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CHANGES IN SUGAR, AMINO ACID AND MINERAL CONTENTS OF BARKS OF TWO MANGO CULTIVARS AFFECTED WITH QUICK DECLINE DISEASE

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ABSTRACT

A disease technically known as Collar/stem rots but commonly known as quick decline of mango is becoming very destructive in Pakistan. The bark samples of healthy and diseased mango plants of two mango cultivars viz. Chaunsa and Langra were analyzed to assess the variations and disturbances in the contents of sugars, free amino acids and metals in relation to quick decline. In general, the contents of total sugars, reducing sugars, non reducing sugars, free amino acids and minerals were found to be decreased in the diseased barks as compared to that of healthy barks of both the mango cultivars, except Fe contents, which increased in both cultivars. The bark area adjacent to diseased portion was also analyzed in both cultivars. A profound decrease in these chemical constituents in this area was observed in cv. Langra as compared to Chaunsa. This reflected some sort of vital role of nutrients in the development of defense mechanism in this area against the penetration of collar/stem rot of mango.

Keywords: Mango, quick decline, bark, sugar, amino acid content

INTRODUCTION

Mango (*Mangifera indica* Linn.) is an important fruit crop of tropical and sub tropical countries of the world. Due to its fine taste and good qualities, it is called as the king of the fruits. It is the 2nd major fruit crop both in area and production in Pakistan. It is grown on an area of 102.8 thousand hectares with annual production of 1034.6 thousand tones of fruit (Anonymous, 2003). Mango, one of the most delicious and nourishing fruits, has special place in the world fruit markets and is an important source of foreign exchange earning for Pakistan. It is considered to be the most popular fruit of the sub-continent and enjoying a prime place in the list of exportable fruits. The growing demands for fresh mango fruit and its processed products in domestic and foreign market have raised the interest of growers. The yield per hectare is about 10 tones in Pakistan, which is quite low as compare to the potential of our commercial varieties. For the improvement of production the problems in mango culture are required to be redressed. Although

soil and climatic conditions are suitable in Pakistan particularly in Punjab and Sindh but some diseases are the significant causes leading to its low production (Persley, 1993), out of which a new disease commonly known as "Quick Decline" but technically called Collar/stem rot is becoming the most destructive one (Mahmood and Gill, 2002).

The main and visible symptom is the sudden collapse of a healthy looking plant in days. The sudden death of mango trees is hurting especially for the mango growers and generally for the nation. This is a serious situation as the intensity of the disease is aggravating day by day and hazard has been observed in the entire mango growing areas of the country. Although pest control work on mango has been done by different research institutions in Pakistan (Khan et al., 1996), but little attention has been paid towards chemical analysis of the mango plants in relation to collar/stem rot.

It was, therefore, imperative to conduct a comparative study of chemical constituents of healthy and diseased barks of two mango varieties i.e. Chaunsa and Langra. Such information was thought to be helpful for success over this danger inflicting enormous loss in mango industry.

MATERIALS AND METHODS

Sample Collection and Storage

Bark samples were collected from the experimental orchard of "Mango Research Station, Shujabad" Pakistan. The samples were picked from the healthy and diseased plants of two cultivars viz. Chaunsa and Langra. Each variety had three replications. The samples were dried under shade and packed in airtight plastic bags. Before the analysis, the samples were powdered in a agate pestle and mortar. The powdered samples were stored in pre-cleaned polyethylene containers.

Extraction and Quantitative Analysis of Sugar and Free Amino Acids

Sugar and free amino acids were extracted and quantified as follows. Two gram of each powdered sample was taken and soaked separately in 75% ethanol (100 ml). After 24hrs, the samples were ground and filtered. The residue was washed with a few ml of 75% ethanol and volume was made up to 100ml. The filtrate obtained in each case was tested for presence of sugars and free amino acids using molish and ninhdrin reagents, respectively.

These showed positive tests in each case. The filtrates were then preserved in refrigerator for further analysis. Total sugars were determined spectrophometrically using anthrone reagent (Travelyan and Harrison, 1952). Reducing sugars were determined by ferricyanide method (Hulme and Narian, 1931). Free amino acids were quantified using ninhydrin method (Pandey, 1984).

Sample Preparation and Metal Analysis

For sample preparation, 0.5 g of dried powdered samples was ashed in a muffle furnance (Gallenkamp, England), at 500 °C for 5 h. After heating the samples were cooled down to room temperature in desicator and ash contents were weighed. The ash contents were dissolved in aqua regia (5ml). The sample was heated to near dryness and 5ml of HNO_3 was added to it. Solution was filtered using whatman filter paper-42 and filtrate was transferred to 50ml measuring flash and volume was made up to the mark with deionized water. The solution was stored in clean polyethylene bottle for metal analysis by flame spectrometric technique. Metals such as Ca, Mg, Fe, Cu, Mn and Zn in sample solutions were estimated by atomic absorption spectrometry (A-1800 AAS, Hitachi, Japan) following wavelength (nm) Ca, 4227; Mg, 2852; Fe, 248.3; Cu, 324.8; Mn, 279.6 and Zn, 213.8. Na and K were estimated by flame emission at wavelengths 589.0 and 766.5 nm respectively under conditions specified by the manufacturer.

