PLANTING AND CARE OF THE YOUNG APPLE ORCHARD

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INDEX

INTRODUCTION

Considering the cost of trees, support systems, labour and materials an orchard is an investment of considerable sum. New, high density plantings can represent grower investments in excess of $25,000 per hectare. Orchard establishment is a long-term investment with newer orchards having a life expectancy of 20 years. It is very important to have a well designed plan for site preparation, planting and tree care in order to maximize yields and returns over the productive life of the orchard.

Mistakes made in the planning and planting of an orchard can be very costly and are very difficult to correct in later years. To be successful, careful attention must be paid to aspects such as site selection, soil quality, soil preparation, nursery tree quality as well as cultivar/rootstock selection and early tree care.

SITE AND SOIL

A new orchard site should be thoroughly investigated with regards to micro-climatic and soil potential. Orchard sites should preferably be on gently slopping hillside with good air drainage to provide greater protection against frost and freezing injury. Avoid planting on flat land in the floor of valleys, these sites are very prone to spring and fall frosts, which can damage fruit buds and mature fruit. Wind can have an adverse effect on tree growth, bee activity for pollination and yields. If the site is exposed to strong winds, wind-breaks should be planted. Bear in mind not to plant them in locations where they will create frost pockets or increase snow load in the orchard.

The soil should be investigated as to its potential for orchard production. The best way to find out is to conduct a proper investigation of the soil and site at least two full years before planting. This will most often require someone who has experience in soil-related aspects of orchard establishment. A thorough soil investigation normally requires the examination of a least four soil profile exposures per hectare, dug on a 50m x 50m grid. Test pits need to be a least one meter in depth and are easily dug and refilled with a backhoe. If the soil is highly variable and more than four exposures are required, the additional pits can be dug in locally depressed or crested topographical positions. The nature of the terrain (slope and

aspect) and the limitations within each soil profile should be recorded and the individual soil units classified and representatively sampled on a layer basis for fertility adjustments.
Although there can be an endless number of soil types in most growing areas in Nova Scotia (sometimes even within a single orchard), there are a limited number of soil properties that can adversely affect the performance of a newly established orchard. One or more of the following limitations are often present: 1) insufficient topsoil depth, 2) impenetrable subsoils (fragipans, compacted clays, weathering bedrock, etc), 3) perched water moving down slope above a restricting subsoil layer, 4) rising water tables in low lying soils, 5) pronounced stratification in alluvial soils, 6) limited soil-water retention, 7) low cation exchange capacity, 8) soil acidity (especially acid subsoils), 9) macro- and micro-nutrient imbalances, 10) soil salinity and 11) toxic elements such as arsenic and copper.

In the vast majority of cases, some form of soil preparation will be necessary before planting. The required soil preparation and in particular, the choice of implement, is determined by the occurrence and severity of the limiting soil physical factors in relation to the required rooting depth. One or more of the soil physical problems listed above as well as replant disease are often the most serious limiting factors. The important thing to remember is that these limitations can only be effectively corrected prior to establishment. Once the orchard is established, elimination of soil constraints becomes impractical - young trees can be severely damaged. Getting to know your soil and its constraints and correcting them first therefore, is the key to successful orchard establishment.

Rooting depth for optimum performance:
Regardless of the rootstock being used, tree fruit root systems have a basic gravi-tropic growth habit, i.e. they exhibit a strong tendency to grow downwards. The depth to which tree roots can penetrate vertically before being deflected laterally is primarily a function of subsoil properties and their effect on root activity. Deeper rooting can result when subsoil constraints are eliminated by deep loosening. Secondary influences are the vigour of the rootstock/scion combination and orchard management practices such as the presence of cover crops and mulch, herbicide use, irrigation frequency and volume, etc. Semi-dwarf rootstocks like M26, CG30 and M7 can have deeper, healthier root systems if subsoil conditions are conducive to high root activity. Keep the following in mind when establishing an orchard: 1) the effective rooting depth of the soil in its present condition in relation to the desired depth of rooting, 2) the requirement for anchorage in relation to the presence or absence of permanent tree support, 3) soil moisture availability in relation to climate and water (rainfall and irrigation) requirements of the tree, 4) protection against adverse fluctuations in soil temperature and moisture, 5) protection against mechanical or herbicide damage to shallow roots.

From the above, it is obvious that a deeper root system is a safer investment. As a general rule of thumb, a minimum rooting depth of 60 cm should be considered as a basic essential soil requirement. This means that the tree root system must be able to penetrate to this depth with ease and that any actions taken to improve the soil environment to achieve this should be of a permanent nature.

