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Application of Functional Bacteria and Rice Straw Compost to Improve Rice (*Oryza sativa* L.) Production in Saline Paddy Fields

Mariani Sembiring^{1*}, Muhammad Syahid Zidan¹, Luthfi Aziz Mahmud Siregar¹, Razali¹, Nursa'adah¹.

¹ Faculty of Agriculture, Universitas Sumatera Utara. Jl. Dr. T. Mansur No. 9, Padang Bulan, Medan 20155, North Sumatra, Indonesia.

*E-mail: marianisembiring@usu.ac.id

Abstract. Soil degradation in paddy fields caused by salinity can induce abiotic stress that reduces the growth and production of rice. This study aimed to examine the effects of functional bacteria application and rice straw compost on the growth and production of rice in saline paddy fields. The study was conducted in Dusun XIV, Tanjung Rejo Village, Percut Sei Tuan Subdistrict, Deli Serdang District, North Sumatra, and analyzed at the Soil Chemistry and Biology Laboratory, Faculty of Agriculture, Universitas Sumatera Utara, at an elevation of ± 32 masl, Medan, from July 2025 to October 2025. The design used was a factorial Randomized Block Design (RBD) with two treatment factors and three replications. The first factor was functional bacterial isolates consisting of three treatments, namely without bacterial application (B0), *Bacillus cereus* (B1), and *Achromobacter xylosoxidans* (B2). The second factor was rice straw compost with three treatment levels, namely 0 g/plant (A0), 50 g/plant (A1), and 100 g/plant (A2). Observed parameters included soil pH, soil electrical conductivity, soil respiration, plant height, number of tillers, heading time, and thousand-grain weight. The results showed that the application of functional bacteria significantly affected plant height, number of tillers, soil respiration, and thousand-grain weight with the best treatment achieved by *Achromobacter xylosoxidans*. The application of rice straw compost had no significant effect on all observed variables, and no interaction occurred between the treatments. However, the combination of functional bacteria *Achromobacter xylosoxidans* and rice straw compost at 100 g/plant increased the thousand-grain weight by 10%.

Introduction

One type of degraded land in terms of fertility is saline land, characterized by high salt content due to the formation of soluble salt minerals, salt accumulation from irrigation water, and intrusion of river, sea, or lake water. The high content of soluble salts in saline soil can inhibit nutrient availability for plants [1]. Additionally, sodium content exceeding the critical threshold can disrupt rice growth and production through Na^+ toxicity absorbed by soil particles, making it difficult to release from the adsorption complex [2].

Rice plants are among the crops sensitive to salinity. *Oryza sativa* L., as the main rice commodity, plays a crucial role in supporting national food security. Rice plants can tolerate saline conditions up to an electrical conductivity (EC) of 3 dS/m, although some tolerant varieties can withstand up to less than [value] dS/m [3]. At an EC level of 4 dS/m, productivity declines by less than 10% [4]. Paddy fields



experiencing increased salinity are generally located near coastlines or have irrigation channels directly connected to the sea [5].

One approach to address this issue is the application of functional bacteria. Functional bacteria refer to microorganisms inhabiting the rhizosphere or plant root zone. These microbes provide direct and indirect benefits to plant growth processes. As key components of biogeochemical cycles—including carbon, sulfur, nitrogen, and phosphorus cycles—functional bacteria possess the ability to fix nitrogen, solubilize phosphate, and produce growth hormones that stimulate plant development. These bacteria are also known as PGPR (Plant Growth-Promoting Rhizobacteria) [6]. Functional bacteria also act as plant helpers under environmental stress conditions by producing ACC deaminase enzyme, which prevents plant damage. Additionally, they protect plants from harmful pathogens [7].

The population and activity of functional bacteria can be enhanced through the application of organic amendments such as rice straw compost, which provides essential nutrients for bacteria—including organic carbon (C-org) in the form of simple sugars, cellulose, hemicellulose, and lignin—as the primary energy source for soil microbes. Rice straw is one of the most abundant sources of organic matter [8]. Compost also improves soil particle aggregation, loosens soil particles, increases porosity, and enhances water and air retention capacity. These changes facilitate root penetration and reduce compaction in paddy fields [9].

Materials and methods

This research was conducted in Dusun 14, Tanjung Rejo Village, Percut Sei Tuan District, Deli Serdang Regency, North Sumatra, and analyzed at the Soil Chemistry and Biology Laboratory, Faculty of Agriculture, Universitas Sumatera Utara, at an elevation of approximately 32 m above sea level (masl), Medan, from July to December 2025.

