EVALUATION OF *HEVEA BRASILIENSIS* CLONES AGAINST ABNORMAL LEAF FALL DISEASE CAUSED BY *PHYTOPHTHORA* SPP.

Sadanand K. Mushrif, Annakutty Joseph, Alice John and C. Kuruvilla Jacob
Rubber Research Institute of India, Kottayam – 686 009, Kerala, India.

Submitted: 03 September 2002 Accepted: 30 July 2004

Mushrif, S.K., Joseph, A., John, A. and Jacob, C.K. (2004). Evaluation of *Hevea brasiliensis* clones against abnormal leaf fall disease caused by *Phytophthora* spp. *Natural Rubber Research*, **17**(1) : 74-78.

Twenty five modern clones of rubber (*Hevea brasiliensis*) were evaluated for tolerance to abnormal leaf fall disease caused by *Phytophthora* spp., consecutively for seven years under standard prophylactic spray. Two trials each consisting of 13 clones were included in the evaluation. High leaf retention was noticed in the clone RRII 105 closely followed by RRII 5 while it was poor in RRIM 703, RRIM 600, Haiken 1, PB 280, PB 260 and PB 314. Rainfall was found to be a major predisposing factor influencing the disease development.

Key words: Abnormal leaf fall. *Hevea brasiliensis*, Clone evaluation, *Phytophthora*.

INTRODUCTION

Abnormal leaf fall caused by *Phytophthora* spp. is the most destructive disease of rubber (*Hevea brasiliensis*) in South India (Edathil *et al.*, 2000). The disease was first reported during 1910 at Palapilly in Trichur District of Kerala State (McRae, 1919). This disease recurs annually during the southwest monsoon period (Ramakrishnan and Pillay, 1961a). An annual yield loss of 9-16 per cent is estimated due to the disease (Jacob *et al.*, 1989). The cumulative crop loss was reported to be 30-50 per cent (Pillay *et al.*, 1980). Besides the direct effect on yield, the disease also favours weed growth due to sparse canopy, ultimately increasing the input costs (Jacob *et al.*, 1989).

One of the efficient methods of protection against the disease is the use of tolerant / resistant cultivars. All the high yielding clones are susceptible to this disease under Indian conditions. The clones PB 86, PB 235, PB 260, PB 311, PB 28/59, RRIM 600, RRIM 628, RRIM 703, RRII 5, PR 107, PR 255, PR 261, Tjir 1 and Tjir 16 are found to be susceptible to this disease while RRII 105, Gl 1, GT 1, PB 217 and BD 10 are observed to retain more leaves than the susceptible clones under one round of premonsoon prophylactic spraying (Ramakrishnan and Pillay, 1961b; Pillay *et al.*, 1980), which is a regular practice in South India. However, when left unsprayed, these clones are observed to be affected severely, under conducive weather conditions. Evaluation of clones for disease tolerance is a prerequisite for their large-scale planting. The present study was aimed at evaluating the relative performance of 25 modern clones under a similar prophylactic fungicidal spray.

MATERIALS AND METHODS

Two field experiments laid out at the

Correspondence: Sadanand K. Mushrif (E-mail: rrii@rubberboard.org.in)

experiment station of the Rubber Research Institute of India, during 1989 in a randomized block design for evaluation of various parameters was used for this study. Both the trials included thirteen clones each with the clone RRII 105 as control (Table 1 & 2) replicated seven and five times in trial I and trial II respectively, with a plot size of seven plants. The trees received all cultural operations including one round of prophylactic spraying during the month of May, every year as per the recommendations (Rubber Board, 2002). Observations on leaf retention were recorded for seven consecutive years from 1995 to 2001. Leaf retention was assessed by the leaf count method (Idicula *et al.*, 1986) from three trees in the middle of each plot.

