Issues of *Ganoderma* spp. and Basal Stem Rot Disease Management in Oil Palm

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Citation

Abstract
The genus *Ganoderma*, in generally the ancient fungus in the fungus world. The genus of the fungus have long been noticed as economically important fungus either as helpful for medicinal purpose use or harmful as pathogen of some economical crop plant such as rubber, coconut or oil palm plant. In both three plants it is caused the disease called basal stem rot, since the causal pathogen appear its fruiting body on the basal portion of the plant. Mainly three species of *Ganoderma*, namely *G. boninense*, *G. zoanatum*, *G. miniatocinctum* are caused the BSR disease. Literature suggested *Ganoderma boninense* is the most devastator species to cause grate economical effect on palm oil industry. This review paper are highlighted the current feature of *Ganoderma* spp. and its controlling approach for basal stem rot disease in oil palm (*Elaeis guineensis* Jacq.).

1. Introduction

Oil palm (*Elaeis guineensis*) is an important and versatile economic crop which used as for food industry as well as non food industry. The monocotyledons crop oil palm is a member of the Palmae family and the Cocoidae subfamily. There are three species of *Elaeis*: *E. guineensis* (from Africa), *E. olifera* (from South America), and *E. odora* (from South America). The African oil palm was named by Jacquin (1763) [1]. The genus name *Elaeis* originated from the Greek word “elaiion”, which means oil, and the specific name *guineensis* indicates it origin at the Guinea Coast ) [2].

The oil palm is a perennial tree crop. It produces a single trunk that bears a crown of fronds [1]. Leaf bases are persistent for years; the prominent leaf scars arranged on the trunk are where bases have fallen. Both female and male flowers grow on the same tree and the pollination is performed by various insects such as weevils, *Mystrops costaricensis* [3]. The oil palm fruit is a drupe which consist with three layers namely the exocarp or called as skin; mesocarp or outer pulp containing palm oil; and endocarp which is a hard shell enclosing the kernel or endosperm, which contains oil known as kernel oil.

The most popular edible palm oil comes from *E. guineensis*. *Dura*, *Tenera*, and *Pisifera* are the common cultivars of *E. guineensis*, and they can be differentiated based on shell thickness (endocarp) and mesocarp content. *Pisifera* palms have no endocarp,
whereas the endocarp of Dura and Tenera palms is around 2–8 mm and 0.5–3 mm thick, respectively. The mesocarp content in Dura, Tenera, and Pisifera is around 35–55%, 60–95%, and 95%, respectively [4,5]. The Tenera cultivar was produced by crossing with Dura and Pisifera (D X P) for the following reasons: Females Pisifera usually are sterile which means they cannot be used for commercial planting, but they have high mesocarp content; crossing with Dura to produce Tenera yielded a cultivar with the desired properties. The most important for oil palm is to produce the edible oil of palm oil. Around the world vegetable oil production is 144 million tonnes per year whereas 47 million tonnes cover by oil palm. Thus, oil palm is the second largest edible oil production source after soybean. Along with oil palm production, oil palm and palm kernel oil is also used for biodiesel production. In addition, oil palm biomass also can be used to make paper. At present, researchers are investigating the feasibility of producing biodiesel from oil palms as a replacement for diesel fuel [6].

Basidiomycetes refer as ‘white rot’ fungi that degrade lignin from 34 genera of plants have been identified as potential hosts [9] such as Areca catechu (betelnut palm), Cocos nucifera (coconut), Elaeis guineensis (African oil palm) palms. Coconut and oil palm which are the main hosts to cause basal stem rot disease by Ganoderma spp. [10]. In various study reported that at list fifteen species of Ganoderma are as being associated with BSR, for example, G. applanatum, G. boninense, G. chalceum, G. cochlear, G. fornicatum, G. lucidum, G. miniatocinctum, G. pseudoferreum etc [11].

4. BSR Disease on Oil Palm

The most and grate problem for basal stem rot disease that it’s cannot detect the early disease symptoms. The earliest external disease detect of oil palm such as the young palms partially trans yellowing or motting of the basal fronds to form necrosis, however, at this time internally more than 50% area of stem base has been destroyed. The histopathological study showed that the roots of parenchyma cells inside the endodermis layer become fragmented to the formation of cavity to colonized the fungus in cortex, endodermis, pericycle, xylem, phloem and pith of the palm [12]. The infected roots by Ganoderma become friable, dry and powdery. Ganoderma infection caused dry rotting of root bole and the stem base, thus, due to this infection oil palm eventually fracture and collapse which leave to disease spread from bole tissue in the ground. The basidiomata of Ganoderma can develop from the area of stem base or leaf base or produced from infected root. The formation of basidiomata reflects the position of infection area within the stem. The disease signs in mature leaves showed unopened spear leaves and pale yellow towards form necrosis to die and upwards this feature through the crown. By the time progress the affected palms may die, the affected young palms normally die within 6-12 months, but 1-2 years take for mature palms to die. The basidiomata at the beginning stage appear as small white buttons which develop rapidly in the form of bracket-shaped can be light to dark brown with shiny polish [13]. Once plant dies, colonization of basidiomata can develop rapidly along of the entire trunk. In young palm decayed of the soft tissues of the stem occurs rapidly compared to mature palm.

