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Research article

Micronutrient status in leaf tissue of mango germplasm conserved under subtropical environment of Lucknow, Uttar Pradesh, India

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Abstract: On-farm conservation of elite and indigenous mango germplasm is crucial from the viewpoint of biodiversity conservation and its utilization for future use. Such conservation contributes to breeding of new varieties, research on biotic and abiotic stress complexes, evaluating nutrient dynamics in supporting their livelihood. One hundred thirty eight mango germplasms conserved in the experimental farm of CISH, Rehmankhera, Lucknow over decades were used for evaluating micronutrient status. The study revealed the lowest Zn content in Pan & Aswania (11 mg kg^{-1}) to the highest in Rousa (28 mg kg^{-1}) across these 138 mango germplasms while the corresponding values of Boron in Langra Digha (6.6 mg kg^{-1}) and Husn-e-ara (44.8 mg kg^{-1}). It was further inferred that a range of 6 mg kg^{-1} (Modami Model) to 52 mg kg^{-1} (Anaiwara) of Cu was estimated across these germplasms. In case of Mn and Fe micronutrients, wider variations across these germplasms were recorded. The concentrations of Mn varied between 122 (Mithua Bihar) and 347 (Prabha Shankar) mg kg^{-1} and Fe being 101(Shohrab Shah) and 461(Bombay Green) mg kg^{-1}. The distribution pattern indicated that highest percentage of B (52.9%) was recorded in the range of 21–30 mg kg^{-1}, 61.6% of Zn (11–20 mg kg^{-1}), 45.7% of Cu (16–30 mg kg^{-1}), 68.1% Mn (101–200 mg kg^{-1}) followed by 75.4% Fe (101–200 mg kg^{-1}). Wider variations in micronutrients contents in some existing commercial mango cultivars were found and such variations in micronutrient contents indicated the differential response of mango germplasms under similar soil-climatic conditions for future nutrient management strategy.

Keywords: Biodiversity conservation - Mango germplasms - Micronutrient - *Mangifera Indica*.

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INTRODUCTION

Mango being grown worldwide, endowed with a huge number of diverse germplasms indicates the scope for its conservation. However, non-availability of some of the elite and ancient germplasms at present may be because of lack of its scientific conservation and proper management. Maintaining biodiversity of mango germplasms under different soil and climatic conditions is a challenge under present scenario of climate change, even within the same agro-climatic conditions. The aberrations in the weather events particularly scanty, uneven distribution of rainfall and extreme temperature variations make the efficient management of germplasms difficult. For fruit crops, on-farm conservation is very difficult for want of space and adequate management. As a result, many of old valuable germplasms virtually vanished from the country and are not at all available in the present scenario. Conservation of these germplasms would offer scope for better utilization for different purposes. Farmers are thus encouraged for on-farm conservation of indigenous and rare germplasms of different fruit crops (Rajan *et al*. 2016). The *in-situ* conservation helps in breeding programmes for developing climate resilient varieties, acts as an excellent source for biotechnological intervention for characterizing number of unexploited diversity (Singh *et al.* 2012), farmer friendly varieties resistant to pests and diseases *e.g*. screening for mango anthracnose resistance in Australia (Bally *et al*. 2013), nutrient rich cultivar (Berardini *et al*. 2005, Ribeiro *et al*. 2008) and also limited nutrient requirement for its longer survivability (Bhupal Raj & Prasad Rao

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2006).

Nutrients, particularly micronutrients are required for supporting the metabolism within the tree-ecosystem and also to support quality fruit production. A number of deficiency symptoms appear in absence of required amount of micronutrients, restricting its potential use (Shukla *et al*. 2014**)**. This reduces the longevity of the germplasms being conserved. In India, under different soil conditions of low, medium and high nutrient contents of tropical, subtropical, humid ecosystem and across different soil types, the question is whether soil nutrient status supporting the germplasms being maintained for its potential use. Foliar spray is often recommended to cater the micronutrient requirement of the germplasms for its survival. However, there is a lack of proper nutritional trial/management for its optimum use and fruit production purpose, hindering scope for its efficient utilization for future endeavor.

