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EFFECT OF BIOLOGICAL AND CULTIVAR CONTROL TO EAR- COCKLE NEMATODE DISEASE CAUSED BY THE NEMATODE (*ANGUINA TRITICI*) ON DIFFERENT GENOTYPES OF BREAD WHEAT (*TRITICUM AESTIVUM* L.)

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Abstract

The experiment was conducted during the agricultural season (2019-2020), at one of the farmers' fields in Dhi-Qar Governorate, to determine Effect of biological and cultivar control to Ear- Cockle Nematode disease caused by the nematode (*Anguina tritici*) on different genotypes of bread wheat (*Triticum aestivum* L.). Completely Random Block Design in Split Plot with three replicates were used, the main plot included biological control, which were (control without infection, nematode infection, nematode infection + treatment with trichoderma and nematode infection + treatment with psilomycosis), the secondary plots included five bread wheat genotypes (Saber beg, Clack, Arass, Sham 6 and Abu-Graib 3). The following traits studied were; spike length (cm), spike number (m^{-2}), 500 grain weight (g), grain number in spike (grain. $Spike^{-1}$) and total grain yield (kg. ha^{-1}). The results showed that a variation in bread wheat varieties with varying degrees of sensitivity to *Anguina tritici* nematode, as the variety Saber beg showed complete superior immunity, especially when infected with these nematodes in the spike length, grain number in spike and grain yield (13.32 cm, 45.07 grains. $spike^{-1}$ and 3425.42 kg. ha^{-1} respectively. The results showed the effect of using the biological control of *Trichoderma harazianum* and *Paecilomycis lilacinus* on the wheat warts nematodes (*Anguina tritici*). The superiority of the biological control of *Trichoderma harzianum* in increasing the parameters of growth and production and reducing the parameters of infection, the average spike length, the number of spikes, the number of uninfected spikes, the weight of 500 grains, and the total grain yield, reached (12.93 and 12.61) cm and (302.06 and 331.26) grains. $spike^{-2}$, (35.48 and 30.89), (15.48 and 14.45) g, and (3383.04 and 2898.44) kg ha^{-1} respectively, compared with the infected plants, which reached (10.78) cm (249.26) grains. $spike^{-2}$, (17.11), (9.37) g, and (1463.28) $kg.ha^{-1}$ respectively.

Keywords: biological and cultivar control, Ear- Cockle Nematode, bread wheat.

1-Introduction

Bread wheat (*Triticum aestivum* L.) belongs to the Graminaceae family, it is the important of strategic crops in the world in terms of area and production, daily uses of his products by consumers, because of its many specifications, it was grown in almost all parts of the world. The grain consists of 63-71% starch, 8-17% protein, 2-2.5% cellulose, 2-3% sugar, 1.5-2% fat, 1.5-2% mineral elements. Despite the food importance and the increasing demand for it as a result of the continuous population increase. Many researchers and farmers sought to increase production and improve quality (Raeed and Saifuldeen , 2020) . However, Iraq is still suffering from low productivity in quantity and quality in some cases, the reason may be the lack of proper crop management methods, such as selecting new varieties (Amer *et al*., 2020). The area cultivated with the wheat crop in Iraq for the year 2020 was about 8574 thousand donums, an increase of 35.4% over what it was in the season 2019, which was estimated 6331 thousand donums, and production reached 6238 thousand tons (Central Bureau of Statistics, 2020).

The wheat crop was like all other crops, exposed to many diseases and various pests, wheat Ear-Cockle disease caused by the nematode (*Anguina tritici*), it was one of the most important nematode diseases that it is exposed to, and it is considered the first plant-parasitic nematode (Al-Jubouri, 2019). Since the disease was first recorded in Iraq by (Roa, 1929), to this day, this disease still afflicts this crop, losses may reach 75% of the outcome, this also happened in Dohuk Governorate in 1989 when growing the Mexibag variety (Stephan and Antoon, 1990), what increases the risk of the disease is its easy spread through infected seeds that are mixed with uninfected seeds at harvest, the possibility of using them in the next season as seeds, also, the nematode has the ability to rest within the seed nodes for long periods that may reach more than 30 years (Al-Jubouri *et al*., 2010).

