Screening of Fungicides and Botanicals for Controlling False Smut of Rice

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ABSTRACT

The present investigation was conducted in the field laboratory of the Department of Plant Pathology, Patuakhali Science and Technology University during August 2017 to December 2017 to evaluate the efficacy of botanicals viz., neem leaf extract, garlic clove extract, tulshi leaf extract and zinger rhizome extract at 10% concentration and fungicides viz., TALL 25EC, RAI 32.5 SC, TOWIN 50 WP, Syconazole 25SC and Y-Thane M-45 at 0.2% concentration to control rice false smut disease. The experiment was set up in a Randomized Complete Block Design (RCBD) with 3 replications. Among the treatments RAI 32.5 SC= Suspension concentrate and tulsi leaf extract performed better in respect of percent hill infection and it was 0.51%, 1.03%, 1.28% and 1.79% respectively at 85, 95, 105 and 115 days after transplanting (DAT). Result showed that the lowest percent plant and panicle infection at different days after transplanting were highest in the plot treated with RAI 32.5 SC followed by garlic extract. RAI 32.5 SC showed minimum percent infected grains which were 0.26%, 1.03% and 1.17% at 85, 105 and 115 DAT respectively and maximum 1.22%, 2.39% and 2.99% respectively, in the control plot at 85, 105, and 115 DAT. The highest thousand grain weight (114.6) and yield (4.790) were obtained in RAI 32.5 SC and the lowest thousand grain weight (108.3) and yield (3.587) harvested from the control plot.

Keywords: *Botanicals, Extract fungicides, False, Infection, Plant, Rice smut, Yield.*

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Highlights of this paper

- To the available fungicides and low cost botanicals in controlling false smut of rice.
- To observed the performance of different fungicides and botanicals on rice yields and yield promoting characteristics.
- There is no report of research work on any aspect of controlling false smut of rice in Bangladesh.

1. INTRODUCTION

Rice production currently plays an essential role in feeding the world's population and will continue to be in the future, because rice is the most important global staple food in many countries. Moreover, the demand for rice is rapidly increasing with the increase of population and this demand is the highest in Bangladesh among the less developed countries [1]. Per acre yield position of this country is comparatively much lower among the other rice growing countries. There are several factors responsible for less per acre yield of rice. Among these, disease is an important one.

In addition to affecting rice production, climate change may alter pathogen dissemination and development rates, and modify the resistance, growth and metabolism of host plants. Climate change is a serious threat to agriculture because it can lead to significant changes in the occurrence and severity of plant diseases [2]. In the recent years, false smut disease has emerged as one of the most devasting grain diseases. It might be due to climate change. Rice False Smut (RFSm), which is caused by *Ustilaginoidea virens* is one of the most common and serious disease in rice growing areas of the world. Rice false smut, also known as pseudo-smut, or green smut, has been recorded in all rice-growing countries worldwide [3, 4].

The importance of the disease in Bangladesh has been highlighted in recent literatures [5]. The disease is predominant during T. Aman (late monsoonal rice) season in the country, which is hindering adoption of promising rice varieties, such as BRRI= Bangladesh Rice research Institute dhan 49. Some plant contains components that are toxic to pathogens. In integrated disease management, chemical pesticides also included due to its higher effect on pest. When plant extracts are applied on infested crops, these components are called botanical pesticides or botanicals. Many of the plant materials used in traditional medicine are readily available in rural areas at relatively cheaper than modern medicine. Plants are the sources of natural pesticides that leads for new pesticide development [6-8].

there is no report of research work on any aspect of controlling false smut of rice in Bangladesh. In view of these facts, the present study has been undertaken To observe the available fungicides and low cost botanicals in controlling false smut of rice and to observed the performance of different fungicides and botanicals on rice yields and yield promoting characteristics.

