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A Survey of Diseases and Disorders in Oil Palms of Southern Thailand

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Abstract: Oil palm is an economically important crop in Thailand with its cultivation concentrated in the southern provinces. Diseases and disorders are the major cause of yield and quality losses to oil palm plantations. The objective of this study was to provide updated information on and to evaluate the geographical distribution of oil palm diseases and disorders in southern Thailand. A survey of oil palm plantations in southern Thailand was conducted during the years 2010-2012, to record diseases and disorders of the crop. This revealed a variety of oil palm diseases, including algal, bacterial and fungal diseases; macro and micronutrient deficiency problems and genetic disorders. Three diseases, namely brown germ, *Curvularia* leaf blight and *Ganoderma* basal stem rot, were classified as major diseases during the survey period. Brown germ and seed rot were the most destructive, affecting the seed germination process. The fungi that were frequently isolated from the collected samples belonged to the genera of *Aspergillus* spp., *Fusarium* spp., *Mucor* spp., *Penicillium* spp., *Schizophyllum commune* and sterile hyphomycetes. *Curvularia* leaf spot caused by *C. oryzae* was widespread at nursery seedling stage, while the basal stem rot caused by *G. boninense* was very destructive at the fruiting stage in the field. This report describes the incidence rates, disease symptoms and the fungi isolated from symptomatic tissue.

Key words: Disease and disorder, oil palm plantation, southern Thailand

INTRODUCTION

The oil palm tree (*Elaeis guineensis* Jacq.) is an important estate crop in southern Thailand. Oil palm production areas in Thailand total approximately 625,600 ha and of these about 528,400 ha are in the south (Chavananand, 2011). Like most other crops, oil palm is infected by several pathogens. The main diseases are caused by fungi, inhibiting the growth and reducing the yield (Turner, 1981; Tengoua and Bakoume, 2005; Flood, 2006). Several diseases of oil palm trees have been reported from many oil palm producing countries.

The basal stem rot or *Ganoderma* butt rot disease, caused by *Ganoderma boninense,* is the most severe oil palm disease in Indonesia and Malaysia (Susanto *et al*., 2005). It has also destroyed oil palms in Africa, Papua New Guinea (Turner, 1981), Colombia (Nieto, 1995) and Thailand.

Seed rot and brown germ caused by *S. commune* have been severe in Malaysia (Dikin *et al*., 2003). The causal agent *S. commune* causes up to 65% loss of germination rate to oil palm. Dikin *et al*. (2003) reported on a number of fungi found during plant quarantine investigations in seeds from Costa Rica and Papua New Guinea: *Aspergillus* spp., *Colletotrichum gloeosporioides*, *Fusarium moniliforme*, *F. solani*, *Penicillium* spp. (Zubir *et al*., 1995).

Some nutrient deficiencies can also severely damage the yield, such as nitrogen, phosphorus, potassium, boron and magnesium deficiency (Von Uexkull and Fairhurst, 1999). Nitrogen deficiency is the most significant nutritional problem in young oil palm. Boron and copper deficiencies of oil palm have been severe in Sumatra (Purba and Turner, 1973; Wanasuria, 1991).

Turner (1981) documented over sixty diseases and disorders of oil palm, from around the world. Only few studies of oil palm diseases in Thailand exist at present, the main one being a survey from 1976-1980 by Limsriwilai *et al*. (1984). They categorized the diseases by

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effects in the different growth stages: Germination (with brown germ diseases); nursery stage and field planting stage.

In nursery stage the diseases were *Curvularia* seedling blight, *Helminthosporium* leaf spot, anthracnose, chlorotic streak and nursery spear rot. In field planting stage they were seedling blight, algal disease, crown disease, frond rot, bud rot, little leaf disease, Marasmius bunch rot, fruit rot, *Ganoderma* trunk rot, charcoal base rot and sudden wilt.

The objective of this study was to assess the geographical distribution of oil palm diseases in the southern regions of Thailand and to provide updated information on the most important diseases that affect oil palm in this region.

