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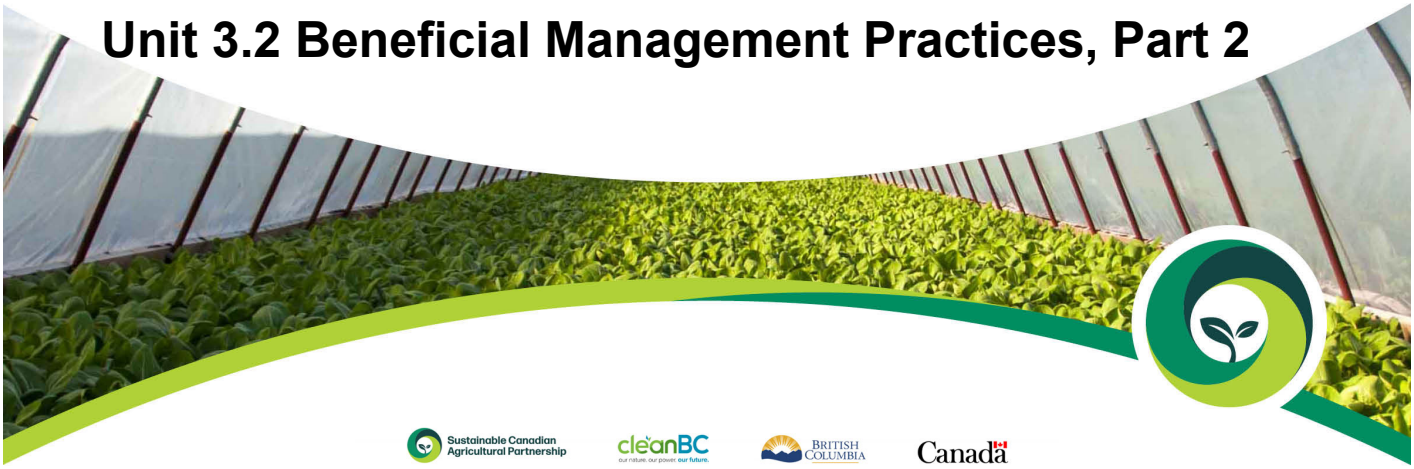
Silvopasture In British Columbia Information Series

Unit 3.2 Beneficial Management Practices, Part 2



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Acknowledgment

This work has been funded by the Governments of Canada and British Columbia under the Sustainable Canadian Agricultural Partnership, a federal-provincial-territorial initiative.

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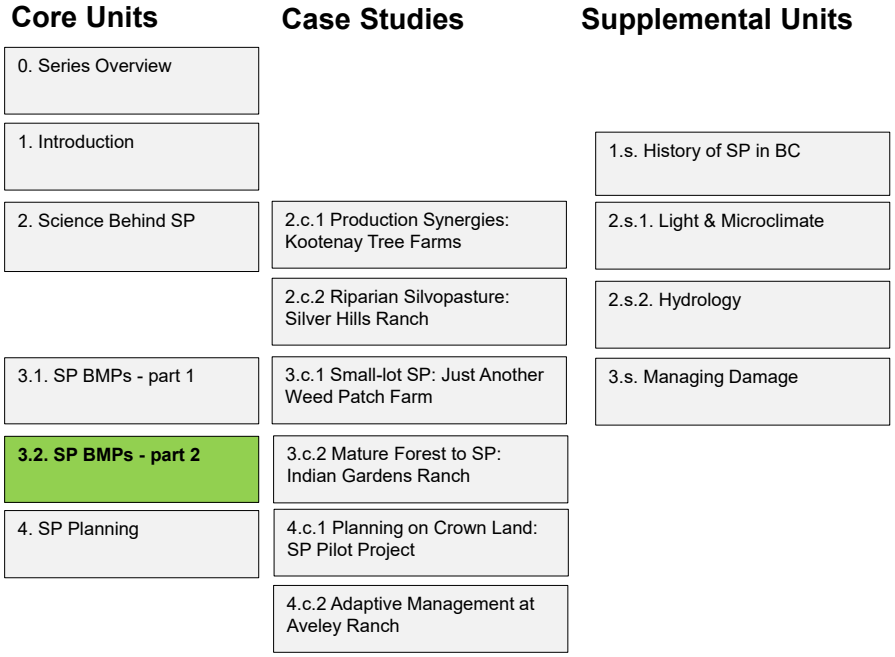
Silvopasture in BC Information Series Content Guide



This is the second part to the third core unit in the information series on silvopasture in BC and is intended to provide basic education on the use of silvopasture as an option to complement pasture and range management in BC.

