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Proceeding Paper

Effects of Different Garlic Straw Additions on Eggplant Rhizosphere Matrix Microorganisms †

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Abstract

Garlic has broad-spectrum antibacterial activity. Returning garlic straw to the field can promote crop growth and soil conditions to varying degrees. To explore the effects of different amounts of garlic straw added to the microorganisms in the rhizosphere substrate of eggplants, potted plant experiments were carried out in the climate room of the East Campus of Tianjin Agricultural University. Three treatments were set up: T0 was eggplant single-cropping (CK), T1 was adding straw with fourteen garlic cloves planted in each pot (a total of 60.2 g), and T2 was adding straw with nine garlic bulbs planted in each pot, totalling 108 garlic cloves (a total of 463.5 g). Each treatment was repeated three times. The abundance of microbial species and the diversity of community structure in the rhizosphere matrix of eggplants were determined by high-throughput sequencing technology. The results indicated that adding garlic straw to the substrate could increase the dominant bacterial species in the microbial community structure of the eggplant rhizosphere substrate. The main bacterial phyla in the substrate were Proteobacteria, Chloroflexi, and Actinobacteriota. The genus of substrate bacteria is mainly Hirschia. The stromal fungi phylum is mainly composed of Ascomycota and Basidiomycota. In terms of Alpha diversity, the diversity and richness of bacteria and fungi in the rhizosphere matrix of eggplants have both decreased, indicating that garlic straw has shown good antibacterial properties, inhibiting the growth of certain pathogenic bacteria, reducing the occurrence of diseases, and improving the microbial environment. Therefore, garlic straw can improve the microbial environment of the rhizosphere substrate by increasing the dominant microbial community of the substrate and inhibiting the growth of pathogenic bacteria. This study provides a scientific basis and technical reference for choosing the appropriate way to add garlic straw and researching the microbial environment of the rhizosphere substrate of eggplants.

Keywords: garlic straw; microbial diversity; high-throughput sequencing; relative abundance of species; eggplant

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1. Introduction

Eggplant (*Solanum melongena* L.) is a widely cultivated and adaptable vegetable crop grown across tropical and subtropical regions globally [1]. Soil microorganisms are one of the important components of the soil ecosystem [2] and they help maintain a healthy and stable soil environment [3,4]. Microorganisms have a significant impact on the ecological functions of soil [5]. As one of the largest agricultural countries in the world, the excellent production of Chinese agricultural straws is becoming an environmental issue rather than

a potential resource for the field [6]. Straw returning is a promising option to alleviate the abovementioned problems caused by chemical fertilisers [7]. Owing to the above properties, straw returning can reduce chemical fertilisers usage and can effectively ensure high and sustainable soil productivity. Allicin present in garlic straw plays a crucial role in inhibiting the growth of matrix microorganisms. The objective of this study is to determine the effects of adding different amounts of garlic straw on the microbial community structure and diversity of the eggplant rhizosphere matrix, providing a scientific basis for selecting the optimal addition method of garlic straw and studying the microbial environment of the eggplant rhizosphere matrix.

2. Materials and Methods

2.1. Test Materials

Baodi garlic, several eggplant seedlings, peat, perlite, vermiculite, and chicken manure.

2.2. Test Methods

2.2.1. Experimental Design

A randomised block design was employed, with three treatments: T0: eggplant monoculture (CK, same below); T1: straw with 14 garlic cloves added per pot (before transplanting eggplant seedlings, where 14 garlic cloves were planted in the substrate of each pot, with an average weight of 4.3 g per clove, with a total of 60.2 g of garlic per pot (same below); T2: each pot was planted with 9 garlic bulbs, totalling 108 garlic cloves (before transplanting the eggplant seedlings, 9 garlic bulbs were planted in each pot of substrate, with each garlic bulb containing 12 garlic cloves, totalling 108 cloves, with a total of 463.5 g of garlic per pot, as described above). Each treatment was replicated three times, with three pots per replicate, and one eggplant plant per pot, totalling 27 plants. The substrate pot experiment was conducted on 18 September 2022 in the climate chamber of the East Campus of Tianjin Agricultural University. The substrate volume ratio was peat:perlite:vermiculite = 6:2:2. Garlic bulbs and cloves were planted according to the treatment.

2.2.2. Soil Sample Collection

Root zone substrate samples were collected during the late growth stage of eggplants (20 September 2023). First, the top 2 cm of substrate in the flower pot was removed. We carefully dug the plant out of the substrate with its roots intact, used the shaking method to remove loosely attached substrate from the root system, and gently brushed off tightly attached substrate using a sterilised brush. After removing plant debris and other contaminants, the remaining substrate was used as the rhizosphere substrate sample. The substrate sample was placed in a sterilised centrifuge tube and stored in liquid nitrogen.

