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ROOT SYSTEM OF HEVEA WITH SPECIAL REFERENCE TO MICROPROPAGATED PLANTS

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SUMMARY

Apart from the uptake of water and soil nutrients, need of a tap root system for *Hevea* is mainly for the anchorage of the tree. Though propagation via bud grafting fulfills this requirement, intraclonal variation found in bud grafted plants is a disadvantage and for this reason a true-to-type propagation method is of interest to the planter which will surely improve the productivity of the plantations and also of a unit land area. Rooted cuttings are not recommended as a planting material, firstly due to the difficulties in inducing roots on clonal materials and secondly due to lack of tap roots on cuttings. Micropropagated plants via axillary bud proliferation also should not produce tap roots. The root system of axillary bud originated plants of juvenile origin did not contain a tap root though the tree growth observed in the field was comparable to that of embryo cultured and bud grafted plants which contained tap root systems.

Key words: root system, micropropagation, rubber,

INTRODUCTION

Seedling plants of *Hevea* consist of a tap root system which provides substantial anchorage to the tree when it is mature and fully grown. Attempts have been made to propagate *Hevea* by rooted cuttings due to the advantages of rooted cuttings over bud grafted plants such as true-to-type propagation. Rooted cuttings of seedling materials are useful to minimize the variation related to stock/scion interactions found in bud grafted plants and rooted cuttings of clonal materials can be used to propagate selected materials with a guarantee of the desirable characteristics such as yield.. The experience on producing rooted cuttings has shown common features for all woody perennial trees, i.e. cuttings taken from young seedlings have produced roots readily but when taken from old seedlings or from bud grafted trees,

rooting has been much more difficult (Baptist, 1939). Vegetative propagation of clonal *Hevea* by cuttings has been successfully demonstrated by Tinley (1960) for some clones including PB 86 and GT 1. The root system consisted of more than one lateral roots and in some cases only one strong root resembling a tap root. The growth of the plants has been vigorous up to about one year of experimental period. However, the trees produced by rooted cuttings lacked tap roots and the laterals developed were said to be not strong enough when the tree is fully grown. Proper tap root system also supports for the uptake of water and soil nutrients from deep in the soil which helps the tree to grow vigorously. Micropropagated plants via axillary shoot proliferation too do not contain a tap root as only seed originated plants or plants obtained by germinating somatic embryos can have tap root systems. The present report discusses the root system produced by the micropropagated plants up to about 3 years in the field with compared to the embryo cultured and bud grafted plants.

MATERIALS AND METHODS

Juvenile shoot materials harvested from glass house–grown plants were used for this study. Roots were induced on axillary shoots of about 4–5 cm long and produced *in vitro*, by transferring them on to a medium containing 2 mg/l IBA. After 2–3 weeks on this medium roots were seen and rooted plants were then acclimatized in propagator trays with adjustable vents on the lid supplied by the BDH Company, England. Unsterilized top soil was used in the propagators and plants were not fertilized during this period. After about 2–3 weeks plants were transferred to soil filled polythene bags of 6" X 6" and fertilized with about 10 ml of liquid fertilizer used for young buddings of rubber (Advisory Circular No 1994/01 – Young budding). Bags were made of gauge 500, guzzetted black polythene. Plants were grown in these bags for about 6 months period and then transfered to 7" X 15" size bags. After another 6 months, they were transfered to 12" X 20" bags and left without transferring until they were field planted at about 1 year of age. Control treatment was the embryo cultured plants, acclimatized and grown in the same manner. After field planting aerial growth was monitored and the root system was exposed to observe the root growth. Grafted plants in bags were also planted in the field to compare the growth of *in vitro* cultured plants. Grafted plants used were of young buddings grown in 6" X 15" bags and they were raised in August 1991 and field planted in May 1992. The recommended size of the polybag for young buddings is 6" X 15" for the plants to be grown for a period of about 9 months starting from the seed.

