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Assessing and mapping the severity of false smut of rice in different rice ecosystems of Karnataka

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Abstract
A roving survey was carried out during *Kharif* 2017 and 2018 in different rice growing ecosystems of Karnataka to assess the severity of false smut of rice. The results revealed that, the mean disease severity ranged from 4.15 to 19.26 per cent and 4.16 to 17.30 per cent during *Kharif* 2017 and 2018, respectively among different ecosystems. The maximum disease severity was recorded in coastal ecosystem (18.59% and 19.26%) followed by hilly upland ecosystem during *Kharif* 2017 and 2018. Among the different taluks surveyed in different rice ecosystem, Udupi taluk of coastal ecosystem recorded the maximum disease severity of 22.99 and 21.42 per cent, respectively during *Kharif* 2017 and 2018. Whereas the least disease severity was recorded by Siruguppa taluk (2.00%) of Tungabhadra and Upper Krishna project area during 2017 and Pandavapura taluk of irrigated Kaveri ecosystem in *Kharif* 2018. The present study clearly revealed the variability of false smut of rice in different ecosystems and different taluks of Karnataka with different degrees of disease severity. The present generated information would help to develop appropriate management strategies under different ecosystems to reduce the severity of false smut of rice.

Keywords: Rice, false smut, *Kharif*, ecosystems, disease severity

Introduction
False smut incited by *Ustilaginoidea virens* (Cooke) Takahashi, was first reported by Cooke (1878) from Tirunelveli district in TamilNadu and whose telomorphic stage was named as *Claviceps oryzae-sativae* (Hashioka, 1971) [4] that belongs to the class Ascomycetes. Recently, the telomorphic name has been rephrased into *Villosiclava virens* because the morphology and biology of sexual form of the false smut causing fungus is closer to *Villosiclava* spp., (Tanaka *et al*., 2008) [15] than the *Claviceps* spp.

False smut prevalent during *Kharif* season is gaining importance as a post flowering disease. The symptoms produced by *U. virens* become visible only after flowering and it occurs in the field at the hard dough to mature stages of the crop. A few spikelets in a panicle transform into globose, yellowish green and velvety spore balls that are two to five cm in diameter and covered by a thin orange membrane. The membrane bursts open and releases powdery spores which appear orange then become green, olive green and finally to greenish black (Atia, 2004) [2]. The grains adjacent to the smut balls may remain sterile and make panicle chaffy and causes yield loss (Ou, 1985; Lee and Gunnell 1992) [10, 6].

Rice cultivation is suffering from many fungal diseases including false smut. Earlier it was regarded as sporadic disease occurring in certain regions, but now the epidemics of disease are also being reported in different rice growing regions (Rush *et al.*, 2000; Singh and Pophaly, 2010 and Anon., 2016) [12, 13, 1]. In India, the disease has become most devastating in major rice growing states *viz*., Haryana, Punjab, Uttar Pradesh, Bihar, Uttarakhand, Jharkhand, Gujarat, Maharashtra, Jammu and Kashmir, West Bengal, Tamil Nadu, Karnataka, Andhra Pradesh and Puducherry (Dodan and Singh 1996 and Mandhare *et al.*, 2008) [7] and disease incidence of 10 to 20, 5 to 85 and 4.44 to 17.12 per cent has been reported from Punjab, Tamil Nadu and Karnataka respectively, on different rice cultivars (Ladhalakshmi *et al.*, 2012 and Muniraju *et al*., 2017a) [5, 9] and even in Karnataka, the false smut disease is becoming an emerging threat for rice cultivation.

A cursory perusal of the literature revealed that research on false smut has been negligible in India because of its minor importance and partly due to a problem in the artificial culturing and inoculation of the pathogen. Though, previous studies revealed the incidence of disease in different rice growing regions and ecosystems of the state, but the present investigation would further support the information on extent of disease severity under different ecosystem, cultivars grown and their role in disease severity and elicits the idea of conducive ecological situations necessary for disease severity, which facilitates us to develop appropriate disease

management strategies. In the present work, we report the occurrence and intensity of false smut disease in farmers' fields of different rice growing ecosystems of Karnataka to find out the significance of disease.

