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Studies on the Management of Brown Spot of Rice

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A B S T R A C T

The pot culture studies were undertaken to investigate the efficacy of certain plant activators for the management of brown spot of Rice caused by *Bipolaris oryzae*. The resistance inducing chemicals viz., Acetyl Salicylic acid, Nicotinic acid, Propionic acid, Naphthalene Acetic Acid, Salicylic acid were sprayed at 20, 50 and 100 ppm conc. individually at disease initiation stage and repeated once at fifteen days interval under pot culture conditions. Among them, salicylic acid @ 50 ppm was the most effective in reducing the disease incidence followed by Salicylic Acid (@100 ppm). It was followed by Acetyl salicylic acid (50 ppm) and Naphthalene acetic acid (100 ppm). Propionic acid at 20 ppm was least effective. Also, four organic sources tested against brown spot pathogen, *Navagavya* recorded maximum growth inhibition. It was followed by *Panchagavya* and Biogas slurry.

***Key words*:** Rice brown spot, *Bipolaris oryzae*, Resistance inducing chemicals, Salicylic acid, Organic sources

Rice is an important staple crop and it has shaped the culture, diets and economic of thousands of millions of people and for more than half of the humanity "Rice is life". The rice plant is a member of *Poaceae* (*Graminae*) family. It has been cultivated in Asia for several thousand years. About fifty per cent of the crop is grown and consumed in Asia and it is the net exporter of rice to the rest of the world. India stands second after China which has developed hybrid rice technology on a commercial scale. India is the home to paddy and the largest paddy growing and second larger paddy producing and consuming country. Rice crop is being affected by several diseases, insects and physiological disorders which accounts several million yield losses. Among them Brown leaf spot disease is the most serious disease of rice [3]. It caused Bengal Famine in 1942, with yield loss of 50-90%, which resulted in death of 2 million people due to starvation. The pathogen can infect both seedlings and mature plants with the coleoptile, leaves, leaf sheath, panicle branches, glumes and spikelets [25].

An emerging strategy in plant protection is the induction of systemic acquired resistance [27]. Studies have shown that SAR is induced in several plant species by treatment with chemicals such as salicylic acid, methyl-2, 6-dichloroisonicotinic acid (INA) or benzo (1-3) thiadiazole-7-carbothionic acid *S*-methyl ester (BTH) [8]. Several chemicals viz., Salicylic acid [20] [24], Acibenzolar – S – Methyl [19], Acetyl Salicylic acid [12], Nicotinic acid [25] and Oxalic acid [18] have shown induced resistance in various crops.

Apart from the above management practices, there are many reports available on the use of organic amendments for improving the efficacy of the activity of antagonists. *Panchagavya* is a single organic input, which can act as a growth promoter and immunity booster. It has a significant role in providing resistance to pest and diseases and in increasing the overall yield. *Navagavya* is being prepared by mixing nine indigenous products namely Cow dung, Ghee, Milk, Curd, Cow urine, Jaggery, Well ripen banana, Tender coconut and water. Spraying of *Navagavya* will promote plant growth and improves immunity of the plants [25]. Therefore, the present studies were undertaken to investigate the effect of certain resistance inducing chemicals and organic sources against brown spot of rice.

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

The disease incidence was assessed by adopting 0-9 scale according to "Phytopathometry" by [13] and the per cent disease incidence /index was calculated based on the formula suggested by Vidhyasekaran [26].

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Disease severity	Description of disease index
0	No lesions
1	Affected leaf area less than 1%
3	1-10% affected leaf area
5	11-25% affected leaf area
7	26 -50% affected leaf area
9	> 50% leaf area affected

$$\text{Percent disease index} = \frac{\text{Total ratings}}{\text{Total number of leaves graded} \times \text{Maximum grade in the score chart}} \times 100$$

Pot culture studies

The pot culture studies were conducted to test the efficacy of certain resistance inducing chemicals and assessing their influence on the reduction of Brown spot of rice with various treatment and combinations. The susceptible variety ADT 36 grown in rectangular pots of size; 30 × 45 cm were used for the study. The plants were given artificial inoculation by spraying the spore suspensions with adequate spore load (50,000 spores/ml) at 15 DAT in the evening hours. The crop was maintained in a poly house with frequent spraying of water to provide adequate moisture and relative humidity to enable successful infection by the pathogen. The experiments were conducted in a randomized block design with three replications for each treatment and a suitable control. The fungicide Mancozeb 75 WP at 0.2 per cent was used for comparison and the standard agronomic practices as recommended by the State Agricultural Department were followed.

Effect of certain resistance inducing chemicals on Bipolaris oryzae (Screening test – Pot culture)

Effect of certain resistance inducing chemicals viz., Acetyl Salicylic acid, Benzoic acid, Nicotinic acid, Propionic acid, Naphthalene Acetic Acid, Salicylic acid were sprayed at 20, 50 and 100 ppm conc. individually at disease initiation and repeated once at fifteen days interval.

Effect of certain organic sources against B. oryzae
Panchagavya (Modified)

The following ingredients were used to prepare approximately 20 liters of *Panchagavya* stock solution. Cow dung (5 kg), cow's urine (3 liters), cow's milk (2 liters), cow's curd (2 litres) and cow clarified butter/ghee (1 litre) [15]. All the materials were added to a wide mouthed mud pot and kept open under shade. The contents were stirred twice a day for about 20 minutes, both in the morning and evening to facilitate aerobic microbial activity. Fifteen days after the preparation, from the stock solution three per cent concentration was prepared. The spray solution (500 liters ha^{-1}) was sprayed using hand-operated sprayer with cone type nozzle four times for each crop as per the treatment schedule. The biogas slurry and cow dung slurry were collected from Annamalai University experimental farm.