RESULTS AND DISCUSSION

In Trial I, highest leaf retention was noticed in the clone RRII 105 except for the years 1997 and 1998 when RRII 5 recorded higher leaf retention though it did not differ significantly from RRII 105 (Table 1). RRIM 703 recorded the lowest leaf retention in five years. Pooled analysis of the data also confirmed the high leaf retention of RRII 105 and RRII 5, and the low retention in RRIM 703 and Haiken 1. Though RRIM 600 showed significantly better leaf retention than RRIM 703 and comparable leaf retention with Haiken 1, the clones PR 261 and SCATC 88-13 were significantly better than it. In spite of spraying, all the susceptible clones showed less than 50 per cent leaf retention. Pillay *et al.* (1980) reported that the clones RRIM 600, Tjir 1 and PR 107 are susceptible to this disease. Though both the parents of PR 255 and PR 261 namely Tjir 1 and PR 107 are susceptible, PR 255 showed significantly more leaf retention.

In Trial II, RRII 105 showed consistently good leaf retention in all the years (Table 2). Pooled analysis of the data revealed that RRII 105 had significantly higher leaf retention than all the other clones. The clone PB 280 recorded the lowest leaf retention and was on par with PB 260 and PB 314. The remaining clones showed significantly higher leaf retention than PB 280.

The observations made in the present study were similar to those made by Pillay *et al.* (1980) who reported RRII 105 as having high and RRIM 600 low leaf retention under similar prophylactic spraying. The clone RRIM 600 was observed to be highly susceptible in Malaysia also (RRIM, 1995). Even though the clone RRIM 703 is reported to be moderately tolerant in Malaysia (RRIM 1975), it had low leaf retention under the present experimental conditions. A similar deviating trend was observed in clones PB 217 and PB 280. The clone PB 217 was found to retain more leaves than PB 280 which was on par with PB 260 and PB 314 under the present experimental conditions. However, in Malaysia, the clone PB 217 was rated as less tolerant to *Phytophthora* and the clones PB 280 and PB 260 as moderately tolerant (RRIM 1995). The disease incidence in general was high during 1999 and 2001 in both the trials. During these years at least 10 rainy days with a minimum of 200 mm rain was recorded for the month of May (Figs. 1 & 2). Similar observations of high disease incidence under such weather conditions have been reported by Ramakrishnan and Pillay (1961a). The weather conditions might have augmented the development of high inoculum density

Table 1. **Leaf retention in Trial I**

Clone	Leaf retention (%)* 1995	1996	1997	1998	1999	2000	2001	Pooled mean
RRII 5	92.85 (77.37)	79.59 (63.61)	98.77 (86.63)	99.59 (88.61)	59.10 (50.41)	67.11 (54.04)	56.82 (48.41)	79.11 (67.01)
RRII 118	94.38 (78.77)	46.38 (43.35)	73.88 (61.90)	93.06 (78.58)	53.52 (47.16)	78.04 (65.86)	71.86 (58.31)	73.01 (61.99)
RRII 208	79.08 (63.25)	51.42 (45.34)	83.26 (68.48)	57.14 (49.28)	34.05 (34.23)	72.05 (59.18)	41.54 (39.83)	59.79 (51.37)
RRII 300	82.65 (66.26)	71.83 (58.86)	50.20 (45.38)	72.24 (60.38)	46.54 (42.17)	55.90 (48.47)	40.06 (38.66)	59.91 (51.45)
RRII 308	88.26 (72.53)	71.83 (58.87)	83.67 (71.91)	86.53 (72.02)	57.97 (49.73)	72.11 (59.36)	52.96 (46.74)	73.33 (61.59)
RRIM 600	69.89 (57.51)	39.59 (38.24)	36.73 (36.02)	30.23 (31.09)	22.17 (24.92)	78.35 (63.12)	51.98 (46.07)	46.99 (42.42)
RRIM 703	55.61 (48.40)	8.16 (12.69)	30.12 (31.46)	20.06 (23.61)	34.96 (35.00)	58.31 (48.27)	33.30 (33.46)	34.36 (32.27)
PR 255	78.57 (62.57)	51.83 (46.24)	83.94 (66.96)	70.20 (57.58)	53.16 (47.36)	62.41 (53.08)	45.51 (42.30)	63.66 (53.73)
PR 261	76.02 (60.87)	40.91 (37.41)	56.32 (49.22)	61.22 (52.08)	36.58 (35.80)	69.07 (56.67)	33.94 (35.27)	53.43 (51.85)
SCATC 88-13	77.55 (63.97)	55.51 (48.47)	54.17 (47.40)	57.14 (49.41)	43.45 (41.08)	82.80 (69.37)	46.93 (43.23)	59.66 (51.85)
SCATC 93-114	70.91 (58.42)	44.89 (39.82)	43.26 (40.81)	32.48 (34.66)	41.37 (39.01)	65.17 (55.64)	42.59 (40.33)	48.66 (44.09)
Haiken 1	70.91 (57.76)	12.65 (16.97)	32.56 (31.33)	43.80 (41.39)	43.19 (40.96)	63.29 (53.69)	39.91 (37.86)	43.76 (39.99)
RRII 105	94.38 (81.43)	86.12 (71.74)	91.01 (74.71)	98.77 (85.83)	68.77 (56.65)	87.60 (70.17)	69.44 (57.89)	85.15 (71.20)
CD (P=0.05)	(10.04)	(16.58)	(15.10)	(11.37)	(13.09)	(NS)	(13.48)	(6.73)

