

An Overview of Bacterial Diseases of Rice in Cauvery Command Area of Karnataka

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ABSTRACT

In Karnataka, the Cauvery command area of southern dry zone of Karnataka is an important rice-growing area that has been making a major contribution to the state pool. Till 2018 blast and sheath blight were the major fungal diseases affecting the crop causing heavy yield loss however, from the past five years the incidence of bacterial diseases are noticed consistently in some areas. To study the incidence, distribution and severity of bacterial diseases a survey was conducted during *kharif* 2018-2020. Bacterial leaf blight (BLB) was recorded from seedling to dough stage with maximum intensity at tillering stage. The intensity of BLB was recorded high ranged from 40-50 per cent at the tillering stage in Jyothi variety at Talakaduhobli of T. Narasipurataluk of Mysuru while in low to moderate ranged from 10 -15 per cent in var., MTU1001, Meenakshi and Sunamman. Bacterial leaf streak disease was recorded ranging from 40-60 per cent in hybrid VNR2233 and MC13. Losses in grain yield ranging from 20-40 per cent was inflicted in the rice crop due to bacterial diseases. The information on the pre-valence of the disease obliges monitoring and promoting the farmers to acquaint with the symptoms and anintegrated management measures.

Keywords : Roving survey, Bacterial diseases, Cauvery command area, Karnataka

RICE (*Oryza sativa* L.) is the most important widely consumed staple food crop for more than half of the world's population, especially in Asia and Africa. In India, rice is the most important food crop in terms of area, production and consumer preference of the various biotic factors limiting rice production and productivity, diseases continue to be an enigmatic problem in different rice ecosystems. The major diseases which cause significant yield losses worldwide are blast, sheath blight, bacterial leaf blight and tungro. Among this bacterial leaf blight, a serious and widespread disease prevailed in all the rice ecosystems. Bacterial leaf blight caused by *Xanthomonas oryzae* pv. *oryzae* (*Xoo*) and the bacterial leaf streak caused by *Xanthomonas campestris* pv. *oryzicola* are the two important bacterial diseases of rice in all the major irrigated / low land ecosystems of India and Asia (Naqvi, 2019). In India Punjab, Haryana, Western Uttarpradesh Uttarkhand plains, Pallakad district of Kerala and parts of Andra Pradesh are the states more prone to bacterial blight (Yugender *et al.*, 2014).

The occurrence of bacterial disease epidemics during the 1960's and 1970's in the Punjab state of India was as an account of the wide adoption of improved varieties and extensive cultivation with the increased use of nitrogenous fertilizers. The yield loss was as high as 50 per cent in fields where the crop is severely infected and infection at the tillering stage can lead to total crop losses (Liu *et al.*, 2014). Under field conditions, blight symptoms are observed usually at the tillering stage increases with plant growth, peaking at the flowering stage. The blight symptoms started as small water-soaked stripes from the tips and rapidly enlarge in length and width forming a yellow lesion with a wavy margin along the leaf edges later turns white to grey. The bacterial leaf streak (BLS) symptoms initiated as narrow, vein-delimited translucent lesions that later turn necrotic. Streak sometimes occurs on the same leaf with blight, but can be distinguished from blight by the thinner, translucent lesions with yellow bacterial ooze. Losses in grain yield due to BLS was ranged from eight per cent - 32 per cent (Liu *et al.*, 2014).

For decades, *X. oryzae* pv. *oryzae* (*Xoo*) a gram-negative bacteria is widely regarded as the only causal agent of leaf blight in rice (Chien *et al.*, 2019). In recent years, bacteria belonging to the genus *Pantoea* sp. and *sphingomonas* sp. have also been reported to cause leaf blight disease in different rice-growing areas around the world (Mondal *et al.*, 2011 and Kini *et al.*, 2019).

Rice is the principal cereal crop cultivated in the Cauvery command area of the southern dry zone of Karnataka. The major diseases limiting rice production in the region are blast, neck blast, sheath blight and brown spot while sheath rot, udbatta and bacterial leaf blight are minor diseases (Chethana *et al.*, 2016). Until 2015 bacterial leaf blight was noticed very less and the severity was negligible. However, from 2016 onwards the incidence of bacterial diseases was noticed during a survey in Mysuru and Mandya district. It was thus decided to study the prevalence, distribution and severity of bacterial diseases in the region. This paper reports the observations on bacterial diseases made during the survey in the Cauvery command area and the reason for the increase in bacterial diseases and measures to be taken to limit the further spread of disease.

