Sustainable Fruit Production for Hobby Farmers

Site and Soil Selection

The fruit crops most likely to be grown in Nova Scotia include strawberries, raspberries, blueberries, apples and pears. Other crops such as grapes, cranberries, peaches, plums and cherries can only be grown in the most favourable locations and even then the odds for success are lower. All fruit crops are perennials and should only be planted on appropriate sites and in the best, or improved, soils. The best planning process for any fruit should include two years prior to the planting year.

The site chosen will have a very significant impact on the long-term success obtained. All fruit crops require almost complete sun exposure, or an absolute minimum of 8 hours of full sun exposure per day. Morning sun exposure is good because it will dry the plants off early in the day and halt fungus infections that may have begun overnight. The site should have a modest slope, if possible, as this will allow cold air to flow off the plot to lower ground. On a cold, still night during the bloom period this may determine whether or not any crop is obtained that year as without good air drainage, frost can kill the blooms. A windbreak or any other solid barrier just downhill from the plot will prevent the beneficial cold air flow. A windbreak to the west or north, that does not shade or block air flow, can break the prevailing wind thus reducing winter damage (e.g. desiccation) and improving the summer micro-climate. It is also worth asking whether the site is close enough to a source of water for summer irrigation as drought can be critical for decent yields.

The soil is as important as the site. If the soil is not adequate for a fruit crop it would be best to do something else and avoid the grief. The best fruit soils are deep sandy loams with good underdrainage. No fruit crops (excepting cranberries) will tolerate wet, poorly drained soils as these will lead to root death, winter kill and disease problems. The shallow-rooted berries like strawberries and raspberries can be planted on permanent raised beds as long as the actual soil is good. As long as the underdrainage is acceptable, a soil depth of 30 cm. should be adequate for shallow-rooted strawberries and raspberries. However, tree fruits and grapes should have at least a meter of good soil that will be penetrated by the roots over time. A hardpan, bedrock or heavy clay layer within a meter of the surface will eventually cause failure. Excessive moisture and drought will both be critical problems. These species are planted for decades of production and must have an excellent site.

Blueberries require an acid soil with a pH of about 4.5. All other fruit crops require a pH of 6.0 – 6.5, or 5.8 – 6.8 if all other aspects are excellent. Soil testing is available from the provincial department of agriculture, for a small fee, and specific directions on sampling the soil and soil sample boxes can be picked up at the regional agricultural offices. It is critical that soil testing be conducted as much as two years before the fruit crop will be planted. Agricultural lime is used to increase the pH of an acid soil. Even

though finely powdered, lime does not dissolve and work its way through the soil immediately. The benefits of the application occur gradually over 2-3 years.

Extra organic matter such as compost, well-rotted manure and cover crops will also be added during the two years prior to planting. This will increase soil fertility for the plants, canes or trees. Other fertility amendments may also be needed according to the soil test.

Land Preparation for Weed Management

Two years are also required for the reduction and elimination of weed populations on the planting site. Fruit crops will be in place for 5 or more years (strawberries) or for decades (brambles, blueberries, tree fruits). Particularly when the objective is to produce under sustainable systems, it is critical that weed populations be minimal at planting time.

From the perspective of weed management, the optimal site for a new fruit planting is one that is already under row crops. Given good weed management, the current weed population will be limited and the 'seed bank' in the soil will also be less due to regular tillage. Advance planning for the fruit crop may include a weed control effort in the row crop(s) that exceeds even the usual effort. In the row crop scenario, where land is not a limitation, the future fruit plot could also be 'summer fallowed' for the year prior to planting. This allows total cultivation, any number of times, with any tool from a hoe to a tractor rototiller. With no current crop, the weeds have nowhere to hide.

Weed management and fertility improvement can be combined by planting a green manure crop the summer or fall before planting. Buckwheat can be planted as a summer crop but it must be tilled in before seeds are produced. Oats or ryegrass would be planted in August-September as a fall cover crop and could follow the buckwheat. All cover crop material must be thoroughly tilled in prior to spring fruit crop planting.

