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Occurrence of Fungal Diseases and Their Importance on Date Palm in Sudan

Altaf M. Elhassan[1*], Mutwakil, A. Mahir[2], Abdelmagid A. Hamad[2] and Mohamed Elfatih Kh.Ali[3]

[1]Agricultural Research Corporation (ARC), Merowe Research Station, Sudan
[2]Agricultural Research Corporation (ARC), Wad Medani, Sudan
[3]Oranose Company, Bahrii North Khartoum, Sudan
**Corresponding author*

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A B S T R A C T

Date palm (*Phoenix dactylifera* L.) is an important fruit tree in north of Sudan and it was observed to be severely affected by many diseases. This study was carried out to evaluate the incidence and distribution of fungal diseases in date palm in its main producing areas in north of Sudan. A total of 87 date palm orchards (average 82 trees/orchard) in 29 locations in 7 localities in northern states were systematically surveyed during 2009-2010-2011 for the occurrence of fungal diseases. Results revealed that, trunk rot disease caused by *Thielaviopsis. paradoxa* occurred at high levels in Merowe (35%), Eldeba (65%), Eldamer (96%), Dongla (45%) localities and at low level in Abuhamed (2%), and East Nile (6%). Bud rot (Belaat) disease caused by *P. palmivora* was observed to occur in Merowe, Eldeba, Dongla and East Nile localities at an incidence of 18%, 31%, 33% and 17%, respectively. Diplodia rot associated with *D. phoenicum* was reported only in Merowe at a level of 19% and in East Nile at 23 % level. Ganoderma foot rot caused by *G. zonatum* was observed at Elbawga scheme (100%), Elselaim scheme (24%) and Tangasi Elsoque (37%) in Berber, East Nile and Merowe locality, respectively. An incidence level of 100% of the fusarium wilt disease caused by *F. oxysporum* was observed only at Tangasi Elrewase (Merowe locality). Further characterization of *F. oxysporum* using molecular markers is needed for proper identification. In conclusion, Date palm under Sudan conditions is affected by many fungal diseases causing considerable losses in yield. Thus a strategy for proper management of these diseases should be formulated.

Introduction

Date palm (*Phoenix dactylifera* L.), of the dry type, is one of the major economically cultivated crops in the Northern State of the Sudan, where dates represent about 75% of the exports and also considered a symbol of social status (Dirar, 2003). Date palm is a multipurpose tree that provides food, material for shelter, fuel and timber products. There have been many date palm cultivars grown in northern Sudan and the number of date palm trees in northern Sudan is estimated to be 8 million (FAO, 2005). Within the last decade, there was a decline in yield of date palm attributed to inadequate cultural practices coupled with infestation of pests and diseases.

However, up to the present, only little and very limited work has been done to describe the diseases of date palm in Sudan (Ali, 2003; Baghdadi *et al.*, 2003; Idris *et al.*, 2006).

Surveys so far done by plant protection directorate jointly with FAO were incomprehensive and covered very limited areas (Obeid, 1987; Dadek, 1993). Prior to formulate strategy for the management of date palm diseases, it is essential to identify and determine the economic importance of the date palm diseases. Since it is not known very well the status of date palm diseases in Sudan, particularly fungal diseases, it is paramount important to investigate the occurrence and distribution of fungal diseases in date palm trees in Northern and River Nile States. The present study is an attempt to provide more detail and comprehensive information on the occurrence and distribution of fungal diseases in date palm trees in Sudan.

Materials and Methods

Surveillance of date palm diseases

Surveys for date palm disease were conducted during 2009-2010- 2011 in the main production areas of date palm in northern Sudan. Orchards in different locations in Merowe, Eldebba East Nile and Dongola localities in the Northern State were visited.

The survey covered 13 locations in Merowe locality namely: Nori, Abudoom, Tangasi Elsoque, Tangasi Elrewase, Elgurier, Elbarkal, Elzooma, New amri, Elberkl, Sheba, Elhegaier Elzooma and Jelass.

At Eldebba locality the survey covered Hussein Narti, Abudoom Goshabi and New hamadab while in Dongola locality it covered Sortoot, Agaja, Marraga, Skiekh Shareef and Artigasha. In East Nile, the location visited were Elselaim scheme, Elborgaig scheme, Bayouda and Karma Elbalad. In the River Nile State, Atmoor and um Gedai, in Abuhamed locality, ELbawga scheme in Berber locality and Acacia (Jandael) in Eldamer locality were also surveyed.

In each location, all date palm trees in three randomly selected farmers' orchards were assessed for disease infections. The percentage of disease infections were assessed based on visual symptoms.

Isolation of the causal agents

Plant samples from the infected date palm trees in the surveyed areas were collected in paper bags and brought to the laboratory for identification of the causal agent.

