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Influence of Nutrient Management Systems on Leaf and Fruit Nutrient Composition of Apple (Malus Domestica Borkh) in Kashmir Valley

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ORIGINAL ARTICLE

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ABSTRACT

A comparative study was carried out to evaluate the influence of organic and conventional nutrient management systems on leaf and fruit nutrient composition of apple (Malus domestica Borkh.) cv. Red Delicious grown in Pulwama district, Kashmir Valley. Apple orchards under two distinct management regimes organic (using FYM and bio fertilizers) and conventional (using chemical fertilizers) were analysed for macronutrient (N, P, K, Ca, Mg) and micronutrient (Fe, Zn, Cu, Mn) contents in leaves and fruits. The organically managed orchards exhibited higher levels of calcium, magnesium, potassium, and micronutrients (Zn, Mn, Cu), while conventionally managed orchards showed higher nitrogen and phosphorus concentrations. Organic nutrient management also improved fruit quality attributes by enhancing nutrient balance and reducing heavy metal accumulation. The results highlight the potential of organic systems for sustainable apple production and improved fruit nutritional value in the Himalayan region.

KEY WORDS

Apple Nutrition, Organic Management, Conventional Farming, Leaf Nutrients, Fruit Quality, Kashmir Valley.

INTRODUCTION

Apple (Malus domestica Borkh) is the most important temperate fruit crop of Jammu and Kashmir, contributing substantially to income and employment in the Himalayan region. However, continuous use of chemical fertilizers in conventional apple production has led to nutrient imbalances, reduced soil fertility and lower fruit quality (Peck et al., 2006). On the other hand, organic management systems based on natural manures and bio fertilizers not only maintain soil fertility but also influence the mineral composition of fruits and leaves,

thereby improving fruit quality (Stockdale et al., 2001; Singh et al., 2011).

The mineral composition of apple leaves is a reliable indicator of the nutrient status of trees and directly affects fruit yield and quality (Han et al., 2011). Macronutrients such as nitrogen, phosphorus and potassium are vital for vegetative growth and fruit development, whereas calcium and magnesium influence fruit firmness and storage quality. Micronutrients such as zinc, copper and manganese play essential roles in enzymatic functions and fruit coloration (Roussos & Gasparatos, 2009).

The present investigation was undertaken to compare leaf and fruit nutrient composition under conventional and organic nutrient management systems in apple orchards of Kashmir Valley.

Materials and Methods

1. **Experimental Site:** The study was conducted during 2018 in apple orchards located at Urr Charsoo village, Pulwama district, Jammu and Kashmir (32°882 N latitude, 74°922 E longitude, altitude 1630 m amsl). The region experiences temperate climate with cold winters and moderate summers.
2. **Experimental Design:** A total of 16 orchards (8 organic, 8 conventional) were selected using purposive sampling. From each orchard, composite samples of leaves (at 90 days after flowering) and fruits (at harvest) were collected from uniform trees of cv. Red Delicious.
3. **Nutrient Management Practices:** Organic system: Farmyard manure (15 kg/tree) + bio fertilizer mixture containing Azotobacter, PSB, KSB and ZnSB (250 g each/tree).
4. **Conventional System:** Urea (1500 g/tree), DAP (750 g/tree) and MOP (2500 g/tree).
5. **Laboratory Analysis:** Leaf and fruit samples were oven-dried, ground and digested in di-acid mixture (HNO*f* :HClO). The digests were analysed for:
   Nitrogen (N): Kjeldahl method
   Phosphorus (P): Vanadomolybdate yellow colour method
   Potassium (K): Flame photometer
   Calcium (Ca), Magnesium (Mg), Fe, Zn, Cu, Mn: Atomic absorption spectrophotometer (AAS)
6. **Statistical Analysis:** Data were analysed using completely randomized design (CRD) and means were compared at 5% significance using the least significant difference (LSD) test.

Results and Discussion

1. **Leaf Nutrient Composition:** Leaf analysis showed notable differences in macronutrient concentrations between the two systems. Conventionally managed orchards had significantly higher nitrogen (2.6%) and phosphorus (0.23%) content due to direct fertilizer inputs, whereas organically managed orchards recorded higher potassium (1.85%), calcium (1.92%) and magnesium (0.48%) contents, attributed to mineralization of organic inputs and microbial activity (Singh et al., 2011).

Micronutrient analysis revealed higher zinc (32 ppm), manganese (68 ppm) and copper (10 ppm) contents in leaves from organic orchards, indicating better nutrient cycling and microbial solubilisation (Raman, 2012). Similar findings were reported by Najar (2002) and Verma & Chauhan (2012) in apple orchards of Kashmir and Himachal Pradesh.

Leaf macronutrients (%)

Nutrient	Organic	Conventional
N	2.10	2.60
P	0.18	0.23
K	1.85	1.50
Ca	1.92	1.40
Mg	0.48	0.30

2. The fruit nutrient profile also varied with management systems. Conventionally grown fruits exhibited higher nitrogen and phosphorus but lower potassium and calcium contents, while organically grown fruits recorded higher K (1.4%), Ca (1.1%) and Mg (0.3%). The improved Ca and K status under organic

management is linked to better ion balance and slower nutrient release from organic sources, leading to enhanced fruit firmness and storage quality (Amarante et al., 2008).

Fruit Macronutrients (%)

Nutrient	Organic	Conventional
N	0.35	0.50
P	0.12	0.18
K	1.40	1.10
Ca	1.10	0.80
Mg	0.30	0.20

Micronutrients such as zinc, manganese and iron were more abundant in fruits from organic orchards. These elements are associated with antioxidant properties, improved coloration, and resistance to physiological disorders (Fu et al., 2011).

3. **Relationship Between Leaf and Fruit Nutrients:** Significant positive correlations were observed between leaf and fruit potassium (r = 0.82) and calcium (r = 0.76) contents, indicating that leaf nutrient status effectively reflects fruit nutrient accumulation. Similar results were reported by Ahmad (2003) and Jivan & Sala (2014).
4. **Implications for Nutrient Management:** The findings suggest that organic nutrient management promotes balanced nutrient uptake, enhances fruit nutritionmanganes and minimizes environmental risks. While conventional systems favour rapid nutrient availability, they may lead to imbalances and reduced fruit quality in the long term.

CONCLUSION

The comparative study revealed that organically managed apple orchards exhibited higher concentrations of beneficial minerals such as potassium, calcium, magnesium, and micronutrients in both leaves and fruits, while conventional systems favoured nitrogen and phosphorus accumulation. Organic nutrient management thus enhances the nutritional quality of apple fruits and supports sustainable production in the temperate ecosystem of Kashmir Valley.

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