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# Evaluation of different rice genotype against rice gall midge, *Orseolia oryzae* (Wood-Mason)

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**Abstract**
The experimental results of field screening of 20 rice genotype against gall midge revealed that, the overall mean values of silver shoot of the two years' of investigations, the least percentages of silver shoot (2.48% SS) was recorded in case of Kavya, which remained at par with those of BVS-I (2.94% SS), Suraksha (3.08%SS), and IR-36 (3.55%SS) followed by Akshay Dhan (3.89%SS), Lalat (3.99%SS), Naveen (4.88%SS), CR Dhan-303 (4.15%SS) and IR-20 (4.28%SS) all receiving below 5 percent silver shoot as against the highest incidence of 16.92 percent of SS in case of the susceptible variety, TN-I in the present studies As such considerably higher grain yields of rice grains were obtained. The test genotype could be arranged in descending order of: Achhay Dhan (61.15 q/ha) > Advanta-801$^{+}$ (59.30 q/ha) > CR Dhan -205 (52.58 q/ha) > CR Dhan – 303 (51.16 q/ha) > Lalat (50.95 q/ha) > IR-36 (50.34 q/ha) > Abhisek (49.78 q/ha) in terms of grains yields and all these seven genotype remained statistically at par and TN-1 appeared as susceptible to gall midge.

**Keywords:** Variety, pest, gall midge, silver shoot, damage, resistant

## Introduction
Rice is the leading food crop and a staple food for 40% of the world population. More than 90% of rice is produced and consumed in Asia [1, 2]. It is grown under a wide range of agro climatic conditions. In India, rice is the most important cereal food crop for more than 65 per cent of population dependent on rice [3]. India has the largest area among the rice growing countries covering about one-fourth of the total cropped area of India. In the Jharkhand state has approximately 17 lakh hectare lands covered by *Kharif* rice and production and productivity are 5614.931thousand tone and 3315 kg per hectare, respectively in the state of Jharkhand [4]. Currently, there are six biotypes of rice gall midge prevalent in our country; biotype 3 is present in Ranchi [5, 6]. The maggot enters inside the young rice plant and starts feeding on growing point of plants. As a result, the meristematic tissue grows and encloses the feeding insect inside. The meristematic tissue as it grows, turns into a pale green tubular structure called "silver shoot". The larvae (maggot) pupate inside the silver shoot and emerges as adult from the top portion of silver shoot. The damaged tiller does not bear panicle. The crop under severe infestation is stunted with more numerous tillers [6, 7, 8]. These new tillers are also eventually attacked resulting in almost 80 to 90 % loss under severe infestation if the weather conditions are congenial for the pest species. s [9]. HPR is an important tool of IPM, because pest can be easily managed by raising pest resistant or tolerant variety for sustainable crop production. HPR is not only environment friendly but also it is cost effective. Resource poor farmers cannot afford the expenses incurred on the insecticidal inputs to protect their crop. They need pest resistant or tolerant rice genotype to realize better and higher yields of grains without use of pesticide application for sustainable rice production. Although a number of gall midge resistant genotype are released, their spread is hampered due to the problem of biotypes of the pest meaning thereby resistant rice genotype against one–biotype of the same species may exhibit as susceptible for another bio-type of the gall midge (*O. oryzae*). Use of resistant genotype of rice is highly feasible for eco-friendly management of rice pests. The experiment was conducted in the consecutive two years 2016 and 2017 in the field conditions. Therefore, attempts were made to use of HPR for identification of resistant/tolerant rice genotype will help to reduce/minimize the yields loss for sustainable production of rice for ensuring food security.

