AN IMPROVED INJECTION TECHNIQUE FOR COCONUT PALMS OF SPECIAL RELEVANCE TO THE CONTROL OF RED WEEVIL *RHYNCOPHORUS FERRUGINEUS* (F)

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Introduction

Injection of suitable substances into the system is a form of internal treatment commonly practised in medicine, and comparatively recently applied in plant therapeutics as well. In the case of plants the injection is made with a view to correcting a deficiency symptom, or combating a fungus disease, or an insect pest, by the introduction of a chemical. For instance, aphids and red spiders feeding on rose plants have effectively been controlled by the application of sodium selenate to the roots; and octamethyl pyrophosphoramide in the translocated sap, after absorption by plants, has been found to be lethal to insects feeding on such plants. This chemical is introduced into the plant through the stem, leaves or the roots, either in the solid form wherever possible or as a solution so that it could be carried along with the sap to the different parts of the plant.

Earlier Observations and Work

Literature on the subject shows that Goff (1897) successfully attempted to supply water in an artificial way to young transplanted trees through the cut end of a root, thus suggesting the possibility of injecting chemicals into trees. Manguin (1898), Morkrjetsky (1903) and Simon (1906) believed that it was possible to obtain some control over fungus diseases in potatoes, cauliflower, etc. by injecting the plants with appropriate chemicals. Rankin (1917) and Scherer (1927) however later obtained negative results in experiments conducted along these lines.

Sanford and Shattuck (1914-1915) have reported favourable results in the control of insect pests by injecting potassium ferrocyanide into trees, while Surface and Flint (1914-1915) could obtain no control whatsoever. Moore and Ruggles (1915) found that in plants hydrocyanic acid diffused in a lateral direction. Lipman and Gordan (1925) cured chlorosis in lemon by injecting ferrous sulphate solution. Wann (1929) found that iron salts introduced by injection of the dry salt into holes bored in the stem proved effective in overcoming chlorosis of grape vines and of peach and apple trees. In the control of bark-beetle, Craighead and St. George (1930) allowed wood alcohol, potassium cyanide and other compounds to penetrate the wood of pine trees. They were able to inject into a tree from two quarts to several gallons of liquid, which got distributed to the branches and leaves.

Davis, Anandan and Menon (1949) made borings in the trunks of unhealthy coconut palms and packed them with copper sulphate, boric acid, ferrous sulphate, manganese sulphate and zinc sulphate in powdered form and plugged the holes with hard arecanut wood *Areca* (sp.). They could observe no beneficial results even after two years. On the contrary, they noticed that the solids affected the tissues around the holes resulting in 'weeping'; thus confirming the observations of earlier workers that solid injection produces deleterious effects. Roach and Roberts (1945) in outlining the advantages of injecting solids, state that 'the most serious drawback to the solid method is the amount of mechanical damage done because of the necessity of having so many holes in the trunk. Thus, about ten times as much wood is removed in making the holes for solid, as is necessary for liquid injection'.

Biddulph (1941) using radioactive iron and phosphorus, demonstrated that when these were injected into the stem, they were found to be translocated to and from mature leaves. Hanna, Judenka and Heatherington (1955) introduced Paraoxon, Parathion, Schradan and Dimefox into the trunks of Cocoa trees through holes drilled in them in an attempt to control Mealy bug. In doing so they poured the chemical into the holes and plugged the latter with Cocoa branches driven hard into the holes. As a result they found that Mealy bug populations were substantially reduced and kept at a very low level (0.6% of that originally found).

Some Early Methods of Liquid Injection

According to Bourcart the results obtained by the injection of nutritive salts into the sapwood of cherry, pear and peach trees, induced Mokrjetsky to inject solutions of ferrous sulphate (green vitriol) into the sap of these plants with the hope of curing chlorosis. He made one or more holes of 2/5 to 5/7 inches in diameter in the stem and injected a 0.05%-0.25% solution. To prevent the entry of air into the hole during the process he proceeded as follows: The point of the centre bit was passed through a metal tube which was connected to a reservoir containing the solution through an India rubber tubing. By working the centre-bit, the liquid was made to fill the drilled space and thus prevent the entry of air. The reservoir was hung on a branch and the liquid was thus injected at a required pressure. It is said that a tree with a diameter of 20 cms. (8 inches) is capable of absorbing 8 litres (1 3/4 gallons) in 24 hours. As soon as the operation was over, the holes were plugged with mastic. By this method he observed that trees affected by chlorosis regained the green colour in their leaves after 4 days; in ten days there was no sign of chlorosis; and in 3 weeks the leaves were deep green. Trials were made on 840 trees. The same observer also pointed out that pests such as *Diaspis fallax* (*Horv.*) of the pear tree and *Mytilapsis pomorum B.* of the apple tree were much less evident in the trees with green vitriol.

