



Significant Colonization of Inoculated Endophytic Fungus, *Hendersonia toruloidea* GanoEF1 within Oil Palm Root at PASFA Bukit Kerisek (Pahang) Using GanoEF biofertilizer

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Abstract

The roots of oil palm (*Elaeis guineensis* Jacq.) previously treated with GanoEF biofertilizer product (500g/planting hole) were sampled from oil palm plantation at PASFA's Bukit Kerisek (Pahang, Peninsular Malaysia). These root samples were identified for the colonization of inoculated endophytic fungus, *Hendersonia toruloidea* GanoEF1 within the oil palm roots. Results showed that *Hendersonia* GanoEF1 colonization in primary and feeder roots were 19.3-21.6%, and 37.5-42.5%, respectively. Therefore, the use of Gano EF biofertilizer was proven successfully colonized in both primary and feeder roots of oil palm. This positive outcome clearly indicated the infection of *Ganoderma* fungus, the causal pathogen of basal stem rot disease can be controlled in oil palm plantation.

Keywords: Basal Stem Rot; *Hendersonia*; Oil Palm

Introduction

The oil palm in Malaysia, the commercial crop oil palm (*Elaeis guineensis* Jacq.) has been challenged with *Ganoderma* fungus, the causal pathogen of basal stem rot (BSR). This has been a serious pathogenic threat to the production of oil palm,

which consequently results in unyielding economic losses [1]. In 2016-2017, the incidence of BSR in Malaysia was 7.4%, with 221 000 ha of affected areas [2]. Therefore, a biological way to control the pathogenic disease is much needed to sustain the oil palm industry in Malaysia.

Environmental problems caused by chemical fertilizers in the oil palm plantation have accelerated research on management methods in line with environmentally friendly fertilizers, such as the use of biofertilizers [3, 4]. Thus, the development of GanoEF biofertilizer containing endophytic fungus, *Hendersonia toruloidea* GanoEF1 incorporated into inorganic and organic fertilizers was successfully produced in collaboration between Malaysian Palm Oil Board (MPOB) and All Cosmos Industries Sdn. Bhd., Pasir Gudang, Johor [5]. The endophytic fungus, *H. toruloidea* GanoEF1 has been found to be strongly antagonistic against *Ganoderma boninense* in various laboratory and nursery studies [6-9]. The benefits of GanoEF biofertilizer including: 1) effectively controlling *Ganoderma* disease, 2) environmental-friendly, 3) easy storage, and 4), easy application in the nursery and field conditions [5].

From scientific research point of view, the use of a proposed product should be tested for their efficacy in order to prove

their effectiveness in the field. Since the evidence of using the GanoEF product in the roots of oil palm at The Pahang Farmers' Organisation (PASFA) Bukit Kerisek, Pahang, Malaysia is lacking in the literature, therefore, the objective of this study was to identify the colonization of inoculated *H. toruloidea* GanoEF1 using the above GanoEF product within the root of oil palm sampled from oil palm plantation at Bukit Kerisek, Pahang, Peninsular Malaysia.

Materials and Methods

Root sample from a treated palm was obtained from oil palm plantation at PASFA's Bukit Kerisek, Pahang, and Peninsular Malaysia. The oil palm chosen in the present study was previously treated with GanoEF biofertilizer product (500g/planting hole). The sampling of the oil palm roots was conducted on the 8th August 2016. The sampling was conducted 8 months after the application of the GanoEF biofertilizer product.

The entire root system was washed with tap water to remove the adhering soil and divided into two parts (Sample 1, Sample 2). The roots were subsequently surface sterilized with chlorox (20% v/v) and ethanol (70% v/v) before washing with sterile water. The surface sterilized roots were then divided

into primary and feeder root sections. A total of 60 primary root sections and 40 feeder root sections from both palms were placed on selective agar media (Rose Bengal Chloramphenicol Agar) and incubated at 28°C for 1 – 2 weeks for *H. toruloidea* GanoEF1 determination. The percentage colonization of *H. toruloidea* GanoEF1 was calculated by using the following equation (adapted from Campbell and Madden, 1990) [10]:

$$\text{Root colonization percentage per sample} = \frac{\text{(No. of root sections with target fungus)}}{\text{(Total No. of sections)}}$$

Results and discussion

Percentages of root colonization of *Hendersonia* GanoEF1 per sample are shown in (Table 1). Sample 1 showed 19.30% of *H. toruloidea* colonization in the primary roots and 42.50% colonization in the feeder roots. Root sections from Sample 2 showed 21.60% colonization in the primary roots and 37.50% colonization in the feeder roots. The present results are also well supported by Munthe and Dahang (2018) [11] who reported 24-28% of root colonization of *H. toruloidea* GanoEF1, based on the roots of oil palm collected in 2017 from two locations in Riau Province, Indonesia.