* Figures in parentheses are arc sine transformed values

Table 2. **Leaf retention in Trial II**

Clone	Leaf retention (%)* 1995	1996	1997	1998	1999	2000	2001	Pooled mean
PB 217	60.71 (51.36)	84.00 (66.58)	53.14 (46.80)	83.77 (66.91)	67.09 (55.44)	63.50 (55.31)	52.71 (46.68)	66.42 (55.58)
PB 235	75.71 (60.79)	72.00 (58.30)	61.14 (52.14)	74.28 (59.73)	45.41 (40.35)	78.12 (62.42)	57.56 (49.53)	66.32 (54.75)
PB 255	83.57 (68.66)	49.52 (44.71)	92.57 (77.90)	89.14 (71.31)	54.00 (47.88)	82.55 (66.32)	64.68 (54.58)	73.72 (61.62)
PB 260	82.01 (67.63)	49.71 (44.16)	84.57 (72.00)	73.71 (59.82)	46.18 (42.60)	54.45 (47.63)	42.86 (40.77)	61.93 (53.52)
PB 280	75.71 (60.48)	33.23 (33.74)	69.14 (62.49)	58.28 (50.10)	24.84 (26.89)	67.75 (55.81)	42.80 (40.67)	53.11 (47.16)
PB 310	98.57 (85.64)	49.14 (44.56)	89.28 (71.86)	68.57 (56.55)	37.30 (36.98)	74.34 (61.03)	59.61 (50.75)	68.11 (58.19)
PB 311	75.00 (60.90)	75.43 (60.48)	55.77 (51.90)	61.71 (53.37)	46.84 (42.51)	87.24 (71.17)	57.34 (48.12)	65.61 (55.49)
PB 312	73.57 (62.09)	73.14 (58.94)	70.28 (58.79)	75.41 (60.62)	46.69 (43.18)	82.99 (69.92)	46.78 (42.97)	66.98 (56.64)
PB 314	79.28 (63.00)	34.28 (35.36)	73.71 (63.14)	73.04 (59.38)	30.22 (32.85)	78.86 (63.84)	66.37 (51.18)	61.39 (52.68)
KRS 25	78.57 (65.66)	74.19 (60.52)	80.00 (67.05)	94.57 (76.79)	58.94 (50.52)	61.15 (53.37)	46.56 (43.63)	70.57 (59.65)
KRS 128	77.14 (61.56)	67.99 (55.89)	86.28 (71.30)	86.85 (72.47)	72.80 (61.53)	70.80 (59.64)	57.51 (50.21)	74.19 (61.80)
KRS 163	87.85 (72.72)	48.00 (43.81)	85.14 (68.25)	89.52 (73.71)	52.60 (46.55)	83.63 (66.96)	51.06 (45.62)	71.11 (59.66)
RRII 105	98.57 (86.90)	69.02 (56.69)	89.14 (73.20)	97.14 (83.83)	66.60 (55.01)	70.28 (58.73)	78.46 (63.51)	81.31 (68.26)
CD (P=0.05)	(13.18)	(13.60)	(16.82)	(11.36)	(17.55)	(NS)	(NS)	(6.21)

