DOMINION OF CANADA
DEPARTMENT OF AGRICULTURE
DOMINION EXPERIMENTAL FARMS

EXPERIMENTAL SUB-STATION

Beaverlodge, Alberta

RESULTS OF EXPERIMENTS
1931 - 1936

W. D. ALBRIGHT,
Superintendent

Grounds and buildings from front entrance, Sept. 2, 1936.
Photo by Superintendent.

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REPORT OF THE DOMINION EXPERIMENTAL SUB-STATION, BEAVERLODGE, ALTA., 1931 TO 1936

INTRODUCTION

Within the compass of this report little but deductions may be presented. Attempt has been made to synopsize the results of work that has been completed or at least fairly well advanced within the six years, 1931-6. Perspective has occasionally been supplied by a background of earlier work.

Of the six seasons under particular review, 1931 brought an early seeding after a mild winter. Harvest was early, yields were a full average and grades were good.

Snow moisture mitigated the effect of summer drouth in 1932, but grains failed to fill well and yielded lightly, though commercial grades were good. It was a banner year for fruits and tender vegetables.

Following a long, steady winter, during which snowshoe rabbits were very plentiful, seeding and maturity were late in 1933. Frost at the end of August and beginning of September depressed grades. Harvest and threshing were beset by inclement weather.

In 1934, over-wintering crops exhibited much damage by ice injury. Spring seeding was early. A very rainy summer was climaxed by rain, snow and hard frost in September. Ruling wheat grades were 4° and No. 5.

Another wet summer in 1935, with a very late seeding and correspondingly late harvest, was featured by a mid-August snow storm. Hay crops were heavy but grain was low in yield and sample. Germination tests on the crop were disappointing.

After a hard winter, 1936 brought good growing conditions and excellent crops, though grades were below expectations, wheat averaging about 3°, partly on account of variety, nearly all the Garnet going into this grade. Harvest was completed and nearly all the threshing was done after a heavy September snowstorm. Nevertheless, fall work was well rounded up, cellars and granaries were filled and Prosperity smiled in the Peace.

During the 21 years, 1916-36, inclusive, the mean of the average monthly temperatures has been 35·34° Fah., and the mean annual precipitation, 17·40 inches. There has been sleighing on an average of 130·58 days per annum. The fifteen-year average (1922-36) of summer evaporation from an open-water surface has been 18·36 inches and the fourteen-year average (1923-36) of bright sunshine 2,088·07 hours.

ACKNOWLEDGMENTS

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RECORD OF PRECIPITATION, BEAVERLODGE, FOR PERIOD 1931-6, INCLUSIVE

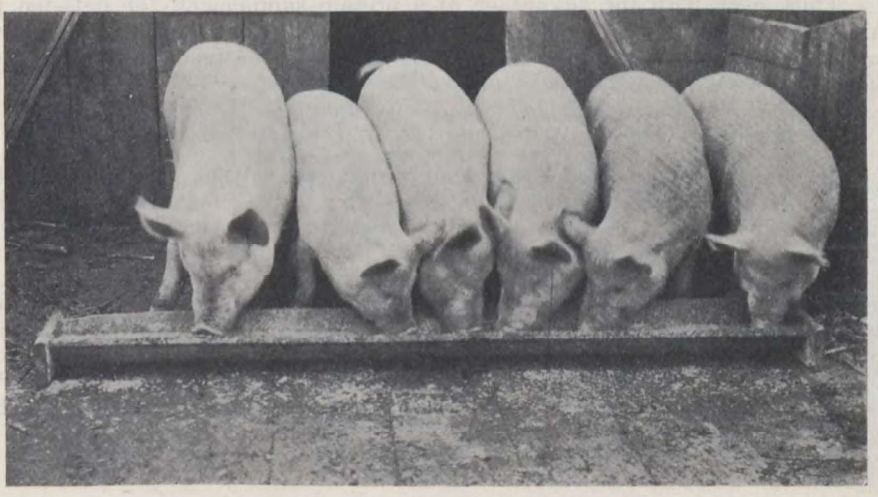
Month	1931		1932		1933		1934		1935		1936	
	No. days on which precipitation occurred	Precipitation	No. days on which precipitation occurred	Precipitation	No. days on which precipitation occurred	Precipitation	No. days on which precipitation occurred	Precipitation	No. days on which precipitation occurred	Precipitation	No. days on which precipitation occurred	Precipitation
		inches		inches		inches		inches		inches		inches
January	2	0·25	7	0·80	11	1·53	13	0·98	18	3·20	24	1·36
February	0	0·00	12	1·86	7	1·78	4	0·30	4	0·85	23	0·98
March	11	1·50	11	1·45	11	1·15	14	1·55	14	1·65	18	0·60
April	1	0·10	10	2·08	8	1·06	7	0·34	13	0·69	13	1·36
May	12	1·34	7	0·93	13	1·76	12	1·25	16	2·21	11	1·14
June	12	2·54	10	0·48	13	1·72	20	2·16	21	3·08	21	4·11
July	9	1·11	12	1·93	12	1·90	16	2·36	18	4·90	20	1·81
August	14	1·66	11	1·38	2	0·30	16	2·99	16	2·33	13	1·87
September	15	1·18	6	0·82	13	1·73	19	3·29	8	0·94	18	3·60
October	4	0·67	10	0·87	16	2·41	15	1·38	17	1·22	17	1·67
November	8	1·40	11	2·42	18	3·43	15	1·71	14	2·32	10	1·11
December	7	0·73	5	0·35	19	3·35	10	1·55	13	0·68	16	1·12
Total	95	12·48	112	15·37	143	22·12	161	19·86	172	24·07	204	20·73

ANIMAL HUSBANDRY

IMPROVING THE OATS RATION FOR HOGS

Because of the feeding quality of plump Northern oats, many farmers have been prone to employ them as the sole grain ration for hogs. An experiment to determine the optimum proportion of oats was undertaken in the autumn of 1934 with the progeny of four purebred Yorkshire sows shipped up from Lacombe. For three feeding periods the data are complete save that one of the ninety carcasses was lost track of in the cooler.

The check lot, i, received oat chop from start to finish. For lot ii the ration was amended by inclusion of wheat chop in the proportion of 1 of wheat to 3 of oat chop during the first stage, 1 to 2 during the second stage and 1 to 1 during the finishing stage. For lot iii the wheat chop was as 1 to 2 during the first stage, 1 to 1 during the second and 2 to 1 at the finish. Lot iv had the same proportions of heavy grain as lot iii, but half the wheat was substituted by barley. Lot v had barley in the same proportions as the wheat in lot iii. With the meal ration of every lot was included 10 per cent tankage during the first stage, 7 per cent during the second and 5 per cent during the finishing. All lots were treated alike as to mineral supplements and green feed. Feeding was done on plank



Hogs fed from weaning to finish on oats and barley with tankage and supplements.
Photo by Superintendent.

floors in front of A-shaped cabins banked with straw. The oats used were 2 C.W. and Extra 1 Feed. The wheat was mostly a No. 5, degraded by frost. The barley was principally 3 C.W. tough or damp. Most of it musted in storage.

The hogs were weighed and graded at the farm on shipping day, off cars at the Edmonton stock yards and on the rail. Through the co-operation of the Dominion Live Stock Branch and of the Swift Canadian Co. Ltd., carcass details were obtained. The Grande Prairie Co-operative Live Stock Shipping Association segregated the experimental hogs in the cars.

An average net selling price of $8 per cwt., off cars, was arrived at and was employed uniformly in all calculations. The initial value per pig was assumed to be $2.75. Labour was charged at $2 per head.

SHIPPING SHRINKAGE

From the gaunt appearance of many Peace river hogs arriving on the market it had been wondered whether oats-fed hogs shrank more than hogs grown or finished on heavier grains. Indications were that the ration affected the shrinkage only or chiefly in so far as it contributed to finish, a thin-bellied hog losing a larger percentage than a thick-bellied one. This is fairly well brought out by computing the shrinkage from Beaverlodge farm weights to Edmonton rail weights. These ran 26·89 per cent for lot i, 26·98 per cent for lot ii; 25·72 per cent for lot iii; 26·02 per cent for lot iv and 24·86 per cent for lot v. Lots ii and iv are somewhat out of line with the general trend.

EARLIER FINISH, BETTER GRADES, BETTER CARCASSES, CHEAPER GAINS

The lots on the heavier rations were marketed from 8·6 to 16·0 days sooner than the oats-fed pigs and had 25 to 75 per cent more selects owing largely to superior finish. Lot iii had the briefest feeding period and graded the best of all. The hogs on the heavier rations exhibited a definite improvement in rail grades, belly rating and fat firmness. Whether significant or not, there seems also to have been an improvement in balance of carcass.

Some of the oats-fed hogs yielded limp sides, with greyish fat and dull flesh. Most of the others had conspicuously white fat and bright-red flesh, particularly those that had received the larger percentage of wheat.

Thus, even with the advantage of a protein supplement, the oats-fed pigs failed somewhat in thickness and finish; in firmness, bloom and quality of carcass; in balance of middles against ends; and in the tenderness and general suitability associated with early maturity.

RELATIVE VALUES OF OATS, WHEAT AND BARLEY

One hundred pounds of straight oats produced only as much gain as 86·5 pounds of the oats-wheat mixture fed to lot iii; 88·3 pounds of the oats-wheat mixture fed to lot ii; 89·8 pounds of the oats-barley mixture fed to lot v, or 92·3 pounds of the oats-wheat-barley mixture fed to lot iv.

On the basis of live grades at Edmonton, the oats used by the check lot netted 84 cents per hundredweight or 28·56 cents per bushel. If oats were worth this figure, say 28½ cents a bushel, one could have afforded to pay (in round numbers) 74 cents a bushel for the No. 5 wheat used by lot ii; 77 cents for the wheat fed to lot iii and 52 cents for the musted barley used by lot v. With sound appetizing barley, the showing for this grain would likely have been improved.

CEREALS

Three major cereal experiments completed their five-year cycle. For one or more years, 333 varieties and strains were grown, and 159 of these have been discarded. Altogether 2,345 head rows and 1,052 junior rod-row seedings were made, involving selections of wheat, oats and barley. Numerous other head-row seedings were for the purpose of purifying seed stocks of the more important varieties. By this method, the sub-station stock of Liberty-hulless oats has been fairly well freed of hull-retentive kernels.

VARIETY TESTING

Varieties recommended in the light of trials and commercial experience are:—

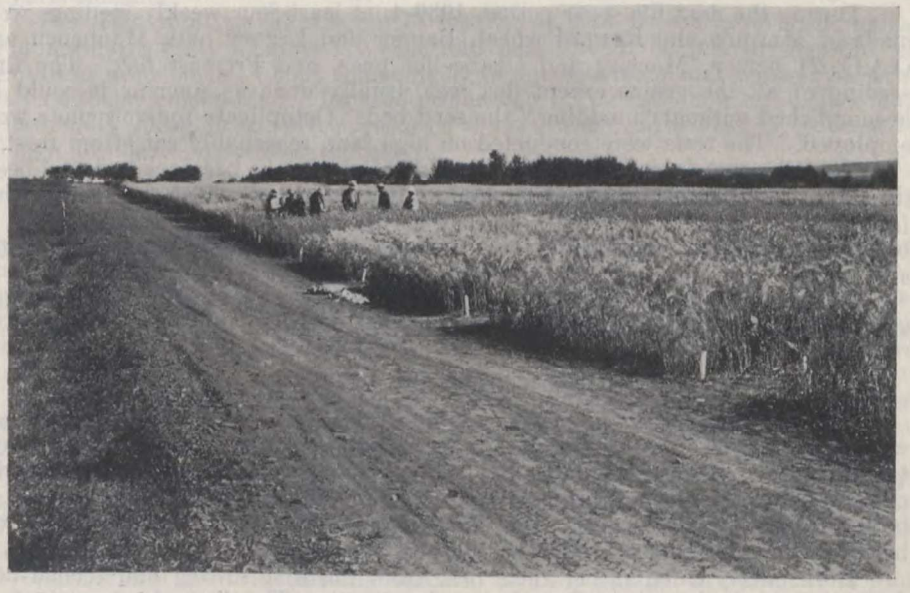
Reward, Red Bobs 222, Garnet, and Marquis wheat;
Victory, Banner and Legacy oats; Liberty-hulless for limited use;
Olli, O.A.C. 21, and Newal barley;
Chancellor peas;
Red Wing and Premost flax.

SOME LONG-TERM YIELDS

Wheat: On the high land of the substation, Marquis wheat during the 22 years, 1915-36, has averaged 37 bushels 34 pounds on clean fallow or equivalent preparation. In a fifteen-year period, Early Triumph exceeded it by almost a bushel, while Garnet fell a bushel short of Marquis, and Reward almost four bushels short. Red Bobs 222 was tested for only nine years, averaging in that time 26 pounds less than the Early-Triumph strain.

In 15 years, Early Triumph matured 3·6 days and Garnet 6 days ahead of Marquis. Reward averaged only one-tenth of a day later than Garnet when both were left to mature fully.

Oats: Since 1920, Banner and Liberty oats have matured 1·3 days and 5 days, respectively, sooner than Victory. Since 1919, Banner has had an average yield of 90 bushels 32 pounds. This is 88 pounds more than the yield of Victory. Liberty in that time yielded only 54 bushels, but if it be credited with allowance for hull this would be raised to 77 bushels, which is only 15 per cent below the yield of Banner. In a fifteen-year period, Legacy ripened 4·5 days sooner than Banner, and in an eleven-year period yielded within 147 pounds as much grain.



Dominion cerealist and party examining the barley plots, Aug. 15, 1936.
Photo by Superintendent.

Barley: In fifteen years, O.A.C. 21 barley matured in 106·3 days, which was 6·6 days less than Hannchen and 2·1 days less than Eureka (beardless and hulless). In seventeen years, O.A.C. 21 yielded 49 bushels 8 pounds, Hannchen 54 bushels 36 pounds and Eureka 45 bushels 15 pounds. If, however, the Eureka be credited with an allowance of ten per cent for hull its yield would be slightly greater than that of O.A.C. 21. Weak straw, susceptibility to fungus and unsuitability for malting are its drawbacks. In four years, Olli ripened a week ahead of O.A.C. 21 and two weeks ahead of Hannchen, yet averaged 61 bushels per acre, being 4 bushels above O.A.C. 21 and 2 bushels above Hannchen. In malting tests of Olli made thus far, this variety appears promising.

Since 1921, the Chancellor pea has averaged 38 bushels 17 pounds, or 19 pounds less than Arthur, maturing in about a week less time.

The fourteen-year average yield of Premost flax is 16 bushels 16 pounds. During seven years Red Wing has exceeded it by more than a bushel per acre and is a little earlier, though the difference in maturing periods is much less than it is to the south.

The winter-wheat crop has varied greatly. In 1934, yields were not taken because of extreme patchiness of the stands due to ice-killing. Since 1921, the average yield of Turkey Red has been 29 bushels 42 pounds. Its most serious rival yet is Kharkov 22, which appears somewhat hardier and which is decidedly stronger in the straw; but it is two or three days later, entailing risk of frost injury in some localities. Though heading much earlier than spring wheat Turkey Red finishes off at about the same time as Garnet.

Most varieties of winter rye have proved hardier than the wheat, and an Ottawa stock averaged 41 bushels 47 pounds.

DATES OF PLANTING SPRING GRAINS

After casual trials of previous years, a five-year experiment with two varieties of spring wheat, three of oats and one of barley was carried from 1925-9, making out rather a strong case for early seeding of all three classes of grain.

During the next five-year period, 1930-4, at least four weekly seedings were made of Marquis and Reward wheat, Banner and Legacy oats, Hannchen and O.A.C. 21 barley, Mackay and Chancellor peas, and Premost flax. The first seeding of all the grains except flax was usually done as soon as it could be accomplished without "mudding" the seed bed. Octuplicate rod-row plots were employed. The tests were conducted on high land reasonably safe from frost.