If an area under sod is chosen for the fruit crop, the land preparation needs to be even more planned and precise. Perennial weeds such as quackgrass (and certain soil insects) can be critical problems. The sod should be plowed under at least two years prior. Then extensive tillage, possibly one row crop, green manure crop(s), and careful scouting with hand pulling / hand hoeing will be used to obtain minimal weed populations. This effort, following sod, must be close to perfect or the fruit planting may never reach its true potential.

Most of the above procedures are directed at eliminating perennial weeds. On a small or medium-size plot these can also be killed by solid black plastic left in place for an entire season. But sod elimination, tillage and green manure crops will still be needed to obtain excellent tilth and fertility.

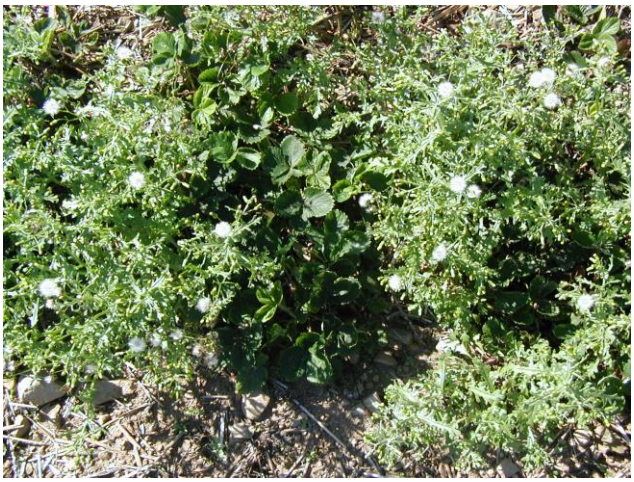
Management of Weed Competition

Just as it was prior to planting, weed management / elimination is critical with these perennial crops. Weeds have much more potential to destroy the planting than do either insects or diseases. Herbicides do not need to be used in a sustainable fruit production system but this means that the cultural techniques must be applied with rigour.

With fruit trees, for the first season bare soil should be maintained throughout the plot using a hoe or a small, hand-held tiller. A full-size rototiller could be used between the rows but not within one meter of the trees. About August a fall cover crop could be planted throughout the plot, to be mowed off or tilled under in the spring. The cover crop suppresses late weeds, helps the trees to harden off, and reduces winter erosion and frost heaving.

In all later years a strip at least one meter wide, under the trees, will be kept free of weeds using mulches, a hoe and hand pulling. The root system of the trees extends roughly out to the "drip line" of the above-ground tree. Weed control in this area is critical to tree growth, production and winter survival. By the second year a regular lawn grass sod will be established throughout the orchard (except in the clean strip centered on the trunks). This sod lawn will be mowed for most of the growing season and will be a key factor in weed management. All of the above needs to be close to perfect for the first 5-10 years, after which the trees are well-established and quite competitive.

Weed control in strawberries is critical in the first year. The daughter plants must be able to contact the soil to root themselves and must have minimal weed competition to grow vigorously. Hand weeding is a given and a hoe (or possibly a small, hand-held tiller) will also be used. A full-size rototiller could be used to keep the walking areas clean; this will be covered with clean straw in later years. The success of your strawberry planting will be largely determined by the end of the first growing season. Late in the year the strawberry bed will be covered with clean, weed-free straw (not hay). This is for winter protection but in the spring the straw will be raked into the area between the beds where it becomes a mulch for weed management and reduced disease pressure (soil splash).



In later years hand weeding and very precise hoeing will be used to keep weeds from taking over the bed. After 5 years or so the battle may be partially lost and this will be part of the reason that a new bed needs to be planted.

Most raspberry plots will be maintained with bare soil through hoeing and cultivation. Larger weeds near the canes may need to be hand pulled. Cultivation near the canes must be no deeper than 5 cm. as the roots are close to the surface. A mulch around the canes of sawdust, wood chips or clean straw has been used in the past but is less recommended now due to disease concerns. Also, in a sustainable production system the mulch would likely tie up too much nitrogen for good fertility. A mowed lawn could be established between the rows, similar to tree fruits, or this area can be rototilled if preferred. Cover crops can also be used in raspberries.

