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FUNGI ASSOCIATED WITH SUDDEN DECLINE DISEASE OF DATE PALM (*PHOENIX DACTYLIFERA* L.) AND ITS INCIDENCE AT KHAIRPUR, PAKISTAN

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ABSTRACT

The date palm (*Phoenix dactylifera* L.) is considered as one of the most important horticultural crop of the world and holds a very significant position in the agricultural horizon of district Khairpur, Sindh, Pakistan. The sudden decline disease of date palm is one of the major problems of the region and has destroyed hundreds of orchards in dispersed areas of district Khairpur that resulted in huge economic losses. The aim of the current study was to investigate the incidence of sudden decline disease of date palm and mortality by surveyed seventeen different locations of district Khairpur and the fungal pathogens associated to the disease were also explored. The sudden decline disease incidence greatly varied at different locations and ranged from 0.25% to 50.17%. Maximum disease incidence was at Noor pur followed by Baberloe and Ahmedpur. The minimum disease incidence was recorded at Nizamani followed by Noonari, Therhi and Shadi shaheed with 1.5%. Six fungi namely, *Fusarium solani*, *Phoma ucladium*, *Helminthosporium sativum*, *Alternaria alternata*, *Aspergillus niger* and *Penicillium chrysogenum* were isolated from different plant parts collected from affected date palm trees of various orchards of Khairpur, Pakistan. The study will help further to find out the control remedies of this devastating disease.

Keywords: Bayoud, decline disease incidence, fungal pathogens, Khairpur, *Phoenix dactylifera* L.

INTRODUCTION

Date palm (*Phoenix dactylifera* L.) is one of the most oldest cultivated fruit crop of the warmer regions of the world like Egypt, Iran, Saudi Arabia, UAE, Pakistan, Oman, Libya, USA etc. (Khan *et al.*, 2008). In Pakistan, date palm cultivation is mainly concentrated in some dispersed areas of Balochistan and Northern Sindh specially district Khairpur. Khairpur is considered as the city of date palm or dates and served as the major dates exporting location of Pakistan. The date palm orchards of district Khairpur are suffering from a sudden decline disease of date palm since last couple of years that is threatening date palm industry of the region (Maitlo *et al.*, 2013). The symptoms of this disease is much similar with the world known disease of the date palm crop the Bayoud disease caused by a soil born fungus *Fusarium oxysporium* that has been destroyed millions of trees in

Northern Africa particularly Morocco (Djerbi, 1983). Several workers from different date palm growing areas of the world reported various fungal pathogens associated with similar kind of date palm diseases such as *Fusarium oxysporum*, *Fusarium moniliforme*, *Fusarium proliferatum* and *Fusarium solani* (Abdalla *et al.*, 2000; Sarhan, 2001; Rashed and Abdul-Hafeez, 2001; Masood *et al.*, 2011).

El-Arose *et al.*, (1982) reported that several soil borne fungi attack on date palm and causing root rot, wilt and decline diseases. Edongli *et al.*, (1985) found that leaf spot and blight diseases in date palm are caused by *Alternaria* and *Diplodia* sp. While, other fungal pathogens were also found to be associated with the leaf spot like *Bipolaris australiensis*, *Drechslera* sp., *Helminthosporium* sp., *Colletotrichum* sp., *Stemphylium* sp., *Pestalotiopsis palmarum*, *Chaetosphaeria* sp., *Phomopsis* sp. and *Phoma* sp. El-Deeb *et al.*, (2007) isolated twenty one fungal pathogens associated with different date palm fungal diseases belonging to

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different genera from different regions of Egypt. The pathogens they isolated were *Thielaviopsis paradoxa*, *Gliocladium Phoenics*, *Diplodia phoenicum*, *Botrodiploia theorbromae*, *Fusarium* sp., *Fusarium oxysporum*, *Fusarium solani*, *Fusarium equesti*, *Fusarium moniliforme*, *Fusarium semitectum*, *Mycospherella scaetiae*, *Mycosphaerella* sp., *Phomopsis phoenicola*, *Phomopsis phoenicum*, *Omphalia tralucida*, *Paecilomyces* sp., *Chaetomium* sp., *Chatosphaeropsis* sp., *Alternaria alternate* and *Mauginiella scaetiae*.

