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Short communication

Boron and Potassium Content of Major Mango (*Mangifera indica* L.) germplasms

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Vast area in mango growing belts in India including Uttar Pradesh had deficiency of macro and micronutrients. Reduction in fruit size, fruit cracking, dropping and quality depends on deficiency of nutrients particularly boron (B) and potassium (K) nutrition. Saran and Kumar (2011) observed that fruit cracking and internal necrosis was severe in Dashehari, Lucknow Safeda, Amprapali, Bombay Green while Chausa was considered as somewhat tolerant. Even leaf nutrient status of B in mango of different regions of Konkan, Maharashtra recorded a range of only 13-33 mg kg^{-1} with an average of 23 mg kg^{-1}. The K deficiency was also higher (average 0.73%, range 0.3 to 1.0%). The foliar and soil application of B and Zn, had corrected spongy tissue in mango cv. Alphonso, a calcium-related disorder observed in acid soils of Konkan, India (Edward Raja, 2009). B is essentially required for flowering and fruiting, regulation of plant hormones, fruit setting, water absorption and sugar translocation etc. However, availability of nutrients in soil depends on its amount, chemical reactions, kinetics, mobility, quantity-intensity relationships, different fractionations, solubility etc. Apart from Zn and soil organic carbon deficiency, B is the second most widely deficient micronutrients (Alloway, 2018). Its deficiency ranged across soils, crops and climatic conditions.

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Germplasms conservation programs in fruit crops globally required effective management modules in order to sustain for longer biodiversity on its soil. It is quite general that nutrient deficiencies are commonly observed in these germplasms over periods of its existence. Sometimes trees showed severe deficiency symptoms and analysis of foliar tissues confirmed the deficient/lower contents of essentially required minerals. Haas (1943) recorded a range of 6.11 to 33.35 with mostly below <20 mg kg^{-1} in water – soluble B in dry matter of mature avocado leaves while in case of water-insoluble B, a range of 11.18 to 25.30 mg kg^{-1} was estimated. Kumar *et al.* (2015) reported wide spared deficiency of K (ranging from 33.3 to 100 per cent) in mango leaves of some mango orchards of Uttar Pradesh resulting into lower yields. Adak *et al.* (2018) concluded that out of 138 mango germplasms, around 61.6% had lower (<20 mg kg^{-1}) Zn content. Thus, the wide spread deficiency in nutrients contents is to be indexed and the present study was conducted in view to assess B and K content of mango germplasms (Fig. 1).

The research farm of ICAR-CISH, Rehmankhera, Lucknow, Uttar Pradesh, India conserved around 735 mango germplasms in its field gene bank. These germplasms were maintained over decades. The present study was conducted in 138 mango germplasms. The area is characterized as subtropical. Foliar samples (35-

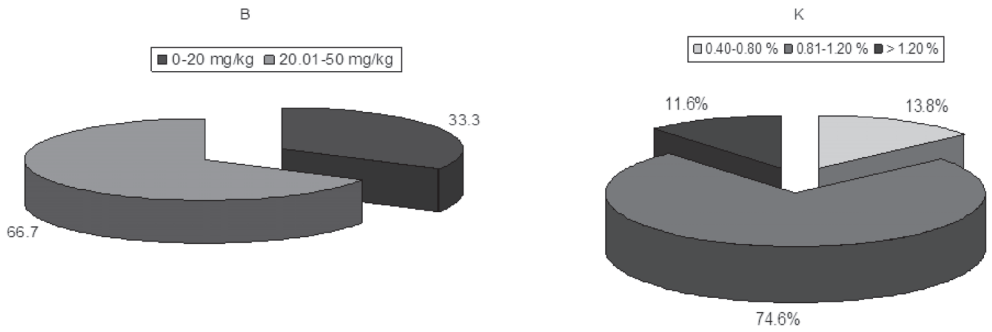

Fig. 1. Distribution of B and K concentrations leaf tissue samples

40) were collected during September-October after harvesting of fruits and were washed in double distilled water. The samples were processed in the laboratory for further analysis. Samples were digested with di-acid mixture of nitric acid and perchloric acid (9:4 ratios) and micronutrient contents were estimated by AAS (model number 203 D, Chemito). Fruit samples were collected and processed in the laboratory. Fruit pulp was digested for estimation of nutrient contents in the AAS.

