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Evaluation of the efficacy of new molecules in the management of sheath blight disease of rice

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Abstract
The six fungicides were taken under the study were Azoxystrobin 18.2% + difenoconazole 11.4% SC (Amistar top 32.5% SC), Azoxystrobin 18.2% + difenoconazole 11.4% SC, Azoxystrobin 18.2% + difenoconazole 11.4% SC, Azoxystrobin 18.2% + difenoconazole 11.4% SC, Azoxystrobin 23% SC (Amistar 25% SC), Difenoconazole 25% EC (Score 25% EC), Kitazin 48% EC (Kitazin 48% EC), Iprodione 25% + carbendazim 25% WP (Quintal), Hexaconazole 5% EC (Contaf 5% EC), with Untreated control under in vitro, pot and field conditions. In vitro evaluation shows that complete inhibition of growth of R. solani by new molecule Azoxystrobin 18.2% + Difenoconazole 11.4% SC 0.75ml dose/liter, Azoxystrobin 18.2% + Difenoconazole 11.4% SC 1.0 ml, Azoxystrobin 18.2% 1.0 ml, Difenoconazole 0.5 ml (Fig. in plates). Whereas Azoxystrobin 18.2% + Difenoconazole 11.4% SC at 1.25 ml and Azoxystrobin 18.2% + Difenoconazole 11.4% SC 2.5 ml, Kitazin 48% 2.0ml, Iprodione 25%z+Carbendazim 25% WP and Hexaconazole 5% EC showed some reduction in inhibition of R. solani. Even inhibition by Azoxystrobin 18.2% + Difenoconazole 11.4% SC at 2.5 ml was significantly higher than Azoxystrobin 18.2% + Difenoconazole 11.4% SC 1.25 ml followed by Iprodione 25%z+Carbendazim 25% WP, Kitazin 48%, Hexaconazole 5% EC, respectively. Hexaconazole 5% EC was found to be least effective among different chemicals. The pooled data for both the years od pot conditions presented in Table 12.6 indicated that the test combination fungicide (azoxystrobin 18.2% + difenoconazole 11.4% SC) was found highly effective against rice sheath blight disease at all the four concentrations tested when compared to the untreated control, wherein the severity was at the maximum (41.57%). There was significant difference among the treatments with respect to sheath blight incidence. Lowest disease severity was recorded with Azoxystrobin18.2% + difenoconazole 11.4% SC @ 1.0 ml (16.23%) followed by 0.75 ml/l (17.97%) and significantly different from the standard recommended fungicide, hexaconazole 5% EC @ 2.0 ml/l (25.25%). Azoxystrobin18.2% + difenoconazole 11.4% SC @ 2.5 ml/l (18.18%), difenoconazole 25% EC @ 0.5 ml/l (18.88%) and azoxystrobin 23% SC @ 1.0 ml/l (20.99%) were also recorded significantly lower sheath blight incidence when compared to untreated control where the disease incidence was 41.57%. Iprodione + carbendazin 50% WP and Kitazin 48% EC were also recorded significantly lower disease severity which recorded 23.41% and 25.02% disease respectively. The pooled data for both the years of field conditions presented in Table 12.7 indicated that the test combination fungicide (azoxystrobin 18.2% + difenoconazole 11.4% SC) was found highly effective against rice sheath blight disease at all the four concentrations tested when compared to the untreated control, wherein the severity was at the maximum (40.74%). There was significant difference among the treatments with respect to sheath blight incidence. Lowest disease severity was recorded with Azoxystrobin18.2% + difenoconazole 11.4% SC @ 1.0 ml (18.10%) followed by 0.75 ml/l (18.51%) and significantly different from the standard recommended fungicide, hexaconazole 5% EC @ 2.0 ml/l (26.15%). Azoxystrobin18.2% + difenoconazole 11.4% SC @ 2.5 ml/l (19.18%), difenoconazole 25% EC @ 0.5 ml/l (20.37%) and azoxystrobin 23% SC @ 1.0 ml/l (21.51%) were also recorded significantly lower sheath blight incidence when compared to untreated control where the disease severity was 40.74%. Iprodione + carbendazin 50% WP and Kitazin 48% EC were also recorded significantly lower disease severity which recorded 24.46% and 25.90% disease respectively.

Keywords: new molecules, management, sheath blight, Azoxystrobin, *in vitro*, pot and field trials

Introduction
Rice (*Oryza sativa* L.) is the major staple food for nearly fifty percent of the world‟s population and also widely cultivated throughout the world and hence, may be the most important plant on this earth. It provides 20% of the worlds dietary energy supply followed by Maize and Wheat.At least 114 countries grow rice and more than 50 have an annual production of 100,000 tonnes or more. About 90 percent of the world‟s rice is grown and consumed in Asia (Mahadevappa, 2004). Sheath blight caused by *Rhizoctonia solani* Kühn (teleomorph: *Thanatephorus cucumeris* (A.B. Frank) Donk) is a major constraint (second only

to rice blast) to rice production (Teng, Torres, Nuque, & Calvero, 1990) [5], causing 5-10% yield losses in low land tropical Asia (Willocquet *et al.*, 2004). Sheath blight is one of the major diseases that was first reported from Japan by Miyake (1910) and reported that Sclerotia irregulare was the casual organism. The presence of this disease from other parts of India in serious magnitude was also reported from Andhra Pradesh, Assam, Jammu and Kashmir, Kerala, Tamil Nadu; Orissa and West Bengal (Das, 1970), Madhya Pradesh. Yield loss ranging from 20 – 50 percent in highly susceptible cultivars was reported by several workers (Lee and Rush, 1983; Rajan and Naidu, 1986; Mizuta 1956 and Hori 1969). Ou (1972) [6] also reported 25 percent loss in grain yield due to sheath blight. The fungus affects the crop from tillering to heading stage. Initial symptoms are noticed on leaf sheaths near water level. On the leaf sheath oval or elliptical or irregular greenish grey spots are formed. As the spots enlarge, the centre becomes greyish white with an irregular blackish brown or purple brown border. Lesions on the upper parts of plants extend rapidly coalesing with each other to cover entire tillers from the water line to the flag leaf. The presence of several large lesions on a leaf sheath usually causes death of the whole leaf, and in severe cases all the leaves of a plant may be blighted in this way. The infection extends to the inner sheaths resulting in death of the entire plant. Older plants are highly susceptible. Five to six week old leaf sheaths are highly susceptible. Plants heavily infected in the early heading and grain filling growth stages prodcuce poorly filled grain, especially in the lower part of the panicle. A yield loss of 25% was reported if the flag leaves are infected.

The disease is soil borne. The fungus produces usually long cells of septate mycelium which are hyaline when young, yellowish brown when old. It produces large number of globoses sclerotia, which are initially white, later turn to brown or purplish brown. There are three types of mycelium produced: runner hyphae, lobate hyphae, and monilioid cells. Sclerotia consists of compact masses of mycelia. They are irregular, hemispherical, flattended at the bottom, white when young, and turn brown or dark brown when older. Individual scleroria are 1-6 mm in diameter. They may unite to form a large mass. Large sclerotia are significantly more virulent than smaller ones.

Hence, the disease is being managed by changing the cultural practices by one of chemical fungicide. Azoxystrobin belongs to group strobilurins or QoI fungicides which have a common mode of action to interfere with respiration and energy production in the fungal cell by blocking electron transfer at the site of quinol oxidation (the Qo site) in the cytochrome bc1 complex, thereby preventing ATP formation. Azoxystrobins move trans-laminarly and systemically through the vascular system of the plant. Some strobilurin fungicides show growth-promoting effects on treated plants, apparently by delaying leaf senescence and having water-conserving effects. Strobilurins are effective against most fungal diseases of most crops. Azoxystrobin 18.2% + Difenoconazole, Azoxystrobin, Difenoconazole, Hexaconazole, Kitazine, Iprodion+Carbendazim were the fungicides with different concentrations evaluated for study against the sheath blight disease of rice.