The present studies were carried out to isolate the putative pathogens associated with sudden decline disease and to assess the disease incidence at different localities of Khairpur district, Sindh province, Pakistan.

MATERIAL AND METHODS

Survey and collection of samples: The survey of seventeen different locations of district Khairpur namely Noorpur, Ahmedpur, Machyoon, Baberloe, Garhi Mori, Kot Mir Mohammad, Piryalo, Hadal Shah, Drib Mahesar, Munghanwari, Khanpur, Maher Ali Shah, Rupri, Shadi Shaheed, Therhi, Noonari and Nizamani were conducted during 2007-08. During survey, symptoms on the affected trees were noted and visualized with the help of digital camera. From each location, the samples were collected from infected parts of date palm like leaf, leaflet, rachis and roots. The root samples were obtained from 5-10 cm deep from dying and partially affected date palm trees. All samples were properly labeled and kept in plastic or paper bags. The collected samples were brought to the laboratory of Date Palm Research Institute (DPRI), Shah Abdul Latif University, Khairpur, Pakistan for the isolation of associated pathogens.

In each locality, the disease incidence and plant mortality was determined with following formulas as described by Cohen *et al.*, (2000).

$$\text{Disease incidence \%} = \frac{\text{No. of infected plants}}{\text{Total number of plants observed}} \times 100$$

$$\text{Plant mortality \%} = \frac{\text{No. of diseased dead plants}}{\text{Total number of plants observed}} \times 100$$

Isolation and identification of fungi: Infected roots were washed thoroughly with tap water to remove the attached soil particles. The samples were cut into small pieces and rinsed with 5% commercial bleach (Sodium hypochlorite) for 1-1.5 minutes and then placed in sterilized petri dishes containing freshly prepared

potato dextrose agar (PDA) medium. Five pieces of diseased plant parts were placed in each petri dish. Later, the petri dishes were incubated at 25°C for five days to induce sporulation of the fungi. Meanwhile, different fungal colonies appeared which were purified using the single spore isolation technique and hyphal tip method.

The isolated fungal species were identified on the basis of their morphological characteristics with the help of keys by Booth (1971), Domsech *et al.*, (1980), Ellis (1971), Singh (1977) and Sutton (1980). The data on frequency of isolated fungi from roots and leaves of different locations were recorded using the following formula:

$$\text{Colonization \%} = \frac{\text{No. of plant spp. colonized by fungus}}{\text{Total no. of plant spp.}} \times 100$$

RESULTS

Symptomatology: The sudden decline disease was observed in all date palm growing regions of district Khairpur throughout the year. Almost all varieties grown in the study area were found suffering from decline disease during the study period.

The affected plants showed the following typical symptoms.

Yellowing of leaves: The disease progresses in infected date palm tree from base to apex. The initial symptoms occur on the lowest outer leaves of the middle crown. The color of the affected leaves change from normal green into pale green to yellow (Fig. 1).

Discoloration of pinnae and spines: The normal yellow color of pinnae and spines became white and the discoloration progresses outward to the apex of the leaf before progressing down the other side to the leaf base. After one side of leaf has been completely white, the whitening begins on the other side from the base to the top of leaf. The dying process of the pinnae may take a few days to several weeks. Similar symptoms then begin to appear on other leaves (Fig. 2).

Discoloration of rachis: The dark spots and brown short streaks were observed on the dorsal side of rachis of affected frond and these streaks may run the full length of rachis and advances from the base to the tip of the frond (Fig. 2).

Drying of the leaves: As the disease progresses, the symptoms appear on other leaves also. The affected leaves showed profound yellowing; later on they became completely dead (Fig. 3).

Death of the whole tree: The infected leaves lose their orange color and under severe conditions fronds starts drying up one after another the date palm die when the

terminal bud is affected. The death of tree can take place for 1-2 year after appearance of first symptom (Fig. 4).



Figure 1. Yellowing of leaflet symptoms on infected date palm.



Figure 2. Discoloration of pinnae, spines and rachis of infected date palm.



Figure 3. Drying of the leaves and branches of infected date palm



Figure 4. Death of the whole tree infected by sudden decline disease of date palm.



Figure 5. Reddish brown color root symptoms of infected date palm.

Reddish colored infected roots: When the affected palm is uprooted, a small number of infected roots showed reddish color. Date Palm fronds manifesting external symptoms exhibit a reddish brown color when cut, showing highly colored vascular bundles (Fig. 5).