MATERIALS AND METHODS

The study site for this experimentation is concentrated on mango trees available in the Field gene bank of ICAR-CISH, Lucknow, Uttar Pradesh, India (Fig. 1) wherein mango germplasms are being maintained over 25–30 years. Leaf samples (35–40) were collected during September–October from 138 mango germplasms after fruit harvesting. The samples were washed in double distilled water, air dried and processed for digestion in the laboratory. Samples were digested with di-acid mixture of nitric acid and perchloric acid (9:4 ratios). Micronutrient contents were estimated by AAS.

Figure 1. Experimental site (CISH, Rehmankhera, Lucknow, Uttar Pradesh, India. [Source: https://www.google.co.in/maps]

RESULTS AND DISCUSSION

The Zinc (Zn) distribution showed wider variations across leaf tissues of 138 mango germplasms. Majority (61.6%) of the contents fall in the range of 11–20 mg kg^{-1} while rests (38.4%) are in 21–30 mg kg^{-1} range (Fig. 2A). The detailed Zn contents in leaf tissues of the said germplasms are tabulated in the table 1. Some of the existing commercial cultivars had marginally higher Zn content like Lucknow Safeda & Elaichi (22 mg kg^{-1}), Mohan Bhog (26 mg kg^{-1}) & Begum Pasand (26 mg kg^{-1}) as compared to Langra, Fazri & Baramasi (16 mg kg^{-1}), Malda (17 mg kg^{-1}) and Himsagar (19 mg kg^{-1}). In terms of Copper (Cu) concentration, the entire germplasms may be grouped into 4 categories *i.e.* ≤15, 16–30, 31–50 and >50 mg kg^{-1} respectively (Table 2). Results showed that majority (45.7%) of the germplasms had Cu contents in the range of 16–30 mg kg^{-1} followed by 28.3% (≤15 mg kg^{-1}), 25.4% (31–50 mg kg^{-1}) and 0.7% (>50 mg kg^{-1}) respectively (Fig. 2B). Similarly in case of Manganese (Mn) concentration, germplasms had 68.1% in the category of 101–200 ppm followed by 30.4% (201–300 mg kg^{-1}) and the least (1.4%) for higher concentration of >300 mg kg^{-1} (Fig. 2C). Results showed mango cultivars like Chausa, Langra Banarsi, Fazri, Gulab Khas, Safeda Malihabad Dashehari etc. had Mn contents of 101-200 mg kg^{-1} whereas Mallika, Baramasi, Langra, Husn-e-ara, Langra Gorakhpur, Langra Digha and Alphonso Ratnagiri had higher concentration in the range of 201–300 mg kg^{-1} (Table 3). As far as Iron (Fe) concentration is concerned, majority (75.4%) of germplasms had recorded the content in the range between 101–200 mg kg^{-1} followed by 18.8 % (201–300 mg kg^{-1}) and 5.8% in higher concentration of

>300 mg kg^{-1} (Fig. 2D). Further, it was observed that majority of the commercial cultivars are not deficient in Fe and had 101–200 mg kg^{-1}, however Bombay green, Baramasi, Dalima had higher contents (Table 4). Since Boron (B) is an important element for not only improving the quality of the fruit but also essentially required during flowering, its contents in the existing conserved germplasms had wider range from less than 10 to >30 mg kg^{-1}. The detailed concentrations were tabulated in the table 5. Some of the commercial cultivars like Langra had a B content of 13.3 mg kg^{-1}, Mallika (17.7 mg kg^{-1}), Langra Banarsi (17.7 mg kg^{-1}), Bombay Green (22.8 mg kg^{-1}), Fazri (26.2 mg kg^{-1}), Elaichi (29.4 mg kg^{-1}), Alphanso Raman (922.5 mg kg^{-1}), Bangalora-2 (26.7 mg kg^{-1}), Husn-e-ara (44.8 mg kg^{-1}), Lucknow Safeda (27.4 mg kg^{-1}), Chausa (28.3 mg kg^{-1}) and Alphanso Ratnagiri (32.8 mg kg^{-1}). It was observed that 52.9% germplasms had B concentration in the range of 21–30 ppm, 22.5% (>30 mg kg^{-1}) followed by 21% (11–20 mg kg^{-1}) and the least in 3.6% (up to 10 mg kg^{-1}), respectively (Fig. 2E).

