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BIOCHEMICAL ALTERATION IN COUNTRY BEAN DUE TO YELLOW VEIN MOSAIC VIRUS

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Abstract

An investigation was conducted to study the biochemical changes in healthy and yellow vein mosaic virus infected leaves of country bean (*Dolichos lablab* L.). Results showed decrease in chlorophyll a, chlorophyll b, chlorophyll a+b, ß-carotene and DNA, but increase in total nitrogen, protein, carbon and RNA contents in infected leaves as compared to healthy one. Malonic acid was identified as main acid followed by oxalic and tartaric acids in healthy leaves, whereas oxalic acid- as main acid followed by malonic and tartaric acids in infected leaves.

Key words : Biochemical alteration, Country bean, Mosaic virus.

Introduction

Yellow vein mosaic virus is a common disease of country bean which limits its seed yield by about 40 percent (Sherf and Macnab, 1986). Due to yellow vein mosaic virus the country bean leaves turn yellow and stunt in growth. Information on biochemical alteration in country bean is not available. However, due to virus infection amount of chlorophyll (Chl) and carotenoids appeared to have reduced in chilli and okra (Joshi and Dubey, 1975, and Atiri and Ibidapo, 1989) and reports on biochemical changes in rose and sandal were described by Singh (1987) and Parthasarthy *et al.* (1976), respectively. The objective of the present study was to quantify the changes in chlorophyll, ß-carotene, nitrogen, protein, carbon and nucleic acids, as well as to identify the qualitative changes in organic acids of country bean leaf infected by yellow vein mosaic virus which finally causes yield reduction.

Materials and Methods

With a local variety of country bean the experiment was conducted in *rabi* season during 1990-91 at the research farm of the Institute of Postgraduate Studies in Agriculture, Salna, Gazipur, under natural environmental conditions. At flowering stage, leaf samples from healthy and diseased plants were taken when typical disease symptom was well

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developed in the plants. Leaf samples were taken from similar position of the main stem. For dry matter analysis leaves were dried at 70±1°C for 48 hrs. Chlorophyll, ß-carotene and nucleic acid contents in leaves were estimated according to Witham *et al.* (1986), Shiraishi (1972) and Spirin (1958), respectively using double-beam spectrophotometer (Model 200-20 Hitachi). Total nitrogen was determined following Kjeldahl method as described by Jackson (1958). Total protein was determined multiplying total nitrogen with 6.25. Organic acids were identified as per Shiraishi (1980) by high performance liquid chromatograph (Model Shimadzu SPD-6AV).

Results and Discussion

Results showed reduced amount of chlorophyll a, chlorophyll b, chlorophyll a+b and ß-carotene in infected leaves than in healthy ones (Table 1). Chlorophyll a : b ratio was higher in infected leaves as compared to healthy leaves. Higher chlorophyll a:b ratio indicated higher degradation of chlorophyll a in infected leaves than in healthy ones. Lower pigment contents in virus infected plants have already been reported by Hossain and Mian (1989), Singh (1987) and, Atiri and Ibidapo (1989). Stevens (1983) mentioned that mosaic infection is generally known to cause a failure of cell chloroplasts to produce chlorophyll. Chlorophyll a provides energy to photosynthetic reaction, and all other pigments transfer their absorbed energy to chlorophyll a. Chlorophyll b and carotenoids protect the plant cell against the photochemical reaction induced by the illumination of chlorophyll (Davies *et al.*, 1964). So lower content of chlorophyll in infected leaves is due to lower content of ß-carotene. Mohr (1980) reported that chlorophyll synthesis depends on the synthesis of all the chlorophyll forming enzymes. It is so assumed that due to virus infection, activity of specific enzyme (chlorophyllase) was reduced which inhibited pigment synthesis.