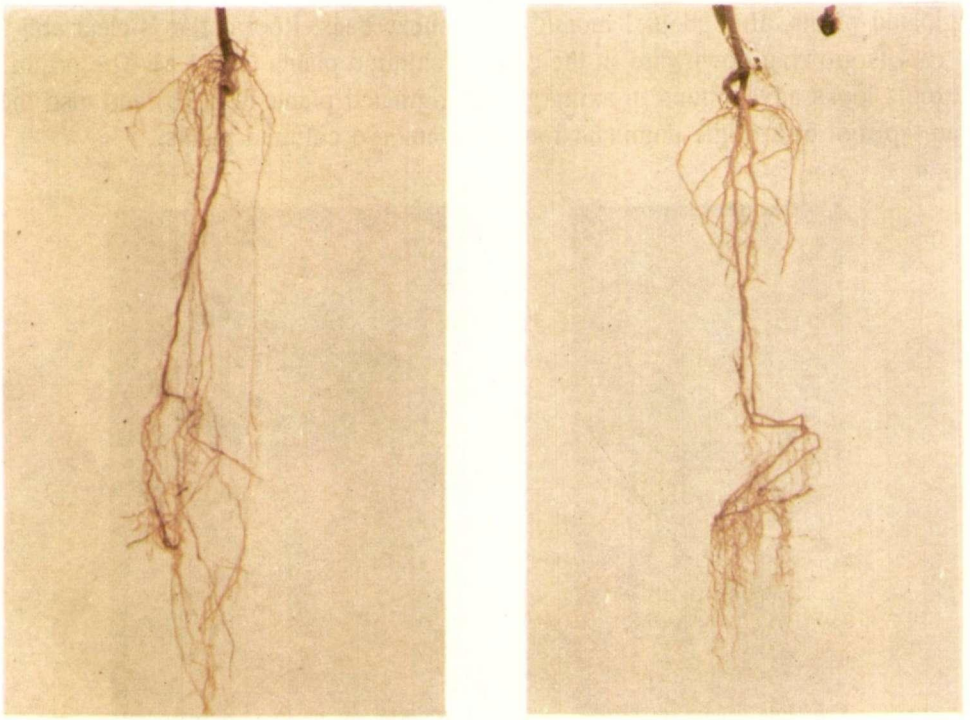
RESULTS

With compared to embryo cultured plants, root initiation and elongation were satisfactory in micropropagated plants. Shoot elongation was observed after the acclimatization period. Fig 1 shows the growth of embryo cultured and axillary bud originated plants, after about 1 month in polythene bags. Root collar is clear and the tap root is growing downward in the embryo cultured plants (Fig 1 a). The origin of the roots looks adventitious in axillary bud originated plants (Fig 1b) and also there is no tap root or a single dominant root as in embryo cultured plants.

a b

Fig. 1. The growth of (a). embryo cultured and (b) axillary bud originated plants after about 1 month of acclimatization.

The root growth after about 2 months are shown in Fig.2. Again the embryo cultured plants show the prominent growth of the tap root. Bending of the roots at about 1 foot deep is due to growing them in shallow polythene bags for too long; if the tap root did not penetrate the bottom of the bag, then it starts coiling.



a b

Fig. 2. The root growth of (a). Embryo cultured and (b). Axillary bud originated plants after about 2 months of acclimatization.

Fig. 3 shows the root system of the two types of plants grown in 20" long bags for about 6 months period. Lateral root growth is comparable but, in the micropropagated plant, two roots are growing; however they are positively geotropic as in embryo cultured plants.

The general appearance of a axillary shoot originated plant is shown in Fig. 4. The plant with a red colour band in Fig.4(a) is an axillary shoot originated one while the plants in the figure 4(b) are bud grafted plants of similar age. The root growth of the plants after 2 years of field planting are shown in Fig. 5.

a b

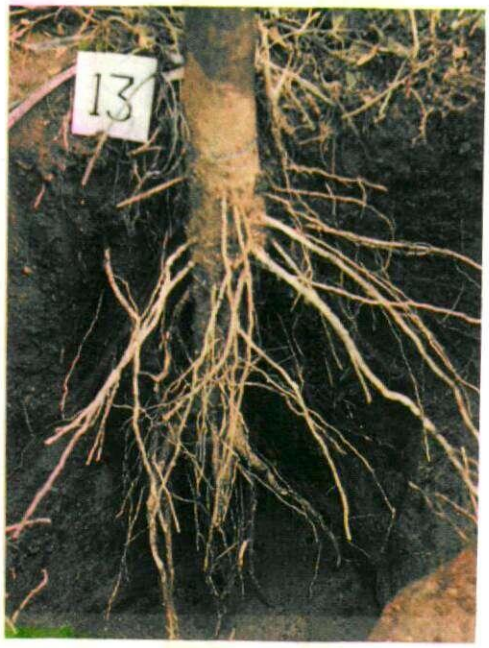
Fig. 3. The root growth of (a). Embryo cultured and (b). Axillary bud originated plants after about 6 months of acclimatization.

