DOMINION OF CANADA

DEPARTMENT OF AGRICULTURE

DOMINION EXPERIMENTAL FARMS

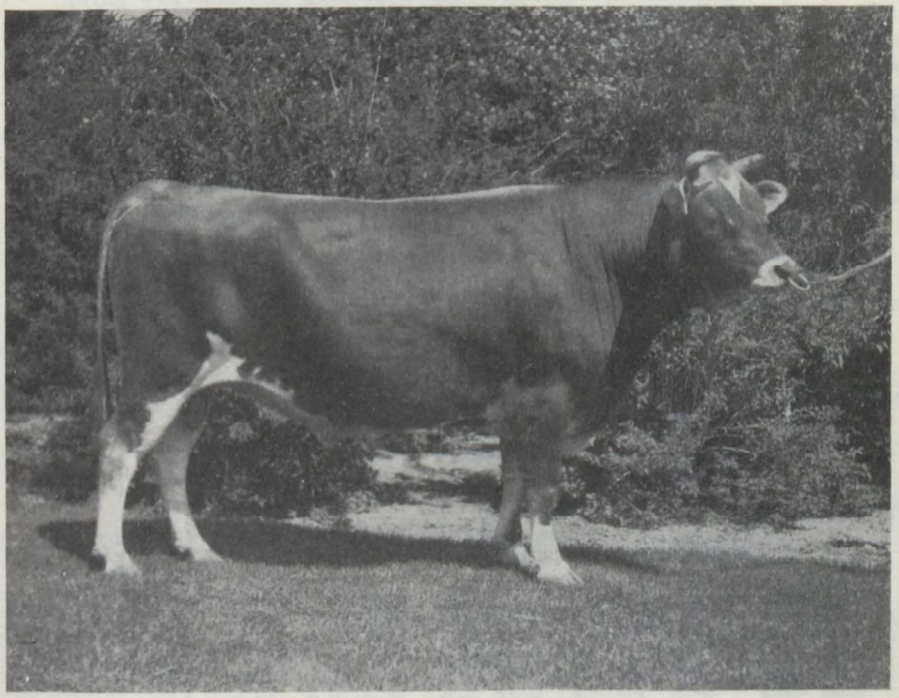
EXPERIMENTAL STATION

SUMMERLAND, B.C.

REPORT OF THE SUPERINTENDENT

W. T. HUNTER

FOR THE YEAR 1927



Rosewood Kitty's Oxford Beau—26182. Jersey herd sire at the Dominion Experimental Station at Summerland, B.C.

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DOMINION EXPERIMENTAL STATION, SUMMERLAND, B.C.

REPORT OF THE SUPERINTENDENT, W. T. HUNTER, B.S.A.

THE SEASON

Following a fall of ideal weather the winter of 1926-27 was moderate in severity. Frost was first recorded on October 30. November was mild. A low dip was experienced about the middle of December, when a temperature of 1 degree above zero was recorded. Temperatures of January, February, and March were about the average. Snowfall throughout the winter was light. Up to January 11 the ground was bare, but about that date there was a fall of 7·5 inches, which remained on the ground until February 18, after which date no more snow fell.

Spring was cold and backward and vegetation was several days later than usual. Precipitation in the early spring months was light but soil moisture conditions were very good as evaporation was retarded by the low temperatures. The ground was in good condition for spring seeding. Irrigation water was plentiful throughout the season. Precipitation during the late summer and autumn months was exceptionally heavy. The total precipitation for the year was 14·36 inches, the average over a period of twelve years being 10 inches. The summer months were characterized by uniform, fairly high temperatures which gave high means, although extremely hot spells were not so marked as in some years. On July 24 a reading of 102 degrees F. was recorded. The fall months were wet, with lower temperatures and less sunshine than usual.

The accompanying table gives a summary of the meteorological data for the year 1927, also the average mean temperatures and precipitation over a period of twelve years, and average sunshine for eleven years.

TABLE 1—METEOROLOGICAL RECORDS, 1927

—	Temperature (F)						Precipitation (inches)				Sunshine (hours)	
	Mean		Maximum		Minimum		Rain	Snow	Total precipitation			
	1927	Average 12 years	Highest	Mean maximum	Lowest	Mean minimum			1927	Average 12 years	1927	Average 11 years
	°	°	°	°	°	°						
January	24·39	25·43	45·0	28·52	−5·0	20·26	0·05	8·6	0·91	0·95	49·7	52·1
February	30·01	28·90	49·0	36·28	6·0	23·75	0·29	4·1	0·70	0·57	64·9	88·1
March	39·95	38·56	57·0	48·20	23·0	31·70	0·19	0·0	0·19	0·50	143·6	133·6
April	46·70	47·44	76·0	57·60	22·0	35·80	0·23	0·5	0·28	0·72	202·8	191·0
May	53·65	55·85	78·0	64·20	33·0	43·10	0·82	0·0	0·82	0·69	187·0	248·5
June	65·70	63·46	89·0	76·70	45·0	54·70	0·90	0·0	0·90	1·07	240·2	256·5
July	71·17	70·56	102·0	84·00	43·0	58·35	0·54	0·0	0·54	0·60	332·3	328·5
August	69·40	68·55	94·0	81·50	51·0	57·30	1·37	0·0	1·37	0·78	280·6	265·3
September	57·81	58·82	74·0	65·76	42·0	49·86	2·17	0·0	2·17	0·85	146·3	203·6
October	48·45	48·10	70·0	55·60	30·0	41·30	1·34	0·0	1·34	0·82	80·4	143·6
November	34·60	36·44	48·0	39·80	16·0	29·50	0·72	18·5	2·57	1·03	43·5	58·6
December	21·70	27·30	52·0	26·80	−8·0	16·70	0·82	17·5	2·57	1·42	51·4	42·8
Totals	.....	.....	.....	.....	.....	.....	9·44	49·2	14·36	10·00	1,802·7	2,017·2

HORTICULTURE

Fruits*

This Station was established primarily to study problems encountered in the production of fruit. Over fifty separate projects are under way, dealing with all phases of orchard operation. A special feature is made of harvesting and storage investigations, and a good deal of attention is paid to experiments with cultural methods, irrigation, pruning, grafting, thinning, and the use of fertilizers. Careful consideration is also given to the testing and introduction of new and promising varieties, while a thorough inquiry is being made into the root-stock question.

It is manifestly impossible to present the detailed annual results of all these projects in a report of this nature. A general statement indicating the scope and purpose of some of the more important lines of work, together with a summary of the results secured, was presented in the reports of this Station for 1925 and 1926. In the present report only one fruit project is discussed. This limitation of subject matter has made it possible to outline methods of procedure and present data in detail. It is hoped in this way to give the grower an insight into the plan followed in attacking his problems at this Station.

APPLE HARVESTING INVESTIGATION

PROJECT H. 414A

The important influence which time of picking exerts on the quality and storage life of apples is only now becoming fully appreciated by growers. The whole problem has been brought to the fore by the commercialization of the fruit industry. As soon as apples began to be shipped in quantity to distant points and kept for long periods of time before being placed on the market attention was drawn to certain storage troubles. Experiments have shown that several of these diseases are correlated with harvesting practice. By 1921 storage troubles of this nature, notably breakdown and scald, had become so serious that the annual loss to the apple districts of British Columbia totalled many thousands of dollars. In that year a Horticultural Assistant was taken on the staff of this Station and this project was selected as one of several meriting his special attention. Some preliminary experiments were carried out in 1921 and a comprehensive investigation of the problem was begun in the fall of the following year. The project has been continued and extended each season so that it is now possible to present the results secured over a six-year period.

PURPOSE OF THE INVESTIGATION

The primary object of this project is to secure accurate information concerning the influence of harvesting practice on the quality and storage life of apples. In order that apples may compete successfully with other products on the markets of the world ways must be found to ensure their delivery to the consumer in prime eating condition. The problem is by no means a simple one, especially when the consuming markets are thousands of miles from the producing areas. Before a solution can be hoped for a very careful study of the life processes which go on in an apple, both on the tree and after it is picked, must be made. Detailed observations are required to ascertain what changes in the composition, structure and appearance of the fruit can be used as a guide to picking time. Furthermore, extensive storage tests must be carried on to

* The work in this division is under the charge of Mr. R. C. Palmer, M.S.A., assistant to the Superintendent, who has been entirely responsible, under the Superintendent, for this work, and has prepared this section of the report.

provide data on the subsequent behaviour of apples picked at various stages of maturity.

Before definite recommendations can be made to the grower this data requires to be studied in the light of possible application to commercial practice. The problem of pickers and the possibility of loss through wind and frost must receive due consideration, while proper weight must be given to the influence of picking practice on the grade and the volume of the crop harvested.

Briefly stated, the idea in mind throughout the planning and carrying out of the investigation has been to apply the methods of science to the solution of some very practical problems of the orchardist. Answers have been sought to such questions as: "How long does an apple continue to take on more colour?" "When does an apple cease to increase in size?" "Can breakdown be prevented by proper harvesting practice?" "Does maturity at picking time exert a controlling influence on the development of scald?" "What effect have seasonal weather conditions on the date when apples reach proper picking maturity?" "Is there any simple maturity test which will enable the grower to tell when his apples are ready to pick?"

METHODS OF PROCEDURE

As a first step in the investigation a study was made of the literature on the subject. It was found that some valuable experimental work had already been carried out by the Bureau of Plant Industry of the United States Department of Agriculture. Officials of this Bureau had established the fact that certain storage diseases, such as scald and breakdown, are definitely correlated with the stage of maturity at which the fruit is harvested. They suggested the possibility of using the changes in "ground colour", or colour of the skin on the unblushed side of the fruit, as a maturity test.

During the past six years these investigations of the Bureau of Plant Industry have been greatly extended under the direction of Dr. J. R. Magness. Colour charts and mechanical pressure testers have been devised. These have made it possible to carry on picking tests, according to a uniform plan, throughout the major commercial apple districts of the United States.

Through the courtesy of Dr. Magness it has been possible to make use of similar equipment at this Station. In fact the rapid progress made in the work here has been due in large measure to the fact that similar experiments have been conducted simultaneously in the United States and there has been frequent interchange of ideas between investigators in the two countries.

At the outset it was realized that it would be necessary to work with several varieties of apples as it was altogether probable that picking practice would require to be modified for each individual variety. Fortunately the Experimental Station orchards contained sixty trees of each of seven important commercial varieties, namely: McIntosh, Grimes Golden, Jonathan, Delicious, Yellow Newtown, Wagener, and Rome Beauty. As these orchards were planted in 1916 the trees are still young, so that it has been considered advisable to secure additional fruit from older trees in commercial orchards in order to have a check on the results secured.

To still further reduce the possibility of experimental error pickings have been made from at least four trees of each variety each year, and in the case of the Jonathan many more trees have been used. Care has been taken to select trees receiving different cultural treatments, and carrying varying amounts of crop.

The first pickings have been made about two weeks earlier than the customary picking time for the variety and harvesting has been continued for a week or two later than the usual practice in commercial orchards. Pickings have been made once a week, and at each picking at least twenty apples have

been harvested from each tree, care being taken to select specimens representative of the stage of maturity of the whole crop.

At picking time careful notes have been made of the maturity of the fruit as indicated by seed colour, ease of separation from the spur, and "ground colour" or colour of the skin on the unblushed side of the fruit. During the past three years it has also been possible to record the hardness of the fruit by means of a pressure tester. An indication of the increase in volume of the crop during the picking season has been secured by making diameter measurements on ten marked apples on each tree each week. Similarly a record of the development of colour on red varieties has been obtained by noting the approximate area of coloured surface on each of the ten marked apples on each tree each week. An estimate of the loss from windfalls has been arrived at by noting the number of these marked apples which have fallen from the trees at each picking date.

Immediately after harvest the specimens have been placed unwrapped in peach boxes and removed to a common storage cellar. This cellar is below ground. The ceiling is insulated but the walls and floor are of concrete without insulation. The temperature is governed mainly by the temperature of the soil surrounding the cellar and averages about 60° F. in August, 55° F. in September, 50° F. in October, 40° F. in November, and 32° F. from December to March. By sprinkling water on the floor the humidity of the air has been maintained at from 75 to 90 per cent of saturation. Ventilation has been used to assist in controlling temperature and humidity. While the above storage treatment may not be identical with that which the fruit would receive in commerce, yet it is considered that the environment is such as to give a very good indication of how the fruit would behave under commercial conditions.

Periodic examinations have been made during the life of the fruit to determine the influence of harvesting practice on condition, quality, and the development of storage diseases, special attention being paid to the effect of maturity at harvest time on the development of flavour, shrivelling, scald, and breakdown. This data has been compiled in tabular form, so that the results secured with any one variety or in any one year may be readily compared with those of another.

EXPERIMENTAL DATA

The data collected during the past six years is so extensive that it is impossible to present it in entirety in this report, but an endeavour has been made to set forth sufficient to show the detailed nature of the records and the care taken to ensure accuracy in these records. In order to facilitate a correct interpretation of the tables information has been supplied concerning the manner in which the data were recorded, and mention has been made of any contributing factors which it is considered may have materially influenced the results secured.

Typical examples of the data concerning the changes which take place in apples as they approach maturity on the tree have been arranged in tabular form to show the manner in which these changes occur in seven important commercial varieties. Attention is then drawn to certain storage troubles which commonly shorten the life of these varieties, and tables are presented to indicate the relation between these diseases and time of picking. Following this, additional tables are furnished to show that by comparing the two previous sets of data it is possible to determine, for each individual variety, what changes in the fruit may be used as maturity tests to facilitate picking at the proper time for best storage results.

DEVELOPMENT OF RED COLOUR

The development of colour is one of the most important changes which takes place as red varieties approach picking maturity. The grade of these varieties is determined mainly by the percentage of their surface which is covered with red colour. The red colouring not only adds to the attractiveness of the fruit but also indicates, in most cases, high quality for the variety. In many varieties a distinct blush is evident quite early in the season but most of the colour development takes place in the last few weeks that the fruit remains on the tree. This statement is borne out by the data presented in table 2.

TABLE 2—DEVELOPMENT OF RED COLOUR DURING PICKING SEASON, 1922

Variety	Percentage of red colour at each picking							
	Sept. 5	Sept. 13	Sept. 20	Sept. 26	Oct. 2	Oct. 10	Oct. 17	Oct. 24
McIntosh (blush)..	15	26	52	75	85	.....	.....	.....
McIntosh (stripe).	7	15	25	34	43	.....	.....	.....
Jonathan.....	.....	8	15	22	45	82	86	.....
Delicious.....	.....	.....	6	14	42	53	61	.....
Rome Beauty.....	.....	.....	.....	5	9	17	35	41
Wagener.....	.....	.....	.....	7	18	26	48	70

Each figure in the above table presents the average of colour estimates made on at least thirty specimens. The records have been made by the same observer on the same specimens each week. Any specimens which fell from the trees prior to the final picking have been eliminated from all averages. Care has been taken to select specimens indicative of the amount of colour carried by apples throughout the tree, some being located in exposed and others in shaded situations. Colour estimates, at best, can only be approximate as it is impracticable to attempt to determine the exact percentage of the surface covered with colour when large numbers of specimens are involved. This is particularly true of striped varieties. However, it is considered that the above procedure has resulted in data which give a substantially accurate indication of the comparative development of colour from week to week.

The figures secured in 1922 indicate a very marked increase of the amount of colour on all varieties especially about the third or fourth week after picking was started. These observations have been substantiated by additional data secured in succeeding years. The data suggest that formation of red colouring matter is associated with maturing processes going on within the apple, and may therefore have value as a maturity test. It has also been observed, however, that colour development is more rapid and extensive on fruit fully exposed to the sun. This indicates that rate of development and amount of red colour are materially influenced by degree of exposure to sunlight. For this reason the amount of red colour cannot be regarded as a safe criterion of picking maturity. Other maturity tests indicate that poorly coloured specimens in shaded parts of the tree are often just as ripe as their highly coloured neighbours located where the light is more intense.

The McIntosh variety presents a special problem on account of the fact that there appear to be two distinct strains, one of which tends to take on more red colour than the other. In table 2 these strains are designated as "blush" and "stripe" respectively. Evidence secured over a period of several years indicates that, while there are undoubtedly two distinct strains, favourable light conditions sometimes cause the colouring on the striped type to run together giving an effect very similar to that found on the blush strain. On the other hand with trees carrying a large amount of foliage the striped strain takes on comparatively little colour even when the fruit is left unpicked until quite late in the season.

While development of red colour cannot be considered a reliable guide to maturity it obviously has a very practical bearing on the time when it is most profitable to harvest red varieties. As apples have been found to take on colour until late in the season it follows that, from the standpoint of improvement in grade, late picking is desirable. It is especially worthy of note that for each variety there appears to be a period of two weeks or so during which colour development is more rapid than during the preceding and subsequent two week periods. In order that full advantage may be taken of this phenomenon careful timing of the harvesting program is necessary.

INCREASE IN SIZE

Increase in yield due to growth of the apples during the last few weeks of the season must be taken into account if the crop is to be harvested to best advantage. The diameter measurements presented in table 3 show the increase in size of several varieties during the harvest season of 1922.

Each figure represents the average of measurements made on at least thirty specimens of various sizes. The apples were calipered to the nearest thirty-second of an inch across their widest diameter. All records were made by the same observer and the same specimens were measured each week, any which fell before the last picking being eliminated from all averages.

TABLE 3.—INCREASE IN SIZE OF APPLES DURING PICKING SEASON, 1922

Variety	Average diameter of apples in inches at each picking date							
	Sept. 5	Sept. 12	Sept. 19	Sept. 26	Oct. 3	Oct. 10	Oct. 17	Oct. 24
McIntosh	2·90	2·98	3·01	3·05	3·08	.....	.....	.....
Jonathan	.....	2·44	2·50	2·53	2·56	2·58	2·60	.....
Grimes	.....	2·78	2·85	2·90	2·94	2·98	.....	.....
Delicious	.....	2·76	2·84	2·92	2·97	3·01	3·06	.....
Newtown	.....	.....	2·72	2·80	2·86	2·94	3·00	3·04
Rome	.....	.....	.....	3·06	3·10	3·16	3·22	3·26
Wagener	.....	.....	.....	3·16	3·22	3·26	3·31	3·36

An examination of the data presented in the above table reveals the fact that the apples continued to increase in size at a comparatively uniform rate right up to the last picking. Records secured in subsequent years are substantially in agreement with those obtained in 1922. It has been observed, however, that in the case of trees suffering from drought the fruit may cease to enlarge and even show slight shrinkage quite early in the season.

The increase in size of the fruit, as indicated by diameter measurements, is sufficient to add very materially to the volume of the crop. This becomes apparent when it is borne in mind that the volume of a sphere 3 inches in diameter is approximately 10 per cent greater than the volume of a sphere 2·9 inches in diameter. While apples are not perfectly spherical in shape, their volumes undoubtedly bear a very similar relation to their diameters. Thus an increase of a tenth of an inch in the diameter of an apple may be regarded as indicative of a 10 per cent increase in volume. On this basis it may be seen from reference to table 3 that an increase in yield amounting to about 10 per cent was secured from each two-week period that the apples were allowed to remain on the trees. This increase in yield is obviously great enough to make up for a fair amount of loss from windfalls, and suggests that, where conditions are favourable for growth, a few boxes of apples under a tree does not always indicate a reduction in the net crop harvested. Within certain limits delayed picking results in increased tonnage, but eventually there comes a time when loss from dropping exceeds the gain from growth.

EASE OF PICKING

The weakening of the bonds which attach the fruit to the spur probably exerts a more far-reaching influence on harvesting practice than any other change which takes place in an apple as it ripens on the tree. As has just been pointed out, picking should be completed before dropping has become so extensive as to decrease the yield. On the other hand, the operation of picking can be performed with much greater rapidity and less damage to the spur system of the tree if harvesting be delayed until the fruit separates easily from the spur. Furthermore, when due allowance is made for variety characteristics, the ease with which the fruit can be picked provides a very useful indication of maturity.

It is impossible to determine the exact time when loss from dropping exceeds gain from growth, but it is undoubtedly good practice to harvest the crop before 20 per cent of the fruit has fallen. With this in mind a table has been prepared showing the date each year when 20 per cent of the crop had dropped from the trees.

TABLE 4.—LOSS IN YIELD FROM WINDFALLS

Variety	Date each year when 20 per cent of crop had fallen				
	1923	1924	1925	1926	1927
McIntosh	Oct. 4	Sept. 27	Sept. 26	Oct. 1	Oct. 7
Jonathan	.....	Oct. 25	Oct. 23	Oct. 15	Oct. 28
Grimes	Oct. 18	Oct. 4	Oct. 9	Oct. 1	Oct. 14
Delicious	Nov. 1	Oct. 25	Oct. 23	Oct. 15	Oct. 28
Newtown	.....	.....	.....	Oct. 22	.....
Rome	.....	.....	Oct. 30	Oct. 15	Nov. 4
Wagener	.....	.....	Oct. 30	Oct. 22	.....