In a method adopted by Roach and Roberts (1945) for injecting liquids a hole was bored through the bark just down to the wood with a sharp 3/8 inch Irwin bit. The hole was continued into the wood with a sharp 1/4 inch similar bit. Into this hole was posted a cylindrical plug of hardwood 3/8 inch diameter, tapered at one end to a little less than 1/4 inch and bored to take the narrow-bore rubber tubing leading to the reservoir. They state that the degree of plugging of the cells in the wood next to the bark was not found to slow up absorption appreciably except when there is only a thin ring of living wood.

Davis, Anandan and Menon (1954) have described a gravitational method of liquid injection which they employed in an attempt to control the red-weevil of coconuts. According to them a hole 3 inches deep, inclining slightly downwards, was made by means of an auger on the trunk of a coconut palm. The hole was then filled with moistened sterile cotton in order to keep the tissues fresh, as well as to distribute the liquid. A glass tube was then tightly fitted into the hole and the free end of it was connected to a vertical funnel by means of a rubber tubing. The solution to be injected was poured into the funnel from where it flows down into the moist cotton.

Elsewhere in the same publication, they also mention how a solution was sent up the roots of a coconut palm. The soil near the roots was excavated and a selected mature root was washed well with cold water. The root was then cut obliquely with a sharp knife, washed with sterile water and a convenient bottle or tower containing the liquid to be injected was attached to the cut end, so that it was completely immersed in the solution. Within 24 hours, they report, that a root functioning normally absorbs about 250 ml. to 400 ml. of a dilute solution. Here again, mention was not made either of the concentration or the solution that had been used but reference has been made to arecanut and palmyrah palms where this technique was tried. They conclude that the effect of injection through roots could be seen in the crown of even a tall palm within 24 hours since the solution is taken along the main conducting channels.

Drawbacks: (*a*) Except in the method adopted by Roach and Roberts (1945) it would be noted that in the other methods attempts have not been made to render the injection system leak-proof especially at the point where the liquid enters the trunk. Because of such leaks the suction forces exerted by the plant on the liquid could also draw along a certain amount of air into the conducting system, through this point, from the atmosphere. Further some liquid may be lost at this region by seepage and gradual evaporation. Hence, it would not be possible to get a correct estimate of the amount of liquid taken in by the plant.

(*b*) In the techniques mentioned above, the methods adopted for the removal of air from the boring are not satisfactory. This is important consideration because entry of air into the conducting system would reduce the efficiency of uptake of the liquid and also exert a negative pressure on the latter.

(*c*) Though not mentioned earlier, connections from a single reservoir where necessary to more than one boring on a tree or trees in the neighbourhood would be an inconvenient and difficult task.

Improved Technique

During the early part of 1957 the writer in an attempt to ascertain the possibilities of correcting deficiency symptoms in coconut palms or rejuvenate senile and ill-nourished ones adopted a method by which a nutrient solution could be administered into the trunk of a palm in the hope of supplementing the plant's requirements. This method is described below and a sketch of the apparatus used is shown in Figure I. In order to determine the extent of distribution of a solution by this method a dye which easily and recognisably stained the vascular elements was at first used. Having ascertained this, solutions of other chemicals were employed in subsequent trials.

