

SUSCEPTIBILITY OF HEVEA CLONES TO BLACK STRIPE DISEASE

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SUMMARY

Bark rot or black stripe of *Hevea brasiliensis* caused by *Phytophthora* spp. is the only economically important disease of the tapping panel. Screening trials were carried out for three consecutive years at four different localities to evaluate the inherent susceptibility of thirty three *Hevea* clones to black stripe disease. The results indicated that the clones commonly grown in the eastern hemisphere or proved to be potential genetic material for future use show a differential inherent susceptibility with RRIC 130 being the most susceptible. Among the other examined RRIC 119, RRIC 133, RRIC 110, RRIC 112, RRIC 114, PB 86, RRIC 117, RRIM 600 and RRIC 132 were susceptible while BPM 24, RRIM 717, RRIC 116, PB 260, RRIC 121 and RRIC 100 were resistant.

Key words: bark rot, black stripe, clonal susceptibility, *Phytophthora* spp.

INTRODUCTION

Bark rot or black stripe of *Hevea brasiliensis* Muell. Arg. is a wet weather disease present in all rubber growing countries in the world. In Sri Lanka bark rot is caused by the fungus *Phytophthora meadii* McRae or *Phytophthora palmivora* (Butl.) and it is the only disease of economic importance among the diseases affecting the tapping panel. The pathogen makes its entry into the host through tapping cuts when the weather conditions are favourable for infection (Peries, 1965; 1976). During periods of wet weather it spreads both above and below the tapping cut, causing considerable damage to the bark, often giving the panels a fluted appearance due to uneven callusing. The infection makes subsequent tapping difficult or impossible (Wastie *et al.*, 1973; Liyanage *et al.*, 1984).

Present management strategy of the disease is the prophylactic application of fungicides regularly during periods of wet weather when infected pods are present (Peries, 1965; Schreurs, 1969; Liyanage *et al.*, 1977; Liyanage, 1982; Edathil *et al.*, 1988; Tan, 1989; Jayasinghe & Fernando, 1991). Although fungicides provide a satisfactory protection against the disease, their use is not always economically justified. Wastie *et al.* (1973) pointed out that there is a wide range of host reactions among *Hevea* genetic material to the different diseases and by screening parent material and progeny for disease resistance those having unacceptably high susceptibility can be eliminated. Further, they pointed out that in

areas of the country where risk of disease is high, clones having an appropriate degree of resistance or tolerance should be planted.

Several screening techniques have been developed to assess clonal susceptibility to black stripe. In all techniques the trunk is artificially inoculated with a known concentration of fungal spore suspension and the severity of the resulting infection subsequently assessed (Satchuthananthavale *et al.*, 1975; Wastie *et al.*, 1973; Liyanage *et al.*, 1984).

In this paper we report the observations of screening trials carried out for three consecutive years on thirty three *Hevea* clones against black stripe.

MATERIAL AND METHODS

Hevea clones

Thirty three *Hevea* clones (Table 1) grown in the eastern hemisphere or identified as potential clones were screened for their susceptibility to bark rot. Experiments were carried out in four major rubber growing districts in Sri Lanka namely Kalutara, Ratnapura, Galle and Kegalle during the South West monsoon period for three consecutive years; 1992, 1993 and 1994.

The organism

The Bt isolate of the fungus *Phytophthora meadii* (International Mycological Institute identification number 342172) obtained from a diseased petiole of the clone PB 86 was used throughout the study. Single spore isolate of the culture was maintained on Lima Bean Agar (LBA) under paraffin oil at room temperature ($28 \pm 2^\circ\text{C}$). The isolate was grown through the petioles of *Hevea brasiliensis* at least once in six months.

Inoculation

The technique employed was the disc method of Satchuthananthavale *et al.*, 1975. Zoospore suspension was prepared by scraping the sporangia on the surface of ten culture plates into 150 ml sterile distilled water and chilling it to 20°C for 20-30 minutes and subsequently incubating at room temperature for a further 5 to 10 minutes for the release of zoospores. The spore suspension used for the inoculation was adjusted to a final concentration of 10,000 spores per ml.

A bark plug of 2.5 cm diameter was made using a bark borer on the trunk at a height of around 150 cm above the ground level. Sterile absorbent cotton plug of the same diameter (2.5 cm) was saturated with 2 ml of the zoospore suspension and was placed in the space of the removed bark plugs and sealed off with budding tape in such a manner as to ensure aeration. Ten trees were inoculated from each clone. The experiment was carried out during the South West monsoon period (May - Sept.).

Susceptibility of *Hevea* clones to black stripe

Recording of observations

Observations were made three weeks after inoculation by exposing the bark around the point at which inoculum plugs were placed. The lesions were traced on paper from the trees and area infected was measured using a planimeter.

Statistical analysis

Results recorded for four sites in three consecutive years were subsequently pooled and standardized by subtracting the mean from corresponding values and divided by the standard deviation before analysis. Subsequently a hierarchical cluster analysis was performed using single linkage method, and clusters formed during the analysis was illustrated as a dendrogram. The procedure PROC CLUSTER in statistical package SAS was employed in the analysis (SAS, 1987).

