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THE EXTENT OF MICRO MINERALS IN HEALTHY AND MALFORMED ORGANS OF MANGO

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Abstract

The present studies were conducted to explore the relation of micronutrient deficiency with malformation disease in three commercial mango cultivars *viz.* Dusehri, Langra and Malda. The concentrations of Co, Ni, Cr, Cd, Pb and Mg were analyzed in healthy and malformed organs of mango. This comparison indicated that these minerals have slight differences in concentration and their contents did not vary significantly between healthy and malformed variables. Some differences among concentration of magnesium in malformed and healthy parts of three cultivars were detected. The results of the study suggest that nutrients play no role in producing symptoms of mango malformation.

Introduction

Mango (*Mangifera indica* L.) is attacked by various animate and inanimate diseases. Malformation is the most notorious malady amongst the animate problems affecting both vegetative and floral parts of mango. Apical or axillary buds turn into deformed and compact structures. In affected panicles, primary and secondary axes are shortened which result in fruit abortion or no fruit setting (Pernezny & Ploetz, 2000). Due to complex nature of the disease, different aetiologies have been reported previously in the world literature. The latest citations confirm that a fungus *Fusarium mangiferae* is the cause of mango malformation (Britz *et al*., 2002). Still some controversial reports mention the causational role of micronutrient deficiency. The deficiency of nitrogen (Chattopadhyay & Nandi, 1978), potassium (Mishra, 1976) and certain micronutrients has been reported to be responsible for causing malformation. In contrast to this, some other citations do not relate nutrient deficiency to malformation. The concentrations of Fe, Zn, Mn, Cu and Co in malformed and healthy panicles of mangoes (cv. Dusehri) and attached leaves and shoots were determined at different stages (swollen bud, bud initiation, fully grown panicles, pre-bloom and full bloom) over 3 consecutive years. It was concluded that floral malformation is not caused by micronutrient deficiency (Singh & Singh, 1998). Singh *et al*. (1991) analyzed malformed and healthy panicles, leaves and shoots of cv. Dusehri at different stages of development over two consecutive years. Malformed panicles contained significantly higher levels of N at all developmental stages except bud inception. Generally, malformed panicles showed lower levels of P, K and Ca than healthy panicles.

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These observations stressed to elucidate the role of micronutrient deficiency in causation of mango malformation. Previously most of the studies have been conducted on floral organs, shoots or leaves. But no systematic study has been done specifically to reveal the nutrient status in the emerging mango buds. Therefore, the present studies on physiological aspects of malformation were imperative to find out the specific changes in the levels of nutrients in malformed and healthy buds of mango.

Materials and Methods

Sampling: To confirm the possible role of nutrients in mango malformation, 36 samples, each of malformed and healthy mango buds/emerging panicles were analyzed for their micronutrients status. Twelve years old mango trees of three common cultivars viz. Dusehri, Langra and Malda growing under uniform conditions at University of Agriculture, Faisalabad, were selected for the study. The experimental trees were provided similar agronomic and cultural practices like fertilizer, irrigation and plant protection as described by Singh & Singh (1998). The samples were collected from north, east, west, top, middle and bottom locations of the tree canopies early in the morning during the month of February. The healthy and malformed organs were collected from the same tree to avoid variation. After picking, the samples were immediately shifted to the laboratory where they were washed quickly and rinsed with distilled water. The samples were air dried, cut into small pieces and oven dried at 70º C for 48 h in paper bags till constant weight and milled to powder in a stainless steel grinder. The powder was stored in paper bags at room temperature. The processed samples were then used for the determination of micro elements (Chromium, Cobalt, Cadmium, Lead, Magnesium and Nickel) as described below:

Wet digestion of plant material: Dried powdered plant material (0.5 g) was transferred to 50 mL digestion flasks and 10 ml of mixture of nitric acid and perchloric acid (HNO_3-$HClO_4$) was added to it. The digestion flasks were heated gently on a hot plate. Heating was continuous until organic material disappeared and 2-3 mL of colourless solution was left. The samples were then cooled down, made to a volume of 50 mL, filtered and stored in air tight plastic bottles for further determination (Toth *et al.,* 1948).

Determination of micro elements: Determination of these elements was made on PYE Unicam Atomic Absorption Spectrophotometer Model Z-8200 using standard conditions given for obtaining maximum sensitivity for the elements.

Results and Discussion

Cobalt, Nickel, Chromium, Cadmium and Lead: Analysis of malformed and healthy mango organs revealed that there is no significant difference in mean concentration (ppm) of these elements in cv. Dusehri, Langra and Malda (Table 1). Comparison of vegetative and floral parts indicated that Co, Ni, Cr, Cd and Pb have slight differences in concentration and their contents did not differ significantly between healthy and malformed variables (Table 1). Both types of growth showed almost similar response to the disease.