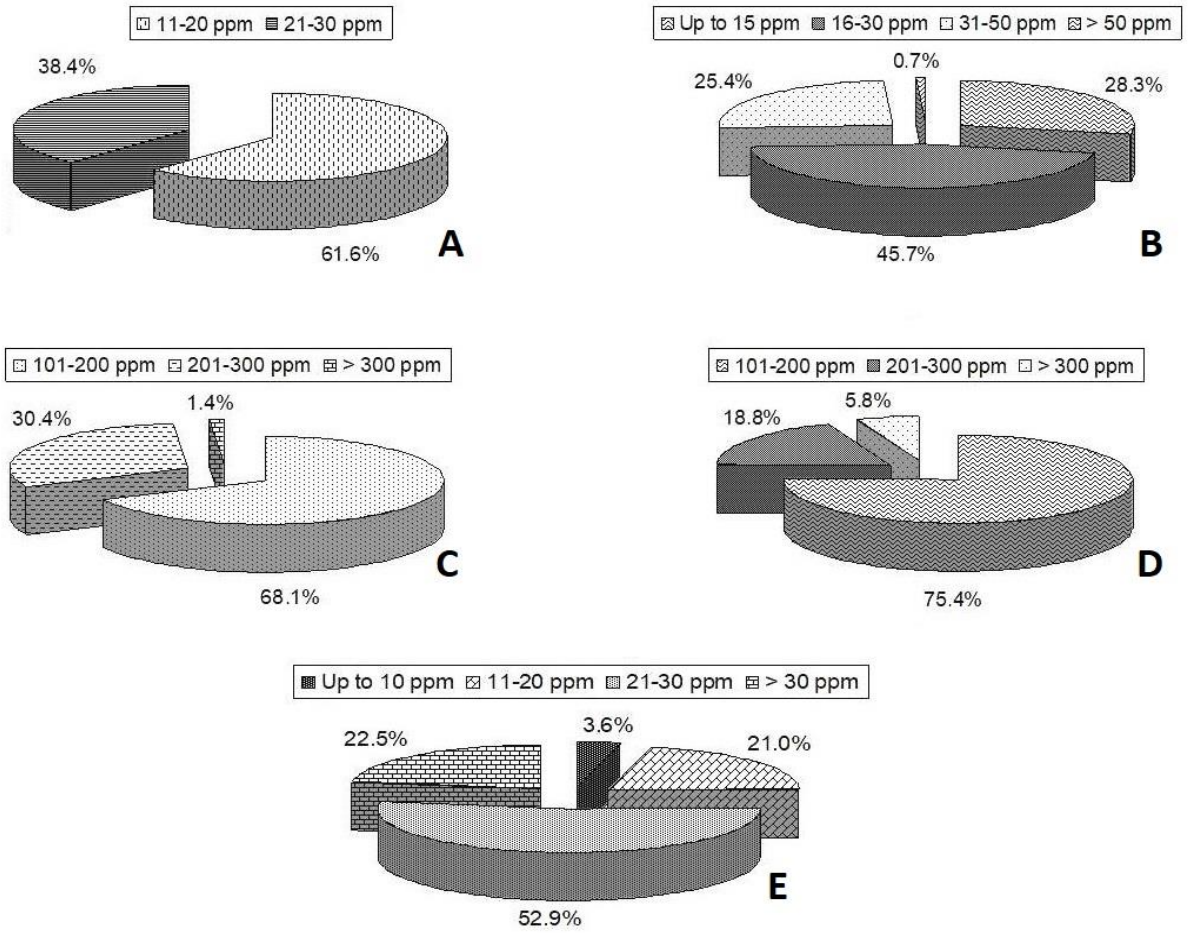

Figure 2. Distribution of micronutrients: **A**, Zinc; **B**, Copper; **C**, Manganese; **D**, Iron**; E**, Boron.

