Vitality of fine roots in spruce stands with different degree of foliage damage in Latvia

Dārta Kļaviņa, Andis Lazdiņš, Andis Bārdulis, Tālis Gaitnieks

Latvia State Forest Research Institute “Silava”, Riga street 111, Salaspils, LV-2169, LATVIA (darta.klavina@silava.lv)

Introduction and background

In year 2010 dieback of Norway spruce (*Picea abies* (L.) Karst.) was observed in forest stands in Latvia (Fig. 1). Comprehensive study has been started to obtain knowledge about these damages and their causes. As spruce is shallow rooted tree we consider that dieback could be encouraged by root damage due to changes in meteorological conditions or soil properties.

In winter 2009 rapid temperature decrease from approx. +2ºC in the first decade of December to approx. -10ºC in the second decade was recorded. Also low precipitation rate in this period, as well as during next summer was observed. This could induce root dieback because of soil frost. The relation between distribution of *Physokermes piceae* in damaged stands and spruce dieback was also identified during the study.

Fig. 1. Spruce stand with damage symptoms

Material and methods

In total we collected root samples in 48 spruce stands from different forest areas in Latvia (Fig. 2). Selected stands had different degree of foliage damage as well as various characteristics of growth conditions and soil types.

Most of the sites were 40 to 50 years old spruce plantations or spruce dominated stands with birch or alder admixture. Sites were mainly on drained organic or mineral soils.

Fig. 2. Map of Latvia with study sites

Fine root samples in each stand were taken at two depths (0-10 cm and 10-20 cm) in five replicates using soil core (Ø 3.6 cm). In laboratory number of mycorrhizal roots in different vitality classes (Fig. 3) were estimated; also average values of fine root biomass (Ø <2mm) from these stands were obtained.

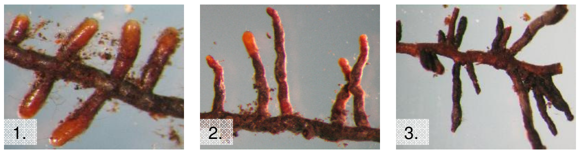

Fig. 3. Root vitality classes (young vital root tips (1.), older root tips with mantle damage (2.), dead root tips(3.))

Results

There were no differences observed between fine root biomass in stands with different degrees of foliage damage. For instance, average fine root biomass in stands with foliage damage less than 50% was 2.66 ± 0.22 t ha^{-1} but in stands with foliage damage more than 50% - 2.51 ± 0.22 t ha^{-1}. On contrary, abundance of living root tips (especially in 2nd vitality class) differed significantly among foliage damage groups (Fig. 4, 5).

Since number of roots depends on soil properties, vitality samples were grouped according to soil types. Significantly lower number of 2nd vitality class roots was observed in stands with higher level of foliage damage on peat (Fig. 6) and podzol soils.

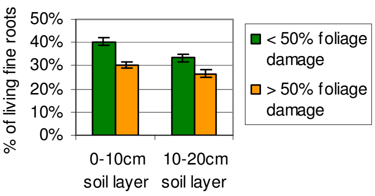

Fig. 4. Percentage of living roots in stands with different foliage damage

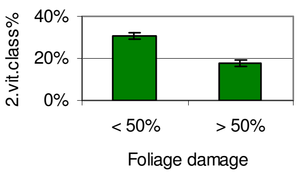

Fig. 5. Percentage of 2nd vitality class roots in stands with different foliage damage

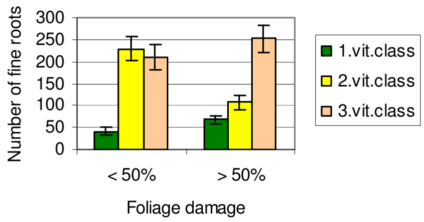

Figure 6. Number of roots in stands on peat soil with different foliage damage, in %

Conclusions

Abundance of 2nd vitality class roots, especially on peat soils, significantly correlated with site moisture indicators and density of peat layer (Table 1).

Table 1. Soil factor correlation with number of the 2nd vitality class roots (* - p<0.05; ** - p<0.01)

	Number of roots in 2nd vitality class	
	Peat sites (n=22)	Podzol sites (n=18)
Peat layer	-0.61**	0.19
Underground water level	0.54**	0.51*
pH	-0.53*	0.50*
Natural soil moisture %	-0.68**	-0.22

- Significantly smaller number of older living roots in sites with greater foliage damage most likely indicate fine-root disturbance during last months.
- Number of older living fine roots is correlating with a site water regime and it can indicate that these soil factors are related to root damage.
- There were observed higher number of young root tips in some stands with severe foliage damage which could indicate regeneration of fine-roots after period of stress.

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