

REACTION OF WHEAT CULTIVARS TO FUSARIUM CROWN AND ROOT ROT UNDER FIELD CONDITION AT DUHOK-KURDISTAN REGION, IRAQ

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ABSTRACT

Field trial was conducted at College of Agricultural Engineering Sciences, University of Duhok, to evaluate the susceptibility of six wheat cultivars, three from durum wheat (Simeto, Doma and Sardar) and three from soft wheat (Cham 6 ,Adana 99 and Tamoz 2) to the Fusarium crown and root rot diseases. Two most common *Fusarium* species (*F. graminearum*, *F. oxysporum*) were used for this experiment. Inoculated plants produced symptoms of root rotting and scurfy, reddish brown to white discoloration of the crown area. The most susceptible cultivar was Doma since disease severity reached (0.33) and Sardar (0.29) whereas, the less susceptible one was Adana99 (0.16). *F. graminearum* caused a significant disease severity (0.41) compared to (0.32) resulted by *F. oxysporum* on all tested wheat cultivars, and subsequently caused comparable reduction of all tested criteria. However no completely resistant cultivar for disease was reported in this study, *F. graminearum* and *F. oxysporum* recorded the lowest infection on Adana99 cv.. Percentage of reduction in number of tillers was more in Doma, it was the most cultivar susceptible to *F. oxysporum* and *F. graminearum* with no significant difference at 48.14% and 45.2% respectively, while the less susceptible one to both fungi was Adana99 at 4.32% and 5.05% tiller reduction successively. *F. graminearum* showed more reduction in plant yield and the highest cultivar affected was Doma while the lowest one was Adana99.

KEYWORDS: *F. graminearum*, *F. oxysporum*, Susceptibility, Wheat, Root rot, FCRR
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INTRODUCTION

Wheat affected by various diseases, root and crown rot are diseases which cause losses in most countries around the world that produce wheat, *Fusarium* spp. produce deoxynivalinol (DON) which has a role in rising fungi virulence (Shaner, 2003). *Fusarium* species are a varied group of fungi that have an effect on cereals through rotting of seeds, root, crown, seedling, basal stem, and spike (Paulitz *et al.*, 2002). Various pathogen species in the genera *Fusarium* cause crown and root rot disease which includes *Fusarium culmorum*, *F. graminearum*, *F. equiseti*, *F. pseudograminearum*, *F. acuminatum*, *F. nivale*, *F. avenaceum*, but *F. graminearum*, *F. culmorum* and *F. pseudograminearum*, are epidemiologically the highly important species involved in this disease (Cook, 2010).

The disease is characterized by several symptoms such as yellowing, seedling death,

stunting of seedling and mature plant, dark brown lesions on root, crown, subcrown internode and stem. Afterword other symptoms appear like tiller death prematurely which contains little grains of its empty (Sallans, 1965). Initial symptoms of seeds or seedlings infection that are caused by disease agents are non uniform emergence, death and missing of seedlings with poor stand establishments (OMAFRA staff, 2016). Cook (2001) reported that host plant resistance is the most effective and dependable approach to reducing yield damages infected by Fusarium crown rot. Despite of a common etiology, various host genes have been found to be included in resistance of wheat to *Fusarium* spp. that cause crown rot (Li *et al.*, 2010). In Turkey through a study performed by (Arici, 2012) to detect resistant or tolerance cultivars to *F. gramineaarum* and *F. culmorum* which cause crown rot 64 wheat cultivars were screened. The results from the screening reported that Demir

2000, Bezostaja 1, Tahirova 2000, Charisma, Karacabey 97 and Adana 99 wheat genotypes were of high to partial resistance to the disease. In 2014, the result of screening wheat cultivars against *Fusarium* root rot in Iraq, showed that the most cultivar susceptible was Cham 5 and the least one was Sabir beg (Taha, 2014) The aim of this study is to evaluate the most common wheat cultivars for resistance to the causes of *Fusarium* Crown and Root Rot (FCRR).

