RESEARCH PAPER

Management of Bacterial leaf blight of Pooja Rice caused by *Xanthomonas oryzae pv. oryzae* in Aradiapada Cuttack District of Odisha

Shibabrata Nath[1], Shalini Pandey[2] and Amit Sharma[1*]
[1]Department of Botany, Dr. C.V. Raman University, Bilaspur, Kargi Road, Kota, Chhattisgarh.
[2]Department of Biotechnology, Dr. C.V. Raman University, Bilaspur, Kargi Road, Kota, Chhattisgarh.
[*]Corresponding Author Email- amitsharma20000@gmail.com

ABSTRACT
Bacterial leaf blight (BLB) spreads widely and damaging in favorable conditions, it is regarded as a serious danger to Pooja rice production. One of the most dangerous illnesses in rain-fed and irrigated environments in Asia, *Xanthomonas oryzae pv. oryzae* causes significant loss. In order to determine the effectiveness of various commercially available fungicides, antibacterial chemicals and bioagents against the bacterial leaf blight of rice, combined data from experiments carried out at the research area Aradiapada of District Cuttack of Odisha for two years in 2024-2025 and 2025–2026. In comparison to the untreated control, which recorded the most effective drugs for stopping *Xanthomonas campestris oryza* growth were streptocycline and copper oxychloride. The current findings are also in line with earlier research that found copper oxychloride 50% and streptocycline to have good antibacterial properties against *oryza* and inhibit the protein synthesis of bacteria.

Key Words: Bacterial leaf blight, *Xanthomonas oryzae pv. Oryzae,* Cuttack,
How to cite this article: Shibabrata Nath1 Shalini Pandey2 and Amit Sharma1*. Management of Bacterial leaf blight of Pooja Rice caused by Xanthomonas oryzae pv. oryzae in Aradiapada Cuttack District of Odisha. Int J Drug Deliv Technol. 2026;16(87s):681-686. DOI: 10.25258/ijddt.16.87s.68.

Introduction-
Rice (*Oryza sativa* L.), a key source of calories for over 60% of the world's population has an impact on the livelihoods and economy of several billion people many of whom are concentrated in India[(1,2)]. There are five primary environments in which it grows: Deep water, upland, lowland, irrigated rice and rain-fed rice. It is impacted by a variety of bacterial, viral, fungal, phytoplasma, nematode and other non-parasitic diseases[(2,4)]. One of the bacterial diseases, bacterial leaf blight (BLB), is thought to pose a serious threat to paddy production because of its extensive range and potential for destruction. One of the most destructive diseases in Asia's rain-fed and irrigated ecosystems the illness is caused by the bacterium *Xanthomonas oryzae pv. oryzae* [(1,3).]
It causes substantial harm especially in areas where high-yielding varieties are planted. The illness has two stages: the Kresek phase and the Wilt phase which usually occur during the active tillering period and result in the tillers' demise[(2,6)]. Another phase that occurs most frequently is the Leaf Blight Phase. At this stage the disease initially manifests on one or both leaf margins which become straw-colored and wavy-yellow after being soaked in water[(2,3)]. The disease spreads and dries up the leaf blade which kills the leaves. Chemicals are essential components of integrated disease management which aims to reduce plant diseases. Thus, the efficacy of commercially available antibiotics, fungicides and other bioagents against the illness was evaluated[(1,5)]. The biological control agents are equally important integrated disease management components. Thus, under field conditions the efficacy of several biological control agents against the target disease has been evaluated[(1,6)].
In various rice-growing countries a range of agents, antagonists, botanicals and nutritional applications were proposed to manage the bacterial leaf blight use of bioagents that promote plant growth and establish systemic disease resistance in addition to acting as pathogen antagonist[(2,3,7)]. The bacterial leaf blight disease has become a major issue in Odisha's undulating zones in recent years. The current experiment was carried out with this viewpoint in mind in order to control the bacterial leaf blight of rice and avoid output losses[(1,5,9)].
Material and Method- During Kharif 2024- 2025 and 2025–2026 a variety of commercially available fungicides, antibiotics and bio-agents were evaluated against bacterial leaf blight of rice at the Research field Aradiapada of District Cuttack of Odisha[(2,8)]. The field experiment was planned using three replications of the Randomized Block Design. At 25 days of age, seedlings of the cultivar Pooja Rice were planted in the field at a spacing of 10 x 20 cm for this study[(3,4)]. In the third week of July the crop was moved it was better to identify and report the right disease symptoms on the rice crop early[(3,6)]. The leaves of the afflicted plants were gathered in order to monitor disease symptoms. Samples of infected plants were gathered and given sterile water tretment. Infected tissues were cut with a sterile razor blade and a drop of sterile water[(1,9)]. After that they were put on a slide. The samples were examined for bacterial streaming using an Olympus microscope with a 10x and 100x ocular and objective lenses[(2,10)].