A glance at the above table is sufficient to disclose the fact that serious dropping occurred much earlier some seasons than others. In this connection it may be well to mention that, although the Experimental Station orchards are in an exposed situation, loss of windfalls has seldom reached 20 per cent until the fruit has become so lightly attached as to fall freely without much help from wind. Conversely, heavy winds while the fruit was still firmly attached to the tree have resulted in comparatively little loss. The data in table 4 may therefore be taken as indicative of the approximate dates when the fruit commenced to drop freely. It will be observed that in 1923 and 1927 the fruit hung on until a late date, while in 1926 loss from windfalls was extensive quite early in the season. In this connection it is interesting to note that in 1926 apples came into bloom almost three weeks earlier than they did in 1923 and 1927. Blooming dates in 1924 and 1925 were intermediate between those of 1926 and 1927. These observations suggest that there may be a definite relation between date of bloom and date of maturity which would make it possible to prophesy the approximate date of harvest even as early as blooming time.

The loosening of fruit from the spur was undoubtedly hastened in 1926 by the unusually low temperatures experienced about September 20. In many cases the leaves were materially injured by frost, and this was apparently followed by premature dropping of the fruit.

From this discussion it is evident that, in order to avoid loss from dropping, it is necessary to vary the date of picking from year to year, harvesting the fruit while it is still fairly firmly attached to the spur. It is difficult to measure the tenacity with which the fruit adheres to the tree, but an attempt has been made to record the degree of attachment. At each date of picking the difficulty of removal has been recorded as hard, moderate, and easy; "hard"

signifying that the apple could only be separated from the spur by the use of both hands; "easy" indicating that the fruit came off easily when lifted with one hand, and "moderate" denoting a degree of attachment intermediate between "hard" and "easy". Some of the data secured in this way have been incorporated in table 5.

TABLE 5.—ADHERENCE OF APPLES TO THE TREE DURING PICKING SEASON, 1927.

Variety	Ease of removal at picking date							
	Sept. 3	Sept. 10	Sept. 17	Sept. 24	Oct. 1	Oct. 8	Oct. 15	Oct. 22
McIntosh	M	E	E	E	E	E	.....	.....
Jonathan	.....	.....	H	H	M	E	E	E
Grimes	.....	.....	M	M	E	E	E	E
Delicious	.....	.....	H	M	M	E	E	E
Newtown (green)	.....	.....	.....	H	H	H	M	E
Newtown (yellow)	.....	.....	.....	H	H	M	E	E
Rome	.....	.....	.....	H	H	H	M	E
Wagener	.....	.....	.....	H	H	H	M	M

NOTE.—"H" indicates hard, "M" indicates moderate, "E" indicates easy.

The information tabulated above was obtained with individual trees of each variety in 1927. It emphasizes the fact that some varieties, such as Wagener and Rome Beauty, adhere very tightly to the spur until they reach an advanced stage of maturity, while others, such as McIntosh and Grimes Golden, can be removed without great difficulty even when in a comparatively immature condition. Even with the latter varieties, however, there was a progressive loosening as the season advanced.

It will be noted that records on the ease of removal of fruit from two Newtown trees, designated as "green" and "yellow", have been included in table 5. It has been observed over a period of several years that Newtown trees produce quite a different style of apple when they are carrying a light crop than is the case when they are heavily loaded with fruit. In the case of a light crop the fruit is commonly quite long and angular in shape, while trees carrying a full crop produce apples which are flatter and more symmetrical in form. Furthermore, the fruit from light crop trees matures earlier, as is indicated by change in colour and by ease of removal. Although some trees have been known to produce several succeeding crops of "yellow" fruit and others repeated crops of "green" fruit, yet there are authentic records of the same individual trees producing "yellow" fruit one season and "green" the next, and in many cases it is quite difficult to determine in which class a particular tree should be placed.

Essentially similar data concerning ease of removal of the various varieties have been secured with fruit from additional trees and in previous seasons. This fact indicates that ease of removal is a most important index of maturity which should be given careful consideration in determining harvesting practice.

HARDNESS OF THE FRUIT

By the use of a mechanical pressure tester it has been possible to record, with a considerable degree of accuracy, the changes in hardness of apples as they ripen on the tree. In making the tests a steel plunger seven-sixteenths of an inch in diameter was forced into the flesh of the apple a distance of five-sixteenths of an inch, and the number of pounds pressure required to perform this operation recorded. A slice of peel slightly larger than the plunger point was removed before making the test. Three tests were made on each specimen and each figure in table 6 represented the average of tests made on at least ten apples. For the sake of simplicity the averages are shown to the nearest half pound.

TABLE 6.—HARDNESS OF APPLES DURING PICKING SEASON, 1927.

Variety	Hardness in pounds at each picking date							
	Sept. 3	Sept. 10	Sept. 17	Sept. 24	Oct. 1	Oct. 8	Oct. 15	Oct. 22
McIntosh	15	14½	14½	13½	13	13	.....	.....
Jonathan	.....	.....	17	15	14½	15	15	14
Grimes	.....	.....	20	18½	19	16½	16½	16
Delicious	.....	.....	17	17	16	15	14½	15
Newtown (green)	.....	.....	.....	20	19	18½	18	17
Newtown (yellow)	.....	.....	.....	20	20	18	18	17½
Rome	.....	.....	.....	20	18½	18	18	16
Wagener	.....	.....	.....	15½	15	15	14	14

NOTE.—Figures indicate pounds pressure required to force a seven-sixteenths of an inch point five-sixteenths of an inch into the flesh of the apple (peel removed).

The figures incorporated in the above table represent data secured with fruit from individual trees of each variety in 1927. The information is typical, however, of that secured with other trees and in previous seasons. From data of this kind it has been ascertained that as a general rule, apples soften slightly as they approach maturity on the tree. Certain exceptions to the rule have been recorded, notably in red varieties and varieties susceptible to water-core. It has been found that apples are commonly harder on the blushed than on the uncoloured side, a difference of one or two pounds being quite common. Similarly the development of water-core has sometimes resulted in an increased resistance of the flesh to pressure.

As will be seen from the figures presented in table 6 the changes in hardness were comparatively slight. Nevertheless a comparison of pressure records indicates that, on a given date, the crop as a whole was appreciably softer in 1926, a year of early maturity, than in 1927 when apples ripened comparatively late in the season. This observation suggests that the pressure test has value as an indicator of maturity. It should be fully appreciated, however, that a large number of pressure determinations is necessary in order to secure accurate information as to the hardness of the crop as a whole. Several other factors in addition to maturity have been found to influence the hardness of the fruit. Thus, small apples grown under conditions of scant moisture supply usually registered a higher pressure than large specimens grown where conditions were more favourable. Even on the same tree large apples were commonly softer than small ones and highly coloured fruit was harder than that carrying little red colour.

The data set forth in table 6 show clearly that there was quite a marked difference in the hardness of fruit from the seven varieties under consideration. McIntosh and Wagener proved to be comparatively soft varieties, while the firm texture of Grimes Golden, Newtown and Rome Beauty was reflected in comparatively great resistance to pressure. It is worthy of note that the "yellow" type of Newtown did not soften more rapidly than the "green" although other maturity tests indicated that it ripened earlier.

It seems evident that although the pressure tester has undoubted value as a maturity index it is not well adapted for use by the individual grower.

CHANGES IN SEED COLOUR

It has been known that, as an apple matures, brown colouring gradually replaces the white on the seeds until eventually they become almost black. The definite points in this change are the first appearance of brown colour and the time when the seed becomes completely brown. As it was found that the brown colour begins to appear quite early in the season with most varieties it was decided to record the time when the seeds became completely light brown,

noting earlier stages of browning as "part brown" and later stages as "dark brown." Some of the data secured by this procedure in 1927 is shown in the following table.

TABLE 7.—CHANGES IN SEED COLOUR DURING PICKING SEASON, 1927

Variety	Colour of Seeds at each picking date							
	Sept. 3	Sept. 10	Sept. 17	Sept. 24	Oct. 1	Oct. 8	Oct. 15	Oct. 22
McIntosh	P	P	P	L	D	D	.....	.....
Jonathan	.....	.....	L	L	D	D	D	D
Grimes	.....	.....	P	L	D	D	D	D
Delicious	.....	.....	P	L	D	D	D	D
Newtown	.....	.....	.....	L	D	D	D	D
Rome	.....	.....	.....	L	D	D	D	D
Wagener	.....	.....	.....	P	L	D	D	D

NOTE.—"P" indicates part brown, "L" indicates light brown, "D" indicates dark brown.

From the data presented in table 7 it is apparent that the seeds of all varieties, except Wagener, had become light brown by September 24. Thus there was practically no difference in the date when browning occurred in the seeds of McIntosh and Yellow Newtown, two varieties which commonly mature about six weeks apart. Very similar results have been recorded in previous seasons so that, at least with the later varieties, browning of the seeds cannot be taken as an indication that the fruit is ready to pick. A comparison of the data secured over a six-year period indicates that seeds of the winter varieties commonly turn brown from two to four weeks before the fruit reaches optimum picking condition. There has been a good deal of variation in time of colouring from year to year, and this has not always been correlated with time of maturity. From these remarks it may be inferred that browning of the seeds, while it is associated with maturity, is not a very consistent or reliable indicator of the ripeness of the fruit.

CHANGES IN GROUND COLOUR

The ground colour or colour of the skin on the unblushed side of an apple changes from a leaf green to almost a clear yellow as the apple matures. By the use of a colour chart it has been possible to record with some exactitude the progress of these changes. The procedure followed has been to compare the ground colour of the fruit with the colours on the chart, the comparison being made in the daylight in the shade. In 1923 a preliminary chart was devised, but in 1925 it was decided to abandon this chart in favour of the standard colour chart used by the United States Bureau of Plant Industry. This chart is made up of four colour plates ranging from a distinct green to almost clear yellow, and numbered one to four respectively. In these experiments it was found, in almost all cases, the ground colour had progressed beyond the colour stage known as stage one on the United States chart at the time picking was started. With this in mind and in order to simplify the test this colour plate has been omitted from the chart as used at this Station, with the result that colours number two, three and four on the United States chart are represented by the figures one, two and three respectively on the chart used in this investigation. Copies of this chart have been prepared in convenient form for carrying in the pocket and may be procured by any grower who cares to write to this Station. This chart makes it possible to record quite a wide range of colour. For instance a colour stage intermediate between numbers one and two may be designated as one and one-half. A cipher has been used to indicate that the ground colour has not yet progressed to stage one. Some data secured by the use of the colour chart are presented in table 8.

TABLE 8—CHANGE IN GROUND COLOUR DURING PICKING SEASON, 1927

Variety	Ground colour at each picking date							
	Sept. 3	Sept. 10	Sept. 17	Sept. 24	Oct. 1	Oct. 8	Oct. 15	Oct. 22
McIntosh	1	1½	1½	2	2	2½	.....	.....
Jonathan	.....	.....	1½	1½	2	2½	3	3
Grimes	.....	.....	1	1½	2	2	2½	3
Delicious	.....	.....	1½	1½	2	2	2½	3
Newtown (green)	.....	.....	.....	0	0	0	1	1
Newtown (yellow)	.....	.....	.....	1	1	1½	2	2½
Rome	.....	.....	.....	1	1½	1½	2	2½
Wagener	.....	.....	.....	1	1	1½	1½	2

NOTE.—Figures indicate degree of yellowing on unblushed side of fruit as compared with colour plates on chart mentioned in the text.

It will be noticed that in all varieties there was a gradual increase in the intensity of the yellow as the season advanced. In most cases a period of about two weeks was required for the fruit to pass from one colour stage to the next. The change was observed to take place irrespective of exposure to sunlight. This fact suggests that changes in ground colour are more likely to prove accurate indicators of maturity than is the development of red colour. A comparison of several years' results indicates, however, that the changes in ground colour are influenced to a certain extent by temperature during the ripening period. Thus in 1926 when apples ripened during comparatively warm weather, changes in ground colour were observed to take place slightly slower, in comparison with other maturity indices, than was the case in 1927 when the fruit matured during a period of comparatively low temperatures. This suggests that the same stage of maturity is accompanied by greater development of yellow colouring in cool seasons than when fruit matures at higher temperatures. It is also probable that, for a given stage of maturity, yellowing is more intense in fruit grown in cool districts than is the case where high temperatures are experienced during the ripening period.

Nevertheless, all things considered, the changes in ground colour have proved to be one of the most useful indicators of maturity.

DEVELOPMENT OF WATER-CORE

In a number of varieties water-soaked areas have been observed to appear towards the latter end of the season. In Jonathans, Romes and Delicious water-core commonly appears first as small water-soaked spots arranged in a circle about the core area. These spots gradually increase in size until they eventually form a complete band of water-soaked tissue. In recording the amount of water-core in these varieties the first appearance of the spots has been designated as "slight", and when the injury has assumed the form of a continuous band the degree of development has been noted as "excessive." The word "moderate" has been used to denote a degree of water-core intermediate between "slight" and "excessive." The same words have been used to designate the degree of water-core in Newtowns and Wageners although the appearance of the injury is commonly somewhat different in these varieties. In order to ascertain the amount of water-core cutting tests have been made on a number of apples at each picking. The data in the following table are suggestive of the kind of information which has been secured in this way.

TABLE 9—DEVELOPMENT OF WATER-CORE DURING PICKING SEASON 1927

Variety	Amount of water-core at each picking date							
	Sept. 3	Sept. 10	Sept. 17	Sept. 24	Oct. 1	Oct. 8	Oct. 15	Oct. 22
McIntosh	—	—	—	—	—	—	.....	.....
Jonathan	.....	.....	—	—	—	S	M	E
Grimes	.....	.....	—	—	—	—	—	—
Delicious	.....	.....	—	—	—	—	S	M
Newtown (green)	.....	.....	.....	—	—	—	—	—
Newtown (yellow)	.....	.....	.....	—	—	—	—	S
Rome	.....	.....	.....	—	—	—	—	S
Wagener	.....	.....	.....	—	—	—	—	S

NOTE.—"S" indicates slight; "M" indicates moderate; "E" indicates excessive.

It will be noted that water-core commonly developed towards the latter end of the season, the severity of the injury increasing as the season advanced. Jonathan, Delicious and Wagener proved more susceptible than the other varieties tested. Very similar results have been recorded in fruit from other trees and in previous seasons. This fact suggests the possibility of using the development of water-core as a maturity test.

DEVELOPMENT OF QUALITY

Quality, as applied to an apple, is a very comprehensive term which it is difficult to define. Flavour, texture, sugar content, acidity and aroma are all involved in that combination of characteristics which we term quality. As the tastes of individual consumers differ greatly it is not easy to devise a scale of quality. Nevertheless, it is considered that a good idea of the comparative excellence of different samples has been secured by a classification into three grades designated good, fair and poor. All specimens having satisfactory commercial quality for the variety have been recorded as "good." Those in which quality was so inferior as to materially reduce their sale value have been classed as "poor." The word "fair" has been applied to fruit intermediate in quality between the above classes. The following table is an example of data secured in this way.

TABLE 10—QUALITY OF APPLES IN STORAGE 1925-26

Variety	Quality of fruit from each picking							
	Sept. 5	Sept. 12	Sept. 19	Sept. 26	Oct. 2	Oct. 9	Oct. 16	Oct. 23
McIntosh	P	F	G	G	G	.....	.....	.....
Jonathan	.....	.....	F	G	G	G	P	.....
Grimes	.....	.....	F	G	G	G	G	.....
Delicious	.....	.....	P	F	G	G	G	.....
Newtown	.....	.....	.....	F	G	G	G	G
Rome	.....	.....	.....	P	F	G	G	G
Wagener	.....	.....	.....	P	F	F	G	G

NOTE.—"P" indicates poor; "F" indicates fair; "G" indicates good.

From a glance at the data presented above it is at once apparent that time of picking has exerted a profound influence on the development of quality in all the varieties studied. Very early picking has invariably resulted in inferior quality. With the Jonathan late picking has given a similar result. These statements are borne out by numerous observations extending over the whole period of the investigation. In certain cases the quality of other varieties besides Jonathan has been injured by allowing the fruit to remain too long on the tree. This condition is referred to again under the heading "Breakdown."

With most varieties and in most cases, however, delayed picking has resulted in an improvement in quality. Since other considerations often make it undesirable to delay picking any longer than is absolutely necessary to ensure good quality, it is important that maturity tests be devised to indicate when harvesting of each variety may safely be begun. Some information concerning the relative efficiency of various maturity tests in preventing poor quality in Delicious is tabulated below.

TABLE 11—MATURITY TESTS AND DEVELOPMENT OF QUALITY IN DELICIOUS

Indications of maturity	1925	1926	1927
Poor quality in fruit picked on and before	Sept. 19	Sept. 15	Sept. 23
Percentage of red colour on above date	22	17	15
Ease of picking on above date	M	M	M
Hardness on above date	17	16	17
Seed colour on above date	L	L	L
Ground colour on above date	1½	1	1½
Date of full bloom	May 7	April 25	May 16

It will be noted that calendar date is not a reliable criterion of picking time, for the date of maturity varies from year to year with seasonal conditions. It has also been observed that local conditions of soil, aspect, culture, etc. influence date of maturity. Nevertheless, a record of picking dates over a series of years has been found useful as a general guide to harvesting practice.

While development of red colour has been shown to be dependent on exposure to sunlight as well as maturity, yet the figures presented in table 11 give some indication of the average amount of red colour which is associated with poor quality. They suggest that Delicious should show at least 20 per cent red colour before picking is begun. This means of course that some individual specimens will have more and some less than 20 per cent of their surface covered with red.

Ease of picking has proved very dependable as a maturity test for the Delicious, the data secured indicating that poor quality is likely to result unless this variety is left on the tree until the fruit separates quite easily from the spur.

Hardness of the fruit has given some indication of the relative earliness of the season, but the wide variation in hardness of individual apples, and the slow rate of softening indicate that great care must be exercised in using this test.

Seed colour has not proved very satisfactory as a maturity test for the Delicious. The seeds of this variety were usually completely brown from one to three weeks before the fruit was ready to pick.

Ground colour has not given entire satisfaction as a means of determining desirable picking time for the Delicious. Under favourable conditions this variety becomes striped and blushed with red over most of its surface so that it is difficult to determine the stage of ground colour with exactitude. However, by selecting specimens from shaded locations for comparison with the colour chart a fairly good idea of ground colour in the rest of the crop has been obtained. Study of a large number of records indicates that poor quality may be expected in Delicious picked before the ground colour has progressed to stage two on the colour chart.

A comparison of blooming dates and harvesting data for the past six years indicates that an early blooming season is commonly followed by an early harvest, but the difference between harvest dates from year to year has not been identical with the difference between blooming dates. Thus in 1927 Delicious bloomed about twenty days later and ripened about ten days later than they did in 1926.

In a manner similar to that outlined above, harvesting and storage data secured with the other varieties during the past six years have been carefully compared in an endeavour to determine, for each variety, what maturity tests may be used to ensure good quality.

PREVENTION OF SHRIVELLING

Shrivelling or wrinkling of the skin of an apple is the direct result of loss of moisture from the flesh of the fruit. This water loss is usually accompanied by a loss of that crispness and juiciness which is so pleasing to the palate. Consequently shrivelling is a distinct detriment which should be reduced as much as possible. In recording amount of shrivelling the word "excessive" was used to denote a condition such that the sale value of the fruit was materially reduced. When the skin could only be caused to wrinkle by pressure with the hand the word "slight" was used; shrivelling intermediate in degree between these two stages was called "moderate". The following table shows data secured by this procedure:—

TABLE 12—SHRIVELLING OF APPLES IN STORAGE JANUARY 11, 1926

Variety	Shrivelling of fruit from each picking							
	Sept. 5	Sept. 12	Sept. 19	Sept. 26	Oct. 2	Oct. 9	Oct. 16	Oct. 23
McIntosh	E	M	M	S	S	.....	.....	.....
Jonathan	.....	.....	M	S	—	—	—	.....
Grimes	.....	.....	S	S	—	—	—	.....
Delicious	.....	.....	—	—	—	—	—	.....
Newtown	.....	.....	.....	—	—	—	—	—
Rome	.....	.....	.....	—	—	—	—	—
Wagener	.....	.....	.....	—	—	—	—	—

NOTE.—"E" indicates excessive; "M" indicates moderate; "S" indicates slight.

It is apparent, from the data presented above, that McIntosh, Jonathan, and Grimes showed much more shrivelling than Delicious, Newtown, Wagener, and Rome. It is also obvious that early-picked fruit was more subject to the injury than that harvested in a more mature condition. Comparison of many additional records indicates that these statements hold true from year to year over a wide range of conditions. It should be pointed out, however, that fruit of susceptible varieties, even though picked in a mature condition, is likely to develop some shrivelling towards the end of the storage season, particularly if the air in the storage room is relatively dry. The tendency to shrivel is apparently greatly reduced by the corking over of the lenticals and development of wax which take place as the fruit nears maturity. The development of protective wax is much more pronounced on some varieties than on others, which undoubtedly accounts for differences in susceptibility to shrivelling.

