Chapter 1

Corynespora leaf disease of *Hevea brasiliensis*: A threat to natural rubber production

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Natural rubber (NR) from the rubbcr tree (*Hevea brasiliensis*) is the most versatile industrial rarv material produced by any plant. Since the discovery of this material and its source by the civilized world in the early eighteenth century, the numerous uses of rubber have come up and now this plant product has become indispensable for civilization. The most important application of rubber is in human movement, from rubber chappals to automotive and aircraft tyres. Human movement in space and water arc also supported by rubbcr components of the 'ships' used. With the improvement in man's mobility, the demand for rubber also increases. It is predicted that the world demand for elastomer will be doubled in the next two decades. Due to shortage in petroleum reserves and increasing environmental awareness, the consumption of natural rubbcr is likely to increase *vis-a vis* its synthetic alternatives (Budiman, 2003; Smit, 2005). However, production is constrained by availability of suitable land and other abiotic and biotic stresses that influence productivity of rubber plantations.

Among the biotic constraints for improvement in productivity of rubber plantations, the most important is the incidence of diseases that cause significant crop loss. In fact, the dominance of Asia in rubber production is partially attributed to the occurrence of a devastating disease of rubber trees in its native homeland. The South American Leaf Blight(SALB) epidemic caused by *Microcyclus ulei* which devastated rubber plantation in the early decades of the twentieth century (Chee and Holliday, 1986) compelled the European Colonial powers to search tor other suitable areas for rubber cultivation and they could locate some regions in Asia. Now Asia dominates in natural rubbcr production. Any serious constraint for rubbcr production in Asia is now a concern for world elastomer industrv. It is in this context that the newly emerged epidemic leaf disease caused by *Corynespora cassiicola* in Asian and African rubber growing countries causes serious concern.

History of Corynespora leaf disease

The earlier report on occurrence of a disease of rubbcr causcd by *C. cassiicola* was that of the nursery disease observed in the Rubber Research Institute of India Farm during 1958 (Ramakrishnan and Pillay, 1961) although association of the fungus with rubber leaves was reported by Deighton (1936) from Sierra

Leone. The disease was mainly confined to the nurseries and young immature plants in tlie main field. Sporadic occurrence of the disease on mature trees have been reported from some locations in India during 1969 to 1976 (George and Edathil, 1980) but was not considered significant as the extent of plantation area affected was very limited. The epidemic form of tlie disease atfecting mature tree and causing significant tree and crop loss was not known until late 1980s.

Disease incidence in Sri Lanka

The first occurrence of severe epidemic of Corynespora leaf disease on mature plantation was in Sri Lanka during 1985 to 1986 (Liyannge *et al.*, 1986; Jayasinghe, 1997) in the clone RRIC 103. The clone RRIC 103 was one of the high yielding clones developed by the Rubber Research Institute of Sri Lanka (RRISL) in 1958 and released to tlie growers in 1978 after prolonged experimentation. In an attempt to increase the productivity of Sri Lankan plantation, large-scale replanting with the new high yielding clones was promoted during the later part of 1970s and RRIC 103 was identified as one among the most promising clones to be popularised. Soon after the release, the clone became very popular with both large estates and small growers and by 1985 about 2.2 % (4500 ha) of the total area under rubber was replanted with this clone. The severe form of Corynespora leaf disease reported in 1985 from Dartonfield Estate of the RRISL spread to all the wet districts of Sri Lanka within two years and by 1987 more than 4000 ha of plantation was affected (Liyanage *et al.*, 1989).

The occurrence of this disease on the new clonc shattered the confidence of growers in the new clones developed in Sri Lanka and in order to retain their confidence it was necessary for RRISL to recommend destruction of all the plantations of RRIC 103 (more than 4500 ha by 1990) and for the Sri Lankan Government to pay compensation for the growers which amounted to over Rs. 60 million. Other clones observed as highly susceptible during that period were RRIC 52 (one of tlie parents of RRIC 103) and a few exotic clones cultivated in Sri Lanka.

One of the alternative high yielding clones available for planting in Sri Lanka was RRIC 110, which proved very promising in early plantings in Sri Lanka, Malaysia and Cote d' Ivoire (Ivory Coast). Vietnam had also used this clone as a parent in their breeding programme. But after about 10 years of large-scale planting, RRIC 110 also was observed to be severely affected by Corynespora leaf disease. This raises serious question on our reliance on tlie so-called 'tolerant' clones for replacement of susceptible populations. The apparent tolerance reported for clones appear to be transient and these may stand healthy only till the development of a new strain of *Corynespora*.