Materials and Methods

The experiment was conducted in randomized block design *in vivo* (field condition with three replications and pot condition with five replications) and *in vitro* with three replicaitons.

In-vitro efficacy of new molecules on *Rhizoctonia solani*

The standard poisoned food technique was employed for the evaluation of new and commonly available fungicides against *R. solani*. The six fungicides were taken under the study were Azoxystrobin 18.2% + difenoconazole 11.4% SC (Amistar top 32.5% SC), Azoxystrobin 18.2% + difenoconazole 11.4% SC, Azoxystrobin 18.2% + difenoconazole 11.4% SC, Azoxystrobin 18.2% + difenoconazole 11.4% SC, Azoxystrobin 23% SC (Amistar 25% SC), Difenoconazole 25% EC (Score 25% EC), Kitazin 48% EC (Kitazin 48% EC), Iprodione 25% + carbendazim 25% WP (Quintal), Hexaconazole 5% EC (Contaf 5% EC), with Untreated control.

These fungicides were tested for their inhibitory action against the sheath blight pathogen at different concentration level. Each fungicide was dispensed and thoroughly mixed in leukewarm potato dextrose agar medium in requisite quantity before pouring. Approximately 20 ml of PDA medium was poured in each petri plate for each fungicidal treatment. The PDA plates without fungicides were served as control. After solidification of the medium each petri dish was inoculated with 7 mm disc of 7 days old culture of *R. solani*. The plates were incubated at 28 ±2 ºC. Three replications were kept for each treatment along with untreated (control) treatment. The observation for mycelial growth were recorded at every 3 days intervals up to 30 days of the inoculation. The percent reduction of mycelial growth was calculated by using the above procedure.

Pot studies

The same above trial was repeated under pot conditions. The experiment was conducted in randomized block design with five replications. Fifty earthen pots of 9 inches height and diameter of 8.5 inches, were filled approximately with 4 kg field soil and fertilized at the rate of N100, P50, K0 kg / ha rate. Prior to this, the soil was sterilized by drenching with 4 percent formalin solution and kept open for a week. The soil thoroughly mixed and covered with polythene sheet for 48 hours. After 48 hours, the sheet was removed and the soil was allowed to dry for a day. The unwanted debris also removed from the soil, prior to the filling in pots. Twenty one days old seedlings of the rice cultivar swarn was used for transplanting at the rate of four seedlings per pot. At the time of transplanting soil was made moist. The Completely Randomized Design was followed during all the pot studies and they were conducted in the mist chamber under controlled conditions of the humidity. There were 9 treatments including control maintained in the field trial and 5 pots were maintained for each treatment as replications.

In this study also, the treatments (fungicidal sprays) were applied 48 hr after the inoculation by fine atomizers. Inoculations were done same as it was done under the field conditions. Other details of the observations were same as in the field study. Four tillers at random were assessed for each pot for measuring the total sheath and developed lesion length.

$$\text{Disease severity (\%)} = \frac{\text{Total lesion length}}{\text{Total sheath length}} \times 100$$

Field studies

Twenty one days old seedlings of the test variety (Swarna) was transplanted in 5 x 2 Sq meter plots with a spacing of one meter between plot to plot and replication to replication. The

fertilizer applied at the rate of N120 P50 K0 kg/ha. There were 9 plots for 9 treatments including control (without any treatment) in each replication.

At maximum tillering stage each plot was inoculated with 200g of seven days old *Rhizoctonia solani* inoculum profusely grown on rice stem bits. For this the rice stem bits were cut into small bits of 2 to 3 cm size, boiled and sterilized in conical flasks. These flasks were inoculated with sclerotia and incubated. The mycelial mass and sclerotia developed on these stem bits were used directly by dropping in between the hills. The treatments (fungicidal sprays) were applied 48 hr after inoculation. Applied the second spray after 15th day from 1st spray.

Disease severity was calculated as

$$\text{Disease severity \%} = \frac{\text{Total lesion length}}{\text{Total sheath length}} \times 100$$

Field trials were conducted during Kharif 2016 and 2017 seasons to evaluate the efficacy of a combination fungicide formulation having azoxystrobin 18.2% and difenoconazole 11.4% SC, azoxystrobin 23% SC, difenoconazole 25% EC, kitazin 48% EC and combination product iprodione 25%+ carbendazimm 25% WP. The trials were laid in a randomized block design with 10 treatments and four replications. Popular rice variety, Swarna (MTU-7029) which is highly susceptible to sheath blight disease was grown during kharif season of 2016 and 2017. A spacing of 15x15 cm was adopted in a gross plot size of 10.0 sq m. The combination fungicide formulation was evaluated at four different dosages (0.75 ml/l, 1.0 ml/l, 1.25 ml/l and 2.5 ml/l). Standard check fungicide that was proven to be effective against sheath blight disease viz., hexaconazole was also included. A check plot was also maintained. A pure culture of a virulent isolate of Rhizoctonia solani was multiplied on rice stem bits. Inoculation with R. solani was carried out at maximum tillering stage during both seasons. The colonized stem bits were placed between the tillers of rice plant, 5-10 cm above the water level. The data on the disease severity and Per cent disease index were collected from the date of first incidence of the disease till 30 days after final spray. The per cent disease severity was calculated from the data collected from 25 hills in each replication in each treatment as per the standard evaluation system for rice (IRRI, 1996). The disease severity data was transformed into arc sine values before statistical analysis. The grain yield was recorded from each gross plot and expressed as kg/ha. The data was subjected to statistical scrutiny and the results are furnished.

The disease was first noticed in the experimental plots at maximum tillering stage during both seasons. Two fungicidal sprays were given with 15 days interval starting from the appearance of initial disease symptoms. A spray fluid of 500 l/ha was used to ensure thorough coverage of the plants. Symptoms of phytotoxicity, if any, were also recorded at 5 and 10 days after the imposition of the treatments.

Result and Discussion

1. *In-vitro* efficacy of new molecules on *Rhizoctonia solani*

Six fungicides were assessed *in vitro* by Food Poisoned Technique to find out the most effective inhibitor for the growth of Rhizoctonia solani at different dose/liter and the result are presented in the Table 1. Three replications were maintained for each chemical and one set without any chemical served as control. Before pouring of PDA into sterilized petri dishes, each chemical was weighted in required quantity as per treatment, mixed and poured. Finally, after solidification of the medium, these petriplates were inoculated with the 5mm disc of the mycelium. The plates were incubated and observed for mycelial growth after inoculation 3rd day to 30 days.

During the year 2016, Table 1 showed complete inhibition of growth of R. solani by new molecule Azoxystrobin 18.2% + Difenoconazole 11.4% SC 0.75ml dose/liter, Azoxystrobin 18.2% + Difenoconazole 11.4% SC 1.0 ml, Azoxystrobin 18.2% 1.0 ml, Difenoconazole 0.5 ml (Fig. in plates). Whereas Azoxystrobin 18.2% + Difenoconazole 11.4% SC at 1.25 ml and Azoxystrobin 18.2% + Difenoconazole 11.4% SC 2.5 ml, Kitazin 48% 2.0ml, Iprodione 25%z+Carbendazim 25% WP and Hexaconazole 5% EC showed some reduction in inhibition of R. solani. Even inhibition by Azoxystrobin 18.2% + Difenoconazole 11.4% SC at 2.5 ml was significantly higher than Azoxystrobin 18.2% + Difenoconazole 11.4% SC 1.25 ml followed by Iprodione 25%z+Carbendazim 25% WP, Kitazin 48%, Hexaconazole 5% EC, respectively. Hexaconazole 5% EC was found to be least effective among different chemicals.

