STUDY ON THE PHYSIOLOGICAL REACTION OF EVERGREEN BROAD-LEAVED TREES TO LIGHT AND TEMPERATURE (III)

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1. INTRODUCTION

Trees and shrubs have a very wide range of adaptation to grow in the shade and this adaptation acts as a decisive factor in plant succesession[2].

Assimilated carbon which has not be consumed by respiration (i.e., the surplus in the CO_2 budget) can be used for growth and storage of substance, and increases dry matter of a tree. The accumulation of carbon in trees is indispensable to increase in weight, which is able to be directly measured by weighing the harvested dry trees. The increase in mass of a tree due to the products from assimilation is called dry matter production[6].

The purpose of this paper is to clarify the effect of controlled shading on the growth and dry matter production of seedlings of broad-leaved trees.

2. MATERIAL AND METHOD

Around two and half year-old trees of *Cinnamomum camphora, Cyclobalanopsis glauca, Distylium racemosum,* and *Machilus thunbergii* were used for the experiment.

90 pots with each two trees were set in the shade controlled room made of wooden frame with the dimension of 100 cm × 100 cm × 120 cm in height. This frame was covered with black nylon screens which have different light penetration for providing expected shade. The resultant light intensity were 100 (no screen), 60, 36, 22% of day light (adjusted with nylon screen transparence and number of layer). The relative light intensity in experimental rooms were measured by using a photocell illuminometer.

The soil in the pots was sandy loam in upper layer and gravels about 2 cm in thickness at the bottom. The pots were treated with fertilizer of 4 grams contained N:P:K = 3:3:2. The potted trees were watered sufficiently every two days. The size of used pot is 17.5 cm in diameter and 20 cm in height.

The trees were transplanted on April, 1982, and harvested on October, 1983. The diameters and heights of trees at transplanting were in range of 0.52-1.10 cm and 44.4-109.8 cm.

The data of the dry matter production of individual trees in all treatments were collected with harvesting method. To clarify the adaptation of each species to shading treatment, relative growth rate, final specific leaf area, net assimilation rate and dry weight increment were studied.

3. RESULTS AND DISCUSSION

The relationship between relative growth rate and relative light intensity is shown as Fig. 1. The growth rate of *C. glauca* is the biggest in four experimented species. More favorable growth tendency under slight and severe shade than in open were observed in *C. glauca* and *C. camphora,* while other two species showed different patterns that those species were favorable growing in the open treatment. The same pattern of *C. glauca* and *C. camphora* are reported in *Cryptomeria japonica* and *Chamaecyparis obtusa*. Also similar patterns of *D. racemosum* and *M. thunbergii* are found in those of *Pinus densiflora* and *Pinus thunbergii*[5].

In Fig. 2, the relationship between final specific leaf area and relative light intensity are shown. All species showed the same tendency of its increase as the decrease of light intensity. The similar tendency also are observed in *Quercus petraea*[1]. The reduction of specific leaf area might be an expression of adaptability to the more light intensity.

The relationship between net assimilation rate and relative light intensity are shown in Fig. 3. *C. glauca,*

D. racemosum, and *M. thunbergii* showed same behavior that the net assimilation rate rose as the increase of the light intensity, except *C. camphora*. Similar are reported in Conifers[7], *Eucomica ulmoides, Alnus hirusta, Ulmus parvifolia, Pinus thunbergii, Cryptomeria japonica* and *Chamaecyparis obtusa*[5]. *C. camphora* showed the decrease in open treatment, as reported in *Quercus petraea*[1]. This decrease in full daylight suggest that these species cause water stress in leaves and show more or less the stomatal closure under full open light condition. It is said that these species are intolerant under strong solar radiation.

The influence of light intensity on dry weight increment are shown in Fig. 4. The tendency of *C. glauca, D. reacemosum,* and *M. thunbergii* were similar and the dry weight increment increased with light intensity increase, while *C. camphora* was different. The increase of dry matter was also observed in *Abies*[8]. The decrease of dry matter of *C. camphora* under full light condition is attributed to the decrease of net assimilation rate.

The sensitivity to light intensity are different among species. With the increase of light, trees show the decrease of specific leaf area, that is, the thickness of leaf increase. This is more clear in *C. camphora*, and this species show lower growth response under strong light condition. It is concluded that *C. camphora* is most sensitive to light and only can grow under low light intensity differing from other tree species. And this suggest that these four species distributed in evergreen broad-leaved forest show different competition during seedling emergence and initial growth.

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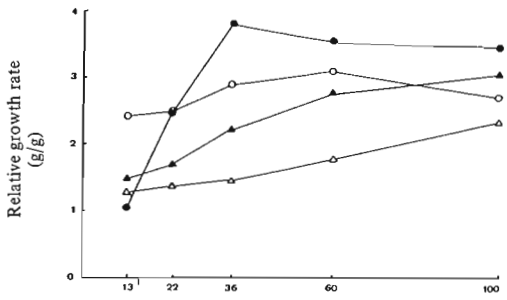

Fig. 1 The relative growth rate of *C. camphora* (○), *C. glauca* (●), *D. racemosum* (△), and *M. thunbergii* (▲) in relation to relative light intensity.

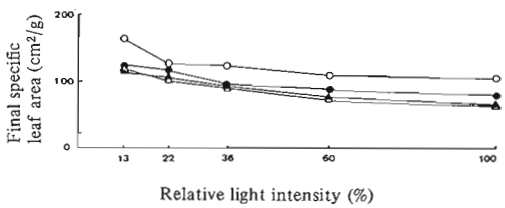

Fig. 2 Final specific leaf area of *C. camphora* (○), *C. glauca* (●), *D. racemosum* (△), and *M. thunbergii* (▲) in relation to relative light intensity.

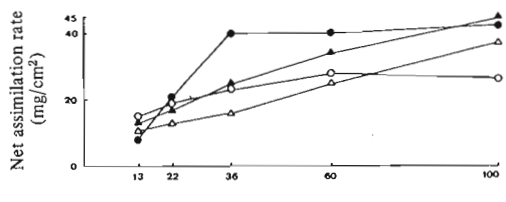

Fig. 3 The net assimilation rate of *C. camphora* (○), *C. glauca* (●), *D. racemosum* (△), and *M. thunbergii* (▲) in relation to relative light intensity.

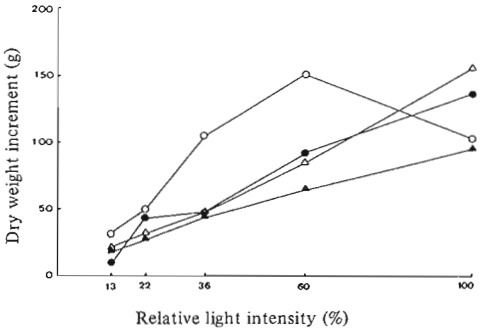

Fig. 4 The dry weight increment of *C. camphora* (○), *C. glauca* (●), *D. racemosum* (△), and *M. thunbergii* (▲) in relation to relative light intensity.