STIMULATION OF YIELD IN HEVEA BRASILIENSIS I. PREWAR EXPERIMENTS WITH VEGETABLE OILS

By

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A brief historical review is given of methods used for stimulating the latex yield of rubber trees and experiments are described in which vegetable oils applied to lightly scraped bark below the tapping cut resulted in large increases in yield. The results of these early experiments provided a clear picture of the reaction of the tree to yield stimulation and led to the development and commercial use of yield stimulants.

The practice of scraping the bark of rubber trees below the tapping cut which is common on many estates and holdings, ostensibly for tapping hygiene, may have been prompted by a belief that the operation increases the yield of latex.

Methods of artificially stimulating the yield of hevea have been tried at various times. A German chemist, P.S. KAMERUN (1912) as early as 1912 patented a method to increase the yield of hevea trees by scraping off periodically the outer dead layers of bark along the whole tapping panel from the ground to the highest level of the tapped area. The patent was not accepted in Malaya. A former Director of Agriculture in Samoa, Dr E. Fickendey (SHARPLES 1918), applied in 1918 for patent rights for a method of scraping away the outer corky bark below the tapping cut which exposed the cork cambium and for which he claimed an increase in yield of about 50 per cent.

Experiments were carried out under the aegis of the Rubber Research Institute of Malaya on a number of estates during the period 1929 to 1930 (See Annual Reports pages 19 and 16 respectively) with bark scraping and application of nitrate of soda, wood ash, cattle manure and an increase in yield was recorded.

About this time a preparation called Neubark, marketed by Parry Davis, consisting of a mixture of cattle manure and clay with minor ingredients which included sulphate of iron and permanganate of potash, claimed to be yield stimulants, was put on the market. The preparation was applied to scraped bark along a six inch strip below the tapping cut and was claimed to result in a marked increase in the yield of latex.

Neubark was soon superseded by another preparation named Solar Vim which was marketed by the Singapore Fertiliser and Chemical Works and described as a 'radiant heat tree vaccine' and 'living cell stimulator' for rubber trees. Solar Vim was manufactured in brick form and required to be made into a paste

before application to the bark above and below the tapping cut. It was claimed to be an improvement on Neubark but from all accounts appeared to be substantially the same. The manufacturers advised that trees treated with Solar Vim be manured with their organic fertiliser sold under the trade name 'Fertilite' in order to keep up the dry rubber content of the latex.

Work on stimulation of bark renewal was undertaken at the Rubber Research Institute of Malaya in 1937 (BAPTIST, 1939; BEELEY and BAPTIST, 1939) and it was shown that the rate of bark renewal during the first year was significantly increased by commercial palm oil applied to renewing bark above the tapping cut. This effect was ascribed by Baptist to the presence of natural hormones present in physiological concentrations in the palm oil rather than to the physical effects of the oil coating.

It was with the intention of distinguishing between these two possible effects that in 1939 an experiment was set up on buddings of four clones with treatments consisting of red palm oil, bleached palm oil and liquid paraffin. The records of this experiment were unfortunately lost during the Japanese occupation of Malaya.

Indolyl-acetic acid at concentrations of 20, 200 and 1,000 parts per million in lanolin applied to the tapping panel and directly on the cambium after stripping the bark, failed to have a measurable effect on the rate of bark renewal (Baptist 1939).

The work on stimulation of bark renewal led to the investigation of the effect on latex yield of palm oil applied to the bark below the tapping cut and in a preliminary experiment carried out in 1939/1940 it was shown that yield was significantly increased by application of palm oil to lightly scraped bark below the tapping cut.

EXPERIMENTAL

Suitably designed experiments were set up during 1941 on two estates to verify the results of the preliminary experiment, and are described in the Rubber Research Institute of Malaya Report for the Period January 1941 to August 1945 on page 28. In these experiments light scraping (grooming) of the bark consisted of the removal of the outer layers of cork to a distance of twelve inches below the tapping cut, and heavy scraping the removal of the outer cortical layers and the stone cell ring resulting in a copious exudation of latex.

Preliminary yields were measured on three consecutive tapping days before the treatments were applied. The yield from each experimental block was recorded separately at weekly intervals during the first month and at fortnightly intervals thereafter.

