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Effect of soil treatment with pathogenic fungi on the growth and production of wheat (*Triticum aestivum* L.) varieties.

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ABSTRACT

The pots experiment was conducted in the Khabat Technical Institute/ Erbil Polytechnic University/ Kurdistan region/ Iraq, 2022-2023, to study the Effect of soil treatment with pathogenic fungi on the growth parameters and production of wheat varieties. A factorial experimental design was applied in a random complete block design (RBCD) with three replications. The first factor represents five varieties of wheat (Adana, Hawler 2, Hawler 6, Jehan, and Pakistany), the second factor represents two soil types (full control and natural soil) and two types of pathogenic fungi (*Pythium aphanidermatum* and *Alternaria alternata*). The fungi *Pythium aphanidermatum* had the most influence on the growth characteristics as the plant height was 65.734 cm, number of tillers 3.866, leaf area (LA) 353.576 cm^2, leaf area index (LAI) 7.07, dry matter 5.09 g per plant, crop growth rate 0.033 g $plant^{-1}$ day^{-1}, while *A. alternate* fungi showed less effect than *P. aphanidermatum*. For wheat varieties, Hawler 2 recorded the best results on the growth characteristic, and the interaction treatment of *A. alternata* with the Hawler 2 variety gave the best results in terms of growth and yield characteristics. The full control had the most influence on the yield characteristics and recorded the heights. of spike $plant^{-1}$ 6.86, No. of seed $spike^{-1}$ 10.53, 1000 grain weight 52.66 g and grain yield 44.93 g $plant^{-1}$, as well as the highest value of the yield components among the varieties was the Hawler 2 variety, the interaction between the full control with the Adana variety achieved the highest result of No. of spike $plant^{-1}$ and grain yield g $plant^{-1.}$

***Keywords*:** Wheat, Pythium sp., Alternaria sp., Growth, Yield..

INTRODUCTION

Wheat crop (*Triticum* spp.) belongs to the Poaceae family and is considered the most important economic crop globally. The global demand for wheat increases annually with the increase in population. The level and quality of cereal yields depend largely on the crop management system [1]. Wheat can grow in most temperatures, especially in the subarctic regions of the world, and its original homeland is northern Iraq; wheat grain is made into flour, which is the main source of bread. Grain fungal infections can cause 15-20% yield reductions and up to 60% in severe situations. The elements that determine the incidence of these infections are the weather condition throughout the growth and plant season, previous crop, soil service, and enough fertilization that restrict plant growth and development and lower production [2].

The wheat crop is exposed to many diseases resulting from pathogens, whether in the field, during harvest, transportation, or storage [3]. Fungi are one of the pathogens because of the advantages they possess that help them survive and compete due to the type of their nutritional needs and their production of many hydrolytic enzymes and some mycotoxins [4,5]. Among the most important fungal pathogens that infect wheat are soil fungi, including the genus *Pythium aphanidermatum* and *Alternaria alternata*, which are transmitted to the plant through infected soil [6]. It can affect crops on the field or plant products at the harvest or post-harvest stage [7]. Some of the fungal diseases are transmitted through seeds. Alternaria sp. is one of the fungal organisms that not only reduces the germination and vigour of wheat seed but also causes seedling blight disease [8].

The Alternaria alternata fungus causes diseases, including Alternaria spot disease, which appears when wheat plants are about 7-8 weeks old. The infestation becomes severe when the crop matures. You may find small, discolored, oval spots irregularly scattered on the leaves. As these spots get larger, they become dark brown to gray and irregular in shape [9]. Alternaria spp. Additionally, destroyed spelt gluten structure [10]. The quality of the flour and the nutritional value are lower due to the decrease in starch and the loss of other important compounds. Therefore, fungi have many harms before or after harvesting and reaping [11]. In Pakistán, Alternaria spp. was detected as predominant, causing an 82% reduction in germination of wheat seeds and also affecting seedling vigor [12].

