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Lutoid membrane composition as a marker for yield in *Hevea brasiliensis*

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ABSTRACT

Latex flow is a primary factor which determines the physiological limit of rubber yield. It has been suggested that the stability of lutoids is a major factor controlling flow. A strong positive correlation exists between plugging index (a measure of the magnitude of latex vessel plugging) and bursting index (a measure of lutoid instability). Although these indices are clonal characters strongly correlated with yield, they have limitations when used as breeding parameters in that it is not known whether the physiological phenomena expressed by these indices are heritable in a simple manner. Hence, attempts were made to identify stable biochemical markers related to yield. We were able to identify two characters related to lutoid membrane composition which showed a high correlation with bursting index and plugging index and thereby yield.

Lutoids were isolated from latex samples of high and low yielding clones of *Hevea brasiliensis*. The phospholipid content of the bottom fraction and protein content of the lutoid membrane were estimated in eight clones with four replicates per clone. The results showed a strong negative correlation of these two parameters with bursting index and plugging index. The possibility of using these parameters for screening clones for yield is discussed.

Introduction

The productivity of a rubber tree depends on its capacity to synthesise latex. The most important factors which determine the physiological limit of rubber yield are the rate of biosynthesis leading to regeneration of latex and the flow of latex on tapping which stops after some time. It has been suggested that the stability of lutoids is a major factor controlling flow and thereby the yield of rubber[1,2]. It was postulated by Southorn[3] that lutoids burst during flow releasing factors which activate flocculation. The duration of latex flow, which is a major factor in rubber production, depends on the extent of wholeness (stability) of the lutoids when they flow out of the latex vessels. Lutoid stability is measured in terms of the bursting index. A positive correlation exists between plugging index and bursting index. These indices have serious limitations in that although these indices are clonal characters and can be correlated with yield, it is not known if the physiological phenomena expressed by these indices are heritable in a simple manner. No reliable methods have been devised to investigate the plugging index and bursting index in young plants and therefore these indices cannot be used in breeding and selection.

Attempts were made in our Institute to identify some plant biochemical markers which may be discernible even at a young age. Studies along these lines will enable us to make use of these parameters as indicators of the flow controlling process. Few investigations seem to have been carried out to relate the lutoid membrane components with yield or yield components except for reports from our Institute. A comparative study on the content of phospholipids and proteins in the lutoid membrane of high and low yielding clones was made.

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Materials and methods

Four trees each of clones RRII 105, PB 235, PB 217 and PB 215, representing high yielders, and clones Ch4, Pil B 84, Ch 29 and Tjir 16, representing low yielders, were selected from a statistically laid out clone trial at the Central Experimental Station of the Rubber Research Institute of India. The trees were in the fifth year of tapping in panel BO1 under the 1/2S d/2 6d/7 system of tapping. Latex samples from individual trees were collected in ice and centrifuged at 23,000 rpm for 45 minutes at 4°C. The rubber phase and C serum were discarded and the bottom fraction obtained was processed for further studies.

Total lipids were extracted from the bottom fraction by the method of Bligh and Dyer[4]. A known volume of the total lipid extract was separated by silicic acid column chromatography according to Hasma and Subramaniam[5]. Phospholipids were estimated by the method of Zilversmit and Davis[6].

Lutoid membrane for protein estimation was prepared according to Gidrol *et al*[7]. For the solublisation and extraction of proteins, the method of Evans[8] was adopted. Protein content of the samples were assayed by the method of Lowry *et al*[9] using BSA as standard. Yield (cup coagulation), plugging index, bursting index and dry rubber content were observed in all the clones.

Results and discussion

A definite pattern in the bottom fraction phospholipid concentration and the membrane proteins could be seen in the high yielders and low yielders. There is significant difference in the concentration of membrane proteins in the high yielding and low yielding clones and the concentration of phospholipids in the bottom fraction was significantly higher in the high yielders compared to the low yielders (Table 1).

Table 1 ***Yield, Plugging index, Bursting index, drc, and Protein content of lutoid membrane and Phospholipids (BF) in eight Hevea clones***

Clone	Yield (g/tree /tapping)	Plugging index	Bursting index	drc	Protein (mg /g dry wt)	Phospholipids (mg/g dry wt)
Ch 4	60.0	2.93	21.05	33.00	9.68	4.42
Pil B 84	43.3	4.58	22.66	33.50	9.34	4.12
Tjir 16	59.3	3.57	43.39	30.70	10.74	0.58
Ch 29	26.3	4.35	33.90	32.54	10.88	3.03
PB 215	126.5	2.90	12.55	44.60	13.04	8.51
PB 235	120.6	3.08	11.27	44.20	16.56	7.42
PB 217	82.2	3.00	11.65	39.00	16.69	12.07
RRII 105	97.25	2.54	7.45	41.80	16.70	6.55
CD (0.05)	-	NS	8.00	7.59	1.79	3.38

Correlations were worked out between the phospholipid content of the bottom fraction and the bursting index, plugging index, yield and drc. A highly significant negative correlation exists between bottom fraction phospholipids and bursting index, (r = -0.835), significant at the 1% level. Significant relations were also observed between bottom fraction phospholipids and yield (r = 0.63) and with drc (r = 0.74), both being significant at the 5% level (Figure 2). Similarly, a significant relation exists between the lutoid membrane protein and bursting index (r = -0.73), membrane protein and yield (r = 0.71) and membrane protein and drc (r = 0.79), all being significant at the 5% level (Figure1).

