Juvenile Spacing

Forest Health

Juvenile Spacing is usually done

- in plantations and natural stands up to 25 years of age,
- to favour certain tree species,
- to reduce stocking to an optimum density,
- to remove tree with defects,
- to increase the growth of the crop trees.

A spacing treatment should consider a stand's site conditions, biodiversity, that it meets landscape level objectives and **forest health**.

- Root disease control should occur at the prescription and stand regeneration stages.
- If this has been done, then spacing can occur if the risk is low.

❖ *If, however, root disease control has not been done and a current silviculture survey shows up to five percent of the host species infected with root disease, then it needs to be determined whether spacing should occur at all, or what the consequences will be on the crop trees if spacing does occur.*

Spacing and Root Disease ---- Epidemiology

If spacing is done in root disease infected stands, the pathogen will quickly and completely colonize the newly available stumps, which become an inoculum source, and root disease will increase on the site.

- Following stump creation, mycelium spreads from existing lesions on roots of stumps onto root systems of susceptible trees.
- Root contacts established before spacing provide a pathway for the fungus to move from stump to trees while the inoculum potential is at its maximum in the stump.

Spacing and Root Disease ---- Soil Moisture

Ecosystem type and microhabitat are factors affecting *Armillaria* disease development.

Two *Armillaria* species that occur most frequently in southern BC are *A. ostoyae* and *A. sinapina*.

Armillaria species are particularly responsive in their pathogenic and saprophytic growth (rhizomorphs) to soil moisture.

- Soil moisture - annual water balance and depth of the growing season water table.

- Continued growth of rhizomorphs through soil depends on the growing tips being covered by a film of water. Below a critical soil moisture level growth ceases.
- *A. sinapina* is weakly pathogenic, so it depends on an extensive rhizomorph network in soil and on root surfaces to be able to colonize spaced stumps. Consequently, spread of *A. sinapina* would be affected by seasonal drying.
- *A. ostoyae*, which is strongly pathogenic and is able to spread through living root systems and would thus be less affected by seasonal drying.

Spacing and Root Disease ---- Anecdotal Evidence

❖ Where juvenile spacing has been done in stands with *Armillaria*, crop tree mortality increases in stands in the interior, but less in stands on the coast of BC.

❖ Because stumps created by juvenile spacing are relatively small, there is the question of whether they are a sufficient food-base for much infection and mortality.

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Spacing and Root Disease ---- Research

Stump colonization and soil moisture

Table 1. Percent of spaced conifers stumps colonized by *Armillaria* spp.
(data adapted from Cruickshank *et al.*, 1997, CJFR, **27**:481-490)

	LOCATION OF STUMPS ON SLOPE					
	LOWER		MIDDLE		UPPER	
	A. ostoyae	*A. sinapina*	*A. ostoyae*	*A. sinapina*	*A. ostoyae*	*A. sinapina*
CWH	**10**	**10**	**15**	**55**	**50**	**7**
CDF	**22**	**22**	**10**	**0**	**0**	**0**
ICH	**82**	**0**	**35**	**42**	**42**	**12**
IDF	**40**	**10**	**0**	**0**	**0**	**0**

The distribution and colonization of spaced stumps, and therefore the subsequent infection severity of the two *Armillaria* species is at least partly determined by the,

- periodic saturation of the soil and roots (anoxia), which limits survival of inoculum, and
- periodic drying of the soil, which limits rhizomorph growth.

Spacing and Root Disease ---- Research

Callus formation

Table 2. Percent callus formation at root lesions on D-fir crop trees
(data adapted from Cruickshank *et al.*, 1997, CJFR, **27**:481-490)

Armillaria spp.		
CWH	**ICH**	**IDF**
70	**22**	**7**

In the ICH and IDF, the limited ability of crop trees to produce callus at infections sites is likely related to their much slower juvenile growth rate.

- The resultant crop tree mortality means the quantity and quality of inoculum on site will remain high, and occurrences of mortality could continue.
- Merchantable volume of crop trees in the ICH and IDF is higher in undisturbed sites than in selectively harvested sites.

In the CWH, there will be a flush of *Armillaria* infection and mortality of crop trees following spacing, because of the increase in inoculum potential at root contacts following colonization of spaced stumps. However, infection and mortality could be minimal because the rapid juvenile growth of trees in the CWH results in 70% of root lesions being callused.

Juvenile spacing done to select the most resistant tree species and the largest crop trees, regardless of the inter-tree distance, should enable stocking targets to be met. This should leave the smallest stumps in contact with the largest resistant trees and minimize mortality.

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