The equipment used in this study included Petri dishes as containers for growing and culturing bacteria on agar media; an oven for bacterial incubation; a laminar flow hood for sterile conditions during microbial culturing; an autoclave for sterilizing equipment or media; Erlenmeyer flasks for mixing and incubating bacteria in liquid media; a Bunsen burner as a flame source for sterilizing inoculation loops; a shaker to ensure even and homogeneous nutrient distribution; test tubes for small-scale bacterial cultures in liquid media; inoculation loops for picking and transferring bacteria; cotton wool; aluminum foil; hoes and sickles for bed preparation; tarpaulin for compost production; syringes for microbial application; plastic clips for sample collection; an analytical balance for weighing plant biomass; a measuring tape for plant height; a camera for documentation; writing materials for data recording; and other supporting tools. The materials used in this study included saline land as the planting medium subjected to treatments; rice seeds (*Oryza sativa* L.) variety Inpari 32; rice straw compost as an organic amendment; functional bacterial isolates, namely *Bacillus cereus* and *Achromobacter xylosoxidans*, from the Soil Biology Laboratory; liquid NA medium; NaCl and distilled water (aquades) for preparing culture media; and chemicals for soil analysis in the laboratory.

This field experiment was conducted on paddy fields using a Factorial Randomized Block Design (RBD) with two factors and three replicates. The first factor was functional bacteria application with three levels: no bacteria application (B0), *Bacillus cereus* application (B1), and *Achromobacter xylosoxidans* application (B2). The second factor consisted of three levels: no compost application (A0), compost at 50g or 9 t/ha (A1), and compost at 100g or 18 t/ha (A2). The study encompassed soil sampling, planting preparation with organic fertilizer application, functional bacteria inoculation, seedling transplanting, plant maintenance, and harvesting. Planting preparation involved plowing the field according to the plot area, constructing separator beds, digging ditches between beds to prevent contamination from adjacent plots, and soaking/prepare seedlings for 20 days after sowing. Organic fertilizer was applied to each planting hole, with 36 planting holes per plot accommodating 36 plants,

of which 7 were samples. Functional bacteria were applied by injecting into the roots of one-week-old transplanted rice plants. Water levels in the paddy fields were maintained to prevent overflow between plots—pumping water in if too low and out (to reservoirs) if too high. Synthetic mulch fences were installed to prevent rodent pest attacks.

The observed parameters in this study included plant height, number of tillers, panicle emergence time, soil pH, soil electrical conductivity (EC), soil respiration, and 1,000-grain weight of rice. The data were analyzed using Analysis of Variance (ANOVA), followed by Duncan's Multiple Range Test (DMRT) at a 5% significance level.

Table 1. Initial Analysis Results of Saline Soil

Parameter	unit	result
EC	dS/m	0,75 (low)
pH H ₂ O	-	7,23
C-Organic	%	1,62 (low)
C/N	-	9 (low)

Table 2. Initial Population of Microbial Inoculants

ACC deaminase-producing bacterial isolate.	Microbe Population
<i>Bacillus cereus</i> (B1)	87x10 ⁷ CFU/mL
<i>Achromobacter xylosoxidans</i> (B2)	91x10 ⁷ CFU/mL

Results and Discussions

Salinity is a major abiotic stress that inhibits rice growth and productivity through osmotic pressure and ion toxicity, which disturb the ionic balance in soil. At the chemical level, high salt levels increase soil electrical conductivity (EC) and affect soil pH stability, thereby directly limiting the availability of essential nutrients for plants. Therefore, an effective land remediation strategy is needed to improve both the physical and chemical quality of the soil in order to support rice growth in saline environments.

One relevant approach is the integration of rice straw compost and functional bacterial inoculation, which helps improve soil structure and facilitates nutrient uptake through biological mechanisms. The application of these two inputs has also been reported to increase biological activity, as reflected by soil respiration. To evaluate the effectiveness of the treatment, chemical parameters such as pH and EC, as well as biological parameters such as soil respiration, are critical indicators of rhizosphere improvement. Analysis of these parameters, combined with morphological observations and yield data, will provide a comprehensive picture of the effectiveness of functional bacteria and rice straw compost in increasing rice productivity on saline land.