Weed management in highbush blueberries and grapes is very similar to that discussed for raspberries. Grapes are much deeper rooted in good soils so are less sensitive to tillage to a 10 cm. depth quite close to the trunks.

Pest Resistant Varieties

Over the past 100 years the science of plant breeding has made tremendous progress in the selection and breeding of varieties with disease resistance. This is natural, genetic resistance that was present at some level in the original wild species and, in many cases, also present in some of the cultivated varieties. Controlled crosses followed by careful selection under disease pressure allows this genetic resistance to be combined with the best horticultural qualities. This has nothing to do with what you may know as ‘genetic engineering’.

There have been several plant breeders and plant pathologists at the Kentville Research and Development Centre who have released successful disease-resistant varieties. Apple scab is a major disease that can require up to a dozen fungicide applications for commercial control. Researchers selected and released Nova Easygro, Novamac and Novaspy which require no treatment for apple scab. Novamac was intended as a replacement for McIntosh (highly popular, but one of the most susceptible varieties) while Novaspy was a replacement for Northern Spy (the best variety for pies). The above apple varieties, and others from the United States such as Liberty, have made the sustainable production of apples much more feasible and are truly the only logical choice.

Red stele, *Phytophthora fragariae*, is a root disease of strawberry that is so critical that when detected at any level in strawberry nursery plant production, the entire field or partial field is rejected for plant sale. A strawberry breeding program at the Kentville Research and Development Centre has produced strawberry varieties such as Annapolis, Cornwallis, Cabot and Mira that have red stele resistance. Mira also has a high level of resistance to most foliar diseases, Blomidon is moderately resistant to gray mold (*Botrytis*) and Cornwallis is moderately resistant to powdery mildew and

verticillium wilt. Mira is relatively new, released as a “named variety” in 1996. Again, under a sustainable production system, a strawberry variety such as Mira is the only logical choice. (The plant breeder notes that Mira also tolerates poorly drained soils and drought.)

In raspberries, Nova (a Kentville variety) is resistant to late yellow rust while Boyne and Royalty are only moderately resistant. Nova and Royalty are also resistant to fire blight. Nova is an excellent variety in all respects.

The variety choices available for disease resistance in the other fruit crops are not as obvious as are the above. Useful levels of resistance to key insects in fruit crops is so limited that it can safely be ignored, in favour of disease resistance.

Control or Avoidance of Plant Diseases

As mentioned, fruits are planted with the expectation that the plot will be productive for anywhere from 5 years to several decades. Every topic discussed above, that is, site selection, soil amendment, weed control before and after planting, and variety selection have direct links with the avoidance, reduction and control of plant diseases.

Most root and crown diseases in fruit crops are only severe in heavy soils, poorly drained soils and level sites where standing water can occur under certain conditions (e.g. spring thaw). This threat is eliminated or reduced to acceptable levels on sites with a modest slope, lighter soils, excellent drainage and/or planting on raised beds. As root diseases can destroy a planting, there is really no choice on these site and soil criteria.

Verticillium wilt is a disease of strawberries and brambles that can be largely avoided by not choosing a site where susceptible crops were grown in recent years. These include the entire solanaceous family (potatoes, tomatoes, peppers, eggplant, nightshade), melons, strawberries and raspberries. The certification system for strawberry and raspberry plants has a zero tolerance level for *Verticillium* in the nursery fields.

Many of the fruit and foliage diseases are fungi (such as the apothecia cups pictured below left which release the spores that cause mummy berries in both wild and cultivated blueberries) and have varying requirements for humidity and surface moisture in order to successfully complete the infection process. In most cases there is also a time requirement that is important. A number of site and management procedures are directly relevant in that they promote air movement and natural drying. This can be very useful under typical summer conditions where there may be overnight dampness and rainfalls that only last a few hours. Good drying conditions may be available shortly after sunrise or soon after the rain ends.

