Paper 35

The effects of Blast disease infection on rice and milling yield

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Abstract

Twelve varieties or lines were tested to determine the effects of blast disease (Pyricularia oryzae) infection on rice and milling yield in two location, Edirne and Uzunköprü in 1995. The experiment was laid out in a randomized complete block design with 4 replications under continuous flood irrigation. 450 pregerminated seed/m² were broadcasted in the standing water. Plot size was 20 m² and fertilizer rate was 150 kg N/ha and 80 kg P/ha. The effects of blast disease infection on rice yield, total rice recovery, head rice and 1000 grain weight were examined.

A heavy blast disease infection occurred in some rice growing areas of our region, in Uzunköprü as well. However, no blast infection was seen on any variety or line tested in Edirne location at Thrace Agricultural Research Institute. The reasons for this disease infection were heavy rainfall in July and August in 1995, excessive nitrogen application, late planting, high seed density, and cold irrigation water. Due to disease infection, the farmer harvested very low grain yield (2 ton/ha) from 35 ha area at the same field next to experiment conducted in Uzunköprü . Normally, if there were no disease problem, he could have more than 7 ton/ha grain yield.

When the results obtained in two locations were compared, it was seen that there were significant differences between two locations for all characters studied. The values of all the characters drastically decreased in Uzunköprü location. The varieties that had a moderately node and neck blast susceptibility, had less difference between two locations, while the susceptible or highly susceptible varieties had higher differences for all traits. The reason for these decreases in Uzunköprü location, in addition to other environmental factors, was mainly disease infection.

Keywords

- Rice (Oryza sativa), blast disease, head rice
- Turkey

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Introduction

All of rice disease reported in other rice growing countries do not occur in Turkey. Three fungal rice diseases have been observed on rice crop in this country. These are blast disease, brown leaf spot, bakanea and foot rot, caused by Pyricularia oryzae, Helminthosporium oryzae, and Fusarium moniliforme, respectively. Bremer and Özkan (1946) and Göbelez (1953) reported that the blast was the most serious disease of rice in Turkey. Göbelez also observed up to 25.7% yield losses in some rice fields in the Black Sea Region. Tekinel et al., (1980) observed yield losses up to 90% in Mediterranean coastal areas and Oran (1975) also reported average 8.3% yield reduction in South-eastern part of Turkey due to blast infection.

Rice blast disease caused by Pyricularia grisea has long been considered as a serious constraint to higher rice yields in both tropical and temperate regions (Barr et al., 1975; O'Toole, 1990; Geddes and Iles, 1991) confirm that blast remains among the most serious biotic constraints of yield in South Asia. Shen and Lin (1996) reported that the loss due to rice blast disease was 30.5% of the total losses from diseases in China in 1980's. Sing (1987) observed sever losses of 60-100% caused by Pyricularia oryzae in the widely grown cultivars Punshi and KD-2-6 in India in 1986.

Raymundo (1975) reported yield losses between 3.2% and 14.5% in Sierra Leone . Formba (1986) observed losses in grain yield due to neck blast at 16.0-30.9% in North-western Sierra Leone. In the Ivory Coast, Awoderu (1990) estimated grain yield losses of 0.5-58% in station and researcher managed farm trials.

The objectives of this study were to determine the effects of blast disease (Pyricularia oryzae) infection on rice and milling yield.

Material and methods

Twelve japonica varieties or lines were tested for this study in two locations, Edirne and uzunköprü in 1995. There was just 80 km distance between two locations. The experiment was carried out at the research farm of Thrace Agricultural Research Institute in Edirne and the farmer field in Uzunköprü. The experiment was laid out in a randomized complete block design with 4 replications under continuous flood irrigation with full water control. Both experiments were planted at the same time on 20 May. 450 pregerminated seeds/m^2 were broadcasted in the standing water. Plot size was 20 m^2 and fertilizer rate was 150 kg N/ha and 80 kg P/ha hectare.

The effects of blast disease infection on rough rice yield, total milled rice recovery, head rice, and 1000 grain weight were examined.

A heavy blast disease infection occurred in some rice growing areas of our region, in Uzunköprü as well in 1995. But, no blast infection was observed on any variety or line in Edirne location. Therefore, the blast disease evaluation was only done in Uzunköprü. According to Standard Evaluation System for Rice after 70 and 100 days of planting for leaf, node and neck blast infection, respectively.

Results and discussion

The blast disease infection occurred in some rice growing areas in North-western part of Turkey (in Thrace) in 1995 was the most harmful disease infection observed in this region in the last 25 years. It caused 20% yield loss in 25 000 ha rice growing area of the region. Some farmers left their crops in the field without harvesting.

