

## **STIMULATION OF RUBBER TREES FOR ENHANCING PERFORMANCE - THE PAST, CURRENT PRACTICES AND FUTURE TRENDS**

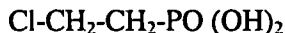
**A Nugawela**

### **INTRODUCTION**

Stimulating of rubber trees had been attempted in the past with the sole objective of enhancing income levels from rubber cultivations through increased latex dry rubber yields. But indiscriminate use of stimulants during this period had resulted in negative results. In this context it is important to realize the fact that the dry rubber yield that could be obtained from a tree will eventually be determined by the capacity of the tree to produce it. If attempts are being made to harvest yields higher than what the tree could give, *i.e.* the potential yield, the tree will not be able to sustain such yields levels. This could lead to lowering of the economic life span of the tree resulting in poor returns for the investments. Therefore, stimulants need to be used at correct concentration, quantity and frequency for the grower to benefit from this technology.

Having realized these, current thinking is to use stimulants to obtain only the potential yield with lowest tapping costs. This is achieved through low frequency tapping coupled with yield stimulation. Low frequency tapping (LFT) with stimulation has other advantages such as low tapping costs, higher tapper income, use of skilled tappers only with the low tapper requirement and enhancing the economic life span of the tree.

In search of effective yield stimulants, various chemicals have been tried in the past. Among many chemicals tested in this manner 2-chloroethyle phosphonic acid (Fig. 1) has been found to be the best for this purpose.



**Fig. 1.** The chemical formula of 2 - chloroethyle phosphonic acid

This stimulant is now available in the market under various brand names such as Ethrel, Ethephon, Ethephon Plus and Levotex. Anyhow the active ingredient in all of these yield stimulants available in the market under different brand names, is 2-chloroethyle phosphonic acid. However, some market the product in different strengths, *i.e.* 2.5, 5 and 10% active ingredient. Low concentrations are generally recommended for the trees being tapped on virgin bark whilst the higher concentrations are recommended for trees tapped on renewed bark.

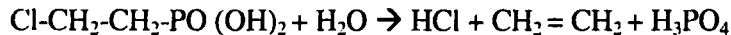
## 2 Chloroethyle phosphonic acid based stimulants

The above yield stimulants are currently marketed in gel form. This helps to apply the stimulant effectively on the tree. If the stimulant is watery wastage could occur due to dripping. Stimulants are applied either on the bark, panel or the groove of the tree.

What is important here is one to ensure that the stimulant applied will get in to the tree. Therefore if bark application is under taken, the bark should be lightly scraped to remove dead cork cells, enabling the stimulant to move into the tree. Light scraping is not necessary for panel application. If wood is exposed in more than 25% of the area of the panel where the stimulant is to be applied due to deep tapping the stimulant applied will not get absorbed to the tree. This is because the wood does not have the capacity to absorb the chemical. If the tree lace is not removed, stimulant that is applied on the lace will not get into the tree in the groove application.

After application it takes about 12 hours for the active ingredient in the stimulant, *i.e.* 2-chloroethyle phosphonic acid to get into the tree. A rainfall prior to this resulting in water seeping along the tree trunk could lead to the stimulants getting washed of fully or partly, depending on the timing and intensity of rainfall.

2-Chloroethyle phosphonic acid in its liquid state and at low pH levels is a stable compound. However, when it gets into the rubber tree due to the relatively high level of pH in the plant tissues, it reacts with water and yields ethylene. This chemical reaction which takes place within the tree is shown below.



$\text{Cl-CH}_2\text{-CH}_2\text{-PO}_3\text{H}_2$  = 2-chloroethyle phosphonic acid (Ethrel)

$\text{H}_2\text{O}$  = Water

$\text{HCl}$  = Hydrochloric acid

$\text{CH}_2 = \text{CH}_2$  = Ethylene

$\text{H}_3\text{PO}_4$  = Phosphoric acid

Ethylene released in this manner within the plant, is the chemical actually responsible for increasing yields from rubber trees.

