MICRO-NUTRIENT STATUS OF MANDARIN TREES IN GORKHA AND LAMJUNG DISTRICTS OF NEPAL

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ABSTRACT

A field survey from six potential pockets (Ashrang, Bakrang, Gaikhur, Ghairung, Manakamana and Tanglichok) of Gorkha and four (Bhorletar, Dhimire Gaun Shishaghat, and Syaut) of Lamjung district was carried out from May 1997 to June 1997 to assess the micro-nutrients in the leaves of mandarin trees for determining the nutrient management of mandarin orchards. Total of 72 samples from Gorkha and 48 samples from Lamjung district were collected from four different plant types (healthy fruit bearing trees, healthy young non-fruit bearing trees, unhealthy fruit bearing trees and unhealthy young non-fruit bearing trees) as treatments and replicated three times in each site. Each sample was a composite of 100-150 leaves. Results revealed that among micro-nutrients, iron and copper were medium to high and very high in rating in all sites indicating these two nutrients are sufficient; except Bhorletar, Shishaghat, Ashrang and Ghairung sites, the rest of the sites were low in zinc content; except Syaut, Bhorletar and Manakamana, all the other sites had medium content of manganese, and all the sites except Tanglichok were deficient in Boron. Therefore, it is necessary to supply different nutrients through external sources in those sites where a particular nutrient is deficient.

Additional Key Words: micro-nutrients, mandarin, fruiting, non-fruiting, healthy, unhealthy

INTRODUCTION

Mandarin is successfully grown in 47 out of the 75 districts of Nepal and the cultivated area and the fruit production is increasing every year in the Western Development Region (NCDP, 1989). Budhathoki *et al.* (1989) and Gurung *et al.* (1992) studied the production constraints and production systems of mandarin in the Central Development Region (CDR), Dhading and Sindhuli districts. A system analysis of soil fertility in relation to mandarin orchards in the mid hills of Nepal during a Samuhik Bhraman indicated that bearing trees are better cared than young seedlings and there was no consistent manuring practice in mandarin orchards (Joshi *et al.*, 1995).

A balance of various nutrient elements both in the soil and plants is essential for high level of plant growth and production. The plant itself is the best indicator of nutrient availability because the leaf is the focal point of many plant functions and is a relatively sensitive indicator to alterations in its mineral composition. According to Smith (1962), foliar analysis is based on four principles (i) the leaf is the principle site of plant metabolism, (ii) the composition of leaf is a genuine reflection of the nutrient supply, (iii) certain stages of development experience more pronounced nutritional changes and (iv) performance of the crop and concentration of nutrients in leaf at specific growth stages are related.

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Deficiencies of zinc (Zn) and extent of hidden hunger was in the order of Zn>Ca>N>Mg>K in the mandarin trees of Kangra district of India (Rana *et al.*, 1984). In Nepal, Gupta *et al.* (1989) surveyed the potential mandarin growing pockets of Dhankuta district and reported that boron, magnesium, copper, calcium and zinc were deficient in the district. Foliar analysis of mandarin leaves to evaluate the nutrient status in the western hills of Nepal was lacking so far. Therefore, the objective of this survey was to assess the micro-nutrients in the mandarin trees grown in some of the potential mandarin growing pockets in Gorkha and Lamjung districts.

MATERIALS AND METHODS

Four mandarin growing pockets (Bhorletar, Shishaghat, Dhimire Gaun and Syaut) in the mid-hills of Lamjung and six pockets (Bakrang, Ashrang, Ghairung, Tanglichok, Manakamana and Gaikhur) of Gorkha district were selected for the study.

Four to seven months old mandarin leaf samples, each sample was a composite of 100-150 leaves were collected from the four directions (east, west, north and south) of the trees during May and June 1997. Separate samples were taken from (a) healthy fruit bearing trees, (b) healthy young non-fruit bearing trees, (c) unhealthy fruit bearing trees, (d) unhealthy young non-fruit bearing trees. Thus, in each pocket, there were four types of sample and each sample type was replicated three times. The total number of samples was 48 from Lamjung and 72 from Gorkha district totaling 120 samples. The samples were kept in perforated Nepali paper bags and transported to the laboratory. Samples were oven dried at 65°C for 48 hrs, ground and analyzed for iron (Fe), zinc (Zn), copper (Cu), manganese (Mn), and boron (B) by Atomic Absorption Spectrophotometer (AAS) (Issac and Kerber, 1971).