According to our observations, the reasons for this disease infection were heavy rainfall with fluctuating daily temperatures in July, August, and September (Table. 1), excessive nitrogen application, late planting, high seed density, and cold irrigation water. The main reason for this infection was heavy rainfall, it was more than twice of long term averages. This sometimes increased relative humidity during rice growing season. The high relative humidity with fluctuating daily temperatures promoted germination of fungal spores (Ou, 1985).

Table.1 Meteorological data of Uzunköprü location in July, August, and September

	July		August		September	
	1980-94 [x]	1995 [xx]	1980-94	1995	1980-94	1995
Average temperature ^{0}C	23.7	23.8	23.3	23.0	19.9	19.2
The average of highest temperature ^{0}C	33.2	30.8	33.0	30.3	28.9	26.5
Total rainfall mm	22.3	39.3	18.8	43.9	19.6	78.3
Rainy days	---	10	---	6	---	8
Average relative humidity (%)	58.6	59.8	60.7	60.5	63.9	66.7

(x): The average of data recorded in 15 years (from 1980 to 1994).
(xx): The average of data recorded in 1995.

The experiment in Uzunköprü location was conducted in a farmer field. The farmer sowed Rocca variety at the same field. He had used high seed density and excessive nitrogen (more than 250 kg/ha) in his crop. Therefore, first , the blast infection appeared in the farmer's crop and then it spreaded to our experiment. Although, the same agronomic techniques were practiced in both locations. However, no blast infection was seen on any variety or line tested in Edirne location. Due to disease infection, the farmer harvested very low grain yield (2 ton/ha). Normally, if there were no disease problem, he could have grain yield more than 7 ton/ha.

When the rough rice yield results obtained in two locations were compared, it was seen that there were significant differences between two locations. These losses ranged between 21% and 55% with average 38% in Uzunköprü location. The varieties that had a moderate leaf blast resistant and moderate node and neck blast susceptibility, had less grain yield difference between two locations, such as Ribe, TR-427, TR-475, TR-489, and TR-765. While, the susceptible or highly susceptible varieties had higher differences for this trait between two locations, such as TR-648, Lap/PG, Ýpsala, Sürek-95, and Serhat-92 (Table. 2). Similar results reported by Göbelez (1953) and Tekinel et al., (1980) in Turkey, Sing (1987) in India, and Raymundo (1975) in Sierra Leone, and Awoderu (1990) in the Ivory Coast.

The node and neck blast infection was more effective than leaf blast. Grain yield losses for node and neck blast susceptible or highly susceptible varieties were higher than moderate susceptible varieties. On the other hand, Ou (1985) pointed out that stem nodes infection may cause the death of all plant parts above the point of infection. It may cause complete yield loss of the effected tiller when the stem breaks at the infected node. Also, the panicles infected near the base (neck) may break causing complete yield loss (Ou, 1985). Sharma et al., (1988) found a significant negative correlation (r = - 0.580) between neck blast incidence and grain yield. Thus, it seems that node and neck blast infection is more harmful than late leaf blast infection.

There were significant difference between two locations for some quality characters, 1000 grain weight, total milled rice, and head rice. The value of these trait decreased in Uzunköprü location (Table.3). All varieties had less values for these characters in Uzunköprü than Edirne. The milled rice produced in Uzunköprü contained much more chalky kernels and it made poor milled rice appearance and decreased the grain quality. Similarly, Goto, (1965) observed reduction in 1000 grain weight due to panicle blast. It also increased the fraction of chalky kernels, thus the grain quality decreased.

Conclusion

There were significant differences between two locations for all characters studied. The values of all the characters decreased in Uzunköprü. The node and neck blast infection gave more damage to the varieties then leaf blast. In general, the environmental factors do not affect 1000 grain weight very much, however, there was huge difference between two locations for this trait as well. Therefore, the reasons for these decreases in Uzunköprü location, in addition to other environmental factors, was mainly disease infection.

Table.2. The mean values of paddy yield in Edirne (E) and Uzunköprü (U) locations in 1995.

No	Variety	*Pady yield (kg/ha)*			*Yield losses*		*Leaf Blast* [(a)]		*Node and neck blast* [(a)]	
		E	*U*	*Mean*	*(kg/ha)*	*(%)*	*E*	*U*	*E*	*U*
1	Ribe	5.8 d	4.6 abc	5.2 bcde	1.2	21	N	MS	N	MS
2	Ergene	6.7 bcd	4.4 bc	5.6 bcd	2.3	34	o	MS	o	S
3	Serhat-92	6.8 bc	3.8 bcd	5.3 bcde	3.0	44		MR		MS
4	Ana/Mar	6.1 cd	3.6 cd	4.9 de	2.5	41	i	S	i	HS
5	Lap/PG	4.7 e	2.2 e	3.5 f	2.5	53	n	HS	n	HS
6	TR-427	7.4 ab	5.7 a	6.5 a	1.7	23	f	MR	f	MS
7	TR-475	6.3 cd	4.6 abc	5.4 bcde	1.7	27	e	MR	e	MS
8	TR-489	6.3 cd	4.8 ab	5.6 bc	1.5	24	c	MR	c	MS
9	TR-648	6.9 bc	3.1 de	5.0 cde	3.8	55	t	MS	t	S
10	TR-765	6.9 bc	5.1 ab	6.0 ab	1.8	26	i	MR	i	MS
11	Ýpsala	6.4 cd	3.2 de	4.8 e	3.2	50	o	MS	o	S
12	Sürek-95	7.8 a	3.9 bcd	5.9 b	3.9	50	n	MR	n	S
	MEAN	6.5	4.0	5.3	2.5	38				
F Values										
Variety		6.637**	6.01**	8.64**						
Location		--	--	267.52**						
Variety x		--	--	3.10**						
location		0.90	1.10	0.70						
LSD (0.05)		9.46	19.42	13.81						
CV (%)										