MATERIALS AND METHODS

Field inspection and collection of samples: During the period of June 2010 to June 2012, on-site surveys were conducted to diagnose oil palm diseases and disorders in eleven provinces of southern Thailand. At first the location of observed symptom was noted. The typical symptoms of disease or signs of pathogen were observed to determine that the disease was caused by a pathogen or an environmental factor. Both un-germinated and germinating seeds that showed brown germ symptoms were collected from the oil palm seed production companies in Nakon Sri Thammarat and Songkhla provinces. Oil palm trees were surveyed in several nurseries and private oil palm plantations, in eleven provinces of Southern Thailand. Seeds and affected tissue samples of infected trees were collected, kept in plastic bags and transferred to laboratory. In the laboratory, the causal agents of diseases were I solated and identified. Disease diagnosis used diagnostic keys for identifying nutrient deficiencies, diseases and disorders (Fairhurst *et al*., 2005; Turner, 1981; Von Uexkull and Fairhurst, 1999; FLREC, 2012).

Data analysis: The disease incidence for each farm was determined as percentage of infection, by counting the number of visibly infected trees and expressing it as fraction of all trees, following Farrag and Abo-Elyousr (2011).

RESULTS

The main diseases noticed in seeds during germinating process were brown germ and seed rot. Losses were variable, in some cases up to 40%. *Curvularia* leaf spot had the highest incidence in the nursery stage. The basal stem rot was found to be the most destructive disease at the fruiting stage, causing decline and death of oil palm trees. Summaries of the diseases found in oil palms, from seed, nursery and field stages, are shown in Fig. 1 and Table 1. The incidence rates of diseases and disorders are located in Table 2.

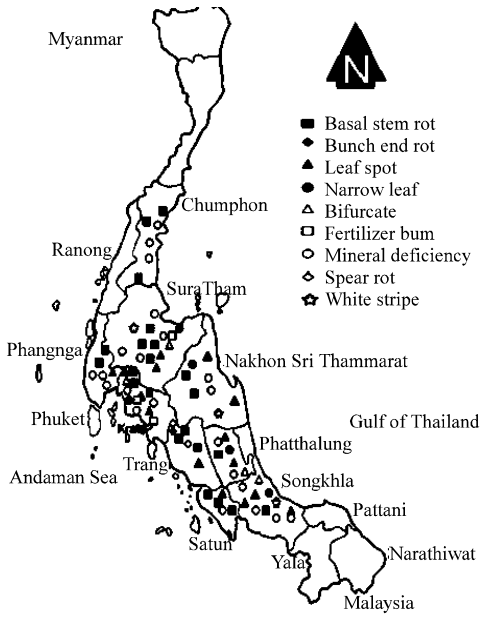

Fig. 1: Survey sites of oil palm nurseries and private plantations in southern Thailand

Table 1: List the pathogens isolated from symptomatic plant parts

Growth stage	Diseases	Causal agents
Seed	Brown germs	*Aspergillus carneus* (7), *A. flavus* (13), *A. flavas* var. *clumnaris* (9), *A. fumigatus* (9), *A. niger* (5), *A. paraciticus* (13), *A. terius* (12), *Bipolaris* sp. (1), *Botrytis* sp. (1), *Dendryphion* sp. (4), *Fusarium* spp. (12), *Mucor* spp. (20), *Paecilomyces* sp. (1), *Penicilium chermesinum* (2), *P. duclauxii* (3), *P. gladitanum* (6), *P. pseudostromaticum* (2), *P. rubicundum* (2), *Schizophyllum commune* (5), sterile hyphomycetes (13), Undetermined bacteria (2)
	Seed rot	*Schizophyllum commune* (2)
Nursery	Leaf spot	*Cercospora* spp. (6) *Colletotrichum* spp. (54) *Curvularia oryzae* (85) *Pestalotiopsis* spp. (23)
	Genetic disorder	-
Field	Algae leaf spot	*Cephaleuros virescens* (3)
	Basal stem rot	*Ganoderma* sp. (24)
	Bunch end rot	*Aspergillus* spp. (5), *Fusarium* spp. (4), *Penicilium* spp. (11), Undetermined bacteria (2)
	Nutrient deficiency	Nitrogen, Potassium, Phosphorus, Boron, Ferrous, Copper, Sulfer, Magnesium, Zinc (-)
	Sooty mold	*Meliola* sp. (9), *Capnodium* sp. (8)
	Spear rot	*Fusarium* sp. (2),Undetermined bacteria (3)

