

Ecology of birch species

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Cost E42 - Growing Valuable Broadleaved Tree Species
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European birch species

- *Betula pendula* - silver birch, European white birch
 - *B. pendula* var. *carelica* - curly birch
- *Betula pubescens* - downy birch, pubescent birch
 - *B. pubescens* subsp. *czerepanovii* - mountain birch
- *Betula nana* - dwarf birch
- *Betula fruticosa* (*B. humilis*)

Silver birch and downy birch

Chromosome number

- silver birch diploid, $2n=28$
- downy birch tetraploid, $2n=56$

Incompatibility

- incompatibility mechanism
- hybridization rare

Silver birch and downy birch

Morphology

- leaves
- shoots
- branches
- stem, bark
- seeds
- catkin scales

Anatomy

- cell size
- wood anatomy

Silver birch and downy birch - leaves



Silver birch and downy birch - twigs



Silver birch and downy birch - bark



Silver birch and downy birch - seeds, catkin scales



Silver birch and downy birch

Area of distribution

Both species have a wide area of distribution in the temperate zone.

Downy birch is better adapted to cool and humid climate, and its distribution area is more northern.

Growing sites

Both species can grow on a variety of sites from fertile, mesic sites to poor, dry sites, even rocks

Silver birch doesn't survive on wet soils, poor of oxygen.

Downy birch is well adapted to wet sites and peatlands

Silver birch and downy birch

Growth and yield

- in growth and yield silver birch is better than downy
- biggest difference on fertile mineral soils, which are optimal to silver birch

Stem and wood quality

- stem quality of silver birch is better
- basic density of silver birch is higher
- no big differences in wood anatomy

Efforts in forest management focused on silver birch,

- tree breeding, planting etc.

Difference between silver birch and downy birch in growth and yield (downy birch as % of silver birch)

(Species trials of FFRI, Reuhkala 2004)

	Average, %	Range, %
Dominant height	86	79 - 91
Average height	84	78 - 89
Dominant diameter	84	76 - 97
Average diameter	83	75 - 92
Yield	72	55 - 88



Betula pubescens subsp. *czerepanovii*



- a polycormic bush or a small tree
- thick, glabrous, roundish leaves
- orange autumn colour
- resprouting from coppice
- short growing period
- introgression from *B. nana*
- adaptation to herbivory and severe climate

Betula nana - dwarf birch



- dwarf shrub, 20-80 cm
- small, round, thick and glabrous leaves
- red autumn colour
- on peatlands
- on hills and moorlands in the north

Regeneration by seed



- cross-pollination by wind
- separate male and female catkins
- monoecism
- self-incompatibility
- male catkins develop in previous summer, visible during winter
- female catkins overwinter within buds

Regeneration by seed



- pollen grains are light and small (\varnothing 24-28 μm)
- large amounts of pollen
- 6 million grains / catkin
- pollen grains are carried long distances by wind (-> 2000 km)

Regeneration by seed



- flowering at the time of leafing
- in southern Finland beginning of May (April - June)
- wide variation among years
- timing of flowering regulated by temperature
- silver birch one week earlier than downy birch

Regeneration by seed



- seeds ripen in July - August
- downy birch later than silver
- controlled by temperature
- temperature sum 800 d.d. is needed for seed collection
- seed crop varies annually
- good crops every 2-3 year, more seldom in the north