2.2.3. Items and Methods Measured

Root zone matrix microbial community structure and diversity: The determination of root zone matrix microbial community structure and diversity was commissioned to Beijing Compuson Biotechnology Co., Ltd. (Beijing, China), using high-throughput sequencing technology.

2.3. Data Analysis

The experimental data were processed and analysed using Excel 2019 and SPSS 27.0 software.

3. Results

3.1. Effects of Different Treatments on the Composition and Abundance of Root Zone Microbial Communities

3.1.1. Species Abundance Bar Chart

In this study, bar charts of relative species abundance at the phylum and genus levels were selected to analyse the community structure composition of bacteria and fungi. Species with relative abundance exceeding 1% were selected from each treatment for analysis. The bacterial composition of the eggplant rhizosphere matrix under different treatments is shown in Figures 1–4.

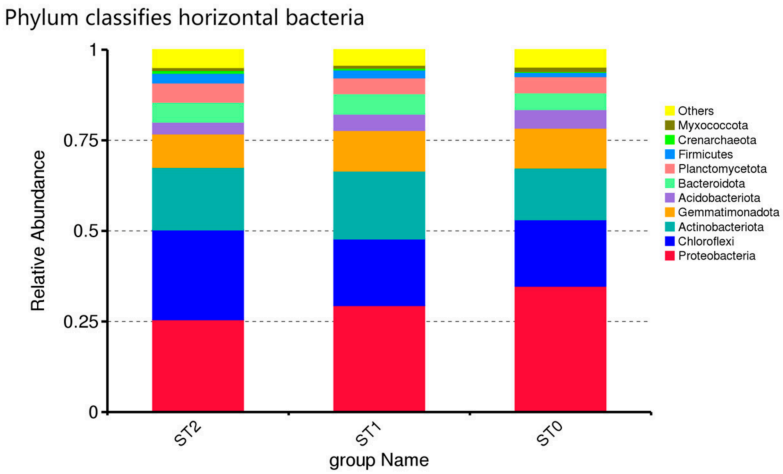

Figure 1. Top 10 bar chart of relative abundance of species at the bacterial phylum classification level. Note: The horizontal axis represents sample information, and the vertical axis represents the top 10 annotated entries ranked by the total relative abundance of all samples at the door classification level. ST0 refers to the matrix sample under the T0 treatment, ST1 refers to the matrix sample under the T1 treatment, ST2 refers to the matrix sample under the T2 treatment, and so on. The lowercase letters indicated in the figure denote the significance letters assigned following statistical analysis of the fungal strains; the same applies below.

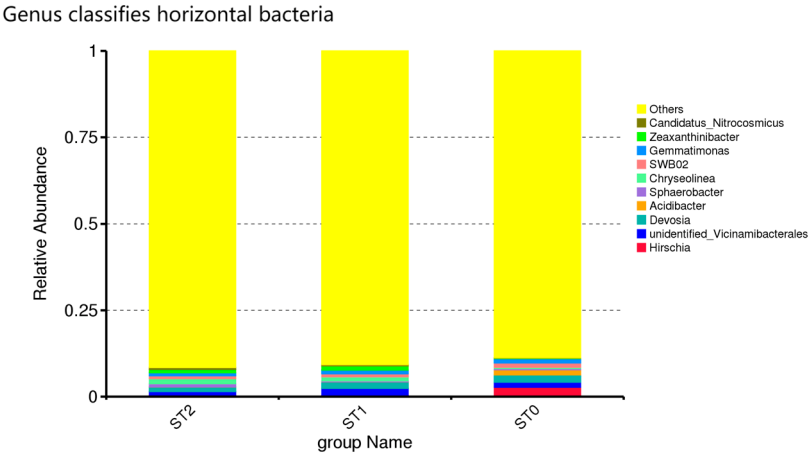

Figure 2. Top 10 bar chart of relative abundance of species at the bacterial genus classification level.

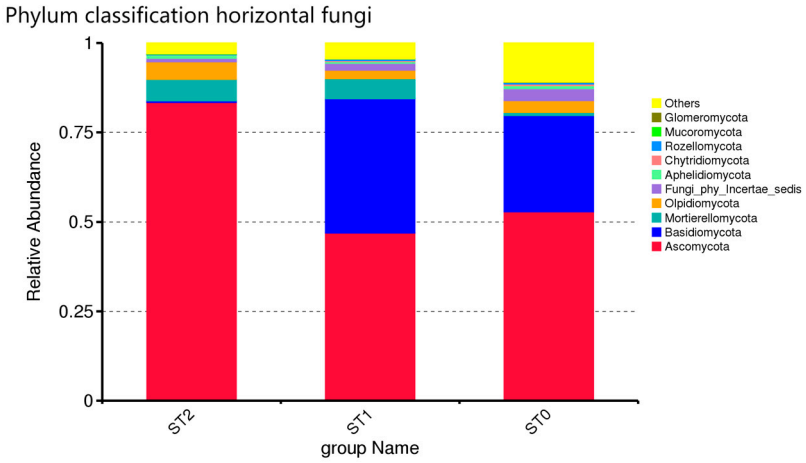

Figure 3. Top 10 bar chart of relative abundance of species at the fungal phylum classification level.

