Coppicing ability and biomass production of downy birch (*Betula pubescens* Ehrh.) – 4-year results

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The WoodBio Project

cost

EUROPEAN COOPERATION IN SCIENCE AND TECHNOLOGY

EuroCoppice

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Content

- Background
- Coppicing of birch
  - Stump mortality
  - Number of sprouts/stump
  - Mean height of sprouts
  - Biomass of sprouts/stump
  - Stump height
  - Stump damage
- Biomass production of coppiced young stands
- Conclusions

Photos: Jorma Issakainen, Jyrki Hytönen, Olli Reinikainen, Seppo Vihanta & Erkki Oksanen

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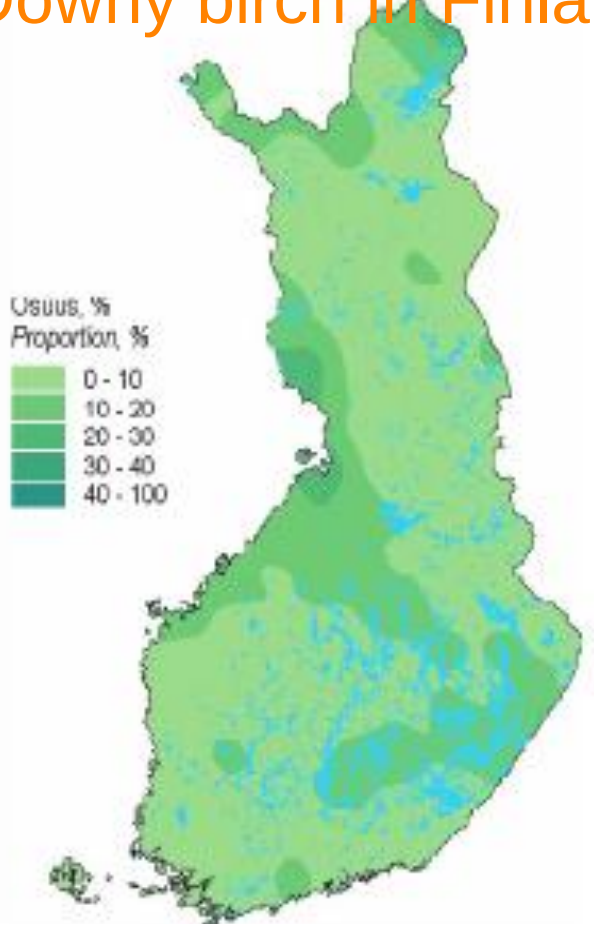
Downy birch in Finland

- Birch dominated forest 8.9 % of area
- Birch 325 milj. m^3
- Could downy birch be a short-rotation energy tree species in Finland?



- Drained peatlands
- Former agricultural fields
- Cut-away peatlands
- Upland soils with drainage problems

Management of downy birch thickets

Peat: 4-5% of Finnish energy consumption
2500 ha annually released from peat production

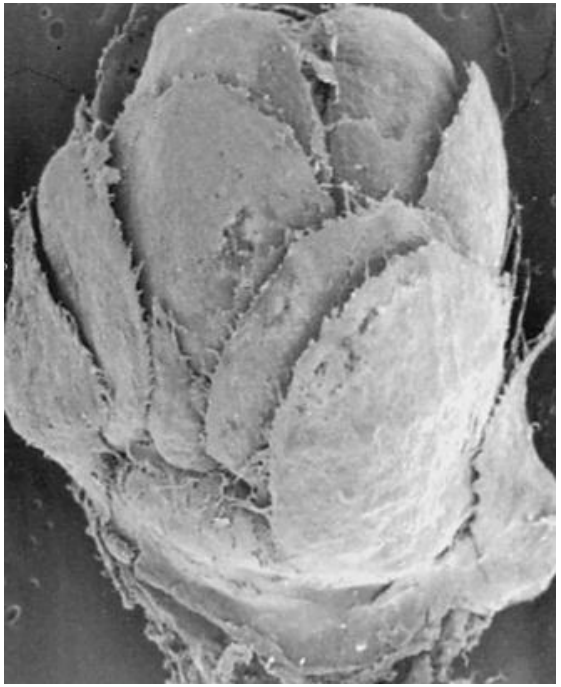
Several projects

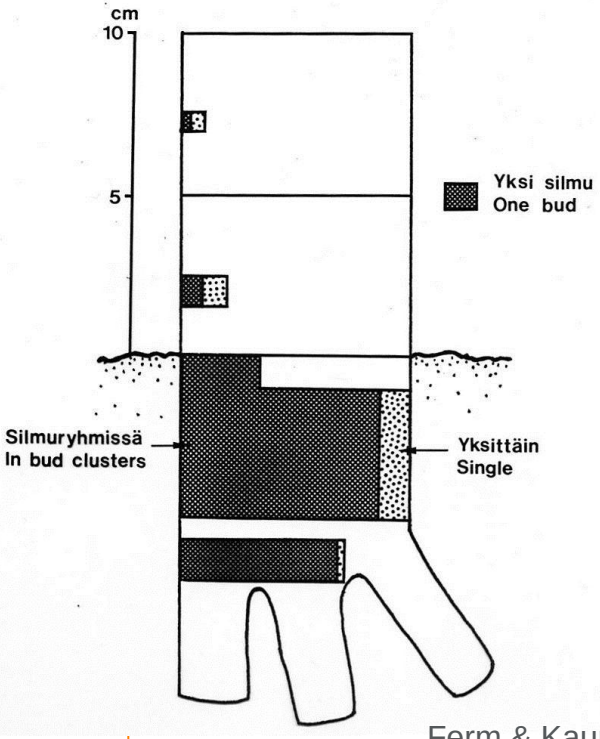
Downy birch buds

Buds in stumps

- Amount of buds
- Location of buds (70-95% below ground)
- Bud clusters

Birch buds are adventious





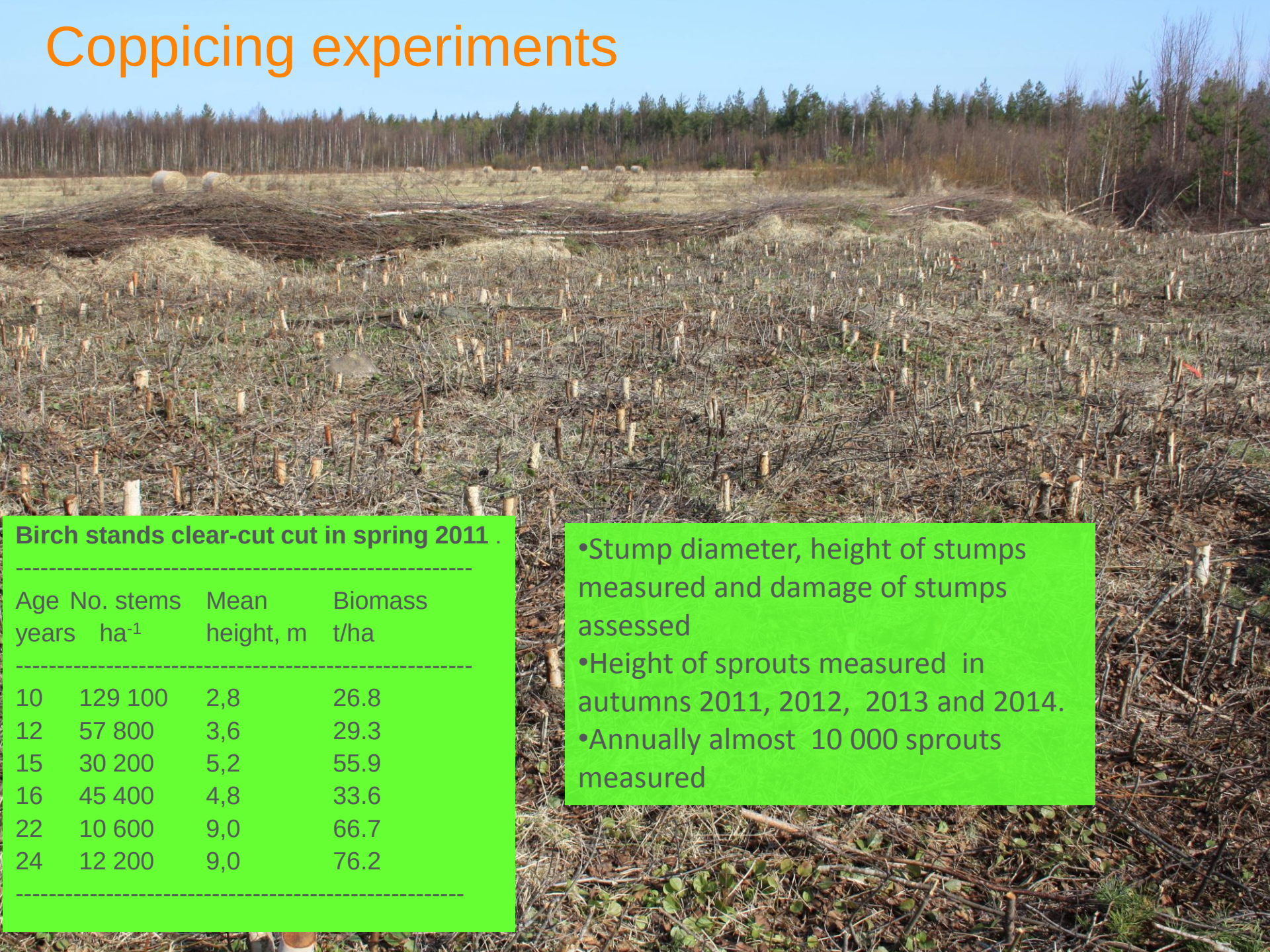
Ferm & Kauppi 1990

Factors affecting coppicing of downy birch

- Time of cutting
- **Tree size and age**
- **Height of stump**
- **Damage of stumps** – cutting method)
- Rotation lenght
- Site quality