The importance of disease on this crop, causes great economic losses, for non-positive use of chemical pesticides. The two most effective pesticides, Oxamyl and Alidcarb, contributed to controlling nematodes, by causing serious pollution to the ecosystem, including threatening human health and safety, in addition to its long survival and toxicity to non-target organisms. Many methods of controlling nematodes have been followed, at the top of which is varietal resistance, which was a form of agricultural pest control, considered the cheapest way and without collateral environmental damage, it does not require additional work by the farmer to control the pest, because it was permanently ready to fight disease and does not add additional production costs (Al-Athari, 1992).

Biological Control was defined in short as the use of a living organism to combat another organism, as it was considered one of the environmentally and human-friendly means, which has proven its efficiency in resisting various agricultural pests, including wheat warts nematodes through fungus spores (*Trichoderma* spp.) Against nematodes as ready-made preparations (Sharon *et a*l., 2001). *Lilacinus Paecilomycis* was also used for its fatal effect on nematodes, for its role in promoting plant growth, increasing the essential nutrients for the plant and stimulating plant resistance (Al-Jabouri, 2019) and (Saifuldeen and Raeed,2020) .

As a result of the importance of this disease and its spread in many agricultural areas of wheat in Iraq, which caused great losses, due to the lack of studies on it, especially in Dhi Qar Governorate, in order to reduce the spread of this disease. The study adopted genotypes approved in agriculture compared to the local variety, Saber beg, which previous studies have proven that he was immune to infection with this disease. The study also aims at the possibility of limiting its spread due to the fungal effect of trichoderma and psilomycosis in the recommended quantities, during the development of indicators of new resistance and low indicators of infection with the disease production characteristics under the conditions of injury (Saifuldeen and Raeed,2021) .

2-Material and Methods:

The study included the cultivation of 5 genotypes of bread wheat during the winter season 2019-2020, at one of the farmers' fields in Dhi-Qar Governorate (Saber beg, Clack, Arass, Sham 6 and Abu-Graib 3). Fungal biological resistance Trichoderma and Psilomycosis. Soil for the field experiment was prepared by plowing it with a plow rig, twice perpendicularly, and perform leveling and smoothing operations, and add the dab fertilizer (46% P_2O_5 and 18% N) in an amount (320 kg / ha), Urea fertilizer (N 46%) was also added at the beginning of the branching and in an amount according to the recommendations. Watering was done according to the need of the plant. The thin, broad-leaved bushes were also removed by hand, to ensure that the pesticides do not affect the activity of fungal biological resistance and the nematode itself, according to the data and the nature of the factors included in the study (Younis *et a*l., . 2022) .

The experiment land prepared for cultivating field treatments was divided into rectangular plots with three replicates by Completely Random Block Design in Split Plot with three replicates were used. The main plots included biological control which included:

- Uninfected treatments (without injury) (Comparison): The treatments were planted in the form of lines, 2 m the length of line and each line 8 g approximately wheat, with a depth of 5 cm.
- Infected treatments: Cultivation lines were infected with Ear- Cockle of wheat grains, ensuring that each grain of wheat is closely related to one Ear- Cockle.
- Infected + Trichoderma: The same steps were followed in (1) and (2). In addition, a solution of 8 g of Trichoderma was added as a solute in 2 liters of water for each experimental unit sprayed in the seed lines before planting.
- Infected + Paecililomycis: A solution of 8 g of Paecililomycis was added, dissolved in 2 liters of water for each experimental unit, and it was sprayed in the seed lines just before planting.

The secondary plots included 5 genotypes of bread wheat (Saber beg, Clack, Arass, Sham 6 and Abu-Graib 3). The area of each plot was 2 m^2, including 4 planting lines, 1 m was left between the main experimental units and between the replicates, to ensure that young nematodes were not transferred to the comparison treatments, using excess irrigation water, although irrigation was by constant spraying.

After the crop has ripened and signs of ripeness are indicated, some measurements related to the study and loss were made, they were; spike length (cm), spike number (m^{-2}), 500 grain weight (g), grain number in spike (grain. $Spike^{-1}$) and total grain yield (kg. ha^{-1}). To determine the loss percentage, this equation was used:

$$\text{the loss percentage} = \frac{\text{The value in the right treatment} - \text{The value in the infected treatment}}{\text{The value in the right treatment}}$$

Data were analyzed according to the ANOVA Table by using a Completely Random Block Design in Split Plot , using SAS 9.0 (2001 V). The means were compared by means of the Duncan multiple range test at a probability level of 5% to cmparison the significant differences between the means.

