieties grow vigourously, and thrive until they produce one or two heavy crops. Then they begin to fail, and for this there seems to be no remedy, as it is probably owing to the heavy drain on the tree in maturing a late ripening crop. The tree has not time to ripen the wood before winter sets in, which injures it seriously and destroys it as a profitable producer. There are under test at the present time fifty varieties of apples, and it is hoped to add several untried or new varieties this next spring.

Since the planting of fruit trees was started here, twenty-nine varieties have been tested. Most of these were choice varieties selected from the Experimental Farm at Agassiz, but a large number were killed some years ago when the thermometer showed thirty degrees below zero. One of the hardiest is the Italian prune, and as it is also a good shipper it is the most popular variety. Plums are not extensively planted, as the crop comes in late, and the prairie market is at that time pretty well supplied by earlier fruit from the American growers in Oregon and Washington. Cherries were started here with a selection from the cherry orchard at Agassiz. Several varieties are fruiting now, but all are of the Duke and Morello classes, as it is found that the large, sweet cherries are too tender to withstand the severe frosts which come occasionally to this district.

At present there is a small plantation of red raspberries and loganberries, and if these succeed, as is expected, both plots will be enlarged. Efforts will also be made, by experimenting with the newer varieties of raspberries, to get one as hardy and as good a shipper as the Cuthbert, and more productive.