BIOLOGIA PLANTARUM (PRAHA)

22 (2) : 154—156, 1980

BRIEF COMMUNICATION

Differences in Stomatal Density, Dimension and Conductances to Water Vapour Diffusion in Seven *Hevea* species

Z. SAMSUDDIN**

Rubber Research Institute of Malaysia*

Abstract. The stomatal density, dimension and conductances to water vapour diffusion of seven *Hevea* species were studied. It was found that these parameters were significantly different between the species. However, no distinct relationship between stomatal density or dimension and stomatal conductances could be discerned.

Differences in stomatal density and dimension have been observed in various cultivars of plant species, for example in *Panicum antidotale* (DOBRENZ *et al.* 1969), in *Medicago sativa* (COLE and DOBRENZ 1970), in *Populus* species (CEULEMANS *et al.* 1978), and between plant species, for example in *Chamaecyparis* species (ZOBEL *et al.* 1978). The present work reports on the differences in stomatal density, dimension and conductances to water vapour diffusion of seven *Hevea* species.

The species of *Hevea* studied were *Hevea rigidifolia* (*H.r.*), *H. guianensis* (*H.g.*), *H. pauciflora* (*H.p.*), *H. nitida* (*H.n.*), *H. benthamiana* (*H.ben.*), *H. spruceana* (*H.s.*), found in the gene pool of the Rubber Research Institute of Malaysia Experimental Station (Kuala Lumpur 3.09 °N, 101.43 °E) and *H. brasiliensis* (clones RRIM 600, RRIM 612, GT 1, and Tjir 1) from the source bushes of the institute.

Stomatal conductances to water vapour diffusion (g_s) were measured with a non-ventilated diffusion porometer (Lambda Instrument), and photon flux densities (400 nm—700 nm) received by the adaxial and abaxial surfaces of the leaves were measured using a quantum sensor (Lambda Instrument), by placing the sensor parallel to the leaves maintaining their original angles of display. Stomatal density and dimension were obtained by stripping the epidermis of the abaxial surfaces of the leaves with the help of cellophane tapes and then taping the strips on microscope slides. Counting and measuring of the stomata were done under a light microscope. Measuring technique was as described by CEULEMANS *et al.* (1978). Preliminary tests showed that the epidermis of the adaxial surfaces of these species had no stomata.

Received July 18, 1979; accepted August 27, 1979

* *Address:* P.O. Box 150, Kuala Lumpur (01—02), Malaysia.

** *Present address:* Département Biologie, Universitaire Instelling Antwerpen, Universiteitsplein 1, B-2610 Wilrijk, Belgium.

TABLE 1

Stomatal density, stomatal dimension (length and width), stomatal pore area, total pore size cm^{-2}, and the mean stomatal conductance (g_s) at saturating photon flux densities ($Q > 300\ \mu mol\ m^{-2}s^{-1}$) for different species of *Hevea*. Number of observations (n) for columns 2, 3, and 4 is 20 each and for column 7 is 10

Species	Stomatal density (Number cm^{-2})	Stomatal dimension length [μm]	Stomatal dimension width [μm]	Pore area [μm^2]	Total pore size cm^{-2} [mm^2]	g_s [$cm\ s^{-1}$]
Hevea rigidifolia	52 836 ± 9 843	12.36 ± 2.10	3.13 ± 0.67	29.41	1.60	0.27 ± 0.06
H. benthamania	45 076 ± 7 464	14.25 ± 1.51	4.67 ± 0.67	52.27	2.36	0.33 ± 0.05
H. spruceana	45 743 ± 7 686	11.89 ± 1.14	3.52 ± 0.94	32.87	1.50	0.29 ± 0.02
H. pauciflora	38 983 ± 5 963	11.67 ± 1.61	3.47 ± 0.67	31.80	1.24	0.18 ± 0.03
H. guianensis	37 856 ± 3 824	12.93 ± 1.44	3.75 ± 0.79	38.08	1.40	0.20 ± 0.03
H. nitida	40 336 ± 5 584	7.64 ± 0.82	2.20 ± 0.42	13.20	0.53	0.28 ± 0.03
H. brasiliensis						
Clones						
RRM 600	46 509 ± 2 758	13.68 ± 2.38	3.23 ± 0.66	34.70	1.61	0.43 ± 0.06
RRM 612	41 799 ± 3 905	11.77 ± 2.15	3.02 ± 0.53	24.92	1.04	0.43 ± 0.04
GT 1	37 180 ± 4 867	11.84 ± 2.20	2.68 ± 0.50	24.92	0.93	0.42 ± 0.03
Tjir 1	50 429 ± 4 411	11.07 ± 0.18	2.59 ± 0.49	22.52	1.14	0.41 ± 0.04