Though scarcely so emphatic in its indications as the previous test had been, the later project unmistakably favoured early seedings of wheat and peas, rather favoured early seedings of oats and by no means discounted early sowing of barley. Flax appeared to do rather the best in its early sowings, which began a fortnight later than those of the other grains.

No good argument was established for an early variety deliberately sown late as compared with a standard sort sown early.

YIELD, GRADE AND SAMPLE

While deferred sowings often exhibited the ranker vegetative growth, both wheats gave their best average grain yield from the first sowing. Grain from the early sowings weighed more per bushel and in critical seasons graded decidedly better than that from the last ones. On the average of four sowings of both varieties, a week's delay in seeding reduced the yield by three pecks, the heaviest falling-off being from the third to the fourth.

Both oats yielded rather their best from the first sowing and second-best from the third, dropping abruptly to the fourth. The first three sowings of Banner were substantially equal. Banner grew longer straw when not sown too early, but this tendency failed to appear with Legacy. In the average of both varieties, grain yields were depleted by over two bushels per week's delay in seeding. Grades usually held up, but in one or two seasons they reflected against the final date.

Both barleys increased progressively in yield to the third seeding and then fell off sharply, the early sort much more than the late one. Hail damage may account for the discrepancy. Straw length, with Hannchen, increased appreciably as seedings were deferred, but insignificantly and irregularly with O.A.C. 21. Generally uniform, grades occasionally favoured the earlier seedings.

Pea yields declined cumulatively as seeding dates were postponed, the greater odds appearing with the late variety Mackay. Vine length increased with one exception. Weights per bushel and per thousand kernels were pronouncedly in favour of the early sowings of Mackay and about a quarter as pronounced with Chancellor.

Flax demonstrated a remarkable capacity to endure autumn frost without depreciation of its grades and without much reduction of its yield. It averaged 35·3 pounds less yield per week's postponement of seeding dates.

SEED TIME AND HARVEST

Twenty-one days' postponement of seeding delayed the ripening of Marquis wheat by 10·1 days; of Reward, 10·0 days; of Banner oats, 12·8 days; of Legacy, 9·4 days; of Hannchen barley, 13·1 days; of O.A.C. 21, 10·1 days; of Mackay peas, 9·7 days; of Chancellor, 9·5 days. In corresponding sequences of flax seeding, three weeks' delay in sowing put ripening back 11·3 days. It is not surprising to find that with the medium-early oat and barley the postponement of seeding delayed ripening about three days less than it did with their later companions.

From a study of ten years' data from the one wheat (Marquis) and the one oat (Banner) that had run through both series of date-of-planting experiments, it appears that in those seasons when spring opened extra early a week's delay of seeding delayed the harvest far less than it did when the spring was late. A week of April weather usually avails much less than a week of frost-free weather in early autumn.

The tests point to the wisdom of seeding as soon as the land is fit, unless in abnormally early seasons. Wheat and peas should be put in first but no hesitation need be felt about following right up with oats and barley, particularly on the acreage intended for seed production. Too early sowings of flax may occasionally succumb to spring frosts or to cutworms. Mid-May is quite early enough for flax—sometimes too early.

DATES OF PLANTING WINTER GRAINS

A systematic date-of-planting experiment with Turkey Red winter wheat and Ottawa Select winter rye was commenced in 1925, run four years, and repeated in a five-year project extending from 1929-30 to 1933-4. Unfortunately, the 1933 seeding was upset by hit-and-miss winter-killing caused by ice; hence, only four harvests were compared. Eight weekly seedings were made yearly.

The best wheat yield was obtained from the third sowing, which worked out to an average date of August 2, but, generally speaking, dates between the first and the middle of August were satisfactory.

The best yield of rye was obtained from the fifth seeding, whose average date was around the middle of August; but results with this crop were scarcely so regular as those from the wheat, due, perhaps, to occasional lodging and to shattering.

With winter grain the seeding needs to be early enough to permit it to root well, tiller freely and form a good top without jointing in the year of seeding. Rye, being more vigorous than wheat, is more likely to sustain injury through July seeding unless the stands are pastured. Early-August seeding of rye as of wheat seems advisable. The rye may, however, be safely seeded two or three weeks later than the wheat.

With neither grain is it feasible to depend upon one season's harvest for seed for the next year's crop.

In the North as the optimum seeding date will nearly always precede the spring-grain harvest, the sowing of winter grain on spring-grain stubble is not very feasible.

RATES OF SEEDING CEREALS

That cereal varieties may respond somewhat differently to seeding rates according to kernel size, tillering habit and other propensities was roughly indicated in a five-year series of experiments reviewed in 1930, following a seven-

year series dating from 1918. In these two projects the seeding had been done with an ordinary grain drill and rates could not be precisely controlled.

In 1930 a new project was laid out, employing three varieties of wheat, three of oats and two of barley, all seeded in octuplicate by the rod-row plan. Seed was precisely allotted, varieties and rates being as follows: Wheat: Marquis, Reward and Garnet, each at 4, 5, 6, 7, 8 pecks per acre. Oats: Banner, Victory and Legacy, each at 8, 10, 12, 14, 16 pecks per acre. Barley: Hannchen and O.A.C. 21, each at 4, 5, 6, 7, 8 pecks per acre.

VARIETAL REACTIONS—BANNER DWARFED BY EXCESSIVE SEEDING

In accordance with the earlier projects, the present data point to Banner oats as more likely than some other varieties to be handicapped by excessive seeding. From the eight- to the sixteen-peck rate the height of Banner decreased nearly one inch per half-bushel of seed and the yield by 49 pounds per half-bushel. Victory yields were depressed only 21 pounds per half-bushel of seed, though the effect on height averaged exactly the same as with Banner and the effect on maturity periods was nearly the same. The tenor of the Legacy yields was irregular, but agreed reasonably well with the behaviour of the two standard sorts.

Marquis wheat gave its best average yield, though not its most profitable increase of crop over seed, from the two-bushel seeding. Reward responded even less favourably to heavy seeding and Garnet still less. Thickening of the seeding did not on the average of all rates decrease the height of the Marquis, but it slightly shortened Garnet and Reward. The variations in maturity periods and other data were of doubtful significance.

No important differences in behaviour appeared between the two varieties of barley.

GENERAL CONSIDERATIONS

In view of what has been discussed already the danger of taking any two or three varieties to represent a particular class of grain must be recognized; yet averages may to some extent give useful indications. From them it would appear that where good seed was evenly applied to clean, well-prepared land, where the plots were hand-weeded and where pests did not unduly thin the stands:

1. Heavy seeding tended to shorten the straw. Wheat was shortened one-sixth of an inch per peck of seed; oats fully three-quarters of an inch per half bushel; barley almost one-third of an inch per peck.

2. Heavy seeding tended to hasten maturity. With wheat it worked out to one-third of a day per peck of seed; with oats, to over one-half a day per half bushel; with barley, to nearly one-half a day per peck.

3. Yield responses were unprofitable. Each 15 pounds of seed wheat increased the crop scarcely 14 pounds; each 17 pounds of oats reduced it by 23 pounds, and each additional 12 pounds of barley increased it by nearly 27 pounds. This, of course, does not mean that the eighth peck of wheat or barley was as effective as the fifth or sixth.

4. Whether from greater maturity or from other influence, the weight per measured bushel had a distinct tendency to rise as seedings thickened. Kernel weight tended to decline.

5. No lodging was recorded, but in the two previous series the degree of this was found to be little affected by seeding rates, save that extremely sparse stands tended to grow crooked straw, which under the weight of its large heads might break or bend down.

6. It has to be kept in mind that a bushel of seed, which has been stored over winter, cleaned, disinfected and filled into the drill box, is worth perhaps

twice as much as a bushel of crop, from whose gross value must be deducted the harvesting and threshing costs. Heavy seeding thus makes a sorry showing, particularly with oats, and most particularly with Banner oats.

ALLOWANCE FOR FIELD CONDITIONS

Allowance must be made for field conditions. Where germinability is low, where seeding conditions are imperfect, or where the growing crop is to be harrowed, extra seed may be called for. Extra seed might in some circumstances be profitable in hastening maturity, especially of oats. A preceding experiment had brought out that where wireworms were prevalent, thick seeding was highly advantageous with Garnet wheat. This conclusion has since been endorsed.

On weedy land where handpulling or other means of control is impracticable, fairly heavy seedings are helpful in choking down seedling weeds among the young grain.

With provisos on either hand, medium rates are advised, such as 6½ pecks of wheat, 2 bushels of barley and one sack of oats per acre.

AT WHAT STAGE SHOULD WHEAT BE HARVESTED?

After two preliminary trials an extensive project was launched in 1930 to investigate the effect of harvesting at different stages upon the yield and quality of the wheat crop. Systematic cuttings were taken for five years from summerfallow crops of Reward and Marquis. Replicate rod-row plots (octuplicate in four of the five years) were gathered by hand daily, the heads with a foot of straw attached being placed in gunny sacks and hung on storage racks until threshed. Cutting generally began when the grain was in the late-milk or early-dough stage and continued, if seasons permitted, until a week after the crop became dead-ripe.

The results have been difficult to summarize, for there are no sharp divisions between development periods. Again, because of seasonal differences in the progress of ripening the periods are not represented by a regular number of takes. Sometimes the crop failed to mature fully. Considering the difficulties it is surprising how consistent are the net results.

Eight stages of maturity are loosely defined and the results within these are compared. The stages are: late-milk, early-dough, medium-dough, late-dough, stiff-dough, hard-dough, ripe and dead-ripe.

Difficulties were encountered in averaging grades. A rating on the following basis was adopted, assuming a full grade difference between No. 1 Hard and 1° and regarding Feed as one grade below No. 6. The highest number represents the lowest grade thus: No. 1 Hard equals 1; 1° equals 2; 2° equals 3; 4° equals 5; No. 5 equals 6; No. 6 equals 7; Feed equals 8.

RESULTS WITH REWARD

With Reward, five years' data are available for the six stages ranging from early-dough to ripe. Average yields, weight per bushel, weight per 1,000 kernels and grading value all improve uninterruptedly from the early-dough to the hard-dough stage, yields increasing from 1,278 to 2,025 pounds per acre and weight per stroked bushel from 57·8 to 65·4 pounds; weight per 1,000 kernels from 21·6 to 32·6 grams and grades from 7 up to 2·4, which being interpreted means from No. 6 to between 1° and 2°.

From the hard-dough to the ripe stage there was a falling off of 129 pounds in yield but an improvement of 0·3 of a grade.

A four-year comparison of dead-ripeness with the several stages already mentioned is available. This table shows a decline of 45 pounds per acre from the ripe to the dead-ripe stage but a slight improvement in grade.

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In 1930 and 1933, harvesting began soon enough to include the late-milk stage. In this two-year comparison, the late-milk takes averaged 337 pounds less yield than the early-dough, weighed 55 pounds per bushel as against 58·6; 17·7 grams per 1,000 kernels as against 21·7, and rated 0·7 of a grade lower.

RESULTS WITH MARQUIS

With Marquis the data are complete only for five stages ranging from early-dough to hard-dough. For these stages, as with Reward, the showing improves uninterruptedly in every respect from the early-dough to the hard-dough. Yields increased step by step from 1,579 to 2,468 pounds per acre; weight per bushel, from 56·5 to 64·8 pounds; weight per 1,000 kernels, from 21·5 to 33·1 grams; and grades, from the equivalent of a little under No. 5 to between 1° and 2°.

A four-year table (excluding 1933) carries the comparison into the ripe stage and here there is a one-bushel reduction in yield from the hard-dough to the ripe. The kernel weight increased slightly, but, whether significantly or not, the bushel weight and the grade declined.

For three years, samples were obtained in the late-milk stage. Their average results compared thus with those from the early-dough: yield 1,625 to 2,044 pounds; weight per bushel, 55·7 to 59·8 pounds; weight per 1,000 kernels, 19·3 to 23·7 grams, and grades, from just above No. 6 to just above No. 5.

Dead-ripe Marquis was obtained only in 1931 and 1932. In the average of these two years, trends were consistent from the early-dough to the stiff-dough stage, after which there was a falling off in yield. The stiff-dough averaged 2,078, the hard-dough, 2,061, the ripe, 1,932, and the dead-ripe only 1,791 pounds. Bushel weights declined slightly after the hard-dough stage but kernel weight was a little the highest from the dead-ripe wheat. Grades were practically level from the stiff-dough to the dead-ripe stage.

DISCUSSION—REWARD DEGRADED BY PREMATURE CUTTING

Wheat harvested in the late-milk may make substantial yields of grain of fair weight per bushel which germinates in good percentage and grades Feed or better. From that stage onward, the development of the kernel proceeds rapidly. On the test grain taken during the stiff-dough stage, yields and grades were satisfactory though not so good as when the hard-dough stage was attained a few days later. Any subsequent development appeared more than offset by losses due to unfavourable weather conditions and to shattering. In commercial practice, the risks entailed by letting the crop stand past the hard-dough stage would more than offset the occasional advantage in grade.

Any lack of uniformity must be carefully regarded in judging the fitness of a crop for reaping, as a small proportion of green kernels may reduce the grade; hence, the earlier parts of a field may have to be left to allow the later patches, the later heads, or the later kernels within unevenly ripening heads a chance to finish off. This applies particularly to Reward, the grading results with which showed some departure from corresponding values of Marquis. While in the ripe stage the two kinds graded almost alike, the Reward was the more severely degraded by premature cutting.

Apart from the susceptibility of Reward to degrading on account of green kernels, the performance of the two varieties was strikingly consistent; which brings out the fact that, from the standpoint of yield and grade, the firm or hard-dough stage was the best condition in which to cut wheat. Thenceforward yields appeared to decline, even when, as in this experiment, the heads were carefully collected and immediately sacked, being thus protected from loss by rodents and birds. The workers have not been able to satisfy themselves that the reductions in yield from the firm-dough to the dead-ripe stage were wholly due to mechanical losses, though it is difficult to assign any other plausible hypothesis.

DOES GRAIN FILL FROM THE STRAW AFTER CUTTING?

To what if any extent do the kernels of grain continue to fill after cutting? To supplement a stage-of-harvesting experiment, uniform stands of Reward and Marquis wheat were harvested during the five years 1930-4 in each of three different ways: (*a*) kernels picked or rubbed from the head at the time of cutting; (*b*) heads separated from the straw at the time of cutting, and (*c*) heads cut with a foot of straw attached and cured in gunny sacks as is the usual rod-row practice. Material was collected about every fourth day. In the first two years, the kernels immediately shelled were put directly into small sacks; but as some musting of the immature kernels occurred, they were thereafter partially dried in trays before being placed in the sacks.

In the second year, a fourth method was introduced: full-length straw was cured in sacks without unnecessary breaking or bending of the straw. In 1932, a fifth method was introduced: full-length straw was taken, tied into small bundles and cured within stooks of non-test wheat.

Comparisons were by three periods: (*a*) early- and medium-dough stages, (*b*) late- and hard-dough stages, and (*c*) ripe and dead-ripe stages.

Indications of post-harvest filling were slight. In the first stage, kernels immediately rubbed out by hand yielded appreciably less than grain cured in the head, whether with or without straw attached; but such differences could easily be accounted for by mechanical loss, as some soft kernels were bound to be bruised and a few to be missed by the operator. Judged by yield, by bushel weight or by kernel weight the grain did not seem to fill much from the straw, although there appeared to be a slight advantage in grade. It is admitted, moreover, that results cannot be properly interpreted without chemical and physical analysis. The tables are full of minor inconsistencies and make out no case for curing in the stook as compared with curing in sacks.

No appreciable argument is afforded to favour the binder to the combine method of harvesting where frost and unfavourable autumn weather do not forbid the latter.

