

Changes in Phenolic Contents in Nodal Tissues of Red rot Infected Sugarcane.

S. Rahman, M. S. Alam¹ and O. I. Joarder²
Bangladesh Sugarcane Research Institute,
Ishurdi, Pabna, Bangladesh.

Received on 12.12.99

ABSTRACT

Changes of phenolic content of nodal tissues were studied in red rot inoculated eight sugarcane varieties of known resistance after 3, 6, 12 and 18 d of inoculation. Total phenolic contents in all varieties showed a decreasing trend after 3 to 6 d except moderately susceptible variety Isd 21 and susceptible variety Misrimala. An increasing trend was observed in all varieties after 6 to 12 d and then again decreasing trend after 12 to 18 d of inoculation. However, it was found that total phenols of all varieties decreased significantly in inoculated canes after 3 d but it increased significantly after 6, 12 and 18 d of inoculation compared to control. When final results after 18 d of inoculation was considered, all varieties showed an increase in total phenolic contents ranging from 49.41 to 162.30% over control. The susceptible variety Isd 5/55 showed the highest increase of 162.3% followed by 132.62% and 98.86% in the moderately resistant variety Isd 16 and resistant variety Isd 20 respectively, over their control. Results indicate that no correlation exists between degree of resistance to red rot and total phenolic contents in healthy or inoculated canes.

INTRODUCTION

The bio-chemical mechanism that imparts resistance to sugarcane is not fully understood. In some cases, resistant plants show high level of total phenolics as compared to susceptible ones (Kirkham, 1957). Phenols or their derivatives have been implicated in the resistance to plant diseases (Cruick shank *et al.*, 1964; Farkes and Kiraly, 1962). Resistance to red rot has been associated with total phenols present in sugarcane varieties (Singh *et al.*, 1976; Sharma *et al.*, 1982). It is reported that after inoculation of red rot organism, there was marked liberation of phenols in resistant varieties than in susceptible varieties (Rao *et al.*, 1968). The phenolic contents of resistant varieties are much higher than red rot susceptible varieties (Wilson and Srivastava, 1970; Sharma *et al.*, 1982). The mechanism of resistance in sugarcane against red rot appears to operate mainly in the internodal tissues (Singh *et al.*, 1976). This study was aimed to find out changes in phenolic content and its relationship with resistance and susceptibility of eight sugarcane clones known resistance after 3, 6, 12 and 18 d of inoculation of red rot organism in nodal tissue of sugarcane.

¹Professor, Dept. of Botany, University of Rajshahi, Bangladesh

²Professor, Dept. of Genetics and Plant Breeding, University of Rajshahi, Bangladesh

MATERIALS AND METHODS

To study effects of red rot infection on phenolic changes, eight sugarcane varieties namely, Isd 2/54, Isd 5/55, Isd 16, Isd 17, Isd 18, Isd 19 Isd 21 and Misrimala of known resistance were planted with 3 replications following RCB design. Forty five healthy canes, 15 from each replication were inoculated in 5th internode from ground level with 0.2 ml spore suspension (6×10^5) of a mixed inoculum prepared from highly virulent isolates of *Colletotricum falcatum* by hypodermic syringe method of inoculation. Inoculation wound was properly sealed by pellet of plasticine and finally wrapped with scotch tapes to avoid external contamination. Similar stalks of each variety were also inoculated with sterilized water to serve as control. Nodal tissues sample adjacent to inoculated internode were taken after 3, 6, 12 and 18 d of inoculation for estimation of total phenols.

The quantitative analysis of total phenolic contents of nodal tissue of red rot inoculated and control (water injected) cane samples was determined from a standard curve prepared using catechol. The amount of total phenols in sample was determined by formula described by Swain and Hillis (1959) using Folin Denis reagent.

$$\mu\text{g total phenol per gram of sample} = (S-B) \times \frac{25(\text{ml})}{\text{Sample (ml)}} \times \frac{1}{\text{Sample weight(g)}}$$

Where, 'S' was the concentration of total phenol ($\mu\text{g/tube}$) for sample and 'B' was that for blank.

RESULTS AND DISCUSSION

Total phenolic contents in nodal tissue samples of eight sugarcane varieties taken from both control and inoculated canes after 3, 6, 12 and 18 d of inoculation are presented in the Table 1. In this study total phenolic contents in diseased canes of 8 individual varieties showed a decreasing trend after 3 to 6 d except varieties Isd 21 and Misrimala and increasing trend after 6 to 12 d and then again decreasing trend after 12 to 18 d of inoculation (Table 1). Mean total phenols of fresh nodal tissues samples of 8 varieties decreased significantly in red rot inoculated canes after 3 d of inoculation but it increased significantly after 6, 12 and 18 d of inoculation compared to control. Phenolic compounds have been found to appear and accumulate in many plant species in response to infection and it has been postulated that this metabolic alteration may be of some importance in resistance mechanism (Farkas and Kiraly, 1962; Shishiyama *et al.*, 1969; Mahadevan, 1979; Padmanaban *et al.*, 1988; Shahabuddin and Anwar, 1992).

