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DRAIN OF RESOURCES IN *HEVEA BRASILIENSIS* ON ETHEPHON APPLICATION

MOLLY THOMAS, D.B. NAIR, JOSHUA ABRAHAM, JAYASREE GOPALAKRISHNAN
S. SREELATHA and JAMES JACOB

Rubber Research Institute of India
Kottayam 686 009, Kerala

Application of ethephon on the bark of mature trees of *Hevea brasiliensis* is widely practiced to increase the rubber yield where the volume of latex harvested per tap per tree is enhanced considerably. As a result, the drain of carbohydrates and minerals alongwith the latex is increased in the trees applied with ethephon. An experiment was conducted in which ethephon was applied on virgin trees of clone RRII 105 and estimated the concentration of sucrose, Pi, Mg^{++}, K^{+} and Cu^{++} in the latex. Concentration of sucrose in the latex was less in ethephon treated plants than control while Pi, Mg^{++}, K^{+} and Cu^{++} were more in the latex. When the total drain of these components per tree was computed for the entire experimental period, the loss of sucrose, Pi, Mg^{++}, K^{+} and Cu^{++} were 21, 400, 186, 68 and 67 per cent, respectively, more in ethephon treated plants than untreated control.

INTRODUCTION

Latex yield in *Hevea* is controlled by factors related to the mechanisms of latex flow and its *in situ* regeneration in the bark between successive tapping (Sethuraj, 1981). Stimulation of latex production by external application of ethephon on the bark is a commercial practice in rubber plantations. Ethephon application prolongs the duration of latex flow and thus increases the total volume of latex during tapping (Ho and Paardekooper, 1965). In addition, it indirectly activates certain enzymes involved in the metabolic conversion of sucrose into rubber (Tupy, 1973a). Ethephon upon hydrolysis on the bark of the tree releases ethylene and will alter the composition of latex. Volume of latex flown from the tree is enhanced by stimulation. As a result the drain of carbohydrates and minerals are more in trees treated with stimulant. The action of ethylene released from ethephon depends to a considerable extent on the clone and its laticiferous functioning typology (Jacob *et al.*, 1989). Considerable knowledge has to be gained in this regard to control and optimise the use of stimulants which can be dangerous unless applied with caution. Very little studies were conducted on this aspect in our country (George *et al.*, 1974). An experiment was carried out to study the alterations in the concentration of sucrose and ions in the latex in response to ethephon application in the clone, RRII 105.

MATERIALS AND METHODS

Hevea trees (clone RRII 105) were planted during 1988 in the Experimental Farm of the Rubber Research Institute of India situated at 76° 36' E and 9° 32' N at an altitude of 73 m above MSL. The clone, RRII 105 selected for

the present study and experiments were conducted between January and April 1996. Twenty virgin rubber trees with girth ranging from 50 to 60 cm (at a height of 150 cm from the base) were used for the study and these plants were divided into two equal groups. Ethephon (2-chloro-ethyl phosphonic acid) was applied as 20 mm wide band just below the tapping cut on the bark of one group of plants at the rate of two ml per tree. These trees were tapped on alternate days. Dry rubber yield, plugging index (PI) and concentrations of sucrose, inorganic phosphorus (Pi), potassium (K+), magnesium (Mg++) and copper (Cu++) were monitored in ethephon applied trees and untreated control.

Dry rubber content (% drc) was determined by gravimetric method. Dry rubber yield was computed by multiplying drc with the weight of latex harvested in one tapping from a tree. Plugging index was determined according to Milford *et al.* (1969). Sucrose, thiols, Pi, Mg++, K+ and Cu++ were extracted from a known amount of latex with 2.5 per cent trichloroacetic acid. Pi was measured by the Taussky and Shorr method (1953) while Mg^{++}, K^{+} and Cu^{++} were estimated using an atomic absorption spectrophotometer (Anon., 1973). Method suggested by Scott and Melvin (1953) was followed for the estimation of sucrose.

RESULTS AND DISCUSSION

Rubber yield was high in the ethephon treated plants compared to untreated control on all tapping dates (Fig. 1A). Plugging index during latex flow showed a marked decrease in the ethephon treated plants compared to control (Fig. 1B). A significant decrease in the plugging index (delaying the coagulation of latex on the panel and termination of the dripping of latex) led to increased volume of latex in ethephon treated trees compared to control plants.