3-Results and discussion:

3-1: Spike length (cm):

Tables (1 and 2) show that the treatment of trichoderma infection was superior to that of the spike length (cm), with a significant difference of 12.93 cm and 12.92 cm, respectively, with a reduction ratio of 4.04% and 21.08%, respectively. The treatment of infection with psilomycosis significantly outperformed the treatment of infection other than treatment with fungi, the average spike length was 12.61 cm and 10.78 cm, respectively, with a reduction ratio of 5.05% and 21.08%, respectively. The reason may be due to the superior treatment of trichoderma and psilomycosis in which biotic resistance fungi were used, to increase the root and vegetative total, resulting in strong and uninfected plants, enables it to reduce the impact of the pests that attack it, and provide protection for plants from attacking pathogens, due to the transmission of antibiotics and enzymes that affect the growth of pathogens and inhibit their growth (Ali, 2018) and (Younis *et a*l., . 2022) ..

The genotypes differed significantly in the average spike length (cm), surpassed the genotype of Saber beg, a significant difference with the genotypes reached 13.32 cm, the reduction rate for that trait was 2.34%, while the lowest was given the genotype Abu Graib 3 and reached 11.94 cm and the reduction rate was 7.68%. The reason for the superiority of the genotype of Saber beg may be due to its resistance to nematode infection, not responding to various pathological influences, may be due to the fact that nematodes do not prefer this species to feeding and reproducing it, through chemical compounds that repel, prevents the juveniles from reaching the plant or the thickness of the cuticle layer, which prevents the juveniles from feeding on the plant during the external parasitism stage, supporting this explanation is the superiority of this genotype also in increasing the concentration of enzymes associated with systemic plant resistance (Saifuldeen and Raeed, 2020).

The interaction between the genotypes and the treatments, the genotype outweighed the genotype Sham 6 when properly treated with this trait and reached 13.37 cm, and the reduction percentage reached 28.69%. Whereas, the genotype of Saber beg gave the lowest when treating infection other than treatment with fungi, and it reached 9.75 cm, and the reduction rate was -1.5%. The reason for this is the role of the fungi in providing plants with the growth regulators necessary for elongation. Whereas, the two fungi used in the experiment have the ability to produce plant growth regulators (Taha and Bassam, 2010).

Table (1) The effect of biological parameters and genotypes on the characteristic of spike length (cm).

Genotypes / Treatments	control without infection	nematode infection	nematode infection + treatment with trichoderma	nematode infection + treatment with psilomycosis	Genotypes mean
Saber beg	13.32 e-h	9.75 h	12.99 c-g	13.23 a-e	13.32 a
Clack	12.63 a-e	12.47 klm	12.77 a-e	13.35 a-e	12.80 b-e
Arass	12.85 b-g	10.45 ij	12.66 e-h	13.13 a-e	12.27 c-f
Sham 6	13.37 a-d	10.34 ijk	12.38 fgh	12.79 c-g	12.22 def
Abu-Graib 3	12.43 fgh	10.9 i	12.28 gh	12.17 gh	11.94 f
Treatments mean	12.92 a	10.78 c	12.61 b	12.93 a	

The averages with different letters indicate significant differences between them at the level of 5% significance.
The averages with similar letters indicate that there are no significant differences between them at the 5% level of significance.

Table (2) Percentage reduction of biological parameters and genotypes in the characteristic of spike length (cm).

Genotypes / Treatments	N	P	T	Genotypes mean
Saber beg	2.34 eh	-1.5 e-h	-7.27 i	2.34 d
Clack	33.83 ab	4.19 efg	1.92 fgh	13.31 ab
Arass	24.1 c	3.04 e-h	-2.71 ghi	13.57 c
Sham 6	28.69 bc	10.12 de	6.47 ef	15.09 a
Abu-Graib 3	16.44 d	2.87 e-h	3.74 efg	7.68 c
Treatments mean	21.08 a	5.05 b	4.04 b	

The averages with different letters indicate significant differences between them at the level of 5% significance.
The averages with similar letters indicate that there are no significant differences between them at the 5% level of significance.

