APPLE GROWING

IN EASTERN CANADA

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APPLE GROWING IN EASTERN CANADA

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LOCATION

When dealing with an enterprise such as apple growing, where a large capital outlay is involved, a grower cannot afford to make serious mistakes. In the case of vegetable crops an error may be repaired at the close of a single season and, with small fruits, within a year or two. With an apple orchard it definitely pays to give plenty of thought to the program to be followed. Careful planning and preparation will be time well spent and will result in greater returns in the years to follow.

One of the first things that the prospective grower must do is to decide upon the district in which he will establish his fruit farm. Certain regions, over a period of years, have become known as sections particularly adapted to this type of culture. Information may be obtained upon request from federal and provincial authorities as to the suitability of any particular district for apple culture. Probably the best information can be had from those who are growing fruit successfully. If there are no successful growers in the district there is probably a good reason; either the district is not suited to the growing of apples or is better adapted to the growing of some other crop or crops.

Modern transportation facilities have done much to extend the fruit growing regions. Today there are small sections, far removed from the well known fruit regions, producing apples within trucking distance of towns and cities that were not previously well supplied with good fruit. Such locations, provided they are not overplanted, are often very profitable as prices obtained on small markets frequently are better than on the general market.

Well established fruit regions soon become well known to the home and foreign markets and buyers look to them for their requirements. There is greater interest in improved practices and each grower is a possible source of new information and ideas. In these sections savings are possible through combined purchases of supplies and equipment on a large scale, by improved storage and transportation facilities, and better outlets for by-products. Moreover, more direct benefit would be obtained from experimental stations which are usually established in such localities.

In selecting a location suitable for orcharding, two main considerations should be kept in mind. These are general climatic conditions, which include such factors as rainfall, humidity, sunshine, winter temperatures and proximity to large bodies of water; and marketing facilities available, such as home market, distant or foreign market, and transportation facilities.

GENERAL CLIMATIC CONDITIONS

Rainfall.—This is a limiting factor in some districts since apple trees require large quantities of moisture. In regions having less than 20 to 24 inches of rainfall annually, well distributed throughout the growing season, the chances of success without irrigation are much less than where the rainfall is equal to or greater than this amount. Where irrigation is possible at a reasonable rate per acre, the amount of rainfall is less important but the grower must be assured of a continuous supply of irrigation water before making his planting.

Humidity.—In districts where the humidity is apt to be high during the fruiting season the cost of production is usually high because heavy expenditure is involved in the control of fungus diseases. Although there is probably no part of Canada where humidity is so high that apple scab cannot be controlled,

nevertheless there is much variation in this respect and spraying costs vary accordingly. Other things being equal, districts where apple scab is easy to control are preferable.

Sunshine.—Plenty of sunshine is an important consideration as it is largely responsible for the high colour obtained in apples, a characteristic required by the market. Summer temperature also is important. Where the season is short and comparatively cool, it becomes difficult to grow fruit of sufficiently high colour, and market prices suffer accordingly.

Winter temperatures directly affect the suitability of a particular district for apple growing. This, however, does not necessarily mean that districts suffering occasionally from winter injury are not so profitable as others, for they may possess advantages that will offset this drawback. However, consideration must be given to winter temperatures in determining the probable life of the orchard and the success of the investment. Apples succeed best in districts where the trees are uninterrupted in their winter's rest. Violent fluctuations in winter temperatures, even though the weather may be relatively mild as a whole, are undesirable for successful apple culture.

Proximity to Large Bodies of Water.—Districts near large bodies of water are preferable because the water tends to retard spring growth until danger of frost injury is past. In addition, the period of ripening and development in the fall is extended and temperature fluctuations during the dormant period are reduced. Locations adjacent to large bodies of water usually are more favourable for apple production than those not so situated.

Marketing Facilities Available.—This is probably the most important consideration of all. The prospective grower should consider whether or not the contemplated location is assured of a home market or of distant or foreign markets at prices sufficiently remunerative to pay production and shipping charges.

Home Market.—The best markets are those near at hand and locating near large consuming centres is likely to be a pretty sound business venture, particularly where early and perishable sorts are grown. A district with an excellent market for its product has an advantage which will largely if not wholly offset its disadvantages with regard to winter injury, provided that the loss from this cause is not too frequent. Orchards planted near cities often show an annual net profit far in excess of that obtained in more favourable localities. Growers in these districts are able to absorb annually a large part of the initial investment, which at the end of, say, fifteen years makes it possible for them to replant if trees should be lost through winter injury. Too much attention has been paid in the past to the possibility of growing the apple only under the most ideal surroundings.

Distant or Foreign Markets.—Certain localities grow fruit largely for distant and foreign markets, particularly the fruit growing districts of Nova Scotia and British Columbia. Before locating in a region dependent entirely on distant markets the grower should assure himself that the transportation charges are offset by advantages due to location.

Transportation Facilities.—The location should be reasonably near a shipping point or main trunk highway. The advantage of a short haul to a shipping point is obvious. Good roads readily accessible are of prime importance in facilitating marketing.

DETERMINING THE SIZE OF THE ENTERPRISE

After selecting the district in which to grow the fruit, the grower must, before selecting the actual site, decide upon the area he wishes to plant. In this connection he must consider; (1) the market to be served and (2) the extent of other farm enterprises.

The market to be served may be; (1) general, in which case he must have an acreage to enable him to ship carlots and (2) local, which will not take so large a quantity at a given time but responds better to a continuous supply in smaller quantities throughout the consuming season. Local markets may require just as large an acreage but this depends on the demands of the market.

Supplementary Enterprises.—Growers should grow other crops that do not conflict seriously in labour requirements with those of the orchard. Such crops may be grown on areas on the farm not well adapted to fruit. This system enables expenses to be met from year to year until fruit comes into bearing.

In most of the older fruit sections in Canada it has been the custom to operate the orchard as part of a general farm business, along with annual cash crops and livestock. In the newer developments, the trend is to produce apples in large units with few if any supplementary enterprises. It would seem that the best possible use is not being made of the land and that certain crops may be grown without involving too much additional outlay for equipment. Vegetables may be grown for a time at least between the rows of trees, after which other areas will have to be utilized.

SITE

There is great variation within a farm as to the adaptability of certain fields for successful apple culture. Future success may largely depend on the selection of a suitable site. Certain factors must be carefully considered in this connection.

Elevation.—In regions where severe winter temperatures prevail, the question of elevation is of great importance. Generally speaking, sloping land or rolling land is preferable to flat, level areas. Orchards located in a hollow or low area, surrounded by higher land, may suffer not only from late spring frost

A typical orchard scene in Eastern Canada.

but from winter injury in severe years. A gentle slope with low lying land at the base of the slope, to which the colder air may drain, is desirable. The important thing in this connection is to select the site at a little higher elevation than the surrounding land so as to ensure good air drainage through and away from the orchard. This not only lessens the risk from late frosts but also helps to prevent the rapid spread of fungus diseases. Flat areas near large bodies of water are quite satisfactory since the air is kept in motion by frequent sea and land breezes.

The value of elevation in relation to winter injury was very marked in certain orchards in the colder regions during the winter of 1933-34. In some orchards, that part located on a side hill with a gentle slope came through the winter in excellent condition, while the portion of the same orchard located on the low land at the base of the slope suffered materially—12 per cent injury on the slope and 65 per cent injury on the flat. The difference in elevation between the two parts was six to seven feet in three hundred feet. These facts should be kept clearly in mind when selecting a site for apple culture. Not only is it possible to reduce loss from winter injury through careful selection of the site but also to eliminate to a large degree injury from late spring frosts. Temperatures taken in spring during frosty nights have registered 5 degrees lower than at points only a hundred feet distant but four feet higher in elevation. Such variations are sufficient to mean a difference between profit and loss.

Exposure.—Successful apple plantations may be found that slope to any point of the compass. Most fruit districts, however, suffer from the effect of violent winds at harvesting time and therefore a slope that provides some protection against such disturbances is desirable. For example, if prevailing winds are from the north a northerly slope should be avoided. If winter injury is a factor, the slope best protected from the prevailing winds should be selected. Apple trees growing on a site exposed to the full blast of the prevailing wintery winds are frequently injured by the drying action of these winds. Southern slopes tend to accelerate development of buds in the spring while northern slopes tend to retard development. Where sunscald is prevalent, observations indicate that this kind of winter injury is more likely to occur on southwestern than on southeasterly slopes.

Drainage.—Apple trees will not stand wet feet. A good orchard site should have ample surface drainage to take care of excess water in late winter and early spring when drainage through the soil is difficult. In addition to surface drainage, under drainage is essential. Good natural drainage of the soil is preferable to tile drains as the latter are very apt to be put out of working order by entry of roots into the tile. A low spot in an otherwise desirable field may be tile drained but usually it is better to plant on land that does not require artificial drainage, which is relatively expensive.

Soil.—While some varieties show a preference for certain kinds of soil, apples generally thrive on a variety of soil types. The nature of the subsoil on the proposed site may be even more important than the kind and quality of the surface soil. The subsoil should be such as to allow for good drainage so that tree roots will at no time be standing in water, and it should be sufficiently loose to permit the roots to make an extended growth. A subsoil which is hard and impervious restricts the root development of a tree, with a subsequent effect on its life and vigour. On the other hand a very open subsoil that will hold little or no water, is the opposite extreme and should be avoided if possible.

An ideal subsoil is a rather gravelly loam. Heavy clay or compact subsoil and hardpan formations that are near the surface and cut off access to the soil areas below should be avoided. A subsoil five to six feet in depth is desirable although there are localities where profitable orchards are growing on shallower

soils. These are usually in districts where climatic conditions are very favourable to apple tree growth. If apple trees are to be thrifty and long of life, their roots must be able to penetrate the soil readily.

PREPARATION OF THE LAND

Soil should be in first-class condition before young trees are planted. Probably the most important period in the life of an orchard is the first four or five years, when the future vigour and shape of the trees are being determined. Time and money expended in building up the plant food content and in establishing a good physical condition of the soil previous to planting is worth many times more than similar efforts after the trees have struggled along indifferently for a period. It will pay to prepare the land a year ahead, by ploughing and using a hoed crop, if possible, such as corn, potatoes or roots. If the chosen site is already in good tilth, a year's delay is not necessary. Minor depressions should be levelled off with a grader or by filling in to promote surface drainage and avoid pockets of water. Where necessary surface drains should be provided so that excess water will flow readily from the orchard area.

Ploughing, preferably in the fall, is the first operation in preparing the land for planting. This should be followed by a thorough working with a disk harrow, in two directions, after which some sort of a smoothing harrow or grubber is used to level down the field.

PROPAGATION

Build-up of an Apple Tree.—Apples reproduce themselves by means of seeds but their offspring differ widely, thus varieties must be maintained by vegetative propagation. By the practice of budding and grafting, two distinct parts, namely, the root system and the stem or branch system which may and do have very diverse characteristics, are made to grow together as a single living organic unit. An apple tree is thus different from many other economic plants. Rootstocks are chosen primarily for their relative capacity to form a good hardy active root system; and scions with particular regard for the variety and quality of fruit required. The growth and productivity of a tree depend essentially on the activity of the roots in removing food from the soil, and the leaves in manufacturing carbohydrates. Therefore, the tree as a whole is profoundly influenced by the nature and relative activity of both the above and below ground portions. The rootstock may influence the scion at one time, the intermediate stem-piece at another, and the top scion at still another; each contributing its share to the build-up of the whole tree.

Rootstocks.—Rootstocks in use today are either raised from seed or by vegetative propagation.

Amongst the former the French crab seedlings are the most commonly used by nurserymen and are grown only from seed obtained from apples used for cider making purposes. The seedlings are either grown in France and then imported to America or the seed is imported and stock grown in this country. It is safe to say that most of the orchards in Canada today are on seedling roots of French crab or are scion-rooted. In the colder regions, seedlings of varieties of Russian parentage, such as Antonovka, Patten Greening and Beautiful Arcade, are more in favour because of their greater winter hardiness. In the Prairie Provinces seedlings of such *Malus baccata* hybrids as Columbia, Bedford and Osman are used for the hardy varieties grown there. In most parts of Canada, particularly eastern Ontario and Quebec, hardiness or resistance to cold is essential in a rootstock.

Occasionally, because of unfavourable environmental conditions, such as lack of snow coverage during the severe winter months, the French crab kills out badly, resulting in a heavy loss of trees. On the other hand seedlings of the

Apple seedlings for rootstocks, Central Experimental Farm, Ottawa. Seeds stratified from March 4, sown May 2 and photographed June 8, 1944.

hardeniest of the Russian varieties, such as Antonovka and Beautiful Arcade can be grown year after year without ever losing a tree from root injury. It is well to bear in mind that no tree is any hardier than the rootstock on which it is grafted. Since the majority of the hardy seedlings employed today for rootstock purposes are as vigorous, if not more vigorous than the French crab seedlings, there seems no reason why they should not be used entirely in these fruit districts. Seedlings of the above mentioned hardy varieties have all proved to be satisfactory for rootstock purposes. It is very difficult at the present time to obtain from nurserymen commercial varieties propagated on these hardy rootstocks, but if each grower living in the colder regions when purchasing trees insisted upon trees budded or grafted on hardy roots it would only be a matter of time before there would be an adequate supply of trees on these rootstocks.

Vegetative Rootstocks.—These are produced from layers or suckers which are, of course, rooted stems. Vegetatively raised rootstocks with both shallow and deep rooting tendencies, with spreading or restricted root systems can be multiplied at will. In England there is a wide range of these vegetatively raised rootstocks in use that have been carefully selected and typed by the workers at the East Malling Research Station, each with its own characteristics.