Concentration of Pi in the latex (Fig. 2A) was very much higher in ethephon treated than normal plants on all tapping dates. This led to more loss of Pi on all tapping dates in ethephon treated plants (Fig. 2B). When the loss of Pi was computed for the entire experimental period, it was 400 per cent more in ethephon treated plants. Phosphorus being a constituent of nucleic acids, the loss due to ethephon treatment might affect the health of the trees. Pi also plays an important role in the phosphorylation of ADP for the production of ATP, which is essentially needed for the biosynthesis of rubber.

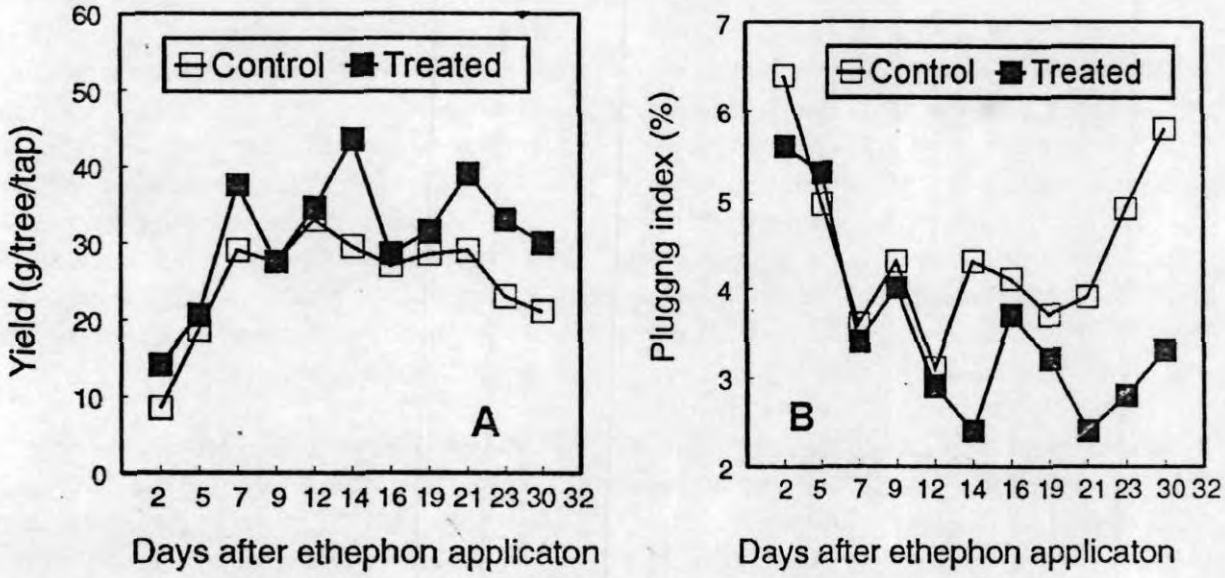

Fig.1. Dry rubber yield (A), and plugging index (B) of control and ethephon applied plants on different tapping dates

