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Survey for the incidence of false smut disease of rice in Tamil Nadu

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Abstract
Rice (*Oryza sativa*) is the most important staple inevitable food crop of the world population. The rice production is hindered by many biotic and abiotic factors. In the recent years, the rice false smut disease is gaining importance in Tamil Nadu state of India, because of its widespread nature. Due to false smut disease, the rice grain yield loss may go up to 50 percent. An intensive survey was conducted in the present study in major rice growing areas during the year 2021-2022 to assess the incidence of false smut disease in Tamil Nadu. The rice false smut incidence ranged from 1.36 to 36.36 per cent and the disease severity ranged between 1.08-379.23 per cent. The higher false smut disease incidence (36.36%) and severity (379.23%) was observed in Thundumainyam village of Salem district and the minimum disease incidence (1.36%) and disease severity (1.08%) was recorded in Killikulam, Vallanad village of Tamil Nadu.

Keywords: Rice false smut, *Ustilaginoidea virens*, survey, Tamil Nadu

1. Introduction
Rice (*Oryza sativa*) is the most important staple inevitable food crop of world which belongs to the family Poaceae. It is cultivated on 162.06 million hectares in 120 countries, with a total output of 497.69 million metric tonnes of milled rice in 2019-20(Shahbandeh., 2021) [15]. The overall area and production in India were reported to be 45 million hectares and 127.93 million tonnes respectively (DAC&FW, 2022) [4]. The rice crop is grown in Tamil Nadu over an area of 18.04 lakh hectares, with a yield of 63.08 lakh metric tonnes in 2020-21(Department of Agriculture, Tamil Nadu) [13]. False smut disease is becoming a new threat to the rice production in the recent years. Ladhalakshmi *et al.*, (2012) [8] reported that 10-20 and 5-85 per cent incidence of false smut disease in Punjab and Tamil Nadu state respectively. Due to higher incidence of the disease, the yield loss was recorded up to 49 per cent (Dodan and Singh, 1996) [5]. The perfect stage of false smut infection takes place in the rice plant at 50 per cent blooming, which is correlated with environmental parameters of 31ºC day temperature, 19 ºC night temperature, >90 per cent relative humidity and a frequent period of rainfall with cloudy weather (Yashoda *et al.*, 2000) [20]. Due to the economic importance of the rice false smut disease, the current investigation was carried out to determine the current status of the disease in Tamil Nadu.

2. Materials and Methods
2.1 Survey
An intensive survey was conducted to know the incidence and severity of false smut disease of rice in major rice growing areas of Tamil Nadu. The survey was conducted in eleven rice growing districts *viz.*, Coimbatore, Cuddalore, Kanyakumari, Madurai, Perambalur, Salem, Tenkasi, Thiruvannamalai, Thanjavur, Tirunelveli and Tuticorin during the year 2021-2022 (Fig.1). During the survey, observations on total number of infected spikelets, total numbers of infected tiller and number of smut balls per panicle on false smut disease were recorded and disease incidence and severity were calculated as per the formula suggested by Mandhare *et al.*, (2008) [10] and Singh and Dube (1978) [16].

$$\text{Per cent infected tillers} = \frac{\text{Number of infected tillers/m}^2}{\text{Total number of tillers/m}^2} \times 100$$

$$\text{Per cent infected grains} = \frac{\text{Number of diseased grains/panicle}}{\text{Total number of grains/panicle}} \times 100$$

"Disease severity = Per cent infected tillers × Per cent infected grains"

3. Results and Discussion

3.1 Symptomology

During the survey the rice false smut disease was observed after the grain filling stage of the crop. At initial stage of the false smut, the pathogen produced snow ball like projection between the spikelets (Fig.1). After that, outer white colour mycelial epidermal cells broken down which turn into yellowish orange colour dusty spore balls and large numbers of chlamydospore were released into the air currents (Fig.2). In the later stage, the smut ball turned greenish black and the size of the smut balls varied from 0.5 to 1.5 cm (Fig.3). When the disease appeared during an unfavorable season, instead of producing a yellow-orange colour smut ball it produced greenish-black colour small sized smut balls (Fig.4). It also induced more numbers of chaffiness and it reduced the quality of rice grains. Similar type of symptom expression was observed in the previous studies *viz.*, Chaudhari *et al.*, (2021) [3], Sanghera *et al*., (2012) [14], Lin *et al.*, (2018) [9] and Wang *et al.*, (2019) [19], Tang *et al.*, (2013) [18], Hu *et al*., (2013) [6], Ashizawa and Kataoka (2005) [1], Ou and Shu Huang (1985) [12] and Ikegami *et al*., (1963) [7].

