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Evaluation of Some Fungicides Alternatives for Control of Root-Rots Disease in Basil Plant

تقييم بعض بدائل المبيدات الفطرية لمكافحة مرض تعفن الجذور في نبات الريحان

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Abstract:

Abstract— Content of the work: The results showed that the fungus *Rhizoctonia solani* is the organism that causes root rots in basil plants, and it is one of the most common pathogens. *Rhizoctonia solani* was isolated from three governorates (Aswan - Luxor - Qena), and the *Rhizoctonia solani* isolates showed different rates of incidence of root rots diseases. Different treatments (clove oil, garlic oil, lemongrass oil) at three different concentrations of 1000 ppm, 3000 ppm, 5000 ppm and the use of biological agents (*Trichoderma harzianum* and *Bacillus subtilis*) were used to inhibit the growth of the fungus in the laboratory. The results showed that the bioagent *Trichoderma harzianum* was the best in inhibiting the growth of the fungus (*Rhizoctonia solani*) by (62.95%). Some different treatments (clove oil, garlic oil,) at two different concentrations of 3000 ppm, 5000 ppm and the use of biological agents (*Trichoderma harzianum* and *Bacillus subtilis*) were used to control root rots disease in the greenhouse, and the results showed that clove oil 5000 ppm was the best in reducing disease severity and also increasing the number of branches. The chlorophyll content increased when the plant was treated with *Trichoderma harzianum*, and the results also showed that salicylic acid 500 ppm led to increased plant growth. In general, the use of organic acids led to improved plant growth.

Keywords— *Ocimum basilicum*; *Rhizoctonia solani*; organic acids; essential oils; biological agents.

ملخص

محتوى العمل: أظهرت النتائج أن الفطر Rhizoctonia solani هو الكائن المسبب لتعفن الجذور في نباتات الريحان، وهو من أكثر الكائنات المسببة للأمراض شيوعاً، وقد تم عزل الفطر Rhizoctonia solani من ثلاث محافظات (أسوان – الأقصر – قنا)، وأظهرت عزلات الفطر Rhizoctonia solani معدلات متفاوتة للإصابة بأمراض تعفن الجذور، وقد استخدمت معاملات مختلفة (زيت القرنفل، زيت الثوم، زيت الليمون) بثلاثة تركيزات مختلفة ١٠٠٠ جزء في المليون، ٣٠٠٠ جزء في المليون، ٥٠٠٠ جزء في المليون واستخدام العوامل البيولوجية (Trichoderma harzianum و Bacillus subtilis)لتثبيط نمو الفطر في المعمل، وقد أظهرت النتائج أن العامل البيولوجي Trichoderma harzianum كان الأفضل في تثبيط نمو الفطر (Rhizoctonia solani) بنسبة (٦٢,٩٥%). تم استخدام بعض المعاملات المختلفة (زيت القرنفل، زيت الثوم) بتركيزين مختلفين ٣٠٠٠ جزء بالمليون، ٥٠٠٠ جزء بالمليون واستخدام العوامل البيولوجية (Trichoderma harzianum و Bacillus subtilis) للسيطرة على مرض تعفن الجذور في الدفيئة، وأظهرت النتائج أن زيت القرنفل بتركيز ٥٠٠٠ جزء بالمليون كان الأفضل في تقليل شدة المرض وأيضا زيادة عدد الأفرع، كما زاد محتوى

الكلوروفيل عند معاملة النبات بـTrichoderma harzianum ، وأظهرت النتائج أيضا أن حمض الساليسيليك بتركيز ٥٠٠ جزء بالمليون أدى إلى زيادة نمو النبات، وبشكل عام أدى استخدام الأحماض العضوية إلى تحسين نمو النبات.

