

A THREAT TO BIODIESEL PRODUCTION FROM PALM OIL BY DISEASE CAUSED BY THE FUNGUS *GANODERMA*

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ABSTRACT: *Oil palm (OP) is a major crop for the production of vegetable oil used in foods, cosmetics and increasingly biodiesel. There is an increasing awareness that crops are vulnerable to nefarious introduction of pathogenic microorganisms. Oil palms are prone to a rot by the fungus Ganoderma. White rot fungi are capable of degrading lignin. It is necessary to consider this mode of attack for effective control. Nevertheless, the existing literature is concerned with the (a) mode of spread and (b) molecular biology of Ganoderma. The high moisture content of coastal soil favour Ganoderma. High salinity and low soil pH appear to discourage the disease. The optimum current method of control is to rid fields of decayed OP. The optimal future approach may be to develop tolerant OP and altering lignin in OP may be possible. In conclusion, Ganoderma of OP is becoming increasingly virulent and control would benefit from consideration of the process as one of white rot.*

Keywords: *Elaeis guineensis Jacq.; White Rot Fungus; Lignin; Biodegradation; Palm Oil: Biodiesel.*

A doença causada pelo fungo *Ganoderma* como ameaça à produção de biodiesel do óleo de palma

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Resumo: *A palmeira é uma cultivar usada na produção de óleos alimentares vegetais, cosméticos e encontra-se em crescente aplicação na produção de biodiesel. Há aumento da consciência que as cultivares são vulneráveis à possível prática criminosa pela introdução intencional de microrganismos patogênicos nas lavouras. De um modo geral, as palmeiras são propensas à degradação quando atacada pelo fungo Ganoderma, conhecido como fungo da podridão branca, por degradar a lignina. É de grande importância considerar este tipo de podridão da palmeira quando atacada pelos microrganismos em questão, de modo a ser estabelecido um controle efetivo.*

No entanto, na literatura são encontrados trabalhos que ressaltam a importância: (a) de estar-se atento ao modo de proliferação desta praga e (b) de conhecer-se a biologia molecular do *Ganoderma*. A alta humidade presente no solo litorâneo favorece o surgimento do fungo *Ganoderma*. A alta salinidade e o baixo pH do solo surge como um ambiente desfavorável para a proliferação deste tipo de microrganismo. Atualmente, o melhor método de controle do *Ganoderma* é a extinção dos campos de palmeiras por ele contaminados. A melhor estratégia para o futuro estaria no desenvolvimento de palmeiras tolerantes ao ataque das referidas pragas, sendo uma possibilidade a alteração da lignina produzida nas palmeiras. Desta forma, conclui-se que o *Ganoderma* da palmeira está se tornando em um problema cada vez maior e o seu controle levaria à resolução de questões como a podridão branca.

Palavra-chave: *Elaeis guineensis* Jacq.; Fungo da podridão branca; Lignina; Biodegradação; Palmeira; Biodiesel.

INTRODUCTION.

A fat was discovered in an Egyptian tomb from 5,000 before present which was considered to be palm oil. In addition, at this period cultivation of oil palm is considered to have started. In Brazil the OP was introduced in XVI century by the sellers of African slaves. Of relevance to this conference, biodiesel is increasing in significance concomitant with technologies to convert palm oil to this fuel. Other scientists and companies are going beyond merely using the oil from oil palm trees, and are proposing to convert the entire biomass harvested from a palm plantation into renewable electricity, cellulosic ethanol, biogas, etc. There are few more interesting and difficult problems in plant pathology than tropical perennial diseases. Favorable conditions for disease and susceptible host tissue exposed over long periods make it a serious disease management problem. The most important disease of oil palm in SE Asia is basal stem rot caused by the fungus *Ganoderma*. There are few reports of the disease in Brazil, although the malady has been recorded in Honduras and Columbia.

OIL PALM

The palms form a distinct group of plants amongst monocotyledons. The genus *Elaeis* is derived from the Greek "elaion" meaning oil and the specific name *guineensis* is attributable to the assumed origin of Guinea.

GANODERMA DISEASE

The reports until World War II indicated that OP was free of serious disease. However, there have been serious or devastating outbreaks in various parts of the world as the area under the crop has expanded. The seriousness of the disease, in the case of *Ganoderma*, appears to have increased dramatically over a short period. The *Ganoderma* rots have been associated with old and replanted areas in Asia. There is scope to search for resistance to *Ganoderma* and producing high lignin OP is an obvious approach, when the white rot mode of attack is acknowledged fully. Breeding for resistance has indicated that the process has potential in controlling *Ganoderma* trunk rot or basal stem rot, especially when integrated with other approaches. Indeed, differences in incidence between (a) West African and Deli material, (b) families and (c) clones have been observed. The age at which palm become infected depends on (a) rate of colonisation of the tissue of previous stand, (b) proximity of colonised tissue to the oil palm, (c) time taken for roots to make contact with tissue and become infected, and (d) growth of the fungus along the root, and then establishment in bole tissue. In younger palms, the infection begins in the centre of the expanding stem and palms die quickly. In older, where the roots and bole are fully expanded, the outer roots are responsible for bringing in the infection and decay usually starts from the outside moving inwards. As stem and bole are fully hardened (*i.e.* lignified) disease progress is slow. Spread within a field is mainly through root contact in contradiction to the statement above that wounds may be required for entry above. The predisposing factors of the disease are nature of soil and water relations. Coastal soils are mainly clays, silty clays or clay loams. That is heavy soil with poor drainage and high water retention. Disease is more serious in fields adjacent to rivers with short periods of flooding. Management of the disease remains fairly conventional: Disease avoidance through sanitation is important (remove source of infection). Infected palms should be promptly felled, shredded and the bole and adjoining root tissue extracted by digging a pit. Shredded tissue should be allowed to rot. Routine inspection began 6 months after planting and continued up to an apparent 20% incidence rate. Early detection and surgery was abandoned.

However, with better detection (e.g. MALDI-TOF) this could represent an attractive option.

PALM DECAY

There is no information linking the OP *Ganoderma* directly with being a white rot fungus. For example, *G. boninense* has not been demonstrated to cause a typical white rot of OP - it simply has not been researched. Even the production of lignin degrading enzymes has not been demonstrated from the fungus. Nevertheless, *G. boninense* is stated as being "a white-rot basidiomycete" and is the main threat to OP production in South East Asia. Fundamental work of this nature requires to be undertaken for OP where *Ganoderma* is problematic. There is some limited information on rate of decay of OP, and the rates of decay of the enzymatically-digested OP.

WEAPONS

It is a sign of the times that the nefarious use of plant pathogens cannot be discounted simply as a science fiction fantasy. The use of pathogens to devastate crops is taken very seriously, for example, in the European Union. The concept is to introduce pathogens into crops with potentially devastating effects on the health and wellbeing of the population and the economies of nations. There is no reason to consider oil palm to be immune for such threats and vigilance is required.

CONCLUSIONS

The role of *Ganoderma* on OP as a white rot disease has been neglected. This type of attack involves the degradation of lignin as the defining mode. Much more knowledge is required on the biochemical structural of the macromolecules in OP, and how they vary within and between species. In addition, the ligninolytic enzymes in the *Ganoderma* involved in OP disease require being determined. An obvious approach for control is to develop OP with altered lignin so that it is resistant to attack. It is possible that an OP can be produced with resistant lignin to *Ganoderma* disease.