RESULTS AND DISCUSSION

In the present study, the determinations were made to access the changes/disturbances in the contents of total sugar, amino acid and ash in the barks of mango varieties viz. Chaunsa and Langra in relation to quick decline disease. A significant decrease was observed in contents of

total sugar i.e. 49.53 and 57.0% in diseased barks of Chaunsa and Langra varieties respectively (Table 1). Similarly, the samples adjacent to diseased areas of both varieties viz. Chaunsa and Langra also had decreased total sugar contents by 3.86 and 23.1 %, respectively. Contents of reducing sugar (67.0%) and non-reducing sugar (26.0 %) were also decreased significantly in case of diseased bark of Langra variety as compared to its healthy bark. Similarly, in the samples adjacent to diseased area, the contents of reducing sugar (17 %) and non reducing sugar (35.95 %) were also decreased. A significant decrease in contents of reducing (55.74 %) and non-reducing sugar (49.07 %) was observed in case of diseased samples of cv. Chaunsa as compared to its healthy bark samples. While the decrease in these contents was not significant in case of samples adjacent to diseased area as compared to healthy bark. Similarly, the decease in total free amino acids (53.70 %) and ash contents (8.06 %) was found in diseased bark of cv. Chaunsa. While their decrease in adjacent to diseased area was 10.49 and 0.76% respectively as compared to healthy bark.

The total free amino acids and ash contents (64.7 and 367 %) in diseased bark and in samples adjacent to diseased area (30.88 and 0.72 %) were found to be decreased as compared to healthy bark of Langra variety.

A uniform trend was observed in total sugars, amino acids, and ash contents, which were found to be decreased in case of diseased barks of two mango varieties viz. Chaunsa and Langra. This may be attributed to the decrease in the rate of anabolism or high rate of degradation of sugars, more utilization of amino acids in protein synthesis in the diseased barks infected by the pathogen. These findings are also in correlation with the earlier report (Shad et al., 2002). While the decrease in these contents was not significant in case of the samples adjacent to diseased area as compared to healthy barks of the each mango variety. But in cv. Langra profound decrease was noticed in the contents of total sugar, reducing, non-reducing sugars and amino acids in the bark adjacent to diseased area as compared to the same area of cv. Chaunsa.

A consistent pattern was found in case of Ca, Mg, Cu and Fe levels in these two-mango varieties viz. Chaunsa and Langra (Table 2). The contents of Ca (13.67 and 6.68 %), Mg (1.99 and 973 %) and Cu (9.24 and 36.13 %) were found to be decreased in the diseased barks of mango varieties viz. Chaunsa and Langra respectively compared with their healthy barks. A uniform trend of increased Fe level was observed in diseased barks of both varieties by 21.18 and 35.08 %, respectively. But more decrease was found in contents of Mg than that of Ca in CV. Langra. While in contrast, more decrease in levels of Ca and less change was found in Mg in CV. Chaunsa.

K (25.14 %), Mn (39.29 %) and Zn (61.52 %) were also increased in the diseased bark of cv. Chaunsa. While only Na (15.45 %) was found increased in diseased bark of Langra. As for as samples adjacent to diseased bark of both varieties are concerned, only in cv. Chaunsa, the contents of Ca and Cu decreased 9.12 and 17.49 %, while their decrease was 6.85 and 42.95 % in Langra variety, respectively. K by 44.04 % in cv. Chaunsa and 2.24 % in cv. Langra was found increased in the adjacent bark of the diseased bark. In addition, Langra variety also showed significant decrease in levels of Fe and Zn by 39.21 and 33.17% respectively. Samples adjacent to the infected portion in both varieties were collected from the bud union level. The site of graft union regarding penetration of collar/stem rot of mango has already been reported as a fundamental source of information regarding resistance and susceptibility in these two varieties (Malik et al., 2003).

So, profound decrease in chemical constituents like total sugars, amino acids, Ca, Cu, Fe and Zn in this area of Langra variety reflected the vital rote in the development of resistance behavior of plants against this disease. In other words, this decrease can be attributed to more utilization of these compounds and metals which might strengthen the observed defense mechanism already reported by Grewal (2002). It is concluded from this study that in addition to the pest control strategies, justified irrigation, application of manures and chemical fertilizers are

paramount in mango orchards to make up the deficiencies of the biologically important components and to rehabilitate the diseased plants.

REFERENCES

Anonymous. 2003. Agricultural Statistics of Pakistan. Ministry of Food, Agriculture and Livestock (Economics wing) Govt. of Pakistan, Islamabad.

Grewal, A.G. 2002. Mini project for quick decline of mango. Mango Research Station, Shujabad. p. 1-13.

Hulme, A.C. and Narain, R. 1931. The ferricyanide method for the determination of reducing sugars. Biochem. J. 67:1051-1061.