Disease Incidence: The sudden decline disease

incidence greatly varied at different locations and ranged from 50.17% - 0.25% (Table. 1). The maximum disease incidence was 50.17% at Noorpur followed by 35.58% at Baberloe and 32.47% at Ahmedpur. The minimum disease incidence was recorded at Nizamani having 0.25% followed by Noonari with 0.54%, Therhi

with 0.69% and Shadi Shaheed with 1.5% (Table. 1).

Table 1. Survey of date palm decline disease incidence in district Khairpur, Sindh, Pakistan.

Location	Disease Incidence%
Noor pur	50.17
Baberloi	35.58
Ahmed Pur	32.47
Kot Mir Muhammad	20.27
Machyoon	13.51
Garhi Mori	11.01
Piryalo	8.77
Drib Mahesar	8.30
Hadal Shah	5.77
Menghan Wari	3.83
Khanpur	3.31
Maher Ali Shah	2.30
Rupri	1.68

Shadi Shaheed	1.50
Therhi	0.69
Noonari	0.54
Nizamani	0.25

SE = 0.06325; LSD at 5% = 0.1822

Plant Mortality: In order to determine the impact of date palm decline disease on tree mortality, the 163 date palm orchards at seventeen different locations were surveyed. The plant mortality varied from 1 to 33%. The significantly severe disease intensity was observed at Noorpur where maximum plant mortality was recorded (33%) followed by Ahmedpur (31%) and Machyoon (30%). In some places where orchards were properly managed the very low impact of disease was observed. As minimum plant mortality was recorded at Noonari (1%), followed by Therhi (2%) and Shadi Shaheed (3%) (Fig. 6).

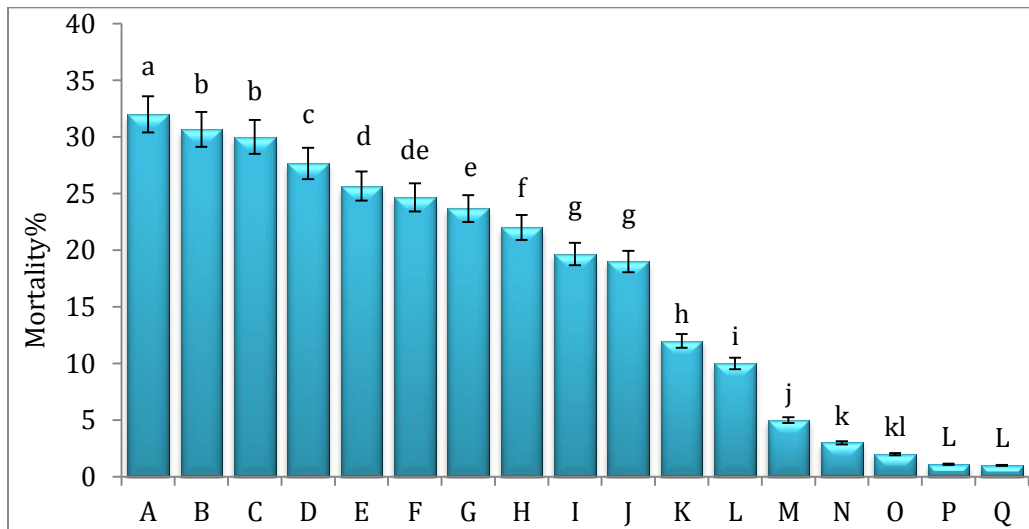


Figure. 6. Plant mortality due to date palm decline disease at different locations of District Khairpur, Sindh, Pakistan. Where: A=Noor pur B=Baberllo C=Ahmed Pur D=Kot Mir Muhammad E=Machyoon F=Garhi Mori G=Piryalo H=Drib Mahesar I=Hadal Shah J=Menghan Wari K=Khanpur L=Mehar Ali Shah M=Rupri N=Shadi Shaheed O=Therhi P=Noonari Q=Nizamani