## Methods and Materials

The experiment to evaluate certain rice genotype for their relative resistance against gall midge was conducted at the rice research farm, B.A.U, Kanke Ranchi, Jharkhand during *Kharif* 2016 and 2017, the brief description of which is given, here, as under:

| **Detail of the field experiment, conducted during *Kharif* 2016 and 2017** | | |
|---|---|---|
| Design | : | RBD (Randomized block design) |
| Rice genotype | : | 20 |
| Replications | : | 3 |
| Spacing (plant to plant) | : | 15 cm |
| Spacing (row to row) | : | 20 cm |
| Plot size | : | 5 x 4 m |
| N:P: K | : | 80:40:20 kg/ha (As per local recommendation) |
| Date of Sowing | : | 5th July |
| Date of Transplanting | : | 24th July |
| Date of harvesting | : | 9th November |

## Treatments details

**Table 1:** List of rice genotype proposed for their field screening for their relative resistance against major insect pests of rice:

| S. No. | Genotype | S. No. | Genotype |
|---|---|---|---|
| 1 | CR Dhan - 303 | 11 | Akshay Dhan |
| 2 | IR-20 | 12 | IR-64 Sub-1 |
| 3 | MTU- 1010 | 13 | CR Dhan -205 |
| 4 | IR-64Drt. | 14 | DRR-44 |
| 5 | Naveen | 15 | BVS-1 |
| 6 | Sahbhagi Dhan | 16 | Kavya |
| 7 | Pusa- 1176 | 17 | Lalat |
| 8 | Abhishek | 18 | Advanta-801+ |
| 9 | IR-36 | 19 | Suraksha (RC) |
| 10 | CR Dhan - 304 | 20 | TN-1 (SC) |

## Result and Discussion

Twenty common rice genotypes were tested for two consecutive years, 2016 and 2017 in *Kharif* against gall midge (*O. oryzae*). The feeding by maggots of Insect pest (*i.e.* gall midge) on the growing point of the newly emerged tiller results in the malformation in the form of gall (*i.e.* silver/onion shoot) which are nothing but it is modified form of central leaf sheath. The gall formation due to attack gall midge could be able to debar the affected rice tiller from initiation and formation of panicle resulting in direct reduction in grains yields.

### Observation on the incidence of silver shoot (SS%)

A perusal of results indicated that none of the rice genotypes remained free from the attack of the pest (*O. oryzae*). It was general observation that relatively higher quantum of the incidence of silver shoot (SS%) was observed during 2017 as compared to that of 2016 at both the observational dated (*i.e.* 30 and 45 DAT).

It was found that silver shoot ranged from 1.61 to 12.42 per cent and that of 2.83 to 18.62 per cent during 2016 and 2017, respectively at 30 DAT and 2.38 to 15.02 and 3.08 to 21.62 per cent at 45 DAT during 2016 and 2017, respectively, the lowest being in case of Kavya and the highest in case of TN-I. As such, the intensity of the pest attack was found to be increased with the advancement of growth and age of the crop from 30 to 45 DAT.

It was found that there were significant differences among the test rice genotypes in terms of extent of incidence of silver shoot, recorded at 30 and 45 DAT during both of the years' of the experimentations. The mean incidence of the pest, in terms of SS (%) of the two year's recorded in the test rice genotypes also differed significantly and the overall mean incidence of the pest of 2016 and 2017 followed almost similar trends (Table 02.)

**Table 2:** Relative incidence of gall midge (*Orseolia oryzae* Wood mason) in some rice genotype in terms of silver shoots (SS%)