Knowledge of micronutrient contents and its distribution in perennial fruit trees is the key component for determining the level of management modules required for biodiversity conservation and its maintenance. Micronutrients particularly zinc and boron play significant role in the quality fruit production system under any agro-ecosystem (Boaretto *et al*. 2011, Somasundaram *et al*. 2011, Kumar *et al*. 2016a). Micronutrient deficiency in orchards should be corrected through proper management system to sustain fruit production level. Germplasms are being maintained worldwide across diverse soil and climatic conditions. Characterizations of these germplasms in terms of their micronutrient status are essential from the viewpoint of determining the sustainability in longer term. Micronutrient contents are thus important factor in any biodiversity conservation programme (Johns 2003, Toledo & Burlingame 2006, Srivastava & Shyam 2006). Enormous problems of Fe in Mango production system under Israel condition were recorded and resolved by Kadman & Gazit (1984). Under Brazilian condition, the mineral nutrition in mango orchards was estimated by da Silva *et al*. (2014). Adak *et al*. (2017) advocated growers for optimized micronutrient management in mango for better productivity under Uttar Pradesh condition. Technological interventions at small and marginal farmer's field were demonstrated and

Table 1. Zinc (Zn) distribution in leaves of mango germplasms.

11–20 ppm				**21–30 ppm**	
Amin Buland Bag (19)	Kishan Bhog (19)	V.N. Chatterjee (17)	Bable Ponesa (19)	Alif Laila (21)	Shohrab Shah (21)
Asaujia Deoband (18)	Mohan Thakur (18)	Jafrani Shahabad (14)	Beauty Maclino (18)	Amin Dofasla (24)	Sukul (21)
Chausa (20)	Fazri (16)	Aswania (11)	Modami Model (16)	Amin Dhudhia (25)	Papla (22)
Gola Bhadaiya (19)	Fazri Kalan (14)	Bombay Battle (14)	Bombay Pedda (17)	Amin Brahinpur (22)	Kala Pahar (23)
Gulab Jamun (20)	Fazri Zafrani (16)	Ladario (19)	Radling (12)	Amin Prince (21)	Begum Pasand (26)
Katakee Bahar (20)	Malda (17)	Pathar (13)	Prabha Shankar (15)	Amin Khurd (22)	Murshidabad (22)
Langra Gorakhpur (18)	Mithua Bihar (19)	Massarat Shastri (14)	Papaya Raja Goh (16)	Anopan (24)	Kohitoor (21)
Langra (16)	Bathui Katikee (17)	Mankhurd (12)		Baramasi Creeping (23)	Kali Pairi (25)
Lat Kampoo (17)	Bathui Katikee (20)	Papatio (16)		Baramasi Aghai Bahar (26)	Zamurad (22)
Mallika (18)	Baramasi (16)	Pan (11)		Baramasi Ahra (24)	Mohan Bhog (26)
Mithua (17)	Mallik (15)	Pairi (17)		Banzeer (21)	Sharda Bhog (25)
Nazuk Badan (19)	Bombay (13)	Sardar (14)		Banzeer Sandila (27)	Gulab Khas (26)
Nisar Pasand (15)	Bombay Green (18)	Bombay (16)		Bareilywala (25)	Khausal Khas (26)
Nayab (18)	Dalima (19)	Batle (17)		Bhoodia (22)	Anda (21)
Pahilwan (16)	Chatterjee Khas (12)	Rataul (19)		Bhadaiya Sukul (21)	Alphanso Ratnagiri (23)
Sadaphal (15)	Jalsain (18)	Gadheymar (17)		Bride of Russia (23)	Hansraj (24)
Rataul (17)	Safeda Mulgoa (20)	Fazri (20)		Dashehari (26)	Hilario (23)
S.B.Chausa (20)	Mallviya Bhog (17)	Neelam Madrasi (18)		Gaurjeet (24)	Sakkar Chini (21)
S.B.Rampur (18)	MadhoRao Pasand (14)	Vellai Colamban (19)		Gilas (21)	Elaichi (22)
Safeda Mallihabad (17)	Mahmooda Bahar (15)	Amina (18)		Hardil Aziz (25)	Alurapali (25)
Serohi (16)	Anaiwara (20)	Anant Pal (17)		Husn-e-ara (22)	Nazuk Badan (26)
Shuvedar (19)	Soria Malda (13)	Amarjio (18)		Katakee Farukhabad (21)	Rousa (28)
Shurkha Burma (18)	Tata Maimidi (17)	Kensingto (19)		Langra Banarsi (23)	Allampur Beneshan (21)
Himsagar (19)	Phol Gaal (18)	Beneshan (17)		Langra Digha (21)	Ashadio (21)
Husn-e-ara (20)	Darbhanga (18)	Banglora-2 (20)		Sharbati Bagrain (21)	Alphanso Raman (22)
Seipia (19)	Bhogal Shah (16)	Bappakan (16)		Lucknow Safeda (22)	Bombay Darsa (24)
					Black Andrew (23)

Table 2. Copper (Cu) distribution in leaves of mango germplasms.

