Bulletin of the Rubber Research Institute of Sri Lanka, (2009) **50**, 6-11

A CENTURY OF RUBBER RESEARCH – DEVELOPMENTS IN RUBBER PLANTING MATERIALS

P Seneviratne and G A S Wijesekera

From the wild plant which grew abundantly in the deep Amazon jungles of South America, rubber tree (*Hevea brasiliensis*) has come a long long way, yielding more than 10 fold yield compared to original genetic materials.

The British who were amazed with properties of latex, desired to have plantations of rubber out side South America. In order to fulfill this objective Sir John Hooker the Director of Kew Gardens of U.K. employed Henry Wickham, later Sir Henry, from which the legend of Wickham started. Several of the circumstances and outright accidents relating to the Wickham seeds will be of special interest to economic botanists. Wickham had not known it then but it is now known that *Hevea brasiliensis* is the only *Hevea* species indigenous to the Tapajoz area where he collected seeds. Had he collected elsewhere, he probably would have come up with seeds of one of the other less productive *Hevea* species because he could not at the time have known enough about the genus to select *Hevea brasiliensis* (Fig. 1). Had he collected one of the other species, the development of rubber cultivation in Asia would have been delayed or would have not taken place at all. Fig. 2 shows the morphological characters of other *Hevea* species.

Fig. 1. Morphological characteristics of *Hevea brasiliensis*

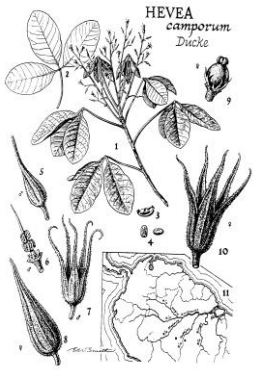
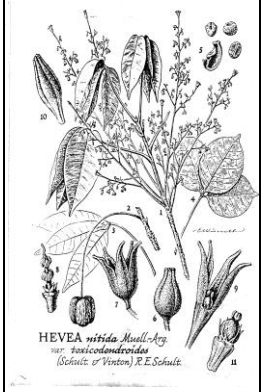
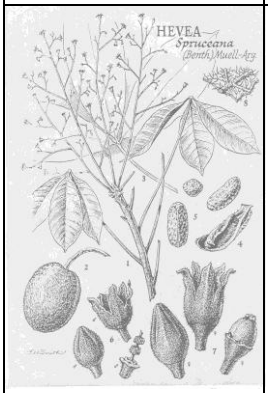
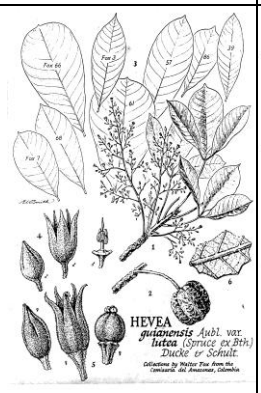
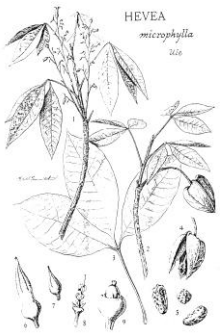
			
Hevea benthamiana	*Hevea camporum*	*Hevea nitida*	*Hevea pauciflora*
			
Hevea spruciana	*Hevea guianensis*	*Hevea rigidifolia*	*Hevea microphyla*

Fig. 2. Other members of the genus *Hevea*

Though, *Hevea* originated in the rain forests of the Amazon river basin in South America, the development of the species to give high amount of latex, has been taken place in South East Asian countries. As far as the world rubber production is concerned, the share of the South American countries is only about 1%. About 4% is produced in African countries and the balance 95% is produced in South East Asia (Fig. 3). The reason for this is though wild rubber are resistant to the deadly foliar disease called South American Leaf Blight (commonly known as SALB), almost all improved clones, though originated from seedlings from South American seeds, are

vulnerable to this disease. Hence, none of these high yielding clones can be grown in South American countries.