Table 1: Changes in total phenolic content ($\mu\text{g/gm}$ fresh tissue weight) in the nodal tissues of different sugarcane varieties due to red rot infection.

Varieties	Total phenols ($\mu\text{g/gm}$ fresh tissues weight)											
	After 3 d of inoculation			After 6 d of inoculation			After 12 d of inoculation			After 18 d of inoculation		
	Control	Diseased	% deviation	Control	Diseased	% deviation	Control	Diseased	% deviation	Control	Diseased	% deviation
Isd 2/54	180.25	170.20	- 5.44	101.68	94.50	- 6.39	164.75	194.00	+ 17.75	66.00	124.75	+ 89.0
Isd 5/55	152.50	162.00	+ 6.58	87.00	107.00	+ 22.98	126.00	161.50	+ 28.17	80.25	110.50	+ 162.30
Isd 16	198.00	187.25	- 5.43	146.00	177.50	+ 21.57	183.00	230.00	+ 25.68	85.75	149.17	+ 132.62
Isd 18	215.00	150.25	- 30.23	93.25	152.76	+ 63.81	146.00	165.50	+ 13.36	85.83	101.00	+ 77.19
Isd 19	180.50	141.00	- 21.66	86.50	91.75	+ 6.07	139.50	200.50	+ 43.73	106.75	159.50	+ 49.41
Isd 20	167.25	122.25	- 26.90	85.50	102.75	+ 20.17	109.50	217.75	+ 98.85	88.00	175.00	+ 98.86
Isd 21	45.75	90.25	- 37.56	83.50	140.25	+ 67.96	145.50	245.17	+ 68.50	96.50	178.67	+ 85.15
Misrimala	37.50	24.08	- 37.78	109.25	81.25	- 25.63	189.25	162.50	- 14.13	113.00	200.50	+ 77.43
Mean	159.54	130.89	- 17.98	99.09	118.47	+ 19.57	150.44	197.11	+ 31.02	86.51	149.89	+ 72.26
LSD (0.05)	11.09	18.50		11.46	17.97		15.37	14.47		14.61	19.13	
C.V (%)	6.00		7.91		4.90				8.22			
S.E. Mean	1.78		1.76		1.74				1.98			
LSD (0.05)	5.15		5.09		5.04				5.75			
(Pooled)												

After 3 d of inoculation, decrease in total phenolic contents in diseased cane was much higher in the susceptible variety Misrimala and moderately susceptible varieties Isd 21 and Isd 18. The moderately resistant varieties Isd 16 and Isd 2/54 showed minimum decrease of 5.43 and 5.44% while resistant varieties Isd 19 and Isd 20 showed 21.66 and 26.90% decrease respectively compared to control. This result indicated that there was no positive role of total phenols in relation to disease resistance. This is in agreement with the findings of Singh *et al.* (1976) who established that there was no positive correlation between amount of total phenols in sugarcane varieties and degree of resistance against *C. falcatum*. Their studies pointed out that total phenolic content in a highly resistant variety CoL 29 was almost at par with the most susceptible variety, Co. 312. An increasing trend of total phenolic contents in diseased cane of individual varieties after 6 d (except Isd 2/54), 12 d (except Misrimala) and 18 d after inoculation was observed. After 6 d of inoculation, the increase in total phenolic content (except Isd 2/54 & Misrimala) in diseased cane varied from 6.07 to 67.96% and after 12 d of inoculation varied from 13.36 to 98.85% (except Misrimala).

The varieties Isd 2/54 and Misrimala showed decrease of total phenolic content of 6.39 and 25.63% respectively after 6 d of inoculation and 14.13% decrease in Misrimala after 12 d of inoculation compared to control. The results are in conformity with the findings of Beniwal *et al.* (1988). They reported that after 12 d of inoculation red rot inoculated canes showed 11.22 and 61.57% increase of total phenols in some sugarcane varieties, whereas in some other varieties it decreased by 8.0 to 32.88%. Similar increase or decrease of total phenolic content has been observed by Talukder (1994) in white leaf disease infected cane. He reported that in the WLD infected cane of Isd 16, phenolic contents decreased by 24.5% and in Isd 20 it was increased by 7.17% over their healthy check. Rahman (1995) reported an increase of 15.20 and 45.67% of total phenols in the clones I 291/88 and I 31/88, respectively in smutted canes compared to their healthy checks. Padmanaban *et al.* (1988) found the increase of total phenols in the varieties Co 740 and Co 1287 by 128.57 and 33.0% respectively due to smut infection in comparison to their respective healthy checks.