Up to 15 ppm	**16–30 ppm**		**31–50 ppm**		**> 50 ppm**
Alif Laila (12)	Amin Buland Bag (19)	Bombay Green (23)	Bride of Russia (33)	Papatio (31)	Anaiwara (52)
Amin Dofasla (15)	Asaujia Deoband (17)	Anda (18)	Dashehari (36)	Pairi (32)	
Amin Dhudhia (14)	Baramasi Aghai Bahar (20)	Dalima (26)	Gola Bhadaiya (37)	Sardar (43)	
Amin Brahinpur (13)	Baramasi Ahra (23)	Chatterjee Khas (28)	Hardil Aziz (34)	Bombay (36)	
Amin Prince (13)	Banzeer Sandila (22)	Jalsain (24)	Husn-e-ara (37)	Batle (33)	
Amin Khurd (10)	Bareilywala (19)	Mallviya Bhog (30)	Katakee Bahar (38)	Rataul (46)	
Anopan (8)	Bhoodia (30)	Mahmooda Bahar (29)	Katakee Farukhabad (41)	Gadheymar (42)	
Baramasi Creeping (11)	Bhadaiya Sukul (26)	Alphanso Ratnagiri (18)	Langra Banarsi (36)	Hansraj (38)	
Banzeer (14)	Chausa (28)	Bombay Battle (19)	Langra Digha (44)	Hilario (31)	
S.B.Rampur (10)	Gaurjeet (17)	Ladario (28)	Langra Gorakhpur (47)		
Sharbati Bagrain (8)	Gilas (16)	Massarat Shastri (29)	Langra (43)		
Lucknow Safeda (9)	Gulab Jamun (27)	Mankhurd (24)	Lat Kampoo (39)		
Safeda Mallihabad (15)	Nisar Pasand (22)	Pan (23)	Mallika (50)		
Serohi (11)	Nayab (29)	Sakkar Chini (28)	Mithua (41)		
Shuvedar (12)	Pahilwan (24)	Fazri (25)	Nazuk Badan (38)		
Shurkha Burma (11)	Sadaphal (20)	Elaichi (31)	Safeda Mulgoa (33)		
Himsagar (14)	Rataul (27)	Alurapali (27)	MadhoRao Pasand (37)		
Papla (13)	S.B.Chausa (18)	Nazuk Badan (21)	Soria Malda (41)		
Kohitoor (12)	Shohrab Shah (16)	Rousa (18)	Tata Maimidi (38)		
Kali Pairi (15)	Sukul (26)	Vellai Colamban (19)	Phol Gaal (43)		
Zamurad (9)	Husn-e-ara (17)	Allampur Beneshan (20)	Darbhanga (47)		
Mohan Bhog (12)	Seipia (22)	Alphanso Raman (16)	Bhogal Shah (38)		
Mohan Thakur (13)	Kala Pahar (24)	Radling (18)	V.N. Chatterjee (44)		
Neelam Madrasi (15)	Begum Pasand (21)	Prabha Shankar (19)	Jafrani Shahabad (35)		
Amina (14)	Murshidabad (16)		Aswania (41)		
Anant Pal (13)	Kishan Bhog (27)		Pathar (34)		
Ashadio (14)	Sharda Bhog (18)				
Amarjio (11)	Gulab Khas (22)				
Kensingto (15)	Khausal Khas (16)				

Beneshan (8)	Fazri (21)				
Banglora-2 (11)	Fazri Kalan (25)				
Bappakan (12)	Fazri Zafrani (27)				
Bable Ponesa (7)	Malda (21)				
Beauty Maclino (9)	Mithua Bihar (18)				
Modami Model (6)	Bathui (16)				
Bombay Darsa (8)	Bathui Katikee (19)				
Bombay Pedda (10)	Baramasi (20)				
Black Andrew (7)	Mallik (22)				
Papaya Raja Goh (14)	Bombay (21)				

Table 3. Manganese (Mn) distribution in leaves of mango germplasms.