| S. N. | Genotype | Percentage of silver shoots (SS) Caused by GM, recorded at | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | SS % 30 DAT | | | SS % 45 DAT | | | Overall Mean | | |
| | | 2016 | 2017 | Pooled Mean | 2016 | 2017 | Pooled Mean | 2016 | 2017 | Pooled Mean |
| T1 | CR Dhan - 303 | 2.17 (8.24) | 4.70 (12.33) | 3.43 (10.28) | 4.21 (11.55) | 5.51 (13.24) | 4.86 (12.40) | 3.19 (10.03) | 5.11 (12.79) | 4.15 (11.41) |
| T2 | IR-20 | 3.15 (10.04) | 4.53 (12.00) | 3.84 (11.02) | 3.65 (10.75) | 5.78 (13.55) | 4.72 (12.15) | 3.40 (10.40) | 5.16 (12.80) | 4.28 (11.60) |
| T3 | MTU- 1010 | 9.17 (17.15) | 12.47 (20.16) | 10.82 (18.66) | 9.63 (17.76) | 14.52 (22.27) | 12.08 (20.01) | 9.40 (17.52) | 13.49 (21.33) | 11.45 (19.43) |
| T4 | IR-64 Drt. | 10.06 (18.30) | 16.38 (23.46) | 13.22 (20.88) | 13.52 (21.32) | 15.45 (22.97) | 14.48 (22.15) | 11.79 (19.86) | 15.92 (23.23) | 13.85 (21.54) |
| T5 | Naveen | 4.46 (12.07) | 5.09 (12.93) | 4.77 (12.50) | 4.72 (12.44) | 5.26 (12.89) | 4.99 (12.66) | 4.59 (12.26) | 5.17 (12.93) | 4.88 (12.59) |
| T6 | Sahbhagi | 7.60 (15.56) | 12.61 (20.50) | 10.11 (18.03) | 9.60 (17.35) | 14.24 (22.05) | 11.92 (19.70) | 8.60 (16.48) | 13.43 (21.30) | 11.01 (18.89) |
| T7 | Pusa- 1176 | 8.30 (16.39) | 13.39 (21.10) | 10.85 (18.75) | 10.49 (18.32) | 13.43 (21.11) | 11.96 (19.72) | 9.39 (17.38) | 13.41 (21.16) | 11.40 (19.27) |
| T8 | Abhisek | 9.34 (17.34) | 14.50 (21.91) | 11.92 (19.62) | 12.39 (19.82) | 14.74 (22.12) | 13.57 (20.97) | 10.86 (18.70) | 14.62 (22.07) | 12.74 (20.39) |
| T9 | IR-36 | 2.59 (9.00) | 3.79 (11.00) | 3.19 (10.00) | 3.39 (10.17) | 4.42 (11.81) | 3.90 (10.99) | 2.99 (9.60) | 4.11 (11.42) | 3.55 (10.51) |
| T10 | CR Dhan - 304 | 5.76 (13.72) | 7.56 (15.55) | 6.66 (14.63) | 6.66 (14.42) | 10.53 (18.56) | 8.60 (16.49) | 6.21 (14.10) | 9.05 (17.11) | 7.63 (15.61) |
| T11 | Achhay Dhan | 2.90 (9.65) | 3.71 (10.77) | 3.31 (10.21) | 3.27 (10.19) | 5.68 (13.41) | 4.47 (11.80) | 3.08 (9.92) | 4.70 (12.16) | 3.89 (11.04) |
| T12 | IR-64 Sub-1 | 7.37 (15.01) | 9.48 (17.23) | 8.42 (16.12) | 8.33 (16.43) | 12.61 (20.62) | 10.47 (18.52) | 7.85 (15.76) | 11.05 (19.05) | 9.45 (17.41) |
| T13 | CR Dhan -205 | 4.25 (11.69) | 7.54 (15.35) | 5.90 (13.52) | 4.65 (12.20) | 9.48 (17.81) | 7.07 (15.00) | 4.45 (11.95) | 8.51 (16.68) | 6.48 (14.32) |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| T14 | DRR-44 | 5.49 (13.22) | 6.63 (14.39) | 6.06 (13.80) | 5.79 (13.56) | 7.56 (15.74) | 6.68 (14.65) | 5.64 (13.39) | 7.10 (15.10) | 6.37 (14.25) |
| T15 | BVS-1 | 1.90 (7.50) | 2.86 (9.42) | 2.38 (8.46) | 2.68 (9.09) | 4.33 (11.75) | 3.50 (10.42) | 2.29 (8.34) | 3.59 (10.65) | 2.94 (9.49) |
| T16 | Kavya | 1.61 (6.88 | 2.83 (9.37) | 2.22 (8.13) | 2.38 (8.60) | 3.08 (9.75) | 2.73 (9.17) | 2.00 (7.80) | 2.96 (9.56) | 2.48 (8.68) |
| T17 | Lalat | 3.57 (10.54) | 3.88 (11.09) | 3.72 (10.81) | 3.70 (10.75) | 4.81 (12.22) | 4.26 (11.48) | 3.63 (10.64) | 4.35 (11.67) | 3.99 (11.16) |
| T18 | Advanta-801+ | 5.57 (13.50) | 7.42 (15.54) | 6.50 (14.52) | 6.77 (14.86) | 9.29 (17.57) | 8.03 (16.21) | 6.17 (14.20) | 8.36 (16.59) | 7.26 (15.39) |
| T19 | Suraksha | 2.29 (8.59) | 3.17 (10.02) | 2.73 (9.30) | 2.62 (9.15) | 4.23 (11.44) | 3.43 (10.29) | 2.46 (8.87) | 3.70 (10.76) | 3.08 (9.81) |
| T20 | TN-1 | 12.42 (20.19) | 18.62 (25.36) | 15.52 (22.77) | 15.02 (22.43) | 21.62 (27.36) | 18.32 (24.89) | 13.72 (21.33) | 20.12 (26.38) | 16.92 (23.86) |
| | SEm± | (1.10) | (1.10) | (0.77) | (1.09) | (1.13) | (0.76) | (0.98) | (0.89) | (0.65) |
| | CD 5% | (3.16) | (3.14) | (2.18) | (3.11) | (3.22) | (2.15) | (2.79) | (2.55) | (1.83) |
| | CV % | (15.02) | (12.30) | (13.53) | (13.40) | (11.54) | (12.38) | (12.58) | (9.50) | (10.91) |

