Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

**E-ISSN:** 2278-4136
**P-ISSN:** 2349-8234
JPP 2018; 7(6): 1870-1874
Received: 13-09-2018
Accepted: 14-10-2018

**Hosagoudar GN**
Junior Rice Pathologist, AICRIP on Rice, Agricultural and Horticultural Research Station, Ponnampet, Kodagu, Karnataka, India

**Correspondence**
**Hosagoudar GN**
Junior Rice Pathologist, AICRIP on Rice, Agricultural and Horticultural Research Station, Ponnampet, Kodagu, Karnataka, India

# Evaluation of fungicides for the management of false smut of paddy

## Hosagoudar GN

**Abstract**
Rice. (*Oryza sativa* L.) Is the most extensively cultivated food crop of the Asia and forms a major part of nourishment for half of the world's population. An experiment was conducted during *Kharif* 2013 and 2014 to know the impact of three chemical sprays were given for different stages of the crop at Booting stage, 50% flowering stage and 100% flowering stage included the ten treatments. Among ten treatments, a spray of Trifloxystrobin 25% + Tebuconazole 50% (Nativo 75 WG) @ 0.4gm/lt at 100% panicle emergence was highly effective in the management of false smut disease with least pooled data of infected spikelets/panicles (4.45%), which was followed by Kresoxim methyl (Ergon 44.3 SC) @ 1ml/lt at 100% panicle emergence (5.84%) respectively. In terms of Infected panicles/sq mt, the treatment with a spray of Trifloxystrobin 25% + Tebuconazole 50% (Nativo 75 WG) @ 0.4gm/lt at 100% panicle emergence was highly effective in the management of false smut disease with least pooled data of infected panicles/sqmt (2.63%), which was followed by Kresoxim methyl (Ergon 44.3 SC) @ 1ml/lt at 100% panicle emergence (3.88%) respectively, the grain yield obtained from each plot it was found that a spray of Trifloxystrobin 25% + Tebuconazole 50% (Nativo 75 WG) @ 0.4gm/lt at 100% panicle emergence gave the highest grain yield of 5077.08 kg/ha which was followed by the Kresoxim methyl (Ergon 44.3 SC) @ 1ml/lt at 100% panicle emergence (4943.75 kg/ha).
However, when cost benefit ratio was calculated, Propiconazole 25EC (Tilt) @ 1ml/lt at 100% panicle emergence (27.07) and Trifloxystrobin 25% + Tebuconazole 50% (Nativo 75 WG) @ 0.4gm/lt at 100% panicle emergence (20.16) respectively.

**Keywords:** Fungicides, false smut, paddy, management

## Introduction
Rice. (*Oryza sativa* L.) is the most extensively cultivated food crop of the asia and forms a major part of nourishment for half of the world's population. It is the primary source of energy and protein for 4.5 billion peoples in the most populous nations of Asia. More than 90 per cent of the world's rice is grown and consumed in Asia, where 60 per cent of the world's population lives. It accounts for 35-60% of the caloric intake of three billion Asians (Guyer *et al.*, 1998) [11].

Worldwide, rice is cultivated in an area of about 161.4 million hectares, production of about 506.3 million tonnes and productivity of 3.14 tonnes per hectare. In India area under rice cultivation is 43.39 million hectare and production of about 104.32 million tonnes with 2.40 tonnes per hectare productivity. In Karnataka, it is grown in area of 1.06 million hectares with a production of 2.70 million tonnes and productivity of 2.67 tonnes per hectare (Annon, 2016). In India, rice crop is produced in almost all the zones including southern, northern and north-eastern zones. The major rice producing states of India are West Bengal, Andhra Pradesh, Tamil Nadu, Karnataka and Punjab. Rice not only a staple food but also a way of living in Asia, with more than 250 million farm households dependent on the crop for their livelihood.

