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Survey and Isolation of Rice Bacterial Leaf Blight Caused by *Xanthomonas oryzae* pv. *oryzae*

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

A survey was conducted at different rice growing regions of Tamil Nadu such as Erode, Tanjore and Coimbatore. Among the areas surveyed the maximum disease incidence was recorded at Tanjore in the rice variety ADT 54 with the percent disease incidence of 50.23%. Initially one bacterial pathogen *Xanthomonas oryzae* pv.*oryzae* was isolated in nutrient agar medium from the leaves having characteristic symptom. Totally 10 isolates of *Xoo* were collected from three different regions of Tamil Nadu. On isolating the pathogen the colonies are found to be well separated with slimy yellow color and mucoid growth.

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1. INTRODUCTION

Rice is the staple food of Asia where about 90% of the world's rice is produced and consumed. Cultivation of rice is the chief and principal activity and serves as important source of income for millions of people around the world. Countries like Asia and Africa is highly dependent on rice as a source of foreign exchange earnings. It is the important food crop covering about one-fourth of the total cropped area and providing food to about half of the Indian population. In India, the production of paddy during the year 2022-23 is 323.54 million tonnes with the productivity of 2.8 thousand kilograms per hectare. Roughly one-half of the world population, including virtually all of East and Southeast Asia, is wholly dependent upon rice. India produces rice in both the kharif and rabi seasons. Kharif rice, which is approximately 70 percent of total rice production and Rabi rice, which accounts for roughly 30 percent of total rice production. It was reported that rice production in the world was 503.27 million tonnes and in India, was to be around 124 million tonnes (milled basis) in 2022-2023. The major constrain in the rice production and productivity of rice was irregular rainfall, pests and diseases. But annually 40% of worlds rice production is lost due to biotic stresses like insect pests, pathogens and weeds (Hossain, 1996). To increase the consumer demand, organic approach to manage the disease is essential [1]. Among various diseases, the bacterial disease caused by *Xanthomonas oryzae* pv.*oryzae* is the most devastating disease due to its high epidemic potential. Yield loss due to bacterial blight can be as much as 70% when susceptible varieties are grown and upto 100% in severe conditions [2], in environments favorable to the disease.

2. MATERIALS AND METHODS

2.1 Identification and Collection of Samples Infected

Paddy leaves showing typical blight symptoms were collected for isolation of the pathogen from Erode, Tanjore, Coimbatore districts of Tamil Nadu. The infected samples were collected based on the roving survey at the tillering stage of the crop [3]. The samples were packed, labelled and stored in refrigerator at 4℃ for further analysis.

2.2 Disease Assessment in *Xoo* Infected Fields

A survey was conducted in various rice cultivating areas such as Erode, Tanjore and Coimbatore districts of Tamil Nadu. During collection of infected samples (January 2023), bacterial leaf blight incidence in paddy fields was also assessed. By grading 50 leaves collected from 25 plants, the disease incidence was calculated with three replications from each paddy field at random, by adopting the following score chart (Chaudhry, 1996).

For the above-mentioned locations the Percent Disease Index was calculated using the following formula (McKinney, 1923).

$$\text{PDI} = \frac{\text{Sum of numerical ratings}}{\text{Total number of leaves observed} \times \text{Maximum grad}} \times 100$$

2.3 Isolation

The leaves showing the bacterial blight symptoms were collected from the cultivars CO 52, CO 55, TN 1, ADT 45, ADT 38, CO 51, CO 38, ASD 16, ADT 54 and IMF 9 were cleaned

Table 1. Disease incidence with rank and description

S.No.	Disease incidence	Ranking	Description
1.	0	0	Highly resistant (HR)
2.	1-10%	1	Resistant (R)
3.	11-30%	3	Moderately resistant (MR)
4.	31-50%	5	Moderately susceptible (MS)
5.	51-75%	7	Susceptible (S)
6.	76-100%	9	Highly susceptible (HS)

with sterile water and air dried (Priyanto *et al*., 2014). Using a sterilised scalpel, the leaves were chopped into small leaf bits and soaked in sterile distilled water for the formation of bacterial ooze [4,5]. After 30 minutes, the bacterial ooze was taken using a inoculation loop and streaked in a sterilized plate containing nutrient agar medium and the streaked plates were incubated at 28℃ for 3 to 5 days.