Hytönen & Issakainen 2000. Biomass & Bioenergy

Coppicing experiments

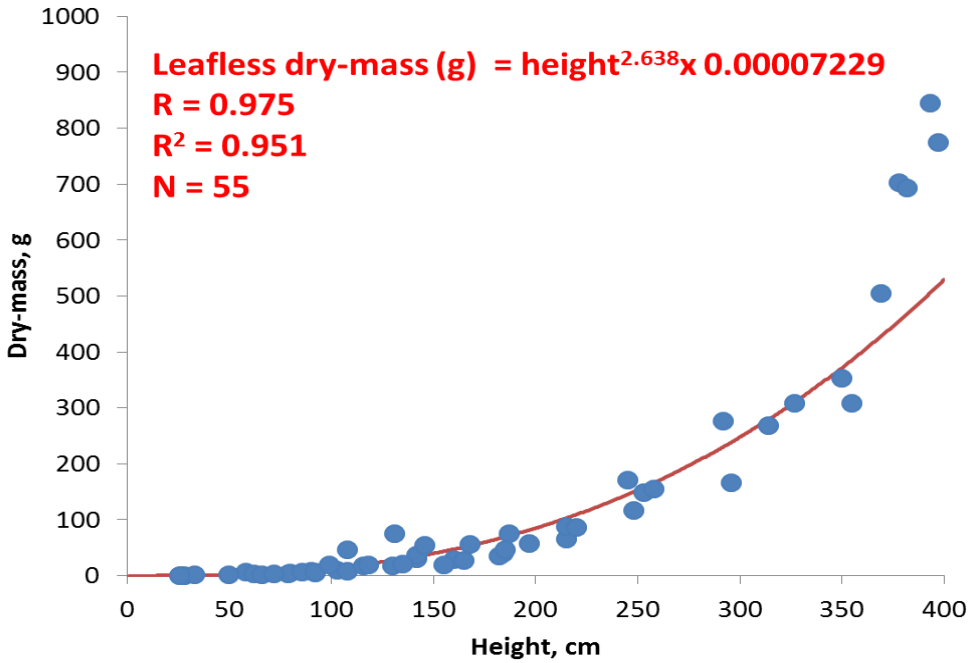


Birch stands clear-cut cut in spring 2011 .

Age years	No. stems ha^{-1}	Mean height, m	Biomass t/ha
10	129 100	2,8	26.8
12	57 800	3,6	29.3
15	30 200	5,2	55.9
16	45 400	4,8	33.6
22	10 600	9,0	66.7
24	12 200	9,0	76.2

- Stump diameter, height of stumps measured and damage of stumps assessed
- Height of sprouts measured in autumns 2011, 2012, 2013 and 2014.
- Annually almost 10 000 sprouts measured

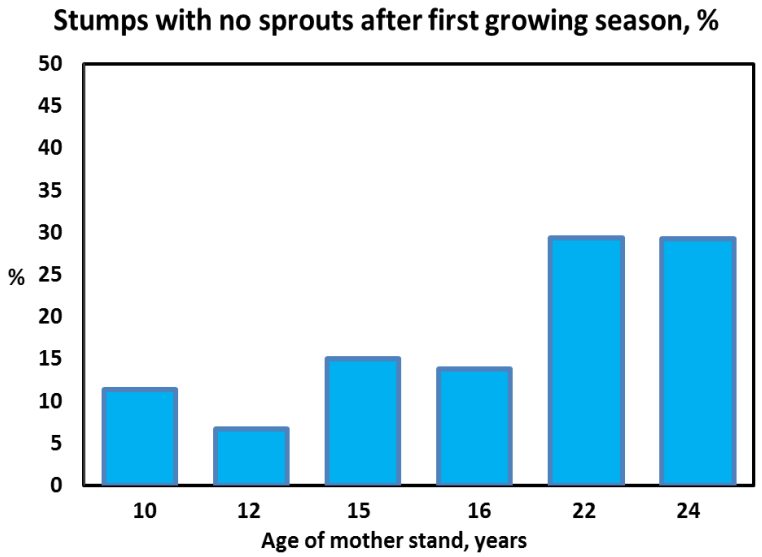
Allometric birch biomass equations

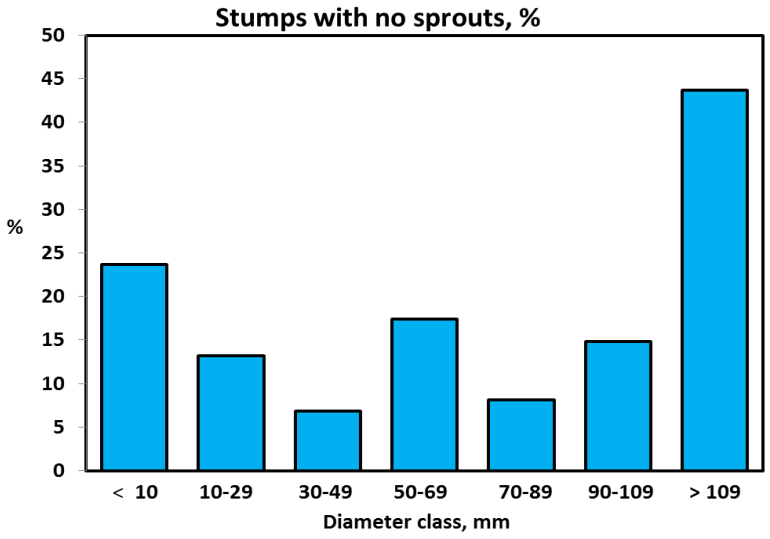


Biomass of birch sprouts calculated with allometric biomass equations.

54 birch sample sprouts
- height,
- diameter at 10 cm height
- leafless dry mass

Mortality of stumps – 1st season

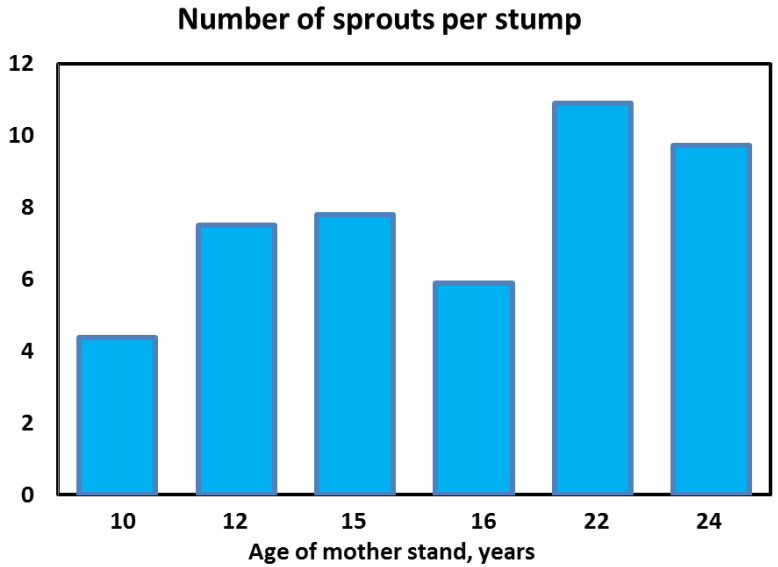


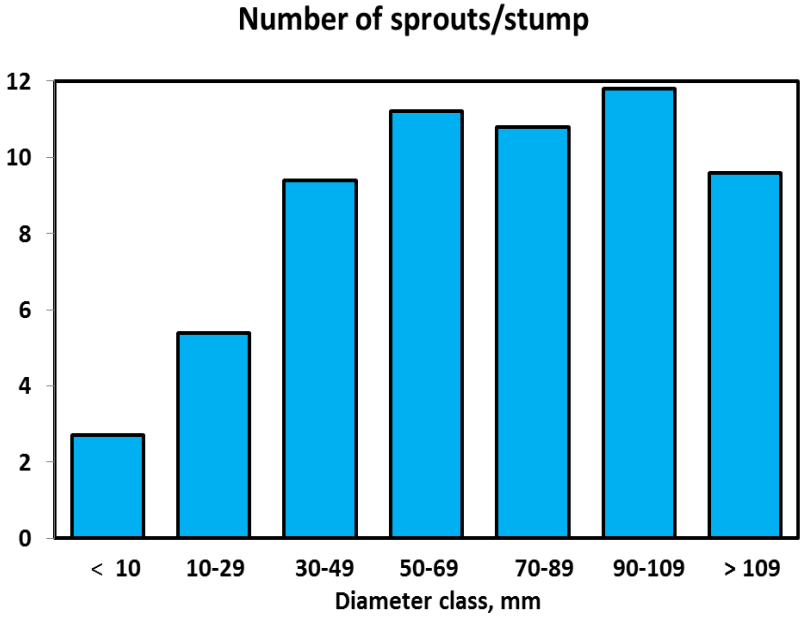


- All birch stumps do not sprout – 5-30% of stumps did not sprout
- Sprouting ability of downy birch decreases with increase of tree age and stump diameter