INTRODUCTION

Sweet basil (*Ocimum basilicum* L.) is one of the most important aromatic plants subjected to be infected with soil borne diseases including wilt and root rot diseases which causes several important considerable losses in yield in the present investigation [1]. Medicinal and aromatic plants have a major role in agriculture and industry. They are the main source for safe drugs and raw substances used in manufacturing of pharmaceuticals. Some of their components are nucleus to the chemical biosynthesis [2]-[4]. Sweet basil is one of the leading herb crops, used fresh or dry sweet basil is used as flavoring agent as a source of oil perfume and acts principally on digestive and nervous system, stomach cramps, colic and indigestion. It can be used to prevent nausea and vomiting and help to kill intestinal worms; it has a mild sedative action [5]. It is produced commercially in Egypt, France, Hungary, Israel, Italy, Mexico, Indonesia and USA [6],[7]. Soil-borne diseases are still a major threat to basil cultivation in Egypt and all over the world [8],[9]. Many soil-borne fungi, including *Rhizoctonia solani*, *Fusarium solani*, *Fusarium oxysporum* and *Macrophomina phaseolina*, infect basil plants causing damping-off and wilt diseases [9]-[11].

MATERIALS AND METHODS

All greenhouse experiments were conducted at the Faculty of Agriculture and Natural Resources, Aswan University, during the period from 2021 to 2023, and laboratory experiments were conducted in the Plant Pathology Laboratory - Aswan University.

2.1. Sampling procedures:

A study was conducted to identify the pathogenic fungi that could be responsible for root rots disease of basil plants (*Ocimum basilicum*). Therefore, Plant samples that showed symptoms of root rots disease (yellowing, wilting, root rot) were collected from three governorates on a large scale. These governorates are Aswan, Luxor, and Qena, where 30 samples were collected from each location. Each sample was recorded and the general conditions of the plant were kept in a plastic bag and sent directly to the laboratory to isolate the fungi associated with them.

2.2. Isolation, purification and identification of fungi:

Basil plants showing symptoms of wilting and root rot were washed with pine water. Then cut them (roots) into small pieces, sterilize them using a 5% sodium hypochlorite solution for 1.5 minutes, re-wash them several times with sterile water put on filter paper to dry, and transfer them to Petri dishes containing medium (potato dextrose agar). Then incubate the dishes at 28°C for 3-5 days. The growing fungi were purified using the single spore technique[12],[13]. The isolated fungi were identified by Assiut University mycological centre.

2.3. Pathogenicity test:

This experiment was conducted at the Faculty of Agriculture and Natural Resources - Aswan University for a period of seven months, starting from the end of March to the end of October 2021. Four isolates of *Rhizoctonia solani* were used in this experiment. The pots (20 cm diameter) were used for planting which were sterilized by immersing them in formalin solution for 15 minutes and left for 30 minutes to dry. The soil was mixed (sand: clay) in a ratio (1:1) and sterilized with formalin and left for 15 days. The pots were then filled with sterilized soil and three basil seedlings were used in each pot. Sorghum grain medium was used for preparing the inoculum, where flasks containing (sorghum + sand + water) were autoclaved and then inoculated with a 7 day-old culture of the pathogen isolate and incubated at 27°C for two weeks.

The inoculum was added and mixed with the soil in the pots, and then the pots were irrigated for a week before planting. Severity of the disease was recorded after ٥ months.

Disease assessment:

The severity of the disease was recorded on the basil plant and the readings that were converted to the disease index were taken using the following procedure.

٠ = No infection
١ = Yellowing and wilting 0 : 25%
٢ = Yellowing and wilting ٢٥:٥٠ %
٣ = Yellowing and wilting ٥٠:٧٥ %
٤ = Yellowing and wilting ٧٥:١٠٠ %
٥ = Plant death

$$Severity = \frac{\text{Number of infected plants x degree of infection}}{\text{total number of plants examined } \times \text{ highest degree of infection}} \times 100$$