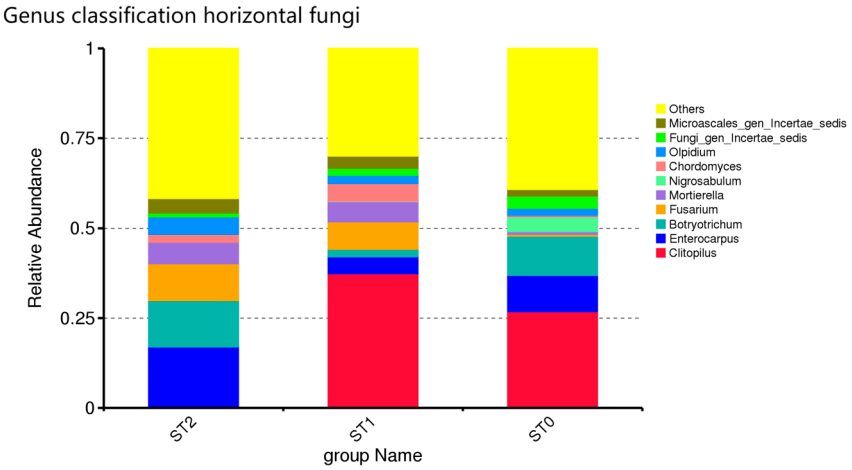

Figure 4. Top 10 bar chart of relative abundance of species at the classification level of the genus Fungi.

As shown in Figure 1, at the phylum level, the bacterial community diversity in eggplant rhizosphere soil is rich, with major bacterial phyla including Proteobacteria, Chloroflexi, Actinobacteriota, and Gemmatimonadota, among which the dominant phyla are Proteobacteria, Chloroflexi, and Actinobacteriota, with relatively high abundance. The Proteobacteria phylum exhibited the highest proportion in the T0 treatment, with an abundance value of 34.75%, significantly higher than in T1 (29.42%, $p < 0.05$) and T2 treatments (25.51%, $p < 0.05$). The Chlorobactea phylum showed the highest proportion in the T2 treatment, with an abundance value of 24.78%. Actinobacteria exhibited the highest proportion in the T1 treatment, with an abundance value of 18.77%, significantly higher than that in the T0 treatment (14.26%). As shown in Figure 2, at the genus level, the main bacterial genera include Hirschia, unidentified Vicinamibacterales, and Devosia.

Figure 3 shows the relative abundance of fungal species in the root zone matrix of eggplants at the phylum level. The main fungal phyla include Ascomycota, Basidiomycota, Mortierellomycota, Olpidiomycota, etc., with Ascomycota being the dominant phylum. In the T2 treatment, the Ascomycota phylum exhibited predominant dominance, accounting for as much as 83.39%, significantly higher than in the T0 treatment (52.78%) and T1 treatment (46.94%). This indicates that the addition of garlic straw in the T2 treatment markedly increased the relative abundance of the Ascomycota phylum in the eggplant rhizosphere matrix. The Basidiomycota phylum dominated in the T1 treatment, accounting for 37.49%, indicating that the addition of garlic straw in the T1 treatment increased the relative abundance of Basidiomycota in the eggplant rhizosphere matrix.

3.1.2. Venn Diagram

Venn diagrams can reflect the number of shared and unique OTUs between groups or samples, and can intuitively show the overlap of OTUs between groups or samples [8]. In Figure 5 the Venn diagram (bacteria) analysis results indicate that, at the OTU level, a total of 3485 classifiable bacterial sequences were obtained from the three different treatment substrate samples. The T0 treatment had the highest number of unique OTUs, accounting for 63% of the T0 treatment. The number of OTUs specific to the T1 and T2 treatment groups accounted for 52% and 47% of those in the T1 and T2 treatment groups respectively. Among these, the T2 treatment had the fewest unique OTUs, followed by the T1 treatment. Compared with the control, adding garlic straw to the substrate reduced the number of OTUs unique to the bacterial community in the eggplant rhizosphere substrate, indicating that the addition of garlic straw significantly altered the OTU richness in the bacterial community of the eggplant rhizosphere substrate. This suggests that adding garlic straw to the substrate has an inhibitory effect on certain bacterial communities, with the T2 treatment showing a more pronounced inhibitory effect.

