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GENETIC DISTANCE BETWEEN THE ROOT STOCK AND SCION OF HEALTHY AND TPD AFFECTED TREES OF *HEVEA BRASILIENSIS*

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The mean genetic distance (GD) between the root stock and scion of budgrafted *Hevea* trees was significantly more in tapping panel dryness (TPD) affected (33%) than healthy (20%) trees. More number of healthy trees tended to have a closer GD while more number of TPD trees had a wider GD between their root stock and scion. Thus a greater GD between the root stock and scion was observed to be associated with TPD even if this may not be an absolute prerequisite for the incidence of the syndrome. Exploitation of optimum GD between root stock and scion may be useful for excellence in agronomic performance of budgrafted plants.

Key words: Bud graft, Genetic distance, *Hevea brasiliensis*, Stock scion interaction, Tapping panel dryness.

Several plantation and horticultural crops are propagated through grafting genetically superior scion to a root stock that has a genetic composition different from the scion. The root and shoot systems of a plant are always under dynamic communication through exchange of metabolites and hormones both ways and the roots have significant effects on the scion (Casper, 1990; Ravishanker *et al.*, 1995). It has been known for long that the root stocks impart profound effect on the scion and *vice versa* like dwarf root stocks altering the canopy architecture of the scion (Hartman and Kester, 1976; Rom and Carlson, 1987) and scion affecting the cation exchange capacity of the roots (Sobhana, 1998).

In *Hevea brasiliensis*, genetically divergent seedlings grown from cross pollinated seeds are used as root stocks and this has been often implicated as a source of the large tree to tree variations in growth and yield of bud grafted trees (Lockard and Schneider, 1981). It also has been reported that the genetic heterogeneity of the root stocks leads to polymorphism in the isozymes of several enzymes in the scion of budgrafted *H. brasiliensis* plants (Krishnakumar *et al.*, 1992; Sobhana, 1998; Thomas *et al.*, 2000). Since the root stock and scion tissues are genetically different, existence of genetic conflicts between them is possible. Even in a single plant, tissues with different genetic constitutions are in constant conflicts for resource allocation (Doust and Doust, 1988). Root stock-scion interaction effects may be physiological expressions of subtle genetic conflicts existing between them, but this has never been properly investigated. For example, it is now known that such interactions are minimal when the genetic distance between the root stock and scion is less and that a particular genetic association between the root stock and scion would lead to better agronomic

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performance (Sobhana *et al.*, 1999).

In the present study, the genetic distance between the root stock and scion of bud grafted trees of *Hevea brasiliensis* was determined and was related with the occurrence of tapping panel dryness (TPD) syndrome, a serious problem affecting the productivity of rubber plantations throughout the rubber growing countries.

Eighteen year old budgrafted trees of the clone GT 1 (grown at the Central Experiment Station of the Rubber Research Institute of India, which were under ½ S d/2 system of tapping, were used for the study. These trees were under regular monthly observation for more than one year before their TPD status was ascertained. Bark samples were collected from the root stocks and scions of 20 healthy and 21 TPD affected trees.

The method described by Porebski *et al.* (1997) was used with modifications for the extraction of DNA (Thomas *et al.*, 2001). PCR amplifications were carried out using thirteen Operon arbitrary decamer primers that gave informative amplifications. They were OPD-08, OPB-15, OPA-10, OPE-01, OPG-17, OPG-10, OPJ-20, OPI-06, OPH-03, OPJ-9, OPA-01, OPG-03 and OPE-03. PCR amplicons were electrophoresed on a 1.5% agarose gel, stained with ethidium bromide and visualised against a UV light source.

The genetic distance between the root stock and scion was calculated from the RAPD profiles using the following modified Jaccard index (Jackson *et al.*, 1989).

$GD_{ij} = (B_{ij}/M_{ij})*100$ where GD_{ij} is the genetic distance between the samples i and j; B_{ij} is the number of polymorphic bands between i and j and M_{ij} is the total number of band positions in i and j.

Although there was a wide range in the genetic distance between the root stock and scion in both healthy (5-34%) and TPD affected (7-69%) rubber trees (Table 1), the mean genetic distance between the stock and scion was significantly more in the TPD affected (33%) than in healthy (20%) trees (Fig. 1). In 43 per cent of the healthy trees, the genetic distance between the stock and scion was less than 20 per cent, whereas in the case of TPD trees, only 20 per cent of the trees fell under this category. Interestingly, only a small fraction of healthy trees (5%) had a genetic distance of more than 33 per cent between their root stock and scion. A large proportion of TPD trees

Table 1. **Genetic distance (GD %) between root stock and scion**

	Healthy trees (%)	TPD affected trees (%)
Genetic distance	0-34	7-69
Trees with GD <20%	43	20
Trees with GD >33%	5	40

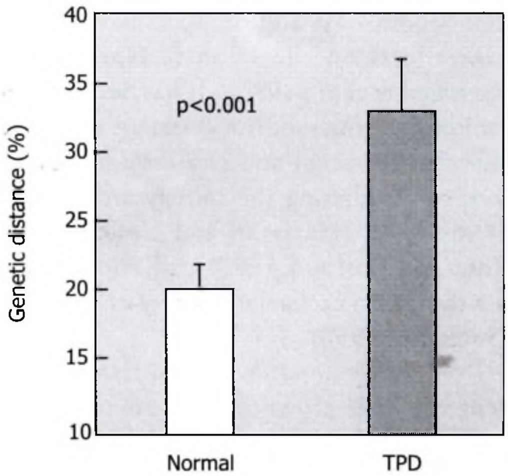

Fig. 1. Mean genetic distance between the root stock and scion

(40%) had a genetic distance greater than 33 per cent between their stock and scion. Thus, it appears that more number of healthy trees tended to have a closer genetic distance between their stock and scion. The above results suggest that a greater genetic distance between the root stock and scion is associated with TPD although it may not be an absolute prerequisite for the incidence of this syndrome.

The present finding on the association between TPD and a large genetic distance between the stock and scion is akin to genetic conflicts occurring between the genetically divergent developing ovules in *Dalbergia sissoo* (Doust and Doust, 1988). Although the mechanism of this conflict in budgrafted *H. brasiliensis* is unknown at the moment, it is suggested that TPD may be a delayed expression of the functional incompatibilities persisting between the genetically divergent root stock and scion that are grafted together to form and function like a single plant. Panel changing did not result in the recovery from TPD of the affected plants indicating that TPD is not a local phenomenon (Krishnakumar and Jacob, 2002). It may be noted that *H. brasiliensis* root stocks were capable of imparting extensive effects on scion at all levels of organization from the molecule to the phenotype (Ravishanker *et al.*, 1995; Sobhana *et al.*, 2001). In grafted tomatoes, it has been shown that specific species of mRNA can migrate from the root stock to scion (Kim *et al.*, 2001), but it is unclear if similar movements can take place in grafted woody plants like *H. brasiliensis*. The existence of different types of TPD with different causative factors may also be possible (De Fay and Jacob, 1989).

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