EFFECT OF SOIL UPON WHEAT QUALITY

It had been observed at Beaverlodge that soil might greatly affect not only the yield but the physical character and the chemical composition of the wheat kernel. The most marked instance was in 1925, when a certain stock of Marquis wheat grown on deep black-loam summerfallow analysed 45 per cent higher in protein than the same stock of wheat grown the same season half a mile distant on somewhat grey soil that had produced sunflowers the year before. In 1926 wheat grown on summerfallow ranged from 14·23 to 15·76 per cent in protein content.

In 1931 a very dwarf growth of wheat was noticed in a low, puddled spot in a field of second-crop Reward wheat. The field averaged about 25 bushels per acre, but on the poor spot it would hardly have exceeded 5. The Division of Chemistry analysed grain and soil samples, finding that while the puddled spot carried only one-third as much nitrogen as the good soil and only one-quarter as much organic matter, being also much more strongly acid, it nevertheless produced a wheat with nearly as high a protein content and almost as large kernels. The ash content was considerably higher in the wheat off the puddled soil. Apparently in this case the inferiority of the soil was reflected in yield more than in kernel composition. Wheat quality is governed by a complex of varietal soil and seasonal factors.

A VERNALIZATION TEST

The pre-sprouting or vernalization of seed wheat was tried out in 1936 with both spring and winter varieties, all spring-sown. The grain was treated at the Central Experimental Farm, Ottawa, and sent to Beaverlodge. It was seeded on May 7, six days after the variety test. The effect on the spring

wheats was not pronounced, but on the winter wheats it was remarkable. All the winter wheats sown with vernalized seed grew tall, strong plants, carrying heads about twice their usual size, and matured unexpectedly well, whereas observation plots of the same kinds sown with untreated seed did not pass the rosette stage. Vernalized Turkey Red matured in 126 days, only 7·7 days later than Marquis, and yielded 3,587 pounds per acre of No. 5 wheat. Kharkov was estimated to be 11 days later than Turkey Red and yielded 1,725 pounds. Yaroslav was likewise late and yielded poorly, but Crail Fife, Dawson's Golden Chaff, Kanred and Minturki produced fairly well.

MISCELLANEOUS

Eight Peace river millers interrogated by the sub-station in 1931 virtually all agreed that they would not grind Garnet wheat for their customers when they could obtain other wheats. One rated Garnet worth about 75 per cent as much as Reward and Marquis. Another put it as low as 50 per cent, while a third was more tolerant.

Safflower, a seed-oil crop, proved unsuitable.

In a co-operative experiment with the Dominion Laboratory of Plant Pathology, Edmonton, no infection of stripe rust was found in the susceptible variety, Chagot.

FORAGE CROPS

EIGHTEEN YEARS TESTING OF GRASSES

During the seven years 1918-24, 1,460 meadow plots occurring in two important cultural experiments had been seeded at Beaverlodge. The 149 plots of western ryegrass had outyielded timothy by 42 per cent, and meadow fescue gave one-tenth less than timothy. In the experiment in which brome occurred it practically equalled rye grass, while Kentucky blue cut only 46 per cent as much as timothy.

During 1927-32, 10 grasses were tested in 183 plots, but brome, ryegrass and timothy were the only ones included throughout. Meadow fescue and Kentucky blue were confined the last year to single observation plots. Crested wheatgrass and red top were included in 4 seedings; orchard grass in 3; meadow foxtail in 2, and reed canary in 1. All seedings were without nurse crops.

Brome.—The six brome seedings averaged 3,717 pounds of hay from their initial crops and 2,545 from the second ones. The three seedings carried to the third cropping season averaged 2,110 pounds in that year. Adapted to hay or pasture purposes, either alone or in mixtures, brome has proved to be the most productive and satisfactory grass to date. Reasonably thorough eradication is practicable in normal seasons. It suppresses weeds exceptionally well.

Western Ryegrass.—Ryegrass rather outyielded brome in the first two crops and, though falling short in the third, averaged a trifle the better in the aggregate of three cuts. It makes a poor showing in May, but shoots up rapidly when heading. The hay is easy to cure. The sod breaks easily, gives no trouble by volunteering, and throws better grain crops than does brome or timothy. On the other hand, ryegrass is subject to root rots which may affect the ensuing crop of wheat. Smut and ergot may infest ryegrass. Within a week or so after heading its hay becomes wiry and unacceptable. It fails to spread across vacant spaces, thus permitting stands to become weedy. No notable superiority occurred among four strains of western ryegrass tested in two seedings, but Grazier and Fyra were more leafy than Mecca.

Timothy.—Timothy and brome yields compared as 2,927 to 3,717 from the first cut; 2,032 to 2,545 from the second; 1,409 to 2,110 from the third, and 1,931 to 2.913 in the average of three cuts. Timothy in the North forms a tight sward

which is fairly stiff to plough and is followed by sparing grain crops; but it suppresses weeds well and may find a place in short leys, for which purpose it is now being compared with a few other grasses, each in combination with sweet clover.

CRESTED WHEATGRASS.—Four seedings of the common strain of crested wheatgrass slightly exceeded the corresponding brome seedings in their first crop, but more than lost this in the second, aggregating 273 pounds less. Crested wheatgrass has a much more profuse root system than western rye and suppresses weeds more effectively; though scarcely so well, at Beaverlodge, as brome or timothy. It propagates root rots that affect wheat and has responded indifferently to nurse-crop seeding, giving in one year three-quarters of a ton when plots that had been seeded alone approached two tons.

MEADOW FESCUE.—Two crops off four seedings of fescue produced 78 per cent as much hay as brome; three crops off two seedings, only 66 per cent as much. Meadow fescue does poorly in dry seasons and winterkills under severe exposure.

KENTUCKY BLUE.—Two cuttings from four seedings yielded only 60 per cent as much hay as brome. Old stands in drouthy seasons produce little. It is, of course, better adapted for pastures and lawns.

RED TOP.—Although in the wet summer of 1935 a fourth crop of red top produced surprisingly well, the species withstands drouth poorly, winterkills somewhat under exposure to dry cold and has proved to be definitely unsuited to upland hay production.

ORCHARD.—Orchard-grass winter-kills readily and is conspicuously unproductive under searing drouth. In two crops from three seedings it yielded 40 per cent as much hay as brome.

MEADOW FOXTAIL.—Two seedings proved plenty. From the two crops of these it yielded 52 per cent as much hay as brome. Heading a month after growth commences, it ripens seed early and volunteers mischievously. It is supposed to be adapted to sour, wet land and to make early pasture.

REED CANARY.—After producing very scantily from its thin stand in the first cropping year, this grass outyielded every species in each of the next three summers but gradually filled up with volunteer grasses. A fuller stand laid down in 1934 outyielded brome in 1935 but produced a very disappointing crop from its tight sward in 1936. Advocated as a lowland crop, reed canary seems capable of large returns on upland when the stands are thin enough and are kept clean. Under dry conditions, rows have been much more productive than broadcast stands. Drawbacks from a rotation standpoint are its spare production of seed, the tendency of the seed to shatter promptly and of the roots to volunteer persistently.

LEGUMINOUS MEADOW CROPS

Among meadow legumes tried the variegated varieties of alfalfa are the hardiest, followed by sweet clover, Altaswede red clover and alsike. Yields are curtailed by dry weather prevailing in the average spring and early summer, the small clovers being often dwarfed by drouth. Some, such as alsike, may nevertheless be featured as seed specialties, and their free occurrence should help to maintain fertility. The seed grower may find their volunteering troublesome unless one variety is adopted and continued with. For hay production any of them is best grown blended with a grass.

ALFALFA

Through fully five hundred plots seeded alone and in mixtures during the past twenty years it has been established that, given effective inoculation and reasonably good preparation, alfalfa may be grown on virtually all soil types. If only one cutting per annum is removed and the aftermath is not grazed, the stands of suitable varieties can be maintained practically intact for twelve years or longer, outyielding the most productive grasses after the second or third season and augmenting the hay crop when sown mixed with them. On a dry clay knoll, seeded to a variety test in 1923 and still producing, Grimm has averaged 3,485 pounds of hay per acre and its plots are still reasonably clean, although Cossack beside it is grassy and yellow-flowered Siberian quite soddy.

GRIMM.—In 160 plot harvests representing ten seedings in replicated plots from 1923 onwards, cut usually but once a year, the annual hay yield of Grimm has been 3,301 pounds. Fifteen other varieties have been compared with it in varying numbers of seedings. Though all alfalfa yields fluctuate sharply according to moisture, Grimm has been one of the most consistent producers. Like other adapted varieties it volunteers persistently, even when the sod is clean-ploughed and thoroughly disked. The greatest problem is to kill it; second greatest, to keep the stands clean.

LADAK.—Grimm's keenest rival is Ladak, the Asiatic introduction featured as wilt-resistant. It is, like Grimm, a variegated sort. Rather slow-starting in spring, it blossoms several days later and may thus be superior for a district where one annual cutting is the favoured practice, unless it proves too late to ripen its seed with reasonable regularity. It holds its foliage better than Grimm and thus far has yielded 6 per cent more hay.

COSSACK.—Cossack has proved to be no hardier than the standard and has yielded a trifle less. It has seemed to compare a little more favourably in the wet than in the dry seasons.

YELLOW-FLOWERED SIBERIAN.—This is distinctly a wet-season, one-cut variety. Nearly all its plots have become grassier than others. When ploughed up it volunteers most aggressively of all.

OTHER VARIETIES.—Ontario Variegated has been distinctly less winter-hardy than Grimm. Macsel has been reasonably promising. Lytton exhibited a tenddency to downy mildew and its weakened stands have produced 12 per cent below Grimm. Several varieties have been tested for too short a time to permit conclusions. Several good kinds have failed to supplant Grimm.

SEED PRODUCTION.—During the 13 years 1924-36, the alfalfa seed crop has virtually failed in 3, has been poor to medium in 7 and good to heavy in 3, with a top yield of 10 bushels of excellent seed per acre in 1925 from inter-cultivated rows of Grimm seeded in 1923. These rows produced seed from clean stands for 10 years. A half-acre broadcast stand seeded at the same time on about the same kind of soil became grassy as the result of stray invaders shattering their seed before the alfalfa was harvested, and after 1931 was no longer worth cropping for seed. Excluding one crop in which there was a slight doubt about the accuracy of the data, we have 7 years' precise comparative records. The rows averaged exactly three bushels of seed per acre; the broadcast, 1 bushel 55 pounds. The rows averaged the better quality of seed, though a fair percentage in both cases was No. 1. The last five years have been less favourable for alfalfa seed production.

SWEET CLOVER

Especially on the gray soils sweet clover succeeds best with non-nurse-crop seeding. Tied loosely in small bundles set four to the stook it cures into bright hay during any but the most extreme periods of prolonged wet weather. It

unfortunately attracts cutworms, whose parent moths are prone to lay eggs among new seedings and whose resultant larvae once stripped and partially killed promising stands in the second season.

Variety testing has established Arctic as the best sort under trial. It has proved to be distinctly more winter-hardy than other kinds, conspicuously so in 1935-6. Five or six days earlier than common biennial white, Arctic has a fair chance of ripening its seed crop, though occasionally failing to do so even on some of the safer lands. Ten crops (1927-36) of Arctic hay from non-nurse-crop seedings have averaged 3,543 pounds.

Common yellow blossom, tried against Arctic in 8 years of the 10, out-yielded it by 4 per cent, but it blooms precociously in dry seasons. I.H.C. yellow was the second hardiest in 1935-6.

Zouave is a strong-growing, yellow-flowered type which bid fair to out-yield the common yellow but did not actually weigh up quite so well.

Common and Maccor biennial whites are stout, tall varieties, but are less suitable than Arctic. Stands of Grundy Co. have been thin.

The thick-growing, fine-stemmed Alpha strains yield less than Arctic and in drouthy seasons are liable to head too low, thus falling short in hay production.

ALSIKE CLOVER

Fairly hardy and very prolific in seed production, alsike works its way along roadsides and volunteers freely wherever established, but its comparatively shallow-rooting and early-seeding propensities render it very susceptible to May and June drouth. In two dry years, plots that had been seeded under favourable conditions the year before averaged 390 pounds of hay per acre—about 13 days' feed for a cow. In 1935, a strip of it cut over two and a half tons. Average expectation would be a ton or so from non-nurse-crop sowings and much less after nurse crops.

The plentiful heads fill well with seed. Small plots carefully cut, raked by hand and scrupulously saved, yielded 810 pounds of seed per acre in 1933 and 962 pounds in 1935—a phenomenal average of 14 bushels 46 pounds. In dry years the seed yield would be less, while commercial harvesting might sometimes be difficult and wasteful.

RED CLOVER

Late-maturing types of red clover are better adapted than the common double-cut. Altaswede, a selection of late red Swedish, ranks fully equal to alsike in winter hardiness. In 1935, a long strip of it yielded 4 tons of hay per acre as against 2½ tons of alsike and about as much of brome. Ontario double-cut beside the Altaswede yielded 1¾ tons in that favourable season.

From small hand-raked portions of these strips the seed yields were 440 pounds of Altaswede and 346 pounds of Ontario double-cut (common red) against 962 of alsike.

WHITE CLOVER

Among several strains of white clover tested during the "'twenties," two Danish ones, Stryno and Morso, exhibited conspicuous hardiness in trying winters. Ladino, a much heralded large white clover from the South, was but partially hardy. Quite the least resistant to dry cold were the Scottish, Kentish and English wild white of the stocks then supplied.

During the past six years, three seedings of white clover have been cropped. Forage yields varied from a little pasture for bees and beet webworms in 1932 up to 1½ tons of hay in the wet summer of 1935. The low-growing English wild white produced 3,167 pounds. In not more than one or two seasons out of ten do any of the white clovers give an appreciable cut of hay.

They do better in seed production, though in most seasons the problem is to gather the seed off the short stems. In 1933, 292 pounds of first-class Ladino seed per acre was secured with the aid of a lawn mower. Two years later, a horse-drawn mower could be used without difficulty, and careful handweeding recovered almost full yields as follows: Ladino, 77; English wild white, 193; Danish Morso, 685; common white Dutch, 722 pounds per acre. Such yields of plump, bright seed would be highly profitable, even allowing for the waste incidental to harvesting operations. Production of these small seeds is, however, an enterprize for the specialist. In dry years the inexpert grower might garner more grief than seed.

The white clovers suffered variably during the winter of 1935-6 and were ploughed under. The Danish ones have continued to excel in hardiness though the very good showing of a Nappan selection of the wild white suggests undoubted differences in strains.

MEADOW-CROP MIXTURES

Correct appraisal of a crop depends upon more than its tonnage. The after effects are too often overlooked.

A dual project was launched in 1933 when 128 plots were seeded in a quadruplicate test of brome, western rye, crested wheat, timothy, meadow fescue, Kentucky blue, Grimm alfalfa and Arctic sweet clover, each by itself and in combination with others. The seeding was repeated in 1934. After the third hay crop, the swards were to be broken and sown twice to spring wheat as a gauge of residual effects.

Abnormal behaviour was induced by two wet summers during which even the grasses produced heavy aftermaths. In some cases these were taken.

Alfalfa conspicuously augmented yields where combined with single grasses or with grass mixtures. It helped to suppress weeds and, as always, combined well with brome, amongst which inoculated stands pretty well held their own—notwithstanding that brome choked weeds better than any other grass.

Sweet clover was also successful in mixtures, but hardly weighed up according to its appearance.

LAWNS

Twelve grasses and mixtures were seeded in 1931 in a quintuplicate lawn-grass test involving incidental comparisons of lime and ammonium-sulphate dressings applied in the initial year. A rank growth of shepherd's purse in the new seeding was held in check by eight successive clippings with a lawn mower. Three sets of plots were sown at the full rate of seeding prescribed by the Division of Forage Plants: 5 pounds of Kentucky bluegrass per 1,000 square feet; other grasses and mixtures in proportion. Where white Dutch clover was added, it was used at 1 ounce per 1,000 square feet. Two sets were sown at half rates.

