Effects of Various Constant Growth Temperatures on Photosynthesis and Dark Respiration of Some Broad-Leaved Tree Seedlings

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1. Introduction

Forest tree species differ from each other in their responses to environmental factors[5]. In certain tree species, growth are determined by the differences in day and night temperature[1,2,3], while others grow better in constant temperature condition[4].

In the present work, we report the results of investigation carried out under the controlled conditions in Biotron about the influence of various constant growth temperatures upon CO_2 exchange of young plants of evergreen broad-leaved species in Southern Japan, to clarify what differences are shown among these species as to photosynthesis-temperature relationships.

2. Materials and Methods

Around 2-year-old young trees of *Cycloblanopsis glauca, Machilus thunbergii, Cinnamomum camphora,* and *Distylium racemosum* with diameters and heights in the range of 0.3-1.3 cm and 25-143 cm respectively were used for the experiment. 24 pots with each two trees were then put in the growth chamber controlled with constant day and night temperature of each 15°, 25°, and 30°C respectively and relative air humidity of 70%.

The pots were fertilized with N, P, K nutrients of 4 grams per pot as a ratio 3:3:2 and watered sufficiently every two days. After the temperature treatment for 6 months in the growth chambers, the photosynthetic and respiratory ratio were measured under the measuring temperature of 15°, 20°, 25°, 30° and 35°C by using of Ultrared Gas Analyzer (Hitachi-Horiba) and the changeable illumination system with spattering shadowless lamps.

3. Results and Discussion

The relation of CO_2 exchange and the growth temperature, under which materials had been treated for 6 months, was investigated. There was found a correlation between growth temperature and rates of photosynthesis of *C. glauca* seedling, as shown in Fig. 1-a, where the growth temperature of 15°C, the maximum and optimum of photosynthesis were found at 20°C and 20°-25°C, respectively. When the growth temperature of 30°C, the same conditions were obtained at 25°-30°C. Furthermore, the effects of the growth temperature upon the rate of respiration increased with the increases of measuring temperature.

Fig 1-b shows the rate of photosynthesis and that of respiration of *M. thunbergii* seedlings. The maximum rates of photosynthesis under each 15°, 25°, and 30°C of growth temperature were found at 15°, 25° and 20°C of measuring temperature respectively, and then the optimum rates of photosynthesis were obtained at 15°-20°C, 25°-30°C and 20°-25°C of measuring temperature respectively. The relationships between growth temperature and the rates of respiration were clearly defined. The respiration increased with decreases of growth temperature.

The effects of the growth temperature on the rate of photosynthesis and respiration of *C. camphora* are shown in Fig. 1-c. The maximum rates of photosynthesis of 15°, 25° and 30°C of growth temperature were found at 20°, 25° and 20°C of measuring temperature respectively, and then the optimum rates of photosynthesis were obtained at 15°-20°C, 25°-30°C and 20°-25°C of measuring temperature respectively. The relationship between the growth temperature and the rate of respiration was fairly clear, and the respiration rates increased with decrease of growth temperature, but at the measuring temperature more than 30°C, 30° of growth temperature was higher in respiration than that of 25°C.

The rate of the photosynthesis and the respiration of *D. racemosum* seedlings are shown in Fig. 1-d. The maximum rate of photosynthesis of 15°, 25° and 30°C of the growth temperature were found at 25°, 20°-25° and 30°C of measuring temperature, and then the optimum rates of the photosynthesis were obtained at 25°-30°C,

20°-25℃ and 25°-30℃ of measuring temperature. The relationship of the growth temperature and the rate of respiration was clearly defined under less temperature than 25℃ of measuring temperature and the respiration rates increased with the decreases in growth temperature. At 30° and 35℃ of measuring temperature, the respiration of 25℃ of growth temperature were lowest.

It can be, for 4 species, said that the growth temperature give an influence to photosynthetic activity and the treatment in 15℃ decreases the activity, especially in a high range of measuring temperature. The relation between the relative photosynthesis and the difference of measuring and growth temperature is shown in Fig. 2. When the difference is +20°, the relative photosynthesis rates decrease drastically in both *M. thunbergii* and *C. glauca*. This might be attributed to the higher latitude of natural distribution of these species in comparison with *C. camphora* and *D. racemosum* which distributed naturally in warmer region. The less difference of measuring and growth temperature, the more relative photosynthesis in the range of optimum measuring temperature, although the optimum temperature for photosynthesis changes with growth temperature.

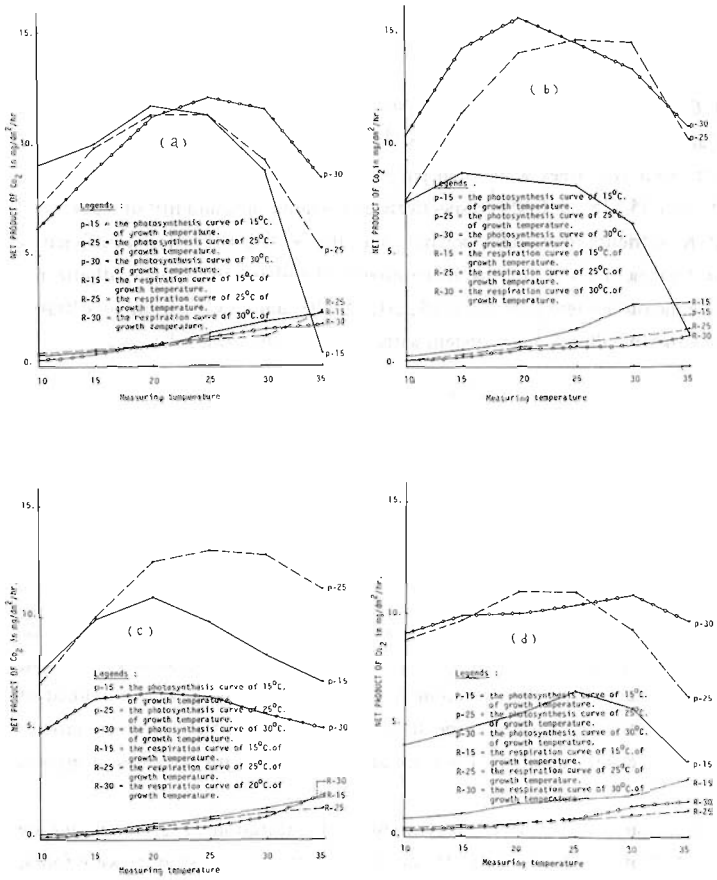

Fig. 1 Net photosynthesis and dark respiration of the seedlings of *C. glauca* (a), *M. thunbergii* (b), *C. camphora* (c), and *D. racemosum* (d) grown under constant temperature and measured over a range of measuring temperature.

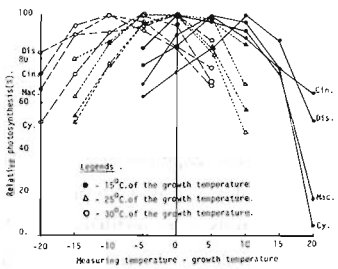

Fig. 2 The relative photosynthesis of the seedlings of *C. glauca, M. thunbergii, C. camphora,* and *D. racemosum* in relation to differences between measuring temperatures and growth temperatures.

References

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