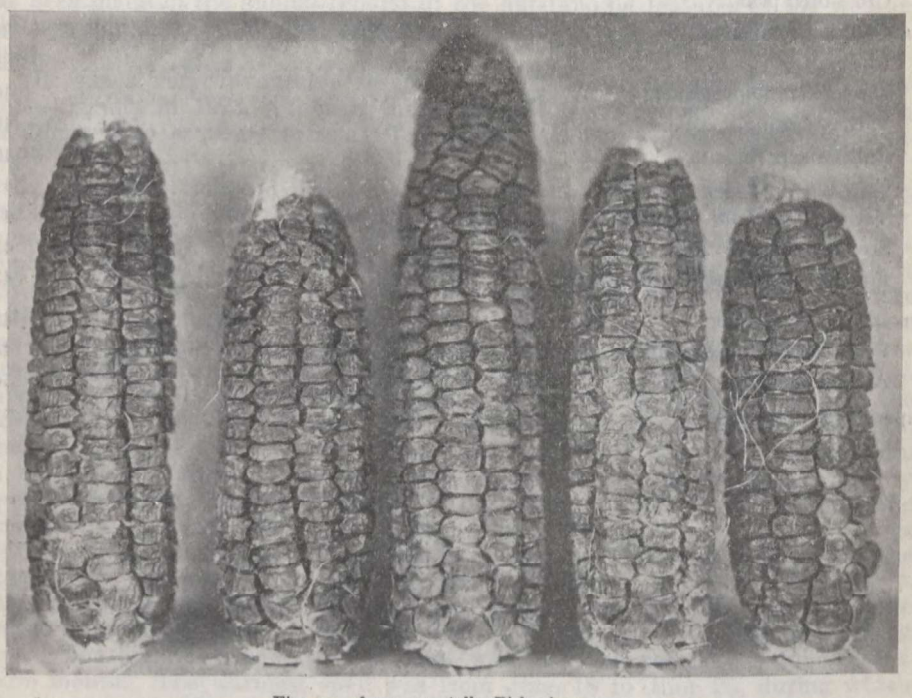
DOMINION OF CANADA
DEPARTMENT OF AGRICULTURE
DOMINION EXPERIMENTAL FARMS

DIVISION OF HORTICULTURE

REPORT
OF THE DOMINION HORTICULTURIST

W. T. MACOUN

FOR THE YEAR 1923



Five ears from one stalk—Pickaninny corn.

Printed by authority of the Hon. W. R. Motherwell, Minister of Agriculture, Ottawa, 1924

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REPORT OF THE DIVISION OF HORTICULTURE

W. T. MACOUN, DOMINION HORTICULTURIST

This is the thirty-seventh annual report of the Division of Horticulture. For reasons of economy, full details of all experiments conducted have not been included herein, but an attempt has been made to deal fully with some phases of the work and briefly refer to results from some of the others. As may be seen from the list of projects at the back of this report, there are 426 different experiments or projects in the Division of Horticulture, so that it will be evident that but a small number of them have been dealt with in this report.

The pomological section of the report this year has been prepared in part by Mr. M. B. Davis, B.S.A., Chief Assistant. The report on vegetable gardening has been made by Mr. T. F. Ritchie, B.S.A., assistant in that work. The Dominion Horticulturist has prepared the remainder of the report.

THE SEASON

The climatic conditions, both in winter and summer, have so much to do with the success or failure of horticultural crops that for many years a record has been made in the annual reports of the outstanding features of the weather which would have a marked effect on the fruits, vegetables, and ornamental plants.

It was a very favourable season for most horticultural crops and ornamental plants in 1923, although there was not quite enough heat to ripen a maximum crop of some things. The period without killing frosts was relatively long.

Following a comparatively mild December in 1922, the month of January was a rather cold one, though the lowest temperature was only 17·4° Fahr. below zero on the 7th. It was below zero, however, on eighteen days of the month. The temperature rose slightly above freezing on four days, but there was no real thaw. February was another cold month, the lowest temperature of the winter occurring on the 4th, when it was 33° Fahr. below zero. There was a very cold spell from that date to the 8th. It was fourteen times below zero during the month. The temperature rose slightly above freezing on two days. There was a good covering of snow, estimated at about two feet on the level, at the end of the month. The coldest day in March was on the 29th, when it was 12·8° below zero. April opened cold, it being 5·1° below zero on the 1st. By April 11 the snow was all gone except in the drifts, and by April 20 the frost was out sufficiently to dig. This is eight days later than the average for the past twenty-six years, which is April 12. Most things wintered well. There was a short warm spell in the latter part of April, the temperature rising to 75° on the 20th and 81° Fahr. on the 21st. May was a warm to rather cool month with only two days when frost was recorded; the temperature being 29·6° on the 2nd and 24·8° on the 11th, the last spring frost. The highest temperature in May was 84·8° on the 25th. June was a warm month. The warmest spell was from June 18 to June 26, during which time it was over 80° on all nine days and over 90° on three days, the hottest day being June 20, when it was 94·8°. This was also the warmest day of summer. Up to this spell of hot weather vegetation had been backward owing to the relatively cool spring. Irises, which always make a fine showing in

early June, lasted longer than usual this year as there was little warm weather until after the middle of June. July was a warm month but the nights were relatively cool. There was no very long hot period. The warmest days were on July 19 and July 20, when it was 90° each day. The first half of August was warm and the last half rather cool. There had been a well distributed and abundant rainfall up to September, but that month was rather dry. No frost was recorded during the month, the closest to frost being 34·5° on the 17th. There were very few frosty days in October. The first autumn frost recorded was on October 6, when 30·9° were registered, and again 30·9° on the 8th. Many plants usually injured by very light frosts were unaffected on high ground, and it was not until October 22 when the first really killing frost occurred, the temperature falling to 27·8°. Thus, the season of 1923 without killing frosts was an unusually long one. November was very mild for that month, the lowest temperature being 18·6° on the 19th, but above freezing afterwards. On December 1 there was no snow on the ground nor frost in the ground and the weather continued mild until December 14, when the temperature was 13° Fahr. Winter may be said to have set in on that day, being eighteen days later than the average for the past twenty-six years, which is November 26. December, 1923, was one of the mildest Decembers on record, the temperature falling below zero but once, and that on the 30th, when it was only 5° below.

POMOLOGY

Plant improvement continued to be the main line of work in this subdivision and a large number of new and very desirable crosses were effected.

APPLES

In apples the most important work done in hybridizing was selfing and intercrossing of the Saunders hybrid crabs, among which were the following combinations:—

Rosilda x Wapella
Rosilda x McPrince
Rosilda x Piotosh
Rosilda selfed
Rosilda x Printosh

It was gratifying to obtain a considerable number of seeds of the cross Rosilda selfed. This variety is probably the most outstanding of the second generation hybrids of the Saunders group. It is the result of Prince x McIntosh and resembles McIntosh very much in colour and texture of flesh. Rosilda x McPrince should also give interesting segregations, as McPrince is a full sister of Rosilda.

As the work with the material left by Dr. Wm. Saunders progresses it becomes more evident that larger numbers of each cross will have to be dealt with to obtain the end in view. Although none of the F_2 generations has yet fruited, the results of second crosses have been reported upon. If, as was hypothecated in our annual report for 1922, the species Malus is largely composed of recessive factors and *Pyrus baccata* of dominants, as appears to be indicated, these second crosses are nothing more or less than back crosses and should give a larger proportion of individuals resembling *Malus* than a self-fertilization of the F_1 hybrid. As none of the parental type has been recovered in these second crosses, comparatively large numbers of the self-fertilized crosses will have to be grown to obtain fruit approaching *Pyrus Malus* in size and quality and *Pyrus baccata* in hardiness.

DESCRIPTIONS OF NEW VARIETIES OF APPLES ORIGINATED IN THE HORTICULTURAL DIVISION, WHICH HAVE BEEN NAMED DURNG THE YEAR 1923-24

Many new varieties of apples begin to fruit each year in the Horticultural Division, but only a very small proportion of them are considered worthy of naming. Those that are named are thought to be sufficiently promising for some part of Canada to take the place of those that are now being grown.

Following are descriptions of those named during the past year:—

Rosetta (Winter Rose Seedling).—Fruit above medium to large size; form roundish conical, slightly ribbed; cavity medium depth and width to open; stem medium length, stout; basin open, medium depth, wrinkled; calyx open; colour yellow, well washed and splashed with dark orange red; predominant colour dark orange red; seeds below medium size, acute and acuminate; dots moderately numerous, yellow, distinct; skin moderately thick, moderately tender; flesh white, crisp, tender, juicy; core small, open; flavour subacid, pleasant, slightly pear-like; quality good; season evidently October to mid January. No marked resemblance to Winter Rose. Suggestion of Sops of Wine in colour and flavour.

Spiland (Northern Spy Seedling).—Fruit medium size; form roundish to oblate, slightly ribbed but regular; cavity deep, medium width to open, russeted; stem long, slender to moderately stout; basin deep, abrupt, medium width, smooth; calyx partly open or closed; colour yellow, washed and splashed with crimson; predominant colour crimson; seeds above medium size, acuminate; dots moderately numerous, yellow, indistinct; bloom thin, pinkish; skin moderately thick, tender; flesh yellowish, crisp, tender, moderately juicy; core medium; flavour mildly subacid, pleasant; quality good; season November to March. Resembles Spy considerably in colour and in flesh and flavour.

Spimore (Northern Spy Seedling).—Fruit above medium to medium size; form oblate conic; cavity medium width, deep; stem short, slender to moderately stout; basin deep, open, wrinkled; calyx open; colour pale yellow, washed with rather dull crimson; predominant colour rather dull crimson; seeds medium size, acute; dots moderately numerous, brownish or yellow, distinct; skin moderately thick, moderately tender; flesh yellowish with traces of red, crisp, juicy; core medium size to small, open; flavour briskly subacid, sprightly, pleasant; quality good; season December, probably to March. Resembles Northern Spy considerably in flesh and flavour.

Spiretta (Northern Spy Seedling).—Fruit above medium to medium size; form oblate to roundish conic; cavity deep, open, russeted; stem short to medium, stout; basin deep, medium width to open, abrupt, nearly smooth; calyx partly open; colour pale greenish yellow, well washed with crimson; predominant colour crimson; seeds medium size, acute; dots few, white, distinct; bloom medium, bluish; skin moderately thick, tough; flesh dull white, firm, crisp, moderately juicy to juicy; core small; flavour subacid, pleasant; quality good; season probably late December to April. Resembles Northern Spy considerably in colour of skin and flavour. A good dessert apple.

Sweetmac (McIntosh Seedling).—Fruit medium to above medium size; form oblate to roundish conic; cavity deep, open; stem medium length to short, stout; basin deep, open, smooth; calyx open; colour pale yellow, washed with crimson; predominant colour crimson; seeds medium to above, broad, acute; dots obscure; skin moderately thick, tough; flesh white with traces of red, tender, juicy; core small; flavour sweet, rich; quality good; season probably October to January. No marked resemblance to McIntosh. A nice sweet apple. Attractive in appearance.

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Toshkee (McIntosh x Milwaukee).—Fruit medium to above medium size; form oblate conic, slightly ribbed; cavity deep, open, russeted; stem short, stout, inclined to be lipped; basin deep, open, smooth; calyx open; colour pale yellow, well washed with crimson, green about cavity; predominant colour crimson; seeds medium size, acute to acuminate; dots few, white, distinct; bloom bluish; skin moderately thick, moderately tough; flesh dull white or yellowish, crisp, tender, juicy; core medium size; flavour subacid, sprightly, pleasant; quality above medium to good; season December, probably to March. Resembles McIntosh considerably in colour, flesh and flavour but not markedly otherwise. No marked resemblance to Milwaukee except in shape. Evidently a better keeper than McIntosh.

CRAB APPLE

Another of the crab crosses with McIntosh as one of the parents was considered promising enough to name this year. This is from one of the second crosses.

Toshprince (Prince x McIntosh).—Fruit above medium size for a crab, $1\frac{3}{4}$ by $2\frac{1}{8}$ inches; form roundish, ribbed, but thin; cavity medium depth and width; stem long, stout; basin open, shallow to medium, wrinkled; calyx closed, persistent; colour yellow, well washed with crimson; predominant colour crimson; seeds medium size for apple, acute; dots obscure; skin thin, tender; flesh yellowish, tender, breaking, juicy; core large; flavour mildly subacid, pleasant; quality good; season probably September. Quite crab-like. Resembles McIntosh in colour. Attractive in appearance.

INTERFERTILITY BETWEEN DOMESTICA AND HYBRID PLUMS

In the plum breeding work a large number of crosses were made between *P. nigra* and *P. domestica* and *Omaha* and *P. domestica*. The *P. domestica* parents used were: Reine Claude, Lombard, Bradshaw, Shropshire Damson, Yellow Egg and Washington.

The Reine Claude was used both under glass and inside as a male parent and inside only as a female. The other Domesticas were used outside only as male parents.

The method used inside was to apply the pollen direct to the pistils of the *Nigra* group (represented in this case by a seedling of Cheney and Cheney itself) without emasculation, it having been previously determined that these trees were self-sterile. This was further tested by self-pollinated checks which set no crop. Outside, all the female trees were tented, but not emasculated. Large numbers of check clusters were left, however, for wind pollination and many were hand brushed.

In the case of Omaha in the open, out of several hundred check blooms only one set fruit, while in *P. nigra* one set out of one hundred and thirteen. From this evidence it was concluded that these varieties were practically self-sterile.

Considerable interfertility was obtained between *P. domestica* and the above groups, as will be noted from the results below:—

Cross	Number pollinated	Number set	Harvested
Omaha x Bradshaw	119	10	1
" x Lombard	107	11	6
" x Reine Claude	269	27	6
" x Shropshire Damson	189	3	0
" x Washington	130	14	7
" x Yellow Egg	134	17	9

In addition to the above, where a record of the number pollinated and the number set was kept, small trees were pollinated where only a record of harvested fruit was kept. The following list gives the total number of fruit harvested for each interspecific cross:—

Cross	Number of fruits	Number of seeds sunk
Omaha x Reine Claude	44	13
Waneta x "	3	0
Ezaptan x "	3	0
Cheney x "	17	0
P. spinosa x "	8	3
Omaha x Washington	2	1
Omaha x Yellow Egg	4	1

The pits from all fruits were water tested and the column marked "Number of seeds sunk" gives the number of pits or stones which sank in water and which, therefore, would be considered to have fully developed embryos and therefore capable of germination. The Omaha-Reine Claude combination appears to be the one giving the largest number of possibly viable seeds. Crosses between these two parents will be continued in 1924.

EXPERIMENT TO ASCERTAIN THE PART PLAYED IN APPLE POLLINATION BY THE HONEY BEE

This experiment was conducted in co-operation with the Bee Division and a report on their phase of the project and their interpretations of the results will be found in the annual report of the Dominion Apiarist for 1923.

Three McIntosh Red trees were used. One tree was covered with a tent composed entirely of cheesecloth, which would exclude all insects and prevent the entrance of pollen from the outside by this agency. Another tree was covered with cheesecloth, but had a hive of honey bees enclosed. The third tree was caged with cheesecloth around the bottom and around the upper portion with a wire mesh which would exclude the honey bee but admit the wild bee. The top of the tent was covered with cheesecloth.

In the tent from which all insects were excluded, branches of bloom cut from Wealthy trees were hung periodically during the blooming season. These were supplied to ensure the presence of pollen from some compatible variety. Similar branches were hung in the wild bee tent, with the addition of cut bloom in pails of water and potted trees. The two last mentioned, namely, cut bloom in water and potted trees, were also in the honey bee tent. The tent from which all insects were excluded would, therefore, be dependent upon either its own pollen or upon pollen from the hanging branches and entirely dependent upon the agency of wind for its distribution, except any dislodgment due to the hanging of the branches. This tree thus acted as indicator of degree of wind pollination. In the bee tent the tree was supplied with its pollen and pollen from cut bloom and potted trees, but had the agency of the honey bee to carry the pollen. As no bloom hung in this tent and as cut bloom and potted trees were much smaller than the tree, wind pollination could not play a very great part in pollination. In the wild bee tent the tree was open to pollen from outside trees, which could be carried by wind through the mesh, to pollen from hanging branches distributed by wind, to pollen from outside brought in by the wild bee, and to pollen from potted trees and cut bloom within, distributed by the wild bee. Evidently this tree was supplied with the greatest number of sources for pollen.

RESULTS FROM EXPERIMENT WITH WILD AND HONEY BEES AS POLLENIZERS

Treatment	Number of blooms per cluster	Number of clusters tagged	Total number of blossoms	Number set 25-6-23	Percentage set
Wild bees	5·75	233	1339·75	256	19·1
Honey bees	5·5	247	1358·5	139	10·2
All insects excluded	5·5	248	1364·0	24	1·7
*Check tree	5·5	250	1375·0	300	21·8

*This tree was not tented, but the clusters were merely tagged and counted. It was, therefore, under perfectly normal conditions.

PERFORMANCE RECORD OF ALL TREES FOR 1921, 1922 and 1923

Tree	Yield 1921	Amount bloom 1921	Yield 1921	Amount bloom 1922	Yield 1923	Amount bloom 1923
	gal.		gal.		gal.	
Wild bees	43	Large	5½	Small	45	Large
Honey bees	11	"	29½	Considerable	13	Considerable
All insects excluded	9½	"	23	Large	2	"
Check tree	18	Considerable	24	Considerable	46	"

From the performance record of the trees, it will be noticed that the wild bee tree is a biennial bearer and was due for a full crop in 1923, which it produced. Evidently, therefore, sufficient wild bees entered the tent to bring about normal pollination. The honey bee tree, on the other hand, although a biennial bearer, was expected to give only a small crop in 1923 and lived up to expectations, so that, although this tree showed practically 9 per cent less of a set than the wild bee tree, when performance history of the tree is taken into consideration the evidence would seem to indicate that the honey bee is capable of playing a full part in apple pollination.

The tree from which all insects were excluded was due for a larger crop than that obtained and the low set (1·7 per cent) could not be entirely attributed to wind pollination, for undoubtedly the hanging branches would actually come in contact with other branches on the tree. As the wild bee tent also had hanging branches of bloom, while the honey bee tent did not, it would seem reasonable to subtract 1·7 from the percentage set of the wild bee tree, thus reducing it to 17·4 per cent as compared with 10·2 in the honey bee tent.

Further evidence that the honey bee tree and wild bee tree were different with respect to crop expected is obtained from an examination of the figures with respect to the number of spurs which blossomed but did not set fruit. On the honey bee tree 53 per cent of spurs set no fruit whatever, indicating that there is a great possibility of these being short blossoming but non-fruiting spurs. The wild bee tree had only 28·7 per cent of spurs which blossomed but did not set, indicating a much larger percentage of blossoming and fruiting spurs.

