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Standardization of leaf sampling technique for macro-and micro-nutrient elements in plum under temperate conditions

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ABSTRACT

Macro-and micro-nutrient elements content as influenced by leaf age and its position on the shoot was studied to determine leaf sampling time for plums grown in temperate region. The results revealed that middle leaves were the most suitable tissue for determining needs of plum trees. Leaf samples should be collected from June 15 to July 15 for determining N, P, K and Ca and from July 1 to July 15 for determining Zn and Cu. For the determination of Mg and Fe in plum leaf, samples should be collected from June 1 to June 15 and August 1 to August 15, respectively.

Key words: Leaf sampling, plum, nutritional diagnosis, suitable sampling date.

INTRODUCTION

Leaf analysis has provided a basis of undertaking of numerous complex problems in widely spaced parts of world. The mineral content of plant parts, in particular leaves is used to identify nutrient deficiencies, excesses or imbalances within the crop. Plant analysis has been used as a diagnostic tool for many years and there is now a renewed interest and activity in such method that greatly improved techniques for making plant analysis, increased amount of calibration information and greater demand from farmers and their advisors on nutrient supply needs for high yields are reasons for the renewed interest (Childers, 2). Soil test results are poorly correlated with tree nutrient uptake (Heckman, 5). Therefore, plant tissue analysis is commonly accepted as being the most reliable guide for evaluating the success of the orchard's fertility programme. Supplying the nutrient need to the tree crops is critical to achieve consistent production and high quality fruits (Smith, 14). Hence, the determination of nutritional needs for efficient production of high quality fruits is an important aspect of nutrient management for the orchardists.

Wide fluctuation in nutrient concentration occur in tissues during growth period, however, most suitable leaf position and sampling time are those which give rise to least variation in its mineral concentration (Mason, 8). Work done in this direction is very limited which calls for undertaking systemic studies to standardize the leaf sampling technique for macro and micro-nutrients in plum. No such information is available for plum grown in temperate region of north-western Himalayas. Therefore, the present studies were intended to fill the gap.

MATERIALS AND METHODS

The studies were conducted on 'Santa Rosa' plum in the Experimental Orchard of Division of Fruit Science, Sher-e-Kashmir University of Agricultural Sciences & Technology of Kashmir, Shalimar, Srinagar (J&K) during the year 2009-10. Leaf samples, consisting of 50 leaves with petioles were collected from the current season's growth of 29-year-old bearing plants of plum cv. Santa Rosa from three different positions, *viz.*, basal, middle and top leaves, at fortnightly interval beginning from May 1 to September 1. The experiment was conducted in randomized block design with four replications. The plants were fertilizer uniformly with 850 g urea, 325 g diammonium phosphate (DAP) and 1,250 g muriate of potash (MOP) per plant. Full dose of potash and phosphorus and half dose of nitrogen was applied three weeks before expected bloom while rest of the nitrogen was applied three weeks after fruit set. The leaf samples following their collection were thoroughly washed with tap water, followed by dipping successively in 0.1N HCl, distilled water and double distilled water. Then these leaf samples were spread on paper sheets for drying in shade and subsequently in oven at 68°C. The dried samples were grounded and kept in butter paper bags for chemical analysis. Nitrogen content was determined by using micro-Kjeldhal distillation method (AOAC, 1), phosphorus by colorimetery and potassium and calcium by flame photometer (Jackson, 6). The magnesium was estimated by using atomic absorption spectrophotometer. Total

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Fe, Zn and Cu were estimated by atomic absorption spectrophotometer and expressed as ppm on dry weight basis. The statistical method described by Gomez and Gomez (3) was followed to analyze data.

RESULTS AND DISCUSION

The seasonal changes in the N content showed a similar trend during the sampling season (Fig. 1). In top leaves, N content increased with the advancement of season till June 15, and thereafter, declined to reach its lowest value on September 1, the last sampling date. The differences between the values of N content were statistically significant and no period of stability of N content was recorded in top portion leaves of current season growth. Leaves from the middle portion of the shoot exhibited a significant increase from May 1 to June 15. Thereafter, it decreased first non-significantly upto July 15 and then significantly till September 1. In basal leaves an almost similar trend as that of top shoot leaves was observed. No period of stability of N content was recorded in basal leaves. Mean N content with respect of position of leaf on shoot was recorded higher in top leaves, followed by middle and basal leaves. This might be due to the reason that nitrogen, being the mobile element, has the tendency to accumulate in top leaves (Singh and Rajput, 12). Present findings are in agreement with those of Rehalia and Sandhu (10).

The P content of leaves sampled from top portion and basal portion of current season shoot followed similar trend and no period of stability or least variation occurred in case of top and basal leaves (Fig. 2).

