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ABSTRACT *Ganoderma boninense* is a basidiomycetes fungus that causes basal stem rot disease in oil palm trees. In Malaysia alone, the loss caused by this disease was estimated between RM 225 Million to RM 1.5 Billion in 2011 by Malaysian Palm Oil Board. Unfortunately, many planters do not realize that their fields were infected with BSR until it is too late. Several methods have been proposed for early detection of *Ganoderma boninense* infection. In this paper, Fourier transform infrared spectroscopy is investigated as a tool to detect the presence of *Ganoderma boninense* in oil palm tree.....(Ariel Narrow, 11pt, Justify, Single Spacing).

KEYWORDS: Watercress; Gluconasturtiin; PEITC; Myrosinase activity; ... (Please provide 5 suitable keywords)

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INTRODUCTION (headings should be written in UPPER-CASE and bold)

Oil palm (*Elaeis guineensis* Jacq.) has been known as a truly "golden crop of Malaysia" since it generated profitable export earnings for the country and truly nature's gifts for alleviating poverty in Malaysia (Basiron - family name, 2007 - for single author; Alexander & Chong, 2013 - for 2 authors; Yunus & Radhakhrisnan, 2004). However, the oil palm industry is being jeopardized with one major disease known as Basal Stem Rot (BSR) which is mainly caused by *Ganoderma boninense* (MPOB, 2012). This disease causes serious threat to the oil palm industry in the Southeast Asian countries, especially Malaysia and Indonesia (Joy et al., 2001 - use et al. for more than 2 authors), as which are of the major producers and exporters of palm oil in the world. Linares (2011) on the other hand found that ... However, according to Corley and Tinker (2003) infection of this disease can cause numerous yield losses and ultimately result in the destruction of basal tissues hence death of disease palms.....(please provide single spacing between paragraph)

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Glucosinolates (GLS) are sulphur-containing secondary metabolites found largely in cruciferous vegetables. Certain GLS are precursor to health-promoting isothiocyanates (ITCs). Watercress (*Nasturtium officinale*) contains phenyl ethyl GLS (PEGLS) or its common name, gluconasturtiin (Williams et al., 2009). The hydrolysis product of PEGLS, i.e. phenyl ethyl ITC (PEITC), is proven to

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restrain the growth of cancer cells (Gill et al., 2007). Gupta et al. (2014) have published a comprehensive review on the anti-cancer effects of PEITC. However, the formation of PEITC is easily affected by various factors such as temperature, pH and presence of additives (Eylen et al., 2008). PEGLS is hydrolyzed into PEITC by the naturally-occurring enzyme myrosinase in plant. This aspect needs to be investigated further because food preparation commonly involved cutting, heating and addition of other additives which may affect the PEITC formation. Currently, there are still scarce reports on the dynamic of hydrolysis of PEGLS in watercress under various external factors. Thus, this paper described the effects of temperature and pH on myrosinase activity and PEGLS hydrolysis products in watercress.

BACKGROUND THEORY

The Beer-Lambert Law for Transmittance and Absorbance (First Level of Subheading With Capitalized Each Main Words)

Protocorm proliferation and regeneration were investigated on KC medium (Knudson, 1946) supplemented with 2% (w/v) sucrose, and treated with organic additives or plant growth regulators. Four types of organic additives tested are coconut water, tomato juice (10%, 15% and 20% v/v), banana pulp (25, 75 and 125 g/L) and peptone (2 g/L). Plant growth regulators tested in this study are Naphthalene acetic acid (NAA), Zeatin and 6-Benzylaminopurine (BAP) at concentrations of 2, 4, 6 μM , respectively. Basal medium devoid of any organic additive or plant growth regulator served as control (Takahashi, 2016). The medium pH was adjusted to 5.3 ± 0.02 and solidified with 0.8% (w/v) agar (Sigma) prior to autoclaving for 20 min at 15 psi, 121°C . The cultures were maintained at $24 \pm 2^\circ\text{C}$ under a 24 h d^{-1} photoperiod with a PPF of $20\text{--}50 \mu\text{mol m}^{-2}\text{s}^{-1}$ provided by cool white fluorescent tubes (Philips, Malaysia).

Eq. (1) is an example how equation is written given as:

$$A_{\lambda} = \log(I/R_{\lambda}) = c\epsilon_{\lambda}I \quad (1)$$

where A_{λ} is absorption, R_{λ} is reflection, c is the concentration of the ingredient, ϵ_{λ} is extinction coefficient of the ingredient for wavelength λ , and I is the pathlength of the light through the sample.

METHODOLOGY

Sample Collection (First Level of Subheading With Capitalized Each Main Words)

Healthy and infected tissues samples were collected from oil palm plantation in Sandakan, Sabah, Malaysia. Collection of trunk tissues was carried out following the method described by (Chong, 2012). Details of the sample collection are as follow.

i. Collection locality for the samples (Maximum second-level subheading, in sentence-case and Roman numeral in lower case)

Maximum second-level subheading is allowed, in sentence-case and numbered in small Roman Numerals.

ii. Samples preparation (Maximum second-level subheading, in sentence-case and Roman numeral in lower case)

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Preparation of Buffered Water and Bligh-Dyer (First Level of Subheading With Capitalized Each Main Words)

300 ml of double distilled water was transferred into a separating funnel and 2.04 g potassium dihydrogen phosphate (KH_2PO_4) was added to create a 0.05 M solution. The pH was adjusted to pH 7.2 by addition of sodium hydroxide (NaOH) pellets and the mixture was extracted with 3 x 50 ml dichloromethane (DCM). The Bligh-Dyer solvent mixture was made up using buffered water: chloroform: methanol with ratio 4:5:10, respectively.

RESULT AND DISCUSSION

In this result, the presence of *Ganoderma* in the infected tissue was detected with the similar peak absorbance in region..... as shown in Fig. 1. Table 1 specify the wavelength of the functional group ...

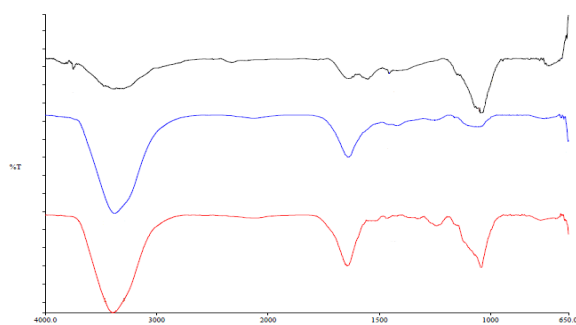


Fig. 1. FTIR spectra of *Ganoderma boninense*, healthy oil palm trunk tissues and infected oil palm trunk tissues (Alexander & Chong, 2013). (Palatino Linotype, 11pt, centred, single spacing. If the caption is more than one line, please make it justify)

Table 1. Functional Group of *G. boninense* mycelia and healthy oil palm trunk tissues. (Palatino Linotype, 11pt, centred, single spacing. If the caption is more than one line, please make it justify)

Wavelength (cm ⁻¹)	Functional group	
	<i>Ganoderma boninense</i>	Healthy trunk tissue
3500-3200		O-H (phenol)
3400-3200	N-H (amine)	
1650-1600	C=O (amide)	C=O (amide)
1580-1500	C=N (imine)	
1470-1450	C-H (alkane)	
1400-1390		C-O(carboxylic acid)
1250-1000	C-O-C (ether)	
1100-1000		Si-O (silicone)

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CONCLUSION

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ACKNOWLEDGEMENTS

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REFERENCES (Arrange the reference list in alphabetical order with numbering, in Palatino Linotype, 11pt.)

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