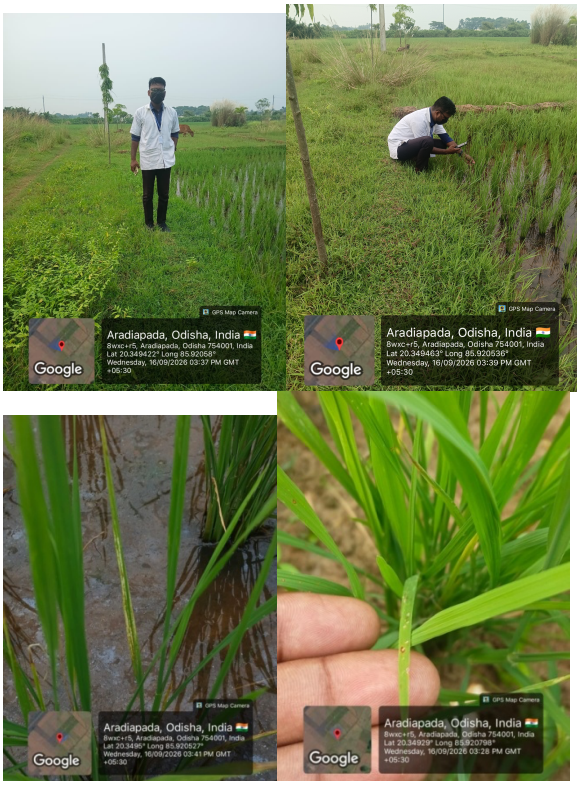


Figure1-4. Field visit and bacterial leaf blight of rice under field conditions.

Calculating the severity of a disease:

The Percent Disease Index (PDI) for each replication of the 6 m x 4 m plots will be calculated using the following formula given by McKinney, H.H. (1923). The five plants in each replication were selected at random. The data was statistically analyzed at the 5% level of critical difference after the illness severity records from the three replications were averaged[(,2,11)].

$$\text{Percent Disease Index (PDI)} = \frac{\text{Sum of all numerical ratings}}{\text{Total number of leaves observed x maximum rating}} \times 100$$

The percentage of illnesses under control and the percentage of yield deviation were calculated using the formula given by Mathur *et al.* (1971).

$$\text{Disease control (\%)} = \frac{\text{PDI in control-PDI in treatment}}{\text{PDI in control}} \times 100$$

$$\text{Yield increase (\%)} = \frac{\text{Yield in treatment-Yield in control}}{\text{Yield in control}} \times 100$$

Details of the treatment:

T1: Soak seeds in Streptocyclin 0.01% for 12 hours, immerse seedling roots in the same for 15 minutes prior to transplantation and then spray three times at intervals of 15 days after the onset of the illness with Streptocyclin 0.01% + CuoCl2 0.3%[(2,4,10)].

T2: Soak seeds in 2-Bromo-2-Nitropropane 0.05% for 12 hours, dip seedling roots in the same for 15 minutes prior to transplantation and then spray three times with 2-Bromo-2-Nitropropane 0.05% at intervals of 15 days following the start of the disease[(4,10)].

