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EFFECT OF CROP AGE AND SHEATH BLIGHT PATHOGEN ON THE CHANGES OF REDUCING SUGAR, NON-REDUCING SUGAR AND ORTHODIHYDROXYPHENOL CONTENTS OF RICE SHEATH

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A study was made on the changes in biochemical constituents of different varieties and lines of rice with or without infection of *Rhizoctonia solani* at different stages of their growth. Reducing sugars, non-reducing sugars and orthodihydroxyphenols were different among the varieties/lines. Binasail, the moderately resistant variety of sheath blight and P-3, the tissue culture line contained statistically similar amounts of these constituents and were high than BR3, Iratom24 and BINA6. Reducing sugars and non-reducing sugars increased up to the panicle initiation stage and thereafter declined. Orthodihydroxyphenols decreased significantly with the progress of crop age. Reducing sugars, non-reducing sugars and orthodihydroxyphenols decreased significantly incomparison to the healthy plants after inoculation with *R. solani*.

Key words: Biochemical changes, Growth stages, Rice varieties/lines, *Rhizoctonia solani*.

Introduction

Resistance of plants is largely dependent on their ability to inhibit the invaders either during their penetration into the host or during their development in the tissue. Of the prohabitions, orthodihydroxyphenols play the most significant role in combating pathogenic diseases. Oxidized products of phenolic compounds are highly toxic to pathogen [1] and this constituent decreased with the age of crop [2]. Biochemical differences in the resistant and susceptible plants were reported by Buxton [3]. Pathogen changes the physiology of plant, thereby overriding the catabolic and anabolic instincts of the plant. Biochemical changes occurring in mango panicle due to infection of powdery mildew pathogen was reported by Sastry *et al.* [4].

As no information is available about the progressive changes in these constituents at different growth stages of rice plants and also *Rhizoctonia solani* infection, the present work was undertaken.

Materials and Methods

Five rice varieties/lines such as BR3, Binasail, Iratom 24, P-3 (tissue culture line developed from BR3) and BINA6 (BR4xIratom38) were selected for the study. These were transplanted during the Amon season of 1989 in Bangladesh Institute of Nuclear Agriculture Farm. The experiment was laid out in a split plot design replicated thrice, keeping five varities/lines in the main plots and six treatment namely: maximum tillering stage, panicle initiation stage, healthy heading stage, infected heading stage, healthy flowering stage and infected flowering stage in the sub plots. The experimental soil was silty loam with pH range from 6.8 to 7.0. Thirty five day old seedings were transplanted in nine row plot of size 2.25 m x 2 m each. Spacings were maintained at 25 cm and 15 cm respectively. Fertilizers were applied at the rate of 80 kg N, 27 kg P, 33 kg K, 10 kg S and 5 kg Zn per hectare. Ten hills of each varieties/lines were inoculated at panicle initiation stage of crop with 7 day old (PDA) Potato Dextrose Agar culture of *Rhizoctonia solani*. An inoculum block of size 10 mm^2 was placed inside each hill near the water level. Each inoculated hill was wrapped with a piece of cotton to ensure contstant moisture for infection by the pathogen. Disease severities data was collected according to the Standard Evaluation System for rice. [5].

Ten gram of fresh leaf sheaths were collected during each stage of the crops. Leaf sheaths were cut into 1-2 cm pieces and plunged in 80% boiling ethyl alcohol at 10 ml/g. They were allowed to boil for 7 mins and then cooled in running water. The residue of the extract was crushed with 80% ethyl alcohol at 3 ml/g. The second extraction ensured completed removal of alcohol soluble substances. Both the extracts were filtered with Whatman paper No.41 and the total volume of the filtrate was finally raised to 50 ml. The reducing sugars were estimated by modified Somogyi method [6], non-reducing sugars were estimated by the difference between the total sugar [7] and the reducing sugars and orthodihydroxyphenols were estimated by Arnow's method [8]. The data was analyzed statistically and the mean differences were adjudged as per LSD test.

Results and Discussion

The results of reducing and nonreducing sugars of the leaf sheaths have been shown in the Tables 1 and 2 respectively.

The mean values of these constitutents were significantly different among the varieties/lines. P-3 tissue culture line contained higher amount of reducing and non-reducing sugars and it was statistically similar to Binasail. BR3 and BINA6 ranked second in sugar contents and the contents were not significantly different from each other. The amount of sugars synthesized by Iratom24 was comparatively lower and even less than half of that synthesized by P-3 and Binasail.

The average content of these two constituents of the leaf sheaths were statistically different among the growth stages of the crop. These constituents increased significantly up to the panicle initiation stage and thereafter declined. The results are in agreement with Shouchi *et al.* [9], who reported that sugar contents of rice plant increased up to the panicle initiation stage and thereafter declined.

After inoculation with *Rhizoctonia solani* at panicle initiation stage of these vcrieties/lines, diseased plant of all the varieties/lines contained smaller amount of reducing and nonreducing sugars both at flowering and heading stages of crop than their respective stages of healthy plant. This result is congruent with Khatri *et al* [10] who observed that 82.47% of reducing sugars and 40.69% of non-reducing sugars were decreased with the infection of *Entyloma oryzae* in rice leaves.