Isolation of fungi: Six fungi namely, *Fusarium solani*, *Phoma ucladium*, *Helminthosporium sativum*, *Alternaria alternata*, *Aspergillus niger* and *Penicillium chrysogenum* were isolated from different plant parts collected from affected date palm trees of various orchards of Khairpur, Pakistan. Among the fungi isolated, *Fusarium solani* appeared as predominant fungus isolated in very high frequency from all locations followed by *Phoma ucladium* and *Helminthosporium sativum* (Fig. 8-14). Among seventeen locations, the date palm orchards

located at Noorpur followed by Baberloe and Ahmedpur appeared as severely infected with isolated fungi as maximum fungi were isolated from these places (Fig. 8-14). However, minimum fungal infections were recorded at Nizamani followed by Noonari (Table 1). *Fusarium solani* was isolated from all locations in varying frequencies ranging from 1.3 - 64% with overall average frequency of 29.38% followed by *Phoma ucladium* 0.6 - 29.3% (avg. 12.36%) and *Helminthosporium sativum* 1.3 - 23.3 % (avg. 10.0%) (Fig. 7).

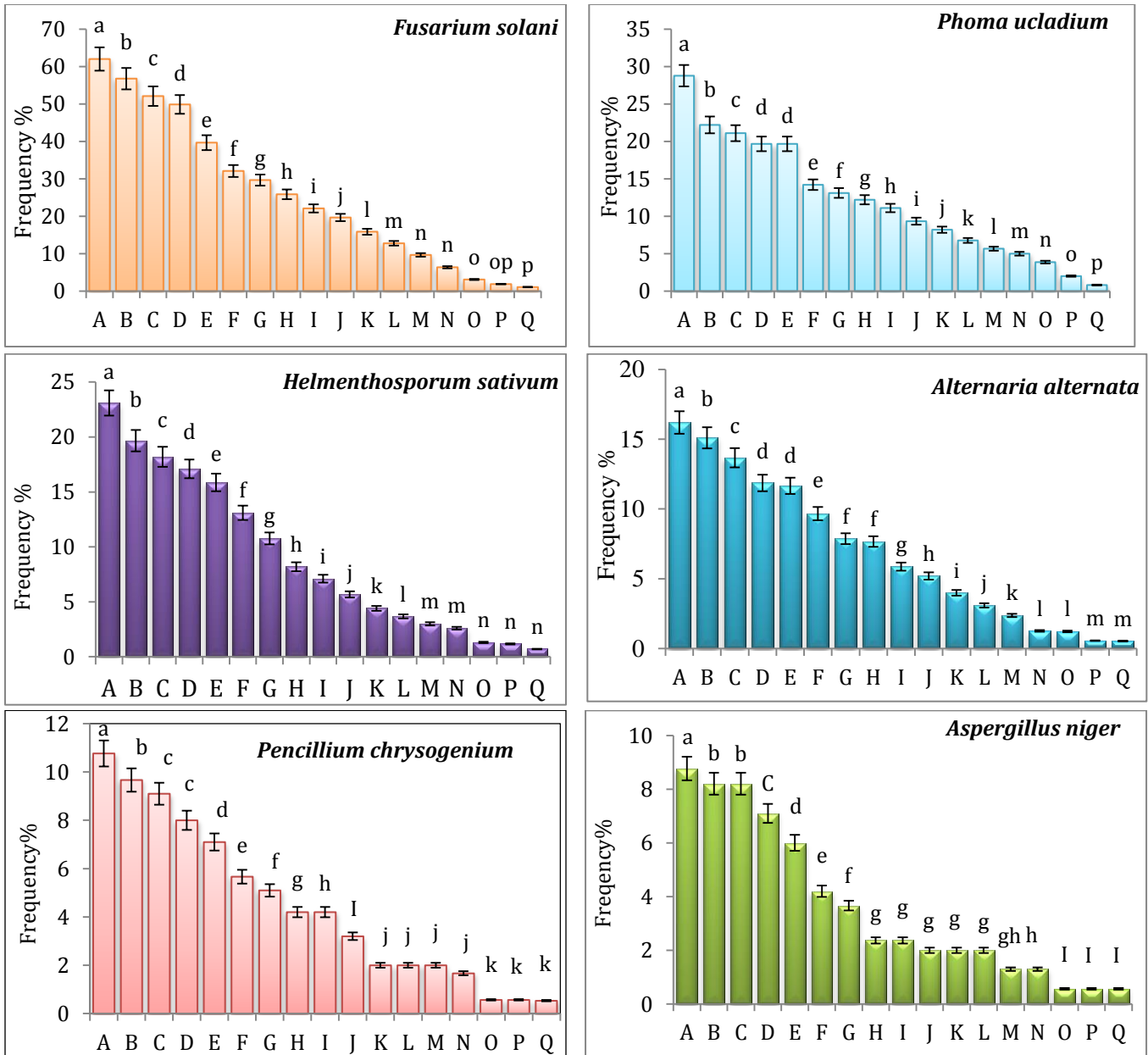


Figure 7. Over all frequency of different fungal pathogens at different location of district Khairpur. Where: A=Noor pur B=Baberllo C=Ahmed Pur D=Kot Mir Muhammad E=Machyoon F=Garhi Mori G=Piryalo H=Drib Mahesar I=Hadal Shah J=Menghan Wari K=Khanpur L=Mehar Ali Shah M=Rupri N=Shadi Shaheed O=Therhi P=Noonari Q=Nizamani

DISCUSSION

Decline disease is considered one of the most severe problems in most of the date palm growing areas of the world. The current study also revealed that decline disease found well established in date palm growing areas of district Khairpur, Sindh, Pakistan and caused significant damage to the socio-economic status of date palm industry of the region. Similar type of fungal disease on date palm also caused severe

losses in Egypt (Rasheed and Abdel-Hafeez, 2001, Barakat *et al.*, 1992; Rasheed, 1998), Saudi Arabia (El-Arosi *et al.*, 1982; Molan *et al.*, 2004), Libya (Edongali *et al.*, 1985; Khalil *et al.*, 1986) and Iraq (Sarhan, 2001). The infected date palm trees showed number of characteristic symptoms including yellowing of leaves, discoloration of pinnae, spines and rachis, drying of the leaves and branches, a small number of infected roots showed reddish color as well.

During the present investigations, the sudden decline disease incidence greatly varied at seventeen different locations of district Khairpur and ranged from 50.17% - 0.25%. At different date palm growing areas, the plant mortality was varied from 1 to 33%. Similar results were obtained by Al-Yaseri *et al.* (2010) who recorded different levels of the incidence of decline of date palm in the orchards of Karbala, Iraq.