Measurements were done on current hardened shoots, with leaves having physiological age of LBC 9 (SAMSUDDIN *et al.* 1978), at the height of 2—4 m. Leaves having a total photon flux density (adaxial plus abaxial surfaces) of more than 300 μmoles $m^{-2}s^{-1}$, which is the saturated photon flux density of the species (SAMSUDDIN, unpublished) were selected.

The stomatal density (N), dimension (*i.e.* length (l) and width (w)), stomatal pore area (A) (derived by likening the stomatal pore to an ellipse, thus the area $A = \pi(l/2) \times (w/2)$), total pore size cm^{-2} (*i.e.* AN) and the mean stomatal conductances (g_s) at saturated photon flux density are summarized in Table 1.

Statistical analysis on the stomatal density of the species showed significant difference ($P = 0.01$) and the Duncan new multiple range test showed overlapping among the species as:

GT 1; *H.g.*; RRIM 612; *H.p.*; *H.n.*; RRIM 600; *H.s.*; *H.ben.*; Tjir 1; *H.r.*

and the analysis on the dimension was also significant ($P = 0.01$) and showed overlapping as:
H.n.; Tjir 1; RRIM 600; RRIM 612; GT 1; *H.ben.*; *H.p.*; *H.s.*; *H.g.*; *H.r.*

Statistical analysis on the mean stomatal conductances of the species showed significant difference ($P = 0.01$) with overlapping as:
H.p.; *H.g.*; *H.r.*; *H.s.*; *H.n.*; *H.ben.*; Tjir 1; RRIM 612; GT 1; RRIM 600.

Thus, there is no distinct relationship between stomatal density or stomatal dimension with g_s, for the *Hevea* species studied, though CEULEMANS *et al.* (1978) and LUUKKANEN and KOZLOWSKI (1972) showed the existence of a relationship between gas exchange and the stomatal density and dimension in poplar clones. Nonetheless, it is interesting to note that though the clones of *Hevea brasiliensis* that had been undergoing intensive selection (SCHULTES 1977) showed overlapping with the other species with respect to the stomatal density and dimension, they belong completely to another group of ranking when the stomatal conductances were studied.

REFERENCES

CEULEMANS, R., IMPENS, I., LEMEUR, R., MOERMANS, R., SAMBSUDDIN, Z.: Water movement in the soil-poplar-atmosphere system. I. Comparative study of stomatal morphology and anatomy, and the influence of stomatal density and dimension on the leaf diffusion characteristics in different poplar clones. — Oecol. Plant. **13** : 1—12, 1978.

COLE, D. F., DOBRENZ, A. K.: Stomate density of alfalfa (*Medicago sativa* L.). — Crop Sci. **10** : 61—63, 1970.

DOBRENZ, A. K., WRIGHT, L. N., HUMPHREY, A. B., MASSENGALE, M. A., KNEEBONE, W. R.: Stomate density and its relationship to water-use efficiency of blue panicgrass (*Panicum antidotale* RETZ). — Crop Sci. **9** : 354—357, 1969.

LUUKKANEN, O., KOZLOWSKI, T. T.: Gas exchange in six *Populus* clones. — Silvae Genet. **21** : 220 to 229, 1972.

SAMSUDDIN, Z., KHIR, M. A. R., IMPENS, I.: Development of leaf blade class concept for the characterization of *Hevea brasiliensis* MUELL. ARG. leaf age. — J. Rubber Res. Inst. Malaysia **26** : 1—5, 1978.

SCHULTES, R. E.: The odyssey of the cultivated rubber tree. — Endeavour, N. S. **1** : 133—138, 1977.

ZOBEL, D. B., LIN, T.-P., LIU, V. T.: Stomatal distribution on leaves of three species of *Chamaecyparis*. — Taiwania **23** : 1—6, 1978.