

# PATENT SPECIFICATION

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NO DRAWINGS

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## (54) PLANT GROWTH REGULATING COMPOSITIONS

(71) We, AMCHEM PRODUCTS, INC., a Corporation organised and existing under the laws of the State of Pennsylvania, United States of America, of Brookside Avenue, Ambler, Pennsylvania, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to plant growth regulating compositions, and is concerned in particular with latex stimulants incorporating, as an active ingredient, a hydrocarbyl-phosphonic acid or a derivative thereof.

It is well known to extract latex from growing rubber plants (*Hevea brasiliensis*, for example) by the selective removal of bark from the trunk of the plant, and allowing the latex (the sap) to drain into a strategically placed vessel. Heretofore certain agents have been suggested, and some employed, to stimulate or increase the flow of latex; the most widely used of those used is 2,4,5-trichlorophenoxyacetic acid.

In our British Patent No. 1,194,433 we have described and claimed various processes for regulating plant growth using certain hydrocarbyl-phosphonic acid derivatives, especially 2-chloroethyl-phosphonic acid and functional derivatives thereof. We also describe and claim various compositions incorporating these phosphonic acid derivatives—these compositions (where liquid) being on the whole “water-thin”—thus, of low viscosity. Now, while such water-thin compositions may be used on rubber plants (for stimulating latex yield) nevertheless they are not entirely satisfactory, primarily because they immediately run off when applied to the bared trunk surface, and furthermore because, in tropical countries such as Malaysia, the extensive rains rapidly wash any remaining composition away.

It is an object of this invention to provide a composition more suited for application to rubber trees for the purpose of stimulating latex yield therefrom.

In one aspect, therefore, this invention pro-

vides an aqueous composition for application to rubber trees to stimulate the flow of latex therefrom containing, as an active ingredient, from 1 to 20% by weight of one or more phosphonic acid derivatives conforming to the general formula

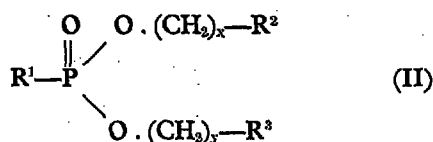


(where R is a vinyl, allyl, haloethyl, halopropyl, methoxyethyl, carboxymethyl or phosphonoethyl group), and/or the corresponding acid chlorides and/or anhydrides and/or amides and/or hydrolyzable mono- and di-esters and/or salts of the said phosphonic acid derivatives, said compositions having a viscosity (measured as specified hereinafter) of at least 1,000 centipoises and:

either containing in addition from 0.5 to 10% by weight of a natural resin or polysaccharide gum, as a thickening agent;

or containing in addition from 3 to 12% by weight of an emulsifying agent, and being in the form of an invert (water-in-oil) emulsion, the continuous phase being a vegetable fat or oil.

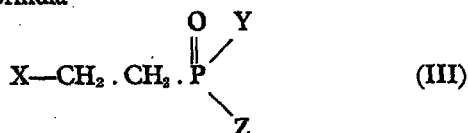
Within the broad area of the above general formula, a preferred area is that encompassed by the general formula



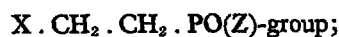
in which one of x and y is 0 and the other is 0 or 1; R<sup>1</sup> is a vinyl, allyl, haloethyl, halopropyl, methoxyethyl, carboxymethyl or phosphonoethyl group; R<sup>2</sup> is a hydrogen atom or a substituted or unsubstituted phenyl group; and R<sup>3</sup> is a hydrogen atom or a substituted or unsubstituted phenyl group or a halogen-substituted or unsubstituted, saturated or unsatur-

ated hydrocarbon chain containing from 2 to 12 carbon atoms.

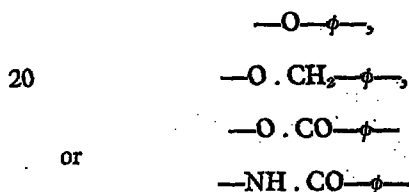
- Another,—and, to some extent, overlapping—area is that encompassed by the general formula



- where X is a halogen atom or a phosphono—PO(Y)Z group; Y is a chlorine atom or an —OR<sup>4</sup> group; R<sup>4</sup> is a hydrogen atom, a salt-forming cation, a substituted or unsubstituted aryl-, arylmethylene-, heterocycl- or heterocyclmethylene group, or the



- and Z is defined as (but not necessarily identical to) Y or is an oxyhydrocarbon group wherein the hydrocarbon chain may be substituted or unsubstituted, saturated or unsaturated; or Z and R<sup>4</sup> together form an



- linkage, where  $\phi$  represents a divalent, substituted or unsubstituted benzene or heterocyclic ring.

The particularly preferred phosphonic acid derivatives are 2 - chloroethyl - phosphonic acid and its functional derivatives.

