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SCREENING OF CLONES OF RUBBER (*HEVEA BRASILIENSIS*) FOR GROWTH AND TOLERANCE TO POWDERY MILDEW DISEASE AT A HIGH ALTITUDE STATION IN KERALA, INDIA

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Ten ortet selections and five popular clones of *Hevea brasiliensis* were screened to ascertain powdery mildew disease tolerance in a high altitude station at Ambalavayal, Wayanad in Kerala. The experiment was conducted during the refoliation from January to April for a period of four years. The plants were protected with alternate application of systemic (carbendazim 0.05 per cent) and non-systemic (wettable sulphur 0.2 per cent) fungicides as per standard practice. Girth of the plants and powdery mildew disease assessments prior to and after treatments were recorded. The ortet selection Iritty 1 showed high degree of disease tolerance with better growth.

Keywords: Disease screening, Fungicides, *Hevea brasiliensis*, Ortets, Powdery mildew, Susceptibility, Tolerance.

Rubber (*Hevea brasiliensis*) grows best at altitudes below 450 m in regions with an evenly distributed rainfall without any marked dry season. Growth of rubber is affected by extremes in temperature. Mean monthly temperatures of 20 to 25 ^{0}C have been found to be optimum (Vijayakumar *et al.*, 2000). The low temperature prevailing in high altitudes during refoliaiton period favours high incidence of powdery mildew disease caused by the fungus *Oidium heveae* affecting growth of the rubber trees adversely (Ramakrishnan and Pillai, 1962; Fernando, 1971; Liyanage *et al.*, 1985).

The replacement of native perennial crops such as pepper, tea, coffee and cardamom in the high altitude areas of Wayanad with more economic tree species like rubber necessitates the screening of rubber clones/selections for growth under low temperature conditions and tolerance to powdery mildew disease. Hence a study was taken up with 10 ortet selections (P 1, P 2, P 90, P 121, P 155, P 213, P 270, P 280, P 296 and Iritty 1) and five popular clones (RRII 105, RRII 203, RRIC 100, RRIC 102 and PB 86). The 10 ortets were selected from the seedling population existing in Panamaram,

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Wayanad and Iritty based on their growth and yield.

Planting of the clones/selections was done in 1996 at the farm of the Kerala Agricultural University, Ambalavayal (Latitude 11°37'N, Longitude 76°12'E and altitude 974 m above MSL). The agrometeorological data of the station for the period of study is given in Table 1. Planting was done in a randomized block design with three replications and a plot size of five plants. Treatments comprising integrated use of systemic and non-systemic fungicides were imposed during the refoliation periods for four years from 2000 to 2003 as per the standard practices for effective control of powdery mildew (Edathil *et al.*, 1998). Powdery mildew disease assessment was done prior to imposition of treatments and again on completion of the experiment by the leaf scoring method of Horsfall and Heuberger (1942) and mean per cent disease intensity (PDI) was calculated.

At the beginning of refoliation, first round of fungicidal spray was given to the tender leaves of plants using a high volume rocker sprayer. For all the four years first round was given with a systemic fungicide, carbendazim, at 0.05 per cent concentration dispersed in water. Second round of spraying was given 10 to 15 days after the first round with a non-systemic inorganic

Table 1. **Agrometeorological data at Ambalavayal**

Month	Temperature (°C)		Relative humidity (%)		Sunshine hours (h)	Rainfall (mm)	Number of rainy days
	Maximum	Minimum	I	II			
2000							
January	28.1	16.5	90	45	7.8	0.8	0
February	28.5	17.2	94	55	7.5	1.4	0
March	31.3	18.9	93	45	8.4	1.4	0
April	30.0	19.8	94	63	6.7	110.8	9
2001							
January	27.6	16.0	89	47	6.6	0.0	0
February	29.4	18.2	94	51	7.7	47.2	3
March	30.7	18.7	90	49	7.8	12.0	2
April	29.9	19.1	93	62	5.8	206.2	8
2002							
January	27.7	16.1	96	54	7.9	15.4	2
February	29.4	17.5	79	43	7.1	0.6	0
March	31.8	18.3	90	42	8.4	29.0	3
April	30.2	19.7	93	61	7.7	93.4	6
2003							
January	28.5	17.0	90	57	8.3	4.8	1
February	29.7	16.5	95	69	7.9	16.0	2
March	30.4	18.3	96	57	7.4	104.2	6
April	29.8	15.6	94	67	6.6	131.4	10

Table 2. **Response of clones/ ortets to fungicidal treatment against powdery mildew**