Based on soil pH measurements using a 1:5 ratio, the functional bacterial factor and rice straw compost did not show a significant effect on soil pH. In addition, there was no interaction between functional bacteria and rice straw compost. The mean soil pH values are presented in Table 3.

Tabel 3. Analisis pH Tanah pada Berbagai Pelakuan

Functional Bacterial Isolates (B)	Rice Straw Compost Dosage			Average
	A0 (Control)	A1 (50g)	A2 (100g)	
B0 (Control)	7,14	6,74	7,13	7,00
B1 (<i>B.cereus</i>)	6,83	7,06	7,16	7,02
B2 (<i>A.xylosoxidans</i>)	7,04	7,15	7,14	7,11
Average	7,00	6,98	7,14	

At the soil pH parameter, the values obtained did not show a consistent pattern of increase or a clearly interpretable trend; therefore, it was not possible to determine which treatment was the best based on this parameter. The pH meter reading was 7, indicating a neutral pH.

The application of functional bacteria in saline paddy fields did not exert a significant effect on soil pH or soil electrical conductivity, as shown by the absence of significant changes in these parameters. According to Wahyuni, although soil bacteria do not directly affect soil chemical properties, their activity is one of the most important factors in maintaining nutrient availability for plants. Soil bacteria actively decompose organic matter and convert it into plant-available nutrients that can be absorbed by plants [10]. This process can increase the availability of macro- and micronutrients, support plant growth, and improve productivity, including rice yield. Thus, the presence and activity of soil bacteria are crucial for soil fertility and the sustainability of agricultural systems.

Based on the soil electrical conductivity (EC) data, the single effects of organic amendment and functional bacteria were not significantly different on soil EC, and no interaction was observed between the two treatments. The mean soil EC values are presented in Table 4.

Tabel 4. Analisis Daya Hantar Listrik Tanah pada Berbagai Pelakuan

Functional Bacterial Isolates (B)	Rice Straw Compost Dosage			Average
	A0 (Control)	A1 (50g)	A2 (100g)	
B0 (Control)	0,73	0,63	0,70	0,69
B1 (<i>B.cereus</i>)	0,67	0,63	0,53	0,61
B2 (<i>A.xylosoxidans</i>)	0,60	0,47	0,63	0,57
Average	0,67	0,58	0,62	

Based on Table 4, the soil electrical conductivity values fell within the slightly saline category. The values did not show a consistent pattern of increase or decrease, so it cannot be concluded that either treatment factor caused a change in soil electrical conductivity.

Functional bacterial application does not directly affect soil electrical conductivity because soil electrical conductivity is primarily determined by the concentration of dissolved salt ions, such as Na⁺, K⁺, Ca²⁺, Mg²⁺, Cl⁻, and SO₄²⁻, which originate from soil minerals, fertilizers, or irrigation water [11]. In contrast, functional bacteria play a role in mobilizing nutrients, fixing nitrogen, and producing organic compounds that support plant growth, but they do not directly reduce the amount of salt ions in the soil.

The application of rice straw compost without a combination of inorganic fertilizer did not cause a significant change in EC, because the decomposition of organic matter releases only a small amount of ions that can affect soil electrical conductivity [12].

Tabel 5. Respirasi Tanah (mg C-CO₂/g/hari) pada Berbagai Pelakuan

Functional Bacterial Isolates (B)	Rice Straw Compost Dosage			Average
	A0 (Control)	A1 (50g)	A2 (100g)	
B0 (Control)	6,49	6,23	6,35	6,36
B1 (<i>B.cereus</i>)	6,12	6,76	6,28	6,39
B2 (<i>A.xylosoxidans</i>)	6,34	6,58	7,40	6,77
Average	6,32	6,52	6,68	

Table 5 shows that, under the single functional bacterial treatment, an increase was observed in B2, namely *Achromobacter xylosoxidans*. The control treatment had a mean value of 6.36 mg C-CO₂/g/day, whereas B2 reached 6.77 mg C-CO₂/g/day, indicating an increase of 6.4%. Under the single rice straw compost treatment, no significant difference was observed; however, a slight increase was

noted in the 100 g rice straw compost dose, with a mean value of 6.68 mg C-CO₂/g/day, which was higher than the control mean of 6.32 mg C-CO₂/g/day, representing an increase of 5.6%. No interaction was found between the 100 g compost dose and *Achromobacter xylosoxidans*, although both treatments showed the highest mean value, namely 7.40 mg C-CO₂/g/day, indicating an increase of 2.9% compared with the control treatment.