Excess soil water:
Excess moisture in the root zone impacts negatively on root activity by restricting gas exchange in and out of the soil, keeping spring soil temperatures low, contributing to frost heaving, forcing new roots to grow just below or even on the soil surface, making the root system more susceptible to attack by soil pathogens and contributing to the old problem of leaning.

Apple replant disease:
Apple trees planted on land that had previously been planted with apple may suffer from apple replant disease. Growers will have to take this into consideration when selecting the orchard site. Apple replant disease and means to control this problem are discussed in the next section of this publication.

FIELD PREPARATION

Preparation of orchard soil should start at least two years prior to planting.

Removal of excess soil water:

The choice, design and capacity of a drainage system should be related the soil type, terrain, slope and most importantly, the degree of waterlogging in a wet year. How many sub-surface drainage systems are there in orchards in your area that do not remove excess water in the root zone rapidly and effectively enough? A very effective way of estimating the depth and duration of water-logging is to install a number of simple well points on the land 2 or 3 years before planting. Rigid, perforated drainage pipe works well. Measure the rise in the water table during the growing season in relation to the amount of precipitation that has fallen in the preceding months. Then use historical rainfall data to find out if the measured water table levels are below or above average. Subsurface drainage systems are often deployed ineffectively on sloping and undulating land when the design incorporates a fixed-interval drain spacing, ignoring the fact that some areas are wetter than others. Consider the following options carefully:

1) Cut-off (stone) drains for preventing surface water, or water perched on an impermeable subsoil layer, from moving laterally down-slope into a lower lying orchard. A critical aspect of installation of these drains is that the trench be dug and the drainage pipe laid at least 20 cm into the impermeable subsoil material, so as to prevent slippage under the drain. Cover the drainage pipe with fine stone and then back-fill with larger ones.

2) Deep (1 to 1.5 m) subsurface systems for deep soils on level terrain with a rising water table. These systems should be properly designed and should be installed one or more years in advance. Make sure that the depth of installation is below the planned depth of sub-soiling or deep ploughing.

3) Shallower subsurface systems for the removal of perched water tables between depths of 0.3 and 1m, often on sloping soils. These drains are normally spaced closer together and should be installed after any required subsoiling, but taking care not to compact the freshly loosened soil along the tree row. For effective removal of excess water, these drains have to be installed at closer spacings than the deeper systems mentioned above. A point is reached where these drains are too shallow and closely spaced to be economical and some form of surface modification should be considered.

4) Ridging/surface modification (ridging, beaming or landscaping) in very shallow, fine textured or slow draining soils. In cases where the topsoil depth is limiting and the subsoil cannot be utilized (i.e. heavy, clay horizons with no structure and permeability, bedrock, other hard-pans, etc), soil depth and drainage can be improved with a form of surface modification. Excess surface water is directed away from the base of the tree line, into the lane-way and out of the orchard, which should always be planted with a row direction conducive to the removal of excess surface water. Surface modification may require some small adjustments to orchard management practices, but the investment in drainage and additional topsoil depth on these shallow soils can lead to a remarkable improvement in tree performance and orchard uniformity.

In soils which are prone to periodic waterlogging, it is critical that the required drainage be correctly installed prior to establishment. Knowledge of the drainage characteristics of your site and soil allow you to make the correct choice of drainage system, ensuring that the additional rooting depth created by deep soil manipulation remains free of excess water - the golden rule of soil drainage.

Physical modification of the soil:

Some form of deep soil manipulation is often required and is used to **1)** break up restricting subsoil layers, **2)** loosen and mix top and subsoils and **3)** mix in any required lime and fertilizers to the desired depth. To ensure effectiveness and permanence of the action, it is important that this be done at optimum soil moisture content. Soil moisture content just below field water capacity, when the soil is most friable, is often required. However, structured clay subsoils and hardpans often need to be slightly drier to ensure the maximum amount of fragmentation and loosening. Only a visual, physical inspection of the soil profile

will reveal this. Sub-soiling a wet soil is a waste of time and money and can negatively affect the potential of the soil as a growing medium.

The choice of the implement used should always match the desired effect on the soil. The implement must also be capable of reaching the required depth (normally between 60 and 100 cm). Three basic actions or a combination thereof are normally considered:

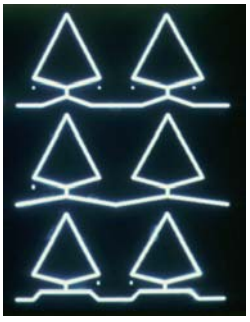
1) Subsoiling or ripping: A ripper shank, normally mounted behind a bulldozer with sufficient horsepower, is used for breaking hardpans and fracturing weathered bedrock materials.

Fig. 1 Subsoiling the summer prior to planting.