- The term "functional derivatives" is used here to mean such derivatives of the hydrocarbyl-phosphonic acid as have the same function in the plant as the hydrocarbyl-phosphonic acid itself. It includes such derivatives as the acid chlorides, the anhydrides, the amides, the hydrolyzable mono- and di-esters, and salts. In particular, it includes the anhydride, the bis - (acid chloride), the pyrocatechol cyclic diester, the 4 - chloro - pyrocatechol cyclic diester, the mixed ethyl and 2-hydroxyphenyl diester, the mixed butyl and 2-hydroxyphenyl diester, the mixed propynyl and 2-hydroxyphenyl diester, the bis - (pentachloro - phenyl) diester, the 2-chloroethyl monoester, the bis - (phenyl) diester, the tetrachloro-pyrocatechol cyclic ester, the saligen cyclic ester, the salicylic acid cyclic ester, the 3-hydroxy-phenyl monoester, the bis - (2 - oxo - pyrrolidinyl - methyl) - diester, the mixed phenyl and o-hydroxy-phenyl diester, the o - hydroxy - phenyl - monoester, the mixed isopropyl and 2 - hydroxy - phenyl diester, the mixed octyl and 2-hydroxy-phenyl diester, the salicylic acid cyclic ester of the hydrocarbyl phosphonamidic

acid, the mixed hexadecyl and 2-hydroxyphenyl diester, the mixed tridecyl and 2-hydroxyphenyl ester, the 2,3 - pyridinediol cyclic ester, the bis - (2 - chloroethyl) - diester, and the sodium, aluminium and zinc salts.

The hydrocarbyl-phosphonic acid, or functional derivative thereof, is preferably present in an amount of from 5 to 15%, especially 5 to 10%, by weight of the composition.

It will be appreciated that the compositions of the present invention will have a gelatinous consistency. Their viscosity is at least 1,000 centipoises (as measured by a Brookfield Viscometer Model RVT, employing a number 4 spindle at 20 rpm, at a temperature of 25°C) and is preferably about 24,000 to 25,000 centipoises (measured in the same way but using a number 5 spindle at 10 rpm).

It will also be appreciated that, when making up the compositions of this invention, the phosphonic acid derivative may be employed either as the pure chemical or as the technical grade chemical (90%  $\pm$  2%).

Aqueous solutions of hydrocarbyl-phosphonic acids (especially 2-chloroethyl-phosphonic acid and its derivatives) are almost invariably made highly acid (a pH of from 1 to 1.5) in order to prevent, as far as possible, any spontaneous breakdown to give ethylene. Accordingly, it will be appreciated that the thickener chosen (when present) must very preferably be capable of the required effect under these conditions. The most suitable thickeners, so far as we are aware, are polysaccharide gums (such as gum tragacanth, locust bean gum, gum acacia, polysaccharide gum-like materials produced by the fermentation of a carbohydrate by a bacterium like *Xanthomonas campestris*, and natural resins (such as gum Damar). Preferably the thickener is a polysaccharide gum such as Biopolymer XB-23. Biopolymer XB-23 is an anionic heteropolysaccharide produced by the fermentation of a carbohydrate by the bacterium *Xanthomonas campestris* (the Biopolymer XB-23 molecule is made up of repeating groups each of which consists of a block of 16 hexose residues with an order of arrangement and linkage of glucuronic acid, mannose, and glucose) and is available from Central Research Laboratories Division of the General Mills Company of Minneapolis, Minnesota, U.S.A. This thickener has an unusual resistance to degradation by acids, and has been found to perform quite satisfactorily at a pH of 1 to 1.5, giving—on combination with an aqueous solution of the phosphonic acid derivative—a pseudoplastic mixture.

The thickening agent is conveniently employed in an amount of from 0.5 to 2.0% by weight.

The compositions of this invention may, instead of containing a thickening agent, be formulated as a water-in-oil emulsion (an invert emulsion), in which case they contain

in addition an emulsifying agent. The emulsifying agent utilized may be any suitable agent known to the art which will enable a water-in-oil emulsion to be formed. Particularly satisfactory results can be obtained, however, by employing an emulsifying agent selected from the group of oxyalkylene derivatives of long-chain aliphatic amides and amines, polyoxyethylene sorbitol poly-fatty acid esters, and fatty acid esters of hexitan.

A preferred amount of the emulsifying agent is from 5 to 10% by weight.

The oil phase (the continuous phase) of the invert emulsions of this invention is a vegetable fat or oil, and is preferably palm oil, palm kernel oil, coconut oil or corn oil.

Apart from the ingredients already explicitly or implicitly mentioned (water, phosphonic acid derivative, and thickener or oil and emulsifier), the compositions of this invention may contain other substances. For example, the non-emulsion compositions may contain from 5 to 50% by weight of a vegetable oil or fat (such as palm oil, palm kernel oil, coconut oil or corn oil) and any of the compositions may contain an anti-oxidant, a bactericide, an insect repellent, a water repellent, a bark penetrant, and such solvents as are necessary to produce a compatible mixture.