A slight increase in soil respiration was observed following the application of the functional bacterium *Achromobacter xylosoxidans* by 6.4%. Soil bacterial activity plays an important role in maintaining nutrient availability for plants. Soil bacteria are actively involved in the decomposition of organic matter, converting it into forms of nutrients that can be absorbed by plants. This process not only increases the availability of macro- and micronutrients but also supports plant growth and improves productivity, including rice production. Thus, the presence and activity of soil bacteria are crucial for soil fertility and the sustainability of agricultural systems.

This increase may also have occurred because the application of organic fertilizer to soil can enhance the number of microorganisms, as organic fertilizer or compost serves as a habitat for soil microorganisms. Compost application can significantly increase bacterial populations in soil. The application of organic fertilizer can increase the number of soil bacteria. This increase in bacterial population is caused by the high organic matter content in compost, which serves as a source of energy and nutrients for soil microorganisms. Therefore, the use of compost is an effective strategy to increase soil bacterial populations and support soil fertility and land productivity [10].

Based on the plant height data, the single functional bacterial treatment had a significant effect, whereas the single rice straw compost dose did not. In addition, no significant interaction was found between the two treatments. The significant interaction was observed in weeks 5 to 6, while during weeks 1 to 4 there was no significant increase in the mean rice plant height. The mean plant height values are presented in Table 6.

Tabel 6. Plant Height (Cm)

WAT	Functional Bacterial Isolates (B)	Rice Straw Compost Dosage (A)			Average
		A0	A1	A2	
		(Control)	(50g)	(100g)	
.....cm.....					
1	B0 (Control)	33,57	36,05	38,67	36,10
	B1 (<i>B.cereus</i>)	34,71	36,05	36,62	35,79
	B2 (<i>A.xylosoxidans</i>)	37,29	38,71	34,33	36,78
	Average	35,19	36,94	36,54	
2	B0 (Control)	42,40	40,67	41,60	41,56
	B1 (<i>B.cereus</i>)	38,29	42,69	41,33	40,77
	B2 (<i>A.xylosoxidans</i>)	40,81	41,88	41,05	41,25
	Average	40,50	41,75	41,32	
3	B0 (Control)	48,48	43,93	48,29	46,90
	B1 (<i>B.cereus</i>)	42,64	52,26	46,81	47,24
	B2 (<i>A.xylosoxidans</i>)	46,81	52,45	46,57	48,61
	Average	45,98	49,55	47,22	
4	B0 (Control)	60,90	60,38	66,95	62,75
	B1 (<i>B.cereus</i>)	62,71	68,71	66,57	66,00
	B2 (<i>A.xylosoxidans</i>)	64,81	72,00	66,33	67,71
	Average	62,81	67,03	66,62	
5	B0 (Control)	65,14	62,67	67,10	64,97 b
	B1 (<i>B.cereus</i>)	64,67	73,81	68,86	69,11 a
	B2 (<i>A.xylosoxidans</i>)	67,05	74,67	68,71	70,14 a
	Average	65,62	70,38	68,22	

6	B0 (Control)	68,71	67,69	71,81	69,40 b
	B1 (<i>B.cereus</i>)	70,98	75,33	75,26	73,86 a
	B2 (<i>A.xylosoxidans</i>)	75,36	76,21	76,74	76,10 a
	Average	71,68	73,08	74,60	

Note: Means followed by different letters in the same column are significantly different at the 5% level according to Duncan's Multiple Range Test (DMRT).

Based on the plant height data, the single organic amendment and functional bacterial treatments did not significantly affect plant height at WAT 1 and WAT 2. At WAT 3, both *Bacillus cereus* and *Achromobacter xylosoxidans* showed an increase. The control treatment had a mean plant height of 46.90 cm, while B1 had 47.24 cm and B2 had 48.61 cm, indicating a 3.6% increase in the single functional bacterial treatment at WAT 3. At WAT 4, the single functional bacterial treatment produced a mean plant height of 67.71 cm, representing a 7.9% increase compared with the control, which had a mean of 62.75 cm. At WAT 5, the single functional bacterial treatment showed a significant increase compared with the control, which had a mean of 64.97 cm, while B2 (*Achromobacter xylosoxidans*) reached a mean of 70.14 cm, indicating a 7.9% increase. At WAT 6, plant height increased significantly, with the control at 69.52 cm and the single B2 treatment at 75.36 cm. This indicates an 8.4% increase in the B2 treatment. The highest plant height was obtained from the application of the functional bacterium *Achromobacter xylosoxidans*, which showed a substantial increase, whereas the single rice straw treatment did not.