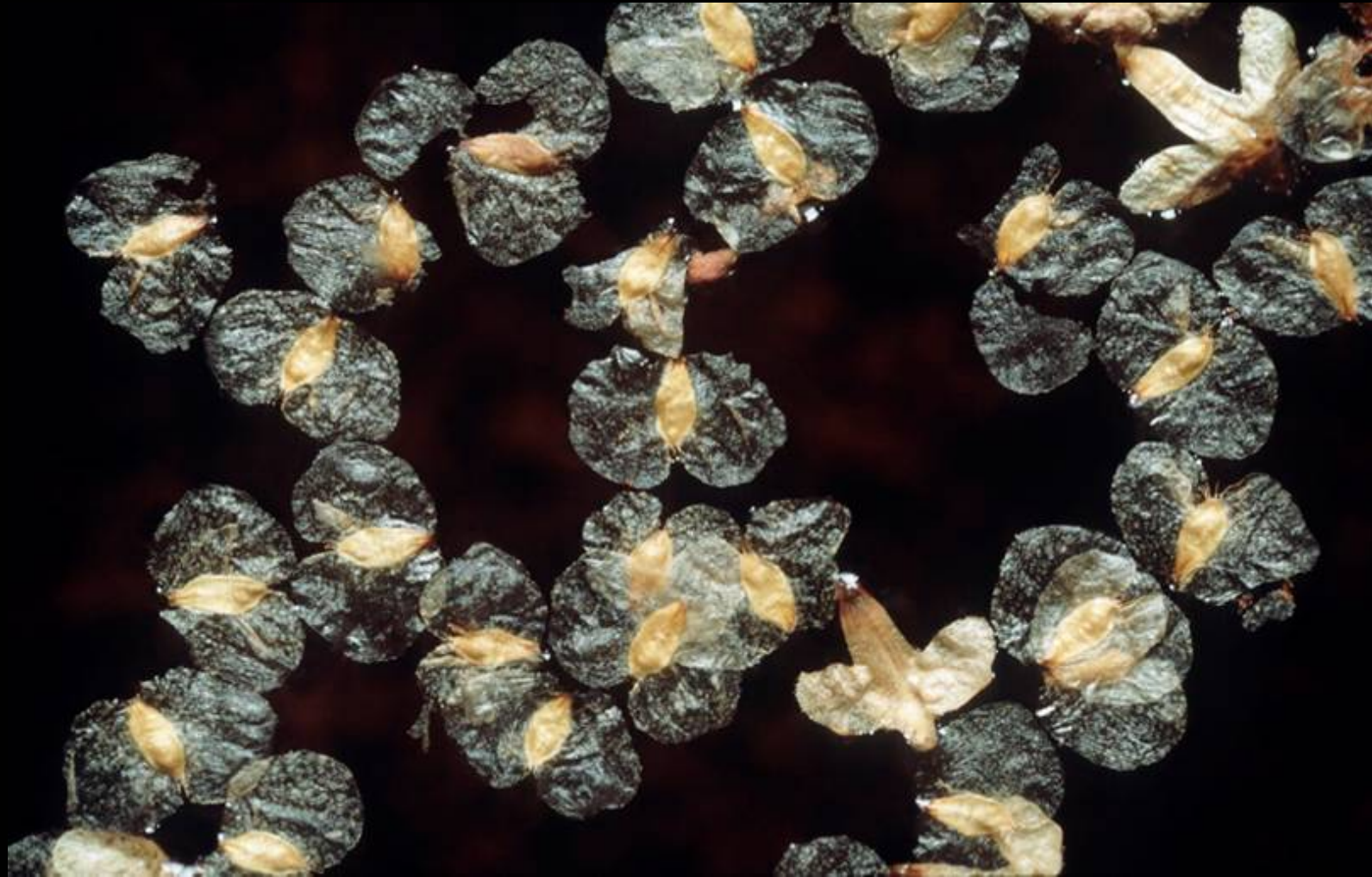
Regeneration by seed

Abundant seed production

- **silver birch:**
 - max. 160 000 seeds/m²
 - average 1 600 - 88 000 seeds/m² (over years and localities)
- **downy birch:**
 - max. 260 000 seeds/m²
 - average 1 300 - 104 000 seeds/m² (over years and localities)

(Koski & Tallqvist 1978)

Regeneration by seed



Regeneration by seed

Germination

- germination of birch seed is regulated by the interaction of photoperiod and temperature
- in cool temperature (+15°C) short day prevents germination
- in warmer conditions (+20°C) photoperiod has no effect
- stratification in +3°C...5°C removes the effect of photoperiod

This mechanism prevents germination in the autumn, favours germination in the spring and improves survival of small plants.

