

Physiological Effects of Biological Control *Aureobasidium pullulans* on Barley Varieties Infected with *Rhizoctonia solani*

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p-ISSN: 1608-9391

e-ISSN: 2664-2786

Article information

Received: 12/8/2022

Accepted: 1/9/2022

DOI: 10.33899/rjs.2023.177288

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ABSTRACT

In a greenhouse experiment, barley varieties infected with *R. solani* showed a significant decrease in plant height, number of leaves, spike number, and number of grains in spike while the treatment of these varieties with biological control *Aureobasidium pullulans* showed a significant increase in plant height, number of leaves, number of spikes, and number of grains in spike compared to untreated one. moreover, of biological control *A. pullulans* to *R. solani* induced a significant improvement in vegetative growth,

In the treatment with biological control *A. pullulans* in addition to *R. solani*, the highest rate of plant height was found in Aswad two rows variety and reaching 38.81cm. in the second reading, up from 16.52 cm. in the first reading. Among Rehan white six rows that received the treatment with *R. solani* alone, the lowest plant height, reached 22.08 cm. in the second reading, and it increased from the first reading. Ebaa 265 White six rows variety produced the most number in the treatment with biological control *A. pullulans* added to *R. solani*, reaching 8.66 leaves per plant., In the Nour white two rows variety, the lowest leaf rate was 6.6 leaves in the treatment *R. solani* alone.

Aswad two rows variety exhibited the highest spike of barley when treated with biological control *A. pullulans* alone, reaching 5 spikes in the first, second, and third readings. Among the three readings, there were no spikes in Samir White variety when treated with *R. solani* alone. the average grains number in spikes, the highest rate was in the treatment of sterilized soil with formalin (control) in Aswad two rows variety which amounted to 7.67 grains in the second reading, up from 7.2 grains in the four reading. Biological control *A. pullulans* were added to *R. solani* in the variety Ebaa 265 White six rows, as it, and increased from 4.6 grains in the first to 9.8 in the second reading.

Keywords: *Aureobasidium pullulans*, *R. solani*, barley, Ebaa 265 White six rows.

INTRODUCTION

Hordeum vulgare, also known as barley, is one of the world's four most widely cultivated crops, Russia, Spain, Germany, and Canada had produced the most barley worldwide in 2020, According to the World Agriculture and Nutrition Organization (FAO, 2020), Syria, Iraq, Algeria, and Morocco produced the most barley in the Arab world in 2020. Human consumption, brewing, malt syrup, and animal feed are the main uses of barley (Brettrager *et al.*, 2022). Barley is a good source of dietary fiber, proteins, carbohydrates, minerals, and vitamins. It is used in the manufacture of many food products, including bread, beer, and alcohol (OECD, 2004).

Fungal diseases are caused by fungi called biotrophic which feed on living plant tissues, such as *Blumeria graminis*, which infects barley in different lifestyles, A different type of fungus called necrotrophic fungi eat dead tissues without requiring living tissue, such as *Pyrenopeziza teres*. Necrotrophic fungi cause death of host plant cells, as opposed to biotrophic fungi, which remain alive until later stages of disease development and infection (Oliver and Ipcho, 2004). *Cochliobolus sativus*, for example, is a type of nematotrophic fungus that initially establishes a biotrophic relationship with its host, but then dies due to infection and becomes a necrophospic organism. Globally, these fungal species are the most important pathogens of barley (Shoaib *et al.*, 2020).

The barley plant is infected with this fungi *Fusarium*, *Alternaria*, *Aspergillus*, *Mucor*, *Cladosporium*, *Penicillium*, *Drechslera*, *Fusarium*, head blight caused by *Fusarium graminearum* and powdery mildew caused by *Blumeria graminis* are among the fungal diseases that affect barley (Liu *et al.*, 2022).

It is one of the soil-borne pathogens that causes great economic losses due to *R. solani*, biological control agents (BCAs) against *R. solani* have been tested in vitro and in vivo using *A. pullulans* strains. There was an 87.9% inhibition of fungal pathogen growth by the metabolites produced by *A. pullulans* strains (Di Francesco *et al.*, 2021). A second study showed that *A. pullulans* can produce iron carriers (essential to plants and microorganisms). The strain also stimulated the growth of tomato roots and stem diameter and acted as a biological resistance agent against *R. solani* with an inhibition rate of 80% (Di Francesco *et al.*, 2022).

