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Efficacy of Combined Application of Fluorescent Pseudomonads, Salicylic acid, Navagavya on the Yield Parameters of Rice Var. ADT 36 Infected by Brown Spot Disease

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A B S T R A C T

The field trial studies were undertaken to investigate the changes in the brown spot disease incidence and yield parameters in Rice var. ADT 36 after the application of bioprotectant fluorescent Pseudomonads, Resistance inducing chemical Salicylic acid, Organic immunizer Navagavya. Among the various treatments undertaken, Seed treatment of talc based fluorescent Pseudomonads with sprouted rice seeds at the rate of 10 g/kg of seeds, along with foliar application of Salicylic acid 50 ppm at 15 DAT and Navagavya (5%) at 30 DAT recorded the minimum disease incidence, increased biometrics and yield parameters. In all the treatments there were significant increase in yield over check.

***Key words*:** Fluorescent Pseudomonads, Salicylic acid, *Navagavya*, Brown Spot, Rice

Rice (*Oryza sativa* L.) is considered as queen of the cereals, because it is one of the most important crops of the world [1]. It is the second most cultivated cereal crop worldwide and is central to the lives of billions of people around the world [2]. Rice (*Oryza sativa* L., 2n=24) is a plant belonging to the family of grasses, *Gramineae* (*Poaceae*). India has a long history of rice cultivation. Globally, it stands first in rice area and second in rice production, after China. It contributes 21.5 per cent of global rice production. Within the country, rice occupies one quarter of the total cropped area, contributes about 40 to 43 per cent of total food grain production and continues to play a vital role in the national food and livelihood security system [3].

Rice crop is widely affected by a number of diseases caused by fungi, bacteria, viruses and mycoplasma which results in considerable yield losses [4]. Among the various fungal diseases of rice, brown spot or sesame leaf spot incited by *Helminthosporium oryzae* (Breda de Haan) Subram and Jain is found to occur in most rice growing areas. The pathogen attacks the crop from seedling to milk stage. The symptoms appear as minute spots on the coleoptile, leaf blade, leaf sheath and glume, being most prominent on leaf blades and glumes and causes about 67 per cent of yield loss [5].

This present field study was undertaken in Cheyyur region of Chengalpet District. To combat the yield losses caused by Brown spot disease, combined application of fluorescent Pseudomonads, Salicylic acid and Navagavya were carried out at different time intervals. Application of those products not only reduced the disease incidence, but also increased the overall yield of the crop as well as quality of the grains.

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MATERIALS AND METHODS

Crop, Variety and Source

Crop : Paddy (*Oryza sativa* L.)
Variety : ADT 36
Source : Tamil Nadu Rice Research Institute (TRRI), Aduthurai, Tamil Nadu

Integrated management of brown spot in rice (Field trial)

The plot size of 5 m^2 was selected in Cheyyur village of Chengalpet district. The land was prepared well and seedlings were transplanted with the spacing of 20 × 10 cm. The test plants were artificially inoculated with the spore suspension which was sprayed at a spore load of 50,000

spores/ml at 15 DAT. The experiments were conducted in a randomized block design with three replications for each treatment. The fungicide Mancozeb 75 WP at 0.2 per cent was used as comparative fungicide.

The combination of treatments mentioned below (Integrated study) was evaluated in field experiment conducted during December, 2020 in Cheyyur village. The disease incidence of Brown spot, biometric and yield parameters of rice were recorded. At maturity 100 panicles for each treatment were collected and the number of filled, discoloured, unfilled (chaffy) grains per panicle and 1000 grain weight were also assessed.

