The Competitive Strength of Moso Bamboo (*Phyllostachys pubescens* Mazel ex H. de Lehaie) in the Natural Mixed Evergreen Broad-Leaved Forests of the Fujian Province, China

Dissertation
Zur Erlangung des Doktorgrades
Der Fakultät für Forstwissenschaften und Waldökologie
Der Georg-August-Universität Göttingen

Vorgelegt von
Jinhe Fu
geboren in Hunan, China

Göttingen 2001

Die Deutsche Bibliothek – CIP-Einheitsaufnahme

Fu, Jinhe:

The Competitive Strength of Moso Bamboo (*Phyllostachys pubescens* Mazel ex H. de Lehaie) in the Natural Mixed Evergreen Broad-Leaved Forests of the Fujian Province, China / vorgelegt von Jinhe Fu. – 1. Aufl. – Göttingen : Cuvillier, 2001
Zugl.: Göttingen, Univ., Diss., 2001
ISBN 3-89873-055-7
D7

Abstract

Bamboo is of major importance for the Chinese forestry sector. With about 2% of the total forest area, moso bamboo (*Phyllostachys pubescens*) is of special interest. The main aim of this research is the characterization and analysis of mixed forests of moso bamboo and broad leaf tree species in the subtropical zone of Central China. It is further more expected that this study will provide the information necessary for improving the management of this specific forest type.

In particular, the spatial competition between bamboo (intraspecific) and between bamboo and trees (interspecific) is described using measurements of important site factors such as water availability, solar radiation and soil nutrients.

All measurements were taken on 25 sample plots in five forest types on a research site in Jianyang in the Fujian province in China. The 25 sample plots represent a cross section of the forest types found on different parts of the same slope between 650 and 850 m above sea level. From the upper to the lower slope the plots represent the five forest types:

- pure moso bamboo stand (“Bam” plot 1-5),
- mixed moso bamboo and broad-leaved tree stand on lower slope, bamboo dominant (“BamTree1” plot 6-10),
- mixed moso bamboo and broad-leaved tree stand on mid mountain, bamboo dominant (“BamTree2” plot 11-15),
- mixed broad-leaved tree and moso bamboo stand on upper slope, trees dominant (“TreeBam” plot 16-20),
- pure broad-leaved tree stand (“Tree” plot 21-25).

Each sample plot was divided into three different sized subplots for the measurement of different parameters:

- subplot A 20·20m (400m²) to record all trees above 5cm dbh,

- subplot B 5·5m ($25m^2$) to record woody species < 5cm dbh and higher than 1.3 m, four plots per sampling unit,
- subplot C 2·2m ($4m^2$) to record seedlings (woody species) between 0.3 and 1.3m in height, 16 plots per sampling unit.

Within each sample plot, species, dbh, total height, commercial height and crown diameter of each bamboo culm as well as broad-leaved tree were recorded. The relative solar radiation was measured with PAR-sensors, whereas the relative crown cover and diffuse radiation were determined via an analysis of fish-eye photos. The plant water potential of selected bamboo and broad-leaved trees was measured with a SCHOLANDER device and the plant osmotic potential was determined cryoscopically on adjacent plant samples. The soil nutrient status and soil volume weight were measured using standard methods.

The dominant woody species in the respective forest types were:
Phyllostachys pubescens dominated in the pure stand Bam, whereas in the mixed forest types (BamTree1, BamTree2 and TreeBam) *Phyllostachys pubescens*, *Castanopsis carlesii*, *Castanopsis sclerophylla*, *Prunus davidiana*, *Choerospondias axillaria*, *Cunninghamia lanceolata* and *Pinus massoniana* were most abundant.

The main results of the structure analysis are presented in the following:

a) mean diameter of moso bamboo in the mixed forest types were 5-15% bigger than in the pure bamboo stand,
b) mean height and commercial height of moso bamboo were 4-14% and 9-21% higher in the mixed forest types compared to the pure bamboo stand,
c) height curves of bamboo in the pure stand and the three mixed forest types were almost parallel,
d) total basal area of bamboos and trees in the mixed stands were 16.9 to 18.4 m^2/ha greater compared to pure stands,

e) bamboo densities varied in the distinctive forest types between 990 and 3095 culms/ha,
f) the bamboo age distribution in the researched stands was irregular. Overaged culms should be harvested in order to optimize bamboo productivity,
g) the breaking rate of bamboo tops increased from 3.7% to 14.7% with higher elevation,
h) standing biomass of bamboo was higher in the mixed stands and varied between 30.7 t/ha and 81.2 t/ha for the respective forest types,
i) cumulative probability curves of the WEIBULL diameter distribution showed that 90 % of the bamboo diameters varied between 8 – 15 cm and the corresponding curves for the four forest types were distinct.

11 single tree competition indices, which are either working with distance-weighted size ratios or overlapping crown area, were used to assess the space competition of woody plants aboveground. According to these findings the main competition effect on bamboo originated from neighbouring bamboo. The competition pressure caused by trees increased with an increase of their respective basal area.

Some of the used competition indices were found to be sensitive to growth parameters, namely the indices by ALEMDAG and SCHÜTZ appeared to be sensitive to bamboo height, the indices by ALEMDAG, SCHÜTZ, BELLA2 and BELLA3 showed a sensitivity towards bamboo culm diameter.

Several other competition indices for the individual bamboo culms showed a relationship with relative crown cover, relative radiation and relative diffuse radiation. The relative crown cover is related to diffuse radiation and relative diffuse radiation. On the plots 1 to 20 a negative relationship was found, between the individual bamboo culm and stand indices on one side and relative radiation as well as relative diffuse radiation on the other side. But the individual culm and stand index values are positively related to the relative crown cover. Each of the bamboo growth parameters dg, h and G increased with the decrease of relative radiation.

Water was not a limiting factor to moso bamboo growth on the research site. The noon and night water potentials show that moso bamboo has a very strong water competition ability. Bamboo water potential differences between noon and night were as low as –21.3 bar and the difference increased from Bam to BamTree1 and BamTree2. The mean water content of bamboo leaves and bamboo biomass followed an identical trend. The results show that the greater the day and night water potential difference is, the higher is the bamboo biomass. The water potential differences of three dominant broad leaf tree species were smaller than the corresponding values for bamboo.

Moso bamboo osmotic potential is -8.8 bar at noon and -6.3 bar at night, the minimum value was as low as -24.7 bar at noon and -9.5 bar at night. At night moso bamboo's osmotic and water potential were negatively related to the soil cation contents (Ak_e) and base saturation.

The soil volume weight decreased from BamTree1 over BamTree2 to TreeBam and was lowest for the forest type Tree. This development is caused by the increase of soil organic matter from BamTree1, BamTree2, TreeBam to Tree. Soil with a low volume weight as found in the mixed stands is favourable for bamboo rhizome and root growth. As a result of a higher nutrient return from trees, soil fertility in the mixed forest is enhanced, hence bamboo grows better in mixed than pure stand. Overall the growth performance of bamboo in mixed stands exceeds the performance found in pure stands.

These findings may contribute to improve further management practises in mixed moso bamboo stands.