

Original Research Article

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## Identification and Diagnosis of Some Pathological Phenomena on the Date Palm caused by *Fusarium* Species in Iraq

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### ABSTRACT

It is known that the fungus *Fusarium* involved in the cases of date palm inflorescence rot, the results of survey and investigation in the general areas of cultivation of palm groves in Iraq for the period from 2005 to 2011, isolating and diagnosis pathogens from soil and plant parts, testing pathogenicity on small plants, many laboratory and field studies, showing that the main causes of some important and serious pathological phenomena that spread largely on the palm and caused death were species of the fungus *Fusarium*. The results proved that the cases of yellowing and dries fronds and numbness dates caused by some aggressive races and toxic metabolites (toxins) of the fungus *Fusarium solani*, which resides in the root zone and contributes to the weakness of palm, and make it susceptible to other vulnerable fungi like *Thialophiopsis paradoxa* which cause curvature of the summit as a results of cellulose analysis. While *Fusarium proliferatum* and the toxins produced by this fungus causing the rapid death and dries completely of the palm (the phenomenon of embalming palm by death of standing palm and drought summit completely). The fungus moves through xylem vessels in the trunk and kill them, and prevent the transmission of water, nutrients and leading to decimation palm during a short period, often the fungus was more active at low temperatures during winter.

#### Keywords

*Fusarium solani*,  
*Fusarium proliferatum*,  
Iraq,  
Palm  
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### Introduction

Since the early nineties of the last century, important pathological phenomena spread in the palm groves in Iraq, a committee of specialists in the ministry of agriculture and other scientific institutions was nominated including the college of agriculture and the atomic energy organization, a number of specialists in plant diseases and insects were

involved, and hosting one of the experts from the Maghreb. They recommended that the cause of these phenomena is the fungus *Thialophiopsis paradoxa*, and this was compatible with Al-Hassan and Abbas, 1978. The insects team focused on the presence of flies which lay their eggs at the summit, the flies work in harmony with the mentioned fungus on the analysis of

cellulose, and lead to curvature of summit, and came out a recommendation for the use of fungicides to combat fungus and insecticides to combat the fly and get rid of the palm trees infected cut it off and burn it as a solution to the problem (Zuwein, 1992).

These recommendations continued until 2003, despite the isolation of some *Fusarium* species by the committee, they neglected the issue and did not account for interest, perhaps to avoid going into the disease and its relationship with the Bayoud disease, that had not been recorded in Iraq, Although there was some papers made up in Iraq and isolate *Fusarium* species from the date palm (Abbas and Mohi, 1990). The work of the committee was stopped at this point, and because of the circumstances experienced by Iraq in the eighties and the subsequent conditions of the economic blockade, which reflected the negative effects, palm groves suffered much of the deterioration of the service due to lower financial benefits of palm, rising costs of services and cultivating crops with quick returns.

Cases continued to deteriorate rapidly, we had reported yellowing of palm fronds in the beginning of 2002, following by requests from departments of agriculture in all the provinces to report on the phenomenon of numbness of dates taken quickly spread on many important varieties including khastawi, Khadrawi and others, as well as marking a state of complete dryness of palm fronds and death fully palm. We started to work through a comprehensive survey of the palm groves with the help of all workers in the plant protection departments in the provinces to determine the prevalence of these phenomena, and then begin to collect samples of soil, plant parts and isolate pathogens associated with them to determine the relationship of their respective to the pathological cases, and continued to work

on the completion of these studies, for the period from 2005 to 2012. We have been noted the relationship between the fungus *Fusarium* and the pathological cases in the palm, but this was faced objections by the reviewer of the Iraqi agriculture journal in 2005. Based on the complaints submitted to the ministry of agriculture, they had been forming a committee comprising researchers from the faculty of agriculture - university of Baghdad and the general of the authority for agricultural research to study the phenomenon of numbness dates and they recommended several years later that the reason for this phenomenon is due to the circumstances of unknown physiological condition result from thirst and injury of mites.

## **Materials and methods**

### **Identifying and diagnosis of injuries**

After conducting a comprehensive survey, determine the pathological phenomena and their extent across the provinces (Alyaseri, *et al.*, 2006), samples had been collected from areas of infection in the provinces which included soil, roots and trunks of the palms. Samples were cultivated on potato dextrose agar (PDA), after superficial sterilization with chlorex solution of 0.05%, dilutions of soil (1/1000, w/v) also were cultivated on potato dextrose agar (PDA), then isolate and purify the fungi from all samples (subcultures) Alexopoulos and Beneke, 1962), after the purification, fungi is being examined under a microscope for the purpose of diagnosis, that made according to the taxonomic keys for each of Booth, 1977, Barnett & Hunter, 1972, Ellis, 1971, Gilman, 1975, Toussoun & Nelson, 1968 and Watanabe, 2002. The first diagnosis of the fungus *Fusarium proliferatum* was according to Sedra Mouly al- Hassan on our presence at the meeting of

the (Regional Project research for early detection of Bayoud disease on the palm and the development of technologies for combating) held in Algeria in 2005.

