A Survey of Rice Sheath Blight Incidence in Key Rice-Growing Regions of Telangana and Tamil Nadu, South India

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ABSTRACT

Rhizoctonia solani, caused by many *Rhizoctonia* species, is a debilitating disease of rice (*Oryza sativa*) that causes significant yield losses in important producing locations. This study aims to determine the incidence of rice sheath blight in Tamil Nadu and Telangana in 2024. A comprehensive survey of rice-growing regions, involving nine districts in Telangana and three districts in Tamil Nadu, indicated varying illness incidences. Polasa (Telangana) has the highest

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percent disease incidence (PDI) of 74.23%, followed by Thidalveli (Tamil Nadu) with 71.26%. The tissue segment method used in pathogen isolation and identification identified *Rhizoctonia* spp. as the main agent. Morphological analysis indicated considerable differences between isolates in colony morphology, Sclerotial features, and growth patterns, indicating a diverse *Rhizoctonia* population throughout the examined sites.

1. INTRODUCTION

"Rice (*Oryza sativa* L.), India's major food crop, plays an essential part in the food security system. The crop is a major intrinsic element of Indian dietary and staple food (more than 60%), and its cultivation has expanded to many regions of the world due to its adaptability" (Koutu and Rao, 2008; Mishra et al., 2005). "China and India are the world's top rice producing countries, accounting for 51.4% of total rice output. In India, roughly 112.9 million tons of rice are farmed across 43.5 million hectares, with a yield of 2578 kg/ha. West Bengal is India's greatest rice producing state, with 5.82 million hectares under rice cultivation, including irrigated and rainfed regions, generating 14.97 million tons at a productivity of 2.6 tonnes per ha. While in Uttar Pradesh, it is cultivated on 5.6 million hectares, yielding 13.28 million tons with an average productivity of 2 tonnes/ha (2017-18)" (www.indiastat.com).Furthermore, various abiotic and biotic variables impact rice production and productivity, resulting in up to 45% yield losses (Margani and Widadi 2018). Fungal infections in rice are the most common biotic stressor worldwide (Asibi et al., 2019). Several pathogens affect rice productivity (Margani and Widadi 2018), "with sheath blight (ShB) disease of rice caused by Rhizoctonia solani Kuhn being one of the most destructive pathogens in rice and considered the world's most significant disease, second only to blast disease" (Zheng et al., 2013; Molla et al., 2020). Pathogens' ability to live in soil and plant waste allows them to survive in a variety of ways, making disease control challenging (Kumar et al., 2009). It has become increasingly common in the majority of modified cultivars now grown in India (Prakasam et al., 2013). Disease prevalence and intensity have increased dramatically in recent decades (Yellareddygari et al., 2014). Currently, it is one of the biggest production constraints in the states of Eastern Uttar Pradesh, Chhattisgarh, Punjab, Odisha, Uttarakhand, Bihar, West Bengal, Haryana, coastal Andhra Pradesh, Tamil Nadu, Kerala, and portions of Karnataka (Prakasam et

al. 2013). A study on disease incidence in a certain region can provide information on the present state of illness in various growth zones, which is required to make decisions about disease management strategies.

As a result, the current survey was conducted in major rice-growing regions of Telangana and Tamil Nadu to determine the incidence and severity of sheath blight in various agro-ecosystems, cropping systems, rice varieties, agronomic practices, and management methods, which is required to make decisions on sustainable disease management practices.

2. MATERIALS AND METHODS

Collection of sheath blight samples: Roving survey was conducted during Rabi 2023- 24 in major rice growing areas of Telangana and Tamil Nadu districts. In Telangana 9 districts, were taken under the survey namely Ranga Reddy, Nagarkurnool, Mahabubnagar, Jagtial, Mancherial, Karimnagar, Warangal, Peddapalli and Nizamabad and from Tamil nadu there are 3 districts were taken under the survey they are Cuddalore, Ariyalur and Thanjavur. In each district, diseased samples are gathered by choosing several plots from each village and calculating the disease incidence. Random sampling has been carried out along the roadside at intervals of 5–10 km and in some inner villages. This method was used to get the average percent disease incidence (PDI). Four one squire meter quadrants were randomly selected in each field and infected plants were counted in each quadrant based on relative lesions height. The disease severity was calculated based on a scale developed by IRRI, (2002).