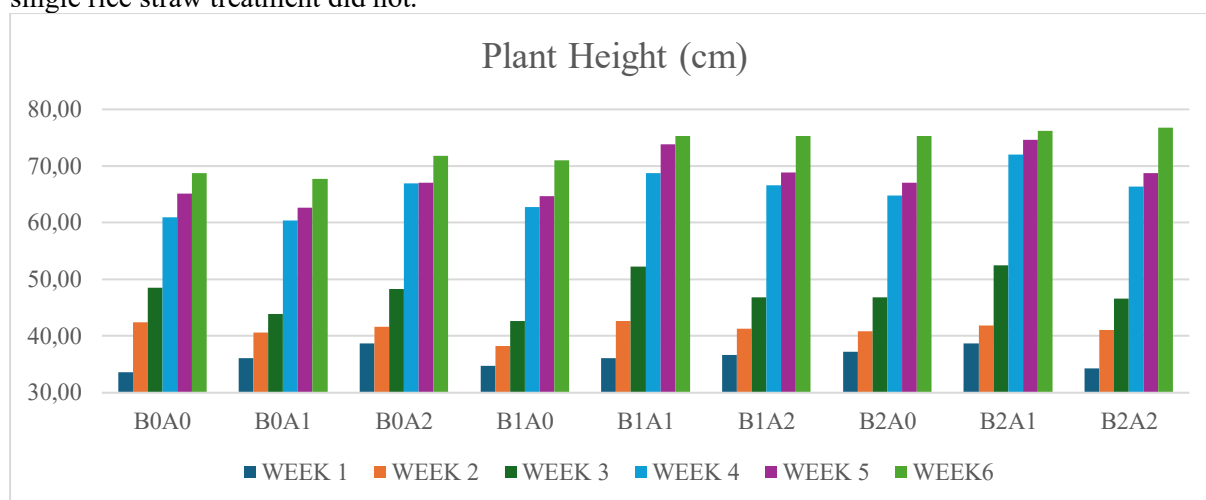


Figure 1. Rice Plant Height Diagram

Based on Figure 1, the highest treatment response was observed in the application of *Achromobacter xylosoxidans* combined with 18 t/ha rice straw compost, with an increase visible from WAT 3 to WAT 6. At WAT 1 and WAT 2, no increase was yet observed in rice plants receiving bacterial application. This may occur because bacteria in compost or organic fertilizers require an adaptation period when introduced into new soil to reproduce and adjust to environmental conditions such as pH, temperature, and nutrient availability [13]. The application of functional bacteria affected plant height from WAT 3 to WAT 6 and resulted in a significant difference at WAT 5 and WAT 6. For the number of tillers, an increase was observed from WAT 3 to WAT 6, with significant differences at WAT 4 to WAT 6. A comparison between the control treatment and the highest treatment, namely B2 (*Achromobacter xylosoxidans*), is presented in Tables 6 and 7, showing an increase of 8.4% in plant height and 12.5% in the number of tillers due to the application of *Achromobacter xylosoxidans*, which produced the highest mean values. However, functional bacterial application did not significantly affect panicle emergence time. The increase in plant height and number of tillers may be attributed to the application of functional bacteria, which can promote rice growth in saline paddy fields. Functional

bacteria have potential as biofertilizers because they can improve soil quality biologically and play an important role in biogeochemical cycles. These bacteria are able to adapt to saline soil conditions, produce growth hormones, and provide nitrogen (N) and phosphorus (P) nutrients for plants [6].

For the number of tillers, an increase was observed under the single functional bacterial treatment. However, the rice straw compost treatment did not show a significant difference, and no significant interaction was found between the two factors. The mean number of tillers is presented in Table 7.