MATERIAL AND METHODS

Rowing survey was carried out during *kharif* 2018-2020 in the Cauvery command area of the southern dry zone of Karnataka covering the Mysuru, Mandya and Chamarajanagar districts (Fig. 1). The survey was undertaken at the nursery stage, tillering, panicle emergence dough and the grain filling stages. Infected plants were diagnosed based on typical water-soaked streaks that spread from the leaf tips and margins and white lesions along the veins. Disease intensity were recorded in the randomly selected ten 1m² subplots in a hectare and scoring was carried out following 0-9 rating scale (Table 1) (IRRI SES., 2013). Per cent disease index was calculated (Wheeler, 1969).

RESULTS AND DISCUSSION

An extensive survey was undertaken to study the scenario of the rice bacterial diseases under a

TABLE 1
Standard Evaluation Scale (2014) for bacterial disease of Rice

Score	% affected lesion area
Immune	0
1	1-5
3	6-12
5	13-25
7	26-50
9	51-100

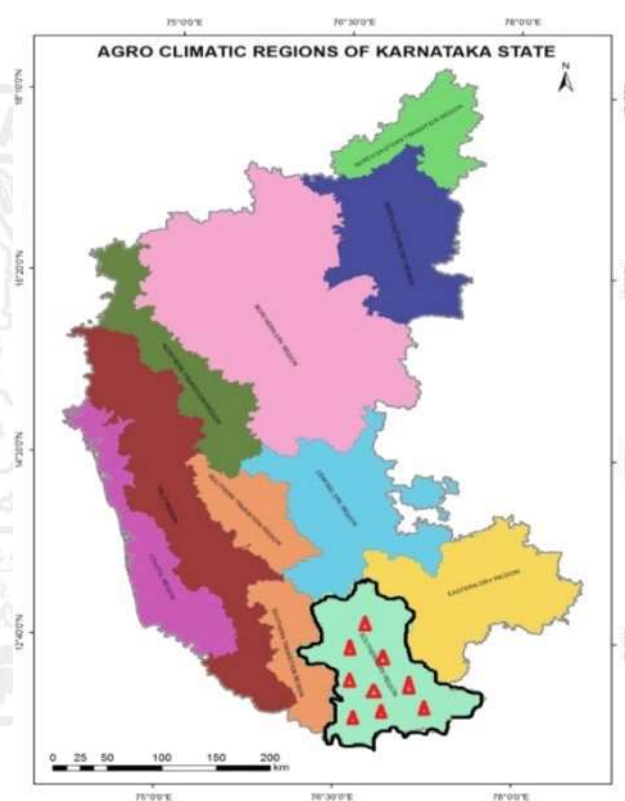


Fig.1 : Location of survey in Cauvery command area of southern dry zone of Karnataka

production-oriented survey programme during *kharif* 2018-2020. A rapid roving survey conducted for three years confirmed the prevalence of bacterial diseases in the Cauvery command areas of the southern dry zone of Karnataka (Table 2). The intensity of disease was recorded high during *kharif* 2019 across the area surveyed as compare to 2018 and 2020. The occurrence of disease every year indicate the weather conditions in the region are becoming more congenial

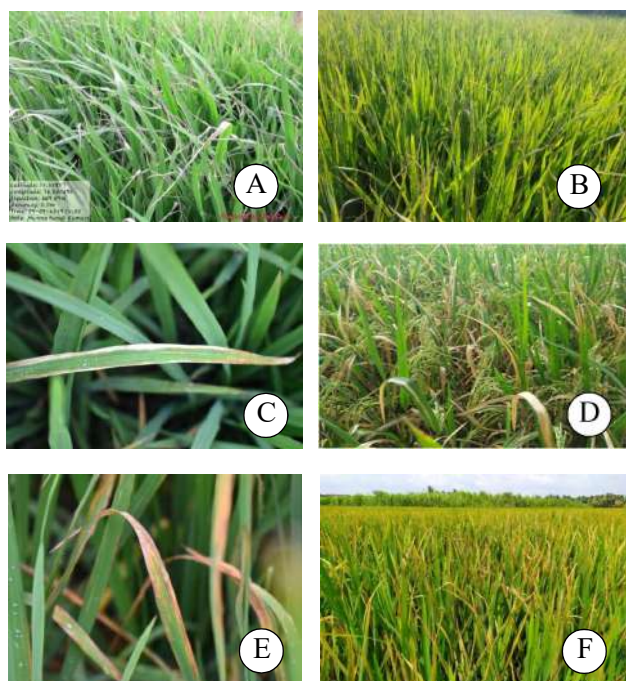


Fig2. Symptoms of bacterial disease of rice in the field

A. Blight affected seedlings in nursery B. Tapering and blighting of leaf at tillering stage C. Marginal blighting of leaf D. Blight affected field at dough stage E&F Bacterial leaf streak affected leaf and the field