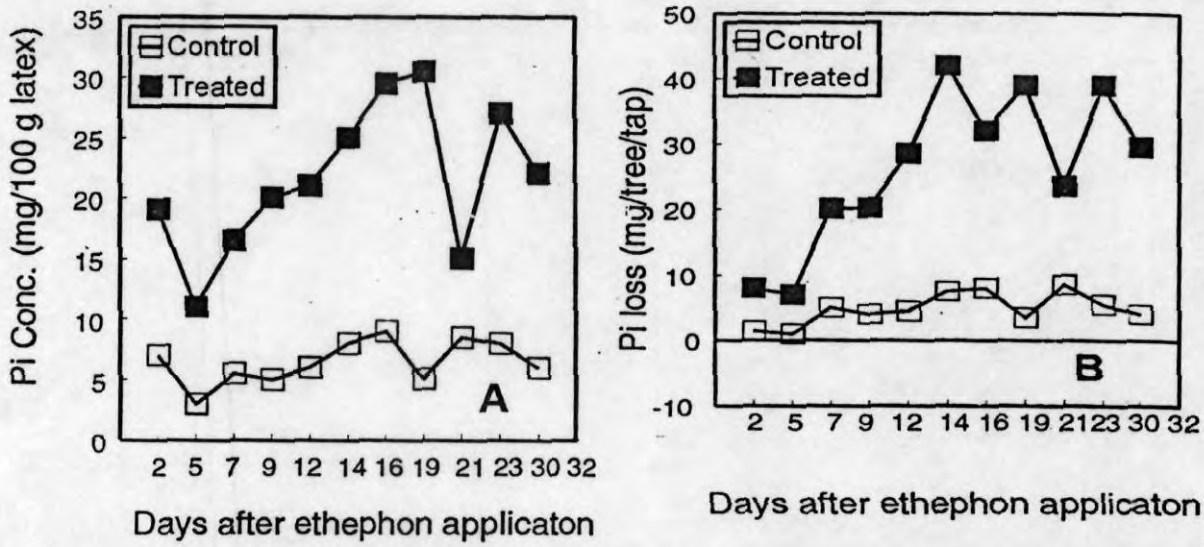

Fig.2.Pi concentration (A) , Pi loss/tree/tap (B) in the latex of control and ethephon applied plants on different tapping dates

Magnesium content was generally high in the latex of ethephon treated plants compared to control plants (Fig. 3A) on all tapping dates. The loss of Mg++ per tree per tap was very much higher in ethephon treated plants (Fig. 3B). When the loss was computed for the entire experimental period, there was 186 per cent more loss of Mg++ in ethephon treated than normal plants. Increase in yield after stimulation is basically a function of reduced plugging index. High Mg++ contents and Mg++/Pi ratio in the latex are reported to be associated with premature coagulation of latex on the tapping panel (Beaufils, 1957). It has been reported that clones with high Mg++/Pi ratios in their latex had a higher plugging index than those of low Mg++/Pi (Yip and Gomez, 1980). Even though the concentration of Mg++ is increased in ethephon treated plants (Fig. 3A) due to a tremendous increase in Pi (Fig. 2A), the Mg++/Pi ratio in the latex is lowered in the ethephon treated plants. A significant positive correlation between Mg++/Pi and plugging index ($r=0.5$, $p<0.05$, Fig. 4A) and a significant negative correlation between the Pi content of latex and

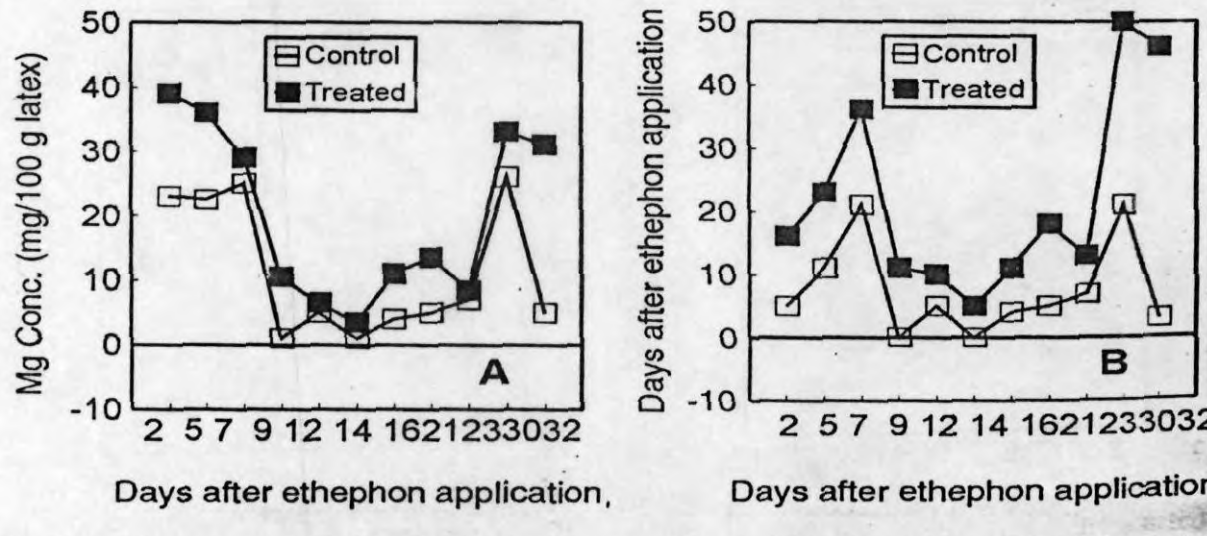

Fig.3. Mg++ concentration (A) , Mg++ loss/tree/tap (B) in the latex of control and ethephon applied plants on different tapping dates