MATERIALS AND METHODS

Field evaluation of six wheat cultivars, three from durum wheat (Simeto, Doma and Sardar) and three from soft wheat (Cham 6, Adana 99 and Tamozi 2) obtained from Agriculture research center/ Duhok province, were screened for resistance to the main species of *Fusarium* causing root and crown rot of wheat under natural condition. The experiment was performed in the field of College of Agriculture/ University of Duhok. The most common *Fusarium* species (*F. graminearum* and *F. oxysporum*) isolated during field survey were used for this experiment. Before sowing wheat seeds in plastic pots (25 x 25cm), seeds were surface disinfected by washing for 5 minutes under tap water, immersed in ethanol 75% and in 0.5% NaOCl about 1 min for each then rinsed two times in sterile distilled water, and finally laminar flow hood was used for seeds air drying.

Seeds were sown in 25/11/2015 at a depth of 2cm in each pot using 20 seeds /pot that contains field clay soil sterilized by 1% Formaldehyde (1L/m³) for fourteen days under polyethylene and left for another fourteen days for aeration, accordingly the soil mixed with peat moss (2:1). Seedlings were inoculated by spore suspension technique, A volume of 10ml of a spore suspension (1 × 10⁶ spores/ml) was added at the base of each plant stem (Mitter et al. 2006). At the physiological maturity of crop, the following measurements were determined from 10 plants/ pot using the standard procedures:- The incidence (%) and Disease severity was estimated according to McKinney (1923), Severity ratings depending on the discoloration from the roots to the crown based on a scale

scoring from 0 to 4 where: 0 = Healthy plant, 1 = (1-10 %) Brown discoloration, 2 = (11-25 %) Brown discoloration, 3 = (26-50 %) Brown discoloration, 4 = (51-100 %) Brown discoloration., Plant height (cm/plant), Spike length (cm/spike), Number of tillers per plant., Number of grains per spike using grain counting, 1000-grain weight (g), Biological yield (gm/plant) the whole weight of ten plants (hay weight + seed weight), Plant yield (Seed yield) (gm/plant) is (The whole weight of grains / real no. of plants in each pot), Harvesting index was calculated by the following formula: Harvest index = Seed yield/Biological Yield × 100 for each plant. The trial applied as factorial in a Randomized Complete block Design (RCBD) with four replications. Data were analyzed using Statistical Analysis System (version 8.2; SAS Institute Inc., 2003). Data were subjected to analysis of variance (ANOVA) and pooled together after testing the homogeneity of variance ($P \leq 0.05$). Means of the treatments were compared by Duncan Multiple Range Test at 5% level.

RESULTS AND DISCUSSION

❖ Response wheat cultivars to FCRR disease incidence and severity

Inoculated plants showed diagnostic symptoms of root rotting and reddish brown to white discoloration of the crown (lower stem), with few number of tillers and stunting. Wheat cultivars in (Table 1) indicated that *F. oxysporum* caused the highest disease incidence on Sardar cv. (durum wheat) (100%) and the lowest on Adana99 cv. (soft wheat) (77.5%), *F. graminearum* was more aggressive on Doma cv. (97.5%) compared to (77.5% and 85%) on Cham6 and Adana99 cvs., respectively. It is obvious from the mean effect of fungi in (Table 1) that there was no significant difference between *F. graminearum* and *F. oxysporum* (88.75 and 85.69% respectively). For more understanding about susceptibility of wheat cultivars to disease, the highest disease incidence was reported by Sardar cv. (63.33%) and Doma cv. (59.16%). Adana99 cv. recorded the lowest disease incidence (54.16%) with a similar impact on Cham6 cv. (55%) (Table 1).

Table (1): FCRR disease incidence on examined wheat cultivars and their overlapping in the field:

		%Disease incidence						Effect of Fungi
Fungi	Cultivars	Simeto	Doma	Sardar	Tamoz 2	Cham 6	Adana 99	
	<i>F.graminearum</i>	90 a-d	97.5ab	90 a-d	92.5 abc	77.5 e	85 cde	88.75 a
	<i>F.oxysporum</i>	86.6 b-e	80 de	100 a	82.5 cde	87.5b-e	77.5 e	85.69 a
Effect of cultivars		58.88 ab	59.16 ab	63.33 a	58.33 ab	55 b	54.16 b	*****

-Means of different letters differ significantly depending on Duncan's Multiple Range test ($P \leq 0.05$)

-Each number is a mean of four replications.