- (1) Very Dwarfing Group: Malling No. IX (Jaune de Metz).
- (2) Semi-Dwarfing Group: Malling Nos. IV and VII.
- (3) Moderately Vigorous Group: Malling No. II (Doucine "English Paradise"); and Malling No. I (Broad Leafed "English Paradise")
- (4) Very Vigorous Group: Malling Nos. XII and XVI.

The practical advantage of planting trees propagated on dwarf rootstocks is that they are more economical trees to prune, to spray, and to pick while the trees come into fruiting at a much earlier age. European countries have, for

years, been largely using vegetative or clonal rootstocks while in Canada seedling rootstocks have been used almost entirely. Over the years apple tree losses, in this country, due to unsatisfactory rootstocks have been considerable. In eastern Ontario and Quebec root injury has taken its toll while collar rot has caused considerable tree loss in all the fruit areas in Canada.

In 1936 a number of apple rootstock investigations were initiated at Ottawa to obtain information on the suitability of the Malling vegetative rootstocks to eastern Ontario and Quebec conditions, particularly their resistance to winter cold and compatibility with Canadian commercial varieties.

Vegetative Rootstock Winter Hardiness Test.—The Malling stocks, together with a number of hardy vegetative rootstocks developed by the Horticultural Division, were subjected to very severe winter conditions in the Division plantations during the winters of 1938-39, 1939-40 and 1940-41. The snow covering the three roots was removed after each snowfall, thus permitting the frost to penetrate deeply; an environmental condition very often experienced in eastern Ontario and Quebec orchards.

TABLE 1.—VEGETATIVE ROOTSTOCK WINTER HARDINESS TEST—1941

Rootstock	Trees Completely Killed	Per cent Injury
Anis 46.....	0	10
Anis 322.....	0	10
Anis 376.....	0	10
<i>M. robusta</i> No. 5.....	0	0
M.A. 452.....	2	40
M.A. 462.....	1	20
M.A. 466.....	5	90
M.A. 472.....	0	10
M.A. 478.....	1	30
E.M. I.....	4	90
E.M. II.....	4	90
E.M. IX.....	5	90
E.M. XII.....	2	80
E.M. Crab C.....	4	80

NOTE.—6 trees of each rootstock were under observation.

General view of the *Malus robusta* No. 5 stool beds at Ottawa.

Stool of *Malus robusta* No. 5 showing rooted shoots being removed.

It will be observed that, by the fall of 1941, two-thirds of the Malling stocks were dead and the remaining third were badly injured. Among the Ottawa clones, no injury was observed on *Malus Robusta* No. 5, and very slight sunscald was the only visible trace of injury on the Anis 46, 322 and 376 and M. A. 472 stocks.

These observations, together with the losses from root killing experienced in the rootstock trial orchard where the trees are growing under orchard conditions, show that the Malling stocks are tender and of doubtful value as rootstocks under eastern Ontario and Quebec conditions. The solution to obtaining a hardy rootstock which will give the grower the desired degree of vigour and precocity would appear to be in selection work within the hardy seedling rootstocks of Russian origin.

Hardy Vegetative Rootstocks.—Probably the only permanent solution to the rootstock problem for commercial apple orchards in Canada, particularly those located in the colder sections, is hardy clonal stocks. For 25 years selection work has been carried on at Ottawa amongst seedling rootstocks of Russian origin, in an endeavour to find a hardy stock that will stool readily. Progress is naturally slow. Stocks must be tested for hardiness, for ease of propagation and for compatibility with commercial varieties. In addition, the resistance of the rootstock to certain diseases, such as collar rot, must be established.

Out of this work has emerged the clone known as *M. robusta* No. 5, which is extremely hardy, stools readily, yielding annually some 70,000 rooted shoots per acre, and is compatible with the commercial varieties. It is vigorous in habit, as shown in Table 2. As yet there are no trees on *M. Robusta* No. 5 in full bearing, but trees of McIntosh, Red Melba and Lawfam budded to this stock have cropped over the past three seasons, and tree performance is satisfactory. This stock is now being distributed to nurserymen for extended trial. Two other clones selected at Ottawa, Anis 322 and M.A. 524, appear promising as semi-dwarf stocks, but further testing is necessary before they are released.

TABLE 2.—CROSS-SECTION AREA OF APPLE TREES ON OTTAWA VEGETATIVE ROOTSTOCK SELECTIONS. TREES TEN YEARS OF AGE

Rootstock	Variety		
	McIntosh	Lawfam	Melba
	(sq. in.)	(sq. in.)	(sq. in.)
Anis 46.....	49.4	65.1	52.4
Anis 322.....	39.4	41.5	62.7
Anis 376.....	56.9	58.8	60.5
<i>M. robusta</i> No. 5.....	85.8	98.6	92.4
M.A. 452.....	62.2	58.8	68.8
M.A. 462.....	77.8	77.8	81.5
M.A. 466.....	92.1	71.3	98.2
M.A. 472.....	86.9	84.2	75.4
M.A. 478.....	82.3	73.5	72.8

NOTE.—8 trees of each combination with McIntosh and Lawfam.
6 trees of each combination with Melba.

McIntosh top-worked on a native seedling. Tree very vigorous and hardy.

It is seen from Table No. 2 that there is a fairly large range in vigour between trees growing on the various Ottawa clonal selections. The rootstock effects illustrated here are not consistent with all three scion varieties. The Anis selections appear to have a dwarfing effect upon all three varieties when compared with *M. robusta* No. 5 and the Mixed Apple selections. Over the three varieties,

trees *M. robusta* No. 5 and M.A. 466 appear to be the most vigorous growing while those of Anis 322 and Anis 46 are the least vigorous of these selections.

In 1947, some five thousand Antonovka and Beautiful Arcade seedlings were stooled. From these, twenty-eight Antonovka and thirty-seven Beautiful Arcade clones were selected on the basis of their ability to stool readily. These clones are being further processed for compatibility, hardiness and resistance to disease.

Hardy Tree Building.—In an endeavour to improve apple tree performance in the colder regions of Canada, extensive tree building trials are being carried out in the Horticultural Division and on grower-owned orchards in eastern Ontario and Quebec. Some sixty varieties are being evaluated as to suitability as hardy frame builders. At the present time, Hibernial, Antonovka and *M. robusta* No. 5 are preferred for commercial planting. Although accurate

Trunk of McIntosh tree shown on Page 13.
Note healthy condition.

comparison between these three frame builders is not yet possible, certain observations relating to the orchard performance of these frame builders have been noted.

Hibernial has been found to be compatible with a large number of commercial varieties and over a period of years has been the easiest of all the varieties under test to train and top-work. It is desirable to force the Hibernial trees, when used as frame builders, in order to have many shoots from which to select a strong well balanced scaffold framework. Antonovka has also proved to be compatible

with a large number of commercial sorts. It has taken a little longer to work over the Antonovka than the Hiberna trees, but, once established, the trees are semi-vigorous in habit and develop a mechanically strong framework. *M. robusta* No. 5 has not been under test for a sufficient length of time to determine if it is compatible with all the commercial varieties. At Ottawa, where a large number of varieties, including McIntosh, have been worked on it, no evidence of incompatibility has been noted. It is a vigorous grower and very

McIntosh on own trunk. Note winter injury on left side of tree.

hardy but is a bit difficult to train as it suckers freely. Virginia Crab, which is probably the most vigorous frame builder under test, has been found to be incompatible with Sandow. Since other workers have found it to be selective as to its partners, Virginia Crab is now not recommended as a frame builder until more information is available.

Collar Rot.—Collar rot or crown rot is prevalent in all apple regions in Canada. The injury may partly or completely girdle the collar or crown of the tree and frequently extends downward, killing the entire root system. It may also extend upward. Collar rot or crown rot is a type of winter injury which weakens the tree, making it vulnerable to a soil-inhabiting fungus (*Phytophthora cactorum*) which finally kills the tree.

Of the various seeding rootstocks under trial at Ottawa, seedlings of Antonovka appear highly resistant to collar rot. Anis seedlings, on the other hand, have been found to be susceptible to this trouble. Among the vegetative stocks Malling II has been quite resistant while Malling I has been highly susceptible and tree losses have been heavy in the orchard where this rootstock has been used.

Trunk of tree shown on previous page.
Note severe trunk injury.

HOME GARDEN TREES

There is an increasing interest in dwarf apple trees among home owners in Canada. These are trees which will grow no taller than a man can reach and which will bear fruit soon after planting. They are not planted primarily to provide the family supply of apples but rather for ornamental purposes and to add interest to the garden.

An apple tree may be dwarfed by several means. Pruning the top regularly and severely is a well known method but it delays fruiting. The dwarf tree, to which this article refers, is one produced by using a rootstock in the propagation of the tree which by its inherent qualities slows down the growth of the fruiting variety budded or grafted upon it. That is, instead of the fruiting variety being budded or grafted upon a standard rootstock which produces a tree of large size it is worked upon a rootstock which has a dwarfing effect.

The rootstock which is best suited for the garden tree, due to its very dwarfing tendencies, is known as Jaune de Metz or Malling IX. It produces a small, low growing bush tree about one-quarter the size of a standard tree, that generally can be depended upon to produce fruit the second year. Malling IX had its origin in France some 60 years ago but became mixed with other rootstocks and it was not until recent years that it was purified and disseminated widely by

the East Malling Research Station in England. Like most European rootstocks, Malling IX is propagated vegetatively, that is, produced from layers or suckers which are, of course, rooted shoots. Since this method of propagation entails more labour than growing the standard seedling rootstocks the cost of dwarf trees is greater than that of standard trees.

Red Melba, on Malling IX rootstock, in the fourth season from planting. Dwarf apple trees such as these are well suited for the home garden.

Dwarf trees are not only small growing but they are shallow rooted and likely to blow out or break off just below the graft union because of the brittleness of the stock. For these reasons they must be staked. Staking can easily be done at time of planting by placing either an iron fence post or a substantial wooden post alongside the tree. Another method is to support the tree on a wire trellis, similar to the "Kniffen" system used for grapes, or on a fence or wall.

Care must be exercised with dwarf trees not to place the graft union below ground level as there is a tendency on the part of the fruiting variety to throw out roots and become established on its own roots thus destroying the dwarfing influence of the dwarf rootstocks. The tree should be planted with the union just at or slightly above ground level. Dwarf trees may be set ten or twelve feet apart.

Much more detailed pruning is necessary for a dwarf tree than for a standard tree. The tree at time of planting should be headed back severely so as to encourage many shoots to feather out low down and to form a low headed tree

with a good scaffold framework of branches. The scaffold limbs are spaced about four inches apart, arranged spirally around the trunk, the first commencing eight inches from the ground. At least eight framework limbs should be developed. The aim in training the tree should be to develop a low headed compact tree. Once the framework is properly formed, little pruning should be practised other than to suppress dominant branches. If the trees are grown on a wire trellis or fence, they are trained to various shapes. Training trees to special forms is as interesting as anything one will find in gardening.

Dwarf trees need fertilizer. A complete fertilizer such as 9-5-7, which is fairly high in nitrogen, is preferred and is best applied in the early spring when the buds are bursting. Mulching the trees with grass clippings, hay or straw is an especially good practice. These trees are quite easily protected from troublesome insects and diseases by the use of a hand sprayer; materials for which may be readily obtained at local stores.

Top-Grafting and Frameworking.—The principal purpose of top-grafting and frameworking is to change over the bearing area of a tree from one variety to another. For example, it might be advantageous to grow Melba instead of McIntosh where a block of bearing McIntosh already existed. In such a case scions or buds of Melba would be grafted onto the framework of the McIntosh trees and eventually, with the ultimate complete removal of all McIntosh-bearing branches, the trees would produce nothing but Melba fruits. Similarly, a chance seedling tree bearing fruits of inferior quality but possessing other desirable characteristics, such as hardiness, well-formed crotches, disease resistance, etc., might be transformed into a profitable tree bearing fruits of any of the established varieties known to succeed in the district.

Double-working is a term applied to the process of tree building, the definite object of which is to produce a tree consisting of a specific combination of root and trunk. By this method, the troubles which attend some of the inherent weaknesses that exist in the trunk and main limbs of some of the fruiting varieties can be avoided. For example, the variety Northern Spy has weak crotches. By budding or grafting Hibernial, which has strong crotches, onto a suitable rootstock, and then budding or grafting Northern Spy onto the Hibernial framework, the weakness would be avoided. Actually all trees that are top-worked are double-worked (unless they happen to be on their own roots) for the fruiting variety is grafted onto a frame structure which has already been grafted onto a rootstock. In the majority of such cases the change-over of the fruiting area has been the prime consideration, whereas in double-working proper the object is to produce a particular combination of rootstock and framework possessing particular characteristics. It therefore is an operation that is performed not on a mature tree but by the insertion of a bud or scion into a young rootstock. The bud or scion will produce a framework having certain desirable characteristics between the rootstock and the fruiting portion of the tree.

Nursery Grown Trees.—In buying trees from a nursery firm for planting in districts where extreme winter conditions prevail and where root injury is likely to occur because of lack of snow coverage, the grower should insist that the trees be propagated on hardy roots resistant to collar rot.

A thrifty one-year whip of good size, (4'-6' high) is preferable to an older tree. With the well grown one-year tree the purchaser has an opportunity to head and shape the tree in a proper manner. It is impossible for the nurserymen to give sufficient personal attention to each tree to ensure the elimination of weak crotches and shock heads. Moreover only the most thrifty of the one-year trees can be sold at that age. The price is usually somewhat lower than for two- or three-year old trees.

With two-year old trees the branches are often poorly placed, necessitating their removal, so that the gain over a one-year whip is more apparent than real.

