Conducting forest experiments and demonstration plots with valuable broadleaves

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2008

Growing valuable broadleaved tree species
COST E42 Conference
Freiburg, Germany
6-9 Oct. 2008

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


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.)
Seeding or planting
Natural regeneration
New silviculture

Forest type

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 Area = 5 - log N + 'research intensity factor'

Plot lay-out, demarcation, sampling and measurements
Site assessment

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

For rare or scattered tree species micro-site assessment is often more relevant than overall site assessment
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 (sinousity)
- No or little spiral grain
- Regular spatial distribution
Exterior wood quality variables

- Tilt
- 6.0 m
- Bend
- Lower live branch
- Forking height
- Epicormics
- Transverse bending
- Spiral grain (bark character)

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

- 7,000 stems per ha
- 5,300 stems per ha
- 300 stems per ha
- 1,000 stems per ha
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

<table>
<thead>
<tr>
<th>COST ITEM</th>
<th>Value</th>
<th>OCCASSIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plot instalment costs</td>
<td>100</td>
<td>Once</td>
</tr>
<tr>
<td>Initial measurement</td>
<td>100</td>
<td>Once</td>
</tr>
<tr>
<td>Re-measurement</td>
<td>50</td>
<td>At regular, short intervals</td>
</tr>
<tr>
<td>Plot maintenance</td>
<td>50</td>
<td>At regular, long intervals</td>
</tr>
<tr>
<td>Final measurement</td>
<td>75</td>
<td>Once</td>
</tr>
</tbody>
</table>

International cooperation

NoLTFox

Northern European Database of Long-Term Forest Experiments and associated literature
The three most important issues - before, during, after

Statistical design
Permanent markings
Documentation
Acknowledgements

E. O’Connor, Ireland
H.C. Graversgaard, DK
E. Hochbihler, Austria
C. Mohni, Switzerland
N. Nicolescu, Romania
P. Niemistö, Finland
F. Pelleri, Italy
H. Spiecker, Germany
I. Stefancik, Slovenia
R. Övergaard, Sweden