Table 7. Number of Tillers

WAT	Functional Bacterial Isolates (B)	Rice Straw Compost Dosage (A)			Average
		A0 (Control)	A1 (50g)	A2 (100g)	
1	B0 (Control)	1,14	1,19	1,05	1,13
	B1 (<i>B.cereus</i>)	1,14	1,14	1,14	1,14
	B2 (<i>A.xylosoxidans</i>)	1,10	1,10	1,14	1,11
	Average	1,13	1,14	1,11	
2	B0 (Control)	2,76	2,76	2,62	2,71
	B1 (<i>B.cereus</i>)	2,67	2,67	2,76	2,70
	B2 (<i>A.xylosoxidans</i>)	2,67	2,76	2,71	2,71
	Average	2,70	2,73	2,70	
3	B0 (Control)	4,76	5,24	5,10	5,03
	B1 (<i>B.cereus</i>)	5,33	5,33	5,38	5,35
	B2 (<i>A.xylosoxidans</i>)	5,05	5,05	5,19	5,10
	Average	5,05	5,21	5,22	
4	B0 (Control)	5,90	6,43	6,57	6,30 b
	B1 (<i>B.cereus</i>)	6,43	6,43	7,10	6,65 a
	B2 (<i>A.xylosoxidans</i>)	6,76	6,43	6,86	6,68 a
	Average	6,37	6,43	6,84	
5	B0 (Control)	6,95	7,29	7,76	7,33 b
	B1 (<i>B.cereus</i>)	7,71	7,71	8,43	7,95 a
	B2 (<i>A.xylosoxidans</i>)	8,05	7,76	8,10	7,97 a
	Average	7,57	7,59	8,10	
6	B0 (Control)	8,05	8,38	9,43	8,62 b
	B1 (<i>B.cereus</i>)	9,52	9,52	9,86	9,63 a
	B2 (<i>A.xylosoxidans</i>)	9,67	9,48	10,10	9,75 a
	Average	9,08	9,13	9,79	

Note: Means followed by different letters in the same column are significantly different at the 5% level according to Duncan's Multiple Range Test (DMRT).

Based on the plant height data, no significant differences were observed at WAT 1 and WAT 2 between the two treatments, namely functional bacterial application and different doses of rice straw compost, and no interaction was observed between the two factors. For the number of tillers at WAT 3, a slight increase was observed under the single rice straw compost treatment at a dose of 100 g. The control treatment had a mean of 5.05, whereas the rice straw compost treatment at 100 g had a mean of 5.22, representing a 3.3% increase. At WAT 4, a significant increase of 6.0% was observed under the single functional bacterial treatment, with *Achromobacter xylosoxidans* showing the highest mean value of 6.68 compared with 6.30 in the control. A 4.8% increase was also observed under the single rice straw compost treatment, with the control averaging 6.37 and the 100 g compost treatment averaging 6.68.

At WAT 5, the number of tillers showed a significant difference under the single functional bacterial treatment. The mean number of tillers in the control was 7.33, whereas B1 was 7.95 and B2 reached 7.97, indicating an 8.0% increase in the highest-mean treatment. This suggests that functional bacterial application had a positive effect on tiller production in rice plants. In addition, the single rice straw compost treatment also showed a significant increase. The 100 g compost dose had a mean of 8.10, representing a 7.0% increase compared with the control mean of 7.57.

At WAT 6, the number of tillers differed significantly under the single functional bacterial treatment. The control had a mean of 8.62, while *Achromobacter xylosoxidans* had the highest mean value of 9.70, representing a 12.5% increase. Under the single rice straw compost treatment, the control mean was 9.08 and the 100 g compost treatment mean was 9.75, indicating a 7.3% increase. WAT 6 also showed an interaction between the two factors, namely *Achromobacter xylosoxidans* and the 100 g rice straw compost treatment, which produced the highest mean value of 10.10. This represented a 23.6% increase compared with the control treatment.