Clone/ortet	2000 PDI		2001 PDI		2002 PDI		2003 PDI	
	Pre-treatment	Post-treatment	Pre-treatment	Post-treatment	Pre-treatment	Post-treatment	Pre-treatment	Post-treatment
P 1	35.71 cde	31.00 ab	63.50 fgh	27.17 cd	81.00 cd	29.58 b	65.00 ab	50.83 def
P 2	39.67 f	34.17 bc	46.29 b	28.34 d	80.60 cd	36.60 e	70.42 bc	41.18 bc
P 90	45.16 g	39.83 c	65.75 hi	27.83 d	90.42 fg	35.67 e	69.50 bc	55.83 fghi
P 121	31.10 ab	34.17 bc	51.83 cd	27.50 cd	78.38 bcd	45.50 h	83.33 defg	49.50 dc
P 155	31.00 ab	34.33 bc	64.00 fgh	34.83 g	83.00 de	40.50 f	78.83 def	55.67 fghi
P 213	32.75 bc	31.17 ab	59.96 efg	25.00 bc	86.58 ef	35.71 e	70.13 bc	36.04 b
P 270	32.78 bc	30.00 ab	55.29 de	27.33 cd	86.46 ef	41.33 fg	84.79 fg	63.54 j
P 280	33.17 bc	30.22 ab	41.17 ab	25.17 bc	74.28 b	34.94 cde	86.28 g	36.67 b
P 296	34.33 cde	37.75 bc	56.69 de	31.50 ef	79.71 cd	36.33 e	69.17 bc	39.50 b
Iritty 1	27.92 a	25.00 a	40.33 a	20.63 a	60.58 a	25.50 a	61.29 a	30.50 a
RRII 105	37.50 def	36.33 bc	65.46 ghi	26.67 cd	86.94 ef	43.36 g	81.67 defg	53.96 efgh
RRII 203	47.67 g	35.50 bc	59.33 ef	31.17 e	93.83 g	52.50 f	71.33 c	58.50 hi
RRIC 100	37.50 def	40.17 c	55.00 de	33.67 fg	77.33 bc	33.33 cd	77.83 d	45.67 cd
RRIC 102	33.67 bcd	49.71 d	69.13 hi	25.96 bcd	82.71 de	32.83 c	78.25 de	39.88 b
PB 86	39.58 f	34.67 bc	59.75 efg	23.67 b	80.21 cd	35.46 de	84.17 efg	49.96 de

Values with same alphabet are not significantly different at P = 0.05.

contact fungicide, wettable sulphur, at 0.2 per cent concentration dispersed in water. Subsequent third and fourth rounds of spray were given with alternate use of carbendazim and wettable sulphur at intervals of 10 to 15 days. Growth observations were also recorded and the data on growth and PDI were analysed statistically.

Pre-and post-treatment mean PDI of the ortet selection/clones as presented in Table 2 ranged from 20.63 to 93.83 per cent over the period of study. The data were subjected to analysis of variance and the differences among means tested using Duncan's New Multiple Range Test (Steel and Torrie, 1960). Untreated control plots were not maintained since the experimental site was in a highly disease-prone area.

The ortet selection Iritty 1 exhibited the lowest intensity of disease in terms of PDI values throughout the study, indicating high degree of disease tolerance both in the pre and post-treatment disease assessments in all the years and was superior to the rest of the clones.

Ortet selections from Panamaram, P 280, P 213 and P 1 and clones RRIC 100, RRIC 102 and PB 86 showed good response in terms of disease control after treatment imposition. Selections P 90, P 155, P 270 and clones RRII 105 and RRII 203 were found to be highly susceptible to the disease (Table 2). There was significant variation in girth among the clones and girth in the seventh year after planting (2003), which ranged from 23.1 to 32.6 cm (Table 3). In general, good girth increment

Table 3. **Annual girth and girth increment**

Clone	Girth (cm)				Girth increment (cm)		
	2000	2001	2002	2003	2000-01	2001-02	2002-03
P 1	12.4	16.6	25.2	32.6	4.2	8.6	7.4
P 2	6.7	10.2	17.0	23.1	3.5	6.9	6.1
P 90	13.5	16.4	24.4	31.2	2.9	8.0	6.9
P 121	8.8	10.7	17.3	23.6	1.9	6.7	6.3
P 155	7.9	11.6	18.2	23.6	2.5	6.7	5.4
P 213	11.3	14.9	22.4	30.4	3.7	7.6	8.0
P 270	11.4	17.0	25.2	32.3	5.6	8.3	7.1
P 280	9.5	13.0	19.5	25.0	2.7	6.5	5.5
P 296	11.6	15.0	21.3	27.2	2.8	6.4	5.9
Iritty 1	12.6	15.6	24.0	31.9	3.0	8.5	7.9
RRII 105	10.3	14.1	20.3	25.8	3.8	6.2	5.5
RRII 203	13.3	16.4	23.1	29.4	2.6	6.7	6.4
RRIC 100	11.1	15.2	23.4	31.0	4.1	8.3	7.6
RRIC 102	10.8	16.1	23.2	30.4	4.1	7.1	7.2
PB 86	11.6	15.1	23.5	31.4	3.5	8.5	7.9
SE	1.2	1.3	1.8	2.3	0.9	0.5	0.6
CD (P = 0.05)	3.4	3.9	5.3	6.5	NS	NS	1.7

was observed in less powdery mildew affected clones/ortet selections either by inherent tolerance or by good response to fungicidal treatments as in selection Iritty 1, P 1, P 213, RRIC 100, RRIC 102 and PB 86 which were on par in girth increment (Table 3). The selection P 280 was an exception in that though the tree showed tolerance to the disease, girth increment was poor. Poor girth increase was noticed in susceptible clones such as RRII 105 and P 155.

The ortet selection Iritty 1 was superior in terms of test tap yield as reported by Lakshmanan *et al.* (2006). The present study provides evidence of its tolerance to powdery mildew, a disease which severely affects rubber in the high altitude regions. It can be inferred that Iritty 1 holds promise as a rubber clone suitable for the high attitude Wayanad region in terms of growth, yield and tolerance to powdery mildew. However, large-scale field evaluation of this clone is required for more conclusive results.

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