TABLE 2
Prevalence of bacterial diseases of rice in Cauvery command area of Karnataka during *kharif* 2018-2020

Taluk	District	Variety	SES scale		
			2018	2019	2020
T. Narasipura	Mysuru	Jyothi	3-5	7	7
Nanjangudu	Mysuru	Jyothi	3	5	5
K.R. Nagar	Mysuru	Jyothi	3	3	5
H.D. Kote	Mysuru	Jyothi	1	3	1
Mandya	Mandya	MTU1001	1	1	3
Kollegala	Chamarajanagar	Jyothi	3	5	7
Madduru	Mandya	MTU1001	1	1	1
K.R. Pete	Mandya	MTU1001	1	1	1
Srirangapatna	Mandya	MTU1001	1	1	1

for disease development. The disease was recorded moderate to high intensity with score 5-7 during *kharif* 2018-2020 in T. Narasipura and Nanjungud taluk of Mysuru district and Chamarajanagara district in Jyothi variety. The disease was recorded low in Maddur,

TABLE 3
Survey of bacterial diseases of rice in Cauvery command area during *kharif* 2019

Place	Districts	Disease	Latitude /longitude	Variety/hybrid	Stage	Ecosystem	Disease severity(%)
Kukkarahalli, Talakadu	Mysuru	BLB	12.1946°N, 77.0305°E	Jyothi	Nursery	Irrigated	20-30
Mugur, T. Narasipura	Mysuru	BLB	12.2110°N, 76.9038°E	Jyothi	Tillering	Irrigated	30-40
K.R. Nagar	Mysuru	BLB	12.4083°N, 76.3927°E	Vasundhara	Dough	Irrigated	10-20
Nagarakere, Maddur	Mandya	BLB	12.5660°N, 76.8231°E	Indus	Dough	Irrigated	50-60
V.C. Farm, Mandya	Mandya	BLB	12.5690°N, 76.8107°E	Jyothi	Dough	Irrigated	25-30
Srirangapatna	Mandya	BLB	12.5212°N, 76.9249°E	Jyothi	Dough	Irrigated	25-30
Guttulu	Mandya	BLS	12.5212°N, 76.9249°E	VNR2233	Dough	Irrigated	30-40
Sampalli	Mandya	BLB	12.5226°N, 76.9305°E	Meenashi	Dough	Irrigated	40-50
Kiragandur	Mandya	BLS	12.5113°N, 76.8656°E	VNR2233	Dough	Irrigated	40-50
Talakadu	Mysuru	BLB	12.1947°N, 77.0305°E	Jyothi	Tillering	Irrigated	BLS
Srirangapatna	Mandya	BLS	12.4237°N, 76.6829°E	VNR2233	Dough	Irrigated	40-50
Guttulu	Mandya	BLS	12.5212°N, 76.9249°E	MC13	Tillering	Irrigated	10-20
Kollegala	Chama - rajanagar	BLB	12.5558°N, 77.0483°E	Jyothi	Tillering and dough	Irrigated	30-40

K.R. Pet and Srirangapatna taluk of Mandya district (ICAR-IIRR POS reports 2018; 2019; 2020).

During *kharif* 2019 the incidence of bacterial disease was noticed in many fields of Mandya, Mysuru and Chamarajanagara districts in the *var.*, Jyothi, Indus, MTU1001, Vasundhara and other private hybrids MC13 and VNR2233 (Table 3). The disease affected the crop at different stages starting from nursery till grain filling. In T. Narasipura, bacterial blight was seen in 20 to 25 days old seedlings in the nursery. Water-soaked symptoms were observed from the tip in the Jyothi variety later the leaves started twisting from the tip and they extended downwards covering 50 per cent of the leaves recording severity ranged from 35-40 per cent (Fig. 2A). However, there was no marginal blighting observed.