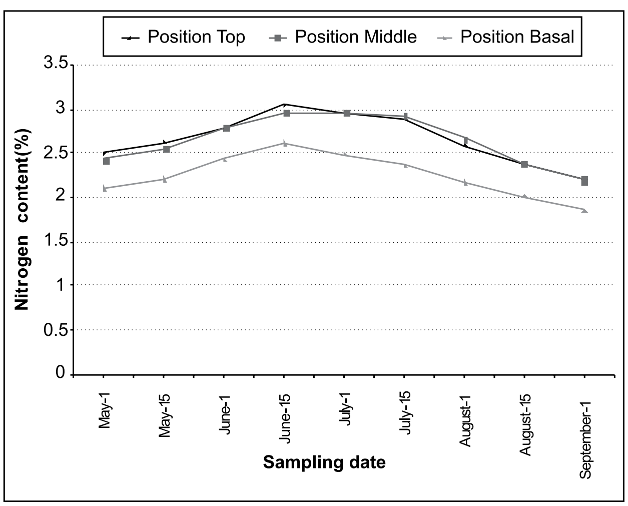

Fig. 1. Nitrogen content of plum leaves as influenced by position of leaf on shoot and time of sampling (% dry weight).

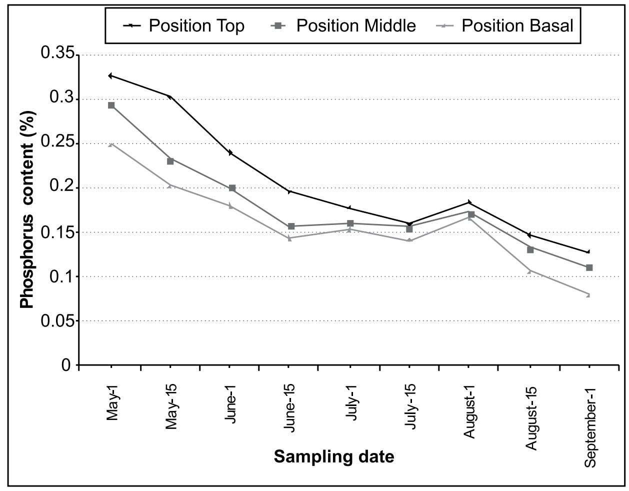

Fig. 2. Phosphorus content of plum leaves as influenced by position of leaf on shoot and time of sampling (% dry weight).

P content of middle leaves exhibited a significant decrease from May 1 to June 15, followed by nutrient stability period till July 15. Between July 15 to August 1, a significant increase in P content of middle leaves was observed. Thereafter, P content again decreased with advancement of sampling season. Mean P content was recorded highest in top portion leaves followed by middle leaves and lowest in basal leaves. The present investigation lends credence to the earlier observations made by Guleryuz *et al*. (4).

K content of top and basal leaves followed increasing trend upto July 15 (Fig. 3). After July 15, a significant decrease was observed in top and basal leaves with no period of stability. Although middle leaves followed similar trend as that of top and basal leaves but nutrient stability period was observed in case of middle leaves between June 1 to July 15. Mean K concentration showed significant increase from basal to top portion leaves since K is mobile in nature and gets accumulated in top portion leaves more than middle and basal leaves. The results are in conformity with the findings of Guleryuz *et al*. (4).

Mean Ca content showed an increasing trend in top, middle and basal leaves during the sampling season (Fig. 4). No period of stability was observed in top and basal leaves but in middle leaves, period of least variation was observed between June 15 to August 1. Mean Ca content was recorded highest in basal leaves followed by middle and top portion leaves. Increase in Ca content with leaf position basipetally may be associated with the deposition of Ca as Ca-pectate in middle lamella with ageing of leaf. The present findings are in congruence with the observations of Malik and Ahmad (7).

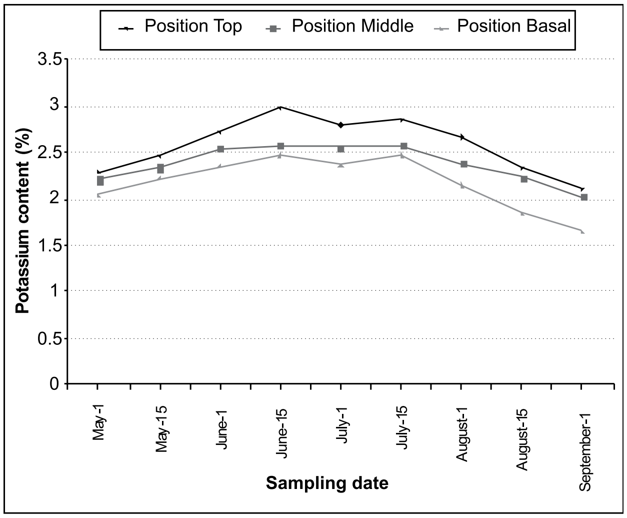

Fig. 3. Potassium content of plum leaves as influenced by position of leaf on shoot and time of sampling (% dry weight).

