

Distribution of natural regenerated *Lindera umbellata* at artificial *Chamaecyparis obtusa* floor by several thinning rates

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Abstract: Thinning cut facilitates natural regeneration of woody species on the forest floor. This research surveyed the natural regeneration of *Lindera umbellata* at the floor of artificial *Chamaecyparis obtusa* stand. It also aimed to reconsider how thinning rate have effects on the distribution of *Lindera umbellata*. The survey plots were 30%, 50%, 70% thinning, and control plot in a 50-year *Chamaecyparis obtusa* stand and each plot area was 400 m². The average tree height of *Chamaecyparis obtusa* was 17.5m, the average DBH was 24cm, and the average crown height was over 6.5m. The results showed the appearance rate of *Lindera umbellata* seedlings was 1 to 3% of all seedlings except *Chamaecyparis obtusa*. Thinning rate and relative illumination and the tree height had correlation. These results suggested it has some possibility of forest floor cultivation of *Lindera umbellata*. There was no correlation between thinning rate and relative illumination and chlorophyll amount of the leaves of *Lindera umbellata*.

Key word: natural regeneration, floor vegetation, appearance rate, space dominant, SPAD

間伐率の異なるヒノキ林床におけるクロモジの分布

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要旨: クロモジ (*Lindera umbellata*)は、北海道から九州にかけての温帯に自生するクスノキ科の樹木であり、スギやマツなどの造林地の林床でも見られる。しかしながら、スギ、ヒノキなどの人工林において、その立木密度や間伐率の違いによる分布、出現率などについてはあまりよく知られていない。そこで本研究では、東京農業大学・富士試験林（標高約900m）の50年生のヒノキ間伐試験林（平均樹高17.5m、平均DBH24cm）において、対照区、30%、50%、70%間伐区の各400m²の試験区を設け、その林床のクロモジ分布を調べた。調査の結果、クロモジ実生の出現率は1~3%であったが、間伐率および相対照度とクロモジの出現率と樹高にはある程度の相関が認められた。このことから、間伐によって、林床のクロモジの出現や生長をコントロールすることも示唆された。しかし、間伐率や相対照度と、クロモジのクロロフィル量との間には相関は認められなかった。

キーワード：天然更新、林床植生、出現率、空間優先度、SPAD

I Introduction

Thinning cut facilitates natural regeneration on the forest floor. Recently, broad-leaf trees regeneration at artificial needle-leaf forests floor has become more important, because it is useful to increase diversity of vegetation and sometimes make mixed forests without planting (2). Natural regeneration is more effective at the difficult stands to plant and is easier to adapt the stand condition (2)(3)(4)(5). In addition, in the view of the point of forestry, how to regenerate the useful

species is important. Especially, medical plants are useful, economically valuable, and worth as forest biomass, too.

Lindera umbellata is a woody plant that can grow on the forest floor of artificial conifer stands. It has characteristic sweet fragrance (1) and produces perfume and medical liquor. Recently, it has come to make bath salt, too. Therefore, this research focused on the *Lindera umbellata* and surveyed the natural regeneration at the floor of an artificial *Chamaecyparis*

obtusa stand. It also reconsidered the effects of thinning by several rates for its growth.

II Materials and Methods

1. Site The survey plots were located in an artificial 50-year *Chamaecyparis obtusa* stand in the Fuji Research Farm Area of Tokyo University of Agriculture. They are located in Susono city of Shizuoka Prefecture and the altitude is 830m. In March of 2001, 30%, 50%, 70% thinning by density were done on the stand. Each survey plot area was 400 m² and all stands were mostly flat. Forest soil was andosol and the soil pH was 3.5 to 4.5. Counting all regenerated seedling of woody plants in each plot and measuring all tree height of each tree (above 0.3m). Table 1 shows the outline of surveying plots.

