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apple growing IN EASTERN CANADA

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apple growing IN EASTERN CANADA

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INTRODUCTION

This publication will be useful to two groups of people. For those who wish to learn something about apple growing and are considering growing apples, it will serve as an introduction to the subject; for those who are now growing apples, it will serve as a general review and updating of ideas.

Apple growing is fascinating. It can be fun, but it can be frustrating at times. Apples will grow themselves with very little or practically no care. Yet because they respond to care, apple growing can become an involved and technically specialized subject.

Some of the complexity of apple growing may be realized if we compare it with other crops. Trees do not bear the year they are planted. Planting seed does not give true varieties (cultivar is the correct term). The seedling must be grafted—thus we have at least a root cultivar and a scion cultivar; sometimes the trunk is another. Each can influence the other. Apple trees are perennial. What happens 1 year may show effects for several years. Bugs and diseases have a permanent home. Each year's crop may be improved by applying treatments while the crop is growing, by harvest techniques, and by storage treatments. With so many areas where changes are possible, the permutations and combinations are large indeed. But apple trees of the desired cultivars can be obtained readily from a nurseryman and be planted; once established, they will eventually produce apples with very little care.

Apple growing is therefore only as challenging as the grower cares to make it. As experience and knowledge are gained, the latest improvements can be used to grow and harvest more and better apples for the efforts expended. There are periods of intense activity, and other periods of no activity when the grower can sit down and plan for a better next year.

Proper timing is often as important as the choice of treatment. The latitude may be only a matter of hours for scab control or certain chemical thinning sprays; it may be a matter of a day or so for many sprays or time of harvest. Many operations are more flexible, but they are easier to carry out and give greater response if done at certain stages. The alert and

successful grower is aware of these critical areas and is prepared to cope with them.

Further information may be obtained from many sources. Some references are listed at the end of this bulletin. You should attend grower meetings in your area and get the extension specialists for your area to know you and your orchard. Keep up with developments at nearby research stations, subscribe to orcharding journals, and travel occasionally to see what is happening elsewhere.

Now a word of caution. Modern orcharding is greatly assisted by a host of chemicals. In this publication we have attempted to give background information on using chemicals for nutrition, for pest control including weeds, and for various types of control of development and growth. To be effective chemicals must have activity; in the wrong situation this very activity can be harmful. A bulletin of this type cannot cover specific details of use for each of the many chemicals. Always, therefore, read and understand the label before using a chemical and each season obtain the latest recommendations for use from your local authorities. You owe this responsibility to yourself, to your community, and to your apple crop.

PRODUCTION TRENDS IN CANADA

Apple growing has an important place among the agricultural enterprises of Eastern Canada. Apples have been tried in almost all the commercial farming regions, and the best areas for growing them have been found. The development of technology through research has enabled the orchards of today to be much more productive than in the past, so that more apples are produced on fewer trees.

The population growth in Ontario and Quebec has provided a steadily expanding market, and production has shifted to these areas (Table 1). Also, adequate methods of scab control have made it possible to grow the hardy but scab-susceptible varieties McIntosh and Cortland profitably in Quebec and New Brunswick where hardiness is a primary consideration.

Best-quality apples usually come from young orchards. Since 1966, the standing of Nova Scotia and New Brunswick among the provinces (Table 1) will probably have improved because of new plantings. Ontario is maintaining a good rate of planting, but the proportion of older trees in Quebec has risen dramatically. British Columbia has an especially high proportion of young trees due mainly to removal of older trees that were damaged in winter and to planting more trees per acre.

Although all provinces export apples or apple products, total Canadian production tends to remain fairly close to 1 bu (19 kg) per person. With increasing world production, often governmentally encouraged, the relative importance of exports from Canada is declining. But with the rising Canadian population, serious imbalance of production and market is not expected from present plantings of apple trees.

Table 1. Canadian apple acreage, percentage of trees bearing, and production, by provinces for selected years

	Thousands of acres			Percentage of trees bearing			Production, 000 bu		
	1941	1961	1971	1941	1961	1971	1941-1945	1961-1965	1972-1973
N.S.	37	13	11	84	85	77	3,711	2,864	2,375
N.B.	2	2	2	62	82	72	249	475	325
Que.	22	25	24	36	74	77	766	5,167	5,340
Ont.	47	38	33	60	65	64	1,848	5,584	5,768
B.C.	24	26	22	75	47	52	5,832	6,504	6,442
Canada	133	104	92	65	65	63	12,405	20,594	20,250

PLANNING FOR COMMERCIAL APPLE GROWING

Before investing money to develop an orchard, consider the following:

- The availability of suitable land and its cost.
- The size of operation.
- The availability of labor, its cost and quality, especially for harvesting.
- The need for at least $1,000 per acre ($2500 per ha) for bringing the orchard into bearing and for storage facilities.
- The prospect of suitable market facilities.
- The availability of water, electricity, labor, and highways.
- The availability of good advice.

CHOOSING A LOCATION

If you are starting a commercial orchard for the first time, try to find good land in an already prosperous apple-growing area. The area need not be large. Some of the most successful orchard operations are located in rather small but favorable areas within easy driving distance of a population center. With the present trend toward roadside markets and 'pick-your-own' fruits, such areas, if suitable for orcharding, will continue to be rewarding for first-class operations.

Where the apple industry is successful, you can assume that there are satisfactory soils and sites and that climate and marketing arrangements are satisfactory. In these areas you are also likely to find experienced labor, as well as readily available machinery and supplies, highways, and transports. Futhermore, you will usually benefit from

being among experienced growers and from taking part in their educational and business organizations. Because of these advantages it is generally more important to be in an established fruit-growing area than to be close to a market.

Be extra careful about the kind of land you choose to turn into an orchard. Too often, land considered marginal for other crops is made into an orchard. What the grower loses as a result is more than the extra cost of better land. Bear in mind that the best areas for hay, grain, and pasture are not usually best for apples.

ORCHARD SIZE

The best size for an orchard depends on a grower's aims, his other interests, and his markets. A small orchard is not necessarily inferior to a large one.

What size of orchard is the most profitable? First, consider the market: will you sell your apples to an established roadside stand, a store in a nearby town, a processor, or a general market outside the area? Economy of marketing a large quantity of fruit may depend on the availability of well-organized facilities for storage, packing, and shipping. Keep in mind that conditions vary from grower to grower as well as from year to year. Profits depend not only on the size of your orchard but also on how efficiently you operate the business.

Many Eastern Canadian growers find that 30 to 75 ac (12 to 30 ha) can be operated by one man plus seasonal help. They can maintain good control of their operations when storage, packing, and marketing are done by others. Because the trend is toward more exacting markets and more intensive orchards, this kind of operation will probably decrease rather than increase.

CLIMATE AND ELEVATION

Sunshine and Temperature

A large body of water near an apple orchard moderates the climate. There is less severe cold in winter and less excessive heat in summer. Also, spring growth may be retarded until the danger of frost is passed. Nova Scotia and parts of New Brunswick are especially favored in this regard. Winter cold is a major hazard in Quebec, New Brunswick, and northern Ontario, and many trees were killed by the winters of 1904, 1917, and 1934. Overhead sprinkling to cool the trees, used in parts of the world, is probably not economic in Eastern Canada, although warm weather in late summer and fall often delays good color development, especially in southern Ontario.

Cold injury usually occurs on clear, still nights when heavy, cold air flows under warm air into low-lying areas. On these nights, temperatures may vary as much as 20°F (11°C) within 2 miles (3.2 km); and differences

of several degrees are common within a few hundred feet. Frost is not so hazardous on windy nights when the wind keeps temperatures almost uniform.

You can avoid some damage by choosing a rolling and sloping field, where the downward flow of air is not blocked by trees or hedges. In otherwise favorable areas, use of frost-control measures such as heaters, sprinklers, and wind machines may be justified for those areas of the farm that are especially subject to frost injury.

Wind

Winds can cause great harm to orchards. They have a bad effect on the shape of trees, and they dry the soil, reduce yields, and make spraying difficult. They also restrict the movement of bees, blow off large numbers of apples, damage fruit by causing it to rub against the limbs of trees, and break limbs. They desiccate twigs, thereby increasing the chances of winter damage.

The damaging effects of wind are evident in the eastern Kings County area of Nova Scotia, where the north and south 'protective' hills are so widely separated that the orchards in the area always suffer when

Figure 1. Trunk of tree severely injured by cold winter weather.

a severe wind occurs, no matter from what direction. Few windbreaks have been developed and in consequence most of the former orchards have been removed as being uneconomic.

The prevailing winds of the Maritimes are westerly, but hurricane winds often come from the south. Windbreaks are useful on the west and north sides of orchards unless they create frost pockets. If windbreaks occupy good land, or are likely to take moisture and nutrients needed by orchard trees, they may not be worth their cost.

Rain

The amount of water needed by an apple orchard during the growing season depends partly on the depth of the soil and how well it holds moisture, and partly on evaporation, which is affected by temperature, ground cover, and wind.

Humidity affects the water requirements of apple trees, the development of apple scab and, probably, fruit russeting. Also, hormone-type thinning sprays are more effective when humidity is high.

The rainfall in the fruit-growing areas of Eastern Canada is usually sufficient for good growth. Growers who have irrigation equipment occasionally apply water in orchards on very light or droughty soils in the Maritimes and more extensively in the warmer areas of Quebec and Ontario. Watering improves the size and color of fruit if rainfall is much below normal, and irrigation during a drought may be profitable. However, a shortage of water rarely does permanent damage to any but new trees. When young trees need extra water, it can be applied without special equipment by using the orchard sprayer as a tank cart. The relatively new technique of trickle irrigation may have special merit for the first year after planting.

DRAINAGE

Apple trees are less productive, are more prone to winter injury, and may even die on poorly drained soils. The ideal is good surface drainage on natural slopes, and a soil that allows excess water to seep away while retaining plenty of moisture.

You can improve surface drainage by digging open ditches and sometimes by leveling. Tile properly installed, at least 3 ft deep (1 m), provides satisfactory drainage around tree roots. In some areas, the cost of a complete drainage system may equal the value of the land but usually you need to drain only small, low areas.

SOIL

A deep, sandy loam soil is best for apples. A good, gravelly loam subsoil provides natural underdrainage. The necessity for good drainage

and freedom from frost limits the choice of sites for orchards more than the type of soil.

Medium to light soils are best for some dessert apple varieties. Apples develop a brighter red color when grown in these soils than when grown in heavy clay or clay loam soils.

Avoid soils that have hardpans, claypans, or dense subsoils because these kinds of subsoils greatly impede root penetration. Also, water may sometimes accumulate on these dense layers and suffocate the roots. Prospective orchard sites should be located on soil classification maps, and especially if there is any question as to suitability, an on-site examination should be made in consultation with an orchard soil specialist.

Replant Sites

Apple trees tend to grow more slowly for the first couple of years when planted on sites where old apple or pear orchards have been removed. Fumigation of the tree site is widely practiced in Europe. In some fruit areas fresh soil is sometimes hauled in for filling around the roots. However, in Eastern Canada, most cases of poor growth can be attributed to other factors such as poor trees, poor planting, lack of weed control, lack of water, or other recognized procedures.

It is advisable to work the land and grow other crops for at least 3 years before replanting an old orchard site. If possible place good topsoil from a nonorchard field immediately around the tree roots when planting. Topsoil in orchards known to have had heavy arsenical sprays should not be placed around the roots. Your agricultural advisor may be able to arrange for tests to determine whether or not the proposed site has a replant problem.