Magnesium: Some differences among concentration of magnesium in malformed and healthy organs of three cultivars were detected. In Dusehri, concentration of Mg was

330.67 and 181.33, in Langra 154.67 and 400.0 and in Malda 213.33 and 376.0 ppm in vegetative part of malformed and healthy organs, respectively (Table 1). In the same cultivars, Mg concentration was 178.67 and 98.67, 237.33 and 117.33 and 221.33 and 109.33 ppm in floral parts of malformed and healthy organs, respectively. It means that more Mg was present in healthy vegetative bud than malformed in cv. Langra (400.0 ppm) and Malda (376.0 ppm). However, mean square values for malformed, healthy and their interactions were statistically non significant (Table 1).

Table 1. Micronutrient levels (ppm) in healthy and malformed organs of Dusehri, Langra and Malda cultivars.

Var.	S. No.	Nutrient	Malformed		Mean	Healthy		Mean
			Vegetative	Floral		Vegetative	Floral	
Dusehri	1.	Cobalt	0.01	0.01	0.01	0.01	0.02	0.015
	2.	Nickel	0.02	0.02	0.02	0.03	0.02	0.025
	3.	Chromium	0.12	0.13	0.125	0.09	0.26	0.175
	4.	Cadmium	0.04	0.04	0.04	0.04	0.04	0.04
	5.	Plumbum	0.19	0.04	0.11	0.13	0.07	0.10
	6.	Magnesium	330.67	178.67	254.67	181.33	98.67	140.0
Langra	1.	Cobalt	0.00	0.01	0.005	0.02	0.01	0.015
	2.	Nickel	0.02	0.02	0.02	0.02	0.01	0.015
	3.	Chromium	0.14	0.15	0.145	0.06	0.14	0.10
	4.	Cadmium	0.03	0.03	0.03	0.03	0.03	0.03
	5.	Plumbum	0.11	0.09	0.10	0.30	0.12	0.21
	6.	Magnesium	154.67	237.33	196.0	400.00	117.33	258.66
Malda	1.	Cobalt	0.01	0.00	0.005	0.02	0.01	0.015
	2.	Nickel	0.02	0.04	0.03	0.01	0.02	0.015
	3.	Chromium	0.13	0.17	0.15	0.16	0.26	0.21
	4.	Cadmium	0.03	0.03	0.03	0.05	0.04	0.045
	5.	Plumbum	0.03	2.47	1.25	0.05	0.22	0.13
	6.	Magnesium	213.33	221.33	217.33	376.00	109.33	242.66

Due to its destructive nature, malformation has been considered a plant disease of international importance. Since its inception (Watt, 1891) the problem remained a crux continuously intriguing the scientists. Due to scanty information on the nature of the causal organism and its mode of infection, effective strategies could not be established. After revelation of the physiology of pathogenesis, the confusion regarding the cause of the disease was resolved (Chakrabarti & Kumar, 1998). Determination of the causal fungus and proving of Koch's postulates have provided unequivocal evidence that a fungus *F. mangiferae* is the cause of the disease (Freeman *et al*., 1999; Britz *et al*., 2002).

The fungus causes biochemical changes and may deplete micronutrients like Zn, Cu and Fe which are required to translocate host metabolite mangiferin as mangiferin ion complex. When micronutrients are made available in the form of mangiferin-Zn complex, much of the disease symptoms may vanish. This phenomenon creates misconception that malformation may be caused by micronutrient deficiency (Chakrabarti & Kumar, 1998).

A single foliar spray application of 1000 ppm cobalt sulphate prior to flower bud initiation in October substantially reduced floral malformation and no differences in Co concentration in healthy and malformed tissues of mango were recorded (Singh & Singh, 1993). The deficiency and toxicity of Co seemed to have no role in causing mango malformation because the concentration of Co did not vary much in malformed and healthy organs. The variation in levels of micronutrients may be attributed to metabolism disruption

caused by the fungus (Chakrabarty & Kumar, 1998). Our results also confirm that malformation is not caused by the deficiency of micronutrients. Ram (1991) found a decrease in malformation by applications of N, K, Fe, Zn or Mn but deficiency or excess of nutrients could not be prove conclusively as causative factor(s). However nutrient deficiency may act as predisposing factor for the malformation incidence. The future studies will be helpful to evolve target specific strategies to curb the disease in mango orchards.

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