



Topic overview

- Historical background
- Research and demonstration objectives
- Treatments
- Statistical design
- Placement of plots
- Number of plots
- Size and shape of plots
- Buffer zone and plot surrounds
- Plot sub-divisions
- Plot demarcation and surveying
- Site assessment
- Sampling procedures
- Measurement procedures
- An example: Measurement procedures for wood quality
- Data recording and processing
- PHOTOGRAPHY
- When to measure and re-measure
- Establishment report
- Catalogue of irregularities
- Administration
- Costs
- Plot maintenance
- Plot priorities
- Information to the public
- Intellectual property rights
- International cooperation

Plot procedure documentation

Ganghofer, A. (ed.) 1881: *Das Forstliche Versuchswesen*, Vol. 1. Augsburg. 504 pp.

Fabricius, L., A. Oudin & W.H. Guillebaud 1936: *Outlines for permanent sample plot investigations*. International Union of Forest Research Organizations. Oxford University Press. 32 pp.

Jeffers, J.N.R. 1959: *Experimental design and analysis in forest research*. Almqvist & Wiksell, Stockholm. 172 pp.

Alder, D. & T.J. Synnott 1992: Permanent sample plot techniques for mixed tropical forest. *Oxford Forestry Institute, Tropical Forestry Papers*, vol. 25. XI + 124 pp.

Research and demo objectives



Above-ground wood production



A range of other issues



Research and demo objectives



- All experiments and demo plots should have a defined objective
- Objectives should be associated with one or more testable hypotheses
- Hypotheses should preferably relate to cause-effect relationships
- Decide on test criteria as early as possible
- Consider the longevity of the investigation
- Often objectives can be viewed under different time constraints, for example, short-, medium- and long-term

Treatments

- Contrasting treatments
- Objective definitions on a numerical basis
- Prefer simple specifications over complex treatments
- Treatments should range beyond, but include contemporary management practices
- Include (at least two) extreme treatments
- Include suitable standards to measure by (i.e., control plots, control trees, control branches, etc.)



Treatment context



F o r e s t t y p e

*For rare or scattered tree species
treatment context is extremely important*

Treatment context example

*How would you design
a provenance experiment
for wild service tree?*



Statistical design

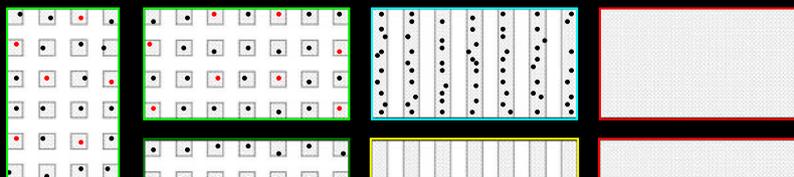
- One-factor experiments
- Randomized block design
- Latin square design
- Factorial design
- Split-plot design
- Balanced and unbalanced incomplete block design
- Combination of experiments carried out on several sites and in different years
- Special designs (Nelder, CCT, Scots plaid, clinal)

The statistical design can be difficult to decide on for rare or scattered tree species in mixed forest types

Placement and number of plots

- Within-site replicates
- Between-site replicates
- International coop
- Single-tree plots
- The issue of covariates

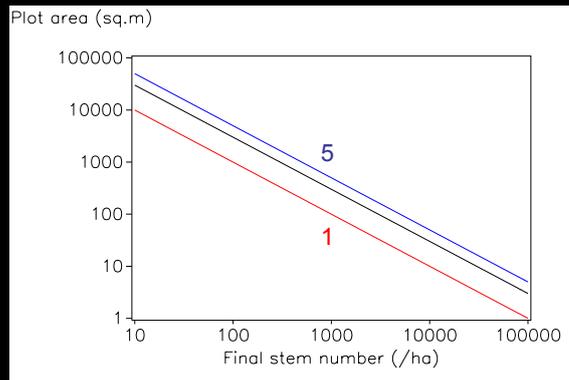
Plot size: 0.05 – 0.20 ha



Almost complete, randomized block design, including within-block pseudo-replications

