

Effect of foliar application of micronutrients on the quality of mango (*Mangifera indica* L.) cv. Dusehri fruit.

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Abstract

The present study was aimed to determine the effect of foliar application of micronutrients (Fe, B and Zn) on the quality of mango (*Mangifera indica* L.) cv. Dusehri plants. For this purpose, 21 healthy, full bearing and mature (20-25 years old) trees were subjected to foliar application of different combinations of FeSO₄, H₃BO₃ and ZnSO₄ before flowering and at full bloom stage. Results revealed that the application of all micronutrients significantly increased the quality of fruit than the control. Whereas, trees sprayed with 0.4% FeSO₄ + 0.8% H₃BO₃ + 0.8% ZnSO₄ (T₆) showed the maximum pulp weight (169.2 g), total soluble solids (27.9 Brix°), ascorbic acid (150.3 mg/100 ml) and non-reducing sugars (8.83%) & less stone weight (28.13 g) along with low acidity (0.178%) in comparison to rest of treatments and control.

Keywords: Biochemical analysis, Fe, B, Zn, foliar spray, *Mangifera indica* L., physico-chemical analysis.

Introduction

Mango (*Mangifera indica* L.) is native to the Indian subcontinent, belonging to family Anacardiaceae, is the most cultivated and favourite fruit of the tropics (Purseglove, 1972). The king of fruits is nutritionally very rich, unique in flavor and smell thus account for approximately half of all tropical fruits produced globally. From last few years, some physiological stresses and quality related issues has been raised in mango orchard in Pakistan. It was observed that unbalanced fertilization, micronutrients deficiencies, poor tree management and inadequate cultural practices are mainly responsible for orchard related quality issues (Ahmad and Rashid, 2003). These problems appear mainly due to enigmatic blooming and vegetative growth behavior (Chacko, 1991). Therefore food supplements, multivitamins and mineral supplements are necessary for the healthy crops. According to horticulturists, only application of primary nutrients could not prove successful to produce high quality fruit in mango trees, the application of micronutrients is compulsory as well. Major elements/macronutrients are quickly taken up and utilized by the tissues of the plants by the catalyzing effect of micronutrients/minor elements (Phillips, 2004). Pakistani soils are highly alkaline in nature due to high use of phosphatic fertilizers that results in the

augmented level of phosphorous in soils. These problems affect the solubility and mobility of micronutrients in the soil and cause the decreased translocation of micronutrients from roots to leaves (Ioro *et al.*, 1996).

Foliar spray of micronutrients is the common practice to overcome the micronutrients deficiencies in order to improve the fruit quality. Nutrients are generally quickly available to the plants by the foliar application than the soil application (Bahadur *et al.*, 1998; Silberbush, 2002). Foliar application of micronutrients may be 6 to 20 times more effective in Pakistan than soil application (Liew, 1988). Foliar application of boric acid on the Langra cultivar improved flushes, inflorescence, fruit setting percentage and biochemical characteristics (Rajput *et al.*, 1977).

Jagirdar and Sheikh (1970) found an increase in the pulp percentage of Bombay Alphonso fruit through fertilization with nitrogen. Singh and Rajput (1977) observed increased fruit yield, fruit sugars and ascorbic acid with the treatment of highest ZnSO₄ application rate. Rath *et al.* (1980) applied zinc or boron each at the rate of 0.2-0.8% on 13 years old mango cv. Langra trees at full bloom stage and found the tremendous enhancement in total sugars, TSS and ascorbic acid of fruit at higher rates of boron or zinc. Singh *et al.* (1987) found significant strengthening in total soluble solids and total sugars of mango fruit due to application of

different concentrations of boric acid to mango trees. Syamal and Mishra (1989) observed that the ascorbic acid increased by the increasing concentration of NPK alone or in combination with micronutrients as a foliar spray on seventeen years old Langara trees. Kumar *et al.* (1992) found the higher sugar content and lower acidity of fruits by the spray of 1 percent ZnSO₄ to 30 years old Dusehri trees.

The present study (2010-11) was conducted to assess the influence of foliar application of Fe, B and Zn in improving the fruit quality. Assessment was accomplished through physico-chemical analysis i.e. pulp weight (g), stone weight (g), peel weight (g) and biochemical characteristics i.e. acidity (%), total soluble solids (Brix°), ascorbic acid content (% or mg/100ml), total sugars (%), reducing sugars (%) and non-reducing sugars (%).