METHODS AND MATERIALS

Barley varieties were studied

For the agricultural season 2020/2021, samples of the studied barley varieties were obtained from the Department of Seed Examination and Certification in Nineveh Governorate/Iraq. Samples include six varieties of local barley (Zanbaka Aswad two rows, Aswad two rows, Nour white two rows, Rehaan white six rows, Samir white six rows, and Ebaa 265 white six rows). For each type of sample collected in September 2021, the ears were cleaned, the seeds were removed, and the weights of 2500 g. were taken for each type, and the bags were sealed tightly.

Sources of *Aureobasidium pullulans*

Aureobasidium pullulans was isolated from seeds of barley varieties in this study.

Sources of *Rhizoctonia solani*

Rhizoctonia solani was isolated from seeds of barley varieties in study.

Treatments in green house

The experiments were carried out in the green house of biology Department/College of Science/ Mosul university/Iraq. Artificial infection of *Rhizoctonia solani* and the biological control *Aureobasidium* spp. isolated from the grains of the barley varieties under study, by mixing the soil of the anvils with a diameter of 15 cm and a height of 20 cm, as one anvil contained 5 kg of mixed soil sterilized with formalin at concentration 2%. (Tortora, 2004).

The greenhouse treatments was carried out according to Saydam *et al.* (1983), then 10 grains of the studied barley varieties were planted at a depth of 2 cm from the surface of the soil, later softened to 5 grains, with 3 replications, each replicate with one anvil, After planting the grains, they were watered as needed and left to grow in the greenhouse under the uncontrolled natural

conditions of heat and light, and recording the results during the experimental time from the date of planting 12/12/2021 until 4/5/2022., The experiment included the following treatments:

- 1- Soil treatment with *Rhizoctonia solani* alone.
- 2- Soil treatment with *Aureobasidium pullulans* alone.
- 3- Soil treatment with *R. solani* + *A. pullulans*
- 4- Soil treatment with sterile soil (control).

Measurement of height plants (cm)

For all plants in the experimental unit, average plant height was measured from two readings, the first on 16/1/2022 and the second on 21/2/2022.

Number of leaves per plant

On 13/3/2022, the average number of leaves for all plants in the experimental units was counted

Number of spikes per plant

The average number of spikes for all plants of the experimental units of the studied barley cultivars was measured using three readings, the first on 28/2/2022, the second on 3/13/2022, and the third on 4/5/2022.

Number of grains per spike

For all plants in the experimental units of the studied barley cultivars, the average number of grains was calculated, with two readings, the first on 13/3/2022 and the second on 4/5/2022.

Statistical analysis of the data was carried out according to SAS system with CRD and Duncan test was used to compare the studied treatments at the level of probability 0.05.

RESULTS

Height of the plant (cm)

Among the barley varieties studied, different treatments have significant effects on plant height, as shown in (Table 1). Among Zanbaka aswad two row varieties, the treatment with biological control *A. pullulans* in addition with *R. solani* resulted in the highest plant height, as it reached 15.51 cm in the first reading, which differed significantly in the second reading and reached 27.89 cm, whereas the lowest plant height rate was in the treatment with *R. solani* alone, which reached 12.32 cm in the first reading and differed significantly in the second reading, resulting in a plant height of 27.71 cm., in the treatment with biological control *A. pullulans* alone, Aswad variety showed the highest rate of plant height, reaching 19.89 cm in the first reading, and 35.58 cm in the second reading. Plant height in the treatment with *R. solani* alone was 14.68 cm in the first reading and 34.99 cm in the second reading. According to the variety Nour white two rows, the highest rate of plant height was in the soil sterilized with formalin (control), reaching 21.4 cm in the first reading and 29.13 cm in the second reading, With *R. solani* alone, the lowest plant height was 17.79 cm in the first reading and 27.37 cm in the second reading.

