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in

Clément G. (coord.), Cocking E.C. (coord.).
FAO MedNet Rice: Breeding and Biotechnology Groups: Proceedings of the Workshops

Montpellier : CIHEAM
Cahiers Options Méditerranéennes; n. 8(2)

1994
pages 27-30

Research Activities on Controlling Rice Bakanae and Foot Rot Disease *(Fusarium moniliforme)* in Turkey

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Turkey has seven geographical regions. Rice is cultivated in all these regions. The climate of Turkey varies from region to region, changing from the temperate Black Sea region to the continental climate of the interior, then to the Mediterranean climate of the Aegean and that of Mediterranean coastal regions. The rice growing area is between 60,000 and 70,000 ha in Turkey; it changes from year to year depending on the available irrigation water and the market price. Average rough rice yield is 5 t/ha. Total milled rice production is approximately 200,000 tons and that is not enough for domestic consumption. Therefore, some milled rice is imported every year.

Two rice diseases prevail in Turkey; Blast: *(Pyricularia oryzae)*, Bakanae and Foot rot *(Fusarium moniliforme - Gibberella fujikuroi)*. Foot rot, also known as bakanae or elongation disease, is widespread in many rice growing areas, both tropical and temperate, and, if no control measures are taken, it may be a factor limiting rice production (Johnston, 1967). Ito and Kimura (1931) reported up to 20 % loss in Hokkaido. Pavgi *et al.* (1964) stated that losses of 15 % occurred in Eastern districts of Uttar Pradesh (India) and Kanjanasoon (1965) found 3.7-14.7% loss in northern and central Thailand. Moletti (1981) reported that foot rot could be controlled using some chemicals (Captan, Captafol + Carboxin, Captan - Carboxin, Mancozeb, and Thiram, etc., between 0.1 and 0.2 kg per 100 kg seed) and Johnston (1967) stated that the chemicals were effective in controlling this disease.

The general symptoms of this disease is that infected plants die at grain filling period, and they bear only white empty panicles. A white or pink growth of the pathogenic fungus may be noticed on the lower parts of diseased plants. Some other symptoms may be observed in early stages: infected seedlings are taller than normal plants and are thin and yellowish-green at the seedling stage, bakanae symptoms can be seen in the vegetative stage, infected plants are taller than the normal plants and have a few tillers and yellow-green leaves. The most important damage occurs at the grain filling period in Turkey.

A study carried on in the North-western part of Turkey in 1981 revealed that crop losses due to foot rot was very important *(Table 1)*. Afterwards, this disease was taken into consideration in the rice breeding programme as a selection criterion.

Table 1 : The foot rot disease survey 1981

Variety	Average disease rate (%)
Baldo	13-15
Gritna	7-10
Ribe	2-5
Rocca	0.5-1

The Baldo variety was the most affected by the foot rot disease, whereas the Rocca variety was resistant. The Baldo variety has been preferred by Turkish consumers for more than 20 years because of its grain quality and it is still sold at the highest price on the market. Thus, we have taken into account the Baldo variety's grain quality in our breeding and selection programme. We have to develop rice varieties

similar to the Baldo variety in terms of grain quality, or we have to grow the Baldo variety under disease-free conditions including chemical control agents. The objective of this study was to breed resistant varieties or to find a chemical control for foot rot disease.

I – Resistant Variety Breeding

Generally susceptible varieties are crossed with resistant lines and disease observations are carried out in segregation material, observation nurseries, and yield trials in field conditions.

The following scale was utilized in disease evaluations, it was adopted from IRRI publication : Standard Evaluation System for Rice.

Severity or incidence (%)	Reaction
0	Highly resistant (HR)
1	Resistant (R)
1-5	Moderately resistant (MR)
6-25	Moderately susceptible (MS)
26-50	Susceptible (S)
51-100	Highly susceptible

The results of the observation done in yield nurseries in 1992, and 1993 are given in *Table 2*. When compared to 1992, it was seen that the conditions in 1993 where more favorable for foot rot disease occurrence. None of the lines showed susceptible reaction in 1992, whereas 8 of the same lines showed susceptible reaction in 1993. Ou (1972) reported that bakanae diseased plants were few or were not observed at all, when the temperature was low. Therefore the difference between two years may be due to climatic changes.

Table 2. The results of disease observation in 1992 and 1993

Year	Number of lines	Disease reaction
1992	9	HR
	36	R
	45	MR
	23	MS
Total	113	
1993	1	HR
	8	R
	29	MR
	63	MS
	8	S
Total	**109**	

Examining the results, it seems that it will be possible to obtain resistant lines from breeding material. Because there are enough lines with disease resistant reaction.

II – Chemical control

In order to develop a chemical control method especially for the Baldo variety, a research study was begun in 1993.

1. Materials and methods

The Baldo variety, which is the most susceptible variety for bakanae and foot rot among rice cultivars, is used in this experiment. Chemicals used for this study are given below.

Table 3. Chemicals used in the experiment

Chemical	Active ingredient	Formulation	Dose (g/100 l of water)
Benlate 50 WP	Benomyl 50	WP	60
Sportak	Carbonazime 50	WP	100
Polyram DF	80 % Metiran-Komplex	DF	200
Dithase M-45	Mancozeb 80	WP	200

The experiment was conducted in randomised block design with four replications at the Thrace Agricultural Research Institute Experimental Field. For this study four different chemicals and one check were tested. Seed rate was 450 grains/m^2 and fertiliser dose was $N_{150}P_{80}$ kg/ha.

The recommended doses of the chemicals were dissolved in 100 l of water and seeds were soaked in the solution for 8 hours. Then, these seeds were rinsed with tap water and germinated. Germinated seeds were infected with 10^7 spor/ml suspension. Spor infected seeds were broadcast into standing water by hand in the experiment field.

Disease evaluation took place in four different randomly selected spots measuring 1 m^2 each just before plant maturity. Diseased plants were determined as a percentage and a variance analysis was done to determine whether there was a difference among chemicals for controlling foot rot or not.

2. Results and discussion

All the chemicals were effective in controlling foot rot. Comparing with check (no application), chemical applications effectively controlled foot rot at the rates of 87.0 %-93.3% *(Table 4)*. There was no significant difference among chemicals in terms of effectiveness, they were in the same group in the Duncan test.

Table 4. Rate of Foot rot control according to chemicals used

Treatment	Dose (g/100 l of water)	Replications Disease (%)					Disease Control (%)					Duncan
		1	2	3	4	Average %	1	2	3	4	Average	
Benlate 50 wp	60	1	2	1	0	1	83.3	77.8	90.0	100.0	87.8	a
Sportak	100	1	1	1	1	1	83.3	88.9	90.0	85.7	87.0	a
Polyram DF	200	1	0	1	0	0.5	83.3	100.0	90.0	100.0	93.3	a
Dithane M-45	200	1	0	1	0	0.5	83.3	100.0	90.0	100.0	93.3	a
Check (control)	-	6	9	10	7	8	-	-	-	-	0	b

F = 1.227 NS. CV = 6.9%

It appears that this disease may be controlled with chemicals, but using this method needs additional labour-power. Hence increasing production cost can be used in small farms, but is very difficult to practice on large farms. The best way for controlling foot rot is developing resistant varieties.

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