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Status of False Smut of Rice in Gujarat

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ABSTRACT: False smut caused by *Ustilaginoidea virens* (Cooke) Takahashi is known to cause significant quantitative and qualitative losses in grain yield. In response to the destructive nature of the pathogen, a survey was conducted during the *Kharif* 2024 in Anand, Kheda and Ahmedabad districts of Gujarat. Among all the surveyed districts highest incidence of false smut, based on the percentage of infected panicles per square meter, was recorded in Anand district (27.86%), followed by Kheda (17.61%), while the lowest incidence was observed in Ahmedabad (5.44%). Similarly, the percentage of infected spikelets per panicles were also highest (26.78) in Anand district, followed by Kheda (18.84%) and the lowest in Ahmedabad (4.74%).

Keywords: False smut, rice, survey, *Ustilaginoidea virens.*

INTRODUCTION

Rice (*Oryza sativa* L.) is one of the most important and widely recognized crop globally. It belongs to the *Poaceae* family, has a chromosome number of 2n = 24 and originated in South and Southeast Asia (Ezuka and Kaku 2000). It is a rich source of carbohydrate and also contains small amounts of protein, fat and vitamin B complexes such as niacin, riboflavin and thiamine (Fresco, 2005). Rice grains are rich source of minerals like calcium (Ca), magnesium (Mg) and phosphorus (P) (Verma *et al*., 2018).

Rice is grown in diverse agro-ecosystems in South Asia, Southeast Asia, Africa and Latin America. China, India, Indonesia, Vietnam and Bangladesh are the highest producers of rice. Over 90% of the world's rice production takes place in Asia, with China and India being the two largest producers contributing about 40% of world rice (Madhu *et al*., 2023). In India the crop occupies an area of 47.83 million hectares with the production of 119.93 million tonnes and productivity of 2838 kg per hectare (Anonymous, 2024a). Whereas in Gujarat state the rice is cultivated on 0.89 million hectares with the production of 2.12 million tonnes and productivity 2403.27 kg/ha (Anonymous, 2024b). Rice is mainly grown in central and southern regions of Gujarat, which include the districts of Kheda, Ahmedabad, Anand, Panchmahal, Mahisagar, Tapi, Vadodara, Surat, Valsad, Dang, Navsari, Dahod, Bharuch and Mehsana.

The crop is grown in diverse ecological and climatic conditions, which makes it susceptible to various constraints, including both biotic and abiotic stresses (Ou, 1985). Among the biotic stresses, diseases are causing more damage than ever before, especially under the influence of changing environmental conditions. Major diseases of rice such as blast, brown spot, sheath blight, bacterial leaf blight and tungro have become more severe over the years and a number of minor diseases like sheath rot, bakanae, false smut, grain discoloration, early seedling blight and narrow brown spot have emerged as major problems (Raghu *et al.*, 2018). Among them false smut caused by *Ustilaginoidea virens* (Cooke) Takahashi is known to cause significant quantitative and qualitative losses in grain yield (Rush *et al*., 2000; Singh and Pophaly 2010). Rice crop is prone to the false smut disease, which is one of the most emerging diseases, causing significant damage of rice yield and quality worldwide (Abbas *et al*., 2014).

In India the disease has been observed in severe form since 2001 in major rice-growing states, *viz*., Haryana, Punjab, Uttar Pradesh, Uttaranchal, Tamil Nadu, Karnataka, Andhra Pradesh, Bihar, Jharkhand, Gujarat, Maharastra, Jammu & Kashmir and Puducherry (Dodan and Ram 1996; Mandhare *et al*., 2008). Low to severe incidence of false smut was recorded in Anand, Ahmedabad and Kheda districts of Gujarat state during 2006 and 2007 (Laha *et al.*, 2016). *U. virens* attacked almost all the rice growing areas of South Gujarat and maximum in Dang district because of favourable climatic conditions like high humidity, cloudy weather, low temperature and continuous cultivation of the hybrid and high yielding rice cultivars susceptible to false smut disease (Chaudhari *et al*., 2021).

The rice false smut disease is favoured by climatic factors such as cloudy weather, high relative humidity (>95%), low temperatures (25 to 30°C), water stress and rainy days during the flowering period (Raji *et al*., 2016; Sanghera *et al*., 2012).

Historically being an uncommon and minor disease by occurring sporadically in certain regions (Dodan and Ram, 1996), now epidemics of the disease are being reported frequently (Singh and Pophaly 2010; Ladhalakshmi, 2012). The estimated yield loss by *U. virens* on different rice varieties in different rice growing areas of the world ranged from 0.2 to 49.0% (Biswas, 2001). Yield loss to the extent of 7 to 75% observed in India (Agrawal and Verma 1978).