If the site has a slope this will increase air movement under non-windy conditions. The requirement that the site have full sun exposure is also clearly relevant. Good weed management in strawberries and brambles improves air movement and drying conditions around the crop plants. The recommended pruning systems for tree fruits, cane thinning for brambles and trellis systems for brambles and grapes are designed primarily for production but are also recognized as improving drying conditions. Any irrigation should be applied early in the morning on fine days.

The selection of resistant varieties is a critical step in disease management for home garden or sustainable production systems. A disease that is as difficult as apple scab simply must be avoided. There is no other logical choice. We need to recognize that the best disease resistant varieties may not be available at the local nursery. The nursery will sell what people ask for and, unfortunately, people will ask for varieties that they know. The McIntosh apple is a fine variety for commercial production systems but it is a terrible variety for someone who plans to control apple scab with sulfur sprays. Planning ahead and ordering ahead may be necessary to obtain the best disease resistant varieties. This must be done.

Other procedures in fruit production systems are designed to reduce disease inoculum (e.g. spores) and to remove diseased material from the plot. It is recommended that strawberries be 'renovated' immediately after fruiting. Depending on the shape of the bed, a mower or cutter bar is used to remove most of the old leaves. These are then raked off the beds and either removed, to be composted, or tilled into the walking strip between the beds. This is a great way to keep several leaf diseases at acceptable levels.

In brambles, each individual cane only lives for two years. The primocane sprouts from the crown the first year, produces fruit the second year as a floricane, and then dies by fall. All the dead floricanes and all primocanes cut out for thinning purposes must be removed from the plot and burned or chipped and composted. This reduces cane diseases that can gradually take over a plot. (It is also recommended that nearby wild brambles be removed, if possible.)

Similarly, tree fruit prunings should be removed from the orchard and either burned or chipped and composted, to reduce diseases such as canker. A disease such as black knot (plums and cherries) must be cut out every year and the infected wood destroyed. The cuts are made 10 cm. below the obvious swelling. This will control black knot unless there is extreme pressure from wild trees nearby (in which case they need to be removed).

For control of gray mold (*Botrytis*) in strawberries and brambles and various soft rots in tree fruits it would always be wise to remove infected, over-ripe and fallen fruit. Of course, there may be practical limitations here in the small fruits depending on the size of the plot. A related point is that fruit should always be picked as soon as it is ripe. Fully ripe fruit quickly becomes over-ripe, when it is more susceptible to infection, which then increases disease pressure on the unripe fruit. In strawberries and brambles, particularly when no fungicides are being used and the weather is bad, the crop can be lost.

Control of Insect Pests

It may be necessary to understand the specific biology and seasonal occurrence patterns of each insect and mite pest in order to obtain control or reduce it to acceptable damage levels. The exact details of the pest life cycle and behaviour are often key to choosing procedures to obtain the upper hand.

In sustainable or organic production of apples, the critical insect pests are those that attack the fruit directly such as apple maggot and codling moth. Both of these have larval stages that feed inside the apple and make it unacceptable to humans. In contrast, various species of caterpillars and mites that feed on the leaves can be tolerated at moderate levels as they just have an incremental impact on tree vigour and crop production. Furthermore, it is a proven fact that pests of this type tend to be under adequate biological control in orchards where broad spectrum insecticides are never used and all relevant biocontrols are employed. The orchard itself is a 'permanent' ecosystem (in contrast to annual crops) and permanent populations of native beneficial species will be present.

The adult apple maggot (also known as the 'railroad worm') is a native fly that attacked American hawthorn before apples were brought to North America. This leads to the first useful control procedure: all American hawthorn and wild apple trees must be removed out to the greatest distance feasible. The apple maggot spends the winter as a pupa in the soil and emerges as an adult fly in July and August. The adult is a moderately strong flier so there will always be some pressure from outside the orchard. The female can be attracted to, and captured on, a bright red apple-sized sphere that is covered in a sticky material. The commercially available traps also have scents added that are found in fully-ripe apples but useful traps could be made at home without scents. The 'red sticky balls' can be used either to monitor for apple maggot, as in determining presence and numbers, or as a direct control method. In either case, the traps will be concentrated on the trees all around the outside of the orchard except where it is known that the orchard itself is badly infested. For direct control from 1 to 10 red sticky balls will be required per tree. The apple maggot larvae feed within the flesh of the apple and infested fruits tend to mature and drop to the ground earlier than normal. Within a week or so the mature larvae leave the apples and enter the soil, to pupate. This leads to the second cultural control procedure: all early drop apples (July-September) should be picked up weekly, or twice weekly, and destroyed (fed to animals, crushed, hot composted). In sustainable apple production, all of the above will be needed to deal with this difficult pest.

