

DEVICE FOR UPTAKE OF GASEOUS STIMULANT FOR INCREASING YIELD OF LATEX BEARING TREES

Technical Field of the Invention

5 The present invention relates generally to a device for stimulating the flow of latex and more particularly to a device comprising an easy to manage and user-friendly inflatable container with sealant for sticking onto the bark of latex bearing *Hevea brasiliensis* and gassing apparatus for supplying liquefied compressed gaseous stimulant into laticiferous tissues.

Background of the Invention

10 Ethephon or 2-chloroethyl phosphonic acid (2-CEPA) as the active ingredient (Patent. No. 1281524; 1972 and patent No. 1192528; 1970) was discovered as a latex stimulating agent in the sixties. The introduction of ethephon allowed the rubber planters, both in the estate and smallholding sectors, to increase the production of latex (Abraham, 1968). Ethephon latex stimulant, marketed
15 commercially in gel form with three concentrations viz. 2.5%, 5.0% and 10% has been accepted and is widely used by the NR industry. Ethephon is applied along the surface of the tapping cut by using a suitable painting brush. Ethylene is produced through hydrolysis and pH change in the laticiferous tissue (Abraham, 1968).

20 Taysum (1961), a microbiologist, first discovered that ethylene oxide gas also stimulated latex production in his studies at the Rubber Research Institute of Malaya (RRIM). The gas which was supplied directly into laticiferous tissue through a polythene jacket pasted onto the outer layer of the bark of *Hevea* trees induced marked increase in latex production. The increase was higher than the
25 conventional stimulants such as 2,4-D and 2,4,5-T used during the period. Subsequently ethylene oxide was found unsuitable as latex stimulant because it was phytotoxic, causing bark necrosis which led to fungal attack. It was also not cost-effective.

The need for a more effective stimulant is of utmost importance as the Natural Rubber (NR) industry of Malaysia is plagued with the problem of low production coupled with shortage of tappers that has adversely affected national rubber production.

5 Research on the gaseous methods of stimulation currently recommended
 namely REACTORRIM (Patent application No: PI 9200890) and RRIMFLOW
 (patent No: MY 111156-A) was initiated by the RRIM in 1990 (Sivakumaran,
 1991; Mohd. Raffali and Ahmad Zarin). These methods of stimulation were
 superior compared to conventional ethephon stimulation. The uptake of
 10 RRIMFLOW and REACTORRIM methods of stimulation was heavily
 influenced by numerous factors. High start-up capital required to purchase the
 stimulation components, low price of rubber, tedious procedures of fixing and
 maintaining gadgets, availability of tappers and workers are the most common
 problems deterring wide adoption of the gaseous methods of stimulation. For the
 15 RRIMFLOW method of stimulation, the first tapping is to commence four to
 seven days after fixing of the components consisting of a plastic applicator,
 plastic tubing and inflow-valve. For REACTORRIM, the first tapping can be
 carried out two days after the installation of the components. A flat and even
 bark surface is required to fix the applicators of RRIMFLOW as uneven surfaces
 20 lead to gas leakage.

 The most important aspect determining effectiveness of gaseous
 stimulation is that both the RRIMFLOW applicators and the REACTORRIM
 diffuser buttons must be leak-proof throughout the economic life of the gadgets.
 The materials required to fix the RRIMFLOW applicators are two types of glue,
 25 latex, a water sprayer, a stapler and a scraper. For REACTORRIM, a diffuser
 button is installed onto the bark of the *Hevea* tree using a button fixer and a
 tapping knife. The gaseous methods of stimulation need constant maintenance to
 prevent gas leakage.

The ethylene gas induced the formation of dry tissue underneath and along the perimeter of the RRIMFLOW applicator creating tiny gaps that allow gaseous stimulant to escape. It is one of the main problems causing gas leakage immediately after gassing. The applicator is attached to the bark by a special glue while a mixture of glue and latex applied during fixing and routine maintenance carried out at bimonthly or quarterly intervals. Generally maintenance is recommended at six monthly intervals.

