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ATTRIBUTES OF THE BARK CRACKING DISORDER IN THE ROOT STOCK OF BUD GRAFTED RUBBER (*HEVEA*) TREES

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INTRODUCTION

Maladies of the rubber tree (*Hevea brasiliensis* Muell.Arg.) are many, mostly caused by pathogenic agents. Physiological disorders of *Hevea* are few, and 'brown bast' is the most important condition of them all as it affects the latex producing capacity of the rubber tree. Physical injuries are also common, some times leading to secondary infections by pathogenic and saprophytic organisms. Apart from these known maladies, a condition of bark cracking in the root stock and oozing out of latex was observed recently in bud grafted trees with different scion genotypes and in some seedlings. This disorder was first observed one and half years back in a RRIC 121 clearing planted in1998, and later found to be present in many trees irrespective of the genotype of the clone, or the location. The presence of this disorder in seedlings was also disclosed (Pathiratna *et al.*, 2006).

Consequent to the first observations made in a RRIC 121 clearing in the RRISL substation at Kuruwita, 6132 bud grafted trees of different ages and belonging to ten rubber clones were investigated. The disorder was initially observed in trees with the 'elephant foot' and exudation of latex was seen from one or several cracks appearing in the 'elephant foot' (Plate 1a). Later trees without the 'elephant foot', but having unusual coagulated latex patches on the soil surface near the base of the trunk (Plate 1b) when inspected by removing the soil below the latex patch to expose the origin of latex, similar cracks as in the 'elephant foot' were seen in positions immediately below the graft union (Plate 1c). Further observations showed that the disorder was present in bud grafted trees of all clones in varying percentages at all sites investigated (Table1). Further details of this investigation are available elsewhere (Pathiratna *et al.*, 2006).

However, this disorder was totally absent in the root-stocks of 1886 bud wood plants comprising of 16 clones investigated in Dartonfield (Kalutara), Kuruwita, Karapinche and Pussellawa (Ratnapura district).

It was also revealed that this disorder was absent in young trees of 1-2 years of age and its occurrence was as low as 0.5% in a three year old RRIC 121 clearing while it was highest (11.8%) in a seven years old clearing of the same clone. The number of affected trees was also very low (0.7%) in older clearing, for example in a 15- year old RRIC 121 clearing (Pathiratna *et al.*, 2006).