Three-year old trees are not generally to be recommended. If they are well grown and thrifty they are too large for the most successful transplanting; if not large, they are culls and should be avoided.

No. 1 trees should be straight, clean and free from diseases or black heart and should have a good fibrous root system.

Trees certified as to variety can now be purchased. One of the great difficulties in recent years in ordering nursery trees has been to obtain trees true to name. Many growers have suffered serious losses through orchards turning out to be of undesirable varieties. Where possible, it pays to buy certified trees.

The source of trees has no effect on their relative hardiness.

Home Grown Trees.—Apple trees may be propagated by three distinct methods: budding, root grafting and crown grafting.

Budding is the most widely used method of propagation today, particularly by nurserymen. The reason is two-fold, a greater percentage of take and more satisfactory nursery trees are obtained.

Root Grafting has in the past been used extensively by the nurserymen and is still used by many. This operation is carried out during the winter months, late January and early February, when there is ample available time.

Crown Grafting is a method of propagating young rootstocks growing in the nursery and is performed in the early spring before growth starts.

For further details on propagation see "Budding and Grafting of Fruit Trees" published by the Canada Department of Agriculture, Ottawa.

PLANTING THE ORCHARD

Planning the Orchard.—Previous to actual planting operations, it is desirable to prepare a plan of the arrangement of the trees. There are several arrangements of trees that orchardists use; four of the most important being the square method, the quincunx, the hexagonal and the alternate.

The square method, which simply consists of placing the trees so that one stands at each corner of a square or rectangular figure, is the easiest to plant and takes the same number of trees as the alternate plan but permits of easier cross cultivation and spraying should intermediate crops be grown during the early life of the tree than any of the other arrangements. In the square method (fig. 1) the trees are placed 40 x 40 feet apart. This distance is sufficient for the largest trees and closer planting may be adopted. The better plan for a closer arrangement of the trees would be to put the permanent or standard trees at 40 x 40 and then plant temporary or filler trees between. These fillers may be placed between each two trees in the row, which is known as filling one way, or they may also be placed in rows between two rows of standards. If placed in both positions, the trees would be 20 x 20 feet and the orchard would be said to be filled both ways. Where early bearing varieties like Melba are used as fillers, the crop from them will contribute substantially toward the cost of establishing the permanent orchard before removal is necessary because of crowding. When filled both ways the temporary rows may be removed first, and later the fillers in the standard rows removed.

The quincunx method, (fig. 2) is very similar to the square, except that a tree is planted in the centre of each square. This makes the rows twenty feet apart but each tree is 28 feet 3 inches from its nearest neighbour. These trees in the centre are usually filler trees to be removed at a later date.

SQUARE PLAN
(Rectangular)

Fig. 1—Distance between trees—40 ft.
Distance between rows—40 ft. Number of trees per acre—27.

QUINCUNX PLAN

Fig. 2—Distance between trees—28 ft. 3 in. Distance between rows—20 ft. (Every other row is a filler row). Distance between standard rows would be 40 ft. Number of trees per acre—43.

In the alternate system (fig. 3) the trees in every other row are opposite. In the case where the rows are put 40 feet apart this makes each tree 44 feet 6 inches from its nearest neighbour.

The hexagonal system, (fig. 4) which places a tree at each corner of a hexagon and one in the centre, enables the rows to be only 34 feet 8 inches apart to get the trees 40 feet apart each way. This system permits of more permanent trees per acre than any other system and is, where space is limited, generally adopted, while the square plan is probably the most generally used because of its simplicity.

ALTERNATE PLAN

Fig. 3—Distance between rows—40 ft. Distance between trees—44 ft. 6 in. Number of trees per acre—24.

HEXAGONAL PLAN

Fig. 4—Distance between trees—40 ft. Distance between rows—34 ft. 8 in. Number of trees per acre—31.

In eastern Ontario and Quebec where the life of an orchard is short the trees should not be planted more than 30 or 35 feet apart both in the rows and between the rows. The following plan has been used extensively in the commercial orchards in Quebec and is very practical.

EASTERN ONTARIO AND QUEBEC PLAN

Fig. 5—Distance between trees—35 ft. Distance between rows—30 ft. Number of trees per acre—36.

As illustrated, filler trees should be removed before they interfere with the standard trees.

Staking Out the Orchard.—Trees should be planted so that they will line up in all directions. This is not difficult but it calls for considerable accuracy in the layout of the plantation. From a base line, a line at right angles should be established. This may be done by using a large wooden square twelve

to fourteen feet long with an accurate right angle. The square is laid on the base line and stakes driven at the other two corners will establish a right angle which may be continued by sighting right across the field. The procedure can be repeated at the other corners. The spacing of the rows and the locations of the trees in the row can be determined by measuring and sighting and stakes should be planted at each tree location. In cases where the field is too hilly or too large to sight from one side to the other, a line may be run across the centre and the two parts staked separately.

After setting the stakes, a planting board will have to be used so that the stakes can be removed to allow the trees to be set. The planting board consists of a piece of lumber about six feet long with a notch cut at the centre and a hole bored at each end. The planting board is set so that the notch fits around the stake and a small peg is driven through each end hole. The board can be removed while the hole is dug and then replaced so that the position of the notch will indicate the exact location of the tree. When this procedure is repeated at each stake, the trees will line up as accurately as did the stakes.

Fig. 6—The board used in setting trees in an orchard.

Planting Operations.—Orders should be placed early with the nursery firm to ensure prompt delivery of the trees in spring. Plant as early in spring as the land can be worked readily. Fall planting is not desirable in eastern Ontario and Quebec. If trees are delivered in the fall, they should be heeled in and covered with soil.

How to Plant.—In digging the holes for the trees, they should be made somewhat larger than the spread of the roots of the young trees after the broken roots and unnecessarily long portions have been removed. The trees should be planted one to two inches deeper than they stood in the nursery, unless the rootstock has a known growth-inducing characteristic, in which case the trees should be planted with the graft union slightly above ground level to guard against scion rooting. It is advisable to dig the holes a little deeper than required; the top soil is laid to one side and subsoil scattered away from the hole. In planting the trees see that the earth is well firmed around the roots by tramping but take care to avoid injury to roots. Moist surface soil is used to fill in around the tree roots. It is important that the young trees should not be allowed to dry out before planting. When trees arrive from the nursery they should be heeled in and watered well. To heel in, dig a trench large enough to hold all the trees in an upright position so that when the soil is filled back, the roots will be completely covered. If at all dry, the trees may be well watered at this time. The earth should be thoroughly firmed around the roots, and it is a good plan to locate the trench in a cool and shady spot such as on the north side of a building or under the shade of a hedge. Handled in this manner there is little danger of trees drying out if planting is delayed a few days. Prior to planting, each tree should be placed next to the dug hole and soil thrown over the roots to prevent drying out until the planting crew is ready to plant.

WINDBREAKS

In exposed areas, a well established windbreak will afford protection and lessen the velocity of the wind over a considerable area. This reduces moisture loss from evaporation, reduces damage to the fruit and to the trees during wind storms and may lessen the danger of winter injury. Tests have shown these effects of the windbreak to vary from eleven to twenty feet for every foot in height of the windbreak. In the Prairie Provinces this is of much more importance than in the east, and probably an assumption that a windbreak would offer adequate protection to a distance equal to fifteen times its height would be approximately correct. As the apple trees grow in size, they develop their own protection in a great measure, except on the edge of the planting.

The breaking down of trees due to severe storms is materially reduced by adequate windbreak protection. Just how much winter injury is due to drying out of the trees is conjectural, but it may be that there is considerable loss that may be curtailed by windbreaks.

A good tree for a windbreak in Eastern Canada is Norway spruce (*Picea abies*). Being evergreen it provides more protection in winter than deciduous trees. For shelter purposes it is planted eight to ten feet apart. In severe localities more than one row may be planted, in which case the rows may alternate, one tree in one row coming between two trees of the other. Where it is necessary to obtain some sort of shelter more quickly than the spruce growth will provide, the Siberian pea tree (*Caragana arborescens*) may be used. This can be planted in front of the spruce, about ten feet or so from it, and being a rapid grower will afford protection in a very few years. *Caragana* may be planted at from three to four feet apart and permitted to form a hedge. Other rapid growing trees recommended for this purpose are Lombardy poplar, cottonwood, white pine and European larch. Manitoba maple or box elder has been largely used on the prairie, but is not a long-lived tree, and although quite hardy and a rapid grower, is not as highly recommended as *caragana* or cottonwood.

Protection from the north and west is usually all that is required in Eastern Canada.

PRUNING APPLE TREES

The pruning of apple trees has been practised since the earliest days of apple culture, yet in spite of its extensive use, pruning is still the one orchard operation that is most generally misunderstood in its practical application. Orchardists are not entirely to blame for this situation, however, since it is only within the last quarter century that carefully planned experiments have been conducted to study the effect of pruning upon growth and fruiting. Even today leading authorities cannot agree on some of the minor details.

Purposes of Pruning.—The main purposes and principles of pruning should be clearly understood and when pruning the grower should have a definite plan in mind whether the trees are young or old. The purpose of pruning the young non-bearing tree is primarily to train or shape the tree so that the main scaffold branches will develop strong, wide-angled crotches capable of bearing fruit without breakage. This training should develop a framework capable of supporting heavy crops of fruit when the trees reach bearing age. The aim in a commercial orchard is not to produce a tree pleasing to the eye but rather one that is commercially profitable within a reasonable period of time. The main objective in pruning bearing trees is to keep the tree reasonably open so that sunlight can reach all parts of the tree to assist in carbohydrate manufacture and the colouring of fruit and also to facilitate orchard operations such as spraying, thinning and picking. Another purpose is to remove from all parts of the tree weak growing wood that never produces fruit of satisfactory size and quality.

With trees in full bearing, pruning assists, along with proper fertilizer applications and other soil management practices, in maintaining a good growth condition in the trees.

Principles of Pruning.—In general, the early shaping of the tree should be accomplished with the minimum amount of cutting. Experiments show that pruning is a dwarfing process and delays fruiting. The total growth attained by an unpruned tree is always greater than that of a pruned tree regardless of the type and amount of pruning. Pruning not only reduces the total growth made by the above-ground portions but total root growth as well. In the case of young trees which have not yet flowered pruning delays flower bud formation. A heading-back cut appears to delay flowering more than the thinning-out cut. Pruning during the early years of a bearing tree rarely inhibits fruit bud formation. Once it is initiated, fruit bud formation is not easily suppressed. Nevertheless, some delay in production is usually necessary in order to obtain a mechanically strong tree.

Reduces Yield.—Pruning bearing trees usually results in a reduction in total yield. Exceptions occur in the case of trees too dense, or devitalized trees which set few fruits. The effect of pruning, however, upon the yield of marketable fruit is the important consideration. Therefore, growers are faced with a very practical problem in determining the amount of pruning which will produce favourable effects and yet not reduce the marketable yield unnecessarily. Where the trees are dense and would shade the fruit considerably a light to moderate pruning tends to increase the marketable yield. On the other hand, if the trees have recently been well pruned and are already open and making satisfactory growth, even a moderate pruning may actually reduce the total marketable yield to the point where the net return is considerably decreased.

Stimulates New Growth in Older Trees.—Pruning with its stimulation of more shoots and spurs produces its most positive and beneficial effect on older trees which have borne heavily for a number of years. Cropping has an exhaustive effect and tends towards a decided reduction in growth of shoots and spurs. Pruning, by removing a number of flowers and stimulating a vigorous vegetative type of growth, results in new wood which in turn will bear its quota of flower buds.

Increases Set of Fruit.—Pruning tends almost invariably to increase the set of fruit. The elimination of certain growing points indirectly increases the supplies of water and nitrogen available to the remainder. Although pruning does have this effect, fruit setting often is more satisfactorily maintained by the application of nitrogen, as pruning alone would involve too great a potential bearing surface. With most varieties increase in set from pruning usually is considerably less than from an application of a nitrogen carrying fertilizer.

Bulk pruning, which removes large limbs and branches, produces such a decided effect near the cuts that water sprouts often become excessive. A less drastic method that will remove smaller branches and twigs is to head back the large, undesirable limbs by degrees and not all at one time. Such a method dwarfs large branches gradually and usually results in fewer suckers. The thinning out of outer small branches is considered preferable but the time and expense involved have prevented its widespread adoption in practice. During this operation certain dominant lateral branches may be clipped off at the end to advantage.

Varietal Aspects.—The habit of the variety in question will often decide the type of treatment to be given. For instance, with varieties which are prone to produce long, rangy growth with few laterals, more heading in and

careful handling is required than with one which naturally produces many laterals. In the latter case the pruning treatment becomes more of a system of heading in certain tip growths.

When to Prune.—The ideal time for pruning is in the early spring before terminal growth starts since wounds made at this time heal more quickly. However, this is not practical in large orchards and for this reason it is a common practice to start pruning as soon as the crop is out of the way and to continue as weather permits, throughout the winter. In districts where sub-zero temperatures may occur this is a hazardous practice since pruning prior to low temperatures may result in severe injury. In these regions it would be safer to defer pruning until the period of very cold weather is past.