While shrivelling is seldom an important factor with Newtown, Delicious, and Wagener, it demands careful consideration in the case of susceptible varieties such as McIntosh, Grimes, and Jonathan. Some data indicating the possible value of various maturity tests for the prevention of shrivelling in the McIntosh are set forth in the following table:—

TABLE 13—MATURITY TESTS AND PREVENTION OF SHRIVELLING IN McINTOSH

Indications of maturity	1925	1926	1927
Excessive shrivelling of fruit picked on and before	Sept. 5	Sept. 1	Sept. 9
Percentage of red colour on above date	18	14	16
Ease of picking on above date	E	E	E
Hardness on above date	14	14	14½
Seed colour on above date	P	P	P
Ground colour on above date	1½	1	1½
Date of full bloom	May 4	April 23	May 13

A study of the information printed above indicates that, in order to prevent shrivelling in the McIntosh, the date of picking must be varied from year to year in conformity with the stage of maturity of the fruit.

The data secured suggest that shrivelling is likely to be excessive in McIntosh of the " blush " type picked before the fruit averages 20 per cent red colour. Under certain conditions the " striped " type of McIntosh has been found to develop little shrivelling when picked with as low as 10 per cent of its surface covered with solid red.

Ease of picking has not proved very satisfactory as a means of determining the best stage of maturity at which to harvest McIntosh. As is indicated in table 13, the fruit usually picks quite easily some time before it has reached satisfactory harvesting maturity.

Hardness of the flesh has been found of value as a maturity test for the McIntosh, but the data secured do not indicate that this test is very well adapted for use by the individual grower.

Seed colour seems to offer greater possibilities as a maturity test for McIntosh than is the case with the other varieties studied. Records over a six-year period show that the change from part white to completely light brown took place within a week of the time that the fruit reached satisfactory picking maturity. This suggests that shrivelling in the McIntosh can be largely prevented by delaying harvest until the seeds have become completely brown.

Ground colour has been found useful as a maturity index for the McIntosh, but the colouring on the unblushed side of this variety is of a somewhat different quality to the tints shown on the standard colour chart. This makes accurate comparison rather difficult.

A study of blooming and harvesting data indicates that the actual number of days required to mature a crop of McIntosh varies only slightly from year to year, and suggests that it is seldom safe to start picking this variety within 130 days from date of full bloom.

In a similar manner to that outlined above a study has been made of the reliability of various maturity tests as a means of preventing excessive shrivelling in the Jonathan and Grimes Golden.

PROLONGATION OF STORAGE LIFE

The storage life of the varieties included in this investigation may conveniently be divided into three stages. At time of picking the fruit is still in a somewhat immature condition—certain chemical and physical changes have still to take place before the prime eating stage is reached. This in turn is followed by an over-ripe stage in which the fruit is still edible but past its prime. The length of these various stages varies greatly with the variety and is profoundly influenced by storage temperature. The pressure tester has been found to provide a very reliable means of recording the progress of the life processes in an apple after it is picked.

In the following table figures are presented showing the hardness of fruit picked on various dates. The pressure tests were made on January 11, 1926.

TABLE 14—HARDNESS OF APPLES IN STORAGE JANUARY 11, 1926

Variety	Hardness of fruit from each picking							
	Sept. 5	Sept. 12	Sept. 19	Sept. 26	Oct. 2	Oct. 9	Oct. 16	Oct. 23
McIntosh	8	8	8½	8½	9	.....	.....	.....
Jonathan	.....	.....	10½	11	11½	11½	10	.....
Grimes	.....	.....	11	11	11	11½	12	.....
Delicious	.....	.....	10½	10½	11	11	11	.....
Newtown	.....	.....	.....	13	13	13½	14	14
Rome	.....	.....	.....	10½	10½	11	11	11½
Wagener	.....	.....	.....	10½	10½	11	11	11

NOTE.—Figures indicate pounds pressure required to force a $\frac{7}{16}$" point $\frac{5}{16}$" into the flesh of the apple (peel removed).

Each figure in the above table represents the average of at least ten determinations. For simplicity averages are shown to the nearest half pound. It will be noted that date of picking has materially influenced the length of life of the fruit as indicated by hardness on a given date. It is evident that the early-picked fruit has ripened faster in storage than has that harvested later in the season. This statement is substantiated by many similar records.

It may be well to mention that the fruit of the various varieties has been found to be in prime eating condition when McIntosh recorded from 9 to 11, Jonathan and Wagener 10 to 12, and the remaining varieties 11 to 13 pounds in hardness.

In general the data secured indicate that, under common storage conditions, the life of the fruit has been appreciably prolonged by leaving the fruit on the tree until a comparatively late date for the variety. There is a limit, however, to "storage on the tree", for with some varieties, notably the Jonathan, very late picking has resulted in the development of breakdown and consequent shortening of the storage life of the fruit.

Where cold storage facilities are available it is undoubtedly advisable to harvest the fruit fairly early as the rate of softening has been found to be slower in cold storage than on the tree, but when the fruit is to be held at temperatures which prevail in common storages at picking time advantage can sometimes be taken of the fact that ripening progresses at a slower rate on the tree than in common storage. This is particularly true of such varieties as Delicious and Rome Beauty, which ripen very rapidly at high temperatures.

Some indication of the comparative value of various maturity tests in the harvesting of Rome Beauty, with a view to prolonging the storage life of this variety, is given by the data furnished below:—

TABLE 15—MATURITY TESTS AND PROLONGATION OF STORAGE LIFE IN ROME BEAUTY

Indications of maturity	1925	1926	1927
Short storage life in fruit picked on and before	Oct. 2	Sept. 25	Oct. 8
Percentage of red colour on above date	13	9	12
Ease of picking on above date	H	H	H
Hardness on above date	19	18	18
Seed colour on above date	D	D	D
Ground colour on above date	1½	1½	1½
Date of full bloom	May 11	April 29	May 20

PREVENTION OF SCALD

Scald is the name given to a brown discoloration which appears on the skin of certain varieties of apples. In a very comprehensive investigation of this disease Brooks, Cooley and Fisher of the U.S. Bureau of Plant Industry have shown that the injury is caused by certain gaseous products given off by the apples. These investigators have also demonstrated that with many varieties the damage can be almost entirely prevented by wrapping the fruit in oiled paper. The oil apparently absorbs the injurious gases. Similarly these deleterious products may be removed by ventilation. In commercial practice it is not always possible to apply these preventatives and they have not always given the results desired. It has long been known that maturity at picking time influences the susceptibility of some varieties to scald, but further information along this line is most desirable.

In this investigation the method of storing the apples unwrapped in ventilated common storage was not conducive to the development of scald. Nevertheless a certain amount of the disease occurred and the severity of the injury was carefully recorded. In making the observations 20 apples of each lot were examined for traces of the disease. Where scald was found to extend over more than half the surface of an apple this specimen was given a rating of five points. Where only a trace of scald was found a rating of one was given. Intermediate degrees of scald were designated by the numbers 2, 3, and 4. Thus if all the 20 specimens had more than half their surface affected by the disease a total rating of 100 would be secured. In this way it was possible to secure a composite figure which took into account both the number of apples affected and the severity of the injury.

Data secured by this procedure are shown in table 16.

TABLE 16.—SCALD ON APPLES IN STORAGE, JANUARY 11, 1926

Variety	Amount of scald on fruit from each picking							
	Sept. 5	Sept. 12	Sept. 19	Sept. 26	Oct. 2	Oct. 9	Oct. 16	Oct. 23
McIntosh	0	0	0	0	0	.....	.....	.....
Jonathan	.....	.....	4	0	0	0	0	.....
Grimes	.....	.....	30	28	15	4	0	.....
Delicious	.....	.....	0	0	0	0	0	.....
Newtown	.....	.....	.....	0	0	0	0	0
Rome	.....	.....	.....	6	0	0	0	0
Wagener	.....	.....	.....	24	7	0	0	0

NOTE.—Figures indicate severity of the injury as explained in the text.

As is indicated by the information presented above, Grimes Golden and Wagener were found to be especially susceptible to scald. McIntosh proved to be practically immune. Jonathan and Delicious were seldom seriously affected, while Rome Beauty sometimes developed quite an appreciable amount of the disease.

The Newtown appears to present a special problem, as scald was found to be much more prevalent on the "yellow" type produced by trees carrying a light crop, than was the case on the "green" type from heavily loaded trees.

With the remaining varieties, fruit picked early in the season proved to be much more susceptible than that left on the trees until more mature. Essentially similar results have been recorded every year throughout the term of this investigation.

A comparison of scald development and harvesting phenomena for the Grimes Golden indicate that other considerations, such as the tendency of the fruit to drop freely when mature, make late picking of only limited practical

value as a means of preventing scald on this variety. Wrapping in oiled paper within a month of harvest seems to be the most feasible and effective means of preventing the development of scald on Grimes Golden.

With the Wagener, however, there is ample evidence to indicate that the losses from scald may be greatly reduced by proper harvesting practice. In past years scald has injured the sale value of this variety very materially. In the advanced stages of scald on the Wagener not only the skin but also the flesh of the fruit becomes discoloured resulting in a condition which it is very difficult to distinguish from breakdown.

The possible value of various maturity tests for the prevention of scald on the Wagener is indicated by the data presented below.

TABLE 17.—MATURITY TESTS AND PREVENTION OF SCALD ON WAGENER

Indications of maturity	1925	1926	1927
Severe scald on fruit picked on and before	Oct. 9	Oct. 1	Oct. 14
Percentage of red colour on above date	26	22	33
Ease of picking on above date	M	M	M
Hardness on above date	14	14½	15
Seed colour on above date	D	D	D
Ground colour on above date	1½	1½	2
Date of full bloom	May 3	Apr. 23	May 12

PREVENTION OF BREAKDOWN

Breakdown is the term used to designate a condition of decay which sometimes develops in apples grown in the Pacific Northwest. The disease is characterized by browning and softening of the flesh accompanied by changes in texture and flavour which completely destroy the sale value of affected specimens. The injury appears first as a very slight discoloration of the flesh, in some cases close to the skin and in others near the vascular bundles. The presence of the disease, even in its early stages, renders the fruit unpalatable. In advanced stages, the injury is quite evident from the exterior, but at first it is often necessary to cut the fruit in order to identify affected specimens. Since no bacteria nor fungi have been found associated with the early stages of breakdown, the disease is considered to be functional or physiological in character.

The fact that susceptibility to breakdown is very markedly influenced by date of picking is indicated by the data furnished below.

TABLE 18—BREAKDOWN OF APPLES IN STORAGE, JANUARY 11, 1926

Variety	Percentage breakdown in fruit from each picking							
	Sept. 12	Sept. 19	Sept. 26	Oct. 2	Oct. 9	Oct. 16	Oct. 23	Oct. 30
Jonathan	.....	0	0	0	9	26	40	.....
McIntosh	0	0	0	0	.....	.....	.....	.....
Grimes	.....	0	0	0	0	3	.....	.....
Delicious	.....	0	0	0	0	0	2	.....
Newtown	.....	.....	0	0	0	0	0	0
Wagener	.....	.....	0	0	0	0	0	5
Rome	.....	.....	0	0	0	0	0	7

It will be noted that breakdown developed in a high percentage of late-picked Jonathans and that the disease occurred in a few late-picked specimens of Grimes, Delicious, Wagener, and Rome Beauty varieties. No injury from this cause was recorded in McIntosh or Newtown even in the fruit harvested late in

the season. The data secured with fruit from additional trees and in other seasons bears out these statements, indicating that harvesting practice has an extremely important bearing on the breakdown problem.

Some indication of the possibility of using maturity tests as a means of preventing breakdown in the Jonathan variety may be gleaned from a study of table 19.

TABLE 19.—MATURITY TESTS AND PREVENTION OF BREAKDOWN IN JONATHAN

Indications of Maturity	1925	1926	1927
Excessive breakdown in fruit picked on and after	Oct. 9	Oct. 8	Oct. 6
Percentage of red colour on above date	60	72	55
Ease of picking on above date	E	E	E
Hardness on above date	14	13	13
Seed colour on above date	D	D	D
Ground colour on above date	3	3	3
Water-core on above date	M	S	M
Date of full bloom	May 10	Apr. 27	May 18

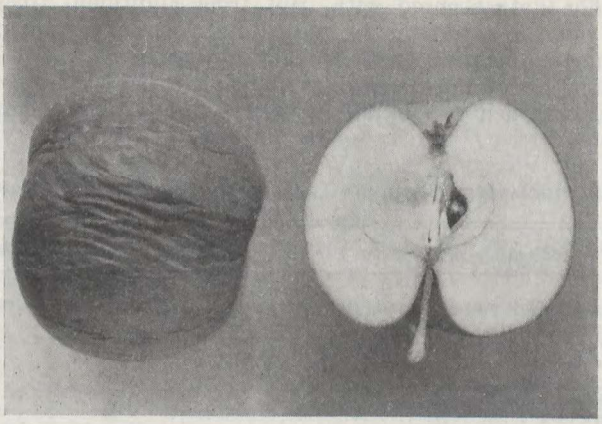
The information tabulated above shows that, with fruit from the particular tree to which this data refers, serious breakdown occurred in apples picked about the same date in 1925, 1926, and 1927. In view of the fact that the crop as a whole is known to have matured almost two weeks later in 1927 than was the case in 1926 this observation suggests that susceptibility to breakdown is influenced by other factors besides maturity. A study of the yield record of the tree under discussion reveals the fact that this tree carried a heavy crop in 1926 and a comparatively light load in the preceding and succeeding years. During the past six years a good deal of evidence has been secured in support of the statement that fruit grown on trees carrying a light crop is far more susceptible to breakdown than that produced by trees carrying a full load. Table 20 furnishes an example of the data recorded.

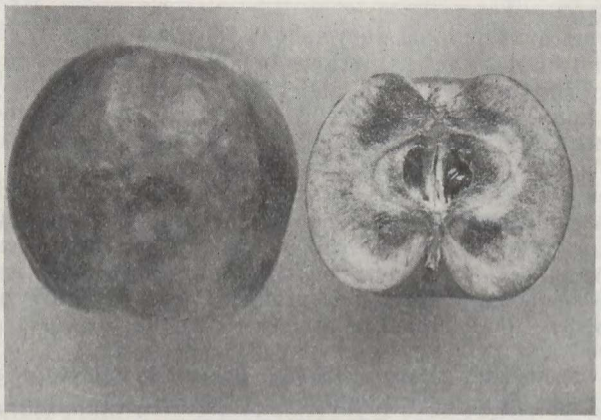
TABLE 20.—AMOUNT OF CROP AND BREAKDOWN IN JONATHAN, 1927

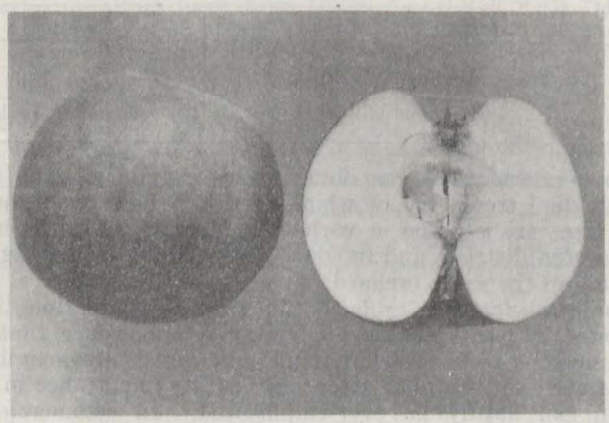
Amount of Crop	Percentage of breakdown in fruit from each picking						
	Sept. 15	Sept. 22	Sept. 29	Oct. 6	Oct. 13	Oct. 20	Oct. 27
Light	0	0	5	37	66	75	82
Heavy	0	0	0	0	1	3	5

The above information was obtained by examination of fruit harvested from ten individual trees, five of which carried a light crop and five a heavy crop. These trees are situated in various commercial orchards in the Summerland and Penticton districts and in some cases the heavy and light loaded trees are side by side in the same orchard.

The figures set forth in table 20 support the contention that breakdown can be prevented by early picking. They indicate, however, that trees carrying a light crop must be picked earlier than those which are heavily laden. This statement has been verified year after year and its importance in the prevention of breakdown can hardly be over-emphasized. In commercial practice the reverse procedure has often been followed. The apples from lightly loaded trees are commonly slow in taking on red colour, with the result that there is a tendency to leave them on the trees until after the more highly coloured fruit from full-crop trees has been picked.







Storage life of the Jonathan apple as influenced by maturity at picking time. The shrivelling shown in the upper figure is encouraged by too early picking. The centre figure shows a type of breakdown prevalent in the late picked Jonathans. The healthy apples in the lower figure were picked at the proper stage of maturity. The three photos were taken on March 1, 1928.

From the evidence at hand it is not possible to state definitely just why the fruit from lightly loaded trees is more susceptible to breakdown than that from trees carrying a heavy crop. At least two factors, size and maturity of the fruit, seem to be involved. The apples on trees carrying less than a full crop have been found to average larger in size than those from heavily laden trees, and the records show that breakdown is more prevalent in large than small fruit. Some evidence concerning this point will be found in the table which follows:—

TABLE 21.—SIZE OF FRUIT AND BREAKDOWN IN JONATHAN, 1927

Amount of Crop	Percentage of breakdown in fruit of various sizes						
	80	96	113	125	138	160	175
Light	81	75	70	69	64	.....	.....
Heavy	.....	.....	3	2	0	0	0

The data presented in table 21 was secured from ten boxes of apples picked from two trees growing side by side in a commercial orchard. The crop from both trees was harvested, sized, and packed in standard apple boxes on October 20, 1927. It will be noted that the fruit from the lightly loaded tree packed from 80 to 138 apples to the box, while that from the heavily laden tree averaged smaller, packing out sizes 113, 125, 138, 150, and 175 apples to the box.

From a consideration of the data set forth in table 21 it is apparent that size of fruit has some bearing on susceptibility to breakdown, for, in the apples from each individual tree, there was slightly more breakdown in the large than in the small sizes. It is significant, however, that fruit of sizes 113, 125, and 138 apples to the box harvested from the lightly loaded tree proved very susceptible to the disease while very little breakdown occurred in fruit of the same sizes picked from the tree which carried a heavy crop.

Maturity tests, such as softening of the flesh and changes in ground colour, indicate that the fruit on lightly loaded trees usually ripens somewhat earlier than that on heavily laden trees growing under similar conditions. The difference in maturity does not appear to be sufficiently great, however, to account for the fact that breakdown is quite prevalent in fruit picked comparatively early in the season from trees carrying a light crop, while harvesting of heavily loaded trees may often be delayed until late in the season without serious consequences. It seems probable that there is some fundamental difference in the structure or composition of apples from heavily and lightly loaded trees which has a profound influence on the susceptibility of the fruit to breakdown. This phase of the problem is certainly worthy of further investigation.

To return to a consideration of the data presented in table 19, attention is drawn to the fact that breakdown was associated with comparatively extensive development of red colour. This observation is amply substantiated by commercial experience, for claims have usually been far more serious on Extra Fancy than on fruit of the lower grades. A good deal of evidence is available, however, to show that a high development of red colour is not in itself a sure indication of susceptibility to breakdown. An example of data bearing on this point is furnished in table 22.

TABLE 22.—RED COLOUR AND BREAKDOWN IN JONATHAN, 1927

Amount of Crop	Percentage of breakdown in fruit with various amounts of colour			
	0—25% red	26—50% red	51—75% red	76—100% red
Light	62	64	75	91
Heavy	0	0	1	3

The above information was secured by grading the fruit from two individual trees into four colour classes. The two trees are growing side by side in the same orchard and the crop from both was harvested on the same day. It will be noted that in the fruit from each individual tree there was more breakdown in the highly coloured fruit than in the grades showing less red colour. It is apparent, however, that very little breakdown occurred in any of the apples from the heavy crop tree, whereas a high percentage of all the colour grades from the lightly loaded tree was affected. The significance of this observation is further emphasized by the fact that 31 per cent of the fruit on the heavily loaded tree and only 26 per cent of that on the light crop tree carried over 75 per cent of red colour. It seems probable that the relation of red colour to breakdown is largely if not entirely a matter of maturity.

Ease of picking has been found somewhat deceptive as a guide to harvesting time for the Jonathan. This variety usually hangs well to the tree for some time after it has reached satisfactory harvesting maturity. Because of this fact, there is a tendency on the part of some growers to delay picking of the Jonathan until other varieties have been harvested. This is a perfectly natural tendency especially as varieties like Delicious can be expected to command a higher price per box than Jonathan. Nevertheless, in the long run, it is undoubtedly wiser to run the risk of losing a few boxes of Delicious than to court disaster on the Jonathan market.

The pressure test has proved of only limited value as a means of preventing breakdown in the Jonathan. This is exemplified by the data furnished in table 23.

TABLE 23.—PRESSURE TEST AND BREAKDOWN IN THE JONATHAN, 1927

Hardness in pounds	19	18	17	16	15	14	13
Percentage of breakdown	0	11	14	23	16	23	38

The figures set forth above were secured by a study of fruit from twenty individual trees in the Summerland and Penticton districts. Pickings were made from each of these trees at weekly intervals from September 15 to October 27, 1927. At each picking the average hardness of the fruit from each tree was determined. Representative samples comprising at least twenty specimens from each picking from each tree were placed in common storage, and on December 10, 1927, the percentage of breakdown in the various lots was ascertained. The data secured indicate that there is a certain degree of correlation between hardness at picking time and susceptibility to breakdown. Thus no breakdown developed in apples testing 19 pounds and susceptibility was quite pronounced in apples testing 13 pounds. It will be noted, however, that there was very little difference in the percentage of breakdown in apples testing between 17 and 14 pounds. In this connection it may be well to mention that, in order to ensure good quality, it has often been found necessary to leave Jonathans on the trees until they tested 15 pounds in hardness. Essentially similar data have been recorded in previous years. This suggests that the

pressure test is not an adequate means of determining the most satisfactory time to pick Jonathans.