The species of Pythium, which belong to the class (Oomycetes) are widely distributed in various environments, including desert and polar regions and soil [13]. Found naturally in soil and water and are widespread in wheat and barley fields, which causes Pythium root rot disease [14]. Some species of Pythium cause global warming and significant crop losses. Several *Pythium* species, including *P. aphanidermatum*, are known to cause seed rot disease or seedling soft wilt. It is multifamily, and this disease spreads when seedlings are crowded together, and ground humidity is high

[15]. Factors contributing to *Pythium's* spread are excessive watering, poor ventilation, and inappropriate temperatures in the root area. This leads to the weakening of the crop and thus leads to the spread of *Pythium* [16]. In research conducted in the United States, North Carolina to find out the cause of wheat plant stunting, the results showed that the cause was the presence of species of Pythium fungus in the soil, which was the cause of some rots appearing in the roots [17]. International scientific collaboration is required to enhance output and lessen the fungal infections that impact cereals, since they are among the most significant farmed crops. Variety selection is complex in different winter crops when grown, as genetic resistance traits depend on plant breeding [18]. This research was conducted to determine the extent to which two types of fungal diseases and their responses by some soft wheat plants affect growth measurements and productivity.

Materials and Methods

This pot experiment was carried out at the Khabat Technical Institute in the winter of 2022-2023. The factorial experiment was applied in a randomized complete block design with three replications. The first factor represents five varieties of wheat (Adana, Hawler 2, Hawler 6, Jehan, and Pakistany), the second factor represents two types of soil (full control and natural soil) and two types of pathogenic fungi (*Pythium aphanidermatum* and *Alternaria alternate*) to study the effect of the two fungi on growth characteristics and yield of five types of wheat which taken from the research station center in Erbil.

The experiment unit was carried out in 5-Kg plastic pots; planting was done manually in each pot at a depth of 3 cm. After planting, 1.77 g pot^{-1} of diammonium phosphate $(NH4)_2HPO4$ (18%N 46% P2O5) fertilizer was applied, and 1.41 g pot^{-1} of urea fertilizer (46% N) was administered to the plant throughout vegetative development. Before planting, samples were collected from different parts of the soil used in the pot, The samples were then dried by air, sieved using a 2mm sieve, and packaged for examination (Table 2). The soil used in the plastic pots was taken from the institute's field, sterilized with an autoclave at 121 C for half an hour, and placed in sterile plastic bags until use. The fungi were obtained from field soil at the institute and isolated in the laboratory using the culture medium (potato dextrose agar). Thirty-nine grams of the substance were used per liter of distilled and sterile water, according to what was recommended on the box. After four days, it was sent to private laboratories to diagnose the fungi using the polymerase chain reaction (PCR) method to verify its types. The PCR method results showed that the two isolated fungi were *A. alternatum* and *P. aphanidermatum*. The soil was contaminated with fungi using one plate of fungi, 9 cm in diameter, six days old, in one liter of distilled and sterile water. The pots were watered and left for two days.

Five plants from each experimental unit were randomly taken at the flowering stage to determine some growth parameters: plant height cm, number of tillers, leaf area (cm^2), and leaf area index (LAI) from the Viti canopy program application [19], dry matter (g $plant^{-1}$); which represents the dry mass of the total of the plant after drying at 80°C for 48 hrs., then weight was converted to g $plant^{-1}$. Crop growth rate (CGR) g $plant^{-1}$ day^{-1}: It was calculated by dividing dry matter yield (g $plant^{-1}$) at the flowering stage by number days from sowing to the flowering stage [20]. From all plants in a pot to study yield and yield components, number of spike $plant^{-1}$, number of grain $spike^{-1}$, weight of 1000 grain (g), and grain yield (g $plant^{-1}$)

According to analyses of variance performed with the Statistical Analysis System [21], the data was statistically analyzed for each of the characteristics that were evaluated [22], used Duncan's multiple range test (DMRT) with a significance level of 5% to compare the means [23].

Table (1): Metrological data for Khabat field station during the rainfall season of (2022-2023).

Months	Air Temperature (°C)			Monthly total rainfalls mm	Relative Humidity R.H%
	Maximum	Minimum	Average		
November 2022	25.2	10.5	17.8	22.5	69.4
December 2022	19.5	6.2	12.8	30.6	68.9
January 2023	17.0	2.1	9.5	46.8	69.3
February 2023	15.6	2.2	8.9	16.3	68.3
March 2023	22.8	8.7	15.8	53.9	70.2
April 2023	26.3	9.8	18.6	95.8	65.1
May 2023	34.6	15.5	25.0	8.8	56.5
Jun 2023	40.7	20.9	30.8	---	47.2
July 2023	45.4	24.0	34.7	---	46.6

Table (2): Some physical and chemical parameters of the soil at the depth of (0 - 30 cm).