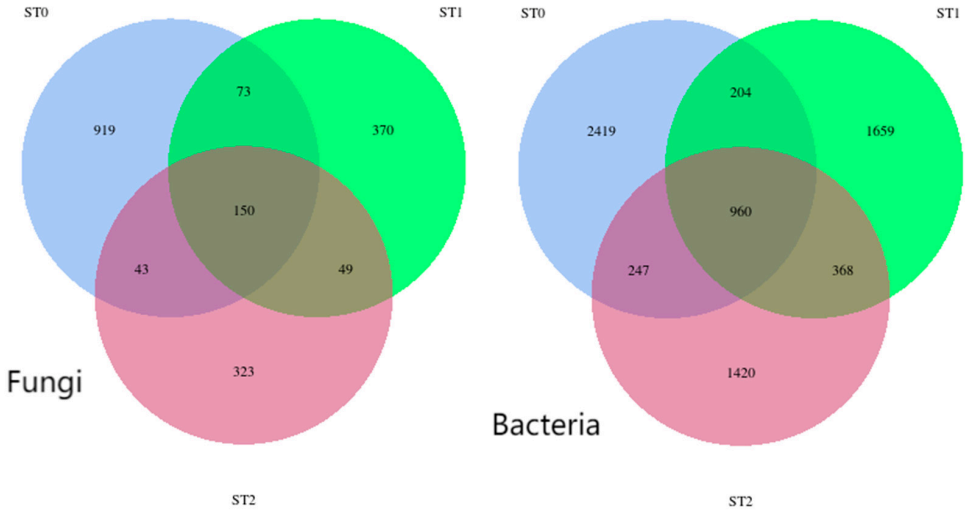

Figure 5. Venn diagram of bacteria and fungi in rhizosphere matrix of eggplant under different treatments. Note: Each circle in the figure represents a sample, and the numbers in the overlapping areas between circles represent the number of feature sequences shared between samples.

As shown in Figure 5 (fungi), among fungi, the number of OTUs unique to T0, T1, and T2 were 919, 370, and 323, respectively, accounting for 77.5%, 57.6%, and 57.1% of the total OTUs in T0, T1, and T2 treatments, respectively; the number of OTUs in each treatment was ranked as T0 > T1 > T2. Compared with the control, adding garlic straw to the substrate reduces the number of OTUs specific to fungi in the eggplant rhizosphere substrate, and the T2 treatment has the fewest OTUs specific to fungi, demonstrating that garlic straw can inhibit fungi. In the Venn diagram of bacteria and fungi, the number of unique OTUs in the T2 treatment was the lowest, indicating that the addition of garlic straw in the T2 treatment had the best antibacterial effect.

3.1.3. Phylogenetic Analysis of Bacteria and Fungi in the Rhizosphere Matrix of Eggplant

From the 100 bacterial strains isolated from the rhizosphere matrix of eggplant under three different treatments (Figure 6), at the phylum level, Proteobacteria and Actinobacteriota were dominant, followed by Chloroflexi and Bacteroidota. As shown in Figure 7, 100 fungal strains were isolated from the rhizosphere soil of eggplant under three different treatments. At the taxonomic level, the Basidiomycota and Ascomycota phyla were dominant, followed by the Mortierellomycota and Olpidiomycota phyla.