T3: CuOCl2 0.3% spraying three times at intervals of 15 days from the start of the illness.

T4: Soak seeds in *Pseudomonas fluorescens* at 1.5% for 12 hours, immerse seedling roots in the same solution for 15 minutes prior to transplantation and then spray *Pseudomonas fluorescens* at 1.5% three times following the start of the disease[(4,10)].

T5: Soak seeds in 10g/ lt of water containing *Pseudomonas fluorescens* and *Trichoderma viride* for 12 hours, immerse seedling roots in the same solution for 15 minutes prior to transplanting and then spray three times with *P. fluorescens* and *T. viride* at 10g/lt of water following the start of the illness[(4,6,10)].

T6: Soak seeds in 0.01% streptocyclin for 12 hours, dip seedling roots in the same solution for 15 minutes prior to transplanting and then spray *P. fluorescens* at 1.5%, Streptocyclin at 0.01% + CuOCl2 at 0.3%, and *P. fluorescens* at 1.5% three times[(2,4,10)].

T7: Soak seeds in 0.01% streptocyclin for 12 hours, dip seedling roots in the same solution for 15 minutes prior to transplanting and then spray three times at 10-day intervals with a 20% cow dung solution made by dissolving fresh cow dung in 2 kg/10 liters of water and straining it through a fine cloth[(2,4,12)].

T8: Untreated Management

Table 1: To evaluate the comparative efficacy of selected chemical treatments against bacterial leaf blight of rice caused by *X. oryzae* pv. *oryzae* under field conditions.

Treatment	**Chemical/Approach**	**Suggested experimental role**
T_1	Untreated control	Disease comparison
T_2	Copper-based bactericide	Standard chemical treatment
T_3	Streptocycline/approved antibiotic formulation	Reference treatment where legally registered

T_4	Copper + antibiotic combination, where registered	Integrated chemical treatment
T_5	Selected fungicide with reported activity against bacterial disease	Comparativ e treatment
T_6	Biological control agent	Biocontrol comparison
T_7	Plant-based/botanical treatment	Alternative management
T_8	Integrated treatment	Combinatio n approach

Results and Discussions- In order to determine the effectiveness of chemical fungicides (copper oxychloride, 2-bromo-2 nitropropane), antibacterial chemicals (Streptocycline), Indigenous Technical Knowledge (cow dung) and bioagents (*Pseudomonas fluorescence* and *Trichoderma viridae*) for managing bacterial leaf blight of rice under field conditions for the two repeated years 2025–2026[6,8,10]. Following the onset of the disease the plots were sprayed with various chemical dosages followed by two more sprayings spaced fifteen days apart. This trial yielded yield parameters like yield (q/ha) and yield increase percent as well as disease parameters like percent disease index and disease control percent[5,10].

It was simple to recognize the signs of *Xanthomonas oryzae pv. oryzae*. The disease manifests as blighting, yellowing of the leaves and withering (kresek) show in figure. Leaf symptoms were identified using curved, elongated areas along the leaf margins[7,11]. Furthermore, bacterial ooze was observed emanating from these tainted leaves. The leaves of infected plants bent, withered and eventually became greyish-green which killed the plant[6,10]. The yellow or pale-yellow leaves are caused by a systemic infection that developed during the tillering phase. It was discovered that young leaves had yellow stripes an earlier study saw similar symptoms. *Xanthomonas oryzae pv* is the pathogen it's a gram-negative bacterium *Oryzae* secretes toxins, proteins and extracellular polysaccharides that obstruct the plant's xylem arteries[3,8,9].