The list of 138 mango germplasms were tabulated in the table 1. The K content in the leaves of mango germplasms is presented in the table 2. The nutrient content (%K) indicated that around 13.8 percent of these germplasms were deficient (in the range of 0.4 to 0.8%), followed by 74.6% in the range of 0.8 to 1.2% and only 11.6 percent samples had higher than 1.2% K content in leaves (Fig. 1). The K content revealed that for longer periods of germplasms maintenance, K levels should be maintained above 1.0%. Some commercially cultivated and available in markets cultivars had lower K content viz., Langra Digha (0982%), Kisan Bhog (0.834%), Fazri (1.029%), Elaichi (1.273%), Hush-e-ara (0.878%), Kensingto (0.768%) and Himsagar (0.808%) etc. The analysis of B distribution indicated wider variations across leaf tissues of 138 mango germplasms with lowest in Langra Digha (6.6 mg kg^{-1}) as observed by Adak *et al.* (2018). Some of the well known cultivars had higher B content like, Langra Gorakhpur (15.80 mg kg^{-1}), Dassheri (24.30 mg kg^{-1}), Hansraj (29.30 mg kg^{-1}), Baramasi (30.80 mg kg^{-1}), Bombay (30.10 mg kg^{-1}) Vellai Colamban (30.20 mg kg^{-1}), Begum Pasand (22.10 mg kg^{-1}), Malda (24.70) and Gulab Khas (29.20 mg kg^{-1}) etc. Of course cent percent samples had B deficiency yet the distribution pattern concluded that 66.7 percent samples had in the range of 0-20.0 mg kg^{-1} while 33.3 percent samples in between 20.01-50.0 mg kg^{-1} (Fig. 2). The concentration of K and B in the fruit pulp was also estimated and it was inferred that 52.4 percent of the samples had lower (0-1.30 mg kg^{-1}) while 47.6 percent pulp was having K content in the range of 1.31-2.0 mg kg^{-1}. In case of B content, 78.6 percent had lower content in the range of 0-20.0 mg kg^{-1} whereas 21.4 percent samples had 20.01-50.0 mg kg^{-1}.

Imbalances of nutrients in fruit trees are known to have impacts on quality production as well as orchard sustainability for longer run. Major nutrients like K are essentially required for quality fruit production whereas B is known for its multipurpose contribution in the plant metabolism. Deficiency of B if any may cause malformation, stunted growth of fruits and terminal young leaves, deformation and cracking of fruits etc. Therefore on-farm mango germplasms conservation programs required special attention for its maintenance and breeding purposes (Rajan *et al*., 2014; Gajanana *et al*., 2015). Several countries like Australia, Brazil, Germany, Thailand, South Africa, Egypt etc wherein germplasms maintenance are going on, nutrient management is placed in schedule of management modules. It is well known that B deficiency coupled with K, Ca and Zn caused several disorders and ultimately reduces the

Table 1. List of 138 mango germplasms used for K and B estimation in subtropical regions of Lucknow