The effect of overlapping between cultivars and fungi in (Table 2) confirmed that *F. graminearum* resulted in the highest disease severity on Doma cv. (0.56) and the lowest one was on Adana99 cv. (0.28), the effect of *F. oxysporum* was also high on Doma and Sardar cv. (0.45 and 0.46 respectively), and the lowest effect was in Adana99 cv. (0.21).

Results of Statistical analysis showed that disease severity of *F. graminearum* was (0.41)

which was considerably different with *F. oxysporum* (0.32). Therefore, wheat cultivars cultivated in Duhok region were more susceptible to FCRR since, the max disease severity (0.33) measured on Doma cv. and Sardar cv. (0.29) whereas the minimum disease severity (0.16) was observed on Adana99 cv. (Table 2).

Table (2): FCRR disease severity on tested wheat cultivars and their overlapping in the field:

		Disease severity						Effect of Fungi
Fungi	Cultivars	Simeto	Doma	Sardar	Tamoz2	Cham 6	Adana99	
	<i>F. graminearum</i>	0.42 b	0.56 a	0.43 b	0.42 b	0.35 bc	0.28 cd	0.41 a
	<i>F. oxysporum</i>	0.3 cd	0.45 b	0.46 b	0.28 cd	0.25 d	0.21 d	0.32 b
Effect of cultivars		0.24 b	0.33 a	0.29 a	0.23 b	0.2 bc	0.16 c	*****

-Means of different letters differ significantly depending on Duncan's Multiple Range test ($P \leq 0.05$)

-Each number is a mean of four replications.

In line with our result, Smiley *et al.* (2005) reported that *Fusarium* spp increased incidence and severity of wheat crown rot. Fernandez and Jefferson (2004) found that durum wheat cultivars is more susceptible to crown and root rot disease than soft wheat, and durum wheat is faster and early accumulated by fungi (Liu *et al.* 2012). Nsarellh *et al.* (2000) recorded that durum cultivars of wheat differ in their susceptibility to crown and root rot, resistant cultivars developed by different responses of germplasm to numerous fungi of this disease.

❖ Effect of FCRR on some growth criteria and yield product

• Percentage of reduction in plant height

The results in (Table 3) showed that *F. graminearum* and *F. oxysporum* reduced the plant height of Tamoz2 cv. greatly with 14.14% and 11.79% for both pathogens respectively. Whereas the lowest cultivar affected by both pathogens was Adana99 (1.71% and 1.44% successively).

Table (4) showed remarkable virulence of *F. graminearum* on the plant height which stunted with (8.59%) compared to *F. oxysporum* which caused (7.07%) reduction rate. The effect of disease on cultivars was obvious in plant height

reduction, the maximum reduction was in Tamoz2 cv. attained to (12.96%) followed by Sardar and Doma with (10.58 and 10.26% successively); the minimum reduction rate observed in Adana99 cv. (1.58%) with no significance with Simeto (3.35%) (Table 5).

The result of this study was in agreement with the result of Stephens (2010) who reported that disease severity of *Fusarium* spp. was inversely correlated with plant height, and the tillers may be stunted with ununiform height. When *F. graminearum* attacks wheat plants, penetrates into crown roots and continues growing entirely to crown tissue, decaying the plant tissues that have role of moving nutrients and water from down to above ground parts of the plant. Therefore, plant with small foliage growth was produced (Draper *et al.*, 2000).

• **Percentage of reduction in spike length**

According to statistical analysis, the interaction between fungi and cultivars in the percentage reduction of spike length showed that *F. graminearum* affected on investigated cultivars noticeably, the most affected one was Sardar cv. (16.5%) and the less was Cham6 (2.95%), *F. oxysporum* also caused a significant reduction in spike length; the highest reduction found in Cham6 cv. (18.31%) with regard to (2.18%) in Adana99 cv. (Table 3).

For the effect of fungi on percentage rate of spike length reduction, *F. oxysporum* was more aggressive when reduced spike length with (10.76%) that different considerably with *F. graminearum* that caused (7.53%) of reduction (Table 4). In the most susceptible cultivar of Sardar, the spikes flaw in length with (12.92%) in the second rank Doma and Cham6 cv. came at (10.69 and 10.63% successively) (Table 5).

