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# Selection of fast growing clones among seedlings of *Schefflera arboricola* Hayata

## *Selektion af hurtigt voksende kloner blandt frøformerede* Schefflera arboricola *Hayata*

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## Summary

Seeds of *Schefflera arboricola* Hayata were delivered from various sources to obtain a large genetic variation. Among approximately 12.000 seeds of which 54 per cent germinated, about 25 per cent of plants with characters such as high growth rate were selected for further observation.

These plants provided the basis for the initial screening, which was followed by three clonal selection trials where the fastest growing clones were compared under high and low irradiance conditions. Large variation in growth and morphological characters was found among clones of *Schefflera arboricola.*

The significant differences in growth were found under both high and low irradiance conditions. Some clones had identical growth under high irradiance, but different growth at low irradiance. Differences were also found in the number of leaves, internodes, their length, number of leaflets and petiole length.

The experiments show that it is necessary to carry out the selection during low irradiance conditions to ensure that selected clones are fast growing both under high and low irradiance conditions.

The coefficient of variation was found to be negatively correlated to plant growth, which could be due to the experimental design.

Previously selected clones 'Andante' and 'Rondo' grew 59 and 91 per cent slower than the fastest growing clones included in this experiment.

**Key words:** Clones, selection, seeds, growth, *Schefflera arboricola.*

## Resume

Frø af *Schefflera arboricola* Hayata fra forskellige provenienser blev indsamlet med det formål at skabe så stor genetisk variation som muligt. Ca. 54 pct. af de 12.000 såede frø spirede, hvoraf der blev udvalgt ca. 25 pct. af de mest hurtigt voksende til yderligere undersøgelse.

Disse planter dannede basis for en undersøgelse bestående af tre klon selektionsforsøg,

hvor de hurtigste kloner blev sammenlignet under høje og lave indstrålingforhold.

Der var stor variation i både morfologi og vækst, og der blev fundet signifikante forskelle i væksthastigheden. Nogle kloners vækst kunne ikke adskilles under høj indstråling, men viste forskelle under lav indstråling. Der var også signifikante forskelle i antallet af blade, internodier og deres længde samt antallet af småblade og bladstilkens længde.

Forsøget viste, at det er nødvendigt at foretage selektionsforøg under lave indstrålingsforhold for at sikre, at klonerne er hurtigt voksende under alle indstrålingsforhold. Variationscoefficienten viste sig at være negativt korrelleret med tilvæksten, hvilket kan skyldes forsøgsdesignet.

De tidligere udvalgte kloner 'Andante' og 'Rondo' voksede 59 og 91 pct. langsommere end den hurtigst voksende klon i disse eksperimenter.

**Nøgleord:** Kloner, vækst, udvalg, frø, *Schefflera arboricola.*

## Introduction

Heterogeneous growth of ornamental plants under a controlled environment in greenhouses has been a factor causing distress in the commercial industry, as it diminishes the effects of detailed production planning (1). The selection of homogeneous, optimally growing clones of numerous ornamentals has thus been included in a number of experiments using both foliage (1, 6, 7, 9) and flowering species (8, 10). Morphological analysis of clonal selection are not common, but has been performed i.e. in grapevines (2). In the foliage species *Ficus benjamina* and *Hedera helix* significant differences in height growth of phenotypically inseparable clones have been observed (1, 9). Both species are propagated vegetatively and may be expected to have a narrow genetic variation.

Using seeds of open pollinated trees, the purpose of this experiment was to select fast growing clones based on a screening of seed propagated plants and to compare these to cultivars of clonal origin.

## Materials and methods

Seeds of *Schefflera arboricola* Hayata were delivered from 4 different commercial seed companies, stressing that the seeds delivered if possible should come from different sources and different batches e.g. geographical locations.

In total 12.000 seeds were sown individually in pots (4×4 cm) in peat with added fertilizer under transparent polythene. After germination the polythene was removed and water including nutrients were added. The germinating percentage of the seed batches ranged from 0 to 62 per cent (mean 54 per cent).

When plants had reached a size of about 15 cm above pot rim approximately two thirds of the plants were discarded, while the one third most vigorously growing plants were potted into 10 cm pots. When the plants reached about 40 cm in height (above potrim) once again the fastest growing individuals, but also a number of clones showing deviating morphological characters such as leaf outline were selected, in all 128 clones, while the rest were discarded.