The anti-oxidant is used to prevent or lessen rancidity and polymerization of the vegetable oil or fat (where included). In some cases, the vegetable oil or fat assists in lending water repellent properties to the latex stimulant composition, and in such cases the anti-oxidant is preferably used. A suitable anti-oxidant is butylated hydroxy anisole.

The bactericide or preservative is of a nature that will readily occur to those skilled in the art, and serves to prevent or lessen biodegradation of the thickening agent. A suitable bactericide is 1 - (3 - chloroallyl) - 3,5,7 - triaza - 1 - azonia - adamantane chloride (Dowcil 100).

In some cases the oil or fat in the composition will attract insects. An insect repellent can be included in the formulation where necessary, and suitable ones are dioctylphthalate, dimethylphthalate and hexanetriol.

In preparing formulations in accordance with the present invention it has been found useful to employ certain solvents in order to hasten the formulation as well as to enhance the stability and shelf life of the finished product. Formulation takes place at room temperature, and suitable solvents which may be employed are butyrolactone, ethanol and xylene.

It is occasionally useful to incorporate a water repellent agent to aid in reducing the possibility that the composition (once applied to the rubber tree) could be washed away by heavy rain. A suitable repellent agent is a silicone oil, such as one of those sold under the marks Union Carbide Silicon Y-5628, R-24, R-270 and Emulsion RE-231.

In some cases the penetration of the compositions into the rubber plant is enhanced by the addition of a bark penetrant to the formulation. Typical examples of bark penetrants which can be employed herein are dialkylphthalates such as dibutylphthalate, diisooctylphthalate, dioctylphthalate and dimethylphthalate.

The compositions of the present invention are used in accordance with well known practices in the art. Strips of bark of the rubber plant are removed, creating what are referred to in the art as "tapping cuts", and the composition is simply applied directly to the bark at a point immediately below the stripped area (or in some cases the composition may actually be applied to the exposed area). In another method of application, the bark is lightly scraped below the tapping cut and the composition is applied onto the lightly scraped area.

The compositions may simply be applied to the trunk of the rubber tree through the use of a brush or other coating or spray equipment as will readily occur to those skilled in the art.

Thus, in another aspect, this invention provides a process for the stimulation of latex yield from rubber plants, in which a composition of this invention is applied to the plant on or just below a tapping cut thereon.

One pint (U.S.) of a composition containing 10% by weight of the hydrocarbyl-phosphonic acid is generally sufficient to treat about 190 trees.

While there is no intention to limit the present invention to any particular theory, nevertheless it is believed that the hydrocarbyl-phosphonic acids, and especially 2-chloroethyl-phosphonic acid, are effective because they have the ability to break down into or otherwise liberate ethylene within the plant tissues. In the practice of the present invention the liberation of ethylene is believed to initiate a biological activity that takes the form of unplugging the severed ends of the latex vessels, thereby prolonging the flow of latex.

It can be seen that the various "latex stimulant" compositions described herein are of a rather thick consistency which can be varied to suit local conditions and problems. The dramatic results achieved through the compositions of the present invention, as well as through the practice of the method of the present invention, easily justify the costs of the active ingredient. The compositions can be simply stored or transported either as a concentrate or in a form ready to use; they are reasonably stable, and have an excellent shelf life.

The following Examples are now given, though only by way of illustration, to show details of preferred compositions of this invention.

"Ethepon" is the descriptive chemical name for 2-chloroethyl-phosphonic acid.

- In all the Examples except Examples 2 and 14 the Ethepon was formulated as a 39.5 wt % solution in propylene glycol (30 wt. %) and water (30.5 wt. %). Example 2 used a 4 molar aqueous solution.

#### Example 1

##### Composition with thickener

- 10 A typical latex stimulant according to the present invention contained the following:

|                         | lbs.  | wt. %  |
|-------------------------|-------|--------|
| Ethepon                 | 1.062 | 11.98  |
| Propylene glycol        | 0.807 | 9.10   |
| 15 Thickener            |       |        |
| (Biopolymer XB-23)      | 0.089 | 1.00   |
| Solvent (Butyrolactone) | 0.177 | 2.00   |
| Water                   | 6.731 | 75.92  |
|                         | 8.865 | 100.00 |

- 20 The foregoing composition had a specific gravity of 1.065 at 20°C. It was formulated by preparing a slurry of the thickener and a solvent. The slurry was added rapidly to the mixture of Ethepon and water under agitation at ambient conditions. The viscosity was about the same as that of the composition of Example 12 below.

#### Example 2

##### Composition with thickener and oil

- 30 A formulation including palm oil was prepared as follows:

|                   | gms.   | wt. %  |
|-------------------|--------|--------|
| Ethepon           | 49.89  | 12.56  |
| Thickener (XB-23) | 4.00   | 0.80   |
| 35 Ethanol        | 8.00   | 1.60   |
| Water             | 393.55 | 75.04  |
| Palm oil          | 50.00  | 10.00  |
|                   | 500.00 | 100.00 |

- 40 The foregoing formulation stimulated the flow of latex by an amount of 329% as compared with the control at 100%, and its viscosity was roughly that of the composition of Example 12 below.