SUPPLEMENTARY CROPS

Some growers add to their income by intercropping orchard land when the trees are young. An intercrop should lower the cost of establishing an orchard but it has disadvantages. Spray used on apple trees may damage the intercrop; lack of spray might ruin the orchard; and late cultivation or heavy fertilizing of the intercrop may cause winter injury to apples by promoting immature, soft tree growth in the fall. With today's trend toward more intensive orchards, their rapid development, and early production, it is doubtful whether intercropping is worthwhile except in unusual circumstances.

MARKETING

The choice of varieties and proportion of each, the rootstocks to use, and the growing practices are all influenced by the anticipated market, and orchards should not be planted without careful consideration of how

and where the crop will be sold. Potential markets include:

- Direct sales, such as through retail and especially chain stores, to truckers, on roadside stands, through fruit-vending machines, and U-Pick operations.
- Sales through a cooperative or private organization that often also stores and packs the crop.
- Sales to a processor for canned, frozen, or refrigerated slices, for sauce, for fresh or fermented juice, or for other apple products.

Present trends are for increasing sales direct to the consumer, for longer storage under more precisely controlled conditions, and for a greater proportion of the total crop moving into processed forms and convenience foods.

Historically, Canada both exports and imports apples and this provides a measure of stability for all three segments of the apple market: fresh, processed, and juice. On a long-term basis, the apple market is greatly influenced by the trading and production policies of Canadian federal and provincial governments and by those of other nations. Within this framework, the marketing of apples in any year may be affected by:

- The size of the local crop and of crops in the other apple-growing areas of the world.
- The carry-over of processed apples and the production of other fruits.
- Economic conditions that may direct more money into the apple market or cause a shift to other foods.

No one method of marketing gives equally high returns to all growers. Although it is self-evident that production and marketing are two sides of the same coin, it is also true that definite answers to production problems are much easier to obtain than are clear-cut answers to marketing problems. Planting an orchard without a companion marketing plan is foolhardy, and continual revision and updating are required. This does not mean that the grower should be involved in selling — usually this is better left to specialists to do on the grower's behalf — but rather, that production must be geared to the market, either actual or developable.

PLANNING THE ORCHARD

Of the many problems facing an orchardist, selecting the right varieties is probably the most important and yet the most difficult to solve. This includes both scion and stock since there are many varieties of each to choose from. Formerly, most orchards were grown with the scion variety budded on a seedling rootstock, but conditions now require that an orchard take fewer years to come into full production and that there be some control over the tree size.

Success or failure of any particular system depends on the use of understocks for each scion variety that gives sufficient control over scion

growth to maintain a balance between vigor and cropping, and on a tree form that provides good exposure of all leaves within the canopy to good light conditions.

ORCHARD DENSITY AND TREE SIZE

Although densities of 300 or more trees per acre (740 per ha) provide exciting early yields, it must be remembered that tree cost becomes increasingly important as the number of trees increases. The information in Table 2 indicates that orchards are most efficient when planted at densities of 50 to 250 trees per acre (125 to 620 per ha). If you plan to have a pick-your-own operation or if you like the more intensive type of operation, you should plan to use a medium density: 100 to 350 permanent trees per acre (250 to 865 per ha). If not, then you should plan your permanent trees at 50 to 100 trees per acre (125 to 250 per ha) and add removable filler trees to more fully use the land while the permanent trees are growing. High-density orchards do not appear to be as economically advantageous as do medium-density ones unless trees are cheap (about 50¢ each), land is valuable (over $1,000 per acre; $2,500 per ha), and you wish to specialize in production of apples of exceptional quality. A standard spacing of 14 ft by 20 ft, 155 trees per acre is now recommended in Nova Scotia and New Brunswick (4.3 m by 6.1 m, 383 trees per ha).

Table 2. Effect of tree density on the cost of a mature orchard

Tree spread ft (m)	Row spacing ft (m)	Trees per acre (per ha)	Years to break even (estimate)	Annual overhead cost of mature orchard (estimate)[1] $/acre	($/ha)
30 (9.1)	38 (11.6)	38 (94)	10	108	(267)
25 (7.6)	33 (10.0)	53 (131)	8	86	(212)
20 (6.1)	28 (8.5)	78 (193)	6	70	(173)
15 (4.6)	23 (7.0)	126 (311)	5	74	(183)
10 (3.0)	18 (5.5)	242 (598)	4	96	(237)
5 (1.5)	13 (4.0)	670 (1656)	3	197	(487)

[1] To provide a 10% return on investment per acre. Assuming the break-even point is at the age given in the previous column, $2 for each tree planted, $50 per acre ($123/ha) per year growing cost, money at 10% interest compounded, no allowance for staking, etc.

SELECTING VARIETIES

The consuming public is much more exacting now than 30 years ago, and with increasing competition due to greater production, an ever-superior product will be demanded. No matter how good the soil or how skillful the grower, if varieties are unsuited to climate and markets, failure will result.

Some of the varieties that have been in existence for a long time remain the foundation of the industry. Several of them have been improved over the years by the discovery of mutants with better tree and fruit characteristics. McIntosh, the most important variety in Canada, was discovered in 1796, Northern Spy nearly as long ago, and Red Delicious in 1885.

You should therefore choose the best strains of the few top varieties that have proved themselves in your locality. More than one variety will be necessary to spread out the harvest season. In the colder areas of Eastern Canada the ability to withstand winter cold is essential. New varieties come and go each year. The best of these should be tried. Look for easy and consistent production of large crops of high quality, good handling ability, and of a marketable season. Plant only a few until their worth has been proved.

Brief descriptions of varieties begin on page 45. Relative time of bloom and pollination characteristics are given in Table 3.

POLLINATION

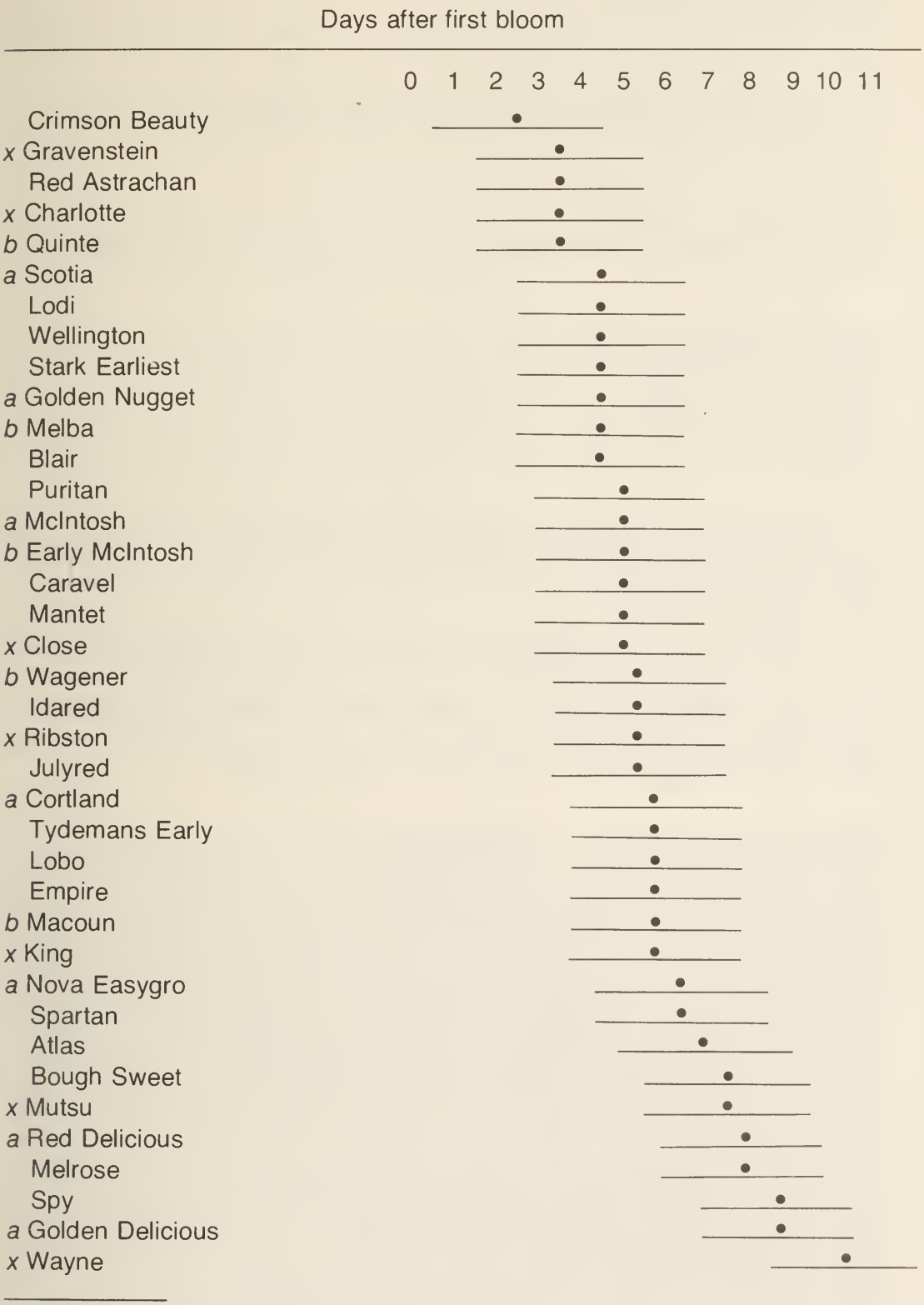
All the present commercial apple varieties require pollination and at least some development of seeds for a crop of fruit. A few varieties under favorable conditions set when self-pollinated but this cannot be relied upon. Several varieties, mainly those with a triploid set of chromosomes, do not produce good pollen.

Most of the pollen transfer is done by bumble, solitary, and hive bees. They work only when the weather is suitable. If rain precedes a fine day there will be several hours delay before good pollen is available. Hive bees should be moved into the orchard a day or two before full bloom for best results, but not earlier than this because bees often scatter widely after a few days. One strong hive per acre should provide ample pollination. The hives should be placed in a sunny sheltered location at right angles to the pollination rows to encourage flight across the rows rather than along them.

Careful consideration of pollination is vital to good orchard management. The original layout of permanent trees should provide a suitable mixture of cross-fruitful varieties that bloom at nearly the same time. Then each year the weather, the bloom, and the bee activity should be closely observed. Where undersetting appears possible, previously planned steps should be taken immediately to correct the situation. If bloom is light, extra bees and pollen will help set all possible blossoms; if pollen is short due to an off year in the pollinating trees or due to rain at the crucial period, large bouquets can be brought in, or commercially purchased pollen distributed via special inserts in the hives of honey bees, or both methods can be used; if oversetting appears probable, all hives of bees should be removed and a chemical thinning program put into effect.

Although undersetting is disastrous, oversetting is not advisable because it results in fruit of poor marketability and lack of crop the next

Table 3. Order of bloom and suitability as pollinators



a, Better-than-average pollinator, annual especially if thinned.
b, Tends to be strongly biennial.
x, Unsatisfactory pollen.

year. The objective should be to produce as few mature seeds per tree as possible because seeds are much more exhaustive than the flesh. Experiments have shown repeatedly that a crop of large apples in one year will be followed in the next year by a much larger crop than will the same crop volume of small apples. (Obviously there were *more* apples and hence more seeds, but since there were also probably more seeds per apple there were *many* more seeds on the tree with the small apples.)

SELECTING AND GROWING PLANTING STOCK

Most apple trees are grown from rootstocks. Scions or buds of desired varieties are grafted to the rootstocks; orchards are rarely propagated from cuttings. Ungrafted seedlings are not used because they lack uniformity and practically always produce inferior fruit. Budding or grafting is therefore necessary to maintain and propagate apple varieties.