Table 1. Outline of survey plots of *Chamaecyparis obtusa* stand

	Control	30% thinning	50% thinning	70% thinning
Stand Density (/ha)	1925	750	675	475
Average Height (m)	16.6	18.1	17.1	17.4
Average DBH (cm)	19.9	26	23.8	26.3
Total Basal Area (m ²)	61.4	40.7	30.6	26.1
Total Volume (m ³)	541.39	420.42	249.77	200.41
Relative illumination (%)	4.37	6.01	11.33	14.22

2. Appearance rate This research surveyed the appearance rate of *Lindera umbellata* on each plot was surveyed as the frequency of seedlings among all species except *Chamaecyparis obtusa*. It also surveyed vertical appearance condition of all seedlings higher than 30cm from the floor.

3. Chlorophyll amount (SPAD) This research also surveyed chlorophyll amount of the *Lindera umbellata* by SPAD-502 analyzer (KONICA MINOLTA) to check physiological activity condition. Measuring twice per a leaf and measured 20 leaves in each 50cm story above the ground.

4. Relative illumination This research measured relative illumination by measuring illuminance at the 1m height from the floor in each stand and

unobstructed sky condition.

III. Results and Discussion

1. Appearing species numbers of each plot

Table 2 shows the appearing species number and appearance rate of *Lindera umbellata* of each plot.

2. Average tree height of *Lindera umbellata*

Next, Fig.1 shows the correlation of thinning rate and the average tree height of *Lindera umbellata*. Thinning rate and the average height showed high correlation ($r=0.7101$). In addition, correlative illumination and the average tree height showed correlation, too ($r=0.6594$).

Table 2. Appearing species number of each plots

	Control	30% thinning	50% thinning	70% thinning
Species numbers	29	34	31	28
Appearance rate of <i>Lindera umbellata</i> (%)	1	1	2	3

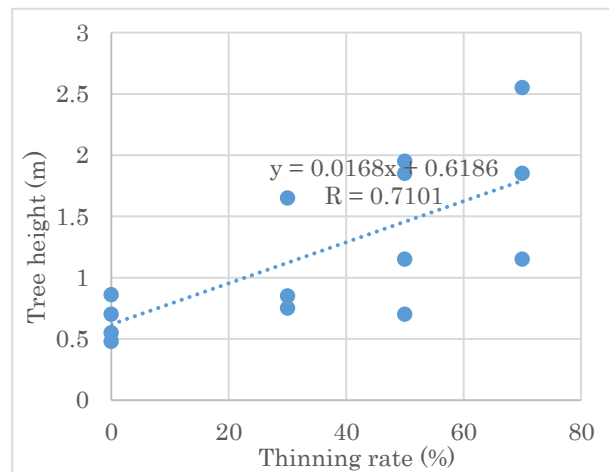


Fig.1 Correlation of thinning rate and the average tree height of *Lindera umbellata*

3. Space dominant conditions of each plot

Space dominant conditions of each plot are shown in Fig.2 to 5. Species over 0.3m height are shown.

