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Integrated management of false smut disease in rice under rice: Wheat cropping system

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Abstract

False smut of rice produced by *Ustilaginoidea virens* (Cooke) Takahshi (Perfect state *Villosiclava virens*) is an emerging disease, decreases both quality and quantity of Rice crop. The symptoms of false smut diseases are observable after panicle initiation of rice crop. Infected individual grains converted into greenish spore ball of a velvety appearance; the surface of infected grains covered by a powdery dark green chlamydo spores once matured. The present study is mainly adhered to evaluate prevailing integrated management modules elsewhere with suitable adjustments efficacious management of false smut.

The results revealed that all treatments were significantly superior over the Control (T₀). The treatments four (T₃: Seed treatment with Vitavax Power (Carboxin + Thiram) @ 3 g/kg seed + spilt dose of nitrogen + two foliar sprays of Propiconazole- 25 SC @ 1.0 ml/lit. of water at tillering and 50% panicle emergence was found utmost effective in dropping False smut disease incidence (74.77%), increasing yield (32.03%), net return (Rs. 16269.15) and cost –benefit ratio (0.21) followed by T₂ (Seed treatment with Tebuconazole- 2 DS @ 1 g/kg seed + spilt dose of nitrogen + one foliar spray of Trifloxystrobin-25% + Tebuconazole- 50% @ 0.4 g/lit. of water at tillering. Hence T₄ may be recommended for sustainable management of rice false smut.

Keywords: IDMs, rice and false smut

Introduction

Rice (*Oryza sativa* L.) is amongst the richest cereal crop covering nearly 63% of total land mass of grain produced in India, ranked second only to China being consumer and producer globally. Nearly 46.38-million-hectare area in India is dedicatedly used for growing rice with an estimated 130.29 million tons of production with around 2809 kg/ha yield (Anonymous, 2023) [2]. In Madhya Pradesh alone, the production and productivity are estimated at around 2.016 lakh ha., 48149.0 m tones and 2085 kg/ha (Anonymous, 2022) [3]. If the crop is not damaged by pests and diseases, the actual yield for farmers would be higher than potential yield. False Smut, a disease among many other caused by *Ustilaginoidea virens* (Cooke) threatens both the quality and quantity of rice yield. At the beginning, it didn't affect the yield as the loss was minimal, and eventually now the severity of it has emerged as one of the major hindrance in high rice crop production. False Smut of Rice was first recounted in Tamilnadu's Thirunelveli district in India by Cooke in 1878 and is majorly causing approximately 49 percent yield losses in country's many different states (Singh and Panwar, 1992) [13]. Agarwal and Verma in 1978 [1] reported that alone in Madhya Pradesh, the yield loss might be up to 75.4 percent. The disease also causes grain quality reduction and mycotoxin production by pathogen which is poisonous to human beings and livestock's (Koiso *et al.*, 1998) [7].

The symptoms of false smut diseases are visible after panicle initiation of rice crop. Infected individual grains converted into greenish spore ball as velvety, surface of infected grains covered in dark green chlamydo spores resembling as powder substance at maturity (Ou, 1972) [9].

In Madhya Pradesh, where Kymore Plateau and Satpura Hills Agroclimatic Zone is inhabited, hybrid rice varieties gain popularity among the farmers due to its higher yield. False Smut disease affects hybrid rice mostly and rice crop yields are affected badly within the multi irrigated ecosystem by high fertility levels (Hosagoudar, 2018) [6].

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As the above-mentioned Agroclimatic Zone area is expanded regularly, where the farmers almost depend on this crop during kharif season, there is an urgent need to address these emerging problems. Very less information's are available on management aspect of false smut disease.

At Krishi Vigyan Kendra Singrauli, Madhya Pradesh, a few farmers participated for a trial run with views that would assess the specific location for a more robust integrated approach to combat the false smut disease for two consecutive periods i.e. 2019-2020.

Materials and Methods

An On Farm Trials (OFTs) conducted by Krishi Vigyan Kendra Singrauli, on integrated False smut management technology in rice at two village farm fields of Chitarwai Kalan and Chachad near Singrauli district during kharif 2019 and 2020. The

outcome we expected was to find effective in tegrated disease management modules, against false smut of Rice under the OFT programme of KVK. The trials were completely random in certain block designs having four treatments which include farmer practice control and maintaining at least 5 replications. The experimental field was ploughed thrice using cultivator then followed by planking to get fine tilt and smooth surface. 30 days before sowing, a recommended dose of FYM (1 t/ha) was mixed in soil with fertilizers (120:60:40 kg NPK/ha) was applied at the time of sowing. After 20 days after transplanting (DAT), weed management with Bispyribac-sodium 10% EC @ 250 ml/ha was applied. To prevent any effect that could arise of cultivar variability high yielding area, suitable hybrid Rice variety US-312 was subjected to this trial. Field size was 500 sqm, spacing dimensions with 30 X 15 cm and the transplanting in trial was conducted in second week of July every year.

