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EVALUATING THE EFFECTIVENESS OF SOME ORGANIC FERTILIZERS, BIO-PREPARATIONS AND THEIR COMBINATIONS TO RESIST FUSARIUM WILT DISEASE ON CUCUMBER

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Abstract:

The results of isolation and pathogenicity testing of the isolates showed that the fungus *F.oxysporium* varied in pathogenicity intensity, reaching the highest intensity for isolate D, which reached a seed inhibition rate of 55.2%. The laboratory results proved the high antagonistic ability of the fungus *T. harzianum* against the fungus *F.oxysporium*, which reached 1 on the Bell scale, and the inhibition rate of the bacterium *B. subtilis* reached 84% for the colony of the fungus *F.O.* The pesticide Tachigazol did not show any effect for the method of working the filtrate, but it showed its high effect in reducing the colony of the fungus. as the inhibition rate reached 93.52% at the highest concentration of 300 PPM and for both methods of working the filtrate filtered and unfiltered, while there was a variation in the results of the inhibition rate according to the method of working the filtrate for organic fertilizer, as the filtrate of Vermicompost fertilizer and Spent mushroom compost *A. bisporus* (S.M.C.A) unfiltered gave an inhibition rate of 74.82% and 49.32% respectively and with a significant difference from the filtered filtrate, as the inhibition rate reached 31.14 and 19.81% respectively. The field results indicate that using fertilizer combinations together with biological preparations reduced the percentage and severity of infection as the combination of Vermicompost fertilizer with *T. harzianum* excelled in recording the lowest percentage and severity of infection, which reached 31.8% and 0.33 respectively, and also improved the fertilizer combination in growth traits, as stem length and root length and wet weight and dry weight reached 186.3 cm and 32.7 cm and 413.71 and 90.10% respectively, as well as achieving the highest rate for yield in a combination of S.M.C.A fertilizer with T.harzianum, as the average plant production reached 1.730 Kg.

Keywords: Vermicompost, Spent mushroom compost, Fusarium oxysporum, cucumber.

تقييم فعالية بعض الاسمدة العضوية والمستحضرات الحيوية وتوليفاتها لمقاومة مرض الذبول الفيوزارمي على الخيار

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الخلاصة

اشارت نتائج العزل واختبار الامراضية للعزلات اظهر فيها الفطر *F.oxysporium* تباين في شدة الامراضية بلغت اعلى شدة للعزلة D وصلت نسبة التثبيط للبذور الى 55.2%. اثبتت النتائج المختبرية القدرة التضادية العالية للفطر *T. harzianum* ضد الفطر *F.oxysporium* بلغت 1 على مقياس Bell، كما وصلت نسبة التثبيط لبكتريا *B. subtilis* الى 84% لمستعمرة الفطر *F.O* , كما ان المبيد Tachigazol لم يظهر تأثير لطريقة عمل الراشح الا انه اظهر تأثيره العالي في اختزال مستعمرة الفطر إذ بلغت نسبة التثبيط 93.52% عند اعلى تركيز 300 PPM ولكلا الطريقتين في عمل الراشح المفلتر وغير المفلتر , في حين حصل تباين في نتائج نسبة التثبيط تبعا لطريقة عمل الراشح للسماد العضوي إذ اعطى راشح سماد Vermicompost و راشح Spent mushroom compost *A. bisporus* (S.M.C.A) غير المفلتر نسبة تثبيط بلغت 74.82% 49.32% على التتابع وبفارق معنوي عن الراشح المفلتر إذ بلغت نسبة التثبيط 31.14 و 19.81% على التتابع , تشير النتائج الحقلية ان استخدام التوليفات السمادية معا المستحضرات الحيوية خفضت من نسبة وشدة الإصابة إذ تفوقت توليفة سماد Vermicompost مع *T. harzianum* في تسجيل اقل نسبة وشدة إصابة بلغت 31.8% و0.33 على التتابع ,كما حسنت التوليفة السمادية في صفات النمو إذ بلغ طول الساق وطول الجذر و الوزن الرطب والجاف 186.3 سم و32.7 سم و 413.71 و 90.10% على التتابع كما بلغ اعلى معدل للحاصل في توليفة سماد S.M.C.A مع *T.harzianum* إذ بلغ معدل انتاج النبات الواحد 1.730 كغم.

الكلمات المفتاحية: الفيرمي كومبوست، مخلفات مزرعة المشروم، *Fusarium oxysporum* ، الخيار.