Figures under the parenthesis are angular transformed values. DAT-Days after transplanting; SS- silver shoots

The experimental results revealed that the lowest intensity of silver shoot (SS%) was found in case of Kavya, amounting to the tune of 1.61, 2.83 and 2.38, 3.08 per cent at 30 and 45 DAT (day after transplanting), recorded during 2016 and 2017, respectively. The rice genotype, *viz.* Suraksha, BVS-1, CR Dhan-303, IR-20, IR-36 and Akshay Dhan almost remained at par with Kavya in terms of significantly lower incidence of silver shoot (SS%) at 30 and 45 DAT, during both the years' of experimentations. The mean values of silver shoot computed from the two years' results, recorded at 30 and 45 DAT and that of the overall mean values of the two years' in respect of the test rice genotypes, followed almost similar trends. The next group of rice genotype receiving silver shoot (SS%) incidence below 5 per cent encompassed Naveen and Lalat based on the overall mean of silver shoot of 2016 and 2017 and, as such, all these nine rice genotype were rated as promising and resistant against gall midge biotype-3 in the agro-climatic conditions of Ranchi Jharkhand in the present studies The highest incidence of silver shoot (SS%) to the tune of 12.42, 18.62 and 15.02, 21.62 per cent was registered in case of the susceptible variety, TN-I at 30 and 45 DAT, recorded during 2016 and 2017, respectively in the present studies

As such based on the overall mean values of silver shoot of the two years' of investigations, the least percentages of silver shoot (2.48% SS) was recorded in case of Kavya, which remained at par with those of BVS-I (2.94% SS), Suraksha (3.08% SS), and IR-36 (3.55% SS) followed by Akshay Dhan (3.89% SS), Lalat (3.99%SS), Naveen (4.88%SS), CR Dhan-303 (4.15%SS) and IR-20 (4.28%SS) all receiving below 5 per cent silver shoot as against the highest incidence of 16.92 per cent of SS in case of the susceptible variety, TN-I in the present studies

Conducted field experiment during wet season of 2009 and 2010 in the farmer's field in the gall midge endemic areas (District Simdega, Jharkhand) to screen out certain popular rice genotype against gall midge. They found that five rice genotypes *viz.*Naveen, Lalat, BVD-203, BG-380-2 and, IR-36 exhibited as resistant to gall midge bio-type -3 which, in turn, gave rise to the higher grains yields to the tune of 43.59, 38.29, 33.58, 34.56 and 32.07 q/ha. The susceptible genotype *viz.* IR-64 and Birsa Mati registered the highest pest incidence of SS (%) to the extent of 23.63 and 39.86 per cent which resulted to the considerably lower yields of 16.94 and 18.60 q/ha, respectively in the gall midge endemic areas (*i.e.* Simdega) of the agroclimatic conditions of Jharkhand [10]. Later on, found that BG-380-2, Lalat and Suraksha proved to be resistant against gall midge and Pusa Basmati-I and Jaya received significantly higher incidence of gall midge resulting in grains yields-loss ranging from 34.5 to 36.23 per cent [11].