2) Deep shift ploughing: For loosening and breaking unstable, structured clay subsoils, but without bringing these materials to the surface, where they would otherwise slake, crust and form barriers against infiltration and aeration. The shifting-plough mouldboard is usually attached to the lower portion of a large ripper shank and operates at depths between 45 and 90 cm.

3) Deep delve ploughing: For deep mixing of applied fertilizers with both the topsoil as well as the subsoil, a larger, higher mouldboard is required. These implements often require at least a D7 Caterpillar to provide sufficient horsepower. Two passes are often required to obtain an adequate soil mix, especially if the lime requirement of the soil is high. Best results are obtained when soil manipulation is done on a full surface basis. A single ripping action along the planting line is at best, second best!

Surface modification-soil:



If soil investigation has revealed that the soil is too shallow and cannot be deepened by sub-soiling, the only alternative is to ridge. As mentioned above, soils are cleared of vegetation first. The required lime and fertilizer are broadcast uniformly over the full surface and the top 25 - 40 cm of soil is thoroughly mixed and loosened to a friable condition. The soil is now ready to be ridged. First mark out the tree rows with stakes at 20 m intervals. A tractor (> 75 hp) is then used to drive down the centre of the lane ways with a pair of disc gangs set to throw soil outwards onto the tree line on either side. Some speed is required and, depending on the desired amount of ridging, 2 - 4 passes. If the soil is in a loose friable condition, the ridging can be done very accurately. With the correct action, very little touching up is required. Make sure the final product has no localized dips and depressions, which will interfere with the removal of surface water. A gradual taper to the midpoint of the drive-way is most often required, but if problems with infiltration are anticipated, the top can be flattened slightly.

Landscape ridge for soils with imperfect drainage.

Planed ridge for poorly drained soils on slopes.

Table top ridge for wet soils on flat land (not applicable for the Atlantic Region).

Fig. 2 Types of soil ridges.

The height difference between the midpoint of the drive-way and tree row is dependent on the chosen row width, depth of topsoil, degree of water-logging and amount of slope, but is rarely more than 25-30 cm (1 ft) in a 5 m (16 ft) row. Row direction must be chosen to facilitate the movement of surface water out of the orchard.

It is important in situations where surface modification is undertaken to make sure that the work is completed in time to establish an effective ground cover in the drive-way in the fall to prevent soil erosion. Ground covers take time to establish. Use your knowledge of the growing conditions in your area to make the right choices. A most noteworthy benefit of surface modification is the remarkable improvement in orchard uniformity that is obtained on non-uniform soils. A rule to remember is that surface modification should never be so drastic as to significantly increase the surface area for evaporation or to allow fluctuations in soil temperature.

Soil nutrient modifications:

Efforts can be made to increase the organic matter content of the soil, since organic matter improves the physical condition and increases moisture and nutrient holding capacities, aeration, and microbial activity. The application of livestock manures, composts and the growing of cover crops will increase the organic matter content.

Soil samples should be collected from orchards for analysis to determine soil acidity and nutrient levels. For more information on the collection of soil samples, contact your local provincial agricultural office. According to the results of the test report, the pH and nutrient level should be adjusted, where necessary, through the application of limestone and fertilizer prior to planting. For general information on soil fertility, see ACC publication No. 1201 “Orchard Fertility”.

Apple replant problems:

If an orchard site is being considered for replanting, it is important that the field be cleared of trees and roots at least one year prior to planting. Soil problems that may have existed in the orchard site, such as drainage and hardpan, should be corrected prior to planting. If a replant test service is available, soil samples should be taken at least two years prior to planting to test for “apple replant disease”. Replant problems have been identified in most tree fruit growing regions of the world. Some apple growing areas have identified soil nematodes as the major contributing factor. Others have identified toxins, such as high levels of lead arsenic and copper, while in Nova Scotia soil-borne fungi appear to be the major cause of replant disease. These organisms have built up over the years in the soil around the root systems and when new trees are planted, the pathogens attack the new roots restricting their growth and development and consequently the performance of the tree. It should be noted that the replant problem has been more serious on light sandy soils than on the heavier-type clay loam soils. Old orchard sites which have not been tested for a potential replant problem should be fumigated the fall prior to planting.

Soil fumigation is expensive and therefore must be done correctly. Soil preparation prior to fumigation is important and the site should be deep ploughed and disc-harrowed thoroughly. This should take place well in advance of fumigation so that debris from the previous crop is well decomposed prior to fumigation. At the time of fumigation the top 25 cm of soil should be loose, friable and in seedbed condition. Do not add fertilizers containing ammonia or ammonium salts or undecomposed manure to the soil at or near the time of fumigation. Use only fertilizers containing nitrates until the soil temperature is above 18°C and the trees are well established. Soil fumigation should take place between mid-August and mid-October. Make sure that the soil temperature and moisture conditions are optimal (near 15°C

and just below field water capacity). This will give an optimum balance between diffusion of the fumigant through the bulk soil volume and contact time with the soil matrix, the two important requirements for effective soil fumigation.