The Rehaan white six rows variety showed highest plant height in treatment soil sterilized (control), reaching 22.24 cm in the first reading and 32.21 cm in the second reading. The plant height in the treatment with *R. solani* was 14.78 cm in the first reading and 22.08 cm in the second reading.

It was found that the plant height in Samir white six rows variety was 22.03 cm in the first reading and 34.77 cm in the second reading when biological control *A. pullulans* alone, while in the first reading, the plant height was 17.78 cm when *R. solani* was applied alone. The second reading is 30.47 cm, Ebaa 265 white six rows variety showed the highest rate of plant height when treated with biological control *A. pullulans* alone, reaching 21.76 cm in the first reading and 30.61 cm in the second reading. The lowest plant height rate was seen in the treatment with *R. solani* alone, which reached 16.57 cm in the first reading and 16.57 cm in the second reading. 24.89 cm second reading, *A. pullulans* added *R. solani* in Aswad variety produced an average plant height of 38.81 cm, which was superior to the rest of the treatments.

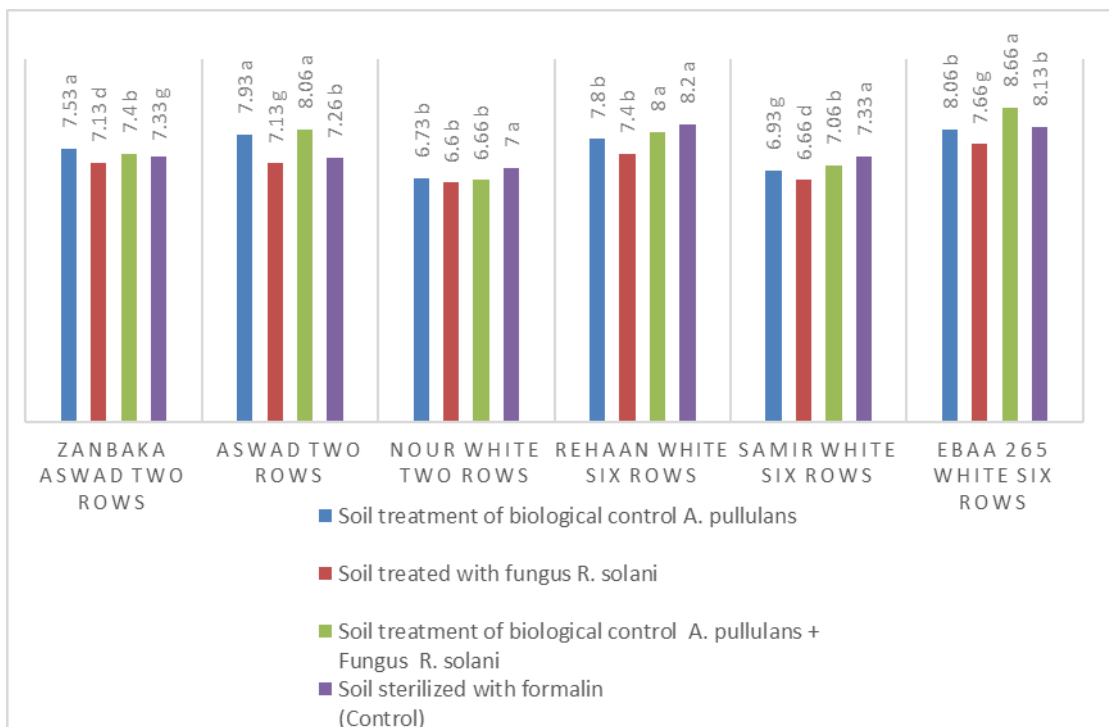
Table 1 : Effect of different treatments on average plant height (cm) for barley varieties