Isolation was done from symptomatic tissues as well as roots, leaves and rachis. Plants material was washed thoroughly under fine spray of tap water to remove adhering soil particles, tissue pieces cut into small pieces of about 0.3 cm, surface disinfected with 0.5% sodium hypochlorite, 2min, rinsed in sterilized distilled water (SDW) for the same period and left to dry on sterilized filtered paper in flow bench then plated on Petri dishes containing water agar (WA) medium. The growing fungus was then sub cultured on potato dextrose agar PDA medium. The cultures were incubated at 25-30°c. The isolated fungi were identified according to their morphological and cultural characteristics.

Pathogenicity test

The pathogenicity test was only carried out for the fusarium wilt fungus isolated from Tangasi Elrwase. Seeds of the two date palm varieties Barakawi and Mishrig wad khateeb, were surface sterilized for 2 min with 0.5% sodium hypochlorite, then washed with sterile distilled water before sowing in plastic pots containing sand and clay in a1:2 ratio.

Each date palm variety was sown in five pots, five seeds each. The seed lings were kept in nursery and plants were inoculated six month after seedling emergence. 2 ml of *Fusarium*

oxysporum suspension were prepared and each seedling was dipped in the suspension.

The Fungal culture were grown for 10 days at 25°c on PDA medium the inoculums was prepared by flooding the agar surface of each Petri dishes with 10 ml of SDW and scraping it with spatula. The resulting spore suspension was filtered through four layers of filter paper and the spore concentration was adjusted to 10^6 spores/ml using hemacytomer.

Results and Discussion

Disease symptoms and incidence

The most distinctive symptom observed at Tangasi Elrwase is the appearance on infected trees of whiting of leaves at the second row of heart and white of leaf lets on one side of the rachis, whereas the ones on the other side are green and healthy. A dark brown streak was also observed on petioles and rachis on the side adjacent to the white leaflets. When the affected petiole or rachis was split transversely, a brown discoloration in the xylem tissue was observed indicating *Fusarium spp*. infection. The Fusarium wilt disease caused by *F.oxysporum* was only observed at Tangasi Elrewase at an incidence of 100% (Table 1).

The most symptoms observed in Hussein Narti, Tangasi Elsoque, Elgurier,Jelas, abudoom Goshabi, Agja, Marraga, Elselaim, Artigasha, sheikh shareif, umgedi, atmoor and Acacia (Jandail) were Several dead trees in which the upper half of the trunks of the affected trees collapsed either falling on the ground or attached to the basal part of the trunk. When a cross section was made on the affected trunk, a brown discoloration starting from the periphery inwards was observed. Another symptoms were black blotches in mid rib varies from spots or blotch**e**s. Also there is harmful phenomenon of wilting and drying of bunches shrunken of fruits this phenomenon appear when the fruit changes its color from khalal to rutab stage. These symptoms most likely are attributed to trunk rot disease caused by *Thielaviopsis. paradoxa* and/ or its imperfect state *Chalara paradoxa* which were repeatedly isolated from the tissues of affected date palm trunks producing long chains of conidia which fragment readily giving two types.

The trunk rot, Bending head and Black scorch Date bunch fading disorder phenomenon incited by *T. paradoxa* and /or *C. paradoxa* was observed in Tangasi Elsouq, Elgurier, Hussein Narti, Jelass, Abudoom goshabi, Agaja, Marrag, Elselaim, Artigasha, Shiekh sherief, Umgedai, Atmoor and acacia Acacia (Jandail) at an incidence of 74, 91,100, 47, 94, 50, 80, 94, 35, 87, 2 and 96% respectively as shown in table 1.

A high incidence of quick decline was observed on date palm off –shoots grown in New Amri, New Hamadaab Elbarkel, Marraga and Sortoot with the first symptoms on affected off-shoots start by drying of the heart and later the leaves around the heart become dry while still keeping the green colour. At a later stage, the heart of the affected trees can be easily removed by hand and the internal tissues become black in color and have fermented odour. All such symptoms were due to bud rot "Belaat" disease associated with *Phytophthora palmivoara* which was consistently isolated from tissues of the affected date palm off-shoots at Nori, Abudoom, New amri, New Hamadaab, Elberkl, and Sortoot.

The bud rot disease "Belaat" caused by *P. palmivora* was observed at Elberkal, Abudoom, New amri, New hamadab, Elborgag, Jelas at an incidence of 85, 61, 87, 93, 71, 61 respectively (Tables 1, 2 and 3).