Conclusions.—(1) That wind plays an unimportant part in apple blossom pollination; (2) that wild bees, when present in sufficient numbers, are able to pollinate apple trees satisfactorily; (3) that evidently the honey bee is a good pollenizing agent, capable of producing results according to expectations.

FRUITING AGE OF SOME WELL-KNOWN VARIETIES OF APPLES

In the following table will be found a list of some well-known varieties of apples, which have been fruited at Ottawa, arranged in the order of their coming into bearing. The age of first bearing is important when varieties are to be used as fillers, and this table aims to present this data for the varieties recommended for eastern Ontario and Quebec:—

MEAN AGE AFTER PLANTING OF COMING INTO BEARING OF SOME VARIETIES OF APPLES, ARRANGED IN ORDER OF MERIT

Variety	Mean age of 1st bearing	Mode	Range	Remarks
	years	years	years	
Wealthy	3·9	4	2–6	
Milwaukee	4·3	4	1–7	
Dudley	4·5	5	4–10	
McIntosh	5·5	6	3–8	
McMahan White	5·7	7	3–10	
Peach of Montreal	6·0	6	....	Only one tree reported.
Yellow Transparent	6·0	6	....	
Duchess	6·1	4	4–10	
Fameuse	6·2	6	6–7	
Charlamoff	6·9	6	3–14	
Bethel	7·6	8	6–9	
Lowland Raspberry	8·1	9	6–10	
Baxter	10·0	10	....	Only two trees.
Hibernal	10·0	5	5–20	

In the foregoing table the mode is given as well as the mean and also the range. As the mode is the largest class it is quite as significant as the mean. For instance, in the case of Hibernal the mean or average age of coming into bearing is ten years, but the greatest number of trees bore at five years after planting. The average was brought up by a few trees taking from eight to twenty years to bear. A grower planting this variety, therefore, could be assured that the great majority of his trees would come into bearing at five years after planting. In most cases, however, it will be noted that the mean and the mode are very close together. From the table it will be seen that Wealthy is outstanding as an early bearer, with Milwaukee and Dudley as two desirable sorts in this respect. Duchess, although it has a rather high average, had the most of its trees come into bearing four years after planting, so can also be considered as an early bearer.

STUDIES IN SELF-POLLINATION

A preliminary report on this work was made in the annual report of this division for the year ending March 31, 1923. During this past season this line of investigation was continued with some nineteen varieties of apples, and the results are here appended.

As these results are not in complete harmony with those of former seasons, or those of other investigators, some comment would seem necessary. In self-pollination studies made, as they have been of necessity under more or less artificial means, there is always the criticism that the conditions are not similar to field conditions. Although this is apparent, nevertheless results should be comparable and varieties showing a high degree of self-fertility under such tests should prove to be self-fertile under field conditions. On the other hand, however, we are coming to look upon results, where varieties are reported as self-sterile, as not being fully acceptable, owing to the many factors which are not

generally under control in such experiments. A comparison of our results this year with those of last illustrate this point. Take, for instance, McIntosh Red, previously reported as having given no set when self-pollinated. This year a set of 50 per cent was reported. As fifty clusters thinned to two blossoms was the count used, one can consider from this that McIntosh is, at least, self-compatible. This brings us to a discussion of methods employed in self-pollination studies, causes of self-sterility and factors influencing the net results, which might be erroneously attributed to self-sterility.

METHODS

Method No. 1.—Clusters may be bagged before opening to prevent open pollination and then shaken daily without any further attention to pollination. Under such conditions the operator has no assurance that pollen has actually reached the pistil, so that negative results are doubtful, while of course positive results, if proper care has been exercised, can be considered acceptable.

Method No. 2.—Clusters may be bagged as above, but pollinated at various intervals by brushing with a brush or the finger, in which case the operator has evidence of pollination having taken place. This method, however, has the objection that in apples the pistil is ready for pollination previous to the liberation of the pollen from the anthers, or, in other words, protogyny may be a deciding factor and so called self-sterility may be due to this condition. Of course all blossoms of a cluster do not open together, but we have observed many clusters where all blossoms were open and where no pollen was liberated while pistils were receptive. In such instances protogyny would play a very important part and would account for practically all of the non-set.

Method No. 3.—Clusters may be bagged as in the two previous cases, but pollinated upon receptivity with pollen from the same variety ripened in the laboratory. This method appears to eliminate the factor of protogyny, for by gathering the early buds and stripping them in the laboratory a supply of pollen is available by the time the earliest pistils show signs of receptivity.

Method No. 4.—This method is a modification of No. 3. Here the pollen used is simply to take an open bloom from a tree outside and apply its free pollen to the bloom to be selfed. As these blooms may have been visited by insects, doubtless the pollen would be contaminated with that from an outside source, so that results from this method cannot be accepted as absolute self-pollination.

Methods Nos. 3 and 4 were used in the 1923 work.

CAUSES OF SELF-STERILITY

Self-sterility, or the failure of a variety to set fruit from its own pollen, may be due to a variety of causes.

1. Difference in time of pollen liberation and pistil receptivity. One phase of this, namely, protogyny, was discussed in preceding paragraphs. So far as our observations go, we have not noted the opposite condition among apples, namely, liberation of pollen previous to pistil receptivity or protandry.

2. To the non-production or scant production of pollen. Some varieties, as Fameuse, for instance, produce a small amount of pollen. In plums hybrid varieties are often found, which produce nothing but abortive pollen.

3. Rate of pollen tube growth.

4. To incompatibility. Here a variety may have sufficient pollen produced at the proper time, but owing to some incompatibility between the pollen nucleus and egg nucleus, fertilization does not take place.

The self-fertility tests reported here, where pollen was actually applied to the pistil at receptivity, covers only No. 3, so are strictly speaking reports on self-compatibility rather than self-fertility.

FACTORS INFLUENCING NET RESULTS

All blossoms or spurs that blossom are not capable of setting fruit, even if the egg cell is properly fertilized. Blossoming spurs may be of two types: (1) those which bloom and will set fruit and (2) those which bloom and will not set fruit. Thus, if the history of the spur is not known, the operator may be working in one instance with a large number of spurs of class one and in another case with a large number of class two. In such cases the results are bound to be weighted. Thus negative results in self-fertility or compatibility tests, unless this factor is controlled, cannot be accepted as positive evidence of self-incompatibility or sterility.

The following table gives the results of self-compatibility tests for 1923, made according to the two methods referred to above. In the column marked "Open pollinated" is the set in per cent from fifty clusters which were tagged but left uncovered to be open pollinated. This should give the normal set for the number of blossoms used. It will be noticed that in seven instances a set of 0·0 per cent was recorded for the open pollinated blossoms. This would indicate that the spurs used were either in group 2 or that pollination did not take place. The latter is hardly probable. Checks of this nature are important, for in this instance Crimson Beauty, Hibernal and Lobo, which did not set any fruit in the checks, did not set any under either system of self-pollination. Without the open pollination results to check up with, the conclusion might be drawn that these two sorts were self-incompatible, whereas, under the circumstances, further evidence is necessary.

PER CENT OF SET

Variety	Group 1 Open Pollinated	Group 2 Pollinated with laboratory pollen	Group 3 Pollinated with bloom from tree
Bethel	5	5	0
Crimson Beauty	0	0	0
Duchess	0	4	4
Dudley	6	not included	not included
Cobalt	4	0	0
Melba	5	20	8
Pedro	8	4	2
Scott Winter	0	12	6
Milwaukee	0	2	0
Yellow Transparent	5	10	0
Fameuse	10	11	0
Charlamoff	11	0	0
Wealthy	43	33	9
Antonovka	0	3	0
Hibernal	0	0	0
Lowland Raspberry	0	3	0
McIntosh	11	15	6
Montreal Peach	33⅓	50	0
Lobo	0	0	0

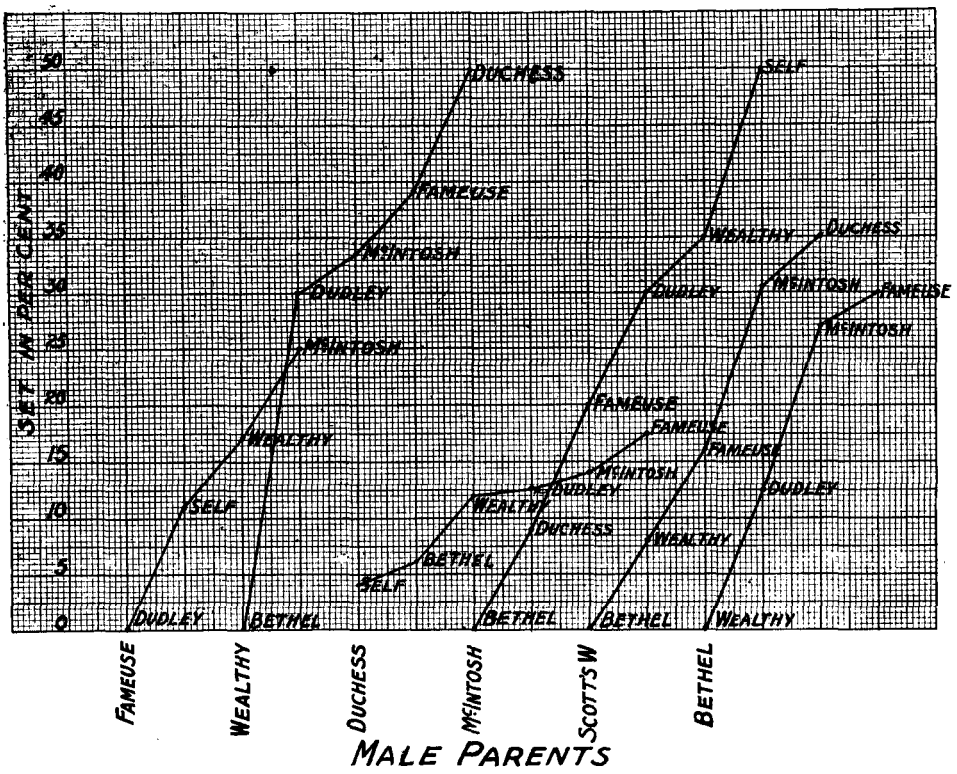
From this table it will be seen that five varieties showed complete sterility in both methods. These were Crimson Beauty, Cobalt, Charlamoff, Hibernal and Lobo. In the 1922 report Hibernal showed a set of 0·85 per cent. Such a low set could almost be considered as complete sterility, so the results are not completely at variance.

The next group to be considered shows rather a high degree of self fertility and includes the following varieties: Montreal Peach, Wealthy, Melba, and McIntosh Red. Of this group Melba and McIntosh had previously been reported as sterile, while Wealthy had been reported as self fertile. Of the remaining

varieties the following are somewhat self fertile and had been previously reported as such: Duchess, Scott Winter, Lowland Raspberry, and Antonovka (to a small degree), while Milwaukee and Pedro, here showing a degree of fertility, had previously given evidence of complete sterility.

The fact that certain discrepancies appear between this year's work and that of previous years cannot be laid entirely to method, as the table indicates. It does, however, demonstrate that evidence of a variety being completely self sterile should be accepted only after very prolonged and exhaustive study. On the other hand, of course, evidence of fertility can be accepted as soon as presented, providing the work has been carefully performed, which we believe to be the case.

SHOWING VALUE OF SIX DIFFERENT MALE PARENTS AS POLLENIZERS



Doubtless much of the sterility of the past and much of the discrepancy between reports on self sterility are due to a lack of knowledge of the history of the individual spur. If in one variety a large number of blossoming but non-fruiting spurs for that season were utilized, while in another sort blossoming and fruiting spurs were used, it is easy to see how results obtained would be misleading.

In close relation with the preceding work on self fertilization evidence was accumulated with regard to the compatibility between varieties. In this work all pollen was ripened in the laboratory and all blooms to be pollinated were thinned two to a cluster, emasculated and bagged. Application of pollen was made at receptivity of the pistils, which were examined daily to determine this point.

As all pollen used showed good viability and, as it was applied at receptivity of the pistils, differences due to date of blossoming were overcome. The results, therefore, although a criterion of compatibility, are not evidence of the best pollinizers for certain varieties. A variety to be a good pollinizer must, in the first instance, produce abundance of pollen, and in this connection Wealthy has been an outstanding variety, while Fameuse has always been noticeably poor in this respect. In addition it should be in bloom slightly earlier than the sort it is to pollinate, and here again Wealthy fills the requirements. Its compatibility with some of the commercial sorts can be gathered from the accompanying table. The outstanding value of Wealthy as a pollinizer is seen from the table where, with the exception of no set with Bethel, its range is thirty and above. Fameuse is noticeably low, its maximum being below thirty. Duchess is still lower, being below twenty in every case. McIntosh comes close to Wealthy as a pollinizer, although not as good, especially with a standard sort like Fameuse. Scott Winter appears about as good as Bethel, although both are low with standard sorts like Wealthy and FameuseFOR TABLE-SEE PAGE 14

SOME RESULTS FROM STRAWBERRY BREEDING

The preliminary results from the 1919 and 1920 strawberry hybrids are now available and a summary of some of the outstanding data is recorded below.

Of the 1919 breeding 1,903 hybrid plants fruited, out of which 97 were marked for propagation and further trial. Of the 1920 breeding 1,900 plants fruited, out of which 211 were marked for further trial and propagation.

It will be seen that the proportion of plants producing inferior fruit was exceedingly large.

TRANSMISSION OF SEX

As crosses were made between perfect and imperfect varieties the transmission of sex in such crosses is of interest.

Parents	Progeny	
	Imp.	Per.
Perfect x Perfect	29	1160
Imperfect x Perfect	222	240
Perfect selfed	17	150

The comparatively small number of imperfect sorts from the crosses perfect x perfect is of interest in breeding, where is is desired to combine the perfect sex condition with other characteristics that are desirable. Even in the case of where an imperfect parent is used the chances are one to one that perfect or imperfect progeny will be obtained.

TRANSMISSION OF THE FALL BEARING HABIT

—	Number of June bearers	Number of Fall bearers
Fall bearing x June bearing	447	143
June bearing x Fall bearing	341	114
Fall bearing x Fall bearing	66	85

In the fall bearing x June bearing and its reciprocal the ratio between June and fall bearing progeny is essentially the same, namely, 3 to 1, while a 1 to 1 ratio exists when fall bearers are used as both parents.

Female	Male	Percentage set	Number of seeds per fruit	Percentage abortive
Duchess x	Melba	38·0	6·6	32·5
"	Pedro	18·0	6·75	37·0
"	Scott Winter	35·0	7·09	6·41
"	Milwaukee	46·0	6·8	25·94
"	Wealthy	48·0	6·6	2·7
"	Dudley	21·0	8·3	4·4
"	Lobo	37·0	7·1	2·3
"	McIntosh	9·0	0·8	37·5
"	Crimson Beauty	3·0	0·6	16·0
Dudley x	Bethel	12·0	0·8	0·0
"	Milwaukee	30·0	7·6	All somewhat shrunken.
"	Duchess	12·0	10·0	30·0
"	Melba	0·0	0·0	0·0
"	McIntosh	28·5	12·0	29·1
"	Fameuse	0·0	0·0	0·0
"	Wealthy	30·0	14·0	4·7
McIntosh x	Wealthy	33·0	8·2	21·7
"	Duchess	14·0	8·0	25·0
"	Dudley	18·0	8·0	12·5
"	Pedro	17·0	8·3	40·0
"	Fameuse	25·0	2·3	42·7
"	Lobo	34·0	8·3	12·03
"	Melba	15·0	8·1	18·3
"	Scott Winter	31·0	8·66	23·0
"	Milwaukee	13·0	9·0	22·2
"	Crimson Beauty	9·0	8·2	63·6
"	Bethel	27·0	9·23	23·33
Fameuse x	Wealthy	39·0	7·0	12·7
"	Duchess	17·0	6·6	1·6
"	Lobo	17·0	8·0	0·0
"	Pedro	16·0	7·8	0·0
"	Crimson Beauty	20·0	7·1	3·8
"	Milwaukee	27·0	5·83	2·85
"	Bethel	30·0	8·4	3·96
"	Melba	27·0	8·0	3·2
"	McIntosh	20·0	7·4	13·5
"	Dudley	24·0	8·9	3·3
"	Scott Winter	16·0	7·42	3·84
Bethel x	Lobo	0·0	0·0	0·0
"	Pedro	2·0	10·0	0·0
"	Scott Winter	0·0	0·0	0·0
"	Dudley	4·0	fruit lost	
"	Milwaukee	4·0	13·0	3·48
"	Melba	0·0	0·0	0·0
"	Duchess	6·0	12·0	8·3
"	McIntosh	0·0	0·0	0·0
"	Wealthy	0·0	0·0	0·0
"	Crimson Beauty	0·0	0·0	0·0
Wealthy x	Melba	14·0	9·3	1·6
"	Duchess	12·0	8·1	26·7
"	Milwaukee	16·0	8·44	3·94
"	Fameuse	17·0	8·37	4·7
"	Bethel	0·0	0·0	0·0
"		9·19	9·5	5·26
"	Pedro	12·0	8·8	0·0
"	Dudley	11·0	8·6	3·8
"	Crimson Beauty	23·0	8·4	2·9
"	Pedro	12·0	8·1	5·2
"	Scott Winter	8·0	8·75	2·85
"	McIntosh	35·3	8·6	20·2

INVESTIGATION OF AN INJURY TO APPLES KNOWN AS "JONATHAN BREAKDOWN"

"Jonathan Breakdown," internal breakdown or flesh collapse is not a new or just recently discovered physiological disease of the variety since it made its appearance first, in slight degree, as much as fifteen years ago in the fruit growing sections of British Columbia. But because of the small quantity of fruit in which the trouble made its appearance it did not come into general notice until the season of 1922, when its prevalence was so general that it claimed the attention of the majority of the fruit growers in the inland sections of British Columbia, when the loss resulting from it ran up into the hundreds of thousands of dollars and was responsible for much of the "red ink" that year.

"Jonathan Breakdown" must not be confused with corky core (also known as core rot, brown core or internal browning). While both of these diseases are related inasmuch that both are physiological and arise through improper methods of growing or time of picking the fruit, they are not actually diseases to the extent of being spread by spores or, as for being in either case, an infection which is carried from tree to tree or orchard to orchard. Jonathan breakdown (or flesh collapse) and corky core (core rot, or brown core) are entirely separate troubles both as to cause and as to their effect on the fruit.