Phenolic contents in control canes also showed a decreasing trend after 6 d and then increasing trend after 12 d and again decreasing trend after 18 d of inoculation (Table 1). Results are in agreement with finding of Beniwal (1985) who reported an increase in the phenolic contents in the control canes of 8 clones after 4 and 12 d of inoculation. Similar increase in control has also been reported by Singh *et al.* (1976).

REFERENCES

- Beniwal, M. S. 1985. Studies on pathogenic variability and durable resistance to red rot of sugarcane caused by *Colletotrichum falcatum* Went. Ph. D. thesis, College of Agriculture, Haryana Agricultural University, Hisar, India, 117 p.
- Beniwal, M.S.; Taniza, A.D.; Satyavir and Khirbat, S. K. 1988. Phenols in relation to sugarcane resistance against red rot disease. *Bhartiya Sugar*, pp. 49-52.
- Cruickshank, I. A. M., and Perrin, D. R. 1964. Pathological function of phenolic compound in plant. In : *Biochemistry of phenolic compounds*. J. B. Harbourne Ed. Academic Press, N. W.

- Farkas, G. L. and Kirlay, Z. 1962. Role of phenolic compounds in the physiology of plant disease and disease resistance. *Phytopath. Z.*, **44** : 105-150.
- Kirkham, D.S. 1957. The significance of polyphenolic metabolites of apple and pear in the host relations of *Venturia inaequalis* and *Venturia pirina*. *J. Gen. Microbiol* **17** : 491- 504.
- Mahadevan, A, 1979. Biochemical aspects of plant disease resistance. *J. Scient. Ind. Res.*, **38**: 156-171
- Padmanaban, P.; Alexander, K. C. and Shanmugan, N. 1988. Some metabolic changes induced in sugarcane by *Ustilago scitaminea*. *Indian Phytopathology*, **41**: 229-232.
- Pappelis, A.J. and Katasanos, R. A. 1965. An approach to study the physiology of senescence and parasitism in sugarcane. *Phytopathology*, **55** : 620-622.
- Rao, K. C.; Krinamurthy, T.N.; Lalitha, E. and Rajalakshmi U.K. 1968. Phenols in relation to resistance of sugarcane varieties to red rot disease *Curr. Sci.*, **37** : 532-534.
- Rahman, M. S. 1995. Effect of smut on some yield components and physiological changes in sugarcane. M. Sc. Thesis. Bangladesh Agricultural University, Mymensingh. pp. 1-65.
- Shahabuddin, M. and Anwar, M. N. 1992. Metabolic changes in the jute plant due to fungal infection. *Bangladesh J. Bot.*, **21**: 205-212.
- Sharma, K. P.; Batta, S. K. and Kanwar, R.S. 1982. Phenolic contents in red rot resistant and susceptible varieties of sugarcane. *J. Research (Punjab) Agricultural University*), **9** : 50-51.
- Shishiyama, J.; Egawa, H.; Mayama, S. and Akai, S. 1969. Role of amino acids in the development of *Helminthosporium* blight disease of rice plant and some enzyme activities relating to amino acid metabolism in the host parasite interaction. *Mem. Coll. Agric., Univ. Kyoto*, **95**: 7-34.
- Singh, K.; Singh, R. P. and Agnihotri, V. P. 1976. Phenolics in relation to sugarcane resistance against red rot disease. *Sugarcane Pathologists' Newsletter*, **15/16**: 37-41.
- Srinivasan, K. V. 1968. Physiology of disease resistance in sugarcane with particular refereance to red rot. *Curr. Sci.* **37** : 35.
- Verma, A.K.; Jaiswal, S. P; Bajaj, K. L. and Bhatia, I.S. 1971. A study of polyphenols in sugarcane in relation to red rot disease present in the stem of sugarcane varieties. *Sug. Azuc.*, **66** : 11-13.
- Wilson, K.I. and Srivastava, D.N. 1970. Phenolic content of sugarcane in relation to red rot disease. *Experientia*, **26** : 1074.
- Wilson, K. I. and Srivastava, D.N. 1977. Post infection changes in the phenolic content of the nodal tissue of sugarcane. *Indian Sugar*, **27** : 559-560.