A second seeding, at the full rate, was made the next year, introducing browntop and the Fairway strain of crested wheat.

All plots in the 1931 seeding passed the first winter successfully, but snow mould was suspected to have caused considerable killing in 1932-33. Its ravages were slow to disappear. Only the bents suffered from the winter of 1934-5. These and browntop wintered the most poorly in 1935-6, although the degree of injury was less than previously. Their plots continued below par throughout the summer.

Neither limed nor sulphated areas were ever found superior to the unfertilized. Probably the lime dressing was too light to be effectual, and the ammonium sulphate might have been more beneficial if applied subsequently to the season of seeding.

The half seeding appeared as satisfactory as the full rate, which was much heavier than the sub-station has usually advised.

Dandelion, yarrow, cinquefoil and shepherd's purse compose the chief foreign growth, which is inclined to be most troublesome in the less complete stands.

Kentucky bluegrass, alone or in simple mixtures, maintains the most dependable and desirable turf. It takes every opportunity to spread and is fast dominating weakly held plots.

Creeping red fescue is a keen rival of bluegrass, making a fine, smooth, dark-green nap and appearing almost as hardy as Kentucky blue.

Chewing fescue at first seemed distinctly less hardy than creeping red, but it has lately improved its showing, so that the two grasses now compare fairly well in some plots.

Creeping bent and velvet bent form beautiful, cushioned carpets, but as they are not hardy enough, they "pocket" too much. Colonial bent promises little more than the creeping bents.

Redtop has not proved to be satisfactory as a lawn grass. Most of its premises are being invaded. As a cheap diluent of a seeding mixture it helps to fill the stand until supplanted by better species.

Crested wheat appears perfectly hardy, but it lacks density and leaves much to be desired when compared with bluegrass or either of the fescues.

Two well-known commercial mixtures and several blends of two or more grasses are not better than, if as good as, a simple mixture of Kentucky bluegrass with white Dutch clover.

Wet seasons favour the intrusion of the clover; 75 per cent of many plots seeded only with grasses became mixed with the legume. During drouthy seasons it largely disappears from any but the lowest spots, but for homemakers who do not mind seeing the lawn patchy at times, it is recommended as an ingredient at the rate of about one-half ounce per square rod. This with one-half pound of Kentucky bluegrass per rod has been successful on the station grounds.

ANNUAL FORAGE CROPS

The usual hoe crops are not well adapted, and among broadcast forage plants, chief interest centres upon cereal roughage. While dry-matter production is an inadequate basis for the appraisal of crops, certain of which command a premium for succulence, vitamines, minerals, wholesomeness or other qualities, a comparison on this score is suggestive. From 1926 to 1934 inclusive, the solids production of ten crops grown on the experimental grounds was tabulated. Preparation was never alike for all the crops, those such as roots enjoying favours at times.

Oat bundles averaged 5,409 pounds of dry matter, equivalent to nearly 3 tons of well cured green feed. Thrice they headed the list, but on the average of nine years, they were exceeded 11 per cent by rape and kale, which ranged from a low of 3,680 to a high of 10,956 pounds.

Sunflowers averaged 88 per cent as much dry matter as oats; swedes, 82 per cent; fall turnips, 66 per cent; millet, 53 per cent; mangels, 48 per cent; sugar beets, 45 per cent; corn 43 per cent; and carrots, 29 per cent.

Whereas under garden culture some big turnouts of root vegetables are obtained, field culture exposes plantlets to cold, lashing winds, to the dry weather often prevailing in May and June, and to insect attack; moreover, the hazard of autumn frost compels early lifting to ensure good keeping. Mangels have been left unscathed until the end of October; at another time, they have been crown-injured in mid-September. Even swedes, most frost-resistant of all the root crops, are unsafe after the middle of October, and they, too, have been threatened a month earlier. Carrots once achieved the stellar production of 2 tons—water and all! Since storage and feeding present further problems,

field roots seemed destined to play a minor role in Peace River agriculture, though a few grown in moist, sheltered spots and stored in cellars conveniently adjoining the stables probably have a place.

Though dwarf varieties of garden corn present usable ears in considerable abundance, only one satisfactory crop of fodder has been raised.

Sunflowers have gone out of vogue as a silage crop.

Millet is too susceptible to spring, summer and autumn frosts for confident reliance.

Rape and kale are not feasibly stored for lengthened feeding periods.

The limitations of the other crops leave oats and oat mixtures the staple crop among annuals.

In a previous five-year comparison, oats and peas had always been less productive than straight oats.

Soybeans have been planted in four years. Only Wisconsin black and Manitoba brown ever podded. None ripened. Some root rot was noted on Mandarin in 1933.

MISCELLANEOUS NOTES

Naphthalene spread in the drills with mangel and turnip seed delayed germination in 1931 and was less effective in repelling flea beetles than when sprinkled along the rows of the emerging crop. Subsequently, these insects were well controlled by timely dustings with Paris green, 1 part; copper carbonate, 4 parts; hydrated lime, 6 parts.

On the Mennonite variety of sunflowers grown in 1931, Dr. G. B. Sanford, of the Dominion Laboratory of Plant Pathology, Edmonton, identified a common root rot (*Sclerotinia*), the first reported on sunflowers from the district.

A forage-crop nursery for the trial in a small way of various introductions and novelties was begun in 1934 and later expanded. In it have been seeded 31 plants regarded as annuals, 15 regarded as biennials and 76 perennials. There are, in addition, many clonal selections of the non-creeping-rooted selection of brome grass called Parkland, and many varying plants of Ladak alfalfa are also under selection.

FIELD HUSBANDRY

METHODS OF SEEDING TO MEADOW

Ten annual seedings have been made of a mixture consisting of equal weights of alfalfa, sweet clover, western ryegrass and brome, applied in four different ways. Three series of plots were seeded with a nurse crop of Banner oats and one series was seeded without. In the first series, the meadow seed was mixed with the oats in the drill box, the grain being sown at two bushels per acre. In the second, it was broadcast ahead of the grain seeder. In the third, it was likewise broadcast ahead of the seeder but every other grain run was blocked, so that a bushel of oats was applied in twelve-inch spacing. In the fourth series, the meadow seed was broadcast alone but the grain drill was used to cover the seeds, as it did in the other series. In all but the first seeding, three depths of placement or covering were compared: shallow, medium and deep. As a rule, each stand was cropped four years to hay.

As in all other experiments, the first hay crop was much lighter after nurse-crop than after non-nurse-crop seeding, but no great difference was evident in the second or subsequent crops.

The oats furnished much more than enough tonnage to compensate for the reduction in hay yields, yet there is much in favour of dispensing with the nurse crop if weeds can be controlled during the first season by grazing or by clipping. Of these alternatives, experience leads the sub-station to favour judicious grazing

during the season of seeding where only edible weeds are to be controlled. The stock must be kept off when the land is soft and should be taken off finally about August 10 to permit a good autumn growth.

Nurse-crop seedings came so weak, thin and weedy in the second season that in ordinary farm practice some of them would have been ploughed up.

The least restrictive of the three nurse crops was the one in which a bushel of oats was seeded in drills 12 inches apart, and this gave fully 90 per cent as much weight of oat bundles as stands seeded with two bushels of oats in six-inch drills. But weeds as well as meadow seedlings flourished in the twelve-inch spaces, requiring almost as much pulling as in the non-nurse-crop seedings, and under less convenient conditions. It has been the least practical of the four methods.

Except in one very dry season, the plots where the meadow seeds were cast ahead of the grain drills caught better, developed better and required less weeding than those in which the meadow seeds were mixed with the grain in the drill box.

Contrary to expectations, no prevailing advantage was observed in favour of shallow covering of the seed. In one or two seedings the sweet clover seemed to do better with shallow than with deep covering, but the advantage was neither regular nor marked. On the strength of general opinion, however, too deep seeding is not advised, and a firm seed bed is recommended.

If a nurse crop is decided upon and a meadow mixture consisting of legumes and chaffy-seeded grasses is to be applied, a practicable method is to seed the former through a grass-seeder attachment casting ahead of the grain runs, the grass seed being mixed with the grain, which forces the feed.

PRE-SOAKING SWEET-CLOVER SEED

A project to determine the value of pre-soaking sweet clover seed has been conducted for five years. In this project, sweet clover seed dry, soaked for three hours and soaked for six hours was mixed with oats and applied in two ways: half was drilled through the grain runs in the usual manner and half was sown with the seed broadcast ahead of the drill discs.

It was found necessary to drain the surplus moisture from the clover seed, as too wet a mixture would not feed freely. When this was carefully watched, the drilled stands in which the clover seed was soaked yielded as much oat crop as those in which the clover seed was sown dry. Broadcast stands of oats were generally lighter than drilled stands, averaging 9 per cent less.

The sweet clover was cropped from only two seedings. Rather a scant case was made for soaking. Unlike the oats, the clover produced 31 per cent more hay from broadcast stands.

On the whole, the practice of pre-soaking failed to commend itself.

RESIDUAL EFFECTS OF VARIOUS GRASSES

In the dry summer of 1923, 25 per cent more hulless barley was produced on western-ryegrass than on timothy sod, and nearly as much after meadow fescue as after ryegrass. In 1924, the ryegrass sod not only outyielded the timothy sod but the barley grain and straw both analyzed a substantially higher percentage of nitrogen. A slight reversal in yields was encountered in the humid summer of 1926.

Corroborative data regarding the adverse residual effect of timothy under certain conditions have been obtained by the Universities of Alberta and Manitoba. Cornell found that in some way timothy seemed to have a depressive influence upon the rate of nitrification in the soil.

ROOT ROTS ENTER THE PICTURE

While decisive data had been obtained from certain residual experiments, a call for repetition arose from the fact that as root rots were becoming evident in wheat following ryegrass their presence might qualify earlier conclusions.

Upon removal of a second season's hay crop, the sods of seven grasses under quadruplicate test were broken in 1931 at three different dates, at fortnightly intervals, commencing July 30.

In the season of breaking, western ryegrass had yielded more than twice as much hay as timothy; brome, 59 per cent more; and meadow fescue, Kentucky blue, red top and orchard-grass, progressively less hay than timothy.

During dry weather after breaking, the sods decomposed slowly. The grass roots were not well killed and volunteering occurred the next year, particularly after Kentucky blue, brome and timothy. As on previous occasions, the blue grass sod remained like a sheepskin.

In the Reward wheat crop planted the next spring root rot was generally noticeable, being most evident on the ryegrass sod. Notwithstanding a reduction obviously due to this cause, the first breaking of this sod outyielded the corresponding breaking of timothy by 14 per cent in bundle weight and 11 per cent in threshed grain. On the average of all dates the spreads were wider. The wheat after fescue yielded highest of all. Brome sod broken on July 30 gave about three-quarters as much wheat as timothy sod broken on that date, and on the average of all three breakings, it gave about 85 to 90 per cent as much as the timothy sod. Red top gave 10 to 15 per cent more wheat than timothy sod, but Kentucky blue and orchard-grass compared poorly with timothy in respect to both hay and grain yields.

CONFIRMATORY DATA FROM A 1933 BREAKING

Eight grasses, including two strains of western rye, had been seeded in 1930 in quadruplicate. One of the western rye seedings had to be ploughed in 1932 because of couch-grass, and its plots were fallowed for a year and a half. The remaining grasses were cropped until 1933, and then broken by thirds on three successive dates. Reward wheat was sown in 1934.

Root-rot infection of the wheat was extensive in the first and third breakings of crested wheatgrass; and there was considerable in the second breaking of it, in all the breakings of western rye, in the first and third breakings of brome, and in the third-date ploughing of the fallow strips. All other areas exhibited some persistence of the fungus.

Timothy sod produced 27 bushels of wheat off the first breaking, and 27½ from the average of all breakings.

After exceeding timothy in hay production, the ryegrass plots yielded 10 bushels more wheat from the first breaking and 6 bushels more from the average of all.

Meadow fescue, producing 70 per cent as much hay as timothy, gave 41 per cent more wheat.

Brome, after producing 31 per cent more hay than timothy, was followed by 97 per cent as much wheat.

Crested wheatgrass outyielded timothy by 35 per cent in hay and 5 per cent in grain.

Kentucky blue had done much better than usual in hay production, and for once it was followed by slightly more wheat than was timothy.

Meadow foxtail, cutting 56 per cent as much hay as timothy, was followed by scarcely any more grain.

SOD CONDITIONS IN THE SECOND GRAIN-CROP YEAR

Backset the next spring, the land was re-seeded to wheat. Performance seemed inconsistent, but August frost caught the crop and yields were not taken.

The fallow areas retained little fibre and a distinct tendency to puddling was evident in the excessively wet spring of 1935.

The brome sod had decomposed fairly well but still had a binding effect. Timothy was similar though its fibre was poorly decomposed. The extremely fibrous sod of crested wheatgrass was still tough, demonstrating the soil-binding capacity of the species. Kentucky blue and meadow foxtail were similar. The fescue and ryegrass turfs, on the other hand, were well decomposed and distributed, the soil being friable.

GENERAL DEDUCTIONS

It seems clear that some turfs decompose more readily than others. Those which decay most slowly are likely to depress the yields of ensuing grain crops, but some of them may be best for the land in the long run. Drouthy seasons appear to accentuate differences in the behaviour of the sods.

Factors such as root rots, volunteering of the grasses, the moisture requirements of rotting sods and the bio-chemical factors involved play their part in decreasing or increasing the yields of ensuing grain crops.

CUTTING ALFALFA ONCE OR TWICE A YEAR

On a dry clay knoll occasionally irrigated with snow run-off, the regular removal of a second cutting of alfalfa gradually impaired the vigour of the stand to a point where two cuttings yielded only about as much crop as a single one. Vigour declined perceptibly and weeds crept in.

In the lee of a windbreak where snow banks annually accumulated to a great depth, twice-cut plots outyielded the once-cut about 28 per cent during a seven-year period, the gain amounting to some 1,100 pounds per annum. Even here the removal of the aftermath may have had a slightly detrimental effect upon vigour.

COMMERCIAL FERTILIZERS

NITRATE OF SODA ON RAPE

Rape is a gross feeder, and broadcast stands of it have been found a good indication of fertility conditions. For six years Dwarf Essex rape in both broadcast stands and in cultivated rows has been dressed with nitrate of soda at 160 pounds per acre. The dry-matter yield of the former has been 5,026 pounds from fertilized and 3,978 pounds from unfertilized stands—an increase of 26·3 per cent. Fertilized rows yielded 3,959 pounds and unfertilized, 3,322 pounds—an increase of 19·2 per cent. Intertillage of the rows had doubtless stimulated nitrification in the soil, and though the rows appeared ranker, their lower total production because of the fewer number of plants must have lessened the draft upon available soil nitrogen.

PHOSPHATIC AND OTHER FERTILIZERS FOR GRAIN

In the dry summer of 1929, little result was obtained from chemical fertilizers applied to Reward wheat on a newly broken area of rather gray soil. In 1930, when moisture was more plentiful, the same fertilizers used on the same type of soil but with the second instead of the first crop after breaking produced definite although not very large increases in yield. Fair responses were obtained that year with the use of fertilizers on the summerfallow wheat crop on deep dark soil.

Ammonium phosphate (carrying nitrogen as well as phosphorus) induced notably larger yields of wheat and of barley than did triple superphosphate, but with neither crop was the increase very profitable.

Subsequent trials with ammonium phosphate applied to wheat in rod-row tests indicated a moderate advantage though a questionable profit. In 1934, ammonium phosphate drilled in with wheat on well-worked alfalfa sod had so little effect that fully half the spectators picked the untreated plots as the better.

DO PHOSPHATIC FERTILIZERS CARRY A RESIDUAL INFLUENCE?