Material and Methods

A random roving survey on the severity of false smut of rice was undertaken during *Kharif* 2017 and 2018 in different rice growing ecosystems of Karnataka such as irrigated and direct seeded rice (DSR) ecosystems of Tunga-Bhadra project (TBP) and Upper-Krishna project command area (UKP), hilly upland, irrigated Bhadra, irrigated Kaveri and coastal ecosystems. Each ecosystem consisting of different districts and taluk and in each taluk, three to four villages were covered and in each village three farmer's fields were selected randomly from both sides of the path. In each field, three random plots of 1 m^2 were selected on different rice varieties and observations on number of infected tillers per m^2 and number of smut balls per infected panicle was recorded. Detailed information of surveyed places is as below (Table 1and 3).

The following formulae were used to calculate the per cent infected tillers; per cent smutted grains and disease severity.

a) Per cent infected tillers and per cent smutted grains (Mandhare *et al*., 2008) [7]

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

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

b) Disease severity (Singh and Dube, 1978) [14]

Disease severity (%) = Per cent infected tillers x Per cent infected grains.

Results and Discussion

A survey on the severity of false smut of rice in different ecosystems of Karnataka during *Kharif* 2017 and 2018 revealed that the disease severity varied widely in different ecosystems and also the intensity of disease varied depending on the cultivars. During 2017, the maximum disease severity was recorded in coastal ecosystem with the severity ranged from 2.19 to 26.99 per cent (Table 1). Among the villages surveyed in coastal ecosystem, the maximum disease severity was noticed in Agradahalli village of Brahmavara taluk followed by Andaru (25.19%) village of Karkala taluk, whereas the least disease severity was recorded in Charitharu village (2.19%) of Brahmavara taluk. This was followed by irrigated Bhadra ecosystem, which recorded the disease severity ranging from 3.34 to 26.71 per cent. The next higher disease severity was recorded in hilly upland ecosystem with the disease severity ranging from 5.50 to 19.12 per cent. The Holtikoti village of Dharwad taluk in hilly upland ecosystem recorded highest disease severity of 19.12 per cent and which was followed by Ponnampet with 17.76 per cent and the least disease severity was recorded in Boppanahalli village (5.50%) of Sirsi taluk. Among the different ecosystems surveyed, the lease disease severity was recorded by irrigated and direct seeded TBP and UKP and irrigated Kaveri ecosystems with a range of 1.95 to 14.68 per cent and 2.41 to 8.64 per cent, respectively. The villages surveyed in the TBP and UKP ecosystem revealed the maximum disease severity in ARS, Gangavathi with 14.68 per cent and least was recorded by Devlapur village of Hospet taluk. In Kaveri rice belt, the maximum disease severity (2.41%) was recorded by Devarahalli village of Maddur taluk. The mean disease severity in the surveyed taluks ranged from 3.95 to 18.59 per cent and the maximum disease severity was recorded in Udupi taluk with 22.99 per cent, followed by Karkala taluk (21.65%), whereas the least disease severity was recorded in Siruguppa taluk with 2.00 per cent (Table 2).