The selected plants were propagated by stem cuttings thus creating a stock plant quarter of 5 plants per clone. The cuttings were grown as above but in 10 cm pots placed on benches with capillary mats, where nutrients and water were added from below. The procedure for selecting cuttings (size and position) followed the recommendations by *Hansen* (4).

When the stock plants had grown to a height of about 30 cm the selection was repeated to eliminate heterogeneously growing clones and the slowest growing clones, thus the number of clones was reduced to 45. These plants acted as stock plants for further trials.

In November 1986 a clonal comparison trial was initiated using 45 clones of 30 plants each. The plants were randomized during growth. Propagation and growth as described previously.

In March 1987 the following parameters were recorded on each plant: Plant height (above pot rim), number of expanded leaves, mean petiole length of the fifth leaf and number of leaflets on the fifth leaf. Eleven fast and two slower

growing clones (in total 13 clones) were then selected for further experiments.

To evaluate the clonal performance under high irradiance conditions (i.e. Danish summer conditions), the experiment was repeated with the above mentioned 13 clones and 2 commercially available cultivars 'Andante' and 'Rondo' (5). Cuttings were propagated in May 1987 and the same parameters were recorded after 12 weeks of growth.

The terminal comparative clonal trial was initiated in November 1987, using the same clones and procedure as in the high-irradiance experiment. The experimental period was chosen, as it is the period with the lowest natural irradiance under Danish conditions. Final recording took place in March 1988. The selected clones have been described and named (3), clone no. 109: 'Minuet', clone no. 74: 'Fuga' and clone 16: 'Presto' (Table 1).

## Results

The selection of fast growing clones and clones with variable morphological characteristics quite naturally results in a not normal distributed clonal height and leaf number.

The plant heights of the fastest and slowest growing clones in 1986/87 ranged from 6.6 to 29.7 cm ($LSD_{0.95}$ 1.7 cm), while the leaf numbers ranged from 7.3 to 11.3 ($LSD_{0.95}$ 0.6). Part of the height differences was due to differences in internode length, which ranged from 0.9 to 2.9 cm ($LSD_{0.95}$ 0.1 cm). The number of leaflets on the fifth leaf varied from 6.3 to 9.3 ($LSD_{0.95}$ 0.2), while the variation in petiole length was 8.1 to 13.0 cm ($LSD_{0.95}$ 0.5). There was a positive and significant correlation between plant height and number of leaves ($r=0.63$ $p>0.001$), internode length ($r=0.86$, $p>0.001$) and the petiole length ($r=0.56$, $p>0.001$).

Plant height of the fastest and slowest growing clones in the high irradiance trial (1987) ranged from 20.3 cm to 60.6 cm, while the leaf number ranged from 9.3 to 15.3 (Fig. 1). The internode length varied from 1.9 to 4.3 cm (Table 1).

There were significant correlations between plant height and leaf number ($r=0.80$, $p>0.001$)

**Table 1.** The number of leaflets and length of petiole of the fifth leaf and the internode length under high and low irradiance clonal trials with *Schefflera arboricola* Hayata. Each value is the mean of 30 plants. The clones are ranked according to the plant height.

*Antallet af småblade og længden af bladstilken på det femte blad i forsøg med* Schefflera arboricola *Hayata under høj og lav indstråling. Hver værdi er gennemsnit af 30 planter. Klonerne er sorteret efter plantehøjde.*