Typically, the codling moth does not have quite the same potential to literally destroy the crop (for human consumption). But this is another difficult pest, the 'worm' in the traditional 'wormy apple'. In order to mate, the male codling moth locates the female by following a pheromone (chemical) plume released by the female. Commercial scale growers can buy pheromone traps, which only capture males, to monitor population numbers. In theory, one could use enough traps in a small area to trap out the males, but in practice the low success rate is not worth the

cost. However, pheromone dispensers are available (to commercial growers) that are used at recommended numbers to make it impossible for the males to locate the females. This is called male confusion and is quite successful. This sort of control procedure, like most discussed here, is much more effective at lower population numbers. It must be used the first year the trees bear fruit, not after the orchard is truly infested.

The mature codling moth larvae crawl down the main trunk of the tree and pupate either on the trunk or in protected areas such as piles of prunings, boards and stacks of bulk bins. Obviously, all of the latter must be removed well away from the orchard. Returning to the tree trunks, in younger orchards pupation sites can be reduced by stripping off loose bark scales, without cutting the living bark. Then, corrugated cardboard bands can be wrapped around every trunk for the larvae to use as artificial pupation sites. As the larvae will pass the entire winter in the pupal stage, timing is not critical but some time in early fall the bands are all removed and burned. This can be remarkably useful in a clean orchard without other pupation sites. Finally, the native downy woodpecker and hairy woodpecker may work on the trees over the winter, particularly on larger trees where it may be impractical to remove the bark scales. (These species cause no bark or wood damage, unlike the annoying yellow-bellied sapsucker in the summer season).

The codling moth will also attack pears so a similar program is needed. The pear psylla is the only other major insect pest. This sucking insect does not attack the fruit directly but it tends to become very numerous and coat the tree in sticky ‘honeydew’ (excrement), which in turn leads to an outbreak of black sooty mold. The result can be unacceptable fruit under any production system. There will be some level of biological control under organic or sustainable production systems. However, it may not be adequate and dormant oil sprays should be applied to keep this species at lower numbers. With this species, the oil is not directly toxic but it makes the bark unacceptable for egg laying by the over-wintered female. The dormant oil must be applied thoroughly immediately before bud break to get the desired result. Again, ‘wild’ pear trees in the area would be a problem because pear psylla has multiple generations over the season and can fly relatively well for a small insect. They should be removed if feasible.

On strawberries, white grubs will be a serious underground problem on a site that was previously in sod if the two years (or more) of site preparation was not followed. As implied above, proper site preparation is the only logical choice.

The tarnished plant bug is a small (6 mm) native insect that feeds on a huge list of native and cultivated plants. Both the little green nymphs and the brownish adults suck sap from the plants. On strawberries there is a locally toxic effect on the plant cells that leads to the nubby berry or ‘catfacing’. This insect is present literally everywhere and is very common. The elimination of weeds within the plot and mowing surrounding land is useful as it reduces the population in the immediate area. The renovation process will also reduce the in-field population. This insect overwinters as an adult in various sheltered locations. In a well-maintained plot, as just discussed, most individuals would fly into the plot from more sheltered areas. Therefore, a floating row cover, carefully applied, will reduce the colonization of the plot. Unfortunately, the row cover must be

pulled back during bloom to allow pollination. It can be reapplied after bloom and direct damage to the berries should be at acceptable levels.