Introduction

The cucumber plant, Cucumis sativus L., is grown in all temperate regions, as its growth requires temperatures higher than 20 degrees Celsius [1] C , K, B6 [2]. The cucumber plant is exposed to many pathogens in the soil that pose a threat to the root system, leading to a deterioration in the health of the plant, which causes a decrease in productivity, and Among those causes is the fusarium wilt disease caused by *Fusarium oxysporumf*. sp. Cucumberinum causes damage and economic losses to the cucumber crop in different parts of the world [3, 4]. Many chemical pesticides have been used to control the disease. Despite its high effectiveness, it is banned due to its dangerous effects on the environment and humans [5], which made international attention turn towards safe agriculture, including the use of organic materials by adding them to the soil as conditioners and also to its fertility, and its decomposition results in a change in the physical and chemical properties of the soil. Relationship in reduction or minimizing plant diseases [6-8] Many microorganisms have also been used as biological control agents against soil diseases, such as *Bacillus spp*, *Trichoderma spp*, [9-11] as they control plant diseases through several mechanisms, including production Antidecomposition, chitinase and protease enzymes, parasitism and stimulation of the defence system of plants and also through competition for food and space [12, 13]. To improve the performance of biological control in the management of plant diseases, the study aimed to use types of organic materials and support them with living organisms as one of the methods of biological systems and biological control.

Materials and methods

Isolation, purification and identification of *Fusarium oxysporum*

The fungus *F.oxysporum* was isolated from several samples of cucumber plants that showed symptoms of yellowing leaves with wilting. The infected parts of the plant were washed with running tap water, and then with distilled water. A part of the stem was taken, 10 cm away from the crown area. It was cut into small pieces, sterilized with 10% NaOCL sodium hypochlorite solution for two minutes, washed well with distilled water to get rid of sodium hypochlorite, placed on filter paper for drying, then transferred to Petri dishes

containing pre-prepared and sterilized PDA culture medium, as each dish contained 4 pieces of plant parts. They were incubated at a temperature of 27 + 2 C for 4 days and fungal colonies appeared. It was purified on another PDA culture medium so that each plate contained one of the isolates. When the growth of these colonies was complete, microscopic examination and phenotypic diagnosis were carried out based on the taxonomic characteristics mentioned in [14, 15].

Pathogenicity test of fungal isolates using Petri dishes

According to what was mentioned by [16] and according to the method of [17], Petri dishes with a diameter of 9 cm containing PDA culture medium were used, the center of which was inoculated with discs of 0.5 cm in diameter, taken from the edge of each fungal colony, at the age of 5 days, in three dishes for each isolate, and the dishes were placed in the incubator at a temperature of 25 + 2 m for two days, physiologically ripe cucumber seeds were selected, superficially sterilized with 1% sodium hypochlorite solution for 5 minutes, then washed with distilled water and placed on filter paper to dry the seeds, then the seeds were distributed in a circular manner around the edge of the fungal colony at a rate of 10 seeds/dish. The treatment was repeated 3 times for each fungal isolate, leaving the control treatment without inoculation with the pathogenic fungus as a comparison. The dishes were incubated at a temperature of 25 + 2 C, after four days had passed and germination was completed for the control treatment. The percentage of germination was calculated for each isolate. The following equation was adopted to calculate the percentage of germination as follows:

% of seed germination = (number of growing seeds / total number of sown seeds) x 100

After comparing the pathogenicity of the isolates, the most effective isolate in the percentage of germination was multiplied and adopted in the research coefficients.

Test activity of Bio-pesticides and a colony inhibition of *F.oxysporum*

Tricholand® contains CFU 10^8 for the fungus Trichoderma harzianum. It was grown by making a solution at a concentration of 1 gm of the preparation in a litre of distilled water. Transferring 1 ml of the solution to a Petri dish containing the culture medium (PDA) Potato Dextrose Agar prepared and sterilized in an autoclave at a temperature of 121 C and a pressure of 15 pounds. / Eng2 for 20 minutes. The Petri dish was moved by the circular method to homogenize the distribution of the biological preparation. It was left in the incubator at a temperature of 25 + 2 for 72 hours until fungal colonies appeared. Part of the edge of the colony was taken to another Petri dish containing another (PDA) prepared as a pure colony.

The dual-culture method was used in the inhibition test, by dividing a 9 cm diameter petri dish into two equal halves, inoculating the centre of each radius with a 0.5 cm diameter disk of both fungi *F.oxysporium* and *T. harzianum* taken from the edge of the colony, 5 days old for both. The treatment included three replications, with Petri dishes left as a control as its centre was inoculated from each fungus by itself, all dishes were placed in the incubator at a temperature of 27 + 2 for a period of 5 days. The growth rate was measured, and the degree of contrast was calculated for each fungus according to a scale [18], and as mentioned before [19].