Disease severity rating scale (based on relative lesion height):

0 - No infection observed
1 -Lesions limited to lower 20% of the plant height

3 - Lesions limited to 20-30% of the plant height

5 - Lesions limited to 31-45% of the plant height

7 - Lesions limited to 46-65% of the plant height

9 - Lesions observed more than 65% of the plant height

Disease incidence (DI) was recorded by using the following formula:

$$\text{Disease incidence } = \frac{\text{Number of infected tillers}}{\text{Total number of tillers}} \times 100$$

Sheath blight symptoms: During survey characteristics symptoms on the leaf sheath at water level and the lesions in its early stages were circular or oblong with dark brown margin. The lesions were usually confined to the lower leaf sheaths at or near the water level described by (Paracer and Chahal 1963). Those diseased samples were collected for isolation of R. solani pathogen.

Isolation of pathogen: The causal organism R. solani Kuhn was isolated from the rice plants showing typical sheath blight symptoms under field conditions. Leaf sheath showing typical symptoms was washed in tap water for few minutes and leaf bits of 3-8 mm size were surface sterilized with 1% sodium hypochloride solution for one minute and then rinsed with sterile distilled water to remove the traces of sodium hypochlorite. These leaf bits are then transferred to potato dextrose agar medium in petriplates and kept for incubation at 28 ± 2° C. When the growth of the fungus from the leaf bits was seen on the PDA surface, the hyphal bits from the periphery of the culture growing in the petriplates was transferred to the PDA in culture tubes. The culture was purified by hyphal tip method and pure culture was maintained on PDA by regular sub culturing at frequent intervals. Pathogenicity of R. solani was proved by mycelial ball insertion technique as observed by (Park et al., 2008 and Nadarajah et al., 2014).

3. RESULTS AND DISCUSSION

The survey data is presented in the Table 1. The data indicated that among the all locations surveyed, from Telangana and Tamil nadu regions Jagtial district recorded the per cent disease severity range 74.23 while Karimnagar district recorded comparatively less disease severity range 17.26 per cent. In Jagtial District, the highest disease severity (74.23 %) was recorded in Polasa (74.23 %) area, whereas the least disease severity (17.26 %) was observed in

Gangadhara area of Karimnagar (D). In Cuddalore district, the highest disease severity was recorded in Thidalveli (71.43%) of Tamil Nadu (D) whereas the least disease severity was observed in Usuppur (21.19%) of Tamil Nadu (D).

Stage of the crop: During the survey, the disease severity was recorded at different stages of rice crop. In seven villages disease severity was observed during Tillering stage and Active tillering stage of the crop, in four village it was during the Panicle stage and Panicle initiation stage, in one village it was during the booting stage, in one village it was during the heading stage, in three village it was during the flowering stage, in three village it was during the milky stage and in one village it was during the Hardening stage.

Disease severity is been shown during the Tillering stage and Active tillering stage varied from 25.66 per cent to 71.43 per cent, whereas during the Panicle stages and Panicle initiation stage it ranged from 28.09 per cent to 69.08 per cent respectively. In Cuddalore districts surveyed maximum severity was recorded during Active tillering stage and in Jagtial district surveyed maximum severity was recorded during the Hardening stage.