Under wartime conditions with a shortage of skilled farm labour there was a greater tendency than in normal times to begin pruning after the completion of the fall work. A general survey of commercial apple orchards in Northumberland, Durham and Ontario counties in the Province of Ontario, in mid-summer of 1943, revealed that wherever McIntosh, Fameuse, Spy and Ben Davis trees had been pruned in December prior to the cold spell of December 20, 1942, the trees were either completely killed or badly injured. In an orchard near Trenton, Ont., thirty-one Spy trees twelve years of age were pruned early in December, the remainder were not touched until late winter. The trees pruned in December killed out entirely whereas the unpruned trees showed no injury. In another

Northern Spy showing trunk and crotch injury which resulted from winter (December) pruning.

orchard near Trenton, severe trunk splitting occurred on McIntosh trees eight to ten years planted that were pruned in the first and second weeks of December. Adjoining trees left unpruned until spring showed no trace of injury. Trees which were pruned just prior to the cold spell showed more injury than those pruned the first week in December. Older McIntosh trees in another block of the same orchard pruned in October did not suffer from winter injury. Location

To build a mechanically strong tree with branches well spaced, as illustrated, training must begin following planting.

and cultural treatments were not contributing factors and there appeared to be just as much injury on trees pruned under one treatment as another. The amount of pruning did not appear to have any bearing on the severity of the injury since trees lightly pruned showed as much injury as those heavily pruned. In an orchard near Whitby, Ont., practically all the Fameuse trees thirty years of age, that were pruned the first three weeks in December, were injured severely. The bark loosened all around the trunks of these trees and, in some, well up the limbs. Trees pruned in November and after the first three weeks in December in the same orchard showed little or no injury.

These observations indicate that severe winter injury resulting often in complete killing of the trees may occur if apple trees are pruned just prior to unusually low temperatures. No clear and satisfactory evidence can be presented as to why pruning prior to low temperatures causes winter killing. It is apparent, however, that pruning, in some way, stimulates cambial activity and renders the trees more vulnerable to winter injury when low temperatures prevail.

How to Prune.—When a one-year-old whip is used, it should be headed back at time of planting, to a good strong bud at a height of about four feet. This will cause the bud below the cut to elongate and side shoots to form. The next spring, if a strong branch has developed two to three feet from the ground it can be selected as the bottom scaffold limb. Two or three additional branches spaced at least six to eight inches apart along the trunk and extending in different directions from the trunk should be selected. If the top-most branch is weak it

Natural braces strengthen weak crotches. In this case the tip of a sucker was grafted into the branch above.

should be removed and the leader should be developed from the lower stronger growing branch. It is not necessary to select all the main scaffold limbs at the commencement of the second growing season. Additional strong laterals will be formed in succeeding seasons to complete the framework. Five to seven branches may be left to form the head of the tree if the modified central leader system is used.

The first step in pruning a two-year-old tree is the selection of laterals for the scaffold limbs. Such trees have usually been headed back in the nursery and have produced a number of laterals closely spaced along the trunk. Two

or three of these laterals, well spaced, are selected. The strongest uppermost lateral is retained for the leader and is headed back slightly and the rest of the shoots are removed. The laterals that remain are cut back to different lengths depending on their location on the trunk and length of leader. Additional branches will arise from the leader during the succeeding seasons and from these the required number of scaffold limbs to complete the framework are selected.

Pruning in the third and fourth years should be light and consist primarily of thinning out rather than heading back branches. Some heading back, of course, will have to be done to maintain balance in the head.

Pruning the young bearing tree involves very little removal of wood until the extent to which the tree is opened by bearing has become evident. The annual corrective type is preferable, and if the trees have been properly trained no large cuts should be necessary. On young bearing trees the fruit is usually of good size and colour even when tops are a bit dense. If after two or three commercial crops the quality is not satisfactory, the top should be thinned out.

Recent experiments indicate the desirability of a light to moderate pruning in the bearing tree. Moderate pruning is followed by less fruit thinning, whereas a light pruning practice tends to emphasize thinning. There is general agreement that pruning must be regulated by the yield and quality of fruit produced. This entails the production of a vigorous tree with a large bearing area. In addition it must be sufficiently open to permit effective spraying. In trees that have been bearing for some years, the removal of large limbs should be avoided as far as possible; the removal of small branches throughout the tree is the better practice.

Thin wood pruning is a light pruning system which has been attracting considerable attention in recent years. This type of pruning involves the removal of wood which is small in diameter for its age and which develops poorly-coloured fruit of small size. This thin wood is no doubt the result of shading or competition and should be removed throughout the innermost portions of the tree or wherever it may occur. As a result of this operation the proportion of culls to crop is considerably reduced and the harvested crop is restricted to the portions of the tree from which a high percentage of the fruits will be of good size and colour.

THINNING

Thinning, or the removal of a portion of the fruit crop before maturity, is an orchard practice which has been considered profitable and recommended by authorities on fruit growing for several centuries. The benefits to be derived from thinning apples are many but fall into two main categories: (1) the improvement of the crop and (2) the conservation of the tree. The main advantage, however, is the improvement of the size and quality of the crop harvested. With the large sizes of extra fancy grade in increasing demand and commanding premium prices, thinning is undoubtedly *more profitable today* than ever before in the history of the fruit industry in Canada. Research has shown that under most conditions the size of the fruit may be increased and a better quality product obtained by an artificial thinning. Not only will under-size apples be eliminated but many apples damaged by insects, disease, hail and rubbing can be removed, thus reducing the cost of harvesting, packing and marketing. Distributing the fruit uniformly over the tree will result in a more uniform product which is of particular importance where box packing is done. Thinning prevents, to a large degree, the breakage of limbs and the splitting of crotches and lessens the cost of propping. One of the most important considerations, so far as tree conservation is concerned, is the tendency of thinning to make the tree more regular in bearing habit. Thinning done reasonably early in the season, together with intelligent pruning, manuring and soil management will bring about more even annual cropping of all except a few varieties which are inherent biennial bearers.

Since there is great variation in the fruiting habits of varieties, thinning cannot be recommended for all. Those varieties which are naturally small fruited or do not shed their fruit heavily during the June drop, such as Melba, Early McIntosh, Wealthy and Wagener, usually require thinning. Thinning is also desirable on certain varieties, such as Delicious, which require a large leaf area per fruit to attain high flavour and dessert quality. Other varieties, like Stayman Winesap, may require thinning in certain seasons and not in others, depending on weather conditions. It prevents a serious drain on trees in years of drought. Obviously the necessity for thinning is dependent upon the number of fruits which survive the June drop but it is advisable to take into consideration the amount of pruning which is being done. If light pruning is practised, thinning is usually necessary to maintain top grades.

Hand Thinning.—Thinning is practised shortly after the June drop when the apples are one to one-and-one-quarter inches in diameter. Summer varieties such as Melba, Yellow Transparent and Early McIntosh should be thinned early, a month after blossom, when the fruit is about one inch in diameter. It is also advisable to thin early, short-stem varieties, like Yellow Newtown, as their fruits are difficult to remove when they get large.

With varieties like McIntosh, which have a heavy June drop, it is best to delay thinning until after the June drop fruits can be readily distinguished.

The distance apart to leave the fruit will depend very largely on the variety and general condition of the orchard. Researches have shown that leaf area is of major importance in determining fruit size. With an increase in the number of leaves per fruit the size increases. Thinning thus affords a means of adjusting the crop to the leaf area in order to obtain the desired size of fruit. This fact must always be kept in mind. In the case of McIntosh the trees have a large leaf area per unit of branch and will develop the required large sizes as well when spaced four inches apart as will Wealthy when spaced six inches apart. Varieties with a small leaf area per unit of branch, such as Winesap, may have to be thinned as far as nine inches apart. In general, however, only one apple should be left per spur or bud and the individual apples on a branch spaced to six inches apart. All blemished and imperfect fruits should first be removed. In spacing, the fruits that are to remain should be left on the upper side of the limb as far as possible where they will be exposed to sunlight.

There are various techniques employed to remove the apples from the tree. The most efficient method is to hold the stem of the apple between the thumb and first finger and with the pressure or force of the remaining fingers separate the apple from the stem. In this way the apple is removed without disturbing the fruit spur and other apples attached to it. Light shears are sometimes used and are advantageous for late thinning when it is difficult to separate the apples by hand but they slow up the work considerably.

Thinning With Chemicals.—Until recently hand thinning, a laborious and costly operation, was the only method used. In 1935 Auchter and Roberts⁽¹⁾ reported the first chemical prevention of fruit set. They used cresylic acid and tar-oil distillate, both of which were effective in reducing fruit set, but cresylic acid caused severe injury to the tree. Since then extensive research has been conducted on various chemicals as a means of blossom thinning. Recently plant hormones have proved effective.

Chemicals Used.—At present the most extensively used materials are the dinitro compounds and the hormones, naphthaleneacetic acid and the sodium salt of naphthaleneacetic acid. Other chemicals which have been used include Dowax T.T.S., 82 and 222; Goodrite p.e.p.s (polyethylene polysulphide) combined with Fruit Thinner (Zimate-cyclohexylamine) and Goodrite p.e.p.s combined with Goodrite Z.A.C. (Zinc dimethyl dithiocarbamate-cyclohexylamine complex.)

Application.—Blossom thinning chemicals are applied in spray form using the power sprayers operating at sufficiently high pressures to give good coverage. Time of application is undoubtedly the most important factor to be considered in the spray method of blossom thinning. Good judgment on the part of the grower is necessary since a lapse of twelve to twenty-four hours may make the difference between success and failure. The dinitro sprays should be applied when seventy-five per cent of the bloom is out, while the hormone sprays are best applied at the calyx stage immediately following petal fall.

Thinning with dinitro sprays. They are applied when the trees are in full bloom.

Effect on Trees.—The dinitro materials are caustic in effect. They destroy the pollen already liberated as well as that still within the anthers. The effect of the plant hormone sprays is different in that it causes the dropping of young fruits which would normally adhere. Dowax does not kill the blossom but forms a wax coating over the stigmatic surfaces and so prevents pollen germination. In the absence of pollen germination, the young fruit drops. The caustic dinitro sprays applied in concentrations sufficient to effect thinning cause severe injury to the young leaves and to such floral parts as the petals and tips of the style. However, the trees quickly recover and at harvest time appear normal. The hormone sprays do not burn the foliage but wilting has been observed immediately after application. Later, some dwarfing of the foliage and crinkling along the midrib of the leaf may occur in some varieties.

The use of blossom thinning sprays to control biennial bearing is of prime interest. Such notorious biennial bearers as Wealthy, Golden Delicious and Yellow Transparent, when heavily thinned with blossom sprays in the "on" year, produce a commercial crop in the "off" year. With these sprays the crop may be completely eliminated, thus changing the tree from the "on" to the "off" year. Such a practice permits the grower to change half the trees of a given variety to the "off" year and by so doing he can regulate annual production. Therefore, chemical blossom thinning offers a means of modifying the biennial bearing habit.

Varietal Differences.—Varieties do not react alike to bloom-killing sprays. With certain varieties a given concentration will completely remove the crop, with others the thinning is quite effective and with still others the crop removal is insufficient. For example, for effective commercial thinning Wealthy requires a higher concentration of spray than Melba.

Variation in Results.—Seasonal conditions have an effect on the degree of thinning. Concentrations that give satisfactory thinning one season do not necessarily give effective thinning annually. Weather and condition of the tree influence the degree of thinning achieved. Variations in degree of thinning at different locations, even when the same concentration is used, may be caused by differences in the thoroughness of application and quantity applied to the tree. It is now thought that the gallonage per tree may be as important as the concentration; in other words, it is the amount of active ingredient applied to the tree that is the governing factor.

Trials on Thinning at the Central Experimental Farm, Ottawa, and Rideau Fruit Farm, Manotick, Ontario.—Preliminary experiments with Elgetol, a dinitro spray, on potted trees in the greenhouse at the Central Experimental Farm were begun in 1943. In the 1943 field trials effective thinning without injury to the foliage was obtained with a strength of one quart of Elgetol to one hundred gallons of water, but in the repeat experiments of 1944, an exact duplicate of the 1943 field trials, the blossoms on most varieties were completely killed. This is evidence of a concentration being satisfactory one year, but unsatisfactory the next.

From 1946-48 extensive trials were made at the Rideau Fruit Farm and at Ottawa. Varieties used in these trials included Atlas, Elmer, Fameuse, Lawfam, Lobo, Duchess, Joyce, Melba, Wealthy, Yellow Transparent and McIntosh. The materials used were: Elgetol; D.N. Nos. 1, 2 and 111; Dowax T.T.S., 82 and 222; Parmone; App-L-Set; Goodrite p.e.p.s combined with Goodrite Fruit Thinner; and Goodrite p.e.p.s combined with Goodrite Z.A.C. All the data cannot be included in a bulletin of this nature. Data for the 1947 experiment on the Rideau Fruit Farm are presented in Table 3.

Table 3 shows that Elgetol used at the rate of two pints on Melba was effective in thinning. With Yellow Transparent effective thinning was accomplished with App-L-Set (6 oz.), Elgetol (1½ pt.) and D.N. No. 2 (1 lb.). From the data it appears that the Goodrite p.e.p.s plus Goodrite Fruit Thinner on Melba and Yellow Transparent, and Dowax on Melba increased rather than decreased the set of fruit. On Wealthy, App-L-Set (8 oz.) resulted in too heavy thinning while Elgetol (3 pt.) and Goodrite p.e.p.s plus Goodrite Fruit Thinner were effective.

Table 4 gives the summarized data on the 1947 experiments at the Central Experimental Farm.

Table 4 shows that in general the dinitros and App-L-Set gave reasonably good thinning on the varieties McIntosh, Lawfam and Melba. Some thinning was effected with Dowax and Goodrite p.e.p.s plus Goodrite Fruit Thinner.