Similarly, development of tiny gaps loosen the REACTORRIM diffuser button allowing gaseous stimulant to escape. Refixing the button into the already stimulated virgin bark is a very delicate job to avoid latex from oozing out and filling the button, and prevent the flow of gaseous stimulant from the canister to the laticiferous tissue. In addition blockage of the plastic tubing connecting the diffuser button to the micro-porous membrane (MPM) attached to the outlet valve of the REACTORRIM canister also stops flow of gas. Frequent maintenance work at monthly intervals is thus required.

Rain water from trunk flow, and moisture from the evaporation and transpiration process may accumulate in the RRIMFLOW applicator. The water has to be drained out completely before application of gas stimulant by detaching the inflow-valve from the delivery tubing. The presence of water in the applicator indicates the occurrence of leakages along the perimeter of the RRIMFLOW applicator.

The REACTORRIM plastic canister can be removed from the tree during the low yielding periods e.g. during the winter, prolonged drought or during the monsoon period like in the East Coast of Peninsular Malaysia. The RRIMFLOW applicator remains on the tree irrespective of seasonal changes. However, RRIMFLOW technique offers more flexibility in gassing as the technique employs intermittent gassing at 10 days interval. The REACTORRIM technique involves continuous but slow release of gas from the canister until the gas pressure in the canister reached an ineffective level. The canister of the

REACTORRIM can be refilled in the field or collected and brought to a refilling center.

5 A flexible and simple gaseous stimulation system that requires less maintenance, cost-effective, easily available and suited to the requirement of users seasonal changes is needed. The system must be simple to fix and required little maintenance. The gassing procedures have to be simplified. The system should be more convenient to operate, manage and is user friendly. The components should be easily available and can be assembled by the users themselves to avoid being too dependent on the suppliers. The new system
10 should overcome the logistical problem faced by a supplier to provide the gadgets to individual smallholders scattered in rural and remote areas.

Summary of the Invention

Accordingly, it is the primary object of the present invention to provide a direct supply of gaseous stimulant to the *Hevea* tree using a device, to stimulate
15 latex production. The container is fixed to the *Hevea* tree using pliable sealant.

It is another object of the present invention to provide the use a rubber-based sealant which is pliable and able to remain in the pliable form for more than a year, as the main component for fixing the inflatable container. Stapling is only required at the four corners of the container to reinforce the position and the
20 firmness of the container.

It is another object of the present invention to provide an easy-fixing mechanism using pliable rubber-based sealant that allows flexibility in fixing the inflatable container, which makes it easier and more user-friendly, easy to manage and can be prepared by the users under the concept of DIY (do it by
25 yourself).

It is yet another object of the present invention to provide a system that allows the supply of gaseous stimulant or gassing to be carried out immediately after the completion of installation of the device.

5 It is yet another object of the present invention to provide a means for easy detection of the presence of gaseous stimulant in the inflatable container during gassing until the next gassing, by looking at the shape and by manually pressing the container. The container expands after gassing and flattens when the container is emptied.

10 It is yet another object of the present invention to provide simplified fixing procedures, allowing reduction of labour and increasing the efficiency of workers when fixing the inflatable container.

It is yet another object of the present invention to provide simple maintenance procedures that effectively minimizes gas leakage from the container.

15 It is yet another object of the present invention to minimize adverse bark reaction and difficulty in dismantling the container from the surface of the bark allowing easy operation in repositioning of the container, if necessary.

It is yet another object of the present invention to provide a device that is reusable.

20 It is yet another object of the present invention to provide a device and system that is easily managed (installation, maintenance and removal from the bark) despite multiple installation over the period of one year.

25 It is yet another object of the present invention to provide a cheaper but more efficient system than the currently available gaseous methods of stimulation.

It is yet another object of the present invention to provide a square or rectangular or other shaped designs of inflatable container with rubber-based sealant to avoid contact between water trapped in the container with the gas outlet because prolonged contact with water would reduce the efficacy of the stimulation process.

It is yet another object of the present invention to provide a device where the perimeter of the contact area of the inflatable container is layered with soft and pliable rubber-based sealant or other types of sealant covered by a silicon paper or other non-sticky material. The gas entrance to the inflatable container is made up of a valve-free plastic tubing attached at the centre part of the lower end of the inflatable container which is connected to a one-way valve at the lowest end of the plastic delivery tubing.

