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Original article

Assessing the Pathogenicity of *Fusarium solani* on Tomato Seedlings

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ABSTRACT

Tomatoes and other vegetables can rot due to post-harvest infections caused by Fusarium species. This study was out to determine Fusarium species that were isolated from tomato plants that were infected, to identify the causative organisms by phenotypic features, and to confirm the pathogenicity of Fusarium solani on tomato plants using pathogenicity tests. The phenotypic of Fusarium isolates was ascertained using potato dextrose agar (PDA) media, with a focus on features such as homogenous cells, growth rates, colony characteristics, macroconidial and microconidial shapes and sizes, and chlamydospores. Fifteen Fusarium isolates in all were acquired. Four isolates were identified as Fusarium solani then tested for pathogenicity. All tested Fusarium isolates were pathogenic to tomato plants with different levels of severity. Uninoculated controls did not exhibit any symptoms of root rot. F19 isolate was the most pathogenic with a DSI of 47.5%, while the least were F7, F22 and F11 isolates with a DSI of 42.5%, 37.5%, 35% respectively. The potential mycotoxin production of these pathogenic isolates in tomato plants can cause health problems when consumed.

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INTRODUCTION

Around the world, tomato (Solanum lycopersicum L.) is one of the most popular vegetables to cultivate and consume. Fresh tomatoes and tomato-based products are high in flavonoids, potassium, lycopene, vitamin C, vitamin E, and folate, among other beneficial nutrients [1]. However, tomato crops are usually exposed to many pathogens, including diseases caused by the *Fusarium* fungus. In tomato farming regions across the globe, *Fusarium* species are regarded as diseases that seriously impair in greenhouse and field crops [2].

One of the most significant soil-borne fungal pathogens is *Fusarium solani*, which can cause root rot illnesses in tomatoes and other crops and vegetables as well as suppressive symptoms [3]. Rain accelerates the development of *Fusarium solani* root rot, which impacts all growth stages [4]. Therefore, the goals of this work are to determine the *Fusarium* species linked to tomato Fusarium root rot based on morphological and biological characteristics, as well as to investigate the pathogenicity phenotypes of the fungal isolates.

METHODS

Fusarium isolation

Tomato samples exhibiting indications of *Fusarium* root rot were isolated from naturally infected tomato plants that were commercially cultivated in a greenhouse. To obtain pure cultures, the samples were surface sterilized in a 10% sodium hypochlorite solution, rinsed for two minutes in sterile distilled water, and then put on potato dextrose agar

(PDA). Morphological characterization was carried out using the Leslie and Summerell (2006). Where that was for identification of microconidial and macroconidial shapes and septation, colony color, growth and pigmentation on PDA and existence or absence of chlamydospores.

Pathogenicity test

Tomato plant seeds were surface sterilized by immersing them for ten minutes in a 20% sodium hypochlorite solution. The seeds were placed in a pot with mixed soil (sandy: loam) after being rinsed three times with sterilized distilled water for five minutes. They were then immersed in a conidial suspension (1 × 105 CFU/ml) of each isolate for ten minutes. The seeds that had been cleaned and immersed in distilled water before being transplanted were used as a control.
Plants were maintained for 45 days in a green house. Relative plant infections caused by the fungi were measured after 45 days from cultivation and data were expressed as follow:

$$\% \text{ Survival (after 45 days)} = \frac{\text{No. of survival plants}}{\text{Total of no. of plants}} \times 100$$

Disease symptoms - widespread root rot, severe stunting, wilting, necrosis, and early defoliation that frequently causes plants to die.
: The following formula was used to determine the disease severity index (DSI)[5]:

$$\text{Disease severity index (DSI)} = \frac{\text{Sum of individual plant}}{\text{Number of tomato plant assessed} \times \text{Maximum disease score}} \times 100$$

A ranking system was used to evaluate the disease's severity and frequency.
0 seeds germinated; there were no wilt signs.
1 seed sprouted, with 1-24% of the leaves displaying a little chlorotic streak.
2 seeds sprouted, growing abnormally, with 25–49% of the leaves displaying curvature or chlorosis.
3 The seed grew abnormally, with 50–74% of the leaves withering and showing signs of chlorosis or mild necrosis.
4 Seeds either did not germinate or did germinate but at least 75% of the leaves shown signs of wilting.

Data analysis

The variance of the DSI distribution among the isolates was then compared using the Friedman test of the non-parametric test of the SPSS program at $p<0.05$, which was applied to the DSI data.

RESULTS

Using the Fusarium synoptic keys for species identification of Leslie and Summerell [6], 15 isolates were classified as *Fusarium* spp. based on the morphology of their colonies; 4 isolates displayed characteristic morphological markers for *F. solani*.