In 1930 an experiment was designed to compare the effects of applying a hundredweight of ammonium phosphate per acre to the first versus the second crop after fallow and these fertilized plots with unfertilized checks. Although the plots fertilized in the second cropping season outyielded those unfertilized it was found when the two years' crops were summed up that 7·5 per cent more bundle weight and 6·7 per cent more wheat were obtained by applying the fertilizer with the first crop. Perhaps to be quite fair the test should have been carried through a third cropping season.

Second-crop yield data were obtained in 1931 from two other experiments in which ammonium phosphate and triple superphosphate had been used in 1930. From the 40 fertilized plots in these and in the experiment above reviewed there was scant if any evidence of a favourable residual influence upon the second crop. This is to be expected from the moderate quantities used, which are designed rather to impart a quick strong-rooting start to the crop than to supply a considerable proportion of its ultimate plant-food requirements.

The general indication of numerous tests is that greatest response from fertilizers may be expected where the most favourable moisture conditions prevail.

DO FERTILIZERS IMPROVE WHEAT QUALITY?

From samples sent to the Cereal Division for milling and baking tests, ammonium phosphate appeared to have increased the crude-protein content of the wheat when applied at the time of seeding; and in one experiment it seemed as though some influence might have been carried through to the second crop. However, baking tests of the first and second crops failed to show that the inherent strength was improved correspondingly with protein content. Wheat from the gray soil in 1930 was inferior for bread-making purposes to that grown on the dark loam, but fertilizer applications failed to improve the quality appreciably on either soil. Other fertilizer tests conducted at Beaverlodge and elsewhere have indicated that spring applications of readily available nitrogenous chemicals are more likely to affect yield than quality.

AMMONIUM PHOSPHATE ON ROW CROPS

In the five years 1932-6, ammonium phosphate was applied experimentally to intertilled annual forage crops at 30 pounds per acre, being spread along the opened drills, into which the seed was then sown with a garden drill. Results have varied much with the seasons, and on the average of five years have ranged from a decrease of 2 per cent with mangels to an increase of 23 per cent with corn.

FERTILIZERS FOR POTATOES

The average of two years' data showed that 300 pounds of triple superphosphate applied in the furrow increased the yield of Irish Cobbler potatoes about 10 per cent, the increase costing (on the basis of 1937 quotations for a 0-43 formula) about 42 cents a bushel without allowance for labour. The same amount of 10-48 ammonium phosphate practically doubled the super-

phosphate increase and at a much lower cost per bushel. At 1937 quotations on an 11-48 formula, the ammonium phosphate would have cost $9.90 per acre or 29 cents per bushel of crop increase. Two hundred and seventeen pounds of sodium nitrate applied in two dressings showed no consistent increase at all, but a combination of nitrate and superphosphate rivalled the showing of ammonium phosphate. Best results were obtained with a complete fertilizer of ammonium phosphate plus muriate of potash. This gave 43 per cent more than the check plot. Muriate of potash by itself had about as much effect as superphosphate alone. Ten tons of good well-rotted manure per acre applied in the drills increased the yield of Cobblers only 29 per cent, or 51 bushels per acre, which at a field value of 30 cents a bushel would amount to $1.53 per ton of manure.

With Carmans the results were somewhat similar, though larger increases over the checks were shown by super and by ammonium phosphate, and smaller increases by the superphosphate plus nitrate, by the manure in drills and by the muriate of potash.

It could hardly be said that any of the commercial fertilizers in the quantities used gave enough increase to repay the fertilizer and the labour of application with marketable potatoes at 30 cents a bushel.

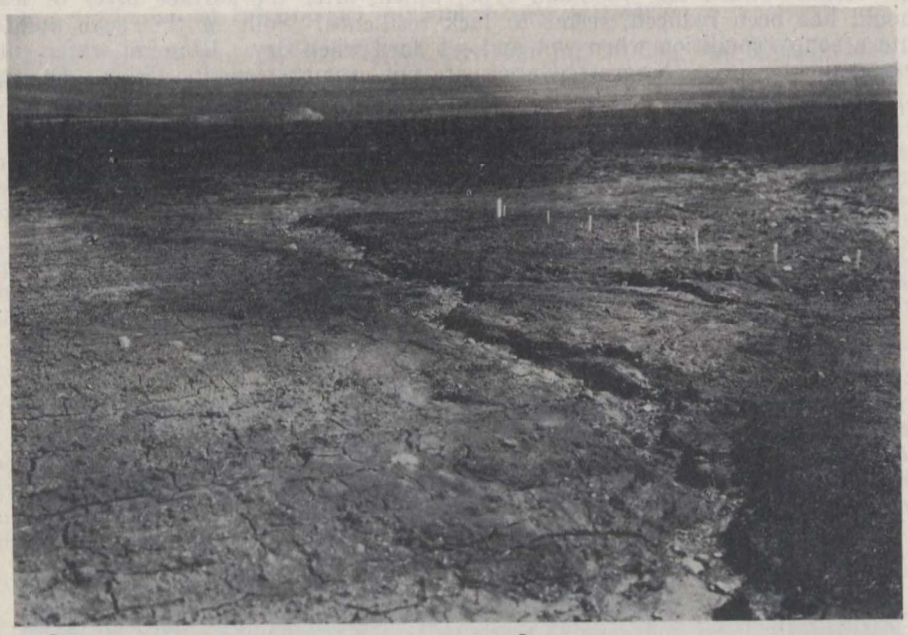
In a supplementary test, the broadcasting of ten tons of well-rotted manure with a spreader before the planting furrows were opened made scant improvement except on the nitrate plots, where the combination of manure and nitrate gave substantial increases, as the combination of superphosphate and nitrate had done in the other section, although nitrate alone gave little or no increase.

CONTROL OF EROSION

While incipient soil drifting has occurred at times on a few cultivated fields, the devastating effects of water erosion are widespread. A good deal of the soil verges toward the woodland type, which, after the surface layer of leaf mould has been reduced, seems to lack resilience. Soils of this type puddle into a soupy condition when wet and set hard when dry. Running water cuts them quickly; even the grassed areas are not exempt from its action. On the

Guttering effect of erosion on bare cultivated ground without turf roots to check the wash. Grande Prairie District, May 15, 1931. Photo by Superintendent.

Effect of soil drifting. Dust bank filling road ditch on May 15, 1931. Loam swept off field shown in the illustration on page 27. Photo by Superintendent.



Guttering effect of erosion on bare cultivated ground without turf roots to check the wash. Where the wash reached ploughed sod the guttering ceased. May 7, 1932. Photo by Superintendent.

league-long inclines characteristic of many portions of the Peace plateaux only time is needed to cheat the plough. Soil washing occurs almost every year on the sharp slopes of the experimental grounds.

In some parts of the region engineering will be required, but elsewhere trees, meadows and crop debris are serviceable. On the sub-station, sod roadways transversing the wash have been found effective. Crop rotation has advantageously interposed broad belts of sod or of unploughed stubble across the direction of the sharper slopes. In one place where an irregularly-shaped gash had been cut in a newly-seeded brome field, oblique ditches with rounded banks seeded to grass have safely arrested the destructive process; and seeding to a mixture of alfalfa and brome grass has checked other incipient troubles. In 1936 a shallow runway was scraped out and seeded to brome. Other precautions adopted have been ploughing and fall cultivation across the prevailing slopes, the strewing or damming of runways in the autumn with manure, and the diversion of spring run-off for the irrigation of dry ridges.

FROST AND MOISTURE

Soil freezing and snow-moisture penetration are related factors. The drier the land when it freezes the less tightly and perhaps also the less deeply it becomes bound. The brasher the crust the greater the chance of snow melt entering it in the spring. It was observed in mid-April, 1932, that what frozen crust remained was veined with crystals and apparently porous so that percolating moisture might be expected to work its way through. Deep snow occurring in autumn or early winter and continuing until the break-up may prevent the ground from freezing and may permit potatoes to remain unspoiled in the field all winter and autumn-volunteering spring wheat to survive and produce heads the next year, as in 1932. Under such conditions a considerable quantity of snow moisture may be received by the soil during the dormant season. On the other hand, snow moisture has slight chance of penetrating a deep crust of frozen soil as fluctuating temperatures thaw and saturate the surface layer. Over such a crust most of the water carries away precious loam in its race down the runways. These and the following deductions are based upon 300 excavations and borings made on the sub-station during the last six years, besides 167 borings incidental to a project for the control of soil drifting.

PERCOLATION OF RAINFALL

Compact soil and undulating topography make for heavy run-off. Soil moisture is a problem in most parts of the Peace.

On the strength of his work at Swift Current, the late S. Barnes wrote in 1932:—

> ". . . . Grain crops can exhaust all available soil moisture within the reach of the roots so that at harvest the soil is relatively dry . . . . The depth to which it will be moistened by a certain depth of rainfall will be quite definite, although it varies in the different soil textures . . . There will be a sharp line of demarcation between the moist and the dry soil. Further downward movement is extremely slow."

Summer borings at Beaverlodge support these conclusions. There is usually after rains a level above which the earth is moist enough to pack on the worm of the earth auger, while below that it crumbles.

Besides emphasizing sharp differences in percolation because of contour, the borings have shown that perennial meadow crops exhaust the moisture to considerable depths and keep the top layer habitually dry so that when moisture falls it does not readily penetrate. Contrast the form of a raindrop balling up on a dusty road with one flattening out on a damp surface. None but heavy

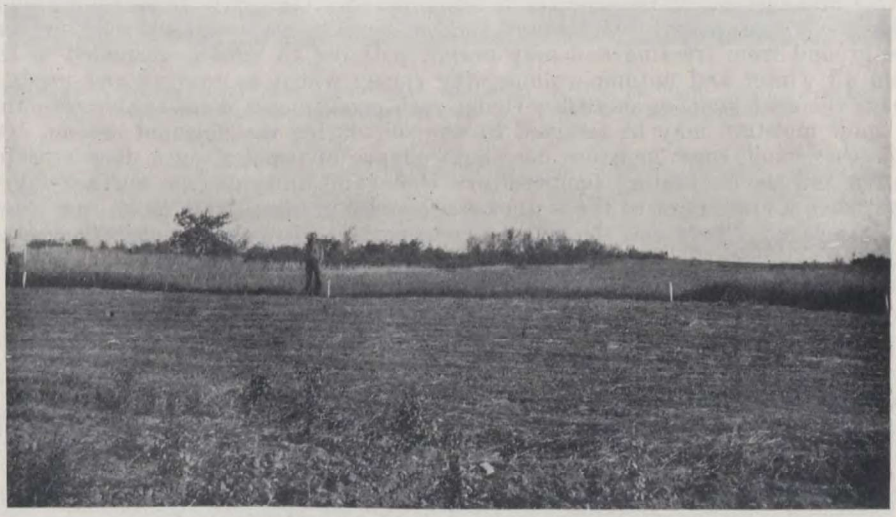
rains enter more than a few inches into land persistently pumped by meadow crops. The moisture that enters merely the top layer is quickly evaporated by sun and wind supplementing the plants' eager demands. In numerous borings alfalfa knolls have been found among the driest spots, for alfalfa has long roots and grows persistently throughout the open season whenever there is moisture to be had.

Fields producing an uninterrupted succession of annual crops sometimes have opportunity for considerable storage of moisture. Well-worked fallow has the best opportunity. The further down the moisture reaches the less the percentage wasted by evaporation and the greater the reserve against future drouth.

Thus it is seen why in a dry climate annuals produce more tonnage than perennials so long as the soil does not blow or wash away. In checking these tendencies the meadow crops have an important place.

SNOW MOISTURE FOR SPRING IRRIGATION

Behind a single row of trees along the crest of a half-mile easterly slope snowbanks annually pile up. In the spring of 1933, this icy drift was calculated to average 50 feet wide by 3 feet deep and to contain over 4,000 tons of congealed moisture. Considerable snow-water irrigation was practised in 1932 and in a few other seasons by furrowing when the frost had drawn to plough depth, at which time a horse could easily pull a walking plough over the frozen



Effect of snow-water irrigation on a four-year-old brome-alfalfa meadow. On each side is an area benefited by the irrigation. In centre an area not reached by any appreciable volume. Comparative hay yields: Left, 4,406 lbs.; centre, 1,303 lbs.; right, 3,721 lbs. July 15, 1932. Photo by Superintendent.

sole. Furrows thus made deflected snow melt obliquely from the draws to the ridges, where on meadow land it spread out and soaked in. On cultivated ground considerable fussing with hoe and shovel was necessary to keep it from finding its way back to the natural water courses. Grain stubble was helpful in spreading the moisture, though less effective than meadow. Even in years of deep freezing a degree of water conservation may be accomplished, for the ridges usually thaw out to some depth while water is still running down the hollows.

An alfalfa knoll spring-irrigated in 1932 yielded 2,924 pounds of hay per acre while patches beyond the spread of the snow water would hardly have

exceeded one-quarter of a ton—a ratio of 5·8 to 1, about the same as had been thus obtained in 1925. Contrast continued to show in the aftermath. A four-year-old brome-alfalfa meadow, spring-irrigated, produced 4,406 pounds of hay while an adjoining spot receiving normal snow melt though not by artificial direction yielded 1,303 pounds. Conspicuous benefit was also observed among forage crops, potatoes, vegetables, fruits, shrubbery and cereals.

SUMMER-FALLOWING FOR SOIL-DRIFTING CONTROL

The Field Husbandry Division's co-operative project on soil-drifting control was conducted at Beaverlodge in 1935-6. Preliminary examinations in June revealed that the earth was already moist to at least four feet on the driest ridges; so with the ample precipitation that subsequently occurred the effect of different practices upon moisture conservation could hardly be established. It is surmized that the reactions of the 1936 wheat crop were due as much to nutritional factors as to moisture. Well-cultivated fallow seemed to support as vigorous a growth as ploughed fallow. Elsewhere the rankness and verdure of the wheat crop were in inverse ratio to the amount of cover crop or weed growth permitted in the fallow year.

SWEET CLOVER IN ROTATION

Twenty acres of land verging toward the woodland type are devoted to a rotation experiment, begun in 1934 and designed to investigate the use of sweet clover with and without barnyard manure and ammonium-phosphate fertilizer. Some interesting results appeared in the wheat crop of 1936 when Reward ranged in yield from 28 to 60 bushels per acre of 1°. This is believed to be one of the most promising lines of work under way.

WIREWORM INVESTIGATIONS

Wireworms constitute one of the gravest agricultural problems of the Peace; they reduce yields, impair grades through irregular maturity and favour the multiplication of weeds.

Work done in 1935 and 1936 under the supervision of Kenneth M. King, entomologist in charge of wireworm investigations, Saskatoon, Sask., emphasized the injurious effect of formaldehyde and copper sulphate as treatments for seed grain to be sown on wireworm-infested land, since these impair or slow up germination and delay early growth, thus prolonging the vulnerable stage of the crop. Particularly bad are the effects when weak seed has to be used or when standard directions in treatment are departed from. One farmer was found who treated a wagon box of seed at a time and left it in the mass, drawing upon it for days according to the progress of his seeding. He was having heavy wireworm loss in his crop. Wireworms, weak seed and formaldehyde constitute a disastrous trinity.

The advantage of thick seeding on infested land was conspicuously demonstrated in a crop of Olli barley, sparingly sown to multiply a valuable stock of seed. Sown in the first place between two and three pecks per acre, part of the field was cross-drilled, the rate being thus doubled. Wireworms almost or quite destroyed upwards of an acre of the thinly seeded crop but ruined not a square foot of the double-seeded area though the edge of the cross drilling bisected two large patches where on the thin side only a plant or two remained. The area seeded at 5 pecks returned a nice yield of evenly ripened grain. The other yielded a ragged, weedy crop of unevenly ripened barley and bore practically nothing on some of the knolls.

SOIL TEMPERATURES

In 1922, a Friez soil and water thermograph was installed on the substation, its bulb buried three inches beneath the surface of cultivated ground.