101–200 ppm			**201–300 ppm**		**> 300 ppm**
Alif Laila (142)	Sukul (176)	Pan (165)	Amin Buland Bag (209)	Elaichi (204)	Pathar (325)
Amin Dofasla (156)	Seipia (179)	Pairi (162)	Asaujia Deoband (211)	Ashadio (231)	Prabha Shankar (347)
Amin Dhudhia (154)	Papla (154)	Sardar (197)	Baramasi Creeping (202)	Kensingto (234)	
Amin Brahinpur (153)	Kala Pahar (130)	Batle (176)	Baramasi Aghai Bahar (236)	Alphanso Raman (217)	
Amin Prince (186)	Begum Pasand (172)	Rataul (171)	Baramasi Ahra (224)	Beneshan (272)	
Amin Khurd (189)	Kali Pairi (178)	Gadheymar (164)	Hardil Aziz (206)	Banglora-2 (268)	
Anopan (162)	Kishan Bhog (166)	Hansraj (173)	Husn-e-ara (218)	Bable Ponesa (265)	
Banzeer (197)	Mohan Bhog (163)	Hilario (132)	Katakee Bahar (201)	Beauty Maclino (288)	
Banzeer Sandila (193)	Gulab Khas (154)	Sakkar Chini (171)	Langra Digha (237)		
Bareilywala (174)	Khausal Khas (169)	Fazri (164)	Langra Gorakhpur (221)		
Bhoodia (153)	Mohan Thakur (148)	Alurapali (179)	Langra (204)		
Bhadaiya Sukul (149)	Fazri (137)	Nazuk Badan (197)	Mallika (261)		
Bride of Russia (146)	Fazri Kalan (128)	Rousa (181)	Nazuk Badan (237)		
Chausa (154)	Fazri Zafrani (167)	Neelam Madrasi (160)	Nisar Pasand (260)		
Dashehari (134)	Malda (146)	Vellai Colamban (136)	Nayab (219)		
Gaurjeet (145)	Mithua Bihar (122)	Allampur Beneshan (149)	Sadaphal (211)		
Gilas (131)	Bathui (176)	Amina (198)	Sharbati Bagrain (214)		
Gola Bhadaiya (196)	Bathui Katikee (161)	Anant Pal (177)	Husn-e-ara (208)		

Gulab Jamun (161)	Mallik (196)	Amarjio (172)	Murshidabad (204)		
Katakee Farukhabad (193)	Bombay Green (168)	Bappakan (150)	Kohitoor (233)		
Langra Banarsi (158)	Dalima (163)	Modami Model (177)	Zamurad (241)		
Lat Kampoo (185)	Chatterjee Khas (128)	Bombay Darsa (134)	Sharda Bhog (248)		
Mithua (174)	Safeda Mulgoa (160)	Bombay Pedda (188)	Baramasi (207)		
Pahilwan (198)	Mallviya Bhog (136)	Black Andrew (156)	Bombay (214)		
Rataul (192)	Soria Malda (152)	Radling (164)	Anda (227)		
S.B.Chausa (147)	Darbhanga (153)	Papaya Raja Goh (180)	Jalsain (202)		
S.B.Rampur (168)	Bhogal Shah (156)		MadhoRao Pasand (213)		
Lucknow Safeda (163)	V.N. Chatterjee (139)		Mahmooda Bahar (222)		
Safeda Mallihabad (126)	Aswania (198)		Anaiwara (203)		
Serohi (134)	Bombay Battle (143)		Tata Maimidi (211)		
Shuvedar (139)	Ladario (200)		Phol Gaal (217)		
Shohrab Shah (146)	Massarat Shastri (196)		Jafrani Shahabad (227)		
Shurkha Burma (161)	Mankhurd (158)		Alphanso Ratnagiri (201)		
Himsagar (153)	Papatio (161)		Bombay (204)		

Table 4. Iron (Fe) distribution in leaves of mango germplasms.