Bsciland® Bacterial Biocide contains 10^8 CFU for *Bacillus Subtilis*. It was grown by making a solution with a concentration of 1 gm of the preparation into a litre of distilled water. Transfer 1 ml of the solution to a glass beaker containing 100 ml of sterile (N.B) Nutrient broth, and place it in the incubator at a temperature of 28 °C for a period of 48 hours until turbidity appeared in the medium liquid implant.

The spotting method was used in the inhibition test, 6 dishes containing PDA culture medium were prepared, three of which were inoculated using sterile glass capillary tubes, where 0.1 ml of liquid medium (N.B) containing bacteria was withdrawn and placed in spots at a distance of 2 cm from the edge of the dish. Leaving three plates as a control culture medium containing (PDA)Only, the centre of all Petri dishes was inoculated with a 0.5 cm drop from the edge of a 5-day-old fungal colony. Incubated at a temperature of 27 + 2 for 5 days, the percentage of inhibition was calculated according to the equation mentioned [20].

% for inhibition = (average fungi colony diameter in the treatment - average fungi colony diameter in the comparison) / (average fungi colony diameter in the comparison) x 100

Method of making a filtered solution of organic fertilizer and chemical pesticide and using it to inhibit the colony of the fungus *Fusarium oxysporum*

Three concentrations of 100, 200 and 300 ppm were made on the basis of the active ingredient of Tachigazol® (Hymexazol 30%) from Vapco. Spent mushroom compost *A. bisporus* (SMCA) was also obtained from the mushroom farm, College of Agriculture, University of Tikrit. And vermicompost (V.C) from worm farms and compost production in the Salah al-Din district, I took a quantity of each fertilizer and after homogeneous mixing and grinding it well and made concentrations of 10, 20, 30% by weight/volume of distilled water (v\w)) left for a period of 48 at laboratory temperature. The materials, including chemical pesticides and organic fertilizers, were filtered in two ways, according to what [21, 22] said:

1. Unfiltered filtrate (non-sterile): Filter the suspension using sterile 3-ply gauze to remove impurities and the suspension. The filtrate was placed in a clean and sterile container and kept in the refrigerator at a temperature of 4 °C.
2. Filtered filtrate (sterile): The suspension was filtered in two stages, starting with using Whatman No.1 filter papers, the filtrate was taken and placed in a test tubes and placed in a centrifuge at 4000 speed for 15 minutes, then The suspension was taken and placed in clean and sterilized glass containers and placed in the refrigerator until use.

Transfer 3 ml of each concentration of the chemical pesticide filtrate and organic fertilizer, both filtered and unfiltered, to each Petri dish containing the PDA culture medium. It was moved in a circular to ensure the homogeneity of the medium and before hardening (the method of poisoning the medium). Repeat this by making 3 dishes for each concentration, leaving 3 dishes for comparison. Distilled water was used in it. The center of each plate was inoculated with a disc of 0.5 cm in diameter. It was taken from the edge of a 72-hour-old F. oxysporium colony with a cork puncture. The flame was sterilized, and then the dishes were incubated at a temperature of 27 + 2 C for a week. Fungal growth was measured using a graduated ruler (cm) by taking the average of two orthogonal diameters passing through the center of the disk at the back of the colony

when the growth of the control treatment reached the edge of the dish, and the percentage of inhibition was calculated according to the previously mentioned equation.

The seeds of the local millet plant, Panicum miliaceum, were used to propagate the fungus *F.oxysporum*, where they were cleaned of impurities, soaked in water for 6 hours, then filtered from the water and placed on blotting paper to get rid of the remaining water. After that, it was distributed in glass flasks with a capacity of 250 ml, 100 gm for each glass flask, then its nozzles were closed using a cotton stopper, and it was entered into the autoclave at a temperature of 121 C and a pressure of 15 pounds/inch for 60 minutes, then it was removed and left to cool. The process was repeated the next day and at the same time as before, after which it was taken out to cool. Tablets with a diameter of 0.5 cm were taken from the edge of a 3-day-old fungal colony, at the rate of 5 tablets per 250 ml beaker containing 100 gm of sterilized millet seeds. [23]

