

THE IDENTITY OF *Ganoderma* SPECIES RESPONSIBLE FOR BSR DISEASE OF OIL PALM IN MALAYSIA - PATHOGENICITY TEST

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Basal stem rot (BSR), caused by species of *Ganoderma*, is the most serious disease of oil palm in Malaysia and Indonesia. The pathogen was originally identified as *G. lucidum* Karts in West Africa (Wakefield, 1920) and also in Malaysia (Thompson, 1931). In Nigeria, four species of *Ganoderma* have been identified as causal agents, namely *G. zonatum* Murril, *G. encidum*, *G. colossus* and *G. applanatum* (Pers. ex. S. F. Gray) (NIFOR 1978). Turner (1981) has listed fifteen species of *Ganoderma* which have been recorded as likely pathogens from different parts of the world to be associated with BSR disease, and he considered that a single species was unlikely to be the sole cause of the disease in any particular area. Ho and Nawawi (1985) concluded that all *Ganoderma* isolates from diseased oil palm from various locations in Peninsular Malaysia were all the same species, *G. boninense*. Ariffin *et al.* (1989c) suggested that other species may be involved and Khairudin (1990) concluded that two species were present, namely *G. boninense* and *G. tornatum*. More recently, Idris (1999) has identified four species of *Ganoderma* to be associated in oil palm in Malaysia, they are *G. boninense*, *G. zonatum*, *G. miniatocinctum* and *G. tornatum*. However, it is not known if these are pathogenic. Therefore, it was important to determine the pathogenicity and to compare the aggressiveness of isolate of *Ganoderma* in oil palm.

PATHOGENICITY TEST

The pathogenicity of 328 isolates of *Ganoderma* obtained from different hosts in Malaysia and 16 isolates obtained from other research institute were compared using an adaptation of the root inoculation technique with ten months old DxP oil palm seedlings (Figure 1). A small incision was made at the side of the polypropylene bag containing the seedlings, revealing a part of the root system. One of the primary roots exposed was then pulled through the opening, washed with water to remove the soil, the distal end excised and placed into a test tube containing



Figure 1. Root inoculation technique on oil palm seedling.

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Ganoderma inoculum grown on POPW medium (mixture of paddy, oil palm wood sawdust and supplemented with sucrose, ammonium sulphate, calcium sulphate and bacto peptone). Approximately 3cm of the root length was inserted into the medium, and the tube then sealed with parafilm and the whole covered with brown paper to maintain darkness.

External symptoms, including the appearance of basidiomata (Figure 2) and foliar discoloration (Figure 3) were recorded after 1, 3, 6, 9 and 12 months. After 12 months, all seedlings were



Fig. 2A



Fig. 2A

Figure 2. Basidiomata of *Ganoderma* formed on inoculated root of oil palm seedling. Small white button (Fig. 2A), and Bracket-shape (Fig. 2B).



Fig. 3A



Fig. 3B



Fig. 3C



Fig. 3D

Figure 3. External (foliar) symptoms. Healthy leaves (Fig. 3A), and Leaves completely yellowing/ browning (Fig. 3B).

removed and examined for internal symptoms (Figure 4). Where internal rotting was obvious, samples were tested for the presence of *Ganoderma* by plating onto Ganoderma Selective Medium. The size of the rotted areas within the stem was estimated using a transparent grid



Figure 4. Internal (stem bulb tissues) symptoms. Slight decay of stem bulb, less than 30% of total stem bulb areas (Fig. 4A), and Severe decay of stem bulb, more than 30% of total stem bulb areas (Fig. 4B).

marked with one cm^2 (Figure 5) from this the percentage area of the colonised tissue estimated.

RESULTS AND DISCUSSION

Of a total of 344 isolates tested, 304 isolates were found to be pathogenic and 40 isolates were non-pathogenic. From oil palm (270 isolates in total), 251 isolates (249 from Malaysia and two from Indonesia) were pathogenic and 19 isolates (18 from Malaysia and one from the Solomon Islands) were non-pathogenic. From coconut (33 isolates in total), 30 isolates (29 from Malaysia and one from Indonesia) were pathogenic and



Figure 5. Measurements of stem bulb areas (total stem bulb, healthy stem bulb and decay stem bulb) with one cm^2 grid.

three isolates (one from India and two from PNG) were non-pathogenic. From other palm species (18 isolates in total), twelve isolates from *Areca catechu* (Malaysia), two isolates from *P. macathurii* (one from Malaysia and one from Singapore), one isolate from *R. regia* (Malaysia), one from *L. chinensis* (Malaysia), one from *O. tigillarum* (Malaysia) and one isolates from *O. horridum* (Singapore) were all pathogenic. Three isolates from rubber (Malaysia, identified as *G. philippii*) and four from cultivated *Ganoderma* (Malaysia, identified as *G. lucidum*) were non-pathogenic. From forest trees (16 isolates in total), only five isolates from Malaysia were pathogenic, and other four isolates (Malaysia, three isolates (two from UK and one from Poland, identified as *G. applanatum*), one from UK (identified as *G. pfeifferi*), one from USA (identified as *G. oregonense*) and two from UK (unidentified isolates) were found to be non pathogenic.

Of the 267 isolates from oil palm in Malaysia that were tested, 18 isolates caused no disease symptoms of any kind and were thus considered non pathogenic. These isolates were all identified as *G. tornatum*, which were found only on dead palms and presumed to be saprophytic. All of the remaining isolates, which were identified as *G. boninense*, *G. zonatum* and *G. miniatocinctum* were pathogenic, but the disease symptoms induced by isolates identified as *G. boninense* were significantly ($p < 0.001$) more severe than those caused by *G. zonatum* and *G. miniatocinctum*.

CONCLUSION

All isolates of *Ganoderma* identified as *G. boninense*, *G. zonatum* and *G. miniatocinctum* were pathogenic but the latter were significantly less aggressive than the former. Isolates of *G. tornatum*, which were found only on dead palms,

were non pathogenic and were presumed to be saprophytic. Isolates from 'cultivated *Ganoderma*' and hardwood species present in forest areas and temperate zones, including *G. applanatum*, *G. lucidum*, *G. oregonense*, *G. pfeifferi* and *G. philippii*, previously implicated in BSR, were not pathogenic to oil palm.

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