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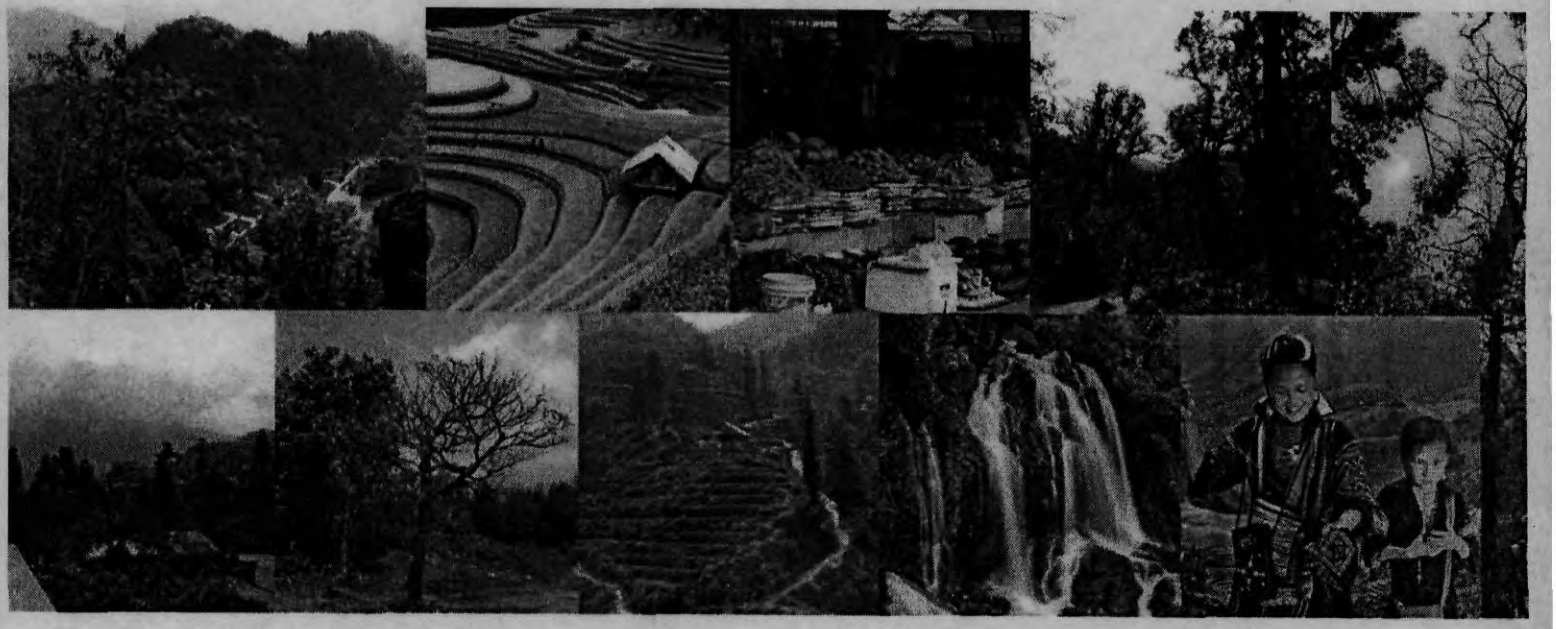
Phytophthora in Forests and Natural Ecosystems



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Phytophthora abnormal leaf fall of *Hevea* and breeding for disease resistance.

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Hevea brasiliensis (Willd. ex A. Juss.) Müll. Arg. (family, Euphorbiaceae; diploid, 2n=36), popularly called Para rubber tree, is a forest tree species native to the tropical rain forests of Central and South America. Para rubber tree is monoecious and insect-pollinated and possesses high outcrossing tendency. The tree produces latex which contains rubber particles (isoprene) and is used for making more than 50,000 end products (mostly tyres) from rubber bands to aviation tyres. Several thousands of hectares of Para rubber tree are being raised predominantly in South East Asian countries including India, China, Vietnam, Thailand, Indonesia and Malaysia. The plantations are also increasingly raised in new areas like Liberia. However, commercial rubber cultivation is under constant attack by native as well as exotic fungal pathogens. Climate change, which is clearly felt in many rubber growing regions, could possibly alter the host-pathogen interactions which can lead to emergence of disease epidemics in hitherto unknown regions posing serious challenges to productivity because *Hevea* breeding mainly focused on rubber productivity (Jayasinghe, 1999; Narayanan and Mydin, 2012; Mydin, 2014).