#### Example 3

- 45 Composition with thickener and oil  
Another formulation employing palm oil was composed of the following:

|                     | gms.   | wt. %  |
|---------------------|--------|--------|
| Ethepon             | 49.94  | 9.97   |
| 50 Propylene glycol | 37.92  | 7.58   |
| Thickener (XB-23)   | 4.00   | 0.80   |
| Ethanol             | 8.00   | 1.60   |
| Water               | 350.14 | 70.05  |
| Palm oil            | 50.00  | 10.00  |
|                     | 500.00 | 100.00 |

The foregoing formulation stimulated the flow of latex by an amount of 331% over control (100%), and its viscosity was roughly the same as that of the composition of Example 12 below.

#### Example 4

##### Composition with thickener and oil

In this Example, the proportion of Malaysian palm oil was raised by 50% as follows:

|                   | gms.   | wt. %  |
|-------------------|--------|--------|
| Ethepon           | 49.94  | 9.97   |
| Propylene glycol  | 37.92  | 7.58   |
| Thickener (XB-23) | 3.75   | 0.75   |
| Ethanol           | 7.50   | 1.50   |
| Water             | 325.89 | 65.20  |
| Palm oil          | 75.00  | 15.00  |
|                   | 500.00 | 100.00 |

This formulation stimulated the flow of latex by an amount of 390% over control (100%), and its viscosity was approximately the same as that of the composition of Example 12 below.

#### Example 5

##### Composition with thickener and oil

In this Example, the Malaysian palm oil proportion was increased so as to double the amount present in Example 3, in the following formulation:

|                   | gms.   | wt. %  |
|-------------------|--------|--------|
| Ethepon           | 49.94  | 9.97   |
| Propylene glycol  | 37.92  | 7.58   |
| Thickener (XB-23) | 3.33   | 0.67   |
| Ethanol           | 6.67   | 1.33   |
| Water             | 302.14 | 60.45  |
| Palm oil          | 100.00 | 20.00  |
|                   | 500.00 | 100.00 |

This formulation stimulated the flow of latex by 407% over control (100%). Its viscosity was about that of the composition of Example 12 below.

#### Example 6

##### Emulsion composition with anti-oxidant

Here, instead of employing a thickener, the Ethepon was formulated as a heavy invert emulsion. An anti-oxidant was included in the oil phase to prevent polymerisation of the palm oil.

|                                                   | gms.   | wt. %  |
|---------------------------------------------------|--------|--------|
| Ethepon                                           | 49.94  | 9.97   |
| Propylene glycol                                  | 37.92  | 7.58   |
| Water                                             | 38.54  | 7.73   |
| Anti-oxidant (butylated hydroxy anisole)          | 3.25   | 0.65   |
| Emulsifier (Atlas * G128 cationic nonionic blend) | 46.75  | 9.35   |
| Palm oil                                          | 323.60 | 64.72  |
|                                                   | 500.00 | 100.00 |

\* "Atlas" is a Registered Trade Mark.

The foregoing invert emulsion formulation was prepared by adding the Ethephon to an oil phase consisting of palm oil, anti-oxidant and emulsifying agent. A stable invert emulsion was formed having an external oil system and an internal aqueous system comprising Ethephon, propylene glycol and water.

- 10 The invert emulsion formulation stimulated latex by an amount of 421% over control (100%). The viscosity was greater than 1000 cps (No. 4 spindle; 20 rpm).

#### Example 7

Composition with thickener, anti-oxidant and bactericide

- 15 The following Example shows the inclusion of a bactericide as well as an anti-oxidant. A latex stimulant was prepared having the following components:

|                                                                                                       | lbs.         | wt. %         |
|-------------------------------------------------------------------------------------------------------|--------------|---------------|
| 20 Ethephon                                                                                           | 0.863        | 10.00         |
| Propylene glycol                                                                                      | 0.656        | 7.59          |
| Biopolymer XB-23<br>(Thickener)                                                                       | 0.069        | 0.80          |
| Ethanol (3-A grade)                                                                                   | 0.138        | 1.60          |
| 25 Dowcil 100 (Bactericide)<br>(1-(3-chloroallyl)-3,5,7-<br>triazia-1-azonia-<br>adamantane chloride) | 0.035        | 0.41          |
| Water                                                                                                 | 5.781        | 66.77         |
| 30 Anti-oxidant (butylated<br>hydroxy anisole)                                                        | 0.010        | 0.16          |
| Xylene                                                                                                | 0.010        | 0.16          |
| Palm Oil                                                                                              | 1.080        | 12.51         |
|                                                                                                       | <u>8.642</u> | <u>100.00</u> |

- 35 The foregoing formulation had a specific gravity of 1.038 at 20°C. It was prepared by stirring at room temperature the Ethephon, Dowcil 100 and water together until solution was achieved. A slurry of the biopolymer and the ethanol was then prepared, and added to the previous solution under vigorous stirring for fifteen minutes. To the foregoing was added a solution of the anti-oxidant, the xylene and the palm oil under continued agitation for another ten minutes. The viscosity of the formulation at 25°C. was measured employing a Brookfield Viscometer Model RVT, employing a Number 4 spindle at 20 rpm. The viscosity was measured at 3270 centipoises.