2.4. The effect of different treatments on the growth of Rhizoctonia solani in the laboratory:-

2.4.١ -Essential oils:-

Essential oils (clove oil - garlic oil - lemongrass oil) were used to combat the fungal pathogen at the following concentrations: 1000 ppm, 3000ppm and 5000ppm. The tested oils were used through small discs of filter paper which immersed in the tested oil and then placed on the cover of the petri dish; the center of a petri dish was inoculated with the pathogen isolate. (Taken from a 10-day-old culture grown on the medium at 27 °C). Each treatment was repeated three times and incubated at 27 °C, and the data was recorded after 5 days. Then the percentage of growth inhibition was calculated using the following formula.

$$Growth\ inhibition\ \% = \frac{growth\ in\ the\ control - growth\ in\ the\ treatment}{growth\ in\ the\ control} \times 100$$

2.4.2 -Biological agents:-

Biocontrol isolates were obtained from the Department of Plant Diseases, Assiut University, and were used during the study. These isolates include *Trichoderma harzianum* and *Bacillus subtilis*. The isolates were evaluated against *Rhizoctonia solani* using the double cultivation technique [14]. The Pathogenic fungus and the bioagent fungus were grown in the nutrient medium, then a disc of the Pathogenic fungus and the bioagent fungus (taken from a 10-day-old culture grown on the nutrient medium at 27 °C) were placed in a petri dish (diameter 9 cm) in two opposite sides, then each treatment was repeated three times and incubated at 27 °C. Data were recorded after 5 days and the inhibition percentage was calculated using the equation mentioned before.

٢,٥- control of root rots disease of basil caused by (Rhizoctonia solani) using different treatments in the greenhouse:-

The greenhouse experiment was conducted during the 2022 and 2023 seasons using the sweet basil variety. Mixed soil (sand: clay) was used in a ratio of (1:1). The following measurements were recorded: disease severity, number of branches, plant height, and chlorophyll content, fresh weight and dry weight.

2.٥.1 -Essential oils:-

The oils (Clove oil and garlic oil) were prepared using tween emulsion (2.5 ml), essential oil (5 ml), and sterile water (42.5 ml) and placed on a magnetic stirrer for half an hour. The tested oils were used in the following concentrations: 3000 ppm, 5000 ppm, where the seedlings were soaked in the different concentrations for 10-15 minutes and then placed in pots which containing soil (sand: clay) in a ratio of (1:1) inoculated with the pathogenic fungus. Then calculate the disease severity after 5 months.

2.٥.٢ -Organic acids:-

Ascorbic acid, oxalic acid, and salicylic acid were prepared using distilled water (1000 ml + 250 ppm of the acid used) at the following concentrations: 250 ppm. 500 ppm, where the seedlings were soaked in different concentrations for 10-15 minutes and then placed in pots inoculated with the tested fungus. Then the disease severity was calculated 5 months after the date of inoculation.

2.٥.٣ -Biological agents:-

Trichoderma harzianum isolate was evaluated in the greenhouse, where it was grown on sorghum grain medium after sterilization and incubated at 27 °C and then it was added to pots inoculated with the pathogenic fungus, where 25 grams of sorghum inoculated with the bioagent fungus were placed. Then the disease severity was calculated after 5 months.

Bacillus subtilis isolate was evaluated, as it was prepared using 5 grams of peptone and 3 grams of beef per liter of distilled water and sterilized inside an autoclave at a temperature of (121 for 20 minutes), after which it was inoculated with the *Bacillus subtilis* and added to the pots inoculated with the tested fungus. Then calculate the disease severity after 5 months.

RESULTS AND DISCUSSION

3.1. Isolation and identification of pathogens

The data in Table (1) indicate that the fungus *Rhizoctonia solani* was the most frequently isolated fungus with an average frequency of (12.5%). The frequency was in Aswan (11.25%), Luxor (15%), and Qena (11.25%), followed by the fungus *Fusarium solani* with an average frequency of (10.83%). The frequency was in Aswan (6.25%), Luxor (10%), and Qena (16.25%). It is followed by the fungus *Alternaria alternata* with an average frequency of (5.83%), followed by the following least common fungi *Aspergillus niger* with an average frequency of (2.5%), *Epicoccum nigrum* with an average frequency of (0.83%).