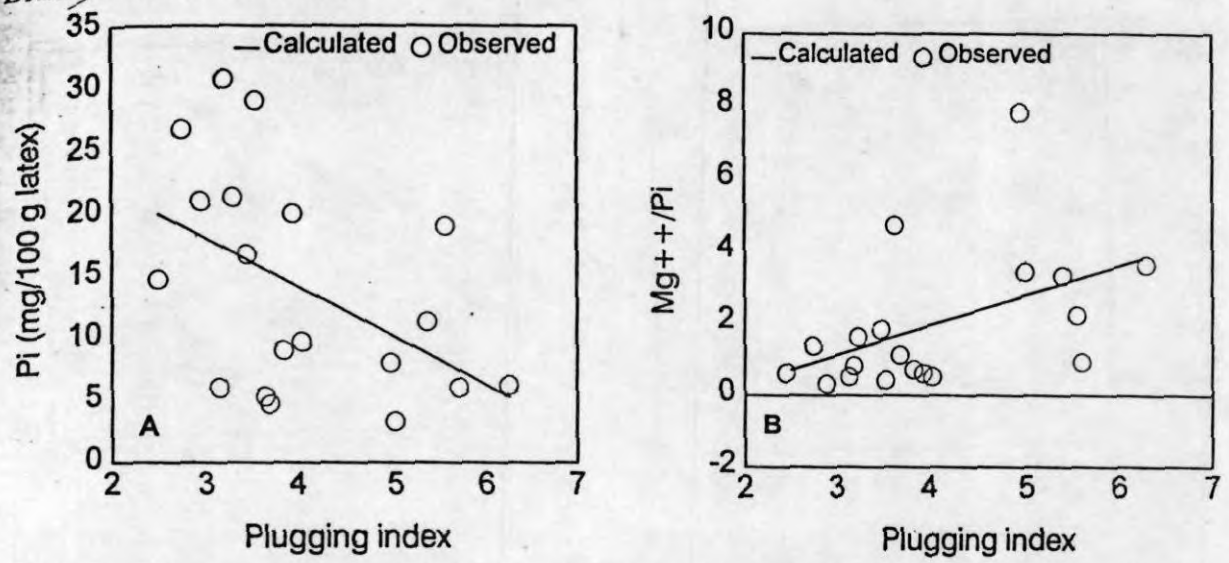

Fig. 4. Correlation between Pi and plugging index (A) and between Mg++/Pi and plugging index (B)

plugging index ($r = 0.47$, $P < 0.05$, Fig. 4B) has been observed in the present study.

The concentration of K+ in the latex was very much higher in ethephon treated plants than untreated control on all tapping dates (Fig. 5A) except for the first tapping date. The loss of K+ per tree/tap was also very much higher in ethephon treated plants (Fig. 5B). There was 68 per cent more loss of potassium in ethephon treated plants during the whole experimental period. Tupy (1973b) also observed an increase in K+ in the latex of plants treated with ethephon. Content of Cu++ in the latex was not affected much by ethephon treatment (Fig. 6A). But the loss per tree per tap was higher in ethephon treated (Fig. 6B) plants. When the overall loss was computed, there was 67 per cent more loss of copper in the ethephon treated plants. Increased concentration of Mg++, K+ and Cu++ in the ethephon treated plants suggests the possibility of increased translocation of cellular constituents into laticiferous cells.