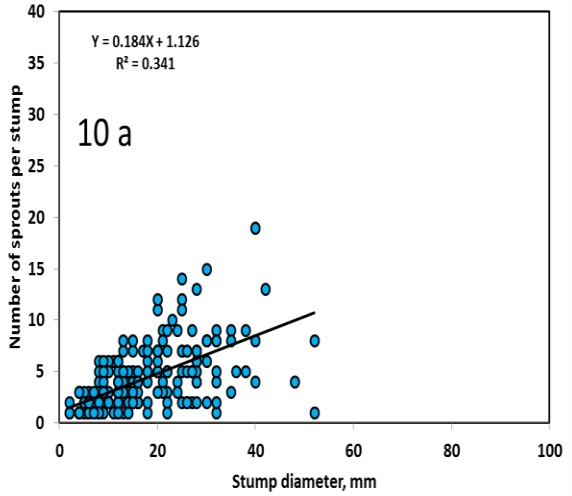
diameter 15 cm

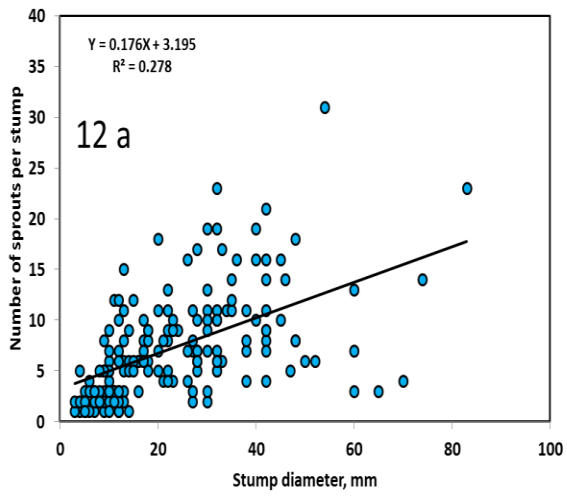
Number of sprouts per stump – 1st season

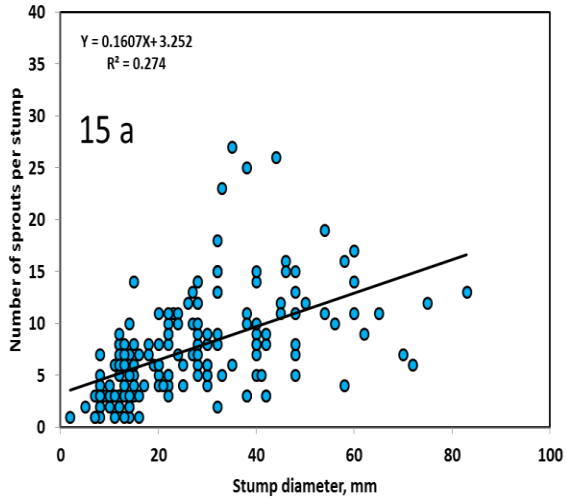


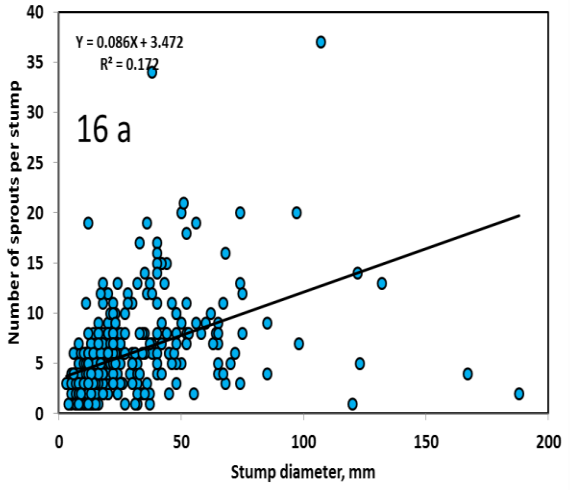


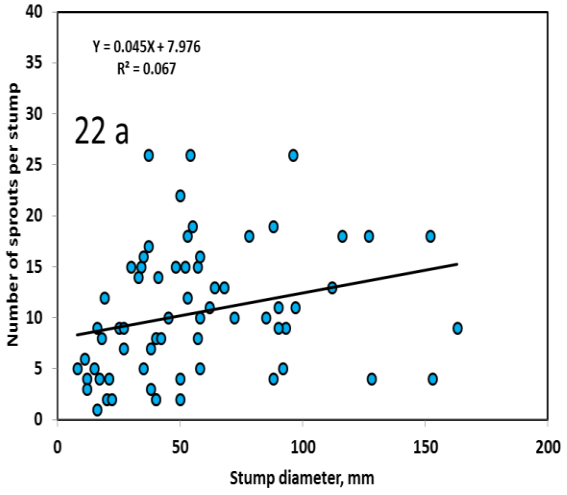
Number of sprouts per stump – 1st season