| | HIGH IRRADIANCE 1987 | | | LOW IRRADIANCE 1987/88 | | |
|---|---|---|---|---|---|---|
| Clone no. | No. of leaflets | Petiole length (cm) | Internode length (cm) | No. of leaflets | Petiole length (cm) | Internode length (cm) |
| 109 | 7.2 | 8.9 | 1.9 | 7.8 | 12.6 | 1.6 |
| 120 | 7.2 | 9.0 | 2.6 | 6.0 | 11.8 | 1.9 |
| 105 | 6.0 | 9.4 | 2.9 | 7.4 | 12.6 | 2.0 |
| 4 | 9.1 | 8.9 | 3.4 | 9.2 | 11.2 | 2.8 |
| 3 | 8.8 | 9.5 | 3.5 | 8.7 | 11.2 | 2.4 |
| 69 | 7.1 | 7.9 | 2.9 | 7.9 | 7.9 | 1.8 |
| 112 | 7.6 | 11.1 | 3.9 | 7.9 | 11.7 | 2.7 |
| 114 | 6.7 | 9.2 | 3.1 | 7.0 | 11.2 | 2.0 |
| 74 | 9.0 | 9.8 | 3.9 | 9.1 | 11.3 | 3.5 |
| 70 | 9.2 | 12.8 | 4.1 | 9.5 | 14.6 | 3.5 |
| 61 | 8.0 | 11.9 | 4.3 | 8.1 | 12.8 | 3.5 |
| 26 | 8.5 | 10.1 | 3.8 | 8.9 | 12.0 | 3.0 |
| 59 | 7.0 | 10.0 | 3.9 | 8.4 | 11.7 | 4.0 |
| 87 | 8.2 | 10.9 | 4.2 | 8.4 | 13.0 | 4.4 |
| 16 | 7.9 | 9.9 | 4.0 | 8.4 | 11.1 | 3.7 |
| $LSD_{0.95}$ | 0.4 | 0.9 | 1.7 | 0.4 | 0.4 | 0.4 |

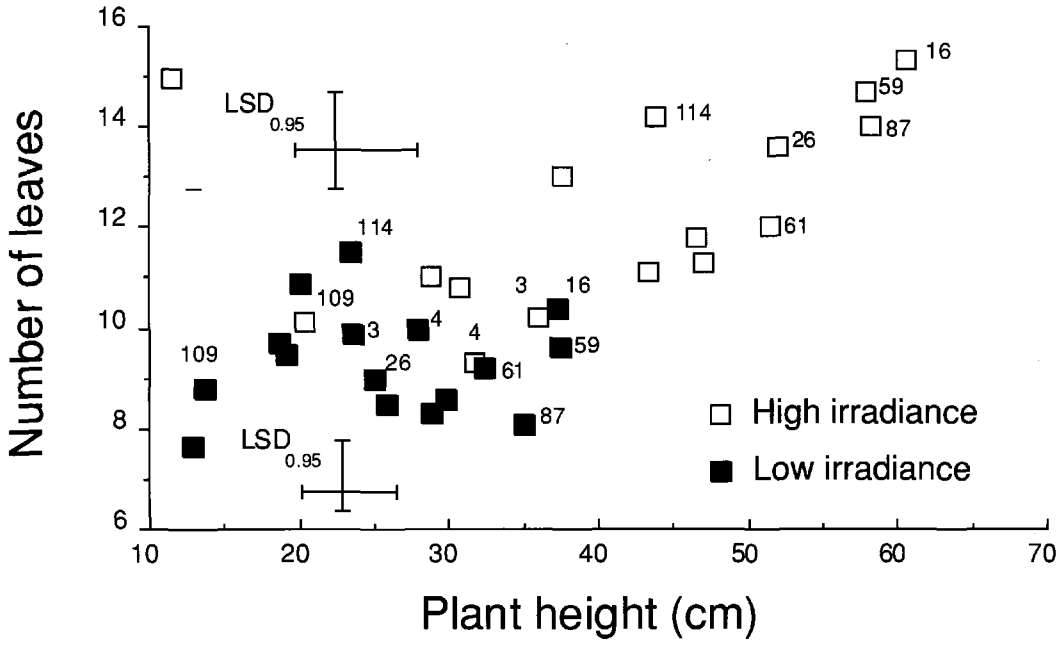


Fig. 1. The relation between number of leaves and plant height in high (1987) and low irradiance (1987/88) clonal comparisons. Each symbol is the mean of 30 plants. A number of clones are marked by number. $LSD_{0.95}$ is indicated for both experiments.

*Forholdet mellem antallet af blade og plantehøjde i forsøg med høj (1987) og lav (1987/88) indstråling i klonsamlinger. Hvert symbol er gennemsnit af 30 planter. Et antal kloner er markeret med nummer. $LSD_{0.95}$ er angivet for begge forsøg.*

(Fig. 1) and internode length (r=0.86, p>0.001) under high irradiance, while no other correlations were found.