The crop growth and production are affected by various biotic and abiotic factors. Biotic stresses include insect pests and diseases caused by fungi, bacteria, viruses, Phyto plasmas and nematodes. Abiotic stresses, drought, cold, heat, chemical injury, salinity and other non-parasitic disorders are also responsible for significant reduction in production and productivity. Fungal diseases like, blast (*Pyricularia oryzae*), sheath blight (*Rhizoctonia solani*), brown spot (*Helminthosporium oryzae*), bakanae disease or foot srot (*Gibberella fujikuroi*), sheath rot (*Sarocladium oryzae*), leaf scald (*Microdochium oryzae*), narrow leaf spot (*Cercospora* oryzae), leaf smut (*Entyloma oryzae*) and udbatta disease (*Balansia oryzae*), bacterial diseases such as bacterial leaf blight (*Xanthomonas oryzae* pv. *oryzae*) and bacterial leaf streak (*Xanthomonas oryzae* pv. *oryzicola*) are of economic importance. Viral disease such as rice tungro disease (*Rice tungro bacilliform virus* and *Rice tungro spherical virus*) is more prevalent and destructive under Indian condition.

In addition to all these diseases, rice crop in recent past is prone to the false smut disease, which is one of the most emerging disease causing significant damage of rice yield and quality worldwide (Abbas *et al*., 2014) [1].

False smut. occurs in. most of the rice growing areas of the world including India, China, Japan, Southeast Asian countries, North and South America, Myanmar, Sri Lanka, Fiji, and Africa. Among the floral diseases of rice, false smut is gaining importance which is a post-flowering disease prevalent mostly during *Kharif* season. It is also known as Lakshmi disease and was believed to be a mark of a bumper harvest. Earlier it was regarded as sporadic but from the year 2000 onwards; it has been reported as an epidemic disease (Rush *et al.*, 2000, Singh and Pophaly, 2010) [20, 22].

False smut disease is caused by the pathogen *Ustilaginoidea virens* (Cooke) Takahashi, Whose teleomorph is *Claviceps Oryza sativa* (Hashioka), was first reported from Tirunelveli in Tami Nadu (Cooke, 1878) [10] and most recently *Villosiclava virens* has been proposed as the new name for the teleomorph of the false smut fungus (Tanaka *et al.,* 2008). The fungus transforms individual grains of the panicle into greenish spore balls of velvety appearance. The spore. Balls are small at first and grow to a size two inches or more in diameter. They are smooth and are yellow covered by a membrane. Later, the membrane bursts and the colour of the ball becomes orange/yellow. When cut open, the ball is white in the center with three outer layers (Sciumbato and Street, 2000) [21].

The fungus attack some of the weed species that commonly occur in rice fields and may also serve as sources of inoculum (Atia, 2004) [3]. The main reason for losses being incited is that the fungus attacks the panicles. About 15-20 percent losses have been reported by different workers from different provinces (Singh, 1998) [24].

It is an important devastating disease causing yield losses from 1 to 11 per cent (Atia, 2004) [3]. Disease incidence of 10-20 per cent and 5-85 per cent respectively has been reported from Punjab and Tamil Nadu on different rice cultivars (Ladhalakshmi *et al.*, 2012) [14]. Reports showed that rice false smut pathogen could produce two kinds of mycotoxins, namely Ustiloxins and Ustilaginoidins (Zhou *et al.,* 2012) [29]. This disease results in yield loss contaminated rice grains and. even more important, generating toxins poisoning to humans and domestic animals (Koiso *et al.,* 1994 and Zhou *et al.,* 2012) [29].

Yield loss estimates due to *U. virens* were ranged from 0.2 to 49 per cent on different rice varieties in different regions of the country (Baruah *et al.,* 1992, Singh *et al.,* 1992 and Biswas, 2001a) [6, 23, 8]. In Karnataka, rice hybrids cultivation is becoming very popular and farmers are adopting the technology easily and obtaining a good yield. Hybrid rice is mostly affected by the incidence of minor diseases like false smut incidence and the crop yield are badly affected by high fertility levels in an irrigated ecosystem. Looking to the expansion of hybrid rice area in Karnataka region, where the farming community almost depends on this important food crop, there is an urgent need to address the biotic stress like false smut. Very meager information is available about disease incidence, resistance cultivars and management aspect of false smut disease under field condition. Therefore the present research studies entitled "Investigation on false smut of rice incited by *Ustilaginoidea virens* (Cooke) in hilly and coastal zones of Karnataka" is undertaken with the following objectives:

## Material and Methods

A field experiments were conducted at Agricultural and Horticultural Research Station, Ponnampet, during *Kharif*, 2013 and 2014 to find out the effective fungicide for the control of the false smut of rice.