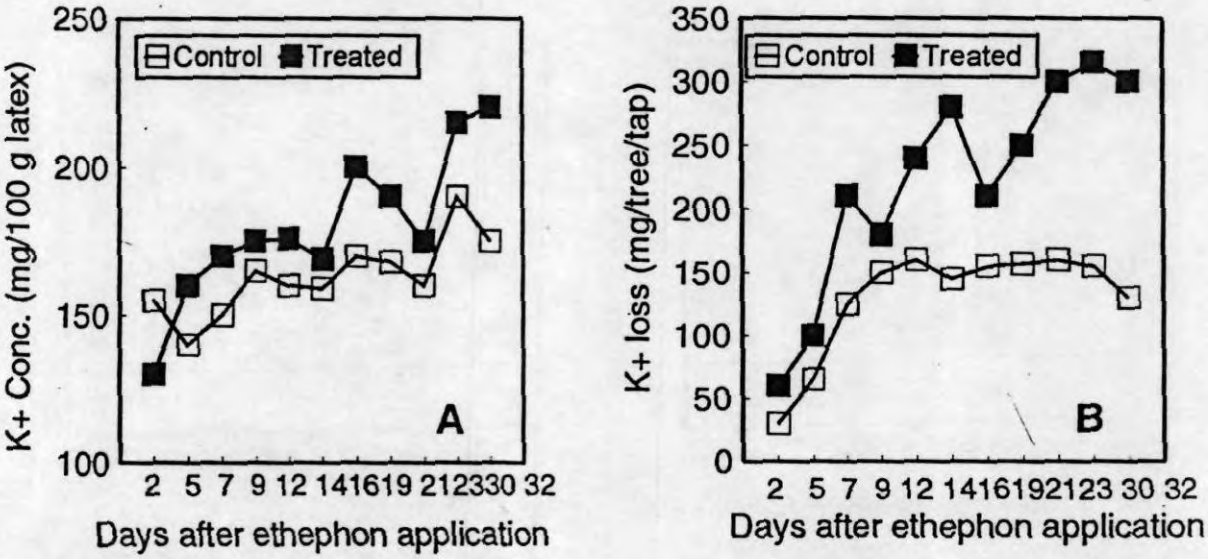

Fig. 5. K+ concentration (A), K+ loss/tree/tap (B) in the latex of control and ethephon applied plants on different tapping dates

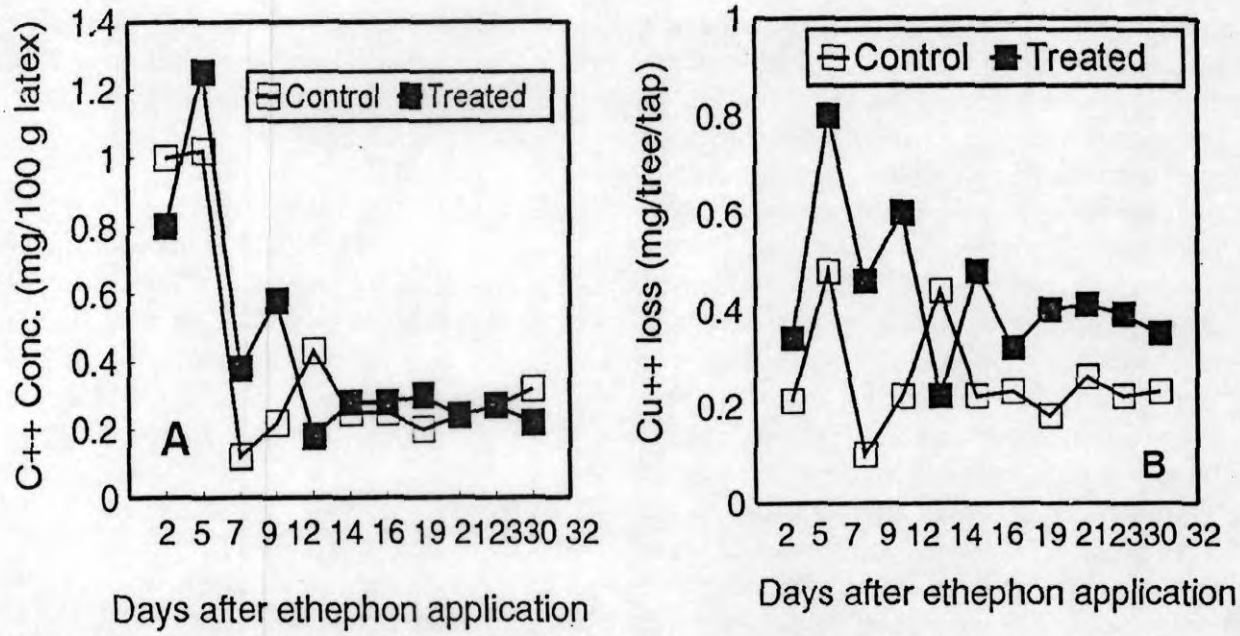

Fig. 6. Cu++ concentration (A), Cu++ loss/tree/tap (B) in the latex of control and ethephon applied plants on different tapping dates.