Treatments	Varieties	Zanbaka Aswad two row	Aswad	Nour white sex rows	Rehaan white six rows	Samir white six rows	Ebaa 265 white six rows
Soil treatment of biological control <i>A. pullulans</i>	First record	14.68e	19.89d	19.63e	17.77e	22.03e	21.76e
	Second record	23.97c	35.58b	29.74a	25.6c	34.77a	30.61b
Soil treated with <i>R. solani</i>	First record	12.32f	14.68g	17.79f	14.78g	17.78h	16.57g
	Second record	27.71b	34.99b	27.37c	22.08d	30.47d	24.89d
Soil treatment of biological control <i>A. pullulans</i> + <i>R. solani</i>	First record	15.51d	16.52f	20.53d	16.54f	18.77g	21.51e
	Second record	27.89b	38.81a	28.17b	29.48b	32.05b	31.92a
Soil sterilized with formalin (control)	First record	14.04e	17.06e	21.4d	22.24d	19.03f	18.33f
	Second record	33.33a	31.35c	29.13a	32.21a	31.03c	29.2c

*According to Duncan's polynomial test, numbers that share one alphabetic letter vertically have no significant difference between them at 0.05 level of significance.

Number of leaves

Fig. (1) show the effect of different treatments on the number of leaves for the studied barley varieties. A biological control *A. pullulans* alone treatment yielded the highest leaf rate of 7.53 leaves in Zanbaka Aswad two rows' varieties, and *R. solani* alone treatment yielded the lowest leaf rate of 7.13 leaves. The highest leaf rate was observed in the treatment with biological control *A. pullulans* added to *R. solani*, reaching 8.06 leaves, while the lowest leaf rate was observed in the treatment with *R. solani* alone, at 7.13 leaves. In variety Nour white two rows the highest rate of leaves in the soil sterilized with formalin treatment (control) reaching 7 leaves, and the lowest rate in *R. solani* alone treatment being 6.6 leaves.

**Fig. 1: Effects of different treatments on the average number of leaves of the barley varieties**

For variety Rehaan white six rows, the highest leaf rate was 8.2 leaves in the treatment with formalin sterilized soil (control), and the lowest leaf rate was 7.4 leaves with *R. solani* alone. In variety Samir white six rows, the highest leaf rate was in the treatment of formalin sterilized soil (control), with 7.33 leaves, and the lowest leaf rate was in the treatment of *R. solani* alone with 6.66 leaves. In variety Ebaa 265 white six rows, the highest leaf rate was 8.66 leaves in the treatment with biological control *A. pullulans* added to *R. solani*, and the lowest leaf rate was 7.66 leaves in the treatment with *R. solani* unit. As Ebaa 265 white six rows variety reached an average of 8.66 leaves, the treatment with biological control *A. pullulans* added to *R. solani* was superior to the other treatments.

Number of Spikes

Table (2) shows that different treatments have significantly different effects on the number of spikes of the studied barley varieties, For the variety Zanbaka Aswad two rows, formalin sterilized soil (control) produced the highest spikes, reaching 4.67 spikes in the first reading and 5 spikes in the second and third readings, while the lowest spike rate was 1.33 spikes in the first reading with *R. solani* alone. The second reading had two spikes and the third reading had 2.67 spikes. With Aswad two rows variety had the highest spike rate in the treatment with biological control *A. pullulans* unit, reaching 5 spikes in the first, second and third readings, while the lowest spike rate in the treatment with *R. solani* alone was 2.67 spikes in the first reading and 4.33 spikes in the second and third readings. The variety Nour white two rows of spikes with the highest spike rate in the treatment with biological control *A. pullulans* alone, reaching 2.67 spikes in the first reading and 5 spikes in the second and third readings, while in the treatment with *R. solani* alone, the spike rate was the lowest, reaching 0.67 spikes at the first reading and 4.33 spikes at the first reading. The second and third reading, the variety Rehaan white six rows had the highest spike rate in the treatment with biological control *A. pullulans* in addition to *R. solani*, reaching 2.33 spikes in the first reading and 5 spikes in the second and third readings. In the third reading, 4.67 spikes were observed, A spike rate was recorded in the third reading for the variety Samir white six rows in both biological control *A. pullulans* alone treatment and biological control *A. pullulans* in addition to *R. solani* treatment, as it reached 0.67 spikes for each treatment, and there were no spikes in the first and second readings, and there were none in the first and second readings with the *R. solani*.

