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Need for Conservation of Crop Genetic Resources with Special Emphasis on Rubber

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In 1970, there was a shocking incidence for the agricultural community of the United States. It was the outbreak of the fungus causing southern corn leaf blight disease which swept across the country. In some areas about 50 percent of the crop was destroyed and the national loss of this major crop averaged about 15 per cent. The crop was, however, saved because a variety of corn with genes resistant to this disease was available with the breeders. This near disaster is a typical example of genetic vulnerability of crops (Anon, 1981 a). Several other instances are also available in the history of various crops. The outbreak of potato blight in Ireland in 1840, coffee rust in Ceylon in 1870 and wheat stem-rust in USA during 1954 are some other examples (Anon, 1973). What are the factors responsible for such a situation and what are the precautions which can be taken to protect our crop plants?

Almost all the crop plants are wild in origin, but man domesticated and exploited them through generations for his livelihood, The ancient farmers cultivated and protected high quality crop plants. Over the centuries, this manmade hybrids, called 'folk' varieties, were widely used for cultivation in all parts of the world. They showed great genetic variability. Their wild relatives also survived in nature. During the course of cultivation, a natural selection process has taken place giving emphasis on high yield. Subsequent scientific breeding and selection also resulted in the evolution of elite cultivars. Progress in vegetative and micropropagation methods further assured the genetic uniformity of most of the crops. This general tendency for directional selection of cultivars resulted in the erosion of valuable genetic traits. The transition from near primitive types to advanced cultivars has had the effect of narrowing down the genetic base (Frankel and Bennet, 1970). Narrowing down the genetic variability leads to monoculture of crop plants. Though monocultures bring about higher crop yields, such cultures will gradually become vulnerable to diseases and pests (Anon, 1974). The problem assumes much more importance as more virulent and new forms of disease evolve naturally.

A uniform population of narrow genetic base, when coincided with a virulent

In situ conservation of *Hevea* germplasm

Germplasm conservation garden at the Central Experiment Station

disease pathogen under a favourable environment,creates a very dangerous stage for the particular crop, known as the 'disease triangle' (Anon, 1976). If an epidemic breaks out at this stage, it will result in the total devastation of the crop.

What is the solution to overcome such a situation? A retreat to the deep jungles in search of the wild relatives of the modern cultivars is the most important solution. Wild species, which are closely related to the cultivated species have to be used for regaining disease resistance (Mehra, 1981). The infestation of a beetle in the potato fields of the US and the escape through the wild gene is a very interesting example. The beetle which feeds on the potato plant developed tolerance to insecticides and the spraying cost reached over 120 million dollars per annum. A wild species, *Solanum chaeoense*, was found to contain an insect repellant glycoalkaloid-leptine. Scientists incroporated the gene responsible for leptine into the cultivated species through cell fusion. Thanks to the wild relative, the beetles after the first bite flew leaving the crop unhurt (Stephen, 1988)
The virgin jungles of our planet are the natural reservoirs of numerous unexploited genetic traits. But the boundaries of the forests are shrinking rapidly. Along with the disappearing forests gene erosion also takes place. This is reported from various parts of the world and about one tenth of angiosperm species is in a hazard of extinction (Heslop 1976). Like any other forests, the world's great treasury of the plant kingdom–the Amazon forest–also is being threatened by axe. It is stated that almost entirely undisturbed till 1973, Rondonia's rain forest appears rusty-red due to the doubling of population during 1980. The Amazon wilderness is disturbed by land-hungry settlers. Experts estimate that more than 20% of the rain forest has already been destroyed. Rehabilitation schemes, construction of highways, mining, timber extraction and all other related unbalanced exploitation of the forest resources are all disturbing the forests (William, 1988).

According to Dr. Peter Raveen, no fewer than 1. 2 million species, at least a quarter of the biological diversity existing in the mid 1980's, will vanish during this quarter century or soon thereafter and that a much higher proportion of the total will follow suit by the second half of the next century, as the remaining forest refuges are decimated (Peter, 1988). The Institute for Space Research estimates the extent of last year's burning at 121,000 square kilometres in Amazonia, of which about 48,000 square Kilometres was rain forests and the most affected part is the Matto Grosso (Ricardo, 1989).

Germplasm collection and conservation is now most carefully persued in various crops by national and international agencies. The US Department of Agriculture has collected and introduced from the wild around 350,000 plant genotypes which are conserved in a living reserve of germplasm of world's plant treasures (Anon. 1971). The outstanding Soviet Plant Collector N.C. Vavilov and his extensive collection constitute the modern gene bank in the Soviet Union (Anon. 1987).

