Effect of Wind on Transpiration of New and Old Leaves of Some Trees.

(Atarasii Ha to Hurui Ha no Zyoosansayoo ni Oyobosu Kaze no Hataraki)

Satoo Taisitiroo *

(* Family name is set ahead according to his mother tongue)

Effect of Wind on Transpiration of New and Old Leaves of Some Trees.

SATOO TAISITIROO[1)]

This paper reports the preliminary results of the comparison of the effect of wind on transpiration of new and old leaves of some trees.

MATERIALS AND METHODS

Shoots of *Lithocarpus edulis*, *Cornus controversa*, *Cryptomeria japonica* and *Rhaphiolepis umbellata*, grown in the garden of the University, were used. For *Lithocarpus* and *Cryptomeria*, leaves of the current year and the last year were compared. For *Cornus* and *Rhaphiolepis*, leaves of spring and summer shoots were compared. Transpiration rates of cut shoots in water were determined gravimetrically, using a balance with a sensitivity of 1 mg. Experiments were carried out in the experimental room, details of which were already described in a previous paper (SATOO, 1948). A single experiment was composed of four individuals, including each two of both, new and old. They were divided into two sets, the experimental and the control. Wind was produced by an electric fan, its velocity was 3.5 m/sec. at the center of the experimental sets. The experiments were carried out under two conditions of light, *i. e.*, diffused light and artificial illumination. Diffused light was nearly the same as shown in the previous paper (SATOO, 1948). As the artificial illumination, a 200 watt bulb at a distance of 50 cm from the experimental sets was used.

Transpiration was determined for 15 minutes in calm conditions and then for 15 minutes in wind. Percentage of increase in transpiration by wind was assumed to represent the effect of wind. Water contents of leaves were determined after setting them in a jar of brown glass, saturated with water vapor, for 48 hours, and assumed as saturated water contents. The comparison of the effect of wind on transpration of new and old leaves were statistically tested by means of analysis of variance, and other comparisons were analysed by *t*-test.

RESULTS

1. *Lithocarpus edulis.*

In all 20 determinations, transpiration of new leaves were more strongly increased

1) Family aame is set ahead accroding to his mother tongue.

by wind than that of old ones. Table 1 shows the average increase of transpiration by wind as percentage of transpiration in calm air conditions. As shown in the table, new leaves were more sensitive to wind than old ones, and this relation was more evident when illuminated by the electric lamp. Transpiration during a period from 13 : 00 to 9 : 00 in the experimental room per unit area of leaves and saturated water content were also higher in new leaves. These relations were statistically ascertained. The greater difference in sensitivity to wind beween new and old leaves under artificial light was chiefly due to the increase of sensitivity in new leaves.

Table 1. *Lithocarpus edulis.*

		New leaves	Sig. at :	Old leaver	Ratio old/new	Note
Increase in transpiration	Diffused light	% 115.8	% 0.1	% 78.0	0.68	T=25.7°C, R.H.=93.7%
	Significant at : %	5	···	insig.	1	Date : VII. 6 – VII.10
	Artificial light	144.5	0.1	73.3	0.51	T=25.9°C. R.H.=94.0%
Saturated water content		65.0	0.1	53.6	0.87	
Transpiration in mg/20hrs. /100 cm² leaf		872	0.1	610	0.70	

2. *Cornus controversa.*

In all 12 determinations, transpiration of new leaves were more sensitively affected by wind than that of old ones. Table 2 shows the average effect of wind on transpiration of new and old leaves. It is apparent that new leaves were more sensitive to wind than old ones, and this relation is more evident under artificial light. These

Table 2. *Cornus controversa.*

		New leaves	Sig. at :	Old leaves	Ratio old/new	Note
Increase in Transpiration	Diffused light	% 91.7	% 0.1	% 37.3	0.41	T=25.8°C. R.H.=90.3%
	Significant at : %	insig.	···	1	0.1	Date : VIII.10 – VIII. 13.
	Artificial light	96.0	1	18.4	0.19	T=25.6°C. R.H.=89.3%

relations were statistically significant. The greater difference in sensitivity to wind under artificial light was chiefly due to the decrease of sensitivity in old leaves.

3. *Cryptomelia japonica.*

In all 13 determinations, transpiration of new leaves were more sensitively affected by wind than that of old ones. Table 3 shows the average effect of wind on transpiration of two types of leaves. It is apparent that sensitivity of transpiration of *C. japonica* to wind was also greater in new leaves than old ones. Saturated water content was also higher in new leaves. These relations were statistically significant.