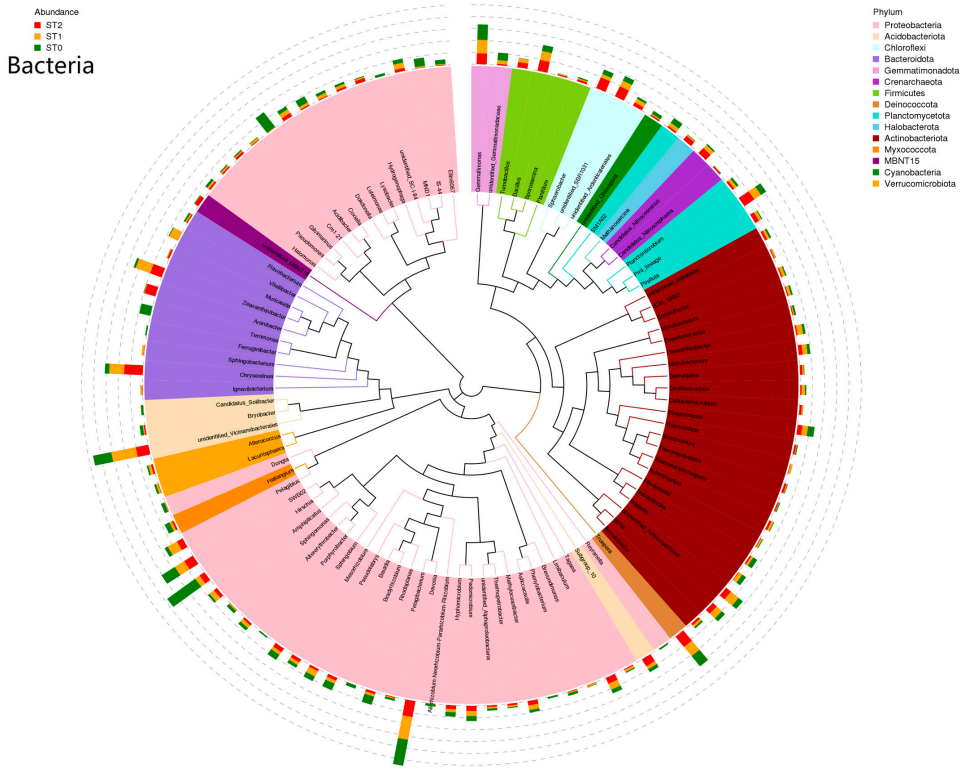

Figure 6. Phylogenetic relationship analysis of rhizosphere matrix bacteria of eggplant under different treatments. Note: The colours of the branches and sectors in the phylogenetic tree represent their corresponding phyla. The stacked bar charts on the outer side of the sectors represent the abundance distribution of the genus in different samples. The same applies below. The larger the area of the bar chart is, the greater the abundance of the genus in that sample is.

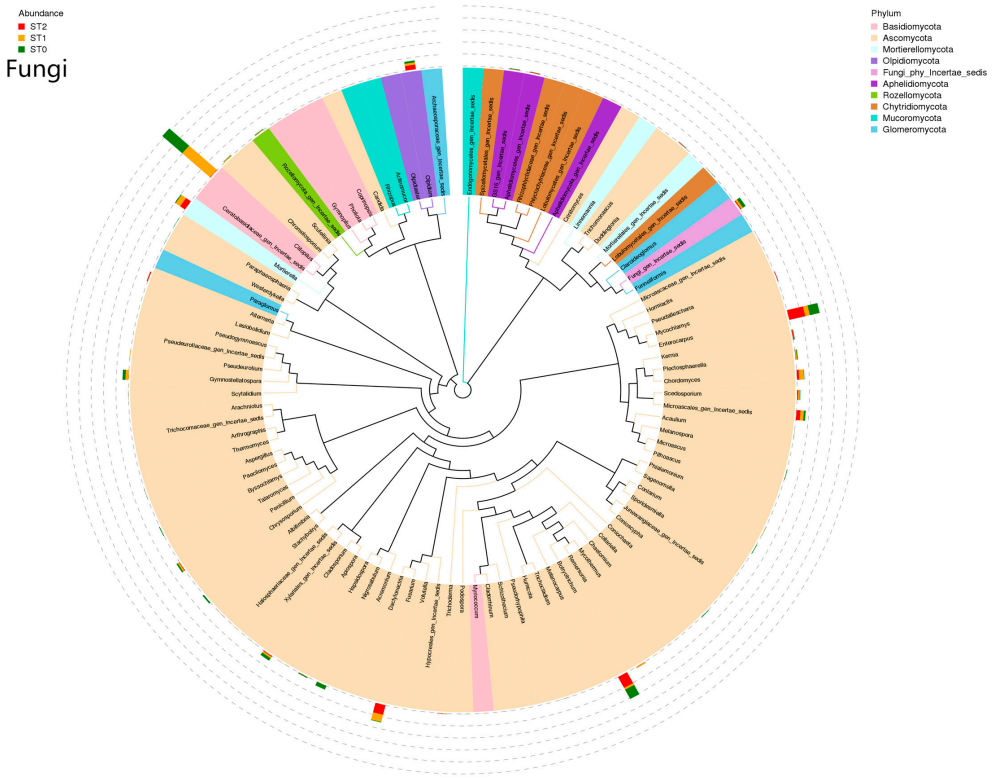

Figure 7. Phylogenetic relationship analysis of rhizosphere matrix fungi of eggplant under different treatments.

3.2. Effects of Different Garlic Straw Addition Rates on Microbial Abundance and Alpha Diversity in the Rhizosphere Matrix of Eggplant

3.2.1. Changes in Bacterial Richness and Alpha Diversity in the Rhizosphere Matrix of Eggplants

Alpha diversity refers to the diversity of a specific region or ecosystem. Commonly used metrics include Shannon, Simpson, ACE, Chao1, and coverage. Information about species diversity can be obtained by examining various index values.

Among these, changes in the Shannon index and Simpson index can be used to measure the species diversity of a community, but their data indications differ. The higher the species diversity of the sample being measured is, the larger the Shannon index and the smaller the Simpson index are. The observed-features and Chao1 indices, on the other hand, measure the richness of species within a community, with higher values indicating greater bacterial community richness. Coverage refers to the community coverage rate, which should exceed 97% [9].