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#### Example 8

Composition with thickener, anti-oxidant and bactericide

A composition very similar to that of Example 7 had the following components:

|                                             | wt. %         |    |
|---------------------------------------------|---------------|----|
| Ethephon                                    | 10.00         | 55 |
| Propylene glycol                            | 5.60          |    |
| Biopolymer XB-23<br>(Thickener)             | 1.60          |    |
| Ethanol (3-A grade)                         | 3.00          | 60 |
| Dowcil 100 (Bactericide)                    | 0.40          |    |
| Water                                       | 66.80         |    |
| Butylated hydroxy anisole<br>(anti-oxidant) | 0.10          |    |
| Palm oil                                    | 12.50         | 65 |
|                                             | <u>100.00</u> |    |

The formed composition had a specific gravity of 1.038 at 20°C, and weighed 8.6388 lbs/U.S. gallon. Its viscosity was 24,720 cps using a number 5 spindle at 10 rpm, at 25°C.

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#### Example 9

Composition with thickener, anti-oxidant and bactericide

Another satisfactory formulation incorporating a bactericide as well as an anti-oxidant was prepared with the following components:

|                                             | wt. %         |    |
|---------------------------------------------|---------------|----|
| Ethephon                                    | 9.98          |    |
| Propylene glycol                            | 7.58          |    |
| Biopolymer (XB-23)<br>(Thickener)           | 1.60          | 80 |
| Ethanol (3-A grade)                         | 3.20          |    |
| Dowcil 100 (Bactericide)                    | 0.40          |    |
| Water                                       | 64.50         |    |
| Anti-oxidant (butylated<br>hydroxy anisole) | 0.12          | 85 |
| Xylene                                      | 0.12          |    |
| Palm oil                                    | 12.50         |    |
|                                             | <u>100.00</u> |    |

The viscosity was roughly the same as that of the composition of Example 8.

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#### Example 10

Composition with thickener, bactericide and bark penetrant

A satisfactory formulation incorporating a bark penetrant was prepared with the following components:

|                                       | wt. %         |     |
|---------------------------------------|---------------|-----|
| Ethephon                              | 9.99          |     |
| Propylene glycol                      | 7.59          | 100 |
| Biopolymer (XB-23)<br>(Thickener)     | 1.67          |     |
| Ethanol (3-A grade)                   | 3.33          |     |
| Dowcil 100 (Bactericide)              | 0.40          |     |
| Water                                 | 54.52         | 105 |
| Diocetylphthalate (bark<br>penetrant) | 10.00         |     |
| Palm oil                              | 12.50         |     |
|                                       | <u>100.00</u> |     |

The viscosity was about the same as that of the composition of Example 8.

|                                                            |        |        |
|------------------------------------------------------------|--------|--------|
| Example 11                                                 |        |        |
| Composition with thickener, bactericide and bark penetrant |        |        |
|                                                            | lbs.   | wt. %  |
| Ethephon                                                   | 0.8725 | 9.99   |
| Propylene glycol                                           | 0.6625 | 7.59   |
| Biopolymer (XB-23)                                         |        |        |
| 10 (Thickener)                                             | 0.1395 | 1.60   |
| Ethanol (3-A grade)                                        | 0.2791 | 3.20   |
| Dowcil 100 (Bactericide)                                   | 0.0296 | 0.34   |
| Dicotylphthalate (bark penetrant)                          | 1.5264 | 17.51  |
| 15 Water                                                   | 5.2115 | 59.77  |
|                                                            | 8.7210 | 100.00 |

The foregoing formulation did not contain any palm oil; it had a specific gravity of 1.048 at 20°C, and a viscosity similar to that of the composition of Example 12 below.

|                                                               |        |        |
|---------------------------------------------------------------|--------|--------|
| Example 12                                                    |        |        |
| Composition with thickener and bactericide                    |        |        |
| Another useful latex stimulant had the following formulation: |        |        |
|                                                               | lbs.   | wt. %  |
| Ethephon                                                      | 0.8749 | 9.99   |
| Propylene glycol                                              | 0.6641 | 7.59   |
| Biopolymer (XB 23)                                            |        |        |
| 30 (Thickener)                                                | 0.1398 | 1.60   |
| Ethanol (3-A grade)                                           | 0.2798 | 3.20   |
| Dowcil 100 (Bactericide)                                      | 0.0306 | 0.35   |
| Water                                                         | 6.7542 | 77.27  |
|                                                               | 8.7434 | 100.00 |