Table 1: Percentages of oil palm root colonization of *Hendersonia toruloidea* GanoEF1.

Sample	No. of root sections	No. of root sections colonized by <i>Hendersonia toruloidea</i>	<i>Hendersonia</i> root colonization (%)
1 (Primary root)	60	11	19.3
1 (Feeder root)	40	17	42.5
2 (Primary root)	60	13	21.6
2 (Feeder root)	40	15	37.5

The presence of endophytic fungus, *H. toruloidea* GanoEF1 in both primary and feeder roots of oil palm has proven that this fungus was successfully colonized (Figure 1). Colonization will be increased proportionately with time (subject to favourable condition) and positively will control the infection of *Ganoderma* disease in oil palm plantation. However, it is highly recommended to apply GanoEF biofertilizer (2kg/palm) for another three subsequent years to enhance more colonization of *Hendersonia* sp. This is an important management strategy to reduce and protect the oil palm from being infected by BSR disease.

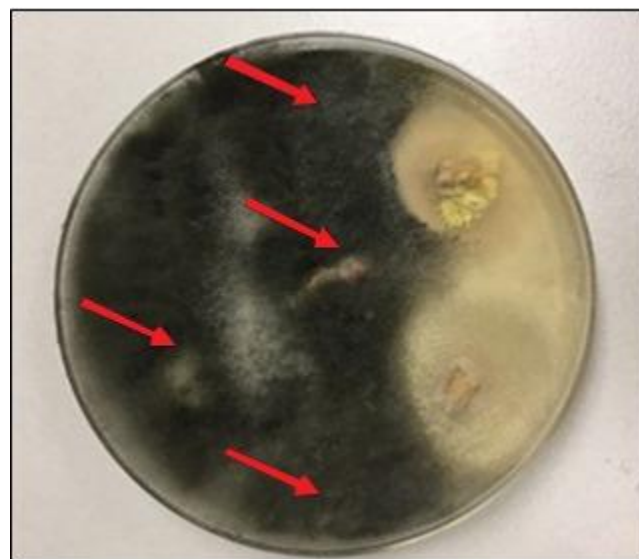


Figure 1: *Hendersonia toruloidea* GanoEF1 on PDA plate after seven days of incubation (red arrows).

Several studies have been reported to the *H. toruloidea* GanoEF can reduce the *Ganoderma* infection in the oil palm plantations. Earlier, Idris et al. (2012) [5] used the biofertilizer GanoEF contained *H. toruloidea* GanoEF and it can significantly reduce the *Ganoderma* incidence up to 69.5%. Based on screening using liquid culture and dual culture bioassays, Ramli et al. (2018) [7] reported that *Hendersonia* sp. isolate GanoEF1 had been proven effective in the control of *G. boninense* growths in both bioassays. It was concluded that *H. toruloidea* isolate GanoEF1 has played a significant role as in controlling BSR disease of oil palm. Kamarudin et al. (2017) [12] reported the enrichment of thiamine biosynthesis by colonization of *H. toruloidea* in oil palm roots. Undoubtedly, GanoEF biofertilizer is one of biotechnological fertilizers product as well as biofungicides, a combination of endophytic fungus, *Hendersonia* GanoEF1 that are advantageous in terms of promoting soil fertility and prevention of *Ganoderma* incidence in oil palm plantation [5].

Conclusions

In conclusion, the present study exhibited that *H. toruloidea* colonization in primary and feeder roots were 19.3-21.6%, and 37.5-42.5%, respectively. Therefore, the use of GanoEF biofertilizer product (500g/planting hole) has proved that the respective fungus was successfully colonized in both primary and feeder roots of oil palm. This positive outcome clearly indicates the infection of BSR disease can be controlled in oil palm plantation. Successful colonization by *H. toruloidea* GanoEF1 into oil palm root will reduce the *Ganoderma* infection. Besides, regular survey and monitoring of BSR incidence are highly recommended at the oil palm plantation so that the *Ganoderma* disease can be controlled effectively by using GanoEF biofertilizer.

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Competing Interests: The authors have declared that no competing interests exist.

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