3. RESULTS AND DISCUSSION

3.1. Symptomatology

The characteristic symptom of bacterial leaf blight of rice *ie*., water soaked lesions with wavy margin was observed during the survey. On seedlings, the tips and margins of the leaves develop grey-green streaks that subsequently merge together, turn yellowish-white with wavy edges, and cause the leaves to wilt, dry out, and die. Early infection on transplanted rice is found systemic, affecting the entire plant, and resulted symptoms referred to as "kresek". Older plants developed pale yellow steaks with wavy margins that extend from the tips towards the base of the leaf before drying up and dying (Fig. 1.). Shankara *et al*., 2016 collected diseased leaves infected with BLB from eighteen agroclimatic zones of southern region during heading and maturity stage. They reported the development of disease during the plant growth stages.

Fig. 1. Severity of symptoms in BLB of rice

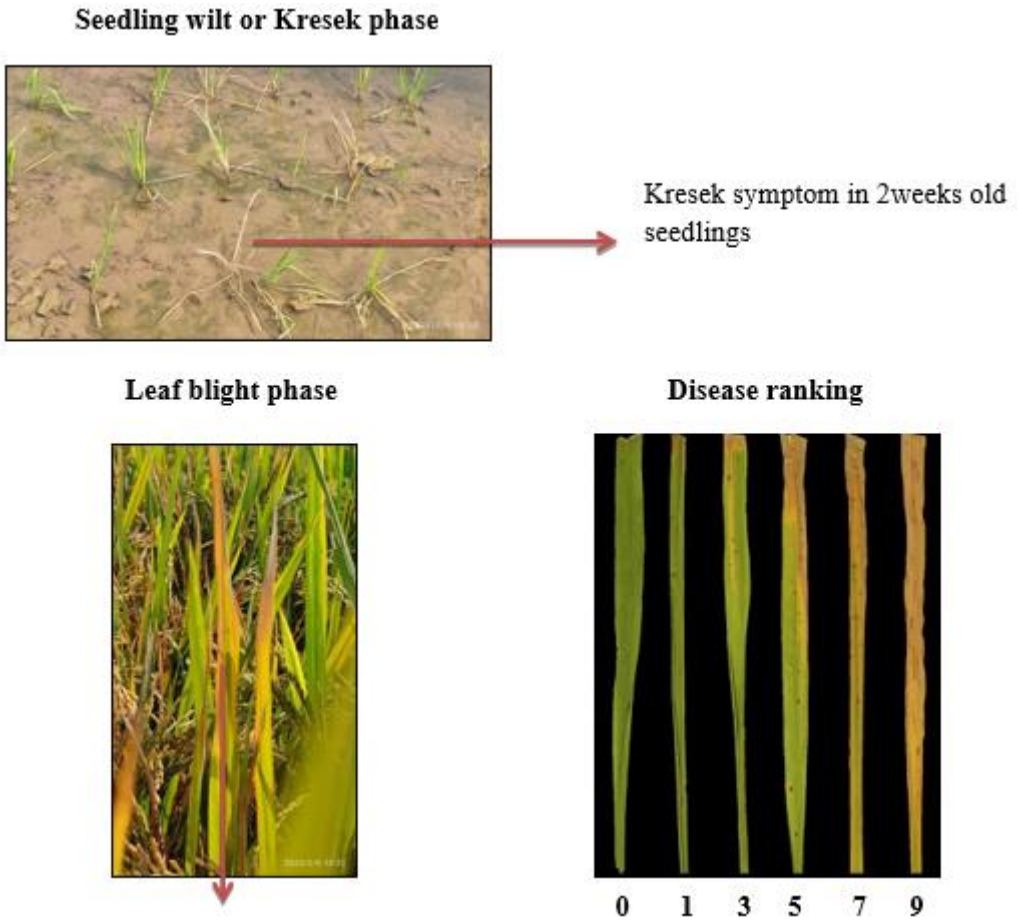

Fig. 2. Water soaked lesion with wavy margin

Table 2. Assessment of Bacterial leaf blight incidence in the paddy fields

S.No.	Isolate	Variety	Place	Percent Disease Index*
1.	XooC1	CO 52	Coimbatore	41.12[d] **(39.89)**
2.	XooC2	TN 1	Coimbatore	25.76[j] **(30.50)**
3.	XooT1	ADT 38	Tanjore	34.98[e] **(36.26)**
4.	XooT2	CO 38	Tanjore	32.01[h] **(34.46)**
5.	XooT3	ADT 54	Tanjore	50.23[a] **(45.13)**
6.	XooE1	CO 55	Erode	45.76[b] **(42.57)**
7.	XooE2	ADT 45	Erode	34.67[f] **(36.07)**
8.	XooE3	CO 51	Erode	32.42[g] **(34.71)**
9.	XooC3	ASD 16	Coimbatore	27.98[i] **(31.94)**
10.	XooC4	IMF 9	Coimbatore	43.11[c] **(41.04)**
Mean				**36.08 (37.25)**
CD (p=0.05)				**0.9542**

** Denotes the mean value*
Arc-sine transformed values are mentioned in parenthesis
Values followed by common letter are non-significant (at 5% level of DMRT)

3.2. Survey for Assessment of Disease