It can be seen that the foregoing formulation did not contain palm oil. The Dowcil component was useful in preventing the gum thickener from degrading. This formulation had a specific gravity of 1.051 at 20°C. The viscosity of the formulation at 25°C. was measured employing a Brookfield Viscometer Model RVT, employing a number 4 spindle at 20 rpm. The viscosity was measured at 7470 centipoises.

|                                                                                                                                                                                                   |  |  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|
| Example 13                                                                                                                                                                                        |  |  |
| Composition with thickener, bactericide and water-repellent                                                                                                                                       |  |  |
| The following Example shows a formulation incorporating a silicone oil as a water-repellent agent to prevent washing away in heavy tropical rainstorms. This formulation contained the following: |  |  |

|                              |        |    |
|------------------------------|--------|----|
|                              | wt. %  |    |
| Ethephon                     | 9.99   | 55 |
| Propylene glycol             | 7.59   |    |
| Biopolymer (XB-23)           |        |    |
| (Thickener)                  | 1.60   |    |
| Ethanol (3-A grade)          | 3.20   |    |
| Dowcil 100 (Bactericide)     | 0.35   |    |
| Silicone oil water-repellent |        | 60 |
| (Union Carbide Y-5628)       | 2.50   |    |
| Water                        | 74.77  |    |
|                              | 100.00 |    |

The formulation was made by preparing a mixture of the biopolymer and the ethanol that was added rapidly to a vessel containing the Ethephon, Dowcil and water under agitation. After stirring for five minutes the silicone oil was added, followed by additional stirring until a uniform mixture was achieved. The viscosity was about the same as that of the composition of Example 12.

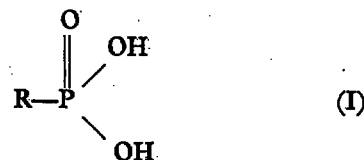
|                                                              |  |  |
|--------------------------------------------------------------|--|--|
| Example 14                                                   |  |  |
| Composition with thickener, bactericide and anti-oxidant     |  |  |
| A composition was prepared having the following ingredients: |  |  |

|                              |        |    |
|------------------------------|--------|----|
|                              | wt. %  |    |
| 2-bromoethyl-phosphonic acid | 8.00   | 80 |
| Dowcil 100 (Bactericide)     | 0.40   |    |
| Biopolymer XB-23 (Thickener) | 1.60   |    |
| Ethanol (3-A grade)          | 3.10   |    |
| Propylene glycol             | 4.00   |    |
| Butylated hydroxy anisole    |        | 85 |
| (anti-oxidant)               | 0.10   |    |
| Palm oil                     | 12.50  |    |
| Water                        | 70.30  |    |
|                              | 100.00 |    |

The viscosity was roughly the same as that of the composition of Example 8.

#### WHAT WE CLAIM IS:—

1. An aqueous composition for application to rubber trees to stimulate the flow of latex therefrom containing, as an active ingredient, from 1 to 20% by weight of one or more phosphonic acid derivatives conforming to the general formula.



(where R is a vinyl, allyl, haloethyl, halopropyl methoxyethyl, carboxymethyl or phosphonoethyl group), and/or the corresponding acid chlorides and/or anhydrides and/or amides and/or hydrolyzable mono- and di-esters and/or salts of the said phosphonic acid derivatives, said composition having a viscosity,

|                              |              |    |
|------------------------------|--------------|----|
| Ethephon                     | wt. %        |    |
| Propylene glycol             | 9.99         | 55 |
| Biopolymer (XB-23)           | 7.59         |    |
| (Thickener)                  | 1.60         |    |
| Ethanol (3-A grade)          | 3.20         |    |
| Dowcil 100 (Bactericide)     | 0.35         |    |
| Silicone oil water-repellent |              | 60 |
| (Union Carbide Y-5628)       | 2.50         |    |
| Water                        | 74.77        |    |
|                              | <hr/> 100.00 |    |

## 5

|                                      | lbs.         | wt. %        |
|--------------------------------------|--------------|--------------|
| Ethephon                             | 0.8725       | 9.99         |
| Propylene glycol                     | 0.6625       | 7.59         |
| Biopolymer (XB-23)                   |              |              |
| 10 (Thickener)                       | 0.1395       | 1.60         |
| Ethanol (3-A grade)                  | 0.2791       | 3.20         |
| Dowcil 100 (Bactericide)             | 0.0296       | 0.34         |
| Dicotylphthalate (bark<br>penetrant) | 1.5264       | 17.51        |
| 15 Water                             | 5.2115       | 59.77        |
|                                      | <hr/> 8.7210 | <hr/> 100.00 |

The foregoing formulation did not contain any palm oil; it had a specific gravity of 1.048 at 20°C, and a viscosity similar to that of the composition of Example 12 below.