Table.1 Incidence of fungal diseases in different sites in Merowe Locality, Northern State, Sudan, (2009-2010)

Site	Disease	No. of orchards Visited	No. of total trees	No. of infected trees	Disease incidence (%)
Tangasi Elrewase	Fusarium wilt	3	320	320	100
Tangasi Elsoque	Trunk rot +foot rot	3	440	327+162	74+37
Elgurier	Trunk rot +diplodia rot	3	362	330+120	92+33
Nori Scheme	Diplodia root rot +Shurnken of fruit	3	470	163+222	35+47
Abudoom	Bud rot	3	102	62	61
New Amri	Bud rot	3	370	322	87
Sheba	Diplodia root rot	3	112	87	78
Elberkel	Bud rot	3	377	322	85
Elzooma	Trunk rot	3	250	130	52
Elmegel	Black scorch	3	222	205	92
Elhegeier	Diplodia rot	3	170	92	54
Elarak	Diplodia rot	3	290	120	41
Jelass	Trunk rot+bud rot	3	150	70+10	47+7

Table.2 Incidence of fungal diseases in different sites in Eldebba Locality Northern State, Sudan, (2009-2010)

Site	Disease	No. of orchard visited	No. of total trees	No. of infected trees	Disease incidence (%)
Hussien Narti	Trunk rot	3	370	370	100
Abudoom Goshabi	Black scorch	3	217	205	94
New Hamadaab	Bud rot	3	115	107	93.

Table.3 Incidence of fungal diseases in different sites in Dongola and East Nile Localities, Northern State, Sudan, (2009-2010)

Site	Locality	Disease	No. of orchard visited	No. of total trees	No. of infected trees	Disease incidence (%)
Marraga	Dongola	Bud rot	3	66	53	80
Agaja	Dongola	Black scorch	3	118	112	95
Sheikh Shreef	Dongola	Bud rot	3	82	71	87
Sortoot	Dongola	Trunk rot	3	42	37	88.
Artigasha	Dongola	Trunk rot	3	55	19	35
Bayod	East Nile	Diplodia rot	3	75	18+17	24+23
Elselaim	Eeast Nile	Foot rot+Trunk rot	3	109	102	94
Elborgag	East Nile	Bud rot	3	89	63	71
Karma	East Nile	Diplodia root rot.	3	64	43	67

Table.4 Incidence of fungal diseases in different sites in Abuhamed, Berber and Eldamer Localities, River Nile State, Sudan, (2009-2010)

Location	Locality	Disease	No. of orchards visited	No. of total trees	No. of infected trees	Disease incidence (%)
Um gedai	Abuhamed	Black scorch	3	570	6	2
Elbawga Scheme	Berber	Foot rot	3	650	650	100
Atmoor	Abuhamed	Bending head	3	210	2	1
Acacia Jandeel	Eldamer	Trunk rot	3	520	500	96

Most symptoms observed in Sheba, Elgurier, Bayoda, Nori, Elhegaier and Elarak caused by *Diplodia phoenicum* were characterized by death of off-shoots either while they are still attached to the mother palm or after they have been detached and planted, while in the leaves of older infected palms the ventral mid portion of the stalks is commonly affected and showed yellowish brown streaks, 15cm to over one meter in length, extending along the leaf base and rachis. Diplodia rot caused by *Diplodia phoenicum* was observed, as shown in tables 1, 2 and 3, to occur at Sheba, Elhegaier Elgurier, Elarak, Nori scheme, Bayod and Karma at an incidence of 78, 54, 33, 41, 35, 24 and 67 %, respectively.

A lot of date palm trees grown in Elbawga scheme Tangasi Elsouqu and Elselaim showed general decline, slow growth and off-colour foliage. In addition, half moon conks (basidiocarps) of the shelf fungus were found attaching to the base of the trunks and this is the sign of ganoderma but rot disease caused by the shelf fungus, *G. zonatum*.

Ganoderma butt rot disease was revealed to occur at Elbawga scheme, Elselaim scheme, Tangasi Elsoque at an incidence of about 100, 94 and 36 % respectively (Tables 1, 2, and 3). Ganoderma has been known in Elbawga scheme since a long time ago (personal communication) and it seems that there is a tremendous increase in the incidence of the disease.

This survey revealed the fact that, fungal diseases are the most important diseases widely spread in all areas grown with date palm trees in Sudan in agreement with Zaid *et al.*, (2002) that fungi are the most pathogen found in date palm. Fungi are most likely play an important role in the decline of date palm yield in Sudan. The old plantations, poor cultural practices and the absence of any control measures will eventually aggravate the situation.

Isolation, identification and pathgenicity test of *F. oxysporum*

The Fusarium wilt fungus, *F. oxysporum*, was consistently isolated from tissues of affected trees at Tangasi Elrewase. The growth of the isolated fungus on PDA was first white in colour and later developed into pinkish white. The characteristic macroconidia, microconidia and chlamydospores of *F. oxysporum* were observed. *F. oxysporum* produced white and brown spots on the leaves of the inoculated seedlings of both date palm varieties, Wad Khateeb and Barakawi. The inoculated seedlings of Wad Khateeb and Barakawi varieties died after 10 and 21 days,

respectively. The morphological and cultural characteristics of the re-isolated fungus from roots of inoculated seedlings were typical to that of *F. oxysporum*.

The identity of the Fusarium wilt fungus was confirmed by the Agricultural Research Centre in Tunisia and the Fusarium Department, University of Sains, Malaysia and ICARDA Syria However, further work is needed for characterization of the *F. oxysporum* using molecular markers.

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