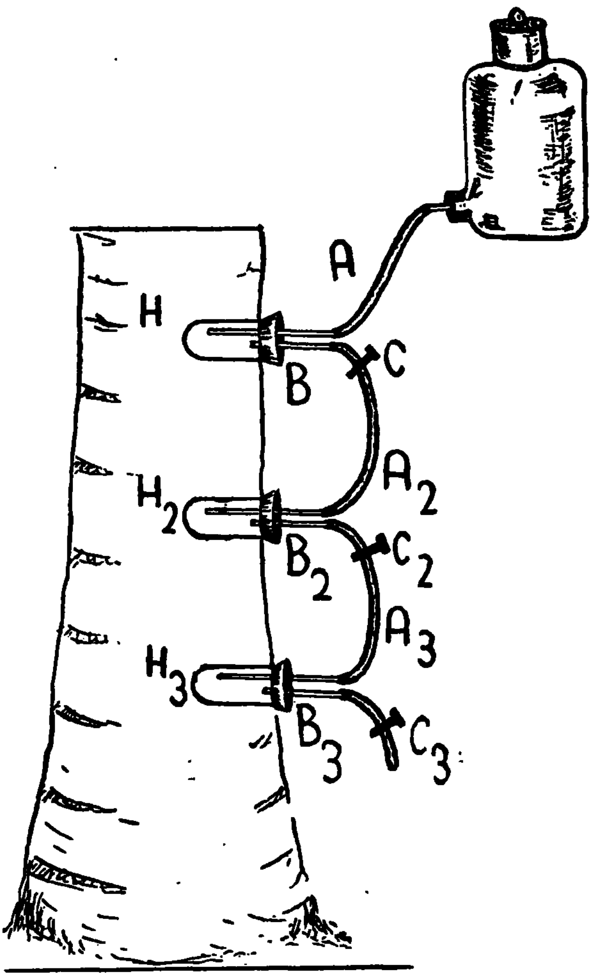

Fig. I. Sectional view of improved injecting apparatus ('Serial' type). [Note the connections and the air outlet tube. cf. Fig. V].

At a height of about 7 feet from the ground a hole H*, 4" deep and 1/2" in diameter was bored in the trunk of a tall palm about 40 feet in height, using a carpenter's auger. The wound was cleared immediately after boring and the hole plugged with a rubber bung which carried two short glass tubes. One of these, A, was connected to a reservoir X, containing the solution, and the other B, was fitted with a rubber tube carrying a Hoffman's clip. The clip C, was kept open and by allowing the solution to flow from the reservoir, all the air in the hole was displaced and the clip C, closed. About a foot and a half below this hole, another hole H_2 was bored, cleaned and plugged with a rubber bung carrying two glass tubes. One of these A_2 was connected to B while the other, B_2, was fitted with a rubber tube carrying a Hoffman's clip C_2. The air in H_2, was displaced by opening C_2 first and then C. After displacement of air from H_2, C_2 was closed. About one and a half feet below H_2 a third hole, H_3, was bored, cleaned and plugged with a rubber bung carrying two glass tubes, one of which A_3 was connected to C_2 while the other B_3 was fitted with a rubber tube carrying a Hoffman's clip C_3, Keeping C_3 open, C_2 was released thus causing the solution to flow into H_3 and displace all the air from it. After the complete displacement of air from H_3, C_3 was closed, any possibility of leaks at the rubber bungs was avoided by the application of molten bees wax.

Injecting of Saffranin Dye. By this method as shown in Table I, a 0.25% solution of Saffranin was injected into the palm for a continuous period of one week through three borings on the trunk placed at 4 feet, 5 1/2 feet and 7 feet from the base of the palm. Test borings after a week in the trunk at a height of 21 feet from the upper-most boring showed deeply stained vascular bundles.

TABLE I

DATE	*Quantity of dye filled into the reservoir (ml.)*	*(Approx.) quantity used up 24 hrs. after filling (ml.)*
5th January	4,000	—
6th January	4,000	5,000
7th January	8,000	6,000
8th January	4,000	5,000
9th January	2,000	4,500
10th January	2,000	3,500
11th January	2,000	2,000
Total	26,000	26,000 approx. reservoir almost empty

After nearly two months of treatment of the tall palm with the Saffranin dye, immature nut-fall occurred; the leaves gradually withered, the crown ultimately wilted and the palm died. At this stage the tree was felled and the dye was found to have risen to a height of 26 feet from the uppermost boring in the trunk and down to some of the roots. But no visible signs of the stain were noticeable in any part of the crown.

Simultaneously with this work a dwarf green palm of about 5 years old with a trunk of about 3 feet in height was treated similarly with a 0.25% solution of Saffranin dye. This solution was administered into the palm through two borings made at approximately one and two feet from the base of the crown. The injecting 'gear' was fitted on 8th January 1957 with 6,000 ml. of the solution. On 10th January, 5,060 ml. had entered the palm. At about this time the leaf stalks turned colour and the veins of the leaflets were reddish against the sun. Cross-section of inflorescence stalks and even the base of fruits were stained by the dye (Fig. II). Unlike the tall palm the dwarf palm died within a week. When the palm was later felled and the trunk split up longitudinally, the conducting vessels were found to be deeply stained while the ground or parenchymatous tissues were lightly stained, indicating that the dye had been conducted mainly through the vascular elements.