* and ** significant at 0.05 and 0.01 level, respsctively.
MR : Moderately resistant, MS: Moderately susceptible, S: Susceptible, HS: Highly susceptible
(a) : Based on field evaluation of 70 and 100 day-old plants in Uzunköprü location only.

Table. 3 The mean values of some quality characters in Edirne and Uzunköprü locations in 1995.

No	Variety	1000 grain weight (g.)			Total rice recovery (%)			Head rice yield (%)			Leaf Blast [(a)]		Node & neck blast[(a)]	
		Edirne	Uzun köprü	Mean	Edirne	Uz.	Mean	Edirne	Uz.	Mean	Edirne	Uz.	Edirne	Uz.
1	Ribe	31.7 fg	31.0 b	31.4 efg	70.7 de	70.5 ab	70.6 bc	63.8 bc	56.3 a	60.1 bc	N	MS	N	MS
2	Ergene	36.0 cd	28.3 cd	32.2 def	72.4 bc	70.5 ab	71.5 abc	63.2 c	53.2 ab	58.2 de	o	MS	o	S
3	Serhat-92	32.5 ef	25.8 e	29.1 hý	73.5 ab	69.7 abc	71.6 ab	68.4 ab	42.4 c	55.4 g		MR		MS
4	Ana/Mar	33.5 e	26.9 de	30.2 gh	69.2 ef	69.2 bc	69.2 de	64.9 abc	47.4 bcd	56.1 fg	i	S	i	HS
5	Lap/PG	30.5 g	25.1 e	27.8 ý	68.3 f	69.1 bc	68.7 e	55.4 d	45.6 cd	50.5 h	n	HS	n	HS
6	TR-427	32.8 ef	28.3 cd	30.6 fgh	72.1 bcd	71.6 a	71.9 ab	69.3 a	54.7 a	62.0 a	f	MR	f	MS
7	TR-475	35.0 d	30.4 bc	32.7 cde	73.1 ab	70.0 abc	71.5 ab	65.5 abc	55.3 a	60.4 abc	e	MR	e	MS
8	TR-489	36.1 cd	32.6 ab	34.3 bc	73.3 ab	71.7 a	72.5 a	63.3 c	56.8 a	60.0 bc	c	MR	c	MS
9	TR-648	39.0 b	32.3 ab	35.6 b	73.1 ab	70.1 abc	71.6 ab	64.4 abc	53.3 ab	58.8 cde	t	MS	t	S
10	TR-765	36.5 c	31.0 b	33.7 cd	74.2 a	69.0 bc	71.6 ab	68.1 abc	55.1 a	61.6 ab	i	MR	i	MS
11	Ypsala	40.8 a	34.2 a	37.5 a	71.1 cd	71.6 a	71.3 abc	64.4 abc	55.0 a	59.7 cd	o	MS	o	S
12	Sürek-95	35.5 cd	26.7 de	31.1 efg	72.2 bcd	68.0 c	70.1 cd	64.4 abc	50.3 abc	57.3 ef	n	MR	n	S
	MEAN	35.0	29.4	32.2	72.1	70.1	71.0	64.6	52.1	58.3				
	F values													
	Variety	40.80**	12.14**	21.42**	9.47**	2.22*	5.21**	3.91**	3.54**	4.11**				
	Location	--	--	262.02**	--	--	41.81**	--	--	189.22**				
	Loc. x variety	--	--	3.11**	--	--	4.02**	--	--	2.83**				
	LSD (0.05) =	1.35	2.43	1.69	1.67	2.25	1.40	5.17	7.11	1.68				
	CV (%) =	2.68	5.75	5.27	1.61	2.23	1.97	5.56	9.49	7.62				

and ** significant at 0.05 and 0.01 level, respectively.
MR : Moderately resistant, MS: Moderately susceptible, S: Susceptible, HS: Highly susceptible
(a) : Based on field evaluation of 70 and 100 day-old plants in Uzunköprü location only.

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