Fig. 3 Apple replant evaluation. Soil in the pot on the left was not fumigated and the soil in the pot on the right was fumigated.

Depth of placement of the fumigant is important. In cases where a single probe is being used to inject the fumigant, a good rule of thumb is to fumigate at half the depth to which the soil has been loosened. This would normally mean a depth between 30 and 45 cm. When a multiple injection system is used, the depth of placement should be below 25 cm. Fumigants are expensive and can only be justified when used under ideal conditions.

It is extremely important to seal the soil immediately after injecting the fumigant to prevent the rapid escape of the fumigant from the soil. This can be done by means of a cultipacker or combination of a drag and a roller. A poor seal means a poor fumigation job. It is preferable not to work the soil until spring following fumigation. In spring the fumigated strip should be worked to permit any lingering fumigant to escape from the soil. Root damage can and has occurred when this was not done. Do not plant when the odour of fumigant remains in the soil. Spring fumigation prior to planting has been done but it is not recommended as it delays the planting of trees and the fumigation may take place under less than ideal conditions.

Getting it all together:

From the above-mentioned discussion, it is apparent that the window of opportunity, during which the soil is at the right temperature and moisture content for optimal physical, chemical and biological manipulation is only open for a relatively short period - especially if the growing season is as short as it is in Nova Scotia. Success will only be achieved with a well thought out plan. Give yourself at least three years to

Getting It All Together
Sequence of events for good site preparation

1.	**Soil investigation; plan for soil prep & orchard layout**	**Summer of year 1**
2.	**Order rootstocks/cultivar**	**Summer of year 1**
3.	**Install deep subsurface drainage, if required**	**Summer/fall of year 1**
4.	**Clear land of any trees; erosion control**	**Fall of year 1**
5.	**Soil samples**	**Spring of year 2**
6.	**Remove sod, soil surface in friable condition**	**Early Summer of year 2**
7.	**Broadcast lime and fertilizers**	**Early Summer of year 2**
8.	**Soil manipulation**	**Summer of year 2**
9.	**Cut-off drainage above orchard, if required**	**Summer of year 2**
10.	**No traffic after soil preparation; mark out rows**	**Summer of year 2**
11.	**Ridging, berming, if required**	**Summer of year 2**
12.	**Fumigation (if required)**	**Summer/fall of year 2**
13.	**Establish cover crop in drive alley**	**Summer/fall of year 2**
14.	**Planting**	**Spring of year 3**

If a considerable number of acres are planned, give yourself 3 to 4 years of planning time. It always pays to invest at the front end and lay a solid foundation!

plan and two years to prepare.

TREES

The first step in determining tree requirements is to measure the field. Then decide on a spacing that will suit the desired management techniques. You may wish to consult with your local tree fruit specialist to determine the appropriate spacing based on rootstock, cultivar, soil type and training system. Tables 1 and 2 provide tree numbers per hectare or acre, based on between-row and in-row spacing. To ease the harvest problem, most orchards are planted in solid rows of one cultivar. Usually these are in even numbered rows of 2, 4 or 6 with provision being made for cross-pollination. A suitable pollinating cultivar is one that has a similar bloom period and is not a triploid. Triploid cultivars such as Gravenstein, Jonagold and Crispin do not provide viable pollen for pollination. Additional cultivars or crab-apples are required when triploid cultivars are planted to properly address cross-pollination.

The success of a new orchard planting can often be determined by the quality of nursery trees planted. Nursery stock should be vigorous, one- or two-year old trees with lateral shoots (feathers). Unfeathered one-year or branched two-year trees will be about a year later in coming into production than one-year old feathered trees. In high density plantings where early production is required growers are advised to plant one-year old feathered trees with a minimum of eight lateral shoots. Trees should be dormant, free from frost or other injury and should never have been subjected to drying conditions. Poor trees are slower to develop and in many cases will never equal a good tree in growth or production. Trees, which have broken dormancy, but are in good condition otherwise, may not suffer much unless warm, dry weather follows their planting. Trees damaged by freezing or by drying out may take several years to recover and, therefore, nursery trees should be examined carefully when received, and rejected if damaged. The added cost of a good quality tree will be recovered several times over during the life of the orchard

Trees should be planted as soon as possible after they are received. If planting has to be delayed, trees can be stored in cold storage or heeled-in in a cool location that is protected from wind, frost and sun. Never store fruit trees in the same location that fruit is being stored as the ethylene gas produce by the fruit will injury the vegetative buds. Prior to placement of fruit trees in into cold storage, the room should be well vented to remove any ethylene gas. If tree roots are on the dry side, soak them in water before planting.