Another useful latex stimulant had the following formulation:

|                          | lbs.   | wt. %  |
|--------------------------|--------|--------|
| Ethephon                 | 0.8749 | 9.99   |
| Propylene glycol         | 0.6641 | 7.59   |
| Biopolymer (XB 23)       |        |        |
| 30 (Thickener)           | 0.1398 | 1.60   |
| Ethanol (3-A grade)      | 0.2798 | 3.20   |
| Dowcil 100 (Bactericide) | 0.0306 | 0.35   |
| Water                    | 6.7542 | 77.27  |
|                          | <hr/>  | <hr/>  |
|                          | 8.7434 | 100.00 |

35 It can be seen that the foregoing formula-  
tion did not contain palm oil. The Dowcil  
component was useful in preventing the gum  
thickener from degrading. This formulation  
had a specific gravity of 1.051 at 20°C. The  
40 viscosity of the formulation at 25°C. was  
measured employing a Brookfield Viscometer  
Model RVT, employing a number 4 spindle  
at 20 rpm. The viscosity was measured at  
7470 centipoises.

## 45

50 The following Example shows a formulation incorporating a silicone oil as a water-repellent agent to prevent washing away in heavy tropical rainstorms. This formulation contained the following:

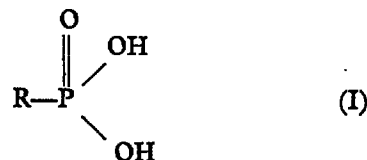
The formulation was made by preparing a mixture of the biopolymer and the ethanol that was added rapidly to a vessel containing the Ethephon, Dowcil and water under agitation. After stirring for five minutes the silicone oil was added, followed by additional stirring until a uniform mixture was achieved. The viscosity was about the same as that of the composition of Example 12.

A composition was prepared having the following ingredients:

|                                             |              |    |
|---------------------------------------------|--------------|----|
|                                             | wt. %        |    |
| 2-bromoethyl-phosphonic acid                | 8.00         |    |
| Dowcil 100 (Bactericide)                    | 0.40         | 80 |
| Biopolymer XB-23 (Thickener)                | 1.60         |    |
| Ethanol (3-A grade)                         | 3.10         |    |
| Propylene glycol                            | 4.00         |    |
| Butylated hydroxy anisole<br>(anti-oxidant) | 0.10         | 85 |
| Palm oil                                    | 12.50        |    |
| Water                                       | 70.30        |    |
|                                             | <hr/> 100.00 |    |

The viscosity was roughly the same as that of the composition of Example 8. 90

1. An aqueous composition for application to rubber trees to stimulate the flow of latex therefrom containing, as an active ingredient, from 1 to 20% by weight of one or more phosphonic acid derivatives conforming to the general formula



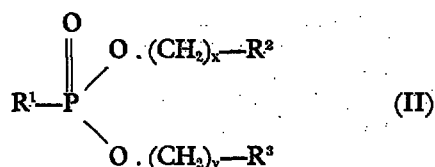
(where R is a vinyl, allyl, haloethyl, halopropyl methoxyethyl, carboxymethyl or phosphonoethyl group), and/or the corresponding acid chlorides and/or anhydrides and/or amides and/or hydrolyzable mono- and di-esters and/or salts of the said phosphonic acid derivatives, said composition having a viscosity,



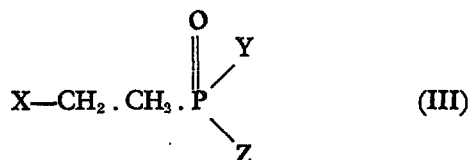
measured as specified hereinbefore, of at least 1,000 centipoises, and:

- 5 either containing in addition from 0.5 to 10% by weight of a natural resin or polysaccharide gum as a thickening agent;  
 10 or containing in addition from 3 to 12% by weight of an emulsifying agent, and being in the form of an invert (water-in-oil) emulsion, the continuous phase being a vegetable fat or oil.

2. A composition as claimed in claim 1, wherein the phosphonic acid derivative(s) conforms to the general formula



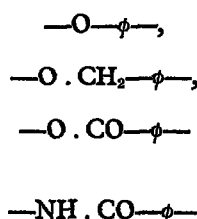
- 15 (in which one of x and y is 0 and the other is 0 or 1; R<sup>1</sup> is a vinyl, allyl, haloethyl, halo-propyl, methoxyethyl, carboxymethyl or phosphono-ethyl group; R<sup>2</sup> is a hydrogen atom or a substituted or unsubstituted phenyl group;  
 20 and R<sup>3</sup> is a hydrogen atom or a substituted or unsubstituted phenyl group or a halogen-substituted or unsubstituted, saturated or unsaturated hydrocarbon chain containing from 2 to 12 carbon atoms).  
 25 3. A composition as claimed in claim 1, wherein the phosphonic acid derivative(s) conforms to the general formula



- 30 (where X is a halogen atom or a phosphono-PO(Y)Z group; Y is a chlorine atom or an -OR<sup>4</sup> group; R<sup>4</sup> is a hydrogen atom, a salt-forming cation, a substituted or unsubstituted aryl-, arylmethylene-, heterocyclyl- or heterocyclymethylene group, or the

- 35 X · CH<sub>2</sub> · CH<sub>2</sub> · PO(Z)-group;

- and Z is defined as (but not necessarily identical to) Y or is an oxyhydrocarbon group wherein the hydrocarbon chain may be substituted or unsubstituted, saturated or unsaturated; or Z and R<sup>4</sup> together from an



linkage, where φ represents a divalent, unsubstituted or unsubstituted benzene or heterocyclic ring).