During the sample collection in the field, farmers were interviewed about the use of manure and fertilizers, productivity trend, production constraints and farmers' perception on soil fertility. The leaf analysis data of the four treatments were arranged in a factorial structure in such a way that plant age included fruiting and non-fruiting treatments and health included healthy and unhealthy mandarin trees. The analysis of variance was performed using genstat 5 software. Zinc and Copper values were transformed onto the log scale. Analysis of variance was undertaken looking at the effects of age, health and the interaction between plant age and health.

RESULTS AND DISCUSSION

Iron

Out of 10 sites, Bhorletar and Ghairung had high Fe (160.0 and 163.0 ppm) in young non-fruiting trees ($P<0.01$ and 0.04 respectively). Unhealthy trees in Bhorletar, Syaut and Bakrang had distinctly high Fe of 160.0 ($P=0.04$), 185.0 ($P=<0.001$) and 161.4 ($P=0.03$) as compared to healthy trees (Table 1). An interaction effect between maturity and health was noted only at Tanglichok ($P=0.02$) because Fe content varied in healthy fruiting and non-fruiting trees as well as unhealthy fruiting and non-fruiting trees and no definite trend of Fe content due to maturity and healthy factors was noted. Mean Fe of each site was either high or very high in rating. One hundred and three mandarin leaves samples (85.9%) had high and very high Fe while 17 samples (14.2%) had medium Fe.

Table 1: Fe content (ppm) in 4 to 7 months old mandarin leaves at different sites Locations

Treatments	Locations									
	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10
Healthy fruiting trees	155	147	154	152	163	147	150	128	110	130
Healthy young non-fruiting trees	131	141	155	151	155	158	107	124	110	137
Unhealthy fruiting trees	124	137	144	192	179	151	139	160	149	119
Unhealthy young non-fruiting trees	196	176	153	178	176	175	165	163	212	133
SEU	11.2	20.5	18.0	8.9	30.0	12.0	19.3	21.3	81.6	15.7
P value of maturity (Fruiting: Non-fruiting	0.01	0.21	0.67	0.20	0.77	0.04	0.47	0.96	0.53	0.28
P value of health (healthy: unhealthy)	0.04	0.36	0.58	<0.001	0.32	0.19	0.08	0.03	0.19	0.43
P value of maturity x health	<0.001	0.11	0.69	0.21	0.90	0.39	0.02	0.80	0.53	0.73

Note: L1=Bhorletar, L2=Shishaghat, L3=Dhimire Gaun, L4=Syaut, L5=Ashrang, L6=Ghairung, L7=Tanglichok, L8=Bakrang, L9=Manakamana, and L10=Gaikhur

Zinc

At Tanglichok, Zn content was high (20.0 ppm) in young non-fruiting trees as compared to fruiting trees (P=0.001) (14.3 ppm). Similarly, healthy trees (P=0.01) had high Zn (18.8 ppm) as compared to unhealthy trees (15.7 ppm) at the same site. An interaction effect between maturity and health was observed in Shishaghat and Tanglichok showing no definite trend of Zn in healthy fruiting and non-fruiting as well as unhealthy fruiting and non-fruiting treatments. Mean Zn at Bhorletar, Shishaghat, Ashrang and Ghairung was medium (28.3 to 34.7 ppm) in rating and the rest of the sites had low Zn (Table 2). 84 samples (70.0%) fall in deficient to low, 35 samples (29.2%) in medium and 1 sample (0.83%) in high rating of zinc.

Copper

Copper content in the leaves of mandarin was not significantly influenced by maturity. However, it was high (18.7 to 21.7 ppm) in the samples of unhealthy mandarin leaves at Syaut (P=0.03), Tanglichok (P=0.02), Bakrang (P=0.02) and Manakamana (P=0.04) sites as compared to healthy trees (10.3 ppm to 16.7 ppm). No interaction effect between age and health was evident at any site. Mean Cu content at four sites of Lamjung (9.6 to 14.5 ppm) was medium. 54 samples (45.8%) had high and very high, 62 (52.5%) had medium and 2 (1.7%) had low copper in the mandarin leaves.