2. MATERIALS AND METHODS

The experiment was conducted during July, 2017 to December, 2017 in the Field Laboratory, Department of Plant Pathology, Patuakhali Science and Technology University, Dumki, Patuakhali. The experimental field was first opened with country plough on 20th August, 2017. Five ploughings and cross ploughings followed by laddering were done to have a good tilth. Weeds and other stubbles were removed from the field. The land was exposed to natural weathering for 7 days. Last ploughing was made at the time of final land preparation and the soil was levelled using laddering, plots were marked and drains were dug between the plots. In this experiment some chemical fertilizers are used (non-variables) at different doses. Ten treatments were used to conduct this experiment. Those are as follows- T_1 = TALL 25EC, T_2 = Garlic clove extract, T_3 = RAI 32.5 SC, T_4 = Neem leaf extract, T_5= TOWIN 50 WP, T_6 = Zinger rhizome extract, T_7 = Syconazole 25SC, T_8 = Tulsi leaf extract, T_9 = Y-Thane M-45, T_{10} = Control.

2.1. Preparation of Plant Extract

Five commonly available plants namely neem leaf, garlic clove, zinger rhizome and tulshi leaf were collected and evaluated against rice false smut (RFSm) disease (Table 1). Hundred gram washed leaves of each plant species with 100 ml distilled water in a blender and filtered through double layered cloth. The filtrates obtained were further filtered through Whatman No. 1 filter paper and used as standard plant extracts. Then required amount of water mixed with standard neem leaf extract to make 10% solution. Same procedure was followed for 10% solution of garlic clove, zinger rhiome and tulsi leaf extract.

Table 1. List of plant extracts used in this experiment.

Sl. No.	Botanical name	Common name	Plant part used
01.	Azadirachta indica	Neem	Leaf
02.	Allium sativum	Garlic	Clove
03.	Zingiber officinale	Zinger	Rhizome
04.	Ocimum tenuiflorum	Tulshi	Leaf

2.2. Preparation of Fungicidal Solution

For the evaluation of chemical fungicides, the fungicidal solutions were prepared by mixing with required amount of fungicides with distilled water. Fungicidal solutions (0.2%) were sprayed with hand sprayer. Details of fungicides used in this experiment are given in the Table 2.

Table 2. List of fungicides used in this experiment.

Plate No.	Chemical Name	Trade Name	Dose
Non-systemic fungicides:			
9	Mancozeb	Y-Thane M-45	2 g/L
10	Propiconazole	TALL 25EC	2 ml/L
11	20% Azoxystrobin + 12.5% Difenoconazole	RAI 32.5SC	2 ml/L
12	(Hexaconazole 3% + Trisaiclazole 22%)	SYCONAZOLE 25SC	2 ml/L
Systemic fungicides:			
13	2- (Methyoxycarbonyl Amino) -Benzimidazole	TOWIN 50WP	2 g/L

2.3. Layout and Design of Experiment

The experiment was set up in a Randomized Complete Block Design (RCBD) with 3 replications. The land was divided into three blocks. Each block was divided into 10 plots. The space between block to block and plot to plot were 1 m and 0.5 m, respectively. Ten treatments were randomly assigned in each block.

BR-22 variety of rice seedling was used in this study. Seedlings of the cultivar were collected from local area of Dumki Upazilla. T. Aman rice (late monsoonal rice) was grown as hand-transplanted in the field experiments. In experiments used 30 days old seedlings. The rice seedlings were transplanted in the main field in 29th August, 2017. Three seedlings were used hill^{-1} maintaining a hill-to-hill distance of 15 cm and line to line distance of 25 cm. In each plot there were 10 lines and in each line there were 13 hills. Thus, there were 130 hills in an individual plot. No chemicals, herbicides, insecticides or fungicides (except for treatment purposes), were used for weed, pest and disease control. The crops received moisture predominantly through monsoonal rains, but supplemented by irrigation water to maintain a water level of 2 to 3 cm. Management of the crops included manual weed control twice, at 30 and 45 DAT. Other intercultural operations were done from time to time as and when necessary.