In the final low irradiance trial (1987/88) the plant height varied from 13.7 to 37.5 cm, while the variation in leaf number was 8.0 to 11.5 (Fig. 1). A number of clones in the figures are labelled by number, and the cultivars 'Andante' and 'Rondo' carry number 3 and 4 respectively.

In the low irradiance experiment (1987/88) there was only significant correlation between plant height and internode length (r=0.94, p>0.001) and petiole length (r=0.55, p>0.05).

The $LSD_{0.95}$ is slightly higher under high irradiance due to the increased plant size, though the relative LSD-size is the same.

The difference between the fastest growing clone (no. 16) and 'Andante' and 'Rondo' reached 40.6 per cent and 91.6 per cent during high irradiance (1987) and 34.4 per cent and 56.9 per cent during low irradiance (1987/88).

Petiole length and number of leaflets of fifth leaf and the mean internode length show significant differences (Table 1). In all clones except no. 59 and 87 the internode length increased under high irradiance conditions, while there was a marked increase in the petiole length during low irradiance in all clones except no. 69 and 112.

The number of leaflets varies only a little in most clones between the experiments.

The ranking of the clones according to plant height was not affected by irradiance (Fig. 2). There was a close correlation between plant height in the high irradiance and the low irradiance experiments. The similar relation between leaf number did not show any correlation, while the internode length showed a relation close to that of an exponential function (Fig. 3).

There were no large differences between the clones with respect to heterogeneity expressed by the coefficient of variation (CV) of the plant

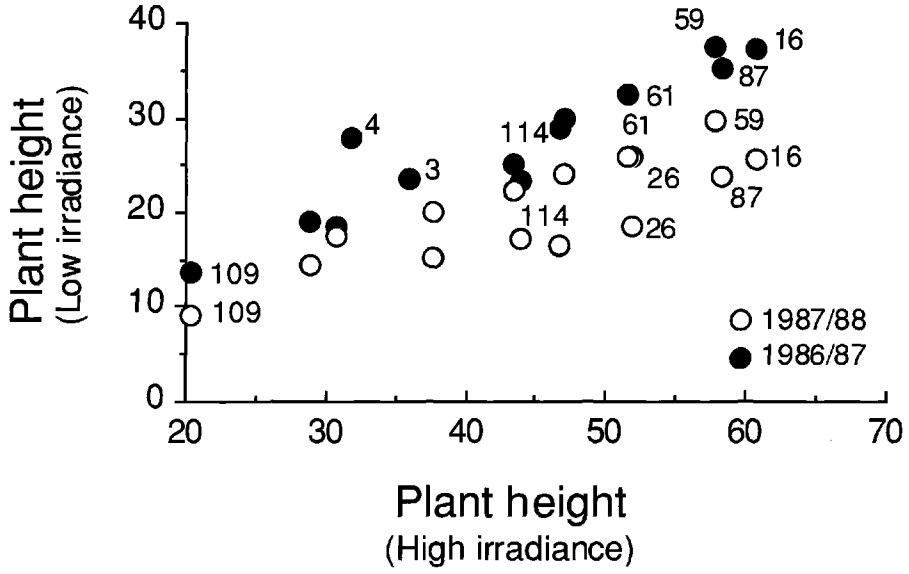


Fig. 2. The relation between clonal plant height under high and low irradiance conditions in three experiments with *Schefflera arboricola.* A number of clones are marked by number. Each symbol is the mean of 30 plants.
*Forholdet mellem plantehøjde i forsøg med høj (1987) og lav (1987/88) indstråling i tre forsøg med* Schefflera arboricola. *Et antal kloner er markeret med nummer. $LSD_{0.95}$ er angivet for begge forsøg.*