Whereas disease severity during the booting stage varied from 29.05 per cent in Vallampadugai area of Cuddalore (D), Disease severity during the heading stage was recorded only in Perampattu area of Cuddalore (D), during the flowering stage maximum severity was recorded in Kadthal (57.41%) area of Ranga Reddy (D) and minimum severity was recorded in Usuppur (21.19%) area of Cuddalore(D). In milky stage maximum severity was recorded in Achampet area of Nagarkurnool district, and minimum severity was recorded in Gangadhara (17.26%) area of Karimnagar district,in hardening stage recorded disease severity ranging from 74.23 per cent in Polasa area of Jagtial (D).

Crop variety: The per cent disease severity recorded in each variety varied depending upon the place of cultivation. MTU1010 variety was cultivated in three area had disease severity ranging from 27.95 (Dharmaram, Nizamabad (D) to 52.03 per cent (Achampet, Nagarkurnool (D), BPT-5204 variety was cultivated in four area had disease severity ranging from 25.66 per cent (Rajendranagar, Ranga Reddy (D) to 74.23 per cent (Polasa , Jagtial (D) and TN-1 variety was

Table 1. Collection of sheath blight disease samples from major rice growing areas from different districts of Telangana and Tamil Nadu

S.No	Isolates	State	Area	Districts	Variety	Soil type	Crop stage	Per cent Disease Incidence (PDI)*
1.	Rs_1	Telangana	Kadthal	Ranga Reddy	BPT -5204	Clay	Flowering	57.41[e] (49.48)
2.	Rs_2		Achampet	Nagarkurnool	MTU-1010	Clay loam	Milky stage	52.03 [g] (46.16)
3.	Rs_3		Makthal	Mahabubnagar	TN-1	Clay	Panicle stage	46.07[hi] (42.74)
4.	Rs_4		Rajendranagar	Ranga Reddy	BPT-5204	Clay	Tillering stage	25.66[m] (30.43)
5.	Rs_5		Polasa	Jagtial	BPT-5204	Clay	Hardening stage	74.23[a] (59.49)
6.	Rs_6		Makulapet	Mancherial	TN-1	Clay loam	Tillering stage	48.02[h] (43.86)
7.	Rs_7		Gangadhara	Karimnagar	JGL-24423	Clay loam	Milky stage	17.26[op] (24.54)
8.	Rs_8		Atmakur	Warangal	WGL-1368	Clay loam	Panicle stage	55.63[ef] (48.23)
9.	Rs_9		Eligedu	Peddapalli	MTU-1010	Clay	Flowering stage	51.01[g] (45.57)
10.	Rs_{10}		Dharmaram	Nizamabad	MTU-1010	clay	Milky stage	27.95[l] (31.85)
11.	Rs_{11}	Tamil Nadu	Thidalveli	Cuddalore	BPT 5204	Clay	Active tillering	71.43[b] (57.99)
12.	Rs_{12}		Saliyanthoppu		TRY 1	Clay	Active tillering	42.08[j] (40.44)
13.	Rs_{13}		Sivapuri		ADT 36	Clay	Active tillering	64.67[d] (53.55)
14.	Rs_{14}		Kadavacheri		ADT36	Clay loam	Panicle initiation	28.09[l] (32.00)
15.	Rs_{15}		Usuppur		ADT36	Clay	Flowering	21.19[n] (27.40)
16.	Rs_{16}		Vallampadugai		CR 1009	Clay loam	Booting	29.05[l] (32.61)
17.	Rs_{17}		Velakudi		ADT 36	Clay	Panicle initiation	69.08[c] (56.24)
18.	Rs_{18}		Perampattu		ADT 36	Clay loam	Heading	34.55[k] (35.99)
19.	Rs_{19}		Pathupullividuthi	Ariyalur	ADT 43	Clay loam	Active tillering	54.75[f] (47.72)
20.	Rs_{20}		Thirumanur	Thanjavur	ADT 43	Clay	Active tillering	44.73[i] (41.88)

cultivated in two area disease severity ranged from 46.07 per cent in Makthal, Mahabubnagar(D) and to 48.02 per cent in Makulapet, Mancherial(D).