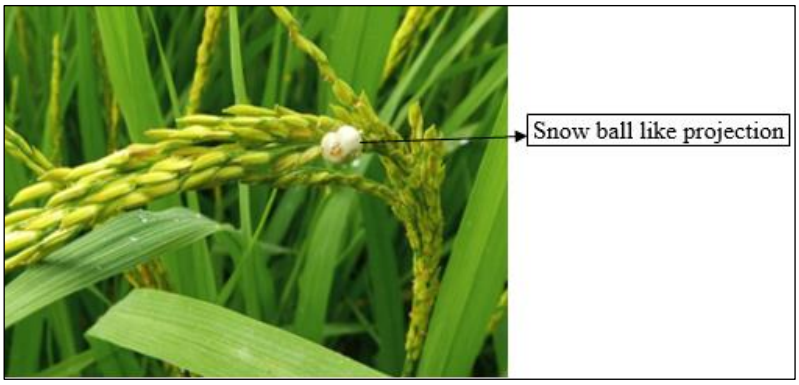

Fig 1: Initial symptom of false smut of rice

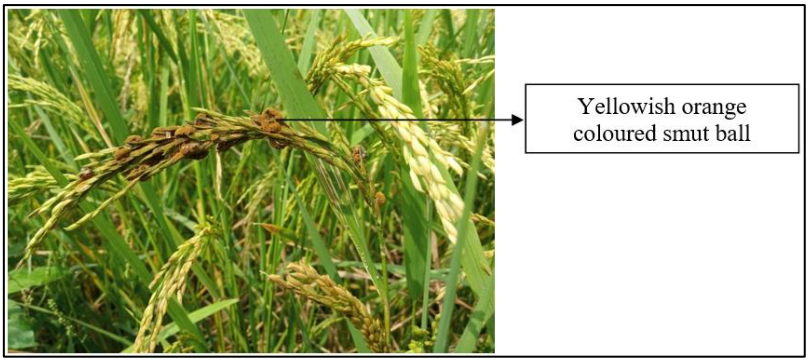

Fig 2: Yellowish orange coloured smut balls

Fig 3: Final stage of false smut of rice

Fig 4: Smut ball production under unfavourable condition

3.2 Survey on the incidence of false smut of rice

A survey was conducted to record the incidence and severity of false smut in major rice growing districts of Tamil Nadu of India *viz.*, Coimbatore, Cuddalore, Kanyakumari, Madurai, Perambalur, Salem, Tenkasi, Thiruvannamalai, Thanjavur, Tirunelveli and Tuticorin during the months between August-2021 to February-2022. During the survey observations on total numbers of infected spikelets, total numbers of infected tillers and numbers of smut balls per panicle were recorded and the disease incidence and severity were calculated. Among the eighteen villages surveyed, the highest percentage (10.43%) of infected spikelets was observed in Thundumaniyam village while the lowest percentage (0.59%) of infected spikelets was recorded in Vittilapuram village of Tuticorin district. The highest incidence (36.36%) of false smut disease was observed in Thundumaniyam village of Salem district and the lowest incidence (1.56%) was observed in Killikulam, Vallanad village of Tuticorin district. The maximum disease severity (379.23%) was observed in Thundumaniyam village and minimum (1.08%) was observed in Killikulam, Vallanad village of Tuticorin District. The data recorded in the present study revealed that the false smut disease incidence and severity were varied from 1.56-36.36 per cent and 1.08-379.23 per cent respectively in Tamil Nadu (Fig 6 and Table 1). This may be due to various environmental factors such as rainfall, cloudiness and other geographical features. Chaudhari *et al.*, (2021) [3] recorded maximum disease severity index of 34.02 and 24.65 in Jamalapada area of south Gujarat in 2017 and 2018 respectively. Banasode and Hosagoudar (2020) [2] recorded the highest mean false smut disease severity of 69.87 per cent in the hilly zone of Kodagu district during Kharif 2017. Muniraju *et al.*, (2017) [11] recorded the highest disease severity of 17.12 per cent during Kharif 2016 in Bhadra irrigated ecosystem. Yu *et al.*, (2017) [21] recorded that highest disease severity of false smut (11.30 per cent) in Palthae rice variety found in Yein area of Karnataka district during Kharif 2017. Several researchers have also reported varying levels of false smut disease incidence in rice in various parts of India. Sanghera *et al*., (2012) [14], Ladhalakshmi *et al*., (2012) [8] and Singh et al., (2010) [17] also recorded difference in the level of incidence of false smut disease in rice.