The variety Ebaa 265 white six rows had the highest spike rate of spikes treated with biological control *A. pullulans* added to *R. solani*, with three spikes in the second reading and five spikes in the third reading, and no spikes in the first reading, while the lowest spike rate was in the treatment with *R. solani* alone. In the third reading, there were 2.67 spikes and no spikes in the first and second readings. In variety Aswad two rows, biological control *A. pullulans* alone produced 5 spikes in the first, second, and third readings, which was superior to the average number of spikes from the other treatments.

Table 2: Effect of different treatments on average amount of spikes/plant for barley varieties

Treatments	Varieties	Zanbaka Aswad two row	Aswad	Nour white sex rows	Rehaan white six rows	Samir white six rows	Ebaa 265 white six rows
Soil treatment of biological control <i>A. pullulans</i>	First record	3.33b	5a	2.67c	1.33d	**	**
	Second record	5a	5a	5a	5a	**	0.33f
	Third record	5a	5a	5a	5a	0.67a	5a
Soil treated with <i>R. solani</i>	First record	1.33 d	2.67c	0.67e	**	**	**
	Second record	2c	4.33b	4.33b	**	**	**
	Third record	2.67c	4.33b	4.33b	4.67b	**	2.67d
Soil treatment of biological control <i>A. pullulans</i> + <i>R. solani</i>	First record	3.66b	4.67a	2.33c	2.33c	**	**
	Second record	5a	5a	5a	5a	**	3c
	Third record	5a	5a	5a	5a	0.67a	5a
Soil sterilized with formalin (control)	First record	4.67a	4.67a	1.33d	**	**	**
	Second record	5a	5a	5a	**	**	0.67e
	Third record	5a	5a	5a	5a	0.33b	4.33b

*According to Duncan's polynomial test, numbers that share one alphabetic letter vertically have no significant difference between them at 0.05 level of significance

**There is no pike

Number of grains/spikes

The results in (Table 3) indicate that different treatments have a significant impact on the number of seeds carried on spikes of the barley variety studied. In Zanbaka Aswad two rows, the highest seed rate was achieved in the treatment with biological control *A. pullulans* added to *R. solani*, which reached 7.6 seeds in the first and second readings, and the lowest seed rate was reached in the treatment with *R. solani* alone, which reached 6.4 seeds in both readings. The highest rate of seeds in variety Aswad two rows was in treatment soil sterilized with formalin (control) at 7.2 seeds in the first reading and 7.67 seeds in the second reading, while the lowest rate of seeds was in the treatment with *R. solani* alone at 4.87 seeds. Nour white two rows variety showed the highest seed rate in the formalin sterilized soil treatment (control), reaching 4.29 seeds in the first and second readings, and the lowest seed rate in the sole treatment with *R. solani*, reaching 3.53 seeds in the first and second readings.

Among Rehaan white six rows variety had the highest seed rate and reached 6.4 seeds in the first and second readings when treated with biological control *A. pullulans* unit, whereas the lowest seed rate was 5.27 seeds in the second reading and no seeds in the first reading when treated with *R. solani* alone. In the treatment with biological control *A. pullulans* alone, the variety Samir white six rows showed the highest seed rate, reaching 10 seeds in the second reading, but the lowest seed rate in the treatment with *R. solani* alone. In the variety Ebaa 265 white six rows produced the highest number of seeds in the treatment with biological control *A. pullulans* added to *R. solani*, reaching 4.6 seeds in the first reading and 9.8 seeds in the second reading. In the second reading of the treatment with *R. solani*, the lowest number of seeds was 5.25, since there were no seeds in the first reading. Biological control *A. pullulans* added to *R. solani* in Ebaa 265 white six rows variety increased the seed rate from 4.6 seeds in the first reading to 9.8 seeds in the second reading.