The strawberry clipper weevil is a problem in older plantings or in new plots adjacent to older plantings. The adults overwinter in trash and wilder areas like fence rows and move into the plot, or further into the plot, each spring. The females destroy one flower bud for each egg that they lay. As all remaining flowers produce undamaged berries, lower numbers can be tolerated. Again, the removal of trash and rough areas around the plot is the only practical control. The typical buildup of strawberry clipper weevil (as well as strawberry root weevil) over time is one of the reasons that strawberry plots are only productive for 5 years or so. A new plot should never be located immediately adjacent to an older planting, if at all possible, to avoid early infestation from these weevils.

On raspberries, the raspberry cane borer (a long-horned beetle) and the raspberry crown borer (a clear-winged moth) attack the canes and the crowns, respectively. In both cases, larvae do the internal feeding damage over a two year life cycle. Sanitation, such as removal of damaged canes or crowns, as well as wild brambles nearby, is the only practical control.

Management of Birds and Mammals

In the overall scheme of things, birds are highly beneficial in insect pest management. During the breeding season, which coincides with much of the growing season, almost all songbirds (even seed eaters) feed their young primarily on insects and other animal life. This is so because the young grow so rapidly that this is the only food source that can supply the necessary nutrients.

Unfortunately, several species such as adult starlings, robins, and cedar waxwings are highly attracted to fruit and crops such as grapes, blueberries and cherries can be seriously damaged. In a home garden or hobby farm plot, most of the crop could be lost in some years. The situation is unpredictable and variable from year to year due to their mobility, flocking behaviour (e.g. starlings) and exact migration time (northern birds passing through) relative to crop maturity. Almost daily checks are needed to see if there is a problem.

The simplest scaring tactics include Mylar ribbons, suspended aluminum pie plates, a scarecrow or a tethered dog. These can be quite effective but should only be installed exactly when needed, and not before. This is because local resident birds will quickly get used to these tactics, feed in the crop anyway, and thus demonstrate to non-local birds / migrants that there is no real hazard. Birds are highly observant and learn from other birds. These simpler scaring tactics are applied about one week before the first fruits will be ripe or when the very first actual fruit feeding is observed.

Birds can also be scared with propane bangers or with more complex recorded sounds (songbird distress calls, hawk calls, weird sounds) that are broadcast over the plot. This

technique can be quite effective but the equipment is somewhat expensive and there can be issues with the neighbours (or yourself).

Netting may be the most satisfactory approach for most home garden and hobby farm situations. A product designed for this use (mesh size, UV resistance, lightness in weight) can be obtained from any large garden supply business. It is usually applied over each individual row or each tree and if installed carefully (sealed at ground level) will eliminate most of the damage. If applied and removed carefully, this netting can be used for several years.

Deer can cause so much feeding damage in a young orchard (especially apples and pears) that the trees will never reach their true potential. In other words, deer can destroy a young orchard. This is true in almost any rural location in Nova Scotia with the possible exception of the immediate backyard. An electric fence is the only control technique against deer that can be expected to work over a number of years. The current designs use light-weight wires and posts. Kits are available for home gardeners. A single wire at 40 cm. height can be effective against deer in certain, limited situations. More permanent, specific fence designs for deer are available here:

https://novascotia.ca/natr/wildlife/nuisance/deer.asp

Raccoons can also be a challenge in strawberries, grapes and cherries especially. Raccoons will do whatever is required to reach their desired food. There are scare tactics, such as a tethered dog or a radio playing, but an electric fence is the true solution. An electric fence for raccoons should have two wires, at 15 and 30 cm. above the ground. The fence only needs to be energized at night. The height to the bottom wire must be uniform all the way around. These are light-weight, temporary fences that will be put up and taken down each year.

Impact on the Environment

The impact on the environment from the procedures outlined in this publication should be neutral to positive. There may be less plant diversity on the hobby farm than under wild vegetation but the diversity compared to commercial agriculture is very high. This publication promotes an integrated pest management approach. The pesticides mentioned are low-impact, non-residuals that would have minimal impact on beneficial insects and on birds and mammals. The home garden or hobby farm as discussed here will provide good feeding habitat for many native songbirds. Some species of songbirds (e.g. robin, eastern kingbird) will nest and successfully raise their young in larger orchard trees under a sustainable production system. Nest boxes could be provided for tree swallows and these would also be successful under this program.

Sources of Additional Information

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