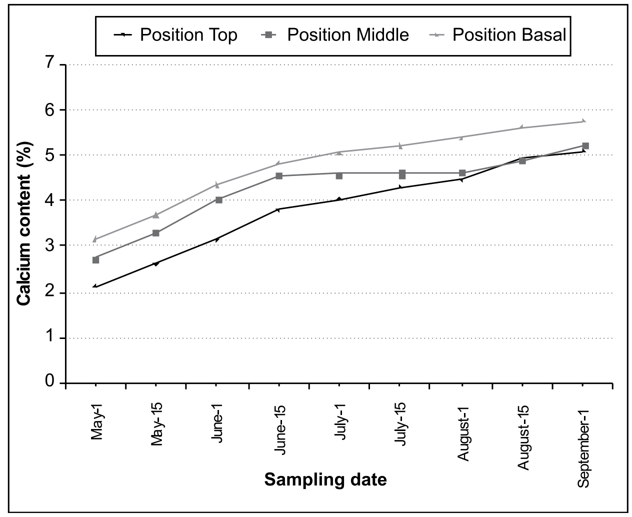

Fig. 4. Calcium content of plum leaves as influenced by position of leaf on shoot and time of sampling (% dry weight).

Magnesium content of top and basal leaves increased significantly from May 1 to June 1 (Fig. 5). Between June 1 to July 1, Mg content decreased significantly. Thereafter, Mg content again increased significantly upto August 15. After August 15, a significant decrease in Mg content of top and basal leaves occurred. No period of stability was observed in Mg content in top and basal leaves. Mg content of middle leaves followed a similar trend as that of top and basal leaves but a period of stability was observed in middle leaves during May 1 to May 15 and June 1 to June 15. The highest content was found in basal leaves followed by middle leaves and lowest in top leaves of shoot. The above findings are in the line with those of Guleryuz *et al*. (4).

Fe content of leaf samples did not show a consistent trend during the sampling period (Fig. 6). In top portion leaves, Fe content increased from May 1 to May 15, declined slightly but significantly on

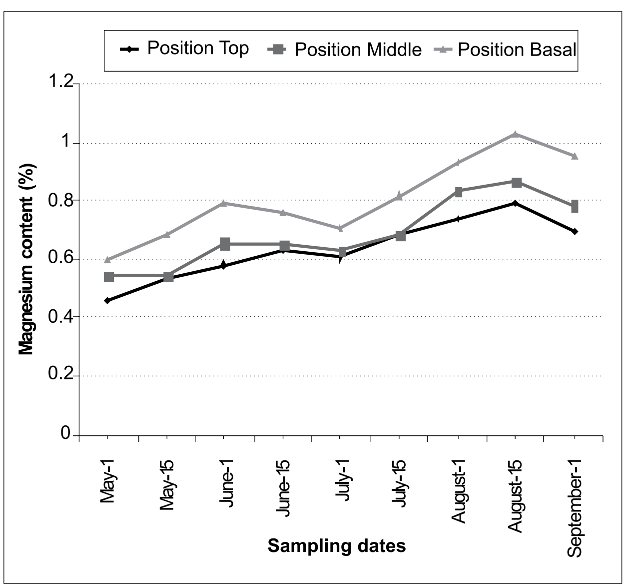

Fig. 5. Magnesium content of plum leaves as influenced by position of leaf on shoot and time of sampling (% dry weight).

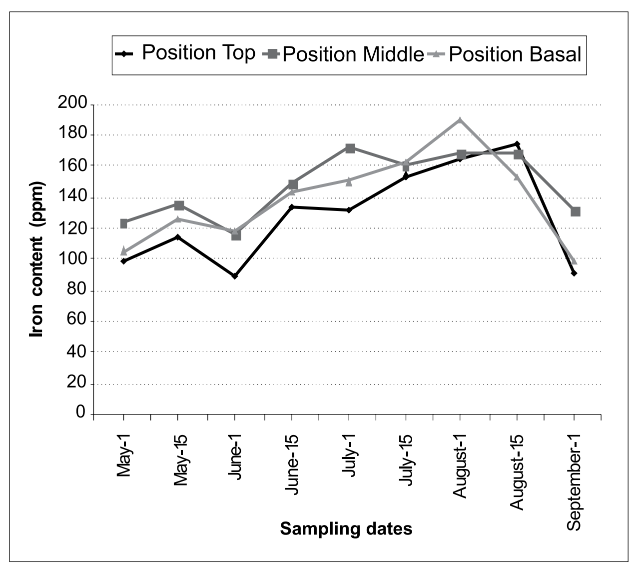

Fig. 6. Iron content of plum leaves as influenced by position of leaf on shoot and time of sampling (ppm dry weight).