PLANTING

In many of the apple growing regions of the world fruit trees are planted in the fall or early winter. Fall planting provides the advantage of allowing trees to become established before the beginning of the growing season; however, there is a high risk of winter injury to fall planted trees in our region. The shock of moving trees from the nursery in the fall makes them more prone to winter injury. Nursery trees can also be difficult to obtain in the fall, especially in late October when planting should occur. Fall planting should be avoided when the soil has become water logged from fall rains (which is often the case in the Atlantic region) and when the temperature is at or below freezing. In the Atlantic region fruit trees should be planted in the spring as soon as the soil can be worked and is not water logged. It is preferable to plant trees in early spring versus late spring because there is reduced risk of drought stress following planting and a greater potential for vegetative growth the year of planting.

Apple trees can either be planted by hand or with a mechanical tree planter. Prior to planting, the orchard site should be staked to indicate tree location so that proper tree spacing is maintained throughout the planting. This may involve the placing of a stake at each tree site, or around the perimeter of the site, when using a mechanical planter. Prior to planting with a tree planter the site can be subsoiled in the row and across the rows to mark the tree location.

In many soils, the holes may be dug by hand at a reasonable cost. Tractor-mounted augers (25-40 cm) have been widely used in the past by producers to reduce planting cost. However, under certain soil moisture and soil conditions, augers may form a compact sidewall, which hinders drainage and lateral

spread of the new root system. Prior to placing a tree in a hole made by an auger, it is advisable to loosen the soil in the bottom of the hole and break the walls with the point of a shovel. In recent years growers have utilized mechanical tree planters, especially when a large number of trees are planted. These planters can plant upwards of 500 trees per hour and greatly reduce the labour cost of planting.

The secret to good planting is to keep the roots from drying out. This can be achieved by keeping trees in a barrel of water or in a bin of damp sawdust until ready for planting. Fifteen minutes in a hot, drying breeze or bright sunlight can result in root injury, which will reduce growth and may even cause tree loss.

Before a tree is placed in the ground, broken or damaged roots should be trimmed off and long trailing roots should also be trimmed so not to encircle the roots in the hole. Place a small amount of loose topsoil in the bottom of the hole, then place the tree in the hole, making sure it is located at the right depth, and place fertile topsoil over the roots.

The depth of planting depends on the rootstock and the height of the graft union. In the case of size-controlling rootstock, the higher the graft union is left above the ground, the greater it's dwarfing effect. Growers can use this trait to adjust for tree size at the time of planting. Planting depth needs to be taken into consideration when determining tree spacing and density. Rootstocks that have a tendency to form **burr knots**, such as EM 26, should be planted as deep as possible to avoid burr knots. The burr knots can restrict trunk growth thereby reducing the size of the tree. Caution should be taken not to plant the tree so deep that the union becomes covered and scion rooting occurs. Plant all trees at a uniform depth to help insure uniform tree size throughout the orchard. The trees should be planted slightly deeper in the orchard then they were in the nursery, with the union at least 5-10 cm above the soil line. If the union is buried, the scion (cultivar) may send out roots that could produce a standard size tree. When using a tree planter, one person should follow the planter to straighten trees and adjust the union height. When placing the tree in the ground, the largest roots and major branches should point in the direction of the prevailing wind.

Fig. 5 Tree planted with the bud union at the proper height.

Fill in the planting hole with loose topsoil while shaking the tree or working the soil in around the roots by hand. Replace more soil and pack firmly to give good contact with the roots and eliminate air pockets. Tamping the soil with one's foot is often a convenient way to ensure good packing around the roots.

In filling the hole, a slight depression should be left so that water from rains can flow towards the tree roots during the summer. However the depression must be filled with soil or crushed stone before winter to allow excess water to drain away from the tree and thus avoid freezing damage.

CARE OF THE NEWLY PLANTED TREES

Throughout the early life of an orchard, the main objective should be to get maximum seasonal growth with adequate autumn hardening, followed by heavy fruit production as soon as the trees cover two-thirds of the allotted space.

Tree training, fertility, weed control, as well as pest management, will all influence the results one might expect.

TREE TRAINING AND PRUNING

Tree training has become highly specialized and should be planned and executed according to design. The following recommendations are general guidelines. Consult your extension specialist for specific designs such System 155, Spindlebush, French Axe, etc, and refer to ACC publication 1208 "Pruning and Training Apple Trees".
Tree training will determine the tree form, the onset of fruit production and influence yields and fruit quality. To be successful with a modern day orchard, tree training must begin at the time of planting. With most training systems newly planted trees should be pruned as soon as possible after planting. A reduction of the top growth will lessen the loss of moisture through the leaf surface and will compensate for the loss of the root system. Most 1-year-old whip and branched nursery trees should be headed back to approximately 1 m from the ground. This heading cut will stimulate lateral branch development at the desired height and promote the growth of a strong central shoot. Heading cuts would not be utilized for high density plantings where tree number exceeds 2,500 trees per hectare or when well feathered one-year-old nursery trees are obtained. The Central Axe is one training system where heading of the central leader is not usually conducted, provided good nursery trees are planted.