Present studies also revealed that six fungi *viz.*, *Fusarium solani*, *Phoma ucladium*, *Helminthosporium sativum*, *Alternaria alternata*, *Aspergillus niger* and *Penicillium chrysogenum* were associated with infected date palm trees. *Fusarium solani* was the predominant fungus among them. Our results are in agreement to those of Al-Yasiri *et al.*, (2010), Besri (1982) and Mansoori (2003) who isolated *Fusarium oxysporium* and *Fusarium solani* from roots of declined date palm trees. Similarly, El-Arosi *et al.*, (1982) and Rasheed and Abdel-Hafeez (2001) observed that *Fusarium moniliform* and *Fusarium solani* were frequently associated with date palm decline problem.

CONCLUSION

The sudden decline disease emerged as a real threat for date palm cultivation in Sindh, particularly at Khairpur, where it destroyed thousands of orchards, and its intensity is increasing day by day. The affected trees showed number of characteristic symptoms including yellowing of leaves, discoloration of pinnae, spines and rachis, drying of the leaves and branches, infected roots with reddish color. Date Palm fronds manifested external symptoms and exhibit a reddish brown color when cut, showing highly colored vascular bundles. As the disease progress, the symptom appears on other leaves also. The affected leaves showed profound yellowing; later on they became completely dead and death of the whole tree. These symptoms were similar to bayoud disease and vascular wilt of date palm trees, which are widely distributed in North Africa. Among the fungal pathogens isolated, *Fusarium solani* appeared as predominant fungus isolated in very high frequency from all locations followed by *Phoma ucladium* and *Helminthosporium sativum*, *Alternaria alternata*, *Aspergillus niger* and *Penicillium chrysogenum*. Among seventeen locations of district Khairpur, the date palm orchards located at Noorpur followed by Baberloe and Ahmedpur appeared as severely infected with isolated fungi as maximum fungi were isolated from these places. However, minimum fungal infections were recorded at

Nizamani followed by Noonari. Therefore keeping in view the gravity of the problem the present study was carried out to determine the etiology of the disease as well as the incidence level at different locations of district Khairpur which will help further to find out effective control remedies of this devastating disease.

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