No. count of isolates with the pathogen is given in parentheses

Diseases associated with oil palm in south Thailand

Seed diseases

Brown germ: The symptoms become apparent as the seed germinates. Typically, light brown spots develop on the elongating radical as it emerges through the micropyle and these lesions merge to produce a solid discoloration of its tip. Seeds affected by the brown germ normally have a stubby radical with brown lesions mostly midway on the plumule and radical (Fig. 2a). Seed rot: Several fungi can kill an embryo and its surrounding kernel tissues before the seed germinates, causing seed rot disease. This disease becomes evident when the seeds are cracked: It cannot be detected without breaking the seeds open (Fig. 2b).

Nursery diseases and disorders

Anthracnose: The disease caused by this disease first appears as small brown spots between the veins and these spots will expand to elongated streaks. Typically, these are brown or black in color and are bordered by a pale yellow halo. Acervuli are produced on the dead tissues and when mature they exude a pink spore mass (Fig. 3a).

Table 2: Severity and incidence of diseases in different growth stages of oil palm

Growth stage	Diseases	Disease incidence (%)
Seed	Brown germs	13.12
	Seed rot	4.20
Nursery	Leaf spot	11.26
	Genetic disorder	6.85
Field	Algae	24.92
	Basal stem rot	1.53
	Bunch end rot	1.16
	Sooty mold	51.30
	Spear rot	1.24
	B deficiency	19.15
	K deficiency	6.53
	Mg deficiency	9.54
	N deficiency	13.46
	P deficiency	7.44

Fig. 2(a-b): Seed diseases of oil palm, (a) Brown germ and (b) Seed rot

Fig. 3(a-h): Nursery diseases and disorders of oil palm, (a) Anthracnose, (b) *Cercospora* leaf spot, (c) *Curvularia* leaf spot, (d) *Pestalotiopsis* leaf blight, (e-h) Genetically abnormal seedlings, (e) Bifurcate, (f) Fertilizer burn at leaf tips, (g) Narrow leaf (grass leaf) and (h) White stripe

Cercospora leaf spot: *Cercospora* leaf spot of the oil palm is caused by *Cercospora elaeidis*. The disease on the leaves initially presents small yellow spots with a brown point in the middle and purple in the margins. The spots spread and merge. At a later stage of the disease, the leaves become brownish-gray and brittle (Fig. 3b).

***Curvularia* leaf blight:** Leaf blight caused by *Curvularia oryzae* is the most important disease of oil palm during nursery stage. The first symptom is spots on the inner whirl and young leaves. The fungal spots grow with yellowing around them. During moist weather, these lesions expand rapidly into large, dark brown or black lesions (Fig. 3c). Damage to foliage in advanced stages includes necrotic lesions that kill leaflets and eventually the entire frond.

Pestalotiopsis leaf blight: Lesions associated with this disease are large, irregularly shaped and orange-red in colour (Fig. 3d).

Genetically abnormal seedlings: These can be classified into two groups, those showing leaf abnormalities and those showing abnormalities of form (Fig. 3e-h).

Bifurcate: The pinnate of older seedlings remain fused; the general morphology of the leaf remains juvenile. In such instances, leaf laminae are either late in dividing into their component pinnate or remain entire (Fig. 3e).

Field diseases and disorders

Algal disease: The algae, *Cephaleuros* sp., usually attack leaves on low-hanging pinnate and can also be found on the rachis. Colonies have the appearance of a flat spot, burnt-orange to brown or rust-colored (Fig. 4a).