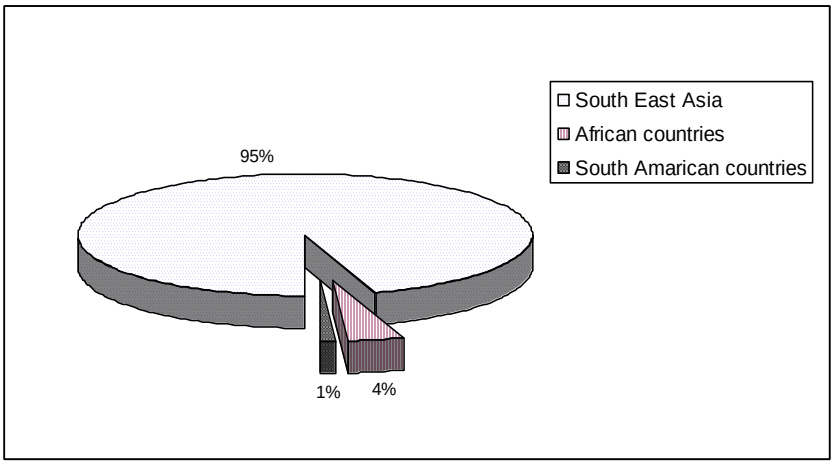


Fig. 3. Rubber production in different regions of the world

The seedlings first grown in Sri Lankan plantations yielded similar to the South American plantations. Having realized the high variation among individuals in seedling plantations the need for a vegetative propagation method was badly felt by the planters. Many attempts were made to produce plants through rooted cuttings by using twigs removed from high yielding trees. However, when the trees are identified as high yielders, they are at least 7-8 years old and are in the mature phase of growth. Therefore, though a few plants could be produced by inducing roots on them, the technique could not be used at commercial scale. Further more, the roots produced on mature cuttings were not morphologically satisfactory as most grew parallel to the ground.

Among the *Hevea* species *Hevea pauciflora* is resistant to SALB and crosses between *brasiliensis* and *pauciflora* have shown remarkable vigour and growth rates in Amazon area. The scientists in South East Asian countries came across with remarkably high yielding individuals and they were more interested on vegetative propagation of rubber. With the introduction of bud grafting technique, the quality of the planting material became much more uniform and reliable as far as the growth and yield are concerned. With the predictable yields of the clones used then, the rubber industry became economical to growers in South East Asia.

Brown budding

Bud grafting technique invented by Van Helton in 1917 made possible the production of thousands of budded plants from an individual mother tree. The process should start with establishing source bush or budwood nurseries of identified

individuals. However, it also had the disadvantage of not being true-to-type due to unselected seedlings used for the root stock. *Hevea brasiliensis* has 46 chromosomes and one can imagine of the many different combinations that are available in a population of seedlings. However, by selecting vigourous seedlings, the variation could be minimized to a reasonable level.

Bud grafting demanded nursery management. The most important factor with regard to budwood nurseries is that the clones or varieties should be grown in such a way that different clones are clearly separated and labeled. The life span of these budwood nurseries is 10 years, thus $1/10^{th}$ of the plants in budwood nurseries should be uprooted and planted each year using new clones. Also it is necessary to train people to identify different clones by their morphological characteristics such as shape of leaves and whorls, colour and texture of the leaves, colour of the trunk *etc*.

In brown budding technique, germinated seedlings are planted in ground nurseries and bud grafted when they are about 1-1½ years old. However, in some cases the age of the seedlings was about 3 years when grafted. When these plants were field planted, the performance of the clearing was lower than the potential of the clones; the plants showed vigorous growth only during the first 2-3 years in the field as they reached the mature phase by then. The unproductive period of such clearings was about 8-10 years (Fig. 4).