Field experiment work

Preparing the ground by making terraces 1 meter wide and 30 cm high from the ground. I made trenches, and on both sides of the terrace 1.5 meters long, 25 cm wide, and 35 cm deep. Holes were made from the bottom to allow ventilation and drain excess water.[24] I used a mix of soil, sterilized with formalin 37%, which was sterilized outside the farm by making layers and treating each layer by adding 5 liters of solution at a concentration of 0.01 per cubic meter of soil, covering it tightly for a week, and lifting the cover with stirring for 10 days to get rid of the sterilization residue. Organic fertilizers were mixed in a ratio of 4:1 organic fertilizer to soil, and according to what the experiment required, the soil was added to the trenches to perform the following treatments:

1. Control treatment (without pathogenic inoculum and without organic fertilizers).
2. *F.oxysporium* (without organic fertilizer) .
3. *F.oxysporium* + vermicompost V.C.
4. *F.oxysporium* + fungus culture residue (SMCA).
5. *F.oxysporium* + *T.harzianum*
6. *F.oxysporium* + *B. subtilis.*
7. *F.oxysporium* + V.C + *T. harzianum*
8. *F.oxysporium* + V.C + *B. subtilis.*
9. *F.oxysporium* + S.M.C.A + *T. harzianum.*
10. *F.oxysporium* + S.M.C.A + *B. subtilis.*
11. *F.oxysporium* + Tachigazol® (Hymexazol30%).

Cucumber seeds (AMIR) of Dutch origin were adopted, with a germination rate of 90% in cultivation. It is the predominant variety grown in autumn in the southwestern regions of Kirkuk Governorate. It was washed with water to remove the translucent substance and sterilized with a solution of 10% sodium hypochlorite with rinsing with water and drying, then the seeds were fogging according to what the experiment required using biological preparations 1 gram / 500 gm seeds, and planted with 5 seeds/hole.

Soil treatment with *F.oxysporium* pathogenic inoculum

The pathogenic fungus inoculum carried on millet seeds was added before planting at a rate of 5 gm/one hole, leaving some holes as control. After 3 days, cucumber seeds were sown, and after germination, the seedlings were reduced to 2 plants/one hole. After

a week of planting, 50 ml of solutions was added. The following pesticides, according to the recommendations of the producing company, are Tachigazol®, Tricholand® and Bsciland®, at a concentration of 2 g / liter of water for each pesticide.

Field measurements and standards

Field measurements were taken 4 weeks after the pesticide treatment and when symptoms of the disease appeared on the control pathogen treatment, as follows:

(1) Average plant height and root length (cm).

(2) Wet and Dry Biological Weight (g)

(3) The infection rate was estimated according to the following equation: -

The percentage of infection = (number of infected plants) / (total number of plants examined) x 100

(4) The severity of the injury was estimated by distributing the degree of injury according to the pathological index, based on a scale [25], my agency:

Grade	severity of infection
0 =	healthy plant (with no visible disease symptoms)
1 =	Yellowing 1-20% (1-3 of the basal leaves, yellow)
2 =	Yellowing 20-40% (4-6 upper leaves with some basal leaves wilting, yellowing)
3 =	Yellowing 41-60% (more than 6 leaves with partial wilting of some branches of the plant, yellowing).
4 =	Yellowing 60-80% with wilting of more than one branch
5 =	Complete wilting of the plant with all branches.

(5) The average weight of a single plant yield is one kilogram.

Statistical analysis

Data were collected and all data were subjected to statistical analysis using the GenStat program, Significant differences between the averages were approved by testing the least significant difference according to Dunkin's multiple test at the level of probability 0.01 and 0.05 for laboratory and field experiments, respectively.

Results and discussion

The results of testing the pathogenicity of the fungal isolates (Fig. 1), given in the following alphabets A, B, C, and D, indicate that there is a variation in their pathogenicity in the percentage of inhibition of germination of cucumber seeds in vitro. The highest inhibition rate was for isolate D, which reached 55.2% (picture 4), followed by isolates A, C, and B, where the inhibition rate reached 41.4%, 34.5%, and 24.2%, respectively, compared to the healthy control without the presence of the pathogenic fungus. This discrepancy is attributed to the differences in the genetic makeup of these fungal isolates, and the low germination rate of seeds is due to the ability of *F. oxysporium* to secrete enzymes, including chitinase and cellulase, that work to destroy the components of the cell wall, as well as the important role of enzymes in the virulence of the pathogen and the resulting substances Toxic metabolites such as Fusaric acid, Dehydro Fusaric acid, Lycomarsmin have an effect on the permeability of the cell

membranes of the affected plant, causing a decrease in the plant cell respiration rate and causing disruption in other vital processes.