TABLE (1) FREQUENCY (%) OF FUNGI ISOLATED FROM THE ROOTS OF BASIL PLANTS FROM THREE GOVERNORATES:

Fungi	Aswan	Luxor	Qena	Average
Rhizoctonia solani	١١,٢٥	١٥	١١,٢٥	١٢,٥
Fusarium solani	٦,٢٥	١٠	١٦,٢٥	١٠,٨٣
Alternaria alternata	١٠	٥	٢,٥	٥,٨٣
Aspergillus niger	١,٢٥	١,٢٥	٥	٢,٥
Epicoccum nigrum	٠	١,٢٥	١,٢٥	٠,٨٣

3.2. Pathogenicity test

A pathogenicity test was conducted by four isolates of the fungus *Rhizoctonia solani* on basil plants within the Faculty of Agriculture and Natural Resources - Aswan University. The isolates showed clear infections in the leaves, roots and stems. The results are shown in Table (2) and

fig. (1). The tested isolates of *Rhizoctonia solani* are able to infect basil plants with different degrees of disease severity.

TABLE (٢) PATHOGENICITY TEST OF PATHOGENIC ISOLATES OF RHIZOCTONIA SOLANI ON BASIL PLANTS:

isolation	Source of isolation	Disease severity %
Rhizoctonia solani 1	Aswan	28.88
Rhizoctonia solani 2	Luxor	88.88
Rhizoctonia solani 3	Qena	26.66
Rhizoctonia solani 4	Qena	42.22
Control	----------	0.00
L.S.D 0.05	----------	24.2581165111

FIG. (1) PATHOGENICITY TEST OF RHIZOCTONIA SOLANI ON BASIL.

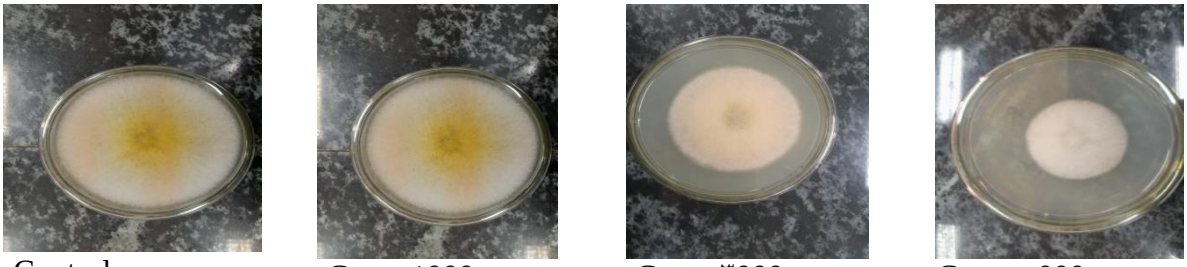
3.3. The effect of different treatments on the growth of Rhizoctonia solani in the laboratory:-

The efficiency of biological agents (*Trichoderma harzianum* and *Bacillus subtilis*) and essential oils (clove oil - garlic oil - lemongrass oil) at the following concentrations: 1000 ppm, 3000ppm, 5000ppm. against the growth of pathogenic fungi on dishes in the laboratory. The results showed that the fungus (*Trichoderma harzianum*) was the most inhibitory to the fungus (Rhizoctonia solani) with a rate of (62.95%) It is followed by bacteria)Bacillus subtilis(. This confirms the results of [15],[16]. They are followed by clove oil 5000 ppm and garlic oil 5000 ppm. This results confirmed by [18],[19].