More recently, findings of Prasad *et al.* 2018 [12] based on the overall mean results of two years' experiments, conducted in the gall midge endemic area (Simdega) in Jharkhand which indicated that five rice genotypes *viz.* Kavya (2.91% SS), Lalat (3.91 %SS), IR-36 (4.66%SS), and RD-202 (4.60%SS) emerged as highly resistant to gall midge bio-type - 3. Suraksha (5.99%ss) and BG-380-2 (6.48%SS) remained moderately resistant to the pest. MTU-7029 (54.39%SS) and TN-I (52.05%SS) receiving silver shoot above 50 per cent were rated as the highly susceptible to the pest. The maximum grains yield of 42.40 q/ha was realized from Lalat which remained at par with that of BG-380-2 (42.15 q/ha), Abhishek (41.65 q/ha), RD-202 (40.60 q/ha) and IR-36 (37.60 q/ha). The lowest yields of 25.65 q/ha was obtained in case of the susceptible variety, TN-I which remained at par with that of IR-64 (28.09 q/ha) and MTU-7029 (29.15 q/ha). As such, findings of scientists were in corroboration with the results of the present investigation [10, 11, 12, 13]. As such, based on the findings of the present investigations, the rice genotypes *viz.* Kavya, Suraksha, IR-36, and BVS-I could be considered as promising and resistant against gall midge biotype-3 and those of Akshay Dhan, Lalat, Naveen, and CR-Dhan-303 could be rated as promising and moderately resistant against gall midge (*O.oryzae*) bio-type-3 in the agro-climatic conditions of Jharkhand.

**Yields of rice grains of some rice genotype**

The results on grains' yields were recorded during *Kharif* 2016 and 2017, after harvest of the crop at attainment of maturity of the crop, in terms of kg per plot and then it was converted into q/ha. The mean yields of grains of two years' were also calculated for drawing the overall conclusion. The result is presented Table 03.

**Table 3:** Yields of rice grain in some rice genotype

| S. N. | Genotype | Yields of rice grain (q/ha) | | |
|---|---|---|---|---|
| | | 2016 | 2017 | Pooled Mean |
| T1 | CR Dhan - 303 | 50.27 | 52.12 | 51.19 |
| T2 | IR-20 | 39.53 | 40.72 | 40.13 |
| T3 | MTU- 1010 | 47.57 | 48.92 | 48.24 |
| T4 | IR-64 Drt. | 41.70 | 42.68 | 42.19 |
| T5 | Naveen | 40.77 | 42.16 | 41.47 |
| T6 | Sahbhagi | 47.42 | 48.78 | 48.10 |
| T7 | Pusa- 1176 | 27.53 | 28.73 | 28.13 |
| T8 | Abhisek | 49.35 | 50.22 | 49.78 |
| T9 | IR-36 | 49.77 | 50.92 | 50.34 |
| T10 | CR Dhan - 304 | 43.60 | 44.87 | 44.23 |
| T11 | Achhay Dhan | 60.47 | 61.83 | 61.15 |
| T12 | IR-64 Sub-1 | 43.70 | 44.73 | 44.22 |
| T13 | CR Dhan -205 | 51.87 | 53.30 | 52.58 |
| T14 | DRR-44 | 45.67 | 47.07 | 46.37 |
| T15 | BVS-1 | 34.52 | 35.78 | 35.15 |
| T16 | Kavya | 45.30 | 46.73 | 46.02 |
| T17 | Lalat | 50.23 | 51.67 | 50.95 |
| T18 | Advanta-801+ | 58.57 | 60.03 | 59.30 |
| T19 | Suraksha | 30.37 | 31.90 | 31.14 |
| T20 | TN-1 | 21.03 | 22.43 | 21.73 |
| | SEm± | 2.40 | 2.45 | 1.54 |
| | CD 5% | 6.87 | 7.03 | 4.31 |
| | CV % | 9.46 | 9.39 | 9.42 |