Seed colour has proved of little value as a maturity test for the Jonathan on account of the fact that the seeds in this variety commonly turn brown two weeks or more before the fruit reaches satisfactory picking maturity.

Breakdown of the Jonathan has been found to be closely correlated with the amount of water-core present at picking time. Some data illustrating this correlation are presented in table 24.

TABLE 24.—WATER-CORE AND BREAKDOWN IN THE JONATHAN, 1927

Amount of water-core	None	Slight	Moderate	Excessive
Percentage of breakdown	2·0	31·0	63·0	71·0

The above data were obtained from the same fruit used in securing the information set forth in table 23. In order to obtain an indication of the amount of water-core present at picking time, at least ten apples from each picking from each tree were cut across midway between stem and blossom end. The remaining apples were stored and the percentage of breakdown determined. While the technique of this procedure is admittedly open to criticism it is considered that the results secured give at least an approximate idea of the degree of correlation between breakdown and water-core. They indicate that the greater the amount of water-core at picking time, the more likely is the fruit to develop breakdown, but they also suggest that breakdown and water-core are not entirely interdependent. Thus the results secured indicate that it is possible for an apple to develop breakdown without first having been affected with water-core. Similarly there is evidence to show that water-core may sometimes be present without rendering the fruit susceptible to breakdown. In any case the fact that water-core has been so frequently followed by breakdown, is ample justification for removing Jonathans from the trees before water-soaked areas appear.

The information available concerning the relation between blooming dates and breakdown suggests that, as a general rule, it is dangerous to leave Jonathans on the trees more than 150 days after date of full bloom. It should be borne in mind, however, that the exact number of days necessary to mature the Jonathan varies somewhat with the amount of crop and with seasonal weather conditions.

Changes in ground colour or colour of the skin on the unblushed side of the fruit appear to furnish a practical and effective maturity test for preventing breakdown in the Jonathan. The efficiency of this test is demonstrated by the data incorporated in table 25.

TABLE 25.—GROUND COLOUR AND BREAKDOWN IN THE JONATHAN, 1927

Colour stage	1	1½	2	2½	3
Percentage of breakdown	0	0	0	7	33

These figures were obtained from the same fruit mentioned in the discussion of table 23. It will be noted that no breakdown developed in fruit having a ground colour corresponding to stages one and two on the colour chart. Some breakdown occurred in apples picked when the skin on the unblushed side was intermediate in colour between plates two and three on the colour chart. A study of the records reveals the fact that these apples came almost invariably from trees carrying a light crop. Similarly it has been observed that in many cases the fruit from trees carrying a full load did not develop breakdown even

though it had a ground colour corresponding to stage three when picked. These observations are substantiated by data secured from several thousand boxes of fruit from as many hundred individual trees during the past six years. They point the way to a practical means of preventing breakdown in the Jonathan.

With regard to the prevention of breakdown in varieties other than the Jonathan, the records show that breakdown has seldom occurred in fruit removed from the trees before it reached an advanced stage of maturity. With all the varieties studied susceptibility has been greater in fruit from lightly loaded trees than in that from trees carrying a full crop. With Delicious and Wagener the correlation between water-core and breakdown does not seem to be so pronounced as is the case with the Jonathan. In fact it has been observed that during storage quite serious water-core often disappears from Delicious and Wagener without leaving any apparent ill effects.

RECOMMENDATIONS

Further information is necessary before definite recommendations can be made concerning some of the problems discussed in this report. It is especially desirable that the experiments should be repeated under a wider range of conditions than has yet been possible. Nevertheless, the fact that the investigation has been carried on systematically over a six-year period makes it possible to advance, with a fair measure of assurance, certain suggestions concerning the harvesting of seven important commercial varieties of apples. While the following recommendations will doubtless require to be modified to suit local conditions, they are presented in the hope that they will provide a useful guide to the apple grower in the territory served by this Station.

HARVESTING THE MCINTOSH

The most important factors to take into account in harvesting the McIntosh appear to be the tendency of this variety to drop freely from the tree and the fact that premature picking results in fruit of inferior quality which is susceptible to shrivelling. These considerations limit the satisfactory harvesting season for McIntosh in any one district to a period of about ten days. In orchards heavily planted to this variety the brevity of this harvest period creates quite an acute economic problem which is rendered still more difficult of solution if Jonathan and Grimes Golden are included in the plantings. Under such conditions a large crew of pickers is essential if the crop is to be harvested to best advantage.

Of the various maturity tests, colour of seeds and amount of red colour have been found especially useful in determining the date when harvesting of McIntosh may safely be begun. Shrivelling and poor quality are likely to result if the fruit is picked before the seeds are completely brown and the skin carries a fair development of red colour. About 130 days from date of full bloom is usually sufficient to bring the McIntosh to satisfactory picking maturity. The calendar date varies from September 1 to September 15 according to seasonal weather conditions and locality.

HARVESTING THE JONATHAN

Proof that breakdown of the Jonathan can be very largely prevented by proper harvesting procedure is undoubtedly the most noteworthy achievement of this investigation. Direct losses from breakdown in this variety have amounted to many thousands of dollars annually. The indirect losses, resulting from injury to the reputation of western-grown fruit in general and the Jonathan in particular, have unquestionably been far greater.

In the light of our present knowledge the most practical means of preventing breakdown appears to be the harvesting of the fruit before it becomes susceptible to the disease. While this might, at first thought, appear to be a simple solution to the breakdown problem, numerous complications are encountered in applying it under commercial conditions. Of special significance is the fact that breakdown seldom makes its appearance until a month or so after the fruit leaves the orchard. This characteristic of the disease makes it very difficult to convince the grower that he is responsible for the injury. Furthermore, this delay in the development of breakdown makes it almost impossible, under commercial conditions, to trace the disease back to the individual orchard. After the fruit has been assembled at a central packing house it loses its identity to a large extent with a result that the industry as a whole rather than the offending grower is usually called upon to bear the loss resulting from any breakdown which may occur. Thus the grower seldom appreciates to the full the seriousness of the disease. On the other hand the substantial premium commonly paid for highly coloured Jonathans constitutes a powerful inducement to leave the fruit on the tree as long as possible. This temptation is all the greater owing to the tendency of the Jonathan to hang well to the tree.

In fairness it should be stated that during the past few years the majority of growers have made an honest endeavour to arrange their picking program so as to minimize the danger of loss from breakdown. That their efforts have not been entirely successful seems to be due mainly to two factors. One of these is the fact that many orchards contain heavy plantings of such varieties as McIntosh, Grimes Golden and Delicious, which tend to overlap the picking season of the Jonathan and so increase the difficulty of harvesting this variety during the comparatively short season that it remains in satisfactory picking condition. The second factor which has militated against the successful prevention of breakdown has been the lack of an effective maturity test simple enough for the grower to use in the orchard. While the results of this investigation do not indicate that there is any infallible maturity test of this nature they do suggest that losses from breakdown can be very materially reduced by an intelligent use of the colour chart described in this report.

In using the colour chart growers should bear in mind that it usually takes the Jonathan about two weeks to pass from one colour stage to the next, and that Jonathans harvested in stage one are likely to be inferior in quality. This means that there is a period of about two weeks within which the fruit from any individual Jonathan tree should be picked. With heavily loaded trees satisfactory results may be expected when the apples are picked during the two weeks that their ground colour is changing from stage two to stage three. Harvesting of light crop trees may well be begun a few days earlier.

HARVESTING THE GRIMES GOLDEN

The Grimes appears to be somewhat less exacting as regards harvesting practice than the McIntosh and Jonathan. Nevertheless, it should be borne in mind that premature harvesting of this variety results in fruit of comparatively poor quality which is susceptible to scald and likely to shrivel. On the other hand the Grimes drops freely after it reaches optimum picking maturity. Fear of loss from this cause and the fact that Grimes is a yellow apple with no colour requirement has often induced growers to pick this variety earlier than is desirable from the standpoint of quality. The results secured in this investigation suggest that in orchards where both Jonathan and Grimes are planted it would be a wise procedure to delay harvesting the Grimes until after the crop had been picked from any Jonathans which carried a light crop. It may be well to mention that the tender skin of the Grimes necessitates very careful handling of this variety in order that the fruit may be delivered to the consumer in an unblemished condition.

With regard to maturity tests for the Grimes, it may be said that ease of removal, hardness and the ground colour test have all proved useful in ascertaining satisfactory picking time. The results secured indicate that harvesting may well be delayed until the fruit picks easily, has a hardness of about 18 pounds and a ground colour corresponding to stage two on the colour chart. The seeds of Grimes have been observed to turn brown a week or more before the fruit reaches desirable picking maturity.

HARVESTING THE DELICIOUS

In determining when to harvest Delicious due weight should be given to the tendency of this variety to drop freely after it reaches an advanced stage of maturity, but it should be more generally recognized that the increase in tonnage due to growth of the fruit during the last few weeks it remains on the tree is frequently sufficient to over-balance the loss of a few boxes of windfalls. Furthermore, the poor quality and grade consequent upon premature harvesting should be accorded full consideration. It has been observed that Delicious usually requires from five to ten days longer to reach satisfactory picking condition than does the Jonathan. This information may well be acted upon by growers producing both these varieties.

Since the Delicious is grown primarily for the high class dessert trade it is especially important that picking practice be such as to ensure attractive appearance and high quality. These desirable attributes have seldom been found in fruit picked before it could be easily removed from the tree. Harvesting when the fruit has a hardness of about 16 pounds and a ground colour corresponding to stage two has also been found conducive to high monetary returns from Delicious. The appearance of water-core may be taken as a sign that the fruit should be harvested without delay, but it has been noted that browning of the seeds often takes place several weeks before the fruit is ready to pick.

HARVESTING THE NEWTOWN

The Newtown can be picked over quite an extensive season without seriously injuring its quality. Nevertheless, it should be borne in mind that best results are usually secured when this variety is harvested after Delicious and before Rome Beauty. Newtowns which are picked too early never develop full flavour, while the storage life of those which are left on the tree until very late in the season is sometimes shortened by browning of the flesh around the core. The fact that Newtowns soften more slowly on the tree than they do after being picked, unless they can be removed at once to low temperature storage, is an important consideration where common storage facilities only are available. Under such conditions the storage life of the fruit can be materially lengthened by delayed picking.

With the Newtown the problem of scald control appears to present special difficulties for neither time of picking nor wrapping in oiled paper have given entire satisfaction in preventing the development of the disease on the "yellow" type of fruit produced by trees carrying a light crop. Under the conditions of adequate ventilation provided in this investigation very little scald developed on either "green" or "yellow" type fruit, but it is very difficult to secure such frequent change of air in commercial storage buildings. In the light of our present knowledge, however, it seems advisable to make special provision for the ventilation of common storage houses where Newtowns are held, the fruit being stored unwrapped to allow the moving air to carry off injurious gases which cause the disease. The development of scald is materially retarded by storage at low temperature so that where cold storage facilities are available, satisfactory results may be expected if the fruit is wrapped in oiled paper and

placed in cold storage soon after picking. In any case it should be borne in mind that the "yellow" type fruit is likely to develop scald earlier and to a much more serious extent than is the "green", so that an effort should be made to dispose of the "yellow" type fruit first. Since the yellow fruit commonly runs larger in size than the green the segregation of the two types should not present insuperable difficulties.

Ease of removal seems to provide the most useful maturity test for the Newtown. This variety commonly adheres firmly to the tree until it is ripe enough to gather. The pressure test has proved of value as a guide to picking time for the Newtown, good results having been recorded with fruit testing about 18 pounds at picking time. The ground colour test has not proved altogether reliable, for differences in colour between the "green" and the "yellow" type apples seem to be greater than the differences in maturity between these two types. Seed colour is deceptive as the seeds of Newtowns are commonly almost black for several weeks before the fruit has reached desirable picking maturity. As a general rule the Newtown seems to require a growing period of at least 160 days from date of full bloom in order to develop high quality.

HARVESTING THE ROME BEAUTY

Rome Beauty is very responsive to storage conditions, ripening very rapidly at temperatures which prevail in common storages during the month of October. For this reason it is sometimes worth while to delay picking of this variety. It should be remembered, however, that there is real danger of loss from freezing if the picking season be permitted to extend into November. Furthermore, the possibility of loss from windfalls must be reckoned with for, although the Rome hangs well to the tree until ready to pick, loosening of the bonds which attach the fruit to the tree sometimes proceeds quite rapidly after the apples have reached picking condition, with the result that harvesting must be completed in a comparatively short time in order to avoid serious loss from dropping. In addition heavy winds have been known to cause an appreciable amount of breakage in the long stems characteristic of this variety, the stem snapping midway between the apple and the spur.

On the other hand premature harvesting renders the Rome susceptible to scald and often results in smaller sized fruit than is desirable in a variety used primarily for baking.

The ground colour test and ease of picking have proved very useful in determining the most desirable time to harvest Romes, very satisfactory results having been recorded with fruit picked when the ground colour corresponded to stage two. Romes have usually tested between 17 and 18 pounds in hardness when in good picking condition. The appearance of water-core may be taken as a sign that the fruit should be picked without further delay. The seeds have been observed to turn brown several weeks before the apples reach proper picking maturity. A period of about 160 days from date of full bloom seems to be necessary to render the Rome resistant to scald. In this connection it may be well to remark that the Rome blooms about a week later than the Newtown, which means that although these varieties require about the same number of days to reach picking maturity, the Rome is seldom ready to pick until after the Newtowns have been harvested.

HARVESTING THE WAGENER

The most serious fault of the Wagener is the tendency of this variety to develop scald in storage. The ravages of this disease have been the chief factor in destroying the popularity of the Wagener on the market. There are many discriminating consumers, however, to whom a properly matured Wagener represents the acme of perfection from both the dessert and culinary standpoint.

To them the flesh of the Wagener has a flavour and a texture unexcelled in any other variety. The small size and biennial bearing habit of the tree, the fact that the apples are often irregular in size and shape, and the tendency of the crop to ripen unevenly undoubtedly constitute adequate grounds for reduction in the acreage planted to the Wagener. Nevertheless, so long as we have an appreciable tonnage of this variety to market, it seems logical to make a special effort to harvest it in such a way as to ensure delivery of the fruit to the consumer in prime eating condition.

To this end attention may well be drawn to the fact that the Wagener requires a comparatively long growing season—about 170 days—to develop full quality. This brings the harvesting season close to the danger line as regards frost and suggests that the sooner the Wagener is pulled out in the short season districts, the better for all concerned.

In the Wagener water-core usually appears in the core area rather than in the neighbourhood of the vascular bundles. With this variety a slight development of water-core does not seem to injure the keeping quality of the fruit. In fact, in order to secure full flavour, it is usually necessary to leave the fruit on the tree until some water-core has developed. Late picking also renders the Wagener quite resistant to scald, while apples of this variety harvested early in the season are very susceptible to this disease.

Ease of picking is a valuable indication of harvesting maturity in the Wagener, for this variety adheres firmly to the spur until it is ready to pick. The ground colour test is also useful, good results being secured when the fruit is left on the tree until the ground colour has reached stage two. Seed colour is deceptive as the seeds turn brown long before the fruit has reached optimum picking condition. Hardness has proved too variable to provide a reliable maturity index.

VEGETABLE GARDENING*

Weather conditions were somewhat unusual as may be noted from "The Season" in the opening pages of this report. Harvesting conditions were difficult. Seed crops suffered severely. Heavy losses were experienced in tomato fields and cantaloupes quickly lost flavour. Cabbage, cauliflower and broccoli crops were better than usual.

The new irrigation system proved to be very efficient in handling vegetable test plots. A uniform and equitable distribution of water was obtained without the annoyance and damage to experiments previously caused by leaking flumes.

SOIL TEMPERATURES IN RELATION TO TIME OF PLANTING CANTALOUPES—Project H. 638

California investigators found that the best time to set out cantaloupes was as soon as the soil temperature had risen to 50 degrees Fahrenheit. In order to check up on this finding under Okanagan conditions soil temperature studies were begun. Commencing April 1 the temperature at a depth of 6 inches was taken three times daily, at 9 a.m., 1 p.m., and 5 p.m. Commencing April 28 the temperature was taken at the same hours at depths of 24 inches and 36 inches.

The temperature at 6 inches varied greatly. A range of 12 to 15 degrees in 4 hours was quite common. At depths of 24 inches and 36 inches the temperature seldom changed more than one degree in 24 hours. The temperature at 24 inches reached 50 degrees on May 8 and rose steadily after that date until July 26 it reached 74 degrees and then it slowly declined to 57½ degrees on September 30.

* The work in vegetable and flower gardening has been under the charge of Mr. W. M. Fleming, M.S.A., who, under the Superintendent, has been responsible for the work in these divisions, and has prepared the sections of the report relating to these divisions.

At 36 inches the temperature was 47 degrees on May 1 and it rose steadily until July 26 when it reached 69¾ degrees. It remained stationary at this temperature until August 8 when it began to decline but more slowly than at 24 inches. On August 30 the soil was the same temperature, 64½ degrees at 24 inches and 36 inches, and from that date until September 30 the soil was warmer at the greater depth. The experiment closed on September 30 with a reading of 58 degrees at 36 inches.

From a study of the data given in table 26, it would appear from one year's tests only that a soil temperature of 50 degrees at a depth of two feet is the optimum temperature for planting cantaloupes and the results are in accord with the California tests.

CANTALOUPE PROTECTION AGAINST FROST—Project H. 607

This experiment begun in 1926 to ascertain the merits of different commercial plant protectors was enlarged this season to show the results of using these protectors with open seeded plants and also with plants started in the greenhouse and planted out at weekly intervals.

The detailed results of this experiment are shown in table 26 and the summary is shown in table 27.

TABLE 26.—COMPARISON OF DIFFERENT TYPES OF PROTECTION FOR CANTALOUPES

Protection	Date planted	Number of plants lived	Date first ripe	Ripe in August	Ripe in September	Total ripe
Open seeding no protection	April 22	5	Aug. 25	2	17	19
" Hot Kaps	" 22	6	" 25	10	63	73
" Glassine	" 22	4	" 25	10	55	65
" Thermogen	" 22	5	" 25	13	45	58
" no protection	April 29	3	Aug. 28	2	48	50
" Hot Kaps	" 29	6	" 28	2	79	81
" Glassine	" 29	5	" 25	3	71	74
" no protection	May 5	5	Sept 7	0	64	64
Transplanted, no protection	" 5	6	Aug. 25	13	48	61
Open seeding, Hot Kaps	" 5	6	" 25	13	65	78
Transplanted, Hot Kaps	" 5	5	" 22	15	42	57
Open seeding, Glassine	" 5	6	" 23	11	67	78
Transplanted, Glassine	" 5	5	" 22	20	47	67
Transplanted, Thermogen	" 5	3	" 25	4	33	37
Open seeding, no protection	May 14	6	Sept. 1	0	64	64
Transplanted, no protection	" 14	6	Aug. 25	5	62	67
Open seeding, Hot Kaps	" 14	6	Aug. 22	3	56	59
Transplanted, Hot Kaps	" 14	6	" 22	13	65	78
Open seeding, Glassine	" 14	5	" 25	3	55	58
Transplanted, Glassine	" 14	6	" 11	12	67	79
Open seeding, "Wee hot house"	" 14	5	Sept. 1	0	51	51
Transplanted, "Wee hot house"	" 14	6	Aug. 25	3	55	58
Open seeding, no protection	May 21	6	" 27	1	27	28
Transplanted, no protection	" 21	6	" 20	14	35	49
Open seeding, Hot Kaps	" 21	6	" 27	3	15	18
Transplanted, Hot Kaps	" 21	6	" 14	14	37	51
Open seeding, Glassine and wire	" 21	6	" 27	2	50	52
Open seeding, Glassine no wire	" 21	6	Sept. 1	0	39	39
Transplanted, Glassine	" 21	5	Aug. 25	7	31	38
Open seeding, "Wee hot house"	" 21	6	Sept. 1	0	44	44
Open seeding, no protection	" 28	6	" 7	0	65	65
Transplanted, no protection	" 28	6	Aug. 27	10	38	48
Open seeding, Hot Kaps	" 28	6	Sept. 7	0	73	73
Transplanted, Hot Kaps	" 28	5	Aug. 27	7	58	65
Open seeding, Glassine	" 28	6	Sept. 7	0	62	62
Transplanted, Glassine	" 28	3	Aug. 27	1	41	42

TABLE 27—SUMMARY OF TRIALS OF EACH TYPE OF PROTECTOR FOR CANTALOUPES

—	No Protection		Hot Kaps		Glassine	
	Open seeding	Trans-planted	Open seeding	Trans-planted	Open seeding	Trans-planted
Number of hills started	36	24	36	24	36	24
Number of hills lived	31	24	36	22	32	19
Total yield	290	225	382	251	389	236
Yield in August	5	42	31	49	29	40

From this summary it may be noted that:—

(1) 91·6 per cent of the open seeded hills lived while 90·3 per cent of the transplanted hills lived.

(2) Open seeded hills produced 10·7 fruits per hill while transplanted plants produced 10·9 fruits per hill.