The aerial growth was comparable in the three types of plants. They all were grown in polybags when they were transferred to the field. The root growth was similar in bud grafted plants and embryo cultured plants. However, smooth root/shoot

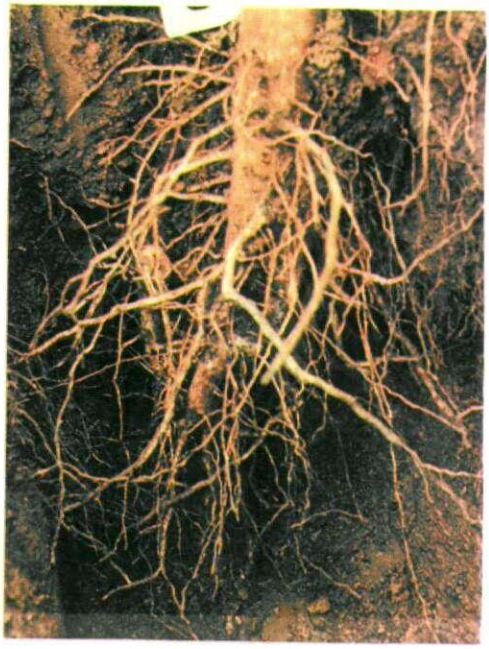
union is observed only in embryo cultured plants (Figs 5a & 5b). In bud grafted plants (Figs 5e & 5f), stock/scion union is visible and similar to those of micropropagated plants. In Figs 5(c) and 5(d) i.e. axillary shoot originated plants, the adventitious origin of the roots is visible.

a b

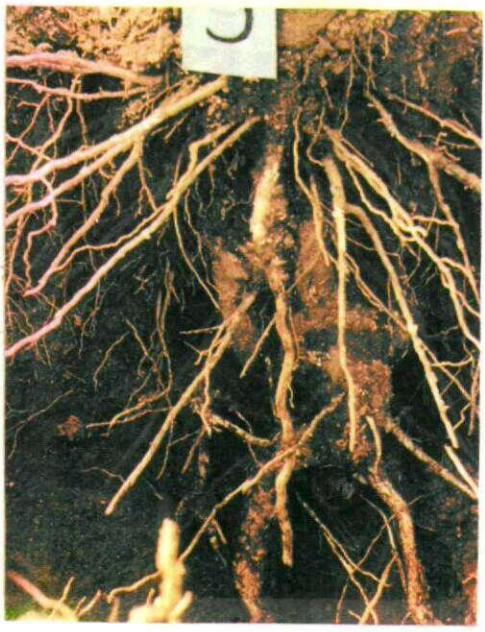
Fig.4. The growth of (a). axillary bud originated plant and (b). budgrafted plant.