Basal stem rot: This disease is caused by *Ganoderma* mushroom that attacks the palm at the stem base. The fungus may be observed as a whitish skin-like layer on the inner surfaces of the exodermises; cortical tissue becomes brown. The disease causes dry rot of internal tissues that severely restricts the supply of water and

Fig. 4(a-e): Field diseases of oil palm, (a) Algal leaf spot, (b) Basal stem rot (1) The oldest fronds have died and collapsed, (2) Fruiting body of *Ganoderma boninense*, (3) The beginning of infected tissues, (4) Mycelia of *Ganoderma boninense* in diseased tissues, (c) Spear rot of oil palm (1,2) The spear leaf and next youngest leaves discolored or collapsed, (3) Yellowing and rotting of spear leaf, (d) Bunch end rot and (e) Sooty mold on the pinnate

nutrients to the palm. The earliest visible symptoms occur on the foliage with the accumulation of unexpanded spear leaves. The foliage generally is much paler green in color than that of a healthy palm (Fig. 4b).

Spear rot: The first symptoms of spear rot are seen in the unexpanded spear leaf. The entire spear is quickly killed once basal rotting begins. Such decaying spears can beeasily pulled out. When this is done, the basal tissues are found to be affected by a dark brown, wet rot. Given some time, the rotting spear collapses and dies and then is often seen hanging down among the outer healthy fronds (Fig. 4c).

Nutrient deficiencies

Boron: Boron deficiency results in a wide array of symptoms. These symptoms always occur on newly emerging leaves but remain visible as they are mature and are replaced by younger leaves. Mild boron deficiency can be manifested as sharply bent leaflet tips, commonly called "wrinkled leaf". One of the most common symptoms of boron deficiency is the failure of newly emerging spear leaves to open normally. They may tightly fuse throughout their entire length, or the fusion can be restricted to basal parts of the spear leaf (Fig. 5a).

Nitrogen: Symptoms may appear on either young or old fronds, with the entire plant often affected. Deficient fronds first become pale green in color, changing to pale or bright yellow as the chlorosis becomes more severe. In advanced cases of deficiency, the apocone also becomes deep orange in color and ultimately the entire petiole and rachis become bright orange in appearance (Fig. 5b).

Fig. 5(a-d): Mineral deficiencies of oil palm, (a) Boron deficiency; wrinkled leaf, (b) Nitrogen deficiency, (c) Potassium deficiency, (1) Confluent orange spotting, (2) Chlorotic or necrotic spots on older fronds and (d) Magnesium deficiency

Potassium: The first symptom of potassium deficiency is pale green spotting on the pinnae of older fronds. The spots expand and either become round or develop an irregular outline, with the color changing to bright orange or red-orange. In a severe deficiency, the number of lesions is greater and the older leaves can be entirely covered by a reticulate mass of orange spots. In these severe cases, entire older fronds may dry up (Fig. 5c).

Magnesium: Mg deficiency results in the development of bright orange color in older fronds. The orange discoloration is very pronounced on the upper rank pinnate exposed to sunlight (Fig. 5d).

DISCUSSION

A global review of literature, up to 1981, on oil palm diseases and disorders is available. Later on, the diseases of oil palm in various growth stages in Thailand were reported by Limsriwilai *et al.* (1984). In this study, the incidence in southern Thailand of oil palm diseases in seed, nursery and field stages were determined. The inspection was conducted and samples were collected to identify the causal agents found in oil palm production areas, within southern Thailand. During the seed stage brown germ (13.12%) and seed rot (4.2%) had the highest incidence rates. During the nursery stage, the disease incidences in decreasing order were leaf spot (11.26%) and genetic disorder (6.85%), while during the field stage similarly sooty mold (51.30%) was followed by algae (24.92%), Boron micronutrient deficiency (19.15%), Nitrogen deficiency (13.46%) and Magnesium deficiency (9.54%).