A rootstock is selected mainly for its ability to form a hardy root system of the desired vigor. Its influence on early and heavy fruit production is also important.

Performance is modified by the soil and cultural conditions and also by the scion variety. Sometimes in order to obtain the desired results a rootstock of one variety and an intermediate stempiece of another are used before the scion variety is added. These trees require more steps to grow and obviously many combinations are possible.

SEEDLING ROOTSTOCKS

The use of seedling rootstocks has several advantages. Trees grown from them are free from virus diseases unless contaminated by the scion variety, they rarely require supports to keep them upright, and they are strong enough to survive and grow even under difficult conditions. They make good replacements in an established orchard, and they give extra vigor to weak varieties such as Wagener and Idared. Diploid varieties such as McIntosh and Northern Spy provide satisfactory seedlings for rootstocks.

The seedlings of Beautiful Arcade, an early-season Russian variety, produce hardy semivigorous trees that are early, heavy fruiting, and well-rooted. Some seed, or occasionally seedlings, are available from the Research Station at Kentville, N.S.

CLONAL ROOTSTOCKS

Clonal rootstocks are rooted stems that can be multiplied indefinitely. They are produced in stool beds in the following way. Trees that are at least 2 years old are cut off at ground level in the early spring. Suckers grow from these stumps and develop roots in soil mounded around them. The next spring the rooted shoots are removed from the

parent stump and are planted in a nursery. Stool beds produce annual crops of uniform rootstocks. Clonal rootstocks are also propagated by softwood cuttings taken in early summer and by long cuttings from special hedgerows taken just before leaf fall or before bud break.

There is now a good selection of rootstocks to choose from. About 50 years ago the East Malling Research Station in England selected and numbered 16 rootstocks designated M 1 to M 16. In a joint project with the John Innes Horticultural Institute, East Malling has also bred and selected another series, the Malling Merton (MM) group numbered MM 101 to MM 115. Over the years, 11 more rootstocks, M 17 to M 27, have been added to the East Malling series.

The Central Experimental Farm at Ottawa has produced a hardy clonal rootstock, *Malus robusta* 5, which can only be recommended for areas with continuous and steady cold. Sweden has also produced an excellent hardy rootstock, Alnarp 2. Recently a new hardy series has been developed at Ottawa numbered, according to expected vigor, Ottawa 1 to Ottawa 22. Of these, Ottawa 3 seems to be the most promising for dwarfing and semidwarfing purposes. Many other varieties of rootstock have been developed and used from time to time and, with the strong interest in control of tree size and performance, more will be introduced in the near future.

The vigor of trees grown on different rootstocks varies slightly with the soil and varieties. Rootstocks are listed in Table 4 in descending

Figure 2. Rooted shoots being removed from stool of *Malus robusta* 5.

Table 4. Characteristics of selected rootstocks

Rootstock	Vigor induced[1]	Productivity	Hardiness	Site & soil adaptability	Anchorage	Collar rot res.	Nursery charact.	Precocity	Virus status	Notes
M 12	105	A	A	A	+++		−	−	+	
M. robusta 5	100	+	+++	+++	+++	++	++++	A	++	Breaks dormancy early
M 16	100	A	A	A	+++		A	−	+	Matures late, starts late
M 25	100	+	−	A	+++		+	A	+	
Domestic sdlgs.	±100	±	±	±	+++	±	+++	−	+++	
MM 109	85	+	−	A	A−	A	A	−	−	
BA sdlgs.	± 80	+	++	+++	+++	++	+++	+	+++	
Alnarp 2	80	+	+	++	++	+?	+++	+	+?	Suscept. to Mg deficiency
M Crab C	80	+	A	++	++	+?	−	+	+?	
MM 104	80	+	A	−−	A	−	++	+	+	Drought & wet intolerant
M 1	75	+	−−	++	A	−	A	+	−	Adapted to cooler areas and heavier soils
M 2	75	+	−	+++	A	A	A	+	−	
MM 111	75	++	+	+++	+	+	+	A	+	Scion variety, matures early
Ottawa 5	?	?	+++	?	++?	+?	+	?	++	
M 4	70	+++	−	−	−−	+	+	+++	A	Wet intolerant, an interstock
MM 106	70	++	A	A	A	−	+	++	+	Scion variety, matures late
M 3	65	++	+	?	−	?	++	++	A	Root suckers, an interstock?
M 7	60	++	−	A	−	A	++	++	7a	Root suckers, prefers deep soils, deep planting
M 26	50	+++	+?	A?	−−	+	−	+++	+	
Ottawa 3	?	?	+++	?	−?	+?	−	++?	++	
M 8	30	+++	+	−	−−−	−	−−	+++	−	Root suckers, drought and wet intolerant, an interstock?
M9	30	+++	−	A	−−−	++	A	+++	9a	Attractive to mice
M 27	15	+++	?	A?	−−−	?	−−	++++	+	

NOTE: A average; + better; − worse; ± somewhat variable; ? insufficient information.
Based on domestic seedlings = 100.

Table 5. Expected tree spread in feet (in m) for various combinations of varietal vigor, understock vigor, and location, together with representative examples of scion varieties and of rootstocks

Variety classification			Site & soil	UNDERSTOCK CLASSIFICATION 30% (M 9)	50% (M 26)	60% (M 7)	70% (MM 106)	75% (MM 111)	80% (BA)	100% (Rob. 5)
LARGE 95-105%	Close Gravenstein McIntosh Spartan King Wayne	R.I. Greening Spy Spy Gold Mutsu Scotia	–	6.6 (2.0)	11 (3.3)	13 (4.0)	15 (4.6)	16 (4.9)	18 (5.5)	22 (6.7)
			M	8.4 (2.6)	14 (4.3)	17 (5.2)	20 (6.1)	21 (6.4)	22 (6.7)	28 (8.5)
			+	10.2 (3.1)	17 (5.2)	20 (6.1)	24 (7.3)	26 (7.9)	27 (8.2)	34 (10.4)
MEDIUM 80-90%	Crimson Beauty Lodi Cortland Ben Davis & Gano Red Delicious	Quinte Caravel Melba Spur McIntosh Jonagold	–	5.6 (1.7)	9 (2.7)	11 (3.3)	13 (4.0)	14 (4.3)	15 (4.6)	19 (5.8)
			M	7.1 (2.2)	12 (3.6)	14 (4.3)	17 (5.2)	18 (5.5)	19 (5.8)	24 (7.3)
			+	8.7 (2.6)	14 (4.3)	17 (5.2)	20 (6.1)	22 (6.7)	23 (7.0)	29 (8.8)
SMALL 70-80%	Ribston Spur Red Delicious	Golden Delicious	–	5.0 (1.5)	8 (2.4)	10 (3.0)	12 (3.6)	12 (3.6)	13 (4.0)	16 (4.9)
	Wagener		M	6.3 (1.9)	10 (3.0)	13 (4.0)	15 (4.6)	16 (4.9)	17 (5.2)	21 (6.4)
	Idared		+	7.6 (2.3)	13 (4.0)	16 (4.9)	18 (5.5)	19 (5.8)	20 (6.1)	26 (7.9)
VERY SMALL 60%	Spur Golden Delicious		–	4.0 (1.2)	7 (2.1)	8 (2.4)	9 (2.7)	10 (3.0)	11 (3.3)	13 (4.0)
			M	5.0 (1.5)	8 (2.4)	10 (3.0)	12 (3.6)	13 (4.0)	13 (4.0)	17 (5.2)
			+	6.1 (1.8)	10 (3.0)	12 (3.6)	14 (4.3)	15 (4.6)	16 (4.9)	20 (6.1)

order of vigor, and Table 5 gives some stock–scion combinations and expected tree size on low, medium, and high vigor locations.

Actually, few rootstocks except seedlings have been fully tested under the growing conditions of Eastern Canada. Only in the milder areas of southern Ontario and in the Annapolis Valley of Nova Scotia can the M and MM stocks be used with confidence. In the rest of Eastern Canada cautions against winter injury should be taken.

VIRUS DISEASES

At least a dozen virus diseases have been recognized. Some of these have very little effect, and some affect only certain varieties. Recognition of virus symptoms has advanced rapidly since 1960. Stocks of both scion and stock varieties free from all known viruses are now, or will soon be, available. Obviously the combination of a symptomless carrier with a clean but susceptible stock can be disasterous. Much so-called incompatibility and failure after grafting has been due to virus interaction. Even where there are no obvious symptoms the latest evidence is that symptomless or latent viruses do reduce tree performance by at least a small degree.

Fortunately apple viruses in general are not a major problem and do not spread readily. They are not seed-borne; chief spread is where infected scions or stocks are used in the nursery. Many of the older clonal rootstocks were infected by latent viruses. As these minor viruses were eliminated an A (e.g., M 9A vs. M 9) was sometimes added. The EMLA series is free from all known viruses.

In the nursery start with clean stocks and any failures in budding should either be regrafted to the same scion-stock or else discarded. Avoid contamination introduced by buds or grafts that did not grow but that lived long enough to pass on their viruses if they had them.

RECOMMENDED ROOTSTOCKS

For standard (large) trees there is a limited choice of stocks. Trees on seedling roots have long been used satisfactorily. *M. robusta* 5 (R 5) has done well in some trials but is now known to delay the onset of hardiness in the autumn, and in the late winter R 5 may become active on warm days and reduce the hardiness of the scion variety. R 5 should only be used in areas of steady cold and should never be used as a frame or trunk stock. Hibernal and Antonovka are good hardy frame stocks. Of the MM series, MM 104 is too subject to collar rot and does not perform well on either droughty or wet sites and M 25 has not been sufficiently tested.

For semistandard (medium to medium-large) trees, Beautiful Arcade (BA) seedlings and MM 111 are good. Both are more widely adaptable to different soils and have fewer difficulties than other stocks, and they induce reasonably early and heavy production. BA is more hardy than MM 111 and when properly selected, it gives trees of good uniformity. Other choices for milder areas include MM 109, M 1, M 2, and Alnarp 2.

For half-size trees there are several choices, each with its own merits and disadvantages. MM 106 is especially productive in its early years, but tree losses may be slightly higher than normal, especially on damp sites. The somewhat smaller M 7 is widely used with success, but tends to produce many root suckers and to be weakly anchored; both these faults are lessened when the rootstocks are planted deeply. In colder areas care must be taken to provide some protection against winter cold, such as planting with the union just at ground level, and sod culture. Further testing may show that BA seedling root with Ottawa 3 as the intermediate stempiece may be the choice for the colder areas. In milder areas intermediates like M 8, M 9, and M 26 on semistandard stocks are also possible winners. M 4 is widely used in Europe and is very productive.

For semidwarf, dwarf, and very dwarf (very small to medium-small) trees, M26 and M9 are good. M26 gives a larger tree than M9 and is not as weakly anchored. Both need staking for at least 10 years and are very productive. Somewhat more hardy is M 8 (Clark Dwarf). Ottawa 3 has been developed for trial as a hardy semidwarf stock. There are several possible intermediate-rootstock combinations, of which MM 106 stock with M9 intermediate shows promise of being especially productive. M 27 was released in 1971 as an ultradwarfing stock. As an intermediate on a semivigorous seedling like BA, it has given very productive dwarf trees, slightly smaller than M 9 at the Research Station.

Figure 3. Staked trees on dwarfing rootstocks.