1	Alif Laila	36	Nazuk Badan	71	Malda	106	Bombay
2	Amin Dofasla	37	Nisar Pasand	72	Mithua Bihar	107	Batle
3	Amin Dhudhia	38	Nayab	73	Bathui	108	Rataul
4	Amin Brahinpur	39	Pahilwan	74	Bathui Katikee	109	Gadheymar
5	Amin Prince	40	Sadaphal	75	Baramasi	110	Hansraj
6	Amin Buland Bag	41	Rataul	76	Mallik	111	Hilario
7	Amin Khurd	42	S.B.Chausa	77	Bombay	112	Sakkar Chini
8	Anopan	43	S.B.Rampur	78	Bombay Green	113	Fazri
9	Asaujia Deoband	44	Sharbati Bagrain	79	Anda	114	Elaichi
10	Baramasi Creeping	45	Lucknow Safeda	80	Dalima	115	Alurapali
11	Baramasi Aghai Bahar	46	Safeda Malihabad	81	Chatterjee Khas	116	Nazuk Badan
12	Baramasi Ahra	47	Serohi	82	Jalsain	117	Rousa
13	Banzeer	48	Shuvedar	83	Safeda Mulgoa	118	Neelam Madrasi
14	Banzeer Sandila	49	Shohrab Shah	84	Malviya Bhog	119	Vellai Colamban
15	Bareillywala	50	Shurkha Burma	85	Madho Rao Pasand	120	Alampur Beneshan
16	Bhoodia	51	Himsagar	86	Mahmooda Bahar	121	Amina
17	Bhadaiya Sukul	52	Sukul	87	Anaiwara	122	Anant Pal
18	Bride of Russia	53	Hushnara	88	Soria Malda	123	Ashadio
19	Chausa	54	Seipia	89	Tata Maimidi	124	Amarjio
20	Dashehari	55	Papla	90	Phol Gaal	125	Kensington
21	Gaurjeet	56	Kala Pahar	91	Darbhanga	126	Alphanso Raman
22	Gilas	57	Begum Pasand	92	Bhogal Shah	127	Beneshan
23	Gola Bhadaiya	58	Murshidabad	93	V.N. Chatterjee	128	Banglora-2
24	Gulab Jamun	59	Kohitoor	94	Jafrani Shahabad	129	Bappakan
25	Hardil Aziz	60	Kali Pairi	95	Aswania	130	Bable Ponesa
26	Hushnara	61	Zamurad	96	Alphanso Ratnagiri	131	Beauty Maclino
27	Katakee Bahar	62	Kishan Bhog	97	Bombay Batle	132	Modami Model
28	Katakee Farrukhabad	63	Mohan Bhog	98	Ladario	133	Bombay Darsa
29	Langra Banarasi	64	Sharda Bhog	99	Pathar	134	Bombay Pedda
30	Langra Digha	65	Gulab Khas	100	Massarat Shastri	135	Black Andrew
31	Langra Gorakhpur	66	Khausal Khas	101	Mankhurd	136	Radling
32	Langra	67	Mohan Thakur	102	Papatio	137	Prabha Shankar
33	Lat Kampoo	68	Fazri	103	Pan	138	Papaya Raja Goh
34	Mallika	69	Fazri Kalan	104	Pairi		
35	Mithua	70	Fazri Zafrani	105	Sardar		

quality of the fruits (Sharma and Singh, 2008). Actually, leaf B concentration of 50 mg kg^{-1} is considered adequate (Littlemore *et al*., 1991). The present study indicated that deficiency of B in both leaf tissues and fruit pulp is an indicator for immediate B management in the field gene bank for improving the plant genetic diversity. Thus, information on nutrient contents in any bio-diversity conservation programme or production system needs special attention for recording genetic diversity, yield variations and orchard sustainability (Dillon *et al*., 2013).

The results inferred that wide spread variations in B and K content across conserved mango germplasms. Some of the commercial and well known cultivars had differential nutrient