It is yet another object of the present invention to provide a gaseous stimulant that is supplied using a gassing equipment comprising liquefied compressed gaseous stimulant in a canister which can be used for 3,000 trees per canister. The gas travels along the delivery tubing into the container which inflates immediately after filling up with the gaseous stimulant. The stimulant diffuses gradually into laticiferous tissue, but the presence of the stimulant can be monitored easily by gently pressing the container or by looking at the shape of the container. The inflation of the container is an indicator of the presence of gaseous stimulant which is easily recognized and detected by the user. The amount of gas required is up to 40 cc per gassing; and the handling of the device is simple, by pressing the sealant before gassing and draining the accumulated water in the container by detaching the one-way valve from the delivery tubing. The new invention offers a simple, user-friendly and cheaper method of stimulation that can be easily operated even by unskilled workers.

These and other objects of the present invention are accomplished by providing,

A device for increasing tapping yield of natural latex comprising:

- 5 a) an inflatable container comprising at least a layer or more of plastic or non-plastic material, to contain low volume liquefied compressed or other form of gaseous stimulant;
- b) an exit point at the rear of the container to allow gradual absorption of the gaseous stimulant into the laticiferous tissue;
- c) a gas delivery tubing made of plastic or polyvinyl chloride (PVC) or any other suitable materials; and
- 10 d) a one-way valve at the lower end of the delivery tubing.

and

A method of increasing the tapping yield of latex bearing tree using the device as claimed in any one of the preceding claims, comprising the steps of:

- 15 a) cleaning the bark of the latex bearing tree to remove any dirt or particulate matter;
- b) attaching the device comprising the inflatable container and its associated components to the cleaned bark; and
- c) passing gaseous stimulant into the laticiferous tissue using the device in (b).

Brief Description of the Drawings

20 The embodiments of the invention will now be described, by way of example only with reference to the accompanying drawings in which:

Figure 1 shows the main features of the inflatable container for stimulating latex bearing *Hevea* tree having components of the present invention in front view.

25 Figure 2 shows the components of the inflatable container in their configuration in rear view.

Figure 3 shows the components of the inflatable container in their configuration in side view.

Figure 4 shows the inflatable container positioned on high panel (HO) in side view.

Figure 5 shows the inflatable container positioned on the basal tapping panels combined with a short-cut tapping system tapped downward direction in side view.

Figure 6 shows the inflatable container positioned on high tapping panel (HO) combined with a short-cut tapping system tapped upward direction ($1/8S\uparrow$) with the canister for gassing.

Figure 7 shows the inflatable container on the second (BO-2) and third (BO-3) basal tapping panels combined with a half spiral ($1/2S$) tapped downward with the canister for gassing.

Detailed Description of the Invention

Development and Field Evaluation of Inflatable Container

Evaluation on High Panel

Field evaluation of the object of the present invention was initiated in year 2001 consisting of inflatable gas containers made of a single or double layered plastic sheets. A special rubber-based sealant was developed to stick the inflatable plastic container onto the surface of *Hevea* bark. These inflatable containers were fixed on the virgin bark located on the first high tapping panel (HO-1), 15 cm above panel BI-2 and 7.5 cm to the right of the back channel of the short-cut tapping system viz one-eight spiral ($1/8S$). The liquefied compressed gaseous stimulant was injected into the containers using a non-metered canister. Tapping is carried out 48 hours later. The first tapping yields ranged from 480.1 to 760.8 gram of wet cup lump per tapping. The yield in the second tapping reduced more than 50% ranging from 277.2 to 459.3 gram of wet cup lump. The average yield over one month tapping ranged from 77.0 to 127.6 gram of dry rubber per tree per tapping (g/t/t) (Table 1). A similar yield pattern was obtained over the two year study period (Table 2).