The experiment on estate *A* situated on an inland alluvial soil, was of a simple randomized block design with six replications of each treatment and was set up on old seedling rubber trees planted in 1906. The treatments consisted of light scraping and of no scraping, with and without one application of red palm oil

or linseed oil. The latex yield from each plot, diluted with water, was coagulated in the tapper's bucket by addition of acetic acid and the coagulum was made into crepe, dried and weighed. The results are presented in TABLE I and are shown graphically in *Figure 1.*

TABLE I: MEAN YIELDS IN GRAMS PER TREE FOR A PERIOD OF FIFTYNINE TAPPING DAYS ADJUSTED BY REGRESSION ON PRELIMINARY YIELDS

Treatment	*No oil*	*Palm oil*	*Linseed oil*	*Difference due to palm oil*	*linseed oil*
Light scraping	1,444	1,571	1,499	+ 127	+ 55
No scraping	1,078	1,276	1,269	+ 198	+ 191
Difference	+ 366	+ 295	+ 230		
Standard error of a treatment mean ±61.2					

The experiment on estate *B*, situated on a coastal alluvial clay with peat soil, was a factorial experiment, 3 × 2 × 2 with interactions partially confounded and balanced, on three tapping tasks of old seedling rubber trees planted in 1919 and yielding over 400 lb per acre per year. The treatments consisted of light scraping, heavy scraping and no scraping with and without one application of palm oil to one foot of bark below the tapping cut, and one application of palm oil at fortnightly intervals to recently tapped bark above the cut.

The latex yield from each plot was weighed to the nearest half ounce and after a thorough stirring a volume of 100 millilitres was measured out in small aluminium pans where it was coagulated. The coagulum was rolled thin, dried, weighed to the nearest gram and the total yield of dry rubber per plot was calculated. The results are presented in TABLE II and are shown graphically in *Figure 2.*

TABLE II: MEAN YIELDS IN GRAMS PER TREE FOR A PERIOD OF SIXTYEIGHT DAYS ADJUSTED BY REGRESSION ON PRELIMINARY YIELDS

Treatment	*No oil*	*Palm oil*	*Difference due to oil*
No scraping	768	976	+ 208
Light scraping	1,513	1,739	+ 226
Heavy scraping	590	584	− 6
Difference due to:			
Light scraping	+ 745	+ 763	
Heavy scraping	− 178	− 392	
Standard error of a treatment mean ±77.03			