### **Pathogenicity test**

Pathogenicity test for all isolates was done using six months age palm seedlings planted in nylon bags, placing one disc (1 cm diameter) taking with cork borer from two weeks fungal culture, covered them with soil.

As well as the treatment of ornamental seedlings of Washingtonia and Sykes palm, followed by monitor and record observations and symptoms that appear on them. Then re-isolate the fungus from parts that developed symptoms.

### **Testing filtrate effect**

Czapex liquid broth in 500 ml flasks were prepared according to Alexopoulos, C.J. and Beneke, E.S. 1962, inoculation by using 1 cm discs taken from two weeks pure fungal culture, and packaging flasks by using black cover and put them in shaking incubator at a temperature of 25 ° C for one month.

Filtration was on two-step using Buchner suppress, subsequent filtration suppression Includes Millipore filter with a vacuum. Filtrates were distributed in 250 ml flasks, five palm seedlings with six months old placed in all flasks, which included a filtrate of culture with fungi, fungus filtrate without the presence of fungi and comparison treatment (distilled water only) with three replicates, then observations recorded.

## **Results and Discussion**

### **Relationship between fungi and pathological phenomena**

Results (table 1) showed that the fungus *Fusarium solani* was the most frequent in the root zone and cause yellowing of leaves, the strong strains lead to get phenomenon numb dates due to production of fungal toxins that lead to a weakening and killing of xylem vessels and preventing the arrival of sufficient quantities of nutrients and water for the stalks (Figure1). This is agree with Wazir *et al.*, 2014, they showed that the sudden decline disease of date palm is one of the major problems of the region and had destroyed hundreds orchards in Pakistan, caused by six fungi namely, *Fusarium solani* and other. Mansoori and Kord, 2006 reported a serious disease of date palm caused by *F. solani* associated with yellowing and death of the fronds in Iran. In Iraq, a similar disease symptoms caused by *F. solani* had been reported (Al Yasiri *et al.*, 2010).

The results also showed that the fungus *Fusarium proliferatum* isolated from palm trees that appear in full dry fronds and die standing (mummified) (Figure 2). Isolation of the fungus from the trunks of palm trees was possible, and was the most frequent in these parts, and this is compatible with K.S. Juber, 2010. It was also observed that the fungus does not reach the upper portions of the affected palm, palm death occurs as a result of secreted fungal toxins that lead to the killing of xylem vessels (Figure 3) and preventing the arrival of water and nutrients to the top. While the fungus *Fusarium moniliforme* cause only slight yellowing symptoms. Also Mansoori, 2012, Explain that *F. proliferatum* was isolated from the xylem of fruit bunch samples with date bunch fading (DBF) disease in Iran. While Julio Hernandez-Hernandez, *et al.*, 2010, made a survey of diseases caused by *Fusarium* spp. on palm trees in the Canary Islands, where palm trees growing in both

gardens and public parks and natural palm groves, showing symptoms of wilt and dieback, *F. proliferatum* occurred in fifteen palms located in Gran Canaria. As well as Armengol *et al.*, 2005 in Spain had identify and study the incidence and characterization of *F. proliferatum* on ornamental palms, Polizzi G. and A. Vitale, 2003, in Italy, indicated that *F. proliferatum* was correlated to the blight on majesty palm. But Hameed, M.A. 2012 had successfully identified that the causal of date palm inflorescence rot disease in southern part of Iraq is *F. proliferatum* and Abdalla *et al.*, 2000.

Also isolated three *Fusarium* species from infected leaves and roots of the date palm trees, pathogenicity test on date palm seedlings showed that *F. proliferatum* should be regard as a potentially dangerous pathogen of date palm in Saudia Arabia.

### **Isolation of the fungi**

*Fusarium* species and other fungi were isolated from most soils samples that were collected, as well as the roots, the more frequent fungi were *Fusarium solani*, *Fusarium proliferatum* and *Fusarium moniliforme* (Table 1) and other facultative fungi that were not responsible for pathogenic phenomena.

### **Pathogenicity test**

Aggressive Isolates of the fungus *F. solani* led to the emergence of symptoms of yellowing and wilting on the seedling after almost one month, they became very weak and die after about two months. While the symptoms of wilt was clear on the seedling that have been inoculated with *F. proliferatum* isolates and led to the drying and death after one month. This was

compatible with Mansoori and Kord, 2006. Also Washingtonia and Sykes seedling have the same symptoms of yellowing and wilting (Figure 4). The isolates of *F. moniliforme* has no effects on all seedlings, but only slight yellowing.

### **The effect of fungi filtrates**

It was observed that seedlings placed in the *F. proliferatum* filtrate began to wilting after 24 hours, dried up and died three days after. While the seedlings placed in the filtrate of the fungus *F. solani* had been died after about seven days. The cause of seedlings death was attributed to mycotoxins produced by these fungi, the filtrate of strong isolates of *F. solani* on Czapek broth media killed palm seedling of six months age during a short period (Figure 5).