By conducting roving survey the percent disease index of *Xanthomonas oryzae pv. oryzae* was assessed in the areas of Bhavanisagar, Aduthurai and Coimbatore regions of Tamil Nadu that ranged from 25.76 - 50.23% (Table 2). Among the areas surveyed, Aduthurai (Tanjore) recorded the maximum disease incidence of 50.23% followed by Bhavanisagar with disease incidence 45.76% whereas the least incidence was recorded at Coimbatore with the PDI 25.76%. Banerjee *et al*., 2018 surveyed to record the incidence of BLB from eastern and north eastern regions and by using molecular markers they identified the susceptible and resistant genotypes. Ahsan *et al*., 2021 surveyed rice growing regions of Punjab, Sindh and Khyber Pakhtunkhwa in which the maximum incidence was recorded at Gujranwala with the disease incidence of 55%.

3.3. Isolation of Pathogen

The bacterial pathogen *Xanthomonas oryzae* pv.*oryzae* was isolated in nutrient agar medium from the leaves having characteristic symptom. Totally 10 isolates of *Xoo* were collected from three different regions of Tamil Nadu (Fig. 3.). Elham et al. [6] isolated the bacteria using NA (Nutrient Agar) medium and Yeast Dextrose Carbonate (YDC) medium that contains cyclohexamid (50 µg/ml). On isolating the pathogen, the colonies are found to be well separated with slimy yellow color and mucoid growth. These results coincide with the isolates of Shankara et al. [7] and Arshad et al. [8,9-12].

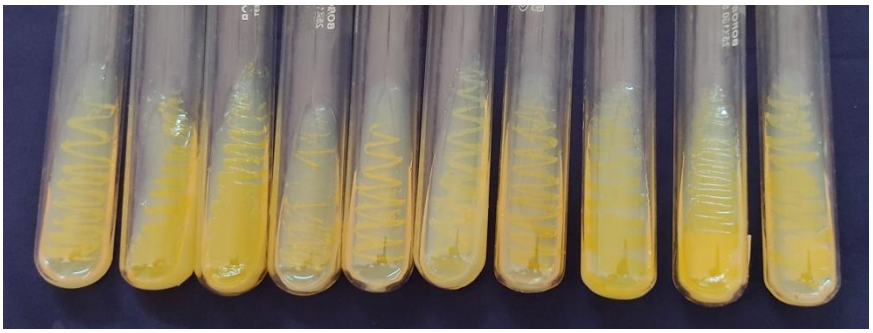

Fig. 3. Ten isolates of *Xanthomonas oryzae* pv. *oryzae*

4. CONCLUSION

The most important rice disease is bacterial leaf blight caused by *Xanthomonas oryzae* pv. *oryzae*. This study shows that the disease incidence was increasing in the major rice growing regions of Tamil Nadu and the pathogen was recovered from the samples collected from the areas. Initially one bacterial pathogen *Xanthomonas oryzae* pv.*oryzae* was isolated in nutrient agar medium from the leaves having characteristic symptom. Our future work depends on the management of disease through eco-friendly aspects.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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