Soil depth cm	PSD %					Ec ds/m	O.M %	(N) %	Available (P)	K^{+}	Ca^{+2}	Mg^{+2}
	Sand	Silt	Clay	Soil Texture	pH							
	g/kg soil					dS/m	%		$mg.g^{-1}$	Mmolic.L^{-1}		
0-30	6	50	44	Silty clay	7.5	1.3	1.1	0.27	3.76	0.22	6.57	3.98

Results and discussion

1- Effect of soil treatment with fungi and variety on growth parameters:

The data in Table (3) indicates that highest values were recorded for control treatment as the plant height reached (76.901 cm), number of tiller (7.133), leaf area (447.750 cm^2), LAI (8.952), dry matter (6.430 g $plant^{-1}$), crop growth rate (0.042 g $plant^{-1}$ day^{-1}) respectively, While A. alternate had less effect than P. aphanidermatum as the plant height reached (68.482 cm), leaf area (407.788 cm2), LAI (8.155), dry matter (5.796 g $plant^{-1}$), crop growth rate (0.038 g $plant^{-1}$ day^{-1}). As for the varieties of wheat, varieties Hawler 6 and Hawler 2 recorded the best results. For variety Hawler 2, the plant height reached (71.389 cm), leaf area (412.378 cm2), LAI (8.245), dry matter (5.966 g m^2), and crop growth rate (0.039 g $plant^{-1}$ day^{-1}). Moreover, for varieties Hawler 6, the plant height reached (73.276 cm), leaf area (413.220 cm2), LAI (8.263), dry matter (5.879 g $plant^{-1}$), crop growth rate (0.039 g $plant^{-1}$ day^{-1}), respectively.

Table (3): Effect of fungi and variety on growth parameters of plant.

Soil treatments	Plant height cm	No. tiller $plant^{-1}$	Leaf area cm^{-2}	LAI	Dry matter g $plant^{-1}$	Crop growth g $plant^{-1}$ day^{-1}
Natural soil	74.596 b	6.266 b	428.225 b	8.562 b	6.186 b	0.413 b
Full Control	76.901 a	7.133 a	447.750 a	8.952 a	6.430 a	0.042 a
A. alternate	68.482 c	4.800 c	407.788 c	8.155 c	5.796 c	0.038 c
P. aphanidermatum	65.734 d	3.866 d	353.576 d	7.070 d	5.090 d	0.033 d
Variety	Plant height cm	No. tiller $plant^{-1}$	Leaf area cm^{-2}	LAI	Dry matter g $plant^{-1}$	Crop growth g $plant^{-1}$ day^{-1}
Hawler 2	71.389 c	5.833 a	412.378 a	8.245 a	5.966 a	0.039 a
Hawler 6	73.276 a	5.500 a	413.220 a	8.263 a	5.879 b	0.039 b
Adana	72.083 b	5.583 a	410.462 b	8.208 b	5.841 c	0.038 b
Jehan	69.850 e	5.333 a	403.707 d	8.070 d	5.854 bc	0.039 b
Pakstany	70.544 d	5.333 a	406.907 c	8.135 c	5.837 c	0.039 b

The data presented in Table (4) shows that the interaction treatments affected significantly, the height value of plant height (79.290 cm) recorded from the combination treatment of (Control with Hawler 6), and the height value of number of tillers (7.133) for (Control with Adana), while leaf area and LAI (453.486 cm^2) and (9.066) respectively recorded from the combination treatment of (Control with Pakstany), for the dry matter the heights value was (6.466 g $plant^{-1}$) when (Control with Jehan) for the crop growth the heights value was (0.043 g $plant^{-1}$ day^{-1}) when (control with

Adana). However, the lowest values were recorded for plant height (64.630 cm), leaf area (341.663 cm^2), LAI (6.830), dry matter (5.033 g $plant^{-1}$), crop growth rate (0.037 g $plant^{-1}$ day^{-1}), when (*P. aphanidermatum* with Pakstany).

Table (4): Effect of Interaction between fungi and Variety on growth parameters of plant.