RESULTS AND DISCUSSION

All the clones produced lesions of varying sizes on inoculation indicating that none of the clones tested were immune to bark rot. However, they showed a differential inherent susceptibility to the disease (Fig. 1). The single linkage cluster method suggests the clones can be categorised into 5 clusters at the distance 0.55. There were only 3 clusters at the distance 0.8, where cluster 2,3 and 4 can be fused together.

Of the clones tested RRIC 130, a clone recommended under group 3 by the Rubber Research Institute of Sri Lanka showed the highest susceptibility. The field susceptibility of RRIC 130 to bark rot has brought to our notice even during the immature period of growth in localities where weather is highly favourable for the development of the disease (Jayasinghe and Wettasinghe, 1993). The more popular clones of the RRIC 100 series which are presently recommended in group 1 and widely accepted by the growers showed a resistant reaction (Fig. 1). For instance RRIC 121, RRIC 100 and RRIC 102 were found to be highly resistant to the disease. The observations for the clones RRIC 100 and RRIC 102 reaffirmed the work of Satchuthananthavale *et al.* (1975) and Liyanage *et al.* (1984). However, it is noteworthy that the clone RRIC 121 which is reported to be highly susceptible to *Phytophthora* leaf fall in the field (Jayasinghe & Wettasinghe, 1993) shows a great degree of resistance to bark rot caused by the same fungus (Fig. 1).

The figure 1 gives the relative inherent susceptibility of 33 *Hevea* clones with different origins (Table 1) to bark rot. Most of these clones are widely grown in the eastern hemisphere and considered as very high yielders while some of these clones are experimentally proved to be potential clones for future use. There are few clones such as RRIC 109, RRIC 111, RRIC 119, HP 74 - 181 and HP 74 - 194 tested in this study which have already been condemned due to high susceptibility to *Corynespora* leaf fall or low yield production in subsequent large scale trials.

Table 1. *Details of the Hevea clones used for the screening programme*

Clone	Country of origin	Parentage
RRIC 100	Sri Lanka	RRIC 52 x PB 86
RRIC 101	Sri Lanka	CH 36 x RRIC 7
RRIC 102	Sri Lanka	RRIC 52 x RRIC 7
RRIC 109	Sri Lanka	CH 36 x RRIC36
RRIC 110	Sri Lanka	LCB. 1320 x RRIC 7
RRIC 111	Sri Lanka	RRIC 52 x PB 5/139
RRIC 112	Sri Lanka	RRIC 45 x CH 36
RRIC 113	Sri Lanka	RRIC 52 x RRIC 36
RRIC 114	Sri Lanka	RRIC 45 x FX 4098
RRIC 115	Sri Lanka	RRIC 45 x FX 4098
RRIC 116	Sri Lanka	RRIC 88 x FX 4098
RRIC 117	Sri Lanka	RRIC 45 x IAN 863
RRIC 119	Sri Lanka	IAN 3434 x RRIC 52
RRIC 120	Sri Lanka	RRIC 36 x FX 516
RRIC 121	Sri Lanka	PB 28/59 x IAN 873
RRIC 130	Sri Lanka	IAN 710 x RRIC 45
RRIC 132	Sri Lanka	IAN 717 x RRIC 117
HP 74-193	Sri Lanka	RRIC 100 x RRIC 101
RRIM 712	Malaysia	RRIM 600 x RRIM 701
HP 74-181	Sri Lanka	RRIC 100 x RRIC 101
BPM 24	Indonesia	GT 1 x Avros 1734
RRIC 133	Sri Lanka	IAN 45/710 x RRIC 45
RRIM 717	Malaysia	PB 49 x RRIM 603
PB 86	Malaysia	PRIMARY
HP 74-194	Sri Lanka	RRIC 100 x RRIC 101
HP 74-213	Sri Lanka	RRIC 100 x RRIC 101
PB 28/59	Malaysia	PRIMARY
RRIM 600	Malaysia	TJ 1 x PB 86
PR 255	Indonesia	TJ 1 x PR 107
PR 261	Indonesia	TJ 1 x PR 107
PB 235	Malaysia	PB 5/51 x pb 5/78
PB 260	Malaysia	PB 5/51 x PB 49
RRII 105	India	TJ 1 x GL 1