Experiment was spread-out in Randomised Block Design (RBD) with nine treatments and three replications. Variety used was Tunga and the gross plot size was 10 sq. meters and all packages of practices were followed for conducting the experiment. Three chemical sprays were given for different stages of the crop at Booting stage, 50% flowering stage and 100% flowering stage.

**Table 1:** List of fungicides evaluated under field condition in different stages of paddy against *U. virens*

| Sl. No. | Name | Dosage / L | Stage of spray |
|---|---|---|---|
| $T_1$ | Trifloxystrobin 25% + Tebuconazole 50% (Nativo 75 WG) | 0.4gm/lt | Booting |
| $T_2$ | Trifloxystrobin 25% + Tebuconazole 50% (Nativo 75 WG) | 0.4gm/lt | 50% PE |
| $T_3$ | Trifloxystrobin 25% + Tebuconazole 50% (Nativo 75 WG) | 0.4gm/lt | 100% PE |
| $T_4$ | Kresoxim methyl (Ergon 44.3 SC) | 1ml/lt | Booting |
| $T_5$ | Kresoxim methyl (Ergon 44.3 SC) | 1ml/lt | 50% PE |
| $T_6$ | Kresoxim methyl (Ergon 44.3 SC) | 1ml/lt | 100% PE |
| $T_7$ | Propiconazole 25EC (Tilt) | 1ml/lt | Booting |
| $T_8$ | Propiconazole 25EC (Tilt) | 1ml/lt | 50% PE |
| $T_9$ | Propiconazole 25EC (Tilt) | 1ml/lt | 100% PE |

## Observations were recorded

Fix three sampling units of 1 Sq.M. at random in each plot, and recorded the observations as follows

Recorded the percentage of infected panicles for calculated the percentage of infected panicles, randomly 10 hills were taken from each of the three sampling units of 1 sq m per plot and total number of panicles and number of infected panicles should be counted and then average percentage of infected panicles were calculated.

Recorded the percentage of infected spikelets/panicle for calculated the percentage of infected spikelets, counted the total number of spikelets and number of infected spikelets in randomly selected 10 panicles from each of the three sampling units of 1 sq m per plot from the same sample taken for recording per cent infected panicles and calculated the average percentage of infected spikelets.

Further, yield from all the treatments was weighed and recorded at the time harvest of the crop.

Statistical analysis was done as per the procedures given by Panse and Sukathme (1985) [15]. Actual data in percentage were converted to Arc sine values, before analysis according to the table given by Snedecor and Cochran (1967) [25].

## Results and Discussion

A field experiments were conducted at AHRS, Ponnampet during *Kharif* 2013 and 2014 to find out the effective fungicide for the management of false smut of rice and the results obtained are presented below (Table 2).