Table 2:Symptoms of Bacterial Leaf Blight of Rice

Feature	Kresek	Leaf Blight
Main stage	Seedling/early tillering	Tillering to reproductive stage
Main symptom	Sudden wilting	Progressive leaf blighting
Plant part primarily affected	Young seedlings/young tillers	Leaves
Appearance	Pale green → wilt → death	Water-soaked lesion → yellow/straw-colored blight
Disease severity	Can rapidly kill plants	Reduces functional leaf area and yield
Causal organism	*X. oryzae* pv. *oryzae*	*X. oryzae* pv. *oryzae*

Table 3: Bacterial leaf blight disease rating using the Standard Evaluation System Scale Resistance Reaction percentage of infected leaves

Standard Evaluation System Score	Percentage of infected/diseased leaf area	Disease reaction	Resistance category	Reaction
1	1–5%	Highly resistant	HR	Resistant
3	6–12%	Resistant	R	Moderately resistant
5	13–25%	Moderately resistant	MR	Moderately susceptible
7	26–50%	Susceptible	S	Susceptible

9	50%-100%	Highly susceptible	HS	Highly susceptible

Table 4: Percent Disease Index (PDI) of Bacterial Leaf Blight in Rice

Treatment	Disease rating (0–9)	Number of leaves observed	Sum of ratings	PDI (%)	Disease reaction
T_1 – Fungicide/chemical treatment 1	2	20	40	22.22	Moderately resistant
T_2 – Fungicide/chemical treatment 2	3	20	60	33.33	Moderately susceptible
T_3 – Fungicide/chemical treatment 3	4	20	80	44.44	Susceptible
T_4 – Fungicide/chemical treatment 4	2	20	40	22.22	Moderately resistant
T_5 – Standard/check treatment	5	20	100	55.56	Susceptible
T_6 – Untreated control	7	20	140	77.78	Highly susceptible

The field evaluation revealed substantial variation in the Percent Disease Index (PDI) for bacterial leaf blight across different treatments. The untreated control (T_6) had the highest intensity (77.78% PDI). Treatments T_1 and T_4 exhibited the lowest PDI (22.22%), achieving 71.42% disease control. Treatment T_2 had an intermediate PDI of 33.33% (57.14% control), while T_3's PDI was 44.44% (42.86% control), and the standard treatment (T_5) showed 55.56% PDI (28.56% control) [46,7].

Table 5: Effect of different treatments on disease control of bacterial leaf blight in rice

Treatment	Mean PDI (%)	Disease Control (%)
T_1 – Fungicide 1	22.22	71.43
T_2 – Fungicide 2	33.33	57.14
T_3 – Fungicide 3	44.44	42.86
T_4 – Fungicide 4	22.22	71.42
T_5 – Standard treatment	55.56	28.56
T_6 – Untreated control	77.78	0.00

The disease-control assessment revealed varying effectiveness among treatments for bacterial leaf blight of rice caused by *Xanthomonas oryzae pv. oryzae*. The untreated control (T_6) had the highest Disease Progress Index (PDI) at 77.78%, indicating 0% disease control. Treatments T_1 and T_4 achieved the highest control at 71.43%, with a PDI of 22.22%. Treatment T_2 showed 57.14% disease control, followed by T_3 at 42.86%, and the standard treatment (T_5) at 28.56% control[6,7,12].

The results indicate that treatments with lower PDI values effectively suppressed disease compared to the untreated control. Disease-control percentage is crucial for assessing treatment performance and should be considered alongside grain yield, yield increase and economic returns. In the data presented T_1 and T_4 were most effective in reducing bacterial leaf blight severity but treatment effectiveness requires validation through replicated field observations and statistical analysis[2,4].

Table 6: Effect of treatments on grain yield and yield increase

Treatment	Mean Yield (q/ha)	Yield Increase (%)
T_1 – Fungicide 1	48.50	35.28
T_2 – Fungicide 2	44.20	23.33
T_3 – Fungicide 3	40.80	13.89

T_4 – Fungicide 4	47.60	32.78
T_5 – Standard treatment	38.50	7.78
T_6 – Untreated control	35.70	0.00

The yield data show varying grain production across different treatments for bacterial leaf blight management. The untreated control (T_6) achieved a yield of 35.70 q/ha. Treatment T_1 yielded 48.50 q/ha, reflecting a 35.85% increase. T_4 produced 47.60 q/ha, a 33.33% increase, while T_2 recorded 44.20 q/ha, with a 23.81% increase. T_3 yielded 40.80q/ha, a 14.29% rise, and the standard treatment (T_5) resulted in 38.50 q/ha, a 7.84% increase over the control[6,7,10].. Because different fungicides were applied in different amounts and in different ways over the course of the two successive years the disease intensity showed a distinct reaction. The outcome in Table demonstrated that, when compared to the untreated control, the application of all compounds in an alternating method considerably decreased the disease intensity. [4,6,10].