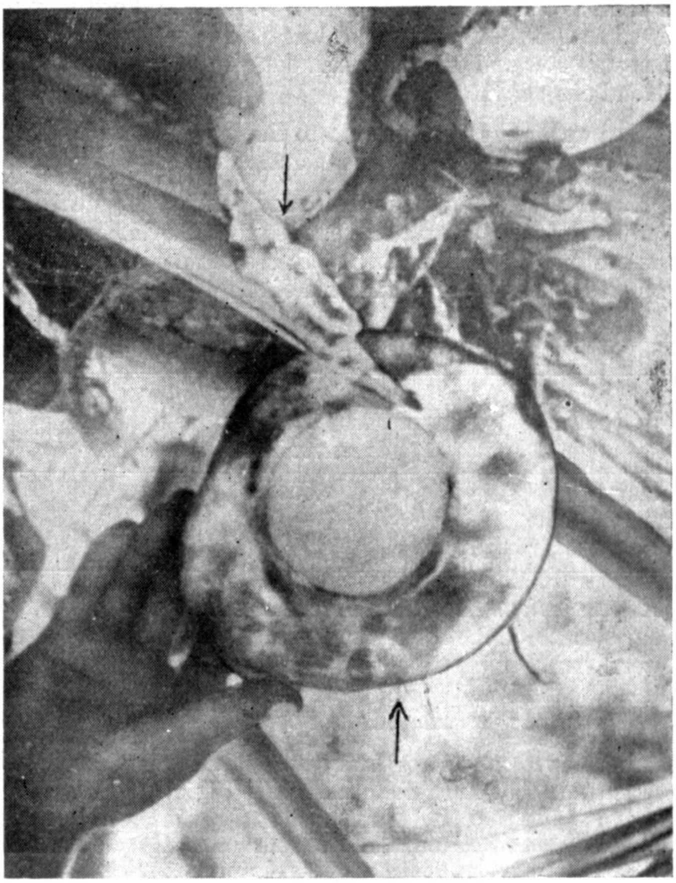

Fig. II. The Dwarf Palm after injection with Saffranin dye. [*Note*—Stain in the cut surfaces of the fruit and the leaf stalk.]

Injection of other Solutions. A series of injections was next made with other solutions and distilled water in order to study the comparative effects of such solutions on the coconut palm. A number of palms were accordingly treated using the same type of injecting 'gear'.

Palm A. 2,000 ml. of a solution of magnesium sulphate containing 12.32 gms/litre was injected into the trunk of a 6 year old palm. The injecting gear was fixed to the palm on a morning through a single boring and by the following morning all the liquid in the reservoir had been used up.

Palm B. 4,500 ml. of a solution of potassium nitrate containing 20 gms/litre was injected through the trunk of a tall palm about 40 years old. After eight days 3,500 ml. of solution were found to have been taken in.

Palm C. A six year old palm absorbed in ten days 1,830 ml. of a 250 ppm. solution of 4 Indolyl acetic acid.

Palm D. In this instance a solution containing 250 ppm. of 3 Indoyl acetic acid was injected into the stalk of an unopened inflorescence. From 1st February to 5th February, 1957, 100 ml. of this solution was taken in. Because of the smaller size of the boring, capillary tubes were used. Later a 0.25% solution of Saffranin was injected through the rachis (leaf stalk) of one of the fronds. The stain was observed to have travelled along the conducting elements.

Injection of Distilled Water. At this stage it was decided to study the rate of absorption of distilled water by a palm as compared with the above solutions. For this purpose a dwarf palm was selected and the same type of injecting gear was used in the trial. Contrary to expectations the rate of absorption was slow and only 2,670 ml. out of a total of 4,000 ml. in the reservoir had been taken in at the end of 15 days.

Injection of distilled water was then resorted to through roots by a method which was somewhat different to that adopted by Davis, Anandan and Menon (1954) (loc. cit.)

The apparatus described below was fitted on 22nd January 1957 with 2,600 ml. of distilled water in the reservoir which was hung up 2 feet above ground level. On the following day 117 ml. of water had been taken up, vide Table II. But thereafter no further appreciable drop in the liquid of the reservoir was observed even at the end of one week.