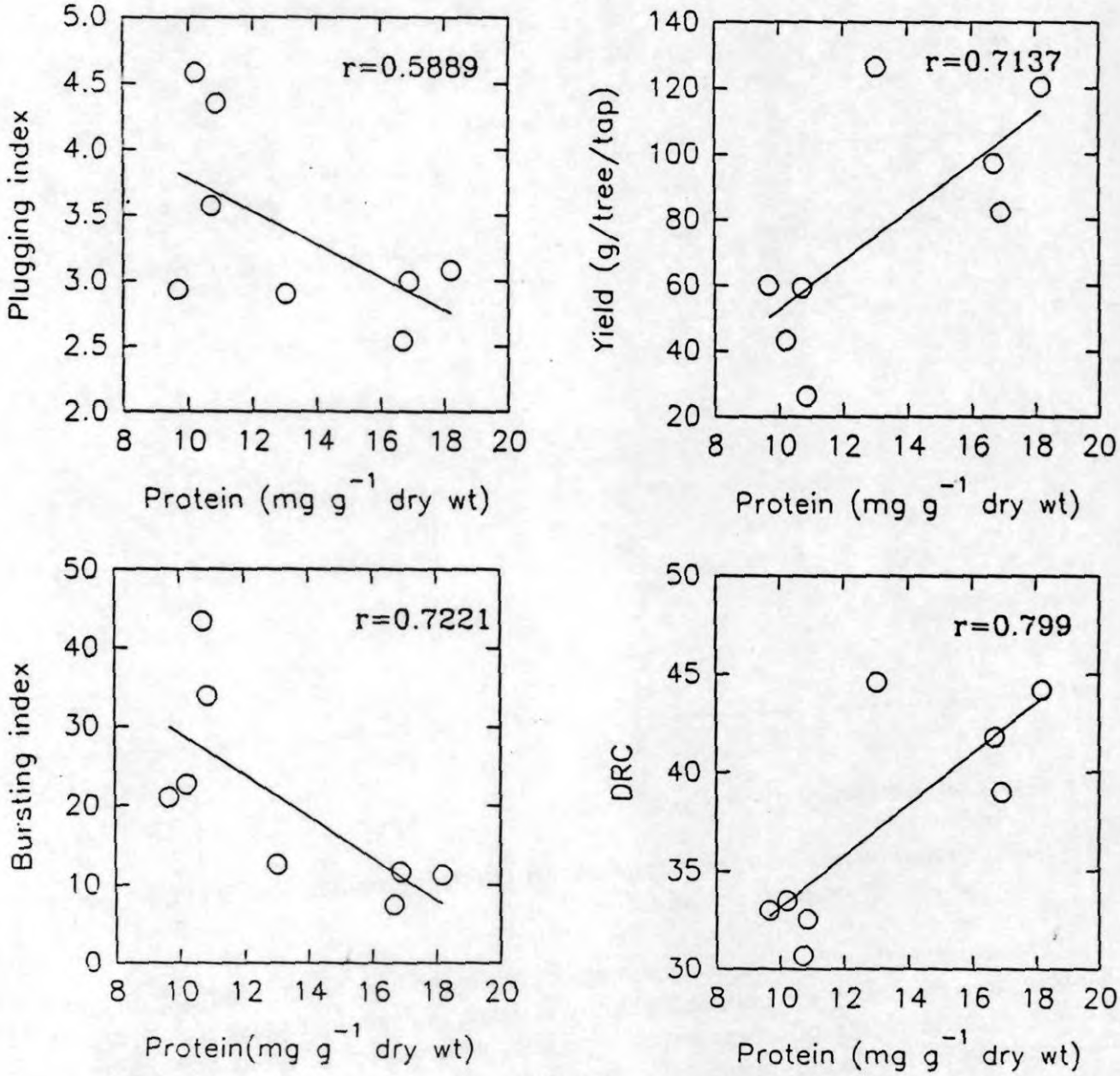

Figure 1 ***Relationship between lutoid membrane protein and yield, plugging index, bursting index and drc.***

A higher concentration of phospholipids and proteins may be contributing to the stability of the lutoids which is one of the major factors determining rubber yield. Both plugging index and yield are influenced by stability of the lutoids, a higher stability facilitating more flow of latex and thereby yield of rubber.