Infected leaves contained 37.21, 37.20 and 5.22 per cent higher total nitrogen, protein and carbon, respectively than healthy leaves (Table

Table 1. Biochemical changes in country bean leaf due to yellow vein mosaic virus

Characters	Healthy Leaf	Infected Leaf	% change over Healthy Leaf
Dry matter, %	18.59±1.30	16.92±0.98	-08.98
Chl a, mg/100 g (fresh wt.)	92.50±3.41	45.04±1.54	-51.31
Chl b, mg/100 g (fresh wt.)	33.51±1.61	13.87±0.63	-58.61
Chl a : b ratio	2.76±0.15	3.25±0.19	+17.75
Chl a+b mg/100 g (fresh wt.)	126.01±5.23	58.91±1.74	-53.25
ß-carotene, mg/100 g (fresh wt.)	17.93±1.34	14.05±0.93	-21.64
Total nitrogen, % (dry wt.)	4.30±0.21	5.90±0.33	+37.21
Total protein, % (dry wt.)	26.88±1.76	40.92±2.01	+37.20
Total carbon, % (dre wt.)	38.92±1.76	40.95±2.01	+05.22
C: N ratio	9.05±0.36	6.94±0.27	-23.31
Nucleic acids:			
RNA, mg/g (dry wt.)	12.19±0.49	14.91±0.56	+22.31
DNA, mg/g (dry wt.)	2.66±0.12	2.58±0.16	-03.01
RNA : DNA ratio	4.58±0.21	5.78±0.32	+26.20

1). Singh (1987) reported higher content of protein, but lower content of nitrogen in diseased rose leaves. Hayashi (1962) claimed that the accumulation of nitrogen is due to an increase in activity of amino-acid activating enzymes. It is reported that an increase in protein content in virus infected leaf is due to synthesis of viral protein. Higher accumulation of carbon in infected leaves may probably be due to higher accumulation of starch as reported by Singh (1987).

The present study showed higher content of RNA, but lower content of DNA in infected leaves (Table 1). It is reported that virus infection accelerates the production of enzyme RNA synthetase and RNA polymerase (Takahashi and Ishii, 1952). These two enzymes probably in presence of higher RNA content synthesize more protein in infected leaves.

Malonic acid was identified as main acid followed by oxalic and tartaric acid in healthy leaves, whereas oxalic acid was identified as main acid in infected leaves (Fig. 1). Malonic and tartaric acids occupied second and third positions, respectively in later case. Specific organic acid plays specific role in a definite metabolic reaction. So conversion of malonic acid to oxalic in infected leaf may alter its metabolic reactions.

From these observations it may be concluded that due to change of pigments, total carbon, nitrogen, protein, nucleic and organic acids in infected leaves the metabolic processes of infected plants is altered as compared with healthy ones which finally affects yield loss of country bean.

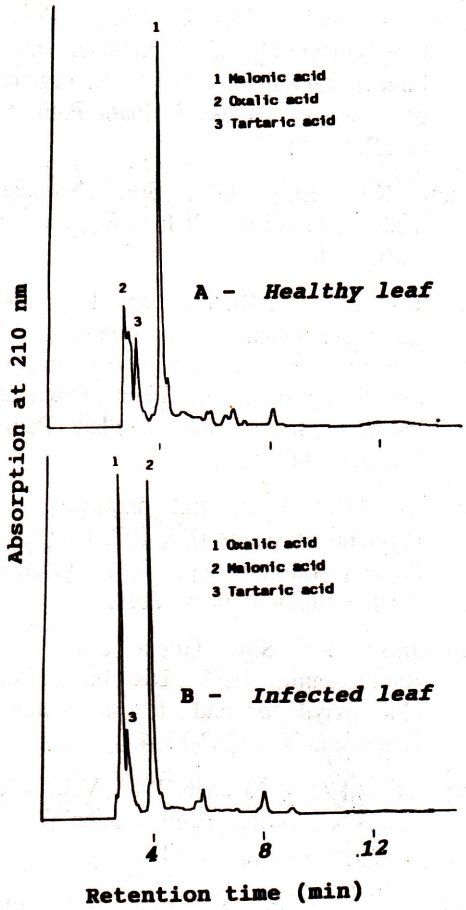

Figure 1. Identification of organic acids in healthy and infected leaf of country bean by HPLC.

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