The International Board of Plant Genetic Resources (IBPGR) with its world wide network of collection centres and gene banks is taking efforts for germplasm acquisition on priority basis. IBPGR has also established *in vitro* gene banks and cryopreservation facilities for crops like cacao, cassava, coconut, sweet potato, musa, citrus etc. (Withers, 1987). Among the highest priority crops for *in situ* conservation, IBPGR has stressed the need for conserv-

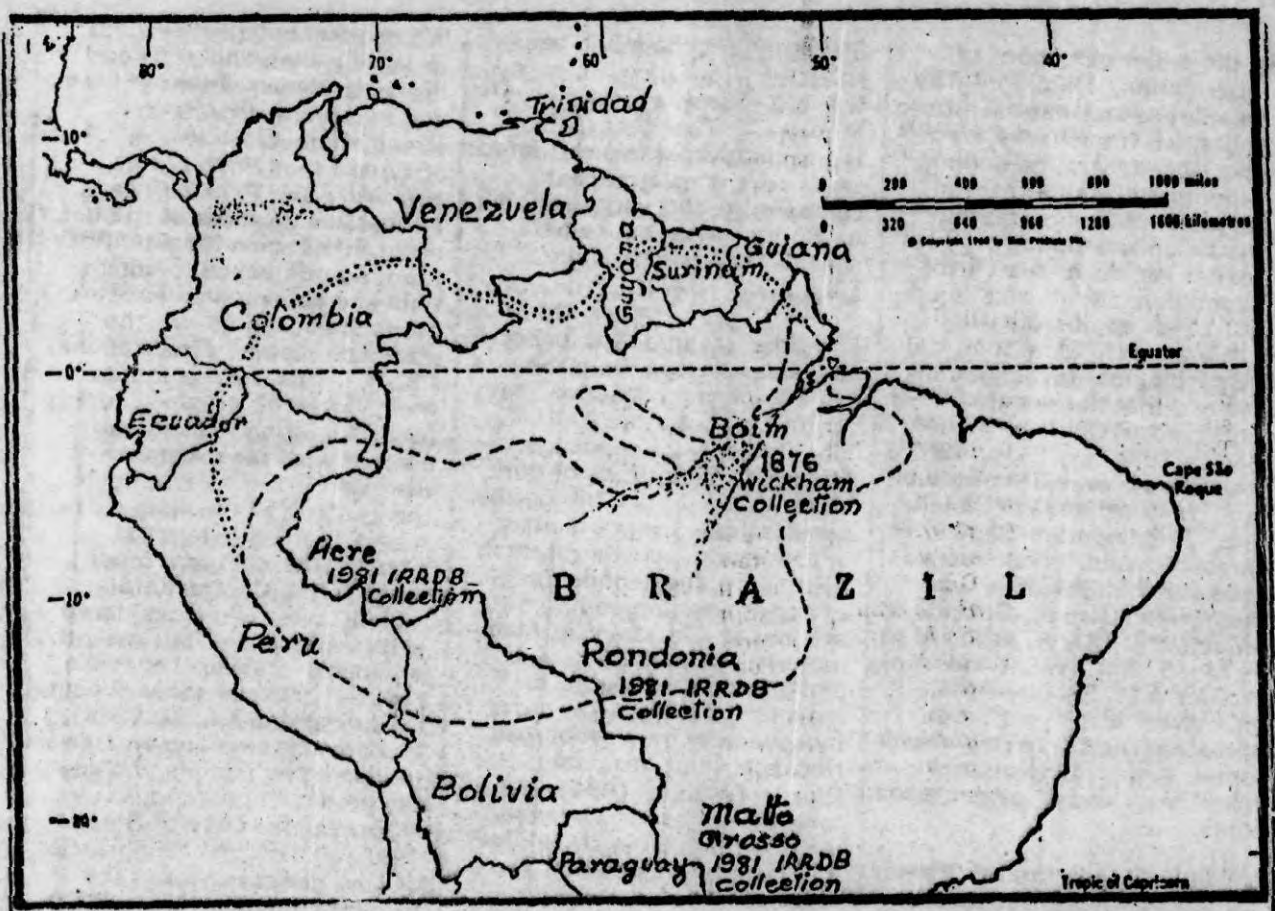
ing the entire gene pool of rubber (Anon, 1986 a). The versatile product-natural rubber is obtained from *Hevea brasiliensis*, Muell. Arg. belonging to the family Euphorbiaceae. Like many other crop plants, *Hevea* also is a native of Brazil. As such search for genetic diversity in this crop will have to be centred in this region. Morphological and cytological investigations revealed that the genus *Hevea* contains ten distinguishable species(Sehultes, 1970, 1987). They are: *H. brasiliensis* Muell. Arg., *H. benthamiana* Muell Arg., *H. camporum* Dueke, *H. quianenis* Aubl. (var. *lutea* Dueke & R.E. Sehultes, var. *marginata* (Ducke), Ducke), *H. microphylla* ule, *H. nitida* Mart ex Muell. Arg. (var. *toxicodendroides* R.E. Sehultes) *H pauciflora* Muell. Arg. (var. *coreacea* (Ducke), *H. rigidifolia* Muell. Arg., *H. spruceana* Muell. Arg. and *H. camargoana* Pires.