2.4. Data Collection

Collection of data on False Smut of Rice (RFSm) started from 75 days after transplanting (DAT) at 10 days interval. Data were recorded on number of hill infected per plot, number of plant infected per hill, number of panicle infected per hill, number of grain infected per panicle and Plant height. The disease incidence was visually monitored weekly at the ripening stage (post panicle emergence to late maturity) of rice crops during last October, 2017 to last December, 2017 by walking across the fields in the experimental site.

2.5. Calculation of Percent Disease Incidence

Percent hill infected per plot was calculated by using following formula:

$$\text{Percent hill infected per plot} = \frac{\text{Number of hill infected/plot}}{\text{Total number of hill/plot}} \times 100$$

Percent plant infected per hill was calculated by using following formula:

$$\text{Percent plant infected per hill} = \frac{\text{Number of infected plant/hill}}{\text{Total number of plant/hill}} \times 100$$

Percent panicle infected per hill was calculated by using following formula:

$$\text{Percent (\%) panicle infected per hill} = \frac{\text{Number of infected panicle/hill}}{\text{Total number of panicle/hill}} \times 100$$

Percent grain infected in infected panicle was calculated by using following formula:

$$\text{Percent grain infected per panicle} = \frac{\text{Number of infected grain/panicle}}{\text{Total number of grain/panicle}} \times 100$$

Data were collected from five plants randomly selected from a unit plot and measurement was done by the meter scale. The heights of selected plant were measured from ground level to the tip of the plant. The average of the five plants in each plot was computed and expressed in centimeters (cm). After the ripening of 90% grain in the rice field, harvesting was done at last week (26^{th}) of December. After harvest post-harvest operation were done like drying, threshing, winnowing etc. and then kept them in sheet under sunshine to reduce the moisture content.

After harvesting yield data such as yield per plot were recorded and converted into yield per hectare. Also thousand grain weight were measured.

a. Yield per plot

The yield per unit plot was calculated in kg and the yields of each individual plot were expressed in kg.

b. Yield per hectare (ha)

The yield per hectare was calculated out by converting from per plot yield data to per hectare and was measured in ton.

c. Thousand grain weight

Thousand grain wt. of individual plot was calculated and expressed them in gram (g).

2.6. Analysis of Data

All the collected data were analysed by Randomized Complete Block Design (RCBD) following the analysis of variance (ANOVA) technique using MSTAT-C package and the mean differences were adjudged by Least Significant Difference (LSD) technique at 5% level of significance.

3. RESULT AND DISCUSSION

3.1. The Symptom of Rice False Smut Disease

False smut of rice is an inflorescence disease. The symptoms are visible only after flowering. The fungus attacks individual grains. Upon infected, the grain turns into a large velvety mass (also known as 'pseudomorph'), which fully encloses the floral parts. This pseudomorph is commonly called as 'smut ball' [9]. Smut balls are initially silvery-white in colour, which turns yellow or orange and finally acquire dark green or almost black colour [10]. Because of the greenness in colour, smut balls as also termed as 'green balls' Figure 1.

Figure 1. Symptoms of false smut disease of rice orange and olivaceous greenish-black.

3.2. Effect of Treatments on Diseases Severity Caused by Ustilaginoidea Virens

3.2.1. Percent Hill Infection

The effect of different treatments on percent hill infection of rice at different days after transplanting (DAT) was observed and presented in Table 3. At 85 days after transplanting (DAT), the highest percent hill infection (2.31%) was found in control plot and the lowest percent hill infection (0.51%) was recorded in RAI 32.5 SC, Syconazole 25SC, Y-Thane M-45, Tulsi extract treated plot, which were statistically identical with the plots treated with TALL 25EC (1.28%), garlic clove extract (1.03%), neem leaf extract (1.03%), TOWIN 50 WP= Wettable powder (0.77%) and zinger rhizome extract (1.03%).