In the 1946 trials it was found that Dowax had no commercial thinning effect on the varieties Melba and Duchess. This material does not appear to emulsify readily. Considerable thinning was accomplished with sodium salt of naphthaleneacetic acid on Melba, Yellow Transparent and Duchess. This material did not cause burning of the foliage although some stunting of the primary leaves resulted. Very effective thinning was accomplished with one and one-half pints of Elgetol on McIntosh and Lobo and with two pints on Melba, Yellow Transparent, Duchess and Wealthy. These concentrations caused considerable foliage injury but the trees recovered quickly and outwardly performed in a normal manner.

TABLE 3.—BLOSSOM THINNING EXPERIMENT. RIDEAU FRUIT FARM, MANOTICK, 1947

Spray	Concentration	Melba			Yellow Transparent			Wealthy		
		Average Mean Temperature	Stage of Bloom	Per cent Set	Average Mean Temperature	Stage of Bloom	Per cent Set	Average Mean Temperature	Stage of Bloom	Per cent Set
App-L-Set.....	6 oz. : 100 gal.	68° F.	F.B.+2	4.58	63° F.	Calyx	3.00	63° F.	Calyx	4.43
App-L-Set.....	6 oz. : 100 gal.	64	Calyx+6	4.50	.....	.....	.....	63	"	0.09
App-L-Set.....	8 oz. : 100 gal.	64	Calyx+6	4.62	.....	.....	.....	64	Calyx+5	0.70
Goodrite p.e.p.s. +F.T.....	2 lb. : 100 gal.	63	Calyx	10.13	63	Calyx	12.80	63	Calyx	1.68
Goodrite p.e.p.s. +F.T.....	2 lb. : 100 gal.	63	Calyx	6.61	.....	.....	.....	.....	.....	.....
Dowax 222.....	4 oz. : 100 gal.	68	Calyx	6.02	.....	.....	.....	.....	.....	.....
Elgetol.....	1 gal. : 100 gal.	70	F.B.+1	3.97	73	F.B.	4.88	.....	.....	.....
Elgetol.....	1½ pt. : 100 gal.	74	F.B.+1	2.25	72	F.B.	4.08	.....	.....	.....
Elgetol.....	2 pt. : 100 gal.	.....	F.B.+1	.....	.....	.....	.....	64	F.B.+1	1.75
Elgetol.....	3 pt. : 100 gal.	.....	F.B.+1	4.44	.....	.....	.....	.....	.....	.....
D.N. No. 1.....	1 lb. : 100 gal.	74	F.B.+1	3.24	74	F.B.	3.82	64	F.B.+1	4.82
D.N. No. 2.....	1 lb. : 100 gal.	74	F.B.+1	.....	.....	.....	.....	.....	F.B.-2	3.43
(a) Elgetol.....	2 pt. : 100 gal.	.....	.....	.....	.....	.....	.....	72	F.B.	5.56
(b) D.N. No. 1.....	1 lb. : 100 gal.	.....	.....	5.22	.....	.....	12.61	.....	.....	.....
Check.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

F.B.+2=2 days after full bloom

F.T.=Fruit Thinner.

Calyx+6=6 days after calyx stage

(a) First Spray

(b) Second Spray

TABLE 4.—BLOSSOM THINNING EXPERIMENT. CENTRAL EXPERIMENTAL FARM, OTTAWA, 1947

Spray	Concentration	McIntosh			Lawfam			Melba		
		Average Mean Temperature	Stage of Bloom	Per cent Set	Average Mean Temperature	Stage of Bloom	Per cent Set	Average Mean Temperature	Stage of Bloom	Per cent Set
Elgetol.....	1 pt. : 100 gal.	70° F.	F.B.	7.43	70° F.	F.B.	3.98	.....	.....	.....
Elgetol.....	1 1/4 pt. : 100 gal.	70	F.B.	7.66	70	F.B.	2.76	.....	.....	.....
D.N. No. 1.....	1 lb. : 100 gal.	64	F.B.+1	13.99	70	F.B.	7.60	72° F.	F.B.	9.60
D.N. No. 1.....	1/2 lb. : 100 gal.	66	F.B.+1	7.67	66	F.B.	6.61	.....	.....	.....
D.N. No. 2.....	1 lb. : 100 gal.	68	F.B.+1	6.02	68	F.B.	3.85	.....	.....	.....
D.N. No. 2.....	1/2 lb. : 100 gal.	70	F.B.+1	7.51	70	F.B.	3.10	.....	.....	.....
D.N. 111.....	1 lb. : 100 gal.	72	F.B.+1	5.59	72	F.B.	6.83	.....	.....	.....
App-L-Set.....	4 oz. : 100 gal.	68	Calyx	4.44	68	Calyx	5.41	.....	.....	.....
App-L-Set.....	8 oz. : 100 gal.	63	Calyx	6.17	63	Calyx	3.46	63	Calyx	4.83
Dowax 222.....	1 gal. : 100 gal.	70	F.B.+1	7.28	70	F.B.	9.74	.....	.....	.....
Goodrite p.e.p.s. + F.T.....	2 lb. : 100 gal.	60	Calyx	9.28	60	Calyx	7.52	.....	.....	.....
Goodrite p.e.p.s. + F.T.....	2 lb. : 100 gal.	63	Calyx	8.23	63	Calyx	6.29	63	Calyx	7.15
Check.....	8 oz. : 100 gal.	.....	.....	15.82	.....	.....	16.00	.....	.....	15.25

F.B. = Full bloom
F.B.+1 = One day after full bloom

In the 1948 trials a new material, Goodrite Z.A.C., was combined with Goodrite p.e.p.s instead of the Fruit Thinner used in 1947. Goodrite p.e.p.s (2½ lb.) combined with Goodrite Z.A.C. (1/3 lb.) gave effective thinning on McIntosh, partial thinning on Lawfam and had little effect on Melba. The other chemicals showed the same trend as in 1947, although the thinning was not so heavy. However, even this lighter thinning greatly reduced the cost of later hand work.

Experimental Results on Thinning at the Dominion Horticultural Substation, Smithfield, Ontario.—Under the supervision of the Substation staff, trials were carried out in the Lake Ontario region in 1948. The data obtained for one orchard are presented in Table No. 5. Thinning was not so marked as in the trials at Ottawa, but the chemicals performed in a similar manner. App-L-Set (10 oz.) gave partial thinning on Wealthy and Fameuse, but overthinned McIntosh. Goodrite p.e.p.s (2½ lb.) combined with Goodrite Z.A.C. (1/3 lb.) was ineffective on Wealthy, appeared to increase the set on McIntosh and gave partial thinning on Fameuse.

TABLE 5.—THINNING APPLES WITH CHEMICALS. W. A. FRASER'S ORCHARD, R.R. #4, TRENTON, ONTARIO, 1948

Spray	Concentration	Variety	Stage of Bloom	Average % Set
App-L-Set.....	10 oz. : 100 gal.	Wealthy	Calyx + 5 days	10.6
Goodrite p.e.p.s.....	2½ lb.	"	"	21.0
+ Goodrite Z.A.C.....	1/3 lb. : 100 gal.			
Check.....				
App-L-Set.....	10 oz. : 100 gal.	McIntosh	"	1.3
Goodrite p.e.p.s.....	2½ lb.	"	"	18.9
+ Goodrite Z.A.C.....	1/3 lb. : 100 gal.			
Check.....				
App-L-Set.....	10 oz. : 100 gal.	Fameuse	"	12.37
Goodrite p.e.p.s.....	2½ lb.	"	"	14.06
+ Goodrite Z.A.C.....	1/3 lb. : 100 gal.			
Check.....				

Recommendations.—Since seasonal conditions have an effect on the degree of thinning it is not possible as yet to give definite rates of application. This is further complicated by the fact that varieties do not react alike. Until definite recommendations are available the grower without previous experience should use these chemicals cautiously. For trial purposes, the dinitros should be used at the rate of one and one-third pints or three-quarters of a pound per 100 Imperial gallons, while the hormone compounds are applied at the rate of five ounces per 100 gallons. The safest policy is to slightly under-thin with the chemicals and finish off with hand thinning.

HARVEST SPRAYS

The pre-harvest dropping of apples is a problem which annually confronts the commercial grower and in many years the resulting losses amount to thousands of dollars. It was not until 1939 that Gardner, Marth and Batjer⁽²⁾ first reported the control of pre-harvest drop by the use of hormone sprays. This discovery stimulated widespread interest among fruit research workers and in subsequent years extensive trials were conducted. From these investigations it was pretty well established that chemicals could be employed successfully as pre-harvest sprays. Several manufacturers responded to the demand for drop control chemicals, and commercial preparations in both liquid and dry form were developed. In 1941 and 1942 harvest sprays were used commercially by hundreds of growers in every apple growing region in the United States and by a number

of growers in Canada. The aeroplane was used for this type of spraying; first in the State of Washington in 1944 when over a thousand acres of apples and pears were treated. The following year the acreage covered by plane spraying increased fifteen to twenty times. At the present time harvest sprays, not necessarily applied by aeroplane, are a standard practice in the control of harvest drop in all apple growing areas of both the United States and Canada.

Chemicals Used.—Most commercial preparations contain either naphthaleneacetic acid, the sodium salt of naphthaleneacetic acid or naphthaleneacetamide as the active agent with carriers to facilitate their use in spraying or dusting operations. 2,4-dichlorophenoxyacetic acid (2,4-D) has been used as a harvest spray, but it is specific to the Winesap varieties. More recently, 2-methyl-4-chlorophenoxyacetic acid, which differs from 2,4-D in that a methyl group replaces the two-position chlorine atom, has proved superior to the sodium salt of naphthaleneacetic acid on McIntosh.

Application.—As in all spraying operations, the effectiveness of the material used is dependent upon good coverage. The rate of application varies according to spraying conditions, amount of foliage and fruit on the tree. Best results are obtained when enough spray is applied to “wet” the entire tree. Time of application is a very vital factor in the effectiveness of the spray. Under average conditions the spray becomes effective within two days after being applied, and reaches its peak in four to five days. The interval between application and effect is longer during cool weather. A spray applied too early, especially on McIntosh, may lose its retarding effect before the crop is harvested. Best results are obtained, especially with McIntosh, by waiting until a few good sized apples, free of insect injuries, have dropped to the ground.

Effect on Trees.—No harmful effect of the spray on the tree, fruit, or foliage, has been recorded. Some may wonder if the spray causes the leaves to hang on longer, thus increasing the risk of winter injury. Apparently the effect on the leaves is temporary and leaf fall takes place at the normal time. The effect on the fruit is merely that of delaying its dropping by slowing down the processes taking place in the abscission layer, thereby allowing for better colour development. This improved colour and longer picking season is perhaps an even more important feature of the spray than preventing fruit drop, since the demand for extra fancy grades is increasing. The grower must exercise extreme care in using this spray to attain fruits of better colour. It is a mistake to allow the fruit to remain on the tree too long, for such fruits are too mature for long storage. Hormone sprays hasten the maturity of summer apples but apparently have little or no effect on the fall and winter apples. This is of commercial importance since it results in a considerable saving in the picking of the summer varieties.

Varietal Differences.—Varieties do not react alike. Harvest sprays generally are more effective on the summer than on the fall varieties. The relatively high temperatures prevailing when the summer apples reach maturity are considered to be the main contributing factor in this effectiveness. Melba and Yellow Transparent, for example, respond well to these sprays while McIntosh is inconsistent.

Variation in Results.—The successful use of harvest sprays depends on the condition of the tree. Trees suffering from disturbances such as leaf scorch and winter injury do not respond to these sprays. Rainfall is also a factor, and in relatively dry years the sprays are less effective.

Harvest Spraying Experiments at Two Ontario Locations.—Investigations with harvest sprays were initiated on pot trees of the Crimson Beauty and U.S.D.A. No. 49 varieties in the greenhouse at the Central Experimental Farm,

Ottawa. The results of these preliminary tests were so significant that large-scale orchard trials were conducted in 1940. Two commercial preparations, Parmone (naphthaleneacetic acid) and Fruitone (naphthaleneacetic acid plus naphthaleneacetamide) were used. Data from the 1940 and 1941 experiments are presented in Table 6. The two preparations gave essentially the same

So effective is the harvest spray that in some cases the apples if not picked cling to the tree beyond maturity and rot on the branches.

control, and both were effective in reducing the pre-harvest drop of all varieties included in these experiments. The sprays were more effective on summer than on fall and winter varieties. The period of effectiveness varied with varieties. With McIntosh the period was approximately one week; with Crimson Beauty, Melba and Yellow Transparent two weeks. The addition of Russian oil to the harvest sprays, one-fourth of one per cent in an emulsifying agent (bordeaux) 3-6-40, did not increase the efficiency of the spray enough to justify its use.

In 1948, the 2-methyl-4 chlorophenoxyacetic acid, also known under the trade names of "Toloxyl" and "A-814", was tried on McIntosh at Ottawa. It was quite effective when applied at a five ounce concentration. The sodium salt of naphthaleneacetic acid (5 oz.) moderately reduced the percentage drop, showing better results than the four ounce concentration of 2-methyl-4 chlorophenoxyacetic acid. Trials in the Lake Ontario region under the supervision of the Dominion Horticultural Substation, Smithfield, Ontario, showed that both the four- and five-ounce concentrations of A-814 were much better than the sodium salt of naphthaleneacetic acid. To date this new compound appears to have promise as a harvest spray for McIntosh.