		Plant height cm	No. tiller $plant^{-1}$	Leaf area cm^{-2}	LAI	Dry matter g $plant^{-1}$	Crop growth g $plant^{-1}$ day^{-1}
Natural soil	Hawler 2	75.070 de	5.666 bcd	428.146 f	8.560 f	6.126 cd	0.413 d
	Hawler 6	76.070 cd	6.666 ab	433.220 e	8.663 e	6.166 de	0.410 d
	Adana	74.106 e	6.666 ab	425.156 g	8.500 g	6.116 e	0.410 d
	Jehan	72.630 f	6.000 bc	423. 490 g	8.466 g	6.166 de	0.410 d
	Pakstany	75.106 de	6.333 bc	431.113 e	8.620 e	6.266 c	0.420 c
Full Control	Hawler 2	77.630 b	7.666 a	491.190 b	9.020 b	6.433 ab	0.043 ab
	Hawler 6	79.290 a	6.333 bc	446.890 c	8.936 c	6.383 b	0.042 abc
	Adana	76.890 bc	7.666 a	444.290 d	8.883 d	6.500 a	0.043 a
	Jehan	74.143 e	7.666 a	442.890 d	8.853 d	6.466 a	0.043 ab
	Pakstany	76.553 c	6.333 bc	453.486 a	9.066 a	6.366 b	0.042 bc
A. alternate	Hawler 2	67. 853 h	5.333 cde	413.326 h	8.266 h	5.933 f	0.039 e
	Hawler 6	70.560 g	4.666 def	411. 253 h	8.223 h	5.833 g	0.039 f
	Adana	70.450 g	4.333 efg	408.180 i	8.166 i	5.733 h	0.038 g
	Jehan	67.663 h	4.333 efg	404.816 j	8.093 g	5.800 g	0.038 fg
	Pakstany	65.886 i	5.333 cde	401.366 k	8.026 k	5.683 h	0.038 g
P. aphanidermatum	Hawler 2	65.003 ij	4.666 def	356.850 n	7.136 n	5.283 i	0.035 h
	Hawler 6	67.186 h	4.333 efg	361.513 m	7.230 m	5.133 j	0.034 i
	Adana	66.886 h	3.666 fg	364. 223 l	7.283 l	5.016 k	0.033 i
	Jehan	64.966 ij	3.333 g	343.630 o	6.870 o	4.983 k	0.033 i
	Pakstany	64.630 j	3.333 g	341.663 o	6.830 o	5.033 k	0.037 i

2-Effect of soil treatment with fungi and variety on yield parameters of the plant

The effect of fungi and variety on yield is shown in Table (5); the highest values were recorded for control treatment as the number of the spike (6.866), No. of seed spike-1 (10.533), grain weight (52.666 g), and grain yield (44.933). While A. alternata had less effect than P. aphanidermatum as the number of tillers (4.800), No. of the spike (4.800), No. of seed/ spike (7.800), grain weight (43.600 g), and grain yield (36.400). Rregarding the effect of varieties, the production of variety Hawler 2 was better.

Table (5): Effect of fungi and variety on yield parameters of plant.

Fungi	No. spike plant^{-1}	No. seed spike^{-1}	1000 grain weight g	Grain yield g plant^{-1}
Natural soil	6.066 b	8.733 b	46.866 b	41.067 b
Full Control	6.866 a	10.533 a	52.666 a	44.933 a
A. alternate	4.800 c	7.800 c	43.600 c	36.733 c
P. aphanidermatum	3.800 d	6.666 d	38.600 d	34.400 d

Variety	No. spike plant^{-1}	No. seed spike^{-1}	1000 grain weight g	Grain yield g plant^{-1}
Hawler 2	5.666 a	9.083 a	46.166 a	39.500 a
Hawler 6	5.333 a	8.833 ab	45.583 ab	39.250 a
Adana	5.416 a	8.416 bc	45.416 b	39.500 a
Jehan	5.250 a	7.833 d	45.000 b	39.083 a
Pakstany	5.250 a	8.000 cd	45.000 b	39.083 a

Table (6) shows that the interaction treatments were affected significantly, the highest values were given for (full control treatment with variety) as No. of the spike plant^{-1} (7.666) for Adana, No. of seed spike^{-1} (11.666) for Hawler 6, 1000 grain weight (55.00 g) for Pakstany, grain yield (64.333 g plant^{-1}) for Adana, and the lowest values were recorded for No. spike (3.333), when (*P. aphanidermatum* with Pakstany and Jehan), No. seed spike^{-1} (6.333), when (*P. aphanidermatum* with Jehan), and the lowest values were recorded for grain weight and grain yield was 35.666 g, 33.333 g plant^{-1} when (*P. aphanidermatum* with Pakstany). For the interaction treatment of *A. alternate* with variety, and the great number of a spike in the plant was 5.333 for Hawler 2 and Pakstany, while No. of seed spike^{-1}, grain weight, and grain yield were 8.666, 45.666 g, and 37.667g plant^{-1}, respectively, for Hawler 2. At the same time, the control treatment, with variety, had results that were close to those of the control treatment

Table (6): Effect of Interaction between soil treatment with fungi and variety on yield of plant.