TABLE II

DATE	*Quantity of distilled water filled into the reservoir (ml.)*	*Quantity used up (ml.)*
22nd January ..	2,600 ..	—
23rd January ..	— ..	117
28th January ..	— ..	—

Technique for Root Injection. According to the method adopted by Davis, Anandan and Menon (1954) the cut surface of the root was washed with sterilized water and a convenient bottle, a flask or tower containing the liquid was attached to the cut end in such a way that the cut surface was completely immersed in the solution. But no mention has been made by them about the removal of any air bubbles which cannot be avoided by using this method.

To displace the air the writer used a capillary tube. The root was cut, washed and one end of a long rubber tube was connected to it, the other end being connected to the reservoir. At the junction of the rubber tube and the root a capillary tube was inserted by piercing it through the wall of the rubber tube. To the free end of the capillary tube a very narrow gauge rubber tubing (bicycle valve tubing) was connected. Once the air was completely displaced the capillary tube was knotted at its end. Figure III, illustrates the apparatus used.

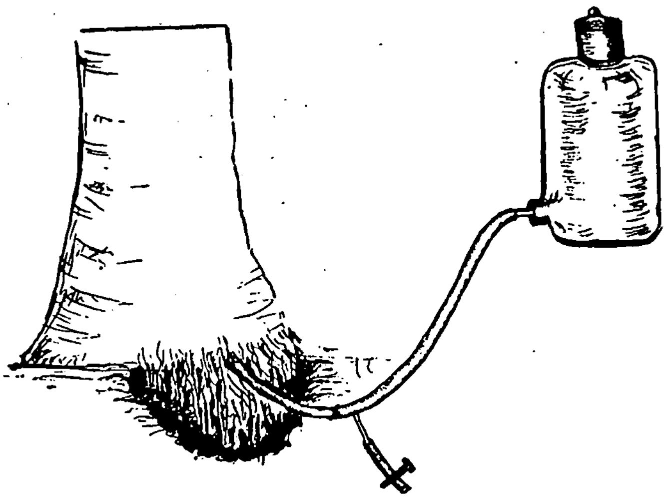

Fig. III. Apparatus for root injection. [Note position of capillary tube to displace air].

Injection of insecticides in the control of the Red Weevil (*Rhyncophorus Ferrugineus F.*)

Of all the pests of the coconut palm, the Red-weevil (*Rhyncophorus Ferrugineus F.*) is perhaps the most destructive. It is very common and widely distributed all over from Southern Asia to Australia.

The damage to the palm is caused by the larvae or grubs of the weevil, by tunnelling inside and feeding on the tissues of the stem. When in large numbers they may kill the tree. Young palms under about ten years of age are particularly susceptible to attack, often fatally. It is not uncommon to find as many as 50-100 fleshy white grubs inside a single palm.

The weevil gains entry to the palm generally through wounds in the trunk or crown of the palm caused frequently by the black-beetle, *Oryctes rhinoceros* L. The female weevil lays her eggs in the crevices or holes and the larvae that hatch out burrow into the stem. It was believed that the weevil would not lay its eggs in sound trees but Nirula (1956) has recorded that females may lay eggs in the tender tissues of the crown of young palms up to about seven years of age. It is difficult to detect the damage in the early stages of an attack. The appearance however of

Fig. IV. Palm attacked by Red Weevil.

protruding chewed fibre from holes and the oozing out of a thick brownish liquid from the stem indicate an infestation.

A trained observer would readily detect damage and would also hear the gnawing of the tissues by the grubs inside the stem. When the grubs are fully grown they construct cocoons of tough twisted fibre within which they pupate to emerge later as adult weevils.

The control of this pest is extremely difficult. Once the weevil gains entry into a palm it certainly is not easy to destroy the larvae and pupae inside. Local application of an insecticide or even a fumigant, as has been pointed out by Vestal (1956), would not be very helpful. Therefore, the customary method of dealing with this pest is to insert a sharp wire or hook to kill the grubs and pupae inside by piercing them. More generally, the method adopted is to remove the attacked tissue and burn it along with all stages of the present. The wound thus caused in the palm is painted with tar, Mason's mixture or other suitable disinfectant and the cavity filled with cement or sand and cement. Such an operation, however, is not always successful, unless very thorough, since tiny larvae or eggs that may be left behind could develop to continue the menace.

No effective parasites or predators of this pest have been recorded.