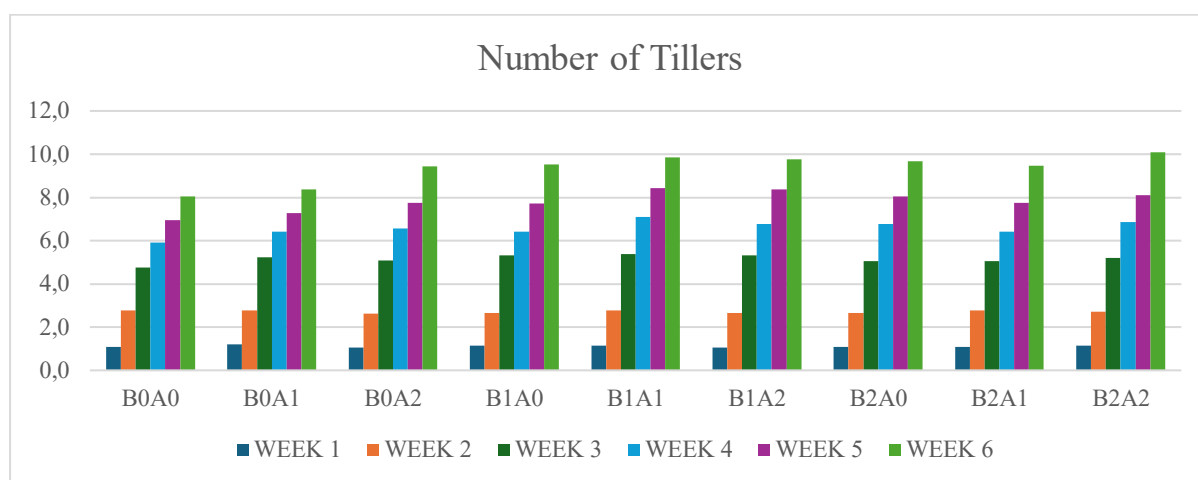


Figure 2. Rice Tiller Number Diagram

The application of rice straw compost can enhance the vegetative phase of rice, particularly by increasing plant height, number of tillers, fresh shoot weight, and dry shoot weight. Rice straw compost provides nutrients, especially nitrogen, which is essential for the growth of vegetative organs such as stems, leaves, and tillers [13]. Compost also has a positive effect on the plant root system because it can improve soil structure, increase nutrient availability, and facilitate root development in absorbing water and nutrients [14]. The use of rice straw compost as an organic amendment can increase the soil's water-holding capacity, improve nutrient availability, and enhance the population of beneficial microorganisms in the soil. In addition, rice straw compost application also contributes to better soil aeration by increasing soil pore space, which in turn supports the vegetative phase of plants, such as root and canopy development in rice [15].

Based on the panicle emergence data, the functional bacterial factor and rice straw compost did not significantly affect panicle emergence time. In addition, no interaction was observed between functional bacteria and rice straw compost. The mean panicle emergence time is presented in Table 8.

For panicle emergence time, no significant change was observed. Panicle emergence in rice is generally not affected by rice straw compost application because panicle formation is more strongly influenced by genetic factors, plant age, and environmental conditions such as light and temperature, rather than by the addition of organic materials like straw compost.

Tabel 8. Panicle Emergence Time

Isolat Functional Bacterial Isolates (B)	Rice Straw Compost Dosage			Average
	A0 (Control)	A1 (50g)	A2 (100g)	
B0 (Control)	8,33	7,67	8,33	8,11
B1 (<i>B.cereus</i>)	7,67	7,33	7,67	7,56
B2 (<i>A.xylosoxidans</i>)	7,33	7,67	7,67	7,56
Average	7,78	7,56	7,89	

Studies indicate that rice straw compost mainly promotes vegetative growth and nutrient availability, but it does not directly accelerate or delay generative stages such as panicle formation. Therefore, rice straw compost application did not have a significant effect on panicle emergence time [16].

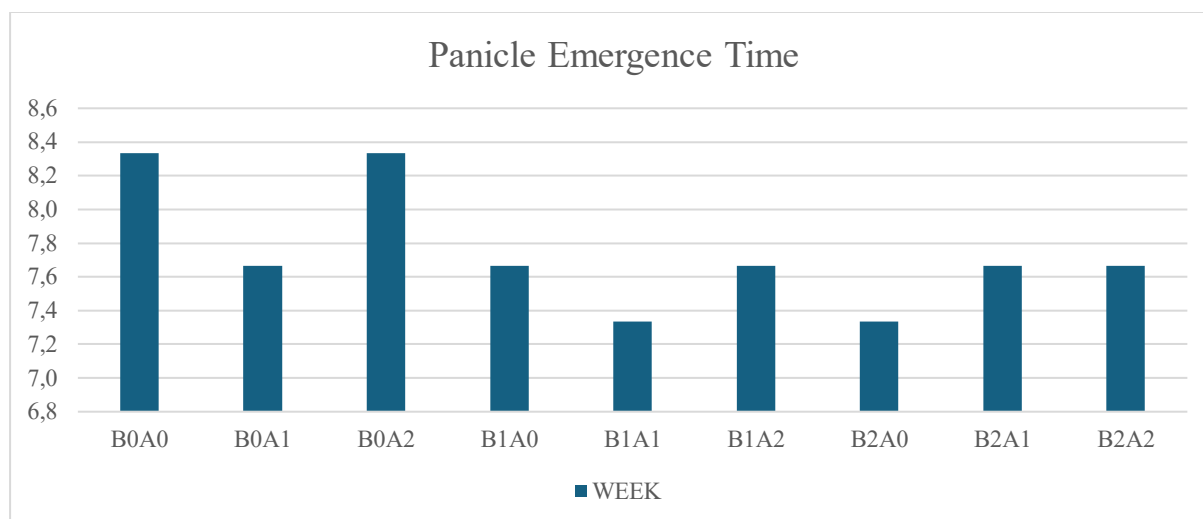
**Figure 3.** Panicle Emergence Time Diagram