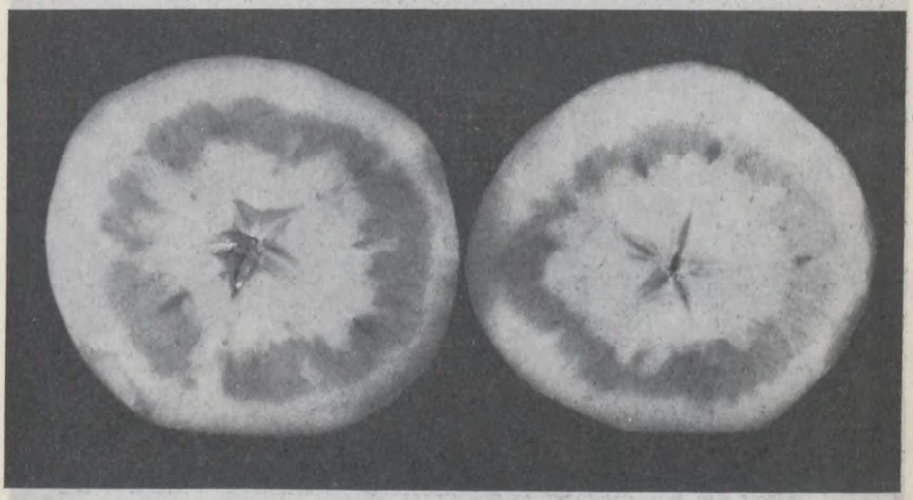


FIG. 1.—Jonathan showing stage of breakdown developing by Dec. 18. The three small dark areas are remaining traces of "Radial water core."

Corky core is distinguishable in that, as the name implies, cork-small brownish spots of somewhat dried out tissue, is found within the core area in the Jonathan; in other varieties such as Gano the cork spots are found as well in the flesh outside the core but are still always dark brown in colour, are scattered through the flesh and are rarely larger than a quarter of an inch in diameter. Corky core, too, is apparent in the fruit a considerable period before it is mature on the tree. It seems to be caused by water deficiencies or disturbed root system, such as would result from ploughing where a surface system of roots has been developed by formation of heavy clover sod in an orchard, is often accompanied by black hearting of the wood and is closely related to "drought spot" and often follows the appearance of that physiological trouble.

"Jonathan Breakdown" ("flesh collapse," or "internal breakdown") on the other hand is seldom, if ever, observed in fruit on the trees. It does not

usually develop until after the apples have been picked nor till the fruit has been held in storage for at least a period, and it does not affect mainly the tissue within the core area but the flesh outside the core. It appears first as light brownish coloured tissue in the flesh of the apple, as seen in figure 1, extending around outside the core midway between the core and the skin. These light brown areas later in the normal storage period of the variety become streaked with darker brown and eventually all the flesh of the fruit becomes affected as seen in figure 2, a photograph of breakdown apples examined the last of February. Breakdown is apparently a disintegration of the cells and sections of breakdown tissue as compared with healthy tissue are shown in figure 3.

To what can this disintegration be attributed? It may be autolysis. It may be the result of enzyme action upon particular tissues of the apple as soon as a certain degree of maturity is reached. Or again it may be preceded by the rupturing of the cell walls due to the osmotic pressure set up by the unequal concentration of the sugars of the apple, which we might reasonably expect would accompany the water core observed radiating into the flesh of the apple. It may be due to any of the above, a combination of the latter two agencies, or perhaps it may not be due to any of these factors.

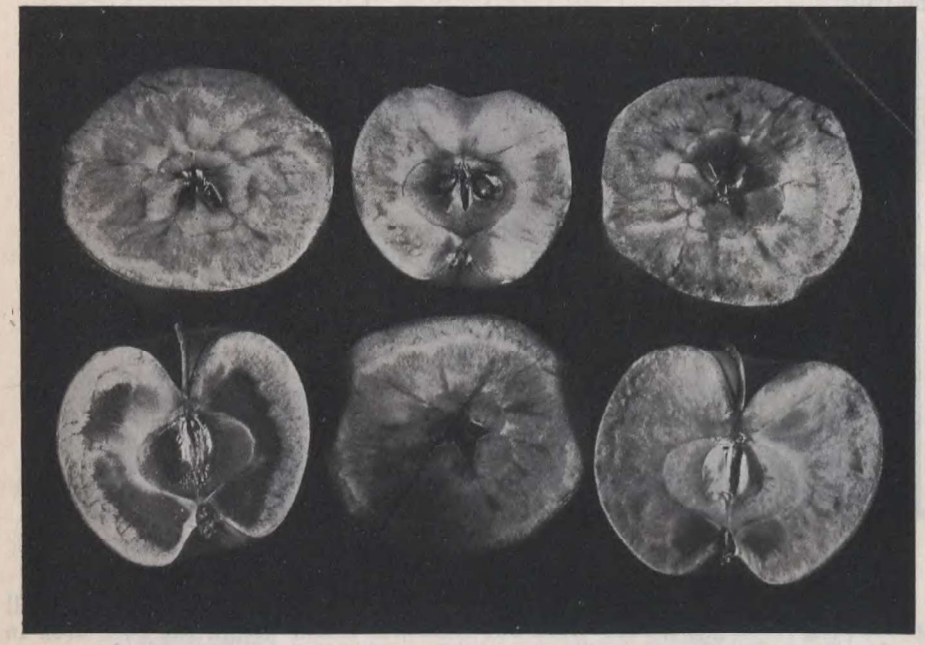


FIG. 2,—Longitudinal and cross-sections of Jonathan showing stage of breakdown developing by Feb. 23. Lower centre apple and upper right hand corner apple still show traces of radial water core, while lower left corner apple shows how water core has extended through the tissue.

To dilate further upon the actual physiological cause of the disintegration found would be to theorize and add mere words which are little less than conjecture to this report. Solution of the concrete causal factors and conditions would probably prove a sufficiently knotty problem to constitute the main concern over a period of at least three to five years or even more for a keen investigator who is both cytologist and physiologist as well as a bio-chemist. Because then of the attention and expense necessary to devote to the problem

if the more delicate phases of it are to be solved it was decided that the best mode of attack at least for the present lay along the lines of those factors most readily accessible to investigation.

As a result of the amount of breakdown occurring in 1922 it was decided that some move must be made to discover the underlying causes of the trouble and attempt to bring about some remedy. With this object in mind, the Horticultural Division at Ottawa drew up a questionnaire in the winter of 1922-23, sending it out to some two thousand growers in the Kootenays, Okanagan and surrounding fruit-growing sections of British Columbia. This questionnaire contained questions as to the character of the soil; depth of surface soil; character of subsoil; whether soil retentive of moisture; whether irrigated regularly or at all; date of first irrigations for 1919, 1920, 1921, 1922; dates of subsequent irrigations for the same years; conditions as regards soil moisture in spring and at freeze up for these same years; amount of water applied at each irrigation; distance of run of water; duration of each irrigation; how orchard was fertilized; names of varieties affected; description of injury; date when browning first noticed; stage of development of fruit when first noticed; date of picking; per cent of crop affected; if stored, what per cent of injury occurred after storage; what conditions of storage seemed to favour develop-

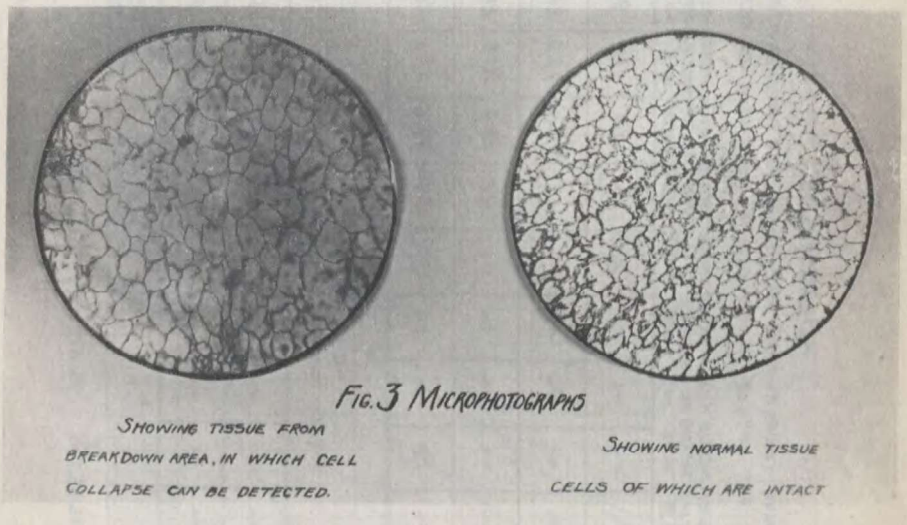


FIG. 3.—Jonathan breakdown.

ment of injury; (last eight questions covered the four years 1919-22); and names of varieties not affected. About four hundred replies were received and these comprised many excellent answers. Considerably diverging opinions were expressed as to the causes of the trouble. Some believed improper storage to blame; others thought soil and location of trees had much to do with the cause. The most valuable suggestion brought out by some of the best growers, however, was that of the relation of maturity of the fruit to the breakdown and that the trouble arose from leaving the fruit too long on the trees waiting for high colour.

On his visit to the branch Farms and Stations, Mr. Macoun made a trip through the Okanagan, and the expressions from some of the growers he met were largely in confirmation of those made in some of the questionnaires, viz., that maturity is closely related to the trouble and that carrying on a picking date experiment for Jonathans would be of considerable service to the grower.

EXPERIMENTAL METHODS FOLLOWED

Hence an experiment was started early in September by the Horticultural Division of the Central Farm with the assistance of the Dominion Experimental Station, Summerland, and with the co-operation of the Fruit Branch as regards much of the transportation from place to place in the Okanagan and as to the details of the experiment. Mr. P. M. Daly, of the Horticultural Division, had charge of the work.

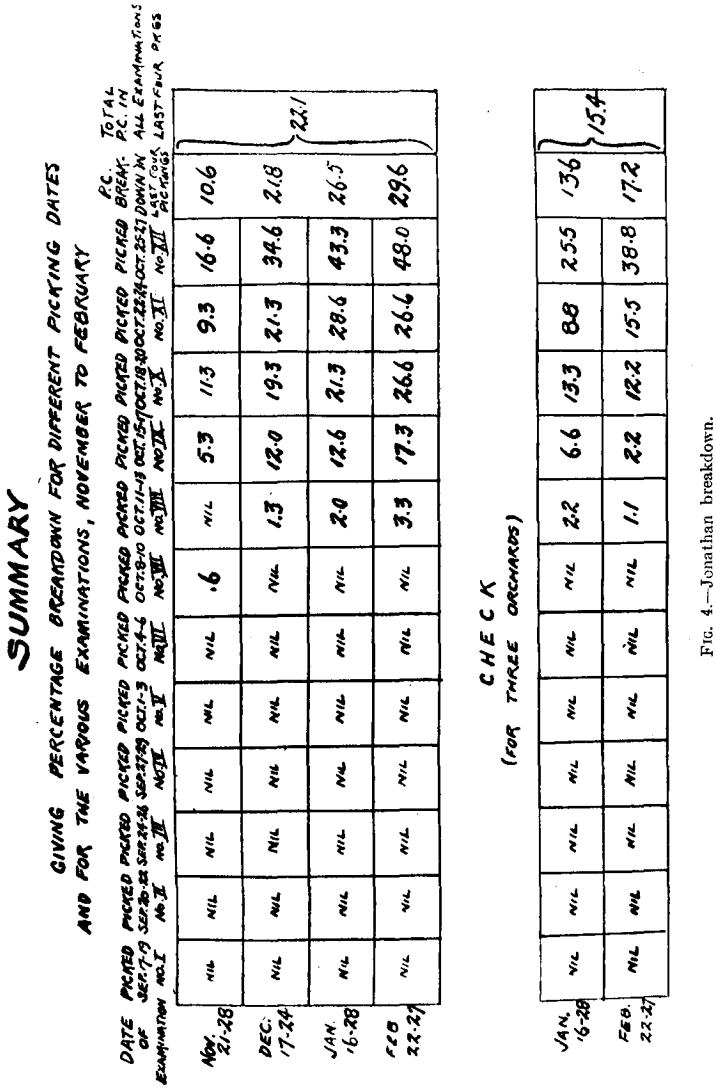


Fig. 4.—Jonathan breakdown.

Five orchards were selected sufficiently well scattered through the Okanagan to give locations fairly representative of the whole valley and yet be accessible enough to admit of making pickings twice weekly in each orchard. The points at which orchards were selected were Summerland, Kelowna, Okanagan Centre, Vernon, and Salmon Arm.

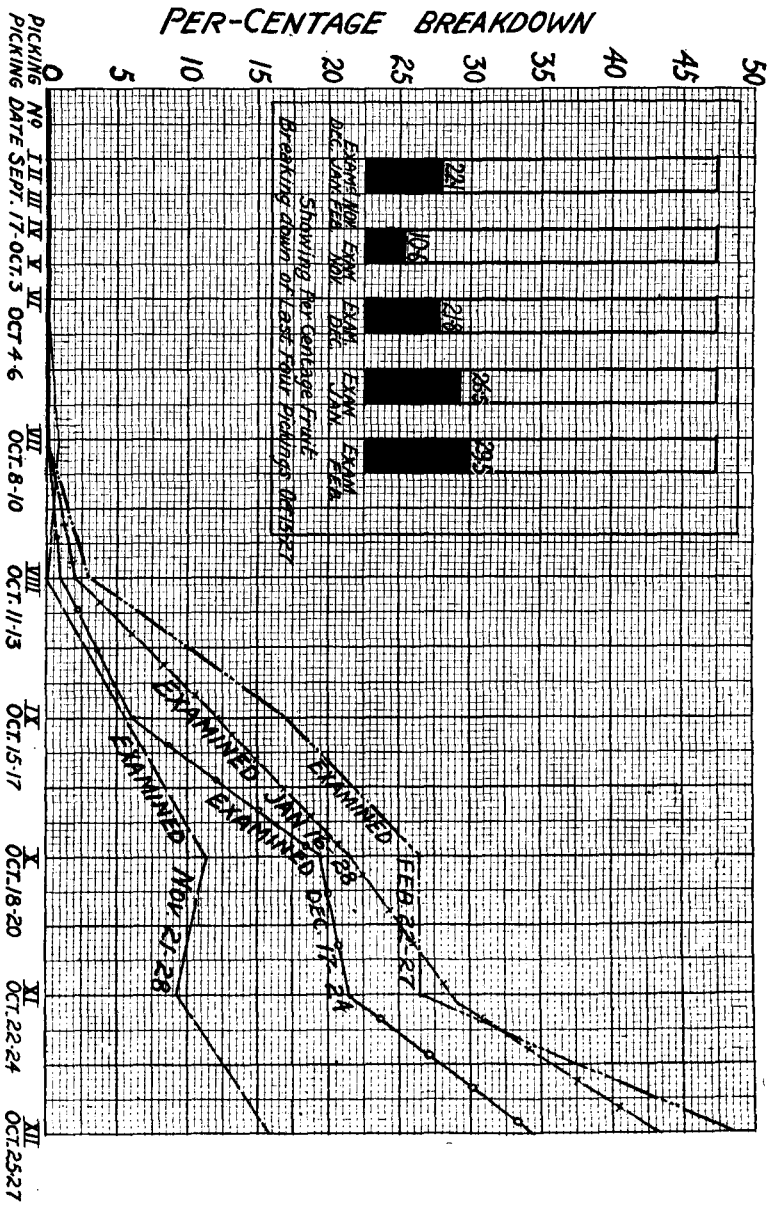


Fig. 5.—Jonathan breakdown.

Trees were selected in pairs in each orchard, adjoining if possible, each tree of the pair as nearly identical as possible to its mate. Six pairs of trees were picked out in each orchard so as to give as great a range as possible as regards kind of soil, location with regard to distance from the flume or ditch, cultural methods practised, condition of tree and fertilizer treatment. The trees selected were then marked with string and with cotton bags to prevent picking with the general crop, and each tree was given a separate number.

Fruit was picked twice weekly from each pair of trees, the apple wraps marked with the number of the tree from which the fruit came and the fruit packed in boxes, thus as nearly as possible duplicating customary orchard prac-

tice. When pickings were made, large and small fruit, well coloured and green, and undercoloured fruit were picked and packed alike in order that each picking be a good representative sample and to determine, if possible, if colour and size had any bearing on breakdown. Each box was numbered with the number of the picking to make possible identification of the actual date on which the fruit was picked. Picking was carried on twice weekly at each point, starting September 17 and concluding October 27. Picking was carried out over this period so as to start before the regular picking date for this variety and to extend beyond the close of picking for the variety as carried on commercially.

The apples were so packed that each box contained equal quantities of fruit from each of the six pairs of trees in each orchard and so that half of the boxes went to Summerland by boat direct for final storage and the other half went into general storage in the cement building of the Kelowna Growers' Exchange. Each of these two lots was in duplicate again, except for Salmon Arm and Vernon, in which latter case the trees selected did not have sufficient fruit for duplication except for the first four pickings. One lot from the Kelowna Growers' Exchange went forward in a general consignment November 5 to Ottawa, arriving there November 17. A second similar lot was held in the Kelowna Growers' Exchange until December 19, arriving in Ottawa early in

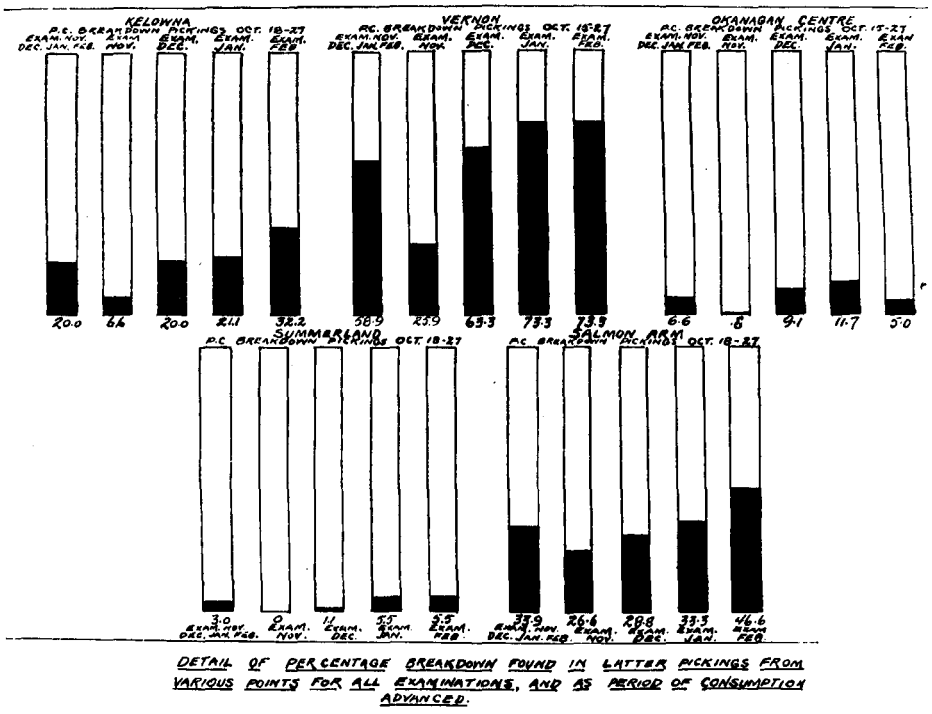


FIG. 6.—Jonathan breakdown.