Table 1: Different Integrated Disease Management Modules (IDMs) for False Smut Management in Rice

S. No.	Treatments	Details
01	T ₀ :-	Control
02	T ₁ :	One spray of Carbendazime -50 WP @ 0.05% after spore ball formation
03	T ₂ :	Seed treatment with Tebuconazole- 2 DS @ 1 g/kg seed + spilt dose of nitrogen + one foliar spray of Trifloxystrobin-25% + Tebuconazole- 50% @ 0.4 g/lit. of water at tillering .
04	T ₃ :	Seed treatment with Vitavax Power (Carboxin-37.5% + Thiram-37.5%) -75 WP @ 3 g/kg seed + spilt dose of nitrogen + two foliar spray of Propiconazole- 25 SC @ 1.0 ml/lit. of water at tillering and 50% panicle emergence

Recorded percent infected panicles per plant for calculated the percent of infected panicles, counted the total number of panicles and number of infected panicles in randomly selected each of the three sampling units of 1 sq m per plot.

Estimation of Cost-Benefit Ratio

The grain yield taken from whole population was of each plot distinctly and yield of each trial was considered by accumulating the successive plucking from respective fields with kilogram per hectare. The data were orderly tabulated, then pooled, and based on their yield performance are ranked. For different modules, the benefit cost ratio (CBR) was calculated as an estimation with different cost of cultivation, yield return after and calculated for one hectare land. Assuming the average market price at rupees 20/- per kg of Rice during experimental period and also cost benefit ratio was calculated.

Results and Discussion

Results are presented in Table-2 and clearly indicated that the False smut disease incidence was significantly reduced in T₂ & T₃ treatment over control (T₀). The minimum average False smut infected panicles (10.05-11.15%) that to consistently for two years of trials which are recorded in T₄. On comparing the disease reduction potential for different treatments tested, it could be stated that the treatment combination-3(T₃) can reduce disease incidence to attuning at average of 74.77% for two consecutive years. As mentioned here in treatments details in the materials and method, the T₃ had Seed treatment with Vitavax Power (Carboxin-37.5% + Thiram-37.5%) -75 WP @ 3 g/kg seed + spilt dose of nitrogen + two foliar spray of Propiconazole- 25 SC @ 1.0 ml/lit. of water at tillering and 50% panicle emergence was superior for management of false smut of rice. The next finest collection of treatments was T₂ and seed treatment with Tebuconazole- 2 DS @ 1 g/kg seed + spilt dose of nitrogen + one foliar spray of Trifloxystrobin-25% + Tebuconazole- 50% @ 0.4 g/lit. of water at tillering having disease incidence of barely 18.0 to 18.90%. The last treatment i.e. T₁ has only one spray of Carbendazime -50 WP @ 0.05%

after spore ball formation have disease incidence was 38.50 to 39.10 percent. Similarly, Raji *et al.* (2016) [10] reports that Propiconazole 25 EC (0.1%) was the recorded lowest disease severity than any other treatments, followed by Trifloxystrobin + Tebuconazole 75 WG. This surely was when it got sprayed at booting or 50% panicle emergence. The Present findings are also corroborated with Mohiddin *et al.*, 2012 [8] and Zhang *et al.*, 2014 [15] whose reports state that nitrogenous fertilizer have increased disease incidence heavily when applicable to with high fertilizer responsive cultivars and hybrids. Brooks *et al.*, 2009 [4] advocates that using moderate nitrogenous, fertility rates reduce false smut disease incidence in vulnerable cultivars. The soil saturating of Trichoderma @ 5.0 Kg/ha with 100 kg FYM (Before transplanting), Seed treatment with Vitavax @ 2.5 gm/kg (During nursery sowing) & two sprays of Tebuconazole 25 EC @ 1.0 ml/lit (During vegetative phase & before panicle initiation) were most effective modules that could be used for management of False Smut of rice (Verma *et al.*, 2020) [14]. The highest loss deduction averaging of two years due to diseases with module-3 was 32.03%.