In Gujarat the mean disease incidence was 6.44% with maximum incidence of 10.06% in Dang, Jamalapada and minimum incidence of 1.27% in Surat, Mahudi (Chaudhari *et al*., 2021). Over all, the loss in yield due to false smut disease in India has been varied between 0.2–49%, depending on disease incidence and rice varieties (Dodan and Ram 1996).

The pathogen responsible for false smut disease in rice, *Ustilaginoidea virens*, initiates infection during the flowering stage of the crop, with visible symptoms only appearing later, at the grain-filling stage. As a result of the infection, individual spikelets on the panicle transform into yellowish-orange to olive-green, ball-like structures known as "smut balls," "pseudomorphs," or "pseudosclerotia," which are nearly twice the size of normal rice grains. These smut balls cause the lemma and palea to open up due to their enlargement. In contrast, when the infection occurs in unfertilized florets, most of the glumes remain sterile with no visible signs of infection, ultimately resulting in the production of chaffy grains.

In view of the destructive nature of the pathogen, a roving survey on the incidence of false smut was carried out during *Kharif*, 2024 in Gujarat.

MATERIALS AND METHODS

The roving survey on the incidence of false smut was carried out during *Kharif*, 2024 in major rice growing districts of Gujarat *i.e*., Anand, Kheda and Ahmedabad. Two talukas from each district and two villages of each taluka were selected. Whereas randomly five fields were selected from each village during this survey. In each field, three quadrate each of 1 m^2 was selected randomly to ensure broad and representative sample of rice crops in the region.

During the field surveys, positive sampling was conducted and infected panicles of rice plants exhibiting typical false smut symptoms (Fig. 1).

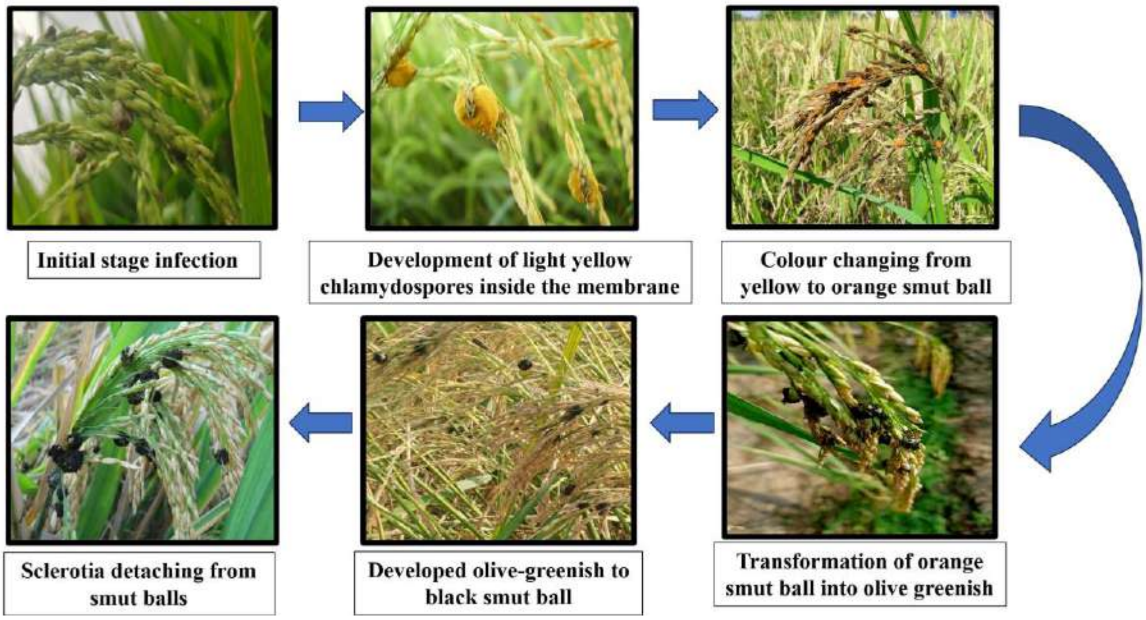

Fig. 1. Developmental stages of false smut caused by U. *virens* on rice plant.

For accurately record observations on the number of infected panicles/sq m and number of infected spikelets/panicles for false smut of rice, several key parameters were recorded.