TABLE (٣) EFFECT OF DIFFERENT TREATMENTS ON THE GROWTH RHIZOCTONIA SOLANI IN THE LABORATORY:

treatment	Average growth (cm)	Inhibition percentage %
Clove oil١٠٠٠	7.5	16.66
Clove oil٣٠٠٠	5.5	38.88
Clove oil٥٠٠٠	3.66	59.25
garlic oil١٠٠٠	6.83	24.07
garlic oil٣٠٠٠	4.33	51.85
garlic oil٥٠٠٠	3.5	61.10
Lemongrass oil١٠٠٠	8.33	7.403
Lemongrass oil٣٠٠٠	8	11.10
Lemongrass oil٥٠٠٠	7.83	12.96
Trichoderma harzianum	3.33	62.95

Bacillus subtilis	3.5	61.10
Control	9	0
L.S.D. (0.05)	8.5459879565	



Control Conc. 1000 ppm Conc. ٣000 ppm Conc. ٥000 ppm

FIG. (٢) : THE EFFECT OF CLOVE OIL ON THE GROWTH RHIZOCTONIA SOLANI

Control Conc. 1000 ppm Conc. ٣000 ppm Conc. ٥000 ppm

FIG. (٣): THE EFFECT OF GARLIC OIL ON THE GROWTH RHIZOCTONIA SOLANI

Control Conc. 1000 ppm Conc. ٣000 ppm Conc. ٥000 ppm

FIG. (٤): EFFECT OF LEMONGRASS OIL ON THE GROWTH RHIZOCTONIA SOLANI

FIG. (٥) THE EFFECT OF TRICHODERMA HARZIANUM ON THE GROWTH OF RHIZOCTONIA SOLANI

3.4. control of root rots disease of basil caused by (Rhizoctonia solani) using different treatments in the greenhouse:-

In the greenhouse, biological agents were used (*Trichoderma harzianum and Bacillus subtilis*), essential oils (clove oil - garlic oil) at the following concentrations: 3000ppm, 5000ppm. and organic acids) and ascorbic acid, oxalic acid, and salicylic acid (at the following concentrations: 250ppm, 500ppm). To Control the root rots of the basil plant in the greenhouse, the application of these factors led to a decrease in the severity of the disease at different degrees. While the most inhibiting resistance to the fungus in the greenhouse was salicylic acid,

clove oil, and garlic oil. The use of salicylic acid led to an increase in the height of the plant. These results are confirmed by Mahmoud and Gomah [20], and Raju *et al.* [21], and also Sagdic *et al.* [22]. The chlorophyll content increased in general, and the use of organic acids led to improved plant growth, as ascorbic acid led to an increase in the number of branches and thus increased the fresh weight and dry weight of the plant. These results are confirmed by [18],[23],[24].

3.4.1. The effect of different treatments on the disease severity of basil plants infected with the fungus (Rhizoctonia solani)

Table (4) shows the results of the different treatments for basil plants infected with the fungus (*Rhizoctonia solani*), which causes root rot. The results indicate that (Clove oil 5000 ppm) was the best in reducing disease severity by (%٧,٧٧). While it was the least in reducing disease severity (Ascorbic acid 250ppm) by (%٥٩,٩٩)

TABLE (4): EFFECT OF DIFFERENT TREATMENTS ON DISEASE SEVERITY OF ROOT ROTS CAUSED BY RHIZOCTONIA SOLANI THROUGH ٢٠٢٢ AND ٢٠٢٣ SEASONS

treatment	Severity of disease%		
	٢٠٢٢	٢٠٢٣	mean
Clove oil ٣٠٠٠	37.77	28.88	33.32
Clove oil ٥٠٠٠	6.66	8.88	7.77
garlic oil ٣٠٠٠	37.77	33.33	35.55
garlic oil ٥٠٠٠	15.55	17.77	16.66
Ascorbic acid 250	59.99	59.99	59.99
Ascorbic acid 500	35.55	33.33	34.44
oxalic acid 250	57.77	55.55	56.66
oxalic acid 500	20	24.44	22.22
salicylic acid 250	24.44	26.66	25.55
salicylic acid 500	26.66	35.55	31.10
Trichoderma harzianum	22.22	19.99	21.10
Bacillus subtilis	37.77	33.33	35.55
Control	86.66	79.99	83.32
L.S.D. (0.05)	١٣,٠٤	٢٤,٠٣	