Table 1: Severity and incidence of rice false smut disease in Tamil Nadu

S. No.	Village	District	GPS	Variety	Disease Incidence*	Percentage of smut balls (%)	Disease severity (%)
1.	Thundumaniyam	Salem	11.74°N 77.99° E	Amman Ponni	36.36[a]	10.43	379.23
2.	Olaipatti		11.76°N 77.95° E	Amman Ponni	21.21[c]	6.14	130.23
3.	Panapuram		11.80°N 77.95° E	Karuippu kayuni	13.6[f]	5.66	76.98
4.	Kasuvaraetipatty		11.71°N 77.96° E	Amman Ponni	27.12[b]	9.20	249.50
5.	Panikanur		11.66°N 77.92° E	Lakshmi	11.76[h]	2.97	34.93
6.	Mutthampatty		11.78°N 77.93° E	Amman Ponni	8.96[i]	3.31	29.66
7.	Agricultural College & Research Institute	Madurai	9.97°N 78.20° E	ADT 54	6.56[k]	1.83	12.00
8.	Tamil Nadu Agricultural University, Wet land	Coimbatore	11.00°N 76.92° E	ADT 47	13.85[f]	2.20	30.47
9.	Annamalai nagar	Cuddalore	11.38°N 79.72° E	CO 43	12.77[g]	3.05	38.95
10.	Valikandapuram	Perambalur	11.31°N 78.92° E	ADT 45	18.33[d]	3.76	68.92
11.	Arasappattu	Thanjavur	10.71°N 79.29° E	ADT 36	13.64[f]	4.91	66.97
12.	Vazhavachanur	Thiruvannamalai	12.07°N 78.98° E	VGD 1	7.89[j]	1.76	13.89
13.	Vasudevanallur	Tenkasi	9.24°N 77.40° E	ASD 16	13.64[f]	4.89	66.70
14.	Ambasamuthiram	Tirunelveli	8.70°N	ASD 16	11.94[g]	3.49	41.67

			77.46° E				
15.	Thirupathisaram	Kanyakumari	8.21°N 77.45° E	TN 1	5.97[l]	1.76	10.51
16.	Vittilapuram	Tuticorin	8.67°N 77.82° E	TKM 13	6.77[k]	0.59	3.99
17.	Kasilingapuram		8.75°N 77.87° E	ASD 16	14.52[e]	2.80	40.66
18.	Killikulam		8.70°N 77.86° E	ASD 16	1.56[m]	0.69	1.08
CD(P=0.05)					0.45		
SE(d)					0.05		
CV					1.76		

*Mean of four replications.
Any two means with a common letter are not significantly different at the DMRT level of P 0.05.