HARDY TREE BUILDING

The use of very hardy rootstocks and tree trunks to increase hardiness in trees of favored varieties is known as 'hardy tree building'. The procedure is to plant trees of a hardy variety on the favored hardy rootstock. The fruiting variety is then grafted or budded into the young tree when the scaffold branches have grown to the desired size. Hardy tree building should be practiced where the hardiness of favored varieties is marginal. Care should be taken not to use virus-infected stocks. *Malus robusta* 5 is a satisfactory stem builder, as well as rootstock, being hardy and compatible with other varieties. Other good stem builders include Hibernal, Ottawa 271, Ottawa 292, Beautiful Arcade, Antonovka, and Haralson.

NURSERY TREES

A good place to obtain your trees is a reliable nursery if you can find one that has the particular type of tree you want. Unfortunately, this is not always possible as nurserymen have no way of accurately forecasting the demand for particular rootstocks, varieties, or ages of trees. When purchasing trees, large 1-year-old trees are preferred. Grade No. 1 trees should be straight, clean, and free from disease, and they should have a good fibrous root system. Two-year-old trees are usually satisfactory. Trees over 2 years old are too large or are culls. It is doubtful if they have

Figure 4. Vigorous trees growing in well-kept nursery.

any value. The area where trees are grown has no permanent effect on their hardiness. To avoid heavy losses from planting incorrectly named trees, purchase only those that are certified true-to-name stock.

GROWING YOUR OWN TREES

If you cannot buy exactly what you want from a nurseryman (many nurseries will grow the trees on contract), you can grow your own trees. However, preparation must be started at least two full seasons before the orchard can be planted.

Order clonal rootstocks at least 6 months before the planting date, or a year before if the desired stocks are likely to be in short supply. In ordering, make allowances for losses from deaths, failures of buds to grow, accidents, and poor growth. These losses usually reduce the numbers by about 20% and occasionally by 50%. Only virus-indexed stocks should be considered.

In propagating apple trees in the nursery three general methods are available:

- Budding is the most widely used method. More of the grafts take than when other methods are used, and more satisfactory trees are usually obtained.
- Root grafting has been widely used in the past and is still practiced. It is done in late January and early February.
- Crown grafting is a valuable method when buds have failed to take. It is done on rootstocks in the nursery early in the spring before growth starts, thereby saving a year that is lost when other methods are used.

Specific methods are described in CDA Publication 1289.

A well-drained, highly fertile sandy loam is best for a nursery. Because snowdrifts can cause serious tree breakage, select a site where drifting is not a problem. Prepare the land by heavy manuring, and grow an intertilled crop the year before planting to eliminate weeds. Plant the rootstocks as soon as the soil is fit to work in the spring, while the ground is still cool and moist. Set them 12 in. (30 cm) apart in rows $2\frac{1}{2}$ to 3 ft (76 to 91 cm) wide, depending on the tillage equipment available. Hoeing, fertilizing, spraying, labeling, disbudding, budding, pruning, and pest and disease control all require attention.

The choice of budwood affects the success of an orchard throughout its life. Only proven strains of the variety should be used, and if possible only buds from a virus-indexed source. If this is not possible, select normal, disease-free, heavy-bearing trees that have produced high-quality apples for several years. Examine the trees and the fruit several times. Carefully mark the trees selected and record their location.

Probably more home-grown nursery trees are damaged by neglect

than from lack of knowledge. Here are some things to remember:

- Only strong-growing, well-established stocks will grow good trees in 1 year. They should be at least 3/8 in. (1 cm) in diameter when budded.
- Bud high (up to 12 in., 30 cm) to avoid scion rooting of the trees on clonal rootstocks.
- Follow a full program of spraying, at least until early August, watching carefully for troubles such as mildew.
- Stop cultivation by early August so that the trees will stop growing and harden off before winter.

PLANTING THE ORCHARD

PLANTING PLAN

Before establishing an orchard, make a thorough study of the general layout of your farm. Then prepare a planting plan. The more accurate your plan, the easier it will be to stake out the orchard and plant the trees.

In the plan indicate varieties and strains of apples, rootstocks, distances between trees and rows, routes of travel, means of conserving soil where necessary, headlands, water supplies, position of drains, arrangement of pollinators and, possibly, location of windbreaks. A level, firm, and convenient area should be reserved for loading and parking. Draw the plan to scale to show where each tree is to be planted. If you are going to use home-grown trees, the plan should accommodate the number of trees you will have available. Keep in mind that trees will have to line up in all directions unless they are contour planted.

If filler trees are to be used, they should not be included until all the details of the permanent orchard are worked out.

For pollination you need at least two cross-pollinating (permanent) varieties, and do not leave more than 50 or 60 ft (15.2 or 18.3 m) between any tree and its pollinator. Cross-pollinating varieties should reach full bloom within 2 days of each other. Planting every third row to a pollinator variety reduces the risk of unsatisfactory fruit set. The efficiency of orchard operations is increased by having two solid rows of each variety side by side.

PREPARING THE LAND

See that the soil is in first-class condition before you plant young trees. Their shape and vigor are determined during the first 4 or 5 years. Time and money are much better spent on plant food and on putting the soil in good condition before planting than after trees have struggled along indifferently for a while. Here are the main points to remember:

- Prepare the land a year ahead unless it is already in good tilth.

- Plow first, preferably in the fall, and then work the land thoroughly with a disc harrow.
- Level any minor depressions with a grader, or fill them in, to promote surface drainage and avoid pockets of water. Install surface and sub-surface drains as needed.
- Plant a cultivated crop, such as corn, potatoes, or a root crop, if possible. This should eliminate serious perennial weeds.

STAKING THE AREA

If your planting plan is accurate, you will have no trouble staking out your orchard. Most areas have a convenient boundary that can serve as a guide in establishing a base line. Put the base line far enough away from the guiding boundary to leave ample space for normal travel after the trees are grown. Also, if you plan to cultivate and spray in both directions, remember to allow room for turning at the ends of rows. The rows and block should be on the square.

From the base line set up a line at right angles. Do this by measuring from A, the corner, 4 units along the base line to B; also, 3 units along what seems like a right angle at A to C. Adjust this spot so that it is 5 units from B. These distance units can be 40, 30, and 50 ft or m. This will establish a right angle that may be continued by sighting right across the field. Repeat the procedure at the other corners.

Determine the spaces between the rows and the locations of the trees by measuring and sighting. Recommended distances are given in Table 6. Drive in a stake at the exact spot where each tree is to be planted. If the field is too hilly or too large to sight from one side to the other, run a line across the center and stake off the two parts separately.

Use a planting board so that you can remove the stakes when digging the holes where trees are to be planted. The planting board is a light piece of lumber about 6 ft (2 m) long with a notch cut at the center and a hole bored at each end. Set it so that the notch fits around the stake and the board is lined up with the other stakes or trees; then drive a small peg through each end hole. Remove the board to dig the hole and then replace it so that the notch will show the exact location for the tree. If you repeat this procedure at each stake, the trees will line up as accurately as the stakes did.

PLANTING

Move your trees from nursery to orchard so that they receive a minimum of shock. Transplanting in the fall has an advantage because trees become established before the beginning of the growing season, but the shock of moving makes them subject to winter injury. Do not transplant trees in the fall in the colder apple-growing areas. Never transplant them when the temperature is at or below freezing. In the spring, plant trees early when the ground is cool and moist. They grow

Table 6. Recommended distance between permanent trees and numbers to plant per acre for different soils

Tree size[1]	Tree spread	Tree volume	Distance between trees and rows (m)		Trees per acre[2] (per ha)	
			Fertile soil	Less fertile soil	Fertile soil	Less fertile soil
Standard	100%	100%	32 × 40 (9.8×12.2)	26 × 34 (7.9×10.4)	34 (84)	49 (122)
Semistandard	80%	61%	25 × 33 (7.6×10.1)	20 × 28 (6.1×8.5)	52 (130)	77 (192)
Half size	60%	31%	18 × 26 (5.5×7.9)	14 × 22 (4.3×6.7)	95 (230)	141 (349)
Semidwarf	40%	14%	12 × 20 (3.7×6.1)	10 × 18 (3.0×5.5)	181 (448)	242 (598)
Dwarf	20%	3½%	6 × 14 (1.8×4.3)	5 × 13 (1.5×4.0)	518 (1281)	670 (1656)

NOTE: It should not be inferred from this table that trees should be closer together on less vigorous soils, but rather that a more vigorous stock will be required to plant at the same spacing.

[1] Standard: Most seedlings, M 12, M 16. Semistandard: Beautiful Arcade seedlings, M1, MM 104, MM 109, MM 111, Alnarp 2. Half sizes: M 2 and MM 106. Semidwarf: M 7 and M 4. Dwarf: M 9 and M 26. Percentages refer to the size of a tree as a percentage of the standard type.

[2] Number of trees per acre (per ha) may be calculated by multiplying the tree distance by the row distance in feet (in m) and dividing into 43,560 (10,000).

faster than late-planted trees. If it is necessary to delay planting, handle the trees with even more care than usual. Holding them in cold storage or in a shady place with the roots and lower parts of the trees well covered with damp soil keeps them dormant and helps to prevent their drying out.

When trees are brought from a distant nursery, they may lose considerable moisture, which should be replaced as quickly as possible. If they are submerged in a pond, do not leave them more than a few hours unless the water is cold and well aerated. Otherwise dip the roots in a muddy mixture of soil and water, and hose down the tops.

Avoid all chances of the trees becoming dried out. Avoid heat, wind, and strong sunlight. Set them in muddy water or cover them with damp soil, moss, or sacks when moving them or waiting to plant them. The cut or broken ends of roots of trees held in storage over winter will have begun to heal by planting time. Do not prune the roots of these trees except to shorten any that do not fit easily into a hole of reasonable size.

Holes for commercial planting are usually dug with a large-bore post-hole digger (10-16 in.; 25-40 cm), though holes dug with a shovel

Figure 5. A large-bore post hole digger is ideal for commercial planting.

are just as good or even better. Always use topsoil to surround the roots and to fill in spaces between them. Trample the soil firmly as the roots are covered. Be careful not to dig holes too deep for low-budded dwarf and semidwarf trees, as the loose soil with the tree will settle considerably and the union may become covered.

Plant trees slightly deeper in the orchard than they were in the nursery, but with size-controlling rootstocks be careful not to cover the union of the root and scion. If the union is covered, the scion very often sends out roots that produce a standard-size tree. In a test at the Kentville research station, high-budded seedlings in which there was no possibility of scion rooting grew well when planted 12 in. (30 cm) deeper than in the nursery. Adding 2 gal (9 litres) of water to each hole as it was being filled helped trees get started, and dissolving $^1/_2$ oz (14 g) of starter fertilizer in the water made them grow even better. The water helped the soil settle and filled the small spaces around the roots, and also watered the trees. As much as $2^1/_2$ oz (70 g) of starter fertilizer could probably be used (3 lb of 10-52-17 in 40 gal; 1.4 kg in 180 litres), but larger amounts are not safe. For the first season a slight depression should be left around each tree to allow water from any showers to run toward the root zone. Remember that the root zone is extremely limited at this time. The young tree can actually be lacking water when the field appears moist simply because the roots are so limited. Under these conditions, application of 1-2 gal (4.5-9 litres) of water per tree should be made to this depression. It should be filled in before the winter with crushed rock or other material. Trees should be pruned immediately after planting.