Severe economic losses have been reported in rubber plantations due to attack of pathogenic fungal diseases caused by *Phytophthora*, *Corticium*, *Corynespora* and *Oidium*. Among above diseases, abnormal leaf fall (ALF) caused by *Phytophthora* is a devastating disease capable of causing upto 40% loss in crop production. Every year, thousands of tons of fungicides are used for prophylactic spraying in plantations for prevention of major disease outbreaks and ensure good yield. Besides huge costs, long-term applications of chemical fungicides pose environmental and socio-economic constraints.

Many clones of *Hevea* exhibit variable levels of susceptibility to the fungal pathogen. Earlier selection and breeding for resistance to *Phytophthora sp.* in Brazil led to identification of resistant clones. Baptists (1961) reviewed the progress in selection and breeding of *Hevea* clones with resistance to *Microcyclus ulei* (=*Dothidella ulei*; causative agent of South American Leaf Blight) and *Phytophthora sp.* in Brazil and developed a list of those resistant clones which have been imported into Malaya and Ceylon since 1953-54.The list included selections from *H. brasiliensis* and *H. pauciflora* but most of the resistant material had been derived from *H. benthamiana* 'F4542', a selection of upper Rio Negro origin. Inter-specific hybridizations (*H. brasiliensis* x *H. pauciflora*, *H. camargoona* x FX 4098) were also attempted but a major breakthrough was not achieved.

Twenty six hybrid clones generated through a hybridization programme conducted during 1990 using Wickham clones and wild germplasm accessions were assessed to find clonal resistance with reference to abnormal leaf fall disease caused by *Phytophthora*. Results indicated high level of resistance in progenies belonging to the family 'RRII 105 x RO 142' as reflected by very high percentage of retention of healthier and uninfected leaves (59%) (Fig. 1). The study indicated that Amazonian accession RO 142 (RO - Rondonia, Brazil) used in the hybridization as well as its hybrid progenies possibly harbor genes for resistance to *Phytophthora* infection and hence useful for future resistance breeding. The above high-yielding hybrids with appreciable levels of disease resistance have already been advanced to final stages of evaluation in field trials laid out in experimental station and diverse environments through participatory plant breeding approach. Results from the above trials are awaited to evaluate and validate field level resistance of the clones under different environmental conditions.

Clone Fx 516 from Brazil was found to be highly resistant to ALF by *Phytophthora* and was used for hybridization with high-yielding modern clones to recover high-yielding recombinants with enhanced levels of resistance. Hybrids successfully produced with above cross combinations have been planted in nursery trials and are being evaluated for yield as well as disease resistance. In addition, open-pollinated progenies were collected from clone Fx 516 and nursery evaluation trials have been raised to rapidly recover progenies with high-yield and resistance to ALF disease. Among indigenous clones, RRII 5 and RRII 33, the clones developed by RRII, were more resistant to diseases including ALF, and hence, these clones and germplasm accessions can also be used in breeding for disease resistance in *Hevea*.

Baptist, E.D.C. (1961) Breeding for high yield and resistance in *Hevea*. Proceedings of the Natural Rubber Conference, Kuala Lumpur, 1960, pp. 430-445.

Jayasinghe, C. K. (1999). Pests and diseases of *Hevea* rubber and their geographical distribution. Bulletin of the Rubber Research Institut, Sri Lanka 40:1-8.
Mydin, K. K. (2014). Genetic improvement of *Hevea brasiliensis*: sixty years of breeding efforts in India, Rubber Science **27:** 153–181.
Narayanan, C. and K. K. Mydin (2012). Breeding for Disease Resistance in *Hevea* spp. - Status, potential threats, and possible strategies. *In*: Sniezko, R.A., Yanchuk, A.D., Kliejunas, J.T., Palmieri, K.M., Alexander, J.M. and Frankel, S.J. (*Ed.s*) Proceedings of the Fourth International Workshop on the Genetics of Host-Parasite Interactions in Forestry: Disease and Insect Resistance in Forest Trees. General Technical Report PSW-GTR-240. Albany, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station, pp. 240-251.
Raman, A. and C. Narayanan (2017). Search for rubber in pre-*Hevea brasiliensis* days and establishment of *H. brasiliensis* in India. Indian Journal of Natural Products and Resources 8: 9-17.