(3) 65 transplanted hills yielded 131 ripe fruits in August or 2 fruits per hill while 99 open seeded hills yielded 65 ripe fruits or 0·65 fruits per hill in August.

(4) Hot Kaps and Glassine gave higher yields than no protection both with open seeded and transplanted plants.

(5) May 5 planting gave the highest average number of early ripe cantaloupes and also the highest average of cantaloupes per hill. The soil temperature had risen to nearly 50 degrees Fahrenheit at this time. Owing to the backward spring the soil was too cold for cantaloupes before this date.

See the data on soil temperatures on another page.

CANTALOUPE VARIETY TEST—Project H. 122

Twenty-two strains were tested in triplicate. Attention is being directed chiefly towards securing an early golden fleshed variety suitable for shipping. Golden Champlain is distinctly the earliest variety tested but is not suited for shipping. It is a good variety for home gardens. Hales Best or H.B. has been tested for three years at this Station. This variety is now being grown extensively in California. It was introduced in 1925 and in 1927 there were approximately 20,000 acres of this variety in California alone. In order to supply seed for this great acreage a great many cantaloupes were saved for seed that should have been culled out. The result is that the commercial strains sent out in 1927 were greatly inferior to the original introduction. This will undoubtedly become a leading commercial variety in B.C. as soon as a supply of good seed is available. It is superior to Hearts of Gold in earliness, flavour and freedom from ribbing. It is very well netted and is an excellent shipper. Superperfecto introduced by Burrell in 1926 is another variety that should shortly become popular. The seed cavity is very small and the flesh is thick. The flavour is good. Harvesting conditions were bad for cantaloupes in 1927. Wet cold weather prevailed. Superperfecto retained its flavour the best of all varieties tested under these conditions. It is well netted and a good shipper.

CANTALOUPE DETERMINATION OF PICKING STAGE

There is a general idea among growers and shippers that cantaloupes picked and shipped in an immature condition will improve in quality during transit. Recent investigations in the United States have shown that the sugar content does not increase after picking. There is little change in composition during shipment. There is some improvement in palatability because of the softening of the fruit.

A knowledge of the sugar content of the cantaloupes from day to day should be of considerable assistance in determining the proper stage of maturity for shipment. This information may be obtained by squeezing out the juice of several representative cantaloupes into a tall cylinder and then taking a reading on a spindle hydrometer graduated in degrees Brix.

In order to determine the value of this test for local conditions a Brix hydrometer was secured and several readings taken. The equipment was not received until the shipping season was well advanced and a systematic record of tests throughout the season could not be made. These tests showed, however, that this method of determining maturity should be of material value to growers and shippers in checking up practical experience of judging maturity by external physical appearance.

CANTALOUPE FERTILIZER EXPERIMENT—Project C. 157

This experiment was carried out as described in the tomato fertilizer experiment and similar results were obtained. Ten tons of barnyard manure per acre produced a very large number of oversized cantaloupes or "jumbos" while on the plots where no manure was applied for three years the fruits were very small. Not a single cantaloupe large enough to pack "27" (twenty-seven to the crate) was found. The inference is that some barnyard manure is required but ten tons per acre every year is too much for cantaloupes on this type of soil, a medium sandy loam. No definite results were noted from the use of commercial fertilizers over the corresponding checks.

CELERY VARIETY EXPERIMENT—Project H. 94

Celery has never proved a successful crop at this station. When early enough to mature before frost it has been of poor quality being injured by the summer heat. When seeded later to avoid this condition it has been frozen before blanching was completed.

It would appear from this season's tests that celery requires much more water than has usually been given it in the Southern Okanagan. When grown in trenches which were flooded frequently celery made a fair growth. More than usual rain fell in the late summer and this no doubt influenced the growth. Fordhook Emperor (Schell) gave the best results. This variety has been grown one season only.

CORN SUCKERING EXPERIMENT—Project H. 101

This experiment was planned to ascertain the effect of suckering on earliness, yield, and ear development. Two varieties, Early Malcolm and Golden Bantam, have been tested for four years. One season the plot was destroyed by pheasants. For the remaining three seasons no appreciable difference in earliness was observed. The yield from the unsuckered plants was slightly higher than that produced by those from which the suckers were removed. The suckered plants showed a tendency to blow over. These results suggest that the extra labour involved in removing the suckers is not justified.

CUCUMBERS VARIETY TEST—Project H. 106

No appreciable difference in yield has been noted in Arlington White Spine, Early Fortune, and Davis Perfect varieties. There is a greater variation in strains of the same variety supplied by different seedsmen than between the varieties named. Commercial growers should select and save their own supply of seed. Windermoor Wonder a new variety introduced by Stokes is of excellent quality and very fine colour and shape for slicing but is a light yielder. It is a good cucumber for the home garden.

DATES OF SEEDING

Beets and Carrots

These should be seeded early in the spring for summer use. For storage and winter use they should be seeded the last week in May or the first week in June. While the total yield may be reduced by later seeding the quality will be much better.

Parsnips

Early seeding has always proved the most satisfactory.

Cabbage

Climatic conditions are unfavourable for successful cabbage growing at this station. Nine years' trials show that early plantings have given the best results. Where the plants have been ready to set out before the middle of May fair crops have been obtained. Transplanting has given better results than seeding in place and thinning out.

Turnips

Early seeding has always proved most satisfactory. Late seedings suffer severely from maggots and aphides. The quality of all turnips goes off in the hot weather. They should be ready to use before the middle of June.

OKRA VARIETY EXPERIMENT—Project H. 126

This vegetable is grown for its green pods, which are used in stews, soups, etc., for flavouring. The seeds are sown in the open in May. When the plants are four to six inches high they are thinned out to one foot to eighten inches apart in the row. The pods are ready for use about the first of August. Dreer Little Gem and White Velvet or Creole have been grown successfully for three years. The former is earlier but produces smaller pods than the latter variety. Five to six pounds of pods may be expected from a thirty-foot row.

PEPPERS, BREEDING FOR EARLINESS—Project H. 437

Some years ago seed selection of Neapolitan peppers were made at this Station. After two years' work the selections " broke up " and showed distinct evidences of natural crossing.

When breeding work with peppers was resumed in 1926 a test was made to ascertain whether crossing was taking place as suspected. Seed was saved from the different peppers grown close together in the variety tests that season. Care was taken to select specimen fruits true to type. The seed from several plants of each variety was collected and mixed to form a composite sample of that variety. Each variety was kept separate.

In 1927 eleven plants of each of these composite samples were planted out and observed for indications of crossing. The following table shows the results of these tests:—

TABLE 28.—RESULTS FROM BREEDING PEPPERS

Variety	Number true to type in fruit and foliage	Number distinctly off type in fruit and foliage
Cayenne	9	2
Sunnybrook	8	3
Rainbow	11	0
Anaheim Chili	9	2
Pimento	9	2
Chinese Giant	6	5
Sweetmeat Glory	8	3

Approximately 22 per cent of the plants appeared to have been crossed.

In raising peppers for seed different varieties must be properly isolated to prevent natural crossing.

POTATOES—LOCAL VS. NORTHERN-GROWN SEED—Project H. 174

This experiment was planned to ascertain whether seed grown in northern British Columbia was superior to local-grown seed. Certified seed was planted in 1923 in the Okanagan and in the Bulkley valleys. This seed was planted in the same district in 1924. In 1925 seed from the 1924 Bulkley valley crop was brought to Summerland and planted beside seed from the Summerland 1924 crop. Seed was saved from both crops. In 1926 seed from the same original stock was brought from the Bulkley valley and planted beside the same variety which had been grown at Summerland two years and one year respectively. The seed was saved from all three crops. In 1927 seed was again brought from the Bulkley valley and planted beside the same variety grown at Summerland for three years, two years, and one year respectively. The results are shown in table 29. The yields shown are for single rows 150 feet long and 3 feet apart. The crops grown at Summerland for one year show almost 100 per cent mosaic. When the northern-grown seed is planted beside the local seed it is comparatively free from mosaic at first, but by midsummer the mosaic has spread from the local seed to the northern-grown seed rows. No definite conclusions may yet be drawn from this experiment. Seed has been saved from all four crops to be planted in 1928 against northern-grown seed.

TABLE 29.—COMPARISON OF HOME-GROWN VS. NORTHERN-GROWN SEED

Variety	Marketable	Culls	Total	Marketable per acre	Total per acre
				lb.	lb.
Early St. George Sd. 3 years	155	23	178	15,004	17,230
" " Sd. 2 years	149¾	22½	172¼	14,496	16,674
" " Sd. 1 year	168¾	20	188¾	16,335	18,271
" " Northern	180	19	199	17,424	19,263
Green Mountain Sd. 3 years	222½	19½	241½	21,514	23,401
" " Sd. 2 years	212½	25	237½	20,550	22,966
" " Sd. 1 year	256½	15½	272	24,829	26,329
" " Northern	200½	22½	223	19,384	21,586
Gold Coin Northern	211	15½	226½	20,425	21,925
Irish Cobbler Sd. 2 years	216	15	231	20,909	22,361
" " Northern	204¼	13	217¼	19,820	21,078

RHUBARB FROM SEED—Project H. 356

Several years' tests show that rhubarb is ready for cutting or for forcing the third season after planting from seed.

TOMATO, VARIETY EXPERIMENT—Project H. 211

Extensive tests of strains of the more common varieties were continued in 1927. Unusually wet weather made harvesting conditions difficult. All varieties showed a great deal of splitting.

All fruit ripening before October 6 was used as a basis for comparing maturity of the different strains. The total weight including green fruits of marketable size were also taken. As Western Yellow Blight was quite prevalent the diseased plants were discarded and all yields have been reduced to the basis of individual plants.

Tables 30 and 31 show the relative merits of five different varieties.

Table 32 gives the complete list of all varieties tested.

TABLE 30—COMPARISON OF DIFFERENT VARIETIES OF TOMATOES FOR TOTAL YIELD

Variety	Number of strains tested	Average of all strains per plant	Highest strain per plant	Lowest strain per plant
		lb.	lb.	lb.
Avon Early	11	26·12	33·17	22·61
Earliana	46	24·77	30·20	19·65
Bonny Best	13	22·46	28·50	15·21
John Baer	14	22·24	30·58	19·10
Chalks Early Jewel	10	21·60	24·29	17·97

TABLE 31.—COMPARISON OF DIFFERENT VARIETIES OF TOMATOES FOR EARLINESS

Variety	Number of strains tested	Average of all strains per plant	Highest strain per per plant	Lowest strain per per plant
		lb.	lb.	lb.
Avon Early	11	17·53	23·08	15·10
Earliana	46	16·05	20·64	10·75
John Baer	14	12·24	14·96	10·14
Bonny Best	13	11·21	15·21	8·21
Chalks Early Jewel	10	10·98	13·96	9·58

TABLE 32—TOMATO VARIETY EXPERIMENT

Average Yield per Plant in Pounds

Variety	Source of seed	Ripe before Oct. 6	Total yield	Rank for total yield	Type
		lb.	lb.		
Avon Early	Ferry	23·08	33·17	1	Good.
Earliana	Spall	20·64	28·57	6	Good.
Earliana 27–26	Sd. 35–6	19·60	30·20	3	Good.
Special Early 498 101–26	Sd. 84–2	19·58	30·00	4	Good.
Earliana 32–26	Sd. 19–2	19·54	27·46	13	Good.
Earliana 21–26	Sd. 22–5	19·46	27·96	11	Rough.
Avon Early	Burrell	19·37	27·03	14	Good.
Avon Early 54–26	Sd. 96–15	19·21	26·79	17	Good.
Avon Early	Steele Briggs	19·20	28·07	10	Uneven.
Earliana 28–26	Sd. 5–3	19·00	28·31	8	Good.
Earliana 33–26	Burpee	18·96	29·54	5	Good.
Avon Early	Haven	18·92	27·75	12	Good.
Earliana	Burrell	18·39	25·96	23	Rough.
Earliana 22–26	Sd. 20–13	18·37	25·54	27	Good.
Earliana 31–26	Sd. 21– 4	18·18	26·11	21	Good.
Earliana	Rice	18·11	26·68	18	Coarse.
Earliana 23–26	Sd. 38–15	18·08	24·54	47	Good.
Alacrity x Earlibell	O–9729	18·04	21·54	87	Very coarse.
Earliana	Bolgiano	17·91	26·92	16	Good.
Earlibell	McDonald	17·89	25·37	32	Uneven.
Alacrity x Hipper 107–26	O–5217	17·82	25·11	36	Poor.
Earliana	Moore	17·21	25·14	35	Good.
Earliana 36–26	Sd. 40–7	16·65	26·11	20	Good.
Alacrity x Hipper 106–26	Sd. 80–2	16·63	27·03	15	Good.
Special Early 498	Morse	16·50	25·00	40	Variable.
Avon Early	Hart & Vick	16·47	24·27	51	Rough.
Earliana No. 32	Le Fray	16·23	25·77	24	Coarse.
Earliana	Haven	16·20	25·07	37	Good.
Earliana	Graham	16·03	26·30	19	Good.
Capiana	Cap Rouge E.S.	16·00	24·70	44	Coarse.
Bolgiano	Spall	15·90	22·83	70	Variable.
Alacrity 108–26	O–6560	15·90	23·90	57	Good.
Earliana	Livingston	15·90	25·50	29	Coarse.
Bolgiano 99–26	Sd. 15–2	15·79	23·57	64	Good.
Avon Early 123–26	Ferry	15·77	23·54	65	Good.
Bolgiano	Bolgiano	15·68	20·82	93	Rough.
Earliana	Morse	15·60	25·66	26	Good.
Canadian	McKenzie	15·54	24·54	48	Variable.
Earliana	Steele Briggs	15·50	24·70	43	Good.
Burbank	Livingston	15·47	24·13	54	Rough.
Burbank	Burbank	15·32	22·82	71	Rough.
Avon Early 40–26	Vaughan	15·30	24·63	45	Rough.
Alacrity 121–26	O–5465	15·27	23·65	62	Good.
Avon Early 37–26	Burrell	15·25	22·61	74	Variable.
Bonny Best	Steele Briggs	15·21	28·21	9	Fair.
Avon Early	Vaughan	15·17	24·03	55	Variable.
Avon Early	Dreer	15·10	25·46	31	Smooth.
Earliana	Ferry	15·07	24·14	52	Good.
John Baer	Ferry	14·96	25·54	28	Good.
Earliana No. 1	Le Fray	14·75	23·85	59	Good.
Earliana Grade 3	Langdon	14·70	21·10	89	Good.
Earliana	Bruce	14·57	23·17	69	Rough.
Earliana	Vaughan	14·54	24·14	53	Coarse.
Canadian	Rice	14·50	26·00	22	Fair.
Earliana 25–26	Sd. 4–1–6	14·39	25·50	30	Good.
Alacrity x Hipper	O–9725	14·11	20·27	99	Good.
John Baer	Burrell	13·96	24·90	42	Very smooth.
Chalks Early Jewel	Langdon	13·96	23·25	67	Good.
Earliana	Ewing	13·93	21·93	84	Good.
Earliana	Risso	13·80	22·20	80	Good.
Alacrity	O–9720	13·77	22·60	75	Good.
John Baer	Quircor	13·65	30·58	2	Extra good.
John Baer	Dreer	13·62	23·23	68	Good.
First Early	Aggler & Musser	13·62	21·00	92	Rough.
Bonny Best	Stokes	13·30	28·50	7	Variable.
Earliana Penn State	Stokes	13·25	23·82	60	Variable.
John Baer	Canners Ltd	13·13	24·33	49	Very good.
John Baer	Rice	13·10	25·03	38	Variable.
Earliana	Neish	12·73	20·27	100	Very coarse.
Bonny Best, Field Type	Stokes	12·64	25·29	34	Rough.

TABLE 32—TOMATO VARIETY EXPERIMENT—*Concluded*

Variety	Source of seed	Ripe before Oct. 6	Total yield	Rank for total yield	Type
		lb.	lb.		
Bonny Best	Langdon	12·64	25·36	33	Good.
Earliana Penn State	Stokes	12·43	22·64	73	Good.
John Baer	Bolgiano	12·42	21·27	88	Good.
Chalks Early Jewel	Burpee	12·41	22·77	72	Smooth.
Alacrity	O–6569	12·13	19·96	103	Good.
A.B.B. No. 2	O–11390	11·93	25·73	25	Small smooth.
Alacrity	O–6558	11·89	20·53	96	Good.
Chalks Early Jewel	Steele Briggs	11·77	22·59	76	Smooth.
John Baer	Vaughan	11·68	22·04	83	Good.
John Baer	Moore	11·57	20·17	102	Variable.
Bonny Best	Vaughan	11·47	20·66	94	Smooth.
Bonny Best 1925	Stokes	11·31	18·54	111	Good.
John Baer	Langdon	11·23	21·08	90	Coarse.
Chalks Early Jewel	Haven	11·11	23·46	66	Rough.
Bonny Best	Dreer	11·10	24·03	56	Good.
Chalks Early Jewel	Morse	11·00	24·29	50	Good.
John Baer	Livingston	10·89	22·11	82	Coarse.
John Baer	Steele Briggs	10·86	21·07	91	Good.
Alacrity x Earlibell 109–26	O–6570	10·75	19·65	104	Good.
Chalks Early Jewel	Ferry	10·43	22·30	79	Rough.
Bonny Best	Ferry	10·42	23·58	63	Rough.
John Baer	Haven	10·23	19·10	108	Variable.
John Baer	Ewing	10·14	19·36	107	Good.
Bonny Best	Haven	10·13	22·13	81	Good.
Chalks Early Jewel	Burrell	10·11	18·68	110	Rough.
Bonny Best	Burrell	10·08	20·61	95	Good.
Chalks Early Jewel	Vaughan	9·83	20·50	97	Variable.
Bonny Best	Hart & Vick	9·78	19·50	106	Good.
Chalks Early Jewel	Bolgiano	9·63	17·97	112	Good.
Chalks Early Jewel	Rice	9·58	20·27	101	Good.
Redhead	Langdon	9·57	24·93	41	Very good.
Bonny Best	Rice	9·46	20·46	98	Good.
Landreth	Canners Ltd	9·12	22·39	77	Good.
Redhead	Livingston	8·67	23·73	61	Good.
Stone	Langdon	8·36	19·57	105	Smooth.
Pink No. 2	O–9730	8·27	24·58	46	Smooth.
Bonny Best	Gregory	8·21	15·21	114	Good.
Marglobe	Stokes	7·90	25·03	39	Good.
Landreth	Landreth	7·82	21·89	85	Smooth.
Pink No. 1	O–9731	7·33	22·33	78	Smooth.
Bloomsdale	Langdon	7·04	23·89	58	Good.
Alpha	Dreer	6·80	16·69	113	Very small.
L.G.B.B. No. 3	O–11392	5·63	18·70	109	Very smooth.
Red Rock	Langdon	4·03	21·70	86	Good.

TOMATOES, FERTILIZER EXPERIMENT—Project H. 388

This experiment has been carried on for three years on a block of land divided into 32 plots each 10.5 feet wide by 166 feet long. Half the plots were planted in tomatoes each year and half in cantaloupes. The next year cantaloupes were planted where tomatoes had been grown and vice versa. In 1927 the plantings were the same as in 1925.

Plots 1 to 16 received a dressing of 10 tons of barnyard manure each year. Plots 17 to 32 received no manure. The whole block was seeded with winter wheat in the fall of 1924 and winter rye in the fall of 1925 and 1926. These cover crops were well disked in before ploughing in the spring. No fall ploughing was done.

Plots 1, 3, 17, 19 each received a dressing of sulphate of ammonia at the rate of 112½ pounds per acre. Plots 5, 7, 21, 23 each received nitrate of soda at the rate of 150 pounds per acre. Plots 9, 11, 25, 27 each received superphosphate of lime at the rate of 500 pounds per acre. Plots 13, 15, 29, 31 each received a dressing at the rate of 150 pounds muriate of potash per acre. No

commercial fertilizers were applied to any of the even numbered plots. All commercial fertilizers were applied in the spring after ploughing and harrowed into the soil. Each plot was divided into three rows of plants lengthwise of the plot. Plants were 3.5 feet apart in the rows. The centre row only of each plot was weighed to avoid overlapping of fertilizers.

A summary of three years results is shown in table 33. From this it will be observed that the barnyard manure gave a marked increase over the plots having no manure and no appreciable difference was noted in the use of commercial fertilizers over the corresponding check plots. The most marked results were obtained in 1925 which was a hot, dry summer with a shortage of irrigation water. Somewhat similar conditions prevailed in 1926. In 1927 with a cool spring, frequent showers in the growing season, a hot July, a very wet harvest season and an ample supply of irrigation water the results were quite different. It would appear that the variations in yields obtained are due almost entirely to the change in water holding capacity of the soil produced by the humus of the barnyard manure. Water ran freely through the unmanured plots. The plots with manure took in water much more readily. This was quite noticeable in irrigating.

The application of ten tons of manure per acre each year produced excessive vine growth although very heavy yields were obtained.