**TABLE 1. PERFORMANCE OF PROTOTYPES OF INFLATABLE
CONTAINER ON CLONE RRIM 600, PANEL HO-1, FIELD 48,
RRIES SG. BULOH.**

5	Prototypes of inflatable containers	Average g/t/t (March 2 to April 23, 2001)
	1. One-layered plastic with sealant applied along the perimeter of the plastic.	110.9
10	2. Two layered plastic with sealant applied along the perimeter of the gas exit (2.5 cm x 2.5 cm) at the rear and with a plastic tubing covered with plastic cover attached.	117.1
15	3. Two layered plastic with sealant applied along the perimeter of the gas exit (2.5 cm x 2.5 cm) at the rear with a plastic tubing with an inflow-valve attached.	127.6
	4. Plastic applicator with sealant	77.0

The prototypes of the inflatable gas containers were further refined and evaluated at the RRIM Experiment Station Sg. Buloh. The main improvements were on the design of the container, the dimensions of the gas outlet located at the rear of the container and the quantity of the rubber-based sealant used. The critical factors of the system were the materials used to make the inflatable containers, the sealant which could stick the container effectively for a longer period onto the tree. The weight of the plastic hose of 60 cm length and a one-way valve at the end was a problem. The situation worsened when a large quantity of water accumulated in the container, especially during the rainy season.

The canister used for supplying the gaseous stimulant was also improved. The current canister has a valve to regulate the release of the stimulant. Laboratory

test showed that the canister released the gaseous stimulant for up to 7,000 pressings or shots before it was empty. In the field, the number of effective pressings where 30 to 40 cc of gaseous stimulant per pressing was released per pressing was about 2000 to 3,000 shots per canister.

TABLE 2. DEVELOPMENT AND YIELD PROFILE OF INFLATABLE CONTAINER IN FIELD 48, RRIES SG. BULOH, SELANGOR, CLONE RRIM 600, PANEL HO-1

Types of E&C Container	g/t/t	Duration of study
1. Prototype	127.6	1 month
2. First model after prototype (2 layered-plastic)	153.4	2 years
3. Improved E&C (non-plastic material)	215.0	2 months

In November 2002, improvements were further made to the container involving the material and the position of gas entrance. The material was changed from high polyethylene plastic (HPP) to a material which permits the sealant to attach the material to the bark without changing the dimensions of the container. Originally, the gas entrance was positioned 1 cm above the bottom of the front section of the container with a 2 cm valve-free plastic hose protruding from the container. The position was later changed to the center of the bottom section of the container without a 2 cm valve-free plastic hose protruding from the container. Instead, a 4 cm valve-free plastic tubing was inserted from below and positioned at the same level of the sealed bottom inner section of the container. The changes improved the performance of the inflatable container and higher yield was obtained compared to the earlier designs. No maintenance work was required during the two months evaluation in the field (TABLE 2).

Tapping on Basal Panel

The performance of the inflatable container fixed to the virgin bark of the second basal tapping panel (BO-2) was also evaluated. Similar to the high tapping panel, the exploitation systems combined the gaseous stimulant using

the inflatable container with either one-eighth spiral (1/8S) or a quarter spiral (1/4S) but tapped downward direction. Tapping was carried out either on a single panel of 1/4S or 1/8S or two panels but tapped alternately namely 1/4S (t,t) or 1/8S (t,t). Both tapping panels are adjacent to each other with the first tapping cut situated on the lower portion while the second cut situated at the upper portion of the 1/4S (t,t) or 1/8S (t,t). The inflatable container was placed approximately 20 to 30 cm below the tapping cut(s). The first tapping was carried out on the first tapping cut followed by the second tapping on the second tapping cut three or four days after the first tapping. The yield obtained over the period of two month from clone RRIM 901, panel BO-2 and BO-3 was very encouraging (TABLE 3).

TABLE 3. YIELD PROFILE OF IMPROVED COLLAPSIBLE AND EXPANDABLE COTAINER IN FIELD 19, RRIES SG. BULOH, SELANGOR, CLONE RRIM 901, PANEL BO-2 AND BO-3.

Tapping month	Average g/t/t	Remarks
November, 2003	96.0	Frequent rain interference
December, 2004	180.2	The average tree productivity ranged from 104.4 g/t/t to 251.9 g/t/t per gassing consisting of two to three tappings per gassing.
Mean	138.1	Average over two months.

While particular embodiments of the subject invention have been described, it will be obvious to those skilled in the art that various changes and modifications to the subject invention can be made without departing from the spirit and scope of the invention. It is intended to cover, in the appended claims, all such modifications that are within the scope of this invention.