Genetic diversity in birch

- wide and continuous area of distribution
- outcrossing breeding system
- pollination by wind
- long-distance dispersal of pollen
- prolific seed production
- wide dispersal of seeds

=> gene flow

=> wide variation within populations

=> continuous variation among populations

Regeneration by coppice



Shoot growth patterns

Free growth at early age

- Internodes lengthen and new leaves are formed simultaneously during height growth.
- Photoperiod has a central role in regulation in height growth cessation, modified by other factors
- SD triggers height growth cessation and dormancy
- In mature trees partly **predetermined growth**

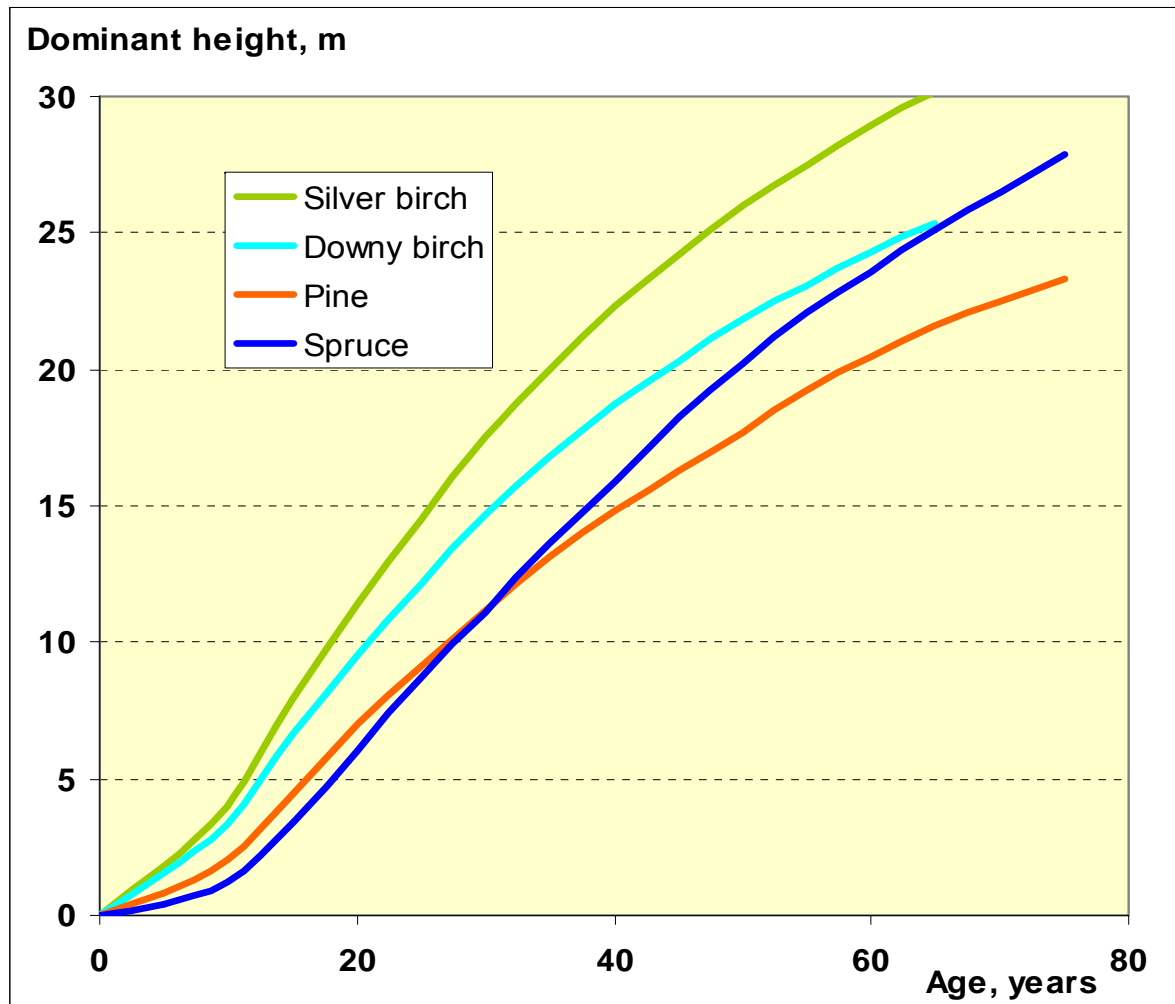
Adaptation to climate



Adaptation to climate



Dominant height development of birches, pine and spruce



Root system



Root system

The root systems of trees consist of two parts:

- long-lived, woody **coarse roots**
- short-lived **fine roots** ($\varnothing < 2$ mm)

Average **depth of coarse roots** (Laitakari 1934)

- birch 13-16 cm
- pine 5-15 cm
- spruce (very near the surface)

Nutrient and water uptake from different soil layers

=> **reduces competition** (birch - spruce mixtures)

Decomposed birch roots => **tunnels** for other species' roots

=> **aeration** of compact soils

Root system

Mycorrhiza

- number of mycorrhizal root tips high (> conifers)
- mycorrhiza forming fungi **specialized in birch:**
 - *Leccinum aurantiacum*
 - *Russula aeruginea*
 - *Lactarius torminosus*
 - other *Leccinum*, *Russula* and *Cortinarius* species
- *Cantharellus cibarius*

Lactarius torminosus



Cantharellus cibarius
(together with *Craterellus cornucopioides*)



Effect on site



Effect on site

Microclimate

- thicker snow cover - lower frost depth - higher soil temperature

Ground vegetation

- herbs and grasses dominate

Forest litter