PROTECTIVE INFLUENCE OF SNOW

Though the air temperature has occasionally fallen to 40 or more degrees below zero, the soil thermograph has never registered below 15° Fah. so long as there was a fair cover of snow. Two or three times when a cold snap coincided with bare ground it dropped to 5° Fah. and might have gone lower had the apparatus been set to take care of a lower register. Such have been the periods in which biennial or perennial crops have suffered from forms of injury other than ice smothering. In February, 1936, when the mean air temperature was -16·19° Fah. the deeply blanketed soil averaged 37·29 degrees warmer than the air.

THE EFFECT OF SUMMER TEMPERATURES ON NITRIFICATION

Summer soil temperatures have an important bearing upon the rate at which plant food is rendered available in the soil. Nitrification barely commences at 40° Fah. and may be said to double in activity with each 10° rise until an optimum is attained between 80 and 90°. During the period 1925-6 on only about half the days of the five summer months did the soil-thermograph needle *at any moment of the 24 hours* exceed 60°; on only about one-third of the days did it pass 65°; on only one-sixth of them, 70°.

The situation in the early months is critical, for May shows only 5 days per month on which the temperature passed 60°, and June, 16 days. Even in July and August it does not always climb to 60°, while in September it achieves that temperature on only about one-seventh of the days.

In the light of these significant figures it is easy to understand why plant food is brought tardily and sparingly into solution in a cool spring (especially if it be also drouthy), why second-crop grain is inclined to be yellow during the early weeks, and why, in old meadows, legumes are likely to be much more productive than grasses. The legumes draw nitrogen from the air and are to that extent independent of soil processes.

MINIMUM TEMPERATURES ON HILL AND HOLLOW

Whilst there is a ruling tendency for the atmosphere to become rarer and therefore colder as altitude increases—averaging for most habitable latitudes about 1° Fah. for each 330 feet of rise—a converse principle called "inversion of temperature" also obtains. After sunset the cooling air settles, and beneath a ceiling of several hundred or perhaps a thousand feet there is usually towards morning a lowering temperature as one descends a slope. During winter cold snaps this condition persists in some degree throughout the day.

Since July, 1926, nightly low temperatures have been indicated by self-registering minimum thermometers placed at the foot and at the apex of a ridge having an eastern slope with a fall of 134 feet in 214 rods. The lower instrument is at the edge of a broad slough in a semi-enclosed basin having a fair degree of air drainage southward yet known to be a particularly frosty place.

Accepted readings number 3,660. On about one-third of the nights the slough thermometer read 10 or more degrees lower than that on the hilltop; on 433 nights, 15 or more degrees lower; on 121 nights, 20 or more degrees lower. The most extreme spread ever recorded was 28 degrees in February, 1929. The net annual minimum has ruled between 6 and 7 degrees lower at the slough edge than on the hill top. Intervening instruments have shown a tendency for spreads to lessen towards the crest. Wind, clouds and humidity appear to diminish the spreads. During raining, snowing or muggy weather the instruments generally read alike.

CONTRAST IN FROST-FREE PERIODS

During the seven years 1930-6 the average frost-free period indicated by thermometer readings on the hill has been 98·4 days; at the slough, 25 days. At the slough, frost occurred in nearly every month of every year. On the hill, roses in the open garden have often bloomed until October. The high land is to be preferred for tender crops and residences. The lowest land has always been safe for hay, usually for green feed and often for threshed oats. Some high and some low land work together advantageously in a farm unit.

METEOROLOGICAL OBSERVATIONS

With the installation at Beaverlodge in August, 1935, of a barometer, barograph, anemometer, hydrograph, thermograph and other instruments, Beaverlodge was raised to the status of a full telegraph station of the Dominion Meteorological Service.

SOIL BACTERIOLOGY

PROBLEMS IN LEGUME INOCULATION

The crucial importance of legume inoculation in a climate where cool, dry weather retards those biochemical processes through which soil nitrogen is rendered available to plants was established by early observations at Beaverlodge. That artificial inoculation is a much more complex matter than mixing a bottle of nitro-culture with a bushel of seed and experiencing an unvarying result has now been emphasized by eight years' careful work, covering six field experiments and three greenhouse tests. It goes to explain many partial or complete failures occurring in field practice and encourages perseverance.

IMPROVED RESULTS BY INOCULATING A WEEK BEFORE SEEDING

In a 1928 test in which moist, earth-coated seed inoculated by the soil-seed method was held for various periods before planting, decidedly the best results, continuing into the third cropping season, attended inoculation one week in in advance of seeding. In the aggregate of three crops, such plots outyielded the checks by 22 per cent; those inoculated two weeks in advance, by 15 per cent; and those inoculated 24 hours in advance, by 14 per cent. The plots seeded immediately after inoculation (per orthodox advice) were only 1 per cent better than the checks. The trends were rhythmically evident throughout the quadruplicate test.

1930 SEEDING—SLIGHT ADVANCE FROM PRE-INOCULATION BUT SOIL SUPERIOR TO NITRO-CULTURE

A more elaborate experiment, seeded in 1930 on the farm of A. H. Johnson, near Beaverlodge, compared pre-seeding intervals of inoculation in two complete series, one in which the seed was treated with soil, the other with nitro-culture. Three dates of seeding were introduced by way of replication. Puddling and baking restricted the growth.

Neither soil nor seed series exhibited any marked advantage of one interval over another, but in the second season all the soil-inoculated plots grew taller and greener than the others. The evidence appeared first on the loamiest soils and gradually increased. In the third season the soil-inoculated outyielded the checks by 143 per cent, while the nitro-culture plots outyielded them by only 36 per cent. There were slight but inconclusive indications that an interval of pre-inoculation was beneficial.

Though the plots were only 8 feet wide, and invasion from one to another was expected, this must have occurred slowly, for contrasts between the soil and nitro-culture series were intensified that summer and did not disappear until the latter part of the fourth.

The soil-inoculated plots outyielded the nitro-culture ones by 9 per cent in 1931; by 78 per cent in 1932, and by 23 per cent in 1933. The fact that some nodules were found in all plots, including the checks, during the first season and repeatedly thereafter makes these comparisons more remarkable.

Effect of soil-seed versus nitroculture inoculation of alfalfa persisting in a two-year-old stand on the Johnson farm, 1932. Short, pale strips represent nitroculture and dark green strips soil-seed inoculation. See text. Photo by Superintendent.

It was surmized that by chance, by adaptation or by eliminative selection there had been locally developed on the sub-station premises, whence the inoculating soil was obtained, a strain of nodule bacteria either superior in vigour or otherwise better adapted to the existing soil conditions than the strain in the nitro-culture supplied from Ottawa in 1930. From Beaverlodge-grown alfalfa roots the Division of Bacteriology cultured a vigorous stock identified as Beaverlodge 3 (or B.L. 3). In certain subsequent seedings this was compared with the pureline strain called Ottawa 173, with a mixed stock designated Ottawa mixed and with an acid-tolerant strain developed by Dr. H. G. Thornton, of Rothamsted, England, for use on some of the sour soils of the Old Country. Since Peace river soil commonly shows a slightly acid reaction, the woodland soils especially, it was hoped the Thornton nitro-culture might prove locally adapted.

1932 SEEDINGS—DIFFERENCES BETWEEN NITRO-CULTURES

Further seedings were made in 1932, not only on the brown soil of the Johnson farm but on a gray woodland soil belonging to Clarke Bros., northeast of Beaverlodge. Besides periods of pre-inoculation these tests compared three inoculating

media: Ottawa 173, Rothamsted culture, and soil. Check plots were included. On extra plots of the nitro-culture series calcium di-acid phosphate was added as an activating agent.

During the first two seasons no contrasts appeared on the Johnson farm, but by 1934 spotty evidence of strong inoculation was observed in the Rothamsted plots.

On the Clarke farm the Rothamsted culture gave definite response by the midsummer of 1933. The plot to which it had been applied a week in advance showed a deeper colour and extra vigour. There was progressively less response as the intervals shortened though it was discernible in all. In 1934 the Rothamsted plots grew much the tallest and continued the darkest green. The Ottawa 173

Effect of various cultures on alfalfa growing on the grey soil of the Clarke farm as appearing at end of June, 1935. Plots left to right: Rothamsted (good), Ottawa-173 (short and pale), Ottawa Mixed (good). Photo by Assistant Superintendent.

plots darkened considerably. The soil series remained almost as yellow as the checks. There was no pronounced advantage of one pre-inoculation interval over another, and neither here nor on the Johnson farm was any benefit from the phosphate manifest. The general difference, however, between the Rothamsted plots and the uninoculated on the Clarke place was remarked by Prof. T. J. Harrison as being the most striking contrast of the kind he had ever viewed.

1934 SEEDING—ROTHAMSTED CULTURE AGAIN EXCELS

The 1934 seeding on the Clarke place involved three intervals of pre-inoculation, employing four nitro-cultures as well as soil-seed treatment. The cultures

were Ottawa mixed, Beaverlodge 3, Rothamsted (acid-tolerant), and Ottawa 173. By the end of August the first three seemed distinctly more effective than the 173 or the soil. The Rothamsted plots ranked first throughout the second summer, closely approached by the Ottawa mixed and the Beaverlodge 3. The soil-inoculated plots were relatively improving. The Ottawa 173 and the check plots fell much below the others.

The one hay crop taken weighed up thus: Rothamsted, 3,771 pounds per acre; Ottawa mixed, 3,660; soil-seed, 3,289; Beaverlodge 3, 3,133; Ottawa 173, 2,668; uninoculated, 1,946.

There had seemed to be an advantage in favour of inoculating a week before sowing but inequality of soil conditions rendered this comparison untrustworthy.

GREENHOUSE WORK

Three crock experiments in the greenhouse, employing several inoculants on washed sterilized river sand, on woodland clay, on a soil of intermediate quality, and on a black loam brought forth three annual boxes of riddles. There was no very convincing advantage of one inoculant over another, although, on the whole, the Rothamsted, the Beaverlodge 3, and the Ottawa mixed gave better results than the Ottawa 173. The Rothamsted was rather the best in 1934; the Beaverlodge 3, in 1935.

Other than the sand, the three soils produced, on the whole, almost equally good growth, even the grey podsol supporting vigorous plants. The comparison of soils varied, however, from year to year. The sand series were particularly puzzling. In no year did the expected degree of difference between inoculated and uninoculated pots of these appear. Growth in all was poor, suggesting the lack of some essential mineral element in the solution supplied or the presence of some factor preventing adequate nitrogen fixation by the bacteria.

EPITOME

The indications of eight years' careful work, comprehending six seedings in the field and three in the greenhouse, agree with the modern findings of bacteriology that there are pronounced differences in the vigour, adaptability and beneficial agency of various strains of the nodule bacteria, and suggest the desirability of differentiating these for specific conditions.

Although in the 1930 seeding, soil-seed inoculation by the glue method proved markedly superior to nitro-culture, subsequent trials suggest that this may have been due to a lack of vigour, of adaptability or to some other factor in connection with the nitro-culture then available.

The lapse of a few days or a week between artificial inoculation and seeding is not necessarily disadvantageous. On the contrary, it has in certain seedings proved to be distinctly beneficial, notably in one in which soil-inoculated seed was held under favourable moisture and temperature conditions. A theoretical explanation is that in such circumstances the nodule bacteria may pass through one or more periods of their life cycle, possibly reaching or advancing toward the motile stage favourable to speedy diffusion and infection.

Copious moisture and good cultural conditions are favourable to the securing and spreading of effective inoculation.

First-class alfalfa crops may be grown on the gray woodland soils where moisture is sufficient and effective inoculants are present.

Artificial inoculation may often be practised faithfully according to prescribed directions without proving effectual. Calcium di-acid phosphate applied to inoculated seed failed to vindicate itself as an activating agent.

Artificial inoculation, when it does "take," may sometimes under drouthy conditions require two or more years to become fully effective. It seems doubtful

whether artificial inoculation may be always depended upon to induce such prompt, thorough nodulation as can be obtained by the sowing of the particular legume on land which has recently carried a vigorous stand of the same crop.

Instead of being discouraged by an initial failure to secure a vigorous growth of a newly introduced legume, the grower's sensible course is to try again on the same ground, taking advantage of the bacteria introduced and probably multiplied by the first attempt, as yeast is multiplied in a bread sponge.

HORTICULTURE

VEGETABLES

VARIETIES RECOMMENDED

ASPARAGUS.—Mary Washington, Giant Washington, Palmetto, Martha Washington, Argenteuil are doing fairly well from 1931 and 1932 seedings though yields have been generally light. Occasional losses of some roots necessitate replacements. The crop is considered productive enough, however, for the farm garden.

RHUBARB.—The most widely adaptable and easiest of cultivation of the popularly known perennial crops. Ruby and MacDonald are good varieties. Seedlings are easily raised. Ruby has generally thrown a high percentage of very satisfactory roots. On account of the persistence and earliness with which rhubarb runs to seed the variety Seedless is suggested for trial.

HORSE RADISH.—Very hardy. As old beds are unproductive of table-quality roots, they should be renovated from time to time or a new bed should be set out.

BEAN.—Bush varieties rarely fail completely on the sub-station although yields vary considerably. Good varieties are Masterpiece, Stringless Green Pod, Round Pod Kidney Wax, Davis White Wax. Masterpiece is generally late and Great Northern later still. Refugee is usually too late. Mazagan succeeds as a broad bean. In a single year's test Windsor Broad yielded satisfactorily; similarly tested Bush Lima were too late. Pole beans are not dependable.

BEET.—The crop is generally good although the percentage of large, coarse, poor-quality and bolted roots is conspicuously more noticeable some years than others. Detroit Dark Red, Crosby Egyptian, Eclipse, Early Model, and Cardinal Globe are generally good. The last-named variety has been the best cooker calculated on a six-year basis, followed by Detroit Dark Red, whereas Crosby Egyptian has been generally poorer.

BORECOLE.—Transplants of Tall Scotch and Dwarf Green Curled are luxuriantly productive in good soils when moisture is sufficient.

BRUSSELS SPROUTS.—Amager Market, Danish Prize, Edinburgh Prize and Dalkeith are satisfactory though the tendency to leaf rather than to form buds is usually strong.

CABBAGE.—Succeeds very satisfactorily. Quite early varieties are Copenhagen Market, Golden Acre, Jersey Wakefield. Mid-season: Glory of Enkhuizen and Succession. Late: Danish Ballhead, Danish Roundhead. Yields of the Ballhead fluctuate considerably and neither it nor Roundhead is among the heaviest producers. Extra Amager Danish Ballhead has been recommended as a winter cabbage and a good keeper, but it invariably yields low. Early Red Haco is an excellent-keeping red variety. Savoy thrive about as satisfactorily as other types but are not so acceptable because of the more open heads and the consequently lighter weight. Chinese cabbage has not yet done well.

CARROT.—Dependably productive. Chantenay, Improved Danvers and Nantes Half Long are satisfactory croppers. Early Scarlet Horn was previously found good but lower in yield. Oxheart is productive but coarse. Coreless is considered satisfactory.

CAULIFLOWER.—A profitable home-garden product though light yields are not uncommon. Deferred transplantings are fairly successful subject to moisture conditions and insects.

CELERY.—Golden Plume and Golden Self-Blanching among others have given considerable satisfaction.

CHARD.—Because it succeeds with a minimum of attention and has an extended picking season, chard is preferred by some as a green to spinach varieties that run early to seed.

CITRON.—Has never matured on the vines and is unsatisfactory. Red-Seeded and Colorado generally yield scantily or not at all. The only years approaching near-success were 1932 and 1936.