Materials and Methods

21 healthy, full bearing and mature 20-25 years old mango cv. Dusehri trees were given with equal dose of recommended NPK i.e. 1000g N, 750g P and 750g K. The experiment was laid out according to RBCD in the Experimental Fruit Orchard, square No. 32, University of Agriculture, Faisalabad, Pakistan. Laboratory analysis was done in the Post-graduate Pomology Laboratory, Institute of Horticultural Sciences, University of Agriculture, Faisalabad.

The experiment comprised of seven treatments of the combination of different concentrations of FeSO₄, H₃BO₃ and ZnSO₄ replicated three times. The following treatments were used: control treatment with distilled water spray (T₀), 0.2% FeSO₄ + 0.5% H₃BO₃ + 0.8% ZnSO₄ (T₁), 0.2% FeSO₄ + 0.8% H₃BO₃ + 0.5% ZnSO₄ (T₂), 0.2% FeSO₄ + 0.8% H₃BO₃ + 0.8% ZnSO₄ (T₃), 0.4% FeSO₄ + 0.5% H₃BO₃ + 0.8% ZnSO₄ (T₄), 0.4% FeSO₄ + 0.8% H₃BO₃ + 0.5% ZnSO₄ (T₅) and 0.4% FeSO₄ + 0.8% H₃BO₃ + 0.8% ZnSO₄ (T₆). The foliar spray of all these treatments was carried out just before flowering and second at full bloom stage. At maturity (after the sign of 'tapka'), when the shoulders of the fruit were swelled out, harvesting was done, leaving 6 cm stalk intact with the fruit to avoid the exudation of cell sap.

During harvest, five disease and insect-free, fruits were taken, wrapped in paper and stored at room temperature in a basket up to ripening. Then the peel, pulp and stone of these fruits were separated and were weighed.

For biochemical analysis, fruits were peeled and flesh was homogenized in a blender. Biochemical analysis of the fresh fruit juice was carried out. Atago hand refractometer was used to determine the total soluble solids percentage. Total acidity (%) was determined by the method given by Hortwitz (1960). Ascorbic acid was estimated by Ruck (1961) method.

Total sugars (%) were determined by the formula $25x(X/Z)$. Where X is the volume (ml) of standard sugar solution used against 10 ml of Fehling's solution and Z is the volume (ml) of sample aliquot used against 10 ml of Fehling's solution. Reducing sugars (%) were determined by using the formula $6.25 \times (X/Y)$. Where X is the volume in ml of standard sugar solution used against 10 ml of Fehling's solution and Y is the volume (ml) of sample aliquot used against 10 ml of Fehling's solution.

The non-reducing sugars (%) were calculated according to the formula $0.95 \times (\text{Total inverted sugar \%} - \text{Reducing sugars \%})$ described by Hortwitz (1960).

Data pertaining to physico-chemical and biochemical analysis of fruit (fruit quality assesment) was subjected to statistical analysis by constructing analysis of variance tables. Mean values for various treatments with significant differences were compared using Least Significant Difference (LSD) Test at 5% probability level (Steel and Torrie, 1984).

Results and Discussion

Analysis of variance (ANOVA) showed significant difference amongst physico-chemical and biochemical contents of the treatments (Table 1, 2 & 3).

Generally, all treatments of micronutrients significantly enhanced the physico-chemical and biochemical contents of fruits. However, maximum pulp weight (169.2 g) and minimum stone weight (24.03 g) was found in T₆ (0.4% FeSO₄ + 0.8% H₃BO₃ + 0.8% ZnSO₄) followed by T₅ over control (Table 1).

Biochemical assays results revealed that all treatments resulted in low acidity of fruits over control. Amongst the different treatments, the maximum total soluble solids (27.9 Brix°), ascorbic acid/vitamin C contents (153.3%), total sugars (50.08%), reducing (19.92%) and non-reducing sugars (8.83%) were found in T₆ (0.4% FeSO₄ + 0.8% H₃BO₃ + 0.8% ZnSO₄) and T₄ (0.4% FeSO₄ + 0.5% H₃BO₃ + 0.8% ZnSO₄), in comparison to rest of treatments and control. These observations were supported by the previous

findings by various eminent workers (Jagirdar and Sheikh, 1970; Singh and Rajput, 1977; Rath *et al.*, 1980; Singh *et al.*, 1987; Syamal and Mishra, 1989). The enhancement in quality of fruit could be due to the catalytic action of micronutrients particularly at higher concentration. Hence, the foliar application of micronutrients quickly increased the uptake of macronutrients in the tissues and organs of the mango plants, decreased

the nutritional deficiencies and improved the fruit quality.