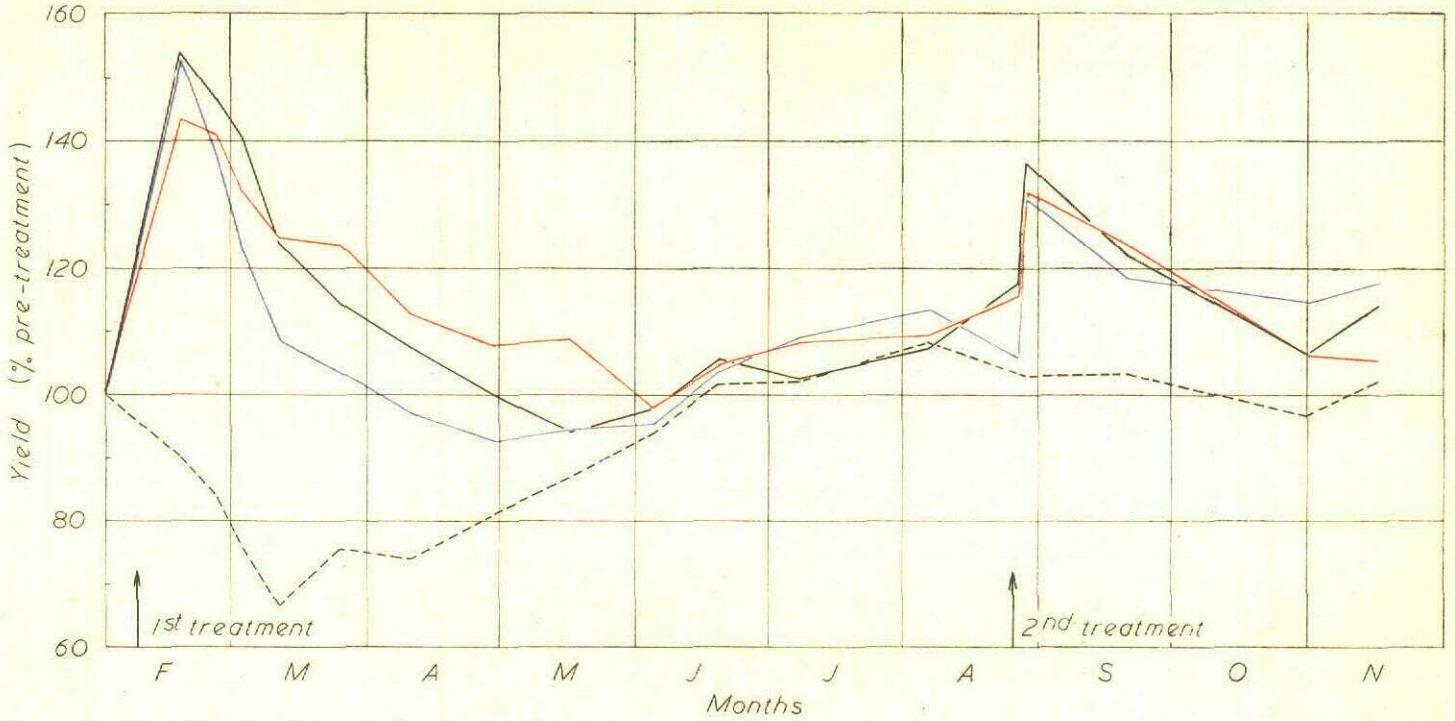

Figure 1. Slaughter tapping experiment with and without yield stimulant. Yields are expressed as a percentage of the yield before treatment.

Scraping and linseed oil

Scraping and palm oil

Light scraping

Control (no treatment)