Efficacy of different chemicals against this disease were reported by different workers. Ali and Archer (2003) reported that Carbendezim, Tilt and Contaf were highly effective *in-vitro* against this pathogen. Haque (1997) reported Hinosan to be very effective under *in-vitro* condition. Acharya *et al*., (1997) reported significant reduction in growth of the fungus by Ziram, Tolcolfos-methyl, Carbendazim and Edifenphos. Bavistin was found to be most effective in inhibiting the growth and mycelial dry weight (Behra *et al*., 1982). Validamycin was found to be effective against sheath blight by several workers (Iwasa *et al*., 1971; Lue and Yang, 1979). The results obtained from the present *in-vitro* study also confirm the efficacy of new molecules on the growth of *Rhizoctonia solani*.

Table 1: Efficacy of new molecules in the management of sheath blight (*in vitro*): Design: CRD; Treatment: 10 Replication:3

Treatments		Dose/ Liter	Mycelial growth (mm)									
			3rd day	6th day	9th day	12th day	15th day	18th day	21st day	24th day	27th day	30th day
T1	Azoxystrobin 18.2% + Difenoconazole 11.4% SC (Amistar top 32.5% SC)	0.75 ml	0.0 mm	0.0 mm	0.0 mm	0.0 mm	0.0 mm	0.0 mm	0.0 mm	0.0 mm	0.0 mm	0.0 mm
T2	Azoxystrobin 18.2% + Difenoconazole 11.4% SC	1.0 ml	0.0mm	0.0mm	0.0mm	0.0mm	0.0mm	0.0mm	0.0mm	0.0mm	0.0mm	0.0mm
T3	Azoxystrobin 18.2% + Difenoconazole 11.4% SC	1.25 ml	12.99	12.99	12.99	12.99	12.99	12.99	12.99	12.99	12.99	12.99
T4	Azoxystrobin 18.2% + Difenoconazole 11.4% SC	2.5 ml	2.10	2.10	2.10	2.10	2.10	2.10	2.10	2.10	2.10	2.10
T5	Azoxystrobin 23% SC (Amistar 25% SC)	1.0 ml	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
T6	Difenoconazole 25% EC (Score 25% EC)	0.5 ml	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
T7	Kitazin 48% EC (Kitazin 48% EC)	2.0 ml	11.66	16.10	16.10	16.10	16.10	16.10	16.10	16.10	16.10	16.10
T8	Iprodione 25% + Carbendazim 25% WP (Quintal)	1.0 g	15.21	15.21	15.21	15.21	15.21	15.21	15.21	15.21	15.21	15.21
T9	Hexaconazole 5% EC (Contaf 5% EC)	2.0 ml	13.09	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0
T10	Control (Untreated)	-	24.55	57.33	85.11	90.0	90.0	90.0	90.0	90.0	90.0	90.0
	SE(m)+		0.4013	0.3756	0.6013	0.1654	0.1654	0.1654	0.1654	0.1654	0.1654	0.1654

	CD (5%)		1.1840	1.1080	1.7738	0.4879	0.4879	0.4879	0.4879	0.4879	0.4879	0.4879

12.2. Pot condition

Under the pot condition during the year 2016 the Table 2 showed that the six chemicals were also tested as per their recommended concentrations for the management of sheath blight of rice under pot condition. The treatment's effectiveness were recorded and compared on the basis of severity at each 3 days interval. Two sprays at 15 days interval were given for each treatment. All the chemicals significantly reduced the disease over control given in Table 2. Out of the total 10 observations recorded, Azoxystrobin 18.2% + Difenoconazole 11.4% SC (1.0 ml) performed superiorly in reducing the sheath blight severity (14.81%). Though there was variation in disease severity progress among the chemicals, the terminal disease severity after 7th observation remained more or less constant without any much increase clearly indicating the efficacy of the chemicals in inhibiting the progress of the disease development with the lapse of time period. The chemicals, Azoxystrobin 18.2%+Difenoconazole 11.4%SC, Azoxystrobin 23%SC, Difenoconazole 25% EC were also superior statistically in their performance over Hexaconazole 5%EC, Kitazine 48%EC and Iprodion25%+Carbendazim 25% WP. Hexaconazole 5% EC was found to be least effective (24.97%) among different chemicals. There were fluctuation in percent disease severity either in terms of increase or decrease within the chemicals between two observations without a particular trend which might be due to the proportionate growth increase of the sheath.

Several workers also reported the efficacy of new molecules on *Rhizoctonia solani* were (Iwasa, 1978; Lakshmanan *et al*., 1980; Viswanathan and Mariappan, 1980; Yamamoto, 1985; Uyeda *et al*., 1988; Anunyanart *et al*., 1986, Dev and Mary, 1986; Jones *et al*., 1987; Torabi and Binesh, 1987; Izadyar and Baradaran, 1989; Mai *et al*., 1993; Akter *et al*., 2001 and Sharma, 2002). The results obtained from the field studies and mist chamber conditions further confirm the efficacy of these new molecules in the management of the sheath blight.

Under the pot condition during the year 2017 the table 4 showed that all the six chemicals significantly reduced the disease over control. Out of the total 10 observations recorded, Azoxystrobin 18.2% + Difenoconazole 11.4% SC (1.0 ml) performed superiorly in reducing the sheath blight severity (17.65%). There was variation in disease severity progress among the chemicals. The chemicals, Azoxystrobin 18.2%+Difenoconazole 11.4%SC, Azoxystrobin 23%SC, Difenoconazole 25% EC were also superior statistically in their performance over Hexaconazole 5%EC, Kitazine 48%EC and Iprodion25%+Carbendazim 25%WP. Kitazine 48%EC was found to be least effective (25.72%) among different chemicals. There were fluctuation in percent disease severity either in terms of increase or decrease within the chemicals between two observations without a particular trend which might be due to the proportionate growth increase of the sheath.

The pooled data for both the years presented in Table 12.6 indicated that the test combination fungicide (azoxystrobin 18.2% + difenoconazole 11.4% SC) was found highly effective against rice sheath blight disease at all the four concentrations tested when compared to the untreated control, wherein the severity was at the maximum (41.57%). There was significant difference among the treatments with respect to sheath blight incidence. Lowest disease severity was recorded with Azoxystrobin18.2% + difenoconazole 11.4% SC @ 1.0 ml (16.23%) followed by 0.75 ml/l (17.97%) and significantly different from the standard recommended fungicide, hexaconazole 5% EC @ 2.0 ml/l (25.25%). Azoxystrobin18.2% + difenoconazole 11.4% SC @ 2.5 ml/l (18.18%), difenoconazole 25% EC @ 0.5 ml/l (18.88%) and azoxystrobin 23% SC @ 1.0 ml/l (20.99%) were also recorded significantly lower sheath blight incidence when compared to untreated control where the disease incidence was 41.57%. Iprodione + carbendazin 50% WP and Kitazin 48% EC were also recorded significantly lower disease severity which recorded 23.41% and 25.02% disease respectively.

With respect to sheath blight severity, all the four concentrations of test fungicide were significantly different from the untreated check in which the severity was 41.57 per cent. Lowest disease severity was recorded in the test fungicide, Azoxystrobin 18.2% + difenoconazole 11.4% SC when sprayed @ 1.0 ml (16.23%) closely followed by 0.75 ml (17.97%), 2.5 ml/l (18.18%) and 1.25 ml/l (21.86%) of the test fungicide and are at par with the recommended fungicide. Azoxystrobin 23% SC @ 1.0 ml/l, Azoxystrobin 18.2% + difenoconazole 11.4% SC @ 0.75 ml/l and Difenoconazole 25% EC @ 0.5 ml/l also gave significantly low disease severity of 20.99, 17.97 and 18.88 per cent, respectively. No phytotoxic symptoms were observed in any of the treatment plots throughout the study.