Unit 3.1 Beneficial Management Practices, Part 2

Goal

Learn beneficial practices that will maximize resource use separation and facilitation, or minimize negative interactions in silvopastures.

Suggested Prerequisites

3.1: Beneficial Management Practices, Part 1.

Introductory pasture and range management concepts.

Content

1. Intermediate Phase Focus: livestock-tree interactions
2. Arboreal Phase Focus: tree-forage interactions

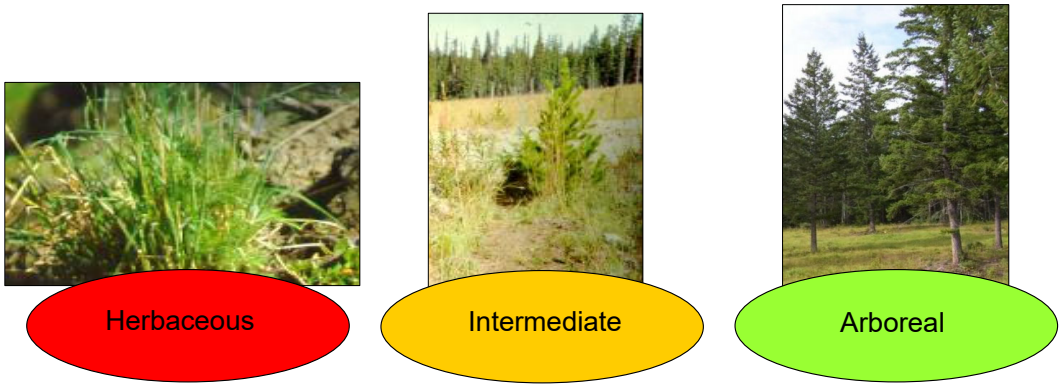
We will use our understanding of the science behind silvopastures gained in unit 2, to select appropriate beneficial management practices (BMPs) that maximize resource sharing and positive interactions while minimizing or mitigating negative effects.

Before undertaking this unit in the series it is strongly recommended that you have completed unit 3.1 on silvopasture BMPs, and you should already have some introductory level understanding of pasture and range management concepts.

This unit is a continuation of Unit 3.1. In this second of two parts on silvopasture BMPs, we will look at BMPs for silvopastures at the mid and later phases of development with an emphasis on critical management procedures that should be followed.

Silvopasture Development Phases

1. **Herbaceous**
2. **Intermediate**
3. **Arboreal**



In the first unit on beneficial practices we learned that silvopastoral management should be tailored to the three distinct development phases:

Herbaceous Phase: All interactions are symmetrical, or proportionate to their size, and all are equally susceptible to direct livestock (positive or negative) impacts;

Intermediate Phase: Tree and shrub canopies have grown to the extent that they no longer compete with the forage layer for light. Competition or facilitation for soil resources are prominent. Livestock interact with, and impact the forage layer, but their impacts on trees and shrubs is limited to physical impacts from rubbing or stepping on surface roots; and,

Arboreal Phase: Mature trees and shrubs are of sufficient size that they control the availability of both above and below-ground resources. They also now exert a strong influence on site microclimate by controlling temperatures, airflow and humidity. Livestock have limited to no impact on the tree and shrub layers, except where there is high concentration of surface or shallow plant roots.

Silvopasture BMPs

Successful silvopastoral management revolves around managing three critical interactions

	Tree-Forage	Tree-Livestock	Forage-Livestock
Herbaceous	Critical	Critical	Important
Intermediate	Normal	Important	Normal
Arboreal	Critical	Normal	Normal

Also, recall that successful management centers on structuring and managing the silvopasture to address critical interactions, with special attention to important interactions, and using the same level of care and attention as would be present under any pasture or range setting for normal interactions.

Intermediate Phase BMPs

2. **Intermediate Phase**: Interactions are limited to soil resources; most livestock impacts on trees and shrubs are diminished.

We will now continue our exploration of silvopasture BMPs by looking at strategies used in the Intermediate Phase.

Silvopasture BMPs - Intermediate Phase

Managing Livestock-Tree Interactions

- Rubbing
- Biting or gnawing
- Soil compaction

Pole sized trees, and sometimes shrubs, are subject to some direct animal impacts, including rubbing, biting or gnawing on the main stem, and compaction of the soil around their roots.