* Figures in parentheses are arc sine transformed values

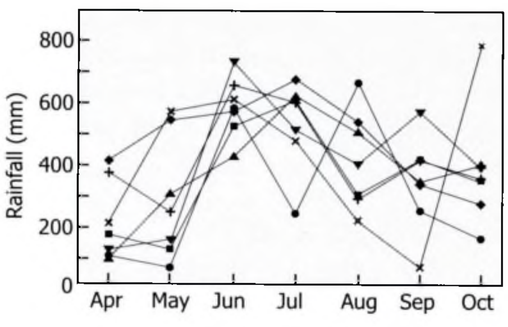

Fig. 1. Monthly rainfall

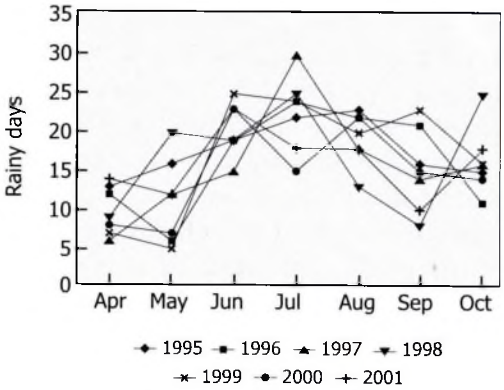

Fig. 2. Number of rainy days

at the beginning of the monsoon. Thus, the high disease incidence can be attributed to high inoculum density together with scattered and high rainfall during the month of June. Ramakrishnan and Pillay (1961a) also reported that the intensity of rainfall and the temperature range of 20 to 29°C during the months of May to August determine the severity of the disease. In the present study, generally the monthly mean temperature was between 24 and 30°C and the relative humidity was found to be 77 per cent or more from May to October during all the years (Tables 4 and 5). Peries (1969) reported that if factors like a rainfall of 2.5 mm per day, a temperature of 29°C and relative humidity of more than 80 per cent prevail continuously for four days, then the disease occurs within 14 days of that period. Such conditions occur in the months of June and

Table 4. **Mean temperature**

Month	Temperature (°C)						
	1995	1996	1997	1998	1999	2000	2001
May	27.9	27.8	27.7	29.9	27.2	29.1	28.4
June	27.1	25.5	26.4	27.6	26.8	26.4	26.2
July	26.0	24.9	24.8	26.7	26.2	26.7	26.0
August	26.1	26.0	25.4	27.0	26.9	26.0	26.6
September	26.6	23.7	26.0	26.6	27.7	27.0	27.3
October	27.2	26.3	26.6	26.7	26.7	26.9	27.0

Table 5. **Relative humidity**

Month	Relative humidity (%)						
	1995	1996	1997	1998	1999	2000	2001
May	80.0	77.0	79.5	78.0	85.5	77.0	80.5
June	89.0	80.5	83.5	87.5	87.5	87.5	91.0
July	90.0	91.0	92.5	86.0	91.5	82.5	87.0
August	90.5	88.5	89.0	86.5	90.0	91.0	85.5
September	82.5	80.0	79.5	87.5	87.5	82.5	80.5
October	81.0	81.5	83.5	85.5	80.5	80.0	82.5