For calculating the number of infected panicles and number of infected spikelets of disease in a field, three quadrates were randomly selected from each field and ten plants were observed for the disease symptoms. Per cent infected panicles and per cent infected spikelets was calculated using the following formula (Anonymous, 2023).

$$\text{Per cent infected panicles} = \frac{\text{Total number of infected panicles/sq m}}{\text{Total number of panicles/sq m}} \times 100$$

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

Observations recorded

(1) No. of infected panicles/sq m

(2) No. of infected spikelets/panicle

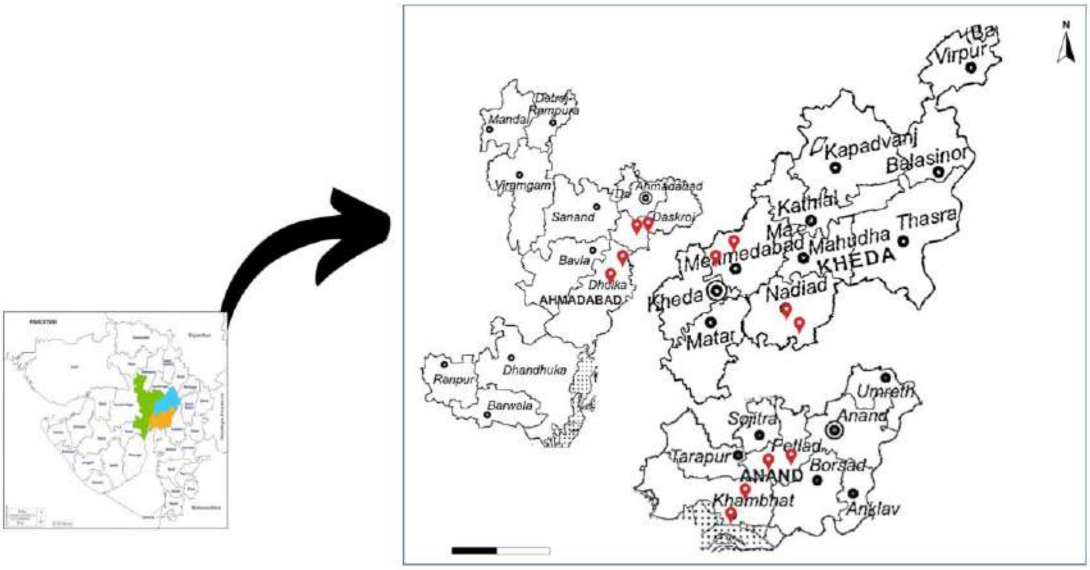

Fig. 2. Major rice growing districts of Gujarat covered during survey.

RESULTS AND DISCUSSION

A roving survey was conducted during September-October of *Kharif* 2024 in major rice growing districts of Gujarat *i.e*., Anand, Kheda and Ahmedabad which are known for their rice cultivation were surveyed to assess the incidence of false smut of rice.

Analysis of the data presented in Table 1 reveals that the highest incidence of false smut, based on the percentage of infected panicles per sq meter, was recorded in Anand district (27.86%), followed by Kheda (17.61%), while the lowest incidence was observed in Ahmedabad (5.44%). Similarly, the percentage of infected spikelets per panicles were also highest (26.78%) in Anand district, followed by Kheda (18.84%) and the lowest in Ahmedabad (4.74%).

Among the talukas, Khambhat recorded the highest incidence of false smut with 31.21 per cent infected panicles/sq m, followed by Anand (24.51%), Mahemdabad (21.08%), Nadiad (14.13%) and Dholka (5.84%). The lowest incidence (5.04%) was observed in Daskroi taluka. The results of per cent infected spikelets per panicle, the highest incidence was again reported in Khambhat (29.62%), followed by Anand (23.93%), Mahemdabad (21.58%), Nadiad (16.10%) and Dholka (5.43%), whereas the lowest incidence (4.04%) also recorded in Daskroi.

At the village level, the highest per cent infected panicles per sq meter was observed in Kalamsar (35.07%) of Anand district, followed by Sansoli (30.22%) of Kheda district, Kansari (27.36%), Hadgud (24.99%) and AAU campus (24.03%) of Anand district. The incidence was also recorded from other villages like Piplata (15.16%), Vaso (13.11%) and Kanij (11.94%) of Kheda district. Where as in Ahmedabad district the per cent infected panicle/sq m were recorded relatively less in Chandisar (6.16%), Devdi (5.63%) and Ambaliyara (5.53%), while it was lowest in Boipura (4.45%).

The village wise data on per cent infected spikelets per panicle were also showed that it was highest in Kalamsar (31.22%), followed by Sansoli (29.95%), Kansari (28.02%), Hadgud (25.30%) and AAU campus (22.55%). Other notable villages included Piplata (16.41%), Vaso (15.78%) and Kanij (13.20%). The per cent infected spikelets per panicle was also recorded lowest in the village of Ahmedabad district *viz*. Chandisar (5.77%), Ambaliyara (5.09%) and Devdi (4.31%) and the lowest incidence (3.77%) recorded in Boipur.