Overall, this type of damage generally only affects a small percentage of trees in a stand, and it is manageable with proper animal distribution and rotational grazing.

Most negative impacts in the intermediate phase only manifest when animals are confined in a silvopasture for prolonged periods of time.

Silvopasture BMPs - Intermediate Phase

Managing Livestock-Tree Interactions

Rubbing Damage

- Some unavoidable - driven by livestock instincts.
- Providing access to a scratching post or oiler can reduce tree or shrub use.

DIY scratching post

For some livestock species, rubbing is an instinctive behaviour and it cannot be eliminated. It is part of their natural cleaning and grooming process. Horned livestock will also use tree stems to clean and buff their horns.

Livestock will also scratch their bodies against the bole of a tree or against a shrub mass to relieve the discomfort from dry skin or insect bites.

Providing access to an oiler or scratching post, and taking other measures to reduce biting insects, can reduce or divert some of the rubbing damage on woody plants.

Silvopasture BMPs - Intermediate Phase

Managing Livestock-Tree Interactions

Biting or Gnawing

- More prevalent with horses and camelids.
- A sign of boredom – rotate livestock between environments.
- May indicate mineral deficiency - provide supplements.

Soil Compaction

- Follow BMPs provided for Herbaceous Phase.

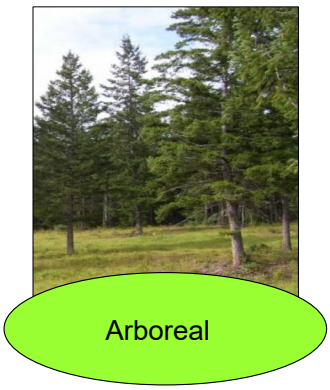
Biting and Gnawing
Similar to rubbing damage, for some livestock species (including horses, llamas and alpacas) gnawing at woody material is an instinctive behaviour, but the resulting damage is usually minimal in the context of the entire silvopasture.

Excessive biting and gnawing can be a sign of animal boredom which may be corrected by rotating livestock between different pasture units. It is also theorized, but not well documented, that it may relate to deficiencies in an animal's diet. This can be avoided by ensuring adequate mineral supplements are available to your herd.

Soil Compaction
For addressing soil compaction risks, use the same BMPs described for the herbaceous phase.

Arboreal Phase BMPs

3. **Arboreal Phase**: Mature trees/shrubs control availability of most resources and understory microclimate; livestock have limited impact on trees.



We will now conclude by exploring BMPs for managing interactions in the Arboreal phase.

Silvopasture BMPs - Arboreal Phase

Managing Tree-Forage Interactions

- Mature trees and shrubs dominate resource availability.
- Understory production decreases when canopy closure greater than 30-40%.
- Manage resource use by controlling woody species:
  1. Density; and/or
  2. Distribution (spatial arrangement)
- Silvopasture design can be implemented:
  1. At planting; or through
  2. Selective harvest or thinning

As trees and shrubs reach maturity, they dominate above- and below-ground resource availability by virtue of their size and superior canopy position.

Because trees and shrubs have the tallest canopy to intercept sunlight, understory forage production starts to decrease exponentially once canopy closure exceeds 30 to 40%.

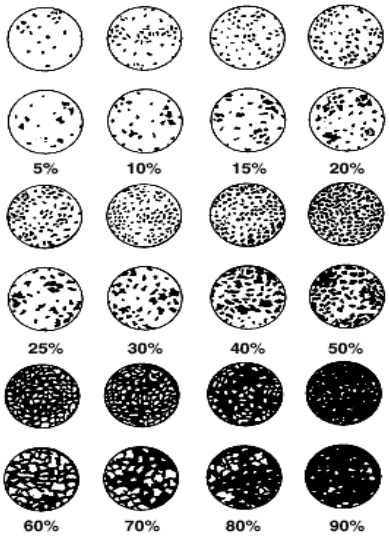
We can manage resource use by the overstory woody species by controlling their density and spatial arrangement. This can be done either:

1. At the time of planting; or,
2. Through selective harvest or thinning.

Silvopasture BMPs - Arboreal Phase

Managing Tree-Forage Interactions

- Canopy closure: not estimated by stem density, but by how much of the sky is blocked.
- Measure with specialized sensors or visual estimates.
- Factor in seasonality for deciduous species.