• **Percentage of reduction in number of tillers**

Results of interaction between cultivars and fungi in (Table 3) showed that Doma was the most cultivar susceptible to both *F. oxysporum* and *F. graminearum* when decreased tillers with 48.14% and 45.2% respectively, while Adana99 with stander pathogen attack though wheat tillers reduced by 4.32% and 5.05% or both fungi successively. No significant difference between *F. oxysporum* and *F. graminearum* in the percentage reduction in number of tillers (26.03% and 24.25% successively) (Table 4). Results of screened wheat cultivars for resistance to FCRR in (Table 5) demonstrated that wheat cultivars produced different response in the reduction rate of number of tillers to disease. The most susceptible cultivar to disease was Doma that produced 46.67% reduction in the number of tillers, while the most resistant cultivar to disease was found in Adana99 cv. when tillers reduced with only 4.68%.

Table (3): Effect of FCRR fungi on the percentage rate of reduction in growth criteria of tested wheat cultivars:

Fungi	Criteria (%Reduction)	Plant height (cm)	Spike length (cm)	No. of tillers/ plant
		Cultivars		
<i>F. graminearum</i>	Simeto	3.21 fg	4.12 de	22.03 bcd
	Doma	13.41 ab	7.58 cde	45.2 a
	Sardar	12.85 ab	16.5 a	25.28bcd
	Tamoz 2	14.14 a	7.12 de	26.76 bcd
	Cham 6	6.24 ef	2.95 e	21.18 cd
	Adana-99	1.71 g	6.92 de	5.05 e
<i>F. oxysporum</i>	Simeto	3.5 fg	12.93abc	29.78 bc
	Doma	7.11 de	13.8 ab	48.14 a
	Sardar	8.31 cde	9.34 bcd	32.83 b
	Tamoz 2	11.79abc	8.01 cde	24.6 bcd
	Cham 6	10.29bcd	18.31 a	16.52 d
	Adana 99	1.44 g	2.18 e	4.32 e

-Means of different letters in each column differ significantly depending on Duncan's Multiple Range test ($P \leq 0.05$)

-Each number is a mean of four replications.

Table 4: Effect of fungi on the percentage rate of reduction in yield product of tested wheat cultivars

Cultivars	Criteria (% Reduction)	Plant height(cm)	Spike length (cm)	No. of tillers/ plant	No. of grains/ spike	1000-grain weight(g)	Biological yield (gm/plant)	Plant yield(gm/ plant)	Harvest index
Simeto		3.35 c	8.53 b	25.9bc	10.08c	2.98c	8.85c	10.54c	6.58bc
Doma		10.26b	10.69 b	46.67a	20.06b	7.59a	38.33a	48.29a	15.67a
Sardar		10.58b	12.92a	29.05b	33.28a	6.15ab	34.4a	38.27b	6.3bc
Tamoz 2		12.96a	7.56bc	25.68bc	10.53c	4.43bc	11.48c	28.11c	17.37a
Cham 6		8.26b	10.63ab	18.85c	19.8b	5.46abc	17.29b	23.32d	7.47b
Adana-99		1.58c	4.55c	4.68d	6.26c	3.82bc	4.65d	8.53e	3.5c

-Means of different letters in each column differ significantly depending on Duncan's Multiple Range test ($P \leq 0.05$)

-Each number is a mean of four replications.

Table (5): Effect of infection on reduction in yield product of tested wheat cultivars:

Fungi	Criteria (% Reduction)	Plant height (cm)	Spike length (cm)	No. of tillers/ plant	No. of grains/ spike	1000-grain weight(g)	Biological yield (gm/plant)	Plant yield(gm/ plant)	Harvest index
<i>F.graminearum</i>		8.59a	7.53b	24.25a	17.09a	5.73a	17.66b	26.45a	12.16a
<i>F.oxysporum</i>		7.07b	10.76a	26.03a	16.24a	4.41a	20.67a	25.91a	6.80b

-Means of different letters in each column differ significantly depending on Duncan's Multiple Range test (P≤0.05)

-Each number is a mean of four replications.