Treatment schedule

T_1:	SA_1 (15 DAT)	T_6:	$T_3 + T_4$
T_2:	SA_2 (30 DAT)	T_7:	$T_3 + T_2$
T_3:	NG_1 (15 DAT)	T_8:	$T_1 + T_4$
T_4:	NG_2 (30 DAT)	T_9:	Mancozeb @ 0.2% (comparison)
T_5:	$T_1 + T_2$	T_{10}:	Control

RESULTS AND DISCUSSION

Impact of Fluorescent Pseudomonads, Salicylic acid and Navagavya on the management of B. oryzae

In field experiments, seed treatment with fluorescent Pseudomonads @ 10 g/kg, foliar application of salicylic acid (50 ppm) and *Navagavya* (5%) were found significantly superior over test fungicide Mancozeb (0.2%) in respect of reducing disease intensity and increasing biometrics and yield parameters of rice. Results of the study showed that, Brown spot disease incidence was effectively controlled by seed treatment with fluorescent Pseudomonads @ 10 g/kg foliar application of SA_1 (at 15 DAT) and NG_2 (at 30 DAT) by (6.32 percent). It was followed by (T_5) seed treatment with fluorescent Pseudomonads @ 10 g/kg and foliar application of SA_1 (at 15 DAT) and SA_2 (at 30 DAT) which recorded a disease incidence of 6.81 percent. The test fungicide Mancozeb 0.2 per cent recorded 09.12 percent (Table 1).

Table 1 Impact of FP, SA and NG in different combinations on the incidence of Brown spot under field conditions

Treatments	Disease incidence (%)	Percent decrease over control
T_1: SA_1	9.92	74.26
T_2: SA_2	10.68	72.28
T_3: NG_1	11.46	70.26
T_4: NG_2	12.26	68.18
T_5: $T_1 + T_2$	6.81	82.33
T_6: $T_3 + T_4$	7.87	79.57
T_7: $T_3 + T_2$	7.34	81.01
T_8: $T_1 + T_4$	6.32	83.60
T_9: Mancozeb (0.2%)	9.12	76.33
T_{10}: Control	38.54	

Impact of FP, SA and NG in different combinations on growth parameters of Rice var. ADT 36 (Navarai 2020)

Generally, all the treatments significantly increased the plant height when compared to Mancozeb (0.2%) treatment and control. Among the treatments, the maximum plant height (89.76 cm) was observed in combined application of bacterial bio control agent, *Navagavya* and inducing chemicals (T_8) and control recorded the minimum plant height (74.60 cm). The field trial conducted in 2020 (Table 2) revealed that the treatments with FP, SA and NG had significantly higher number of productive tillers per clump, increased panicle length when compared to control.

Table 2 Impact of FP, SA and NG in different combinations on the incidence of brown spot under field conditions

Treatments	Plant height (cm)	No. of tillers/clump	No. of productive tillers/clump	Panicle length (cm)
T_1: SA_1	86.91	13.62	12.61	17.59
T_2: SA_2	86.36	13.31	12.28	17.41
T_3: NG_1	85.46	13.24	11.98	16.95
T_4: NG_2	84.79	12.51	11.62	16.64
T_5: $T_1 + T_2$	89.15	14.29	13.21	18.42
T_6: $T_3 + T_4$	88.46	14.03	12.85	18.10
T_7: $T_3 + T_2$	88.82	14.12	12.98	18.25
T_8: $T_1 + T_4$	89.76	14.47	13.38	18.58
T_9: Mancozeb (0.2%)	87.71	13.87	12.72	17.89
T_{10}: Control	74.60	11.32	9.60	14.65

Impact of FP, SA and NG in different combinations on yield parameters of rice var. ADT 36 (Navarai 2020)

All the treatments with FP, SA and NG had increased the thousand grain weight when compared to control. However, the treatment T_8 recorded the maximum thousand grain weight of 20.44 g in 2020. All the treatments with FP, SA and NG recorded significant increase in grain and straw yield, when compared to test fungicide and control. Among them T_8 (FP + SA_1 + NG_2) recorded the maximum grain yield of 5.28 t/ha during the year 2020. The maximum straw yield was also recorded in T_8 with 7.57 t/ha during the year of 2021. The fungicide treatment recorded a grain yield of 5.07 t/ha and straw yield of 7.35 t/ha during the year 2020. The biological yield and harvest incidence were found significantly increased in all the treatments when compared to test fungicide and control treatments. And also, the treatment T_8 recorded the maximum filled grain percentage (84.07%), minimum level of grain discolouration (5.39%) and chaffy grains (11.28) when compared to control treatments.