CULTURE

Competition from weeds and grass must be prevented in a young orchard for at least 5 years after planting or until it produces a bushel (20 kg) of apples annually per tree. You may use a small machine or hand hoe around each tree. Avoid deep cutting with heavy implements close to trees. To prevent erosion on hillsides, cultivate only within a radius of 3 or 4 ft (1-1$^1/_2$ m) around each tree. Herbicides are as good as or better than cultivation, but in the colder areas of Eastern Canada care should be taken to retain a cover crop or weed growth late in the season to harden young trees and to prevent root injury due to excessive frost penetration. This is more easily done on cultivated sites. Buckwheat seeded at 3/4 bu/ac (54 kg/ha) is one of the most reliable cover crops because it can be successfully seeded even during hot dry periods in late July.

SOD CULTURE

Mature orchards should be in sod, and the herbage under the trees should be controlled with herbicides, though not eliminated. A good mixture for seeding 1 acre (1 ha) is:

Chewings or creeping red fescue	5 lb (5.5 kg)
Wild white or white Dutch clover	2 lb (2.2 kg)
Ladino clover	2 lb (2.2 kg)
Kentucky or Canada blue grass	10 lb (11.2 kg)
Oats	1 bu (38 kg)

Grass in the orchard should be cut at least twice a year.

CHEMICAL WEED CONTROL

Use of chemical herbicides for suppression of competitive plants in orchards is recommended provided they are used correctly. The maintenance of just about any degree of vegetation ground cover down to and including bare ground is technically possible.

Each year there is new information on herbicides: new materials, changes in registered uses, and better methods of application. You should therefore obtain up-to-date information from your extension specialist and *always* read and follow the label directions each season before starting weed spraying.

Adjust the rate of application by spraying a tank full of plain water, then recheck frequently to be sure that the recommended amount of active material is actually being spread over the recommended area of land.

The objective should be to use the chemical at the correct rate for the conditions of application in order to accomplish the degree of control of the vegetation previously suggested. Applications should be even and uniform. With care most cases of overkill or of underkill can be avoided.

Figure 6. Clean cultivation keeps this orchard essentially free from weeds and grass.

Figure 7. A herbicide was used to control the growth of grass and weeds in strips under the trees.

Figure 8. A herbicide was applied under the trees only.

If these problems do occur: Cover excessively bare ground with mulch before winter and do not apply residual herbicides for a year or two. Adjust underkill by careful retreatment or by spot spraying with the appropriate herbicide.

NUTRITION

With the possible exception of some orchards in the Eastern Townships of Quebec, all apple trees in Eastern Canada require fertilizing. Fertilizing influences the growth, yield, and appearance of the trees, as well as the appearance, size, quality, and storage life of the fruit.

USE OF FERTILIZERS

Practically all orchard soils in Eastern Canada are improved by the addition of ground limestone. Have orchard soils tested occasionally for acidity. If such tests are not available, apply 500 lb of limestone per acre per year (560 kg/ha) at convenient intervals of 4 to 8 years. Dolomitic limestone is usually recommended because it supplies magnesium; in the few orchards where magnesium is in ample supply, calcium nutrition is improved by using calcitic limestone. There are good, productive orchards on soils of widely varying acidities, but a pH of about 6.0 is considered best. If the pH reading is under 5.5, more limestone is required.

Apply nitrogen at a rate that will result in about 20 in. (50 cm) of growth on some terminals of young trees and about 8 in. (20 cm) on older bearing trees. Remember that fruit color is a guide to nitrogen level: lack of good red color on mature fruit is an indication of too much nitrogen. Apply fertilizer in the spring, as soon as most of the danger of excessive loss from heavy rain and runoff has passed.

A 10-10-10-0.1B or equivalent mixture generally provides satisfactory nutrient levels. The rate of application depends on soil fertility, type of culture, size of trees, and varieties. Red Delicious and Spartan appear to require more than most other varieties. Orchards of large trees or thickly planted smaller trees on poor soil may require annual applications of 800 to 1,000 lb/ac (900 to 1,120 kg/ha). Cultivated orchards on good deep soil may need less than half as much. At least half the nitrogen should be in the nitrate form.

Young trees usually require $^1/_2$ lb (225 g) of 10-10-10-0.1B applied 1 month after planting, with yearly increases of $^1/_2$ lb, depending on tree growth and the fertility of the soil. Depending on local conditions it may be possible to use less P and K once the trees are established.

Animal manures are satisfactory, well-balanced fertilizers. A ton of good cow manure supplies approximately the same amount of plant food as 100 lb (45 kg) of 9-5-7 and valuable organic matter as well. Limit applications of fresh poultry droppings to 2 tons (2 tonnes) per acre. Manures can damage young trees if applied near their trunks. Manure should be applied in late fall after harvest up to bud burst in spring.

Organic mulches are valuable and can replace cultivation and use of fertilizers when liberally applied. Uncured hay or hay from legumes or succulent grass when applied in the summer may give an excess of nitrogen late in the season. This excess can cause late growth and soft, poorly colored apples. Thick, dry mulches applied in summer may prevent rainfall from reaching the tree roots. It is much better to apply hay mulch in the fall and early spring. Mulch attracts mice, however, which can be a problem.

In mature orchards, fertilizer may be broadcast with a whirligig type of spreader. In younger orchards it should be spread evenly around each tree out to a couple of feet (0.6 m) beyond the branches. High dosages near the trunks of young trees may be injurious, especially on sandy soils if the summer is dry.

DEFICIENCY SYMPTOMS

Shortage of nitrogen, the most common deficiency in orchards, would be widespread and severe if extra nitrogen were not added to the soil. Trees moderately or highly deficient in nitrogen have light green or yellowish leaves. They grow slowly and produce small crops. The fruit is small and highly colored. Trees surrounded by grass are more likely to be deficient in nitrogen than those in cultivated soil. An excess of nitrogen, other factors being equal, causes large, dark green leaves, excessive

growth, heavy fruit set, and poor fruit color. Fruit production is delayed in some varieties when young trees are overvegetative. This condition can be caused by heavy pruning or heavy nitrogen fertilizing.

Excesses or deficiencies of phosphorus are rarely severe enough to cause noticeable symptoms in apple orchards and many growers do not apply phosphorus fertilizer on a regular basis.

In some varieties, boron deficiency causes poor fruit set, drought spot, and corky core on the apples, and twig dieback is severe. McIntosh and Cortland are particularly affected by a lack of boron.

Potassium deficiency may occur and is shown by pale leaves with frayed, cigar-ash margins. Although good levels of potassium are helpful for good fruit color, excessive amounts may interfere with uptake of magnesium and calcium.

Magnesium deficiency causes severe leaf scorch. The scorch is usually preceded by a yellowing between the veins near the midribs. Magnesium deficiency usually shows its greatest effect on older leaves of the current year's growth. It is noticeable in late July and, when severe, causes leaf and fruit drop. The apples of deficient trees mature early, are of low quality, and are often highly colored but dull. Occasionally tree growth is seriously retarded.

Calcium deficiency is seldom severe enough to cause tree symptoms. In the fruits, bitter pit and York spot are less severe where there is adequate calcium uptake, and storage life and handling ability may also be improved.

Manganese problems are those of excess rather than deficiency. The symptoms of measles disorder on bark, especially of young Red Delicious shoots, is associated with excess manganese.

Many deficiencies are corrected by nutritional sprays such as urea (for nitrogen), magnesium sulfate or nitrate, calcium nitrate or chloride, and borax or Solubor, which are the most widely used materials. See local spray guides for recommendations.

TRAINING AND PRUNING

Pruning is a major expense for the apple grower. In a cost study of apple production in Nova Scotia in 1939 and 1940 it was found that 23% of the time spent on growing and harvesting was spent on pruning. In a similar study conducted in British Columbia in 1939 the proportion was 17.8%.

Pruning increases the strength of trees, although unpruned young trees grow faster, begin bearing earlier, and yield more heavily than pruned trees. Cultivation, fruit thinning, spraying, and picking are all made easier by proper pruning, and fruit size and quality are improved.

There are differences in the way branches of different apple varieties grow. Gravensteins usually have excellent spreading branches; Delicious and Northern Spy tend to be upright with narrow weak crotches; Cortland trees tend to be droopy.

The art or science of pruning has been developed in Europe and Asia over the centuries. The cordon, the espalier, the dwarf pyramid, and the fan are all interesting pruning forms for apples, pears, and other tree fruits, and there is a great variety of decorative forms for ornamentals.

There appears to be little uniformity in pruning practices in this country. Trees grow and yield well under the many different systems in use. The instructions given below apply to the central leader type of tree, which is recommended for Eastern Canada.

TRAINING YOUNG TREES

Since pruning is a dwarfing process and since we want a tree to develop its bearing capacity as quickly as possible, it is desirable to prevent undesirable growth from developing or to bend it into its proper place, rather than to let unwanted shoots grow only to be cut off. Thus we should regard any pruning on growing trees as part of a training process.

A newly planted tree should be headed back at about 3 ft (1 m) and any narrow crotches removed. After growth starts select the best top shoot and remove all others within 2 in. (5 cm). This will give one dominant leader and it in turn will induce good angles in the lateral branches. If an imbalanced growth or too many shoots develop, these should be pinched during the season to check their growth.

In the second season, again cut back the leader, this time by about half. Continue the pinching and training as before.

Clothes pins may be clipped on the main leader just above a developing lateral to further assist in developing good crotch angles. With some varieties further bending is worthwhile. Special wire clips or special spreaders may be used. When inserting these, you should be careful to bend the branch rather than pull out too hard on the crotch.

Another training procedure is to cut a notch above a bud to force out a shoot where one side of a tree is lacking. Also, a notch below a shoot can be used to slow the growth if the shoot is excessively vigorous. Notches should not girdle more than one-third of the shoot circumference or be deeper than twice the bark thickness.

It is usually wise to leave more branches than appear necessary for the mature tree. They assist in developing good angles, give quicker production, and enable rapid pruning once the tree is bearing. Until that time, pruning should be limited to removing cross branches, a few low branches, or those growing up through the tree.

The objective should be to develop a central-leader or Christmas-tree form in trees that are less than 10-12 ft (3-3$^1/_2$ m) in spread. In trees

Figure 9. Two styles of pruning. The thicker tree, on the right, has consistently yielded more and better fruit.

that have greater spread, the central leader should be allowed to 'top over' and become a lateral so that the modified central leader tree form is developed.

PRUNING OLDER TREES

Older trees constantly need to have broken and dead branches removed. It is good to anticipate the death of shaded, useless, and weak branches. Some varieties have many small twigs and branches; they should be thinned by removing the slow-growing weak ones. This is an especially useful practice to increase fruit size and should be standard practice for varieties like Red Delicious.

Water sprouts can sometimes be used to develop natural braces to strengthen weak crotches. When nature has produced a water sprout on a weak branch, and a conveniently located one on a strong branch, they can be twisted around one another and securely tied. When they grow together they become an excellent brace. Sometimes you can graft a water sprout into another branch with a similar effect. Sometimes strong water sprouts can be tied down and trained to replace broken branches. Otherwise, upward-growing water sprouts should be removed in trees of all ages.

If possible, have the same person prune young trees for the first 4 or 5 years so that one general plan of development is followed. Pruning is simplified if done in steps. First, remove any large branches; second, make any smaller cuts necessary to control or develop the desired tree structure; and only then attend to details such as crossed branches,

water sprouts, thinning out, and heading back. Remove branches by means of cuts that will heal as quickly as possible to reduce the possibility of organisms entering the wound and causing decay. You can avoid trunk splitting when removing large limbs by undercutting first, and then making two cuts, the first one a foot or more from the trunk. When using loppers or long-handled saws, be careful to avoid leaving small stubs.