• Percentage of reduction in grains number per spike

F. oxysporum was the most forcible fungi in the reduction number of grains, the highest affected cultivar was Sardar at 37.54%, on the contrary, the lowest affected cultivar was Tamoz2 and Adana99 which grains reduced with 1.47 and 5.69% successively. Sardar cv. was the highest affected cultivar to *F. graminearum* at 29.01% and the lowest affected cultivar was Adana99 at 6.83% (Table 6).

Results in (Table 4) showed that both fungi caused reduction in spike content of grains but the effect of *F. graminearum* was more than *F. oxysporum* in spite of non-significant difference between them at 17.09 and 16.24% respectively. The results of analysis (Table 5) showed that the most and significant reduction in number of grains was in Sardar cv. at 33.28%. Doma cv. came in the second degree at 20.06%, and the less reduction rate 6.26% found in Adana 99cv. This result was consistent with the result of Fernandez and Corner (2011) who also reported that infected tillers by FCRR producing few or became seedless.

• Percentage of reduction in 1000-grain weight

Weight of 1000 grains is an important growth criteria which is regarded as the degree of wheat filling. Through the results of analysis of interaction between cultivars and fungi from (Table 6) we observed that *F. graminearum* and *F. oxysporum* caused the highest reduction rate

in Doma cv. with 9.19% and 6.0% respectively. The lowest reduction of grains weight caused by both pathogens found on Simeto cv. 2.92% and 1.81% on Tamoz2 cv., respectively. The results of analysis about the effect of fungi on the reduction rate in the 1000-grain weight (Table 4) clarified that *F. graminearum* was distinguished fungi in reduction of grains weight with 5.73% compared to *F. oxysporum* with 4.41%. Wheat cultivars showed different susceptibility to FCRR disease in reduction weight of 1000-grain; Doma cv. was supersensitive at 7.59% from most remaining cultivars, while less reduction rate was showed by Simeto at 2.98% and Adana99 at 3.82% (Table 5).

The results were in agreement with the publication of Smiley *et al.* (2005) who demonstrated that the weight of mature spikes reduced by *Fusarium* spp. in the pathogenicity trail under field conditions. Chekali *et al.* (2013) reported that weight of 1000-grain was reduced by *Fusarium* foot and root rot disease. This reduction may be due to aggressive invasion of *F. graminearum* that destroying storage protein, starch granules and cell walls, during the second week of anthesis wheat kernels when reached its maximum shape and size. Therefore, it must have grown to its mature size before the fungus invaded development (Bechtel *et al.*, 1985).

• Percentage of reduction in biological yield

Statistical analysis of interaction between fungi and investigated wheat cultivars revealed

the highly affected Sardar cv. run to (51.25%) in the presence of *F. oxysporum*, Doma came at 40.95%. The lowest affected cultivars was Tamoz2 and Adana99 with 2.29% and 2.89% reduction, respectively. *F. graminearum* also caused higher reduction rate in Doma cv. (35.71%), while the lowest and non-significant reduction found in Adana99 (6.42%) and Simeto (8.41%) (Table 6). The effect of fungi on the reduction rate of the biological yield of wheat cultivars, *F. oxysporum* was more virulent at 20.67% than *F. graminearum* which caused 17.66% reduction rate with significant difference between them (Table 4). The results of screening the susceptibility of six wheat cultivars to FCRR disease as shown in (Table 5) illustrated that the Doma and Sardar cvs. Were highly affected in the biological yield reached to 38.33% and 34.4% successively, with no significant difference between them whereas the lowest affected cultivar was Adana99 (4.65%).

Percentage of reduction in plant yield

Grains yield is considered as essential growth criteria. As its clear in (Table 6) the results of statistical analysis of interaction between cultivars and fungi demonstrated that *F. oxysporum* was the most affected fungi on the most susceptible cultivar of Sardar (54.4%), then Doma came (46.79%), whereas the less susceptible cultivar was Adana99 (5.77%), *F. graminearum* was most aggressive on Doma which decreased 49.79% of grain yield, followed by Tamoz2 (42.64%) but the most resistant cultivars against *F. graminearum* was Simeto when (11.11%) and Adana99 (11.29%). Results of the effect of fungi on the percentage rate of reduction in plant yield in (Table 4) showed that both fungi are affective, *F. graminearum* caused 26.45% reduction rate more than *F. oxysporum*

that caused 25.91% reduction. Results of analysis in (Table 5) indicated that the highest percentage rate of reduction in the plant yield was in Doma cv. (48.29%) and Sardar cv. came in the second rank with 38.27%, in contrast the lowest reduction rate was in Adana99 (8.53%). Similar results were reported in Tunisia by Chekali *et al.* (2013) when the highest losses in grain yield of durum cultivars caused by Fusarium foot and root rot fungi reached 48% and soft cultivars was less affected.