January, thus giving two different shipping dates and temperatures, and giving one lot storage at Kelowna for a longer period as compared with longer storage at Ottawa. This method of handling afforded a basis of comparison between storage in the valley till time of consumption, against storage at point of consumption. A record of humidity kept at Kelowna for the month of October showed, according to the records of the officials of the Kelowna Growers' Exchange, a relative humidity ranging from 71 to 88, which is very creditable

indeed. Thermographs were also placed with the shipments and in the cars through the courtesy of the Fruit Branch, and these thermograph charts showed a very favourable temperature except for a rather excessive rise for a few hours during the period on the boat from Kelowna to Penticton. The storage temperature at Ottawa, where the fruit was held in good ordinary storage, ranged usually around 38 to 40° F.

When the trees were selected complete notes were taken on condition of tree, size of foliage, soil, location, distance from water supply, cultural methods, fertilizer, whether thinned, etc., and again at the conclusion of picking these notes were checked up and additional notes made on the stage of maturity of the trees, etc. Also when the fruit was picked a number of apples were cut open from each pair of trees and notes made on seed colour, colour of fruit and ground colour, amount and extent of water core, whether any browning was present at the fibro-vascular bundles and presence or absence of other physiological troubles than breakdown such as "drought spot" or "corky core". The object of keeping such a complete record of the tree was to discover, if possible, if any one condition or set of conditions, such as nature of soil, condition of tree, amount of water applied, cultural methods used, gave breakdown as contrasted with trees where no breakdown occurred. The object of a thorough examination of fruit at picking was to learn if there are any distinguishing characteristics by which it can be discovered beforehand whether fruit will later break down or not. Soil samples were also taken from under each tree from both the first and second foot of soil.

The number of boxes of fruit picked was in all 186, of which 98 were shipped to Ottawa and the balance, 88 boxes, were stored at Summerland.

The fruit shipped to Ottawa, in the case of the first shipment, was examined between November 21 and 28, 1923, December 17 and 24, 1923, January 16 and 28, 1924, and February 22 and 27, 1924, while in the case of the second shipment it was examined twice, between January 16 and 28, 1924, and February 22 and 27, 1924.

Notes were taken, when the fruit was examined, on the percentage of breakdown occurring in each picking and the record of each pair of trees in each orchard kept separately. Whether breakdown had occurred or not was determined by cutting the apples open. Record was also made of the flavour and texture particularly of the earlier pickings to determine when picking of the variety can judiciously be commenced without sacrificing quality and flavour.

In all, 51 trees were included in the experiment and from the 96 boxes, 9,360 apples were examined and from these the data given in the summary are compiled.

RESULTS OF THE EXPERIMENT

From the 51 trees used in the experiment 38 trees bore fruit which later broke down and only 13 trees bore fruit absolutely free from breakdown. Of the trees which showed breakdown 26 showed appreciable quantities, while in the other 12 trees breakdown was present only in a very slight degree and was therefore practically negligible.

The detail of trees breaking down is as follows:—

—	Breaking Down	No Breakdown
Kelowna	10	2
Vernon	11	1
Okanagan Centre	7	5
Summerland	7	5
Salmon Arm	3	0
	38	13

Vernon would have shown all 12 trees breaking down but for the fact that one tree had a particularly light crop and the amount of fruit borne did not admit of carrying out the final pickings on that particular tree.

The outstanding fact shown in both the summary and the graph, showing quantity of breakdown found with various picking dates (figures 4 and 5 respectively), is that fruit picked prior to October 11 shows only one apple breaking down of the 5,460 examined. Therefore, picking of Jonathans before October 11 in a season such as that of 1923 can be assumed to be perfectly safe as regards breakdown. The amount of breakdown found in the fruit picked October 11-13 is slight (but 13 of 780 apples picked during the period October 11-13) so that a fairly safe margin of the period of picking, may in fact be said to exist until October 13 in such a season as that of last year.

In addition to the fact that only fruit picked after October 11 showed any breakdown whatever, thus conclusively proving that maturity is one of the most important, if not the most important factor in breakdown, this conclusion is amply borne out by close observation of the fruit actually breaking down. Only a relatively very small proportion of the fruit which broke down was other than the large sized and highly coloured fruit. Practically no green, undercoloured or undersized fruit whatever broke down, hence this observation entirely supports the conclusion that stage of maturity is the main factor in breakdown.

Another outstanding fact, in addition to the amount of breakdown appearing in fruit picked on or after October 15, is the gradual increase in percentage of breakdown found as the date of picking advanced, increasing in the case of the November examined fruit, from 5·3 per cent to 16·6 per cent of all fruit picked on the respective dates October 15-17 and October 25-27. In other words, in the fruit examined in November there was an increase in the amount of breakdown in fruit picked ten days later of 11·3 per cent. It will be seen from the data in the summary (figure 4) that the examinations of December, January and February gave a similar increase—from 12.0 per cent to 34.6 per cent, from 12·6 per cent to 43·3 per cent and from 17·3 per cent to 48·0 per cent respectively—as date of picking advanced.

It will also be seen that the total percentage of breakdown in the last four pickings increased for November examined fruit as compared with December from 10.6 per cent to 21.8 per cent, from 21.8 per cent to 26.5 per cent for December as compared with January, and from 26.5 per cent to 29.6 per cent for January as compared with February. This shows that not only does breakdown occur in the latter pickings only but that it appears in greater quantity as the storage season and the period before the fruit is consumed, advances. The ranges of percentage breakdown found, from 12.0 per cent to 34.6 per cent for December examined fruit, from 12.6 per cent to 43.3 per cent for January examined fruit and from 17.3 per cent to 48.0 per cent for the final examination in February shows how great this increase in breakdown actually is for later pickings.

It will be seen in the last two columns of the summary (figure 4) and in the small chart in the upper left corner of figure 5 that 22·1 per cent of fruit picked in the last four pickings, October 15-27, broke down when the various examinations made from November to February inclusive are considered. Not only does this represent a loss of sufficient proportions to render practically valueless Jonathans picked after October 13, but there is also shown in the same chart and in the last two columns of the summary the increase of from 10.6 per cent breakdown in November to 29.6 per cent, or nearly three times as much breakdown in the same fruit, when stored till the last of February. Hence, it would seem that not only is early picking of this variety essential, preferably not later than October 10, but also when breakdown is through any chance risked by picking beyond that date, that the fruit should be rushed

immediately after packing to the consuming market. Otherwise, instead of a 10.6 per cent loss through breakdown, keeping such fruit till well into the season will be seen to entail a much larger loss—several times multiplied, and quite sufficient to render fruit practically valueless.

In the chart showing the detail of the later-picked fruit from the various orchards where the experiment was carried on (figure 6) the same consistent increase of breakdown in storage may be noted. In one orchard only, at Okanagan Centre, was there an actual decrease of the per cent breakdown found as the period of consumption advanced and that for only one examination, February. In the other three examinations, November to January, there is the increase in storage characteristic of the experiment. This increase in storage may be noticed for the Kelowna, Vernon, Summerland, and Salmon Arm orchards and is not due to any particular faults of the storage used since both main lot and check lot showed the same characteristic increase although differently treated as regards place of storage and time of shipment.

As previously stated, one lot (from which most of the data are compiled) was shipped November 5 to Ottawa and the second (check) lot was shipped December 19, until which dates both lots were held at the Kelowna Growers' Exchange, and on arrival at Ottawa both lots were stored under the same storage conditions. The percentage breakdown found in both lots would go to show that there is no particular advantage as far as breakdown is concerned in shipping earlier, say November, and holding in storage at point of consumption over holding in storage at the point where packed until the last of December, then shipping to point of consumption. The slightly lower percentage of breakdown in the check lot has no bearing on the case whatever, and is but what would be expected in view of the fact that the data for the check lot does not include any Vernon or Salmon Arm fruit (from which places, in the experiment, much the heaviest breakdown was found) except for several early pickings from Vernon. The Vernon and Salmon Arm results would tend to somewhat increase the totals in the main figures given, whereas in the check, the lack of their inclusion would materially decrease the figures of percentage breakdown.

A fact which is apparent from the chart in figure 6, showing the per cent breakdown somewhat in detail, is the great variation with the various orchards in per cent breakdown found. Fruit from the Vernon experiment will be seen to be appreciably more affected as regards breakdown than are any of the other orchards; and again that from Salmon Arm showed a much greater percentage than did the other three orchards and second only to Vernon. Fruit from the Kelowna experiment stands third, with the Okanagan Centre next, and Summerland last. The small percentage in Summerland fruit is especially noteworthy, being so little as to be almost negligible.

In this connection it may be said here that the Summerland experimental results are excellent proof of the fact that the physiological troubles, "breakdown" and "corky core" (or "brown core"), have absolutely no relation to each other. Breakdown is apparently not preceded by the appearance of corky core or brown core, which may be detected early in the season, whereas breakdown is not evident till a few weeks or longer after the fruit is harvested. Of the twelve trees used at Summerland, nine showed a considerable quantity of corky core (or brown core) both at picking and at time of examination, and some of the trees used were also affected with drought spot. Hence, since none of the other orchards where the experiment was carried on showed any corky core and were much more seriously affected with breakdown in the later pickings, while this Summerland orchard showed comparatively little breakdown, it is quite reasonable to assume that the underlying disturbed water relations and disturbed nutritional balance which apparently cause corky core, inhibit

and decrease the chances of breakdown occurring in even the later pickings. Hence, too, it may be quite safely assumed that corky core (brown core, core rot, or internal browning) is not in the least related to internal breakdown or flesh collapse as far as the causes of these two physiological diseases are concerned.

INVESTIGATIONS AS TO THE CAUSE OF BREAKDOWN

The thorough and complete notes made on the trees used in the experiment made possible for reference a record of the condition of the trees, and with all notations on the fruit when examined by individual trees, enabled the keeping of the record of each tree as an individual to more readily assist in locating the cause of breakdown.

The results of this part of the experiment proved entirely negative, in that while maturity can be pointed to as the factor of foremost importance, no definite set of conditions can be indicated as causing the trouble. It occurred almost equally in non-irrigated fruit at Salmon Arm and in irrigated fruit at Vernon.

A devitalized tree on clean cultivated clay soil ran a heavy percentage of breakdown, whereas a nearby tree in the same condition and on the same soil similarly cultivated showed no breakdown whatever. A tree in good condition under clean culture gave no breakdown under test, whereas a tree not sixty feet away in similar condition, and under alfalfa cover cropping, gave a considerable percentage of breakdown. Four trees growing in clover sod all showed some breakdown.

The only tree which did not show breakdown in the Vernon experiment was one on which the crop did not permit of picking till the conclusion of the experiment, and yet the twelve trees in the orchard were variously located from 150 to 1,000 feet from the main ditch and the amount of water applied must have varied considerably. Not only did the water conditions vary, but six trees were located on a bench where the soil was a good loam with plenty of humus, whereas the other six trees were located on a much more gravelly soil. Again, some of these trees received an application of barnyard manure and others an application of lime, but neither treatment had any effect on the amount of breakdown.

Trees on a splendid soil at Okanagan Centre, in the best of condition, with a heavy alfalfa cover crop, while not showing a heavy percentage breakdown, nor any appreciable quantity till the pickings of October 22, nevertheless showed the trouble when picked after the date mentioned, although in addition to the conditions mentioned several of these trees received a much heavier application of water—almost every week, due to seepage—as compared with the twice-irrigated trees at Vernon or non-irrigated at Salmon Arm. Several clean cultivated trees at Okanagan Centre did not show breakdown till the very last picking, but this is explained by the highly vegetative nature of these particular trees and the immaturity of fruit which resulted from that condition.

The locations of the trees at Summerland comprised soils of almost clear sand to a fairly loamy soil, and although these trees were all somewhat devitalized there was exceedingly little difference in the quantity of breakdown notwithstanding the soil differences and wide differences as regards water availability.

With these above results in mind it will be seen that it is extremely difficult to point out any particular conditions or set of conditions which cause breakdown; where one set of conditions is found under which breakdown occurs in one orchard an entirely different set of conditions prevails in another orchard and even with different trees. According to the work of Ballard, Magness and Hawkins, "Internal Browning of the Yellow Newtown Apple," done in the Pajaro Valley of California, this conclusion is confirmed in that they found

adjacent trees giving a distinct variation in the amount of breakdown found. They also found from the records of three seasons' work that very often a tree which produces sound fruit one year will produce fruit tending to break down badly the next year. This finding would confirm the varied conditions under which breakdown was found to occur in the Okanagan.

Another conclusion of Ballard, Magness and Hawkins from their work in the Pajaro section, that breakdown cannot be prevented or even particularly lessened by any one of various fertilizer treatments—nitrogen, manure and phosphorus, is in accord with results found at Vernon; where barnyard manure or lime application was made there was no decrease or prevention of the trouble.

The second finding—that lime applications did not prevent the trouble at Vernon would tend to dispose of the theory which has been advanced that fruit broke down because of lack of lime. While disproven as far as possible by one year's results, the latter theory also seems rather an illogical conclusion in that apple trees are known to thrive on a slightly acid soil and are acid tolerant to a considerable degree.

It will be seen then that no particular underlying conditions can at this stage of the work be blamed for causing breakdown and that if more definite results are sought as regards the underlying cause of breakdown, further work must be done. Apparently, too, no fertilizer treatment will prevent the trouble nor can it be known what may be expected the second year from a tree which produces broken down fruit the first. In this particular it may be stated that two of the three trees selected in 1923 at Salmon Arm showed breakdown in 1922, while in 1923 all three trees, including the one tree which did not show breakdown in 1922, produced fruit breaking down in considerable quantities in the later pickings.

With regard to the large quantity of breakdown, unprecedented in the history of the Okanagan, occurring in 1922, the impression gathered from some of the fruit growers that the trouble in that year was largely seasonal seems to be confirmed by fact. Since the experimental work done in 1923 appears to fix the trouble as practically entirely due to the stage of maturity at which the fruit was picked, this finding can be linked with the somewhat unusual weather conditions prevailing during the season of 1922, and to these two causes the exceptional amount and widespread prevalence of breakdown that season can be largely attributed.

Copies of the official weather records for May to October, inclusive, for 1922 and 1923, were obtained, through the kindness of Messrs. Johnson and Madden of Summerland and Vernon respectively, and a close examination and comparison of these made to discover the outstanding differences between the two years, 1922 and 1923, which would account for the earlier maturity of the fruit the season of 1922.

The season of 1922 was an exceptionally dry one, and all seasonal factors till September tended to mature fruit early. At that period many growers left their fruit to colour, and thus the fruit was left on the trees till about the usual time of picking, although maturing earlier than usual due to these exceptional conditions. That unusual weather conditions existed during the season of 1922 is substantiated by the weather records. The precipitation for May to August was not a third of that for 1923 for the same period, and this dry weather would tend to bring on maturity earlier than usual. The hours of sunshine, too, were materially more in 1922, when the record of the season as a whole is compared with 1923. Hence, it will be seen that exceptional weather conditions caused earlier maturity than usual while the picking season was not correspondingly advanced; and it is more than likely that these factors may be held largely responsible for the amount of breakdown in 1922.

CONCLUSIONS

Although as varied conditions as possible were chosen for the trees used as regards distances from irrigation, number of irrigations, fertilizer, cultural methods, tree conditions, age of tree, etc., there is as yet no definite conclusion possible that any one condition or set of conditions is largely responsible for breakdown in the Jonathan. It is true that clean cultivated trees with two irrigations gave relatively a much greater quantity of breakdown, appearing earlier, than did fruit to all appearances of approximately the same stage of maturity grown on vigorous trees with heavy alfalfa cover crop which had a more regular supply of irrigation water. But this is only the result of one season's work, and further work would have to be done before this conclusion, viz., that alfalfa cover cropping and regular irrigation decrease the amount of breakdown, can be confirmed.

The primary conclusion, and the outstanding one possible from the results so far, go to show that maturity is the main factor in the prevention of the trouble, and Jonathans must be picked prior to October 10-12 in such a season as that of 1923. The date before which picking must be concluded may be advanced in an abnormal season such as that of 1922. But such a season as 1922 occurs but once in several, say eight to ten years, and by close observation of the stage of maturity of the fruit even in such a season the danger from breakdown may be largely averted.

WHEN JONATHANS SHOULD BE PICKED

From the data here given, October 10-12 is about the last safe date on which Jonathans can normally be picked.

The earlier pickings (from September 17 to 24 or 27) are somewhat too early, and fruit picked between these dates was not only lacking in requisite colour and flavour but shrivelled badly before the period of consumption was over.

Any time after September 24 or September 27 that sufficient colour can be secured, before October 12, is then the best time approximately in a normal season to pick this variety. Seeds should not be just changing from white or a light brown or even a medium brown colour; they should be showing considerable dark brown, or, at least, a moderately dark brown.

One indication as to when fruit should be picked is found in the fibre-vascular bundles. Just outside the well defined core area are small dots, usually ten in number, normally of a more greenish colour than the surrounding tissue. These dots or bundles turn yellowish to brown in many cases where the fruit later breaks down. And while these bundles often turn brown and yet the fruit does not break down, their appearance is so closely linked apparently with the maturity of the fruit that when becoming brownish, fruit should invariably be picked.

A condition even more closely associated with breakdown and also an indicator of when fruit should be picked is also found when water core, usually bounded by the core area, starts to extend into the flesh of the apple or area outside the core. When this occurs the water core is in somewhat oval areas, small at first, extending radially all round the core. This condition does not appear until the fruit is fully mature enough to pick, hence as soon as it develops fruit should be picked as rapidly as possible. When this condition was observed in the experiment, it was found that usually the radial water core appears at the same time that fruit picked on that date would later break

down, although in some few cases radial water core made its appearance before the fruit then picked would break down in storage. But at the earliest time of appearance, this condition was a few days only, not more than four or five days, prior to the date at which breakdown would occur if picking was continued. Hence, the slightest extending of water core in clearly defined areas radially from the core into the flesh of the apple signalizes danger in picking beyond that date if breakdown is to be avoided. There would seem to be then a definite, close relation between this radial water core and breakdown, but what the exact relation is can only be determined by further observation and by physiological and cytological study of the actual tissue concerned.

Therefore, because of the characteristics mentioned above, which must be observed as indications of maturity, viz., browning of the bundles and the appearance of radial water core, these indicators may be used in determining when Jonathans should be picked along with colour, ground colour, and seed colour.

Seed colour, as stated previously, must be moderately dark brown. Colour should be solid and should extend over a good proportion, 25 per cent to 50 per cent, of the whole surface of the fruit, and finally, the ground or under colour should be at least changing from a solid green to somewhat yellowish or showing considerably yellow.