Lateral shoots below 50 cm from the ground should be removed as they will be too close to the ground when the tree is mature. Any laterals that make narrow angles (greater than 45°from the vertical position) with the trunk should also be removed, as they will be structurally weak. A single lateral should not be left on a newly planted tree as its growth will be vigorous and disproportionate to new lateral growth. A good rule to follow is to remove all laterals from newly planted trees when there are fewer than six laterals above the 50 cm mark. In cases were a limb is at a desired position on the trunk but must be removed, leave a short stub or use a Dutch cut so that a new limb will grow from this position on the trunk. Avoid laterals developing opposite each other on the trunk as they weaken the growth of the central leader portion of the tree.

A delay in pruning after planting will place a stress on the tree, which may prevent the tree from getting off to a quick start.

Tree training can be carried out during the summer months as well as when the tree is dormant. Limb spreading can be used to help shape the tree and induce earlier fruit production. Laterals with narrow crotch angles can be improved with clothespins or cocktail toothpicks on new lateral shoots. Wooden spreaders, weights and twine can be utilized on 2-year-old and older limbs to spread and bend them.

Pinching out the tip of new terminal growth will slow the growth of vigorously growing laterals allowing the remaining shoots to catch up. Nicking and notching can also be utilized to promote or slow the growth of lateral shoots.

In the structural development period it is most important to regulate crop load. This is particularly important on dwarf rootstocks, which promote early fruit production. Too much fruit on the central leader can result in the leader bending and this in turn will reduce terminal growth. Lateral limbs that are bending beyond the horizontal will have terminal growth greatly diminished. Cropping a tree too heavily in the early years will be at the expense of terminal growth and often results in a tree that does not fill it's allotted space or reach its maximum production level. Chemical thinners and hand thinning should be utilized to regulate crop load.

FERTILITY

Large quantities of fertilizer are not required in the first season on sites that have been properly prepared. A light application of a mixed fertilizer such as 17-17-17-3B, not exceeding 150 grams per tree, should be applied soon after planting. A light side dressing of ammonium nitrate, not exceeding 110 grams per tree, in mid-June, can follow this up. Fertilizer should be spread out around the tree just beyond the spread of the branches. As the width of the tree increases, so should the spread of the fertilizer, with the band extending 0.25 to 0.5 m beyond the spread of the branches.

Deficiencies of major or minor elements should be watched through careful observation of terminal growth, leaves and bark, and by annual leaf analysis.

During the non-fruiting period of tree development, it is important to promote rapid growth during the early part of the growing season: May, June and July should be the months for growth.
Excessive fertilizer rates or late season applications may cause late growth, which makes the tree more prone to winter injury. The placement of the fertilizer too near the trunk may result in high salts concentration and consequential burning of the roots, which will result in poor growth or death of trees.

Lack of fertilizer may cause poor growth. Poor growth due to other causes, such as poor soil drainage, cannot be corrected by applying more fertilizer. Deficiencies are less apt to occur where the field was properly prepared prior to planting.

Broadcasting a general type of fertilizer with a spreader over the entire area as necessary should ensure continued good growth of the sod in the orchard aisle.

WATER AND MANAGEMENT

It should be remembered that the roots of newly planted trees occupy only a small reservoir of soil, which can be depleted of water in a short period of time during dry weather.

Water (more than four litres per tree) should be applied whenever necessary to prevent obvious moisture deficiency symptoms. A tensiometer, an instrument to measure soil moisture, if properly placed among the roots of newly planted trees, will help determine when extra water is required. One of the best ways to ensure adequate moisture is to eliminate competition from grass and weeds.

WEED CONTROL

Tree growth can be significantly reduced by weed growth, which competes with the tree for soil moisture and nutrients. Controls for weed growth should start prior to or soon after planting. Hand or machine hoeing can be used to keep an area of at least 1.5 metres in diameter free of weeds. Herbicides can also be used to control weeds, for details on herbicides registered for tree fruits and suggested application rates see ACC publication 1211 "Guide to Weed Management in Orchards".