Injection of Insecticides. Four Weevil infested palms were selected and the new method tested out on two of them. The other two palms were treated in the customary manner and were painted with tar.

Insecticide. As the main objective was to investigate the efficiency of the proposed technique rather than a comparison of the efficiency of insecticides, an appropriate insecticidal solution of the writer's choice was used as a suitable substitute for a mixture of 1% pyrethrum and 10% piperonoyl butoxide diluted in water (or Pyrocone-E), which has been recommended by Nirula (1953). This commercial product was not available at the time the experiment was carried out. The palm which was less affected was treated with a solution of 55 ml. Malatox in 1 gallon water to which a small quantity of Dieldrex Extra was added. The injection of the solution was done through a single boring as the attack was diagnosed around a small area. Unfortunately the quantity of substance that entered the palm was not recorded.

The other palm, which had been subsequently detected to be in an advanced stage of infection, was treated with the same insecticides, using 9 oz. Dieldrex Extra and 165 ml. Malatox diluted to 3 gallons with water. Both Dieldrex Extra and Malatox are commercial products containing Dieldren in the former and organophosphorus in the latter as active ingredients.

The injection in this instance was made through five borings. The number of borings was decided upon by the extent of pest infection within the palm. Red-Weevil activity in this palm was noticeable to a height of about 6 feet from the base of the palm at which point the weevil had originally entered the trunk. Here too the exact quantity that entered the palm could not be recorded.

Method. The 'gear' used for injecting the liquid through five borings was as elaborate as the one used with Saffranin dye. But the gear was modified in order to deliver the liquid independently from the reservoir to the borings without circulation through the latter. Thus it differed from the former type already referred to as the 'serial' type.

In the modified form Figure V and VI, named the 'parallel' type, the liquid was led down a long rubber tube which was suspended from the reservoir, and closed at the free end.

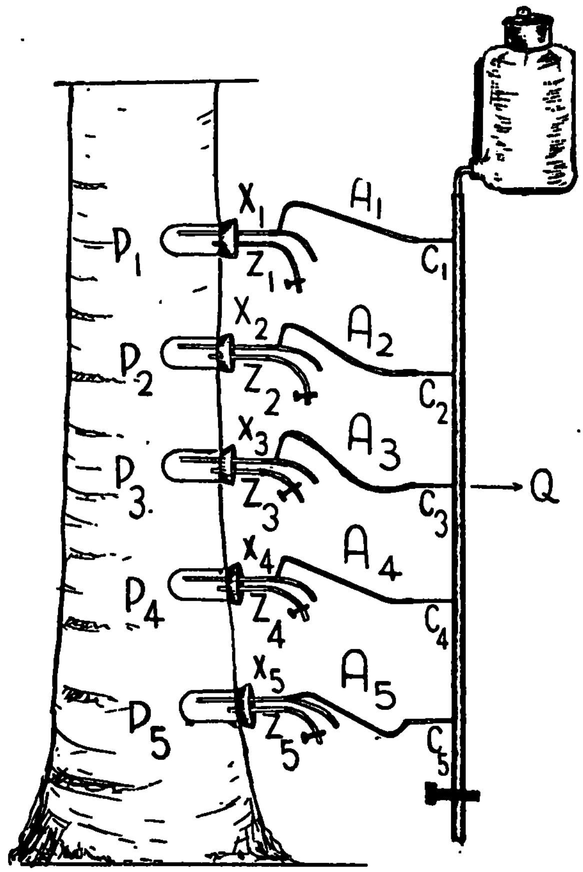

Fig. V. Sectional view of improved injecting apparatus. (Parallel type). [Note the connections and the air outlet tubes cf. Fig. I].

The first bore P_1 (vide Fig. VI), .4″ deep, made with a 1/2″ diameter auger at approximately 7 feet from the base was cleaned and fitted, with a rubber bung carrying two glass tubes X and Z. The tube X_1, was then connected to a capillary tube C_1, through a fine gauge rubber tubing (of the size of a bicycle valve tubing). This capillary C_1 was then connected to the main rubber tube Q by piercing it into the latter. Such a connection does not leak and should require no further attention. The other glass tube Z_1, on the bung was fitted to a short rubber tube the end of which was clipped on. By opening the clip the air in the boring P_1, was displaced by allowing the liquid to flow through X_1. When all the air was displaced the rubber tube on Z_1, was clipped on. The other borings P_2, P_3 P_4 and P_5 were similarly made and likewise connected to the main tube Q. The borings being connected in the order they were made and the air in the borings displaced as before by operating the clips Z_2, Z_3, Z_4 and Z_5 provided on the tubes. The lowest boring P_5 was made at 1 1/2 feet from the base of the palm, the others being more or less equidistant and arranged round the trunk. (Figure VI).