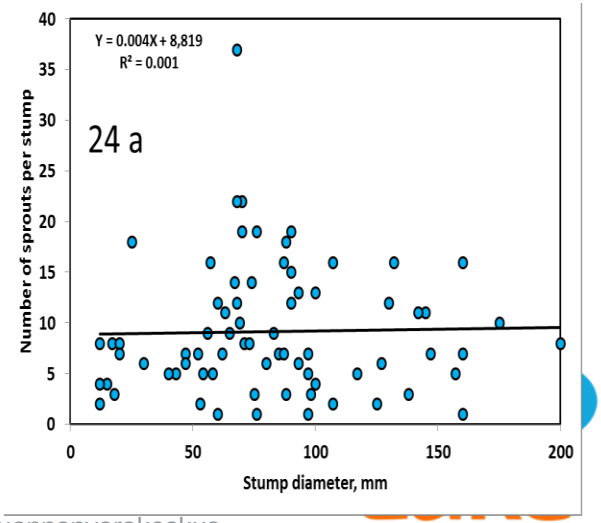




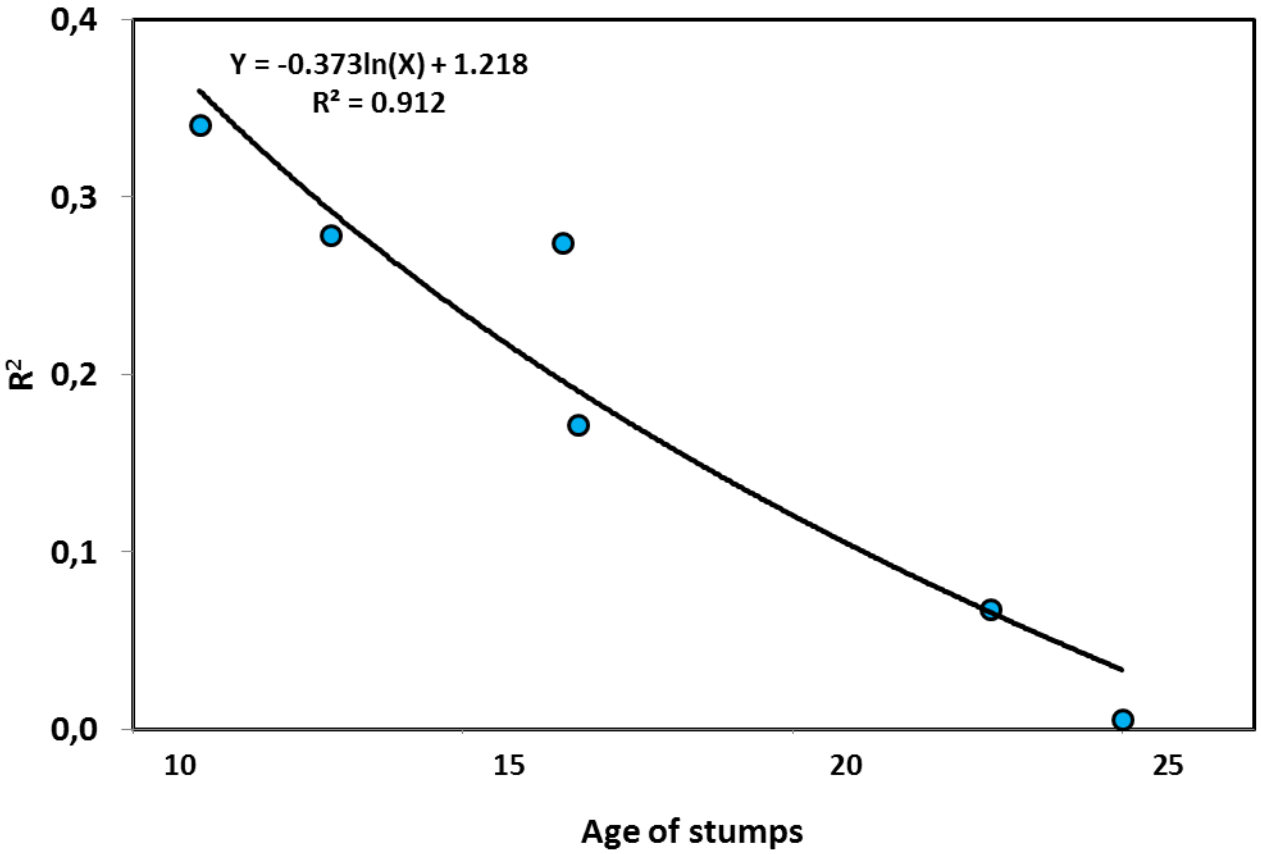






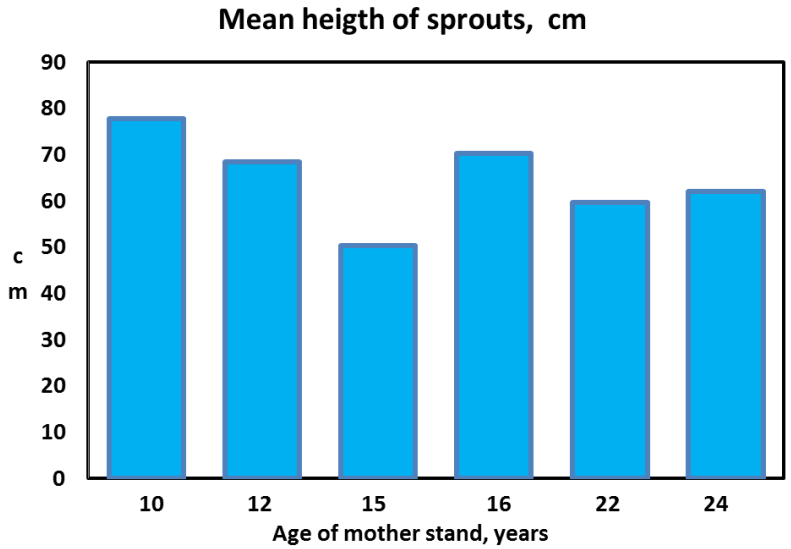


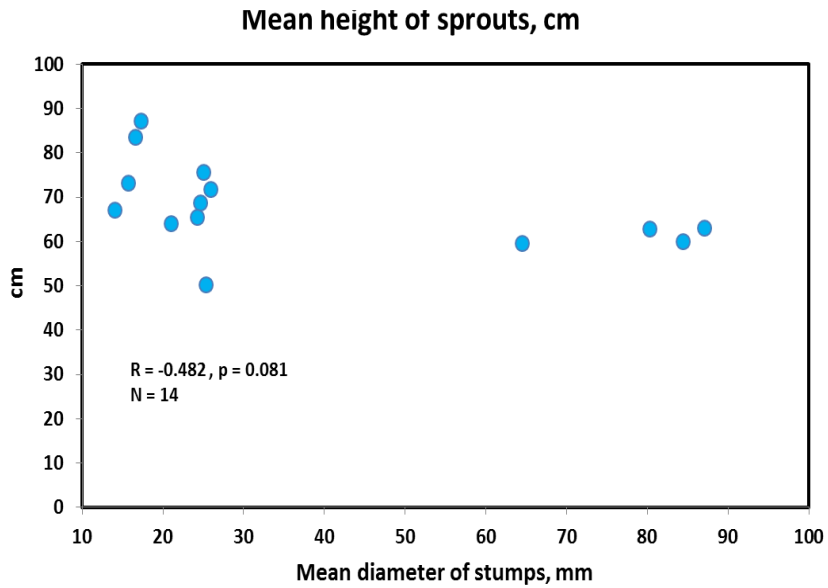
Effect of stand age on the degree of determination (R^2) - Number of sprouts/stump = a + x * $D_{0.1}$



In older the stands stump diameter does not explain the number of sprouts/stump

Mean height of sprouts – 1st season





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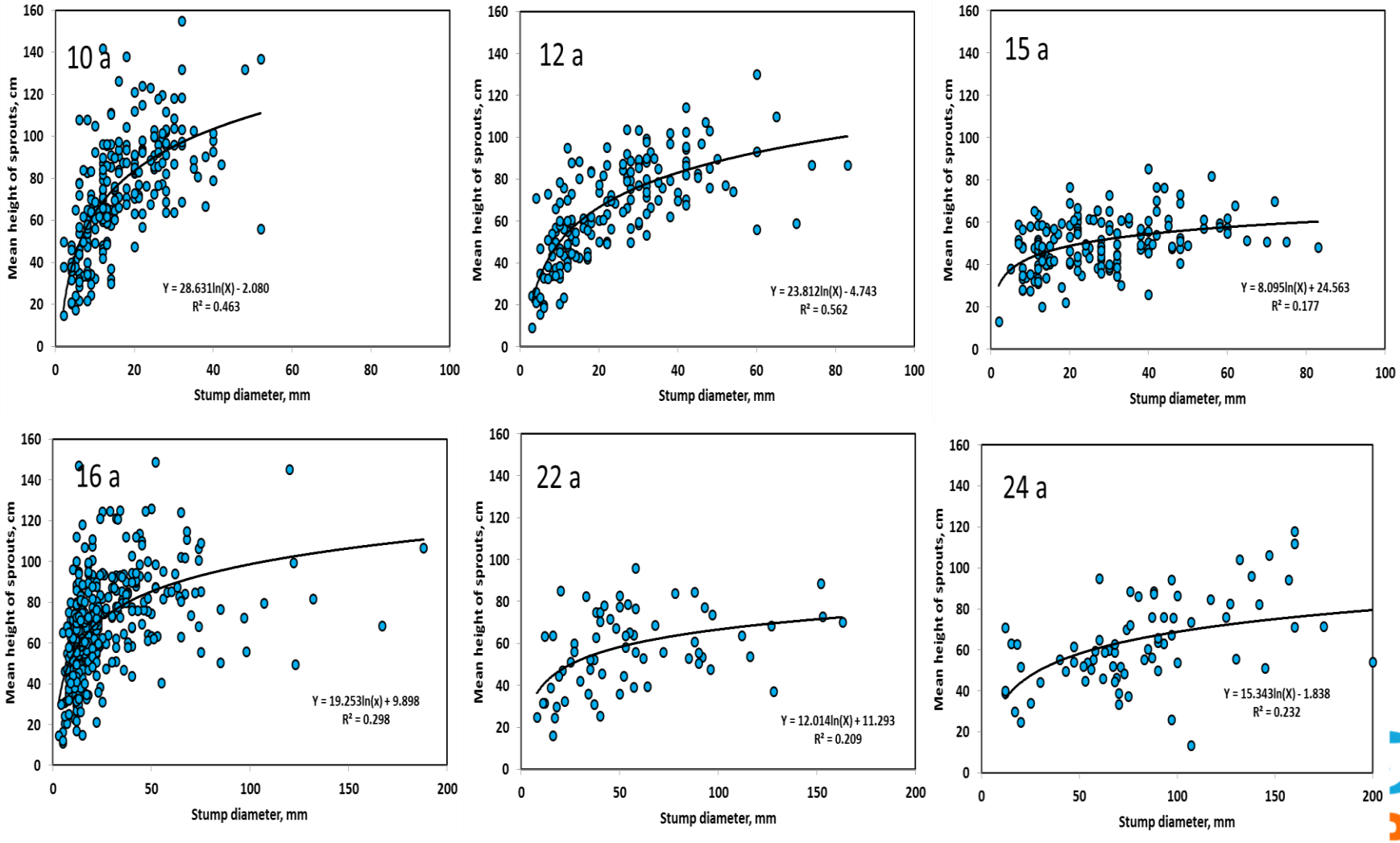
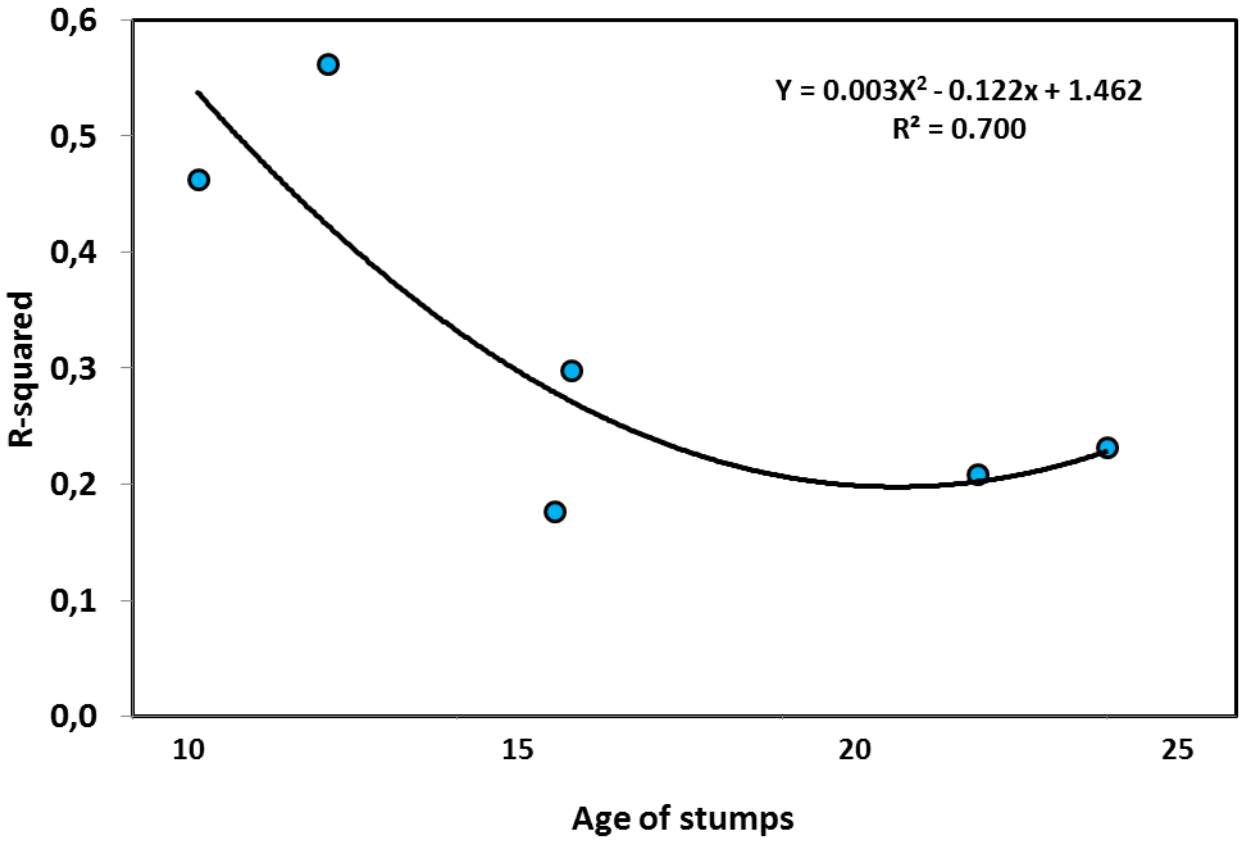
Mean height of sprouts, cm – 1st season