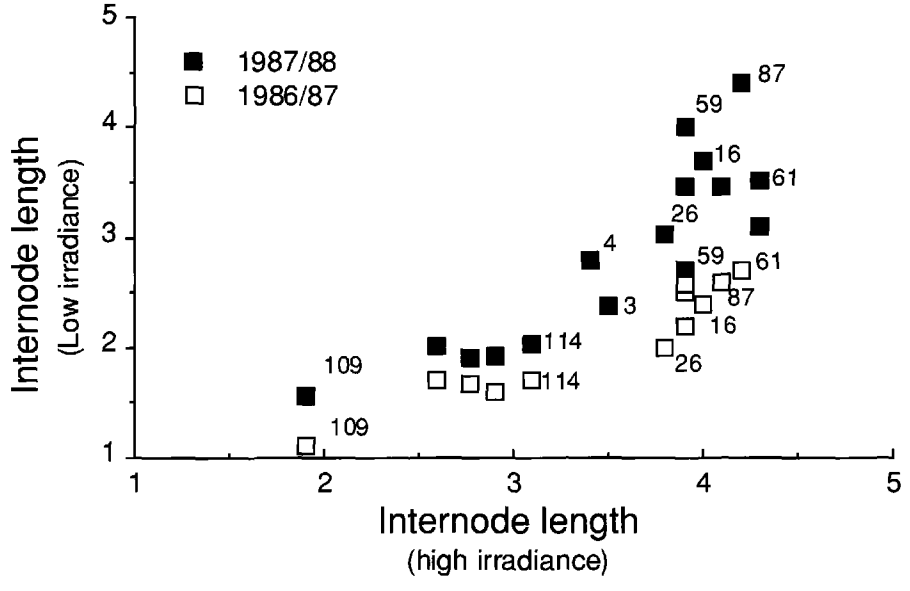


Fig. 3. The relation between internode length under high and low irradiance conditions in three experiments with *Schefflera arboricola.* A number of clones are marked by number. Each symbol is the mean of 30 plants.
*Forholdet mellem internodielængde i forsøg med høj (1987) og lav (1987/88) indstråling i tre forsøg med* Schefflera arboricola. *Et antal kloner er markeret med nummer. $LSD_{0.95}$ er angivet for begge forsøg.*

height. However, a negative correlation between plant height and CV (significant in 1987) ($r= -0.83$, $p<0.01$) indicated that fast growing clones are most homogeneous. There was no difference with respect to mean CV in the experiments, which ranged from 23 to 25 per cent.

## Discussion

In previous experiments clonal selection has been performed under low irradiance conditions in order to enhance the clonal differences and select the highest productive clone in periods of the lowest productivity (1). However, clonal comparisons under high irradiance with *Ficus benjamina* showed no significant differences (11), while this experiment with *Schefflera arboricola* showed highly significant differences. The growth rate of the plants are highest during summer. However, the relative differences between slow and fast growing clones are approximately identical.

The clones no. 59 and 87 have similar growth at the high irradiance experiment, but in the low irradiance experiment (1986/87) clone no. 59 was significantly faster in growth than clone no. 87 (Fig. 2). Also for clones no. 61 and 26 no significant difference in growth was found in the high irradiance experiment, while clone no. 61 had a significantly higher growth than clone 26 in both low irradiance experiments.

The cultivars 'Andante' (clone no. 3) and 'Rondo' (clone no. 4) were collected in connection with a propagation experiment (4, 5), where selection was focused not necessarily on fast growth, and the number of clones was very limited, so the location of the clones in the mid-range of sizes was expected.

Clone no. 4 ('Rondo') had an atypical growth (Fig. 2.), because it had a faster growth under low irradiance than could be expected from the performance under high irradiance conditions, or clone no. 4 does not grow fast enough under high irradiance conditions. Part of the differences in height growth of clones in the high irradiance experiments was due to increases in internode length, but among the fastest growing clones no difference was found in leaf number otherwise. Identical slower growing clones showed marked differences in the number of leaves.

The exponential relation between internode lengths in the high and low irradiance experiment may be related to the effect of the plant density. Fast growing clones having a higher leaf area index are able to catch more light, thus being better competitors by increasing the internode length under low irradiance.

The negative correlation between CV and plant size may be an effect of the randomization pattern during the experiment, where the neighbourhood of small plants may be occupied by larger plants (negative effect) and plants of similar size (no effect), resulting in an increase in heterogeneity in the smallest clones. The calculation of heterogenity has, however, proved to be difficult (7).

The three experiments showed that clonal selection should be performed under low irradiance conditions. Clone no. 59 had significantly faster growth than clone 87 in the low irradiance experiment (1986/87), but not in the 1987/88 experiment and high irradiance experiment. This also indicate that it is necessary to repeat such experiments.

Clones selected as fast growing during low irradiance conditions are also fast growing during high irradiance conditons.

The use of seedling origin clones was a superb method of increasing not only the growth rate, but also to obtain a wider spectrum of morphological characters such as leaf outline and colour.

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