101–200 ppm				**201–300 ppm**	**> 300 ppm**
Alif Laila (163)	Lat Kampoo (185)	Mohan Bhog (163)	Papatio (124)	Katakee Bahar (206)	Bathui Katikee (310)
Amin Dofasla (168)	Mallika (199)	Sharda Bhog (178)	Sardar (163)	Langra Banarsi (211)	Baramasi (348)
Amin Dhudhia (146)	Nazuk Badan (196)	Gulab Khas (167)	Batle (160)	Langra Digha (203)	Mallik (450)
Amin Brahinpur (192)	Pahilwan (192)	Khausal Khas (131)	Gadheymar (179)	Langra Gorakhpur (251)	Bombay Green (461)
Amin Prince (188)	Rataul (129)	Mohan Thakur (138)	Hansraj (165)	Langra (216)	Dalima (304)
Amin Buland Bag (152)	S.B.Chausa (132)	Fazri (146)	Hilario (139)	Mithua (204)	Pan (384)
Amin Khurd (148)	S.B.Rampur (121)	Fazri Kalan (143)	Fazri (166)	Nisar Pasand (224)	Rousa (361)
Anopan (157)	Sharbati Bagrain (134)	Fazri Zafrani (139)	Elaichi (180)	Nayab (231)	Beneshan (304)
Asaujia Deoband (151)	Lucknow Safeda (118)	Malda (182)	Nazuk Badan (134)	Sadaphal (216)	
Baramasi Creeping (138)	Safeda Mallihabad (102)	Mithua Bihar (134)	Vellai Colamban (194)	Hardil Aziz (201)	
Baramasi Aghai Bahar (159)	Serohi (122)	Chatterjee Khas (161)	Allampur Beneshan (143)	Bombay (255)	
Baramasi Ahra (134)	Shuvedar (125)	Jalsain (165)	Amina (135)	Anda (223)	

Banzeer (150)	Shohrab Shah (101)	Safeda Mulgoa (158)	Anant Pal (122)	Mallviya Bhog (247)	
Banzeer Sandila (142)	Shurkha Burma (127)	MadhoRao Pasand (154)	Ashadio (114)	Tata Maimidi (256)	
Bareilywala (147)	Himsagar (114)	Mahmooda Bahar (148)	Amarjio (136)	Bathui (201)	
Bhoodia (143)	Sukul (135)	Anaiwara (133)	Kensingto (117)	Bhogal Shah (251)	
Bhadaiya Sukul (152)	Husn-e-ara (143)	Soria Malda (144)	Banglora-2 (172)	V.N. Chatterjee (269)	
Bride of Russia (168)	Seipia (136)	Phol Gaal (118)	Bappakan (113)	Alphanso Ratnagiri (262)	
Chausa (164)	Papla (127)	Darbhanga (127)	Bable Ponesa (166)	Pairi (241)	
Dashehari (167)	Kala Pahar (148)	Jafrani Shahabad (112)	Beauty Maclino (145)	Bombay (241)	
Gaurjeet (156)	Begum Pasand (111)	Aswania (138)	Modami Model (118)	Rataul (247)	
Gilas (171)	Murshidabad (143)	Bombay Battle (116)	Bombay Darsa (114)	Sakkar Chini (251)	
Gola Bhadaiya (166)	Kohitoor (156)	Ladario (143)	Bombay Pedda (116)	Alurapali (296)	
Gulab Jamun (176)	Kali Pairi (174)	Pathar (137)	Radling (165)	Neelam Madrasi (289)	
Husn-e-ara (189)	Zamurad (159)	Massarat Shastri (133)	Prabha Shankar (149)	Alphanso Raman (233)	
Katakee Farukhabad (178)	Kishan Bhog (170)	Mankhurd (146)	Papaya Raja Goh (138)	Black Andrew (256)	

Table 5. Boron (B) distribution in leaves of mango germplasms.

