CONTROL OF *GANODERMA*-INFECTED PALM – DEVELOPMENT OF PRESSURE INJECTION AND FIELD APPLICATIONS

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The high basal stem rot (BSR) disease incidence in existing of oil palm stands calls for immediate short-term measures to control this disease. The use of fungicides together with a correct technique of application need to be investigated. *In vitro* studies reported that numerous fungicides were strongly inhibitory towards the *Ganoderma* growth. Attempts to control this disease in the field with fungicides have been made by various workers, but the results are inconclusive, though some systemic fungicides seem to be promising. The methods of fungicide application include soil drenching, trunk injection, or combination of these two methods. Failure to deliver fungicides to the advancing disease margin and within disease lesion, is one of the reasons for ineffective chemical control of BSR in oil palm. To overcome this problem, a pressure injection apparatus (PIA) was developed for pressure-injecting fungicides treatments quickly and efficiently.

DEVELOPMENT OF PRESSURE INJECTION APPARATUS

The PIA consists of injector, hose, stop cork, connector, pressure pump engine and chemical tank. To get treatment into the palm, injection hole was drilled using engine drill with a drill bit (size 40 cm length and 1.1 cm diameter), at a slight downward angle into the palm trunk. The stainless steel injector (size 50 cm length and 1.2 cm diameter) was inserted into the drilled hole, and the supply high pressure hose was connected by the injector to the stop cork and the chemical tank. The performance of PIA was studied by injecting different volumes of 0.1% eosin dye solution on healthy oil palm stem tissues. Four palms were used for each volume. The time taken for the solution to be taken in was recorded. Immediately after injection, the palm was felled and distribution of the dye solution was measured. The diameters of X1, X2 and Y1 depicting the extent of the movement horizontally, sideways and vertically were taken (*Table 1*). Working at a pressure of approximately 15 kg cm^{-2} (= 200 p.s.i.), 5 litres of dye solution could be injected into the palm less than 3 min. Cross and longitudinal sections cut from the point of injection showed that 5 litres of dye solution could moved about 40 cm up and down and sideways. The application of PIA and distribution of dye solution in healthy stem tissues is shown in *Figure 1* (a, b and c), and in diseased stem tissues is shown in *Figure 2* (a, b and c).

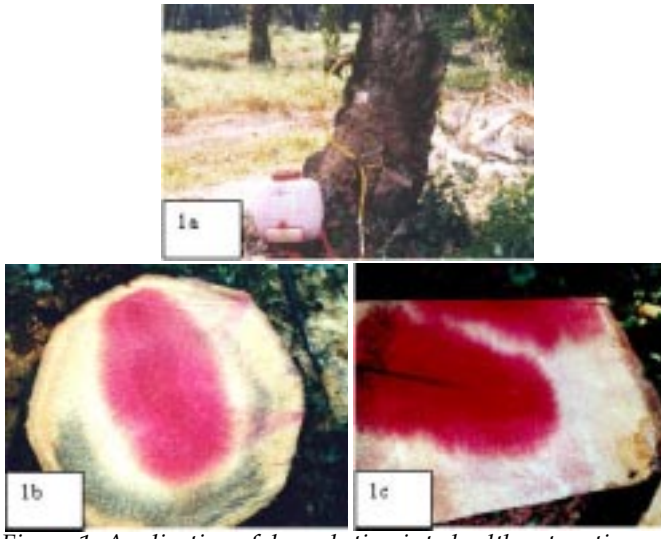

Figure 1. Application of dye solution into healthy stem tissues using (a) PIA; (b) distribution of dye solution, cross section and (c) longitudinal section.

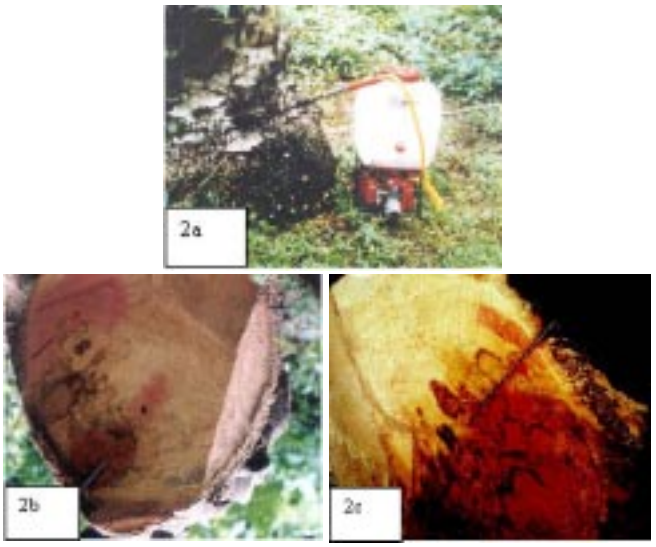

Figure 2. Application of dye solution into diseased stem tissues using (a) PIA; (b) distribution of dye solution, cross section and (c) longitudinal section.