3.4.2. ٢The effect of different treatments on the number of branches of basil plants infected with the fungus (Rhizoctonia solani)

Table (5) shows the results of the different treatments for the basil plant infected with the fungus (*Rhizoctonia solani*), which causes root rot. The results indicate that (Clove oil 5000 ppm) was the best in increasing the number of branches by (٤,٠٥). While it was the least in reducing the number of branches (salicylic acid٢٥٠ ppm) by (٢,١١)

TABLE (5): EFFECT OF DIFFERENT TREATMENTS ON NUMBER OF BRANCHES OF BASIL THROUGH 2022 AND 2023 SEASONS

treatment	number of branches		
	٢٠٢٢	٢٠٢٣	mean
Clove oil ٣٠٠٠	3.77	3.66	3.72
Clove oil ٥٠٠٠	4	4.11	4.05

garlic oil ٣٠٠٠	2.66	2.55	2.61
garlic oil ٥٠٠٠	3.88	3.55	3.72
Ascorbic acid 250	3.77	3.44	3.61
Ascorbic acid 500	3.88	3.77	3.83
oxalic acid 250	2.44	2.66	2.55
oxalic acid 500	3.77	3.66	3.72
salicylic acid 250	2.11	2.11	2.11
salicylic acid 500	2.33	2.22	2.27
Trichoderma harzianum	3.66	3.77	3.72
Bacillus subtilis	2.55	2.55	2.55
Control	1	1.33	1.16
L.S.D. (0.05)	١,٠٣	١,١٥	

3.4.3. The effect of different treatments on the Chlorophyll content of basil plants infected with the fungus (Rhizoctonia solani)

Table (6) shows the results of the different treatments for the basil plant infected with the fungus (*Rhizoctonia solani*), which causes root rot. The results indicate that (*Trichoderma harzianum*) was the best in increasing the Chlorophyll content by (٢٦,٣٢). While it was the least in reducing the Chlorophyll content (oxalic acid 250 ppm) by (٢٢,٠١)

TABLE (6): EFFECT OF DIFFERENT TREATMENTS ON CHLOROPHYLL CONTENT IN BASIL PLANTS THROUGH 2022 AND 2023 SEASONS

treatment	Chlorophyll content		
	٢٠٢٢	٢٠٢٣	mean
Clove oil ٣٠٠٠	22.16	23.53	22.85
Clove oil ٥٠٠٠	24.45	25.18	24.82
garlic oil ٣٠٠٠	24.92	25.74	25.33
garlic oil ٥٠٠٠	25.54	25.4	25.47
Ascorbic acid 250	22.71	23.77	23.24
Ascorbic acid 500	22.77	23.03	22.90
oxalic acid 250	21.58	22.44	22.01
oxalic acid 500	24.32	25.45	24.88
salicylic acid 250	22.31	23.98	23.14
salicylic acid 500	24.65	25.92	25.28
Trichoderma harzianum	26.55	26.08	26.32
Bacillus subtilis	23.5	24.77	24.13
Control	6.87	8.76	7.82
L.S.D. (0.05)	٣,٤٦	٣,١٦	

3.4.4. The effect of different treatments on the plant height of basil plants infected with the fungus (Rhizoctonia solani)

Table (7) shows the results of the different treatments for the basil plant infected with the fungus (*Rhizoctonia solani*), which causes root rot. The results indicate that (salicylic acid 500ppm) was the best in increasing the Plant height by (٨٣,٤٤ cm). While it was the least in reducing the Plant height (oxalic acid 250 ppm) by (٦٠,٨٣ cm)

TABLE (7): EFFECT OF DIFFERENT TREATMENTS ON PLANT HEIGHT OF BASIL THROUGH 2022 AND 2023 SEASONS

treatment	Plant height (cm)