Pathogenicity test

Four Fungal isolates of *F. solani* were that isolated from infected tomato plants. Where significant reduction in germination of contaminated seeds was observed in comparison to the control group that was healthy. Pathogenicity of *F. solani* isolates were evaluated on tomato plants. After being transplanted, inoculated plants were allowed to grow for 45 days. Based on the evaluation of the disease, the plants were inspected to determine the extent of fungal infections, and the averages were noted. There was little tomato seedling mortality after Fusarium inoculation. The other evaluated characteristics, such as seedling foliar symptom, root rot symptom, fresh plant weight, fresh root weight, dry plant weight, and dry root weight, showed significant differences ($p<0.05$) between the isolates (Table 1). Isolates were classified according to their relative pathogenicity on inoculated seedlings after all parameters had been gathered. In comparison to the control group, all tomato plants infected with pathogens grew more slowly. Compared to other infections, F19 was more successful in lowering the weight of both fresh and dry plants when it came to disease parameters involving fresh plant weight. When compared to the control, all infections generally affected the dry root weight. F19 had a greater impact on fresh plant and root weights than on dry plant and root weights when it came to the severity of foliar symptoms. The degree of root rot was similarly impacted by all pathogens, with F11 being the least virulent (Table 1).

Table 1. Disease indices of tomato plants inoculated with investigated isolates of Fusarium solani under greenhouse conditions after 45 days of sowing.

Treatments	Mean Length		Mean dry–weight		Mean wet-weight		Disease index (DI)%	Survival plants%
	Shoot	Root	shoot	Root	shoot	Root		
Control	60.66	10	1.55	0.028	10.07	0.44	0	100
F11	55.00	7.82	1.51	0.021	9.43	0.25	35	90
F7	49.00	6.16	0.80	0.013	6.41	0.19	42.5	70
F22	49.66	4.53	0.76	0.013	7.31	0.18	37.5	80
F19	46. 33	6.66	0.45	0.011	5.89	0.18	47.5	70

DISCUSSION

The aim of this study was to discover *Fusarium* species that are harmful to tomato plants. Two isolates of *Fusarium solani* were found to be extremely harmful, whereas other isolates were found to be less hazardous, according to the pathogenicity test. These results corresponded to Abiala [7] where they isolated 26 *Fusarium* species morphologically identified as *F. solani* (FS1, FS9, FS10, FS17, FS21 and FS26), where their found tomato seed germination was severely decreased by the strains FS17, FS21, and FS26, while FS17, FS21 and FS26 significantly reduced root and shoot total in the tomato plant. [8] Reported that all pathogens under study affected the severity of root rot. In contrast, *F. oxysporum* was the least hazardous of the fungi under investigation, affecting the severity of disease symptoms and the weights of plants and roots in both their fresh and dried states. Using these parameters results in similarly high levels of virulence for *R. solani*, *M. phaseolina*, and *F. solani*.

Our results were consistent with [9] experience on isolating *Fusarium solani* from infected tomato plants where 27 isolates were tested for pathogenicity test then Every studied *Fusarium* isolate was harmful to tomatoes, but to varying degrees of severity. Twenty tomato plants were subjected to pathogenicity testing for 60 days at a temperature of 23 to 26 C in a growth chamber. The plants cultivated in the greenhouse were found to exhibit identical symptoms to those of the diseased plants in the field [10].

CONCLUSION

The results of this study provided that all of the isolates of were pathogenic on tomato plants. Therefore, we advise assessing the harmful effects of *F. solani* isolates on different tomato cultivars in Libya.

Conflicts of Interest

There aren't any disclosed conflicts of interest, either personal, professional, or financial.

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تقييم القدرة الامراضية لفطر *Fusarium solani* على شتلات الطماطم

زينب افكيرين

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المستخلص

تعد أنواع الفيوزاريوم أحد مسببات الأمراض الشائعة لأمراض ما بعد الحصاد التي تسبب تعفن الطماطم والخضروات الاخرى . كانت أهداف هذه الدراسة هي تحديد تنوع عزلات الفيوزاريومالمعزوله من نباتات الطماطم المصابة، وتحديد العزلات المسببه لمرض تعفن الجذر باستخدام الخصائص المظهرية. تم استخدام أوساط اجار دكستروز البطاطس لتحديد المستعمرة، ومعدلات النمو، والخلايا المتجانسة والجراثيم الكلاميديا. تم الحصول على اجمالي 15 عزله من الفيوزاريوم. تم تشخيص اربع عزلات منها على انها فيوزاريوم سولاني ثم تم اختبار قدرتها الامراضية باستخدام اختبار الامراضية. فكانت جميع عزلات الفيوزاريوم المختبرة مسببه للأمراض لنباتات الطماطم بمستويات مختلفة من الشدة. ولم تظهر الضوابط غير الملقحة اي أعراض لعفن الجذور، حيث كانت عزلة F19 هي الأكثر خطوره حيث بلغ مؤشر DSI 47% ، بينما كانت العزلات الأقلF7، F22،F11 بمؤشرDSI 42.5%، 37.5%، 35% على التوالي. حيث يمكن ان يسبب انتاج السموم الفطرية المحتملة لهذه العزلات مشاكلا صحية عند استهلاكها.

الكلمات الدالة. مؤشر شدة المرض - فيوزاريوم سولاني - شتلات الطماطم