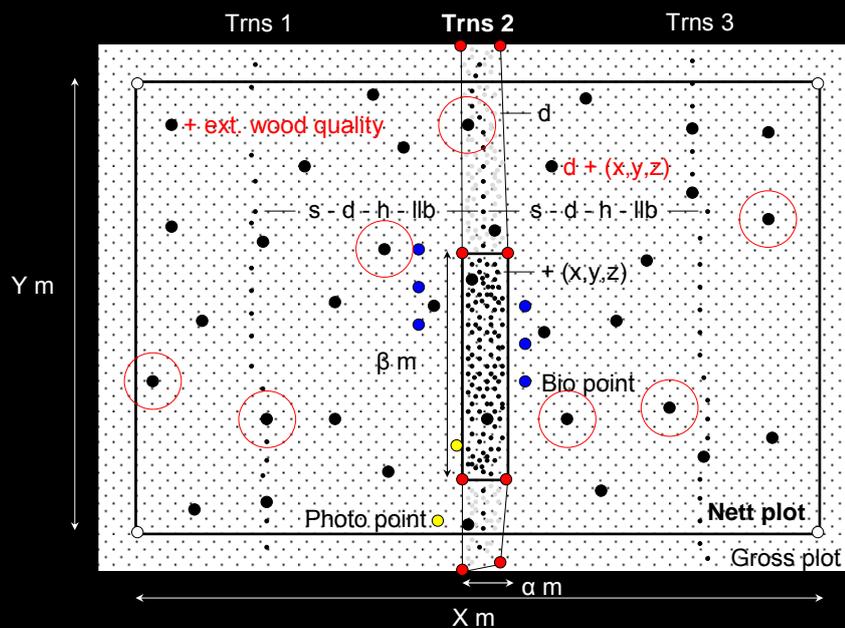
Size and shape of plots

Minimum number of trees = 10 in final sample ?



$$\log \text{Area} = 5 - \log N + \text{'research intensity factor'}$$

Plot lay-out, demarcation, sampling and measurements





Site assessment

- Land-use history
- Site mapping
- Soil pit combined with auger samples



Sampling procedures

The accuracy of the results of a survey depends, not on the larger or smaller number of observations made, but on the method of obtaining correct representation.

The Norwegian statistician Kiær in 1899

Proper representation
Rational selection of sample units

Sampling procedures

- Define the statistical population
- Sampling methods:
 - Unrestricted random sampling
 - Stratified random sampling
 - Subjective sampling
 - Sequential sampling
 - Point sampling
 - Sampling for rare objects
- Shape and size of sampling unit
- Selection of sampling units
- Number of sample units required (CV + power tests)
- Uniformity trials and pilot surveys (CV)
- The sampling scheme should consider the options for statistical analyses

Measurement procedures

- Measurement intensity and accuracy should relate to research objective
- Consistent measurement standards (instruments, staff, QA)
- Variables to measure
- Measurement size thresholds
- Number of observations for CV to stabilize
- Tree numbering and marking
 - Paint
 - Metal numbers
 - Plastic numbers - two different types
 - Electronic chips
 - Stem mapping
- Numbering and marking of other measurement items
- Consider measurement error relative to rate of change to decide on when to re-measure