There is no cytological barrier for natural hybridisation between the most common species. The resultant gene pool of natural hybrids and variants are yet to be exploited. During the early exploration, the whole eco-geographic regions of wide genetic diversity were not properly represented. Besides the Amazon, the genus *Hevea* also grows in Bolivia, Columbia, Ecuador, Guyana, Peru, Surinam and Venezuela (Wycherley, 1977). It was discovered that *H. brasiliensis* grew along the bank of Amazon within a broad semicircle centered West of Manaus, south of Matto Grosso, Acre, Northern Bolivia and Eastern Peru, upto an altitude of about 800 meters with well distributed annual rainfall of about 1800 mm (Warren, 1987).

The seventy thousand seeds brought to Kew in 1876, by Sir Henry Wickham had been collected from near Boim on the Rio Tapajoz and Rio Madeira. The geographic representation of this restricted small area is insignificant compared to the very vast area in South America, where species diversity is more (Sehultes, 1977).

From the meagre 3.6 per cent seeds germinated from the 1876 Wickham collection, the South East countries had inherited only 22 seedlings. The entire plantations of our areas are built upon this narrow genetic base. Plant breeders in the field of rubber research pointed out the genetic dangers of continuous inbreeding attempted with the Wickham materials of the 1870's and had urged to take steps to replenish the breeders' stock by collecting new genotypes from the Amazonian rain forests (Ahmed, 1986). How long these genetic materials will be retained in its original habitat is unpredictable. The Amazonian forest is being destroyed and the Brazilian farming community is not keen to plant rubber. Despite the promotional efforts of SUDHEVEA and other agencies, the general lack of faith in rubber planting among the farmers divert their attention to cultivate other profitable crops. This situation is created due to the formidable challenge of fungus *Microcyclus ulei*, causing the devastating South American Leaf Blight (SALB) disease which is specific to *Hevea* spp. (Thomson, 1986). It is surprising to note that of the 4,05,000/-tons of elastomers that Brazil's industries consumed in 1985, only 2 per cent was from its own plantations (Warren, 1987). We need to safeguard our plantations from the unpredictable 'disease triangle' and sluggish genetic advancement. We need genotypes resistant to rapidly changing pests and diseases. Newer strains of fungi and herbivorous pests are already detected. It was observed that *Phytophtora palmivora* and P. *meadii* causing various diseases of rubber, occur in the same locality. Both the fungi are sexually compatible and some paired isolates produced oospores in the artificial media (Thankamma, 1974). This also points to the chances of disease causing fungi acquiring virulence to combat with the resistance of the cultivar and to overcome the strength of the fungicides. A bark feeding caterpillar *(Aetherastis circulata* Meyr.) found in the Central Kerala region, was once considered to be a minor pest, but recently, it became a severe endemic pest on rubber in some localities (Jayaratnam et al, 1989). The adverse environments and the changing climate including the predicted greenhouse effect (Anon. 1989 a; Steve 1988) all warrants introgression of new genetic traits in the present cultivars. None of the high yielding clones has any form of resistance against South American Leaf Blight. Analysis of the past breeding data also shows that crop improvement based on the existing depleted and limited genetic stock has its own limitations (Anon. 1981 b).

Timely action of the International Rubber Research and Development Board (IRRDB) on a priority basis has enabled the rubber producing countries to send a team of Scientists 1981 to the Amazonian jungles for collection of wild genotypes of *Hevea*, which was funded by the member Institutes of the IRRDB including the Rubber Research Institute of India. The team had collected 64734 seeds and 190 ortet clones from the Western Brazilian states of Acre, Rondonia and



Map showing distribution of Hevea (adapted from various sources) ---- Hevea brasiliensis ::::: Other species of Hevea.

Matto Grosso. The seeds have been distributed in three main germplasm centres in Brazil. Malaysia and Ivory Coast.

Preliminary reports on these wild genotypes indicate that there is clear distinction between the 1981 germplasm materials and the Wickham collection (Anon 1989 b). The Rubber Research Institute of India also is getting its share of the Brazilian germplasm. Preliminary studies on a few genotypes at the nursery stage indicate that the genotypes exhibit wide variability with respect to vigour and certain morphological characters Annamma et. al, 1986).

Rubber and cocoa are natives of South America but widely cvltivated in South-East Asia. Such man-made distribution of crop species in various parts of the world coupled with rasearch efforts to suit locational requirements has also affected the pattern of variation leading to secondary diversity (Anon. 1986 b). Secondary diversity is also an important factor in broadening genetic resources. Rubber planters prefer modern clones to older cultivars. As a result, during the process of replanting older clones, some of which are the donor parents of modern high yielders, are also being eliminated. This is another channel of gene erosion. Timely action has been taken by the Rubber Research Institute of India to identify and collect the older genotypes before they are lost, which have now been conserved *in situ* in the gene banks of the Institute.

Collection and conservation of genetic resources, especially of all crop plants, shall have to be done on warfooting. Close liaison at the national and international level is necessary. Thanks to the NBPGR and IBPGR for what has already

been done. The combined effort of taxonomists, geneticists, biochemists, plant breeders and agriculturists is of vital importance. What has been already achieved though only a little is significant, but what is yet to be done is much more.

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