The results of this study align with the findings of Chaudhari *et al*. (2021) who observed during the *Kharif* seasons of 2017 and 2018 showed that the disease incidence ranged from 1.49 per cent to 11.11 per cent. The mean disease severity index with the highest severity of 34.02 recorded in Jamalapada and the lowest of 2.34 in Mahudi during 2017. The mean disease severity index was 11.85, with Jamalapada showing the highest severity at 24.65 and Mahudi the lowest at 1.63 during 2018. The results have close concern with those reported by Raju *et al*. (2023), who observed a highest mean disease severity (36.61%) was observed in the Thanjavur district followed by the Trichy district (30.67%), least mean disease severity (29.08%) was observed in the Ariyaluru district. Masurkar *et al*. (2023) also reported that the per cent of infected tillers were seen highest (53.64%) in Varanasi followed by Dehradoon (53.15%). A minimum percentage infected tillers were observed in Kangra, and Faizabad with per cent infected tillers of 20.68% and 26.3%, respectively.

Table 1: Per cent infected panicles/sq m and per cent infected spikelets/panicle of false smut of rice in different rice growing districts of Gujarat.

Sr. No.	District	Taluka	Village	Per cent infected panicles/m^2			Per cent infected spikelets/panicle			GPS Coordinates	Cultivar/ Varieties
				Village	Taluka	District	Village	Taluka	District		
1.	Anand	Khambhat	Kalamsar	35.07	31.21	27.86	31.22	29.62	26.78	22.313057 72.744278	Moti Gold, Sriram-110, 125
2.			Kansari	27.36			28.02			22.313049 72.744276	Sriram-110, Sonam
3.		Anand	AAU Campus	24.03	24.51		22.55	23.93		22.52909 72.965285	Gurjari
4.			Hadgud	24.99			25.30			23.093682 73.018717	Moti Gold, GAR-13
5.	Kheda	Mahemdabad	Sansoli	30.22	21.08	17.61	29.95	21.58	18.84	22.777391 72.511587	Sri-101, Surya Moti, 6444
6.			Kanij	11.94			13.20			22.777416 72.511604	Moti Gold, Shriram-110
7.		Nadiad	Piplata	15.16	14.13		16.41	16.10		22.798497 72.572037	GAR-13, Gurjari, Sonam
8.			Vaso	13.11			15.78			22.673769 72.774006	Moti Gold, Sri-101
9.	Ahmedabad	Dholka	Ambaliyara	5.53	5.84	5.44	5.09	5.43	4.74	22.778036 72.510656	Surya Moti, Laxmi, GAR-13
10.			Chandisar	6.16			5.77			22.778031 72.510649	Surya Moti, Moti Gold, GAR-13
11.		Daskroi	Devdi	5.63	5.04		4.31	4.04		22.777759 72.512181	GAR-13, Sonam, Punjab
12.			Boipura	4.45			3.77			22.155848 73.431465	Moti Gold, Surya Moti

CONCLUSIONS

Disease incidence of false smut of rice was recorded across major rice-growing districts of Gujarat *viz*., Anand, Kheda, and Ahmedabad, revealed significant variability in the incidence of false smut of rice (*Ustilaginoidea virens*). Anand district recorded the highest disease incidence, both in terms of per cent infected panicles per sq meter (27.86%) and per cent infected spikelets per panicle (26.78%), followed by Kheda (17.61%, 18.84%) and the least incidence in Ahmedabad (5.44%, 4.74%). The widespread cultivation of cultivars such as Moti Gold, Sriram-110, and GAR-13, frequently grown in high-incidence areas. The study findings are consistent with past literature from different agro-ecological regions, confirming the increasing threat of false smut in rice-growing belts and the need for region-specific disease management approaches. Effective management of false smut can be accomplished through the adoption of appropriate cultural practices, cultivation of resistant varieties and timely application of fungicides. Identifying high-risk regions is crucial for implementing site-specific interventions aimed at minimizing disease incidence and enhancing crop productivity.

FUTURE SCOPE

The findings of this study will be highly useful in guiding future research and management strategies for false smut of rice in Gujarat. By identifying districts with varying levels of disease incidence, this baseline data can help prioritize high-risk areas for targeted surveillance and intervention. In the future, this study will aid in tracking disease progression over time, evaluating the effectiveness of control measures, and detecting shifts in disease patterns due to climate change or changes in cultivation practices. The identification of commonly affected cultivars can inform breeding programs focused on developing resistant varieties. Moreover, this data will support the development of region-specific integrated disease management plans, enhance predictive modelling efforts and guide policy decisions related to disease forecasting, extension services and resource allocation.

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Conflict of Interest. None.

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