3-2 : Spikes number (spike m^{-2}):

The treatment of the two biological fungi in the two subjects of the study showed a significant and significant superiority over the treatment of unninfected control and treatment of infection other than treatment with fungi (Table 3 and 4). It was noticed that the treatment of injury was treated with trichoderma and a non-significant difference with the treatment of infection treated with psilomycosis, and the number of spikes was 302.068 and 331.266 spikes m^{-2}, respectively, and the reduction rate for this trait was -12.28% and -8.47%, respectively. The treatment of infection other than treatment with fungi gave the lowest level for this trait and reached (249,266) spike m^{-2}, and the highest reduction rate of 10.41%, with a significant difference with the non-infected control treatment, in which the number of spikes reached 274.998 m^{-2}. The reason for this superiority of the biotic fungi may be due to its ability to equip plants with growth regulators and produce hormones (the hormone ethylene), which increases the readiness of the mineral elements of the plant (El-Nagdi *et al*.,2011; Amer *et al*.,2020).

The results also showed the superiority of the genotype Sham 6 in the characteristic of the number of spikes, which amounted to 314.85 spikes m^{-2}, with a reduction rate of -5.32%, with a non-significant difference with the genotype of Saber beg, gave 304.59 spike m^{-2}, and the reduction rate was (-8.66%. Clack genotype gave the lowest level for this trait and reached 259.51 spike m^{-2}, with a reduction rate of -3.06%. It is attributed to the different genes that control this trait for the different genotypes, which is reflected in the nature of branching, which was reflected in the number of spikes per unit area (Al-Jubouri, 2019).

As for the interaction, it showed a significant effect on this characteristic between genotypes and treatments. The genotype of Sham 6 exceeded when the infection was treated with trichoderma, and it reached 353.93 spike m^{-2}, with the lowest reduction of -17.06%. Clack genotype, when properly treated, recorded the lowest number of spikes, which reached 250.93 spikes. m^{-2}, and the reduction rate was 11.7%, due to the difference in the trait in its genetic base that controls this trait (Mahdi, 2020).

Table (3) The effect of biological agents and genotypes on the characteristic of the number of spikes (m^{-2}).

Genotypes / Treatments	control without infection	nematode infection	nematode infection + treatment with trichoderma	nematode infection + treatment with psilomycosis	Genotypes mean
Saber beg	260.93 f-l	259.6 f-l	402.93 b-g	294.93 b-f	304.59 cd
Clack	250.93 h-l	225.27 lm	280.6 c-i	281.27 c-h	259.51 ef
Arass	271.93 d-k	230.93 klm	299.27 b-g	290.27 b-g	273.1 de
Sham 6	300.6 b-g	272.6 d-k	353.93 ab	332.27 a	314.85 a
Abu-Graib 3	290.6 b-n	257.93 g-l	319.6 b-e	311.6 abc	294.93 bc

Treatments mean	274.99 b	249.26 c	331.26 a	302.06 a	

The averages with different letters indicate significant differences between them at the level of 5% significance.
The averages with similar letters indicate that there are no significant differences between them at the 5% level of significance.

Table (4) Percentage reduction of biological treatments and genotypes in the characteristic of number of spikes (m^{-2})

Genotypes / Treatments	N	P	T	Genotypes mean
Saber beg	0.15 d-g	-10.62 fgh	-15.52 gh	-8.66 bc
Clack	11.7 a-d	-9.95 fgh	-10.94 fgh	-3.06 bc
Arass	16.3 abc	-5.89 fgh	-8.71 fgh	0.56 a
Sham 6	10.7 a-e	-9.61 fgh	-17.06 h	-5.32 bc
Abu-Graib 3	13.22 a-d	-6.3 fgh	-9.17 fgh	-0.75 bc
Treatments mean	10.41 a	-8.47 b	-12.28 b	

The averages with different letters indicate significant differences between them at the level of 5% significance.
The averages with similar letters indicate that there are no significant differences between them at the 5% level of significance.

3-3 : The number of grains in a uninfected spike (grain. spike^{-1}):

Tables (5 and 6) showed the effect of nematodes on the number of seeds in a uninfected spike with significant differences between the treatments. The treatment of non-infected control was significantly superior to 48.92 grains. As for the treatment of infection other than treatment with fungi and treatment of infection treatment with fungi, the treatment with Trichoderma was outperformed by a non-significant difference with the treatment with Psyllomiasis, reaching 30.89 and 35.48 grains. spike^{-1}, respectively, with a reduction ratio for this trait 35.33 and 29.13%, respectively. While the treatment of infection other than treatment with fungi was the lowest in the number of spike grains 17.11 grains. spike^{-1}, with a reduction rate of 67.75%, the positive role of fungi in reducing the reduction ratio of the number of grains per spike, may be attributed to the secretion of a number of toxic compounds and enzymes by these fungi, thus reducing infection (Sukmer *et al*., 2005).

