

On the Diurnal Rhythmic Change in the Stem Diameter of Japanese Black Pine (*Pinus thunbergii* PARL.)*

Kazuo SUMIYA**

Diurnal changes in the stem diameter of trees have been recognized by several investigators^{1~4)}, in which the stem generally contracts in day-time and thickens at night. A general assumption would be that the changes in diameter are a direct result of changes in water content of trees. On the other hand, it could be considered that they are controlled by a biological diurnal rhythm of about 24 hrs' cycle within tree, although these measurements have been carried out, so far, only on the trees grown in the natural condition, the cycle of which is 24 hrs. If the latter case is true, the diameter of trees grown in the condition having any cyclic time other than 24 hrs., for example even in the continuous light, must also change with the cyclic time of about 24 hrs. It will be tested in this report.

Material and Method

A four years old tree of Japanese black pine (*Pinus thunbergii* PARL.) grown in the nursery of Uji campus were moved into the phytotron, which was controlled at 25°C in the lighting-time of 15 hrs. and at 20°C in the dark of 9 hrs., in early August, 1980 and in late May, 1981. After about one month, it was transferred into the growth cabinet working at constant temperature of 25°C and exposed to the series of light and dark as follows:

14 hrs. light - 10 hrs. dark (3 cycles) → continuous light of 48 hrs. → continuous dark of 48 hrs. → 20 hrs. light - 16 hrs. dark (2 cycles[#]) → 14 hrs. light - 10 hrs. dark (1 cycle^{##}).

The changes in the stem diameter were replaced by the changes in length of strain gauges put along the circumference of the stem, the diameter of which was

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** Research Section of Wood Physics.

[#] One cyclic time of light and dark was equal to one and a half of natural days.

^{##} Light and dark periods were the reverse of natural condition outside the growth cabinet.

about 1 cm, from which an outermost bark was removed by a razor blade in advance. They were amplified by a strain meter and recorded continuously. The strain gauge was adhered on the third internode from the apex by Aron Alpha, when the tree was transferred into the growth cabinet. The water content in soil was maintained to almost constant throughout these experiments.

Result and Discussion

Fig. 1 shows the results obtained. The general responses for light and dark are the same in all cases. From these facts, it is obvious that the stem diameter of tree changes similarly in the controlled conditions, irrespective of their growth stages through the growing season.

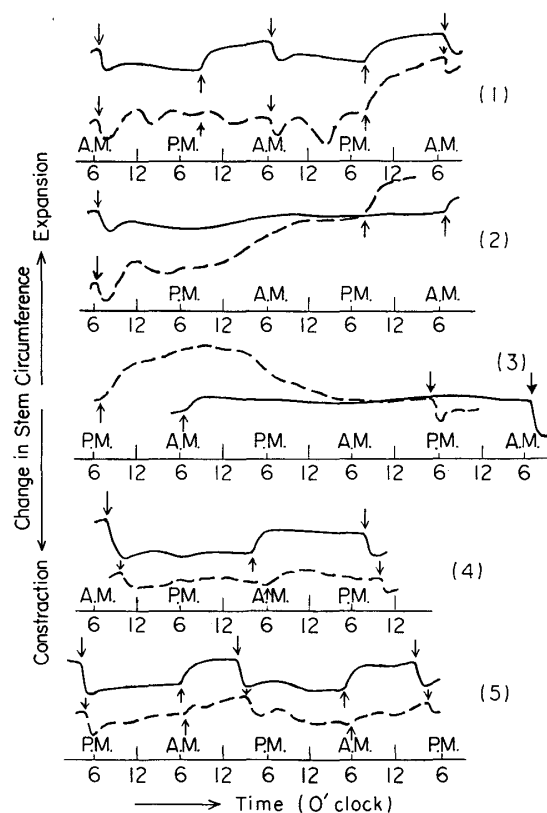


Fig. 1. Changes in the stem circumference with lighting cycle. (1) analogous to the natural day, (2) in the continuous light, (3) in the continuous dark, (4) in the lighting cycle of 36 hrs., (5) reversal to the natural day. Symbols: ↓ Light on, ↑ Light off, — treated in May, 1981, --- treated in August, 1980.

Under all conditions of light and dark in these experiments, the stem begins to contract immediately after the lighting and to expand immediately after the darkening. Therefore, it is confirmed that the changes in the stem diameter must not have

a biological diurnal rhythm, but it is controlled by the changes in the environmental light and dark conditions around trees.

If the changes in the diameter are a direct result of changes in water content of trees, and if the water content of trees is mainly controlled by stomata, the opening and shutting of stomata must not have a biological diurnal rhythm, although it is said that stomata may open and shut in a diurnal rhythm. This point remained to be solved.

References

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