Figure 3 shows that panicle emergence time did not increase significantly under either the single functional bacterial treatment or the rice straw compost application. No interaction was also observed between the two treatments. Therefore, the application of functional bacteria and rice straw compost did not have a significant effect on rice panicle emergence time.

The application of functional bacteria did not significantly affect the 1,000-grain weight parameter; however, an increase was observed in both single factors. The application of *Achromobacter xylosoxidans* produced a mean value of 22.83, which was higher than the control (21.64). Similarly, the rice straw compost treatment at a dose of 100 g showed an increase of 3.5% compared with the control (22.00), with a mean value of 22.77.

Tabel 9. Grain Weight per Thousand Seeds (gr)

Functional Bacterial Isolates (B)	Rice Straw Compost Dosage			Average
	A0 (Control)	A1 (50g)	A2 (100g)	
B0 (Control)	21,10	21,30	22,53	21,64
B1 (<i>B.cereus</i>)	22,07	21,93	22,53	22,18
B2 (<i>A.xylosoxidans</i>)	22,83	22,43	23,23	22,83
Average	22,00	21,89	22,77	

Although no significant interaction was observed between the two factors, the combination of the functional bacterium *Achromobacter xylosoxidans* and the 100 g compost dose produced the highest mean value among all treatments, namely 23.23. The application of functional bacteria and rice straw compost can improve rice yield because functional bacteria such as *Achromobacter xylosoxidans* contribute to phosphate solubilization, nitrogen fixation, and phytohormone production, all of which support plant growth and health. Rice straw compost supplies organic matter and nutrients that enhance soil fertility and beneficial microbial activity, ultimately supporting nutrient uptake and optimal rice growth. Together, these two inputs may produce a synergistic effect on rice productivity through increased microbial populations, improved nutrient absorption, and better soil structure [17].

Based on Table 7, neither treatment factor showed a significant effect on the 1,000-grain weight of rice. However, an increase was observed under the functional bacterial treatment, with the highest mean value recorded for *Achromobacter xylosoxidans* at 22.83 g, indicating an increase of 5.4% compared with the control. Likewise, the rice straw compost dose treatment did not show a significant effect on 1,000-grain weight, although a 3.5% increase was observed with the 100 g rice straw compost dose, which produced the highest mean value of 22.77 g, whereas the control had a mean of only 22.00 g. No significant interaction was observed between the functional bacterial application and rice straw compost treatment. Nevertheless, a slight increase was noted in the combined treatment of *Achromobacter xylosoxidans* and 100 g rice straw compost, which produced the highest mean value of 23.23 g.

These bacteria act as biofertilizers with the ability to fix nitrogen, solubilize phosphate, and produce compounds that support both vegetative and generative growth in rice. Therefore, the use of functional bacteria is an effective and sustainable strategy to improve rice productivity under various field conditions, including suboptimal and saline soils. [18].

Conclusions

The application of the functional bacterium *Achromobacter xylosoxidans* had a significant effect on rice plant height and tiller number, but it did not significantly increase pH or electrical conductivity. It showed only a slight increase in soil respiration and 1,000-grain weight. Rice straw compost application did not produce a significant increase in several parameters; however, it caused slight improvements in soil respiration, plant height, number of tillers, and 1,000-grain weight. Based on the results of this study, the use of *Achromobacter xylosoxidans* combined with rice straw compost at a dose of 18 t/ha or 100g/plant is recommended because it produced the best results for rice growth and yield.

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