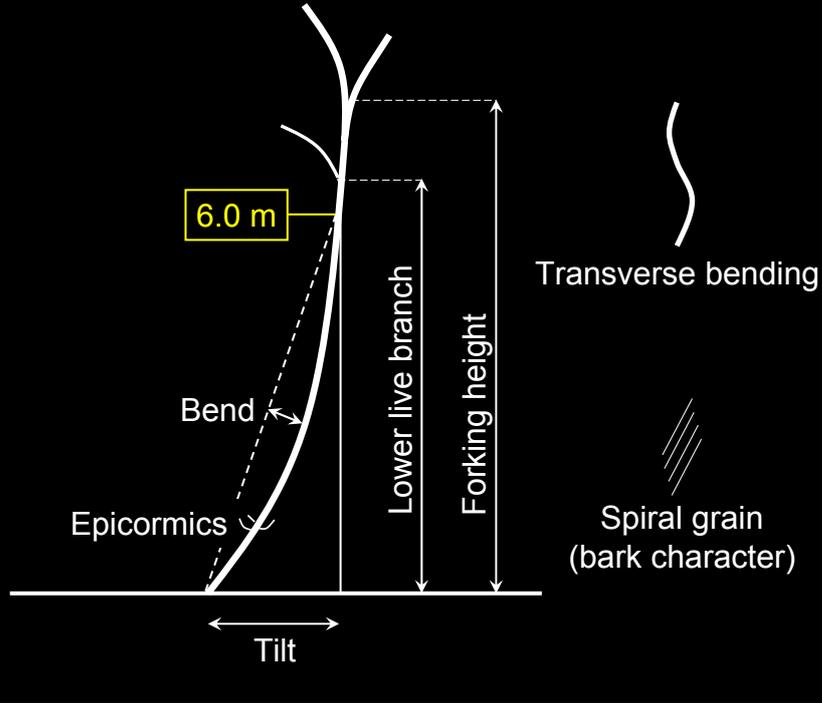
Iron pipes may be needed
for scattered trees

Example: Exterior wood quality

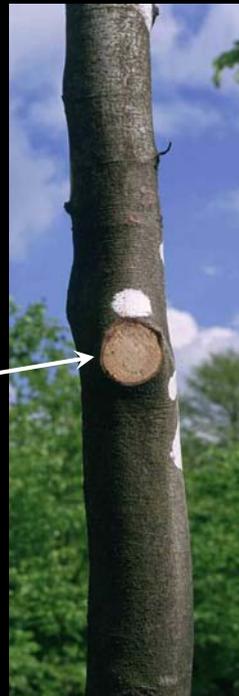
THE EIGHT POSITIVES

- No forking < 6 metres
- High natural pruning
- Vertical (no tilting)
- Straight (no bending)
- No epicormics
- No or little transverse bending (sinosity)
- No or little spiral grain
- Regular spatial distribution

Exterior wood quality variables



Example: High pruning



Example: Biodiversity

- Permanently marked points for monitoring biodiversity



Ground flora 3 years after precommercial thinning to 1,000 / ha

Example: Recreational preferences



Documentation

- Establishment report
- Data recording and processing, including quality assurance
- Photography: *'A picture tells you more than 1000 words'*
- Catalogue of irregularities
- Information to the public
- Intellectual property rights
- - - -
- Plot maintenance

Example: Photography



- Permanently marked points for photography

Costs

• COST ITEM	Value	OCCASSIONS
• Plot instalment costs	100	Once
• Initial measurement	100	Once
• Re-measurement	50	At regular, short intervals
• Plot maintenance	50	At regular, long intervals
• Final measurement	75	Once

International cooperation



NOLTFOX
Northern European Database
of Long-Term
Forest Experiments
and associated literature

NOLTFOX Northern European Database of Long-Term Forest Experiments - Windows Internet Explorer

http://noltfox.metla.fi/

Google C-NOLTFOX Start + M Bogmaerker 1

What's new in NOLTFOX?
 - Experiments from Baltic countries and UK
 - about 2000 References from experiments

CONTACT INFORMATION

NOLTFOX
 Northern European Database of Long-Term Forest Experiments

ABOUT FORESTRY

BACKGROUND

Sorbus aucuparia

Fraxinus excelsior

start DA 100% 10:33 sönadag



*The three most important issues
 - before, during, after*

*Statistical design
 Permanent markings
 Documentation*





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