All the fungicidal treatments were significantly different from the check plot with respect to grain yield. Highest grain yield was obtained in azoxystrobin 18.2% + difenoconazole 11.4% SC @ 1.0 ml (5037.60kg/ha) followed by azoxystrobin 18.2% + difenoconazole 11.4% SC @ 0.75 ml (4768.80 kg/ha), 2.5 ml/l (4758.40 kg/ha), and 1.25 ml/l (4251.80kg/ha) respectively and at par with standard recommended fungicides azoxystrobin 23%SC (4276.50kg/ha), Difenoconazole 25% EC (4617.22kg/ha), Iprodione25%+Carbendazim 25%WP (3804.30kg/ha) and hexaconazole @ 2.0 ml/l (3740.38kg/ha).

Table 2: Efficacy of new molecules in the management of sheath blight (Pot conditions): Design – RBD; Treatments-10; Replication-5, Year-2016

Treatments		Dose/Liter	Disease severity %										PDI	Yield (Kg/ha)
			3rd day	6th day	9th day	12th day	15th day	18th day	21st day	24th day	27th day	30th day		
T1	Azoxystrobin 18.2% + Difenoconazole 11.4% SC (Amistar top 32.5% SC)	0.75 ml	3.01 (9.98)	9.64 (18.09)	12.25 (20.48)	17.18 (24.47)	19.72 (26.36)	19.12 (25.93)	18.77 (25.67)	17.82 (24.97)	17.48 (24.70)	16.87 (24.24)	11.11 (19.47)	4891.6
T2	Azoxystrobin 18.2% + Difenoconazole 11.4% SC	1.0 ml	3.09 (10.08)	5.10 (12.98)	7.09 (15.41)	8.76 (17.18)	11.12 (19.46)	11.76 (20.05)	13.19 (21.28)	14.22 (22.14)	14.81 (22.63)	14.81 (22.62)	11.11 (19.47)	5191.04
T3	Azoxystrobin 18.2% + Difenoconazole 11.4% SC	1.25 ml	3.0 (9.90)	7.16 (15.42)	10.09 (18.38)	13.58 (21.59)	15.37 (23.06)	16.17 (23.71)	17.04 (19.29)	18.16 (25.22)	19.05 (25.88)	22.28 (26.82)	19.55 (26.17)	4252.6
T4	Azoxystrobin 18.2% + difenoconazole 11.4% SC	2.5 ml	3.15 (10.17)	2.96 (9.74)	7.15 (15.47)	8.87 (17.30)	11.46 (19.76)	11.24 (19.57)	12.78 (21.11)	13.77 (21.78)	14.89 (22.69)	17.36 (24.61)	12.0 (20.22)	4871.8
T5	Azoxystrobin 23% SC	1.0 ml	3.22	6.94	11.48	12.20	14.03	14.04	14.77	15.79	17.45	19.38	17.86	4477.0

	(Amistar 25% SC)		(10.24)	(15.24)	(19.78)	(20.44)	(21.46)	(22.0)	(22.61)	(23.42)	(24.68)	(26.10)	(24.84)	
T6	Difenoconazole 25% EC (Score 25% EC)	0.5 ml	3.18 (10.25)	5.97 (14.09)	9.48 (17.83)	11.14 (19.48)	12.22 (20.46)	12.55 (20.78)	12.68 (20.86)	13.96 (21.94)	15.88 (23.48)	18.48 (25.45)	17.79 (24.79)	4673.04
T7	Kitazin 48% EC (Kitazin 48% EC)	2.0 ml	3.15 (10.14)	7.22 (15.46)	11.62 (19.89)	14.77 (22.58)	16.66 (24.04)	16.77 (24.15)	17.04 (24.36)	19.63 (26.30)	22.28 (28.16)	24.32 (29.54)	33.33 (35.26)	3755.56
T8	Iprodione 25% + Carbendazim 25% WP (Quintal)	1.0 g	2.96 (9.89)	4.67 (12.40)	10.09 (18.38)	13.47 (21.50)	15.58 (23.22)	17.80 (24.95)	19.63 (26.28)	20.56 (26.95)	21.38 (27.52)	22.35 (28.17)	26.97 (31.02)	3740.6
T9	Hexaconazole 5% EC (Contaf 5% EC)	1.0 ml	3.25 (10.36)	8.91 (17.36)	13.55 (21.59)	18.07 (25.15)	22.49 (28.31)	22.97 (28.64)	22.32 (28.19)	21.68 (27.74)	23.19 (28.78)	24.97 (29.97)	33.33 (35.26)	3724.76
T10	Control (Untreated)	-	5.03 (12.96)	12.27 (20.50)	20.23 (26.72)	23.98 (29.32)	25.67 (30.44)	27.80 (31.82)	30.14 (33.30)	35.57 (36.01)	39.53 (38.95)	41.78 (40.26)	55.56 (48.19)	2968.8
	S Em±		0.450	0.670	0.733	0.476	0.395	0.316	0.450	0.317	0.355	0.355	1.173	
	CD (5%)		1.2905	1.92280	2.10197	1.365150	1.131775	0.907436	1.290500	0.908349	1.017618	1.018629	3.364385	

Average of 5 replications * Figures in parenthesis are Arc sine transformed values

Table 3: Efficacy of new molecules in the management of sheath blight (Pot conditions): Design – RBD; Treatments-10; Replication-5, Year-2017

Treatments		Dose/Liter	Disease severity %										PDI	Yield (Kg/ha)
			3rd day	6th day	9th day	12th day	15th day	18th day	21st day	24th day	27th day	30th day		
T1	Azoxystrobin 18.2% + Difenoconazole 11.4% SC (Amistar top 32.5% SC)	0.75 ml	2.74 (9.51)	5.50 (13.52)	10.22 (18.66)	15.75 (23.37)	20.53 (26.94)	20.28 (26.76)	19.34 (26.08)	19.12 (25.92)	19.07 (25.89)	19.07 (25.89)	11.11 (19.47)	4646.0
T2	Azoxystrobin 18.2% + Difenoconazole 11.4% SC	1.0 ml	3.17 (10.25)	6.69 (14.52)	8.06 (16.50)	11.57 (19.87)	14.06 (22.02)	14.96 (22.75)	16.62 (24.04)	17.44 (24.67)	17.65 (24.83)	17.65 (24.83)	11.11 (19.47)	4884.16
T3	Azoxystrobin 18.2% + Difenoconazole 11.4% SC	1.25 ml	2.90 (9.80)	5.35 (13.33)	8.57 (16.99)	12.12 (20.35)	14.85 (22.62)	15.23 (22.96)	16.08 (23.63)	17.43 (24.72)	19.53 (26.21)	21.43 (27.49)	25.55 (29.87)	4251.0
T4	Azoxystrobin 18.2% + Difenoconazole 11.4% SC	2.5 ml	3.06 (9.85)	4.32 (11.99)	6.59 (14.85)	9.51 (17.95)	12.47 (20.67)	12.50 (20.70)	13.24 (21.33)	15.55 (23.22)	17.17 (24.47)	18.99 (25.79)	12.22 (20.39)	4645.0
T5	Azoxystrobin 23% SC (Amistar 25% SC)	1.0 ml	2.67 (9.33)	5.35 (13.35)	8.50 (16.93)	11.52 (19.82)	16.27 (23.78)	16.20 (23.72)	16.46 (23.92)	17.50 (24.72)	20.52 (26.92)	22.59 (28.37)	29.99 (33.03)	4076.0
T6	Difenoconazole 25% EC (Score 25% EC)	0.5 ml	3.94 (11.40)	5.64 (13.63)	9.37 (17.79)	12.29 (20.49)	13.85 (21.83)	14.59 (22.43)	14.75 (22.56)	16.12 (23.67)	16.77 (24.16)	19.28 (26.03)	16.67 (23.55)	4561.40
T7	Kitazin 48% EC (Kitazin 48% EC)	2.0 ml	4.37 (11.92)	8.92 (17.37)	13.03 (21.11)	15.69 (23.32)	18.97 (25.82)	19.22 (26.0)	19.86 (26.45)	21.13 (27.36)	23.58 (29.05)	25.72 (30.47)	33.33 (35.26)	3732.0
T8	Iprodione 25% + Carbendazim 25% WP (Quintal)	3.0 g	3.15 (10.61)	4.89 (12.77)	10.17 (18.58)	14.16 (22.08)	16.34 (23.83)	18.88 (25.73)	20.80 (27.12)	22.72 (28.46)	23.22 (28.80)	24.46 (29.63)	33.33 (35.26)	3868.0
T9	Hexaconazole 5% EC (Contaf 5% EC)	3.0 ml	5.81 (14.18)	8.57 (17.0)	14.22 (21.80)	18.95 (25.80)	23.69 (19.12)	23.89 (29.25)	23.19 (28.78)	23.28 (28.84)	23.50 (28.86)	25.52 (30.34)	33.33 (35.26)	3756.0
T10	Control (Untreated)	-	8.88 (17.33)	13.22 (21.32)	17.15 (24.47)	20.90 (27.19)	24.82 (29.88)	27.0 (31.31)	29.87 (33.13)	32.77 (34.80)	36.76 (36.84)	41.35 (40.01)	55.56 (48.19)	2792.0
	S Em±		0.515	0.474	0.495	0.478	0.411	0.383	0.429	0.404	0.379	0.389	1.542	
	CD (5%)		1.478175	1.358935	1.419028	1.369460	1.179096	1.097873	1.230360	1.159946	1.087942	1.114742	4.422270	