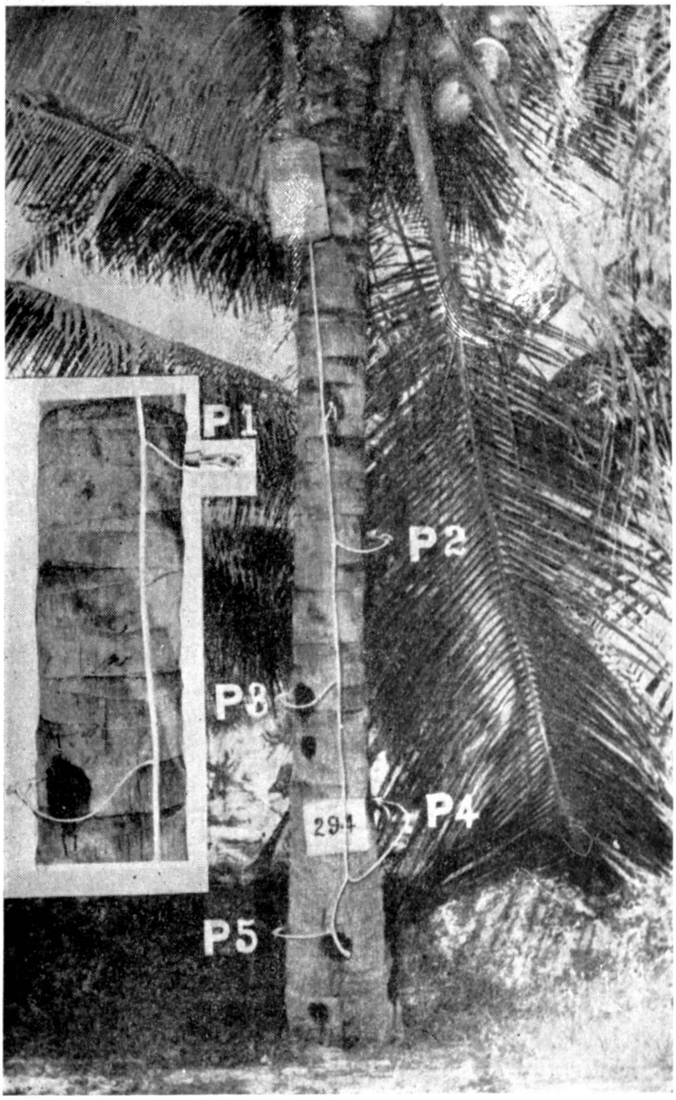

Fig. VI. Injection of the palm attacked by red-weevil, using the apparatus shown in Fig. V.

Observations and Results

On the 4th day after injection, as liquid was found to seep through the original wound at the base of the palm, (through which the weevil had possibly gained entrance and which had previously been sealed) the flow of liquid through the lowest boring P_5 situated just above this wound was stopped after knotting the rubber tube connecting X_5 with the capillary C_5. Thereafter, the liquid was allowed to be taken in by the palm for a further period of two days and on the seventh day the 'gear' was removed and the holes sealed, with a mixture of quick drying paint and fine sand.

Owing to the poor condition of this palm it was later manured in the circle with a mixture of 2:3:2 of ammonium sulphate, muriate of potash, and saphos-phosphate, and watered for 10 minutes by means of a power pump. Thereafter because of the severe drought which prevailed the palm was occasionally watered (for nearly two months) till the rains set in. The other palm, where the liquid was injected through a single boring, was however not nursed in this manner.

The first palm treated with a solution of 55 ml. Malatox in 1 gallon water to which a small quantity of Dieldrex Extra was added showed no signs of red-weevil activity on the second day. The boring was sealed with cement and paint and the palm is now growing healthily, nearly 25 months since it had been treated.

The second palm treated with 9 oz. Dieldrex Extra and 165 ml. Malatox in 3 gallons of water showed no signs of living insects on the sixth day. The palm improved considerably thereafter. At the time of writing 22 months after the treatment the palm appears quite healthy and is carrying a good crop.