		No. spike plant^{-1}	No. seed spike^{-1}	1000 grain weight g	Grain yield g plant^{-1}
Natural soil	Hawler 2	6.000 cd	9.666 cde	45.666 e	41.667 d
	Hawler 6	6.000 cd	8.666 efg	45.666 e	40.333 e
	Adana	6.333 bcd	8.666 efg	47.333 d	41.333 de
	Jehan	6.000 cd	8.333 fgh	48.000 d	40.333 e
	Pakstany	6.333 bcd	8.333 fgh	47.666 d	41.667 d
Full Control	Hawler 2	7.000 abc	10.666 abc	51.000 c	43.333 c
	Hawler 6	6.333 bcd	11.666 a	51 333 c	45.333 ab
	Adana	7.666 a	11.000 ab	53.333 b	64.333 a
	Jehan	7.333 ab	9.333 def	52.666 b	45.333 ab
	Pakstany	6.000 cd	10.000bcd	55.000 a	44.333 b
A. alternate	Hawler 2	5.333 def	8.666 efg	45.666 e	37.667 f
	Hawler 6	4.666 ef	8.333 fgh	44.666 e	36.667 fg
	Adana	4.333 fg	7.666 ghi	43.333 f	35.667 gh
	Jehan	4.333 fg	7.333 hij	42.666 fg	36.667 fg
	Pakstany	5.333 def	7.000 ij	41.666 gh	37.000 f
P. aphanidermatum	Hawler 2	4.666 ef	7.333 hij	42.333 fg	35.333 h
	Hawler 6	4.333 fg	6.666 ij	40.666 h	34.667 hi
	Adana	3.333 g	6.333 j	37.666 i	34.667 hi
	Jehan	3.333 g	6.333 j	36.666 ij	34.000 ij
	Pakstany	3.333 g	6.666 ij	35.666 j	33.333 j

It is clear to us from the results of the research that the fungi have negatively affected the growth of the wheat plant and affected the characteristics of growth and production, as the high humidity in the region affects the activity of the fungi and the humidity rate reached 70.2%, as the rainfall rate was high and reached 53.9 mm. Temperatures are suitable for the growth of fungi and reach 22.8 during the day (Table 1). This was confirmed by researchers [17], who stated that fungal activity increases with high humidity and affects the growth characteristics of wheat plants. The researchers [24]. confirmed this: one of the most important factors influencing the occurrence of fungal diseases is the weather conditions during the growing season.

One of the reasons for the decrease in plants' height is that the roots in plants absorb water and salts from the soil and supply them to the rest of the plant parts. When these roots are infected with a pathogenic fungus, it affects the function of the roots, making them absorb a smaller amount of water, which results in reduced yields and shorter plant, grain shrinkage, and lack of filling. The results were consistent with the findings of [25], [26], [27], [28], and [29]. Moreover, in research conducted in the United States, North Carolina to find out the cause of wheat plant stunting, the results showed that the cause is the presence of species of Pythium fungus in the soil, which was also the cause of some rots appearing in the roots [17]. Also, fungal pathogens can produce a variety of enzymes that degrade the plant cell wall, and these enzymes help the pathogens penetrate and colonize their host plants. We show that the pathogen *A. alternata* produced cellulolytic and pectinolytic enzymes [30]. In contrast, mycotoxins are harmful to plants and detrimental to both humans and animals. Cell death, reduced growth, chlorosis, disturbed mitosis, and modifications to protein metabolism are consequences that plants may experience from these harms. Mycotoxins change from their parent forms into modified ones in cereal plants to defend against their phytotoxic effects. These are free mycotoxins attached to carbohydrates or proteins. The ultimate mycotoxin level in grains is much harder to detect and ascertain since these forms are more elusive than free mycotoxins [31]. The occurrence of fungal diseases in cereals is influenced by tillage technique, cultivation technology, fertilization rate, and variety selection. In the traditional breeding process, when using different varieties of wheat, great progress has been made by identifying genes responsible for resistance to certain diseases, such as fungal diseases [32]. However, throughout plant growth and development, the weather significantly impacts the incidence of these diseases. Fungal diseases lead to low grain production and a decrease in the number of grains per ear, which reduces the assimilative area of leaves and ears and results in large yield losses. They contribute to the decline in grain quality by introducing mycotoxins, which harm human health, according to [33].