The observed-features index and Chao1 index reflect the richness of a community's species. As shown in Table 1, significant differences in bacterial community richness were observed in the eggplant rhizosphere matrix under different garlic straw addition levels. The bacterial observation feature index and Chao1 index for the three treatment groups were, in descending order, T0 > T1 > T2. Compared with T0, both the bacterial observation feature index and Chao1 index in the rhizosphere matrix decreased in treatments T1 and T2, indicating that adding garlic straw to the matrix reduces bacterial community species richness.

Table 1. Effects of different garlic straw supplemental levels on bacterial community richness and diversity index of eggplant rhizosphere matrix.

Treatment	Chao1	Coverage %	Observed-Features	Shannon	Simpson
T0	2041.875 ± 259.024 a	99.7	1995.667 ± 233.304 a	9.411 ± 0.272 a	0.993 ± 0.003 a
T1	1760.174 ± 10.469 a	99.8	1729.000 ± 15.695 a	9.346 ± 0.029 a	0.996 ± 0.000 a
T2	1699.047 ± 63.053 a	99.8	1661.667 ± 57.853 a	8.815 ± 0.123 a	0.987 ± 0.003 a

Note: Values = mean ± standard error; The same letter "a" indicates no significant difference between treatments at the 0.05 level ($p < 0.05$).

The Simpson index and Shannon index can reflect community species diversity. As shown in Table 1, the order of the Simpson index for the three treatments was T1 > T0 > T2, and the order of the Shannon index was T0 > T1 > T2. Among these, both the Simpson indices and Shannon indices for rhizosphere matrix bacteria treated with T1 and T2 showed a decrease. It is evident that the addition of garlic straw to the substrate affects the species diversity of bacterial communities in the rhizosphere of eggplants. Except for the Simpson index in the T1 treatment, which increased by 0.3% compared to the T0 treatment, other results indicated that T1 and T2 treatments would correspondingly reduce the bacterial diversity of the rhizosphere matrix of eggplants.

3.2.2. Changes in Fungal Richness and Alpha Diversity in the Rhizosphere Matrix of Eggplants

In Table 2, the sequencing results indicate that the fungal community coverage in the eggplant rhizosphere matrix reached 100% under different garlic straw addition levels. However, there were significant differences in fungal community richness in the eggplant rhizosphere matrix under different garlic straw addition levels. The order of the observed-features index and Chao1 index for the three treatments was T0 > T1 > T2. Specifically, compared with T0, both the observed-features index and Chao1 index of the rhizosphere fungal community decreased under T1 and T2 treatments. The addition of garlic straw

to the substrate significantly reduced fungal community species richness, indicating that garlic straw has an inhibitory effect on the growth of certain fungi, with the T2 treatment showing a more pronounced inhibitory effect.

Table 2. Effects of different garlic straw supplementation on rhizosphere matrix fungal community richness and diversity index of eggplant.

Treatment	Chao1	Coverage %	Observed-Features	Shannon	Simpson
T0	583.852 ± 26.322 a	100	573.000 ± 26.001 a	5.434 ± 0.032 a	0.939 ± 0.001 a
T1	350.435 ± 15.211 b	100	347.667 ± 14.450 b	4.883 ± 0.083 b	0.916 ± 0.004 b
T2	289.583 ± 11.856 b	100	288.000 ± 11.061 b	4.318 ± 0.093 c	0.891 ± 0.006 c

Note: Values = mean ± standard error; different lowercase letters indicate significant differences between treatments at the 0.05 level ($p < 0.05$).

Studies on the Simpson index and Shannon index of fungi, as shown in Table 2, indicate that the order of Simpson index and Shannon index for all three treatments was T0 > T1 > T2. Compared to T0, both Simpson's index and Shannon's index for fungal communities in the rhizosphere matrix decreased under T1 and T2 treatments. Furthermore, Simpson's index and Shannon's index for fungi in the rhizosphere matrix under T2 treatment were lower than those under T1 treatment. In terms of fungal diversity Simpson and Shannon indices, T1 was significantly lower than T0 treatment, while T2 treatment was significantly lower than T1 treatment. It is evident that the T1 and T2 treatments reduced fungal diversity in the eggplant rhizosphere matrix. Adding garlic straw to the matrix significantly reduced fungal community species diversity, with the T2 treatment showing a more pronounced effect in reducing fungal diversity in the eggplant rhizosphere matrix.