**Table 2:** Evaluation of Fungicides for the Management of False Smut, Pooled data of 2013 and 2014

| Tr. No. | Name | Dosage /L | Stage of spray | Infected spikelets /panicles (%) | | | Infected panicles/ sqmt | | | Grain yield Kg/ha | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 2013 | 2014 | Pooled | 2013 | 2014 | Pooled | 2013 | 2014 | Pooled |
| $T_1$ | Trifloxystrobin 25% + Tebuconazole 50% (Nativo 75 WG) | 0.4gm/lt | Booting | 14.23 (21.81)* | 9.45 (17.82) | 11.84 (19.92) | 13.50 | 10.50 | 12.00 | 4416.67 | 4441.61 | 4422.92 |
| $T_2$ | Trifloxystrobin 25% + Tebuconazole 50% (Nativo 75 WG) | 0.4gm/lt | 50% PE | 8.15 (16.22) | 4.85 (12.72) | 6.50 (14.65) | 4.75 | 4.75 | 4.75 | 4862.50 | 4887.63 | 4868.75 |
| $T_3$ | Trifloxystrobin 25% + Tebuconazole 50% (Nativo 75 WG) | 0.4gm/lt | 100% PE | 5.87 (13.99) | 3.03 (9.97) | 4.45 (12.14) | 3.25 | 2.00 | 2.63 | 5070.83 | 5095.75 | 5077.08 |
| $T_4$ | Kresoxim methyl (Ergon 44.3 SC) | 1ml/lt | Booting | 17.03 (24.32) | 12.10 (20.35) | 14.57 (22.41) | 16.25 | 12.25 | 14.25 | 4325.00 | 4300.00 | 4318.75 |
| $T_5$ | Kresoxim methyl (Ergon 44.3 SC) | 1ml/lt | 50% PE | 10.66 (19.01) | 6.78 (15.03) | 8.72 (17.13) | 6.75 | 5.75 | 6.25 | 4770.83 | 4795.67 | 4777.08 |
| $T_6$ | Kresoxim methyl (Ergon 44.3 SC) | 1ml/lt | 100% PE | 7.65 (15.52) | 4.03 (11.53) | 5.84 (13.73) | 4.00 | 3.75 | 3.88 | 4937.50 | 4962.42 | 4943.75 |
| $T_7$ | Propiconazole 25EC (Tilt) | 1ml/lt | Booting | 21.99 (27.95) | 16.55 (23.98) | 19.27 (26.02) | 19.50 | 15.00 | 17.25 | 3970.83 | 3995.91 | 3977.08 |
| $T_8$ | Propiconazole25EC (Tilt) | 1ml/lt | 50% PE | 16.46 (23.89) | 11.68 (19.91) | 14.07 (21.97) | 8.25 | 7.25 | 7.75 | 4241.67 | 4266.59 | 4247.92 |
| $T_9$ | Propiconazole25EC (Tilt) | 1ml/lt | 100% PE | 14.60 (22.45) | 6.03 (14.20) | 10.31 (18.72) | 7.00 | 5.50 | 6.25 | 4412.50 | 4437.63 | 4418.75 |
| $T_{10}$ | Untreated control | | | 29.58 (32.96) | 23.48 (28.98) | 26.53 (31.01) | 28.50 | 18.50 | 23.50 | 3237.50 | 3337.33 | 3262.50 |
| | Mean | | | 14.62 (21.81) | 9.80 (17.45) | 12.21 (20.44) | 11.18 | 8.53 | 9.85 | 4424.58. | 4452.05 | 4431.46 |
| | CV (%) | | | 13.05 | 8.09 | 10.41 | 12.17 | 13.50 | 11.64 | 6.30 | 5.74 | 6.13 |
| | CD (0.05) | | | 4.39 | 2.14 | 3.15 | 1.99 | 1.71 | 1.70 | 406.25 | 370.70 | 395.84 |

*Figures in parentheses indicate angular transformed values

Among the different treatments at different stages of the crop, a spray of Trifloxystrobin 25% + Tebuconazole 50% (Nativo 75 WG) @ 0.4gm/lt at 100% panicle emergence was highly effective in the management of false smut disease with least pooled data of infected spikelets /panicles (4.45%), which was followed by Kresoxim methyl (Ergon 44.3 SC) @ 1ml/lt at 100% panicle emergence (5.84%) and Propiconazole 25% EC @1ml/lt at 100% panicle emergence (10.31%) respectively. The highest per cent pooled data of infected spikelets/panicles were observed in untreated control (26.53%).

In terms of Infected panicles/sqmt, the treatment with a spray of Trifloxystrobin 25% + Tebuconazole 50% (Nativo 75 WG) @ 0.4gm/lt at 100% panicle emergence was highly effective in the management of false smut disease with least pooled data of infected panicles/sqmt (2.63%), which was followed by Kresoxim methyl (Ergon 44.3 SC) @ 1ml/lt at 100% panicle emergence (3.88%) and Propiconazole 25% EC @1ml/lt at 100% panicle emergence (6.25%) respectively. The highest per cent pooled data of infected panicles/sqmt were observed in untreated control (23.50%).

On comparison with the grain yield obtained from each plot it was found that a spray of Trifloxystrobin 25% + Tebuconazole 50% (Nativo 75 WG) @ 0.4gm/lt at 100% panicle emergence gave the highest grain yield of 5077.08 kg/ha which was followed by the Kresoxim methyl (Ergon 44.3 SC) @ 1ml/lt at 100% panicle emergence (4943.75 kg/ha) and Propiconazole 25% EC @1ml/lt at 100% panicle emergence (4418.75 kg/ha) as against grain yield of 3262.50 kg/ha in untreated control.