Conclusions

The findings of this research revealed that the wheat varieties Hawler 6 and Hawler 2 were highly susceptible to different types of pathogenic fungi. Among these, *Pythium aphanidermatum* had the greatest impact on the growth parameters, including plant height (cm), number of tillers, leaf area (cm^2), leaf area index (LAI), dry matter (g $plant^{-1}$), crop growth rate (g $plant^{-1}$ day^{-1}), and yield components; number of spikes, number of seeds $spike^{-1}$, 1000 grain weight (g), and grain yield (g $plant^{-1}$).

References:

[1]. Chaves, M. S., Martinelli, J. A., Wesp-Guterres, C., Graichen, F. A. S., Brammer, S. P., Scagliusi, S. M., ... and Consoli, L. (2013). 'The importance for food security of maintaining rust resistance in wheat', Food security, 5(2), pp. 157-176. https://doi.org/10.1007/s12571-013-0248-x

[2]. Bozo, G. T., Dervis, S., Imren, M., Amer, M., Özdemir, F., Paulitz, T.C., Morgounov, A., Dababat, A.A., and Özer, G. (2022). Fungal Pathogens Associated with Crown and Root Rot of Wheat in Central, Eastern, and Southeastern Kazakhstan. J. Fungi, 8, 417. https://doi.org/10.3390/jof8050417.

[3]. Al-Husseini, A. M., Abdul Mahdi,S. A., and Ali A.(2012). Test the efficiency of Bacillus circulans in protecting wheat plant from infection by Pythium aphanidermatu. V 4. N 1. Magazine of Al-Kufa university journal for biology. https://2u.pw/HmoWKk6k.

[4]. Jovana N. Đ., Marija I. B.,, Jelena A. K., Lato L. P., Nataša Ž. Ć., Jovana S. K., and Vladan M. U. (2018). Impact of Alternaria spp. and Alternaria Toxins on Quality of Spelt Wheat Journal of Agricultural Science; Vol. 10, No. 2; ISSN 1916-9752 E-ISSN 1916-9760 Published by Canadian Center of Science and Education. https://doi.org/10.5539/jas.v10n2p89

[5]. Al-Khairu, A. N. (2011). Chromatographic identification of some fungal toxins Simmons conjunct Alternaria causing + olive leaf spot growing in Iraq. College of Agriculture and Forestry. University of Al Mosul.

[6]. Prescott, J.M., P.A.Burnett, E.E.Saari, J.Ranson, J.Bowman, W. de Milliano, R.P. Singh and G.Bekele. (2007). Wheat Diseases and Pests: a guide for Field Indemnification International maize and wheat improvement center, Mexico. http:greengenes.cit.cornell.edu/wpest. https://2u.pw/rmpDkeVA

[7]. Hoffmann, A., Gunnar L., Matthias K. , Peter L., Thomas, S., and Marina E. H. M. (2021).Co-Cultivation of Fusarium, Alternaria, and Pseudomonas on Wheat-Ears Affects Microbial Growth and Mycotoxin Production. Mdpi Journal Microorganis ms. https://doi.org/10.3390/microorganisms9020443

[8]. Perello, A., and Silvina L. (2013) .Nature and effect of Alternaria spp. Complex from wheat grain on germination and disease transmission. Article in Pakistan Journal of Botany. https://2u.pw/4s2bsRt5