PRUNING TOOLS

Knives, saws, pruning shears, loppers, and long-handled saws all have their place in pruning. Although pruners and saws powered by compressed air, hydraulics, or electricity, often mounted on a 'giraffe' (mobile platform), have been available for many years their use has proved to be only marginally advantageous. Recently the very light chain saw has become the most accepted power tool. A good rule-of-thumb is to select the tool that will most easily make the types of cuts desired.

GRAFTING ESTABLISHED TREES

Occasionally it is desirable to change the variety of apples borne by one or more trees. With young trees this is quite practical. In the colder areas of Canada it is desirable to grow a hardy frame, and then graft the more tender but better varieties on this frame, because the parts most often injured by fall freezes are the collar and the large crotches. Trees at Kentville planted as 2-year-olds that were grafted after 2 years in the orchard lost only about half a season's development, whereas trees grafted as 12-year-olds produced only half the total crop of ungrafted trees in the 10 years after grafting. Excellent trees, grafted at maturity, have been developed, however, and where most of the orchard is profitable, grafting is preferred to replacement for trees of obsolete varieties within the block.

Large limbs may be cut off and several scions inserted around the circumference of the cut end (hub grafting) by one or more types of grafts. Or the grafter may retain the limb, removing all or most of the laterals and inserting scions under the bark every foot or so on alternate sides along the length of the limb (frame grafting). Again several types of grafts may be employed. Do not attempt to graft low-vigor trees or limbs. Scion take and growth are poor on shaded low limbs unless the top is cut back severely.

Grafts should seldom be inserted above 7 ft (2 m) from the ground if manageable trees are to be developed. Also, the number of growing buds should not be reduced below 10% of those present before grafting. Thus in a young tree enough scions can be inserted so that, with the goodly proportion of latent buds on the limbs that will grow, one can replace the entire top in one operation. On larger trees this becomes less practical and parts of the original tree must be left for a year or more. Some very successful grafting has followed the principle of cutting out the top, hub grafting these large cuts, frameworking the laterals, and leaving a large skirt of original branches around the tree. Excellent crops

of the obsolescent variety were secured with very large and easily harvested fruit. This continued for several years while the new top was being developed and trained and the trees actually never missed a season of meeting expenses.

Success in grafting depends on i) good trees and good scions, including freedom from virus problems; ii) good match between cambium layers of stock and scion; iii) prevention of drying of the scion before new conducting tissue can grow together; iv) use of nontoxic grafting compound; v) good training care of the developing shoots.

Hot brush wax based on resin and beeswax is preferred for initial waxing, asphalt emulsion compounds for rewaxing. Rewaxing should be done as necessary a week after grafting and again soon after growth has started. Blow-out of scions can be prevented by heading back excessive growth in midsummer. Pruning, training, and removal of suckers should be adjusted according to vigor and type of growth and must be faithfully carried out if a satisfactory tree is to be redeveloped. Excessive growth may be partially controlled by reducing the supply of nitrogen fertilizer.

PREVENTING AND TREATING INJURY

It is better to prevent damage than to treat broken trees. Keep trees well pruned, trained, and propped, and the fruit thinned. Grow windbreaks wherever possible to avoid wind damage. Use cultivating methods that reduce the possibility of winter injury.

When a tree produces 20 bu (0.4 tonne) of fruit of a superior variety each year, the tree is very valuable. If it becomes damaged, considerable expense is justified to save it or at least parts of it. There are several methods of treatment.

Painting with grafting wax or commercial emulsified asphaltic materials to promote healing and to keep wounds from drying out is often all that is required. Small trees may need bridge grafting or inarching to help them overcome the effects of girdling by rodents, winter injury, or fire. Staking will keep trees upright and improve anchorage. Supporting branches with eye screws and wires, or long bolts although not completely satisfactory, is often useful to prevent or repair breaks in heavy branches. Also natural bridging braces may be developed from water sprouts or springy grafts.

When the bark on a tree trunk is separated from the wood by winter cold, tack it down with large-headed tacks as soon as possible and cover the wound with grafting wax. If conditions are favorable, the bark and wood will reunite as the tree grows, and in any case this treatment will promote healing.

If a section of a valuable tree produces small apples or grows poorly, examine the trunk for injury. You can supply extra life-giving nutrients to a damaged tree by planting a small tree close to it and by inarching (grafting) its top into the ailing branch or into the trunk of the damaged tree just below the branch.

If trees are blown down in a storm, pull them upright within a day or two and brace them securely. Almost all the trees blown over by Hurricane Edna in 1954 at the Research Station were saved in this way.

Southwest injury and sunscald are greatly reduced if the exposed sides are painted in the fall with a flat-finish, exterior latex paint.

QUALITY CONTROL

Thinning, or removing part of the crop from trees, improves the growth, color, quality, and rate of maturity of the remaining fruit. When done early, usually with chemical sprays, the same or even a slightly greater volume of fruit can be produced with less stress on the tree. This is because fewer fruitlets begin growth only to fall off in the late June drop and also because there are fewer seeds per tree, seeds being much higher in energy requirements than the flesh of the apple.

Some varieties need more thinning than others. However, it is usually necessary to thin some trees of each variety every year. Cortland seldom needs thinning, King practically never. Golden Delicious and Spartan are varieties of superior quality that have been planted only lightly in Eastern Canada, probably because heavy thinning is needed to develop good-sized fruit and high quality, as well as the bright yellow color of the Golden Delicious. Practically all pre-Gravenstein varieties require heavy thinning, otherwise they bear biennially and set heavily when they bloom.

Careful assessment of conditions for cross-pollination and potential set should be made for each variety when it is in bloom. Factors affecting the amount and vigor of bloom; and the availability of compatible pollen coupled with bee activity should all be considered and a tentative decision reached on the thinning program.

The fruit size of most varieties can also be improved by proper pruning; heavy fertilization may have the opposite effect because of increased fruit set.

HAND THINNING

Unwanted fruitlets are easiest to remove when small, although it is most economic to wait until you can pick out the apples that will drop by themselves in early shedding. Grasp the stem by the thumb and forefinger and push the fruit from the stem with the other fingers. The stem will remain on the twig and removal of the apple will not loosen other apples on the same fruit spur. When fruitlets are a bit bigger, you may find it handy to use light shears for thinning, especially for short-stemmed varieties, but it is usually quicker to use your fingers.

Hand thinning should be regarded as a culling operation in which slow-growing, shaded, and imperfect fruitlets are removed. Total yield will usually be reduced in proportion to the lateness in the season, but

Figure 10. Several fruitlets are beginning to develop on one spur. All but the two strongest fruitlets will soon fall naturally; then hand thinning can be started. Proper chemical thinning would have removed the weaker fruitlets before they developed this far.

since only the best apples are worth the costs of harvesting, storage, and packing you can continue hand culling almost up to harvest.

CHEMICAL THINNING

Four chemicals are especially useful for thinning in Eastern Canada. Some of these are available under several trade names. Consult your local fruit extension specialist for up-to-date recommendations for your area. He may also use radio for release of day-to-day advice.

Dinitro sprays are caustic and are only effective when applied within a matter of hours of the correct time. This is when sufficient cross-pollination has taken place and before the rest of the blossoms have been fertilized — usually this is when the tree is fullest in bloom. Rates vary from 1/2 to 1 qt/100 gal (125-250 ml/100 litres). Some foliage injury may result, especially when weather is humid and growth is especially succulent. Dinitro is used mainly on Gravenstein and Spy varieties.

Naphthaleneacetamide is less critical as to timing and seldom causes injury or overthinning. It is used at 20 to 80 ppm (directions on label) at early petal fall up to 3 weeks after full bloom. Insufficient thinning may be a problem in Eastern Canada especially when applied after the petals are all off and under windy or rapid drying conditions. Applications to Red Delicious and Macoun trees may result in some pygmy fruits if made after petal fall. Naphthaleneacetamide may cause overthinning

only when applied at full bloom or at the higher rates while some petals are still on or to weak or juvenile trees.

Naphthalene acetic acid is regaining some popularity in Eastern Canada as a more effective material than naphthaleneacetamide and less tricky in timing than dinitro. Formerly, the use of naphthalene acetic acid was restricted to the period from 10 days to 3 weeks after bloom because considerable foliage distortion usually resulted from earlier applications. Rates ranged from 12 to 36 ppm. Recently much lower rates, from 4 to 8 ppm, have proved useful on varieties like Gravenstein and Spy when applied at petal fall.

Carbaryl approaches an ideal thinner except for its insecticidal properties; it kills pollinating insects and predators of orchard mites. It is mild with no damage to fruit or foliage, reasonably effective, and not critical as to concentration or timing. Because it is rather insoluble, it may be necessary to make two applications 4 to 8 days apart rather than a higher rate in orchards where thinning is a severe problem. Rates vary from 1/2 to 1 lb actual carbaryl per 100 gal (50-100 g/100 litres). Applications are especially effective when the larger fruitlets are at the 1/2-in. (1-cm) stage.

The approach to chemical thinning varies somewhat among the different areas of Eastern Canada. Where late spring frosts are a problem it is wise to delay application somewhat; carbaryl will be the primary thinner. Growers who wish maximum natural control of insect pests should avoid carbaryl. This dilemma is best resolved by using a thinner at the earlier stages to cause a partial reduction and following with a second application, or hand thinning limbs or trees still requiring thinning when the set can be evaluated with more certainty.

PREHARVEST SPRAYS

Many varieties of apple trees drop many of their fruits before normal harvest time. The drop of McIntosh apples may be serious especially in the warmer areas of Eastern Canada. There are several 'stop-drop' sprays that are effective in reducing this loss from healthy trees. Naphthalene acetic acid is most commonly used. Another chemical, fenoprop or 2,4,5-TP, although somewhat slower acting, is effective over a longer period. Consult your provincial specialist and follow manufacturers' instructions when using either of these sprays. Spray the trees in warm weather for best results. Apply fenoprop about 1 week before the harvest drop is to start. Do not use more stop-drop spray than necessary as it may hasten maturity and reduce the storage life of apples.

SADH is an effective stop-drop material. It is used earlier in the season than the other two and, especially in the cooler areas like Nova Scotia, should be used at the lower range of the recommended rates. The manufacturer's label gives full details for using SADH. Be sure to read and understand the directions and cautions.

Ethephon is an effective material for improving fruit color and maturity. On fall varieties it has given better appearance and quality and

Figure 11. Preharvest drop is beginning. Note the excellent fescue sod.

reduced the number of pickings required. It also ripens the fruit and causes it to drop more readily. Applied thoroughly at the minimum rate necessary for effectiveness, often in conjunction with a stop-drop of naphthalene acetic acid or fenoprop and sometimes preceded by a summer spray of SADH to improve firmness and color, ethephon has been a very profitable spray. But excessive use of ethephon can be disastrous; you should therefore not treat more apples than can be handled properly. Be sure to follow the directions on the label. Consult your agricultural specialist for up-do-date recommendations.

HARVESTING

PICKING DATES

Several criteria have been used to predict the best picking dates for different varieties. These include the number of days from full bloom, the degree-days accumulated in the 4 to 6 weeks after full bloom, calendar date, iodine test, ground color of fruit, and ease of picking. Generally, the most workable method is to schedule the harvest according to usual calendar dates and to make adjustments as information from other criteria become available.

If foliage on trees is good, fruit continues to grow in volume at a rate of about 2% per day almost until the fruit drops or cool weather comes.

Picking the crop when it is either immature or overripe will reduce quality. Red color improves as long as the fruit remains on the trees, except that some varieties turn too dark when they are overmature. If harvesting is delayed until apples are overmature, the storage life of the fruit will be shortened. For any given variety, the late-picked fruit should be marketed first and the early-picked last. This is especially applicable when a variety like McIntosh is spot-picked.