Combination fungicides are better compare to the other solo fungicides due to their broad range of action, lower dose and also possess lower risk of fungicide resistance development in target fungal population. In rice, efficacy of such combi products in managing many fungal diseases has been reported (Bag and Saha, 2009, Bhuvaneshwari and Raju, 2012, Kumar and Veerabhadraswamy, 2014 and Pramesh *et al.*, 2016 a & b) [4, 7, 13, 17, 18]. In our study, Trifloxystrobin 25% + Tebuconazole 50% (Nativo 75 WG) @ 0.4gm/lt at 100% panicle emergence stage of a spray showed their superior bio efficacy in reducing false smut disease incidence and they can be utilized under epidemic condition. In case of rice, there are no resistance varieties against false smut disease. Moreover, bio-efficacy of the bio-control agents under the severe epidemic condition are not demonstrated, therefore, chemical control is an inevitable and ultimate means for disease management for farmers. Thus, in present situation cultural practices combined with foliar spray of fungicide is the most common practice to manage the disease and even in integrated pest management system where need based application of fungicide has been recommended (Bag *et al.*, 2016) [5]. In case of rice, many researchers have reported the increased grain yield after application of fungicides due to reduction in biotic stress on plant during critical growth stages (Sood and Kapoor, 1997, Tirmali *et al*., 2001, Prabhu *et al.*, 2003, Usman *et al.*, 2009, Naik *et al.*, 2012, Bhuvaneshwari and Raju, 2012, Bag *et al.*, 2016 and Pramesh *et al.*, 2016 a & b) [26, 28, 16, 7, 17, 18, 5]. For management of false smut disease, efficacy of many fungicides has been reported previously (Chen *et al.*, 2013, Kumar, 2015 and Raji *et al.*, 2016) [9, 19].

In the present study, in addition to the previously reported fungicides, we are reporting the efficacy of new combination of fungicides such as Trifloxystrobin 25% + Tebuconazole 50% (Nativo 75 WG) @ 0.4gm/lt at 100% panicle emergence, for the management of false smut disease under field condition.

**Economics of Fungicidal Evaluation**

The economics of cost benefit ratio has been worked out for different fungicides and are presented in Table 3 and Fig 1. The highest total returns were obtained by Trifloxystrobin 25% + Tebuconazole 50% (Nativo 75 WG) @ 0.4gm/lt at 100% panicle emergence (Rs. 76156.20) followed by Kresoxim methyl (Ergon 44.3 SC) @ 1ml/lt at 100% panicle emergence (Rs. 74156.25). Similarly net returns and

additional net returns over control were also high in Trifloxystrobin 25% + Tebuconazole 50% (Nativo 75 WG) @ 0.4gm/lt at 100% panicle emergence (Rs. 30800.20 and Rs. 25690.70 respectively) followed by Kresoxim methyl (Ergon 44.3 SC) @ 1ml/lt at 100% panicle emergence (Rs. 27718.25 and Rs. 22608.75 respectively) than any other fungicides. However, when cost benefit ratio was calculated, Propiconazole 25EC (Tilt) @ 1ml/lt at 100% panicle emergence (27.07) and Trifloxystrobin 25% + Tebuconazole 50% (Nativo 75 WG) @ 0.4gm/lt at 100% panicle emergence (20.16) proved better because of curative effect and systemic in nature of the chemical than any other fungicides.