Table 3 Impact of FP, SA and NG in different combinations on yield parameters of rice var. ADT 36 (Navarai 2020)

Treatments	Thousand grains weight (g)	Grain yield (t/ha)	Straw yield (t/ha)	Biological yield (t/ha)	Harvest index (%)
T_1: SA_1	20.36	5.00	7.32	12.36	40.81
T_2: SA_2	20.36	5.00	7.29	12.25	40.38
T_3: NG_1	20.35	4.45	7.28	11.80	37.71
T_4: NG_2	20.35	4.30	7.25	11.58	37.13
T_5: T_1 + T_2	20.42	5.23	7.52	12.80	41.07
T_6: T_3 + T_4	20.40	5.09	7.38	12.41	41.01
T_7: T_3 + T_2	20.41	5.18	7.43	12.61	41.01
T_8: T_1 + T_4	20.44	5.28	7.57	12.80	41.25
T_9: Mancozeb (0.2%)	20.38	5.07	7.35	12.38	40.85
T_{10}: Control	20.30	3.90	5.62	9.52	40.96

Seed treatment with Fluorescent Pseudomonads had been widely used for the management of plant diseases [6]. A talc-based powder formulation of *P. fluorescens* was effective for the control of rice blast [7]), brown spot [8], sheath blight [9], sheath rot [10] and bacterial leaf blight [11]. The present study also indicated the effectiveness of the talc-based formulation of *P. fluorescens* for the control of blast of paddy.

The fluorescent Pseudomonads stimulated the production of plant growth promoting auxins, gibberellins and cytokinins and thereby suppressed the pathogen. The increase in grain yield due to the application of *P. fluorescens* may be associated with increased plant growth because of the plant growth promoting characteristics of fluorescent Pseudomonads and decreased disease incidence. Fluorescent Pseudomonads are known to induce resistance against many pathogens [12].

Pre-treatment of groundnut leaves with SA reduced the number of rust pustules, uredospores per pustule and delayed the development of rust disease [13]. SA has been shown to be a signalling molecule involved in both local defense reactions at infection sites and the induction of systemic resistance. The present study confirmed the systemic nature of resistance against the pathogen which is induced through exogenous application of SA. Similar results were made on the effect of SA on induction of systemic resistance by [14] who mentioned that salicylic acid enhanced the resistance in rice plants against sheath blight disease and also increased the grain filling percentage. It has been suggested that the growth promoting effects of SA could be related change in the hormonal status or by improvement of photosynthesis, transpiration and stomatal conductance. Grain yield grain filling percentage was significantly enhanced in wheat seedlings, raised from the grains pre-treated with lower conc. of SA [15]. Foliar application of salicylic acid increased the biometric characters and suppressed brown spot of rice [16].

Results of the present series of investigations clearly proved that cow products induced appreciable resistance in rice plants against *B. oryzae* and the reduction in disease incidence reflected in the increased yield as well. This is in line with observations recorded by earlier workers [17]. Cow products such as *Panchagavya* spray during tillering and boot leaf stage of rice reduced the brown leaf spot incidence [18]. He also stated that one of the probable reasons attributed for decreased disease intensity in *Panchagavya* spray treatment was the induction in enzyme activity. Increased phenols and defense enzymes which led to the development of resistance in rice plants. More over cow products such as *Panchagavya*, *Navagavya*, *Dasagavya* acted both as fertilizer and bio-pesticide (https://agritech.tnau.ac.in/org_farm/orgfarm_dasakavya.html). In light of the above, the present observations made on *Navagavya* spray treatment were confirmed.

CONCLUSION

In the present study, the cumulative effect chemical spray SA_1 and NG_2 spray not only minimized the disease incidence but also had positive influence on the biometrics and yield of ADT 36. This might be due to the positive interaction and synergism between Salicylic acid and *Navagavya* in minimizing the disease incidence and enhancing the plant growth and grain yield of ADT 36.

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