Table 3: Effect of different treatments on average number of grains/ spikes for barley varieties

Treatments		Zanbaka Aswad two row	Aswad	Nour white sex rows	Rehaan white six rows	Samir white six rows	Ebaa 265 white six rows
Varieties							
Soil treatment of biological control <i>A. pullulans</i>	First record	7a	6.47b	4.27a	6.4a	**	1.67c
	Second record	7a	6.47b	4.27a	6.4a	10a	7.6cb
Soil treated with <i>R. solani</i>	First record	6.4b	4.87d	3.53b	**	**	**
	Second record	6.4b	4.87d	3.53b	5.27b	**	5.25c
Soil treatment of biological control <i>A. pullulans</i> + <i>R. solani</i>	First record	7.6a	5.13c	3.6b	**	**	4.6d
	Second record	7.6a	5.13c	3.6b	6a	6b	9.8a
Soil sterilized with formalin (control)	First record	7.13a	7.2a	4.29a	**	**	0.93e
	Second record	7.13a	7.67a	4.29a	5.36b	5b	7.77b

*According to Duncan's polynomial test, numbers that share one alphabetic letter vertically have no significant difference between them at 0.05 level of significance

**There is no spike

DISCUSSION

Similarly, Al-Kubaisi (2013) found that barley height decreased in soil contaminated with the fungus *R. solani*, which causes root rot. As a result of the treatment with the fungus *R. solani*, the height of cultivated barley decreased, and these results were also observed in the study of *R. solani* effect, A significant reduction in plant height was observed in leguminous plants due to the negative effect of fungus *R. solani* on the roots of plants because it secretes decomposing enzymes such as phosphatase, cellulase, and pectinase that cause their roots to disintegrate (Al-Turjuman, 2017), Wheat plants infected with the pathogenic *R. solani* also became shorter (Al-Hamdani, 2021).

A study by Hassan and Saleh (2020) found that cucumber plants treated with the pathogenic fungus *Macrophomina phaseolina* 59.9 cm shorter than healthy plants, which reached 131.0 cm in the cultivar Magic. This may be due to pathogenic fungi producing decomposing enzymes that penetrate and decompose plant tissues, feeding on their components and decomposition products. Cellulase is one of the most important enzymes, as it degrades the primary defense of plants (cellulose), the compound that makes up cell walls (Agrios, 2005). As a result, the fungus penetrates the cell walls of the plant, affects the plasma membranes, interferes with protein synthesis, plays an important role in causing systemic resistance of the plant (Okereke *et al.*, 2017; Gupta *et al.*, 2017).

It was noted in Fig. (1) that all varieties produced the lowest percentage of leaves when treated with *R. solani*. It is the result of the negative effect of *R. solani* on roots that causes the disintegration of their walls, which results in a decrease in their ability to absorb water and nutrients, which affects the plant's growth as a whole (Al-Turjuman, 2017). It is possible that genetic variation between cultivars is responsible for variations in the number and size of leaves on the plant. A greater efficiency of photosynthesis also resulted in a greater wet and dry weight of the vegetative and root systems, It might be the result of increasing the efficiency of the leaves, as they contain auxins that assist in cell division and root formation, as plant growth hormones increase the resistance of the plant, reduce the effort on the plant, increase the growth and development of roots and branches, increase the efficiency of photosynthesis, and increase vegetative growth (Al-Amri, 2014).

It is clear from the results that the pathogenic fungus *R. solani* reduced the number of spikes and seeds in the spike, as it caused a significant reduction in the number of spikes and seeds (Abboud *et al.*, 2017). According to Weinhold and Sinclair (1996), when wheat plants are treated

with the pathogenic fungus *R. solani*, the number of spikes and grains decrease significantly, and the root walls disintegrate as a result of the enzymes it secretes (Phosphatase, Cellulase, Pectinase). In addition, it causes a weakness in the absorption of nutrients, causing weak plant growth, the absence of spikes, and incomplete formation of seeds in the ears, either empty or atrophic, resulting in a small number of seeds (Abboud *et al.*, 2017).

study of Hassan and Awad (2017), the number of spikes and seeds treated with bio-control *A. pullulans* increased and this could be attributed to the ability of this fungus to increase the readiness of elements or its secretion of plant hormones that stimulate growth and encourage resistance to disease. In the effect of the fungus *Trichoderma harzianum* on the productivity of the bean plant, treatment with the bio-resistant *T. harzianum* resulted in higher yields and fresh weights of beans. In this study, the fungus *T. harzianum* demonstrated its ability to reduce the rate and severity of infection through biological control. It stimulates plant growth and resistance to disease by increasing chitinase activity, peroxidase activity, and polyphenol oxygenase activity.