Table 3. Effect of different treatments on the hill infection of rice at different date of transplanting (DAT).

Treatment	Hill infection (%)				
	75 DAT	85 DAT	95 DAT	105 DAT	115 DAT
T_1(TALL 25EC)	0.77	1.28 b	1.79 bc	2.05 bc	3.34 abc
T_2 (garlic clove extract)	1.03	1.03 b	1.79 bc	2.57 bc	3.34 abc
T_3 (RAI 32.5 SC)	0.26	0.51 b	1.03 c	1.28 c	1.79 d
T_4 (neem leaf extract)	0.77	1.03 b	1.54 bc	2.31 bc	2.82 bcd
T_5 (TOWIN 50 WP)	0.51	0.77 b	1.54 bc	2.31 bc	3.08 bcd
T_6(zinger rhizome extract)	1.03	1.03 b	2.57 ab	2.82 ab	3.59 ab
T_7 (Syconazole 25SC)	0.51	0.51 b	1.79 bc	2.31 bc	3.08 bcd
T_8 (tulsi leaf extract)	0.26	0.51 b	1.28 c	1.54 bc	2.05 cd
T_9 (Y-Thane M-45)	0.51	0.51 b	1.79 bc	2.05 bc	3.08 bcd
T_{10} (Control)	1.03	2.31 a	3.59 a	4.11 a	4.62 a
LSD $_{0.05}$	NS	0.9317	1.279	1.362	1.467

Note: Means followed by same letter(s) in a column did not differ significantly at 5% level by LSD.

The highest percent hill infection (3.59%) was observed in control followed by zinger rhizome extract (2.57%) and the lowest (1.03%) was recorded in RAI 32.5 SC followed by tulsi leaf extract (1.28%) at 95 days after transplanting (DAT). Similar trend also observed at 105 and 115 DAT. At 115 DAT, the minimum percent hill infection (1.79%) was found in RAI 32.5 SC and the maximum (4.62%) hill infection was recorded in control plot.

Cartwright, et al. [11] observed that the preventive application of 'propiconazole' fungicide during the booting stages of rice suppressed the false smut of rice, with reductions in false smut balls.

3.2.2. Percent Plant Infection

Results on percent plant infection of rice at different days after transplanting (DAT) influenced by different treatments Table 4. At 85 days after transplanting (DAT), percent plant infection (13.55%) was higher in control plot followed by Neem (10.25%) and Zinger (10.43%) and the lower (3.87%) in RAI 32.5 SC followed by Garlic extract (5.56%) and Syconazole 25SC (6.27%). Percent plant infection was (8.14%) and (7.51%) in Y-Thane M-45 and Tulsi extract treated

plot, respectively which were statistically identical with the plots treated with TOWIN 50 WP (7.55%). At 95 days after transplanting (DAT), the highest percent plant infection (17.61%) was observed in control and the lowest (10.04%) in RAI 32.5 SC followed by TOWIN 50 WP (12.27%). TALL 25EC (T_1), Garlic extract (T_2), Neem extract (T_4), Zinger extract (T_6) treated plot which was statistically identical with the plots treated with Syconazole 25SC (T_7), Tulsi extract (T_8) and Y-Thane M-45 (T_9). Similar trend also observed at 105 and 115 DAT. At 115 DAT, the minimum percent plant infection (12.34%) was found in RAI 32.5 SC and the maximum plant infection was recorded in control plot (18.50%).

Table 4. Effect of different treatments on the plant infection of rice at different date of transplanting (DAT).