The survey carried out in *Kharif* 2018 revealed the mean maximum disease severity of 17.30 per cent in the coastal ecosystem (Table 3). Among the different villages surveyed, the Shirlal recorded the maximum disease severity of 23.05 per cent followed by Kukkehalli village (21.32%). The least disease severity was recorded by Chanthar village (2.35%). The next higher mean disease severity was recorded by hilly upland ecosystem with 11.70 per cent. The Honnapur village of hilly upland ecosystem recorded the maximum disease severity of 19.12 per cent, whereas the least was recorded by Shirgod village of Sirsi taluk. The irrigated Bhadra ecosystem recorded the disease severity ranged from 3.59 to 24.01 per cent and highest was recorded in Shiralal village (23.05%). The surveyed villages of TBP and UKP ecosystems recorded the disease severity ranged from 1.90 to 13.86 per cent and the maximum severity was noticed in Diggi village (13.86%) of Shahpur taluk. Among the surveyed ecosystems, the least mean disease severity was recorded in irrigated Kaveri ecosystem (4.16%). Where, Rampur village of Maddur taluk recorded the maximum disease severity of 8.50 per cent and least by Bydarahalli village of Maddur taluk. The mean disease severity in the surveyed taluks ranged from 3.89 to 17.04 per cent and the maximum severity was recorded in Udupi taluk (21.42%) followed by Karkala taluk (20.38%) and the least disease severity was recorded in Pandavapura taluk (2.10 per cent) (Table 4).

Table 1: Assessment of false smut disease parameters in different rice ecosystems of Karnataka during *Kharif* 2017

Sl. No.	Ecosystem	Taluk	Village	No. of fields surveyed	Type of cultivation	Variety	Infected tillers (%)	Infected grains (%)	Disease Severity (%)
1	Irrigated & DSR ecosystems of TBP and UKP command	Raichur	Burdipad	3	Transplanted	BPT 5204	2.08	2.81	5.84
			Yapaldinni	4	Transplanted	RNR 15048	2.50	2.02	5.05
			Kasabe camp	3	DSR	BPT 5204	2.42	2.22	5.37
			Chandrabanda	3	Transplanted	RNR 15048	3.47	2.82	9.79
		Sindhanur	Gorlati	3	DSR	BPT 5204	2.80	1.88	5.26
			Hanumapur	3	Transplanted	BPT 5204	3.70	2.54	9.40
		Manvi	Neermanvi	3	Transplanted	BPT 5204	2.62	3.06	8.02
			Mustoor	3	Transplanted	BPT 5204	2.99	3.38	10.11
		Gangavathi	Siddapur	3	Transplanted	GNV-05-01	2.18	1.92	4.19
			ARS, Gangavathi	3	Transplanted	GVT 6201	3.52	4.17	14.68
			Vaddarahatti	3	Transplanted	BPT 5204	2.23	2.69	6.00