Up to 10 ppm	**11–20 ppm**	**21–30 ppm**		**> 30 ppm**
Langra Digha (6.60)	Alif Laila (17.10)	Amin Dofasla (26.60)	Baramasi (30.80)	Gulab Jamun (33.40)
Bappakan (10.80)	Amin Khurd (20.70)	Amin Dhudhia (21.20)	Mallik (27.70)	Hardil Aziz (38.60)
Modami Model (12.20)	Asaujia Deoband (15.90)	Amin Brahinpur (26.30)	Bombay (23.20)	Husn-e-ara (44.80)
Bombay Pedda (10.60)	Baramasi Aghai Bahar (20.80)	Amin Prince (26.60)	Bombay Green (22.80)	S.B.Chausa (38.70)
Black Andrew (12.80)	Baramasi Ahra (18.10)	Amin Buland Bag (21.30)	Anda (27.10)	Sharbati Bagrain (33.80)
	Bareilywala (16.80)	Anopan (27)	Dalima (26.80)	Zamurad (36.40)
	Bhoodia (16.30)	Baramasi Creeping (23.60)	Jalsain (24.40)	Khausal Khas (31.70)
	Bhadaiya Sukul (15.70)	Banzeer (25.30)	Mahmooda Bahar (29.00)	Fazri (34.70)
	Gilas (20.40)	Banzeer Sandila (25.10)	Anaiwara (30.30)	Fazri Kalan (35.80)
	Gola Bhadaiya (17.50)	Bride of Russia (27)	Soria Malda (27.10)	Bathui Katikee (31.80)
	Katakee Bahar (12.30)	Chausa (28.60)	Phol Gaal (23.50)	Chatterjee Khas (31.80)
	Katakee Farukhabad (15.80)	Dashehari (24.30)	Darbhanga (28.30)	Safeda Mulgoa (33.10)
	Langra Banarsi (17.70)	Gaurjeet (22.20)	V.N. Chatterjee (26.10)	Mallviya Bhog (31.60)
	Langra Gorakhpur (15.80)	Nazuk Badan (23)	Jafrani Shahabad (22.40)	MadhoRao Pasand (32.20)

	Langra (13.30) Lat Kampoo (14.60) Mallika (17.70) Mithua (16.60) Nisar Pasand (12.90) Nayab (19.60) Pahilwan (14.10) Sadaphal (20.60) S.B.Rampur (15.10) Seipia (20.30) Murshidabad (19.20) Mithua Bihar (16.20) Anant Pal (17.10) Ashadio (19.20) Amarjio (11.70)	Rataul (26.20) Lucknow Safeda (27.40) Safeda Mallihabad (24.80) Serohi (26.70) Shuvedar (28.30) Shohrab Shah (24.40) Shurkha Burma (25.30) Himsagar (26.00) Sukul (26.40) Husn-e-ara (23.60) Papla (29.10) Kala Pahar (30.60) Begum Pasand (22.10) Kohitoor (30.00) Kali Pairi (27.50) Kishan Bhog (26.30) Mohan Bhog (30.80) Sharda Bhog (28.50) Gulab Khas (29.20) Mohan Thakur (26.10) Fazri Zafrani (30.20) Malda (24.70) Bathui (27.60)	Aswania (30.90) Ladario (28.70) Mankhurd (22.20) Bombay (30.10) Rataul (29.60) Hansraj (29.30) Fazri (26.20) Elaichi (29.40) Nazuk Badan (28.20) Rousa (25.70) Neelam Madrasi (26.60) Vellai Colamban (30.20) Allampur Beneshan (24.90) Amina (21.50) Alphanso Raman (22.50) Beneshan (25.20) Banglora-2 (26.70) Bable Ponesa (28.40) Beauty Maclino (30.30) Bombay Darsa (21.10) Prabha Shankar (27.90) Papaya Raja Goh (30.40)	Tata Maimidi (34.60) Bhogal Shah (32.70) Alphanso Ratnagiri (32.80) Bombay Battle (31.40) Pathar (37.80) Massarat Shastri (31.30) Papatio (33.50) Pan (38.00) Pairi (35.70) Sardar (37.60) Batle (33.40) Gadheymar (38.90) Hilario (34.40) Sakkar Chini (36.80) Alurapali (32.50) Kensingto (31.20) Radling (32.70)

basis for resource utilization based on nutrient contents in soil and leaf tissues along with other technologies were advocated (Kumar *et al*. 2016b). The mineral compositions of normal or high density mango plantations were also equally important in order to have yield sustainability (Adak *et al*. 2016). Thus, information on nutrient contents in any biodiversity conservation programme or production system needs special attention for recording yield variations and orchard sustainability.

CONCLUSION

The present study indicated wide variations across micronutrient contents in 138 conserved mango germplasms.Some of the commercial cultivars had differential Zn, B, Mn, Cu and Fe contents in its foliar tissues indicating the basis for wider quality production. Majority of the B contents are recorded in the range of 21 to 30 mg kg^{-1}, Zn for 11–20 mg kg^{-1}, Mn & Fe 101 to 200 mg kg^{-1} respectively. Maintenance of optimum quantity of micronutrients are thus required for the good plant health.

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