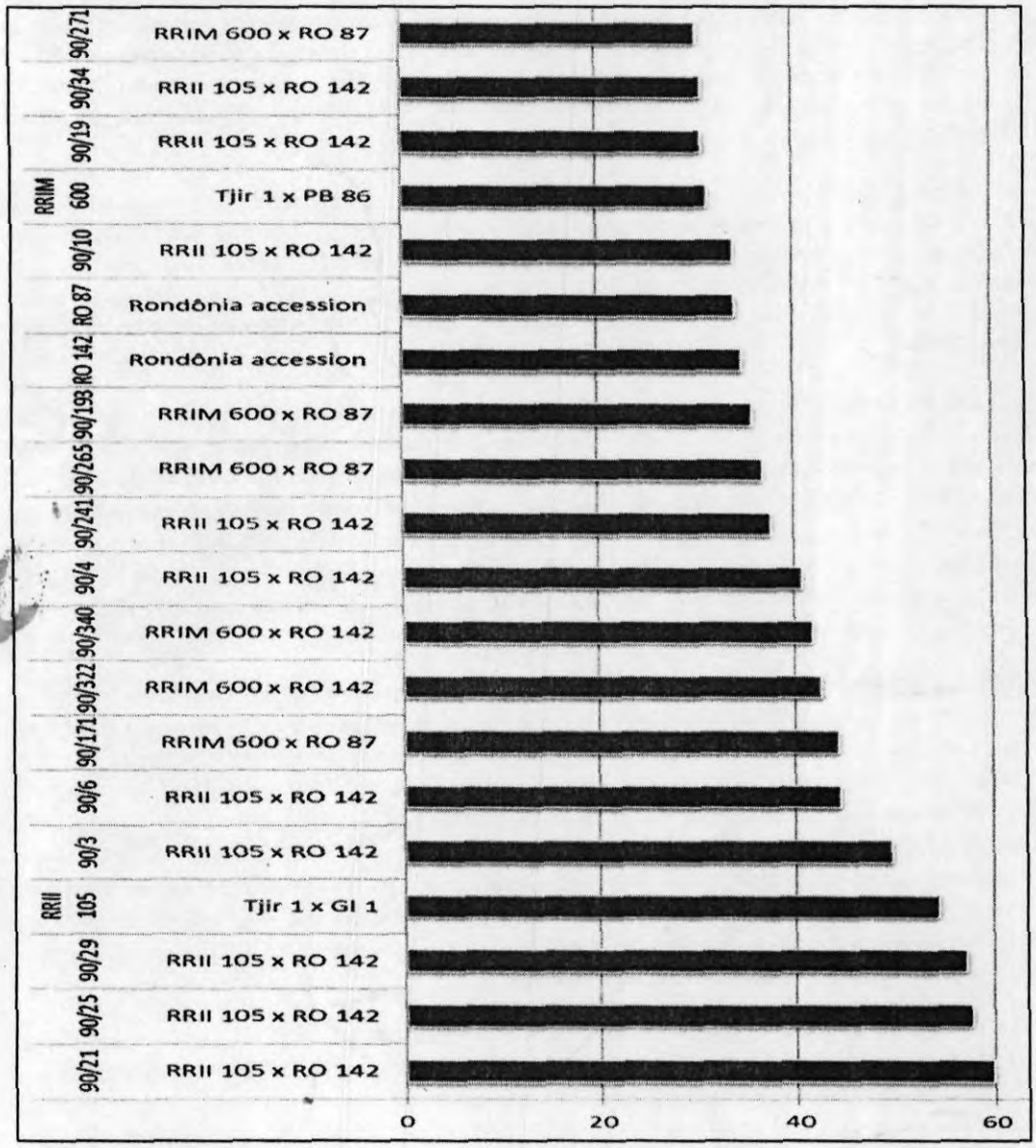

Figure. 1. Percentage (X axis) of uninfected, healthy leaves in parental clones and their hybrids in response to Phytophthora leaf disease in a field trial (RRII – Rubber Research Institute of India, India; RRIM, Rubber Research Institute of Malaysia; RO – Rondonia, Brazil; RRII 105 and RRIM 600 are high-yielding parental clones; RO 87 and RO 142 are Rondonian germplasm accessions from Brazil).