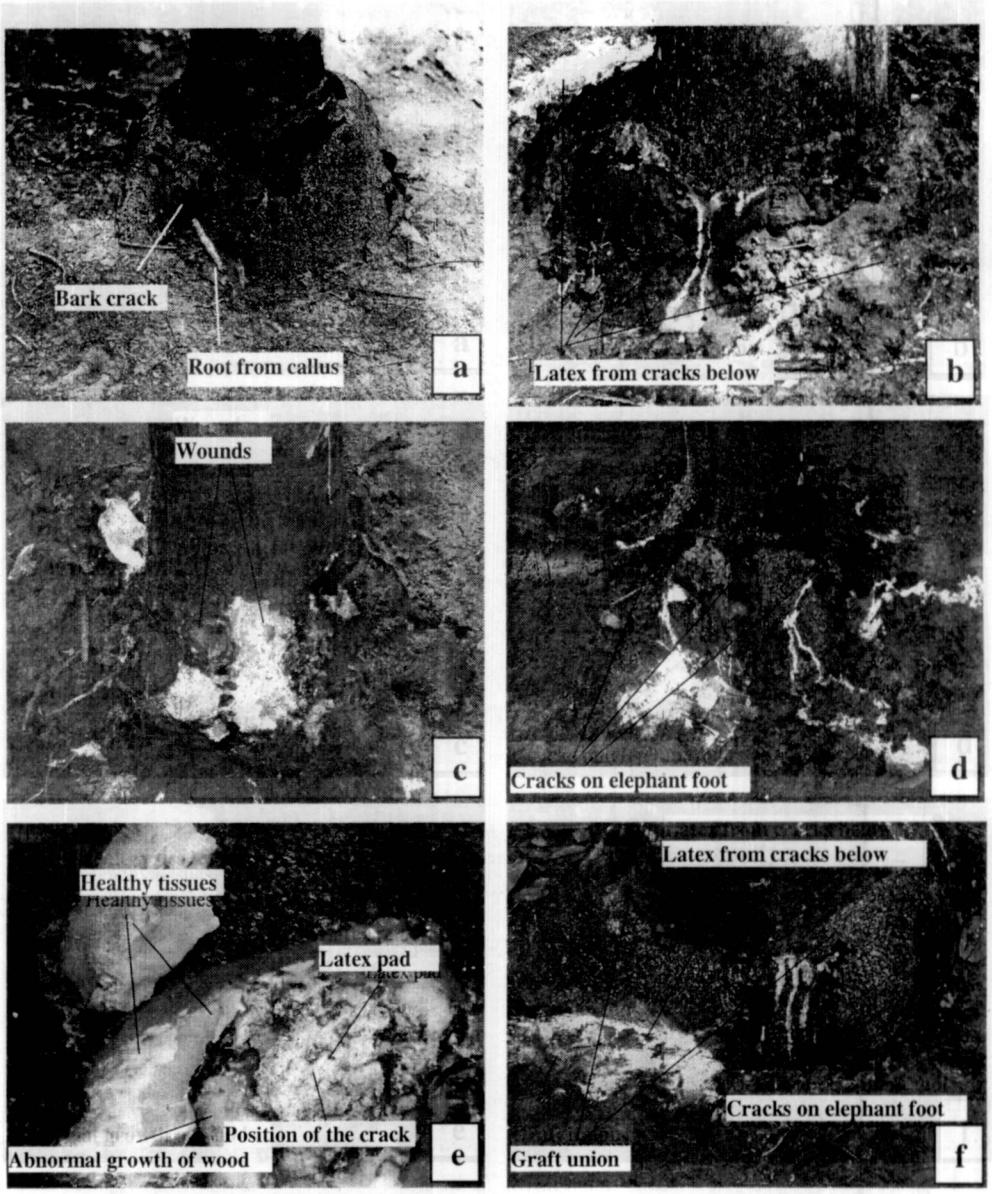

Plate 1 (a) Bark cracks on the 'elephant foot' with exuded latex in a bud grafted seven year old RRIC 121 tree. Bark under the crack regenerates and have produced a root **(b)** Latex coming out of cracks underneath in a RRIC 121tree in the same clearing; **(c)** Extent of damage caused due to bark cracks below the soil surface. Soil was removed to expose the wounds. **(d)** Latex oozing out from cracks on the 'elephant foot', enlargement of the elephant foot seen. **(e)** Crack in (d) cut open to show the latex pad under the crack, abnormal growth of wood and the healthy tissues under the crack not showing any infection **(f)** A severely affected tree where cracks are found in the 'elephant foot' and root collar immediately below the ground level of a seven year old RRIC 121 tree

Table 1. *Age, percentage of affected trees and severity of the disorder in different rubber clones investigated*

Clone of the scion	Age (years)	% affected	Severity (1-4)
RRIC 121	3	0.5	1
RRIC 121	4	3.1	1-3
RRIC 121	7	7.4	1-4
RRIC 121	7	11.8	1-4
RRIC 121	15	0.7	3
RRIC 121	13	2.9	1-2
RRIC 100	7	5.6	1-4
RRIC 100	10	4.5	1-2
RRIC 100	13	1.3	2-3
RRIC 100	18	0.2	1
RRIC 102	11	2.7	1-4
RRIC 133	10	3.0	1-3
RRIC 110	13	1.0	3.0
RRISL 201	10	2.6	1-3
RRISL 217	10	2.6	1-3
RRISL 202	10	3.2	1-3
RRISL 222	5	0.85	1

(Severity: 1= small cracks with very little exuded latex as in Plate 2b; 4 = Severe wounds with continuous oozing of latex and with decaying roots as in plate 1c)

Attributes

These bark cracks seem to appear as small openings in the root stock and are visible in trees with the 'elephant foot'. Continuous oozing of latex from these cracks was seen and formation of callus underneath the cracks was a feature when they were on the 'elephant foot' (Plate 1e). This also has resulted in the abnormal enlargement of the 'elephant foot' in contrast to those without the disorder (Plate 1a). Exudation of latex from cracks in the 'elephant foot' has been there for nearly two years, but without any signs of infection or bark decay (Plate 1e). This is probably due to the ability of exuded latex to flow out freely without coagulating underneath the bark and chance for the soil microflora to come in contact with the bark crack is less.