HARVESTING METHOD

Careless picking can seriously reduce the value of a crop. Sometimes the value of fruit lost through picking damage equals the cost of picking. There can also be as much loss from poor picking as from insect damage or apple scab. With some pickers, up to one-third of all fruits picked will have the stems pulled out. Under proposed regulations for European markets, apples without stems will all be classed as culls.

Cup the apple in the fingers and roll it upwards; a finger or thumb may be held against the stem to assist the separation from the spur. Place, not drop, the apple in the basket. Apples should slide in mass, not pour individually out of the basket. Pick lower branches first. Avoid dropping fruit down through unpicked crop below. Where bushel containers are used it is advisable to pick directly into them; place them on special low sled-runnered tables. Never allow filled containers to drop even 1/2 in. (1 cm) either in loading or hauling. Place apples in cool storage 32°F (0°C) within 24 hours of harvest unless it is desired to ripen the fruit.

SPOT PICKING

Most early apple varieties mature over a period of about 2 weeks. You can avoid heavy losses from immature culls picked too early, or from fruit drop when picked too late, by making several spot pickings. Spot picking is particularly good for roadside stands, as early apples quickly lose quality when held at normal summer temperatures after harvesting. Total yield can be increased in addition to the quality improvement. Use of preharvest sprays should be an integral part of the harvest operation. (See that section).

Valuable results are also obtained by spot-picking later varieties. In the first picking it is usual to remove apples that will grade large Fancy ($2^1/_2$ in.) and leave the others. Pick either none or all apples from a cluster. After 2 more weeks of growth and development, many of those that are left will meet grade requirements. If a good proportion of the fruit is left until the second picking and only the easily reached fruit is picked at the first picking, the cost for total harvesting need be no more than for a single picking. Under extreme pressure to get the crop harvested use of available labor to harvest only the best fruit first may get it under cover before frost, excessive drop, or other disaster occurs.

CONTROL OF PESTS AND DISEASES

MICE AND RABBITS

Mouse damage to trees during winter may be severe in orchards especially where ground vegetation is thick and long; damage may occur as early as September. The winter of 1970-71, with early and continuous snow over unfrozen ground, was especially bad for injury by mice.

Natural predators such as foxes, cats, hawks, and owls should be encouraged by the orchardist, and when coupled with the use of herbicides to remove the vegetation close to the trunk plus good mowing practices, they will keep mice under control except for the unusual season. Young trees are especially favored and should be protected until the trunks are almost 3 in. ($7^1/_2$ cm) in diameter.

Commercial plastic wrap-around guards are easy to install. They may remain on the tree indefinitely, but tend to become distorted and give less protection as the tree grows. More permanent are the commercial guards made from perforated metal sheet with rubber or plastic backing to protect the young tree from chafing as it bends in the wind. Guards may be made from 18-in. strips of 1/4-in. galvanized wire mesh

Figure 12. The bark of this tree was eaten by mice *above* the wire protector.

or equivalent material. Length of 12 to 18 in. (30-45 cm) may be sufficient for mice, but 24 in. (60 cm) is better especially where rabbits are a problem. Because these guards may chafe very young trees, it is often better to use tarred felt building paper or aluminum foil for the first 2 years. Any paper that has tar in it should be removed early in the spring to prevent heat and tar injury. All guards should be imbedded in the ground when installed, to prevent mice from going underneath and to hold them steady.

Spraying and painting the trunk and lower limbs of trees with mixtures containing thylate will provide some protection from rabbits. Home garden trees may be protected by wrapping the entire trunk and lower limbs with strips of burlap. Do not use plastic or other 'nonbreathing' material.

Poison baits may be used, but natural predators may also be reduced due to consumption of poisoned mice, or a favorite cat may be killed. Every effort should be made to protect birds and other wildlife. Placing bait under a board, hiding it in a tube made from an empty pop can with both ends removed, or imbedding it in paraffin wax are all good. Commercial units of this type may be used or bait prepared according to the following formula:

> 100 lb (45 kg) cracked corn, 2 lb (900 g) zinc phosphide, 1 qt (1.1 litres) vegetable oil, and 1/2 oz (14 g) methyl green dye. Mix the corn, zinc phosphide, and methyl green dye thoroughly in the dry state so that the poison covers the corn completely and evenly. Then add the oil and again mix the bait carefully. Because the fumes of this poison are lethal, mix it out-of-doors. Keep it in a tightly covered container and label it carefully. Always handle it with care.

DEER

In some areas damage to young trees by deer is so serious that it is difficult to start an orchard. The damage is more serious in summer than when trees are dormant. You can usually prevent deer damage by putting several moth balls in a cheesecloth bag hung from a tree. In hot weather the moth balls last nearly a month, and in cooler weather at least twice as long. Bone and blood meal used in the same way work just as well and last somewhat longer.

INSECTS AND DISEASES

An orchard business would fail if the grower did not control diseases and injurious insects. To grow apples foliage and fruit must be protected from apple scab fungus. This requires 8 to 10 fungicide sprays annually during May, June, and July. Materials that will also control mildew may be advisable in some sprays. Storage rots may be a problem if sprays are not applied in August. Fire blight is a problem in some years, especially in areas with continental rather than maritime climate; pruning and removal of infected shoots are part of the control procedure. Where trees appear

Figure 13. Spraying with a large blower sprayer.

weak, collar rot, damage by rodents, winter injury, or other root and crown problems may be suspected.

Because insects often cause economic damage, you must be regularly on the lookout for them at critical times and apply control measures whenever outbreak numbers become imminent. The objective should be to use chemical sprays only when necessary to get control and no more. Rate or dosage, timing, selection of material, and method of application are all part of the bag-of-tricks that enable the fruit grower to work with nature in producing 95% or better undamaged fruit.

For the latest information, consult spray calendars each year and heed spray warnings issued by local specialists.

TREES FOR THE HOME GARDEN

Very dwarf trees on M 27 and dwarf trees on M 9 or the slightly larger M 26 rootstocks, although they require special attention to give them proper support, are ideal for the gardener who has fertile soil. Bush-type trees can be grown that are less than a quarter the size of standard trees and rarely over 8 ft high (2 m) when they mature. If desired, they can be planted close together and carefully pruned to keep them smaller still. As cordons, they have been planted $2^1/_2 \times 6$ ft (0.75×2 m) apart and as dwarf pyramids at 3×7 ft (1×2 m). They should be headed low, perhaps 12 in. (30 cm). Where deep snows occur some precautions may be necessary to keep branches under crusts and melting snow from breaking. Pruning depends on the type of tree required. Dwarf type trees stand heavy pruning into special shapes much better than standard trees. Dwarf trees need special cultivation, or a mulch such as lawn

clippings or hay. Spraying and fertilizing are as necessary as for commercial trees. Indeed, dwarf trees suffer more from lack of good care than do trees on more vigorous rootstocks.

Scab-resistant varieties such as Prima, Priscilla, Nova Easygro, Macfree, Priam, and to a lesser extent, Tangowine, many older varieties, and Dolgo and Geneva crabs will considerably reduce the home gardener's spraying problems. Red Fleshed Crab is one of the good ornamental crabs for both bloom and fruit.

If extra varieties are desired, one or more other varieties can easily be grafted into these trees. The added varieties should increase both the usefulness of the trees and their general interest.

Usually the most difficult problem for home growers is the control of the apple maggot or railroad worm. This insect, which may fly half a mile, moves beyond the boundaries of large orchards as well as gardens. Then, probably without further feeding, the flies lay eggs beneath the skin of fruit. When the maggots hatch and feed, they cause the characteristic damage. Unfortunately, the problem is most difficult with the early varieties, which are of particular interest to the home gardener. Planting apple trees without due care to apple maggot control is discouraged.

DESCRIPTION OF VARIETIES

The varieties are listed in approximate order of ripening; dates given are average for first, Vineland, Ont.; and second, Kentville, N.S. Especially hardy varieties are marked*.

CLOSE July 30, Aug. 5 (Parentage unknown, introduced by the USDA in 1938) This is the earliest-ripening apple at Kentville. The apples ripen unevenly and drop seriously unless sprayed with a stop-drop spray. They have better quality than Crimson Beauty. The trees are cross-unfruitful.

STARK'S EARLIEST Aug. 8 Distinctive bright rose-pink streak-blush, fair quality. Too small except in best conditions.

VISTA BELLA A new, dark red apple from New Jersey, firmer than Julyred.

***QUINTE** Aug. 12, Aug. 20 (Crimson Beauty x Melba, named in 1964 by the Canada Department of Agriculture, Ottawa) This new early-season variety matures about midseason between its parents. The tree is above medium in size. The fruit is attractive, being well covered with a bright solid red color. Its quality is good. Biennial.

***CRIMSON BEAUTY** Aug. 14, Aug. 9 (Also known as Early Red Bird, originated in New Brunswick) A highly colored striped apple of good size and sprightly flavor, as a culinary apple it has value for local markets. The tree is hardy and vigorous but often biennial in habit. Banks Crimson Beauty is a very attractive solid red strain.

***CARAVEL** Aug. 14, Aug. 22 (Melba x Crimson Beauty) Also called Portia. Fairly attractive, medium quality, tends to be biennial. Does better in Nova Scotia than in southern Ontario.

***RED ASTRACHAN** Aug. 15, Aug. 20 An old variety from Russia. It has good quality and color if well grown, but is small and of little value on large old trees.

***MANTET** Aug. 17 (Tetofsky seedling) Fairly attractive, streaked, good quality, medium size.

***LODI** Aug. 18, Aug. 20 (Montgomery x Yellow Transparent, originated at the New York State Agricultural Experiment Station) This early summer variety is the best early yellow apple known for the Maritimes. It resembles Yellow Transparent in tree and fruit characteristics, but the fruit ripens slightly later and is larger. Careful thinning is required to keep it bearing annually.

***JULYRED** Aug. 13 A new variety from New Jersey, of multiple parentage. Large, attractive, good quality, rather soft.

***CHARLOTTE** Aug. 20 (K) A McIntosh seedling from New Brunswick with excellent quality, above medium size, striped, can be used to start the season of McIntosh-type apples.

MELBA AND RED SPORTS Aug. 20, Sept. 8 (McIntosh seedling, originated at Ottawa) Undoubtedly the highest-quality early variety grown in Canada, this apple has been planted heavily. It is a short-season variety desirable for local-market and roadside-stand trade. The attractive fruit resembles McIntosh, being washed and streaked with red, and it is medium to above average in size. The tree is vigorous, hardy, and an early bearer. It gives a good crop but is often biennial in habit. This variety ripens unevenly and spot picking is necessary. The fruit bruises easily and should be moved to market as soon as possible.

Several bud sports of Melba are available and are superior to the original variety in appearance, firmness of flesh, and keeping qualities, but they ripen a few days later. They do not bruise so easily as Melba. Melba and red sports are commercially grown in most of Eastern Canada.

JERSEYMAC Aug. 31 (K) A new selection (introduced as NJ 38) from New Jersey which has promise as a McIntosh-type of excellent quality and appearance.

PURITAN Aug. 21, Sept. 12 (McIntosh x Red Astrachan) Attractive McIntosh-type early apple with considerable merit.

WELLINGTON Aug. 21, Sept. 1 (Crimson Beauty x Cortland) Less biennial than many earlies. Fruit is large and of good quality and appearance when fully matured.

EARLY MCINTOSH Aug. 21, Sept. 12 (Yellow Transparent x McIntosh) A small apple of good quality, too difficult to grow in the cooler areas of Eastern Canada.

