

Chemical Control of Bakanae Disease of Rice Caused by *Fusarium moniliforme*

¹Javed Ahmad Bhalli, ²M. Aurangzeb and ³M. B. Ilyas

¹Department of Biology, PAEC Boys College, Chashma, Mianwali, Pakistan

²Department of Botany, Government F.C. College, Lahore, Pakistan

³Department of Plant Pathology, University of Agriculture, Faisalabad, Pakistan

Abstract: *Fusarium moniliforme* was found pathogenic on rice variety Basmati-385, after seed or soil infestation. Out of eight fungicides tested, Derosal was most effective in inhibiting the mycelial growth *in vitro*. The same fungicide when used for seed treatment and soil drenching was found most effective to control the disease *in vivo*.

Key words: Chemical control, bakanae disease, *Fusarium moniliforme*

Introduction

Rice (*Oryza sativa* L.) an important crop of Pakistan is cultivated in over 2096.9 thousand hectares with a production of 3243.1 thousand tones or 1546 kg ha⁻¹ (Anonymous 1991-92). Of the various diseases, which effect the crop production, Bakanae is the leading one. Bakanae disease caused by *Fusarium moniliforme* Sheldon has caused great damage during the last few years (Wahid *et al.*, 1991). This disease is seed as well as soil borne (Ahmad and Raza, 1991). Approximately 10-20% of the seeds were found naturally infected with this fungus. Studies were carried out showing the effect of seed treatment or soil drenching with the fungicides on the control of the disease.

Materials and Methods

The study was carried out at F.C. College, Lahore in collaboration with Rice Research institute, Kala Shah Kaku, Sheikhpura and Department of Plant Pathology University of Agriculture, Faisalabad in 1994. The study was divided into following parameters.

Isolation of pathogen: The stem of the rice plants showing the disease symptoms were collected from the Rice Research Institute, Kala Shah Kaku, Sheikhpura and were brought to the lab. They were cut into 1cm pieces, surface sterilized with 0.1% aqueous solution of Mercuric chloride, rinsed twice with distilled water and planted on Potato Dextrose Agar (PDA) medium. The plates were incubated at 30 ± 2°C for four days. The isolated fungus was identified after reference to Booth (1971) and Nelson *et al.* (1983).

Pathogenicity test: Pathogenicity was carried out on an important rice variety Basmati-385. Twelve earthen pots (12"x14") were divided into four sets of three each. In the first set the pots were filled with sterilized soil and twenty seeds of rice surface sterilized with 0.1% Mercuric chloride were sown in each pot. This set served as control. The sterilization of the soil was carried out by the procedure used by Ilyas *et al.* (1982). The second set was infested by adding half petri plate of a seven days old culture of *F. moniliforme* at a uniform depth of soil in two layers i.e. at 3.5 and 7.5cm distance. The culture was allowed to grow for seven days for maximum infestation. Sterilized seeds were sown in it. In the third set, the sterilized soil and infested seeds were used. In the fourth infested soil and

infested seeds were used.

The experiment was conducted during the month of May in the open environment and data on percentage of plant infection and disease severity was recorded after 75 days of sowing.

***In vitro* Sensitivity of Pathogen to Fungicides:** Apron, Benlate, Derosal, Healthied, Ridomil, Score, Topaz and Topsin-M were evaluated for toxicity against the mycelial growth of *F. moniliforme* by food poisoning technique (Ilyas *et al.*, 1982) The fungicides were mixed into Potato Dextrose Agar medium @ 10, 30, 50 and 100 ppm. The medium without fungicide served as control. The plates were inoculated with the pathogen by placing an agar disk of 5 mm diameter in the center, the plates were then incubated at 30 ± 2°C for four days.

Effect of seed treatment with fungicides: Seeds artificially infested with fungus were treated with Benlate, Derosal, Healthied, and Topsin-M by slurry method @ 1, 2, 3 and 4 g/kg of seeds. These seeds were sown into the (12"x14") pots filled with sterilized soil. Artificially infested seeds without fungicide treatment sown in sterilized soil served as control. Data on the percentage of disease control was recorded after 75 days of sowing.

Effect of Soil Drenching: The fungicides used in seed treatment were also used as soil drench @100, 200, 300 and 500 ppm (mg/L). Earthen pots (12"x14") were filled with sterilized soil and the soil was infested with seven days old inoculum at the rate of half petri plate of 90 mm diameter per pot. The inoculum was added in the form of 6-mm agar blocks in two layers at 3.5 and 7.5 cm depth. After inoculation the pots were left for a period of seven days to give enough time to the pathogen for its growth and then each pot was drenched with 1500 ml of the respective concentration of fungicides. The control pot was drenched with distilled water. After drenching five healthy seedlings from 20 days old nursery were transplanted into these pots. The data was recorded after 75 days of transplantation.