The results showed the superiority of the genotype of Saber beg in the characteristic of the number of spike grains, and it reached 45.07 grains. Spike^{-1}, this difference in the number of healthy grains may be due to the difference in the degree of sensitivity of the genotypes to this disease in addition to the genes that control this trait, was reflected in its ability to give a different number of ears and flower beds, although it was not distinct in the length of the spike, since the spikelets were crowded on the axis of the spike (Al-Jubouri, 2019).

As for the inteaction between genotypes and transactions, it showed a significant effect on this trait. The genotype exceeded Sham 6 when treating uninfected control, and it reached 49.36 gains. spike^{-1}, with a reduction rate of 32.81%, the lowest was the genotype of Arass and reached 8.06 grains. spike^{-1}, with a reduction rate of (25.15%), agreed with Al-Jubouri et al. (2010). The Saber beg genotype showed complete immunity to this pest, the percentage of reduction in the number of spike beans for the genotype and treatment with Trichoderma and Psilomycetes was clearly visible and in all genotypes except for the genotype of Saber beg compared to those infected only, it has decreased the rate of infection rate by more than half in many of them and agreed with Amer et al. (2020).

Table (5) The effect of biological parameters and genotypes on the characteristic of the number of seeds in an intact spike.

Genotypes / Treatments	control without infection	nematode infection	nematode infection + treatment with trichoderma	nematode infection + treatment with psilomycosis	Genotypes mean
Saber beg	44.43 c-g	43.16 d-i	45.33 c-g	47.36 cde	45.07 a
Clack	57.36 b	13.23 pq	22.73 mno	34.76 h-k	32.02 bc
Arass	44.23 c-h	8.06 q	34.06 i-l	35.93 h-k	30.57 bcd
Sham 6	49.36 b-e	8.1 q	31.33 j-m	34.46 i-l	30.81 cd
Abu-Graib 3	46.2 c-f	13.03 pq	21 l-o	24.93 op	26.29 d
Treatments mean	48.31 a	17.11 c	30.89 b	35.48 b	

The averages with different letters indicate significant differences between them at the level of 5% significance.

The averages with similar letters indicate that there are no significant differences between them at the 5% level of significance.

Table (6) Percentage reduction of biological treatments and genotypes in the characteristic of number of seeds in a healthy spike.

Genotypes / Treatments	N	P	T	Genotypes mean
Saber beg	4.2 l	-0.96 l	-5.78 l	-0.84 b
Clack	81.5 e-h	55.16 def	48.07 ab	61.57 ab
Arass	87.53 k	25.15 ik	20.67 a	44.45 cd
Sham 6	89.1 h-k	39.57 f-j	32.81 ab	53.82 abc
Abu-Graib 3	76.43 e-h	57.73 cde	49.88 ab	61.34 ab
Treatments mean	67.75 a	35.33 b	29.13 b	

The averages with different letters indicate significant differences between them at the level of 5% significance.
The averages with similar letters indicate that there are no significant differences between them at the 5% level of significance.

3-4 : 500 gains weight (g):

Tables (7 and 8) showed that the treatment of non-infected control significantly outperformed the rest of the treatments by showing the highest weight of 500 gains (g) and reached 19.61 g, as for the treatment of fungi with trichoderma, it achieved a superiority and a non-significant difference with the treatment of psilomycetes, reached 14.45 g and 15.48 g, respectively, and a reduction rate for this trait was 25.68 and 30.36%, respectively. While the injury treatment recorded the lowest weight 9.37 g, with a reduction rate 57.66%, indicates that biological control with the fungi Trichoderma and Psilomiasis reduced the incidence of the lesion and that it may meet the crop's need for growth regulators and increase the activity of defense enzymes (Al-Jubouri, 2019).

The genotypes differed significantly in the average weight of 500 grains, the genotype exceeded the Arass and reached 18.39 g, and a reduction rate of 34.57%. While the genotype Abu-Graib 3 gave the lowest level for this trait and reached 11.88 g, and the reduction rate was 49.21%. Clack genotype was the most reductive for this trait, reached 55.79%. Whereas, the Saber beg genotype was the least restrictive genotype (1.87%), may be due to the different genes that controlled this trait (Amer *et al*., 2020).