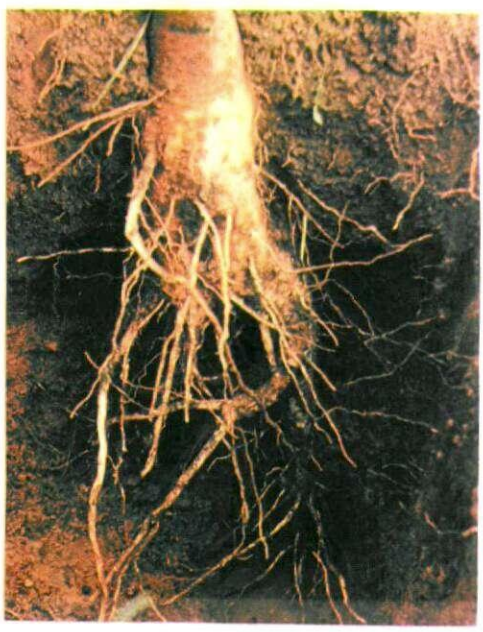
a



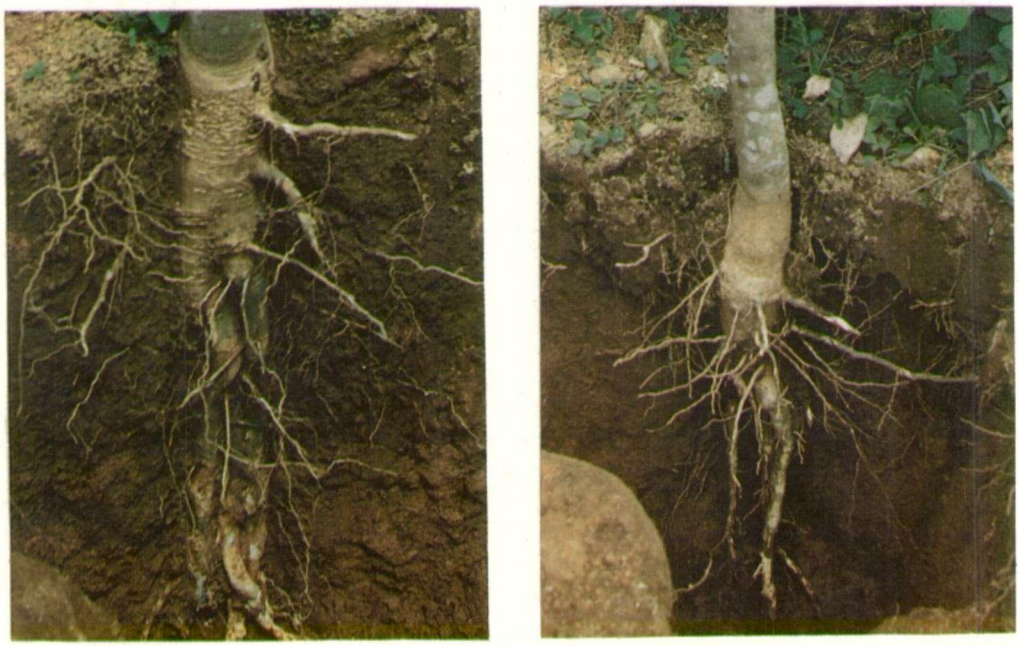
b



c



d



e f

Fig. 5. The root system of embryo cultured (a & b), axillary bud originated (c & d) and budgrafted (e & f) plants after about 2 years growth in the field.

In all cases most of the lateral roots got damaged when exposing the root system. As far as the tap root growth is concerned, they do not seem to grow very deep in any case. Coiling of the roots observed in axillary bud originated plants is partially due to growing them in shallow polythene bags for too long, prior to field planting. Anyhow, the performance of the root system of the axillary shoot originated plants is satisfactory as measured by the aerial growth and also comparable with the other types of planting materials.

DISCUSSION

No reports are so far available on the performance of the root systems of micropropagated plants of *Hevea* under field conditions. It is practically and theoretically proved that rooted cuttings are not producing tap roots. Micropropagated plants produced by axillary shoot proliferation are more or less similar to those of rooted cuttings and hence should not contain tap roots. The plants produced by somatic embryogenesis are said to have a tap root system as somatic embryos are similar to zygotic embryos.

Tinley (1960) has stated the possibility of formation of tap roots on cuttings as some cuttings produced only one root growing down ward. Though it is highly unlikely that a cutting would produce a tap root, as stated by Tinley (1960) if the root system produced is sufficient to give the required anchorage to the tree and also supports the growth of the plant then the need of a tap root will be minimum. However, in his report only up to one years growth has been monitored and it is clear that at least 5 – 6 years of growth is required before making any comments on the effect of the root system on the growth and the survival of the plant.

Though the plants produced by somatic embryogenesis have been planted in field more than 10 years ago, no reports are available on the performance of the root system. However, somatic embryos are supposed to produce tap root systems and accordingly there will not be a problem of the root system. Microcuttings or plantlets produced by axillary shoot proliferation (Carron et al, 1984) too have been transferred to field conditions about 10 years ago, and according to Carron et al, (1989) the growth of the trees has been satisfactory. But no reports are available on the root system produced or on the performance of the roots. However, the satisfactory growth of the aerial part gives an indication of the good performance of the root system.

The root system of the micropropagated plants of the present study does not show any characteristics to be a tap root. Anyhow, some embryo cultured and also bud grafted plants too show poor root systems such as branched tap roots. Deep planting may be practiced to advantage, so that the root system will be established deeper in the soil. However, there will be no roots formed on the buried scion. But if the bud grafting is carried out about 6" – 12" high on the stock plant, and the stock plant is buried up to the graft union, then the buried stock stem is said to produce roots (Yoon and Leong, 1986). In both cases, establishment of proper roots deeper than the usual may be advantageous for better anchorage. Anyhow, burring the scion shoot, though does not produce roots has the additional advantage of providing the drainage area when the tapping cut reaches the ground level.

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