In trees with the graft union below the ground level. bark cracks are not visible (Plate 1b). They can only be traced by removing coagulated latex patches and soil at the base of the tree to expose the origin of latex (Plate 1c). Further inspections

revealed that the bark in the vicinity of the crack was decaying and beneath these were large coagulated latex pads in between the rotten bark and the wood (Plate 1c). Formation of latex pads is due to restriction to flow of exuded latex from cracks underneath the soil. Even in these instances symptoms similar to bark rot caused by *Phytophthora* spp. was not visible but secondary infections is a possibility. Callus and root formation was also observed in these wounds (Plate 1e). In both these instances peculiar feature was the restriction of the cracks to the root-stock just below the graft union (Plate 1c).

Consequences of the disorder

These bark cracks appear very small at the onset (Plate 2 b), and have not led to serious complications when they appear on the 'elephant foot' because there was no bark decay around the crack except that there was continuous oozing of latex and abnormal enlargement of the 'elephant foot'. The problems have arisen only when bark cracks appeared in rootstocks below the ground or in the root collar below the ground level in seedlings. Latex pads formed in between the bark and the wood seems to have enriched the populations of soil microorganisms to cause rotting of bark (Plate 1c). In such instances, though there has been some recovery (Plate 1c), severe damage to the wood and bark around the wound was seen affecting the root system (Plate 2d). This has made these trees susceptible to wind damage (Plate 2d) and all trees subjected to wind damage in this experiment was due to this disorder. Trees looked healthy and also the latex yields were normal until they fell due to the weakening of the root system by breaking of one or more of the lateral roots or the tap root (Plates 2 d and 2e).

These circumstances demand early attention and care to those trees with above symptoms. All trees should be inspected for the presence of unusual patches of latex at the base of the trunk. It may not be possible to treat trees with the advanced stages of the disorder, as damage to roots can be severe at such later stages. Removal of latex pads and rotten bark has become essential and the wound should be treated. Covering the wound with soil even after treatment can further aggravate the situation. The wounds in such treated trees showed good recovery, but exudation of latex seems to continue from new cracks (Plate 2c).

Conclusion

This disorder was present in all clones investigated and also in many seedling progenies that were available for investigation. Its restriction to the root-stock in all bud grafted trees and to positions even above the root collar region in seedlings is peculiar. This type of cracks though absent in the scion of present day rubber clones, similar bark cracks, probably different from the above were seen in the trunk (scion) of RRIC133 and in some hand pollinated seedling progenies and in some trees of the IRRDB germplasm collection planted in 1985 (Plate 2f & 2g). It's absence from young trees below three years of age and in bud wood nurseries that are kept without

allowing to attain maturity by continuous pruning throughout suggests this to be a feature connected with the maturity of rubber trees.