Table 2: Zinc content (ppm) in 4 to 7 months old mandarin leaves at different sites

Treatments	Locations									
	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10
Healthy fruiting trees	36.2	20.2	28.9	19.1	28.6	42.7	17.3	18.5	18.7	23.4
Healthy young non-fruiting trees	33.8	48.7	19.6	20.2	31.7	56.1	20.2	21.8	23.2	27.8
Unhealthy fruiting trees	19.4	43.1	16.6	20.4	25.1	15.4	11.2	17.0	21.1	12.4
Unhealthy young non-fruiting trees	42.8	16.3	15.9	18.6	27.7	24.5	20.2	2[illegible].6	31.5	17.9
SEU	25.8	16.7	10.4	2.5	4.1	30.6	1.5	4.6	6.9	10.9
P value of maturity (Fruiting: Non-fruiting	0.48	0.71	0.53	0.84	0.39	0.29	0.001	0.07	0.13	0.35
P value of health (healthy: unhealthy)	0.71	0.68	0.16	0.86	0.16	0.15	0.01	0.97	0.36	0.10
P value of maturity x health	0.40	0.01	0.67	0.39	0.89	0.82	0.01	0.42	0.60	0.59

Table 3: Copper content (ppm) in 4 to 7 months old mandarin leaves at different sites.

Treatments	Locations									
	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10
Healthy fruiting trees	8.6	6.9	12.2	9.7	45.2	20.2	14.9	14.6	16.7	11.7
Healthy young non-fruiting trees	8.7	12.2	11.6	10.9	43.6	15.1	15.9	13.7	16.6	12.1
Unhealthy fruiting trees	7.4	35.7	17.3	12.6	46.4	13.8	17.5	21.3	25.6	20.4
Unhealthy young non-fruiting trees	13.8	13.2	14.5	24.8	52.0	15.3	25.9	20.1	18.6	19.2
SEU	4.2	16.1	4.3	6.6	13.8	6.3	4.1	3.9	3.3	4.3
P value of maturity (Fruiting: Non-fruiting	0.21	0.64	0.87	0.09	0.41	0.85	0.07	0.82	0.09	0.93
P value of health (healthy: unhealthy)	0.55	0.36	0.15	0.03	0.40	0.49	0.02	0.02	0.04	0.02
P value of maturity x health	0.19	0.38	0.71	0.23	0.96	0.45	0.17	0.79	0.11	0.75

Manganese

High manganese content (24.9 to 36.3 ppm) was found in young non-fruiting mandarin leaves at Bhorletar (P=0.02), Dhimire Gaun (P=0.04), Ghairung (P=0.02), Tanglichok (P=0.001), Bakrang (P=0.02), Manakamana (P=0.02) and Gaikhur (P=01) as compared to fruiting trees (18.9 ppm to 23.7 ppm). Among ten sites, Tanglichok (P=0.01) and Manakamana (P=0.01) had high manganese content (31.5 ppm and 25.3 ppm respectively) in healthy trees of mandarin leaves as compared to unhealthy trees (19.4 ppm to 24.6 ppm). An interaction effect between maturity and health factors was evident only at Manakamana site. The data did not show a definite trend in manganese content in fruiting and young non-fruiting as well as healthy and unhealthy trees (Table 4). Mean Mn at two sites (Bhorletar and Syaut) in Lamjung and only one site Manakamana in Gorkha district showed low Mn (22.3 to 24.1 ppm). The remaining seven sites of both districts had medium mean Mn (24.6 to 27.6 ppm). A total of 63 samples (52.5%) had medium and 57 (47.5%) had deficient and low manganese content in the mandarin leaves.

Table 4. Manganese content (ppm) in 4 to 7 months old mandarin leaves at different sites.