If the grower watches closely for these evidences of a fair state of maturity and yet picks before the slightest trace of brown bundles around the core or water core extending into the flesh makes its appearance, prior approximately to October 10-12, there seems no reason why the amount of breakdown subsequently developing in Jonathans cannot be reduced to a negligible minimum and eventually be entirely eliminated.

It must not be thought, however, that October 10-12 is a fixed date until which picking can be safely carried on every year, because, although last year was apparently nearly normal as to the date of maturity of fruit, much hot, dry weather, much dull, wet weather, or other abnormal weather conditions may either advance or retard the date of maturity for Jonathans. Hence, in such a case it will be seen that the date given above is purely an arbitrary one, and determination of the date of maturity in an abnormal season, such as, for instance, that of 1922, when Jonathans apparently matured earlier than usual, must depend on the good judgment of the growers.

But, while a hot, dry growing season might advance the final date of picking to as much as a week to ten days earlier than usual, or a dull wet growing season retard maturity as much as a week later than the limit of the ordinary safe picking period for this variety, from the data secured in the experiment carried on in the fall and winter of 1923-24 it appears that shortly before the middle of October in an ordinary season is the latest date that growers should attempt to pick Jonathans.

Picking beyond this date is liable not only to diminish the individual grower's returns, through the greatly decreased prices obtained for Jonathans, due to the inclusion in his pack of fruit that is bound to break down, but will also injure the name of the variety.

Because Jonathans comprise something like 25 per cent to 30 per cent of all trees planted in the Okanagan and since the variety is a popular one with the Canadian and overseas consumer normally, a measure, such as picking at the right time, is well worth while in order to preserve the good name of this variety and to secure the greatest return possible for the growers on their heavy investment in bearing Jonathans and land planted to this variety.

IDENTIFICATION OF APPLE VARIETIES BY LEAF CHARACTERS

The attention of pomologists and fruit growers over a wide area has been turned to the splendid results being achieved by Dr. J. K. Shaw of Massachusetts Agricultural Experiment Station, in his work on the identification of apple varieties through characters exhibited in the leaves. The work done at that station over a period of years has been reported on by him at various meetings of fruit growers, and more recently in Dr. Shaw's bulletin issued on the work April, 1923. (Leaf Characters of Apple Varieties, Bulletin 208, Massachusetts Agricultural Experiment Station.) The importance of being able to tell whether a tree is true to name or not before it comes into bearing is readily appreciated. If found not true to name, it can be replaced at once and much time and loss saved. In view then of the apparent success being secured in this particular line of work, the first steps along this line were made in Canada in 1920 when specimens of leaves of a large number of apple varieties were collected at Ottawa from practically all of the branch Farms and pressed and mounted. This collection showed a considerable range in the leaves of each variety and although many points in common were noticeable this result is what would be expected when the leaves were collected by different individuals and from various parts of the tree, and collected alike from old and new wood. Mr. P. M. Daly, B.S.A., was put in charge of this work in 1923.

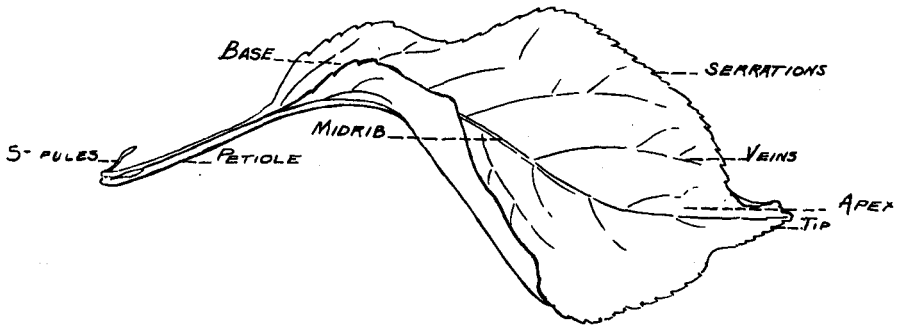


FIG. 7.—Leaf characteristics and apple varieties.

In June and July of that year, therefore, a start was made following Dr. Shaw's method of procedure, namely, that of always taking the leaves from about one foot to one and one-half feet back from the tip of the branch on new wood only. By this method a very uniform type of leaf is obtained. About twenty or thirty leaves secured as above mentioned were taken and considered entirely apart from the tree. The characters and out-standing points were carefully noted until every point in each variety had been considered and until it was possible to name each variety from the characters of the leaf alone. Figure 7 shows a drawing of a leaf with the most important parts designated.

Using these distinguishing characters and any others that were evident the following descriptions were made of the varieties upon which work was done and it was also possible to make the appended notes upon the most out-

standing differences between some of the varieties used. As a test of the efficiency of this method, although these varieties were all studied at Ottawa, it was found possible as a result of the work to identify the following varieties in various orchards in the Okanagan Valley, B.C.—Duchess, Wealthy, McIntosh, Yellow Transparent, Lowland Raspberry, Wolf River, Bethel, Milwaukee, Fameuse, Scott Winter, Delicious, Stayman Winesap, and Golden Russet.

DESCRIPTIONS OF LEAF CHARACTERS IN THE APPLE

Duchess of Oldenburg.—Stipules small size. Petiole long and slender. Leaf broad at base and apex, but with greatest breadth across the central part of the leaf. Colour dark green, moderate gloss. Apex wide, not sharp but tip quite pronounced for apex. Moderately pubescent. Of medium thickness. Serrations fine and fairly regular. Angle of leaf with branch 45° and less—somewhat acute. Sides seldom folded but considerably waved. Leaf moderately reflexed with much more gloss than McIntosh or Yellow Transparent.

Wealthy.—Stipules medium to large. Petiole medium to long, slender. Blade of medium to large size. Spiral, somewhat reflected midrib, much waved edges. Oval shape, narrow at the base and apex, greatest breadth across the centre of the leaf. Thick leaf, only slight pubescence. Serrations rounded, few at the base and not always regular. Colour medium green. Narrower base and apex than Oldenburg. Angle of leaf with branch almost invariably 45°. Lobes of leaf not always even at the base. A touch of pink on the base of the petiole.

McIntosh.—Stipules of medium size. Petiole medium length, moderate stoutness. Leaf medium green in colour, large, oval, broad at base. Pointed at apex but not as much as Wealthy. Flat dull surface, folded, but not the slightest tendency to be wavy. Many of cross veins on under surface parallel each other at right angles to leaf midrib. Strongly pubescent—even visible from upper surface of leaf beyond serrations, which are dull, rounded and shallow. Veins from midrib have pronounced tendency to come off parallel. Inclined to be cordate at the base, wide angle with branch 45-90°.

Melba.—Petiole short to medium and slender, pinkish at the base, stipules large and outstanding. Blade, large, broad across the base and apex, greatest width across the centre. More or less flat, slightly waved around edges. Halves of leaves not always even at the base. Medium to light green in colour with but slight if any gloss. Moderately pubescent but mostly along midrib and veins. Serrations considerably rounded, somewhat irregular. Angle with branch 45-90° somewhat over 60°, and 60-70° usually. Slightly reflexed. Rounded back of point of each serration. Veins not parallel, narrowing often. Leaf thin to medium thick.

Yellow Transparent.—Petiole medium to long, moderately stout, stipules small. Blade medium size, reflexed, wavy edges and moderately folded from the midrib, sometimes slightly spiral. Comparatively narrow leaf, fairly broad at base and narrowing at the apex with well marked tip. Pubescent, thickly so, and thick leaf. Serrations dull, not deep and regular. Little gloss, dull surface. Colour medium to dark green.

Lowland Raspberry.—Stipules medium size. Petiole short, moderately stout. Blade medium size, but broad, distinctly cordate shape—often as broad as long. Leaf folded, little if any waviness. Broad at base, much narrower at apex. Serrations semi-sharp, deep and irregular. Pubescence only slight to medium, mainly along midrib and veins of leaf. Thin leaf. Colour light or

pale green, glossy. Main serrations sometimes doubly and quadruply split. Angle of leaf with branch usually vicinity of 45°.

Wolf River.—Stipules large and fairly prominent. Petiole slender, medium to long in length. Blade large, broad and long, narrowing more at the base and apex than many varieties. Midrib and veins on under side of a lighter colour than rest of under surface. Leaf wavy at edges but not folded at all. General shape oval. Serrations fairly regular, often one main serration with another small serration between main indentations, moderately sharp. Reflexed and sometimes slightly spiral. Dull surface, little gloss, dark green. Pubescent especially over veins which have a tendency to run at right angles to midrib. Narrowing so each side of leaf edge makes 45° angle with petiole or tip of midrib. Leaf moderately thin. Angle with branch 45°-90°, fairly wide angle compared with some other varieties.

Bethel.—Stipules fine and small. Petiole slender, medium length. Blade long, and narrow for length, considerably pointed towards base and apex with clear cut tip. Narrowest and longest of leaves of varieties covered. Veins usually coming off fairly regularly and parallel to each other. Leaf slightly folded but has considerable waviness. Serrations very sharp, considerably more pointed to apex than some varieties, and regular. Leaf is much reflexed, slight tendency to turn spirally, lustrous, slightly glossy, slight pubescence—except midrib and veins where it is thicker. Narrowing runs well up to the base and back from the tip. Leaf is moderately thick. Veins (small) inclined to run at right angles to midrib. Angle with the branch 45°, moderately narrow angle with branch.

Dudley.—Stipules small, fine, inconspicuous. Petiole medium length, medium stoutness, some cases moderately stout. Blade large, narrowing well back from the apex and with greatest breadth near the centre, slightly nearer the base sometimes. Generally shape ovate. Veins from midrib many cases opposite, especially at base of blade and spaced regularly and well apart. Slightly folded, wavy at edges. Serrations sharp, especially outer half of leaf, those nearer base more rounded, not regular and fairly shallow cut. Often reflexed and quite often slightly spiral. Dull surface with but little lustre. Leaf is fairly thin and thickly pubescent all over under surface. Has pronounced tip. Angle with branch 35-60°—moderate angle with branch.

Milwaukee.—Stipules medium to small. Petiole medium length, moderately stout. (Sometimes tinged purplish but not as much as Fameuse). Blade medium size to small, oval in shape as a rule. Greatest breadth across centre of leaf. Reflexed, spiral—usually tip alone spiral, not leaf proper. Serrations sharp and irregular, rounded more in basal half of leaf. Leaves have a dull to slightly lustrous surface of medium thickness and thickly pubescent.

Fameuse.—Stipules large in size and prominent. Petiole of medium to short length, medium stoutness, pronounced pinkish purple colour at the base. Leaf has regular oval shape, small in size. Small size tip. Generally reflexed. slightly folded, very slightly wavy and very slightly spiral. Serrations mainly rounded, but much sharper at apex than towards base, fairly regular, slightly pubescent on upper side, somewhat glossy, dark green in colour. Pubescence thick along midrib and veins. Moderately thick leaf.

Scott Winter.—Medium sized stipules. Petioles sometimes have purplish tint and are medium to long for size of leaf, of moderate stoutness. A small leaf, noticeably conical in shape at apex. Shiny leaf, dark green in colour. Serrations semi-rounded irregular and coarse. Thickly pubescent on under side. Reflexed but seldom spiral. Slightly folded and slightly wavy. Square across base at petiole, right angles with the petiole.

Northern Spy.—Stipules small to medium. Petiole medium to long for size of leaf, and slender. Leaf small to medium size, usually longer than broad, sometimes length almost twice breadth. Somewhat oval in shape, tapering well to base and apex, fairly prominent tip. Somewhat reflexed, slightly spiral. Serrations dull but shallow, not deep, fairly regular. Leaf medium dark green. Slight gloss to some leaves. Slight pubescence. Moderately thick leaf. Pubescence extending beyond serrations.

Delicious.—Stipules small. Petiole of medium length, slender, with purplish tinge for about a quarter of an inch from base. Leaf small, somewhat oval in shape, narrowing well back from the apex. Dark green in colour, dull, thin. Veins not paralleling and marked tendency to turn inwards towards leaf tip. Serrations sharp but with marked rounding back of point. Small markings on back of leaf very definite. Very slight amount of pubescence, least of any of leaves studied. Pointed nature toward apex a feature of this leaf along with shouldered appearance toward the base.

Stayman Winesap.—Stipules small to medium in size. Petiole slender, medium length, pinkish purple at the base and extending up the midrib sometimes. Blade small, roundish oval, narrowing but slowly at the apex, with a pronounced tip. Leaf folded, with but little waviness, very slightly reflexed. Serrations coarse and sharp, often two, three and four lobes within one main serration. Practically no inclination to turn spirally. Slight gloss to upper surface, which is lighter green than Fameuse. Thickly pubescent on underside of leaf and veins.

Golden Russet.—Medium to large stipules. Petiole moderately stout, medium length, no red showing whatever. Blade small, greatest breadth at centre, narrowing well to base and apex though usually more to base than to apex. Slightly folded, considerably reflexed and wavy. Whole apex and tip of leaf inclined to turn spirally. All green leaf and petiole, no traces of red. Upper surface of leaf, which is leathery in texture, glossy, light to medium green in colour, pebbly and ingrained like Yellow Transparent. Serrations very fine and regular. Under surface of leaf very thickly pubescent. Leaf often crinkled at base of blade where attached to the midrib.

MAIN OR OUTSTANDING DIFFERENCES BETWEEN LEAVES OF VARIETIES EXAMINED

Large Leaves.—Wolf River, Bethel, Dudley, Duchess, McIntosh, Melba, and Wealthy.

Medium-sized Leaves.—Yellow Transparent, Lowland Raspberry.

Small Leaves.—Scott Winter, Fameuse, Milwaukee, Delicious, Northern Spy, Golden Russet, and Stayman Winesap.

DISTINGUISHING FEATURES BETWEEN VARIETIES

Bethel.—A long leaf, very long for width, long petiole. Length.

Duchess.—Oval leaf, sharper and more prominent serrations than Dudley. Markings on back distinct. Darker green

Dudley.—Centre greatest breadth, tapering more to base and apex than Duchess. Serrations more pointed towards the tip. Pubescence confined to veins mainly.

McIntosh.—Shape distinctive, shoulder towards apex, cordate at the base. Serrations shallow, more or less distinctive.

Melba.—Coarser and more rounded serrations than McIntosh, shape more oval, thinner and less pubescent.

Wealthy.—Long shape for width. Waviness and reflexed nature distinctive, most wavy and spiral of the whole group studied.

Wolf River.—Long petiole and tapers widely to base, especially for width of the leaf, shape somewhat diamond like, wavy.

Yellow Transparent.—Much rounded serrations, pebbly upper surface, thickly pubescent under surface, oval-ovate.

Lowland Raspberry.—Cordate shaped, folded, with coarse serrations light green in colour as wide almost as long.

Delicious.—Oblong, ovate shape, quarter inch base of petiole pink purple, shoulders at base.

Northern Spy.—Somewhat diamond shape, serrations coarse but not deep.

Scott Winter.—Acute apex, conically tapering, more or less triangular in general shape. Coarse, sharp serrations. Pinkish petiole.

Fameuse.—Oval shape, rounded serrations. Most pink on petiole of varieties. Stipules prominent and large.

Milwaukee.—Spiral turn of leaf tip. Dark green colour. Pinkish tinge to petiole. Dull, smooth surface.

SIMILAR LEAVES AND THE DISTINCTIONS BETWEEN THEM

Duchess and *Dudley.*—Duchess more distinctly perfectly oval in shape, more distinct, coarse, regular serrations and fine markings on the back of the small veins more distinct.

Dudley has decidedly more narrowing towards the base, serrations slightly less coarse and leaf not as dark green. Also no noticeable markings on the back or under surface.

Scott Winter.—Distinguished from *Fameuse* by shape which is more triangular, while Fameuse is oval. Sharper coarser serrations than somewhat rounded serrations of McIntosh or Melba. Not so pink on petiole as is Fameuse.

Yellow Transparent is distinguished from *Milwaukee* since latter has more clearly marked tip with spiral turn and has sharper serrations and is smooth, while Transparent has pebbly, ingrained upper surface, oval ovate shape, thick leaf, thickly pubescent and rounded serrations.

Duchess is more oval, thinner and has coarser serrations, while Yellow Transparent has rounded serrations and is not nearly so perfect an oval shape as Duchess nor as large a leaf.

Fameuse and *Duchess* are immediately distinguishable on size along with serrations, which are not so coarse nor as sharp in the case of Fameuse as are they in Duchess.

Lowland Raspberry is immediately distinguishable by cordate shape, light green colour, along with coarse serrations.

McIntosh can be distinguished from *Duchess* on shape, it is longer than Duchess for breadth of the leaf, has shallower serrations and similarly might be distinguished from *Yellow Transparent* in that McIntosh is less regular in

shape and has very shallow serrations and is medium light green in colour and Yellow Transparent is dark green. McIntosh also is folded without any waviness.

McIntosh and Melba, though somewhat similar, are differentiated in that Melba is more perfectly oval, as a rule is thinner and has more rounded, deeper serrations than McIntosh and again Melba is nearly flat whereas McIntosh is one of the distinctly folded varieties.

Milwaukee and *Duchess* are distinguishable, while similar in shape somewhat, in that Milwaukee is much the smaller and is not so distinctly oval. Also the spiral turn of the tip in Milwaukee is typical.

Bethel is quite easily discovered by its length for the width of the leaf as is *Wolf River* by its tapering leaf at base and apex.

Delicious is also a long leaf and is distinguished from *Northern Spy, Milwaukee, Fameuse* and *Scott Winter* by its greater length for the width of the leaf than any of others and the fact that it has decided shoulders at the base of the blade and the pink tinge at the base of the petiole is usually definitely marked for a quarter of an inch at the base. In other varieties this tinge extends further and is less definite. *Northern Spy* in shape is somewhat similar to *Wolf River* although smaller, it is also a thicker leaf and has finer shallower serrations, but the tapering to the base and the greatest breadth at the centre is typical.

Golden Russet is first distinguished in that though one of the small leaves it has no pink tinge on the petiole, secondly it is more wavy than any of the rest of the group and has a very pebbly, ingrained, shiny upper surface. In shape it somewhat resembles *Northern Spy* but the characters mentioned, along with a very spiral tendency of the tip and apex, leathery texture, considerably reflexed, decidedly pubescent nature, and dark green colour along with a slight wrinkling at the base of the midrib distinguish *Golden Russet.*

Stayman Winesap resembles *Fameuse* somewhat, but has a longer petiole as a rule than Fameuse. The pink on it is limited usually to about a quarter of an inch at the base, the serrations are sharper (those of Fameuse are more rounded) and Fameuse is longer also (although Stayman is also oval) it is more roundish oval in shape and a more perfect oval than is Fameuse.