CONCLUSIONS

Among the barley varieties studied, different treatments have significant effects on plant height, Zanbaka Aswad two row varieties, the treatment with biological control *A. pullulans* in addition with *R. solani* resulted in the highest plant height, A biological control *A. pullulans* alone treatment yielded the highest leaf rate of 7.53 leaves in Zanbaka Aswad two rows varieties, and *R. solani* alone treatment yielded the lowest leaf rate, that different treatments have significantly different effects on the number of spikes of the studied barley varieties, For the variety Zanbaka Aswad two rows, formalin sterilized soil (control) produced the highest spikes.

The results indicate that different treatments have a significant impact on the number of seeds carried on spikes of the barley variety studied. In Zanbaka Aswad two rows, the highest seed rate was achieved in the treatment with biological control *A. pullulans* added to *R. solani*,

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التأثير الفسلجي للمقاوم الحيوي *Aureobasidium Pullulans* على اصناف الشعير المصابة بالفطر *Rhizoctonia solani*

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الملخص

اظهرت نتائج التجربة الحقلية لاصناف الشعير المصابة بالفطر *R. solani* وهو احد مسببات الامراض التي تنتقلها التربة ويسبب خسائر فادحة في المحاصيل ويصيب الجذر والساق والاوراق والاجزاء الاخرى من النبات مسببا تعفن الجذور والبذور واللفحة الغمدية وموت الشتلات، ان الفطر *R.solani* سبب انخفاضاً معنوياً في ارتفاع النبات وعدد الاوراق وعدد السنابل وعدد

البذور في السنابل مقارنة مع معاملة اصناف الشعير بالمقاوم الحيوي *Aureobasidium pullulans* الذي سبب ارتفاعا معنويا في ارتفاع النبات وعدد الاوراق وعدد السنابل وعدد البذور في السنابل، وتشير النتائج الى تحسن النمو الخضري في المعاملة بالفطر *R. solani* مضافا اليه المقاوم الحيوي *A. pullulans*، اذ كان اعلى معدل لارتفاع النبات في المعاملة بالمقاوم الحيوي *A. pullulans* مضافا اليه الفطر *R. solani* في صنف اسود صفيين وبلغ 38.81 غم في القراءة الثانية وزاد عن القراءة الاولى اذ بلغ 16.52 غم وكان اقل معدل لارتفاع النبات في المعاملة بالفطر *R. solani* وحده في صنف ريجان ابيض ست صفوف اذ بلغ 22.08 غم في القراءة الثانية وزاد عن القراءة الاولى اذ بلغ 14.78 غم، وكان اعلى معدل للأوراق في المعاملة بالمقاوم الحيوي *A. pullulans* مضافا الى الفطر *R. solani* في صنف ابااء 265 ابيض ست صفوف اذ بلغ 8.66 ورقة في حين كان اقل معدل للأوراق في معاملة الفطر *R. solani* وحده في صنف نور ابيض صفيين وبلغ 6.6 ورقة.

وكان اعلى معدل للسنابل في المعاملة بالمقاوم الحيوي *A. pullulans* وحده في صنف اسود صفيين اذ بلغ 5 سنبله في القراءات الاولى والثانية والثالثة في حين كان اقل معدل للسنابل في المعاملة بالفطر *R. solani* وحده في صنف سمير ابيض ست صفوف اذ لا توجد سنابل في القراءات الثلاثة، اما بالنسبة لمعدل عدد البذور في السنابل كان اعلى معدل في المعاملة بالمقاوم الحيوي *A. pullulans* مضافا الى الفطر *R. solani* في صنف ابااء 265 ابيض ست صفوف اذ بلغ 9.8 بذرة في القراءة الثانية وزاد عن القراءة الاولى اذ بلغ 4.6 بذرة.

الكلمات الدالة: *Aureobasidium pullulans*، *R. solani*، الشعير، ابااء 265 ابيض ست صفوف.