			Uddihal	3	Transplanted	Kaveri sona	2.33	1.97	4.59
			Ulenoor	3	Transplanted	Nellur sona	3.10	3.26	10.11
		Siruguppa	Boggur	3	Transplanted	BPT 5204	1.00	1.97	1.97
			Malapur	3	Transplanted	BPT 5204	1.11	1.82	2.02
		Hospet	Devalapur	3	Transplanted	BPT 5204	1.51	1.29	1.95
			Jeeriganur	3	Transplanted	BPT 5204	2.06	2.10	4.33
		Shahpur	Doranahalli	3	Transplanted	BPT 5204	3.52	4.06	14.29
			Gonal	3	Transplanted	BPT 5205	2.32	1.00	2.32
						Mean	2.50	2.47	6.59
2	Hilly upland	Sirsi	Bommanahalli	3	Transplanted	Jaya	2.81	3.81	10.71
			Boppanahalli	3	Transplanted	Abhilash	2.58	2.13	5.50
		Dharwad	Kalakeri	3	Transplanted	Thanu	2.17	3.81	8.27
			Holtikoti	3	Transplanted	Jaya	4.72	4.05	19.12
		Virajpet	Ponnampet	3	Transplanted	KPR-1	4.31	4.12	17.76
						Mean	3.32	3.58	12.27
3	Irrigated Bhadra	Tarikere	Bargenahalli	3	Transplanted	Jaya	2.42	2.79	6.75
			Basavapur	3	Transplanted	Jaya	2.58	2.00	5.16
		Shivamogga	Kumsi	3	Transplanted	MTU 1010	2.44	4.81	11.74
			Kudli	3	Transplanted	BPT 5204	2.95	2.21	6.52
		Channagiri	Rudrapura	3	Transplanted	Jaya	1.84	5.12	9.42
			Somlapur	3	Transplanted	BPT 5204	3.61	7.40	26.71
		Davanagere	Hulikatte	3	Transplanted	Kaveri sona	2.86	2.93	8.38
			Jarikatte	3	Transplanted	Kaveri sona	2.20	4.33	9.53
		Harihara	Hulaginahole	3	Transplanted	Sonal	3.19	2.24	7.15
			Malebennur	3	Transplanted	Sriram sona	2.95	2.67	7.88
			Ditur	3	Transplanted	RNR 15048	4.00	4.76	19.04
		Harapanahalli	Nittur	3	Transplanted	JGL1798	2.66	3.80	10.11
		Bhadravati	Agasanahalli	3	Transplanted	JGL1798	1.39	2.40	3.34
			Holehonnur	3	Transplanted	Super Aman	2.20	2.00	4.40
						Mean	2.66	3.53	9.72
4	Irrigated Kaveri	Mandya	VC Farm	3	Transplanted	Thellhamsa	1.02	2.65	2.70
			Sowdenahalli	3	Transplanted	Thanu	0.82	3.03	2.48
		Maddur	Gejjalagere	3	Transplanted	MTU1001	1.73	5.00	8.65
			Maddur	3	Transplanted	MTU 1001	1.80	3.71	6.68
		Pandavapura	Devarahalli	3	Transplanted	Jaya	1.93	1.25	2.41
		Malavalli	Banasamudra	3	Transplanted	MTU 1001	1.52	1.71	2.60
			Byadarahalli	3	Transplanted	MTU 1001	1.82	1.94	3.53
						Mean	1.52	2.76	4.15
5	Coastal	Brahmavara	Agradahalli	3	Transplanted	MO-21	4.27	6.32	26.99
			Charitharu	3	Transplanted	Irga	1.19	1.84	2.19
		Udupi	Varamballi	3	Transplanted	Champaka	2.07	10.36	21.45
			Anjaru	3	Transplanted	Jaya	3.18	7.12	22.64
		Karkala	Andaru	3	Transplanted	Narmage	4.38	5.75	25.19
			Jarkal	3	Transplanted	Irga	2.47	6.91	17.07
						Mean	2.92	6.38	19.26

Table 2: Taluk-wise overview of false smut parameters in Karnataka during *Kharif* 2017

Sl. No.	Ecosystem	Taluk	Infected tillers (%)	Infected grains (%)	Disease Severity (%)
1	Irrigated and DSR ecosystems of TBP and UKP command	Raichur	2.62	2.47	6.47
		Sindhanur	3.25	2.21	7.18
		Manvi	2.80	3.22	9.02
		Ganagavathi	2.62	2.51	6.58
		Siruguppa	1.06	1.89	2.00
		Hospet	1.78	1.69	3.01
		Shahpur	2.92	2.53	7.39
		Mean	2.44	2.36	5.95
2	Hilly upland	Sirsi	2.7	2.97	8.02
		Dharwad	3.44	3.93	13.52
		Virajpet	4.31	4.12	17.76
		Mean	3.48	3.67	13.10
3	Irrigated Bhadra	Tarikere	2.50	2.40	6.00
		Shivamogga	2.69	3.51	9.44
		Channagiri	2.73	6.26	17.09
		Davanagere	2.53	3.63	9.18
		Harihara	3.38	3.22	10.88
		Harapanahalli	2.66	3.80	10.11
		Bhadravati	1.80	2.20	3.96

		Mean	2.61	3.57	9.52
4	Irrigated Kaveri	Mandya	0.92	2.84	2.61
		Maddur	1.77	4.36	7.72
		Pandavapura	1.93	1.25	2.41
		Malavalli	1.67	1.83	3.06
		Mean	1.57	2.57	3.95
5	Coastal	Brahmavara	2.73	4.08	11.14
		Udupi	2.63	8.74	22.99
		Karkala	3.42	6.33	21.65
		Mean	2.93	6.38	18.59