Khan, I. A., Khan, M.A., Khan, S.M., Asif, M., Jaskani, M.J., Daud, K., Labar, N.H., Kazmi, M.R. and Khan, L.A. 1996. National coordinated Research Project on Mango: First Annual Report, Department of Horticulture, Univ. of Agric., Faisalabad, Pakistan. p. 240.

Mahmood, A. and Gill, M.A. 2002. Quick decline of mango and *in vitro* response of fungicides against the disease. Int. J. Agric of Biol. 4 (1):39-40.

Malik, M.T., Grewal, A.G., Haq, C.A. and Khan, M.I. 2003. Survey and detection of resistant rootstock against collar/stem rot of mango. J. Agric. Res. 41(1):91-98.

Pondey, B.P. 1984. Economic Botany. J.V. College, Barout, India.

Persley, D. 1993. Diseases of fruit crops. Department of Primary Industries, Brisbane, Queensland, Australia.

Shad, M.A., Ansari, T.M., Pervez, H., Rubab, H. and Mahmood, T. 2002. Changes in sugar, amino acid and mineral contents of leaves of two mango varieties affected by quick decline disease. Online J. of Biological Sciences 2(10):694-696.

Travelyan, W.E. and Hauison, J.S. 1952. Studies on yeast metabolism, fractionation and micro determination of cell carbohydrates. Biochem. J. 50:298-303.

TABLES

Table 1: Mean value and standard deviation of chemical constituents in barks of mango cultivars viz. Chaunsa and Langra in relation to quick decline (g/100g)

Parameters	Chaunsa			Langra		
	Healthy bark	Adjacent to diseased bark	Diseased bark	Healthy bark	Adjacent to diseased bark	Diseased bark
Total sugars	6.48±0.36	6.23±0.85 (-3.86 %)	3.26±0.29 (-49.53 %)	4.63±0.43	3.13±0.047 (-23 %)	1.98±0.40 (-57 %)
Reducing sugars	0.61±0.02	6.60±0.08 (-1.64 %)	0.27±0.02 (-55.74 %)	1.07±0.21	0.84±0.138 (-17 %)	0.79±0.25 (-26 %)
Non reducing sugars	5.87±0.33	5.63±0.76 (-4.09 %)	2.99±0.29 (-49.06 %)	3.56±0.46	2.28±0.099 (-35.95 %)	1.19±0.47 (-67 %)
Total free amino acids	1.62±0.14	1.45±0.10 (-10.49 %)	0.75±0.22 (-53.70 %)	0.68±0.33	0.47±0.36 (-30.88 %)	0.24±0.11 (-64.70 %)
Ash contents	91.70±1.68	91.00±1.4 (-0.76 %)	84.30±4.04 (-8.60 %)	90.66±3.77	90±1.63 (-0.72 %)	87.33±1.88 (-3.67 %)

Table 2: Mean value and standard deviation on metal contents in the barks of mango cultivars viz. Chaunsa and Langra in relation to quick

Metals	Chaunsa			Langra		
	Healthy bark	Adjacent to diseased bark	Diseased bark	Healthy bark	Adjacent to diseased bark	Diseased bark
Ca (mg/g)	3.07±0.48	2.79±0.12 (-9.12 %)	2.65±0.20 (-13.68 %)	5.98± 0.97	5.57±1.13 (-6.85 %)	5.58±0.56 (-6.68 %)
K (mg/g)	8.47±1.06	12.20±1.59 (+44.04 %)	10.60±2.65 (-25.14 %)	12.03± 1.38	12.30±1.24 (+2.24 %)	11.30±0.24 (-6.06 %)
Na (mg/g)	1.82±0.66	1.34±0.15 (-26.37 %)	1.45±0.14 (-20.33 %)	1.10± 0.20	1.13±0.18 (+2.72 %)	1.27±0.25 (-15.45 %)
Mg (mg/g)	15.10±0.58	15.05±0.26 (-0.33 %)	14.80±0.14 (-1.99 %)	21.05± 1.95	21.22±0.88 (+0.88 %)	19.00±0.26 (-9.73 %)
Cu (ug/g)	30.30±4.96	25.00±0.25 (-17.49 %)	27.50±0.43 (-9.24 %)	53.75± 6.36	30.66±9.05 (-42.95 %)	34.33±5.59 (-36.13 %)
Fe (ug/g)	784.80±27.1	643.83±88.08 (+17.96 %)	951.00±25.10 (-21.18 %)	364.58± 93.31	221.62±35.29 (-39.21 %)	492.5±36.50 (-35.08 %)
Mn (ug/g)	42.00±10.60	32.50±13.66 (-22.62 %)	58.50±29.00 (-39.29 %)	22.66± 3.90	11.16±1.64 (+50.75 %)	18.50±4.94 (-18.35 %)
Zn (ug/g)	9.16±0.80	11.16±1.84 (21.83 %)	14.80±2.74 (-61.52 %)	19.08± 2.55	12.75±1.94 (-33.17 %)	16.25±2.66 (-14.83 %)