4. Discussion

Microorganisms are one of the components of the soil microecosystem [10]. In this study, we analysed the relative abundance of bacterial and fungal communities within the rhizosphere matrix of eggplant. The results showed that the dominant bacterial phyla in both T1 and T2 treatments were *Proteobacteria*, *Verruconella*, and *Actinobacteria*, which is consistent with previous studies by Li Rungen [11] and Zhang Hongxia [12]. The addition of garlic straw to the substrate increased the abundance of the *Actinobacteria* phylum. It is hypothesised that garlic straw, as an organic material, releases specific carbon sources, nitrogen sources, and other nutrients during decomposition, potentially promoting the growth and reproduction of actinomycetes. Furthermore, the degradation process of garlic straw may release certain substances that stimulate antibiotic synthesis, thereby creating favourable conditions for actinomycete growth and reproduction. This exerts a beneficial influence on the microbial environment within the eggplant rhizosphere substrate.

In this experiment, as shown in the top 10 bar chart of the relative abundance of rhizosphere matrix bacterial species (Figure 1), the Proteobacteria phylum was the dominant phylum in this study, with the highest content in the T0 treatment and the lowest in the T2 treatment. Studies have shown that the green bend bacteria phylum can degrade toxic substances in soil and produce energy-rich microorganisms through photosynthesis using CO_2 as a carbon source [13]. Furthermore, the green bend bacteria phylum exhibits strong adaptability to adverse environments and can tolerate extreme soil conditions [14], demonstrating strong competitiveness [15]. In this experiment, the green bend bacteria phylum had the highest content in the T2 treatment, with no significant differences in the T0 and T1 treatments.

At the fungal phylum level, the *Ascomycota* phylum had the highest relative abundance, followed by the *Basidiomycota* phylum. A number of studies have demonstrated the

importance of *Ascomycota* in soils and their ubiquitous presence [16,17]. In this experiment, the *Ascomycota* phylum content in the T2 treatment was significantly higher than in the other two treatments. *Basidiomycetes* play a crucial role in soil carbon cycling [18]. In this study, the *Basidiomycota* content was most abundant in the T1 treatment.

The results of this experiment indicate that, among the bacterial and fungal groups subjected to different treatments, the observed-features indices, Chao1, Simpson's index, and Shannon index were all lowest in the T2 treatment group. It can be seen that after adding garlic straw to the substrate, the diversity and richness of bacteria and fungi in the eggplant rhizosphere substrate both decreased. This differs from the results of previous studies by Gong Biao [19] on the effects of garlic straw on the rhizosphere microbiome of tomatoes; in this experiment, the addition of garlic straw to the substrate effectively inhibited the increase in bacteria and fungi, which may be due to the allicin secreted by garlic roots in the garlic straw having good antibacterial and antifungal effects. Garlic straw demonstrated good antibacterial properties, potentially inhibiting the growth of certain pathogens, reducing disease incidence, and improving the microbial environment. This was particularly evident in the T2 treatment, where the diversity and abundance of rhizosphere bacteria and fungi decreased more significantly, indicating that garlic straw exhibited better antibacterial properties and more pronounced and effective antibacterial effects under this treatment.

5. Conclusions

In this study, high-throughput sequencing technology was used to sequence and analyse the diversity of microbial community structures in the rhizosphere matrix of eggplants under different treatments. The structure and diversity of fungal and bacterial communities in the rhizosphere matrix of eggplants were clarified. Adding garlic straw to the substrate can increase the types of dominant microbial communities in the rhizosphere matrix, and these dominant microbial communities can promote changes in the composition and structure of the microbial community. This can improve the soil environment. Moreover, garlic straw has a significant antibacterial effect on the growth substrate of eggplants, which can eliminate the adverse effects of some harmful bacterial communities on eggplants. This study plays an important role in choosing the appropriate way to add garlic straw and researching the microorganisms in the rhizosphere substrate of eggplants.

Author Contributions: Conceived and designed the experiments: M.W. and X.M. Performed the experiments: X.M. and M.W. Analysed the data: X.M. Contributed reagents/materials/analysis tools: M.W. Wrote the paper: X.M. All authors have read and agreed to the published version of the manuscript.

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References

1. Sidhu, M.; Dhatt, A.; Sidhu, G. Plant regeneration in eggplant (*Solanum melongena* L.): A review. *Afr. J. Biotechnol.* **2014**, *13*, 714–722. [CrossRef]
2. Delgado-Baquerizo, M.; Reich, P.B.; Trivedi, C.; Eldridge, D.J.; Singh, B.K. Multiple elements of soil biodiversity drive ecosystem functions across biomes. *Nat. Ecol. Evol.* **2020**, *4*, 210–220. [CrossRef] [PubMed]