Treatment	Plant infection (%)				
	75 DAT	85 DAT	95 DAT	105 DAT	115 DAT
T_1(TALL 25EC)	5.05	9.38 bc	14.49 b	16.45 ab	17.41 ab
T_2 (garlic clove extract)	4.42	5.56 de	12.68 b	13.62 bc	15.21 bc
T_3 (RAI 32.5 SC)	2.22	3.87 e	10.04 c	12.34 c	12.34 c
T_4 (neem leaf extract)	5.49	10.25 ab	13.91 b	15.38 ab	16.86 ab
T_5 (TOWIN 50 WP)	1.96	7.55 bcd	12.27 bc	14.13 bc	15.95 ab
T_6(zinger rhizome extract)	9.36	10.43 ab	14.12 b	15.96 ab	16.86 ab
T_7 (Syconazole 25SC)	6.07	6.27 cde	12.85 b	14.07 bc	16.13 ab
T_8 (tulsi leaf extract)	2.78	7.51 bcd	13.61 b	16.13 ab	17.55 ab
T_9 (Y-Thane M-45)	6.48	8.14 bcd	14.41 b	15.26 ab	15.88 ab
T_{10} (Control)	5.28	13.55 a	17.61 a	17.90 a	18.50 a
LSD $_{0.05}$	NS	3.445	2.265	2.895	2.964

Note: Means followed by same letter(s) in a column did not differ significantly at 5% level by LSD.

3.2.3. Percent Panicle Infection

The effect of different treatments on percent panicle infection of rice at different days after transplanting (DAT) was summarized and presented in Table 5. At 85 days after transplanting (DAT), the highest percent panicle infection (13.55%) was found in control plot followed by Neem (10.25%) and Zinger (10.43%) and the lowest percent plant infection (3.87%) was recorded in RAI 32.5 SC followed by Garlic extract (5.56%) and Syconazole 25SC (6.27%). It was (8.14%) and (7.51%) in Y- Thane M-45, Tulsi extract respectively, which were statistically identical with the plots treated with TOWIN 50 WP.

At 95 days after transplanting (DAT), the highest percent panicle infection (17.61%) was obtained in control and the lowest percent panicle infection (10.04%) was recorded in RAI 32.5 SC followed by TOWIN 50 WP (12.27%). TALL 25EC (T_1), Garlic extract (T_2), Neem extract (T_4), Zinger extract (T_6) treated plot which was statistically identical with the plots treated with Syconazole 25SC (T_7), Tulsi extract (T_8) and Y-Thane M-45 (T_9). Similar trend also observed at 105 and 115 DAT. At 115 DAT, the minimum percent panicle infection (12.34%) was found in RAI 32.5 SC and the maximum panicle infection was recorded in control plot (18.50%).

Table 5. Effect of different treatments on the panicle infection of rice at different date of transplanting (DAT).

Treatment	Panicle infection (%)				
	75 DAT	85 DAT	95 DAT	105 DAT	115 DAT
T_1(TALL 25EC)	5.05	9.38 bc	14.49 b	16.45 ab	17.41 ab
T_2 (garlic clove extract)	4.42	5.56 de	12.68 b	13.62 bc	15.21 bc
T_3 (RAI 32.5 SC)	2.22	3.87 e	10.04 c	12.34 c	12.34 c
T_4 (neem leaf extract)	5.49	10.25 ab	13.91 b	15.38 ab	16.86 ab
T_5 (TOWIN 50 WP)	1.96	7.55 bcd	12.27 bc	14.13 bc	15.95 ab
T_6(zinger rhizome extract)	9.36	10.43 ab	14.12 b	15.96 ab	16.86 ab
T_7 (Syconazole 25SC)	6.07	6.27 cde	12.85 b	14.07 bc	16.13 ab
T_8 (tulsi leaf extract)	2.78	7.51 bcd	13.61 b	16.13 ab	17.55 ab
T_9 (Y-Thane M-45)	6.48	8.14 bcd	14.41 b	15.26 ab	15.88 ab
T_{10} (Control)	5.28	13.55 a	17.61 a	17.90 a	18.50 a
LSD $_{0.05}$	NS	3.445	2.265	2.895	2.964

Note: Means followed by same letter(s) in a column did not differ significantly at 5% level by LSD.