Table 3: Assessment of false smut disease parameters in different rice ecosystems of Karnataka during *Kharif* 2018

Sl. No.	Ecosystem	Taluk	Villages	No. of fields	Type of cultivation	Variety	Infected tillers (%)	Infected grains (%)	Disease Severity (%)
1	Irrigated & DSR ecosystems of TBP and UKP command	Raichur	Appandoddi	3	Transplanted	BPT 5204	1.70	2.90	4.93
			Ganmur	3	Transplanted	BPT 5204	2.37	2.03	4.81
			Matmari	3	DSR	BPT 5204	2.16	2.67	5.77
			Singodi	3	Transplanted	Gangavathi sona	3.65	2.61	9.53
		Sindhanur	Bassapur	3	Transplanted	BPT 5204	2.60	1.74	4.52
			Jalihal	3	Transplanted	BPT 5204	2.80	3.33	9.32
		Manvi	Bettadur	3	Transplanted	GNV-05-01	2.75	3.08	8.47
			Buddini	3	Transplanted	BPT 5204	3.23	2.50	8.08
		Ganagavathi	Gunduru	3	Transplanted	GNV-05-01	2.29	2.06	4.72
			Gonal	3	Transplanted	BPT 5204	2.53	2.71	6.86
			Basavapatna	3	Transplanted	BPT 5204	2.31	2.61	6.03
			Hiribenkal	3	Transplanted	BPT 5204	2.27	1.88	4.27
			Manur	3	Transplanted	Kaveri sona	2.72	2.29	6.23
		Siruguppa	Desanur	3	Transplanted	BPT 5204	1.10	2.77	3.05
			Ibrampur	3	Transplanted	BPT 5204	1.14	1.74	1.98
		Hospet	Upparahalli	3	Transplanted	Nellur sona	1.52	1.25	1.90
			Gonahal	3	Transplanted	BPT 5204	2.04	1.94	3.96
		Shahpur	Diggi	3	Transplanted	BPT 5204	3.27	4.24	13.86
			Badiyal	3	Transplanted	BPT 5204	2.32	1.54	3.57
						Mean	2.36	2.42	5.88
2	Hilly upland	Sirsi	Tilvalli	3	Transplanted	Thanu	2.73	3.40	9.28
			Shirgod	3	Transplanted	Jaya	2.81	2.50	7.03
		Dharwad	Kyarakoppa	3	Transplanted	Jaya	2.10	4.10	8.61
			Honnapur	3	Transplanted	Jaya	4.72	4.05	19.12
		Virajpet	Begur	3	Transplanted	Jaya	4.21	3.44	14.48
						Mean	3.31	3.50	11.70
3	Irrigated Bhadra	Tarikere	Chakonahalli	3	Transplanted	Jaya	2.59	2.86	7.41
			Baggavalli	3	Transplanted	Jaya	2.58	2.00	5.16
		Shivamogga	Ayanur	3	Transplanted	BPT 5204	2.67	5.56	14.85
			Suguru	3	Transplanted	MTU 1001	3.01	2.31	6.95
		Channagiri	Chikkulikere	3	Transplanted	JGL1798	1.78	4.83	8.60
			Kunchuru	3	Transplanted	BPT 5204	3.33	7.21	24.01
		Davanagere	Halekal	3	Transplanted	Sonal	2.86	2.75	7.87
			Mudahadadi	3	Transplanted	Kaveri sona	2.29	3.44	7.88
		Harihara	Halasabalu	3	Transplanted	Kaveri sona	3.33	2.32	7.73
			Malebannur	3	Transplanted	RNR 15048	2.92	2.00	5.84
			Kadathi	3	Transplanted	Sriram sona	4.23	4.76	20.13
		Harapanahalli	Rajanahalli	3	Transplanted	JGL1798	2.80	2.96	8.29
		Bhadravati	Katikere	3	Transplanted	Jaya	1.47	2.44	3.59
			Holehonnur	3	Transplanted	Aman	2.12	2.19	4.64
						Mean	2.71	3.40	9.50
4	Irrigated Kaveri	Mandya	Hale budanur	3	Transplanted	Thellhamsa	1.06	2.81	2.98
			Siddegowdanadoddi	3	Transplanted	MTU1001	0.78	3.10	2.42
		Maddur	Rampura	3	Transplanted	MTU1001	1.70	5.00	8.50
			Somanahalli	3	Transplanted	JGL1798	1.60	3.71	5.94
		Pandavapura	Byadarahalli	3	Transplanted	Jaya	1.64	1.28	2.10
		Malavalli	Hadli	3	Transplanted	MTU 1001	1.56	1.88	2.93
			Agasanapura	3	Transplanted	MTU 1001	1.95	2.19	4.27
						Mean	1.47	2.85	4.16
5	Coastal	Brahmavara	Haradi	3	Transplanted	MO-21	4.17	5.00	20.85
			Chanthar	3	Transplanted	MO-21	1.21	1.94	2.35
		Udupi	Handadi	3	Transplanted	Jyoti	2.11	9.29	19.60
			Kukkehalli	3	Transplanted	Jaya	3.39	6.29	21.32