TABLE 6.—HARVEST SPRAY EXPERIMENTS
1940, 1941

Variety	1940 Percentage Drop			1941 Percentage Drop		
	Fruitone	Parmone	Check	Fruitone	Parmone	Check
Crimson Beauty.....	4.9	9.3	30.0			
Yellow Transparent.....	2.6	.....	14.8			
Melba.....	1.0	0.7	10.2	14.75	14.25	32.00
McIntosh.....	13.8	18.0	24.4	6.50	5.75	9.25
Wealthy.....	27.9	22.5	47.8	11.00	12.75	31.50
Joyce.....	0.5	.....	2.9	7.25	6.50	17.25
Honora.....	1.0	.....	6.6	7.50	7.25	13.75
Brisco.....	.....	5.7	12.1	19.25	.....	53.75
Lobo.....	1.9	2.9	6.2	.....	5.25	6.25
Stonecrop.....	.....	.....	.....	11.00	.....	50.00
Atlas.....	.....	.....	.....	6.50	6.50	8.50
Dudley.....	.....	.....	.....	7.75	5.03	19.75
Gilda.....	.....	.....	.....	.....	21.00	23.75

Recommendations.—The standard recommendation for controlling pre-harvest drop of apples is either naphthaleneacetic acid, the sodium salt of naphthaleneacetic acid or naphthaleneacetamide, all at five oz. per 100 Imperial gallons. On the basis of one year's results, 2-methyl-4 chlorophenoxyacetic acid appears to be promising as a harvest spray for McIntosh when applied at the rate of five oz. per 100 Imperial gallons.

TREATMENT OF WINTER INJURED APPLE TREES

The treatment of winter injured apple trees is of great importance in fruit districts where trunk and crotch injury frequently occur. Trees severely injured in the trunk and crotch regions, if properly treated immediately after the injury occurs, may be brought back into profitable production in a relatively short time. The time and money spent on treating injuries of this nature are more than repaid by increased production.

In winters when extreme temperatures occur, growers should examine the trees at frequent intervals for signs of loose bark which first appears as a bulge and later splits usually on the southwest side of the trunk. Professor Potter⁽³⁾, University of New Hampshire, found that the tacking of the bark to the tree with broad-headed nails and covering the cracks with wax kept the wood from drying out and prevented the water supply to the leaves from being cut off through drying of the sapwood. Moreover, he noted that trees treated in this way in many instances made a new growth inside the bark. Where tacking was done early and properly in the apple orchards of Quebec, following serious damage due to the cold winter of 1933-34, very beneficial results were obtained.

The separation of the tissue may take place in the cambium layer or very young sapwood. Since the cambium layer initiates the development of the sapwood and bark, theoretically, the tacking together of the separated cambium should permit it to knit together. Without tacking, callus may form on the inner surface of the raised bark without attaching to the sapwood. This causes a rolling back of the bark or the formation of a thick bulging ridge of callus along the margins of the crack. When the separation takes place in the sapwood the cambium and bark are exposed to drying out. Tacking will prevent this drying out and permit the cambium to lay down new wood, thus bridging the injury.

In cases where trunk splitting is not noted early in the season, and the bark tissue is completely dried out, curled up and the sapwood darkened—symptoms of definite killing of the cambium tissue—the bark should be carefully cut back to live tissue. The bark on the lower edge of the wound should be cut in a

V-shape to permit good drainage. If this is not done rainwater will lodge between the bark and sapwood and cause the tissue to rot. The area left exposed by the removal of the dead bark is treated or painted with a preparation capable of disinfecting and protecting the tender area until it is completely healed over. Many preparations have been tested for treating wounds of this nature and bordeaux linseed oil mixture has been found to be very satisfactory. It gives excellent protection to the wound and is very durable. Bordeaux linseed oil mixture is prepared by mixing 4 ounces bordeaux powder in 1 pint of boiled linseed oil. Emulsified asphalt preparations obtainable from regular dealers in horticultural sundries are also widely used for this purpose and are fully satisfactory. Where there are large wounds, bridge grafting should be done. For details see chart on "The Budding and Grafting of Fruit Trees" published by the Canada Department of Agriculture, Ottawa.

McIntosh tree saved by inarching after trunk had been severely injured by a grass fire. This method can be used to save trees with severe trunk injury.

All dead tissue should be carefully removed from winter injured patches on main framework limbs and in the crotches of the tree. The dead bark should be cut back to where callus or live tissue has formed at the extreme edge of the injured area. When removing the dead bark care should be exercised not to injure the new callus forming around the edges of the wound. If no new callus has formed, the dead bark should be cut back into the healthy or live tissue. The injured area should be thoroughly scraped and cleaned, freeing it from all

foreign matter such as fungi and bacteria. If the dead tissue is allowed to remain, it will afford a place for organisms to harbour and thrive, resulting in a decay of the woody tissue and ultimate death of the tree. After the wound is properly cleaned it is painted with bordeaux linseed oil or an emulsified asphalt preparation.

These injured areas should be painted on the first indication of the tissue drying out until the wound is completely healed over, also scraped when necessary. The presence of cankers or fungi shows that organisms are present and the areas should be thoroughly scraped, cleaned and painted.

Trunk splits, which extend deep into the wood and are too broad to heal over readily, should be filled with "Arcomastic". This is an emulsified asphalt, semi-plastic, that will mould itself into any shape, and will dry sufficiently hard to form a solid mass that will not crack or disintegrate. It can be applied by means of a trowel or paddle.

Main framework branches severely injured in the crotches should be braced with 5/16 or $\frac{1}{4}$ inch iron rods. The rod is so placed as to extend directly through the main limb and trunk or central leader, with both ends clinched into the tree where they soon become covered with the growing tissue.

If the tree is badly weakened as a result of these injuries, the orchard practices should be modified. No pruning, other than the removal of dead limbs, should be practised for a year or two. Great care should be exercised in the spraying operations so that no injurious sprays will come in contact with the sparse and unusually tender and weakened foliage. The rate of application of fertilizers should be reduced below normal. If a moderate or relatively heavy crop of fruit is set on the limbs badly weakened by crotch or body injury, it is advisable to materially reduce the number of fruits by thinning operations.

Invigorating.—Trees suffering from winter injury, mice injury and mechanical injury can be invigorated and restored to profitable production by two simple orchard practices—bridge grafting and inarching. If bridge grafting and inarching had been employed more freely following the test winter of 1933-34, many of the trees, which later died from severe trunk and crotch injuries, would now be producing commercial crops.

Bridge grafting and inarching are best done in the early spring just as soon as the bark slips easily. This is usually after the first flush of sap has taken place and the buds on the tree have begun to swell. The operations can, however, be carried out at any time during the summer when the bark is slipping but it is better to bridge and inarch when dormant scions and seedlings are available. Seedlings that have leafed out can be used but are more difficult to transplant. For details in connection with bridge grafting and inarching operations see Canada Department of Agriculture chart on "The Budding and Grafting of Fruit Trees."

MOUSE AND RABBIT CONTROL

Each year thousands of fruit trees of all kinds are injured in Canada by mice and rabbits. Just as manuring, cultivating, pruning, spraying and thinning are regular orchard practices, so also should the control of mice and rabbits be considered. There is nothing more discouraging to a fruit grower, or would-be fruit grower, than to see his orchard which he has cared for, perhaps for several years, ruined by mice or rabbits or both, and yet this frequently happens.

Control of Field Mice.—The greatest injury from mice generally occurs in November and again in March. Control measures should therefore be put into operation previous to these periods. Some of the accepted methods are removing hibernation shelters, use of mechanical protectors, poisoning and repellent washes. All these methods have their merits but the best practice is a

combination of all. Mice can be controlled to a point where they cease to be a pest, but this requires constant attention on the part of the growers.

All methods of mice control have their merits, but none is perfect, as shown above.
The best practice is a combination of methods.

The ravages from mice vary from one year to another, depending upon the scarcity or abundance of food, the number of mice which are in the vicinity and the character of the winter. However, the injury is always the greatest when the orchard is in sod, sod mulch or when there is rubbish lying about. Clean cultivation will do more to discourage mice than any other method of control because without grasses, sedges, and other herbaceous vegetation upon which to feed, they will leave an orchard. The most widely advocated system of cultivation, namely, clean cultivation from early spring until some time early in June followed by a cover crop, will help to minimize the mouse population. In many cases it is not necessary nor advisable to have an orchard in sod, particularly when the trees are young. However, if the trees are growing in a permanent sod certain precautions must be exercised to prevent injury from mice. The removal

of the sod for a width of $1\frac{1}{2}$ feet around the trunk before late September is very effective. It is best to fill the trench caused by the removal of the sod with coarse sand, cinders or crushed stone as this will prevent the grass from growing up again and will act as a permanent protector. A small mound of soil or coal ashes packed to a depth of six inches around the trunk of the tree, when properly done, will often prevent injury and even snow tramped firmly around the trunk after each snow fall has been effective as it prevents the mice from working in beneath the snow.

For young trees wire guards give good protection against mice. The wire guard should be of one-quarter-inch mesh, galvanized, eighteen inches wide and from eighteen to twenty-four inches high. Rolls of wire of desired height may be purchased and cut to proper width or the guards ready for use may be purchased from a wire manufacturer. The bottom of the guard should be inserted into the ground to a depth of from two to three inches to prevent the mice tunnelling under the barrier. Each fall the wire guards should be checked because a few may have been disturbed during the summer. The wire protector will give protection to a young tree for seven or eight years, following which it can be removed and used on younger trees. Wooden veneer barriers about the same size as wire guards have been used with a great measure of success by some orchardists. Light coloured building paper wrapped tightly around the trunk and held firmly in place with twine gives good protection throughout the winter months but should be removed in the spring. Tar paper and roofing paper is not satisfactory as the bark underneath the paper is often injured. A small mound of earth should be placed about the base of the paper to prevent the mice from working up underneath.

Supplementary to the methods already mentioned, an annual clean-up of the mice by use of poison baits should be a regular orchard operation. If there are not too many fallen apples in the orchard in late fall, probably the most efficient poison bait is the apple. However, if drops are plentiful and the temperature is below freezing, grain baits are likely to prove more attractive to mice. The poisons used in poison baits are either strychnine, zinc phosphide or white arsenic. Zinc phosphide, when used in natural form is not so attractive as when mixed with saccharine, but to get an effective mix the two have to be put through a micronizing process. The United States Fish and Wild Life Department have a process for mixing this material and they are now offering it for sale to growers in the United States. This poison is being handled by local co-operatives and spray dealers in Canada and sold under the name of United States Fish and Wild Life Rodenticide. The following baits have been very effective at Ottawa:

Apple Bait Treated with United States Fish and Wild Life Service Rodenticide.—The bait is prepared as follows: cut up good firm apples into half-inch cubes and dust these evenly with the rodenticide. This is supplied in a shaker-top can, which will prepare ten quarts of bait. The bait should be stirred until an even light coating is obtained. The use of one level teaspoonful per quart of cut bait is the proper amount. *The mixing of the poison with the apple bait must be done with extreme caution and at no time should the hands come in contact with the poison. All utensils used should be thoroughly washed after preparation is completed.* A honey pail is a convenient means of carrying the bait in the orchard. The operation of placing the bait should be carried out in a systematic way by following up each row of trees, lifting the mulch at intervals, and examining the ground underneath carefully for mouse trails. When trails or runways are found, a cube of bait is placed in it by means of a long handled fork or a steel wire sharpened at one end with a loop for a handle at the other end. Care is taken to place the mulch back over the trail after the bait is placed. The number of placements about a tree depends entirely on the number of trails

or the infestation. If the mouse population is high, at least four baits are placed per tree. Where possible, it is preferable to place the bait early in the day, since the afternoon is the most active part of the day for field mice.

Grain Bait Treated with Strychnine.—Mix 1 level tablespoonful of laundry starch in $\frac{1}{4}$ teacup of cold water; stir this into $\frac{3}{4}$ pint of boiling water to make a clear paste. Mix 1 ounce strychnine sulphate (not strychnine alkaloid) with 1 ounce of baking soda and stir this into the hot starch paste to make a smooth creamy mass free from lumps. Stir in a $\frac{1}{4}$ pint of heavy corn syrup and 1 tablespoonful of glycerine or liquid petrolatum. When this is well mixed pour it over 8 quarts of rolled oats from which the fine particles have been screened out. Mix thoroughly until all the lumps are broken up and the poison is thoroughly mixed with the rolled oats.

Some growers find difficulty in getting a thorough mixture with the above. Wheat, although not so palatable to the mice as rolled oats, may be substituted, using 12 pounds. Mix thoroughly until every grain is coated.

A New Method of Using Poison Grain Bait.—A new method of poisoning mice has recently been reported by W. R. Eadie⁽⁴⁾ of Cornell University. It is the distribution of a poisoned grain very thinly throughout the orchard in parallel rows along the drip line of the trees by use of a mechanical seeder. The results obtained compare very favourably with the hand placed baits. The advantage of the mechanical method over the hand placed baits is the greater saving in labour costs. A 17-acre orchard was poisoned by one man in 13 hours using 31 pounds of grain. A No. 36 Planet Jr., with furrow opener raised and closers removed, was used, seeding at the rate of 10-20 grains per linear foot. Zinc phosphide proved to be the most effective poison and cracked corn the best bait. To repel the birds the corn was dyed green. The cost of preparing the poisoned grain was estimated at 10 cents per pound exclusive of labour. The following formula was used: 100 lb. cracked corn, 2 lb. zinc phosphide, 1 quart vegetable oil. The materials were mixed as follows:

“The zinc phosphide was mixed with oil to form a thin paste and this was poured over the grain in a large metal tub, outdoors. A hoe was used to mix the mass thoroughly in order to coat each grain as uniformly as possible. A large sized metal laundry tub will not contain more than 50 pounds conveniently for mixing. Because of the poisonous gas evolved it is essential to perform the operation in the open air unless an appropriate gas mask is worn. If green coloured cracked corn is used it must be dyed beforehand because the dye used is not oil soluble. This may be done by dissolving $\frac{1}{2}$ ounce methyl green in 1 gallon of water for each 10 pounds of grain, pouring it over the grain, mixing it thoroughly. The dyed grain must be allowed to dry completely before using it to prepare the poisoned bait. The poisoned bait will keep for several months in a dry place without deteriorating seriously. Since zinc phosphide is poisonous to humans and all animals, gloves should be worn in preparing baits, all containers used should be labeled, and the material stored carefully”.