3.2.4. Percent Grain Infection

The highest percent grain infection (1.22%) was found in control followed by Zinger (1.09) and the lowest percent grain infection (0.26%) was recorded in RAI 32.5 SC followed by Tulsi extract (0.42%). Percent grain infection was (0.55%), (0.81%), (0.83%) and (0.93%) in TOWIN 50WP, TALL 25EC, Garlic extract and Neem extract, respectively. Percent grain infection was statistically identical between the plots treated with Syconazole 25SC and Y-Thane M-45 Table 6

At 105 days after transplanting (DAT), the highest percent grain infection (2.39%) was found in control plot followed by Zinger extract (1.99%). The lowest percent grain infection (1.03%) was recorded in RAI 32.5 SC followed by TOWIN 50 WP (1.29%). Plots treated with Y-Thane M-45 (1.92%) and Syconazole 25SC (1.85%) was statistically identical followed by TALL 25EC (1.72%) and Neem extract (1.67%).

Table 6. Effect of different treatments on the grain infection of rice at different date of transplanting (DAT).

Treatment	Grain infection (%)				
	75 DAT	85 DAT	95 DAT	105 DAT	115 DAT
T_1(TALL 25EC)	0.41	0.81 ab	1.36	1.72 bcd	2.38 ab
T_2 (garlic clove extract)	0.44	0.83 ab	1.44	1.51 cd	1.82 bcd
T_3 (RAI 32.5 SC)	0.19	0.26 c	1.03	1.03 e	1.17 d
T_4 (neem leaf extract)	0.51	0.93 ab	1.18	1.67 bcd	1.89 bcd
T_5 (TOWIN 50 WP)	0.19	0.55 bc	1.28	1.29 de	1.47 cd
T_6(zinger rhizome extract)	3.92	1.09 a	1.34	1.99 ab	2.42 ab
T_7 (Syconazole 25SC)	0.45	0.72 abc	1.33	1.85 bc	2.14 abc
T_8 (tulsi leaf extract)	0.16	0.42 bc	1.39	1.56 cd	1.71 bcd
T_9 (Y-Thane M-45)	0.48	0.76 abc	1.47	1.92 bc	2.29 abc
T_{10} (Control)	0.35	1.22 a	2.02	2.39 a	2.99 a
LSD $_{0.05}$	NS	0.5118	NS	0.4271	0.8611

Note: Means followed by same letter(s) in a column did not differ significantly at 5% level by LSD.

At 115 days after transplanting (DAT), the highest percent grain infection (2.99%) was found in control plot followed by TALL 25EC (2.38%) and Zinger extract (2.42%). Plot treated with Syconazole 25SC and Y-Thane M-45 was statistically identical. The lowest percent grain infection (1.17%) was recorded in RAI 32.5 SC followed by TOWIN 50 WP (1.47%). Percent grain infection Tulsi extract treated plot was statistically similar to that in the plot treated with Garlic and Neem extract.

3.3. Effect of Treatments on the Yield And Yield Contributing Characteristics (Plant Height, Thousand Grain Wt., Yield)

Maximum plant height (115.6) was observed at RAI 32.5 SC treated plot followed by TALL 25EC (114.2), Garlic extract (114.0), Neem extract (114.0) and Zinger extract (113.2) and minimum plant height (106.3) was observed at

control plot. TOWIN 50 WP (109.7) and Y-Thane M-45 (110.0) treated plot were statistically similar and showed minimum plant height after control plot. Table 7

Maximum 1000 grain weight (114.6g) was recorded in RAI 32.5 SC treated plot and minimum 1000 grain weight (108.3g) in control plot followed by TOWIN 50 WP (108.7). Thousand (1000) grain weight was 114.2g; 114.0g; 114.0g and 113.9g respectively, in TALL 25EC, Garlic extract, Neem extract and Zinger extract which have no statistical difference with RAI 32.5 SC treated plot Table 7.