Results and Discussion

Pathogenicity test: The culture of *F. moniliforme* was found pathogenic to rice crop. Diseased plants were pale yellow in colour, developed characteristic elongated seedlings as compared to the healthy plants and died soon. The

seedlings, which survived, produced no panicles. While the seedlings in control remained 100 percent free from the disease (Table 1). When only soil was inoculated 25% of the seedlings got disease, whereas in case of seed infestation 70% of the plants were infected with pathogen. Presumably not only the diseased seedlings were produced from the infested seeds but the healthy one also got disease from the soil resulting in 100% infestation (Ito *et al.*, 1974; Sun, 1975; Ou, 1985).

In vitro sensitivity of *F. moniliforme* to fungicides: Benlate and Derosal showed complete suppression in growth of the fungus when used even @100 ppm. All the fungicides used showed an increase in growth suppression with an increase in fungicide concentration (Table 2). Apron was the least effective fungicide against *F. moniliforme*. The results indicated that the active ingredient of both Derosal and Benlate is almost the same as reported earlier by Ito and Kimura (1971).

Table 1: Percent infection of rice seedlings by *F. moniliforme* using various methods of inoculation

Treatments	Diseased Seedlings	Healthy Seedlings	Percent Disease
Control (T1)	0	20	0
Infested Soil + Sterilised Seeds	5	15	25
Infested Seeds + Sterilised Soil	14	6	70
Infested Soil + Infested Seeds	20	0	100

T1 = Sterilised Soil + Sterilised Seeds.

Table 2: Effects of different concentrations of fungicides on In vitro growth of *F. moniliforme*

Fungicides	Mycelial Growth (mm) at various Fungicide Concentrations (ppm)				
	0 ppm	10 ppm	30 ppm	50 ppm	100 ppm
Apron	90	89.88	82.50	75.32	65.19
Benlate	90	N.G	N.G	N.G	N.G
Derosal	90	N.G	N.G	N.G	N.G
Healthied	90	20.00 [*]	18.25 [*]	13.75 [*]	10.00
Ridomil	90	83.71	73.44	69.50	50.75
Score	90	20.52 [*]	19.56 [*]	15.00 [*]	12.58 [*]
Topase	90	36.00	28.00	20.18	16.36 [†]
Topsin-M	90	16.71 [*]	14.35 [*]	8.00 [*]	N.G

N.G = No Growth * Significant

Table 3: Effect of seed treatment with different concentrations of fungicide in the control of Bakanae disease of rice

Treatments	Percent Mortality of Rice Seedlings at various fungicide concentrations (g/kg)				
	0 g/kg	1 g/kg	2 g/kg	3 g/kg	4 g/kg
T.1 + Derosal	100	37.32 ^{**}	10.67 ^{**}	2.63 ^{**}	0.00 ^{**}
T.1 + Benlate	100	41.65 ^{**}	16.00 ^{**}	8.00 ^{**}	5.34 ^{**}
T.1 + Topsin-M	100	48.31 ^{**}	26.40 ^{**}	14.67 ^{**}	9.63 ^{**}
T.1 + Healthied	100	73.35 [*]	36.82 ^{**}	19.89 ^{**}	17.34 ^{**}

T.1 = Infested Seed * Significant, ** Highly Significant

Table 4: Effect of soil drenching with different concentrations of fungicide in the control of Bakanae disease of rice

Treatments	Percent Mortality of Rice Seedlings at various fungicide concentrations (ppm)				
	0 ppm	100 ppm	200 ppm	300 ppm	500 ppm
T.1 + Derosal	100	60.00 [*]	33.32 ^{**}	20.00 ^{**}	0.00
T.1 + Benlate	100	61.10 [*]	46.67 ^{**}	32.37 ^{**}	6.65 ^{**}
T.1 + Topsin-M	100	73.23 [*]	53.34 [*]	40.79 ^{**}	22.54 ^{**}
T.1 + Healthied	100	83.32 [*]	83.30 [*]	60.76 [*]	20.44 ^{**}

T.1 = Infested Soil, * Significant, ** Highly Significant

Statistical analysis of results: The results were analyzed statistically by using Randomized complete block design of two way analysis of variance and were found significant.

Fungicidal Control of Disease by Seed Treatment and Soil Drenching: All the four fungicides used for the seed treatment or soil drenching showed effective suppression in the infection to the seedlings by *F. moniliforme*. The efficacy of the fungicides increased with an increase in its concentration (Yu and yang, 1978). Derosal was the most effective one followed by Benlate, Topsin-M and Healthied (Table 3 and 4). Soil drenching technique was proved to be the most effective in controlling the Bakanae disease of rice. The results were in accordance with those of Sarkar (1986) and Yasuda (1986).

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