Sustainable Canadian Agricultural Partnership

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Appendix A:

Site Assessment, Selection and Development for Perennial Crops Guide

Perennial Crop Development Program

Prince Edward Island CANADA

Canada

1.3 PERENNIAL CROP DEVELOPMENT APPENDIX A: Site Assessment Selection and Development for Perennial Crops

INTRODUCTION

Thoughtful selection of an orchard/vineyard site is perhaps the most important decision a producer will make to ensure success. Considering the high costs of land preparation, labour, trees, trellis materials, and the long-life expectancy of an orchard, thoughtful site selection is essential.

This guide serves to introduce prospective perennial crop entrepreneurs to the site assessment and development process. The goal of this guide is to ensure that new orchards/vineyards have the best possible chance for success. This guide will be updated as new evidence and industry feedback is received over time.

Please note: The Perennial Crop Development Program application process requires a thorough assessment of prospective perennial crop planting sites, particularly for long-lived perennials (trees and vines). This guide is primarily written with orchards (tree fruit/haskap/highbush blueberry) and vineyards, but many principles are applicable to other perennial crops. In this guide, the term “orchard” will be used to describe a perennial cropping system, regardless of crop.

The site assessment process will help you make an informed decision about whether to plant perennials on a site by identifying the risks to your future orchard and how they can be mitigated through site preparation and modification (i.e., installing drainage tile to improve drainage, planting windbreaks and hedgerows to filter potentially damaging winds, etc.).

Remember that the best site for your future orchard may not be the land you presently own. After conducting an assessment of your identified orchard site, you might find that it is not appropriate for a profitable and productive orchard. Given the investment required, it is important to weigh the merits and challenges of relocating your intended farm site.

Ideally, you will be able to observe the intended orchard site for a full year prior to making investments.

- Watch to see where water pools in the spring
- Observe the effect of wind on the landscape
- Look for patterns in soil productivity with the existing vegetation

CONTACT

If you have questions, you are encouraged to contact the Department’s **Organic and Perennial Crop Development Officer** or **Berry Crop Development Officer/Provincial Apiarist** at:

(902) 368-4880
or
perennialcrop@gov.pe.ca

TOPOGRAHHY

Appropriate site topography is the foundation for a successful orchard. The ideal site is on elevated land, on a gently sloping hillside, allowing for good air drainage, which provides greater protection against frost and freezing injury. Spring frost can damage fruit buds and blossoms and fall frosts can damage fruit tissues, thereby decreasing yield. The ideal land has a 4-8% slope. It may be difficult to operate orchard machinery on land with greater than 8% slope. Avoid flat, low lying areas (such as at the bottom of a hill), where cold air settles and frost pockets might form.

Slope exposure affects the orchard's exposure to sunlight, and how fruit trees and vineyards come out of dormancy. A southern-facing slope warms up faster in spring, while the opposite is true of a northern slope – northern slopes are colder and warm up later in the spring. Accumulated heat units will be different on the two slopes, impacting orchard performance. Growers may want to avoid planting early- blossoming varieties on southern slopes in an effort to avoid too much tender tissue subject to those frosts. However, all other factors considered, south sloping land is preferred over other directions because of greater exposure to sunlight (and greater accumulation of heat units).

On PEI, west-facing slopes tend to be windier.

CLIMATIC FACTORS

Is there protection provided by shelterbelts, woodlands or topography?

Ideal orchard sites are less exposed to consistently strong winds.

Shelterbelts can protect orchard sites from the damaging effect of winds. However, they can also serve to interrupt the flow of cold air/frost, creating frost pockets that increase the orchard's susceptibility to winter damage. Thoughtful thinning of hedgerows can help them maintain wind-filtering capacity, while also allowing cold air to flow through them to lower areas. Note the age and effectiveness of existing hedgerows – they may be getting old and needing replacement. They may also be too thick for effective filtering of winds – this is often the case with coniferous hedgerows that form a solid wall. A thick wall of trees can create turbulent airflow patterns leeward of the trees.

Consistent, excessive wind can make it difficult to achieve good spray coverage for foliar fertilizers and crop protectants and reduce the opportunities for responsible spraying of crop protectants. Strong winds can also interfere with pollinator activity at critical periods.

Gentle winds are helpful, as they help dry perennial crop foliage, reducing likelihood of fungal issues. These winds can also decrease russeting of apples.

SOIL DEPTH AND DRAINAGE

The ability for soil to drain excess moisture is the most important consideration in selecting an orchard site.

Perennial crops thrive in deep, well-drained soils, as they establish deep roots that anchor the plant and feed it for many years. Drainage is essential, as plants will fail to thrive in soils that are wet for much of the season.

Wet/saturated soils can become anaerobic and deprive the roots of oxygen for extended periods, thus leading to the development of root/trunk rots, root diseases, poor vigour, anchorage issues, and a plant that is more susceptible to disease and winter injury.