The overlap between the genotypes and the treatments, showed that the genotype was superior to the genotype when the correct treatment reached 23.74 g, with a significant difference with all the genotypes and treatments, as for the lowest genotype, Abu-Graib 3, when treating infection other than treatment with fungi, reached 8 g, with a reduction rate of 61.05%, we note from the results that all infection treatments treated with fungi have significantly exceeded the treatment of infection with fungi. It was shown that the treatment with these two fungi has significantly reduced the incidence of this lesion, the Saber beg genotype was not affected by the infection, and there were no significant differences between the control treatment and the rest of the treatments among all the cultivated genotypes, and this confirms that this variety is immune to infection with this pest and this is in agreement with Amer *et al*. (2020).

Table (7) The effect of biological agents and genotypes on the trait of 500 grains of weight (g).

Genotypes / Treatments	control without infection	nematode infection	nematode infection + treatment with trichoderma	nematode infection + treatment with psilomycosis	Genotypes mean
Saber beg	17.03 f	16.55 f	17.28 f	16.96 f	16.95 c
Clack	21.31 cd	8.73 mn	11.23 ijk	12.94 g-j	13.55 de
Arass	23.74 b	6.82 no	19.54 de	23.47 b	18.39 a
Sham 6	18.72 ef	6.76 no	13.48 gh	12.53 j-k	12.87 e
Abu-Graib 3	17.25 f	8 mno	10.74 kl	11.54 h-k	11.88 f
Treatments mean	19.61 a	9.37 c	14.45 b	15.48 b	

The averages with different letters indicate significant differences between them at the level of 5% significance.
The averages with similar letters indicate that there are no significant differences between them at the 5% level of significance.

Table (8) The percentage of reduction of biological treatments and genotypes in the weight of 500 grains (g).

Genotypes / Treatments	N	P	T	Genotypes mean
Saber beg	4.51 kl	-0.55 l	1.65 kl	1.87 e
Clack	67.73 a-d	54.55 c-g	45.1 e-i	55.79 ab
Arass	80.45 ab	21.05 jk	2.22 kl	34.57 d
Sham 6	74.57 abc	31.63 hij	38.01 g-j	48.07 abc
Abu-Graib 3	61.05 a-f	45.14 e-i	41.44 e-j	49.21 abc

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Treatments mean	57.66 a	30.36 b	25.68 b	

The averages with different letters indicate significant differences between them at the level of 5% significance.
The averages with similar letters indicate that there are no significant differences between them at the 5% level of significance.

3-5 : Grain yield (kg. ha^{-1}):

Tables (9 and 10) showed that the treatment of non-infected nematodes was significantly superior to the rest of the treatments, and the yield amounted to 4029.18 kg. ha^{-1}. The reason for this is that there is no affliction with these treatments and its superiority in the yield components (number of spike grains, number of spikes, and weight of 500 grains). Also, the treatment of infection with the treatment of the fungus Trichoderma was significantly superior to the treatment of the infection treated with psilomycosis, which gave a yield of 3383.04 and 2898.44 kg. ha^{-1}, respectively, with a reduction ratio of 16.59 and 27.78%, respectively. While the treatment of infection other than treatment with fungi recorded the lowest level of total yield and reached 1463.28 kg. ha^{-1}, the reduction rate was 59.25%. The positive effect of fungi in increasing the yield may be due to the fungi secretion of organic acids and growth regulators, and to facilitate the necessary elements for plant growth and strengthening, increasing the amount of yield compared to treatment of infection other than treatment with fungi and reducing the rate of infection due to the low percentage of reduction in the yield components, which are represented by the number of spike seeds, number of spikes, weight of 500 kernels and the weight of the spike (Mahdi, 2020).

As for the genotypes, they showed a significant effect on this trait, as the genotype exceeded Saber beg and reached 3425.42 kg. ha^{-1}, and the reduction percentage was -13.84%, with an insignificant difference from the genotype of Arass, reaching 3402.02 kg. ha^{-1}, reduction rate 28.87%, while the genotype Abu-Graib 3 gave the lowest yield and reached 2084.15 kg. ha^{-1}, and the reduction rate was 52.79%, may be due to the different genes that control this trait (Al-Jabouri, 2019).