This is agree with Muneera Alkahtani, *et al.*, 2011, studying on *F. moniliforme* they indicated that Fumonisin was highest toxin in tested date cultivars followed by T-2 and Zeralenone, reduction in quality of date fruits due to loss of their nutrients as the result of biochemical change.

Abdalla, M.Y. *et al.*, 2000, found in Saudi Arabia that all nine *F. proliferatum* strains isolated from diseased plants were shown to belong to mating population D of *Gibberella fujikuroi*. Finally, the strains were also tested for the production of beauvericin, fumonisin B1, fusaproliferin, fusaric acid, and moniliformin. Also Abbas, H.K. *et al.* 1999, Studying on rice *Fusarium sheath* indicated that all 15 isolated of *F. proliferatum* produced Fumonisin B1 (FB1), Fumonisin B2 (FB2), moniliformin (MON) and Beauvericin (BEA) in culture on rice.

**Table.1** Fungi isolated from different parts of the date palm in the provinces

No	Provinces	Frequency of the fungus <i>Fusarium</i> (%)**								
		<i>Fusarium solani</i>			<i>Fusarium proliferatum</i>			<i>Fusarium moniliforme</i>		
		Soil *	Roots	Trunks	Soil	Roots	Trunks	Soil	Roots	Trunks
1	Basrah	0.4	5.3	-	0.1	1.8	1.2	0.2	1.9	-
2	Misan	0.5	10.1	-	0.0	1.1	3.1	0.1	2.6	-
3	Dhi Qar	2.2	43.3	-	1.9	2.9	45.1	0.8	33.6	-
4	Samawah	0.2	1.6	-	0.5	0.3	0.9	0.5	1.1	-
5	Diwaniya	0.7	12.9	-	0.1	1.4	4.9	0.9	5.4	-
6	Najaf	0.8	15.2	-	0.2	1.6	7.8	1.2	10.9	-
7	Karbala	2.3	45.6	-	1.0	3.3	66.8	2.9	40.3	-
8	Wasit	0.4	4.8	-	0.3	1.3	1.1	3.5	4.2	-
9	Babylon	1.4	29.8	-	1.2	2.0	25.9	3.3	28.2	-
10	Diyala	0.3	2.1	-	0.1	0.4	1.4	2.1	2.1	-
11	Baghdad	0.6	1.8	-	0.2	0.5	4.8	4.5	2.5	-
12	Anbar	0.8	2.8	-	0.4	1.3	3.9	1.3	3.2	-
13	Salah Al-Din	1.6	35.5	-	0.8	2.1	30.3	2.1	23.8	-
<b>The mean</b>		<b>0.94</b>	<b>15.5</b>	<b>-</b>	<b>0.52</b>	<b>1.54</b>	<b>15.2</b>	<b>1.8</b>	<b>12.3</b>	<b>-</b>

\*Soil dilution of 1/1000. \*\*Total frequency of fungi in six treatments with five replicates.

**Fig.1** Date numbness caused by *Fusarium solani*





**Fig.2** Drying summit caused by *Fusarium proliferatum* (mummified palms).



**Fig.3** Xylem vessels of (mummified palm), brown and alcohol odor.



**Fig.4** Pathogenicity test (Date palm, Washingtonia and Sykes seedling inoculated with *Fusarium* isolates).





Fig.5 The effect of the fungi filtrate on date palm (6 month seedling).



### Conclusion and Recommendation

Fusarium species can be considered as a basic fungi responsible for the degradation of palm groves in Iraq, especially *F. solani* and *F. proliferatum*, and are likely to be the key pest that lead to a weakening, and affecting with other secondary fungi like *T. paradoxa* and *Alternaria alternata* that were considered by some researchers as a major pathogenic on the palm (Al-Hassan *et al.*, 1978; Ghali, 2001; Zuwein, 1992).

Most of the Iraqi soils contain all Fusarium fungi mentioned, this means for the continuation of pathological cases of yellowish, dry fronds, weakness and death to the date palm. Thus will continue to decrease in number of palm trees during the following years, especially in orchards that suffer from neglect and poor services.

Iraqi soil based on tests conducted by Sedra Moulay Hassan, 2010 has prospective high receptivity to *Fusarium oxysporum* f.sp. *albedinis* in most types of palm groves across the provinces.

Iraq need to breeding resistant varieties to the fungi (*Fusarium* spp.), depending on the seed and wild varieties after studying their resistance to the strong strains and isolates (Aggressive ones).

After getting resistant varieties they must being bred with tissue culture technique, by cooperation with one of the specialized international companies, in order to obtain large numbers of them (mass production), to cultivated for compensation palms in the old orchards and cultivation of new orchards. Also it is important to create a research center dedicated includes advanced devices, technologies mean palm trees and pests, and conduct research and studies on these aspects.

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