Figures in parenthesis are Arc sine transformed values

Table 4: Efficacy of new molecules in the management of sheath blight (Pot conditions) (Pooled data of two years) Design –RBD; Treatments-10; Replication-5

Treatments		Dose/Liter	Disease severity %										PDI	Yield (Kg/ha)
			3rd day	6th day	9th day	12th day	15th day	18th day	21st day	24th day	27th day	30th day		
T1	Azoxystrobin 18.2% + Difenoconazole 11.4% SC (Amistar top 32.5% SC)	0.75 ml .	2.88 (9.71)	7.57 (15.96)	11.24 (11.25)	16.47 (23.93)	20.13 (26.65)	19.70 (26.35)	19.06 (25.88)	18.47 (25.45)	18.28 (25.30)	17.97 (25.08)	11.11 (19.47)	4768.80
T2	Azoxystrobin 18.2% + Difenoconazole 11.4% SC	1.0 ml	3.13 (10.18)	5.90 (13.79)	7.58 (7.58)	10.17 (18.58)	12.59 (20.78)	13.36 (21.44)	14.91 (22.70)	15.83 (23.43)	16.23 (23.76)	16.23 (23.76)	11.11 (19.47)	5037.60
T3	Azoxystrobin 18.2% + Difenoconazole 11.4% SC	1.25 ml	2.95 (9.88)	6.26 (14.44)	9.33 (9.34)	12.85 (20.99)	15.11 (22.85)	15.70 (23.34)	16.56 (24.0)	17.80 (24.97)	19.29 (26.05)	21.86 (27.16)	22.55 (28.18)	4251.80
T4	Azoxystrobin 18.2% + difenoconazole 11.4% SC	2.5 ml	3.11 (10.02)	3.64 (10.96)	6.87 (6.87)	9.19 (17.64)	11.97 (20.23)	11.87 (20.15)	13.01 (21.22)	14.66 (22.51)	16.03 (23.59)	18.18 (25.21)	12.11 (20.34)	4758.40
T5	Azoxystrobin 23% SC (Amistar 25% SC)	1.0 ml	2.95 (9.85)	6.15 (14.34)	9.99 (9.99)	11.86 (20.14)	15.15 (22.65)	15.12 (22.88)	15.62 (23.27)	16.65 (24.08)	18.99 (25.83)	20.99 (27.26)	23.93 (29.21)	4276.50
T6	Difenoconazole 25% EC (Score 25% EC)	0.5 ml	3.56 (10.86)	5.81 (13.89)	9.43 (9.40)	11.72 (20.0)	13.04 (21.16)	13.57 (21.61)	13.72 (21.73)	15.04 (22.82)	16.33 (23.83)	18.88 (25.75)	17.23 (24.44)	4617.22
T7	Kitazin 48% EC (Kitazin 48% EC)	2.0 ml	3.76 (11.09)	8.07 (16.48)	12.33 (12.33)	15.23 (22.96)	17.82 (24.95)	18.00 (25.09)	18.45 (25.43)	20.38 (26.84)	22.93 (28.61)	25.02 (30.01)	33.33 (35.26)	3743.78
T8	Iprodione 25% + Carbendazim 25% WP (Quintal)	1.0g	3.06 (10.30)	4.78 (12.62)	10.13 (10.13)	13.82 (21.81)	15.96 (23.54)	18.34 (25.35)	20.22 (26.71)	21.64 (27.72)	22.30 (28.17)	23.41 (28.91)	30.15 (33.25)	3804.30
T9	Hexaconazole 5% EC (Contaf 5% EC)	2.0 ml	4.53 (12.43)	8.74 (17.19)	13.69 (13.69)	18.51 (25.48)	23.09 (28.72)	23.43 (28.95)	22.76 (28.49)	22.48 (28.30)	23.35 (28.82)	25.25 (30.16)	33.33 (35.26)	3740.38
T10	Control (Untreated)	-	6.96 (15.29)	12.75 (20.92)	18.69 (18.69)	22.44 (28.27)	25.25 (30.16)	27.40 (31.57)	30.01 (33.21)	34.17 (35.41)	38.15 (37.90)	41.57 (40.14)	55.56 (48.19)	2880.40
	SEm		0.365	0.453	0.499	0.381	0.311	0.234	0.283	0.249	0.244	0.259	0.900	
	CD (5%)		1.04678	1.299498	1.429759	1.091530	0.893015	0.672264	0.8127221	0.714240	0.699279	0.7422851	2.580770	

Figures in parenthesis are Arc sine transformed values

Field conditions

During the year 2016 six molecules were evaluated for their efficacy against sheath blight disease (Plate). The disease severities after 10 days of each observation have been given in Table 3.

After the two spray of fungicides, the observation on the 30th day showed in the Table 3 that the disease severity was least in Azoxystrobin 18.2% + Difenoconazole 11.4% SC 1.0 ml dose/lit. (17.92 %) followed by Azoxystrobin 18.2% + Difenoconazole 11.4% SC 0.75 ml (18.49%), Azoxystrobin 18.2% + Difenoconazole 11.4% SC 2.5 ml (19.13%), Difenoconazole 25% EC (20.31%), Azoxystrobin23%SC (21.40%), Azoxystrobin 18.2% + Difenoconazole 11.4% SC 1.25ml (21.81%), Iprodione25%+Carbendazim25%WP (24.30%), Kitazine 48% EC (25.82%) and Hexaconazole 5% EC (26.20%). All the chemicals tested were significantly effective in minimizing the disease severity. The control treatment recorded 40.10 per cent severity. Among the chemicals at this stage of observation there was also statistical difference in severity reduction. Azoxystrobin 18.2% + Difenoconazole 11.4% SC (1.0 ml) showed superior efficacy in comparision to any of the chemical tested. There were fluctuation in percent disease severity either in terms of increase or decrease within the chemicals between two observations. A wide range of fungicides were found to be effective in reducing this disease severity. Chemicals like Azoxystrobin 18.2% + Difenoconazole 11.4% SC, Azoxystrobin 23% SC, Difenoconazole 25% EC, Iprodione 25% + Carbendazim 25% WP, Kitazine 48% EC and Hexaconazole 5%EC were found to be most effective against this disease over control in the present studies. Efficacy of different chemicals in reducing this disease reported by several workers. Carbendazim were reported to be most promising in the management of sheath blight.