Table 3. *Cryptomeria japonica*

	New leaves	Sig. at :	old leaves	Ratio old/new	Note
	%	%			
Increase in transpiration	73.1	0.1	34.9	0.78	T = 26.0°C, R.H. = 88.5%
Saturated water content	80.3	1	70.7	0.89	Date : VIII.4 – VIII.7.

It is apparent that in three types of trees, conifer (*Cryptomeria iaponica*), deciduous (*Cornus controversa*) and evergreen (*Lithocarpus edulis*) broad leaved trees, transpiration of new leaves were more sensitively affected by wind. Besides these three species, the same relation was observed between leaves of summer and spring shoots of *Rhaphiolepis umbellata*, though it was impossible to carry out frequent experiments. Under diffused light, average increase in transpiration rates of *R. umbellata* by wind were 49% for new leaves and 24% for old ones. For broard leaves, it was also found that the difference in sensitivity to wind was increased by artificial illumination.

DISCUSSION

On the relation of age of leaves to transpiration, there is no constant trend. Guttenberg (1907) reported that new leaves transpired less than old leaves, while Mittmeyer (1931) reported the reverse results. But Bergen (1904) and Rouschal (1939) reported that in some species new leaves transpired more than old leaves, and in others the former transpired less than the latter. The data for *Lithocarpus edulis* in this study showed that one year leaves transpired more than two year leaves.

Bernbeck (1924) reported that transpiration of shade leaves of *Impatiens* were affected more strongly by wind than that of sun leaves. Wrenger (1935) found that

transpiration of mesophytes were generally affected more strongly than that of xerophytes. SEYBOLD (1929) also reported that transpiration of mesophytes and hygrophytes were increased by wind while that of xerophytes were not affected at all. The results indicates that between new and old leaves exist such relations as found between sun and shade leaves and between xerophytes and mesophytes. It was also found that this relation was more evident under artificial light. It can be ascribed to the increase of the effct of wind on new leaves and decrease of that on old ones, under artificial light. GRIEP (1940) found that the stronger the light intensity was, the less affected the transpiration by wind. The results for old leaves in this study showed general agreement with GRIEP's results, but for new leaves it did not agree. It needs further experiments. KÔKENTSU (1926) found that daily fluctuation in transpiring power of too young and too old leaves of *Coleus blumei* was less than that of the most developed ones. It suggests that sensitivity of new and old leaves to the change of environmental factors is somewhat different.

SUMMARY

1. The effect of wind on transpiration of new and old leaves of *Lithocarpus edulis*, *Cornus Controversa*, *Cryptomeria japonica* and *Rhaphiolepis umbellata* were compared.

2. The transpiration of new leaves was more strongly increased by wind than that of old ones. This relation was more evident under artificial light than under diffused light in the experimental room in basement.

The writer is indepted to Prof. Dr. NAKAMURA KENTARO[1] for guidance throughout his investigations.

LITERATURE CITED.

BERGEN, J. Y. (1904) Bot. Gaz. **38**, 446. BERNBECK, O. (1924) Flora **117**, 293. GRIEP, W. (1940) Zeitschr. Bot. **36**, 1. GUTTENBERG, H. (1907) ENGLERS Bot. Jahrb. **38**, 383. (cited by ROUSCHAL, 1939). KÔKETSU, R. (1926) Bot. Mag. (Tokyo) **40**, 122. MITTMEYER, G. (1931) Jahrb. Wiss. Bot. **74**, 364. ROUSCHAL, E. (1939) ibid. **87**, 436. SATOO, T. (1948) Jour. Jap. Forest. Soc. **30**, 26. SEYBOLD, A. (1929) Die physikalische Komponente der pflanzlichen Transpiration. Berlin. WRENGER, M. (1935) Zeitschr. Bot. **29**, 257.

1) Family name is set ahead according to his mother tongue.

Atarasii Ha to Hurui Ha no Zyoosansayoo ni Oyobosu Kaze no Hataraki

—— Arasuzi ——

1. Matebasii, mizuki, sugi, oyobi syarinbai no atarasii ha to hurui ha no zyoosansayoo ni oyobosu kaze no hataraki o kurabeta.

2. Atarasii ha no zyoosansayoo wa hurui ha no sore yori mo kaze ni yoru huekata ga ookii. Kono kankei wa dentoo de terasita toki no hoo ga tikasitu no surigarasu no mado o toosita hikari dake no toki yorimo itizirusii.