Concentration of sucrose in the latex was very much lower in ethephon treated than normal plants (Fig. 7A) on all tapping dates. But because of more volume of latex harvested, the amount of sucrose loss/tree/tap was very much higher in ethephon treated plants (Fig. 7B) on almost all tapping dates. When the loss of sucrose was computed for the entire experimental period, there was 21 per cent more loss in ethephon treated plants than normal ones. As observed in the previous studies (Abraham *et al.* 1968; 1971) the ethephon induced yield increase progressively disappeared with time. In ethephon applied trees there was a significant reduction with time in the sucrose content in the latex. Since sucrose being the basic substrate for rubber biosynthesis, the

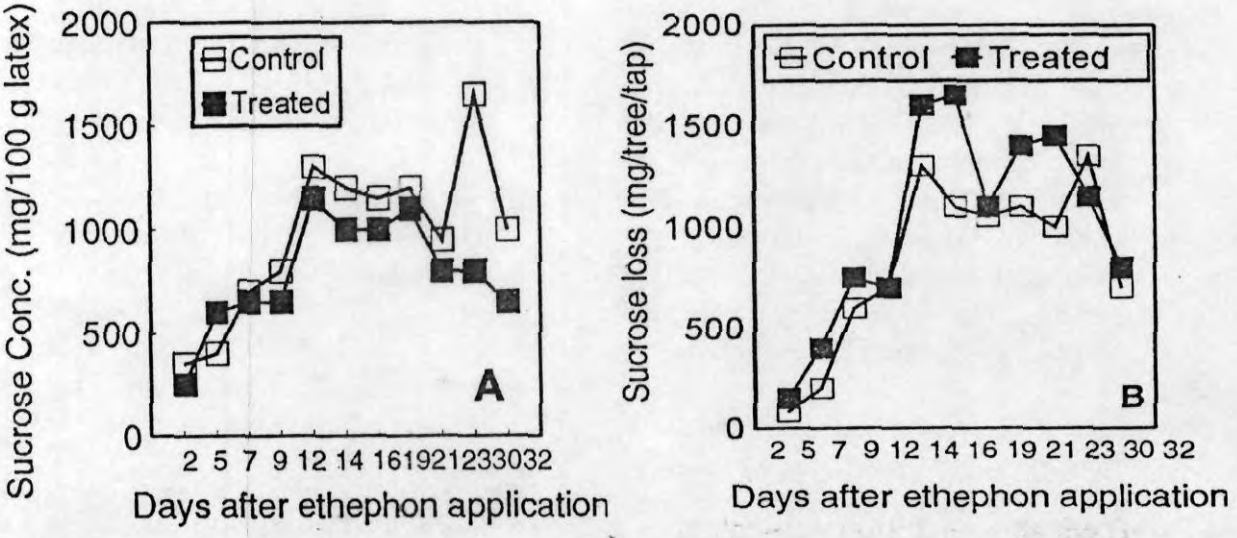

Fig.7. Sucrose concentration (A), sucrose loss/tree/tap (B) in the latex of control and ethephon applied plants on different tapping dates

reduced availability of sucrose for rubber synthesis may be one of the reasons for the lack of continued increase in rubber yield in plants applied with ethephon. The excessive loss of sucrose and ions in the exuded latex of stimulated trees might create a physiological stress situation that renders the trees more prone to dryness. From the results, it is clear that stimulation of latex production by applying ethephon causes considerable modification at cellular level and results in the activation of physiological and biochemical parameters involved in the latex flow and regeneration of latex between two tapings. Increased yield followed by elevated levels of phosphorus, magnesium and potassium in the latex suggests that the requirement of these nutrients are more in the case of trees stimulated with ethephon. The present results point towards more thorough investigation on the management requirements of stimulated trees.

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