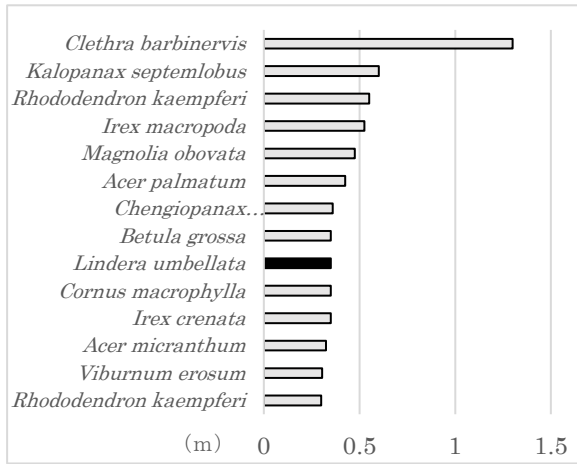


Fig.2 Space dominant conditions of control plot

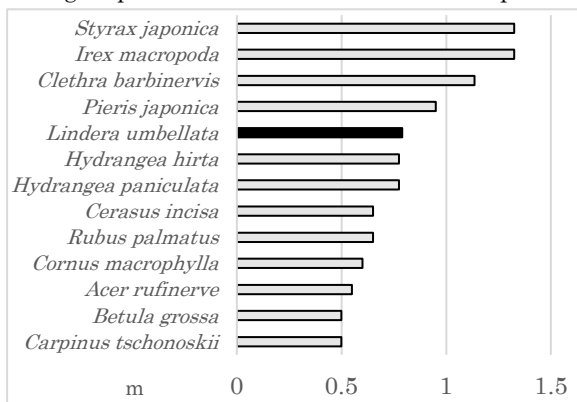


Fig.3 Space dominant conditions of 30% thinning plot

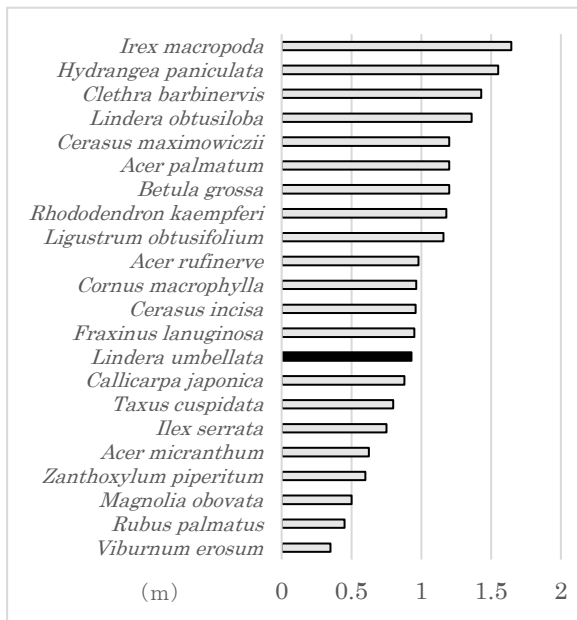


Fig.4 Space dominant conditions of 50% thinning plot

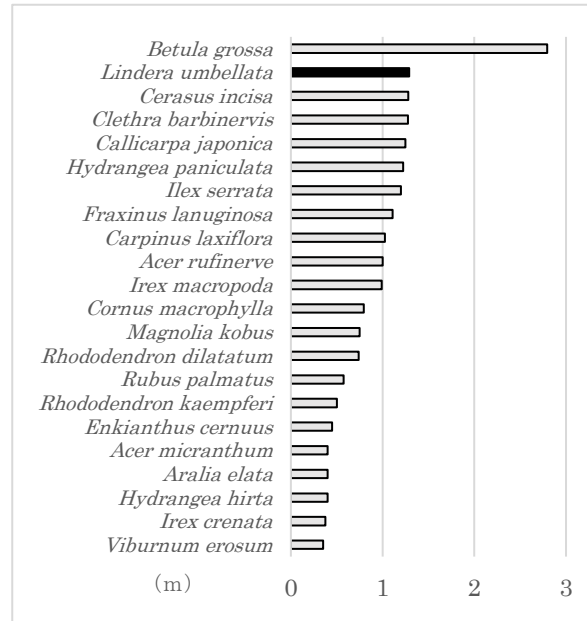


Fig.5 Space dominant conditions of 70% thinning plot

4. Correlative illumination of the places of *Lindera umbellata* appearance

Fig.6 shows the average correlative illumination of the places of *Lindera umbellata* appearance. The percentage in control, 30% and 50% thinning plots were extremely low. These data suggested that *Lindera umbellata* could germinate and grow under the low illumination level at artificial *Chamaecyparis obtusa* stand.