The interaction between the genotypes and the treatments that the genotype of Clack exceeds when treating the uninfected control, with a non-significant difference with the genotype Sham 6 when the same treatment and the rate of outcome was 4799.2 and 4669.1, respectively, while the lowest was in the amount of yield at the genotype Aras, reached 821.8 kg. ha^{-1}, and the reduction rate was 17.85%. Saber beg genotype is superior to the rest of the genotypes, there were no significant differences between the control treatment and the infection treatment in the total grain yield trait, which were given a yield of 3095.8 and 3101.2 kg. ha^{-1} respectively. Perhaps the reason for the superiority of the Sabbeek genotype is the immunity it shows against nematode infection and the lack of response to its various pathological effects, this supports the explanation of the superiority of this genotype also in the aforementioned plant growth traits, while the nematode infection

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affected the yield of all the implanted genotypes and significantly reduced the yield, agreed with Haidar et al., (2016), infecting plants with the nematode significantly decreases the plant growth characteristics, which negatively affects the yield, also note that the treatment of genotypes with the two fungi in the study, and for all genotypes, increased the amount of outcome compared with infection treatments other than treatment with fungi. The reason for this increase in the yield may be due to the fact that treatment with these two mushrooms reduced the infection rate by increasing the concentration of some defensive enzymes, which led to a decrease in the infection rate, which reflected positively on plant productivity (Saifuldeen and Raeed , 2020).

Table (9) The effect of biological agents and genotypes on the yield characteristic of grains

Genotypes / Treatments	control without infection	nematode infection	nematode infection + treatment with trichoderma	nematode infection + treatment with psilomycosis	Genotypes mean
Saber beg	3095.8 h-l	3101.2 h-l	3667.5 d-k	3837.2 d-j	3425.42 ab
Clack	4799.2 c-e	1413.7 opq	2448.5 j-o	2839.1 i-m	2875.12 b
Arass	4512.5 c-g	821.8 q	3647.8 d-k	4626 c-f	3402.02 ab
Sham 6	4669.1 c-f	970.2 pq	2769.8 i-n	3313.7 f-l	2930.7 b
Abu-Graib 3	3069.3 h-l	1009.5 pq	1958.6 l-q	2299.2 k-p	2084.15 c
Treatments mean	4029.18 a	1463.28 d	2898.44 c	3383.04 b	

The averages with different letters indicate significant differences between them at the level of 5% significance.
The averages with similar letters indicate that there are no significant differences between them at the 5% level of significance.

Table (10) Percentage of reduction of biological treatments and varieties in the characteristic of grain yield (kg. ha^{-1})

Genotypes / Treatments	N	P	T	Genotypes mean
Saber beg	-0.43 hi	-18 i	-23.11 i	-13.84 c
Clack	72.08 abc	50.36 bcd	39.71 d-g	54.05 a
Arass	70.92 abc	17.85 e-h	-2.16 hi	28.87 b
Sham 6	80.51 a	41.8 def	30.24 d-g	50.85 a
Abu-Graib 3	73.19 abc	46.89 cde	38.3 d-g	52.79 a
Treatments mean	59.25 a	27.78 b	16.59 c	

The averages with different letters indicate significant differences between them at the level of 5% significance.
The averages with similar letters indicate that there are no significant differences between them at the 5% level of significance.

4- Conclusions:

1. The genotype of wheat and Saber beg was superior to the other varieties in its complete immunity to *A. tritici* nematode.
2. The two biological fungi included in this study contributed to reducing the infection rate by stimulating the plant's internal resistance.
3. The two biological fungi included in this study have the ability to improve the growth and yield characteristics of the wheat plant because they contain multiple substances that stimulate growth, and *T. harazianum* was superior in improving the growth and yield characteristics.

5- Recommendations:

1. The adoption of the Saber beg genotype in the breeding programs and the use of the fungus *Trichoderma harzianum* in the control program for warts of wheat grain resulting from the nematode *Anguina tritici*.
2. It was possible to study the molecular enzymatic indicators to shorten the time and effort exerted and search for the genes responsible for them in the quadruple and hexagonal wheat chromosome group to select the genotypes resistant to nematodes in selecting the pure and promising strains in the breeding programs before releasing them.
3. Considering resistance to nematodes among the priorities of pure strains tests that are promising to get rid of them permanently, as is the case in developed countries.

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