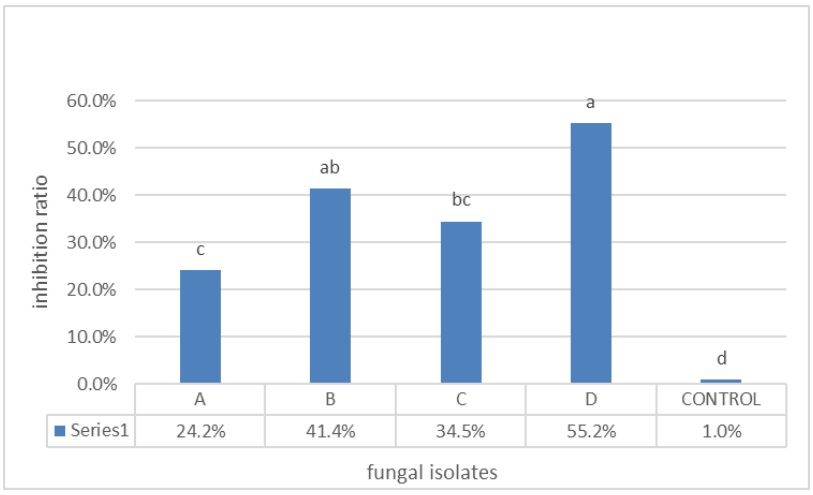

Figure (1) the pathogenicity test of fungal isolates of the causative agent *Fusarium oxysporum*

Biological antagonism test of *T. harzianum* against *F. oxysporum*

The results showed that the fungus *T. harzianum* had a high antagonistic ability against the fungus *F.oxysporum*, as it reached grade 1 on the Bell scale, indicating the high efficiency of the biological fungus against the pathogen, (as the fungus covers the whole plate, including the pathogenic fungus, according to [18] scale. The results with [26] and [27] indicated that the biological fungus *T. harzianum* has parasitic properties as well as its secretion of chemical filters that have an effect on the vitality of pathogens. It secretes antibodies and some enzymes that analyze the cell walls of pathogenic fungi, such as Protease, Chitinase, and B-1-3-glucanase, which work on the decomposition, death, and feeding of host cells.

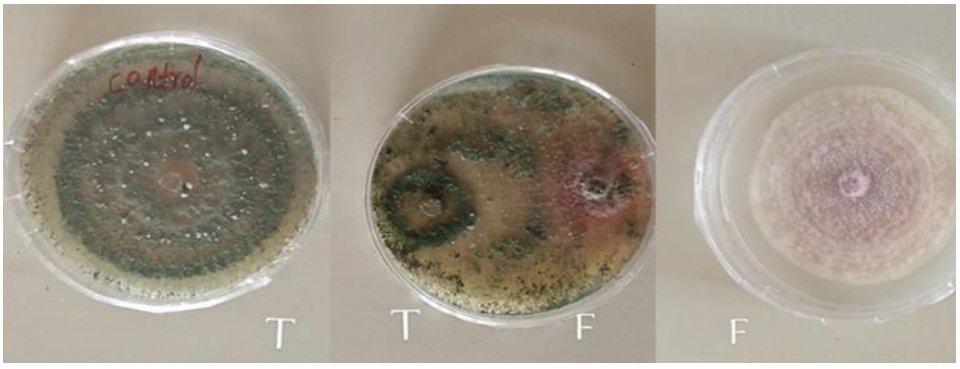

Figure (1) shows the antibiotic test of the fungus *T. harzianum* against the fungus *F. oxysporum*

Testing the effect of *B.subtilis* bacteria in inhibiting the colony of the pathogenic fungus *F. oxysporum*

The results of Figure (2) indicate the ability of *B.subtilis* to inhibit the growth of the *F.oxysporum* colony, as the inhibition rate was 84%. The reason for this is due to the inhibitory ability of *B.subtilis* and its ability to produce many different antifungals such as subtilisin, subtilizing, bacillomycin, iturin, fengycin, surfactin, which works to inhibit the growth of fungi and germination of spores of the fungus *F. oxysporum*, and it was also found that this bacterium has the ability to Competition for food and place through its high ability to exploit the components of the food medium on which it grows and the speed of its reproduction compared to other living organisms such as fungi [28-30].