TABLE 33—SUMMARY OF THREE YEARS FERTILIZER EXPERIMENT WITH TOMATOES

(Weight of centre row in pounds, 1/75 of an acre)

Plot	Sulphate of ammonia	No fertilizer	Nitrate of soda	No fertilizer	Super-phosphate	No fertilizer	Muriate potash	No fertilizer	Total all plots with manure
	1	2	5	6	9	10	13	14	
				WITH MANURE					
1927	479·0	705·0	758·5	838·5	974·0	876·0	756·5	828·0	6,210·5
1926	1,416·5	1,322·0	1,125·0	1,082·0	1,275·5	1,339·0	1,228·0	1,185·5	9,973·5
1925	642·0	909·0	1,066·0	976·0	971·5	1,007·0	948·5	882·5	7,402·5
Average	845·8	978·7	983·2	965·5	1,073·7	1,074·0	977·7	963·7	
	Increase or decrease by fertilizers from check								
1927	−226·0	.....	−80·0	.....	+98·0	.....	−66·5	.....	.....
1926	+ 94·5	.....	+43·0	.....	−53·5	.....	+42·5	.....	.....
1925	−267·0	.....	+90·0	.....	−35·5	.....	+66·0	.....	.....
Average	−132·9	.....	+17·7	.....	− 0·3	.....	+14·0	.....	.....

Plot	Sulphate of ammonia	No fertilizer	Nitrate of soda	No fertilizer	Super-phosphate	No fertilizer	Muriate of potash	No fertilizer	Total all plots with manure
	17	18	21	22	25	26	29	30	
				WITHOUT MANURE					
1927	766·5	679·0	722·0	740·0	781·5	791·0	706·5	701·6	5,888·0
1926	575·0	452·0	850·5	903·5	764·5	807·5	889·5	880·5	6,123·0
1925	550·0	443·5	449·5	500·0	412·5	365·5	444·5	424·0	3,581·0
Average	630·5	524·8	674·0	714·5	652·8	654·7	680·2	668·7	
	Increase or decrease by fertilizers from check								
1927	+ 87·5	.....	−18·0	.....	− 9·5	.....	+ 5·0	.....	Total increase by manure over no manure
1926	+ 23·0	.....	−53·0	.....	−43·0	.....	+ 9·0	.....	+ 5·5%
1925	+115·0	.....	−50·5	.....	+47·0	.....	+20·5	.....	+ 68%
Average	+105·7	.....	−40·5	.....	− 1·9	.....	+11·5	.....	+107%

The results of variety trials with different vegetables at this Station have shown that in many cases the strains of seed offered commercially are not uniform from year to year. A dependable source of seed of the leading truck crops is becoming more important each year.

Climatic conditions in the Okanagan are excellent for the production of seed of the majority of vegetable crops and vegetable growers should at as early a date as possible make definite plans to secure their own supply of seed. The different organizations should arrange with one or more of their members to grow seed for them under supervision. Such seed should prove superior to any commercial strains which may now be obtained.

Breeding work with several of the leading vegetables is well started at this Station. It will be the policy of this Station to isolate and develop superior strains, and wherever possible turn these over to growers selected by the organizations. These growers will increase and distribute the improved strains of seed.

This work is being done with the approval of the vegetable committee of the Canadian Seed Growers' Association. The following varieties have been allotted to the Dominion Experimental Station, Summerland, by this committee and breeding work is under way with Earliana tomato, Hales Best cantaloupe, Scarlet Globe, Scarlet Turnip White Tip, and Icicle radishes, Harris Earliest pepper, Sugar pumpkin, Davis Perfect cucumber, Black Beauty eggplant, Golden Bantam corn, Yellow Globe Danvers onion, and Round Pod Kidney and Stringless Refugee beans.

Flowers, Trees and Shrubs

Considerable progress was made in this department this year. A greenhouse 18 feet by 75 feet with a potting shed 20 feet by 24 feet was erected early in the year. The old greenhouse had to be torn down and as a result many of the plants usually started in the greenhouse were started in cold frames with indifferent results. Such records as dates of blooming were materially affected by this procedure. Heavy losses of bedding out plants were experienced in the winter and this made the planting of formal beds later than usual. The new greenhouse made possible the development of fresh stocks of bedding plants for next season.

The change in the irrigation system from the old wooden flumes to underground concrete pipes made possible extensive rearrangements in the garden. A new driveway was laid out continuing from the main road along the end of the garden thence between the garden and orchard and back to the office.

The iris "walk" was transferred from the nursery to a position across the end of the garden and flanking this driveway. Experimental hedges were set out on each side of the driveway for the entire length of the garden. A peony "walk" was laid out adjoining the path which marks the south side of the garden and nineteen varieties were planted. Groups of shrubbery and foundation planting were made adjoining the Superintendent's house, the cottages of the assistant superintendent, the foreman and the herdsman, the boarding house and the office. Lawns were made around the Superintendent's house, the log bungalow and flanking the main driveway in front of the boarding house.

Organization and systematic arrangement were further continued. A start was made with a varietal test of cannas.

Many perennials were added to the border and also were grouped in classes for closer study. Local horticultural associations were aided in many ways. Organization was furthered locally and also as a district. Addresses were given, a garden competition was scored. Flower shows were judged at Armstrong,

Okanagan Centre, Kelowna, Vernon, Oyama, Summerland and Penticton. Flowers were also judged at Armstrong and Peachland fall fairs.

Frequent requests were received for assistance in landscape design. Advice was given in choice of material to use and numerous plans were proposed for improvement of private and public grounds.

ASTER, VARIETY EXPERIMENT—Project H. 263

This experiment was commenced in 1926 for the purpose of investigating the possibilities of an aster seed production industry for the Okanagan. Yields of seed secured over two years would indicate that a profitable business might be built up if conducted on right lines.

The wide variation in type and colour in many commercial strains as sold in packets shows the importance of a knowledge of the breeding characteristics of asters required to build up pure strains of seed. The market for aster seed is very discriminating and nothing but pure seed will be accepted. Apparently very little work of this nature has been published and it has been impossible to obtain the desired information elsewhere. A knowledge of the colour variations that may be expected is of material assistance in detecting rogues. With the object of giving assistance to growers a study of the order of dominance of colour has been undertaken. From one year's trials no conclusions may safely be drawn without further tests. The following results are suggestive of probable dominance and will be used as a guide for further study. Homozygous or true strains have not been included in this summary.

TABLE 34—SUMMARY OF ASTER BREEDING TESTS FOR COLOUR

Number of Plants tested	Colour of Stock planted	Colour of Progeny
222	Pink	196 pink; 12 purple; 2 lilac; 3 lavender; 1 violet; 8 white.
95	White	82 white; 3 lavender; 10 purple.
33	Lilac	22 lilac; 6 light purple; 5 white.
131	Lavender	117 lavender; 14 purple.
120	Purple	105 purple; 15 lilac.

FORAGE CROPS*

In the following forage crop tables, yields in green and dry matter per acre are recorded. The method of determining the green and dry matter per acre was as follows: Each plot after cutting was immediately weighed, which gave the yield in green matter per acre. From each plot a representative sample weighing approximately 50 pounds was taken and passed through an ensilage cutter and thoroughly mixed. Duplicate samples, each weighing 2 pounds, were taken for the determination of the absolute dry matter. These samples were air-dried in the sun and the drying process continued until no further shrinkage was observed. The samples were then placed in an electric oven and dried to constant weight.

ALFALFAS, CLOVERS, GRASSES AND HAY AND PASTURE MIXTURES OTHER THAN ANNUALS

During a period of six years, from 1922 to 1927, nine hundred plots of biennial and perennial grasses and legumes have been tested singly and in various combinations to determine what single plant or combination of plants gives the maximum yield of both hay and pasture. These tests were conducted on gravelly and sandy loam soils and under irrigation as well as under very unfavourable cultural conditions. Each year, many of the plots under test did not produce sufficient stands to harvest. Accordingly, it has been impossible to record average yields over a period of years of a considerable number of these fodder crops which have been under test. However, much information has been obtained on the growth and yield of many grasses and legumes when seeded singly and in various combinations on gravelly loam soils under irrigation at this station.

ALFALFA VARIETAL TEST FOR HARDINESS, YIELD AND SUITABILITY—Project Ag. 126

Varieties of alfalfa obtained from different sources were tested on gravelly loam and sandy loam soils under irrigation. All varieties were seeded broadcast at the rate of 12 pounds of seed per acre and without a nurse-crop. The varieties tested and the yields obtained in green and dry matter per acre are given in tables.

During the four-year test, 1924 to 1927, no variety of alfalfa showed a marked superiority in yield. The results would indicate that Turkestan alfalfa, source of seed unknown, is the most suitable variety to grow. However, in view of the fact that alfalfa fields are often weakened by the ravages of insects, inadequate irrigation, over-pasturing, especially in late autumn, and also that many farmers fail to secure profitable stands of alfalfa and that winter-killing occasionally occurs in these districts, it is recommended that farmers use good quality alfalfa seed of a hardy variety or strain and which has been grown in a northern climate and from a known source. Considering the variable soil, moisture and season prevailing throughout the southern interior of British Columbia, farmers would do well to give western Canadian-grown Grimm a trial.

For additional information on alfalfa, see annual report of this Station for the year 1925.

*The work in forage crops and tobacco has been under the charge of Mr. A. J. Mann, B.S.A., who, under the Superintendent, has been responsible for the work in these divisions and has prepared the sections of the report relating to them.

TABLE 35—ALFALFA VARIETIES SOWN, 1923

Name	Source of Seed	1927							Four-year average 1924-1927 Total of all cuttings			
		Yield per acre—green weight				Percentage dry matter	Dry matter per acre		Yield per acre green weight		Percentage dry matter	Dry matter per acre
		First cut June 21	Second cut July 27	Third cut Sept. 21	Total three cuttings							
		lb.	lb.	lb.	tons lb.	%	tons	lb.	tons	lb.	%	tons lb.
Turkestan	Commercial	21,300	17,200	11,000	24 1,500	23·22	5	1,494	21	1,281	26·74	5 1,567
Variegated	Steele Briggs	22,000	20,900	14,000	28 900	23·22	6	1,212	19	925	26·64	5 1,496
Grimm	Brooks, Alberta	21,600	18,300	11,800	25 1,700	23·19	5	1,989	21	1,512	24·76	5 1,397
Grimm	A. B. Lyman	23,100	15,000	13,400	25 1,500	23·97	6	344	19	1,375	23·05	5 963
Cossack	D. I. S. C.	23,300	15,500	12,000	25 800	24·33	6	360	19	1,162	27·45	5 705
Sample	McCannus	19,800	12,900	14,300	23 1,000	23·74	5	1,158	19	370	29·87	5 598
Grimm	Cap Rouge	22,500	18,900	13,100	27 500	22·39	6	202	20	87	24·55	5 223
Cossack	Hansenstock	21,400	16,300	11,600	24 1,300	23·80	5	1,733	19	1,800	27·40	4 1,621
Siberian Yellow (Medicago Falcata)	Rife, Alberta	20,100	.....	9,800	14 1,900	28·28	4	456	16	1,446	26·87	4 1,006
Siberian Yellow (Medicago Falcata)	Nelson, B.C.	15,000	.....	11,100	13 100	26·22	3	843	14	825	29·42	4 362
Siberian Yellow (Medicago Falcata)	Rife, Alberta	12,300	.....	12,900	12 1,200	28·67	3	1,225	12	1,537	29·01	3 1,426

TABLE 36—ALFALFA VARIETIES, SOWN 1925

Name	Source of Seed	1927							Two-year average, 1926-1927 Total of all cuttings			
		Yield per acre—green weight				Percentage dry matter	Dry matter per acre		Yield per acre green weight		Percentage dry matter	Dry matter per acre
		First cut June 21	Second cut Jnly 27	Third cut Sept. 21	Total three cuttings							
		lb.	lb.	lb.	tons lb.	%	tons	lb.	tons	lb.	%	tons lb.
Marlborough	New Zealand	31,300	24,000	14,100	34 1,400	22·25	7	1,441	34	1,500	22·70	7 1,780
Alfalfa	Lytton, B. C.	24,700	13,500	16,100	27 300	23·01	6	494	24	550	29·25	6 1,842
Cossack	.....	22,600	19,100	13,200	27 900	22·25	6	215	25	1,250	24·35	6 402
Broadleaf	Victoria, Australia	14,500	13,300	13,000	20 800	23·91	4	1,755	20	200	26·98	5 827
Grimm	Summerland	12,800	8,600	14,900	18 300	26·02	4	1,445	13	1,900	37·86	4 1,568

ENSILAGE CROPS

INDIAN CORN—Project Ag. 1

Twenty varieties of Indian corn were tested in triplicate 1/220 acre plots on gravelly loam soil which had grown a hay crop the previous year. In the autumn of 1926, manure was applied at the rate of 15 tons per acre and the land ploughed. The following spring the land was irrigated and prepared for seeding. All varieties were seeded on May 18, in rows 3 feet apart and later thinned to 8 inches apart in the row. All varieties were harvested September 14. The crop was irrigated in July and again in August. The results obtained in 1927 and the average results over a number of years are given in tables 37 and 38.

Compton's Early, from seed obtained from J. O. Duke, continues to give highest yields over a number of years. This variety recorded highest yield of green weight and dry matter in the three-year average of twelve varieties (1923-25); second highest yield in green weight and fourth highest yield in dry matter of twenty-three varieties under test in 1925; the highest average yield green weight of six varieties for five years (1921-25); highest yield in green weight and dry matter of twenty-six varieties under test in 1927 and highest yield in green weight and dry matter of ten varieties for four years (1923-26), and highest yield in green weight and second highest in dry matter of ten varieties for a five year average (1923-27).

A comparison of results for the years 1923-27 shows considerable variation in yields of corn sold under the same variety name but obtained from different sources. Thus North Western Dent may vary as much as twenty days in time of maturity, and 14,520 pounds in green weight per acre, and 4,037 pounds in dry matter per acre. Several other varieties tested show the same tendency and indicate that source of seed is a very important factor for growers to consider when purchasing seed corn.

Under adequate soil moisture conditions, practically all varieties of corn may be grown to maturity in the southern Okanagan valley. Under field conditions at this station, the following varieties have ripened:—North Western Dent, Leaming, Golden Glow, Wisconsin No. 7 and Longfellow. In districts with a higher altitude than 1,500 feet and in the northern districts of the southern interior of British Columbia (districts where the season is shorter than at this station and where frosts occasionally occur during the growing season for corn) early maturing varieties or strains should be planted. The varieties North Western Dent, Quebec 28 and Twitchell's Pride, which are approximately 20 days earlier than the heavier yielding varieties, such as Wisconsin No. 7 and Leaming, may well be considered for short season districts where early maturity is essential. Each farmer who is producing corn should aim to grow the highest yielding variety or strain of corn that will mature under his particular soil and season, and throughout the districts of the southern interior of British Columbia, considerable variable soil and season exist.

TABLE 37—INDIAN CORN—VARIETY FOR ENSILAGE, 1927

Name	Source of seed	Number of days			Height in inches			Number		Percentage dry matter	Yield of fodder per acre, 1927			
		Emerge	Tassel	Silk	Plant	Upper ear	Lower ear	Ears	Suckers		Green weight		Dry weight	
										%	tons	lb.	tons	lb.
Wisconsin No. 7	J. O. Duke	12	78	80	114	42		1	0	21·63	28	760	6	277
Burr Leaming	G. S. Carter	12	72	78	84	40		1	0	24·34	24	1,280	5	1,995
Longfellow	Dakota Imp. Seed Co.	12	72	76	93	31		1	2	24·11	22	660	5	767
North Western Dent	Dakota Imp. Seed Co.	10	67	71	108	32		1	0	27·71	18	1,620	5	424
North Western Dent (Nebraska grown)	A. E. McKenzie	12	67	81	111	31		1	0	24·56	20	480	4	1,942
North Western Dent (Dakota grown)	A. E. McKenzie	10	67	73	117	42	38	2	1	25·31	19	1,160	4	1,911
90 Day White Dent	Dakota Imp. Seed Co.	10	65	69	108	30		1	0	28·95	16	1,660	4	1,745
Yellow Pride Dent	Dakota Imp. Seed Co.	10	67	75	117	29		1	0	25·27	17	1,640	4	1,006
Golden Glow (Kelowna grown)	Kelowna, B.C., C. E. Lewis	12	64	73	102	31		1	0	25·40	16	1,880	4	605
Compton's Early	J. O. Duke	12	64	72	105	30		1	1	23·24	18	300	4	436
White Cap Yellow Dent	Steele Briggs Seed Co.	11	64	71	105	28	25	2	0	25·25	15	140	3	1,610
North Western Dent	Dom. Exp. Farm, Brandon	10	56	61	84	21		1	0	35·82	10	20	3	1,171
North Western Dent	Crookston	9	57	63	90	19	18	2	0	29·94	12	860	3	1,443
North Dakota	Steele Briggs Seed Co.	12	63	69	90	24		1	2	24·68	14	820	3	1,113
Golden Glow	J. O. Duke	12	65	72	96	27		1	0	25·83	12	1,740	3	649
Leaming	J. O. Duke	10	71	77	108	42		1	0	26·36	12	1,080	3	611
North Western Dent (Kelowna grown)	Kelowna, B.C. Dr. C. W. Diekson	10	59	63	108	24		1	2	31·98	11	1,100	3	387
Longfellow	J. O. Duke	12	71	76	99	29		1	2	21·33	14	820	3	147
Yellow Dent	A. J. Wimple	10	65	66	108	30		1	0	25·06	11	1,540	2	1,889
Quebec 20	J. L. Todd	10	57	64	87	16		1	1	35·82	8	60	2	1,753
Twitchell's Pride	Dom. Exp. Stn. Fredericton	9	57	62	87	16		1	2	31·26	7	1,620	2	883

TABLE 38—INDIAN CORN—VARIETY TEST FOR ENSILAGE—FIVE YEAR AVERAGE, 1923-1927

Name	Source of seed	Number of days			Height in inches			Number		Percentage dry matter	Yield of fodder per acre, Five year average 1925-1927			
		Emerge	Tassel	Silk	Plant	Upper ear	Lower ear	Ears	Suckers		Green weight		Dry weight	
										%	tons	lb.	tons	lb.
Longfellow	Dakota Imp. Seed Co	10	62	74	110	47	40	1-2	0-2	25·59	16	248	5	66
Compton's Early	J. O. Duke	10	63	72	103	44	42	1-2	1-2	25·78	18	25	4	644
North Western Dent	Dakota Imp. Seed Co	9	59	67	102	38	37	1-2	0-2	28·00	15	1,428	4	217
90 Day White Dent	Dakota Imp. Seed Co	12	65	70	81	28	.....	1	0	26·77	14	1,904	3	1,755
Wisconsin No. 7	J. O. Duke	10	66	73	112	53	.....	1	0-2	24·89	15	1,842	3	1,511
North Dakota	Steele Briggs Seed Co	10	57	70	96	41	39	1-2	2-4	24·99	13	1,657	3	851
Golden Glow	J. O. Duke	10	65	70	102	43	.....	1	0-2	25·71	13	238	3	665
Leaming	J. O. Duke	10	68	75	106	53	.....	1	0-2	26·26	12	1,525	3	554
Longfellow	J. O. Duke	10	62	71	101	40	37	1-2	0-3	24·52	12	1,341	2	1,990
Twitchell's Pride	Fredericton, N.B	9	57	59	93	29	24	1-2	1-5	25·69	9	1,572	2	1,680

TABLE 39—INDIAN CORN—VARIETY TEST FOR ENSILAGE—THREE YEAR AVERAGE 1925-1927

Name	Source of seed	Number of days			Height in inches			Number		Percentage dry matter	Yield of fodder per acre, three year average 1925-1927			
		Emerge	Tassel	Silk	Plant	Upper ear	Lower ear	Ears	Suckers		Green weight		Dry weight	
										%	tons	lb.	tons	lb.
Burr Leaming	G. S. Carter	10	67	79	99	54	.....	1	0-2	24·09	20	147	4	1.621
North Western Dent (Nebraska grown)	A. E. McKenzie	9	65	77	113	50	.....	1	0-1	23·95	20	195	4	1,336
North Western Dent (Dakota grown)	A. E. McKenzie	9	56	61	101	37	.....	1-2	1-4	28·38	15	678	4	577
Golden Glow (Kelowna grown)	Kelowna, B.C. C. E. Lewis	9	62	71	106	48	.....	1	0-1	25·89	16	1,853	4	308
North Western Dent	Dom. Exp. Farm, Brandon	9	55	60	85	23	.....	1	0-3	33·61	12	1,928	4	90
Yellow Dent	A. J. Wimple	10	64	69	106	42	.....	1-2	1-2	28·76	14	1,223	3	1,376
White Cap Yellow Dent	Steele Briggs Seed Co	10	59	71	111	36	35	2	0-2	26·98	13	705	3	1,009
Quebec 28	J. L. Tood	9	50	59	93	27	21	1-2	0-4	32·07	8	1,913	2	1,317

HAY AND PASTURE MIXTURES, WITH ALFALFA, WHITE SWEET CLOVER AND RED CLOVER AS BASES

Projects Ag. 258B, 258C, 258D

A brief summary of the results, to date, of these experiments in a form that may be of service to the farmer is presented at this time.

Hay and pasture mixtures were started in 1922 to determine what grasses can be economically grown in a mixture with alfalfa as the base. In 1924 the experiment was enlarged and included hay and pasture mixtures with alfalfa, white sweet clover and red clover as the bases. During the period 1925 to 1927, forty hay and pasture mixtures were tested.