	٢٠٢٢	٢٠٢٣	mean
Clove oil ٣٠٠٠	68.22	68.55	68.38
Clove oil ٥٠٠٠	79	78.11	78.55
garlic oil ٣٠٠٠	65.22	66.66	65.94
garlic oil ٥٠٠٠	80.77	80.88	80.83
Ascorbic acid 250	67	68.44	67.72
Ascorbic acid 500	72.88	73.77	73.33
oxalic acid 250	60.66	61	60.83
oxalic acid 500	76.22	77.55	76.88
salicylic acid 250	79.66	79.33	79.50
salicylic acid 500	83.22	83.66	83.44
Trichoderma harzianum	73.77	73.55	73.66
Bacillus subtilis	66.77	67.88	67.33
Control	27.22	29.88	28.55
L.S.D. (0.05)	١١,٨٤	٧,٥٤	

3.4.5. The effect of different treatments on the fresh weight of basil plants infected with the fungus (Rhizoctonia solani)

Table (8) shows the results of the different treatments for the basil plant infected with the fungus (*Rhizoctonia solani*), which causes root rot. The results indicate that (salicylic acid 500ppm) was the best in increasing the fresh weight by (٢٧,٨٨ gm). While it was the least in reducing the Fresh weight (oxalic acid ٢٥٠ppm) by (٢١,٢٢ gm)

TABLE (8): EFFECT OF DIFFERENT TREATMENTS ON PLANT FRESH WEIGHT OF BASIL THROUGH 2022 AND 2023 SEASONS

treatment	Fresh weight (gm)		
	٢٠٢٢	٢٠٢٣	mean
Clove oil ٣٠٠٠	23.88	23.44	23.66
Clove oil ٥٠٠٠	24.55	25.66	25.11
garlic oil ٣٠٠٠	22.33	22.66	22.49
garlic oil ٥٠٠٠	25.55	26.22	25.88
Ascorbic acid 250	24.22	25.88	25.05
Ascorbic acid 500	26.88	26.55	26.72
oxalic acid 250	20.66	21.77	21.22
oxalic acid 500	24.33	25.55	24.94
salicylic acid 250	25.11	26.44	25.77
salicylic acid 500	27.33	28.44	27.88
Trichoderma harzianum	25	26.66	25.83
Bacillus subtilis	23.11	24.66	23.88
Control	8.11	9.11	8.61
L.S.D. (0.05)	٤,١٠	٧,٢٧	

3.4.6. The effect of different treatments on the dry weight of basil plants infected with the fungus (Rhizoctonia solani)

Table (9) shows the results of the different treatments for the basil plant infected with the fungus (*Rhizoctonia solani*), which causes root rot. The results indicate that (salicylic acid 500ppm) was the best in increasing the dry weight by (١١,٢٢ gm). While it was the least in reducing the dry weight (oxalic acid ٢٥٠ppm) by (٨ gm).

TABLE (9): EFFECT OF DIFFERENT TREATMENTS ON PLANT DRY WEIGHT OF BASIL THROUGH 2022 AND 2023 SEASONS

treatment	dry weight (gm)		
	٢٠٢٢	٢٠٢٣	mean
Clove oil ٣٠٠٠	9.33	8.88	9.11
Clove oil ٥٠٠٠	9.55	10	9.77
garlic oil ٣٠٠٠	8.33	8.55	8.44
garlic oil ٥٠٠٠	9.88	10.33	10.11
Ascorbic acid 250	9.55	10.11	9.83
Ascorbic acid 500	10.66	10.33	10.50
oxalic acid 250	7.88	8.11	8.00
oxalic acid 500	9.33	10	9.66
salicylic acid 250	10	10.55	10.27
salicylic acid 500	11	11.44	11.22
Trichoderma harzianum	9.66	10.55	10.11
Bacillus subtilis	8.77	9.55	9.16
Control	2.55	3	2.77
L.S.D. (0.05)	١,٨٦	٣,٥٦	

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