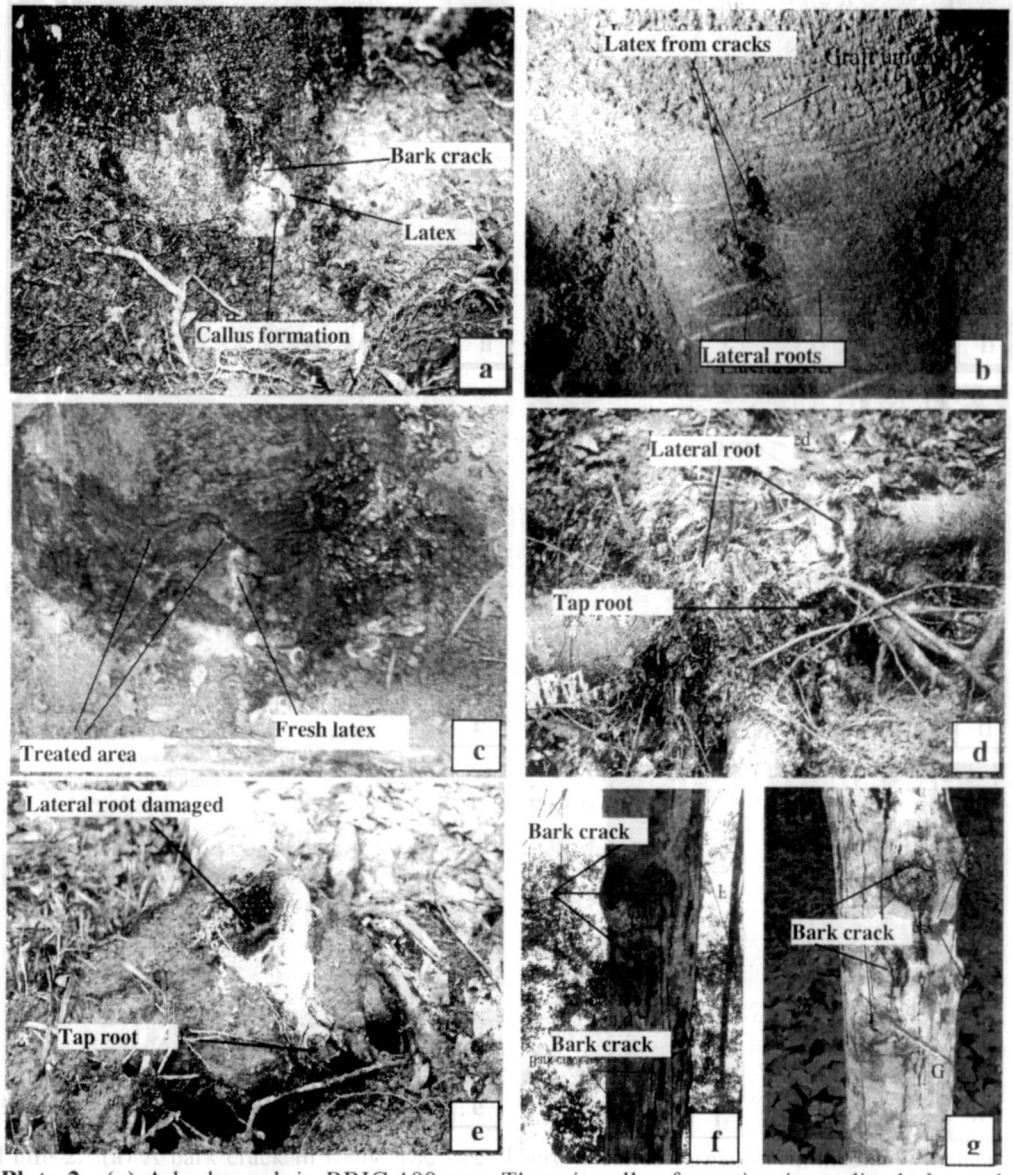

Plate 2. **(a)** A bark crack in RRIC 100 tree. There is callus formation immediately beneath the crack, but there is still exudation of latex around the crack. **(b)** Two small drops of coagulated latex coming from small cracks below the ground level in a three year old RRIC 121 tree. This is the early stage of the appearance of bark cracks. **(c)** Bark cracks treated by removing latex pads, and damaged bark but oozing of latex continues. **(d)** The root system of an affected tree fallen due to the destruction of the tap root and a main lateral root **(e)** Another tree fallen due to damage to a lateral root and the tap root is also broken. **(f)** Bark cracks on the trunk of a tree from an old hand pollinated progeny. **(g)**The trunk of a RRIC 133 tree showing bark cracks

The symptoms and the appearance of these bark cracks and continuous exudation of latex for many months without any disease symptoms, particularly of cracks in 'elephant foot' suggests that a pathogen is not the cause of this disorder (Plate 1e). Pathogens such as *Phytophthora* spp. usually enters through wounds and appearance of cracks in the root collar region due to the twisting of the trunk by winds is most unlikely to occur because this is the strongest part of the tree with lateral roots supporting the trunk.

The peculiar features of this disorder such as its restriction to the root-stock in bud-grafted trees, abnormal enlargement of the 'elephant foot', its relationship to the maturity of trees and its presence only in some seedling families (Pathiratna *et al.*, 2006), suggests that the most probable cause for this disorder is physiological. The possibility of the cause being inherited in seedlings used as root-stock is not remote.

Bark cracks in the trunk of bud grafted trees are not common and cannot be considered similar to these described here. However, cracks seen in some of the trees from hand pollinated progenies found in the RRISL sub station in Kuruwita (Plate 2f), in the common clone RRIC 133 (Plate 2g) and in PB 86 (Riggenbach, 1957) also needs some attention when studying this particular disorder.

The data collected so far shows that this disorder can bring about severe damage to rubber plantations, but evidence available at this stage is not conclusive on the possible cause. But immediate identification of affected trees and treating them is essential as most of such trees are vulnerable to wind damage.

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