Torabi and Binesh (1987) reported that Iprodione + Carbendazim and Validamycin effectively decreased the disease. In the field experiments conducted by Vanitha and Thagamani Naryanswamy (1992) at Coimbatore, Tilt and Contaf were found to be superior to control in reducing the disease. Under Chhattisgarh region, Tiwari (1997) reported maximum disease control by Hexaconazole followed by Edifenphos. Contaf and Hinosan were reported to significantly effective reducing the disease severity by Haque (1997).

Chahal *et al*. (2003) reported the efficacy of Tilt, Hinosan and Carbendazim against this disease, where as Hossain and Mia (2001) reported the efficacy of Carbendazim and Tilt with two additional doses of murate of potash i.e. 20 and 40 Kg / ha against sheath blight of rice. The present findings are also corroborating with these reports.

During the year 2017 six molecules were evaluated for their efficacy against sheath blight disease (Plate). The disease severities after 10 days of each observation have been given in Table 3.

After the two spray of fungicides, the observation on the 30th day showed in the Table 3 that the disease severity was least in Azoxystrobin 18.2% + Difenoconazole 11.4% SC 1.0 ml dose/lit. (18.27 %) followed by Azoxystrobin 18.2% + Difenoconazole 11.4% SC 0.75 ml (18.52%), Azoxystrobin 18.2% + Difenoconazole 11.4% SC 2.5 ml (19.23%), Difenoconazole25%EC (20.42%), Azoxystrobin23%SC (21.62%), Azoxystrobin 18.2% + Difenoconazole 11.4% SC 1.25ml (21.84%), Iprodione25%+Carbendazim25%WP (24.61%), Kitazine 48%EC (25.98%) and Hexaconazole 5%EC (26.10%). All the chemicals tested were significantly effective in minimizing the disease severity. The control treatment recorded 41.37 per cent severity. Among the chemicals at this stage of observation there was also statistical difference in severity reduction. Azoxystrobin 18.2% + Difenoconazole 11.4% SC (1.0 ml) showed superior efficacy in comparision to any of the chemical tested. There were fluctuation in percent disease severity either in terms of increase or decrease within the chemicals between two observations. A wide range of fungicides were found to be effective in reducing this disease severity.

The pooled data for both the years presented in Table 12.7 indicated that the test combination fungicide (azoxystrobin 18.2% + difenoconazole 11.4% SC) was found highly effective against rice sheath blight disease at all the four concentrations tested when compared to the untreated control, wherein the severity was at the maximum (40.74%). There was significant difference among the treatments with respect to sheath blight incidence. Lowest disease severity was recorded with Azoxystrobin18.2% + difenoconazole 11.4% SC @ 1.0 ml (18.10%) followed by 0.75 ml/l (18.51%) and significantly different from the standard recommended fungicide, hexaconazole 5% EC @ 2.0 ml/l (26.15%). Azoxystrobin18.2% + difenoconazole 11.4% SC @ 2.5 ml/l (19.18%), difenoconazole 25% EC @ 0.5 ml/l (20.37%) and azoxystrobin 23% SC @ 1.0 ml/l (21.51%) were also recorded significantly lower sheath blight incidence when compared to untreated control where the disease severity was 40.74%. Iprodione + carbendazin 50% WP and Kitazin 48% EC were also recorded significantly lower disease severity which recorded 24.46% and 25.90% disease respectively.

With respect to sheath blight severity, all the four concentrations of test fungicide were significantly different from the untreated check in which the severity was 40.74 per cent. Lowest disease severity was recorded in the test fungicide, Azoxystrobin 18.2% + difenoconazole 11.4% SC when sprayed @ 1.0 ml (18.10%) closely followed by 0.75 ml (18.51%) and 2.5 ml/l (19.18%) of the test fungicide and are at par with the recommended fungicide. Azoxystrobin 23% SC @ 1.0 ml/l, Azoxystrobin 18.2% + difenoconazole 11.4% SC @ 0.75 ml/l and Difenoconazole 25% EC @ 0.5 ml/l also gave significantly low disease severity of 21.51, 18.51 and 20.37 per cent, respectively. No phytotoxic symptoms were observed in any of the treatment plots throughout the study.

All the fungicidal treatments were significantly different from the check plot with respect to grain yield. Highest grain yield was obtained in azoxystrobin 18.2% + difenoconazole 11.4% SC @ 1.0 ml (4632.28kg/ha) followed by azoxystrobin 18.2% + difenoconazole 11.4% SC @ 0.75 ml (4622.0 kg/ha), 2.5 ml/l (4668.40 kg/ha), and 1.25 ml/l (3940.38kg/ha) respectively and at par with standard recommended fungicides azoxystrobin 23%SC (4131.30kg/ha), Difenoconazole 25% EC (4354.13kg/ha), Iprodione25%+Carbendazim 25%WP (3767.45kg/ha) and hexaconazole @ 2.0 ml/l (3642.03kg/ha).

In the present studies, a new combination fungicide azoxystrobin 18.2% + difenoconazole 11.4% SC @ 0.75 ml/l and 1.0 ml/l was the most effective with the least disease severity. The other test concentrations of azoxystrobin 18.2% + difenoconazole 11.4% SC also recorded significantly low disease over control. Efficacy of propiconazole + difenconazole 30 EC followed by contaf (hexaconazole) was found very effective by other workers in reducing the disease. Singh and Sinha (2004) reported that contaf was effective for decreasing the disease severity, increasing the grain yield and 1000 grain weight as 23.5%, 60.9%, 34.2 g/plant and 29.3g

respectively as against 74.7%, 95.6%, 24.4g/plant and 25.5 in control. Thangasamy and Rangaswamy (1989) studied the efficacy of carbendazim and mancozeb in the control of thisdisease by applying them at different stages of crop growth like panicle initiation (65 days of sowing) or 80 days of sowing and found them effective in controlling the disease development. Earlier researchers have also reported the effectiveness of thiafluzamide and hexaconazole in suppressing the disease (Sunder *et al*. 2003). Krishnam Raju *et al*. (2008) reported the efficacy of hexaconazole 5 EC @ 2.0 ml/l, propiconazole 25 EC @ 1.0 ml/l and tebuconazole 25 EC @ 1.5 g/l against sheath blight of rice. Several other workers like Bhattacharya and Roy (1998) demonstrated the use of different chemicals such as phytoalexins inducers in rice plants, effective against sheath blight of rice where as Dantre *et al*., (2003) reported that SA (Salicylic acid), BABA (DL-amino-n-butyric-acid) and GABA (g-amino-n-butyric-acid) strongly suppressed the lesion size of sheath blight when tested on excised rice leaf under *in-vitro* conditions.

Azoxystrobin belongs to group strobilurins or QoI fungicides which have a common mode of action to interfere with respiration and energy production in the fungal cell by blocking electron transfer at the site of quinol oxidation (the Qo site) in the cytochrome bc1 complex, thereby preventing ATP formation. Azoxystrobins move trans-laminarly and systemically through the vascular system of the plant. Some strobilurin fungicides show growth-promoting effects on treated plants, apparently by delaying leaf senescence and having water-conserving effects. Strobilurins are effective against most fungal diseases of most crops. The study revealed that Amistar Top 32.5 SC was found effective against sheath blight of rice when sprayed at effective concentration of 1.0 ml/l.