To evaluate drainage, observe the site through the seasons and observe for accumulation of water at surface (without it draining), spring flooding, and water seeping from soil surface. To get more information, dig holes throughout your intended orchard to examine the soil profile. Poorly drained soils may have horizontal layers of light-coloured soil, indicating oxidation of minerals due to excess moisture.

Soil Drainage Test

The following is a guide to evaluating soil drainage.

- Dig a hole, 1 foot wide and 1 foot deep
- Fill the hole with water, and let it completely drain
- Fill the hole with water again, and note the time
- Measure the amount of time it takes for the water to completely disappear (i.e. 10 minutes, half hour, 2 hours? If it is draining very slowly, determine how much water drains every 30 minutes (e.g., ½" water in 30 minutes?).

Interpreting results of soil drainage test

- **0-4 min:** Fast draining soil – fine for trees, though these soils will have lower water holding capacity, thus increasing the need for irrigation, particularly when establishing new orchards
- **5-10 min:** Good draining soil – ideal for trees
- **16-60 min:** If the soil is draining at least 1"/hr, the area is marginal, though possibly acceptable for fruit tree production. Consider tile drainage to improve drainage.
- **More than 3 hours:** Unacceptable for fruit tree production

Many prospective orchard or vineyard sites on PEI would benefit from a carefully designed and installed tile drainage system.

COMPACTED SUBSOILS/RESTRICTIONS TO ROOTING

Compacted subsoils, often caused by historical plowing practices, can also limit perennial crop performance. Compacted subsoil, or plow pan, will impede root development. The minimum rooting depth of orchard land should be 60cm, though deeper is better. Deeper soils will support better tree anchorage, and support trees in getting access to water during periods of drought.

TEXTURE

Ideal soil types are coarse textured soils, such as the sandy loam soils found over the majority of PEI's farmland. When these soils are wet, they will crumble in your hands, rather than forming a sticky mass.

Sandier soils often (not always) have better drainage, but lack the water holding capacity of a soil with higher levels of clay. This may be an issue during our increasingly common periods of drought in July and early August, particularly during the early years of establishing an orchard.

Soils with higher levels of organic matter are preferred, as they hold more water and promote nutrient cycling. Soils with too high of a clay/silt content can lead to drainage issues.

Soils that are too sandy/gravely often do not retain sufficient moisture in periods of drought. Supplemental irrigation (i.e. drip line) is recommended in these instances.

You can evaluate your soil texture by feeling it. A video that describes how to determine soil texture by feel is found at https://www.youtube.com/watch?v=GWZwbVJCNec (Soil texture by feel – UCDavisIPO).

PH, ORGANIC MATTER AND FERTILITY

Soil fertility is perhaps the easiest site characteristic to modify. It is very important to address soil pH and fertility/mineral imbalances BEFORE planting trees. Most perennial planting layouts will impede easy spreading of lime and fertility, thus requiring special equipment and/or inefficient use of labour. Furthermore, amending soils prior to planting will ensure that soils fertility levels are in the recommended ranges at planting – this is important to ensure the best possible soil conditions to support the establishment of young trees.

It is crucial to test your soils, ideally at least two years prior to the planned planting. Information on how to appropriately sample soils for testing is found at https://www.princeedwardisland.ca/en/information/agriculture-and-fisheries/why-and-how-soil- testing. You will need a soil probe, which is available to borrow from the PEI Analytical Labs (23 Innovation Way). For the analysis package, be sure to select the S3 “Detailed Field Soil Package”.

Apples prefer a slightly acidic soil of pH 6.0-6.5. Optimal soil pH for hybrid grapes is 6.0-6.5, and for Vinifera grapes, it is 6.5-7.0. Other perennial crops have their own respective optimal soil pHs. PEI soils are naturally acidic (below 6.0) and will respond well to liming. pH affects the availability of important nutrients including nitrogen, phosphorous, potassium, magnesium, calcium and sulfur. A pH of 6.5 will increase availability of these nutrients, and will also increase microorganism activity, thus accelerating the decomposition of organic matter.

Organic matter decomposition makes nutrients available to plants, and also improves soil tilth, infiltration of precipitation, supports tree root development, and increases the soil’s water holding capacity.

Highbush blueberries differ in that they prefer a more acidic soil pH of 4.0-5.5, a range in which iron is most available, reducing the risk of iron chlorosis. PEI’s relatively acidic soils are better suited for blueberries but some sulfur or other acidifying amendments may be necessary two years in advance of planting to achieve the ideal soil pH range.
Calcium is crucial for quality apple production. Calcitic or dolomitic lime are required to amend most Island soils. Dolomitic lime is recommended when soils are also deficient in Magnesium.

OTHER MANAGEMENT CONSIDERATIONS

Ease of Management

For your identified orchard site, is it practical to align crop rows in a north-south orientation?
This orientation allows more sunlight to be captured evenly throughout the tree, supporting quality fruit production through the entire canopy.