4. A composition as claimed in any of the preceding claims, wherein the phosphonic acid derivative is 2-chloroethyl-phosphonic acid or a functional derivative thereof.

5. A composition as claimed in any of the preceding claims, wherein the phosphonic acid derivative is the anhydride, the bis-(acid chloride), the pyrocatechol cyclic diester, the 4-chloro-pyrocatechol cyclic diester, the mixed ethyl and 2-hydroxyphenyl diester, the mixed butyl and 2-hydroxyphenyl diester, the mixed propynyl and 2-hydroxyphenyl diester, the bis-(pentachloro-phenyl) diester, the 2-chloroethyl monoester, the bis-(phenyl) diester, the tetrachloro-pyrocatechol cyclic ester, the saligen cyclic ester, the salicylic acid cyclic ester, the 3-hydroxy-phenyl monoester, the bis-(2-oxo-pyrrolidinyl-methyl) diester, the mixed phenyl and o-hydroxyphenyl diester, the o-hydroxyphenyl monoester, the mixed isopropyl and 2-hydroxyphenyl diester, the mixed octyl and 2-hydroxyphenyl diester, the salicylic acid cyclic ester of the hydrocarbyl-phosphonamidic acid, the mixed hexadecyl and 2-hydroxyphenyl diester, the mixed tridecyl and 2-hydroxyphenyl diester, the 2,3-pyridine-diol cyclic ester, the bis-(2-chloroethyl) diester, or the sodium, aluminium or zinc salt.

6. A composition as claimed in any of the preceding claims, wherein the phosphonic acid derivative is present in an amount of from 5 to 15% by weight.

7. A composition as claimed in claim 6, wherein the phosphonic acid derivative is present in an amount of from 5 to 10% by weight.

8. A composition as claimed in any of the preceding claims, wherein the polysaccharide gum thickener is gum tragacanth, locust bean gum, gum acacia, or a polysaccharide gum-like material produced by the fermentation of a carbohydrate by a bacterium.

9. A composition as claimed in claim 8, in which the thickener is an anionic heteropolysaccharide produced by the fermentation of a carbohydrate by the bacterium *Xanthomonas campestris*.

10. A composition as claimed in any of the preceding claims, wherein the thickening agent is employed in an amount of from 0.5 to 2.0% by weight.

11. A composition as claimed in any of claims 1 to 7, wherein the emulsifying agent is selected from the group of oxyalkylene derivatives of long-chain aliphatic amides and amines, polyoxyethylene sorbitol poly-fatty acid esters, and fatty acid esters of hexitan.

12. A composition as claimed in any of claims 1 to 7 and 11, wherein the amount of the emulsifying agent is from 5 to 10% by weight.



13. A composition as claimed in any of claims 1 to 7, 11 and 12, wherein the oil phase of the invert emulsion is palm oil, palm kernel oil, coconut oil or corn oil.
- 5 14. A composition as claimed in any of claims 1 to 10, wherein the non-emulsion composition also contains from 5 to 50% by weight of a vegetable oil or fat.
- 10 15. A composition as claimed in any of the preceding claims, which also contains an anti-oxidant, a bactericide, an insect repellent, a water-repellent, a bark penetrant, and/or such solvents as are necessary to produce a compatible mixture.
- 15 16. A composition as claimed in claim 15, wherein the anti-oxidant is butylated hydroxy anisole.
- 20 17. A composition as claimed in either of claims 15 and 16, wherein the bactericide is 1 - (3 - chloroallyl) - 3,5,7 - triaza - 1 - azania-adamantane chloride.
- 25 18. A composition as claimed in any of claims 15 to 17, wherein the insect repellent is dimethylphthalate, dioctylphthalate or hexanetriol.
19. A composition as claimed in any of claims 15 to 18, wherein the solvent is butyrolactone, ethanol or xylene.
20. A composition as claimed in any of claims 15 to 19, wherein the water-repellent agent is a silicone oil. 30
21. A composition as claimed in any of claims 15 to 20, wherein the bark penetrant is dibutylphthalate, diisooctylphthalate, dioctylphthalate, or dimethylphthalate. 35
22. A composition as claimed in any of the preceding claims and substantially as described herein, especially with reference to the Examples.
23. A process for the stimulation of latex yield from rubber plants, in which a composition as defined in any of the preceding claims is applied to the plant on or just below a tapping cut thereon. 40

For the Applicants:  
SANDERSON & CO.,  
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Colchester, Essex.

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