It was concluded that the foliar application of the combination of FeSO₄, H₃BO₃ and ZnSO₄ resulted in less acidic fruits having more TSS and ascorbic acid contents. Increased concentration of ZnSO₄ caused the increase in TSS of the mango fruit and the increase in the concentration of FeSO₄ and ZnSO₄ enhanced the total sugar percentage.

Table 1: Effect of Foliar Application of Micronutrients on Pulp Weight (g), Stone Weight (g) and Peel Weight (g) during 2010 - 11.

Treatments	Pulp Weight (g)	Stone Weight (g)	Peel Weight (g)
T ₀ (Control)	132.50 c	35.17 a	37.00 a
T ₁ 0.2%FeSO ₄ +0.5%H ₃ BO ₃ +0.8%ZnSO ₄	132.8 c	31.00 b	29.10 b
T ₂ 0.2%FeSO ₄ +0.8%H ₃ BO ₃ +0.5%ZnSO ₄	135.5 c	27.63 cd	35.00 a
T ₃ 0.2% FeSO ₄ +0.8%H ₃ BO ₃ +0.8% ZnSO ₄	136.2 c	27.83 c	32.17 b
T ₄ 0.4%FeSO ₄ +0.5% H ₃ BO ₃ +0.8% ZnSO ₄	149.2 b	27.83 c	27.13 c
T ₅ 0.4%FeSO ₄ +0.8% H ₃ BO ₃ +0.5% ZnSO ₄	167.2 ab	25.13 d	28.93 c
T ₆ 0.4%FeSO ₄ +0.8% H ₃ BO ₃ +0.8% ZnSO ₄	169.2 a	24.03 e	28.13 c

Values followed by same letters do not differ significantly at 0.05% significant level.

Table 2: Effect of Foliar Application of Micronutrients on Acidity (%), TSS (Brix°) and Ascorbic Acid (mg/ 100 ml) during 2010 - 11.

Treatments	Acidity (%)	TSS (Brix°)	Ascorbic acid (mg/ 100 ml)
T ₀ (Control)	0.287 bc	25.1 b	93.7 c
T ₁ 0.2%FeSO ₄ +0.5%H ₃ BO ₃ +0.8%ZnSO ₄	0.178 ab	26.8 a	132.0 b
T ₂ 0.2%FeSO ₄ +0.8%H ₃ BO ₃ +0.5%ZnSO ₄	0.179 ab	26.9 ab	123.1 b
T ₃ 0.2% FeSO ₄ +0.8%H ₃ BO ₃ +0.8% ZnSO ₄	0.179 ab	27.8 ab	125.4 b
T ₄ 0.4% FeSO ₄ +0.5% H ₃ BO ₃ +0.8% ZnSO	0.178 ab	27.6 a	153.3 a
T ₅ 0.4% FeSO ₄ +0.8% H ₃ BO ₃ +0.5% ZnSO ₄	0.178 ab	27.1 a	137.0 b
T ₆ 0.4% FeSO ₄ +0.8% H ₃ BO ₃ +0.8% ZnSO ₄	0.178 ab	27.9 a	150.3 a

Values followed by same letters do not differ significantly at 0.05% significant level.

Table 3: Effect of Foliar Application of Micronutrients on Total Sugar (%), Reducing Sugar (%) and Non-Reducing Sugar (%) during 2010 - 11.

Treatments	Total Sugar (%)	Reducing Sugar (%)	Non Reducing Sugar (%)
T ₀ (Control)	44.00 b	14.77 b	7.28 e
T ₁ 0.2%FeSO ₄ +0.5%H ₃ BO ₃ +0.8%ZnSO ₄	48.85 a	18.15 ab	8.10 d
T ₂ 0.2%FeSO ₄ +0.8%H ₃ BO ₃ +0.5%ZnSO ₄	48.40 a	17.39 ab	7.91 e

T₃ 0.2% FeSO ₄ +0.8% H ₃ BO ₃ +0.8% ZnSO ₄	48.80 a	17.96 ab	8.29 c
T₄ 0.4% FeSO ₄ +0.5% H ₃ BO ₃ +0.8% ZnSO ₄	50.08 a	21.30 a	8.60 b
T₅ 0.4% FeSO ₄ +0.8% H ₃ BO ₃ +0.5% ZnSO ₄	49.05 a	18.80 a	8.32 c
T₆ 0.4% FeSO ₄ +0.8% H ₃ BO ₃ +0.8% ZnSO ₄	49.82 a	19.92 a	8.83 a

Values followed by same letters do not differ significantly at 0.05% significant level.

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