Fig. VII. The palm shown in Fig. VII 15 months after treatment. [Note the newly opened inflorescences].

Discussion

As regards the effects on the palm of injecting liquids it was found that whereas palms treated with 0.25% Saffranin solution died, no ill-effects were noticed with any of the other solutions tried at the concentrations indicated earlier, *viz.* Magnesium sulphate potassium nitrate and Indolyl acetic acid. These observations naturally lead to the subject of toxicity of substances to plants. Such substances, organic or inorganic, may be toxic only above certain concentrations or due to slow accumulation within the tissues of the palnt. Whether certain solutions form insoluble derivatives with the plasma of the cells or bring about chemical changes which disturb the physico-chemical balance or act as inhibitors in the uptake of certain essential elements, should form a separate study, and is outside the scope of this paper.

From the results so far obtained it is apparent that the introduction of appropriate insecticides into palms by injection is particularly advantageous in controlling boring insects and intracellular pests. The success of the technique however, depends on the rate, transport and dispersion of the liquid within the tissue. In affected tissue the pest could be killed while in the surrounding portions the chemical could act as a prophylactic. Again the advantage of injecting an insecticide through multiple borings is particularly evident on plants where the infection is advanced and spread over a large area. The reason being that a chemical is more efficiently distributed within the tissues when it is injected. through more than one boring than through a single one.

Though this present method of control for the Red-weevil needs further investigation using other insecticides at different concentrations, yet the present trials have shown that it has more advantages and is more efficient than the present practice of removing the affected tissue and the insects from inside the affected palms. This method may also prove useful in the control of the coconut scale (*Aspidiotus destructor*). The possibility of feeding plants with antibiotics* to prevent their infection by fungi and bacteria, is another interesting speculation. For instance Streptomycin was first used against plant diseases soon after the discovery of its beneficial effect in human medicine. The absorption and translocation of this antibiotic by the aerial portion of a plant in an amount sufficient to retard or inhibit a bacterial disease was first reported by Mitchell, Zammeyer and Anderson (1952).

It is hoped that this improved technique of liquid injection would be of use to persons conducting field trials against pests and fungus diseases of economic importance.

Summary

1. The relative merits of the techniques of injecting a liquid into trees have been assessed. Earlier workers have found it inadvisable to inject solids. The drawbacks of the earlier methods of injecting liquids into trees have been outlined and the writer, to overcome these difficulties suggests an improved system, which is simple to operate though somewhat elaborate in arrangement. By using this gear it is now possible to—(*a*) inject a liquid into the trunk at a desired pressure, (*b*) prevent access of air into the conducting system and (*c*) effectively inject through a number of borings on a single tree (or trees growing close together) liquid from a central reservoir.

2. The gear adopted by the writer to inject a liquid through a palm through borings has been named the 'serial Type'. In the control of the red-weevil, however a somewhat modified version of the 'serial' type was adopted. This has been named the 'parallel type'. Here the liquid is delivered into the borings independent of one another, unlike in the 'serial type' where the liquid circulates through all the borings in succession. The adoption of the improved technique of delivering the insecticide either through the 'parallel' system as for red-weevil control or the

*An antibiotic may be defined as a chemical substance produced by micro-organisms, which has the capacity to inhibit the growth or even destroy fungi and bacteria; such as penicillin; streptomycin; aureomycin and terramycin. Their use in agriculture is being worked out in different countries and encouraging results reported.

'serial' system already described for Saffranin dye injection is therefore suggested as a more effective means of controlling boring insects. The parallel system however, is claimed to have more advantages than the serial system for the following reasons:

(*a*) One or more borings could be connected or disconnected from the reservoir as required.

(*b*) In the 'serial' system a chance blocking of any of the tubes leading to a particular boring will prevent the flow of liquid into those below it. This will not happen in the case of the 'parallel' system.

Using this technique an insecticidal solution comprised of (1) a mixture of 9 oz. Dieldrex Extra and 165 ml. Malatox in 3 gallons of water, and (2) 55 ml. Malatox in 1 gallon of water with a small quantity of Dieldrex Extra, were separately injected into two coconut palms with success in a preliminary trial to control the red-weevil. In the case of the two palms tested no ill-effects of the chemical on the palms have been observed, for nearly 22 and 25 months respectively since treatment with the mixture of Malatox and Dieldrex Extra.

Acknowledgements

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