Navagavya

Navagavya was prepared by mixing indigenous products namely Cow dung, Ghee, Milk, Curd, Cow urine, Jaggery, Well ripen banana, Tender coconut and water. Firstly, 700g of fresh cow dung and 100 g of ghee were mixed in a clean plastic cylinder (10 lt). After 48 hrs, one liter each of cow urine and water were added. All the contents were stirred well and incubated at room temperature (25±2°C) for 13 days. Further, 300 ml cow milk, 200 ml curd, 300 ml fresh tender coconut water, 300 g jaggery and one well-ripen banana fruit (100 g) were added to the mixture and stirred well. The mixture was fermented for 6 days at room temperature (25±2°C). Fermented mixtures was filtered and stored in a refrigerator at 4°C for further use [11].

Mycelial dry weight

Effect of *Panchagavya*, *Navagavya*, biogas slurry and cow dung slurry on the growth of *B. oryzae* was studied by incorporating the organic sources separately in PDA medium. All the sources were tested at 5 per cent concentrations. Fifty ml of the PDA broth with respective organic sources was dispensed in 250 ml Erlenmeyar flasks and autoclaved. Each flask was inoculated aseptically with 9 mm fungal discs obtained from the actively growing region of a week-old culture. The flasks were incubated at room temp at (28 + 2°C) for 15 days. After the incubation the contents of the flask were filtered through a Buchner funnel under suction, using a filter paper of known weight. The fungal growth retained on the filter paper was dried in an oven at 105°C to a constant weight and the dry weight of the mycelium was recorded as mg.

RESULTS AND DISCUSSION

Among the various resistance inducing chemicals, salicylic acid @ 50 ppm was the most effective in reducing the brown spot incidence followed by Salicylic Acid @100 ppm. It was followed by Acetyl salicylic acid (50 ppm), Naphthalene acetic acid (100 ppm), Nicotinic acid (100 ppm), Acetyl salicylic acid (100 ppm) and Propionic acid (100 ppm). PA at 20 ppm was least effective. The test fungicide (Mancozeb 0.2%) was found to be effective in reducing the Brown spot incidence (Table 1). Among the different resistance inducing chemicals Salicylic acid was found as most effective chemical when compared to other resistance inducing chemicals.

Table 1 Effect of certain resistance inducing chemicals on brown spot disease incidence of Rice var. ADT 36 (Screening test- Pot culture)

Concentration	ASA	NA	SA	PA	NAA	Mancozeb (0.2%)
20 ppm	57.09	59.01	46.23	59.44	58.58[b]	
50 ppm	30.17	48.02	**26.75**	43.05	50.32[c]	14.56
100 ppm	32.67	30.53	28.97	35.95	30.21[f]	
Control			61.12[a]			
C.D.(p=0.05)	1.26	1.11	1.24	1.48	1.12	

Salicylic acid was reported to reduce the mycelial growth and zoospore germination of *P. aphanidermatum* [5] and was shown to induce resistance to Cucumber Mosaic Virus (CMV) and increase the yield characters in squash and

tobacco [10]. ASM is one of the most potent disease resistance activators used in crops to control pathogens including viruses [22], bacteria [16] and fungi [1]. The induction of resistance with ASM was accompanied by a significant increase in peroxidases and polyphenoloxidases activities in sugarcane [17]. Nicotinic acid is also known as a resistance inducing substance in various plants against virus and fungal pathogens [9]. The resistance induced by chemical treatment can be very effective [6] and may provide commercially useful broad-spectrum plant protection that is stable, long-lasting and environmentally safe. In some cases, chemical treatment induces expression of the same genes and resistance against the same spectrum of pathogens as pathogen-induced resistance [14]. The results concluded that, five different resistance inducing chemicals were tested against Brown spot of rice, among them salicylic acid @ 50 ppm was the most effective in reducing the disease incidence.

Table 2 Effect of certain organic sources on mycelial growth of *Bipolaris oryzae*

Organic sources	Colony diameter (mm)	Growth inhibition (%)
Panchagavya	39.5	56.11
Biogas slurry	45.3	49.66
Cow dung slurry	56.2	37.55
Navagavya	21.6	76.00
Mancozeb (0.2%)	--	100
Control	90.0	--

Effect of different organic sources on the mycelial growth of B. oryzae

Four different organic sources were tested against *B. oryzae* and the data are presented in (Table 2). The results clearly revealed that all the organic sources significantly inhibited the growth of the fungus when compared to control. Among the organic sources tested *Navagavya* recorded maximum growth inhibition with a value of 76.00% as against control. It was followed by *Panchagavya* (56.11%) and Biogas slurry (49.66%).

Among the different organic sources *Navagavya* @ 5 per cent to inhibited the growth of *B. oryzae* (Table 2). The present findings are in accordance with the reports of [15] who observed that application of cow products reduced the growth of *Helminthosporium oryzae*. Numerous reports on the control of plant diseases with cow products applied to foliage are available in the literature [2], [4], [7], [21], [23], [25]. Some of the diseases controlled are Rice Sheath blight and Chilies anthracnose [15].

CONCLUSION

The results concluded that, four different organic sources were tested against *B. oryzae*, among them Navagavya (@5%) recorded maximum growth inhibition as against control.

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