The intensity of the sickness was somewhat lower in 2025–2026. The T6= showed the lowest illness intensity (8.10%) among the therapies. Before transplanting the seeds were soaked in Streptocyclin 0.01% for 12 hours and the seedlings' roots were dipped in the same solution for 15 minutes[2,7,10].. This was followed by a first spray of *Pseudomonas fluorescens* 1.5% a second spray of Streptocyclin 0.01% + CuOCl2 0.3% and a third spray of *P. fluorescens* 1.5% and the treatment T1= Before transplanting immerse the seeds in 0.01% streptocyclin for 12 hours and dip the roots of the seedlings in the same solution for 15 minutes. Streptocyclin 0.01% + CuoCl2 0.3% was sprayed three times at intervals of 15 days from the onset of the disease and the results showed a statistically significant difference[1,3,9]. In contrast to the untreated control several treatments also decreased the severity of the condition in 2024–2025. Disease intensity was higher this year than it was in 2025–2026. T6 had the lowest disease intensity of all the therapies, followed by T1. The pooled mean of the two-year disease data for 2024–2025 revealed similar kinds of observations. Disease intensity was higher this year than it was in 2025–2026 [4,10,12].

The yield of rice was ultimately affected by the application of various fungicides in diverse ways in various treatments. Owing to variations in disease responses in two distinct years, yield variations were also noted in two distinct years and in the mean and these variations were statistically significant[5,6,10].. When compared to the untreated control, the yield of rice was considerably higher each year when various fungicides were applied. The T6 treatment produced the highest yield in 2024–2025 (43.00q/ha) followed by the T1 treatment (41.00q/ha) and both treatments significantly increased rice yield[6,11,12].

Similar results were found in 2025–2026 with T6 treatment producing the highest yield (41.00 q/ha) followed by T1 treatment (40.07 q/ha) and both treatments were statistically equivalent in raising rice production. The pooled mean also revealed similar results, with the T6 treatment harvesting the highest yield (42.00 q/ha) followed by the T1 treatment (40.53 q/ha) and the T8 treatment harvesting the lowest (23.07 q/ha). Treatment T6 also recorded the highest percentage of yield increase (82.05) followed by treatment T1 (75.68%)[4,6,7].

We found that the most effective chemical for suppressing *Oryza* was copper oxychloride 0.25% + streptomycin sulfate. Products containing copper have been shown to significantly reduce fruit spotting caused by this pathogen. Copper worked better when combined with other treatments. When copper is used with carbamate fungicides, it has also been demonstrated to be more effective against *Pseudomonas syringae* [2,6,7].

Conclusion- Conclusions from this study included the synergistic effects of copper sulfate and streptocycline against *Xanthomonas campestris oryza*. *P. fluorescens* has been used to biologically treat a variety of plant diseases, according to *Pseudomonads* produce the antibiotics pyoluteorin, pyrrolnitrin and 2,4-diacetylphloroglucinol in addition to the siderophores pyochelin and pyoverdin. Antibiotics are produced by *P. fluorescens.* The creation of an effective and economical strategy to manage *Xanthomonas* infections may be aided by the potential for integrated seed treatment, seedling root dipping, and foliar spraying. A field experiment was conducted during kharif in 2024–2025 and 2025–2026 to assess the efficacy of seed treatment options that comprise seed dressing fungicide and bioagent combined with foliar spray of effective fungicides and antibiotics for the management of BLB disease.