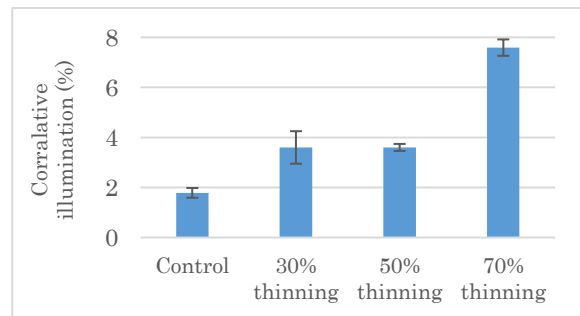


Fig.6 Average correlative illumination of the places of *Lindera umbellata* appearance (*Error bar means SD)

5. Chrolophyll amount (SPAD) of each plots

Chrolophyll amount (SPAD) of *Lindera umbellata* in each plot are shown in Fig.7. Significant difference among the thinning rate was not shown.

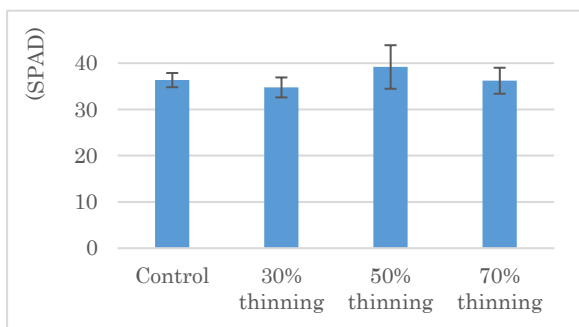


Fig.7 Average data of SPAD in each plot
(*Error bar means SD)

Next, average data of SPAD of each story are shown in Fig.8. These data also showed no significant difference among the stories.

These results suggested that *Lindera umbellata* thoroughly distributes chlorophyll regardless of light condition.

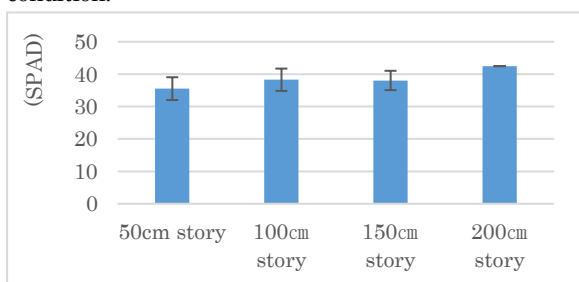


Fig.8 Average SPAD data of each stories of all plots
(*Error bar means SD)

6. Other features *Lindera umbellata* appeared under *Chamaecyparis obtusa* crowns. Fig. 9 shows the changing of the tree shape under the crown of *Chamaecyparis obtusa*. It branched widely to absorb light under the tree shade. This shaping phenomenon suggested *Lindera umbellata* has adapting ability for low light condition.

There were sprout regeneration in each plot, too.

Fig.10 showed the root system of *Lindera umbellata*. Rootlets and hair roots were few.

IV. Conclusion

This research showed the appearance rate of *Lindera umbellata* was 1 to 3 % under an artificial *Chamaecyparis obtusa* stand. The space dominance was from the middle to the high class in the floor vegetation. Thinning had correlation with the

correlative illumination and tree height. *Lindera umbellata* might thoroughly distribute chlorophyll regardless of light condition. It can regenerate by sprout, too.

Next step is considering how to promote the growth or cultivating *Lindera umbellata* on the artificial forest floor.



Fig.9 Growth of branches of *Lindera umbellata* under the high story tree shade.

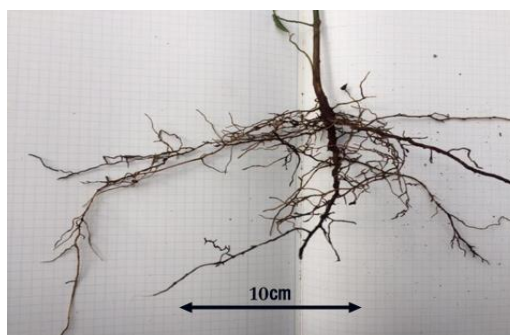


Fig.11 Root system of *Lindera umbellata*

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