A perusal of results revealed that the significantly highest grains yields of 60.47 and 61.83 q/ha with the mean yields of two years' (61.15q/ha) was realized from the rice variety, Akshay Dhan which, in turn, remained at par with Advanta $801^{+}$ yielding 58.57 and 60.03 q/ha during, 2016 and 2017, respectively with the higher mean yields of 59.30 q/ha followed by CR Dhan-205, CR Dhan – 303, Lalat, IR-36, Abhishek and MTU-1010, as against the lowest yields of 21.03 and 22.43 q/ha recorded during 2016 and 2017 with minimum mean yields of 21.73 q/ha in the present studies. s in case of the susceptible rice variety, TN-1.

It is an established fact that the yields realizing capacity of any genotype or variety of any crop is regulated not only by its own genetic yields' potentiality as well as their resistance and tolerance ability against the prevailing biotic and abiotic factors of the environment but also by the optimal inputs' supplies. d to the plants by the growers under the given set of congenial agro-ecological situations. It is not always possible and feasible that the pest resistant variety will always be higher yielder because the yields potentiality may also be relatively lower despite the desirable quantum of tolerance or resistance ability against the given set of biotic and abiotic factors. If any variety could be able to realize higher grains-yields in spite of higher degree of attack of the pest then in that case, the variety will be said to be tolerant to that vary pest specie. s. In the present studies, Akshay Dhan, Advanta $801^{+}$, Abhishek, CR-Dhan-205 and MTU-1010 could be able to realized relatively higher grains yields to the tune of 61.15, 59.30 49.78, 52.58 and 48.24 q/ha in spite of suffering from relatively higher incidence of gall midge. As such the results showed that these genotypes remained tolerant to gall midge in the present studies

However, the rice genotype *viz.* Suraksha, Kavya, CR Dhan-303, CR Dhan-304, IR-36 and Naveen exhibited as promising and resistant to gall midge in the present studies The test genotype, based on their overall mean higher yields of grains could be arranged in descending order of: Akshay Dhan (61.15 q/ha) > Advanta $801^{+}$ (59.30 q/ha) > CR-Dhan – 205 (52.58 q/ha) > CR-Dhan-303 (51.16 q/ha) > Lalat (50.96 q/ha) > IR-36 (50.34 q/ha) > Abhishek (49.78 q/ha) in terms of grains yields.

## Conclusion

The experimental results of field screening of 20 rice genotype against gall midge revealed that, As such based on the overall mean values of silver shoot of the two years' of investigations, the least per centages of silver shoot (2.48% SS) was recorded in case of Kavya, which remained at par with those of BVS-I (2.94% SS), Suraksha (3.08% SS), and IR-36 (3.55% SS) followed by Akshay Dhan (3.89% SS), Lalat (3.99%SS), Naveen (4.88%SS), CR Dhan-303 (4.15%SS) and IR-20 (4.28%SS) all receiving below 5 per cent silver shoot as against the highest incidence of 16.92 per cent of SS in case of the susceptible variety, TN-I in the present studies As such considerably higher grain yields of rice grains were obtained. The test genotype could be arranged in descending order of: Achhay Dhan (61.15 q/ha) > Advanta-$801^{+}$ (59.30 q/ha) > CR Dhan -205 (52.58 q/ha) > CR Dhan – 303 (51.16 q/ha) > Lalat (50.95 q/ha) > IR-36 (50.34 q/ha) > Abhisek (49.78 q/ha) in terms of grains yields and all these seven genotype remained statistically at par and TN-1 appeared as susceptible to gall midge.

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