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TABLE 1. PERFORMANCE OF PIA UNDER DIFFERENT VOLUMES OF DYE SOLUTION IN THE HEALTHY STEM OF OIL PALMS

Volumes of dye solution (ml)	Distribution of dye solution (cm) @			Injection period (s) @
	Cross section		Longitudinal section	
	X1	X2	Y1	
100	12.4	8.0	8.4	20
250	9.3	8.4	8.6	31
500	21.2	19.1	9.8	76
1 000	25.0	20.0	21.3	88
2 000	28.2	25.5	26.3	121
5 000	40.5	40.0	40.6	178

Note: @average from four palms.

FIELD EVALUATION OF FUNGICIDES WITH PIA

The first field trial on the use of PIA for application of fungicides to control *Ganoderma*-infected palms was carried out at Teluk Merbau Estate, Sepang. Seven treatments were evaluated, they are benomy&thiram (60 g palm^{-1}), bromoconazole (50 ml), hexaconazole (90 ml), triadimefon (40 g), triadimenol (40 ml), tridemorph (20 ml), and untreated as a control. All fungicides were dissolved in 10 litres of water and the solution was pressure injected into three points (4 litres in diseased stem and 3 litres each in two points in healthy stem) at the palm trunk using PIA. The treatment was applied to 22-year-old palms. The palms were selected based on the presence of *Ganoderma* basidiomata and rotted stem tissues at the base, and palms still producing fruit bunches. The design was a completely randomized design with 30 replications of single palm plot. The effects of the treatments were assessed at three-months interval by checking for palm mortality and the presence of fruit bunches. The results showed that bromoconazole and hexaconazole, both triazole groups, were effective in delaying the death of infected palms in comparison with four other fungicides and untreated control. It might be possible to reduce the yield loss due to *Ganoderma* to a certain degree. The benomy&thiram, triadimefon, triadimenol and tridemorph were relatively ineffective to slow down *Ganoderma* spread in infected palms. The pattern of palm survival at three-months interval suggests that the fungicide application should be repeated every six months.

The second trial was carried out to determine the effects of different methods of fungicide application to control *Ganoderma*-infected palms. This trial was conducted on 18-year-old palms using hexaconazole (90 ml palm^{-1}, 10 g a.i.). Five treatments were evaluated: T1-trunk injection of fungicide with PIA, where three holes were drilled using engine drill with a drill bit 40 cm length and 1.1 cm diameter, then 90 ml of fungicide was dissolved in 10 litres of water and the solution was pressure injected into these holes using PIA; T2-trunk injection of fungicide without PIA, where three holes were drilled using engine drill with a drill bit 48 cm length and 1.9 cm diameter, and the fungicide was introduced slowly into these holes at 30 ml hole^{-1} (90 ml palm^{-1}) using a syringe; T3-fungicide with soil drenching, where 90 ml of fungicide was dissolved in 10 litres of water using a watering can, then applied within a radius of 0.3 m from the trunk; T4-untreated as a check control, where three holes were drilled, then 10 litres of water was pressure injected into these holes (approximately 3.3 litres hole^{-1}) using PIA; and T5-untreated as a control treatment. The treatments were repeated at approximately six-months interval. The experimental design and the methods of assessments used in this study were as described above. Differences were markedly observed at 24 and 36 months after treatment. At 24 and 36 months, palms treated with fungicide using PIA showed significantly lower mortality rate and higher number of palms producing fruit bunches when compared to other treatments.

CONCLUSION

A pressure injection apparatus capable of delivering the chemical to the target sites for controlling BSR has been developed at MPOB. Studies have demonstrated that the application of fungicides with PIA appeared to limit the spread of *Ganoderma* infection within the infected standing palms. With development of this apparatus, control through the use of fungicides should not be limited to treating oil palms with confirmed cases of *Ganoderma* only but also to neighbouring oil palms which are in potential danger or might have already been infected at sub-clinical level. The use of fungicides to treat young oil palms not showing obvious signs of infection but in an area with serious history of *Ganoderma* also needs to be evaluated as a preventive measure.

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