Among all the treatments, maximum yield (4.790) was observed at T_3 (RAI 32.5 SC) treated plot followed by T_2 (Garlic extract) (4.580) and minimum yield (3.587) was observed at T_{10} (Control) followed by T_6 (Zinger extract), T_5 (TOWIN 50 WP) and T_8 (Tulsi extract) showed yields 3.997, 3.957 and 3.920 respectively which were statistically identical and give minimum yield after control. Plot treated with TALL 25EC and Y-Thane M-45 are statistically identical and give comparatively lower yield than Garlic extract treated plot. T_4 (Neem extract) and T_7 (Syconazole 25SC) treated plots are statistically identical and give better yield than T_5 (TOWIN 50 WP), T_6 (Zinger extract) and T_8 (Tulsi extract) treated plot Table 7.

Table 7. Effect of different treatments on plant height of rice, , thousand grain wt., Yield.

Treatment	Final plant height (cm)	1000 grain weight (g)	Yield (t/ha)
T_1(TALL 25EC)	114.2 ab	114.2 a	4.413 abc
T_2 (garlic clove extract)	114.0 ab	114.0 a	4.580 ab
T_3 (RAI 32.5 SC)	115.6 a	114.6 a	4.790 a
T_4 (neem leaf extract)	114.0 ab	114.0 a	4.247 bc
T_5 (TOWIN 50 WP)	109.7 c	108.7 c	3.957 cd
T_6(zinger rhizome extract)	113.2 ab	113.9 a	3.997 cd
T_7 (Syconazole 25SC)	112.8 b	112.8 ab	4.170 bc
T_8 (tulsi leaf extract)	112.0 bc	112.9 ab	3.920 cd
T_9 (Y-Thane M-45)	110.0 c	110.0 bc	4.290 abc
T_{10} (Control)	106.3 d	108.3 c	3.587 d
LSD $_{0.05}$	2.385	3.251	0.5031

Note: Means followed by same letter(s) in a column did not differ significantly at 5% level by LSD.

Result showed that the percent plant infection and percent panicle infection at different days after transplanting (85, 95, 105 and 115 DAT) were significantly lower in all the plots treated with fungicides and botanicals than control plot. In both cases the fungicide RAI 32.5 SC (20% Azoxystrobin + 12.5% Difenoconazole) showed highest efficacy to control this disease followed by garlic clove and neem extract. Protective, curative and antagonistic activity of different plants against variety of diseases has been reported by several workers [12, 13].

In terms of percent infected grains, the treatment with the fungicide RAI 32.5 SC (20% Azoxystrobin + 12.5% Difenoconazole) performed better at 85, 105 and 115 DAT followed by TOWIN 50 WP. The highest percentage of infected grains was observed at the untreated (control) plot. It might be due to similar findings also found by Muniraju, et al. [14]. They also observed azoxystrobin (18.2 %) + difenconozole (11.4 %) SC was most effective in reducing percent grain infection. Significantly the highest plant height, thousand grain weight and yield were found in the plot treated with RAI 32.5 SC (20% Azoxystrobin + 12.5% Difenoconazole) followed by Garlic extract. similar findings also found by many researchers [15-21] they reported that after application of fungicides due to reduction in biotic stress on plant during critical growth stages.

Ultimate findings were also supported by different researchers [22, 23]. They noticed that the application of fungicides not only increased the yield but also improved the quality of rice grain.

4. CONCLUSION

From the present investigation it may be concluded that RAI 32.5 SC (20% Azoxystrobin + 12.5% Difenoconazole) significantly reduced the percent hill, panicle, grain infection and increased the yield and thousand grain weight of rice. So, the fungicide RAI 32.5 SC could be used in controlling the false smut of rice. Garlic clove extract may also be applied as alternative options in controlling false smut of rice caused by *Ustilaginoidea virens*. Further investigation in this regard is suggested.

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