A Compression with grain yield attained from each plot was found for Seed treatment with Vitavax Power (Carboxin-37.5% + Thiram-37.5%) -75 WP @ 3 g/kg seed + spilt dose of nitrogen + two foliar spray of Propiconazole- 25 SC @ 1.0 ml/lit. of water at tillering and 50% panicle emergence gave highest grain yield (43.34 qt./ha) of Rice which was followed by seed treatment with Tebuconazole- 2 DS @ 1 g/kg seed + spilt dose of nitrogen + one foliar spray of Trifloxystrobin-25% + Tebuconazole- 50% @ 0.4 g/lit. of water at tillering (40.56 qt./ha) as against yield (32.90 qt./ha) obtained in untreated control (T₀). These findings are conformity with the observations of Raji *et al.* (2016) [10]; Singh *et al.* (2019) [11] and Singh *et al.* (2020) [12].

The financial side was also considered once the experimentation based on the expenditure was incurred for different treatments under trial were completed. The income data accumulated from the Rice yield is represented in Table 3. On economical comparison of all treatments, maximum net returns obtained

from T₃ of Rs. 42067.7 to 44969.0/ha, followed by T₂ (Rs. 38280.9 to 39924.0/ha) marking a significantly higher growth than the typical practice done by the farmers in the area. Highest benefit–cost ratio 2.00:1 and to 2.07:1 was recorded in the year 2020-21 and 2021-22, respectively in the T₃ which was followed by T₂ with 1.96:1 and 1.95:1 in 2020-21 and 2021-22. The lowest number among these benefit – cost ratio is 1.80:1 and 1.85:1 in cropping season were recorded in control plot (T₀). The

results are in-sync with the conclusions drawn by Singh *et al.* (2019)^[11] and Singh *et al.* (2020)^[12].

Hence, observing the disease control potential scenarios, grain yield gain, maximum protection and disease losses, the net return with favorable benefit cost ratio, and importantly the crop sustainability, the T₄, is the recommended approach to manage false smut of Rice.

Table 2: Effect of Different Integrated Disease Management Modules (IDMs) on False Smut Disease Incidence and Yield in Rice

Details of technology	Yield (qt./ha)			Increase in Yield (%) over farmers Practice			Disease Incidence (%)			Reduction in Disease incidence (%) over farmers practice		
	2020-21	2021	Pooled	2020	2021	Pooled	2020	2021	Pooled	2020	2021	Pooled
T ₀	32.81	33.00	32.905	-	-	-	42.15	41.90	42.025	-	-	-
T ₁	33.86	34.90	34.38	0.3.20	05.75	5.75	39.1 0	38.50	38.5	07.20	08.11	7.655
T ₂	40.19	40.94	40.565	24.89	24.06	24.475	18.90	18.00	18.45	55.16	57.04	56.1
T ₃	43.20	43.49	43.345	32.28	31.78	32.03	11.15	10.05	10.6	73.54	76.01	74.775
CD at 0.05	3.15	4.57	3.97	NA	NA	NA	9.17	7.38	7.49	NA	NA	NA

Note: NA= Not analyzed

Table 3: Economic of different IDM modules of False Smut management practice in Rice

Details of technology	Cost of cultivation (Rs./ha)			Average Gross Return (Rs/ha)			Average Net Return (Rs/ha)			B:C ratio		
	2020	2021	Pooled	2020	2021	Pooled	2020	2021	Pooled	2020	2021	Pooled
T ₀	34652.5	35627.5	35140.0	62429.2	66000.0	64214.6	27776.7	30372.5	29074.6	1.80	1.85	1.83
T ₁	35187.5	37148.5	36168.0	65688.4	69800.0	67744.2	30500.9	32651.5	31576.2	1.87	1.88	1.87
T ₂	39687.5	41956.0	40821.7	77968.4	81880.0	79924.2	38280.9	39924.0	39102.5	1.96	1.95	1.95
T ₃	41740.3	42011.0	41875.6	83808.0	86980.0	85394.0	42067.7	44969.0	43518.4	2.00	2.07	2.04

Conclusion

The investigations results presented herein illustrates that disease control potential scenarios, grain yield gain, maximum protection and disease losses, the net return with favorable benefit cost ratio, and importantly the crop sustainability, the module T₃ (Seed treatment with Vitavax Power (Carboxin-37.5% + Thiram-37.5%) -75 WP @ 3 g/kg seed + spilt dose of nitrogen + two foliar spray of Propiconazole- 25 SC @ 1.0 ml/lit. of water at tillering and 50% panicle emergence) would be the recommended approach to manage false smut of Rice.

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