Aspergillus flavus and *A. parasiticus* were the fungi most often detected in oil palm seeds showing brown germ, while *Schizophyllum commune* was rarely found. This deviates from a report on Malaysia, where *S. commune* was the most important pathogen causing brown germ and seed rot (Dikin *et al.*, 2003). According to Turner (1981), brown germ is also caused by *Aspergillus* spp., *Mucor* spp. and *Fusarium* spp.; however, *S. commune* was recorded as a causal agent. There is no epidemic of *S. commune* in southern Thailand; its incidence rate is probably due to low humidity storage of seeds.

Leaf spots caused by *Curvularia oryzae* were quite widespread in nurseries, with moderate to severe infection levels. The disease was of a mild form in nurseries with good sanitation. High incidence of the disease may be due to the absence of control management system. In Malaysia, *C. lunata* and *C. maculans* have been reported as causal agents of leaf spots in oil palm (Englert *et al.*, 1999).

The sooty mold and algae occurred widely at oil palm plantations in the south, where the climate is tropical. While severe levels of infection were recorded, the diseases occurred on the surface of the oil palm tree and did not attack the inner tissues of the plant.

Basal stem rot also occurred widely and as a lethal disease for palm trees. This appears the most serious of all diseases affecting the oil palm in southern Thailand. Basal and stem rot are the main factors accountable for the low yields of oil palm in Cameroon, Malaysia (Kinge and Mih, 2011). The disease has been recorded in Malaysia and Indonesia, Angola, Ghana, Nigeria, North Mozambique, Zaire and Tanzania (Turner, 1981). Several species of *Ganoderma* are reportedly pathogenic on oil palm, in various countries. In Malaysia and Indonesia the causal agents identified include *G. boninense* Pat., *G. chalceum* (Cooke) Steyaert, *G. miniatocinctum* Steyaert, *G. tornatum* (Pers.) Bers., *G. xylonoides* Steyaert and *G. zonatum* Murill (Turner, 1981; Pilotti, 2005; Utomo *et al.*, 2005). The most serious fungal pathogen in Malaysia and Indonesia has been identified as *G. boninense* (Al-Obaidi *et al.*, 2010; Susanto *et al.*, 2005). The current observations agree, with *G. boninense* occurring widely at oil palm plantations in southern Thailand; particularly on older plants.

During the seed stage, oil palms are faced with several diseases including seed rot and brown germ (Fig. 2). In order to reduce the severity of these diseases, the seeds should be cleaned before planting. The most effective way is to remove the pericarp of oil palm seed, with sanitation in seed germinator. The major diseases in nursery stage include leaf spot, genetic disorders and nutrient deficiency. The best way to control leaf diseases is to reduce excessive shade and ensure adequate air movement. Preventive fungicide applications can be repeated at fifteen day intervals. A balanced fertilizing program would remedy nutrient deficiencies, both in the nursery and field stages of oil palm. Avoiding damage to oil palm stem, caused by man or insects, may reduce the penetration of most oil palm pathogens. In the field stage, the basal stem rot is the most destructive disease for oil palm plantations. It can lead up to 80% losses with repeated planting cycles. There is no effective method to cure this disease because the mycelia have penetrated and reside within the palm tree. Chemical application is useless against basal stem rot, while the use of antagonistic microorganisms has no quick effects.

Infected oil palms have to be eliminated and removed from the planting field, to prevent further spreading of the disease.

This study was conducted to survey the diseases and disorders of oil palm. The reporting has been structured by the seed, nursery and field stages. Numerous diseases were found in each stage. The observed incidence rates encourage pursuing effective disease management of oil palm diseases in southern Thailand. This study on the incidence rates of diseases and disorders of oil palm has also listed some valuable appropriate control measures and can guide the development of further measures. These will help farm advisors guide farmers in effective disease management.