BC Ministry of Forests, 1997

Canopy closure by the tree or shrub crop is not estimated by stem density, but rather by how much of the sky is blocked by stems and leaves.

Specialized electronic sensors can be used to measure the degree of canopy closure and aid in directed pruning or thinning management to a desired target canopy level.

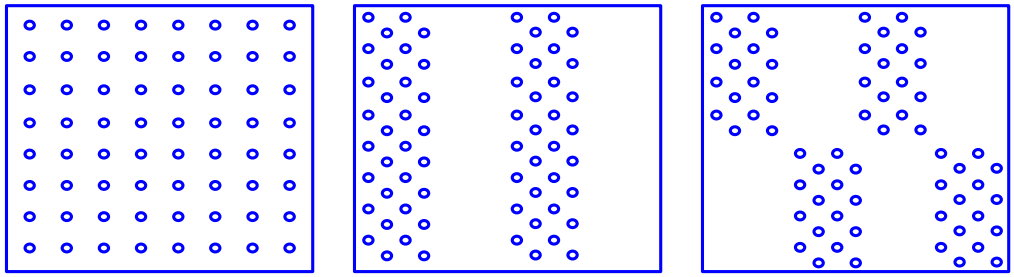
More commonly though, you will use visual estimates by lying on the ground and looking up into the overstory from the centre of your silvopasture. A guide produced by the Ministry of Forests provides an array of canopy closure levels for both random and clustered tree and shrub groupings to aid your estimates.

Seasonality of canopy cover is also a consideration for deciduous species. Full canopy closure is less impactful for trees and shrubs that leaf-out later than the onset of the forage crop growth, or drop leaves earlier than the cessation of production in the understory.

Silvopasture BMPs - Arboreal Phase

Managing Tree-Forage Interactions

- Spatial arrangement (planting or retention patterns) will have strong effects on understory at the arboreal phase.
- Three basic arrangements with many variations possible.



Grid | Multi Rows | Clusters

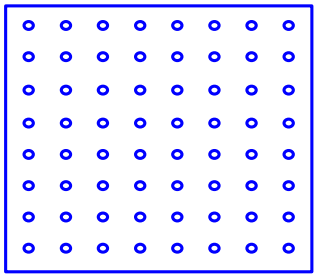
In addition to the density of the tree or shrub crop, how woody plants are arranged can have a profound impact on understory resource availability and sharing.

There are three basic patterns for silvopastures, with many planting variations possible within each configuration: Grids, Multi Rows and Clusters.

Random arrangements of crop trees and shrubs across the silvopasture, is not a design. But it may be encountered in some silvopasture settings where forage and livestock grazing are layered into an existing forested unit, and the tree and shrub productivity is not the primary goal for using silvopastures (e.g. when used solely for animal welfare benefits).

Silvopasture BMPs - Arboreal Phase

Managing Tree-Forage Interactions

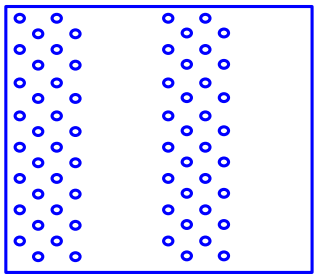


Grid

In Grid Designs the trees and shrubs are equally spaced in both directions.

Silvopasture BMPs - Arboreal Phase

Managing Tree-Forage Interactions

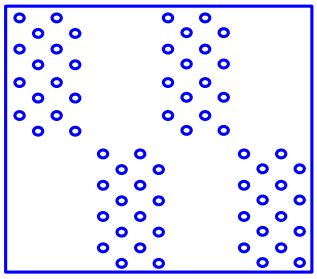


Multi Rows

With Multi Row Designs the trees and shrubs are arranged in rows alternating with forage zones in strips. The trees and shrubs in the rows can be arranged in structured or random patterns, and the width of tree/shrub rows and forage zones can be adjusted.

Silvopasture BMPs - Arboreal Phase

Managing Tree-Forage Interactions



Clusters

With Cluster Designs the trees and shrubs are arranged in groups alternating with forage patches. The trees and shrubs in the clusters can be arranged in structured or random patterns. The length and width of individual tree/shrub clusters, as well as the forage patches, can be adjusted.

Silvopasture BMPs - Arboreal Phase

Managing Tree-Forage Interactions

Spatial Considerations - Livestock Distribution

- Grid patterns maximize the interface between livestock and trees/shrubs.
- Multi-row and cluster patterns may have adverse impacts on livestock access over the full area.
- Multi-row and cluster designs also allow for livestock sheltering from extreme weather.