CORN.—Except in 1935 Pickaninny (dark) and Banting (yellow) have not failed for some years to give a good supply of usable ears. The former variety has always produced a very high percentage of nubbins even in years of banner production for this crop. Pollination difficulties may be responsible. Early Alberta and Howes Alberta, both flints, supply good usable ears but of only fair quality. Sometimes crops have been had from Improved Squaw and Assiniboine Flint. Dorinny surpasses in quality but is on the late side. An unusual range of varieties eared up in 1932, including Sixty-Day Golden, Burleigh County Mixture, Spanish Gold, Early Alpha and even Golden Bantam, which, however, is really too late even for an exceptionally favourable season.

CUCUMBER.—Generally not very satisfactory, success or failure depending upon the season. Yields at best are light. Growing in heated frames is recommended. Early Russian, Davis Perfect, Snow Pickling, Early Fortune and Improved Long Green are equally good.

HERBS.—Annuals: Anise, sometimes indifferent though fairly satisfactory. Balm, generally poor. Borage, luxuriant growth but too weedy, hence discontinued in tests. Sage, usually satisfactory but should be grown as an annual for best results. Bush Basil, satisfactory. Caraway, for the last two years the catch has been extremely good; formerly it was very poor. Catnip, easily grown, with considerable degree of winter hardiness; volunteers freely. Chives, easily grown, winterhardy. Coriander, dependable. Dill, has always made full stands. Fennel, germination usually good. Hore hound, fairly suitable. Hyssop, fairly long-lived perennial, usually good. Lavender, poor though not extensively tried. Marjoram, generally good; should be grown as an annual. Mint, perennially adaptable. Pennyroyal, fairly good. Rosemary, poor. Rue, very good as an annual. Summer Savory, easily grown and usually makes sturdy growth. Sweet Basil, generally good. Thyme, usually satisfactory grown as an annual.

KOHL RABI.—Successive transplantings sometimes satisfactory. Crop is adaptable. White Vienna recommended.

LETTUCE.—Leaf and Cos lettuces never disappoint; success with head types variable. Grand Rapids and Trianon Cos recommended. Big Boston, Hanson and Iceberg are satisfactory head lettuces.

MISCELLANEOUS NOVELTIES.—EGG PLANT and PEPPER have responded fairly well to transplanting from eight-inch pots. The transplants when set out should be in flower and with the first fruit set, if possible. LEEK, fair success from transplants. CHERVIL, fair success. CHICORY very easily grown, roots winter-hardy.

CRESS, easily grown. ENDIVE, very easily raised. ORNAMENTAL GOURDS, NEW GUINEA BUTTER VINE, OKRA, VINE PEACH, YARD LONG BEAN, PEANUT, VEGETABLE SPAGHETTI, have not yet been grown succesfully. LENTIL, late, fair in 1936. POPCORN, too late, but kernels almost mature in 1936. GROUND ALMONDS, always a good stand, but seldom any almonds until 1936 when there was a good set, but every nut was partly decayed when lifted in the autumn.

MUSKMELON.—Has never succeeded. In the Peace river canyon under irrigation, Champlain succeeds.

ONION.—Better results from sets than from spring-sown seed. Some gardeners sow in late July and August, harvesting the following summer to get mature bulbs. The average season is too short for most localities to mature onions from spring plantings. Large Red Wethersfield and Yellow Globe Danvers are recommended. Some do not like the strong flavour of the former. Early White Barletta is suitable for picking.

Sweet corn and tomatoes, Aug. 29, 1936. Gardener holding basin of Buza's Polar Circle (alias "Earliest Dwarf") tomato. Photo by Superintendent.

PARSLEY.—Quite good; endures considerable frost; outdoor-seeding very satisfactory; Champion Moss-Curled and Triple-Curled, both good.

PEA.—Thos. Laxton (medium-early) for market, canning, home garden; Gregory Surprise and American Wonder (extra early), Lincoln (Homesteader) intermediate, and Stratagem, intermediate to late, the former recommended for canning. English Wonder and Gradus have been previously recommended. Successive planting of Thos. Laxton will serve nicely.

POTATO.—Among numerous varieties tested these may be recommended for various conditions: Early: Irish Cobbler, Early Rose, Early Ohio, Bliss Triumph; Mid-season: Early Bovee, Country Gentleman, Warba; Late: Carman No. 1, Netted Gem, Columbia Russett, Wee McGregor, British Queen, Burbank. Green

Mountain. Most settlers, particularly in the brushy districts, will be well advised to choose an early sort, for the yield is then surer, the crop more mature, and the average table quality consequently higher. A moderate yield of good, mealy potatoes is preferable to a heavy tonnage of soapy immature ones. Some of the red potatoes often show a discoloration of flesh associated with bitterness. Some promising new potatoes are under test.

PUMPKIN.—Connecticut Field, Sugar, Pie and King of the Mammoth, are all good varieties. The average season is a little short to mature fruit on the vine.

RADISH.—White Icicle, Rennie Oval, French Breakfast, Scarlet Turnip White Tip and Saxa recommended. Successive sowings advised. Winter radish successful.

SALSIFY.—Stands of Mammoth Sandwich Island seldom fall short of normal. Long Black (Scorzonera) usually has less perfect stands but its roots are generally smoother. Both varieties are very fibrous-rooted in the sub-station soils.

SPINACH.—Viroflay, King of Denmark and Victoria are good, but may go to seed early. New Zealand is later but good.

SQUASH.—Golden Hubbard, Blue Hubbard, Delicious, Arikara, Giant Summer Crookneck are all good. Scalloped types are unsatisfactory.

TOMATO.—Earliana, Bonny Best, Alacrity, John Baer, Princess Mary, Pink No. 2, Abel all about equal though yields vary considerably from year to year. Chalk Early Jewel formerly did well. Polar Circle (alias Northern or Earliest Dwarf), obtained from B. Buza, Poland, early and prolific, though rough.

VEGETABLE MARROW.—More dependable than pumpkin or squash. Long White Bush Marrow and English Vegetable Marrow recommended. The former occupies much less space.

WATERMELON.—Unsatisfactory at Beaverlodge. Under irrigation on the Peace river flats Sweet Siberian is favoured.

CULTURAL EXPERIMENTS WITH VEGETABLES

FALL VS. SPRING SOWING OF VEGETABLE SEED.—Nine years' results would indicate that occasionally fall-sown parsnips, carrots and lettuce germinate completely in the spring. Beets, radish and onions present poorer and more ragged stands. Beets from fall sowing have a strong tendency to bolt. Fall-sown cabbage, turnip and spinach have always completely failed. The outcome of fall seeding is never dependable and very exceptionally does it favour size or quality.

CELERY CULTURE.—Success with celery depends largely upon suitable weather conditions and on an early seeding and judicious watering till mid-summer. It would seem that in dry seasons trench culture is more retentive of moisture than level culture and is favoured from this standpoint. In wet seasons level cultures are probably superior. In most instances soil has given a more complete blanch than boards. Earth sometimes wards off an early frost when plants in boards completely succumb. Golden Plume and Golden Self-blanching, among others, have given considerable satisfaction.

ONION-MAGGOT CONTROL.—Of the several methods tried to control onion maggots, including lime-paste, Bordeaux-oil emulsion and corrosive sublimate, none has given complete protection. For ease of preparation and results obtained the last is decidedly superior, although expensive. It is an equally useful insecticide for root maggots attacking cabbage, turnips, radish and allied crops. Corrosive sublimate has been applied first when the seedlings emerge and thrice afterwards at ten-day intervals. The poison is administered in a water dilution of 1 ounce to 10 gallons, sufficient to wet the roots around each plant.

PRUNING EXPERIMENT WITH TOMATOES.—Unfortunately, no one plan has been strictly adhered to throughout the seven years that tomato-pruning experiments have been conducted, but general observations indicate that any drastic system of pruning cuts down the yields. On the other hand, an entirely unpruned condition does not always appear to be best. A moderate amount of vegetation would seem to be most satisfactory as a rule. Pruning to a single stem has appeared to be disadvantageous, especially when the single stem was cut back to the first or second truss of fruit. For four years, pinching out all trusses of fruit on each stem above a given number of trusses has been compared with cutting the stem back to the last truss left. The latter has been consistently disadvantageous, losses running from 6·7 to 20·3 per cent. Vine pruning in general has not advanced ripening, although in the season of 1935 the cutting back of stems to the last truss of fruit left increased the production of ripe fruit by 55·2 per cent. On the other hand, the importance that abundant foliage plays in protection from late autumn frosts must not be overlooked. It would appear that considering the labour involved in training the vines and the uncertain benefit derived therefrom one would be as far ahead to leave them largely unpruned.

STAKING TEST WITH TOMATOES.—The tomato-staking experiment presents some very conflicting data which are accounted for in part by the smallness of the plots. The years 1928, 1933, 1934 and 1935 showed an increase from staking in total weight of fruit ranging from about 24 per cent to 75·2 per cent; and 1930, 1931 and 1932 showed a decrease from staking by percentages about half as great, viz., 8 per cent to 40·6 per cent. Results pointing to increased earliness are still less positive.

POTTING TOMATOES.—Increased earliness and yields have been consistently achieved by transplanting tomato seedlings into eight-inch clay pots either direct from the seedling flats or after one previous transplanting, leaving them in the pots until bloom or marble-sized fruit appears, and setting them outdoors by the second week in June. During the three years this system has been on trial, practically all the ripe fruit raised has been from potted plants, though these constitute but a minor proportion of the plants set out.

SUCKERING CORN.—In every year since 1924 that a comparison between suckered and non-suckered corn was made, the advantage, though sometimes slight, has been in favour of the removal of suckers. Increases in total weight of ears range from 2 per cent in 1928 to 100 per cent in 1931. Suckering has not materially increased earliness.

SOAKING SEED TO PROMOTE GERMINATION.—Variable results have attended the soaking of vegetable seeds before planting; but on the average of all the data, covering nine years for some kinds, nearly all seeds have benefited from soaking for one day. Beans and radish usually did better without any soaking. Corn responded equally well from one- or two-day soakings. It is doubtful whether two-day soaking is helpful, and prolonged soaking of most kinds resulted in defective stands.

DATE-OF-PLANTING TEST.—Too early seedings in spring are inclined to produce erratic results. The end of April or the first part of May seems to be early enough for most of the commoner, hardier vegetables such as onion, radish, lettuce, pea, beet, carrot, and parsnip; and as a rule good results can be obtained from seeding as late as May 24. Parsnips will stand early seeding and the first pickings of peas, though not necessarily the largest yields, are generally obtained from early sowings. The second week of May appears to be a good average season to sow corn, beans, pumpkins and squash. If sown too early the plants appear to suffer in stand and vigour; if left too late they do not have time to mature their produce. Because of seasonal irregularity, two or three sowings of most kinds are much safer than one sowing.

FRUIT

Success with tree fruits has been scant. Bush fruits, however, especially currants, have won permanent recognition as staple culinary types. Only once since 1917, when records were first kept, have currants completely failed. Raspberries are slightly less reliable but seldom fail to supply local tables. Gooseberries are more problematical. Quality in bush fruits has always been good, though strawberry size, subject more to available surface moisture than is the size of bush fruits, is reflected by seasonal conditions.

CURRANT

All kinds have borne with surprising regularity, except in 1936, which was the first year in twenty that this crop failed completely.

REDS.—The 20-year averages per bush of the following good kinds are: New Red Dutch, 8·35 pounds; Victoria Red, 7·74 pounds; Cumberland Red, 6·06 pounds. Wilder Red and Fay Prolific, both tender, averaged only 2·95 and 2·46 pounds, respectively. A 1928 planting of reds has not equalled average production of the 20-year planting. Of these, Raby Castle yielded most heavily, with 3·72 pounds per bush; Holland, 3·50 pounds; Diploma, 3·04 pounds; Ruby, 2·88 pounds; London Market, 2·67 pounds; Versailles, 2·47 pounds; Cherry, 2·08 pounds; and Red Grape, 2·05 pounds per bush.

WHITES.—Two varieties tested for 19 years and a third tested for only 8 years represent all the experimenting with white currants. In quality there would seem little to choose between the varieties Large White and White Cherry. However, the latter averaged 6·11 pounds per bush and the former only 4·10 pounds for 19 years. White Grape, another good sort, averaged 4·60 pounds in eight years in a solo test.

BLACKS.—In a 20-year comparison from a 1916 plantation Collins Prolific averaged 3·46 pounds per bush, comparing with 3·27 pounds from Topsy, which, however, has a larger and choicer berry. Yields from a 1927 planting averaged better than from either a 1916 or 1928 setting. In the 1927 planting Eclipse stood highest with 8·18 pounds per bush; Saunders had 7·06 pounds; Eagle, 6·29 pounds; Kerry, 6·11 pounds; Magnus, 5·81 pounds; an unknown variety received from the Roman Catholic Mission at Grouard, 5·74 pounds; Clipper, 5·58 pounds; Black Champion, 5·02 pounds; Collins Prolific, 4·55 pounds (1·09 pounds more than it averaged from the 1916 plantation); Black Naples, 3·95 pounds. Of the three varieties planted in 1928, Merveille de la Gironde averaged highest, with 3·56 pounds per bush; Buddenborg, next, with 2·98 pounds; Victoria Black with 2·65 pounds.

GOOSEBERRY

No variety yet tried has been found fully hardy. Oregon Champion, hardiest, has been most productive for this reason. Eight years' pickings of it averaged 5·07 pounds per bush. A different group of the same variety averaged 5·02 pounds for 7 years. An average of 17 pounds per bush is the heaviest picking for all varieties on record. Smith Perfection outyielded Houghton by an average of 4·88 pounds to 4·49 pounds per bush. Red Jacket and Pearl are too tender. Red Jacket averaged 0·57 pounds for 5 years; Pearl, 1·05 pounds on a 4-year basis. Pixwill has just been introduced.

The gooseberry averages are based on results from scattered plantations.

STRAWBERRY

Strawberries are not commercially profitable except in isolated instances although a home patch is recommended for every one interested. (Early) Dakota or Senator Dunlap is recommended. Everbearing sorts have not been

successful. Early-spring planting is advised, though late-summer plantings sometimes succeed. A setting of August, 1934, yielded 3,568 pounds of fruit in 1936, almost as much as a 1934 spring planting, but this result was exceptional and there seems no good reason for deliberately deferring the planting. The matted-row system is usually adopted for economy of labour. Because of the invasion of weeds it has not been found profitable to harvest more than two fruit crops. Considerable trouble has been experienced with plants "running out." No remedy is known at present, but thorough roguing at planting time may sometimes help to check the spread. If the patch becomes too badly over-run with diseases new disease-free stock should be introduced in fresh soil. Winter mulching with straw or other clean litter is advised.

RASPBERRY

Raspberries have failed by winter-killing of canes only twice since 1918. In order of preference, Herbert, Viking and Newman have been very good. The last two mentioned were lost on account of disease in 1933. The isolated Herbert row averaged 2,978 pounds per acre for a 13-year period. Spur blight depresses yields in some years. Brighton, Sunbeam and King have shown a greater degree of hardiness than other varieties but they are not considered so desirable. The canes are laid down for the winter by weighting the tips.

SASKATOON

Because of the widespread distribution of the saskatoon, its regularity of bearing and its more or less heterogenous make-up, breeding work would seem to offer a fine opportunity to add to the size and quality of an already popular berry. From a number of selections made a few years ago, No. 9 has been picked as superior and is being used as one starting point in the improvement work.

APPLE, CRABAPPLE AND PLUM

Although Blushed Calville and Hibernal apples, and Osman, Columbia, Olga, Florence, N.E.S. seedling and Beauty crabapples have borne, the results are more interesting than encouraging. The trees are tender and short-lived at

The station's biggest apple crop, 138·5 pounds of apples and crabs produced in 1932. In foreground five 3-quart boxes of Blushed Calvilles. Photo by Superintendent.

best. A thousand apple seedlings of Russian pedigree planted in 1930 give no particular promise. A 1925-planted seedling bore first in 1933 but it likewise lacks a future.

Except for a few native Manitoba-plum seedlings and perhaps Opata and Tom Thumb hybrids, results with plums have been disappointing.