Treatments	Locations									
	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10
Healthy fruiting trees	22.6	21.0	21.8	21.9	26.9	21.4	27.2	24.3	19.9	20.1
Healthy young non-fruiting trees	25.1	27.8	27.4	23.9	28.9	32.5	35.7	32.0	30.6	38.7
Unhealthy fruiting trees	17.8	30.1	22.1	23.7	21.9	23.1	18.9	23.0	19.5	17.6
Unhealthy young non-fruiting trees	28.1	24.7	27.2	26.8	27.9	31.3	30.3	33.2	19.2	33.9
SEU	3.6	15.3	3.38	2.33	4.69	5.3	3.01	3.05	2.7	7.1
P value of maturity (Fruiting: Non-fruiting	0.02	0.94	0.04	0.11	0.19	0.02	0.001	0.002	0.02	0.01
P value of health (healthy: unhealthy)	0.69	0.75	0.97	0.13	0.30	0.94	0.01	0.98	0.01	0.41
P value of maturity x health	0.11	0.52	0.90	0.72	0.48	0.66	0.43	0.50	0.01	0.79

Boron

Mandarin leaves of fruiting trees only at Bakrang (P=0.03) had high B content (31.3 ppm) as compared to young non-fruiting trees (22.6 ppm) in the same site. Differences due to healthy and unhealthy trees on B content was not obtained in the survey sites. An interaction effect between maturity and health on B was evident only at Manakamana site due to variations of B content in the treatments (Table 5). Except Tanglichok (44.9 ppm), all the nine sites had

deficient to low B (7.3 to 41.2 ppm). Ninety five samples (79.2%) were deficient to low while 25 (20.8%) were medium in B content.

Table 5: Boron content (ppm) in 4 to 7 months old mandarin leaves at different sites

Treatments	Locations									
	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10
Healthy fruiting trees	21.2	21.7	15.9	2.60	32.9	32.3	45.2	20.7	8.6	22.8
Healthy young non-fruiting trees	35.4	35.0	2.2	7.30	26.2	36.1	36.9	13.6	27.9	32.6
Unhealthy fruiting trees	35.6	34.0	5.0	6.70	22.4	43.4	43.6	41.9	26.0	33.5
Unhealthy young non-fruiting trees	19.3	35.4	13.0	12.8	31.5	53.0	53.9	31.6	17.6	23.8
SEU	12.5	15.3	11.3	7.82	9.76	11.8	17.8	12.4	6.5	22.0
P value of maturity (Fruiting: Non-fruiting	0.89	0.44	0.68	0.28	0.84	0.36	0.93	0.27	0.20	0.99
P value of health (healthy: unhealthy)	0.91	0.50	0.99	0.33	0.66	0.09	0.48	0.03	0.38	0.94
P value of maturity x health	0.08	0.53	0.15	0.89	0.21	0.69	0.40	0.83	0.01	0.47

During the field visit, farmers at all sites expressed that they apply either farm yard manure (FYM)/compost or poultry manure to their mandarin trees. Ten to forty kg of FYM is incorporated around the trunk of each mandarin trees depending on the age of the trees. In certain sites, FYM is used for maize/finger-millet crops planted as inter-crops in mandarin orchards and a portion of this manure is utilized by mandarin trees. At Dhimire Gaun (Lamjung), Mr. Purna Bahadur Gurung has a well established mandarin orchard with 700 to 800 plants which are 5-7 years old. According to his experience, even very old dying-back mandarin trees started fruiting well after pruning and a heavy application of poultry manure.

In the commercial mandarin orchard of Ashrang (Mr. Iswar Pandey and Mr. Krishna Pandey) and Manakamana (Mr. Insan Babu Thapa), diammonium phosphate (DAP) and urea have been used along with FYM/compost. These orchards are well managed. During the survey, farmers raised the issues of green stinkbug attack on fruits in July-August. In some sites, powdery mildew, root-rot, foot rot and pink diseases were observed. One of the progressive farmer of Ashrang shared his experience with us that root-rot and foot-rot diseases could be controlled by pruning and removing diseased parts, and drenching with 1 percent Bordeaux mixture around the trunk as well as applying Bordeaux paste in the foot-rot infected area. At Bhorletar area, farmer mentioned that the local mandarin trees are well adapted to their fields and varieties brought from out side started dying after a few years of fruiting. In all the potential sites of these two districts, very few budded and grafted mandarin trees were found.

CONCLUSION

Iron and copper are medium to excess and are not deficient at any site. Except Bhorletar, Shishaghat, Ashrang, and Ghairung, all the other sites are deficient in Zn while Mn is deficient in Bhorletar, Syaut, and Manakamana and sufficient in other sites. Boron is deficient in all the sites except Tanglichok. Sites, where nutrients are deficient, the nutrients should be applied through different sources, so that normal growth and fruit development and quality will be maintained.

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