Table 2. Potassium (K) distribution in leaves of mango germplasms

0.40-0.80 %	0.81-1.20 %				> 1.20 %
Himsagar (0.808)	Alif Laila (0.982)	Katakee Farukhabad (0.879)	Kali Pairi (0.942)	Pairi (0.894)	Bhoodia (1.248)
Sukul (0.781)	Amin Dofasla (1.014)	Langra Digha (0.982)	Kishan Bhog (0.834)	Sardar (1.168)	Langra Banarsi (1.307)
Kala Pahar (0.769)	Amin Dhudhia (1.033)	Lat Kampoo (1.046)	Khausal Khas (1.197)	Bombay (0.945)	Langra Gorakhpur (1.231)
Zamurad (0.793)	Amin Brahinpur (1.024)	Mallika (1.055)	Fazri (1.029)	Batle (0.966)	Langra (1.302)
Fazri Kalan (0.737)	Amin Prince (1.146)	Mithua (1.196)	Fazri Zafrani (1.098)	Rataul (1.057)	Mohan Bhog (1.372)
Chatterjee Khas (0.778)	Amin Buland Bag (0.887)	Nazuk Badan (0.965)	Mithua Bihar (1.118)	Hilario (0.963)	Sharda Bhog (1.242)
Mallviya Bhog (0.780)	Amin Khurd (0.864)	Nisar Pasand (0.878)	Bathui (1.102)	Sakkar Chini (1.041)	Gulab Khas (1.388)
MadhoRao Pasand (0.792)	Anopan (1.054)	Nayab (1.173)	Bathui Katikee (0.986)	Fazri (1.128)	Mohan Thakur (1.219)
Phol Gaal (0.718)	Asaujia Deoband (0.855)	Pahilwan (0.968)	Mallik (1.004)	Alurapali (0.900)	Malda (1.336)
Jafrani Shahabad (0.693)	Baramasi Creeping (1.206)	Sadaphal (0.870)	Bombay (1.135)	Nazuk Badan (0.865)	Baramasi (1.388)
Papatio (0.802)	Baramasi Aghai Bahar (1.012)	Rataul (0.984)	Anda (1.101)	Rousa (1.136)	Bombay Green (1.362)
Pan (0.773)	Baramasi Ahra (1.039)	S.B.Chausa (1.247)	Dalima (1.161)	Vellai Colamban (0.911)	Soria Malda (1.267)
Neelam Madrasi (0.783)	Banzeer Sandila (1.022)	S.B.Rampur (1.004)	Jalsain (0.988)	Allampur Beneshan (1.002)	Bhogal Shah (1.484)
Amarjio (0.781)	Banzeer Sandila (1.022)	Sharbati Bagrain (0.943)	Safeda Mulgoa (0.984)	Amina (0.813)	Gadheymar (1.482)
Kensingto (0.768)	Bareilywala (1.063)	Lucknow Safeda (0.964)	Mahmooda Bahar (1.111)	Anant Pal (0.907)	Hansraj (1.574)
Beneshan (0.791)	Bhadaiya Sukul (1.014)	Safeda Mallihabad (0.858)	Anaiwara (1.191)	Ashadio (0.846)	Elaichi (1.273)
Banglora-2 (0.766)	Bride of Russia (0.856)	Serohi (0.877)	Tata Maimidi (0.984)	Alphanso Raman (0.887)	
Bable Ponesa (0.792)	Chausa (1.160)	Shuvedar (1.079)	Darbhanga (1.037)	Bappakan (0.804)	
Modami Model (0.776)	Dassheri (0.968)	Shohrab Shah (0.923)	V.N. Chatterjee (0.868)	Beauty Maclino (0.888)	
	Gaurjeet (0.871)	Shurkha Burma (0.895)	Aswania (0.876)	Bombay Darsa (1.084)	
	Gilas (0.855)	Hush-e-ara (0.878)	Alphanso Ratnagiri (0.846)	Bombay Pedda (0.872)	
	Gola Bhadaiya (1.108)	Seipia (0.911)	Bombay Battle (1.105)	Black Andrew (1.038)	
	Gulab Jamun (0.881)	Papla (1.076)	Ladario (0.878)	Radling (0.947)	
	Hardil Aziz (0.962)	Begum Pasand (0.955)	Pathar (0.935)	Prabha Shankar (0.806)	
	Hushnara (0.994)	Murshidabad (0.826)	Massarat Shastri (1.121)	Papaya Raja Goh (1.071)	
	Katakee Bahar (1.083)	Kohitoor (0.814)	Mankhurd (0.978)		

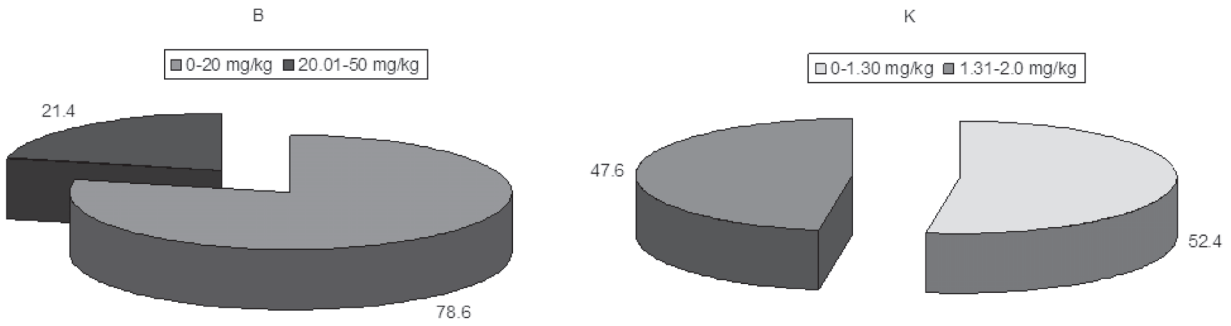

Fig. 2. Distribution of B and K concentrations in fruit pulp of mango

contents in its foliar tissues indicating the basis for wider quality production. Almost majority of the leaf tissues showed K deficiency while cent percent B deficiency was recorded. Majority of the mango fruit pulp showed <1.30 mg kg^{-1} K content and <20.0 mg kg^{-1} B content respectively. Thus, for survivability as well as quality production and maintaining genetic diversity of mango germplasms, optimum nutreint management is also essential and maintenance of both B and K concentration should be given top priority in case of mango.

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