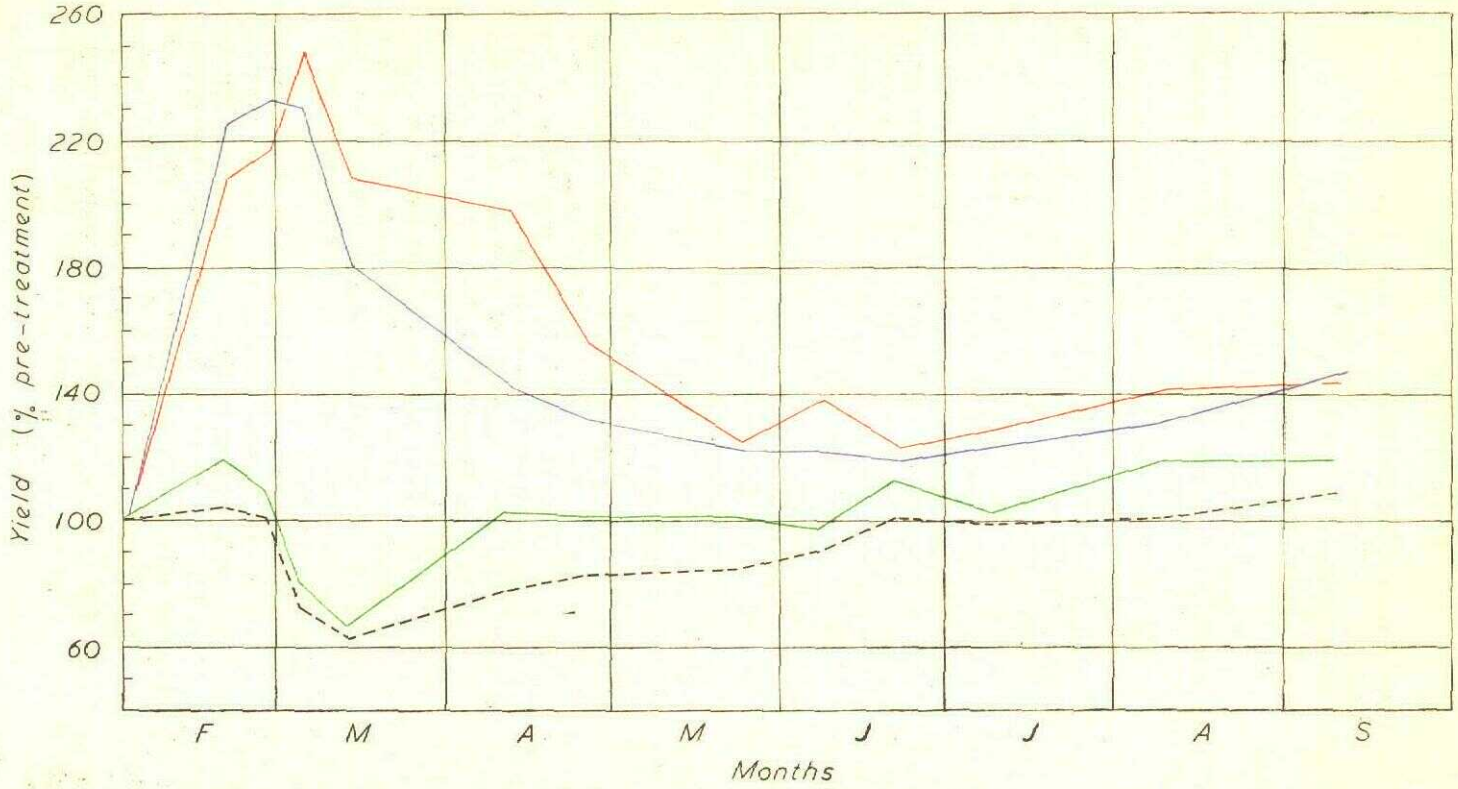

Figure 2. Yield stimulation experiment at estate B on coastal clay soil with peat. Yields are expressed as a percentage of the yield before treatment.

..... *Control (no treatment)*

——— *Light scraping*

——— *Palm oil alone*

——— *Scraping and palm oil*

DISCUSSION

The results from these experiments show that:

Light scraping of the bark has produced very highly significant differences in yield ($P<0.001$).

Heavy scraping (estate *B*) is highly detrimental to yield.

Responses to oils are significant at the 5 per cent level. The response to oils is not detectably different in presence or absence of light scraping.

The difference between linseed oil and palm oil (estate *A*) is not statistically significant.

The biggest response is obtained as a result of one application of palm oil to lightly scraped bark below the cut. Increased yields of 1.1 lb per tree (estate *A*) and of 2.1 lb per tree (estate *B*) were obtained during the period of four months after treatment.

A rapid increase in yield of over 80 per cent (estate *A*) and 150 per cent (estate *B*) recorded during the first month gradually declined; yield was almost back to normal (estate *A*) and to 20 per cent above normal (estate *B*) at the end of four months.

A second treatment six months after the first of light scraping and palm oil on estate *A* caused an increase in yield of 30 per cent which fell to normal after three months.

There was no detectable effect on yield of palm oil applied above the cut (estate *B*).

The results of these experiments have been given in some detail as they are the first statistically designed experiments on yield stimulation carried out by this Institute. The form of the yield curve consisting of the sharp rise in the first month followed by a gradual fall, the effect of the treatment lasting for three to four months, provides a picture which is essentially the same as that obtained in subsequent post-war experiments with yield stimulants containing synthetic growth substances (2,4-D or 2,4,5-T) or with injection of copper sulphate.

The duration of the yield increase found in these experiments led to the adoption of a three inch wide strip of bark below the tapping cut as the site of application of the yield stimulant so as to allow for renewal of the treatment when the yields have returned to normal.

These yield stimulation experiments were unfortunately interrupted by the war in Malaya. They were, however, repeated at the Rubber Research Scheme of Ceylon (see Annual Reports for 1942, 1944 and 1945) where it was observed that applications of vegetable oils (palm oil and coconut oil) to lightly scraped bark for a distance of twelve inches below the tapping cut led to an immediate increase in yield of 70 to 100 per cent which gradually fell to about normal by the end of the fourth month. A light scraping gave better results than a heavier

scraping both with and without the application of oil and scraping for twelve inches below the tapping cut was more effective than scraping for six inches.

These high responses to light scraping alone have not, however, been confirmed in a post-war experiment carried out at this Institute on old seedling rubber trees with thin corrugated renewed bark. In this experiment the yield increase in the first month following light scraping of a 12 inch wide strip of bark below the tapping cut did not exceed 20 per cent although the application of a yield stimulant to the scraped bark resulted in a yield increase of almost 90 per cent.

SUMMARY

Methods of artificially stimulating the yield of hevea are reviewed.

Two experiments are described and it is shown that a light scraping of the bark for a distance of twelve inches below the tapping cut results in large increases in yield which are further enhanced by the application of palm oil to the scraped bark.

The response to treatment is very rapid, peak yields are obtained in the first month and these gradually return to normal over a period of three to four months.

A smaller but highly significant response was obtained as a result of a second application of the treatment six months after the first.

I have to record my indebtedness and thanks to Messrs E.M. Stewart and A.G. Barron-Toop, the Managers of estates on which the experiments were carried out, for their generous cooperation and to my field assistant, Mr M.I. Nayar, for the competent recording and summarising of yield records.

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