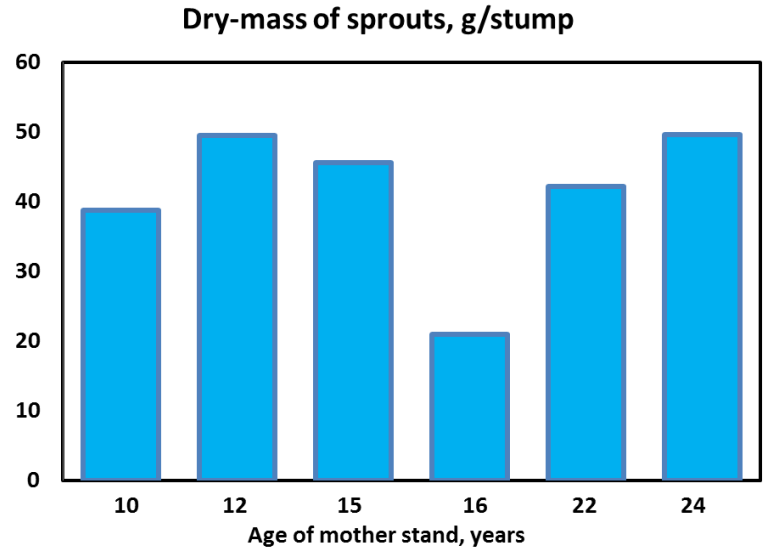


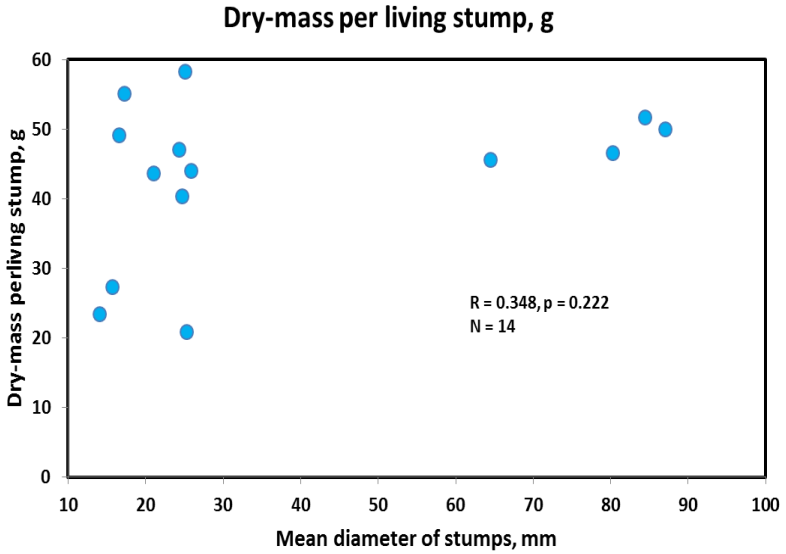
Effect of stand age on the degree of determination (R^2) - Mean height of sprouts = a + ln($D_{0.1}$)



In older the stands stump diameter does not explain the mean height of sprouts

Dry-mass of sprouts per stump - 1st season





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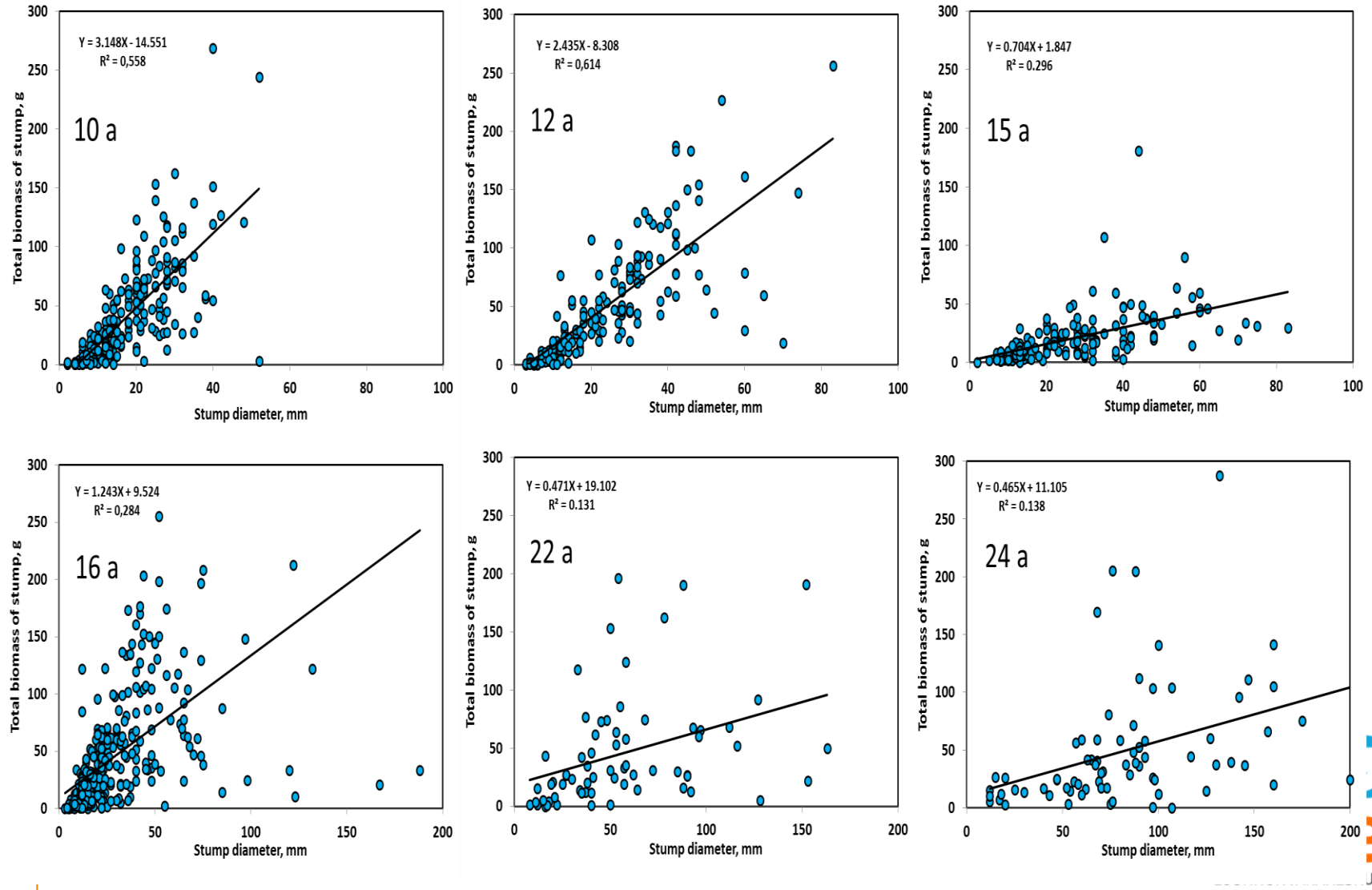
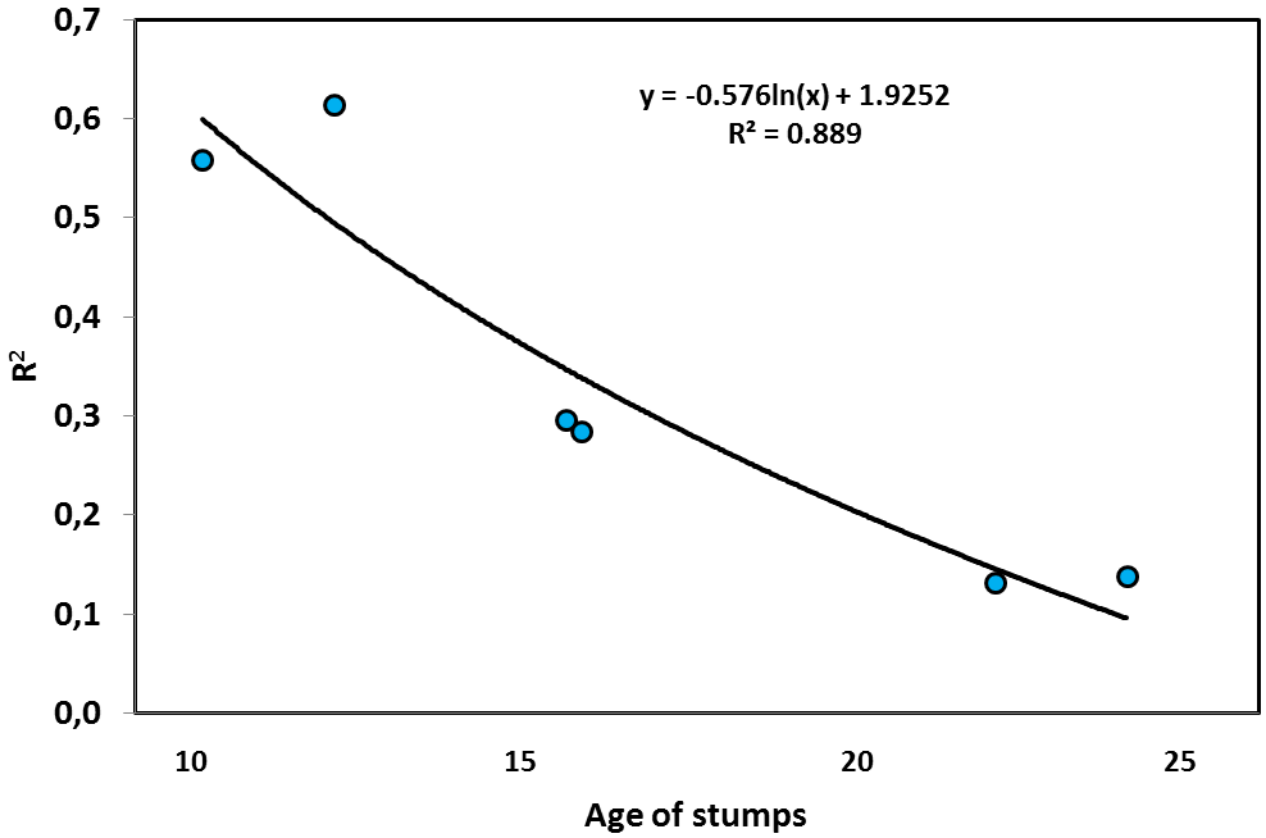
Dry-mass of sprouts per stump – 1st season