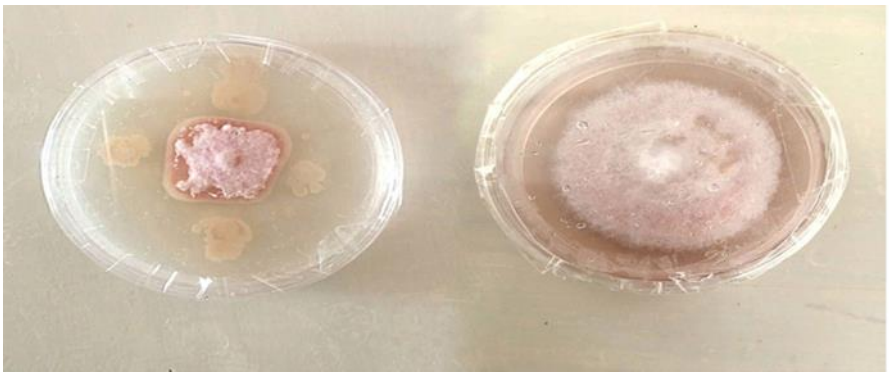

Figure (2) shows the inhibition of the biological agent *B.subtilis* of the pathogenic fungus *F. oxysporum*

Effect of chemical pesticide and organic fertilizer filtration solution on inhibition of *Fusarium oxysporum*.

The results of Table (1) show that there are significant differences between the organic matter infiltrate compared to the fungicide Tachigazol, which gave the least diameter of the fungal colony at a concentration of 300 ppm. For both the filtered and unfiltered methods, the effectiveness of the pesticide was not affected by the way the filter works. The effect of the pesticide is due to its containing Hymexazol, which has the ability to damage fungal hyphae, as it possesses monosaccharides containing oxygen that inhibit the fungus [31], followed by the effect of the V.C fertilizer filter at a concentration of 30%, as the rate of colony diameter measurement and the inhibition rate of the unfiltered solution reached 2.14 cm and 74.82 cm. % respectively. Which differed significantly from the filtered solution, the diameter of the colony and the percentage of inhibition were 6.81 cm and 19.81%, respectively. These results confirmed what was indicated by [32] that the chemicals in the organic fertilizer did not have a direct inhibitory effect on the fungus *Fusarium* wilting of tomatoes, as the VC fertilizer added to the culture medium PDA lost its activity after sterilization. While the effect of S.M.C.A a fertilizer filter at a concentration of 30% on the diameter of the mushroom colony, the inhibition percentage for the unfiltered solution was 4.33 cm and 49.11%, respectively, with a significant difference from the filtered solution, as the colony diameter and the inhibition percentage were 5.85 cm and 31.14%, respectively. It agreed with experiments carried out by [33] on cactus stem rot disease due to the causative agent

Fusarium oxysporum, as the steam sterilized S.M.C.A fertilizer did not reduce the rot disease, indicating that the activity of the fertilizer was biological.

Table (1) shows the effect of chemical pesticide and organic fertilizer filtrate inhibition on the fungal colony *F. oxysporum*

Treatments	concentric %	filtered solution		Unfiltered solution	
		Colonial diameter	Inhibition %	Colonial diameter	Inhibition %
(S.M.C.A)	10	7.83 b	7.88%	6.81 c	19.84%
	20	6.49 cd	23.69%	6.25 de	26.49%
	30	6.81 c	19.81%	4.33 f	49.11%
V.C	10	8.01 b	5.73%	6.53 cd	23.14%
	20	7.98 b	6.16 %	4.29 f	49.11%
	30	5.85 e	31.14%	2.14 g	74.82%
Tachigazol	100 ppm	1.3 h	84.73%	1.3 h	84.73%
	200 ppm	1.05 h	87.67%	1.05 h	87.67%
	300 ppm	0.55 i	93.56%	0.55 i	93.52%
control		8.5 a	0.00	8.5 a	0.00

Spent mushroom compost *A. bisporus* (S.M.C.A) Vermicompost (V.C) *T.harzianum* (T.h) *B.subtilis* (B.S) *Fusarium oxysporium* (*F.O*)

The effect of chemical pesticides, organic fertilizers, Bio- fungicides and their combinations on the percentage and severity of infection with *F. oxysporum*.