3. Jacobsen, C.S.; Hjelmso, M.H. Agricultural soils, pesticides and microbial diversity. *Curr. Opin. Biotechnol.* **2014**, *27*, 15–20. [CrossRef] [PubMed]
4. Locey, K.J.; Lennon, J.T. Scaling laws predict global microbial diversity. *Proc. Natl. Acad. Sci. USA* **2016**, *113*, 5970–5975. [CrossRef]
5. Qi, Y.; Liu, H.; Wang, J.; Wang, Y. Effects of different straw biochar combined with microbial inoculants on soil environment in pot experiment. *Sci. Rep.* **2021**, *11*, 14685. [CrossRef] [PubMed]
6. Chen, J.; Li, C.; Ristovski, Z.; Milic, A.; Gu, Y.; Islam, M.S.; Wang, S.; Hao, J.; Zhang, H.; He, C.; et al. A review of biomass burning: Emissions and impacts on air quality, health and climate in China. *Sci. Total Environ.* **2017**, *579*, 1000–1034. [CrossRef]
7. Ma, Y.; Liu, D.L.; Schwenke, G.; Yang, B. The global warming potential of straw-return can be reduced by application of straw-decomposing microbial inoculants and biochar in rice-wheat production systems. *Environ. Pollut.* **2019**, *252*, 835–845. [CrossRef]
8. Liu, C.; Zhang, L.; Li, H.; He, X.; Dong, J.; Qiu, B. Assessing the biodiversity of rhizosphere and endophytic fungi in *Knoxia valerianoides* under continuous cropping conditions. *BMC Microbiol.* **2024**, *24*, 195. [CrossRef] [PubMed]
9. Reid, C.J.; Farrell, M.; Kirby, J.K. Microbial communities in biosolids-amended soils: A critical review of high-throughput sequencing approaches. *J. Environ. Manag.* **2025**, *375*, 124203. [CrossRef] [PubMed]
10. Li, M.; Yang, F.; Wu, X.; Yan, H.; Liu, Y. Effects of continuous cropping of sugar beet (*Beta vulgaris* L.) on its endophytic and soil bacterial community by high-throughput sequencing. *Ann. Microbiol.* **2020**, *70*, 39. [CrossRef]
11. Li, Y.; Luo, S.; Peng, J.; Ding, Y.; Xie, X.; Ma, H.; Yu, M.; Liu, Y.; Ma, Y. Impacts of florfenicol on soil bacterial community structure and diversity by high throughput sequencing analysis. *Biologia* **2024**, *79*, 1931–1938. [CrossRef]
12. Essel, E.; Xie, J.; Deng, C.; Peng, Z.; Wang, J.; Shen, J.; Xie, J.; Coulter, J.A.; Li, L. Bacterial and fungal diversity in rhizosphere and bulk soil under different long-term tillage and cereal/legume rotation. *Soil Tillage Res.* **2019**, *194*, 104302. [CrossRef]
13. Du, Y.-Y.; Kang, W.-J.; Shi, S.-L.; Han, Y.-L.; Guan, J.; Lu, B.-F.; Wu, B. Effects of Exogenous Hormones on Endophytic Rhizobial Proliferation and Growth Promotion in Alfalfa. *Agronomy* **2025**, *15*, 2799. [CrossRef]
14. Neilson, J.W.; Quade, J.; Ortiz, M.; Nelson, W.M.; Legatzki, A.; Tian, F.; LaComb, M.; Betancourt, J.L.; Wing, R.A.; Soderlund, C.A.; et al. Life at the hyperarid margin: Novel bacterial diversity in arid soils of the Atacama Desert, Chile. *Extremophiles* **2012**, *16*, 553–566. [CrossRef] [PubMed]
15. Dincă, L.C.; Grenni, P.; Onet, C.; Onet, A. Fertilization and Soil Microbial Community: A Review. *Appl. Sci.* **2022**, *12*, 1198. [CrossRef]
16. Ali, A.; Ghani, M.I.; Haiyan, D.; Iqbal, M.; Cheng, Z.; Cai, Z. Garlic Substrate Induces Cucumber Growth Development and Decreases Fusarium Wilt Through Regulation of Soil Microbial Community Structure and Diversity in Replanted Disturbed Soil. *Int. J. Mol. Sci.* **2020**, *21*, 6008. [CrossRef] [PubMed]
17. Sruthy, K.S.; Shukla, L.; Kundu, A.; Singh, S.K.; Abdulrahman Alodaini, H.; Hatamleh, A.A.; Santoyo, G.; Kumar, A. Effect of Microbial Consortium Constructed with Lignolytic Ascomycetes Fungi on Degradation of Rice Stubble. *J. Fungi* **2023**, *9*, 567. [CrossRef]
18. Chen, J.; He, J.; Zhang, Y.; Huang, J.; Chen, Z.; Zeng, W.; Deng, X.; Hu, Q. Effects of tobacco plant residue return on rhizosphere soil microbial community. *Ann. Microbiol.* **2022**, *72*, 42. [CrossRef]
19. Gong, B.; Bloszies, S.; Li, X.; Wei, M.; Yang, F.; Shi, Q.; Wang, X. Efficacy of garlic straw application against root-knot nematodes on tomato. *Sci. Hortic.* **2013**, *161*, 49–57. [CrossRef]

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