Herbicides can damage the bark of young trees and therefore growers should consult the “Guide to Weed Management in Orchards” as to which herbicides are suitable for new plantings. Roundup (glyphosate) should never be used around newly planted trees as spray drift onto the bark can result in tree mortality. Early and mid-season weed control is important for obtaining maximum tree growth. Late season weed growth on the other hand may remove excess nitrogen from the soil, assist with hardening the young trees off and provide root insulation in years of an open winter. The drawback with late season weed growth is that it provides cover for mice, which can feed on the bark and kill the tree.

MOWING AND MULCHING

The space between the rows should be planted with a low growing cultivar of grass that does not require frequent mowing and is tolerant to orchard traffic. This may be a Creeping Fescue or Bluegrass. A 50:50 mixture of Canada and Kentucky bluegrass will meet the above requirements. The newly planted orchard can be seeded later in the summer of the year of planting or the following spring. Mid-August to mid-September seedings have proven to be more successful than spring planting when warm temperatures and dry weather can have an adverse effect on the establishment of Bluegrass.

Grass should be mown when required to reduce water loss, especially while trees are growing larger and require more water. In some cases growers are able to use rotary mowers that “throw” the chopped grass out under the tree where it can serve as mulch.

Mulching trees with hay or straw can provide various degrees of weed control depending on the rates and timing of application. The mulch can also help to conserve soil moisture, protect the roots from extreme cold in the winter and add to the nutrient status of the soil. Where mice are a problem, it should be kept in mind that the mulch or other refuge will make an excellent cover for them. Therefore, extra precautions should be taken to make sure mice populations remain low. A 2.5 to 5.0 cm depth of mulch is sufficient to provide the desired benefits. Adding more mulch than this will only result in a more rapid decomposing of the mulch and provide a better habitat for mice.

DISEASE AND INSECT SPRAYING

Regular sprays to control scab and insects should be made throughout May, June and July to keep the tree actively growing without setbacks. Leafhoppers, aphids and chewing injury are the principal problems to be expected. Injury by disease or insect can reduce tree growth substantially. Refer to ACFC publication 1218 “Orchard Management Schedule” for information on registered pesticides and rates for apple trees.

PREPARATION FOR WINTER

In preparing apple trees for winter, an orchardist should do everything possible to ensure that the trees will with stand cold winter temperatures and will remain free from mice and other vertebrate injury. The slowing of growth during August, through good fertilizer and sod management practices, should allow the tree to harden off properly in preparation for winter.

REDUCING TRUNK INJURY

Some orchardists have found that the application of a good water-based outdoor white latex paint on the trunks of young trees (especially the south and west sides) helps to reduce trunk injury. Uneven heating of the trunk (i.e. cold sunny day in winter followed by a quick drop in temperature at night) is believed to be the cause of trunk injury. The white latex paint helps prevent such major changes in temperature by reflecting some of the heat from the sun.

Trunk injury is not a problem every year, but where injury has occurred frequently, painting is good insurance. Trunk injury has been more of a problem in New Brunswick than in Nova Scotia.

The depression left at planting time should be filled before winter. This will help prevent the pooling of water and formation of ice around the trunk. The thawing and freezing action could cause pressure injury to the base of the trunk or even death of the tree.

PROTECTION AGAINST MICE

Coarse sand, fine gravel or crushed rock can be applied around the base of young trees to discourage mice from digging to the trunk or roots under the soil line. When placing crushed rock around the base of the tree, care should be taken to keep these sharp rocks away from the trunk as they may cut the bark. This should be done before the ground freezes in the fall.

Another protective measure that should be taken is to apply a tree guard. Use commercial plastic wraps (preferably white coloured) or screening made of wire or plastic to cover about one foot of trunk, making sure the wraps are embedded an inch or so into the gravel. The guards should be removed in the spring to reduce the incident of cankers and replaced in the fall. To discourage mice further, mow all grass in late September to allow foxes, owls, etc. good access to mouse runways. Putting out poison bait in sunny weather during the fall can also reduce the mouse population.

Young orchards should be checked frequently during late fall and winter for evidence of mouse and other animals such as rabbit or deer feeding. When noted, take steps to reduce or eliminate further damage.

ORCHARD CARE BEFORE BEARING

SECOND YEAR:
Care during the second year should be more or less a repetition of the first year with weeds, insects and disease control being continued. Fertilizer should be applied early in the spring to assure early season growth. Mowing, mulching and watering when necessary should allow trees to grow actively.

Dormant pruning and tree training should be carried out according to the planting system being utilized. Pruning should be used where increased tree vigour is desired. Limb bending or spreading should begin, or continue, to induce good crotch angles and to reduce vigour where required. Vegetative shoot pinching or removal should be conducted to control or redirect limb vigour. All fruit should be removed to help ensure maximum tree growth.