### Role of Ethylene in plant growth and increasing dry rubber yield

Ethylene is a growth substance produced in all higher plants; however, at the present time, it is unclear as to its range of production among lower plants. Ethylene is produced from methionine by essentially all parts of higher plants; however, production varies with the type of tissue and the stage of development

Ethylene has the simplest structure of all known plant growth substances (Fig. 2).

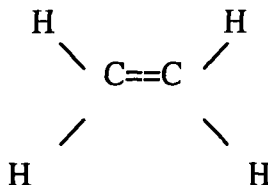


Fig. 2. Structural formula for ethylene

Ethylene is involved in many physiological processes in plants from seed germination through senescence and death of the plant. Fruit ripening, dormancy, abscission, flowering, senescence, shoot and root growth and apical dominance are some of the major events associated with ethylene in plants.

How does ethylene increase dry rubber yields of rubber trees? Scientists have suggested many ways in which it could happen. Ethylene can convert starch reserves found in the tree to sugars as in ripening of fruits. These sugars get into the latex vessels of the rubber tree to get converted into latex increasing the production. Further the sugars that get into the latex, vessels increase the osmotic pressure in them. This results in water from neighboring tissues getting into the latex vessels, increasing the turgor pressure resulting in high initial flow rates of latex on tapping. Latex flow after tapping ends due to plugging of cut latex vessels. Ethylene is believed to delay the plugging reaction, prolonging the latex flow time. Further ethylene has the capacity to act as a catalyst to produce more of the same in the plant tissues. These changes upon stimulation of a rubber tree are known to be responsible for increases in yield.

#### **Intensity of stimulation under current recommendations**

When clones recommended to be tapped at d/2 frequency are tapped at d/3 frequency, four rounds of stimulation per annum are recommended using 2.5% strength stimulant. For both virgin and renewed bark a 2.5cm band of stimulant is recommended to be applied on the panel about 1mm above the tapping groove along the tapping cut or on the scraped bark below the cut. The quantity of the stimulant a tree will get per application, will depend on the size of the tree. It could vary from 1.4 to 2.6 g. During large scale adoption the management of the plantation should device a system to ensure that each and every tree is stimulated, every tree gets the required quantity and the stimulant is applied at the correct place. In order to prevent any yield losses due to prolonged latex flow time upon stimulation, split application is recommended.

The dry rubber content of latex can be used as an indicator of the extent to which a rubber tree is being exploited. If it falls below 30%, *i.e.* a metrolac reading of below 100 is an indication of possible over exploitation. Fields yielding latex with



be the capacity of the rubber tree to produce latex using the end product of photosynthesis, *i.e.* the process in which a tree produce its food. Therefore in the gaseous stimulating methods the amount of ethylene given to a tree has to be regulated so that only the potential yield of the tree will be harvested and not over exploited.

Recommended intensity of stimulation in gaseous methods is equivalent to the use of 5% Ethrel every 10 days at the rate of 2g/tree. *i.e.* ET5%Pa2.0 (2.5)1/10d.

With high doses of stimulant most of the latex in the drainage area of the tree will be harvested during tapping and the tree will not have the genetic capacity to regenerate same at the same rate. This situation will remove a natural defense mechanism a rubber tree has to protect it self from pests and diseases and the tree may become vulnerable to such attacks. This may be a reason for bark infections commonly observed in trees stimulated through gaseous stimulation systems. This situation could be further aggravated by the high sugar levels of the bark in the drainage area due to the action of ethylene on food reserves in the bark.

It is also apparent that with 4-5 months of gaseous stimulations the DRC levels of latex drops to very low levels, *i.e.* 24-26%. This is an indication of over stimulation and exploitation.

Gaseous stimulation is a good concept for exploiting rubber trees by overcoming the problems associated with it currently. Nevertheless the quantity given per tree per stimulation and frequency of gassing and tapping have to be regulated to prevent any negative impacts. Further use of a gas mixture, *i.e.* an optimum percentage of ethylene mixed with a non harmful gas, rather than using pure ethylene could be a method to control the amount of stimulant given per tree per stimulation.