We notice through the data of Table (2) that there is a significant difference between the treatments in the percentage and severity of infection, as the lowest percentage and severity of infection in the Tachigazol pesticide treatment was 9.8% and 0.08, respectively, compared to control treatment. It was consistent with what was confirmed by [31] that Tachigazol reduced the incidence of *fusarium* wilt disease on ornamental plants. While the highest percentage and severity of infection were for the fungus-contaminated treatment, reaching 68.1% and 0.75, respectively. The result agrees with what was reached by [34] that the infection rate amounted to 71.43% through a study conducted in central and southern Iraq on cucumber wilt disease caused by *F.oxysporum.* The percentages also graduated to the lowest level in the percentage and severity of infection for fertilizer combinations with Bio-pesticides, with a significant difference from using them alone, as the percentage and severity of infection for the combination of V.C fertilizer and S.M.C.A fertilizer with *T.harzianum* reached 31.8%, 0.33, 35.8%, and 0.37, respectively, compared to T.harzianum alone, the infection rate and severity were 43.2% and 0.50%, respectively. It was followed by a combination of V.C fertilizer and S.M.C.A fertilizer with *B.subtilis*, where the infection rate and severity were 36.5%, 0.38, 38.7%, and 0.48, respectively, compared with *B.subtilis* treatment alone, where the infection rate and severity were 41.3% and 0.53, respectively. The results agreed on the effectiveness of the combined use of biological control agents with organic materials in reducing the percentage of root infection of cucumber plants caused by *Rhizoctonia, Fusarium, Pythium, and Sclerotinia* [12, 35, 36].

Table (2) shows the effect of chemical pesticides, organic fertilizers, Bio-pesticides and their combinations on the incidence and severity of infection with the fungus *F. oxysporum*

Treatments	Infection incidence	Infection severity
F. oxysporum	68.1 a	0.75 a
T.harzianum	43.2 bc	0.50 bc
B.subtilis	41.3 bcd	0.53 b
Vermicompost	45.6 b	0.49 bc
S.M.C.A	48.3 b	0.53 b
T.harzianum + V.C	31.8 e	0.33 e
B.subtilis + V.C	36.5 de	0.38 d
T.harzianum + S.M.C.A	35.8 bc	0.37 d
B.subtilis + S.M.C.A	38.7 cd	0.48 e
Tachigazol	9.8 f	0.08 f
Control	0.00	0.00

Spent mushroom compost *A. bisporus* (S.M.C.A) Vermicompost (V.C) *T.harzianum* (T.h) *B.subtilis* (B.S) *Fusarium oxysporium* (*F.O*)

The effect of chemical pesticides, organic fertilizers, biocides, and their combinations on wet and dry biological weight (gm).

The results of Table (3) indicate a decrease in wet and dry biological weight in the treatment contaminated with *F.oxysporum* only, as it amounted to 258.28 and 66.87 gm, respectively, compared to the control, as the wet and dry biological weight reached 445.65 and 93.67 gm, respectively. The effect of Fusarium fungus is due to its ability to penetrate the root of the host, either directly or through wounds, or it can enter through the root hairs in the growing tops, which leads to brittleness and reduction in the number of root hairs, and the fungus grows inside the root tissues and this extends until it reaches Woody tissues and wood vessels, which impedes the rise of water and nutrients, as this leads to a reduction in the root length and a decrease in the average fresh and dry weight of the plant [37, 38]. It was followed by the Tachigazol treatment, as the wet and dry biological weight reached 418.37 and 91.81 gm, respectively, and the fertilizer combinations with Bio-pesticides gave the highest biological weight, as the wet and dry weight of the treatment of V.C fertilizer and S.M.C.A fertilizer with *T.harzianum*, reached 413.71, 90.10, 399.88 and 89.49, respectively, compared to the use of the fungus *T.harzianum* alone, as the wet and dry weight reached 368.36 and 78.21, respectively, followed by the use of V.C fertilizer and S.M.C.A fertilizer with *B.subtilis*, as the wet and dry weight reached 390.01, 88.36, 393.82, and 87.15, respectively, compared to the use of *B.subtilis* alone, as the wet and dry biological weights were 372.48 and 74.66, respectively. The results agreed with [39], which indicated that the growth characteristics improved for tomato plants infected with *fusarium* wilt caused by *Fusarium oxysporum.f.sp. lycopersici* using V.C fertilizer alone or fortified biologically with microorganisms *Trichoderma harzianum*, *Pseudomonas fluorescens* and *Bacillus subtilis*, and the best results were obtained by combining V.C fertilizer with T. harzianum. Experiments also proved that the use of compost with *Azotobacter* increased the dry weight of the shoot of tomato plants, compared to control [40]. Increasing the growth parameters

and dry matter accumulation of cucumber plants using mushroom residues agrees with [41] when it is partially replaced by the culture medium for the production of seedlings.