VEGETABLE GARDENING

COMPARISON OF TOMATOES

To gain some information concerning the value of the Ottawa varieties and strains of tomatoes, a collection of forty-three commercial varieties comprising a large number of the early sorts, were planted in lots of ten plants each, in the tomato trial plots. All the plants were trained to one stem and tied to stakes. This method enabled a large number of varieties to be tested under very uniform conditions and treatment.

In the table to follow, will be seen the yields for each of the varieties of commercial origin, as well as those of the Ottawa varieties and strains. The records cover the results for two important periods in the production of tomatoes, for the early crop, or as is better known, the paying part of the tomato season, namely the first two weeks and first month. As will be noticed, the yields are divided into marketable and unmarketable for both periods.

TOMATO—COMPARISONS OF VARIETIES AND STRAINS

Variety	Average weight fruits in ounces	First two weeks				Average weight fruits in ounces	First Month			
		Marketable		Unmarketable			Marketable		Unmarketable	
		lbs.	ozs.	lbs.	ozs.		lbs.	oz..	lbs.	ozs.
Burbank (B)	3·70	13	7	2	5	4·58	21	11	6	5
Bolgiano (B)	4·50	12	1	6	8	4·76	11	14	13	1
Prosperity (P)	4·98	10	1	5	4	4·65	18	9	7	9
Alacrity, 4–9·2	3·33	9	3	2	13	3·86	15	14	5	2
Avon Early	2·49	8	7	5	13	3·89	17	11	9	0
Alacrity, 1–2·2	3·92	8	3	2	1	3·88	17	8	5	1
Alacrity, 10–4·2	4·07	8	1	1	11	4·49	15	7	4	0
Alacrity x Hipper, 5–2·1	3·71	8	1	2	10	3·79	16	0	6	14
Alacrity, 6–6·1	3·19	7	13	1	13	3·87	12	2	6	4
Magnum Bonum	2·0	7	9	4	0	2·04	15	10	7	15
Alacrity (K)	3·11	7	4	3	13	3·16	14	4	7	15
Alacrity x Hipper ,6–7·1	3·28	6	15	2	1	4·27	16	6	5	10
Prosperity (B)	3·32	6	15	2	0	4·11	15	1	5	0
Weaver	3·74	6	5	4	11	4·81	19	11	11	8
Alacrity x Earlibell, 4–2.1	3·05	6	4	1	13	3·39	15	6	8	0
Alacrity, 7–8·1	3·83	6	4	1	15	3·98	12	3	6	0
Sparks Earliana (B)	3·35	6	1	4	4	5·63	15	7	11	14
Alacrity x Earlibell, 1–4·2	3·38	5	14	1	5	4·06	16	11	5	1
Earliana (K)	2·69	5	14	3	12	4·15	13	12	7	14
Golden Queen	2·23	5	14	.....		1·98	12	6	0	2
Burbank (I)	4·70	5	13	2	5	4·87	12	6	8	12
Sunnybrook Earlliana	4·03	5	11	1	10	4·48	14	2	5	11
Faukes No. 1 (J)	2·84	5	8	2	1	3·3	15	15	2	1
Earliana (H)	4·17	5	8	7	0	4·7	12	7	13	12
Danish Export	1·87	5	0	0	2	2·78	13	0	0	6
Red Head	3·61	4	7	1	4	4·80	9	9	2	12
Golden Nugget	0·8	4	5	.....		·51	11	10	0	2
Open Air	4·04	3	9	7	3	4·13	11	15	3	9
Alacrity, 4–5·1	3·38	3	6	2	10	4·59	11	2	11	4
Burbank (G)	3·35	3	1	..	15	4·64	9	15	5	13
Sparks Earliana (E)	3·23	2	14	2	6	4·26	15	1	5	7
Earliest Globe Trotter	0·91	2	13	.....		1·22	11	9	0	1
Earliana Gr. 2	3·81	2	12	3	5	4·34	9	3	6	13
Belle de Baltimore	3·0	2	11	..	3	5·42	10	12	6	4
Avon	3·7	2	10	2	3	4·87	15	8	7	5
Earliana Gr. 3	3·99	2	8	4	6	4·31	10	4	15	13
Comet	2·94	2	4	..	13	3·44	10	12	3	6
Millets Dakota	3·05	2	3	..	7	3·94	8	0	4	2
Best of All	2·16	2	3	..	4	4·30	13	7	1	7
Rosy Morn	3·61	2	0	0	3	6·28	11	8	4	1
Gulf State Market	5·14	2	0	2	2	5·2	6	0	3	5
Burbank	2·97	1	15	.....		2·69	4	15	0	4
Bonny Best II	3·82	1	13	0	6	4·66	13	15	3	9
Bonny Best (S)	3·57	1	13	0	6	5·26	7	10	3	9
Pink No. 2	2·87	1	7	.....		2·99	5	12	.....	
Hudson Valley Maid	3·10	1	1	..	10	5·42	12	15	3	6
Glory	3·0	1	0	..	10	3·45	6	12	3	0
Sunrise	2·66	1	0	.....		3·08	7	8	.....	
Matchless	5·5	..	11	.....		5·37	5	5	2	1
Detroit	7·0	..	14	.....		4·77	5	10	1	2
Raycroft	1·8	..	9	..	2	4·38	10	5	1	1
Ignotum	5·0	..	5	.....		3·94	5	13	3	4
Faukes No. 1	1·66	..	5	.....		1·85	4	6	..	1
Livingstone Globe	.....	.....		.....		6·64	8	12	..	7
Coreless	.....	.....		.....		5·30	..	8	..	8
Matchless	.....	.....		.....		5·4	4	5	1	8

From the above results, it is quite clear that four of the varieties at the top of the table are outstanding for early yielding, and amongst these is found Alacrity 4-9.2, which is one of the Ottawa varieties. Alacrity has maintained a place at the top of the list of varieties as an early yielder. The adaptability of Alacrity to conditions where quick development is required, has been reported as most satisfactory. This applies to regions north and northwest, where the season is comparatively short.

While one strain of Burbank heads the list, yet it will be noticed that two other strains are quite well down in the yield for both periods.

This fact demonstrates the desirability of securing a strain that has been carefully selected, as regional conditions may have a considerable influence in the performance of a variety. The same may be said of the other varieties included in this list.

Growers of tomatoes might find these early, heavy-yielding varieties of value, and are therefore advised to give them a trial.

PRUNING TOMATOES FOR EARLY MATURITY

By close planting and pruning of tomato plants, there is a possibility of obtaining a paying early crop from a comparatively small area of land. Last season, an experiment was started to ascertain whether planting 18 by 24 inches apart and pruning the plants to one truss, two trusses and three trusses of fruit, would yield results of commercial value, when further compared with plants trained to one stem on stakes as commonly grown.

PRUNING TOMATOES

Variety	Yield first two weeks				Yield for Month			
	Average weight fruits in oz.	Marketable		Unmarketable	Average weight fruits in oz.	Marketable		Unmarketable
		One Truss						
		lb.	oz.	lb. oz.		lb.	oz.	lb. oz.
Alacrity 4-5-1	3·13	2	4	2 4	2·76	2	7	3 13
Alacrity 1-8-1	2·81	3	15	1 14	2·82	4	6	1 14
Bonny Best 5931	2·64	2	8	1 5	2·84	2	12	3 2
		8	11	5 7		9	9	8 13
		Two Trusses						
Alacrity 4-5-1	4·03	14	14	9 7	3·39	20	0	22 0
Alacrity 1-8-1	3·28	5	13	1 4	3·32	7	3	2 6
Bonny Best 5931	2·53	2	9	2 7	3·26	4·14		6 7
		23	4	13 2		32	1	30 13
		Three Trusses						
Alacrity 4-5-1	3·46	3	4	2 12	3·74	4	9	6 3
Alacrity 1-8-1	3·06	4	1	1 1	3·19	4	11	3 11
Alacrity 4-9-2	3·38	5	4	1 8	3·59	6	15	3 0
		12	9	5 5		16	3	12 14
		Single Stem not Headed Back						
Alacrity 4-5-1	3·17	1	14	3 1	3·70	4	7	6 8
Alacrity 1-8-1	3·29	3	14	3 0	3·83	6	8	4 5
Alacrity 10-4-2	3·11	4	5	1 1	3·76	8	2	2 14
		10	1	7 2		19	1	13 11

While the above results are based on but one season's work, yet they bring out very nicely that two trusses of fruit proved a decided advantage over the yields from the one truss and those plants not headed back. It seems to point out that under favourable conditions, and with a suitable strain of an early variety, good results could be obtained.

SEEDLING POTATOES

For many years past the growing of potatoes from seed has been carried on to quite an extent in this division, but up to date there have not been any new productions of value obtained, when compared with the standard commercial varieties. However, one factor that may have had influence on the success or failure of the work is that all the seed used was obtained from outside sources.

FIG. 8.—Seedling potato—Seed sown March 31; photo taken June 13.

During the season of 1922 there was found to be a considerable quantity of potato seed balls formed on some of the varieties of potatoes that were being grown on loamy land. Although these seed balls were quite green at the time of harvesting, October 21, they were carefully gathered and stored in paper bags, which were placed in a warm room with the tops left open. When the seed balls began to shrivel, the seeds were extracted, washed and spread out to dry on muslin.

To obtain tubers of desirable size, so as to be able to discard the poor type hills, the first season the seed was sown in flats in the greenhouse the last week in March, in a manner quite similar to that of sowing tomato seed. When the

plants were large enough, they were pricked out into flats, two by two inches apart. These were again transplanted into strawberry boxes in warm beds and grown along in this way until June 15, when they were planted out in the field in rows 36 inches apart and 30 inches apart in the rows. By planting time, the plants had attained the height of ten to twelve inches.

FIG. 9.—Vine from one hill grown from seed 1923. This vine measured 32 inches in height and produced seed balls.

The cultivation and general care given the main potato crop was all that was found necessary for the seedlings. A very wide variation was found in the habit of growth in the various groups of plants, and it was only the rare exception to find a plant that lacked vigour, or showed indications of plant diseases, such as leaf roll or mosaic. In fact, many of the plants did so well that they produced seed balls.

Out of five hundred hills, it was possible this year to select sixty-five hills that gave promise of being of value.

The yield from the individual hills ranged in weight from a few ounces up to five pounds fifteen ounces. Quite a number of tubers were obtained, which weighed between nine and ten ounces, with a large percentage of the balance of the hills running a good table size. In the accompanying picture will be seen desirable tubers from selected hills, which are to be used for further propagation.

Fig. 11.—Potatoes of marketable size grown from seed in one season.

CROSS-BRED PEAS

The crossing of garden peas, for the purpose of combining certain good qualities in the resulting offspring, has been carried on to quite an extent. The crosses, Gradus x American Wonder, and Gregory Surprise x English Wonder, have both been found to possess superior quality and productiveness and have been propagated in sufficient quantities to be available for distribution.

During the season of 1922, further crossing was done between the following varieties for the purpose of combining earliness, productiveness, sweetness and size of pods.

The varieties used in these crosses and reciprocal crosses were as follows:—

Alaska x Laxton Progress
" x English Wonder
" x Thomas Laxton
" x Gradus.

The results to the present have been satisfactory in that a wide range of variation has been obtained in the character of the progeny and the type of crop borne on each plant. It is hoped that from these crosses, some valuable additions will be made to the varieties now existing.

CORN IMPROVEMENT

The improvement of the early maturing strains of Pickaninny, Early Malcolm and Sweet Squaw corn has been pursued during former years with the object of perfecting them as nearly as possible for fixed types. The ideals worked for in the past were earliness, length of ears, number of rows per ear and number of ears per stalk. To a large measure these ideals were obtained. The large number of favourable reports concerning these varieties, received from experimenters from all parts of Canada, clearly indicate that the work done in the past had produced something worthy of note.

During the past three years, the establishment of pure strains of corn traceable to the progeny of one plant has been under way, with good results recorded. This line of work seems clearly to point to the establishment of a better seed supply of these varieties in the future. In the table to follow will be seen the results obtained from a strain selected from the Pickaninny corn crop of 1920. While there is a constancy in the rows per ear remaining fairly fixed, yet there is a slight tendency for an increase from 8 to 10 and even 12 rows per ear. In the case of percentage of length of ears, it will be seen that there is a decided increase in the 4 and 5 inch columns, while the number of ears per stalk in the 2 and 3 ear columns showed advancement. The chief objects with this particular variety are to maintain its superiority in earliness and productiveness, and to increase the length of ears and number of rows without the sacrifice of the former two qualities.

CORN IMPROVEMENT—PICKANINNY

Year	Record Number	Rows per Ear			Length of ears in inches					Ears per Stalk				
		8	10	12	2	3	4	5	6	1	2	3	4	5
		%	%	%	%	%	%	%	%	%	%	%	%	%
1920.....	846-58	1·0	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1921.....	1914	96·9	3·1	.....	3·1	39·8	35·7	20·1	1·1	.....	.....	*	*	.....
1922.....	2827	87·41	11·93	0·64	21·29	30·0	25·48	19·67	3·54	77·74	18·06	4·19	.....	0·42
1923.....	5553	82·63	17·36	.....	4·73	22·63	47·36	24·21	1·05	86·31	13·63	....	.....	.....
1920.....	846-58	1·0	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1921.....	1914	96·9	3·1	.....	3·1	39·8	35·7	20·1	1·1	.....	.....	*	*	.....
1922.....	2827	87·41	11·93	0·64	21·29	30·0	25·48	19·67	3·54	77·74	18·06	4·19	.....	0·42
1923.....	5554	88·32	11·67	.....	5·11	16·05	30·65	43·79	4·37	70·07	28·46	1·46	.....	.....
1920.....	846-58	1·0	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1921.....	1914	96·9	3·1	.....	3·1	39·8	35·7	20·1	1·1	.....	.....	*	*	.....
1922.....	2827	87·41	11·93	0·64	21·29	30·0	25·48	19·67	3·54	77·74	18·06	4·19	.....	0·42
1923.....	5555	93·93	4·54	1·5	6·06	22·72	30·30	37·87	3·03	59·09	36·36	4·23	.....	.....
1920.....	846-58	1·0	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1921.....	1914	96·9	3·1	.....	3·1	39·8	35·7	20·1	1·1	.....	.....	.....	.....	.....
1922.....	2827	87·41	11·93	0·64	21·29	30·0	25·48	19·67	3·54	77·74	18·06	4·19	.....	0·42
1923.....	5556	89·55	10·4	.....	5·92	26·86	23·88	40·29	2·98	77·61	13·43	8·95	.....	.....

Further selfing and isolating of strains will be carried on as far as safety will permit, with these three varieties now on the market.

RHUBARB

The Ottawa seedlings Nos. 1, 3, 7, 10 again proved their worth as high yielders this season. The good qualities of these seedlings merited consideration as a valuable addition to the list of varieties now under name. Mr. W. T. Macoun, Dominion Horticulturist, named this variety this year, calling it *"RUBY."*

To enable people in all parts of Canada to obtain information concerning the performance of *RUBY* rhubarb, one entire plant of Ruby No. 10 was sent to each of the Experimental Stations in Canada.

MUSKMELON IMPROVEMENT

The improvement of Emerald Gem muskmelons by inbreeding and selection has been carried on to quite an extent. The resulting strains are worthy of mention, and seed of some of the strains was sent to the branch farms this year for trial.

FIG. 12.—A Central Experimental Farm strain of Emerald Gem muskmelon.

VARIETY TESTING

While plant breeding and selection work is stressed to a considerable degree, yet this work is not being conducted to the exclusion of the comparison test work. The comparison test work serves as a check on the value of the new sorts produced and is a measure of ascertaining the real value of these new sorts. The many kinds of vegetables tested in the plots last season are as follows: asparagus, beet, bean, cabbage, carrot, cauliflower, celery, citron, corn, cucumber, cress, chives, endive, muskmelon, onion, parsnip, peas, pepper, potato, pumpkin, radish, rhubarb, squash, tomato and watermelon.

CULTURAL EXPERIMENTS

The value of cultural experiments cannot be overestimated, because it is very often the case that the cultural methods employed have a definite bearing on the results obtained. Work of this kind is being carried on with beets, beans, cabbage, carrots, cauliflower, celery, corn, parsnips, peas, potatoes and tomatoes, much of which is yielding valuable information concerning the production of crops by varied means.

CABBAGE

From time to time there is an occasional new variety advertised for which great claims are made. During the past season, the Golden Acre variety of cabbage was tested in a comparison with Early Jersey Wakefield and Copenhagen Market, and while both the latter two varieties have been acknowledged to be outstanding, early sorts of extremely good quality, yet they were outstripped for earliness by Golden Acre.

In the table it will be noticed that the season of cutting was comparatively short in the case of Golden Acre, but a glance at the weight of heads shows that the latter two produced much heavier heads. However, considering the earliness and short cutting season it looks as if this variety might have an advantage over the latter two.

VARIETY TEST OF CABBAGE

Name of Variety	Date Seed Sown	Date Planted	Date First Cutting	Date Last Cutting	Weight of 24 heads
					lb.
Golden Acre	May 17	June 21	Aug. 9	Sept. 6	85
Early Jersey Wakefield	May 17	June 21	Aug. 12	Sept. 26	102
Copenhagen Market	May 17	June 21	Aug. 14	Sept. 26	108

There was found to be quite a wide variation in the plants, which was very pronounced in the colour of the foliage and also in the shape of the foliage. However, the form of heads was quite uniform, resembling Copenhagen Market very closely. No doubt if all the strains of Golden Acre on the market prove as satisfactory as this one, it is safe to recommend this new sort to the growers of cabbage.

VARIETY TESTING FOR TRUENESS

The great demand for reliable vegetable seeds made by the growers of vegetable crops has been the instigation of some new lines of work being started, with special stress upon the purity of varieties and trueness to type. In the past, there has been a very large number of so-called new varieties offered for sale, when in reality they were only the same old varieties with new names, or as is often found, the terms "Improved," "Reselected," etc., were coupled with the old variety name. This led to disappointment, for in many cases it was found that these "Improved" or "Reselected" strains were in reality no better than the original old strains of the variety. Very often it had been discovered that the plants obtained from packages of seed did not yield crops comparable with the descriptive advertising in the catalogues or on the packages.

During the season of 1923, the Seed Branch of the Dominion Department of Agriculture collected three thousand and sixty-seven samples of nine of the important vegetable crops, and submitted these seeds to this Division, under numbers, for trial. The seeds were sown in the trial plots, under very uniform soil conditions, the week of June 14. Notes were kept concerning the dates of germination, whether strong or weak, and when the variety or strain was ready for use. Very careful comparisons were necessary to establish the relationship of the various strains. This entailed the taking of very complete notes and photographs to show the desired types which are accepted as standards of the various varieties.

In the accompanying abbreviated table, is given the varieties with the total numbers and total percentages, under each heading.