Susceptibility of *Hevea* clones to black stripe

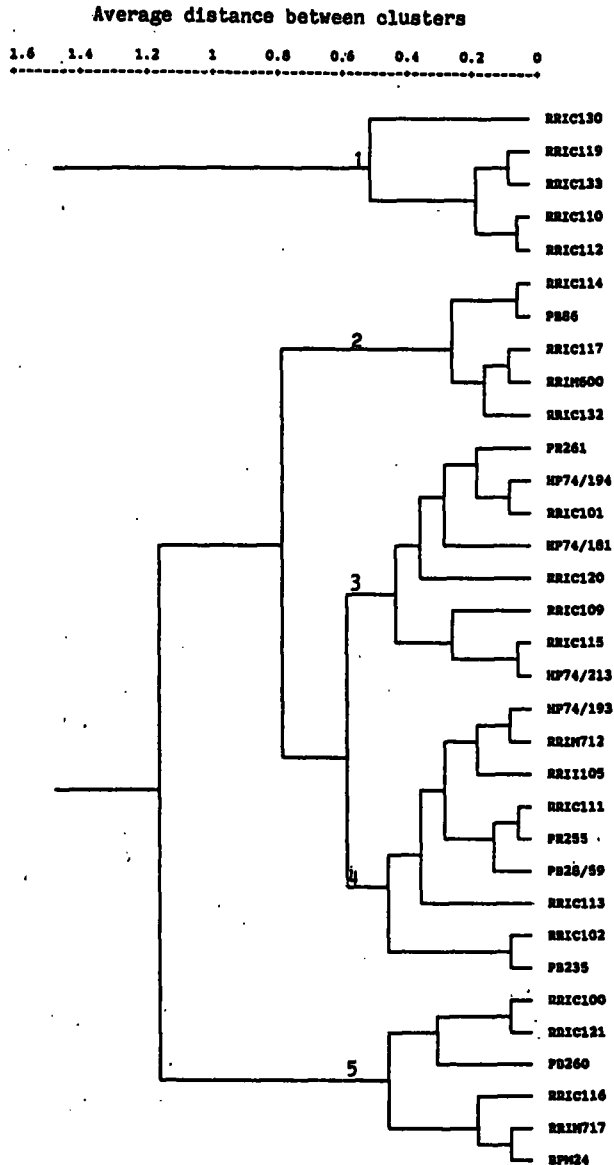


Fig. 1. Dendrogram showing the grouping of 33 *Hevea* clones based on the susceptibility to bark rot caused by *Phytophthora meadii*. The average linkage method of clusterine was applied to Euclidean distance

A knowledge of the inherent susceptibility or resistance of a clone would be of great advantage in recommending suitable planting material for the different agro-climatic zones as pointed out by Satchuthananthavale *et al.* (1975) and Wastie *et al.* (1973). Hence, these observations are of vital importance in selecting parental material for future breeding programmes.

It should also be noted that generally the field susceptibility to black stripe disease is determined not only by the inherent susceptibility of the cultivar but also by the pod set of the particular clone and prevailing weather conditions (Peries, 1976). Hence, it appears that breeding clones resistant to bark rot with sparse pod production is the most economical method of controlling this disease as the major rubber growing districts in Sri Lanka are in the South West monsoon belt where climatic conditions are conducive for the development of the fungus.

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REFERENCES

- Edathil, T T, Idicula, S P and Jacob, C K (1988). Field evaluation of fungicides to identify a substitute for organo - mercurials in the control of black - stripe disease of rubber in India. *Indian Journal of Natural Rubber Research* 1, 42-47.
- Jayasinghe, C K and Fernando, E B (1991). Review of Plant Pathology and Microbiology Department. *Annual Review of the Rubber Research Institute of Sri Lanka* 32.
- Jayasinghe, C K and Wettasinghe, D S (1993). Review of Plant Pathology and Microbiology Department, *Annual Review of the Rubber Research Institute of Sri Lanka*, 1993: 61.
- Liyanage, A de S, Nadarajah, M, Liyanage, G W and Dantanarayana, D M (1977). Investigations on new fungicidal systems for control of bark rot on *Hevea brasiliensis*. *Journal of the Rubber Research Institute of Sri Lanka* 54, 316-328.
- Liyanage, A de S (1982). Review of Plant Pathology Department. *Annual Review of the Rubber Research Institute of Sri Lanka*, 1981: 53-68.
- Liyanage, A de S, Liyanage, N I S, Fernando, E B and Dharmaratne, A (1984). Factors affecting the spread of bark rot in *Hevea* caused by *Phytophthora meadii*. *Proceedings of the International Rubber Conference, Sri Lanka*, 1: 325-343.
- Peries, O S (1965). Recent developments in the control of the disease of the *Hevea* rubber tree. *Quarterly Journal Rubber Research Institute of Ceylon* 41, 33-43.

Susceptibility of *Hevea* clones to black stripe

- Pertes, O S (1976). Factors affecting infections of *Hevea* bark by *Phytophthora* species with special reference to disease control. Proceedings of the International Rubber Conference, Kuala Lumpur, 3: 199-212.
- SAS (1987). SAS/STAT guide for personal computers. SAS Institute, Cary, NC, USA.
- Satchuthananthavale, V, Satchuthananthavale, R and Dantanarayana, D M (1975). Screening of clones for black stripe disease in *Hevea*. *Rubber Board Bulletin* 12, 50-53.
- Schreurs, J (1969). Difolatan: a promising fungicide for control in *Hevea brasiliensis*. *Netherland Journal of Plant Pathology* 75, 113-118.
- Tan, A M (1989). New fungicides and formulations for the control of black stripe. *Rubber Growers Conference*, Malaysia: 463-470.
- Wastie, R L, Chee, K H and Lim, T M (1973). Screening clones of *Hevea brasiliensis* for disease resistance - a review. *Planter* 49, 164-169.

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