Table (3) shows the Effect of chemical pesticides, organic fertilizers, biocides and their combinations on wet and dry biological weight (g)

Treatments	Wet weight	Reduction %	Dry weight	Reduction %
F. oxysporum	258.28 i	42.1	42.1	28.6
T.harzianum	368.36 f	17.3	17.3	16.5
B.subtilis	372.48 e	16.4	16.4	20.3
Vermicompost	347.3 h	22.1	22.1	22.6
S.M.C.A	363.67 g	18.4	18.4	26.8
T.harzianum + V.C	413.71 b	7.2	7.2	3.8
B.subtilis + V.C	390.01 d	12.5	12.5	5.7
T.harzianum + S.M.C.A	399.88 c	10.3	10.3	4.5
B.subtilis + S.M.C.A	393.82 d	11.6	11.6	6.9
Tachigazol	418.37 b	6.1	6.1	1.9
Control	445.65 a	0.00	0.00	0.00

Spent mushroom compost A. bisporus (S.M.C.A) Vermicompost (V.C) T.harzianum (T.h) B.subtilis (B.S) Fusarium oxysporium (F.O)

The effect of chemical pesticides, organic fertilizers, Bio-pesticides and their combinations on the length of the stem and root (cm) and the yield rate per plant (kg)

The results of Table (4) indicate a decrease in the length characteristics of the stem and root in treatment with the pathogenic fungus F. oxysporum, which reached 106.9 and 18.4 cm, respectively, compared to the control treatment, which amounted to 187.3 and 32.2 cm. The combination of vermicompost V.C with T.harzianum excelled in The highest length of stem and root 186.3 and 32.1 cm respectively. Followed by the treatment of Tachigazol and the mixture of S.M.C.A fertilizer with T.harzianum, as the stem and root length reached 186.2, 32.1 cm, 183.4 and 31.2 cm, respectively. The yield production rates for one plant also varied, as the highest production rate in the S.M.C.A fertilizer with T.harzianum reached 1.730 kg compared to the infected treatment, in which the production rate decreased to 0.535 kg per plant. This is due to the fact that plants that grow in soil rich in suitable organic materials have good root systems that reduce the development of plant diseases by compensating for losses from the roots and prolonging their life cycle [42, 43, 44]. Trichoderma also has activity in stimulating plant growth through the secretion of many enzymes and growth regulators, including harzianopyridone, Koninginins, 6-pentyl-a-pyrone, trichocaranes A–D, cyclonerodio, harzianolide, and harzianic acid, all of which promote plant growth [45] The results of [46] indicate that the hormone harzianolide, a product of Trichoderma, is responsible for root length in rice plants. The increase in production is also attributed to the use of mushroom farm waste effect on the physical and chemical soil properties of the soil by reducing soil acidity, PH, which makes the soil elements of phosphorus, potassium and magnesium available to the plant, resulting in an increase in the yield of cucumber plants [47]. The use of mushroom residues in feeding the earthworm with its biological support using the fungus T. harzianum resulted in obtaining

the highest production of 1.7 kg per plant of tomato fruits, with an improvement in the quality of the fruits [48].

Table (4) shows the effect of chemical pesticide, organic fertilizer, biocide and their combinations on stem and root length (cm) and yield rate per plant (kg)

Treatments	Plant length (cm)	Root length (cm)	Yield ($Kg.plant^{-1}$)
F. oxysporum	106.9 h	18.4 i	0.535 i
T.harzianum	168.8 e	29.9 e	1.103 g
B.subtilis	155.2 f	26.1 f	1.217 f
Vermicompost	154.3 f	24.1 g	1.109 g
S.M.C.A	140.6 g	23.2 h	0.980 h
T.harzianum + V.C	186.3 a	32.7 a	1.667 b
B.subtilis + V.C	181.4 c	32.1ab	1.560 c
T.harzianum +S.M.C.A	183.4 bc	31.2 cd	1.730 a
B.subtilis + S.M.C.A	177.3 d	30.8 d	1.643 bc
Tachigazol	186.2 a	32.1ab	1.343 e
Control	187.3 a	32.2 a	1.440 d

Spent mushroom compost *A. bisporus* (S.M.C.A) Vermicompost (V.C) *T.harzianum* (T.h) *B.subtilis* (B.S) *Fusarium oxysporium* (*F.O*)

Conclusion

The pesticide Tachigazol did not show any effect for the method of working the filtrate, but it showed its high effect in reducing the colony of the fungus. as the inhibition rate reached 93.52% at the highest concentration of 300 PPM and for both methods of working the filtrate filtered and unfiltered, while there was a variation in the results of the inhibition rate according to the method of working the filtrate for organic fertilizer, as the filtrate of Vermicompost fertilizer and Spent mushroom compost A. bisporus (S.M.C.A) unfiltered gave a significant difference from the filtered filtrate.

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