Red clover as a base in hay and pasture mixtures has not given satisfactory yields, that is, when compared with alfalfa or white sweet clover. The results of this experiment indicate that red clover is not suitable for seeding on light gravelly soil, silt loam or sandy loam, even under irrigation. White sweet clover used as a base in hay and pasture mixtures has given good yields of fodder and also the promise of being suitable for soil conditions that are slightly too light and dry for alfalfa. Mixtures with alfalfa as the base have given higher yields than white sweet clover mixtures. Legumes, grasses, and mixtures of grasses have not given as high yields as mixtures which contain a legume. *The problem then for each farmer who desires to establish hay and pasture mixtures is to determine what legume does best under his particular soil and season and then to include this legume as the base in the mixture.* From observations taken in the fields of these various hay and pasture mixtures and also from the yields obtained, the following mixtures may be taken as a guide for seeding on gravelly loam, silt loam, and sandy loam soils under irrigation. The figures given represent pounds of seed to be seeded per acre:—

For hay only: alfalfa 6, meadow fescue 6, tall oat grass 6, Italian rye grass 2.

For pasture only: alfalfa 6, tall oat grass 3, meadow fescue 4, orchard grass 2, Italian rye grass 2, western rye grass 2, and a small amount of timothy and Canadian blue grass.

For hay and pasture: alfalfa 6, meadow fescue 6, tall oat grass 6, Italian rye grass 2, timothy 2 and brome grass 2.

In mixtures with sweet clover as the base, use 10 pounds of white sweet clover in place of 6 pounds of alfalfa and the same number of pounds of grasses as is given in the alfalfa mixtures.

The number of pounds of seed given in these mixtures may be varied to suit the needs of the farmer without the yield being influenced to any appreciable extent.

ANNUAL HAY CROPS

Projects Ag. 247, 248, 249, and 251

A number of legumes, grasses and mixtures for annual hay crops were tested in duplicate 1/100 acre plots on gravelly loam soil which had grown mangels the previous year. The land was fall-ploughed in 1926 and the following spring irrigated and prepared for seeding. The plots were seeded May 28. The crop was irrigated on June 22 and again on July 16. The annual hay crops sown, the rate of seeding and the yield per acre are given in table 40.

The varieties of oats which have been tested required from 60 to 75 days to reach the early dough stage, the stage of maturity when they were harvested. The results of these tests indicate that late varieties outyield the early varieties of oats. Accordingly, it would seem that a late oat would be suitable for seeding during the early part of the season and an early oat for seeding as an emergency crop in mid or late summer, and also for seeding in the early part of the season in districts where the seasons are short.

Sudan grass, one of the most promising annual hay plants which have been tested at the Summerland Station. The plants shown in the picture are from 6 to 7 feet high.

Eight varieties of millets were tested this year for general suitability for hay. Over a period of years, the highest yielding varieties of millets have outyielded the highest yielding varieties of oats. For a very early maturing variety, Early Fortune is essentially suitable when the crop is required to mature in from 40 to 50 days. The variety Japanese continues to be the least desirable of the millets under test. This variety consistently burns at the tip of the leaf. Hog millet is tall and leafy, Siberian is leafy and of finer texture than hog millet, Golden is very leafy, but late in maturing, and common millet is coarse and wiry. Millets like a warm growing season and respond to a plentiful supply of irrigation and when grown under suitable cultural conditions require approximately 60 days to mature for hay.

The suitability of soybeans for hay has been tested and when seeded alone and raised on gravelly, sandy, loam soils, and under irrigation, they have not given promise of being a profitable crop. When used in mixtures, soybeans have given excellent results and are recommended. Soybeans require about 85 days to reach the early pod, which is the stage of maturity to cut for hay. They require less irrigation than millets.

A number of mixtures or combinations of sorghums, Sudan grass, cow peas, soybeans, spring vetch and winter vetch have been tested for annual hay. Of these mixtures the most promising are sorghums and Sudan grass; sorghum and cow peas; sorghum, Sudan grass, cow peas and soybeans;sorghum and soybeans; Sudan grass and soybeans; and Sudan grass and cow peas. These mixtures require from 70 to 75 days to mature for hay. Early varieties or strains of sorghum, soybeans and cow peas that mature approximately the same time as Sudan grass should be used in these mixtures.

When seeded alone, Hubam and white sweet clover have not given high yields. White sweet clover is finer in leaf and stem, but is not as early as Hubam.

Hubam clover and spring rye, and white sweet clover and spring rye, are not suitable mixtures for hay at the Summerland Experimental Station. The clovers grow so slowly that they are only a few inches high when the rye is in early blossom and ready to cut.

Mixtures of white sweet clover and Siberian millet, Hubam clover and Siberian millet, and white sweet clover and Banner oat, have given heavy yields over a period of two years.

Of the annual hay crops which have been seeded alone, sorghum, Sudan grass and early amber sugar cane have given the heaviest yields.

Teff grass was seeded at the rate of 2, 3, and 5 pounds per acre. The lowest rate of seeding gave the heaviest yield. The results indicate that 2 pounds of seed per acre is sufficient for this grass when grown on gravelly loam soils. This grass has not given heavy yields.

Under irrigation, spring rye, except for its earliness, has not been a suitable crop to grow for hay. On non-irrigated light lands in districts where, in the spring, the soil and moisture conditions are satisfactory for plant growth, but where the late spring and early summer precipitation is light, spring rye may be suitable for an annual hay crop.

Peas do not thrive on light soils in the British Columbia Dry Belt, even when grown under irrigation. Accordingly, in a mixture of peas, oats and vetches, it is more economical to use less peas and more vetches. Spring and winter vetches thrive on the irrigated light soils of these districts, but they are only suitable for hay crops when used in mixtures. Serradella, an annual legume which has been tested for 2 years has not produced sufficient growth to harvest for hay.

Some desirable characteristics of an annual hay crop are: wide range of adaptability to soil and season; ability to grow fast and compete with weeds, especially in the early stages of growth; ease of harvesting and curing and economical yields of palatable nutritious fodder.

For additional information on the results of tests with annual hays at this station, see reports of this station for the years 1925 and 1926.

TABLE 40—ANNUAL HAY CROP

Name	Seeding rate per acre	1927			Average		
		Percentage dry matter	Yield per acre		Percentage dry matter	Yield per acre	
			Green weight	Dry matter		Green weight	Dry matter
	lb.	%	tons lb.	tons lb.	%	tons lb.	tons lb.
Oat Varieties—					(3-year	average	1925-27)
Gold Rain	100	24·29	3 1,100	0 1,724	30·26	4 0	1 821
Alaska	100	42·85	5 1,200	2 799	42·64	4 33	1 1,305
Leader A	100	45·96	4 700	1 1,998	37·50	3 1,900	1 941
					(2-year	average	1926-27)
Laurel	100	35·37	4 1,000	1 1,183	32·87	6 1,100	2 203
Longfellow	100	35·62	5 0	1 1,562	33·30	6 400	2 73
Columbia	100	43·35	4 900	1 1,858	36·42	5 1,800	2 95
Leader B	100	35·42	5 300	1 1,648	32·65	5 1,850	1 1,826
Banner	100	37·79	6 200	2 610	.....	.....	.....
Victory	100	49·29	8 800	4 280	.....	.....	.....
Millet Varieties—					(4-year	average	1924-27)
Hog	30	21·29	7 1,000	1 1,193	23·87	7 437	2 717
Siberian	30	25·93	8 700	2 330	30·21	7 1,100	2 408
Golden	30	29·29	3 1,100	1 80	26·15	7 1,438	1 1,785
Common	30	32·83	5 700	1 1,513	30·62	6 187	1 1,732
Hungarian	30	27·48	6 1,900	1 1,820	29·80	6 1,062	1 1,507
Japanese	30	28·24	7 800	2 179	27·50	6 1,340	1 1,304
*Hursk	30	28·26	5 700	1 1,024	27·68	6 1,600	1 1,747
Early Fortune	30	28·56	5 200	1 913	24·43	6 1,237	1 1,245
Pea Varieties—					(2-year	average	1926-27)
Invermere	90	26·46	3 1,900	1 90	27·03	5 1,750	1 698
Tangier	90	29·95	2 1,300	0 1,587	25·74	1 500	0 1,219
Mixtures—					(4-year	average	1924-27)
Sorghum	20	.....	.....	.....	.....	.....	.....
Sudan grass	12	24·85	5 1,000	1 733	22·17	9 800	2 153
Sorghum	20	.....	.....	.....	.....	.....	.....
Cow peas, Summerland	45	18·62	9 100	1 1,370	18·04	10 1,488	1 1,703
					(3-year	average	1925-27)
Sorghum	10	.....	.....	.....	.....	.....	.....
Sudan grass	6	.....	.....	.....	.....	.....	.....
Cow peas, Summerland	22	.....	.....	.....	.....	.....	.....
Soy bean, Summerland	22	30·76	4 1,200	1 830	27·61	9 1,333	2 919
Sorghum	20	.....	.....	.....	.....	.....	.....
Soy bean, Summerland	45	24·43	6 0	0 1,466	21·99	13 600	2 439
Sudan grass	12	.....	.....	.....	.....	.....	.....
Soy bean, Summerland	15	40·43	4 1,800	1 1,962	33·28	7 700	2 617
Sudan grass	12	.....	.....	.....	.....	.....	.....
Cow peas, Summerland	45	38·50	5 1,200	2 312	30·98	7 133	2 150
Soy bean, Summerland	35	.....	.....	.....	.....	.....	.....
Cow peas, Summerland	35	.....	.....	.....	.....	.....	.....
Spring vetch	20	28·71	3 600	0 1,895	.....	.....	.....
Cow peas, Summerland	45	.....	.....	.....	.....	.....	.....
Soy bean, Summerland	45	29·91	3 100	0 1,824	.....	.....	.....
Sorghum	15	.....	.....	.....	.....	.....	.....
Sudan grass	10	.....	.....	.....	.....	.....	.....
Cow peas, Summerland	30	.....	.....	.....	.....	.....	.....
Soy bean, Summerland	30	.....	.....	.....	.....	.....	.....
Hairy vetch	15	32·83	5 1,200	1 1,677	.....	.....	.....
Soy bean, Summerland	35	.....	.....	.....	.....	.....	.....
Cow peas, Summerland	35	.....	.....	.....	.....	.....	.....
Hairy vetch	15	24·32	6 200	0 1,509	.....	.....	.....
					(2-year	average	1926-27)

TABLE 40—ANNUAL HAY CROP—*Concluded*

Name	Seeding rate per acre	1927			Average		
		Percentage dry matter	Yield per acre		Percentage dry matter	Yield per acre	
			Green weight	Dry matter		Green weight	Dry matter
	lb.	%	tons lb.	tons lb.	%	tons lb.	tons lb.
White sweet clover	15	.....	.....	.....	.....	.....	.....
Siberian millet	20	26·59	9 1,100	2 1,079	24·99	9 1,650	2 902
Hubam	15	.....	.....	.....	.....	.....	.....
Siberian millet	20	29·66	13 600	3 1,889	27·58	12 850	3 890
White sweet clover	15	.....	.....	.....	.....	.....	.....
Banner oat	80	39·37	6 1,200	2 1,097	33·33	6 700	2 213
Hubam	15	.....	.....	.....	.....	.....	.....
Banner oat	80	40·20	6 0	2 100	32·35 (4-year	6 950 average	1 1,753 1924-27)
Peas	15	.....	.....	.....	.....	.....	.....
Oats	68	.....	.....	.....	.....	.....	.....
Spring vetch	45	28·63	12 1,100	3 1,186	29·40	5 1,075	1 1,232
Miscellaneous Crops—							
Sudan grass, commercial	25	31·42	8 0	2 1,027	29·89	7 825	2 158
Spring rye	90	30·35	4 1,300	1 822	36·92	3 375	1 516
Barley, feeder	100	36·07	5 1,200	2 40	39·30	3 1,083	1 703
Hubam clover	20	23·38	1 500	0 584	25·18	1 1,536	0 1,761
White sweet clover	20	24·26	3 500	0 1,577	25·68 (3-year	3 837 average	0 1,726 1925-27)
Sorghum	40	17·67	15 800	2 1,442	20·01	15 1,933	2 1,807
Cow pea, Summerland	90	18·92	2 500	0 851	21·35	5 1,700	1 915
Teff grass	3	28·50	0 1,667	0 475	.....	.....	.....
Soy bean	90	38·37	3 100	1 340	32·39 (2-year	3 1,767 average	0 1,790 1926-27)
Sudan grass, China	25	35·58	6 900	2 590	31·69	10 1,250	3 409
Early amber sugar cane	25	20·19	7 1,200	1 1,069	18·32	12 100	2 248
Milo maize	25	23·79	3 1,800	0 1,856	21·15	8 950	1 1,345
Kaffir	25	21·09	6 100	0 1,286	18·87	9 1,200	1 832
Yellow sweet clover	20	24·99	1 500	0 625	.....	.....	.....
Teff grass	2	.....	0 1,800	.....	.....	.....	.....
Teff grass	3	.....	0 1,700	.....	.....	.....	.....
Teff grass	5	.....	0 1,500	.....	.....	.....	.....

*Hursk millet 2-year average 1926-27.

SUNFLOWERS—VARIETY TEST FOR YIELD AND PURITY

Project Ag. 76

Five varieties of sunflowers were tested under the same cultural conditions as the variety test with corn. The Mammoth Russian and Giant Russian varieties were cut when in the full blossom stage. The Manchurian, Ottawa 76, and Mennonite varieties were cut when the heads were in the dough to ripe stage. A comparison of the varieties under test shows a considerable variation in the number of days to blossom. Thus, the variety Mennonite blossoms 24 days earlier than the Mammoth Russian.

On light, gravelly, sandy loam soils, even under irrigation throughout the southern interior of British Columbia, sunflowers are not recommended as a satisfactory or profitable crop to grow. On the heavier and richer lands in districts that have a much shorter season than at this station and where corn cannot be successfully grown, sunflowers would appear to be a profitable crop to grow for ensilage.

A comparison of tables 37, 38, 39, with 41 and 42 shows that under irrigation, the highest yielding varieties of corn yield considerably more in both green weight and dry matter per acre than the highest yielding varieties of sun-

flowers. Of the majority of the varieties tested, corn considerably out-yielded sunflowers in dry matter per acre.

In comparing sunflowers with corn for ensilage, sunflowers are more resistant to cold weather during the spring and therefore may be seeded to advantage earlier than corn, an important factor in districts where the season is short and where corn is not likely to thrive or mature. As compared with sunflowers, corn is more palatable, more nutritious, more drought-resistant, more economical to harvest and where corn can be successfully grown, yields more green and dry matter per acre. However, the sunflower crop for ensilage has a place in Canadian agriculture and that place is on suitable soils in districts where corn or other more desirable ensilage crops cannot be economically grown.

TABLE 41—SUNFLOWERS—TEST OF VARIETIES—1927

Name	Source of seed	Percentage dry matter	Yield per acre			
			Green weight		Dry matter	
		%	tons	lb.	tons	lb.
Mammoth Russian	K. McDonald & Sons	19·33	18	960	3	1,144
Ottawa, No. 76	C.E.F. Ottawa	18·31	16	1,220	3	83
Manchurian	A. E. McKenzie	17·30	15	1,680	2	1,422
Giant Russian	Dakota Imp. Seed Co	16·84	12	1,280	2	257
Mennonite	Rosthern Exp. Station	15·75	11	1,100	1	1,638

TABLE 42—SUNFLOWERS—TEST OF VARIETIES—FOUR YEAR AVERAGE, 1924-1927

Name	Source of seed	Four year average 1924–1927					
		Number of days to		Height of plant in inches	Percentage dry matter	Yield per acre	
						Green weight	Dry matter
		Emerge	Blossom				
					%	tons lb.	tons lb.
Mammoth Russian	K. McDonald & Son	9	80	103	23·89	15 10	3 377
Ottawa	C.E.F. Ottawa	11	61	74	24·64	13 459	2 1,432
Manchurian	A. E. McKenzie	10	67	79	24·39	13 532	2 1,305
Giant Russian	Dakota Imp. Seed Co	10	83	94	22·80	14 23	2 1,044
Mennonite	Rosthern Exp. Station	10	56	58	21·67	10 1,592	2 740

FIELD ROOTS

MANGELS—VARIETY TESTS FOR YIELD AND PURITY—Project Ag. 21

Twelve varieties of mangels were tested in triplicate 1/220-acre plots on sandy loam soil which had grown a crop of hay the previous year. All varieties were seeded on April 18 and harvested on October 14. The crop was irrigated on May 15, July 14 and on August 4.

The five-years' test with mangels indicates the importance of seeding with the best quality seed obtainable, seed that is pure and true to type and of a variety which is suitable for the soil and season of the district. The Yellow Intermediate, Long Red and Half Sugar types have given the highest yields.

The yields for 1927 and the average yields of a number of varieties which have been tested are given in tables 43 and 44.

TABLE 43—MANGELS—TEST OF VARIETIES—FIVE-YEAR AVERAGE—1923-1927

Name	Source of seed	1927			Five year average, 1923-1927		
		Percentage dry matter	Yield per acre		Percentage dry matter	Yield per acre	
			Green weight	Dry matter		Green weight	Dry matter
		%	tons lb.	tons lb.	%	tons lb.	tons lb.
Yellow Intermediate	C.E.F. Ottawa....	12·30	20 1,800	2 1,141	15·01	23 643	3 1,217
Long Red Mammoth	Wm. Ewing.....	12·42	22 1,760	2 1,683	14·48	21 1,905	3 273
*Half Sugar White...	Steele Briggs.....	10·71	28 540	3 55	11·99	22 623	2 1,199
Giant Yellow Intermediate.....	William Ewing....	11·67	17 1,200	2 108	12·10	18 1,764	2 588
Giant Yellow Globe.	William Ewing....	9·06	19 500	1 1,488	10·86	21 86	2 565
Yellow Globe.....	Steele Briggs.....	8·99	13 1,460	1 469	11·54	16 1,630	2 362

*Half Sugar White, 2 year average, 1926-1927.

TABLE 44—MANGELS—TEST OF VARIETIES—FOUR-YEAR AVERAGE, 1924-1927

Name	Source of seed	1927			Four year average, 1924-1927		
		Percentage dry matter	Yield per acre		Percentage dry matter	Yield per acre	
			Green weight	Dry matter		Green weight	Dry matter
		%	tons lb.	tons lb.	%	tons lb.	tons lb.
Elevetham Mammoth.....	Hartman.....	9·80	14 1,260	1 867	14·08	19 1,304	2 1,681
Half Sugar Red.....	Hartman.....	12·14	18 1,180	2 514	14·59	19 608	2 1,649
Taaroje Barres.....	Hartman.....	9·65	28 980	2 1,499	11·93	22 139	2 1,222
Eckendorfer Red....	Hartman.....	8·58	23 1,080	2 39	11·63	21 1,210	2 985
Barres Oval.....	General Swedish .	10·71	17 980	1 1,746	12·43	19 1,454	2 960
Eckendorfer Yellow .	General Swedish .	8·98	11 1,760	1 134	11·93	17 108	2 213

CARROTS—VARIETY TEST FOR YIELD AND PURITY—Project Ag. 36

Eighteen varieties of carrots were tested for purity and yield of green and dry matter per acre under the same cultural conditions as the mangels. Yields for 1927 and the average yields for five years 1923 to 1927 are given in table 45.

In comparison with the yields which have been obtained with mangels, it will be noted that a number of varieties of carrots which have been tested have yielded almost as much dry matter per acre as mangels. The difference in yield of the varieties of carrots tested, indicates the importance of seeding with the best quality of seed obtainable, and of a variety which is most suitable for the soil and season of the district.

TABLE 45—FIELD CARROTS—TEST OF VARIETIES

Name	Source	1927					Five-year average, 1923–1927				
		Percentage dry matter	Yield per acre				Percentage dry matter	Yield per acre			
			Green weight		Dry matter			Green weight		Dry matter	
		%	tons	lb.	tons	lb.	%	tons	lb.	tons	lb.
White Intermediate	Summerland	9·45	24	1,280	2	657	14·69	17	666	2	688
*White Belgian	Hartman	10·82	22	1,220	2	893	13·95	17	91	2	587
White Belgian	Wm. Ewing	10·90	18	1,060	2	39	14·53	16	1,077	2	565
Improved Short White	Steele Briggs	9·57	25	1,040	2	1,073	13·44	17	1,485	2	437
Imp. Intermediate White	Wm. Ewing	10·56	24	1,060	1	1,068	14·49	18	1,210	2	298
Long Red Surrey	Steele Briggs	11·71	17	980	2	96	15·54	14	223	2	239
Long Orange Belgian	John A. Bruce	11·32	15	800	1,	1,487	14·02	25	640	2	148
Yellow Belgian	Wm. Ewing	10·76	22	220	2	758	14·87	14	128	2	102
White Belgian	Halifax	10·93	12	540	1	682	14·07	14	1,736	1	1,994
Danish Champion	C.E.F. Ottawa	10·79	14	1,260	1	1,157	14·56	12	1,770	1	1,778
Mam. Intermediate White	John A. Bruce	10·31	25	1,700	2	1,330	13·68	14	1,751	1	1,655
Improved Intermed. White	Dupuy & Ferguson	9·50	25	1,040	2	849	12·40	16	805	1	1,617
White Belgian	John A. Bruce	10·41	17	1,200	1	1,664	13·95	13	835	1	1,617
Long Orange	John A. Bruce	11·51	14	1,480	1	1,393	16·89	11	377	1	1,548
New Yellow Intermediate	Wm. Ewing	9·94	16	120	1	1,193	13·86	13	598	1	1,391
New Yellow Intermediate	Halifax Seed Co.	12·20	11	440	1	737	17·86	10	822	1	1,201
*Champion	Hartman	11·44	11	1,100	1	643	14·15	10	895	1	922
**Champion	General Swedish	9·77	14	1,260	1	859	11·03	11	293	1	372

*Average 3 years 1925–1927.
**Average 2 years 1926–1927.