Effect of stand age on the degree of determination (R^2) - Biomass of sprouts/stump = a + X * $D_{0.1}$

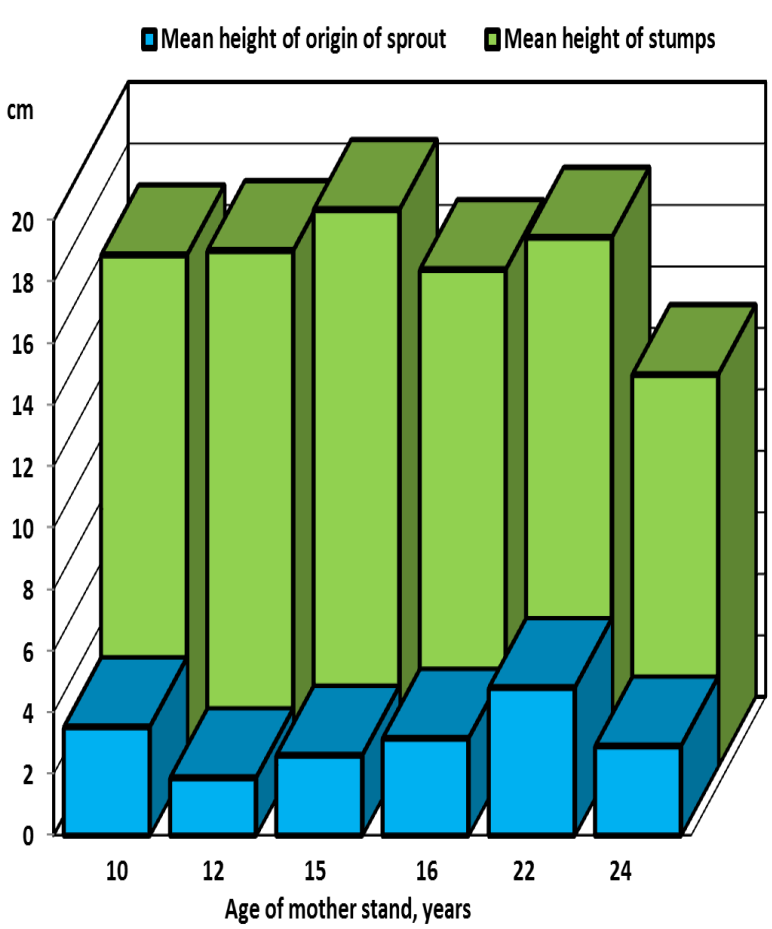


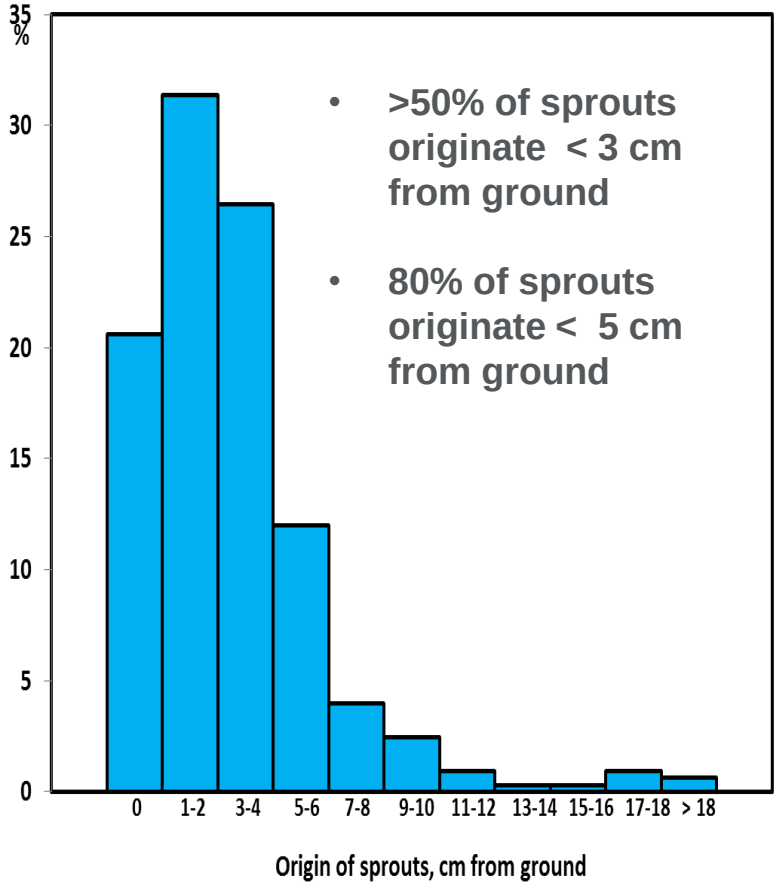
In older the stands stump diameter does not explain the growth of sprouts

Origin of sprouts

9.5.2012

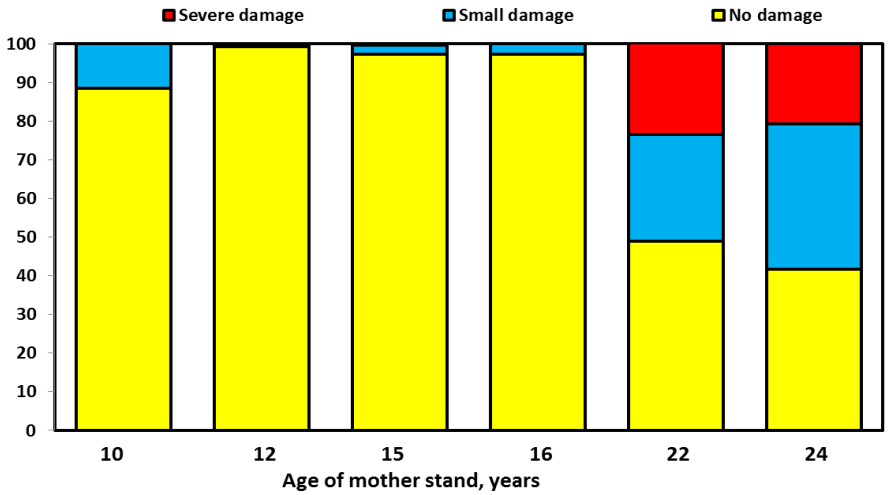
Origin of sprouts (cm from ground) and stump height



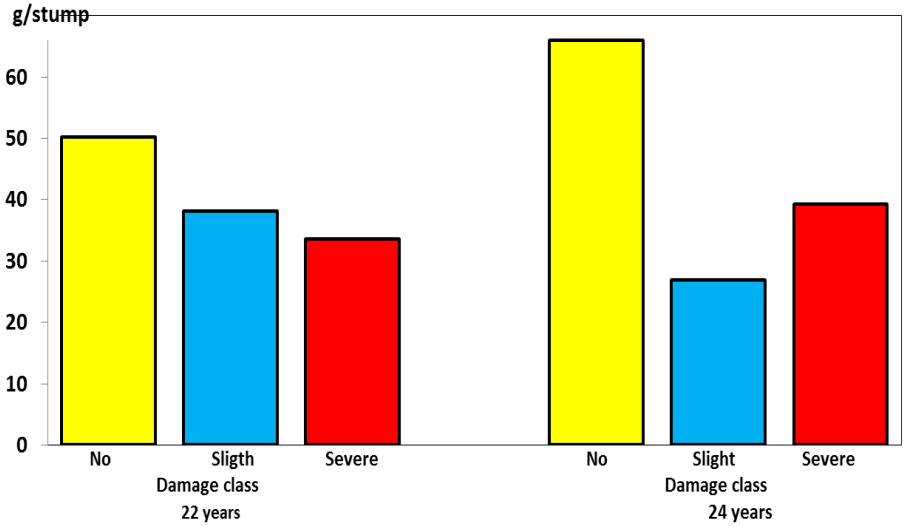


- >50% of sprouts originate < 3 cm from ground
- 80% of sprouts originate < 5 cm from ground