VIKING A new red apple from Wisconsin showing promise.

***SCOTIA** Aug. 30, Sept. 10 (McIntosh seedling, originated at Kentville) Annually productive, fruit of good quality and size. McIntosh-type apples.

BOUGH SWEET Aug. 30 (K) Very old variety of good size, greenish yellow with light blush. Distinctive good flavor.

TYDEMANS EARLY Sept. 7, Sept. 10 (McIntosh x Worcester Pearmain). Attractive, good-quality apple, widely planted in British Columbia. Some tendency to blind wood and small fruit in the east, new spur-type sport may reduce this problem.

GRAVENSTEIN AND RED SPORTS Sept. 15 (K) (Originated in Germany). This attractive blushed apple is of good commercial size and quality. It is ready for picking before McIntosh but must be marketed by late fall. The tree is a heavy producer and a vigorous grower, but it lacks hardiness and is subject to flat limb virus and to crown rot. It is grown commercially in Nova Scotia. Sports of this variety such as Washington are better in appearance than the original variety. It is a superior cooking apple. Cross-unfruitful.

PAULARED Sept. 12 (K) A chance seedling of the McIntosh type, firm, stores well for season, good quality, new, and relatively untested.

***ATLAS** Sept. 20 (V) (Winter St. Lawrence seedling) Productive, medium quality; red sport is more marketable. Has been a useful fall apple in Quebec.

***BLAIR** Sept. 20 (K) (McIntosh x Fameuse) Earlier, more pointed, and better colored than McIntosh. Selected at Ottawa in 1944, named in 1973. Keeps nearly as well as Lobo.

PRIMA (Multiple parentage) A new variety of good quality, red blush, attractive, good size, maturing just after Gravenstein, high resistance to apple scab.

RIBSTON AND RED SPORTS Oct. 5 (K) In Nova Scotia this high-quality old English variety is valued for processing. It makes a very good solid pack and is excellent in blends of apple juice. The spur-type trees are semivigorous and annual bearing. The variety would be more valuable for processing if the fruit were larger. Cross-unfruitful.

***LOBO** Sept. 23 (K) (McIntosh seedling) Much like McIntosh; does not sell as well as McIntosh. Grows better than McIntosh in southern New York State. Grown in New Brunswick.

GOLDEN NUGGET Sept. 30 (K) (Gol. Russet x Cox Orange, origi-

nated at Kentville) Rather small, very high quality, russeted with light blush. For home gardeners and specialty growing.

JONAMAC Oct. 1 (K) (McIntosh x Jonathan selection from New York) A very nice apple at Kentville, more sprightly than McIntosh, needs further testing before its ability to compete with McIntosh can be determined.

NOVA EASYGRO Oct. 5 (K) (Multiple parentage, originated at Kentville) Medium size, good quality, annual, scab resistant. Especially for noncommercial areas.

***MCINTOSH AND RED SPORTS** Oct. 2, Oct. 4 The original McIntosh was found growing as a seedling near Dundela, Ont., by John McIntosh in 1796. Today it is the most popular variety grown in Canada. Many red sports of this variety that have been selected on the basis of high color are now being grown. McIntosh is recommended for commercial planting in all the apple-growing districts of Eastern Canada. Only blushed red sports such as Summerland, Blackmac, Rogers, Hamilton, and Cornell should be planted. More recently, sports of the spur type but with less branching and shorter growth have been developed and are attracting a good deal of interest.

PRISCILLA A new variety, attractive red, good quality, McIntosh season, resistant to scab.

KING (OF TOMPKINS COUNTY) AND RED SPORTS Oct. 10 (K) This old American variety is valued in Nova Scotia for processing. The trees are vigorous and have long branches. The fruit is very large and of distinctive flavor. The trees are not hardy in the cooler fruit-growing districts of the Maritimes. Cross-unfruitful.

WAYNE Oct. 6 (K) (Northwest Greening x Red Spy) An attractive orange red blushed apple of Spy type, good quality both fresh and for processing. Very large core. Tree very vigorous, matures late, subject to collar rot.

GREENING R.I. (Rhode Island) Oct. 10 (K) The fruit of this very old, yellowish green variety is valued for solid-pack processing. It is excellent for cooking. The tree is a vigorous grower and is productive, but it is not particularly hardy and can be grown only in the more favored regions. Cross-unfruitful.

MACFREE Oct. 7 (Multiple parentage, originated at Ottawa and Smithfield). A new McIntosh selection, scab resistant and of good quality.

***CORTLAND** Oct. 8, Oct. 10 (Ben Davis x McIntosh) The fruit ripens at the same time as McIntosh, or later, and has a longer harvesting period. Apples cling better but do not keep longer. The fruit is larger and flatter than McIntosh and fully as attractive. The flesh is firmer but is sometimes considered not so high in quality. Flesh is nonbrowning and therefore

especially useful in salads. The tree is an annual bearer and a heavy feeder. It is commercially grown in Eastern Canada.

MACOUN Oct. 8, Oct. 10 (McIntosh x Jersey Black) The fruit of Macoun ripens at the same time as McIntosh or a bit later. It is very dark red and has superior quality. Fruit often requires thinning; by careful thinning annual production is attained.

***SPARTAN** Oct. 11, Oct. 12 (McIntosh x Yellow Newtown) This apple is highly colored and attractive, and has excellent quality. When taken from the same storage as McIntosh, it is invariably crisper and of finer quality. It is slightly later than McIntosh. The fruit set is often very heavy, and if not thinned the fruits are small or even very small. Biennial bearing may result from overbearing. The market acceptance of this variety has been excellent.

EMPIRE Oct. 10 (K) (A McIntosh x Red Delicious selection from New York) High quality, dark red, medium size. Is gaining acceptance in U.S. but does not appear superior to Spartan in limited experience at Kentville. Excellent tree, well spurred, moderate vigor.

JONATHAN Oct. 14, Oct. 10 An old variety that has very high quality, adequate size, and good color only when grown in the warmest parts of Eastern Canada. Red bud sports are available.

PRIAM Another scab-resistant sort from the international breeding program, selected in France; good but rather acid, stores fairly well.

RED DELICIOUS Oct. 17, Oct. 10 on (Seedling) One of the standard apple varieties of the world. It has a conic shape and five distinctive points at the calyx end. About 25 good 'super-red' and spur-type sports are available. The variety is not suited to the colder parts and in the rest of the area must be given extra fertilizer and detailed pruning. The very dark strains are apparently too dark for this area.

JONAGOLD Oct. 10 (K) (Golden Delicious x Jonathan) A new variety, large, smooth, greenish with blush, moderately attractive, very good, annually productive. Cross-unfruitful. Promising.

WAGENER Oct. 12 on. An old variety grown in Nova Scotia. Attractive and of good quality when well grown, high in vitamin C. Trees spur type and semidwarf, somewhat tender, biennial.

LINDEL Oct. 14 on (Delicious x Linda) A new selection from Smithfield (T-397). It is productive and the large fruit is of good quality, stores well, will process.

IDARED Oct. 20, Oct. 15 on (Wagener x Jonathan) Good size and attractive red, needs storage to develop full quality. Semispur tree, productive. Gaining favor as a spring apple.

GOLDEN DELICIOUS Oct. 24 on (Seedling from West Virginia) Great care is required in growing, harvesting, and storing this superb-quality, high-yielding, attractive apple. It needs very heavy thinning, a special spray schedule, careful handling to avoid bruising, and excellent storage to prevent withering. It requires a long season. The trees are not hardy in the colder parts of the Maritimes. Spur-type sports are available but not recommended. There are selections that are claimed to be more resistant to russeting, and also seedling selections that are much like but are not true Golden Delicious.

HONEYGOLD Oct. 18 (K) (A Golden Delicious x Haralson selection from Minn.) Shows some promise at Kentville as a hardy, smooth-skinned, large-fruited replacement for the Golden Delicious market both fresh and processed. Shorter storage life.

MUTSU Oct. 16, Oct. 18 on (Golden Delicious x Indo) Renamed Crispin in England, where it is gaining favor. It is a large green apple that processes well. Tree is very vigorous, semispur type, and very productive.

MELROSE Oct. 20 on (Jonathan x Delicious) A high-quality late storage apple that markets well although it does not grade well because of its moderate and somewhat dull color.

NORTHERN SPY AND RED SPORTS Oct. 24, Oct. 20 on (Originated in New York State) In Ontario this variety ranks second only to McIntosh in popularity. It grows especially well in certain apple-growing regions in Ontario and is also recommended for Nova Scotia. It is a late winter apple, harvested just before the heavy frosts occur. The tree has many faults, being notoriously slow in coming into bearing, being tender in the colder regions, and having weak crotches. Mature trees yield heavily. The fruit is large and attractive when well finished and is excellent for processing, dessert, and culinary use. The fruit bruises easily and must be picked and handled with care. In light crop years, and when trees are young, the apples are subject to bitter pit.

Many red sports of Spy are now being propagated. All of them are more highly colored than Northern Spy but many do not have the colored striped appearance of the original, nor is their quality always as good.

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FURTHER INFORMATION

Available from Information Division, Agriculture Canada, Ottawa, K1A 0C7:

Fruit tree propagation, Publ. 1489. 59 pages. 1968.

Pruning apple trees in Eastern Canada, Publ. 1429. 4 pages. 1971.

Pruning and training fruit trees, Publ. 1513. 32 pages. 1973.

Available from offices of the local agricultural representative, or from your agronomic or tree fruit extension specialist:

Spray calendars for the province, and
Provincial publications on special topics.

CONVERSION FACTORS FOR METRIC SYSTEM

Imperial units	Approximate conversion factor	Results in:	
LINEAR			
inch	x 25	millimetre	(mm)
foot	x 30	centimetre	(cm)
yard	x 0.9	metre	(m)
mile	x 1.6	kilometre	(km)
AREA			
square inch	x 6.5	square centimetre	(cm^2)
square foot	x 0.09	square metre	(m^2)
acre	x 0.40	hectare	(ha)
VOLUME			
cubic inch	x 16	cubic centimetre	(cm^3)
cubic foot	x 28	cubic decimetre	(dm^3)
cubic yard	x 0.8	cubic metre	(m^3)
fluid ounce	x 28	millilitre	(mL)
pint	x 0.57	litre	(L)
quart	x 1.1	litre	(L)
gallon	x 4.5	litre	(L)
WEIGHT			
ounce	x 28	gram	(g)
pound	x 0.45	kilogram	(kg)
short ton (2000 lb)	x 0.9	tonne	(t)
TEMPERATURE			
degrees Fahrenheit	(°F-32) x 0.56 or (°F-32) x 5/9	degrees Celsius	(°C)
PRESSURE			
pounds per square inch	x 6.9	kilopascal	(kPa)
POWER			
horsepower	x 746	watt	(W)
	x 0.75	kilowatt	(kW)
SPEED			
feet per second	x 0.30	metres per second	(m/s)
miles per hour	x 1.6	kilometres per hour	(km/h)
AGRICULTURE			
gallons per acre	x 11.23	litres per hectare	(L/ha)
quarts per acre	x 2.8	litres per hectare	(L/ha)
pints per acre	x 1.4	litres per hectare	(L/ha)
fluid ounces per acre	x 70	millilitres per hectare	(mL/ha)
tons per acre	x 2.24	tonnes per hectare	(t/ha)
pounds per acre	x 1.12	kilograms per hectare	(kg/ha)
ounces per acre	x 70	grams per hectare	(g/ha)
plants per acre	x 2.47	plants per hectare	(plants/ha)