I*s it practical to align crop rows up and down the slope?*
This would help ensure air drainage, reducing the likelihood of frost damage. Ideally, trees could be simultaneously aligned up and down the slope and along a north-south orientation

Access to water for irrigation or spraying foliar fertilizers and crop protectants. While the climate on PEI typically provides sufficient precipitation for established orchards, recent dry summers on PEI have made it difficult to successfully establish young trees. Increasingly, growers should carefully consider the merits of drip irrigation for establishing trees. This means the site would have to have existing access to irrigation water or the grower will have to budget for the costs of establishing a well.

Previous crops and potential pathogens

Apple orchards that are being planted at the location of a previous apple orchard site need to be carefully assessed for the risk of apple replant disease. Apple replant disease, caused by soil pathogens and nematodes, is not always present, is difficult to predict, and at its worst, can reduce orchard profitability significantly.

The primary means of correcting soils with apple replant disease is to fumigate the soil prior to planting. However, soil fumigation is not permitted on Prince Edward Island. The best solution is to avoid planting a new orchard on land that has previously had apples. The risk of replant disease decreases with time.

Land and Soil Preparation

Preparation of orchard land should start some years before planting.

Conduct a thorough assessment of the proposed orchard site, using the information in this guide and in the recommended reading/resources listed below. Identify challenges that will increase the risk of poor outcomes. Identify strategies to mitigate those risks where possible. If risks cannot be appropriately mitigated, select another orchard site.

Collect soil samples for analysis and identify lime requirements to adjust pH and ensure sufficient supplies of calcium and magnesium. Identify other soil fertility/mineral imbalances and prioritize investments to address those deficiencies.

Where drainage is marginal, invest in tile drainage. Contact a qualified designer and installer of tile drainage. For more information on addressing surface and soil drainage issues, please contact a Soil & Water Engineer with the Department at perennialcrop@gov.pe.ca. During the preparation period, do everything possible to increase soil organic matter and microbial activity.

Organic matter will improve the physical structure of the soil, improve water holding capacity and support effective nutrient cycling. The first step is to bring pH into an appropriate range and address any major mineral nutrient imbalances. Applying composted livestock manures will help build soil organic matter.

Subsoil compaction layers/plow pans will seriously undermine the success of tree establishment. This issue must be addressed prior to planting. A multispecies cover crop mix that includes tap-rooted plants capable of penetrating compaction layers (including oilseed/tillage radish) can help achieve this goal.

Subsoil cultivation (with a subsoil ripper) will also help alleviate compaction issues. Subsoiling requires a high horsepower tractor, beyond what will be required for orchard maintenance and management. This cultivation practice needs to occur when soil is most friable (i.e. not too wet and not too dry) – otherwise the management practice can make the problem worse.

A SEQUENCE OF EVENTS FOR GOOD SITE PREPARATION (Adapted from "Best Management Practices for Nova Scotia Apple Production," edited by B. Craig, Perennia)

Activity	Timeframe
Detailed site assessment process. Identify factors that will undermine orchard productivity and develop a plan to prepare site and soils. Based on soil tests; develop fertility plan.	Spring/Summer year 1
If site assessment supports orchard establishment: Order trees/ rootstocks/ cultivars (at least a year in advance of planting)	Spring/Summer year 1
Install deep subsurface tile drainage, if required.	Summer/Fall year 1
Apply lime and fertilizers to address soil deficiencies. Incorporate lime and fertilizers into soil, plant fall rye cover to hold soil and incorporate/trap fertility.	Fall year 1
Mark out tree rows	Fall year 1
Plant tree rows	Spring Year 2
Plant interrow multispecies cover crop mix and or perennial forages	Spring Year 2

Please note: This sequence of events compresses the orchard development process into the tightest possible timeframe. If more time is available, a grower would be advised to initiate a cover cropping sequence to build soil organic matter as quickly as possible, and to pre-empt potential weed challenges. More time will also allow a grower to measure impact of liming/fertilizing activities and identify whether additional inputs are required to bring mineral levels into adequate ranges to support new tree development. Depending on site conditions and grower resources, other site preparation sequences are possible. The primary point of this table is to highlight some of the work that has to precede planting.

Recommended reading and resources used to create this guide

Bradshaw, T. (n.d.). *Site Selection and Preparation in Vermont Apple Orchards*. https://www.uvm.edu/~orchard/fruit/treefruit/tf_horticulture/AppleHortBasics/SiteSelection.html.

New Brunswick Department of Agriculture, Fisheries and Aquaculture. ‘(n.d.). *Site Selection for Productive Apple Orchards*. https://www2.gnb.ca/content/gnb/en/departments/10/agriculture/content/crops/apples/site_selection.html.

Ontario Ministry of Agriculture, Food & Rural Affairs (2012). *Site Selection for New Plantings*. http://www.omafra.gov.on.ca/neworchard/english/apples/3site.html.

Pernnia, C.B. (2010). *Best Management Practices for Nova Scotia Apple Production*. https://www.perennia.ca/wp-content/uploads/2018/04/best-management-practices.pdf.