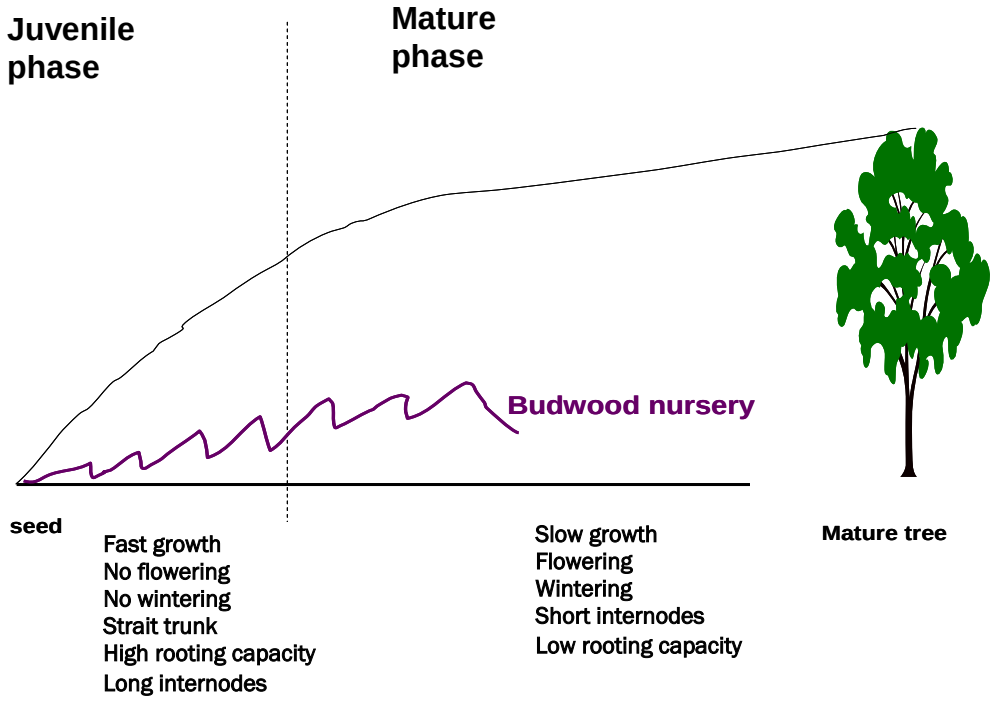


Fig. 4. The growth phases of rubber clearings and the characteristics of each phase

Green budding

In order to cut down on the age of the seedlings and thereby the age of budded plants, the technique of green budding was developed. In this technique, green shoots are used to harvest buds and the age of the seedlings at the time of grafting was reduced to 6-8 months. Though this method had the advantage of producing budded plants within a shorter period, compared to brown budded plants, the slightest mistake in the field led to death of plants. They were very sensitive to adverse weather conditions leading to poor field establishment rates.

Poly bag plants

In an attempt to improve field establishment rates, all green budded bare root plants were planted in poly bags and once they develop 1-2 leaf whorls they were field planted. This method reduced the problem of high casualties experienced with green budded bare roots, but there were also disadvantages such as high cost due to prolonged nursery period, lack of proper root systems and difficulties in handling large size bags.

Young buddings

In this technique germinated seedlings selected as early germinates from the germination beds are directly planted in small size poly bags. There is no ground nursery involvement and therefore, the cost is reduced to a greater extent. With regard to the root system, it was superior to bare root budded plants (Fig. 5).

Fig. 5. Root system of a young budding

Seedling plants are bud grafted at the age of 4-5 months using budwood of similar diameter. When the graft is a success, the stock shoot is removed allowing the grafted bud to grow. With this technique, two whorl budded plants having a root system of uninterrupted growth and growing in a small bag can be produced in 8-10 months. Due to the superior qualities over the bare roots and conventional poly bag plants, young buddings establish easier and grow fast in the field making the immature period shortest possible.

Young buddings are used by almost all planters everywhere in the world today. However, no one would declare that this is the end of the development of planting material, but young buddings produced according to the recommendations serves the purpose of achieving the potential yields of recommended clones.

Sources: Richard Evans Schultes, F.L.S. "Wild *Hevea:* An Untapped Source of Germ Plasm", (1977), *Jl. Rubb. Res. Inst. Sri Lanka* Vol. **54,** Part 1, No. 1. pp. 227-257.