Disease incidence in Malaysia

Corynespora leaf disease was detected in budwood nurseries in Malaysia during 1960 (Newsam, 1961) and was confined to plants which were weak due to iron deficiency. The first disease outbreak in the trees planted in the main field was reported on clone RRIM 725 in 1975 and subsequently on a few clones. The widely cultivated cloncs RRIM 600 and GT I were rated as moderately susceptible.

The survey on disease incidence carried out in 1990 revealed that Johore, Selangor, Terengganu, Malacca and Perak were regions that showed high disease incidence. RRIM 600, GT 1, PR 107, RRIM 703 and RRIM 725 were reported as severely affected (Tan, 1990; Tan *et nl.*, 1992). A subsequent survey in 1993 also revealed high disease incidence in Johorc and Terengganu. There were some variations in the disease incidence in tlie different clones although clones rated as susceptible continued to show symptoms (Kamar, 1994). The survey during 1996 added Negri Sembilan to the list of susceptible states and Terengganu remained as most susceptible region. RRIM 600 was severely infected while PB 2L7 showed moderate susceptibility in Johore. There was a clear indication of movement of the discase severity from south to north in Peninsular Malaysia over these years. However the environmax planting recommendation had been helpful in keeping the disease under some control. The clones reported to remain disease free are PB 213, RRIM 628 and RRIM 937 (RRIM, 2000).

Corynespora leaf disease in Indonesia

In Indonesia, Corynespora leaf disease was detected for the first time in 1980 in the Sembawa experimental station, South Sumatra (Soepena, 1983). Later the disease was observed to spread to Central and West Java (Socpena, 1986). Subsequent observations revealed disease spread to Aceh in 1990, Jambi, Riau and Lampung in 1992, East Java in 1993 and Kalimantan in 1994 and most other rubber growing regions. During 1980s, nearly 1200 ha was severely affected of which 400 ha had to he uprooted causing an economic loss of RP 200 billion (Sinulingga *et nl.*, 1996). The recent reports indicate that 70 per cent of rubber area in Indonesia shows varying degrees of disease incidence. There was up to 2-ycar delay in infected young plants to reach maturity. The crop loss estimated is 30-50 per cent (Sujatno and Suhendry, 2000).

Disease incidence in Thailand

Corynespora disease incidence was tirst rcportcd in Thailand in 1985 (Kajornchaiakul, 1987). The disease was observed in clones RRIC 107 and KRS 21. In tlie international clone exchange trials at Surat Thani Research Centre, up to 2 per cent tree mortality was reported due to disease incidence. Disease was also observed at Songkhla Rubber Research Centre. The survey conducted

in 1999 revealed that the disease was present in southern, eastern and northeastern regions of Thailand and the clones found susceptible include Songkhla 36, PR 255, PR 305 and RRIT 251 (Chanruang, 2000).

Disease incidence in India

The fist incidence of epidemic form of Corynespora leaf disease was observed in the Rubber Research Institute of India (RRII), Hevea Breeding Sub Station at Nettana in South Karnataka during 1996 (Rajalakshmi and Kothandaraman, 1996). The disease was noticed in the nearby plantations in 1997. Attempts to evolve appropriate control measures were soon initiated by RRII. Both high and low volume (oil-based) spraying of copper and mancozeb were observed to be effective (Jacob, 1997). An extensive survey carried out in 1998 revealed that the epidemic was widespread in Subramanya, Sullia and Puttur and had extended up to Kanhangad region in Kerala, which adjoins South Karnataka. In order to create awareness and demonstrate the effectiveness of chemical control, demonstration spraying was carried out in about 20 smallholdings in the elisease-illiceled region during 1998.

During 1999, the disease became very severe (50-70% disease intensity) in Subramania, Sullia, Puthur, Madikeri and Kanhangad regions and a disease eradication campaign was launched in which more than 10, 000 ha were sprayed using either copper or mancozeb fungicide.; with the aid from World Bank Assisted Rubber Project. This helped in suppression of the inoculum (Jacob and Idicula, 2004). Subsequent annual surveys in the disease endemic areas have revealed that the intensity of the disease has remained low (up to 35 %) (Manju *et al.*, 2001). Although moderate disease incidence is noticed in some plantations recently, the disease has remained fairly under control and signiticant tree or crop loss was reported only from very few plantations. Chemical control measures are undertaken if severe occurrence of disease is noticed in plantations. The clone most widely cultivated in this region is RRII 105 and it was observed that this clone is susceptible and this causes concern (Idicula *et al.*, 2000). Low disease incidence was observed in areas planted with GT 1.