[9]. [9]- CABI International, (2022). Alternaria triticina (leaf blight of wheat), cabicompendium.4534, CABI Compendium, https://doi.org/10.1079/cabicompendium.4534
[10]. Jovana, Disalov. Marija, Bodroža-Solarov. Miljanić, Jelena. Pezo, Lato. Curcic, Natasa. Kojić, Jovana & Ugrenović, Vladan. (2024). Impact of Alternaria spp. and Alternaria Toxins on Quality of Spelt Wheat. Journal of Agricultural Science. https://doi.org/10.5539/jas.v10n2p89
[11]. Jaber, J. M. (2014). The effect of some fungi transmitted by the seeds of some wheat and barley varieties, their metabolites, and the pesticide Benelite on the percentage of germination in the laboratory and field. College of Agriculture, Dhi Qar University Journal for Agricultural Research, Volume 3, no 1, Pages 200-210. https://www.iasj.net/iasj/article/94684
[12]. Rajput, M.A., M.A. Pathan, A.M. Lodhi, G.S. Shah and K.A. Khanzada. (2005). Studies on seed-borne fungi of wheat in Sindh Province and their effect on seed germination. Pak.J. Bot., 37(1): 181-185. https://2u.pw/vHnBGsc8
[13]. Nam, B., & Choi, Y. J. (2019). Phytopythium and Pythium Species (Oomycota) Isolated from Freshwater Environments of Korea. Mycobiology, 47(3), 261–272. https://doi.org/10.1080/12298093.2019.1625174
[14]. Abboud, H. M., Abdullah A. H., and Mustafa M. M. (2017). Isolating and diagnosing the fungi associated with wheat root rot and identifying the causes of the disease and its resistance. Tikrit University Journal of Agricultural Sciences - Volume 17, no(1), 319-332. https://2u.pw/qVVwyzAK
[15]. Rai, Mahendra; Kamel Ahmed Abd-Elsalam; Avinash P. Ingle. 2020. Pythium Diagnosis, Diseases and Management. 1st Edition. Pub. LocationBoca Raton. ImprintCRC Press. Pages392. https://doi.org/10.1201/9780429296406
[16]. Ministry of agriculture food and fisheries. (2021). Pythium Diseases of Greenhouse Vegetables, British Columbia. https://2u.pw/aKAUFBwD
[17]. Lookabaugh, E., Barbara S., and Christing, C. (2017). Three pythium species isolated from severely stunted wheat during an outbreak in North Carolina. Plant health progress. vol. 18, no. 3, page 169 – 173. https://doi.org/10.1094/PHP-03-17-0015-RS
[18]. Feledyn-Szewczyk, B.; Cacak-Pietrzak, G.; Lenc, L.; Stalenga, J. Rating of spring wheat varieties (Triticum aestivum L.) according to their suitability for organic agriculture. Agronomy 2020, 10, 1900. https://doi.org/10.3390/agronomy10121900
[19]. De Bei, R., Fuentes, S., Gilliham, M., Tyerman, S., Edwards, E., Bianchini, N., Smith, J., and Collins, C. (2016). VitiCanopy: A free computer app to estimate canopy vigor and porosity for grapevine. Sensors (Basel). 16(4), 585. https://doi.org/10.3390/s1604058.
[20]. Hunt, R. 1978. Plant Growth Analysis, Studies in Biology, no. 96. Edward Arnold, London. PP: 67.
[21]. SAS. (2004). Statistical Analysis System. SAS/STAT User's Guide. Version 9.1, Cary, NC: SAS Institute Inc. USA. https://2u.pw/r3Cq93
[22]. Gupta, V.K., Rajender, P., Lal, M.B. and Baidya, N. M. (2016). Statistical Analysis of Agricultural Experiments. ICAR-Indian Agricultural Statistics Research Institute. New Delhi – 110012. iasri.res.in. https://2u.pw/wece7szG
[23]. Steel, R. G. H., Torrie, J. H. & Dicky, D. A. (1997). Principles and Procedures of Statistics. Abiometrical Approach. 3rd Ed. McGraw Hill, Inc. Book Co. N.Y., 352-358. https://www.nhbs.com/principles-and-procedures-of-statistics-book.
[24]. Szwejkowski, Z., Kurowski, T. P. (2009). Research on the influence of weather factors on the degree of invasiveness of fungal pathogens in the environment on the example of winter wheat. Przegląd Nauk. I. K. Sr., 26, 102–108.
[25]. Al-Abdalall, A. H. A. (2008). Pathological Studies on Root Rots of Wheat and Barley Induced by Rhizoctonia solani and Fusarium Culmorum and their Effects on the Crop. Middle Eastern and Russian Journal of Plant Science and Biotechnology, 2(2), 67-70. https://2u.pw/YE4EgNsj
[26]. Paulitz, T. C., R. W. Smiley, and R. J. Cook. (2002). Insights into the prevalence and management of soilborne cereal pathogens under direct seeding in the Pacific Northwest, USA. Can. J. Plant Pathol., 24:416- 428. https://2u.pw/6Opm64wd
[27]. Smith, J. D., K. K. Kidwell, M. A. Evans, R. J. Cook and R.W. Smiley. (2003). Evaluation of spring cereal grains and wild Triticum germplasm for resistance to Rhizoctonia solani AG-8. Crop Sci., 43:701-709. https://doi.org/10.2135/cropsci2003.7010
[28]. Smiley, R.W. (2005). Compendium of Wheat Diseases and Pests. 3rd edition. The Pennsylvania State University Press, University Park, MN, USA,. 37-39. Pp
[29]. Taha, Z. A. (2015). Wheat Root Rot in Ninevah Government and its Biological Control. Theses of master. University of Mosul, College of Agriculture and Forestry.
[30]. AL-Hachami, A. N., Obaid, Y. K. A., and Meethaq S. A. (2022). The enzymatic effect of Alternaria alternata on wheat plant and its role in pathogenicity as a virulence factor. Wasit Journal for Pure Science. Vol. (2) No. (1) https://2u.pw/0r2FIjD0