In addition to tree-forage interactions, the spatial pattern of the silvopasture can also impact livestock access and behaviour.

Grid patterns maximize the interface between livestock and the woody species. This can elevate the potential for impacts on tree roots and soil compaction, but it also evenly distributes both the positive microclimate effects for animal welfare across the entire silvopasture, and the distribution of livestock manure and urine, as a positive contributor to soil health and productivity.

Multi-row and cluster designs allow for livestock sheltering from wind/temperature extremes, but with less risk of livestock physically damaging woody plants. This may be particularly important if you use a silvopasture as part of wintering grounds for livestock.

Multi-row and cluster patterns with dense tree/shrub stocking may adversely impact livestock access to the full area of the silvopasture. Some forage production can therefore become ‘trapped’ ; whereas a grid pattern provides superior access to forage production and maximizes the benefits of grazing as a vegetation management tool for reducing competition.

Silvopasture BMPs - Arboreal Phase

Managing Livestock-Forage Interactions

Secondary Livestock Distribution Effects

- Low-density cluster designs may be a strong attractant for livestock seeking shade or improved forage palatability.
- Can result in increased trailing with greater risk of soil compaction.
- Can result in uneven distribution of manure and urine deposition.

Independent of the animal welfare benefits, overuse from livestock congregating and loafing in the shade and shelter of your overstory crop can occur.

This overuse effectively increases the stocking density and can lead to trampling of the forage crop, compaction of the soil, and an uneven distribution of animal manure and urine deposits.

This is generally only an issue, however, with very low density tree/shrub designs.

Silvopasture BMPs - Arboreal Phase

Managing Tree-Forage Interactions

Spatial Considerations - Tree Growth

- Low-density tree grids may adversely affect tree growth form.
- If you thin a grid silvopasture, pruning may be needed.
- Multi-row and cluster designs benefit from self-pruning.

In grid designs, thinning or planting at a low density will change the growth form of most tree species, relative to those grown with a denser stand of trees and shrubs. This can have negative outcomes if the tree crop is intended for certain solid wood products because open-grown trees will have more branches, taper and flaring at the base of the tree. For other non-timber management intents however, this impact of tree growth form is usually inconsequential.

For trees in silvopastures managed for timber value, if they are thinned, pruning may need to be considered to counter-act excessive branching and stem taper. The act of pruning can also contribute to reducing the amount of canopy cover contributing to achieving your target percentage for sustaining forage production.

With multi-row and cluster designs, the trees will benefit from natural self-pruning and better stem form.

Silvopasture BMPs - Arboreal Phase

Managing Tree-Forage Interactions

Establishment Costs from Mature Stands

- Can be lowered because pasture zones are only prepared on a portion of the silvopasture.
- Rocks, stumps and logging slash can be retained in treed zone.

Establishment costs may also factor into the design you choose. For silvopastures established by removing existing tree and shrub cover, strips designs may be less costly to harvest than either clusters or retaining trees in a grid pattern.

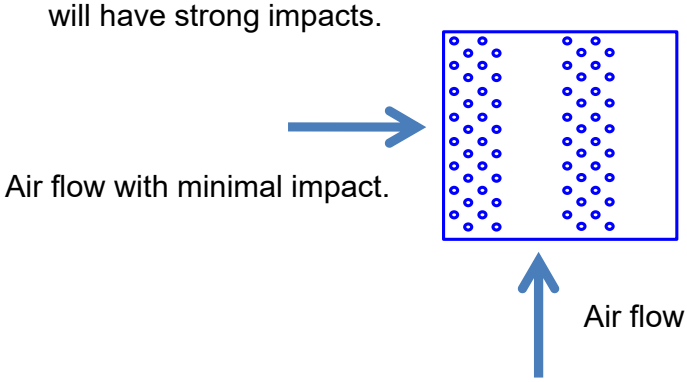
Preparation of the forage zones in the strips or clusters of the silvopasture can also be lower relative to a grid pattern, because rocks, stumps and logging slash can be retained in the strips or moved a short distance into the non-forage areas with limited impacts on tree/shrub production.

Silvopasture BMPs - Arboreal Phase

Managing Tree-Forage Interactions

Capturing Microclimate Benefits

- Temperature and humidity effects are generally independent of canopy cover within grid or cluster arrangements.
- Within multi-rows, the orientation of the openings to the prevalent wind flow will have strong impacts.