Control of Rabbits.—By far the most effective method of ridding orchards of rabbits is organized hunts or drives. In districts where the jack rabbit is a serious menace hunts should be carried out on a large scale.

Wrapping young trees with burlap is effective. Burlap bags are ripped open and joined together to make large sheets which are wrapped around the top of the tree, enveloping the entire head. Narrow strips of burlap are wrapped in a spiral fashion around the trunk to protect this area.

Good results have been obtained in Ontario by painting fruit trees with a resin-alcohol solution. This repellent is easily prepared and is apparently not harmful to the tree even when the buds are covered. It is prepared by dissolving

12 pounds of lump resin, finely broken, in 1 gallon of cheap alcohol. The cheaper grades of denatured commercial ethyl alcohol are as satisfactory as higher grades. It is important to use the lump resin and not the powdered as the latter has other foreign material in it which will not dissolve. The lump resin should be broken into small bits, pulverized and sifted through a fly screen so that it will dissolve quickly. The resin is added to the alcohol slowly and stirred until completely dissolved. It is a good plan to let the solution stand over night so that the resin is thoroughly dissolved. As alcohol evaporates readily the solution should be kept in an air-tight can. *Because of the inflammable nature of the material it must never be placed near a fire.* The solution is applied with a paint brush and precautions must be taken to treat trees only when bark is dry. If applied to moist bark it will flake off soon after application.

Poison baits have proved effective for rabbit destruction. A good bait for rabbits is prepared as follows: Dissolve 1 ounce of strychnine sulphate in $1\frac{1}{2}$ gallons of boiling water in one dish and 4 tablespoonfuls of laundry starch in $\frac{1}{2}$ pint of cold water in another dish and then add starch to the strychnine solution and boil for a few minutes until the starch is clear. A little saccharine or corn syrup may be added, if desired, but it is not essential. Pour or spray the solution of strychnine and starch over alfalfa hay or sweet clover, and allow it to soak in well. Tie the hay into very small bundles and distribute throughout the orchard, tying a small bundle of poisoned hay to a branch of a tree about a foot or so above the snow level.

POLLINATION

From the standpoint of their requirements for pollination, apple varieties may be either *self-fruitful*, that is, they are capable of producing mature fruit when pollinated with their own pollen or *self-unfruitful*, that is, they require pollen from another variety in order to produce fruit. Apple varieties vary from those that yield little or no fruit when self-pollinated to others that produce a set little short of that obtained from favourable cross-pollination. Furthermore, apple varieties are *cross-fruitful* and *cross-unfruitful*. When the pollen from one variety results in fruit production when placed on the stigma of another variety, the first variety is said to be cross-fruitful with the second variety. On the other hand, if fruit does not result the condition is known as cross-unfruitful. Only a few apple varieties are completely self-unfruitful and there are few cases in which the pollen from one variety is completely useless for pollinating another variety though there are many combinations that give very poor results commercially. It is quite obvious from the foregoing that the pollination problem in commercial orchards consists of:

1. Planting together varieties that are cross-fruitful and which bloom at the same time.
2. "Working over" a sufficient number of trees in blocks of self-unfruitful or cross-unfruitful varieties to secure adequate pollination.
3. Supplying insect pollinators where they are not present in adequate numbers.

In the established fruit sections in Canada a great many varieties are grown and most of the older orchards are planted to a large number of varieties. While this has been a definite drawback from a commercial standpoint, it has resulted in the pollination problem being less serious than in the newer orchards where a few desirable sorts have been planted. In the plantations set out in more recent years the mixture of varieties, from the standpoint of pollination, has been unsuitable and has undoubtedly resulted in subnormal crops, especially in years when the weather conditions for cross pollination were unfavourable. In a few cases large blocks of self-unfruitful varieties have been set out. A good

example is Northern Spy which is one of the most self-unfruitful of the commercial varieties. In Nova Scotia considerable difficulty has been experienced in getting good crops of Blenheim, Stark and Ben Davis, especially where these varieties have been planted in large blocks. With the recent trend to restrict new plantings to a few of the more profitable varieties and to graft out unprofitable ones comes the need for closer attention to the question of pollination. In considering the question of setting out new orchards or top grafting over old ones, consideration should be given to the following:

1. The planting of a solid block of orchard to one variety should be avoided.
2. The selection of cross-fruitful varieties, of which the bloom overlaps sufficiently to permit cross-pollination, should be the aim of all growers.
3. If the bloom does not exactly coincide it is preferable for that of the variety introduced as a pollinizer to be a little earlier rather than a little later than that of the variety it is desired to pollinate.
4. The varieties used as pollinizers must themselves be provided with pollinizers as many varieties that produce excellent pollen for crossing purposes are themselves quite self-unfruitful.
5. When pollinizers are employed, the minimum provision for pollination is a full row every fourth row. Full rows of pollinizers seem to be preferable to scattered trees.

The following discussion taken from Dominion of Canada Department of Agriculture Bulletin No. 162, New Series, entitled "Apple Pollination Studies" gives a splendid picture of the cross-fruitfulness of the commercial varieties grown in Nova Scotia.

"The blossoming period of Gravenstein and King, for example, sufficiently overlaps that of Golden Russet or Wagener to enable the former to be pollinated by the latter, but neither King nor Gravenstein will give best results as pollinizers for other varieties. Gravenstein, however, is superior to King in this respect. Golden Russet and Wagener are inter-fruitful and are sufficiently overlapped by Cox Orange to give fairly satisfactory results. Cox Orange is also an excellent pollinizer for Baldwin and Golden Russet also overlaps sufficiently to be of service, especially to the earlier bloom. Spy presents the greatest problem of our commercial sorts. Cox Orange overlaps to a sufficient extent in most years to give a good crop, but in seasons where the bloom is more prolonged Ben Davis gives the better results. However, Ben Davis is no longer recommended for new plantings. Rome Beauty has given good results elsewhere, but there appears to be some difference of opinion as to the commercial value of Rome Beauty in the Valley, owing mainly to the poor growth habits of the tree. In a season like 1930, when the bloom came and went practically within a week, there is not the same problem as regards overlapping of bloom, but in some seasons the unevenness of bloom of the different varieties constitutes a difficulty. However, Cox Orange can be depended upon to give at least fair results on Spy, and owing to the fact that this variety blossoms very unevenly, it is suitable for pollinating a wider range of varieties than almost any other. When the pollen of Golden Russet or Wagener is dried and properly stored it gives excellent results on Spy, but under orchard conditions the difference in the blooming period is too great to make them dependable pollinizers for the latter variety. If McIntosh is used, it works well with the medium blooming varieties, including Golden Russet. For Blenheim, Golden Russet and Wagener provide suitable pollinizers and McIntosh works fairly well. Cox Orange, in some seasons, is late for best results. The same varieties are satisfactory for Stark. In providing

pollinizers for Blenheim and Stark it would seem to be advisable to do so in greater abundance than for the standard varieties, in order to make pollination more certain. It is suggested, in setting out poor pollen-producing varieties, that not more than two rows be placed together, followed by a row or two of a pollinizing variety, which, in turn, should be followed by one or two rows of a variety cross-fruitful with the latter. Whether one or two rows would be used would depend upon the proportion of each that it is desired to have in the orchard. Where it is necessary to top work a block of a self-unfruitful variety, such as Blenheim, for the purpose of improving the set, every third row should be worked over, one-half with a variety introduced primarily to pollinate Blenheim and one-half with a variety introduced primarily to pollinate the pollinizer of the Blenheim. In introducing varieties for pollinizing purposes, the most desirable commercial sorts should be selected."

Due to similarity of climatic conditions the commercial varieties grown in New Brunswick, Quebec, and in Ontario along the St. Lawrence River Valley to Kingston, are much the same. The main varieties are McIntosh, Fameuse, Melba, Lobo, Cortland, Joyce, Atlas and Hume. The blossoming period of these varieties overlaps to a sufficient extent in most years to give a good crop. In controlled crossing at the Central Experimental Farm it has been observed that McIntosh, the variety that constitutes forty to sixty per cent of the commercial plantings in these regions, is cross-fruitful with Cortland, Fameuse, Hume, Joyce, Lobo and Melba. Cortland is cross-fruitful with Fameuse, Hume, Lobo, McIntosh and Melba; Fameuse with Cortland, Hume, Lobo, McIntosh and Melba; Hume and Lobo with Cortland, Fameuse, McIntosh and Melba; Melba with Cortland, Fameuse, Hume, Lobo and McIntosh.

TABLE 7.—AVERAGE BLOOMING PERIOD AT OTTAWA, 1944-45-46-48

—▲— Average date full bloom.

In the apple growing areas of Ontario, west of Kingston, the leading varieties grown are McIntosh, Northern Spy, Delicious, and Rhode Island Greening. The blooming dates of McIntosh, Delicious and Rhode Island Greening are much the same but these varieties bloom two or three days earlier than Northern Spy. Since Rhode Island Greening produces poor pollen only McIntosh and Delicious are suitable pollinizers for Northern Spy. In a plantation of McIntosh and Northern Spy, or McIntosh, Rhode Island Greening and Northern Spy, a suitable pollinizer for McIntosh must be included. Suitable varieties for this purpose include Cortland, Delicious and Hume.

VARIETIES

Of the many problems facing an orchardist, the question of selecting the right varieties is probably the most important, yet the most difficult of solution. Frank discussions on the pros and cons of newer varieties are of material aid to the grower upon whom rests the final selection.

In Eastern Canada, particularly eastern Ontario and Quebec, the ability of a variety to withstand cold is essential, and is the basis of selection of all the Ottawa named seedling varieties. McIntosh and Northern Spy have been the standard of quality aimed at. Seedlings earlier and later than McIntosh have received major attention.

The consuming public are much more exacting in their requirements now than they were twenty years ago and with increasing competition, due to greater production, an ever superior product will be expected in the years to follow. No matter how good the soil may be, or the skill used in growing the fruit, if the varieties are unsuited to the climate and markets, failure is the result.

Varieties for new plantings should be selected from the accepted fruit lists. New varieties should be planted in limited numbers until their worth has been proved. Whether the new planting is for commercial or home use will make a big difference in choosing varieties. Commercial plantings generally are made up of a comparatively few varieties, while in home plantings it may be desirable and profitable to plant as many varieties which ripen early, midseason, and late, as can be used in the home or sold locally. Obviously all the varietal characteristics cannot be included in a publication of this type. Before setting out new plantings growers are well advised to consult with Federal and Provincial Departments of Agriculture.

Apple Descriptions

ASTRACHAN (*Red Astrachan*), an old variety of merit because of its hardiness and earliness. It is highly coloured, ripens unevenly and drops badly. Recommended only for home use.

ATLAS (*Winter St. Lawrence Sdlg.*) Originated at Ottawa, is harvested after Joyce. It resembles a well coloured Winter St. Lawrence, is a good dessert and cooking apple that keeps especially well for a fall variety. The tree is very hardy, upright in habit and has a strong framework. It comes into bearing at an early age and produces heavy crops but does not require thinning. It is recommended for commercial planting in the Ottawa and St. Lawrence River Valley districts of Ontario, in Quebec and in Prince Edward Island.

BANCROFT (*Forest × McIntosh*) is one of the newer Ottawa hybrids that has proved to be almost the ideal variety. The tree resembles McIntosh in habit, is a strong grower, bears at a young age and appears to be fully as hardy as McIntosh. The fruit is of good size, is highly coloured and is an excellent keeper in cold storage, holding in first class condition until April 1. Its quality, however, while moderately good is far below that of Sandow, Spy or McIntosh. Despite this lack of very high quality it may be the variety that will have to be accepted for some years to come. It is recommended for extended trial in the St. John River Valley of New Brunswick, in the fruit growing regions of Quebec and in the St. Lawrence and Ottawa River Valleys of Ontario.

CLOSE (*parentage unknown, introduced by U.S.D.A.*) This is the earliest ripening variety at Ottawa, ready for picking a few days before Crimson Beauty. It is an attractive striped apple of commercial size, and better in quality than Crimson Beauty. Ripens unevenly, has a short marketing season, and is adapted for local market use in eastern Ontario and Quebec. Tree is quite susceptible to fireblight.

CORTLAND (*Ben Davis* $\times$ *McIntosh*) is the most outstanding of the New York State Agricultural Experiment Station introductions at Ottawa and has been planted heavily in certain districts in Eastern Canada. It ripens with and later than McIntosh, has a longer harvesting period as the apples cling better but does not keep longer. The fruits are larger and flatter than McIntosh and fully as attractive; the flesh is firmer but not so high in quality. This variety is an annual bearer and heavy feeder. It is commercially grown in the St. John River Valley of New Brunswick, in the fruit growing regions of Quebec and appears promising in some districts of eastern Ontario.

CRIMSON BEAUTY (*also known as Early Red Bird*). Originated in New Brunswick, it is one of the earliest varieties to ripen. It is a highly coloured striped apple of good size and sprightly flavour, a culinary apple of value only for local market. The tree is hardy and vigorous but biennial in habit. It is recommended for limited commercial planting in all the apple growing districts in Eastern Canada where adequate local and roadside markets exist.