Solution to successful plum, apple and crabapple culture does not lie in testing present existing varieties. The problem is deeper than that and involves a comprehensive breeding program with a view especially to the production of hardy bush types.

OTHER FRUITS

Sandcherry sets fruit heavily but nearly all bushes lack hardiness. Constitutional vigour, earliness, size and quality and upright bush habit combined into one plant would seem to be possible with a plastic species. Seedlings from yellow-fruited varieties received from Dr. Seager Wheeler are tender.

Grapes and pears have failed to bear.

Blackcaps have yielded some delicious berries in one or two gardens but are generally too tender.

Elderberries ripened first in 1932, and in 1936 a few matured but the bushes are semi-hardy and the blossoms are late.

ORNAMENTAL TREES AND SHRUBS

HARDY OR ALMOST HARDY SPECIES

Lists of Trees and Shrubs Grown at Beaverlodge Suitable for Street, Windbreak, Mass, Group or Specimen and Foundation Planting.

Species are arranged as far as possible in order of desirability, hardiness being kept in mind as an important factor.

EVERGREENS—

White spruce *(Picea glauca)*—suitable for windbreaks.
Scotch pine *(Pinus sylvestris)*—suitable for windbreaks.
Jack pine *(Pinus Banksiana)*—suitable for windbreaks.
Lodgepole pine *(Pinus contorta latifolia)*—suggested for windbreaks.
Colorado spruce *(Picea pungens)*—includes blue spruce.
Common juniper *(Juniperus communis)*.

DECIDUOUS TREES—

Balsam poplar *(Populus balsamifera)*—suckers badly.
Northwest poplar *(Populus sp:)*—very promising.
Russian poplar *(Populus Petrowskyana)*—reputedly short-lived.
Aspen poplar *(Populus tremuloides)*—not much shade.
Manitoba maple *(Acer Negundo)*—fairly hardy in some locations.
Green ash *(Fraxinus lanceolata)*—nearly hardy.
Laurel willow *(Salix pentandra)*—semi-hardy.
Golden willow *(Salix alba vitellina)*—semi-hardy.
Green willow *(Salix acutifolia)*—semi-hardy.
Britzensis willow *(Salix alba chermesina)*—perhaps the least hardy of the four.
Tamarack *(Larix laricina)*.
Canoe birch *(Betula papyrifera)*—desirable but of questionable adaptability.
Manitoba scrub oak *(Quercus macrocarpa)*—interesting novelty.

TALL SHRUBS—

Caragana arborescens—most widely used species of caragana.
Caragana frutex—suckers badly.
Chinese lilac *(Syringa villosa)*—very hardy, disliked by rabbits.

Common lilac in varieties *(Syringa vulgaris vars.)* needs shelter but may kill some years in spite of it.
Preston hybrid lilacs in varieties—*Syringa Prestoniae vars.* Isabella, Jessica, Francisca and Sylvia. Hardy and effective.
Tartarian honeysuckle *(Lonicera tatarica)*—very hardy.
Semipalatinsk honeysuckle *(Lonicera tatarica semipalatinsk)* (Orange berries).
Saskatoon, native *(Amelanchier alnifolia)*.
May Day tree *(Prunus Padus commutata)*—good when established.
European mountain ash *(Sorbus Aucuparia)*—moderately hardy.
Sea buckthorn *(Hippophae rhamnoides)*—berries ornamental in fall and winter.
Buffalo berry *(Shepherdia argentea)*.
Yellow bullberry.
European red elder *(Sambucus racemosa)*—vigorous grower but thrives best with moderate shelter.
Pincherry *(Prunus pennsylvanica)*—good, until smitten by fungus.
Chokecherry *(Prunus virginiana)*—subject to aphids on sub-station.

MEDIUM-TALL SHRUBS—

Native mountain ash *(Sorbus sp?.* probably *americana)*.
Oriental spirea *(Spiraea media)*.
Cotoneaster acutifolia—good, but killed badly 1935-6.
Cotoneaster lucida—resembles the preceding.
Cotoneaster intergerrima—very promising, red berries.
Hansa rose *(Rugosa hybrid)*—sometimes kills severely.
Scotch rose *(Rosa spinosissima)*—nearly hardy.
Burnett rose *(Rosa spinosissima, double-flowered variety)*—good.

Oriental spiraea planted 1928, in bloom June 7, 1932. The station's best and hardiest spiraea to date. Photo by Superintendent.

Red osier dogwood *(Cornus stolonifera).*
Variegated dogwood *(Cornus argenteo-marginata)*—fairly hardy.
Red-leafed rose *(Rosa rubrifolia)*—half hardy.
Betty Bland rose *(Rosa blanda* hyb.)—good some years.
Harison yellow rose *(Austrian Briar)*—blooms below snow line.
Ginnalian maple *(Acer ginnala)*—useful, greatly benefits by protection.
Siberian or Russian flowering almond *(Prunus nana)*—half hardy.
Garland spirea *(Spiraea arguta)*—attractive plant but kills back extensively.
Wild honeysuckle *(Lonicera sp.* ?)—shaggy in late summer but useful.
Bearberry honeysuckle or twin blackberry *(Lonicera involucrata)*—nearly hardy.
Silverberry or wolf willow *(Elaeagnus argentea)*—suckers badly.
Dwarf birch (*Betula sp.* ?)—may be useful in some locations.

DWARF SHRUBS—

Dwarf caragana *(Caragana pygmaea).*
Caragana aurantiaca erecta (resembles the preceding species).
Native hazelnut *(Corylus cornuta)*—almost hardy.
Pikow spirea *(Spiraea Pikoviensis)*—recently introduced but promising.
Germander spirea *(Spiraea flexuosa)*—recently introduced but promising.
Korean spirea *(Spiraea tricocharpa)*—recently introduced but promising.
Froebel spirea *(Spiraea Froebeli)*—half hardy, useful.
Anthony Waterer spirea *(Spiraea Anthony Waterer)*—half hardy, useful.
Billiard spirea *(Spirea Billiardii).*
Sorb-leafed spirea *(Sorbaria sorbifolia).*
Snowberry or waxberry *(Symphoricarpus albus) (S. racemosus).*

LESS HARDY SHRUBS

The following have considerable ornamental value, and although they sometimes kill extensively their recovery is usually rapid and sufficient to justify their use in group planting to a limited extent. They succeed best if given a sheltered position.

TALL—

Golden currant *(Ribes odoratum).*
Ninebark *(Physocarpus opulifolius).*
Golden elder *(Sambucus nigra aurea)*—nearly always renews almost entirely from ground line.
Cut-leaf elder *(Sambucus sp.* ?)—renews from crown almost always.
American elder *(Sambucus canadensis)*—renews from crown almost always.
Rosa davurica.
Rosa Willmottiae—not promising in recent years.
Rosa pomifera—not promising in recent years.
Rosa canina—not promising in recent years.
Buckthorn *(Rhamnus davurica)*—not promising in recent years.
Buckthorn *(Rhamnus Pallasii)*—not promising in recent years.
Buckthorn *(Rhamnus saxatilis)*—not promising in recent years.
Buckthorn *(Rhamnus utilis)*—not promising in recent years.
Buckthorn *(Rhamnus tinctoria)*—not promising in recent years.

MEDIUM TALL—

False indigo bush *(Amorpha fruticosa)*—pleasing foliage.
Japanese rose *(Rosa rugosa* and *R. rugosa alba).*
Spiraea Fontenaysii rosea—not promising in recent years.
Spiraea Fontenaysii alba—not promising in recent years.
Salt bush *(Halimodendron halodendron)*—did well first few years.
Vanhoutte spirea *(Spiraea Vanhouttei)*—fair some years, but quite tender.

DWARF—

Rose, F. J. Grootendorst *(Rugosa hybrid)*.
Rose, Ardelia (Seedling Harison yellow).
Rose, Agnes *(Rugosa hybrid)*—quite good some years.
Moss rose *(Rosa centifolia muscosa)*.
Cabbage rose *(Rosa centifolia)*.

ROSES REQUIRING SOIL COVER

These need the protection of soil each year.
Rose, Hugh Dickson, H.P.
Rose, Gruss an Teplitz, H.T.
Rose, General McArthur, H.T.
Rose, General Jacqueminot, H.T.
Rose, Souvenir de Claudius Pernet (Pernetiana).
Some promising varieties among a long list of recent acquisitions.

HEDGES

Common caragana *(Caragana arborescens)*.
Dwarf caragana *(Caragana pygmaea)*.
Caragana frutex—may give trouble from suckering.
Saskatoon *(Amelanchier alnifolia)*—fruitful and ornamental.
White spruce *(Picea glauca)*.
Snowberry *(Symphoricarpus albus)*—not of dense growth.
Caragana aurantiaca erecta—promising, resembles *C. pygmaea*.
Silverberry or wolf willow *(Elaeagnus argentea)*—suckers badly.

HARDY CLIMBERS

Hop *(Humulus lupulus)*—herbaceous perennial.
Virginia creeper *(Parthenocissus quinquefolia)*—satisfactory with some protection.
Native clematis *(Clematis ligusticifolia)*.
Golden clematis *(Clematis tangutica)*.

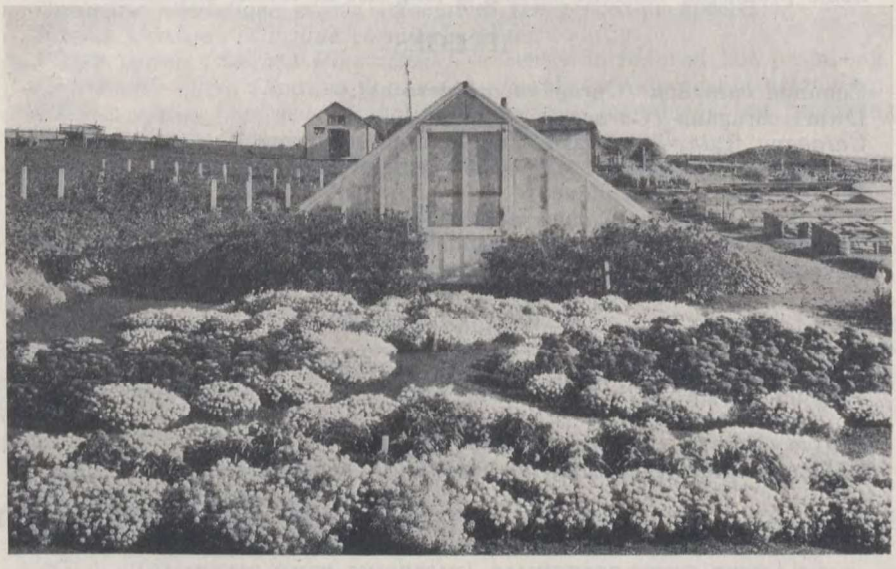
ANNUAL AND HERBACEOUS PERENNIALS FOUND SATISFACTORY

HERBACEOUS PERENNIALS (INCLUDING SOME BIENNIALS)

(Asterisk (*) indicates effective and very satisfactory kinds)

*1. Tulip.
*2. Iris, bearded types, winter-kill some years. Japanese varieties promising.
*3. Peony—absolutely hardy to date.
*4. Columbine.
5. *Dianthus* species: *plumarius, brevicaulis, deltoides.*
*6. Siberian perennial lavatera *(Lavatera Thuringiaca)*.
7. Hollyhock *(Althaea rosea)*—biennial.
8. Forget-me-not *(Myosotis alpestris)*—biennial, self-sows but may need renewing from time to time.
9. Gladiolus. Early varieties fairly satisfactory.
10. Lilies **(Lilium tigrinum)* and its varieties, a little late.
(Lilium concolor Dropmore).
(Lilium croceum).
(Lilium dauricum).
*Coral Lily *(Lilium tenuifolium)*.
**(Lilium unbellatum)*.

11. Dahlia (Large type such as Decorative fairly satisfactory in some years. Coltness hybrids, including the *Coltness Gem variety, are more effective—certainly far more reliable.
12. *Veronica* species: *incana, spicata, longifolia* and *repens.*
13. Ribbon grass *(Phalaris arundinacea variegata).*
14. Pansy—roots short-lived. Volunteers fairly freely some years.
*15. Sneezewort *(Achillea Ptarmica).*
16. Tansy *(Tanacetum vulgare).*
17. Golden-glow *(Rudbeckia lacinata).*
18. Hybrid oxeye daisy *(Chrysanthemum leucanthemum hybridum).*
19. Cranesbill *(Geranium grandiflorum).*
20. Monkshood *(Aconitum sp.).*
*21. Sweet rocket *(Hesperis matronalis).*



Flower beds in front of partly-sunken greenhouse. Aug. 25, 1936. Photo by Superintendent.

22. Narrow dwarf daylily *(Hemerocallis Dumortierii).*
*23. Scarlet lychnis *(Lychnis chalcedonica).*
24. Hybrid lychnis *(Lychnis Arkwrightii).*
*25. Oriental poppy *(Papaver orientale)*—short season.
*26. Perennial white phlox *(Phlox paniculata Pyramide).*
*27. Carpathian bellflower *(Campanula carpatica).*
28. Harebell *(Campanula rotundifolia Hostii).*
29. *Narcissus poeticus.*
30. Canterbury bell *(Campanula medium)*—biennial.
31. Baby-breath *(Gypsophila paniculata).*
32. Ladybell *(Adenophora stylosa).*
*33. Pyrethrum *(Chrysanthemum coccineum).*
34. *Linaria macedonica.*
35. Stonecrop *(Sedum Aizoon).*
36. *Scilla sibirica.*

Annual Flowers

(Asterisk (*) indicates effective and very satisfactory kinds)

(† Better sown in greenhouse or hotbed and transplanted)

† 1. *Helipterum roseum*—everlasting.
2. Sweet alyssum.
*† 3. Snapdragon *(Antirrhinum majus)*.
*† 4. Aster *(Callistephus chinensis)*.
5. Blazing-star *(Bartonia aurea)*.
*† 6. Pot marigold *(Calendula officinalis)*.
* 7. California poppy *(Eschscholtzia californica)*.
8. Candytuft *(Iberis)*—patchy some years.
* 9. Annual chrysanthemum *(Chrysanthemum carinatum)*.
10. *Clarkia*, species, **elegans* and *pulchella*.
11. Cornflower, bachelor's button *(Centaurea Cyanus)*.
12. Ornamental sunflower *(Helianthus annus)*.
13. Strawflower *(Helichrysum bracteatum)*.
* 14. *Linaria* species.
* 15. Scarlet flax *(Linum grandiflorum rubrum)*.
16. Sweet mignonette *(Reseda odorata)*.
†17. Nasturtium *(Tropaeolum majus)*.
†18. Flowering tobacco *(Nicotiana* species).
19. Love-in-a-mist *(Nigella damascena)*.
*†20. Petunia *(Petunia hybrida)*.
* 21. Harebell phacelia *(Phacelia campanularia)*.
22. Poppies, Flanders, Tulip, Opium, etc. *(Papaver)*.
†23. Sweet pea *(Lathyrus odoratus)*—transplants are earlier.
*†24. Ten-week stocks *(Mathiola incana annua)*.
25. Sweet Sultan *(Centaurea moschata)*.
26. *Viscaria*.
†27. Tidy tips *(Layia elegans)*.
*†28. *Dimorphotheca* species, *aurantiaca* and *hybridus*.
29. Woodruff *(Asperula azurea—setosa)*.
30. Collinsia *(Collinsia sp.)*.
31. Birdseye gilia *(Gilia tricolor)*.
†32. African marigold *(Tagetes erecta)*.
33. Evening stock *(Mathiola bicornis)*.
34. Tansy phacelia *(Phacelia tanacetifolia)*.
35. Sweet-william catchfly *(Silene Armeria)*.
†36. Phlox, nemesia, verbena and schizanthus—sometimes good, then very effective.

Note.—Much more extended lists of trees, shrubs, and flowers in mimeograph form are available on application.

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