In the majority of the area surveyed, the maximum severity of the disease was observed at tillering, dough / milky stage which have incurred loss to the farmers. Varied symptoms were observed especially at tillering stage. In the Meenakshi variety grown at Sampalli village of Mandya taluk the BLB disease started as yellowing in the margins later the tip started drying, tapering and curling and spread very fast covering the entire crop, (Fig. 2B). In some fields at tillering stage, the leaves exhibited yellow-white discolorations along both margins later the tip of the leaf turning white (Fig. 2C). The BLB disease developed as water-soaked spots at the leaf tips and margins later the leaves become chlorotic and necrotic along the leaf veins. At the dough stage, marginal blighting was observed on one or both edges and at the centre of the leaf increase in length downwards and turn into straw-colored stripes with wavy margins

TABLE 4
Symptoms of bacterial diseases observed in the fields of Cauvery command area

Place	Disease	Symptoms appeared in the field
Kukkarahalli	BLB	Creamish white lesions in one or both sides of the leaves and from the tips which get extended rapidly in length and width, developing a yellow lesion with a wavy margin along the edges of the leaf later turn white to grey.
Mugur	BLB	Water-soaked greyish white wavy lesion from the tips progress downwards and started drying.
K.R. Nagar	BLB	Water-soaked straw colour wavy linear lesions from both edges of leaves progress downward later dries up.
Nagarakere	BLB	Linear straw-colored stripes with a wavy margin on both edges of the leaf, extend downwards. Leaves become stiff followed by the drying and twisting of the leaf tip.
V.C. Farm	BLB	Straw-colored stripes with a wavy margin on both edges of the leaf, extend downwards followed by the drying and twisting of the leaf tip.
Srirangapatna	BLB	Creamish white stripes in one or both sides of the leaves and from the tips which get extended rapidly in length and width, developing a yellow lesion with a wavy margin along the edges of the leaf later turn white to grey.
Guttulu	BLS	Initiated as small, water-soaked lesions along with the leaf between the veins resulting in translucent and yellow streaks finally the infected leaves turn greyish white and die.
Sampalli	BLB	Greyish white wavy lesion surrounded by dark margins at the initial stage at the tips progress along the edges later the leaves started twisting from the tip and dries up giving blighted appearance.
Kiragandur	BLS	Orange-yellow colored linear lesions from the tips at the center and on both sides giving blighted appearance progress down the leaves, later tip dries.
Talakadu	BLB	Water-soaked yellow linear lesions with wavy margins on leaf blades later turn to a whitish straw colour over some time.
Kudalakoppe	BLS	Orange-yellow colored linear lesions from the tips at the center and on both sides at giving blighted appearance progress down the leaves, later tip dries.
Guttulu	BLS	
Kollegala	BLB	Greyish white wavy lesion surrounded by dark margins at the initial stage at the tips progress along the edges later the leaves started twisting from the tip and dry up giving the blighted appearance.

(Table 4). The tip of the leaves become stiff and stand straight in the field (Fig. 2D). The symptoms observed were similar to that as reported (Lee *et al.*, 2011). The highest incidence and severity of the disease ranged from 40-50 per cent at the tillering stage in Jyothi variety at Talakadu hobli of T. Narasipura taluk of Mysuru district. In Mandya district it was observed that in majority of the fields the blight symptoms started at booting stage. The symptomatology observed was similar to reports describing leaf blight reporting *Pantoea ananatis* as the causal agent for leaf blight. In some fields, the symptoms of BLB and BLS were observed in the same field on the Jyothi variety.

In *kharif* 2019 bacterial leaf streak disease was recorded in Guttulu and Kiragandur village of Mandya taluk in Hybrid MC13 whereas, in VNR2233 in Srirangapatna. The streak symptoms initiated as small, water-soaked lesions along the leaf between the veins resulting in translucent and yellow streaks (Fig. 2E). The yellow streaks widen length and breadth wise, coalesce and finally change to light brown. Eventually, entire leaves turn orange-brown and then straw color and die (Fig. 2F). The intensity of leaf streak disease ranged from 40-60 per cent was recorded in hybrid VNR2233. The symptoms observed were similar to the description given by earlier workers (Nino-Liu *et al.*, 2006 and Saha *et al.*, 2015). The disease incidence was recorded maximum in tillering stage in Mysuru district comparatively at Mandya it was at flowering stage. In some fields, the symptoms of both streak and blight were observed on the same leaf as reported by Mew *et al.* (1993). However, streak can be distinguished from blight by the thinner translucent streaks.

The present investigation has given reliant information on the prevalence and distribution of disease in Cauvery command area. The recurring occurrence of BLB and BLS in this area is showing the possibility of the outbreak of the disease in the future and can become major threat to rice production in the Cauvery command area of Karnataka. Most of the affected rice varieties were newly introduced varieties / hybrids confirming the fact that the disease is seed-borne. In this perspective strict pest risk

analysis has to be undertaken to identify the phyto sanitary measures required against the disease. Further more, the farmers need to be promoted to adopt the integrated disease management measures to combat the bacterial disease.

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