5. BSR Control Methods

Currently, there is no perfect methods are available to control this disease completely. Though the control of BSR disease did not give complete result yet but some methods are consider good for BSR control practices as found in several studies [14,15].

6. Mounding of Soil

The soil mounding technique has taken attention that this technique is cost effective to prevent BSR in oil palm. Mounding of soil builds near the adjacent area of oil palm collect to make slop around 75 cm height and 1m radius wide
form the base land [16]. Eventhough, this method cannot control the disease in economic level but the technique can extent the yielding life of oil palm which already affected by BSR. The study form Ho and Khairuddin from reported that the soil mounding which chemical fumigation or soil mounding alone prolonged the productivity of palms and also protect the weakened boles [17]. Both in Malaysia and Indonesia or other BSR affected country have been implemented this technique to take the benefit for palm oil production [16].

7. Trenches

Digging trenches around infected palms to prevent mycelium spread by root contact with neighboring healthy palms has been recommended as a control measure [18,19]. Usually, the area of trenches is 2m X 2m followed by 0.5 m is wide and 1 m is length but in case of young mature palm the area of trenches up to 4m X 4 m followed by 30 cm is wide and 75 cm is deep [20]. In trenches system regular monitoring on desilted or cleaning of dropping soil and materials is very important.

8. Fungicides Treatment

Fungicide treatment by chemical method is another approach to control BSR in oil palms. Fungicides are mainly used to protect seeds from infection and to control BSR. Screening of fungicides against Ganoderma in vitro showed that numerous fungicides strongly inhibited Ganoderma growth. The effects of the following fungicides on Ganoderma growth have been tested: drazoxolone and cycloheximide [23]; triadimefon, triadimenol, methfuroxam, carbonix, carbendazim, benomyl, biloxazol, and cycloheximide [24]; hexaconazole, cyproconazole, and triadimenol [25]; and penconazole, tridemorph, and triadimenol [26]. The trunk injection technique using a pressure injector to apply systemic fungicide (e.g. bromoconazol) appeared to limit the spread of Ganoderma infection [27]. A significant reduction in BSR incidence was found when the oil palm trunk was injected with a combination of the fungicides carbonix and quintozone fungicides [27, 28]. While, Tey and Mohd Abdly [29] found no differentiations between untreated and treated palms with hexaconazole until one and half years of the experiment. However, chemical control can only delay the spread of the disease; it cannot cure the infected plant. Moreover, chemical control agents are not good for the environment since they also inhibit the growth of good microbes. Nowadays, growing concerns about the environment and the high cost of chemicals have encouraged farmers and researchers to look for alternative means to control BSR, such as the use of biological control agents and pathogens-resistant cultivars.

9. Biological Control

Biological control represents a major alternative to the use of pesticides for the management of plant diseases. Several meaningful antagonists, especially species of Trichoderma, Aspergillus, and Penicillium showed the antagonistic against Ganoderma boninense related to pathogenic in oil palm and coconut plants [30, 31]. In the study of Dharmaputra et al., [32], some fungal isolated of Penicillium sp 2, Trichoderma sp 2, Trichoderma sp. 3 all were isolated form Adolina, Gunung Bayu, and Tinjowan, North Sumatra showed promising isolate in invitro against G. boninense. The bacterial agent also help to control Ganoderma boninense, for example, endophytic bacterial agent Bacillus sp; Pseudomonas aeruginosa strain EB6 showed as potential for biocontrol agent against G. boninense [33]. The species Trichoderma have shown the grate effect to controlling Ganoderma boninense. In several study found that several species of Trichoderma such as T. harzianum, T. viren, T. hamatum or strains have shown the antagonistic activity with G. boninense, while T. harzianum and T. viren were the most effective agent against G. boninense [34,35]. Trichoderma is the species that save the plant from the pathogen in two ways. In first way Trichoderma acts as mycoparasitism process like towards the growth on the pathogen and colling around to kill the pathogen. In 2nd way Trichoderma elicitors help to induced plant defence response like glucanase or chitinase to suppress G. boninense invasion in oil palm [36]. Thus, the role of Trichoderma species as biocontrol agents have took grate attention for sustainable crop protection.

10. Conclusion

Ganoderma basal stem rot disease is a soil borne disease. The disease caused major loss in palm oil industry. Though the disease progress slowly but 80% plant can be died due to this disease. Several techniques have been used to control this disease but none of them given satisfactory results. Thus the issue of Ganoderma and its disease control still remain unsolved. Nevertheless, the approaches manage of controlling the disease which subsequently reduced the disease disaster.

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References