SUGAR BEETS—VARIETY TEST FOR YIELD AND PURITY—Project Ag. 66

A number of lots of sugar beets for sugar-content analysis were grown this year for the Dominion Chemist, who reports as follows:—

"The roots were large, well formed, with no forks; the yields were very satisfactory. These beets are excellent in respect to both sugar content and purity, and of good weight."

OTHER FORAGE CROP PROJECTS IN PROGRESS

PROJECT AG. 17.—Mangels, breeding of pure strains. From selected and isolated plants, seed and roots were harvested for the continuance of this work in 1928.

PROJECT AG. 37.—Field carrots, breeding of desirable types. From selected and isolated plants, seed and roots were harvested for the continuance of this experiment in 1928.

PROJECT AG. 111.—Alfalfa, breeding of improved strains. From selected plants, seed was harvested for the continuance of this experiment in 1928. From seed which was obtained from Russia, China, and Western Canada in 1925 and 1926, a very promising block of plants has been established.

PROJECT AG. 117.—Soybeans, breeding improved strains. This experiment was continued.

PROJECT AG. 181.—Soybeans, variety test for forage. This experiment was continued and seed harvested for the continuance of the project.

PROJECT AG. 256.—Miscellaneous legumes. A number of legumes were grown to determine their suitability for orchard cover-crops and forage crops. Seed of a very promising Russian lupine is being increased.

TOBACCO

THE SEASON

The spring season in the Okanagan and Similkameen valleys was very unfavourable for the production of early, sturdy, healthy tobacco seedlings, especially as most of the seed beds were cotton-covered. The sowing of the seed beds started during the last week in March and continued throughout the first two weeks in April. By reason of the unfavourable season and also the lack of experience in the making and care of tobacco seed beds, many growers experienced considerable difficulty in raising early sturdy plants. Consequently many small tender seedling plants (not well hardened off) were transplanted to the fields and in some districts many tobacco fields were from one to five weeks late in being planted. During the last week in May and the first week in June the weather was cool and favourable for transplanting. Late transplantings, however, experienced hot weather and the loss of many plants.

Throughout the Okanagan valley, cutworms were numerous and it was necessary to make several applications of poisoned bran mash to control this pest. In the Vernon district, flea beetles caused considerable damage to young tobacco plants in the field. Wireworms were again very troublesome in some fields in the district of Kelowna and also at the Summerland Station. At the latter place, rice bran traps were used with satisfactory results. At the Summerland Station, hornworms were very numerous throughout the entire growing season and caused considerable damage to the leaves. It is very probable that in the future it will be necessary to control this pest by spraying, as the hand-picking method was found to be entirely inadequate.

The summer months were slightly above the average in temperature. The early-planted and well-cared-for fields were ready to harvest during the latter part of August. During August and September the precipitation was much higher than usual, and tobacco crops which were not harvested by the end of the first week in September experienced very unfavourable weather during the harvest. Although many fields were late in being harvested, yet practically no damage by frost occurred to the standing crop. From August to December inclusive the precipitation was exceptionally heavy for these districts.

Many growers, because of the large increase in acreage, hung the tobacco too close in the curing barns and also made use of buildings which were inadequately equipped for curing tobacco. Many tobacco fields, especially in districts where tobacco was produced for the first time on a commercial basis, were harvested late and with a large proportion of immatured leaf. For these reasons and on account of the continued unfavourable curing weather, a large loss was occasioned by shedburn and freezing of uncured and unripe leaf. A large proportion of fat stems, wet butts and wet leaves had to be sorted out and redried at stripping time.

There was a large increase in the acreage of tobacco planted this year. In 1926, in the Okanagan valley, approximately fifty-five acres were planted to tobacco, whereas this year, 1927, it is estimated that three hundred and fifty acres were planted. This acreage of tobacco was grown under very variable cultural and environmental conditions and gave much information on the many cultural problems and physiological maladies that are peculiar to these districts. Some of these problems which are important at this time are discussed below.

Field observations of a number of commercial and experimental fields of tobacco throughout these districts this year indicate that soil-building, either by the application of manure or cover-crops or commercial fertilizers or a combination of these soil-building materials, will need to be generally practised, especially on the lighter soils, if best results with tobacco are to be secured. This probem is especially important to growers who are operating with a high cost of production crop like tobacco, on high-priced land and under irrigation.

Tobacco worm or hornworm. A very destructive pest to tobacco crops in the field on the Summerland Station.

In the irrigated sections there is a real need for information on the time of irrigation and rate of application that is most suitable for the culture of tobacco. A study of irrigation methods which are practised in the culture of tobacco throughout these sections indicates in many instances that irrigation is untimely and that the rate of application is considerably in excess of what is required by this crop. At the Summerland Station, although no definite duty of water experiment has been conducted with tobacco, yet this crop has been grown under very careful irrigation during the past three years and the response or behaviour of this crop under irrigation indicates that to produce on irrigated land a large crop of high-quality leaf in from seventy to ninety days in the field it is essential to maintain through judicious irrigation and cultivation a continuous available supply of moisture in the soil. *At the same time it has been noted that the tobacco plant does not thrive under a slight excess of irrigation.* At this Station over a ton of good-quality cured leaf per acre has been produced for three years on unfertilized sandy loam bench soil with three medium irrigations. As previously mentioned, although no definite duty of water experiment

has been conducted with this crop at this Station, *yet the results which have been obtained strongly indicate that the judicious irrigation of tobacco in the southern interior irrigated valleys of British Columbia is a very exacting cultural operation and should be given very careful supervision. Care should be exercised not to overirrigate.*

In addition to these two important cultural problems of fertilization and irrigation are the diseases. There are many physiological maladies to which tobacco succumbs here that are not found elsewhere. Among these may be mentioned leaf drop, sunburn and several unnamed injuries. In addition to these, several well-known physiological maladies, such as Frenching and Curly Dwarf, occur here in much more profusion than in the older growing districts in Eastern Canada.

EXTENSION WORK

During the past year great interest has been shown in the culture of tobacco throughout the southern interior of British Columbia, the Lower Mainland and Vancouver Island. From these districts, and from places outside the province, numerous requests for information on the culture of tobacco in British Columbia have been received. In order to meet this demand a heavy correspondence has been conducted and many bulletins and reports on the culture of tobacco have been distributed. Meetings of growers, growers' associations, boards of trade and service clubs have been attended and addressed. In the field, as time and opportunity would permit, practical demonstrations and cultural information have been given to the growers. A quantity of tobacco seed of recommended varieties which was supplied by the Tobacco Division was distributed to growers and to the British Columbia Tobacco Products Association.

EXPERIMENTAL WORK

Considerable work has been conducted and the results placed on file for future reference and information. However, as this is a report on experiments in progress, only a portion of the work is presented at this time.

FIELD EXPERIMENTS CONDUCTED IN THE OKANAGAN AND SIMILKAMEEN VALLEYS, 1927

General Varietal Test.—This experiment was begun in 1925 to determine the types and varieties of tobacco that are most suitable to grow in these southern interior districts. The tests have been conducted on soils which varied from sand to clay and which included bench land, low land, irrigated and non-irrigated land. All varieties tested were air-cured and then shipped to the Tobacco Division, Central Experimental Farm, Ottawa, where quality tests of the cured leaf are conducted.

FIELD TESTS AT KELOWNA, 1927

Tobacco Varietal Test.—In the district of Kelowna four types of tobacco which included eight varieties were tested on non-irrigated low level clay loam land. The seed was sown in cotton-covered semi-hot beds on April 8 and the seedlings transplanted into the field on June 15. During the season the plots were given four hoeings, four cultivations and two suckerings. The varieties tested made, in most instances, a vigorous growth in the field and gave a heavy yield of cured leaf. All varieties were harvested in early September. The field results of this test for the year 1927 are given in table 46.

The appreciation and thanks of the Tobacco Division and of the Dominion Experimental Station, Summerland, are tendered to Mr. Ralph Turner, Willow Brook Farm, Benvoulin, Kelowna, whose support and co-operation have made the experimental work with tobacco in the Kelowna district this year possible.

TABLE 46—TOBACCO, VARIETY TEST—CONDUCTED AT BEVOULIN, KELOWNA, B.C. 1927

Variety and type	Number of days		Twenty-five plants					Yield of cured leaf per acre 1927
			Average height of plants at topping	At harvest time		At stripping time		
	To topping	To harvest		Average maximum length of leaf	Green weight	Weight		
						Stalks	Cured leaf	
			Inches	Inches	lb.	lb.	lb.	lb.
Cigar Binder Type—								
Comstock Spanish Pomeroy	55	75	55	28	51	15·7	13·3	2,020
Connecticut Broadleaf	61	90	29	25	60	7·5	12·2	1,608
Connecticut Havana 38	55	75	45	26	53	10·1	8·8	1,522
Virginia or Flue-cured Type—								
Warne	61	91	39	27	67	21·2	16·2	2,098
Hickory Pryor	61	91	33	25	65	22·0	14·3	1,792
White Burley Type—								
Halley's Burley	61	91	33	29	89	13·5	10·8	2,423
Broadleaf Burley	61	91	24	29	93	15·5	7·8	2,201
Station Standup Burley	61	91	27	29	76	16·0	12·1	2,073
Kelly Burley	61	91	26	26	86	14·5	9·7	2,067
Judy's Pride Burley	61	91	27	26	84	14·5	9·1	1,987
Standup Resistant Burley	61	91	28	26	89	14·8	8·5	1,557
Dark-fired Type—								
Greenwood	61	91	32	27	70	11·5	8·2	2,128

Warne, Hickory Pryor and Greenwood air-cured.

VARIETAL TESTS CONDUCTED AT THE DOMINION EXPERIMENTAL STATION, 1927

Five types of tobacco, which included sixteen varieties were tested on sandy loam bench land and under irrigation. The seed was sown in cotton-covered semi-hot beds on April 6 and the seedlings transplanted into the field on June 8. During the season the plots were given four hoeings, three cultivations, two suckerings and three medium irrigations. With the exception of Hester, a flue-cured type of tobacco, the varieties made a vigorous growth in the field and gave a heavy yield of cured leaf. All varieties were harvested by early September and were well cured by early November. The field results of these tests for the year 1927 are given in table 47.

A number of Turkish varieties which were tested during 1925-1927 have yielded at an average rate of 970 pounds of cured leaf per acre. The leaf was harvested by the priming method. Complete data on these sorts is not yet available.

TABLE 47—TOBACCO, VARIETY TEST—CONDUCTED AT THE DOMINION EXPERIMENTAL STATION, SUMMERLAND, B.C. 1927

Variety and type	Number of days		Twenty-five plants					Yield of cured leaf per acre 1927
			Average height of plant at topping	At harvest time		At topping time		
	To topping	To harvest		Average maximum length of leaf	Green weight	Weight		
						Stalks	Cured leaf	
			Inches	Inches	lb.	lb.	lb.	lb.
Cigar Bender Type—								
Comstock Spanish Pomeroy	45	69	23	27	58	6·8	5·6	2,161
Connecticut Havana 38	45	69	17	25	57	7·3	5·6	2,047
Virginia or Flue-cured Type—								
Hickory Pryor	49	87	37	30	75	9·2	8·6	2,483
Warne	49	87	36	32	62	8·9	9·0	2,470
Hester	49	85	14	26	67	8·6	8·1	1,658
White Burley Type—								
Halley's Burley	59	93	30	30	73	11·4	8·4	2,052
Broadleaf Burley	59	93	33	31	78	11·7	9·1	2,023
Standup Resistant Burley	59	93	35	28	72	11·7	7·6	1,994
Kelly Burley	59	93	26	30	73	11·1	8·4	1,936
Judy's Pride Burley	59	93	35	29	74	11·8	7·9	1,908
Station Standup Burley	59	93	31	32	74	9·0	8·2	1,884
Dark-fired Type—								
Greenwood	59	93	34	32	81	9·7	9·6	2,127

Hickory Pryor, Warne, Hester and Greenwood were air-cured.

CO-OPERATIVE VARIETAL TESTS WITH TOBACCO IN THE SIMILKAMEEN AND OKANAGAN VALLEYS

Co-operative tests with tobacco were begun in 1925. These tests are conducted in districts where a considerable acreage of tobacco is being grown for the first time. The object of these tests is to determine whether tobacco can be successfully grown, to test the quality of the cured leaf, to secure information on environmental conditions and cultural problems that are peculiar to the district, and also by actual demonstration to show inexperienced growers the proper practices in the culture of tobacco.

In 1927, these tests were conducted on seven farms in the Keremeos, Oliver, Vernon and Lavington districts. The plots were located on low land, irrigated and non-irrigated land and under very variable soil, moisture and climatic conditions. These districts had never before grown a commercial acreage of tobacco and the crop was entirely new to the grower. Tobacco plants for these tests were supplied by the Summerland Station and throughout the growing season the plots were frequently visited and notes on the cultural conditions of the plots and on the growth of the plants were recorded. Soil samples were collected from each plot and forwarded to the Tobacco Division to be analyzed as to their suitability for the culture of tobacco and to determine what qualities of leaf are produced by these soils.

The growth made by the varieties under test indicate that good yields of quality leaf may be grown in these districts, if the crop is grown on the most suitable soils and if given judicious cultural treatment and if proper curing barns are used.

Samples of the cured leaf of each of the eleven varieties under test and from each of the seven farms in the four districts were forwarded to the Central Experimental Farm, Ottawa, for examination.

The appreciation and thanks of the Tobacco Division and of the Dominion Experimental Station, Summerland, are tendered to Messrs. Huntley of Oliver, Daly, East and Hemming of Keremeos, Howe, Postil and Ricardo of Vernon, and Jackson of Lavington, whose support and co-operation have made these co-operative varietal tests possible; and also to the British Columbia Tobacco Growers' Associaton, Kelowna, and Vernon Boards of Trade, Provincial Department of Lands, at Oliver, Provincial Department of Horticulture at Victoria, Vernon and Kelowna, and to John McVittie, Tobacco Field Inspector of the Department of Agriculture, Victoria, B.C., for their support and co-operation.

COMMERCIAL SAMPLES OF TOBACCO FOR TESTS OF QUALITY OF THE CURED LEAF

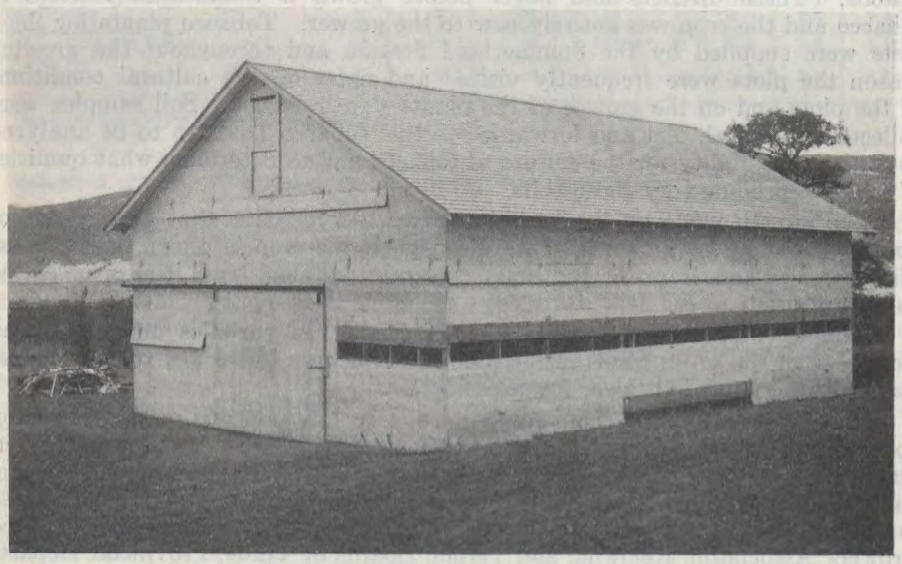
Samples of cured leaf of different varieties which were grown under variable soil, moisture and climatic conditions and representative samples of soil from the fields which produced these samples of tobacco were collected from a number of commercial tobacco farms in the districts of Oliver, Keremeos, Okanagan Mission, Vernon and Grand Forks and shipped to the Tobacco Division where quality tests of the cured leaf and analysis of the samples of soil will be conducted.

The appreciation and thanks of the Tobacco Division and of the Dominion Experimental Station, Summerland, are tendered to Messrs. Stowell of Oliver, Lewis of Keremeos, Luckett of Okanagan Mission, Atwood of Grand Forks, and Miss Cameron of Vernon, for their samples of cured tobacco leaf for quality tests by the Tobacco Division.

CURED LEAF QUALITIES OF VARIETIES OF TOBACCO GROWN IN THE OKANAGAN IN 1926

District of Kelowna.—The results secured were only fair, much of the cured leaf being of only medium quality. Field growth was somewhat uneven, and the transplanting date, June 23, was probably a little late for best results. In spite of these facts some of the White Burley lots showed very good quality, particularly the Judy's Pride and Station Standup varieties. The flue-cured varieties, Hickory Pryor and Warne, although air-cured, produced a good quality of leaf on the Belgo bench land.

Dominion Experimental Station, Summerland.—The yields of cured leaf were very high. An excellent field growth is indicated by the large sized leaves, a high proportion of which averaged more than 30 inches in length. A good quality of leaf was secured with all varieties, and some of the Burleys were of outstanding excellence.



A type of tobacco curing-barn which has given excellent service at the Summerland Station.

YIELD AND QUALITY OF TOBACCO PLANTED AT DIFFERENT SPACINGS AND YIELD AND QUALITY OF TOBACCO AS INFLUENCED BY MATURITY

*"Manufacturers and leaf dealers criticized many of the British Columbia samples grown in 1925 because of improper leaf body, the cigar leaf being too heavy bodied for a prime cigar binder, and the Burley and Green River being too thin. In 1925 Okanagan Burley was what may be classed as cigarette leaf, the leaves being thin in body, with uniform light colours. This type of leaf not being used to any extent in Canada or the British Isles, the experiments of spacing the plants at different distances in the field, and harvesting at different degrees of maturity, were carried out in 1926, with the aim of ascertaining the proper cultural practices to produce marketable leaf of the Connecticut Havana, White Burley and Green River types."

These spacing and harvesting experiments were continued in 1927 at this Station and at Kelowna. The field results and cured leaf which were obtained from these tests have been forwarded to the Tobacco Division at Ottawa, where quality tests of the cured leaf will be conducted.

* A report on the test of the quality of the cured leaf which was conducted by the Tobacco Division at the Central Experimental Farm, Ottawa.

In the spacing experiment all rows were spaced 36 inches apart, and the distance between the rows was varied from 18 inches to 36 inches.

The 1926 results of these experiments are given in the Tobacco Division report for that year.

COSTS OF PRODUCTION, KELOWNA, B.C., 1926 AND 1927

The economic feasibility of the culture of tobacco in comparison with other crops in the district is of considerable importance at this early stage of the tobacco industry in the Okanagan valley, especially to prospective tobacco growers who are operating on high-priced land under irrigation. An experiment was therefore begun in 1926 to determine the cost per pound to produce cigar leaf and other types of tobacco. A detailed report of this work for the year 1926 is given in the report of the Tobacco Division for the year 1926. The results of this experiment for the year 1927 are not available for publication in this report.

The appreciation and thanks of the Tobacco Division and of the Dominion Experimental Station, Summerland, are tendered to Messrs. Price, Barlee, Chamberlain, Turner, and James Thompson, all residing in the Kelowna district, whose support and co-operation have made the cost of production studies for this year possible.

PUBLICATIONS ON TOBACCO CULTURE

The following publications of the Dominion Department of Agriculture relating to tobacco culture are available on application to the Publications Branch, Department of Agriculture, Ottawa, or to the Dominion Experimental Station, Summerland, B.C.:—

Tobacco-Growing in Canada—Bulletin 25.

Tobacco Seed-Beds—Bulletin 21.

Tobacco, Summary of Three Years' Experiments at Harrow—Bulletin 41.

Flue-Cured Tobacco in Canada—Bulletin 38.

Heating Appliances for Flue-Curing Tobacco—Pamp. 51.

White Burley Tobacco in Canada—Bulletin 66.

Tobacco-Growing in Southwestern Ontario—Bulletin 76.

Annual Reports of the Tobacco Division, Central Experimental Farm, Ottawa.

Annual Reports of the Dominion Experimental Station, Summerland, B.C., for years 1925, 1926, and 1927.