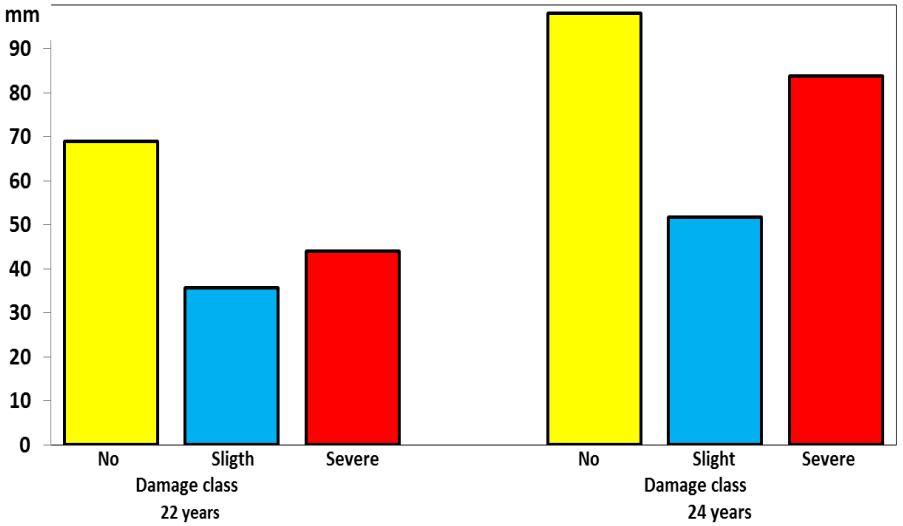
Effect of stump damage on sprouting



Dry mass of sprouts/stump by damage class

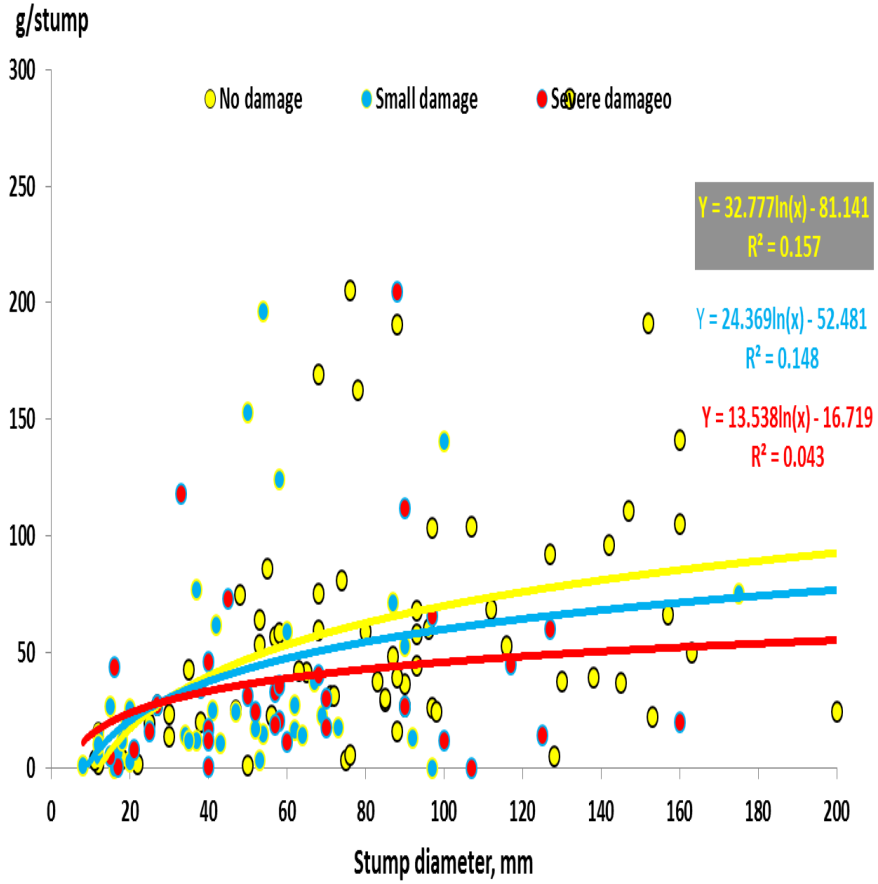


Diameter of stumps by damage class

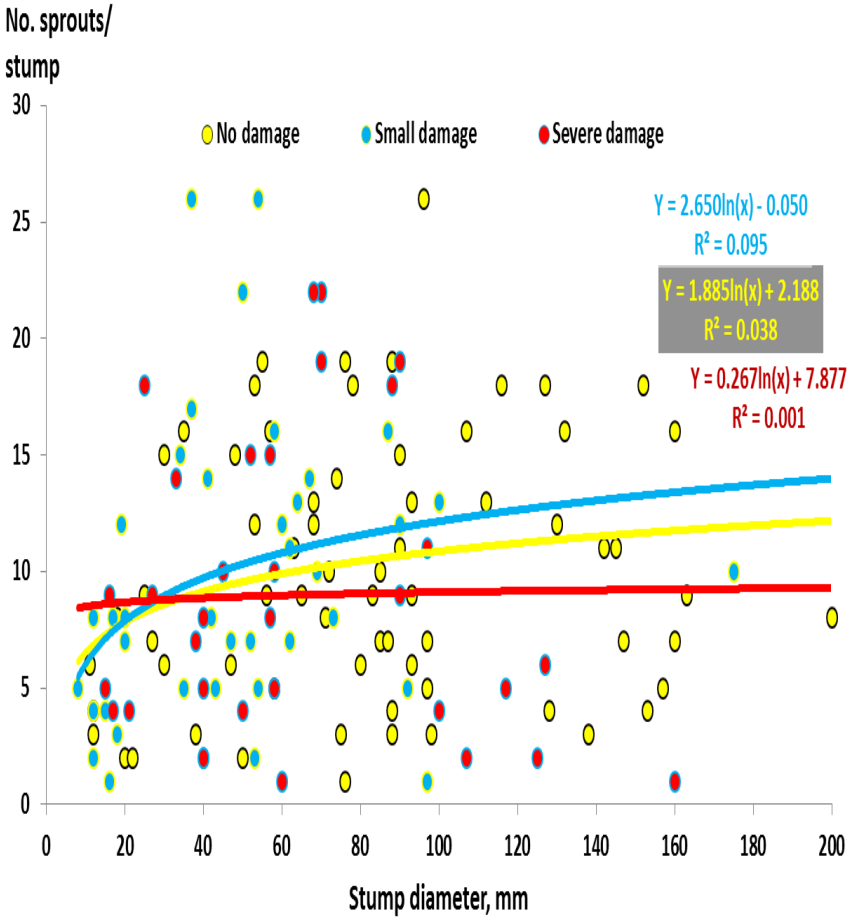


Effect of stump damage on sprouting

Dry mass of sprouts/stump by damage class



Number of sprouts/stump by damage class



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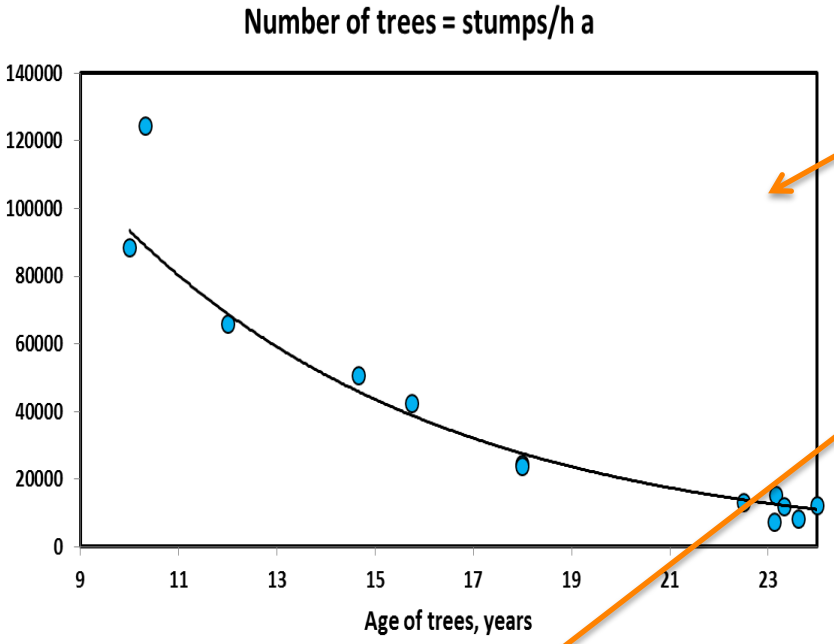
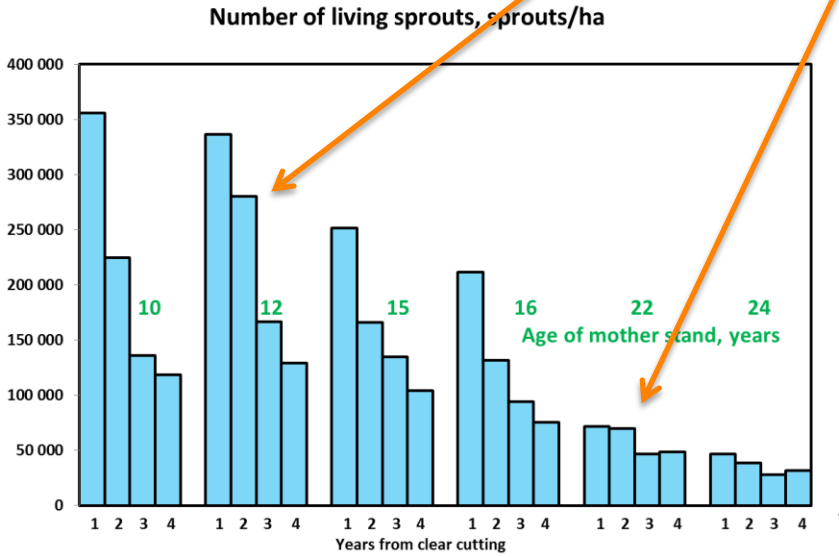
Stand: number of stumps and sprouts

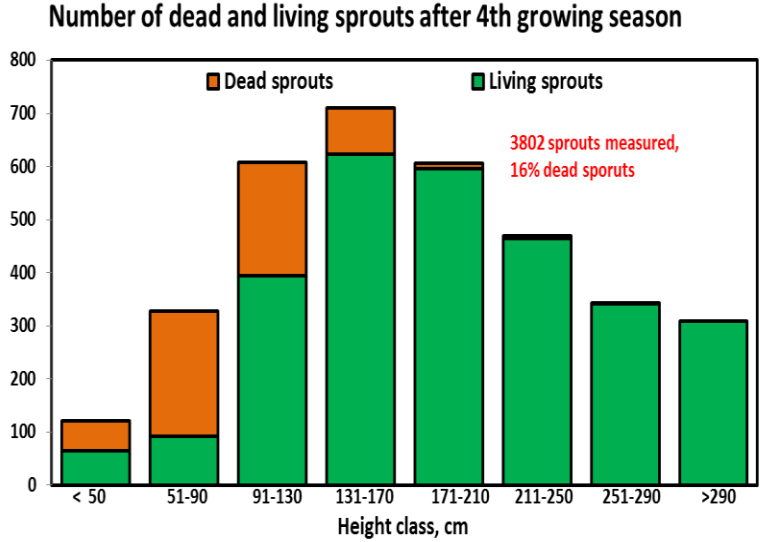


Mother stands: Number of trees decreased with increase of age

Sprout stands:

- When mother stand is young (and has many trees) self-thinning is fast
- When mother stand is old: self-thinning is slow
- Smallest sprouts die first





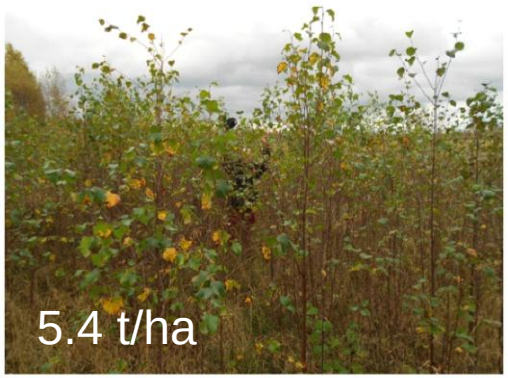
Example of development of coppiced downy birch stand

Stumps 9.5.2011

First summer 29.7.2011

Second summer 10.8.2012

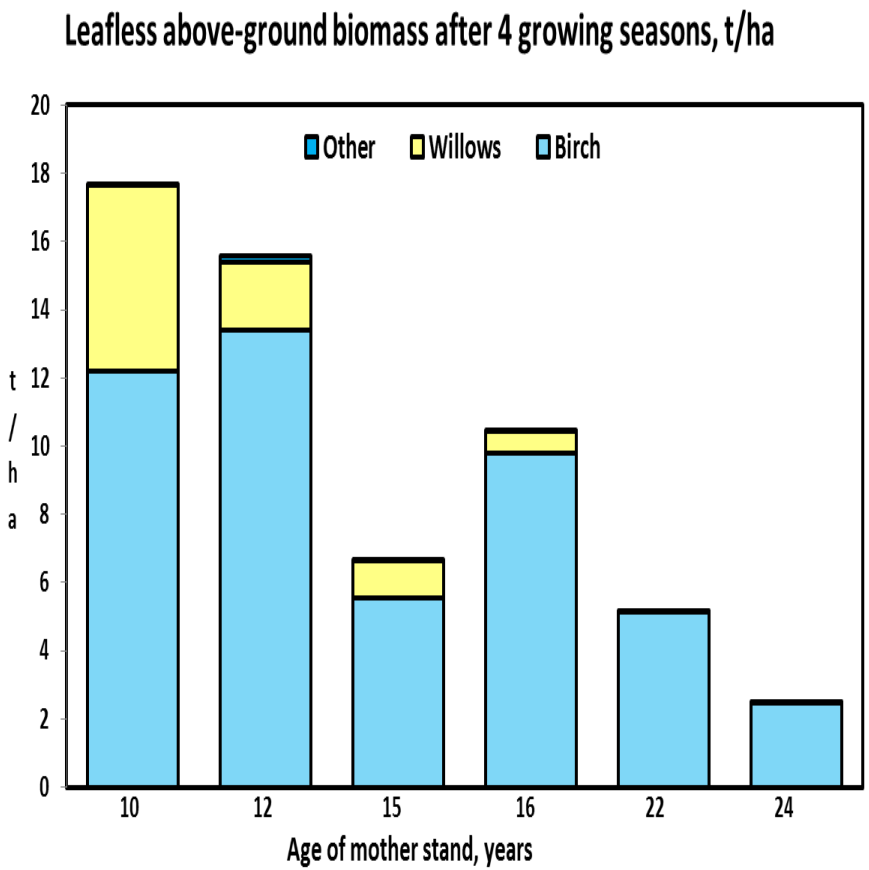
Third summer 18.9.2013

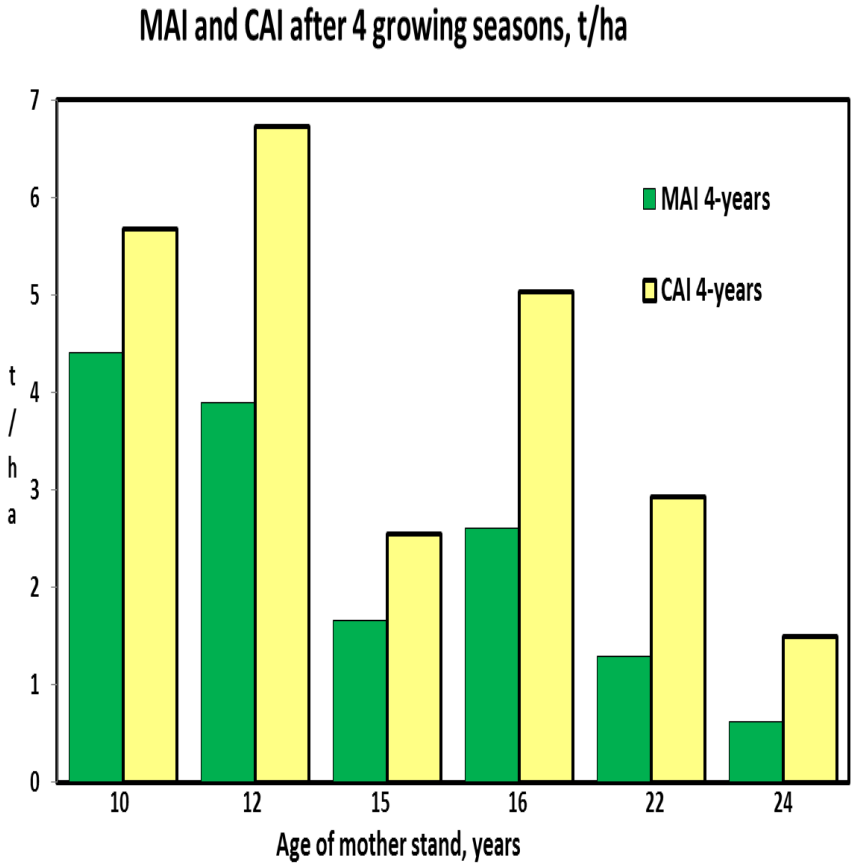


Fourth summer 22.8.2014

Fotos from same place

Biomass production: total, MAI and CAI, t/ha





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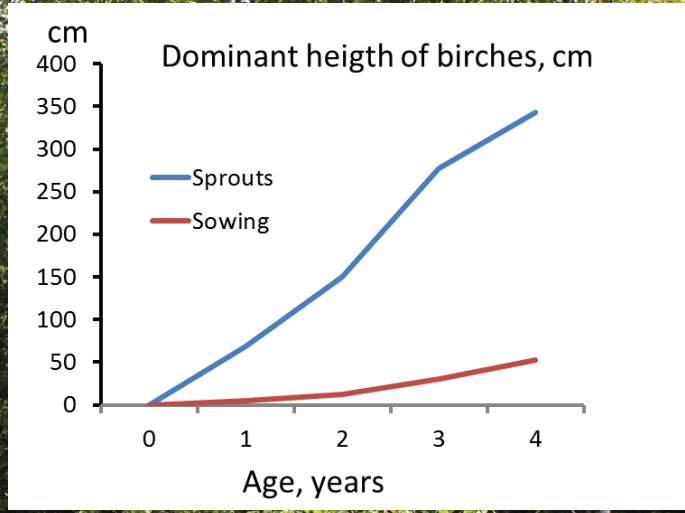
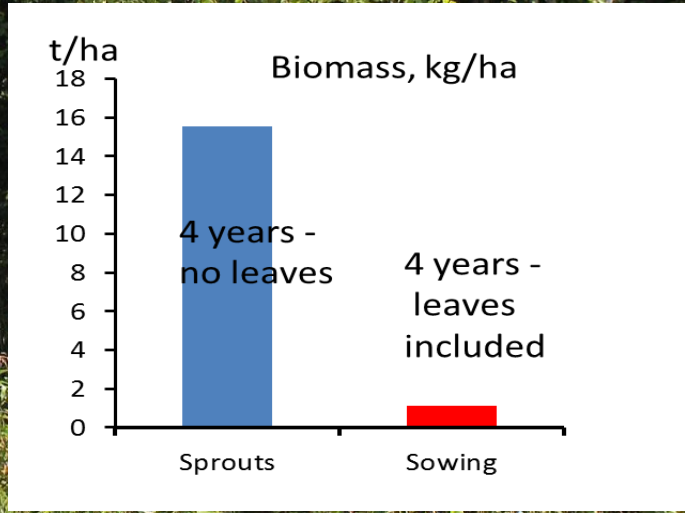
Development of seed orignated and coppiced downy birch





Conclusions

- Sprouting of downy birch
  - Mortality of stumps
    - All birch stumps do not sprout: 7-30% of stumps without sprouts
    - Small (< 1 cm) and thick (>11 cm) stumps have highest mortality
  - Sprouting (Number of sprouts/stump, mean height of sprouts and dry-mass of sprouts/stump)
    - Young stands: increase with increase in diameter .
    - In older stands (>20 years): diameter had no effect. (Possible reasons: increase in thickness of bark, and number of bud clusters)
  - Stump height:
    - Birch sprouts originate very low: 80% < 5 cm from ground)
  - Damage of stumps
    - Small effect of sprouting (sprouts originate very low)
- Growth of sprouts much faster than that of seed originated seedlings (4 a)
- Decrease in rotation length (coppice vigour)
- Cost-efficient method for stand regeneration
- Further research needed (e.g. risk of animal damages)

14.4.2015