**Table 3:** An economic analysis of fungicides against false smut disease of Rice under field condition

| Tr. No. | Treatment | Cost of The chemical (Rs)/lt or Kg | Qty required/ ha* in 1 spray ml/gm | Total cost of chemical/ ha in 1 spray (Rs) | Cost of Cultivation (Rs) | Total Cost (Rs.) | Additional cost over control (Rs.) | Yield (kg/ha) | Total Returns (Rs)** | Net returns (Rs) | Additional returns over control (Rs) | B:C |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7(5+6) | 8 | 9 | 10 | 11(10-7) | 12 | 13 (11/7) |
| $T_1$ | Trifloxystrobin 25% + Tebuconazole 50% (Nativo 75 WG) | 7640 | 200 | 1528 | 43823 | 45356 | 1528 | 4422.92 | 66343.80 | 20987.80 | 15878.30 | 13.74 |
| $T_2$ | Trifloxystrobin 25% + Tebuconazole 50% (Nativo 75 WG) | 7640 | 200 | 1528 | 43823 | 45356 | 1528 | 4868.75 | 73031.25 | 27675.25 | 22565.75 | 18.11 |
| $T_3$ | Trifloxystrobin 25% + Tebuconazole 50% (Nativo 75 WG) | 7640 | 200 | 1528 | 43823 | 45356 | 1528 | 5077.08 | 76156.20 | 30800.20 | 25690.70 | 20.16 |
| $T_4$ | Kresoxim methyl (Ergon 44.3 SC) | 5220 | 500 | 2610 | 43823 | 46438 | 2610 | 4317.75 | 64781.25 | 18343.25 | 13233.75 | 7.03 |
| $T_5$ | Kresoxim methyl (Ergon 44.3 SC) | 5220 | 500 | 2610 | 43823 | 46438 | 2610 | 4777.08 | 71656.20 | 25218.20 | 20108.70 | 9.66 |
| $T_6$ | Kresoxim methyl (Ergon 44.3 SC) | 5220 | 500 | 2610 | 43823 | 46438 | 2610 | 4943.75 | 74156.25 | 27718.25 | 22608.75 | 10.62 |
| $T_7$ | Propiconazole 25EC (Tilt) | 1600 | 500 | 800 | 43823 | 44628 | 800 | 3977.08 | 59656.20 | 15028.20 | 9918.70 | 18.79 |
| $T_8$ | Propiconazole 25EC (Tilt) | 1600 | 500 | 800 | 43823 | 44628 | 800 | 4247.92 | 63718.80 | 19090.80 | 13981.30 | 23.86 |
| $T_9$ | Propiconazole 25EC (Tilt) | 1600 | 500 | 800 | 43823 | 44628 | 800 | 4418.75 | 66281.25 | 21653.25 | 16543.75 | 27.07 |
| $T_{10}$ | Control | - | - | - | 43823 | 43828 | | 3262.50 | 48937.50 | 5109.50 | 0.00 | 0.12 |


**Fig 1:** Best treatments observed against false smut of rice

However from the farmer's point of view, the economics of disease management is important. In the present investigation the Trifloxystrobin 25% + Tebuconazole 50% (Nativo 75 WG) @ 0.4gm/lt at 100% panicle emergence stage has given highest total returns, net returns and additional returns over control than any other fungicides. The Propiconazole 25EC (Tilt) @ 1ml/lt at 100% panicle emergence was next in order with respect to the cost benefit ratio. This is obviously due to their mode of action and also lowering of false smut incidence.

## References


1. Abbas HK, Shier WT, Cartwright RD, Sciumbato GL. *Ustilaginoidea virens* infection of rice in Arkansas: toxicity of false smut galls, their extracts and the ustiloxin fraction. Amer. J Pl. Sci. 2014; 5:3166-3176.
2. Anonymous. 2016, Statistical database. http://www.fao.org
3. Atia MMM. Rice false smut in Egypt. J Pl. Dis. Prot. 2004; 111:71-82.
4. Bag MK, Saha S. Fungitoxic effect of nativo 75 wg (trifloxystrobin 25% + tebuconazole 50%) on grain discoloration disease of rice in West Bengal. Pestol. 2009; 33:47-49.
5. Bag MK, Yadav M, Mukherjee AK. Bio efficacy of strobilurin based fungicides against rice sheath blight disease. Transcriptomics. 2016; 4:128.
6. Baruah BP, Senapoty D, Ali MS. False smut: a threat to rice growers in Assam. Ind. J Mycol. Pl. Pathol. 1992; 22:274-77.
7. Bhuvaneswari V, Raju KS. Efficacy of new combination fungicide against rice sheath blight caused by *Rhizoctonia solani* (Kuhn). J Rice Res. 2012; 5:1-2.
8. Biswas A. Field reaction of hybrid rice varieties to false smut and kernel smut disease in West Bengal India. Environ. Ecol. 2001a; 19:299-30.
9. Chen Y, Zhang Y, Yao J, Li YF, Yang X, Wang WX, *et al*. Frequency distribution of sensitivity of *Ustilaginoidea virens* to four EBI fungicides, Prochloraz, difenconazole, Propiconazole and tebuconazole and their efficacy in controlling false smut in Anhui Province of China. Phytoparasitica. 2013; 14(3):277-284.
10. Cooke MC. Some extra-European fungi. Grevillea. 1878; **7**:13-15.
11. Guyer D, Tuttle A, Rouse S, Volrath S, Johnson M, Potter S, Gorlach J, *et al*. Activation of latent 171 transgenes in arabidopsis using a hybrid transcription factor. Genetics. 1998; 149:633-639.
12. Kumar DM. Studies on false smut of rice caused by *Claviceps oryzae sativae* Hashioka. M. Sc. Thesis. Univ. Agric. Sci. Dharwad, Karnataka (India), 2015.
13. Kumar PMK, Veerabhadraswamy AL. Appraise a combination of fungicides against blast and sheath blight diseases of paddy (*Oryza sativa* L.). J Exp. Biol. Agric. Sci, 2014, 2(1).
14. Ladhalakshmi D, Laha G, Singh R, Karthikeyan A, Mangrauthia S, Sundaram R, Thukkaiyannan P, *et al*.