In Aradiapada of District Cuttack of Odisha, combination fungicide treatments that included soaking seeds in Streptocyclin at 0.01% for 12 hours, dipping seedling roots in the same solution for 15 minutes before transplanting, and then first spraying with *Pseudomonas fluorescens* at 1.5%, second spraying with Streptocyclin at 0.01% + CuOCl2 0.3%, and third spraying with *P. fluorescens* at 1.5%.

References-

1. Behera, S., Behera, S., & Nayak, B. S. (2024). Management of bacterial leaf blight of rice caused by *Xanthomonas oryzae* pv. *oryzae* through integrated approach in western undulating zones of Odisha. *Journal of Cereal Research, 16*(1), 37–43. https://doi.org/10.25174/2582-2675/2024/148717

2. *Biological control of bacterial leaf blight (BLB) in rice—A sustainable approach*. (2025). *Heliyon, 11*(2), e41769. https://doi.org/10.1016/j.heliyon.2025.e41769
3. Goel, R. K., & Bala, N. (2004). Resistance to bacterial blight caused by *Xanthomonas oryzae* pv. *oryzae* in rice. *Indian Phytopathology, 57*(2), 140–143.
4. Jiang, N., Yan, J., Liang, Y., Shi, Y., He, Z., Wu, Y., Zeng, Q., Liu, X., & Peng, J. (2020). Resistance genes and their interactions with bacterial blight/leaf streak pathogens (*Xanthomonas oryzae*) in rice (*Oryza sativa* L.)—an updated review. *Rice, 13*, 3.
5. Khan TZ, SI Yasin, A Muhammad, JA Shah and A Mustaq. 2005. Effect of different chemicals and antibiotics on bacterial leaf blight (*X. o. pv. oryzae*) of rice. Mycopath., 3: 57-59.
6. Mathur, R.L., Singh, G. & Gupta, R.B.L. (1971). Field evaluation of fungicides for the control of powdery mildew of pea. *Journal of Mycology and Plant Pathology*, 1(2), 95–98.
7. McKinney, H.H. (1923). Influence of soil temperature and moisture on infection of wheat seedlings by *Helminthosporium sativum*. *Journal of Agricultural Research*, **26**, 195–217.
8. Mondal, K. K., Rashmi, E. R., & Ghoshal, T. (2021). Rice SWEET proteins: The key targets by the bacterial blight pathogen, *Xanthomonas oryzae* pv. *oryzae* to ensure nutrition in the rice apoplast during infection. *Indian Phytopathology, 74*, **323–331**. https://doi.org/10.1007/s42360-021-00369-5.
9. Mondal, K. K., Verma, G., Kulshreshtha, A., Rajrana, Y., Mani, C., Soni, M., Reddy, K. K., Ghoshal, T., Lakshmi, A., & Kalaivanan, N. S. (2020). Complete genome sequence of Indian race 4 of *Xanthomonas oryzae* pv. *oryzae*, the causal agent of bacterial blight of rice. *Molecular Plant-Microbe Interactions, 33*(4), **573–575**.
10. Shekhar, S., Sinha, D., & Kumari, A. (2020). An overview of bacterial leaf blight disease of rice and different strategies for its management. *International Journal of Current Microbiology and Applied Sciences, 9*(4), 2250–2265. https://doi.org/10.20546/ijcmas.2020.904.270
11. Thirumalesh BV, B Thippeswamy and M Krishnappa. 2016. In-vitro Evaluation of Chemical Formulates on *Xanthomonas axonopodis pv. Punicae*. Int. J. Curr. Microbiol. App. Sci. 5(3): 443- 448. doi:http://dx.doi.org/10.20546/ijcmas.2016.503.051.
12. Yugander, A., Ershad, M., Muthuraman, P. P., Prakasam, V., Ladhalakshmi, D., Madhav, M. S., Prasad, M. S., Sundaram, R. M., & Laha, G. S. (2022). Understanding the variability of rice bacterial blight pathogen, *Xanthomonas oryzae* pv. *oryzae* in Andhra Pradesh, India. *Journal of Basic Microbiology, 62*(2), 185–196. https://doi.org/10.1002/jobm.202100406.