VEGETABLE VARIETY TEST FOR TRUENESS

Vegetables	Total number of samples	Per cent of total number 100 per cent true to name	Per cent of total number 99 per cent true to name	Per cent of total number 98 per cent true to name	Per cent of total number 97 per cent true to name	Per cent of total number 96 per cent true to name	Per cent of total number 95 per cent true to name	Per cent of total number under 95 per cent true to name
Celery	169	36·0	.....	.....	.....	.....	0·5	63·5
Lettuce	382	59	.....	.....	0·5	.....	2·0	38·5
Radish	488	49	0·4	3·4	1·4	2·2	1·8	41·8
Beet	273	40	.....	.....	0·3	2·0	.....	57·7
Peas	469	87	.....	0·2	.....	0·2	0·8	11·8
Parsnips	90	57	.....	.....	.....	.....	.....	43·0
Onion	391	71·1	.....	0·8	6·9	6·2	3·8	11·2
Carrots	298	27	0·6	0·6	0·3	.....	.....	71·5
Beans	507	51	.....	.....	.....	0·3	0·5	48·2

From the above table a fair idea can be obtained of the purity percentages of the various kinds of vegetable seeds. By the continued testing of the various seeds advertised for sale and the enforcement of the Seed Act, a decided improvement may be expected in the very near future.

SEED DISTRIBUTION

Although the free distribution of Ottawa-grown vegetable seed has been reduced as compared with the distribution of former years, yet the demand for this seed is enormous and especially from parts in the east and middle west of Canada. The first applications were received early in November and a constant flow maintained until quite late in May, but as the stock of seed of most of the varieties was very limited, it was found necessary to discontinue accepting applications after February 15. Consequently, a very large number of applicants were disappointed.

As this distribution of garden seed was, and is yet, for the purpose of obtaining some idea of the value of the Ottawa-grown seed, and especially to obtain information concerning the new varieties, it would be wrong to allow this branch of the work to be abused, and made the source of supply for free garden seeds in a general way. In the table will be seen the results concerning the accepted applications, number of reports received, number of good reports in which specific reference was made to the dates of sowing, ready for use, quality with reference to other varieties compared and the yield from a specified size of plot. In the useless report column, quite a percentage of the reports had to be placed, while a very large number did not report at all.

1923 REPORTS FROM SEED DISTRIBUTION

Province	Number of collection packages sent out	Number of reports received	Number of useful reports	Number of useless reports	Number that did not report
Prince Edward Island	3	2	2	.....	1
Nova Scotia	23	6	4	2	17
New Brunswick	21	2	2	.....	19
Quebec	152	52	30	22	100
Ontario	114	25	15	10	89
Manitoba	43	19	12	7	24
Saskatchewan	78	38	30	8	40
Alberta	74	20	12	8	54
British Columbia	41	14	12	2	27
Unclassified	3	2	2	.....	1
Totals	552	180	121	59	372

FORCING CUCUMBERS IN GREENHOUSE

OBJECT OF THE EXPERIMENT

First, to test the seedlings from crosses made in the Central Experimental Farm greenhouses in 1921 between Hescrow and Deltus (Hescrow 61-8-15 x Deltus); in other words, to compare individual plants of the F_2, also to compare individual plants of F_2 of Hescrow 61-8-15 x Vaughan.

Second, to compare two systems of training F_2 Hescrow 61-8-15 x Deltus, namely, the fan system, in which the plants were allowed to grow three feet high, then pinched back. Then when the first fruit set on the laterals they were pinched back, and as each lateral was developed it was pinched back as the first. In the upright system the plants were allowed to grow naturally without any pruning.

Third, to determine the total yield of cucumbers for the whole house, the cost of operations, and price obtained for the product.

HOW THE EXPERIMENT WAS CONDUCTED

The vegetable, or west house, was used for this experiment. The soil was rotted sod and manure. The average temperature was 70° F. The soil was sterilized with steam before planting.

The varieties were:—

F_2 Hescrow 61-8-15 x Vaughan No. 1.
F_2 Hescrow 61-8-15 x Vaughan No. 2.
F_2 Hescrow 61-8-15 x Deltus No. 1.
F_2 Hescrow 61-8-15 x Deltus No. 2.
F_2 Hescrow 61-8-15 x Deltus No. 3.

Date of sowing seed, March 5, 1923.

Planted in vegetable house out of 4-inch pots, April 5, 1923.

In the fan system of training the plants were three feet apart in rows three and one-half feet apart. In the upright system the plants were two feet apart in rows two feet apart.

The plants on the benches were trained in the fan system and were in a single row three feet apart.

Date of first picking in each system, May 11, 1923.

YIELD FOR FIRST FOUR WEEKS FROM ALL CUCUMBER PLANTS EXCEPT DUPLICATES

Variety	Number of plants	Number of marketable fruits	Weight of marketable fruits		Weight of unmarketable fruits		Average Yield per plant for first four weeks
			lb.	oz.	lb.	oz.	lb.
West Side—Fan System							
F_2 Hescrow 61-8-15 x Vaughan No. 1	1	19	20	7	..	..	20·43
F_2 Hescrow 61-8-15 x Vaughan No. 2	6	104	116	11½	22	15½	19·44
F_2 Hescrow 61-8-15 x Deltus No. 1	9	146	158	5	8	9	17·59
F_2 Hescrow 61-8-15 x Deltus No. 2	4	63	70	3	2	12	17·53
F_2 Hescrow 61-8-15 x Deltus No. 3	3	52	55	6½	1	7½	18·45
East Side—Fan System							
F_2 Hescrow 61-8-15 x Vaughan No. 1	5	83	86	8	1	10	17·30
F_2 Hescrow 61-8-15 x Vaughan No. 2	2	32	34	14½	..	9	17·43
F_2 Hescrow 61-8-15 x Deltus No. 1	9	175	187	4	2	14½	20·80
F_2 Hescrow 61-8-15 x Deltus No. 2	4	75	84	14½	..	..	21·21
F_2 Hescrow 61-8-15 x Deltus No. 3	3	48	64	14½	5	10	21·62

YIELD FOR WHOLE SEASON FROM ALL CUCUMBER PLANTS EXCEPT DUPLICATES

Variety	Number of plants	Number of marketable fruits	Weight of marketable fruits	Weight of unmarketable fruits	Average Yield per plant for whole season
			lb. oz.	lb. oz.	lb.
Centre Bed—Fan System					
F_2 Hescrow 61-8-15 x Deltus No. 1	9	296	332 12½	7 12½	36·97
F_2 Hescrow 61-8-15 x Deltus No. 2	9	332	382 11	8 2	42·52
Upright System					
F_2 Hescrow 61-8-15 x Deltus No. 1	20	362	385 2	8 4	19·25
F_2 Hescrow 61-8-15 x Deltus No. 2	20	368	409 13	6 4½	20·49
Total	58	1,358	1,510 5½	30 7	.....
West Side—Fan System					
F_2 Hescrow 61-8-15 x Vaughan No. 1	1	23	25 6	1 7	25·37
F_2 Hescrow 61-8-15 x Vaughan No. 2	6	152	185 5	12 12½	30·88
F_2 Hescrow 61-8-15 x Deltus No. 1	9	283	307 8	13 12	34·16
F_2 Hescrow 61-8-15 x Deltus No. 2	4	136	146 9	7 12	36·64
F_2 Hescrow 61-8-15 x Deltus No. 3	3	130	139 5½	4 15½	46·43
East Side—Fan System					
F_2 Hescrow 61-8-15 x Vaughan No. 1	5	132	140 5	5 7	26·06
F_2 Hescrow 61-8-15 x Vaughan No. 2	2	70	80 13	1 2	40·40
F_2 Hescrow 61-8-15 x Deltus No. 1	9	343	388 4½	12 ½	43·14
F_2 Hescrow 61-8-15 x Deltus No. 2	4	151	170 8½	.. ..	42·62
F_2 Hescrow 61-8-15 x Deltus No. 3	3	129	136 3½	4 15	45·39

TOTAL YIELD OF ALL CUCUMBER PLANTS FOR WHOLE SEASON

Variety	Number of plants	Number of marketable fruits	Weight of marketable fruits	Weight of unmarketable fruits	Average Yield per plant for whole season
			lb. oz.	lb. oz.	
F^2 Hescrow 61-8-15 x Deltus No. 1	50	1,399	1537 5½	41 13	30·74
F^2 Hescrow 61-8-15 x Deltus No. 2	37	987	1,109 9½	22 2½	29·98
F^2 Hescrow 61-8-15 x Deltus No. 3	9	343	357 9	12 6½	39·72
F^2 Hescrow 61-8-15 x Vaughan No. 1	6	155	165 11	6 14	27·61
F^2 Hescrow 61-8-15 x Vaughan No. 2	8	222	266 2	13 14½	33·26
Total yield from whole house	110	3,116	3,436 5	97 2½	.....

TIME SPENT ON VARIOUS OPERATIONS

Preparing bed	30 hours
Sowing seed	2 "
Transplanting into 4-inch pots	4 "
Planting in beds	7 "
Pollination	37 "
Watering	133½ "
Tying	21 "
Harvesting	39½ "
Cutting down vines	6 "
Total	280 "

Receipts

259¾ dozen cucumbers at $2.50 per dozen	$ 649.38

Expenditure

280 hours of labour at 37 cents per hour	103 60
Balance	$ 545 78

This was a good experiment. The plants grew well and were not affected by nematodes or other enemies.

ORNAMENTAL GARDENING

PERENNIAL CLIMBING PLANTS

For many years a large number of kinds of climbing plants have been under test at the Central Experimental Farm, Ottawa, and much information obtained in regard to their relative hardiness, attractiveness and usefulness. There are many houses which could be made much more attractive-looking by the judicious use of some of these vines. A house which lacks any pretence of beauty in architecture may have much of the stiffness taken from it by planting a vine where it will break the monotony of a straight wall. Verandahs, summer houses, fences, rocks and old stumps of trees covered with climbing plants will so change the appearance of a place that it will hardly be recognized by one who has known it before. There are so many good, hardy, native climbers that it is not necessary to go to any expense in procuring something which will produce the desired effect. In the following list of vines found most satisfactory at Ottawa are a number of native plants.

Climbers usually make rapid growth when once established. The best results will be obtained, however, by preparing the ground well beforehand. Usually the soil about buildings is poor, and, if such be the case, it will well repay anyone to remove it where the vines are to be planted and replace it with some of a good loamy character, thoroughly mixing well-rotted manure with it. If such preparation is given the results will almost certainly be satisfactory.

The following perennial climbers all have woody stems except the Wild Hop, Kudzu Vine and Perennial Pea:—

Ampelopsis quinquefolia (Virginia Creeper).—This native climber, also known as *Parthenocissus quinquefolia, Psedera quinquefolia* and *Vitis quinquefolia,* is one of the most popular ornamental vines. It is a rapid grower and, being a native of the colder parts of Eastern Canada westward to Manitoba, is one of the hardiest. Its glossy, green leaves become very brilliant in autumn, when they assume many shades of red. Although it has tendrils by which it clings, if there are crevices into which they can be inserted, it will not cling to a wall where there are not such places and has to be supported in some other way. It is very desirable for training over summer houses, fences, verandahs, and even on walls, where it falls in graceful festoons and becomes very attractive. Unfortunately it is much subject to leaf hoppers and, while there is a remedy in whale oil soap, tobacco preparations or kerosene emulsion, they have to be applied very persistently and the work begun before the vines have become disfigured. Where there is a good circulation of air, or where the vines are often moved by the wind, they will not be so troublesome.

Ampelopsis quinquefolia Engelmannii (Engelmann Virginia Creeper).—This variety has smaller foliage than the type and has discs on the tendrils by which it clings to walls, thus not needing to be provided with a special support as does the type. At times, however, such as when there is a high wind, these discs are not sufficient to hold the vines and they are blown down, hence the variety hirsuta, which is provided with more discs, is more satisfactory.

Ampelopsis quinquefolia hirsuta (Self-fastening Virginia Creeper or Hairy Virginia Creeper).—The Self-fastening Virginia Creeper is a very distinct variety found growing wild at Ottawa and other districts in Eastern Canada and, no doubt, in the United States. The leaves are smaller than the type and are distinguished from it also by being downy or hairy and are of a duller colour in summer, though they become bright red in autumn. Its great value lies in its having discs on the short tendrils by which it clings tightly to brick, stone, concrete, or wood, hence needs no special support. Moreover, the downiness of the leaves is evidently unpleasant to the leaf hopper, as there is usually little or no injury.

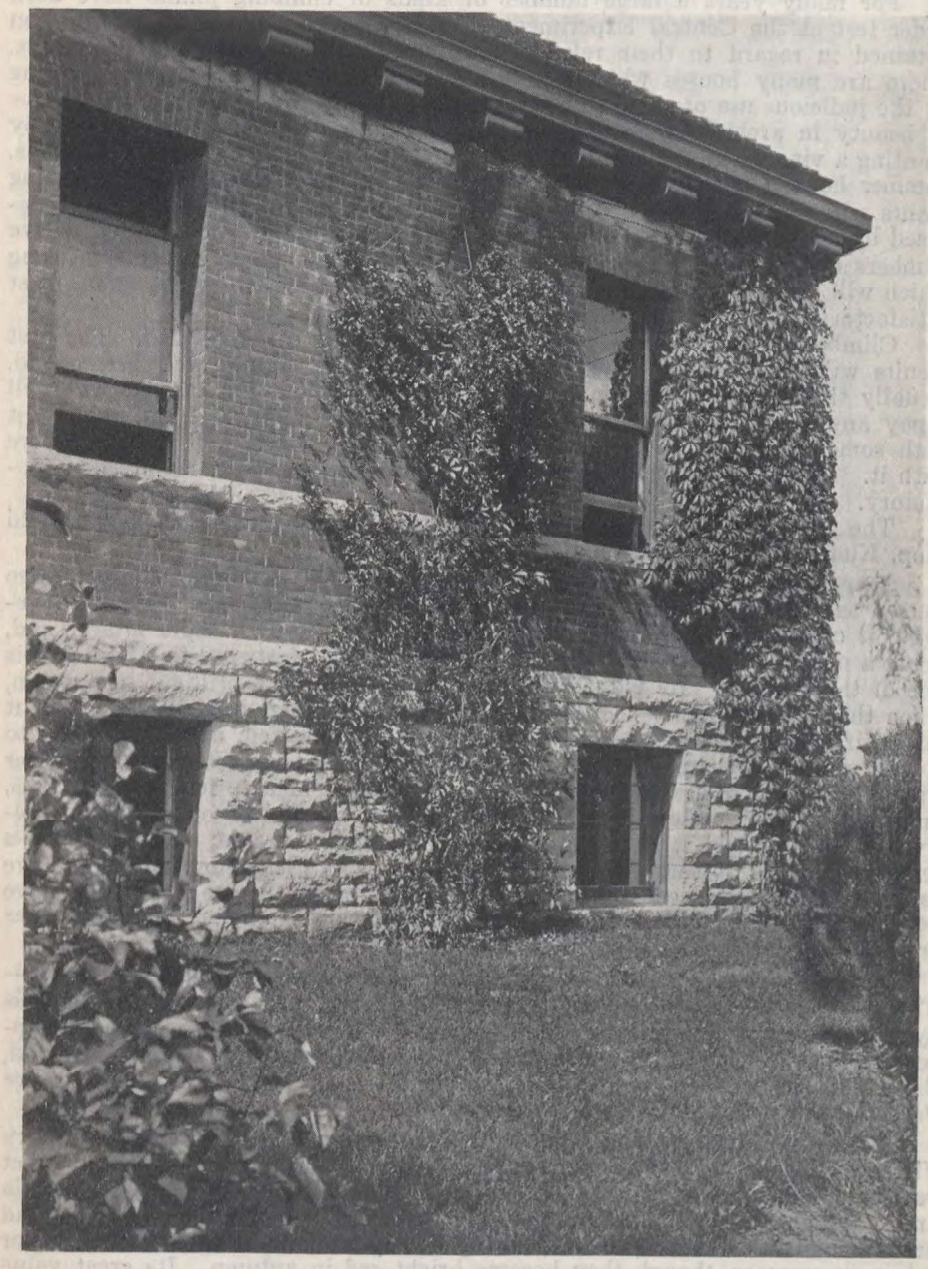


FIG. 13.—Englemann Virginia Creeper on the left; Self-fastening Virginia Creeper on right. The latter clings much better than the former.

Ampelopsis tricuspidata (Japanese Ivy or Boston Ivy).—Other names for this excellent climber or creeper are *Ampelopsis Veitchii, Parthenocissus tricuspidata* and *Vitis inconstans*. The Japanese Ivy is not quite hardy enough in Eastern Ontario. Occasional vines at Ottawa develop well, but it kills back more or less every year and sometimes is killed out altogether. In the warmest parts of Canada, however, it is grown with good success. It is a beautiful vine and clings so tightly to the wall on which it is trained that it is unsurpassed in this regard. The leaves are of an attractive green in summer and, at times, are highly coloured in autumn. When grown in those parts of Canada where it kills back badly in winter a north or west exposure is desirable. The thawing and freezing which it often gets on a south side in early spring is very hard on it. It is desirable to protect the lower part of the vine with sacking, or wood with straw underneath, which will better ensure part of the plant coming through safely.

Aristolochia Sipho (Dutchman's Pipe).—Although this fine climber is somewhat slow in becoming established and usually does not make much growth for two or three years, once it is well rooted it grows very rapidly and becomes one of the most beautiful and striking hardy vines available. The leaves are large, heart-shaped and deep green and give a semi-tropical effect. It has a heavier look than some other vines and seems in keeping rather with the more massive style of verandah than that of lighter design. It is of a twining habit and looks well on either a trellis or verandah. The flowers, which are partially hidden by the large leaves, are brown and of a peculiar shape, much resembling a Dutchman's pipe. It is a native of the Eastern States and grows from twenty to thirty feet or more high.

Celastrus orbiculatus (Japanese Bittersweet).—Although the native species is very attractive, this, in some respects, is still more so, as the fruits are smaller, more numerous, and the whole effect more graceful. It is, however, after the leaves have fallen that the fruit is so noticeable, as before that time, that of the native Climbing Bittersweet is, perhaps, more conspicuous. There is a greater contrast between the outside and inside of the fruit of the Japanese than there is in *Celastrus scandens,* the colours being distinct yellow and orange. This is a native of Japan and China. It is quite hardy, is a rapid grower and very desirable, especially for covering fences. One should be sure of getting a plant having both male and female flowers to ensure having a crop of fruit.

Celastrus scandens (American Bittersweet, Wax-work).—This is one of the best native climbers. It is a very rapid, even rampant grower, with glossy green leaves and highly ornamental fruit, and very suitable for training over summer houses and verandahs as it twines about everything it can get hold of. It is particularly free from injurious insects and diseases. In the autumn and early winter, after the leaves have fallen, the attractiveness of this vine is continued by the orange coloured fruit or berries which, after the early frosts, crack open, revealing a scarlet interior. In procuring this vine one should get one which is known to fruit or has been propagated from one that is known to fruit, as some vines have only male blossoms and there is no fruit on such.