• Percentage of reduction in harvest index

Through the interaction between cultivars and fungi the results of statistical analysis in (Table 6) demonstrate that the more reduction (25.81%) was caused by *F. graminearum* on cultivar Tamoz2 and Doma (21.57%) and the lowest reduction (5.43%) found in cultivar Adana99 and Sardar (5.6%). For *F. oxysporum*, the most susceptible cultivar was Doma (9.77%) with no significant differences from cham6, Tamoz2 and Sardar and the less susceptible cultivar was Adana99 (1.57%). The results in (Table 4) indicated that *F. graminearum* was more affective when caused a significant reduction rate of harvest index (12.16%) compared to *F. oxysporum* (6.80%) that are significantly different to each other. Results in (Table 5) showed that the highest reduction was observed in cultivars Tamoz2 (17.37%) and Doma (15.67%), while the lowest reduction was realized in Adana99 (3.5%). Harvest index is the ratio of plant yield to biological yield. High biological yield will reduce harvest index in the case when plant yield is relatively lower, our results consistent obviously with Omer (2015) as in Tamoz2.

Table (6): Effect of FCRR fungi on the percentage rate of reduction in yield product of tested wheat cultivars:

Fungi	Cultivars	Criteria (% Reduction)	No. of grains/spike	1000-grain weight(g)	Biological yield (gm/plant)	Plant yield (gm/ plant)	Harvest index
<i>F. graminearum</i>	Simeto		12.77 ef	2.92 cd	8.41 de	11.11 ef	8.9 b
	Doma		18.94cde	9.19 a	35.71 b	49.79 ab	21.57 a
	Sardar		29.01 b	7.15 ab	17.56 c	22.14 d	5.6 bc
	Tamoz 2		19.59 cd	7.05 ab	20.67 c	42.64 c	25.81 a
	Cham 6		15.41 de	4.77 bcd	17.2 c	21.72 d	5.64 bc
	Adana-99		6.83 fg	3.30 bcd	6.42 de	11.29 ef	5.43 bc
<i>F. oxysporum</i>	Simeto		7.4 fg	3.04 cd	9.29 d	9.97 ef	4.26 bc
	Doma		21.17 cd	6.00 abc	40.95 b	46.79 bc	9.77 b
	Sardar		37.54 a	5.14 bcd	51.25 a	54.4 a	6.99 b
	Tamoz 2		1.47 g	1.81 d	2.29 e	13.59 e	8.94 b
	Cham 6		24.19 bc	6.15 abc	17.38 c	24.93 d	9.3 b
	Adana 99		5.69 g	4.33 bcd	2.89 e	5.77 f	1.57 c

-Means of different letters in each column differ significantly depending on Duncan's Multiple Range test (P<0.05)

-Each number is a mean of four replications.

In our study all cultivars that had been used were susceptible or had medium or partial resistance to FCRR disease; the high susceptibility was shown in cultivars Doma and Sardar, and the most resistant cultivars to disease were Adana99 and cham6. These results were in agreement with the reports of Arici (2012) who showed that Adana99 cv. had moderate resistance to *F. graminearum*. Salih (2015) demonstrated that among the cultivars used for seedling blight Adana99 cv. was less susceptible to disease.