- higher nutrient content (N, P, K, Ca)
- higher decomposing rate, more water-soluble compounds

Structure and chemistry of soil

- higher activity of soil fauna and microbes
- faster circulation of nutrients
- higher pH

Succession



Succession



Biodiversity

- Birches are the **most common broadleaved tree species** => important to biodiversity
- A large number of species feed on or live together with birch in different phases of succession
- **Species composition** changes by age of trees
 - seedling and young stands
 - mature stands
 - old growth forests

Herbivores

Over 500 herbivore species feed on birch leaves, shoots or buds: generalists / specialists

- moose (*Alces alces*)
- mountain hare (*Lepus timidus*)
- voles (*Microtus*, *Clethrionomys*)

- black grouse (*Tetrao tetrix*),
- willow grouse (*Lagopus lagopus*)

- macrolepidoptera: 60 species
- sawflies: ca. 100 species
- coleoptera: over 50 species

Moose (*Alces alces*)



Stem breakage by moose



Discoloration and decay after stem breakage



Effect of moose on vegetation



Voles (*Microtus*, *Clethrionomys*)



Damage by vole



Damage by vole



Discoloration and decay after vole damage



Autumnal moth (*Epirrita autumnata*)



Diseases

Lesions on small seedlings

- in nurseries and young plantations
- *Phytophthora cactorum*
- *Godronia multispora*

Leaf diseases

- *Melampsorium betulinum*
- *Pyrenopeziza betulicola*

Wood decaying fungi

Wood decaying fungi



- *Piptoporus betulinus*



- *Fomes fomentarius*

Wood decaying fungi



- *Inonotus obliquus*

Biodiversity

Insects living on dead and decaying wood

- over 350 coleoptera species live on decaying birch
- pests:
 - *Scolytus ratzeburgi*
 - *Hylecoetus dermestoides*
- saproxylic species
- threatened species
 - 70 threatened coleoptera species / 15 specialists

Photos were taken by:

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