		Karkala	Shirlala	3	Transplanted	Narmage	4.61	5.00	23.05
			Kukundoor	3	Transplanted	Jaya	2.68	6.19	16.59
						Mean	3.03	5.62	17.30

Table 4: Taluk-wise overview of false smut parameters in Karnataka during *Kharif* 2018

Sl. No.	Ecosystem	Taluk	Infected tillers (%)	Infected grains (%)	Disease Severity (%)
1	Irrigated & DSR ecosystems of TBP and UKP command	Raichur	2.47	2.55	6.30
		Sindhanur	2.70	2.54	6.86
		Manvi	2.99	2.79	8.34
		Ganagavathi	2.42	2.31	5.59
		Siruguppa	1.12	2.25	2.52
		Hospet	1.78	1.6	2.85
		Shahpur	2.79	2.89	8.06
		Mean	2.32	2.42	5.79
2	Hilly upland	Sirsi	2.77	2.95	8.17
		Dharwad	3.41	4.08	13.91
		Virajpet	4.21	3.44	14.48
		Mean	3.46	3.49	12.19
3	Irrigated Bhadra	Tarikere	2.58	2.43	6.27
		Shivamogga	2.84	3.93	11.16
		Channagiri	2.56	6.02	15.41
		Davanagere	2.57	3.1	7.97
		Harihara	3.49	3.03	10.57
		Harapanahalli	2.80	2.96	8.29
		Bhadravati	1.79	2.31	4.13
		Mean	2.66	3.40	9.11
4	Irrigated Kaveri	Mandya	0.92	2.96	2.72
		Maddur	1.65	4.36	7.19
		Pandavapura	1.64	1.28	2.10
		Malavalli	1.75	2.03	3.55
		Mean	1.49	2.66	3.89
5	Coastal	Brahmavara	2.69	3.47	9.33
		Udupi	2.75	7.79	21.42
		Karkala	3.64	5.60	20.38
		Mean	3.03	5.62	17.04

The overall inference of the survey executed during *Kharif* 2017 and 2018 in rice growing ecosystems of Karnataka revealed that (Fig. 1), the mean maximum severity of false smut of rice was recorded in coastal ecosystem with 18.59 and 17.04 per cent, during *Kharif* 2017 and 2018, respectively. This was followed by hilly upland ecosystem with 13.10 and 12.19 per cent and irrigated Bhadra ecosystem with 9.52 and 9.11 per cent, respectively. The disease severity of 5.95 and 5.79 per cent was noticed in irrigated and transplanted Tunga-Bhadra rice ecosystem. The least false smut severity was observed in the Irrigated Kaveri ecosystem with 3.95 and 3.89 per cent, respectively.