July in Sri Lanka. Pillay *et al.* (1980) reported that if a rainfall of 250 to 300 mm occurs in a period of 7 to 10 days, with a temperature range of 22 to 30°C and relative humidity of 98 per cent, commencement of the disease is expected. Similarly Jayarathnam *et al.* (1987) observed that if a total rainfall of 122 mm or more occurs within five days with a temperature of 22 to 31°C and a relative humidity of 80 to 93 per cent, the disease develops within 9 to 15 days. Severe occurrence of disease was observed in the present study during the years 1999 and 2001 in which similar conducive conditions prevailed during pre-monsoon period particularly in the month of May. Low disease incidence was recorded in most of the clones in the absence of such a period of conducive weather in spite of the high total rainfall received in any particular year.

ACKNOWLEDGEMENT

The authors are grateful to Dr. N.M. Mathew, Director, Rubber Research Institute of India, for providing the necessary facilities. The authors express their gratitude to Mr. Ramesh B. Nair, Asst. Director (Statistics), for carrying out the statistical analysis of the data. They are also thankful to Ms. T. Sailajadevi, Agrometeorologist, for providing the meteorological data.

REFERENCES

Edathil, T.T., Jacob, C.K. and Joseph, A. (2000). Leaf diseases. In: *Natural Rubber: Agromanagement and Crop Processing* (Eds. P.J. George and C. Kuruvilla Jacob) Rubber Research Institute of India, Kottayam, pp. 273-296.

Idicula, S.P., Edathil, T.T. and Jacob, C.K. (1986). Spray fluid requirements in high volume spraying of rubber. *Journal of Plantation Crops*, 16 (Supplement) : 273-275.

Jacob, C.K., Edathil, T.T., Idicula, S.P. and Jayarathnam, K. (1989). Effect of abnormal leaf fall disease caused by *Phytophthora* spp. on the yield of rubber tree. *Indian Journal of Natural Rubber Research*, 2(2) : 77-80.

Jayarathnam, K., Rao, P.S. and Krishnankutty, V. (1987). A study on the weather associated with abnormal leaf fall disease of rubber (*Hevea brasiliensis*). Proceedings of the National Seminar on Agrometeorology of Plantation Crops, March 1987, Pilicode, Kerala, pp. 93-97.

McRae, W. (1919). A disease of the para rubber tree caused by *Phytophthora meadii*. *Agriculture Journal of India*, 14(4) : 566-577.

Peries, O.S. (1969). Studies on the epidemiology of *Phytophthora* leaf disease on *Hevea brasiliensis* in Ceylon. *Journal of Rubber Research Institute of Malaya*, 21 : 73-77.

Pillay, P.N.R., George, M.K. and Rajalakshmy, V.K. (1980). Leaf and shoot disease. In: *Handbook of Natural Rubber Production in India*. (Ed. P.N. Radhakrishna Pillay). Rubber Research Institute of India, Kottayam, pp. 249-278.

Ramakrishnan, T.S. and Pillay, P.N.R. (1961a). Abnormal leaf fall disease of rubber caused by *Phytophthora palmivora* (Butler) Butler in South India. 1. *Rubber Board Bulletin*, 5(1) : 11-20.

Ramakrishnan, T.S. and Pillay, P.N.R. (1961b). Abnormal leaf fall disease of rubber caused by *Phytophthora palmivora* (Butler) Butler 2. *Rubber Board Bulletin*, 5(2) : 76-84.

RRIM (1975). Enviromax planting recommendations, 1975-1976. *Planters' Bulletin*, 137 : 27-50.

RRIM (1995). RRIM planting recommendations, 1995-97. *Planters' Bulletin*, 224 & 225 : 51-72.

Rubber Board (2002). Rubber and its cultivation. Rubber Board, Kottayam, India, pp. 108.