Whereas JGL-24423 variety was cultivated only one area Gangadhara bit (17.26%) of Karimnagar (D) and WGL-1368 variety was cultivated in Atmakur (55.63%) of Warangal (D). whereas disease severity in TRY-1 variety was observed only in Saliyanthoppu (42.08%)of Cuddalore (D) and CR1009 variety in Vallampadugai (29.05%) of Cuddalore (D), ADT-36 variety was cultivated in five area had disease severity ranging from 21.19 per cent (Usuppur, Cuddalore (D) to 69.08 per cent (Velakudi, Cuddalore (D), ADT-43 variety was cultivated only two area Thirumanur (44.73%)of Thanjavur (D) and in Pathupullividuthi (54.75%) of Ariyalur (D).

During survey both Telangana and Tamil nadu districts clay loam soils were the predominant type of soil for rice cultivated. Similarly, (Reddy et al. 2018) carried out "survey for the assessment of sheath blight severity in rice in nine districts of Telangana state. In Adilabad district the maximum severity (9scale) was observed Huzurnagar and Miryalaguda villages. The disease was observed from panicle initiation to grain hardening stage. Whereas some other workers were found different growth stages susceptible for infection". (Shahjahan et al. 1990) reported "panicle initiation to booting stage is most susceptible stage for sheath blight infection". (Pal et al., 2016) also found "grain filling stage as most susceptible for sheath blight disease to occur".

Similar results were also recorded by (Kapse et al. 2012) and (Pal et al. 2015) plant variety is the major factors influencing sheath blight disease. Pratiwi et al. (2021) reported "disease severity on rice plants in Northern Sumatra, Indonesia. Highest disease incidence (99.48%) and the highest disease severity (12.38%) was recorded Sumber tani and Talawi in Batubara district".

Isolation and purification of Pathogen: "Sheath blight pathogen was isolated from rice plants exhibiting typical symptoms were greenish grey ellipsoid lesions on the leaf sheaths near the waterline. Infected plant tissues were cut into small bits (~0.5 cm), surface sterilized with 1 % sodium hypochlorite solution for 30 sec rinsed three times with sterile distilled water, and blotted dry. Three sections are placed at equidistance per plate containing PDA medium. The plates were incubated in a BOD incubator at 28±2°C in the dark. Plates were checked regularly for hyphal growth. Hyphae resembling Rhizoctonia were identified under a microscope and pure cultures were obtained using the hyphal tip technique. The emerging edges of the mycelium were transferred to PDA medium-amended plates. All isolates were maintained on PDA slants and stored in a refrigerator at 4°C. Totally twenty isolates were isolated and were designated as Rs_1 to Rs_{20} respectively.The sheath blight pathogen was isolated from diseased samples collected during the survey and isolated by tissue segment method" (Rangaswami and Mahadevan, 1999) Then purified by single hyphal tip method and were identified as R. solani based on morphological characters using the descriptions given by (Banniza, 1996). These observations were in accordance with (Sneh et al., 1991) who described "hyphal branching at right angle, constriction at the point of branching of the mycelium and presence of a septum near the branching junction".

4. CONCLUSION

A survey on the prevalence and spread of rice sheath blight in key rice growing regions of Telangana and Tamil Nadu, South India, revealed that disease is a serious constraint in the zone. The sickness occurrences varied among nine districts in Telangana and three districts in Tamil Nadu. Polasa (Telangana) has the highest percentage disease incidence (PDI) at 74.23%, followed by Thidalveli (Tamil Nadu) with 71.26%. The predominance of sheath blight may be attributed to the most favorable circumstances, such as high relative humidity and water logging produced by constant rain at these surveying sites. Large-scale cultivation of vulnerable types, such as monocropping in the same field, may boost the viruses' ability to survive in plant waste. The current study might serve as a forerunner for building an effective integrated management plan for the region to ensure long-term agricultural development in the state.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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