Among the ecosystems surveyed, the coastal ecosystem comprising Brahmavara, Udupi and Karkala taluks recorded notable disease severity of 18.59 and 17.04 per cent, respectively during *Kharif* 2017 and 2018. The increased disease severity could be credited to mean maximum temperature existed during flowering; intermittent rainfall throughout the cropping season and high humidity that might be favouring the higher disease severity. The cultivation of high yielding and bold seeded varieties like MO-21, Jaya and Narmage by the farmers, congenial weather conditions and admixtures of stored seeds and their usage in the next season for sowing might be contributed for maximum disease severity. The disease was found to be more severe at coastal ecosystem compared to other ecosystems, because the rice growing tracts of coastal ecosystems are low lying areas and receive annual rainfall ranging from 3010.9 to 4694.4 mm resulting in more disease severity. The findings are in agreement with the work carried out by Mouton and Merny (1959) [8], who reported that the incidence by *U. virens* was always greater in the lowlands than at higher altitudes. The disease was found to be more severe in medium duration varieties like Narmage, Irga, MO-21 and Jyothi which was more prevalent and recurring in fields having continuous cultivation of this variety. Ahonsi *et al.* (2000) reported that the continued cultivation of susceptible varieties leads to a build-up of the disease inoculum in the field. Rao (1964) [11] observed that rice varieties of medium duration were most affected by false smut, while those of shorter and longer duration were comparatively less affected and he attributed the higher disease incidence to higher relative humidity existed during flowering period of medium duration varieties. Ladhalakshmi *et al.* (2012) [5] reported that false smut disease had been observed in severe form since 2001 in India due to widespread cultivation of high fertilizer-responsive cultivars and hybrids. Fujita *et al.* (1989) reviewed that variation in the disease assessment between different districts as well as between seasons might be referred to one or more of various environmental factors including relative humidity, duration of plant wetness, temperature, cultivars and differences in sowing dates, soil type, diversified agricultural practices, pathogen virulence and host resistance. The results of the survey conducted by Ladhalakshmi *et al.* (2012) [5] implied that false smut disease is emerging as one of the major diseases of rice in India and the infected tillers were found to vary between 2 and 85 per cent in both the Northern and Southern parts of India.

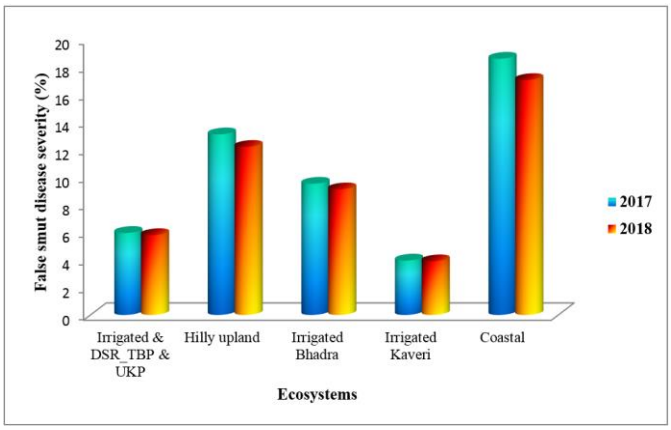

Fig 1: Severity of false smut of rice in different ecosystems during *Kharif* 2017 and 2018

Conclusion

The present study clearly revealed that false smut of rice showed variability in different ecosystems and different taluks of Karnataka with different degrees of disease severity. This could be due to the significant differences in mean temperature (31.5 to 27.3 ℃), mean rainfall and mean relative humidity, which might have influenced the per cent occurrence of false smut in different regions of Karnataka. The higher severity in Udupi taluk might be attributed to high relative humidity that prevailed during booting and flowering stages. The high rainfall and humidity are more critical as it may predispose the crop for the infection by false smut fungus. Therefore, it is concluded that cultivation of susceptible cultivars, heavy doses of nitrogenous fertilizer, mono cropping and favourable weather conditions are essential for higher false smut disease severity.

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