Similar work was done by Bhuvaneswari and Raju (2012) [1], Johnson *et al.* (2013) [2], Laxmikant *et al*. (2017) [3], Pramesh *et al*. (2017) [4], Reddy and Krishnaiah (1997), UD Singh *et al.* (2013).

Table 5: Efficacy of new molecules in the management of sheath blight (Field condition): Design – RBD; Treatments-10; Replication-4, Year-2016

Treatments		Dose/Liter	Disease severity %										PDI	Yield (Kg/ha)
			3rd day	6th day	9th day	12th day	15th day	18th day	21st day	24th day	27th day	30th day		
T1	Azoxystrobin 18.2% + Difenoconazole 11.4% SC (Amistar top 32.5% SC)	0.75 ml	2.81 (9.53)	6.63 (14.78)	11.11 (19.42)	15.95 (23.54)	20.64 (27.02)	20.10 (26.79)	19.46 (26.18)	19.30 (26.06)	18.97 (25.66)	18.49 (25.46)	12.44 (20.58)	4536.25
T2	Azoxystrobin 18.2% + Difenoconazole 11.4% SC	1.0 ml	3.11 (10.16)	5.38 (13.41)	7.47 (15.86)	10.77 (19.01)	13.90 (21.89)	14.98 (22.77)	16.43 (23.91)	17.28 (24.56)	17.92 (25.22)	17.92 (25.04)	11.11 (19.47)	4560.25
T3	Azoxystrobin 18.2% + Difenoconazole 11.4% SC	1.25 ml	2.95 (9.90)	6.95 (15.27)	9.43 (17.89)	12.98 (21.12)	14.84 (22.67)	15.38 (23.06)	16.24 (23.76)	17.54 (24.76)	18.90 (25.74)	21.81 (27.83)	25.35 (30.04)	3661.0
T4	Azoxystrobin 18.2% + Difenoconazole 11.4% SC	2.5 ml	3.27 (10.41)	3.52 (10.77)	5.28 (13.28)	8.36 (16.80)	12.31 (20.54)	12.11 (20.33)	13.45 (21.48)	15.19 (22.93)	16.93 (24.28)	19.13 (25.93)	12.44 (20.58)	4400.05
T5	Azoxystrobin 23% SC (Amistar 25% SC)	1.0 ml	2.48 (9.05)	4.64 (12.40)	7.01 (15.35)	11.88 (20.16)	15.89 (23.48)	15.83 (23.44)	15.99 (23.57)	17.57 (24.76)	19.32 (26.07)	21.40 (27.53)	22.66 (27.99)	4032.0
T6	Difenoconazole 25% EC (Score 25% EC)	0.5 ml	4.09 (16.67)	7.23 (15.59)	10.37 (18.78)	13.84 (21.84)	14.36 (22.25)	14.68 (22.50)	14.91 (22.68)	15.83 (23.41)	17.85 (24.99)	20.31 (26.78)	17.33 (24.18)	4305.75
T7	Kitazin 48% EC (Kitazin 48% EC)	2.0 ml	4.43 (12.15)	7.69 (16.09)	11.30 (19.62)	14.59 (22.46)	17.22 (24.51)	17.32 (24.59)	17.84 (24.98)	20.10 (26.64)	22.94 (28.61)	25.82 (30.51)	30.89 (33.75)	3600.8
T8	Iprodione 25% + carbendazim 25% WP (Quintal)	1.0g	2.80 (9.64)	4.87 (12.75)	9.67 (18.12)	12.16 (20.41)	15.20 (22.94)	18.10 (25.23)	20.96 (27.24)	22.63 (28.40)	23.44 (28.96)	24.30 (29.52)	32.22 (34.58)	3719.3
T9	Hexaconazole 5% EC (Contaf 5% EC)	2.0 ml	5.68 (13.79)	9.50 (17.97)	14.08 (22.04)	19.38 (26.12)	23.44 (28.93)	23.91 (29.25)	23.19 (28.78)	22.37 (28.23)	24.50 (29.67)	26.20 (30.79)	33.34 (35.27)	3640.0
T10	Control (Untreated)		6.13 (14.34)	10.34 (18.75)	16.13 (23.68)	20.31 (26.78)	24.41 (29.58)	27.39 (31.55)	30.22 (33.34)	34.51 (36.05)	37.53 (37.78)	40.10 (39.29)	55.56 (48.19)	3031.70
	S Em±		0.296	0.500	0.350	0.199	0.449	0.411	0.427	0.390	0.343	0.577	1.854	75.177
	CD (5%)		0.857669	1.450043	1.014882	0.578451	1.304054	1.191612	1.239384	1.13072050	0.9943446	1.67507515	5.379064	218.110392

Figures in parenthesis are Arc sine transformed values

Table 6: Efficacy of new molecules in the management of sheath blight (Field condition): Design – RBD Table; Treatments-10; Replication-4, Year-2017

Treatments		Dose/Liter	Disease severity %										PDI	Yield (Kg/ha)
			3rd day	6th day	9th day	12th day	15th day	18th day	21st day	24th day	27th day	30th day		
T1	Azoxystrobin 18.2% + Difenoconazole 11.4% SC (Amistar top 32.5% SC)	0.75 ml	2.87 (9.71)	6.73 (14.99)	11.48 (19.78)	17.08 (24.40)	20.81 (27.13)	20.45 (26.88)	19.59 (26.26)	19.31 (26.06)	19.10 (25.90)	18.52 (25.48)	12.00 (20.23)	4707.75
T2	Azoxystrobin 18.2% + Difenoconazole 11.4% SC	1.0 ml	3.36 (10.54)	5.25 (13.23)	7.58 (15.97)	10.72 (19.09)	14.11 (22.05)	15.08 (22.84)	16.78 (24.15)	17.51 (24.71)	18.27 (25.28)	18.27 (25.28)	13.11 (21.17)	4704.30
T3	Azoxystrobin 18.2% + Difenoconazole 11.4% SC	1.25 ml	3.20 (10.29)	6.49 (14.67)	9.55 (17.95)	13.35 (21.40)	15.11 (22.86)	15.54 (23.20)	16.39 (23.86)	17.50 (24.70)	19.17 (25.94)	21.84 (27.84)	20.44 (26.44)	4219.75
T4	Azoxystrobin 18.2% + Difenoconazole 11.4% SC	2.5 ml	3.30 (10.43)	3.45 (10.68)	5.46 (13.47)	8.63 (17.07)	12.58 (20.76)	12.35 (20.56)	13.59 (21.61)	15.39 (23.09)	17.16 (24.46)	19.23 (25.99)	12.89 (20.99)	4536.75
T5	Azoxystrobin 23% SC (Amistar 25% SC)	1.0 ml	2.68 (9.31)	4.49 (12.19)	7.37 (15.71)	12.16 (20.38)	16.57 (24.0)	16.46 (23.91)	16.62 (24.04)	17.99 (25.08)	19.65 (26.30)	21.62 (27.69)	25.11 (29.65)	4230.60
T6	Difenoconazole 25% EC (Score 25% EC)	0.5 ml	3.94 (11.39)	6.83 (15.05)	10.38 (18.75)	13.76 (21.73)	14.53 (22.38)	14.75 (22.56)	15.06 (22.80)	15.81 (23.40)	17.90 (25.02)	20.42 (26.84)	19.56 (25.70)	4402.50
T7	Kitazin 48% EC (Kitazin 48% EC)	2.0 ml	4.89 (12.75)	9.02 (17.46)	12.10 (20.35)	16.55 (23.99)	19.14 (25.94)	19.44 (26.15)	19.95 (26.51)	21.13 (27.34)	23.74 (29.15)	25.98 (30.64)	33.33 (35.26)	3616.95
T8	Iprodione 25% + Carbendazim 25% WP	1.0g	2.74 (9.42)	5.17 (13.12)	9.98 (18.40)	13.18 (21.25)	16.54 (23.97)	19.10 (25.89)	21.10 (27.33)	22.92 (28.58)	23.24 (28.81)	24.61 (29.73)	30.44 (33.39)	3815.60