THIRD AND SUCCESSIVE YEARS:
Continue as in the previous years with cultural practices as suggested previously. Dormant pruning should be restricted to the heading back of the terminal and removal of narrow angled branches where the training system dictates. If possible corrective pruning should be avoided until the tree gets into fruit production. With certain cultivars and rootstock combinations, it may be necessary to remove blossoms or small fruit to prevent premature fruiting. If such trees are allowed to fruit, vegetative growth will be significantly reduced. In the early years of the orchard it is critical to maximize tree growth in the orchard so that the trees will fill their allotted space.

BRINGING THE ORCHARD INTO PRODUCTION

Cropping should only be allowed once the trees have filled more than half of their allotted space. In the newer planting systems it is desirable to have early cropping; however, growers will have to learn to balance cropping and vegetative growth for these plantings to be economically viable. The ability to balance cropping to vegetative growth with the cultivar Honeycrisp is quite critical because overcropping can shut down vegetative growth in the early life of the orchard. Fruit production will vary with cultivar

and rootstock, and should be avoided until the new structure can support a crop without adversely affecting tree growth. In some situations, it may be necessary to remove fruit from the outer third of the tree canopy to reduce limb and/or leader bending. Limbs bent beyond horizontal by crop load will lose vigour while bending of the central leader can result in its weakening and subsequent loss. It is desirable to obtain early cropping but the grower must learn to balance cropping and vegetative growth to ensure that the tree fills its allotted space. Failure to do so will result in the orchard failing to reach its maximum production, which in turn could make the difference between a profitable and unprofitable orchard.

If an orchard is not bearing fruit by the time it has filled one half to two thirds of its allotted space, which can be the case with vigorous cultivar and rootstock combinations, then steps should be taken to bring it about. Techniques include adjustment of nutrition, scoring, bending and pruning. This is a rather specialized area and professional advice should be obtained if an orchard does not come into good production when it should.

As a guide and goal to production expectations, it is suggested that yields of 1,500 - 2,500 bu/ha (600 - 1,000 bu/ac) can be achieved when trees have covered their allotted space.

Revision of:
Planting and Care of the Young Orchard, AHC-9, 1976, C.G. Embree, Tree Fruit Specialist, N.S. Dept. Agriculture and Marketing, and E.N. Estabrooks, Extension Horticulturist, N.B. Dept. of Agriculture.

Preparing For the New Orchard, 1977, C.G. Embree, Tree Fruit Specialist, and M.J. Porter, Horticulturist, N.S. Dept. Agriculture and Marketing.

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Table 1. Number of trees per hectare based upon between and in row spacing.

	Space between rows of trees (metres)											
Space between trees in the row (metres)	Metre	1.5	2.0	2.5	3.0	3.5	4.0	5.0	6.0	7.0	8.0	9.0
	1.0	6667	5000	4000	3333	2857	2500	2000	1667	1428	1250	1111
	1.5	4444	4000	2667	2222	1905	1667	1333	1111	952	833	740
	2.0	3333	2500	2000	1667	1428	1250	1000	833	714	625	556
	2.5	2666	2000	1481	1333	1143	1000	800	667	571	500	444
	3.0	2222	1667	1333	1111	952	833	667	556	476	417	370
	3.5	1904	1428	1143	952	816	714	571	476	408	357	317
	4.0	1667	1250	1000	833	714	625	500	417	357	313	278
	4.5	1481	1111	888	741	635	556	444	370	317	278	247

	5.0	133	100	800	667	571	500	400	333	286	250	222
	6.0	111	833	667	556	476	417	333	278	238	208	185
	7.0	952	714	571	476	408	357	286	238	204	179	159
	8.0	833	622	500	417	357	313	250	208	179	156	139
	9.0	740	555	444	370	317	278	222	185	159	139	123

Table 2. Number of trees per acre based upon between and in row spacing.

Space between rows of trees (feet)												
Space between trees in the row (feet)	Feet	6	8	10	12	14	16	18	20	22	24	26
	3	2420	1815	1452	1210	1037	907	806	726	660	605	558
	4	1815	1361	1089	907	777	680	605	544	495	453	418
	5	1452	1089	871	726	622	544	484	435	396	363	335
	6	1218	907	727	605	518	453	403	363	330	302	279
	8	907	680	544	453	388	339	302	272	247	226	209
	10	726	544	435	363	311	272	242	218	207	181	167
	12	605	453	362	302	259	226	201	181	165	151	139
	14	518	388	311	259	222	194	172	151	141	129	119
	16	453	339	272	226	194	169	151	136	123	113	104
	18	403	302	224	201	172	151	134	121	110	100	93
	20	363	272	218	181	155	136	121	108	99	90	83
	22	330	247	207	165	141	123	110	99	90	82	76
	24	302	226	181	151	129	113	100	90	82	75	69
	26	279	209	167	139	119	104	93	83	76	69	64