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REFERENCES

Al-Obaidi, J.R., Y. Mohd-Yusuf, T. Chin-Chong, N. Mhd-Noh and R.Y. Othman, 2010. Identification of a partial oil palm polygalacturonase-inhibiting protein (EgPGIP) gene and its expression during basal stem rot infection caused by *Ganoderma boninense*. Afr. J. Biotechnol., 9: 7788-7797.

Chavananand, K., 2011. Future of the Thai palm oil industry. IMPACT, Bangkok, September 8, 2011. http://www.thaipalmoil.com/paper2011/MR.%20KRISADA_CHAIRMAN%20THAI%20PALM%20OIL%20INDUSTRY%20CLUB.pdf

Dikin, A., K. Sijam, M.A. Zainal Abidin and I.A. Seman, 2003. Biological control of seedborne pathogen of oil palm, *Schizopyllum commune* Fr. with antagonistic bacteria. Int. J. Agric. Biol., 5: 507-512.

Englert, J.M., J.G. Scheetz and R.S. White, 1999. Improved conservation plant materials released by NRCS and cooperators through September 1999. USDA-NRCS, Beltsville, MD.

FLREC, 2012. Palm diseases and plant pathology. University of Florida IFAS. http://flrec.ifas.ufl.edu/palm_prod/palm_diseases.shtml

Fairhurst, T., J.P. Caliman, R. Hardter and C. Witt, 2005. Oil Palm: Nutrient Disorders and Nutrient Management. Vol. 7, PI/PPIC-IPI, Singapore, Pages: 125.

Farrag, E.S.H. and K.A. Abo-Elyousr, 2011. Occurrence of some fungal diseases on date palm trees in upper Egypt and its control. Plant Pathol. J., 10: 154-160.

Flood, J., 2006. A review of fusarium wilt of oil palm caused by *Fusarium oxysporum* F. sp. elaeidis. Phytopathology, 96: 660-662.

Kinge, T.R. and A.M. Mih, 2011. *Ganoderma ryvardense* sp. nov. associated with Basal Stem Rot (BSR) disease of oil palm in Cameroon. Mycosphere, 2: 179-188.

Limsriwilai, P., S. Likhitekarat and P. Surin, 1984. Diseases of oil palm in Thailand. Agric. Res. J., 2: 221-228.

Nieto, L.E., 1995. Incidence of oil palm stem rots in Colombia. Palmas, 16: 227-232.

Pilotti, C.A., 2005. Stem rots of oil palm caused by *Ganoderma* boninense: Pathogen biology and epidemiology. Mycopathologia, 159: 129-137.

Purba, A.Y.L. and P.D. Turner, 1973. Severe boron deficiency in young oil palms in Sumatra. Planter, 49: 10-13.

Susanto, A., P.S. Sudharto and R.Y. Purba, 2005. Enhancing biological control of basal stem rot disease (*Ganoderma boninense*) in oil palm plantations. Mycopathologia, 159: 153-157.

Tengoua, F.F. and C. Bakoume, 2005. Basal stem rot and vascular wilt, two treats for the oil palm sector in Cameroon. Planter, 81: 97-105.

Turner, P.D., 1981. Oil Palm Diseases and Disorders. Oxford Unviersity Press, Oxford, pp: 88-110.

Utomo, C., S. Werner, F. Niepold and H.B. Deising, 2005. Identification of *Ganoderma*, the causal agent of basal stem rot disease in oil palm using a molecular method. Mycopathologia, 159: 159-170.

Von Uexkull, H.R. and T.H. Fairhurst, 1999. Some nutritional disorders in oil palm. Better Crops Int., 13: 16-21.

Wanasuria, S., 1991. Copper deficiency of oil palm on sandy soils in Sumatra. Better Crops Int., 7: 22-24.

Zubir, Z., A. Dikin and H. Widjaja, 1995. Introduction handling seeds palm of foreign origin in the development of agribusiness in South Sumatra. Proceedings of the 13th National Congress and Scientific Seminar Association of Indonesian Phytopathology, (NCSSAIP'95), Mataram, Indonesian, pp: 298-302.