	(Quintal)														
T9	Hexaconazole 5% EC (Contaf 5% EC)	2.0 ml	5.96 (14.12)	9.86 (18.27)	13.94 (21.94)	19.26 (26.01)	23.60 (29.06)	24.10 (29.39)	23.36 (28.89)	22.52 (28.31)	23.85 (29.22)	26.10 (30.71)	33.33 (35.26)	3644.05
T10	Control (Untreated)		9.03 (17.47)	12.15 (20.39)	16.67 (24.09)	20.68 (27.03)	25.0 (30.0)	27.30 (31.49)	30.13 (33.29)	32.75 (34.91)	37.61 (37.82)	41.37 (40.03)	55.56 (48.19)	3048.45
	S Em±	0.503	0.627	0.572	0.600	0.487	0.522	0.549	0.572	0.505	0.518	1.908	107.550	
	CD (5%)	1.4605935	1.8192840	1.660745	1.741367	1.413473	1.513784	1.591594	1.660780	1.4643843	1.5022096	5.534541	312.03396	

Figures in parenthesis are Arc sine transformed values

Table 7: Efficacy of new molecules in the management of sheath blight (Field condition): (Pooled data of two years) Design – RBD; Treatments-10; Replication-4

Treatments		Dose/ Liter	Disease severity %										PDI	Yield (Kg/ha)
			3rd day	6th day	9th day	12th day	15th day	18th day	21st day	24th day	27th day	30th day		
T1	Azoxystrobin 18.2% + Difenoconazole 11.4% SC (Amistar top 32.5% SC)	0.75 ml.	2.84 (9.64)	6.68 (14.91)	11.30 (19.61)	16.52(23.98)	20.73 (27.08)	20.28 (26.84)	19.53 (26.22)	19.31 (26.06)	19.04 (25.79)	18.51 (25.47)	12.22 (20.44)	4622.00
T2	Azoxystrobin 18.2% + Difenoconazole 11.4% SC	1.0 ml	3.24 (10.36)	5.32 (13.33)	7.53 (15.92)	10.75 (19.06)	14.01 (21.98)	15.03 (22.81)	16.61 (24.04)	17.40 (24.64)	18.10 (25.25)	18.10 (25.15)	12.11 (20.35)	4632.28
T3	Azoxystrobin 18.2% + Difenoconazole 11.4% SC	1.25 ml	3.08 (10.10)	6.72 (15.15)	9.49 (17.94)	13.17 (21.27)	14.98 (22.77)	15.46 (23.15)	16.32 (23.82)	17.52 (24.74)	19.04 (25.86)	21.83 (27.85)	22.90 (28.55)	3940.38
T4	Azoxystrobin 18.2% + difenoconazole 11.4% SC	2.5 ml	3.29 (10.43)	3.49 (10.75)	5.37 (13.39)	8.50 (16.94)	12.45 (20.65)	12.23 (20.47)	13.52 (21.56)	15.29 (23.02)	17.05 (24.38)	19.18 (25.97)	12.67 (20.83)	4468.40
T5	Azoxystrobin 23% SC (Amistar 25% SC)	1.0 ml	2.58 (9.22)	4.57 (12.32)	7.19 (15.55)	12.02 (20.27)	16.23 (23.75)	16.15 (23.68)	16.31 (23.81)	17.78 (24.93)	19.49 (26.19)	21.51 (27.62)	23.89 (29.12)	4131.30
T6	Difenoconazole 25% EC (Score 25% EC)	0.5 ml	4.02 (11.54)	7.03 (15.35)	10.38 (18.79)	13.80 (21.80)	14.45 (22.33)	14.72 (22.55)	14.99 (22.76)	15.82 (23.43)	17.88 (25.01)	20.37 (26.82)	18.45 (25.26)	4354.13
T7	Kitazin 48% EC (Kitazin 48% EC)	2.0 ml	4.66 (12.46)	8.36 (16.79)	11.70 (19.99)	15.57 (23.24)	18.18 (25.23)	18.38 (25.38)	18.90 (25.76)	20.62 (27.0)	23.34 (28.89)	25.90 (30.58)	32.11 (34.51)	3608.88
T8	Iprodione 25% + Carbendazim 25% WP (Quintal)	1.0 g	2.77 (9.56)	5.02 (12.94)	9.83 (18.26)	12.67 (20.84)	15.87 (23.49)	18.60 (25.57)	21.03 (27.30)	22.78 (28.50)	23.34 (28.88)	24.46 (29.63)	31.33 (34.02)	3767.45
T9	Hexaconazole 5% EC (Contaf 5% EC)	2.0 ml	5.82(13.96)	9.68 (18.14)	14.01 (22.0)	19.32 (26.07)	23.52 (29.0)	24.01 (29.33)	23.28 (28.84)	22.45 (28.27)	24.18 (29.45)	26.15 (30.76)	33.34 (35.27)	3642.03
T10	Control (Untreated)	-	7.58 (15.98)	11.25 (19.59)	16.40 (23.89)	20.50 (26.91)	24.71 (29.80)	27.35 (31.53)	30.18 (33.32)	33.63 (35.48)	37.57 (37.80)	40.74 (39.66)	29.10 (48.19)	3040.08
	SEm		0.324	0.441	0.360	0.306	0.338	0.303	0.330	0.334	0.295	0.363	1.001	
	CD (5%)		0.9400674	1.278424	1.043965	0.8873938	0.981018	0.8777351	0.9567666	0.9675869	0.8547861	1.0522646	2.9027486	

Figures in parenthesis are Arc sine transformed values

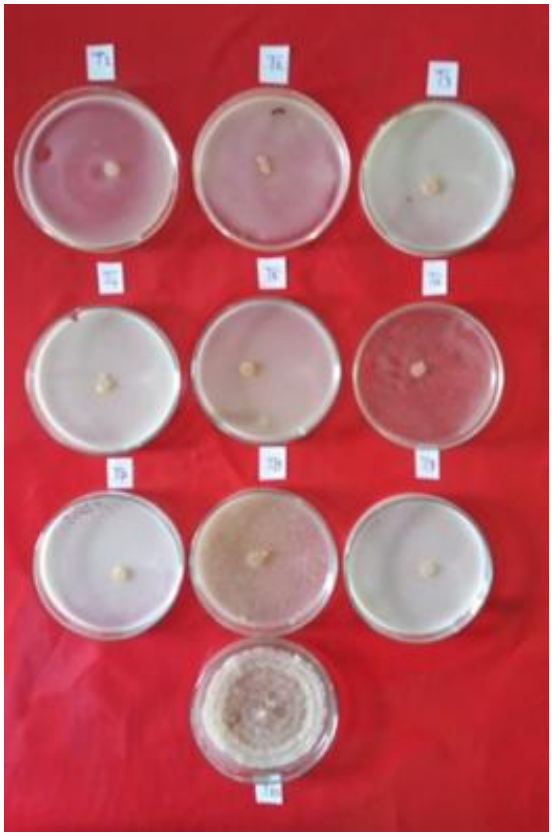

Fig 1: Type of graph

Fig 2: Type of graph

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