Claims:

1. A device for increasing tapping yield of natural latex comprising:
 - a) an inflatable container comprising at least a layer of plastic or non-plastic material, to contain low volume liquefied compressed or other form of gaseous stimulant;
 - b) an exit point at the rear of the container to allow gradual absorption of the gaseous stimulant into the laticiferous tissue;
 - c) a gas delivery tubing made of plastic or polyvinyl chloride (PVC) or any other suitable materials; and
 - d) a one-way valve at the lower end of the delivery tubing.
2. The device as claimed in Claim 1, wherein the inflatable container is square, rectangular or any other shape, is a single or double layer non-plastic, plastic, polyvinyl chloride (PVC), rubberized sheet, cellulose, or composite material with an exit point located at the rear section of the inflatable container.
3. The device as claimed in Claim 1 or 2, wherein the inflatable container is attached to the bark of *Hevea* tree or any latex-producing tree, using rubber-based soft and pliable sealant or any form of rubberized sealant aligned along the perimeter of the exit point and covered with a silicon coated paper or any non-sticking detachable cover.
4. The device as claimed in any one of Claims 1 to 3, wherein attachment of the inflatable container is carried out by lightly removing dirt or any other particulate matter on the surface of the bark without exposing the living tissue of the *Hevea* tree.
5. The device as claimed in any one of Claims 1 to 4, wherein a connecting plastic tubing or polyvinyl chloride (PVC) tubing, positioned at the bottom of the centre section of the inflatable container is connected with a valve-

free delivery tubing, either in a single piece plastic or PVC tubing or several pieces of tubing connected to each other, inserted to the connecting plastic tubing.

- 5 6. The device as claimed in Claim 5, wherein the valve-free plastic delivery tubing or tubing made of any other suitable materials, such as rubber, is attached to a one-way valve at the lowest end of the valve-free delivery tubing.
- 10 7. The device as claimed in any one of Claims 1 to 6, wherein the inflation and deflation of the inflatable container may be used as an indicator of successful gassing or stimulation and the need of re-gassing.
8. The device as claimed in any one of Claims 1 to 7, wherein the supply of gaseous stimulant into the inflatable container is carried out immediately after the completion of installation of the container while the subsequent gassing is carried out intermittently at least at 10-day interval.
- 15 9. The device as claimed in any one of Claims 1 to 8, wherein the gassing apparatus consists of a non-metered or metered canister or any other material which can contain liquefied compressed gaseous stimulant up to 20 bars (290 psi) pressure, or any apparatus that can regulate up to 40 cc of gaseous stimulant per pulse or per pressing.
- 20 10. The device as claimed in Claim 9, wherein the container has to be emptied from any residual stimulant or air trapped prior to gassing by dismantling the delivery tubing from the valve-free plastic tubing at the gas entrance and manually pressing to flatten the front section of the container until reaching the inner rear section of the container.

11. The device as claimed in any one of Claims 1 to 10, wherein the sealant is pressed to the *Hevea* tree bark during the pressing of the front section of the container which reinforces the stickiness of the sealant to the bark to avoid gas leakage.
- 5 12. The device as claimed in any one of Claims 1 to 11, wherein direct contact between the exit point of the inflatable container and water collected in the container from evaporation and transpiration process or from trunk flow which seeped through the leakages between the sealant and the container, can be prevented, by draining the water completely by dismantling the plastic delivery tubing and the valve-free delivery tubing or by dismantling
10 the one-way valve from the plastic delivery tubing.
13. The device as claimed in any one of Claims 1 to 12, wherein the inflatable container is reusable by applying new sealant after the left-over sealant along the perimeter of gas outlet is cleaned and washed with water.
- 15 14. The device as claimed in any one of the preceding claims, wherein the tapping yield of *Hevea* tree is increased by delaying the plugging mechanism that permits longer duration of latex flow in the presence of gaseous stimulant, using an inflatable container pasted onto a cleaned surface of the tree bark with rubber-based sealant, without exposing living
20 tissue.
15. A method of increasing the tapping yield of latex bearing tree using the device as claimed in any one of the preceding claims, comprising the steps of:
 - 25 a) cleaning the bark of the latex bearing tree to remove any dirt or particulate matter;
 - b) attaching the device comprising the inflatable container and its associated components to the cleaned bark; and
 - c) passing gaseous stimulant into the laticiferous tissue using the device in (b).