Several authors suggested that number of genes associate with the resistance of wheat cultivars to *Fusarium* spp. which caused disease (Moya, 2010), and presence of Quantitative trait locus (QTL) in chromosomes of some wheat cultivars represent important loci because it is responsible for FCR resistances and it reduces disease severity which affect plant height and growth rate (Liu and Ogonnaya, 2015). In this aspect, Lemmens *et al.* (2005) explained that locus Qfhs.ndsu-3BS has effect on deoxynivalenol (DON) resistance by encoding a DON-glyco syltransferase or by regulating the expression of such enzyme; it acts as a detoxification that converts DON to DON-3-O-glucoside which is a detoxification product. Also high levels of hydrolytic enzymes β -1, 3 -

glucanase and chitinase in plant release oligosaccharides from the fungal cell wall which elicit plant defenses against *Fusarium* spp. (Desmond *et al.*, 2006).

However, *F. graminearum* has virulence factors that secreted during all stages of disease which designed to use the physiology of plant for its need (Walter *et al.*, 2010). Enzymes for plant cell wall degrading like (hemicellulases, cellulases and pectinases) are essential group of virulence factors which promote early infection of flower and fast colonization of spikes (Wanjiru *et al.*, 2002). Furthermore, cell-wall degrading enzymes related during both pathogenic and saprotrophic stage of *F.graminearum* life cycle (Belien *et al.*, 2006). Mycotoxins produced by *Fusarium* crown rot during FCR infection, inhibit protein synthesis that could suppress host defense responses production as proposed by Mudge *et al.* (2006).

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هه ستیاریا توخمین گه نومی بو نه خو شیبا رزینا گهه و رهین فیوزاریومی ل دهوک - هه ریم کوردستان - عیراق

پوخته

تاقیکرنا هه ستیاریا توخمین گه نومی بو نه خوشیا رزینا گهه و رهین فیوزاریومی هاته نه نجامدان ل بن کاودانین کیلگهیی چونکی دهینه هه لبرارتن گرنگترین ریک بو بهرگریا که روین نه خوش نه وین کو نه گهری وان هه ردوو جورین *Fusarium* و *Fusarium graminearum* و *oxysporum*. د نه نجامین تاقیکرنن دا خویا بو کو هه ردوو جورین که رویان شیانا نه خوشیا بلند ل سهر توخمین هه لبرارتی هه بوو ل جوری *F. graminearum* توندیا نه خوشیی بلندتریبوو (0.41) به راورد ل گه ل جوری (0.32) *F. oxysporum*. کو بو نه گهری کیمرنا سالوخه تین رووه کی نه وین مه فه کولین ل سهر کری نه وژی (بلندیا رووه کی ، دریزیا گول ، ژمارا تایان ، ژمارا دندکان دگولن دا، کیشا هزار دکان ، بهرهمی بایولوجی، بهرهمی رووه کی و گروقی درینن) و پترترین توخمی هه ستیار دوما (0.33) ل دویف دا توخمی سهر دار (0.29) به لی کیمرین توخمی هه ستیار توخمی نه ده نه-99 (0.16) بووچ توخمین هه لبرارتی به ره قانیا تمام دژی که روین نیشار نه دیتن د قی فه کولینن دا.

حساسیة اصناف الحنطة لتعفن التاج و الجذور الفیوزاریومی فی محافظة دهوک - اقلیم کوردستان - العراق

الخلاصة

اجرى اختبار حساسية اصناف الحنطة لمرض تعفن التاج والجذور الفيوزاريومي تحت ظروف الحقل باعتبارها اهم الطرق المتبعة لمقاومة الفطر الممرض المتسبب عن النوعين *F. graminearum* و *F. oxysporum*. اظهرت النتائج ان كلا النوعين اظهرت قدرة امراضية عالية على الاصناف المختبرة واظهر النوع *F. graminearum* شدة مرض عالية (0.41) مقارنة مع النوع *F. oxysporum* (0.32) حيث أدى الى اختزال فى صفات النبات المدروسة متمثلة ب (طول السنبله ، ارتفاع النبات ، عدد الاشطاء ، عدد الحبات فى السنبله ، الحاصل البيولوجي ، وزن الف حبة ، حاصل النبات ودليل الحصاد) . ان اكثر الاصناف حساسية كان الصنف دوما (0.33) تلاها الصنف سردار(0.29) بينما اقل الاصناف حساسية كان الصنف ادنة99 (0.16). لم تظهر اي الاصناف المختبرة مقاومة كاملة ضد الفطر الممرض خلال هذه الدراسة.