DELICIOUS AND RED SPORTS. There are several bud sports of Delicious but only two are grown commercially in Eastern Canada, namely, Starking and Richared. The fruits of both are more highly coloured than Delicious but all other varietal characteristics are similar. Like Delicious, these two sports require heavy feeding, and must be thinned heavily to produce fruits of good commercial size. They are not sufficiently hardy to be planted in eastern Ontario, Quebec and New Brunswick. Starking was introduced by Stark Bros., Mo., and Richared was found in Jack Richardson's orchard at Manitor, Washington, U.S.A. and introduced by Wenatchee Nurseries, 1926. Delicious and Red Sports are recommended for planting in the southern counties of Ontario, Toronto to Sarnia and south, and along the north shore of Lake Ontario to Northumberland county. It is also recommended for planting in Nova Scotia.

DUCHESS AND RED SPORTS. Duchess is a Russian variety possessing considerable hardiness and can be grown successfully in Eastern Canada. The fruits lack dessert quality but are used for culinary purposes. The trees tend to overbear and must be thinned to produce fruit of commercial size.

Several bud sports of Duchess have fruited at Ottawa. All are more highly coloured than Duchess but are of no better quality and are suited only for culinary use.

EARLY MCINTOSH (*Yellow Transparent* $\times$ *McIntosh*) is a N.Y. State Agr. Exp. Sta. origination that ripens with or a little later than Melba. This variety is a vigorous grower and is equal to Melba in hardiness. It tends to overbear but when thinned heavily produces commercial crops annually. The fruits are uniform and more attractive than Melba at Ottawa, not so good in quality and inclined to drop readily. This variety may be grown in any district where Melba succeeds.

EDGAR (*McIntosh* $\times$ *Forest*). One of the newer Ottawa hybrids that follows McIntosh in picking season. The fruit is of good commercial size, highly coloured and of very good texture and quality. Its chief merit is that it has a longer season than McIntosh. Trees are equal to McIntosh in hardiness but are slower to come into bearing. Recommended only for trial in districts where McIntosh can be grown.

FAMEUSE (*Snow and Red Sports*). An old variety that is being replaced by McIntosh. It has not proved to be so hardy as McIntosh and is more susceptible to fireblight. It is somewhat biennial in habit and in the "on year" a large percentage of the fruits are below marketable size.

There are several sports of this variety, some are more highly coloured while others are of better size. However, they are considered to be inferior in quality. The Jones Red Fameuse is the more attractive sport and is generally preferred.

GOLDEN DELICIOUS. A chance seedling originated in West Virginia, U.S.A. Resembles Delicious somewhat in shape, not so large, but is superior in quality and is golden yellow in colour. Although this variety is not fully hardy it is superior to Delicious in tree characteristics.

GRAVENSTEIN AND SPORTS. Originated in Germany, this is an attractive striped apple of commercial size and good quality. It is ready for picking before McIntosh but must be marketed by late fall. Tree is a vigorous grower, lacks hardiness, is subject to crown rot but is commercially grown in Nova Scotia. Sports of this variety such as Banks Red and Crimson Gravenstein are superior to the original variety in appearance and are preferred.

GREENING, N.W. (*Northwestern*) is a large uniform green culinary apple. The fruits on young trees and in seasons of light crops are very susceptible to internal breakdown. It is hardier than R.I. Greening but is an inferior culinary apple and can be grown in Quebec and eastern Ontario.

GREENING, R.I. (*Rhode Island*). A very old strictly culinary variety. The fruits are green, uniform, good commercial size, and although excellent for cooking, the market at the present time shows a definite preference for more highly coloured apples. This variety is productive but is not hardy and can be grown only in the more favoured fruit regions, such as southwestern Ontario and Nova Scotia.

HUME (*McIntosh Sdlg.*) is an Ottawa introduction, ready for picking about a week before McIntosh. The fruit, of very good quality, is large, uniform, very highly coloured but has a tendency to become too dark. The tree is very vigorous, and if fertilized as heavily as other varieties is slow to come into bearing. It is productive and bears annually. It is recommended for extended trial along the north shore of Lake Ontario, in Quebec and in Prince Edward Island.

JOYCE (*McIntosh Sdlg.*) originated at Ottawa, follows Melba in season. It is a striped apple possessing considerable colour and excellent quality. The tree is hardier than McIntosh, rather spreading, somewhat difficult to prune, and a good yielder. When thinned heavily it produces annual crops. This variety is recommended for commercial plantings in the St. Lawrence and Ottawa River Valleys of Ontario and in the fruit growing regions in Quebec.

JUBILEE (*McIntosh* × *Grimes Golden*) is a recent introduction of the Dominion Experimental Station at Summerland, B.C. It has not been under test long enough at Ottawa to establish its tree hardiness. The apples are smooth, attractive, of fine texture and good quality but when grown at Ottawa are lacking good commercial size and finish. It is a late winter apple.

KENDALL (*McIntosh* × *Zusoff*) is a N.Y. State Agr. Exp. Sta. introduction that ripens a little later than McIntosh and keeps slightly longer. The fruits are very large, uniform, highly coloured, sprightly, and of good quality. The tree appears as hardy as McIntosh but is susceptible to fireblight. Although more highly coloured than McIntosh it is of inferior quality. It does not extend the marketing season greatly and if planted extensively with McIntosh presents a harvesting problem.

LAWFAM (*Lawver* × *Fameuse*). Originated at Ottawa, is harvested after McIntosh. It is a very highly coloured, very uniform apple of good quality and keeps a little longer than McIntosh. The tree is a strong grower, of good form,

with strong crotches and appears to be as hardy as McIntosh. It is very susceptible to magnesium deficiency, which can, however, be controlled by adoption of recommended practices. It is a heavy feeder, requiring considerably more feeding than McIntosh to enable it to carry a crop. Under low nutritional conditions it is a shy bearer while under a high level of nutrition it tends to overbear and does not size up too well. It is recommended for trial in the St. John River Valley district of New Brunswick, in Quebec and in the Ottawa and St. Lawrence River Valley districts of Ontario.

LASALLE (*Parentage unknown, originated in Lachine, Quebec.*) A mid to late winter apple that is ready for picking before Spy. The tree is hardier than Spy and is being given extended trial in regions where Spy is not fully hardy. It is a roundish striped apple of commercial size with a red blush on the sunny side, white flesh and good quality. Recommended for trial along the north shore of Lake Ontario.

LINDA (*Langford Beauty Sdlg.*) is an Ottawa introduction ready for picking with McIntosh. It is an attractive apple of large size, sprightly flavour and in mid-winter is of good eating quality. The tree is vigorous and comes into bearing at an early age. Although it has not proved to be fully hardy at Ottawa when top-worked on a hardy framework it is recommended for limited trial in the Ottawa and St. Lawrence River Valleys of Ontario and in Quebec.

LOBO (*McIntosh Sdlg.*) originated at Ottawa, is harvested a few days before McIntosh but has a shorter marketing season. It is a highly coloured apple of large size and although somewhat inferior to McIntosh in quality is a good dessert and culinary apple. The tree, mechanically strong and hardy, is a regular bearer. This variety is recommended for commercial planting in the Ottawa and St. Lawrence River Valleys of Ontario, in Quebec, in New Brunswick, and in Prince Edward Island.

LODI (*Montgomery × Yellow Transparent*), originated at the N.Y. State Agr. Exp. Sta., is the best early yellow apple fruiting at Ottawa. It resembles Yellow Transparent in fruit and tree characteristics but the fruits ripen later and are larger and the tree bears annually. This apple is a decided improvement over Yellow Transparent and is recommended for extended trial in districts where Yellow Transparent is grown, the trees being more highly resistant to fireblight than Yellow Transparent.

MACOUN (*McIntosh × Jersey Black*). A N.Y. State Agr. Exp. Sta. introduction that is harvested with or just after McIntosh. The tree appears hardy at Ottawa, productive to the extent that in some years it requires thinning and bears annual crops. The fruits resemble McIntosh in shape, texture and high aromatic flavour but are a darker red in colour. Due to its excellent quality and attractive appearance it should be given extended trial but because of its picking season should be planted only in small numbers where McIntosh is the main crop variety.

MCINTOSH AND RED SPORTS. The original McIntosh was found growing as a seedling in the woods near Dundela, Ontario, by John McIntosh in the year 1796. Today it is undoubtedly the most popular variety grown in Canada. Several red sports of this variety are being grown at present. These have been selected on the basis of high colour. McIntosh is recommended for commercial planting in all the apple growing districts in Eastern Canada.

MELBA AND RED SPORTS (*McIntosh Sdlg.*). Originated at Ottawa is undoubtedly the highest quality early variety grown in Canada and has been planted very heavily. It is a short season variety desirable for local market and roadstand trade. Fruits are medium to above in size, attractive, being washed

and streaked with red, resemble McIntosh in flesh and flavour, highly aromatic, and of very good quality. The tree is vigorous, hardy and an early bearer, good cropper but biennial in habit. This variety ripens unevenly and spot picking is necessary. Fruits bruise easily and should be moved to market as soon as possible.

Several bud sports of Melba are available and are superior to the parent in appearance, firmness of flesh and keeping qualities, but ripen a few days later. They appear to show bruises less readily than Melba. Melba and Red Sports are commercially grown in Prince Edward Island, New Brunswick, Quebec and in the St. Lawrence and Ottawa Valleys in Ontario.

MILTON (*Yellow Transparent* $\times$ *McIntosh*) is another N.Y. State Agr. Exp. Sta. introduction. It is pretty much of Joyce and Atlas season and ripens unevenly, requiring two to three pickings. The tree is a strong grower at Ottawa, appears hardy, comes into bearing at a young age and bears annually. The apples are very attractive when well coloured and of good size and quality. Growers prefer Joyce and Atlas because the trees are more productive and ripen more evenly.

NEWTOSH (*McIntosh* $\times$ *Yellow Newtown*), is another Ottawa introduction. It is a highly coloured, good quality winter apple which keeps until April. The tree more closely resembles McIntosh than Yellow Newtown, comes into bearing at about the same age, is of the same hardness and is as resistant to fireblight as McIntosh. It produces abundant annual crops and because of its tendency to overbear the fruits often run small unless thinned. Fruit is medium to above in size, resembles McIntosh somewhat in colour of skin and Yellow Newtown in flesh and flavour. It is recommended for limited trial in the St. Lawrence River Valley of Ontario and in Quebec.

NORTHERN SPY AND RED SPORTS. An apple which grows especially well in certain apple growing regions in Ontario and in popularity ranks second to McIntosh in this province. It is a late winter apple which is not harvested until just before the heavy frosts occur. The tree has many faults, being notoriously slow in coming into bearing, tender in the colder fruit regions and having weak crotches. The fruits are of large size and attractive when well finished and excellent for both dessert and culinary use. The fruits bruise easily and must be picked and handled with care. When the trees are young and in light crop years the apples are subject to bitter pit.

Many red sports of Spy are now being propagated, all of which are more highly coloured than Northern Spy but it is generally accepted that none of these is of as good quality as the original Spy which is of a highly coloured striped appearance. The Northern Spy and Red Sports are commercially grown in Nova Scotia and in all the apple growing districts of Ontario, except the St. Lawrence and Ottawa River Valleys.

SANDOW (*Northern Spy* *Sdlg.*) is the highest quality winter apple originated at Ottawa. It is of good size, resembles Northern Spy in character of flesh, flavour, but is more highly coloured. It is ready for picking two to three weeks after McIntosh and it keeps equally as well as Northern Spy. Like its parent it is susceptible to bitter pit. The tree is somewhat susceptible to fireblight, and although hardier than Spy it is not fully hardy at Ottawa. It is recommended for commercial planting in the St. John River Valley of New Brunswick. In southern Ontario from Sarnia to Toronto and in the Lake Ontario region from Toronto to Belleville, Sandow is recommended for limited trial. In eastern Ontario and in Quebec it is recommended for trial when top-worked on a hardy blight-resistant framework.

SECOR (*Salome* $\times$ *Jonathan*), originated at the Iowa Agr. Exp. Station. It is a winter apple requiring a long growing season to finish properly and must be

left on the tree as late as possible. The tree is hardy with a strong framework and productive, sometimes requiring thinning. The apples when well grown are attractive, resembling a highly coloured Northern Spy, and of good quality. It is recommended for limited trial along the north shore of Lake Ontario and in the Georgian Bay and Lake Huron regions.

SPARTAN (*McIntosh* $\times$ *Newtown*) introduced by the Dominion Experimental Station, Summerland, B.C., is harvested a full two weeks later than McIntosh, keeps fully as long, and is less susceptible than McIntosh to core flush and other disorders. At Ottawa the trees bear early, are productive and produce annual crops but hardiness is still to be evaluated. The fruits resemble McIntosh in appearance but are more highly coloured and have better handling qualities. As the trees become older the fruit size appears to fall off and this may prove a serious fault in Eastern Canada. It is recommended for limited trial in Eastern Canada.

WAGENER is an old variety that is especially adapted to Nova Scotia conditions. It is an attractive apple, of good quality that handles well. The tree although biennial in habit comes into bearing at an early age. This variety continues to be recommended for commercial planting in Nova Scotia.

WEALTHY is another old variety that is gradually being replaced by improved varieties of the same season, such as Joyce, Atlas and Lobo. Its main virtues are tree hardiness and early bearing habits. It is a biennial bearer and has to be thinned in the "on" year.

WOLF RIVER is largely grown in eastern Ontario and Quebec where it is valued because of its tree hardiness and large fruits which are excellent for baking. It should only be planted in regions where there is a demand for a large culinary apple.

YELLOW TRANSPARENT. An old favourite summer apple which is largely being replaced by Melba. The tree is biennial in habit and tends to overbear and must be thinned to produce a high percentage of marketable fruit. Suited only for local market use.

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