[31]. Panasiuk, Ł., Piątkowska, M., Pietruszka, K., Jedziniak, P., and Posyniak, A. (2018). Modified mycotoxins—A hidden threats beyond official control. Vet. Life, 93, 543–547. https://doi.org/10.1007/s12550-018-0327-0
[32]. Laidig, F.; Feike, T.; Hadasch, S.; Rentel, D.; Klocke, B.; Miedaner, T.; Piepho, H.P. Breeding progress of disease resistance and impact of disease severity under natural infections in winter wheat variety trials. Theor. Appl. Genet. 2021, 134, 1281–1302. https://doi.org/10.1007/s00122-020-03728-4
[33]. Róz˙ E., M., Wyzin´ S. M., and Grabi, N. J. (2021). The Most Important Fungal Diseases of Cereals— Problems and Possible Solutions. Agronomy, 11, 714. https://doi.org/10.3390/agronomy11040714.

تأثير نوعين من الفطريات المسببة للأمراض في قياسات النمو والإنتاج لبعض أصناف الحنطة

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الخلاصة

أجري البحث في حقل معهد خبات التقني/ جامعة اربيل التقنية خلال الموسم الشتوي 2022-2023. لدراسة تأثير نوعين من الفطريات المسببة للأمراض في قياسات النمو والإنتاج لبعض أصناف الحنطة. تم تطبيق التصميم التجريبي العاملي بتصميم القطاعات العشوائية الكاملة (*RBCD*) بثلاثة مكررات؛ يمثل العامل الأول خمسة أصناف من الحنطة (أدنة، هولير 2، هولير 6، جيهان وباكستاني)، ويمثل العامل الثاني نوعين من التربة (معاملة السيطرة والتربة الطبيعية) ونوعين من الفطريات المسببة للأمراض (*Pythium-aphanidermatum* و*Alternari alternata*) على قياسات النمو والحاصل. كان للفطر *Pythium aphanidermatum* التأثير الأكبر على صفات النمو حيث بلغ ارتفاع النبات 65.734 سم وعدد الاشطاء 3.866 ومساحة الورقة *353.576* سم2 دليل مساحة الورقة *7.07 (LAI)* والمادة الجافة 5.09 غم للنبات ومعدل نمو المحصول 0.033 غم نبات-1 يوم-1 بينما أظهرت الفطريات *A. alternata* تأثيراً أقل من *P. aphanidermatum* وبالنسبة لأصناف القمح سجل *Hawler 2* أفضل النتائج في صفات النمو وأعطى التفاعل بين *A. alternata* مع صنف *Hawler 2* أفضل النتائج من حيث صفات النمو والمحصول. وكان التحكم الكامل التأثير الأكبر على صفات الانتاجية حيث سجل ارتفاعات عدد السنابل نبات-1 6.86 وعدد البذور سنبلة-1 10.53 ووزن 1000 حبة 52.66 غم حاصل الحبوب 44.93 غم نبات-1 وكذلك كانت أعلى قيمة لمكونات الحاصل بين الأصناف للصنف هولير 2 وحقق التفاعل بين التحكم الكامل مع الصنف ادنة أعلى نتيجة لعدد السنابل نبات-1 وغلة الحبوب غرام نبات-1.

الكلمات مفتاحية: الحنطة، البيثيوم، الالترناريا، النمو، الحاصل.