It is evident that the timely intervention to prevent the progress of the disease through the disease eradication campaign carried out during 1999 has been fruitful in reducing the intensity of disease in subsequent years.

Disease incidence in Vietnam

The disease was first detected in Laikhe Rubber Experimental Station of Rubber Research Institute of Vietnam in August 1999. Severe disease incidence with fish bone type symptoms was noticed. By September 1999, disease was reported from various estates in Southeastern Vietnam. A severe outbreak of disease was reported from Locninh where more than 200 ha of immature plantation of RRIC 104 was completely defoliated in January 2000. The disease

is reported from South Eastern region and Central Highlands of Vietnam. The cloncs LI 188/372 (a hybrid of RRIC 110 and GU 1479) RRIC 103 and RRIC 104 are severely infected in Vietnam.

In an attempt to eliminate susceptible trees, 221 trees were removed from Laikhe Experimental Station. More than 3000 susceptible trees were also removed from different estates in Vietnam to avoid the danger of disease spread from affected trees (Dung and Hoan, 2000).

Disease incidence in Africa

Disease in Cote d' Ivoire, Gabon and Cameroon

The incidence of Corynespora leaf disease in *H. brasiliensis* cultivated in Cote d' Ivoire was observed in 1989 particularly severe on clone RRIC 103 and this clone was completely eradicated immediately. Mild infection was observed on other clones like RRIC 110, PB 260, PB 28/59 and some IRCA clones. Severe disease in RRIC 110 was observed in one location.

In Gabon and Cameroon, the disease was observed on the clone PB 260 causing 50 per cent defoliation. Some IRCA clones and MGF 372 were also attacked (Jean, 2000).

Disease incidence in Nigeria

Corynespora leaf disease of rubber was reported for the first time in Nigeria in 1966 (Awoderu, 1969) in the Western, Mid-western and Eastern States. In a clonal screening carried out at RRI of Nigeria Research Station, Iyanomo, Nigerian cloncs NIG 800, NIG 801, NIG 802 and NIG 803 were found to be susceptible. Besides RRIM 600 and GT 1 also showed infection (Begho, 2000). However, detailed reports on disease incidence in the plantation in the country are not available.

Impact of **Corynespora** leaf disease

It is evident that in the last two decades Corynespora leaf disease has emerged as one of the most important leaf diseases of rubber in Asia. The extent of disease incidence in Africa is not clearly known. Asia contributes nearly 95 per cent of the world's natural rubber production. Chee (1990) estimated that the crop loss due to this disease, if occurring in severe form, would be nearly 20 per cent. The crop loss estimated in Indonesia is 30-50 per cent in individual plantations. Although highly susceptible clones like RRIC 103 has been withdrawn from recommendation and largely destroyed, the threat of disease to other cultivated clones still exists. The attempts to face the situation by planting cloncs that show tolerance to the disease has the potential danger of those cloncs becoming susceptible to a new race of the pathogen as was observed in the case of RRIC 110, RRIM 600 and GT 1. Chemical control for the disease appears to be costly and not practical in many countries

due to lack of appropriate machinery and to the high cost of labour involvement besides the environmental concerns. Crown budding of susceptible high yielding clones with disease resistant crown clone has not become popular as the technique involved is cumbersome and success low in plantations.

The future success in Corynespora leaf disease control appears to he in the efficient use of integrated disease management techniques involving attempts his reduction in the inoculum and virulence of the pathogen and improvement in the resistance of *Hevea* clones. Molecular biological tools now available coupled with the success in plant biotechnology offers hope. Detailed investigation on host-pathogen interaction will help in identifying the post-infection events that lead to resistance or susceptibility. The genes involved in triggering resistance mechanism in the host can be located and genetic engineering can develop resistance in the high yielding (susceptible) varieties. The genetically engineered resisl.int high yielding material can be multiplied using the tissue culture systems which have already been developed.

Rubber being a smallholders' crop in most of the producing countries, epidemic disease.; like Corynespora leaf disease can cause serious impact on the life of the poor farmers. As most of the rubber growing countries are developing countries which cannot afford such serious set hacks to rural economy, intensified research to develop control strategy for this disease is essential.

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