Modifications to the understory humidity and temperature can be a positive factor for understory forage growth. Both reflect the combination of solar input, heat radiated by the overstory, and air flow through the site.

Temperature and humidity are generally independent of canopy cover after a threshold density in the woody cover is achieved in grid and cluster designs.

However, if a multi-row design is used, the row orientation relative to the prevalent wind flow will have significant impacts because of its impacts on air mixing. Rows perpendicular to, or angled across the main atmospheric air flows will achieve similar temperature and humidity profiles to grid and cluster designs. Whereas, rows aligned parallel to the air flow over the site may have temperatures and humidity nearly identical to open pasture, and thus negate any positive microclimate modifications.

Silvopasture BMPs - Arboreal Phase

Managing Tree-Forage Interactions

Reducing Competition for Light

- Light availability is strongly affected by location (latitude) and topography (aspect and slope).
- Shade is more evenly distributed in a grid design.
- Solar input is maximized on sites with a south to south-west aspect on gentle slopes.
- Light modeling can factor in all the site conditions and the height and density of the tree/shrub crop.

Trees and shrubs reduce light, but light availability is also strongly affected by your geographic location and topography. For sunlight availability we also need to consider:

1. Latitude: how far north of the equator impacts the angle of the sun;
2. Aspect: direction of how your land is oriented towards the sun; and,
3. Percent slope: slopes that match the angle of the sun capture more sunlight.

In a grid arrangement, the overstory shade is more evenly distributed than in clusters or rows, where groups of trees result in more patchy shade. In order to maximize solar input with clusters or row designs, you need to orient the openings to a south to south-west direction when on gentle slopes.

Steeper sloped sections with a southerly aspect are more forgiving of the row and cluster orientation because of the added solar input. Sites with a north-facing aspect will not get good light penetration into the forage zone under any silvopasture design.

Light modeling can be done which will factor in all the site conditions and the height with the density of the tree/shrub crop relative to daily and seasonal movements of the sun. This is an advanced topic and you should generally seek a qualified professional to complete this work if desired.

Silvopasture BMPs - Arboreal Phase

Managing Tree-Livestock Interactions

Spatial Considerations - Animal Welfare

- Low tree density in very hot / cold conditions can have poor animal distribution
- Grid and cluster designs restrict line-of-sight (may cause livestock stress), and provide cover for predators.

Over-use of Limited Shade Zones

If you employ too low a tree or shrub density in your silvopasture, it can have adverse effects on animal distribution when the silvopasture is used as part of an animal welfare strategy.

If there is inadequate overstory to allow the entire herd to seek shelter under very hot or cold conditions, or if the tree cover is restricted to a small portion of a much larger management unit, both can result in concentrations of animal use with stronger impacts on soils and forages under the limited shaded areas.

Animal Behaviour and Well Being

Line-of-sight may also factor into livestock well being and should be considered when matching an appropriate design to your intended livestock production. Mature grid and cluster designs will restrict the field of view for animals, and can also provide a measure of hiding cover for predators. Sheep, in particular, tend to prefer long lines of sight, and trees and shrubs that block their views may become a stress factor leading to avoidance of use.

Silvopasture BMPs - Arboreal Phase

Managing Livestock-Tree Interactions

Browsing in Orchards

Browsing of foliage and fruit can occur on accessible branches.

- Prune lower branches; or
- Delay turn-out past fruiting.

There are some additional considerations when pasturing livestock in a silvopasture composed of fruit and nut trees.

- Livestock can continue to use both the palatable foliage and fruit for their fodder into the arboreal phase, if it is both a preferred food source and is accessible. If the amount of canopy removed by browsing is minor relative to the total canopy volume, the impact will also be negligible and can be regenerated by the next year's tree growth. Indeed, some producers will use tree leaves and small stems for fodder as part of their overall livestock feeding strategy. And, many tree and shrub leaves are highly nutritious animal feed.
- Where orchard browsing may be detrimental (e.g. removal of fruit buds or fruit in orchards) you can use pruning to shape the canopy and direct tree growth such that fruit-bearing branches become inaccessible.
- Delaying turn-out past the fruiting period into the dormant season is also an option.
- You may also need to consider food safety standards when timing livestock access in an orchard. Refer to the Canadian Good Agricultural Practices (GAP) guidelines for determining the appropriate time between livestock access and potential manure deposition and the safe window for fruit harvest.

Questions and Discussion

Question and discussion break.