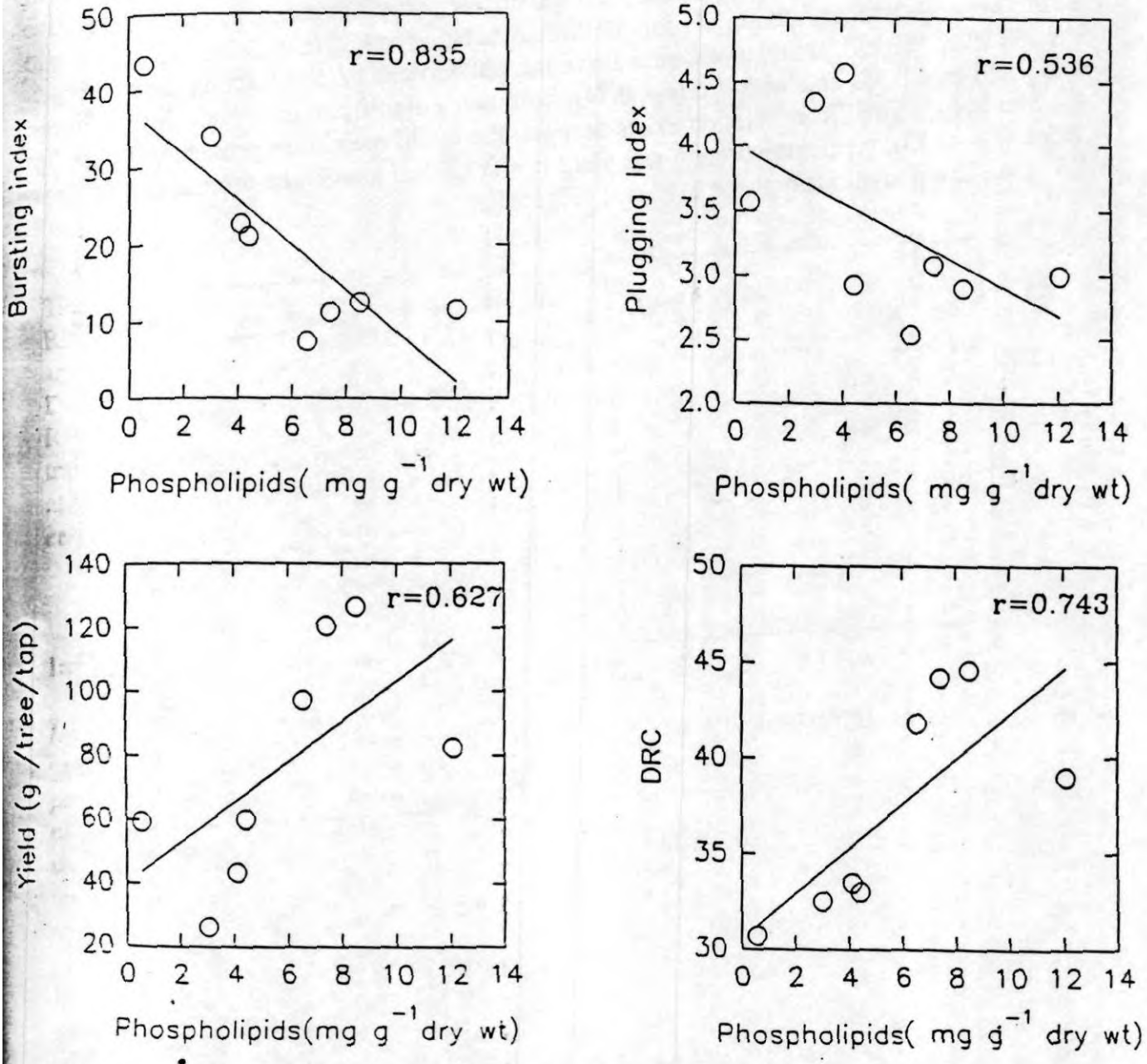

Figure 2 ***Relationship between phospholipids (Bottom fraction) and yield, plugging index, bursting index and drc.***

The higher bottom fraction phospholipid content in the high yielders indicate a higher negative charge increasing the colloidal stability of latex. Phospholipids also play a role in imparting selective permeability properties especially with respect to the concentration of certain cations in the lutoid serum. The significant relation that exists between lutoid membrane protein and drc and also phospholipids and drc leads us to think that these two factors, apart from imparting a higher stability to lutoids, favour an active metabolism within the latex vessels resulting in a higher rubber production.

In the light of the above results, the possibility of using lutoid membrane proteins and bottom fraction phospholipids as markers for yield in *Hevea brasiliensis* is suggested.

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