Isolation and characterization of *Ustilaginoidea virens* and survey of false smut disease of rice in India, Phytoparasitica. 2012; 40(2):171.
15. Panse VG, Sukathme PV. Statistical Methods for Agricultural Workers. ICAR Publications, New Delhi, 1985, 145-155.
16. Prabhu AS, Filippi MC, Zimmermann FJP. Cultivar response to fungicide application in relation to rice blast control, productivity and sustainability. Pesq. Agropec. Bras, Brasilia. 2003; 38:11-17.
17. Pramesh D Maruthi, Muniraju KM, Mallikarjun K, Guruprasad GS, Mahantashivayogayya K, Mastanareddy BG, *et al*. 2016a, Bio-efficacy of a combination fungicide against of blast and sheath blight disease of paddy. J Exp. Agric. Int. 2003; 14(4):1-8.
18. Pramesh D Maruti, Saddamhusen A, Muniraju KM, Guruprasad GS. A new combination fungicide active ingredients for management of sheath blight disease of paddy. Advances in Res. 2016b; 8(5):1-7.
19. Raji P, Sumiya KV, Renjisha K, Dhanya S, Narayanankutty MC. Evaluation of fungicides against false smut of rice caused by *Ustilaginoidea virens.* Int. J App. Nat. Sci. 2016; 5:77-82.
20. Rush MC, Shahjahan AKM, Jones JP. Outbreak of false smut of rice in Louisiana. Pl. dis. 2000; 84(1):100.
21. Sciumbato G, Street JE. Mississippi rice diseases. Delta Res. Ext. center, 2000. http: www.msstate.edu/dept/drec.
22. Singh AK, Pophaly DJ. An unusual rice false smut epidemic reported in Raigarh District, Chhattisgarh, India. Int. Rice Res. Notes. 2010; 35:1-3.
23. Singh RS. Plant Diseases. Sev. Ed. Oxf. IBH Publ. New Delhi,N 1998, 283-286.
24. Singh S, Vijai P, Panwar MS. False smut of rice-its impact on yield components. Crop Res. 1992; 5:246-48.
25. Snedecor VG, Cochran WG. Statistical methods, 6th Edn. Oxf. IBH Publ. Comp, Calcutta, 1967, 67.
26. Sood GK, Kapoor AS. Efficacy of new fungicides in the management of rice blast. Plant Dis. Res. 1997; 12:140-142.
27. Tanaka E, Tanaka C. Phylogenetic study of clavicipitaceous fungi using acetaldehyde dehydrogenase gene sequences. Myco sci. 2008; 49:115-125.
28. Tirmali AM, Latake SB, Bendra NJ. Evaluation of new fungicides for control of blast disease of rice. J Maha. Agric. Uni. 2001; 26:197-198.
29. Zhou L, Lu S, Shan T, Wang P, Sun W, Chen Z, *et al*. Chemistry and biology of mycotoxins from rice false smut pathogen. In Mycotoxins: Properties, Applications and Hazards; Melborn, B.J., Greene, J.C., Eds.; Nova Science Publishers: New York, NY, USA, 2012, 109-130.