June 1. Thereafter, it increased till August and from August 15 to September 1 decreased significantly. Almost similar trend was observed in basal leaves. However, period of least variation was not observed in top and basal leaves. In middle leaves, an almost similar trend was observed as in top and basal leaves but during August 1 to August 15, statistically non-significant variation was observed in middle leaves. Middle leaves showed significantly higher value for leaf Fe than top and basal leaves. This pattern may be due to their partial or incomplete mobility of Fe in plant system. The present findings are in line with those of Smith and Taylor (13).

Zinc content of top and basal leaves were recorded highest on May 1, reached a minimum value on August 1. No period of stability was observed in zinc content in top and basal portion leaves of current season's growth (Fig. 7). Zn content of middle leaves followed a continuous decreasing trend from first sampling date to last sampling date. However, decrease in Zn content of middle leaves during July 1 to July 15 was non-significant. Mean Zn content was highest in top shoot leaves followed by middle leaves and lowest in basal leaves. Decrease in Zn content basipetally may be due to reason that young leaves and regions where xylem is differentiating actively have higher auxin level and it decreases with age. The present findings are in congruence with those of Neilson (9), and Sharma *et al*. (11).

The foliage Cu levels did not show a consistent trend during the sampling season (Fig. 8). Cu content

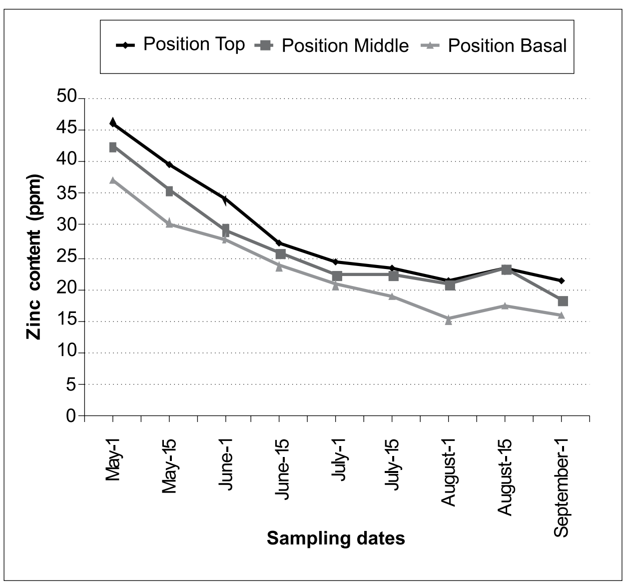

Fig. 7. Zinc content of plum leaves as influenced by position of leaf on shoot and time of sampling (ppm dry weight).

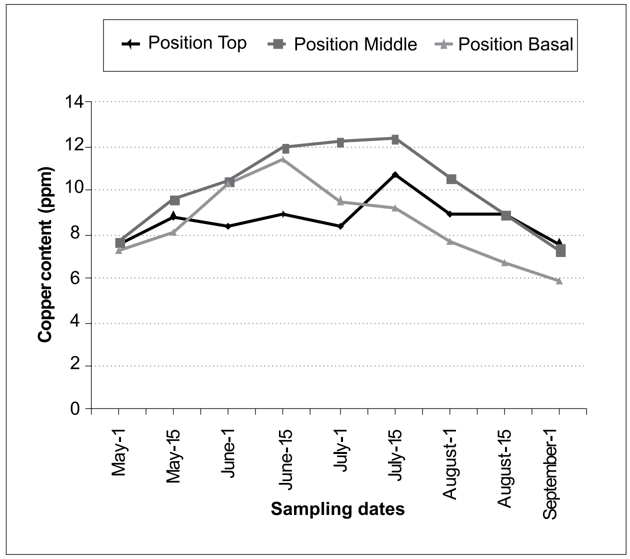

Fig. 8. Copper content of plum leaves as influenced by position of leaf on shoot and time of sampling (ppm dry weight).

of top portion leaves changed significantly during May 1 to July 15. Thereafter, it started declining; however, decrease in Cu content during August 1 to August 15 was not significant. Copper content of middle leaves showed increasing trend from May 1 to July 15 and thereafter, decreased with the advancement of growing season. In case of basal leaves Cu content increased significantly from May 1 to June 15 and thereafter, declined significantly to its lowest value on September 1. Mean Cu content was recorded highest in middle leaves followed by top portion leaves and lowest in basal leaves. The differences between mean values of Cu content in basal and top portion leaves were non significant. The trend observed in present investigation may be due to partial mobility of Cu in the plant system. The present findings lend credence to the observation made by Sharma *et al*. (11), and Malik and Ahmad (7).

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