Clematis Jackmanii (Jackman Clematis).—This is the most satisfactory of the large-flowered Clematis. It is a very free bloomer and remains in flower for several weeks. The flowers are very large and rich violet purple in colour, with a velvety appearance. Where a strong colour effect is desired this is a good plant to use. There are many large-flowered hybrid clematis and a good range in colour can easily be obtained. The chief defect in these varieties is that they are subject to the injury known as collar rot, especially the first year or two after setting out, but once they become well established they usually thrive well.

Clematis ligusticifolia (Western Virgin's Bower).—The Western Virgin's Bower is a native of the drier districts of Western Canada and the United States, and when grown in Eastern Canada it should be planted in as dry a situation as possible. It is particularly valuable in the Prairie Provinces, where the number of hardy perennial climbers is limited and where the summers are relatively dry. There it makes an excellent climber for a trellis on the verandah or house and reaches a height of twenty feet or more. The leaves are glossy and attractive in appearance and these, combined with the numerous small white flowers which this native vine bears, make it a very desirable plant, especially for the colder and drier parts of Canada.

Clematis paniculata (Japanese Clematis).—This clematis, which is also called Sweet Autumn Clematis because of its sweet-scented flowers, is a very ornamental climber, and because it blooms in September is particularly valuable where it succeeds well. A warm and well-drained situation is best for it. At Ottawa it often kills out if not given some protection before winter sets in and is really not as generally satisfactory as in the warmer districts. The flowers are larger and whiter than most of the other small-flowered species. When it succeeds well it reaches a height of fifteen feet or more. It is a native of Japan.

Clematis virginiana (Virgin's Bower).—The Virgin's Bower is a common native climber in Eastern Canada and is not used as much as it should be for beautifying the home. Next to the Virginia Creeper it is, perhaps, the most satisfactory native climber to plant, and where Virginia Creepers are badly affected with leaf hoppers or thrips it may give better satisfaction than the latter. It is a very rapid grower and soon covers anything it is planted near, reaching a height of twenty feet or more. It clings by tendrils and should have something to which these can fasten.

Clematis Vitalba (Traveller's Joy).—The Traveller's Joy is an European species very much like the Virgin's Bower, and where the latter cannot be obtained the Traveller's Joy is a good substitute. It is an even stronger grower than the Virginia Creeper and reaches a height of from twenty to thirty feet.

Humulus Lupulus (Common Hop).—The common hop is used more in the Prairie Provinces as a climber about the house than in any other part of Canada. It is a native of the prairies and very hardy and makes rapid growth from the ground each year. It is not, however, as attractive a vine as some others, but where the number of hardy vines is limited the common hop is not to be despised. It makes an excellent screen from sun during the hot weather.

Lathyrus latifolius (Perennial Pea).—While not a tall climber the perennial pea is quite satisfactory if one does not desire a vine which grows more than eight or nine feet high. While the flowers are not sweet-scented, they are very attractive and of great substance and are usually in bloom before the sweet pea. The white and pale pink shades are among the most attractive.

Lonicera hirsuta (Hairy Honeysuckle).—There are several native climbing honeysuckles, but this is perhaps the best of them. It bears attractive orange-yellow flowers during the month of June. It is not, however, as satisfactory a climber as the Scarlet Trumpet Honeysuckle, as its blooming season is soon over.

Lonicera japonica Halliana (Hall Japanese Honeysuckle).—This honeysuckle is not hardy at Ottawa, but is often planted, as it is much recommended when it succeeds, as it does in the warmest parts of Canada. The flowers are small white, turning to yellow. Where hardy it blooms well during the latter part of summer.

Lonicera Periclymenum (Woodbine, English Honeysuckle).—Because of the agreeable, spicy odour of its flowers and its association with the Old Land this is a very popular climber with many where it succeeds well. At Ottawa, however, it has not proved very hardy and usually there are but few flowers and occasionally the vines are killed out altogether.

Lonicera sempervirens (Scarlet Trumpet Honeysuckle).—No other honeysuckle has proved as desirable at Ottawa as this one. It blooms almost continuously from the first week of June until late in the autumn and the bright scarlet, trumpet-shaped flowers, which are borne profusely, are very effective. It is a native of the Eastern United States and almost perfectly hardy at Ottawa.

Lycium chinense (Chinese Matrimony-Vine).—Where a tall-growing climber is not desired and something is needed for covering rocks, stumps or trees this is very useful. While neither the leaves nor flowers are particularly ornamental, the graceful habit of the plant commends it, together with the fact that in the autumn the bright scarlet fruit gives it a very attractive appearance. The European or common Matrimony-Vine (*Lycium europaeum*) is a desirable climber also, but is not so good as *L. chinense,* as the fruit is smaller and the foliage not so attractive.

Pueraria hirsuta (Kudzu Vine).—The Kudzu vine is one of the fastest and strongest growing climbing plants and will make a growth of from forty to fifty feet in one season when conditions are favourable. It has not proven hardy at Ottawa and is only suited to the warmest parts of Canada and is really too rampant a grower to be very satisfactory even when it does succeed. It is a native of Japan.

Roses—Climbing Varieties.—The climbing roses give wonderfully charming effects in the garden and about the house and, as hardier sorts are originated, their use will, no doubt, become much more general than it is at present. Now, the climbing roses that are available have all to be protected in winter at Ottawa and other places where the winters are as severe. Even when protected there are many which are not satisfactory, but the following have proved among the hardiest and most reliable: American Pillar, Crimson Rambler, Dorothy Perkins, Dr. Van Fleet, Euphrosyne, Evangeline, Hiawatha, Mrs. F. W. Flight, and Tausendschon.

Vitis vulpina (Riverbank Grape).—The Riverbank Grape is very hardy and grows wild as far west as Manitoba. It makes an ornamental climber and is a very rapid grower. The male and female flowers of this species are grown on different vines and to have the delightful perfume of the flowers, for which this species and other grapes are noted, one with male flowers should be planted. However, by having two vines, one with male and the other with female flowers, planted close together, one could have both the perfume and the fruit. One drawback to having the wild grape used as a climber near the house is that it is subject to the attacks of leaf hoppers, which often disfigure the leaves. In exposed places, however, where there is a good circulation of air, they will not be so troublesome.

Wisteria sinensis (Chinese Wisteria).—This beautiful climber is not hardy at Ottawa without protection, but if planted in a naturally protected place and the vine laid down and protected before winter sets in, it will bloom fairly well and is of such striking beauty when in bloom that a little special effort is well worth while. If left unprotected the wood will withstand the cold, or there will be very little killing back, but the flower buds are killed and there will be no bloom.

Other climbers to which reference should be made, which are not hardy at Ottawa, but which succeed in the milder parts of Canada, are the English Ivy *(Hedera Helix)*, the Trumpet Creeper *(Campsis radicans, Bignonia radicans, Tecoma radicans), Euonymus radicans vegeta* and the *Actinidia arguta.*

There are a few fine vines of English ivy on the Niagara peninsula, but it is not hardy at Ottawa. It is one of the few very good evergreen climbers and a hardy form of this would be very desirable.

The Trumpet Creeper makes strong growth each year at Ottawa, but is killed back badly each year and does not bloom well at all, although it has bloomed there. It is a native of the Eastern States, but extending south, and plants from the coldest part of its range are most likely to succeed. In some places in southwestern Ontario it blooms satisfactorily.

The evergreen climber or creeper known as *Euonymus radicans vegeta* is considered a little hardier than the English ivy and if it proves generally so will be a welcome addition, but this Euonymus is not hardy where the climate is as cold as Ottawa.

A Chinese vine known as *Actinidia arguta* is a very strong grower and has attractive fruit, but is only suitable for the warmest parts of Canada. It kills back badly at Ottawa.

Another very attractive climber when in full bloom is *Polygonum Baldschuanicum*, or Silver Fleecevine. The many small, pink and whitish, buckwheat-like flowers borne during the summer months give a very graceful appearance to this vine, which will grow to twenty feet in height. Unfortunately it is not quite hardy enough at Ottawa, being killed out from time to time.

ANNUAL CLIMBERS

Space does not permit a detailed description of the various satisfactory annual climbers, among which should be included the Sweet Pea, Nasturtium, Variegated Japanese Hop, Scarlet Runner and Canary Bird Vine, but there are two tender perennial climbers which are treated as annuals in Canada to which greater reference should be made. These are:—

Cobaea scandens.—This is a perennial plant in Mexico, where it is native, but it is treated as an annual in Canada as it will only stand a few degrees of frost. To get the best results from this fine climber the plants should be started in a hot-bed or in pots before being set out in the open after danger of frost is past. It makes a rapid and luxuriant growth during the summer and comes into bloom towards the latter part of the season. The flowers are about two inches in diameter and are either purple or greenish white, according to the variety planted. The purple flowering variety is the best, as the vine of this has purple stems, making the contrast with the leaves better. They are prettier also than the white ones. If the first autumn frosts are very light the Cobaea will withstand them. It is during the early autumn when it is in the best condition.

Boussingaultia baselloides (Madeira Vine).—This is another perennial which must be treated as an annual in Canada. The root is bulbous and is taken up in the autumn and kept dry during the winter and is planted in the spring after danger of frost is past. The growth of this pretty climber, which is an old favourite, is very rapid when the warm weather comes and a vine will cover a large surface during the summer. Its thick, bright green leaves are its chief attraction. The Madeira Vine is a native of Ecuador, but runs wild in the Southern States.

EXPERIMENTAL PROJECTS UNDER WAY IN THE HORTICULTURAL DIVISION, CENTRAL EXPERIMENTAL FARM, OTTAWA

HORTICULTURE

POMOLOGY—SMALL FRUITS

Project No.	Title
H. 1.	Blackberry, breeding.
H. 2.	Blackberry, variety experiment.
H. 3.	Currant, breeding.
H. 4.	Currant, variety experiment.
H. 5.	Gooseberry, breeding.
H. 6.	Gooseberry, variety experiment.
H. 8.	Raspberry, breeding.
H. 10.	Raspberry, protection versus no protection for winter.
H. 11.	Raspberry, variety experiment.
H. 13.	Strawberry, breeding.
H. 14.	Strawberry, bud heredity.
H. 17.	Strawberry, irrigation versus no irrigation.
H. 18.	Strawberry, plant age and yield correlation.
H. 19.	Strawberry, protection versus no protection for winter.
H. 20.	Strawberry, runners and yield correlation.
H. 21.	Strawberry, variety experiment.
H. 311.	Strawberry, genetic study of inheritance.

POMOLOGY—TREE FRUITS

H. 22.	Apple, breeding.
H. 23.	Apple breeding for the prairie provinces
H. 24.	Bud heredity.
H. 25.	Close planting experiments.
H. 27.	Genetics.
H. 28.	Influence of stock on scions.
H. 29.	Keeping experiment.
H. 31.	Pollination.
H. 32.	Pruning experiment.
H. 33.	Variety experiment.
H. 34.	Cherry, breeding.
H. 35.	Cherry, variety experiment.
H. 37.	Grape, breeding.
H. 38.	Grape, pollination.
H. 416.	Jonathan breakdown.
H. 418.	Apple identification by the leaves and stems.
H. 39.	Grape, pruning experiment.
H. 40.	Grape, variety experiment.
H. 43.	Pear, breeding.
H. 45.	Plum, breeding.
H. 46.	Plum, pollination.
H. 48.	Plum, variety experiment.
H. 50.	Tree repair.

VEGETABLE GARDENING

H. 54.	Asparagus, variety experiment.
H. 56.	Bean, breeding for yield.
H. 57.	Bean, of different seasons versus one variety planted at different dates.
H. 58.	Bean, distances of planting.
H. 61.	Bean, variety experiment, bush.
H. 62.	Bean, variety experiment, pole.
H. 59.	Bean, selected seed versus not selected.
H. 64.	Beet, breeding for trueness to type.
H. 65.	Beet, different dates of sowing.
H. 66.	Beet, seed production.
H. 67.	Beet, thinning experiment.

Project No.	Title
H. 68.	Beet, variety experiment.
H. 70.	Brussels sprouts, variety experiment.
H. 71.	Cabbage, breeding for trueness to type.
H. 72.	Cabbage, different dates of sowing for storage purposes.
H. 75.	Cabbage, protection from root maggot.
H. 76.	Cabbage, seed production.
H. 77.	Cabbage, variety experiment.
H. 78.	Carrot, breeding for trueness to type.
H. 79.	Carrot, different dates of sowing.
H. 81.	Carrot, seed production.
H. 82.	Carrot, thinning experiment.
H. 83.	Carrot, variety experiment.
H. 85.	Cauliflower, paper pots or collars versus none.
H. 86.	Cauliflower, protection from root maggots.
H. 88.	Cauliflower, variety experiment.
H. 89.	Celery, breeding for trueness to type.
H. 90.	Celery, blanching experiment.
H. 93.	Celery, seed production.
H. 94.	Celery, variety experiment.
H. 95.	Corn, breeding for earliness.
H. 96.	Corn, breeding for trueness to type.
H. 101.	Corn, suckering experiment.
H. 102.	Corn, variety experiment.
H. 104.	Cucumber, breeding.
H. 105.	Cucumber, pruning versus non-pruning.
H. 106.	Cucumber, variety experiment.
H. 107.	Egg plant, variety experiment.
H. 115.	Lettuce, seed production.
H. 116.	Lettuce, variety experiment.
H. 118.	Melon, musk; breeding.
H. 121.	Melon, musk; pruning experiment.
H. 122.	Melon, musk; variety experiment.
H. 125.	Melon, water; variety experiment.
H. 127.	Onion, autumn versus spring sowing.
H. 128.	Onion, breeding for trueness to type.
H. 131.	Onion, growing sets.
H. 132.	Onion, method of controlling maggots.
H. 133.	Onion, seed production.
H. 134.	Onion, seed versus sets.
H. 138.	Onion, variety experiment.
H. 139.	Parsley, seed production.
H. 140.	Parsley, variety experiment.
H. 141.	Parsnip, breeding for trueness to type.
H. 142.	Parsnip, different dates of sowing.
H. 143.	Parsnip, seed production.
H. 144.	Parsnip, thinning experiment.
H. 145.	Parsnip, variety experiment.
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H. 147.	Pea, breeding for yield.
H. 148.	Pea, different distances of planting.
H. 150.	Pea, of different seasons versus one variety planted at different dates.
H. 151.	Pea, seed treated chemically versus not treated.
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H. 153.	Pea, variety experiment.
H. 154.	Pea, variety experiment for yield of green peas.
H. 157.	Pepper, variety experiment.
H. 159.	Potato, cut before sprouting versus sprouted and then cut.
H. 166.	Potato, few versus many cultivations.
H. 161.	Potato, different dates of planting to obtain best seed.
H. 162.	Potato, different dates of planting to obtain best yield.
H. 169.	Potato, grown on different soils to obtain best seed.
H. 170.	Potato, harvesting at different dates for seed.
H. 171.	Potato, hill selection for seed.
H. 172.	Potato, hill versus level cultivation.
H. 174.	Potato, home grown versus northern or eastern grown seed.
H. 175.	Potato, home grown from new soil versus northern or eastern seed

Project No.	Title
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H. 177.	Potato, irrigated harvested at different dates for seed.
H. 178.	Potato, methods of storage.
H. 183.	Potato, sprouted versus unsprouted for earliness.
H. 184.	Potato, sprouted versus unsprouted dug at different dates for seed.
H. 185.	Potato, straw mulch versus cultivation.
H. 186.	Potato, variety experiment.
H. 187.	Pumpkin, breeding.
H. 188.	Pumpkin, variety experiment.
H. 189.	Radish, breeding to improve quality.
H. 190.	Radish, seed production.
H. 192.	Radish, variety experiment.
H. 193.	Rhubarb, breeding.
H. 195.	Rhubarb, variety experiment.
H. 197.	Salsify, variety experiment.
H. 196.	Salsify, seed production.
H. 198.	Spinach, seed production.
H. 199.	Spinach, variety experiment.
H. 200.	Squash, breeding.
H. 201.	Squash, variety experiment.
H. 204.	Tomato, breeding for earliness.
H. 206.	Tomato, method of ripening green fruit.
H. 207	Tomato, methods of training.
H. 208.	Tomato, mulching experiment.
H. 209.	Tomato pots, boxes versus flats.
H. 211	Tomato, variety experiment.
H. 214.	Turnip, variety experiment.
H. 216.	Vegetable marrow, variety experiment.
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GREENHOUSE

FLOWERS

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H. 227.	Hyacinth, variety experiment.
H. 228.	Narcissus, variety experiment.
H. 229.	Nemesia cut flower experiment.
H. 230.	Primula, Malacoides, variety experiment.
H. 231.	Schizanthus, variety experiment.
H. 232.	Tulip, Cottage, variety experiment.
H. 233.	Tulip, Darwin, variety experiment.
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VEGETABLES

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H. 239.	Cauliflower, seed production.
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H. 241.	Cucumber, breeding.
H. 242.	Cucumber, cost of production.
H. 243.	Cucumber, distances apart.
H. 244.	Cucumber, English versus American varieties.
H. 245.	Cucumber, variety experiment.
H. 246.	Lettuce, cabbage lettuce at different distances.
H. 247.	Lettuce, cabbage variety experiment.
H. 248.	Lettuce, cabbage versus loose leaf.
	Melon, musk, breeding.
	Melon, musk, variety experiment.
H. 249.	Radish, distances apart.

Project No.	Title
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H. 251.	Tomato breeding.
H. 252.	Tomato, distances apart.
H. 253.	Tomato, pots versus benches or beds.
H. 254.	Tomato, training experiment.
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POMOLOGY

H. 256.	Fruit breeding.
H. 257.	Grape, variety experiment in pots.

ORNAMENTAL GARDENING

FLOWERS

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H. 264.	Aster "Yellows," development on different soils.
H. 266.	Canna, variety experiment.
H. 268.	Dahlia, variety experiment.
H. 271.	Geranium, variety experiment.
H. 272.	Gladiolus, variety experiment.
H. 273.	Gladiolus, wintering experiment.
H. 274.	Herbaceous perennial, variety experiment.
H. 276.	Iris, variety experiment.
H. 277.	Lily, variety experiment.
H. 278.	Narcissus, variety experiment.
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H. 280.	Paeony, variety experiment.
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H. 283.	Seed, home grown versus imported.
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H. 285.	Seed, herbaceous perennials, autumn versus spring sowing.
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H. 288.	Sweet pea, change of soil versus no change.
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H. 291.	Tulip, variety experiment treated as perennials.
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TREES AND SHRUBS

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H. 302.	Rose, variety experiment.
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