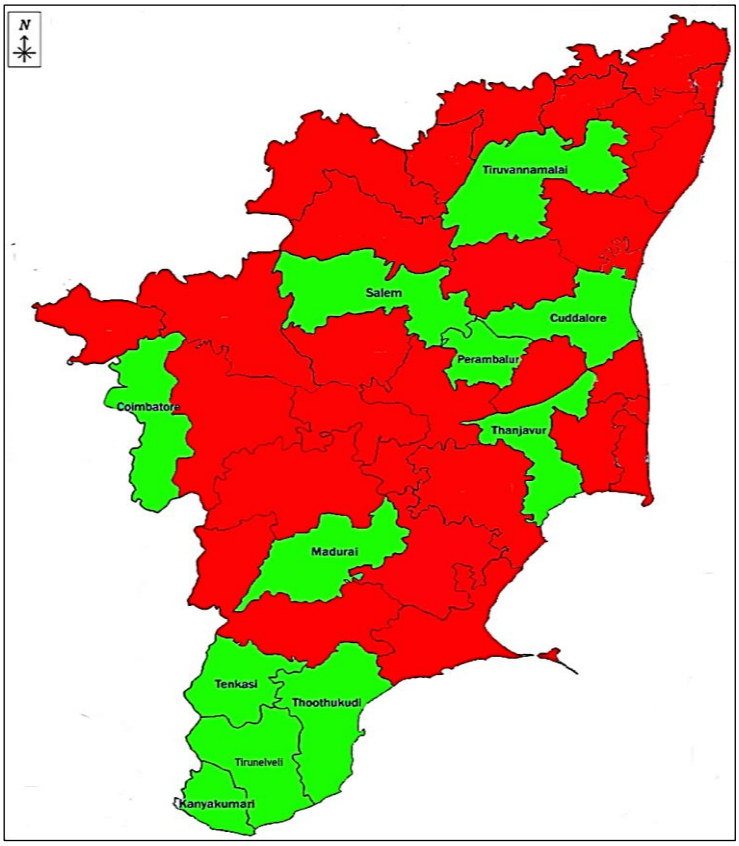

Fig 5: Districts surveyed for the incidence of rice false smut in Tamil Nadu

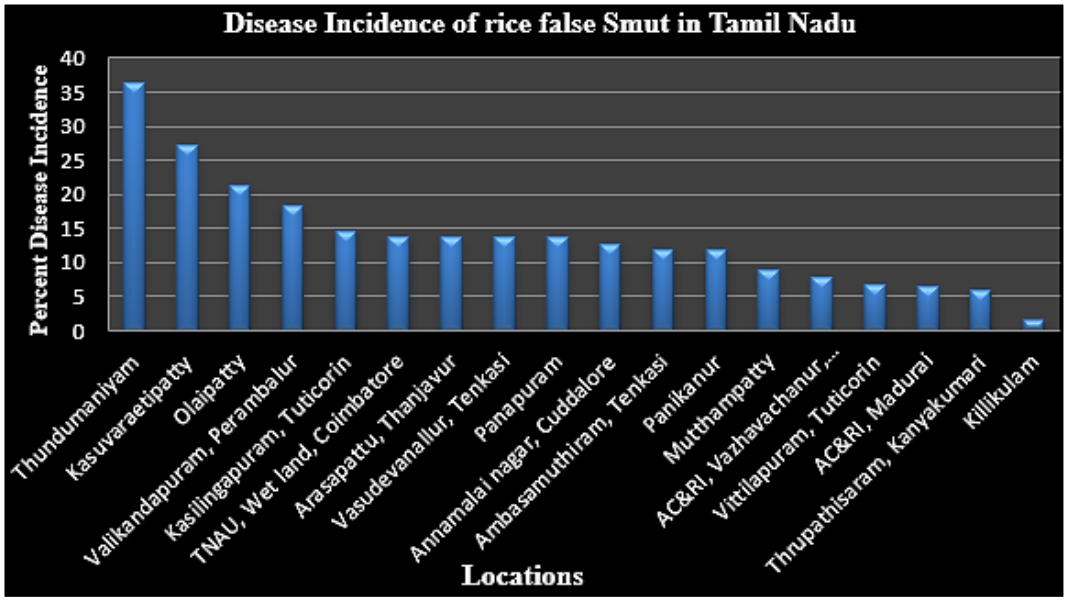

Fig 6: Disease incidence of rice false smut in Tamil Nadu

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