Table 3 presents the orthodihydroxyphenol content at different growth stages of rice (healthy and infected). The mean values of the constituent were significantly different among the varieties/lines. The highest and statistically identical amounts was synthesized by P-3 and Binasail followed by BR3, BINA6 and Iratom24. The average content of the constituent was statistically different among the stage. This constituent increase significantly up to the maximum tillering stage and then the values decreased significantly up to the flowering stages of the crop. Such decreased with the age of crops have been reported by a number of works [2,11,12].

After inoculation with *Rhizoctonia solani* at panicle initiation stage of these varieties/lines, infected plants of all varieties contained smaller amount of orthodihydroxyphenol both at flowering and heading stages of crop then their healthy plant. The decline of orthodihydroxyphenol in rice plant due to the infection of *Entyloma oryzae* pathogen also has been reported by Khatri *et al.* [10].

TABLE 1. REDUCING SUGARS (mg/g FRESH LEAF SHEATH) AT DIFFERENT GROWTH STAGES OF RICE.

Varieties/lines	Growth stages of the crops						
	Maximum tillering stage	Panicle initiation stage	Heading stage		Flowering stage		Mean
			Healthy	Infected	Healthy	infected	
BINA 6 ...	1.08	2.47	1.39	1.17	1.05	0.46	1.27
P-3 ...	1.23	3.72	2.85	2.17	1.60	1.0	2.09
BR3 ...	1.10	2.61	2.0	1.44	1.78	1.30	1.71
Binasail ...	1.59	2.51	2.31	1.56	1.79	1.30	1.84
Iratom 24 ...	0.55	1.15	0.80	0.33	0.60	0.23	0.61
Mean ...	1.11	2.49	1.87	1.33	1.37	0.86	—
LSD (0.05)	G			GXV			V
	0.25			0.59			0.51

TABLE 2. NON-REDUCING SUGARS (mg/g FRESH LEAF SHEATH) AT DIFFERENT GROWTH STAGES OF RICE.

Varieties/lines	Growth stages of the crop (G)						
	Maximum tillering stage	Panicle initiation stage	Heading stage		Flowering stage		Mean
			Healthy	Infected	Healthy	infected	
BINA 6 ...	10.22	16.43	10.81	5.98	7.15	2.18	8.80
P-3 ...	13.45	19.46	14.72	9.41	10.52	8.66	12.70
BR3 ...	9.29	17.11	11.19	8.18	4.92	2.53	8.87
Binasail ...	13.03	19.88	12.71	9.96	7.06	5.38	11.34
Iratom 24 ...	6.18	10.42	6.49	2.90	3.76	1.25	5.17
Mean ...	10.43	16.67	11.19	7.29	6.68	4.0	—
LSD (0.05)		G		GXV			V
		1.18		2.28			1.76

TABLE 3. ORTHODIHYDROXYPHENOLS (µg/g FRESH LEAF SHEATH) AT DIFFERENT GROWTH STAGES OF RICE.

Varieties/lines	Growth stages of the crops						
	Maximum tillering stage	Panicle initiation stage	Heading stage		Flowering stage		Mean
			Healthy	Infected	Healthy	infected	
BINA 6 ...	87.70	76.73	71.13	40.60	55.43	26.03	59.60
P-3 ...	125.73	105.60	85.33	44.97	68.43	39.83	78.26
BR3 ...	91.23	74.40	63.27	41.00	49.77	30.40	58.35
Binasail ...	113.20	98.80	87.50	42.67	70.27	36.17	74.76
Iratom 24 ...	61.27	51.77	43.83	25.90	55.70	16.70	39.19
Mean ...	95.75	81.46	70.21	39.03	55.92	29.83	—
LSD (0.05)	G			GXV			V
	3.99			7.20			7.67

TABLE 4. DISEASE SEVERITIES (0-9) AT DIFFERENT STAGES OF RICE VARIETIES/LINES.

Vareities/ lines	Disease severities score			Disease reaction
	Heading stage	Flowering stage	Mean	
BINA 6	3.17	4.33	3.75	MS
P-3	1.17	1.40	1.28	MR
BR3	2.10	4.03	3.10	MS
Binasail	1.33	1.75	1.53	MR
Iratom	7.53	9.00	8.27	HS

MR= Moderately Resistance;MS= Moderately Susceptible; HS= Highly Susceptible

Above results showed that P-3 and Binasail contained higher amount of these three constituents then the other two varieties BR3 and Iratom24 and one hybrid line BINA6. The mean disease severities of the vareities and lines were different. P-3 and Binasail showed moderately resistance, BR3 and BINA6 were moderately susceptible and Iratom24 was highly susceptible to the pathogen Table 4. P-3 and Binasail had relatively higher amounts of reducing, non-reducing sugars and orthodihydoxyphenol which earned them the character of moderately resistance to the pathogen. Resistance varieties contained higher amount of these constituents has been reported by many workers [13-16].

The reason for the decrease of the three constituents in the diseased leaves compared with the healthy leaves may be explained in the following way. The pathogen destroyed chloroplasts and other organic structural units of leaves. As a result the rate of sugar synthesis was relatively low in the infected leaves.

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