Journal of Pharmacognosy and Phytochemistry
Available online at www.phytojournal.com

**E-ISSN:** 2278-4136
**P-ISSN:** 2349-8234
JPP 2018; 7(4): 3185-3188
Received: 01-05-2018
Accepted: 05-06-2018

**A Raouf Malik**
Assistant Professor, Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, Shalimar, Srinagar, Jammu and Kashmir, India

**M Feza Ahmad**
Professor, Bihar Agricultural University Sobour Baghalpur, Bihar, India

**RHS Raja**
Ph.D. Scholar Division of Fruit Science SKUAST-K, Jammu and Kashmir, India

**Shabir A bangroo**
Assistant Professor, Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, Shalimar, Srinagar, Jammu and Kashmir, India

**Shoaib Kirmani**
T6 Central Institute of Temperate Horticulture Srinagar Jammu and Kashmir, India

**Rafiya Mushtaq**
Ph.D. Scholar Division of Fruit Science SKUAST-K, Jammu and Kashmir, India

**Correspondence**
**A Raouf Malik**
Assistant Professor, Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, Shalimar, Srinagar, Jammu and Kashmir, India

# Seasonality of nutrients in the leaves of apple trees cultivars Red Delicious and Benoni

**A Raouf Malik, M Feza Ahmad, RHS Raja, Shabir A Bangroo, Shoaib Kirmani and Rafiya Mushtaq**

**Abstract**
The nutrient accumulation or depletion curves are good indicators of plant nutrients demand for each developmental stage. They are also useful tool to evaluate orchard nutritional status and to estimate the amount of soil nutrient removal. This investigation aimed at evaluating the seasonality of macro-nutrients contents of apple trees during the agriculture year 2007. Therefore, leaf samples from the apple trees cultivar Red Delicious and Benoni were collected at fortnightly intervals form 1st may to 1st October and evaluated for macronutrients (N, P, K, Ca, and Mg). Red Delicious had higher foliar concentration of N, Ca and Mg and lower levels of P and K than Benoni leaves. In General concentration of N, P, K decreased and those of ca and Mg increased from first to last sampling in both the cultivars of apple. The distinct period of stability for N, and P and K contents occurred from July15- August 15 and July 1 to august 1 respectively. However, Ca content of leaves showed least variation from July 1 to august 15 while stability period for leaf Mg was recorded from June 15-july 15. Thus proper diagnosis of macro nutrients apple leaves should be sampled in the, month of July or in the first fortnight of august.

**Keywords:** apple, leaf, sampling, dates

## 1. Introduction
Nutrients are essential for the productivity and quality of different fruits. Hence, the determination of nutritional needs for efficient production of high quality fruits is an important aspect of nutritional management for the orchardists. Leaf is the principle site of metabolism and the optimum concentration of nutrients in the leaf at specific growth stage have positive relationship between the leaf nutrient content and yield. Foliar analysis has come into widespread use in helping to guide soil fertility and management practices in fruit crops.

## 2. Materials and Methods
### 2.1 Experimental site
Our studies were conducted st the experimental orchard of the Division of Pomology SKUAST-K Shalimar Srinagar. The experimental site is located at an elevation of 1570 m a.s.l. and lies in temperate zone of J&K. (India).

### 2.2 Experimental details
The studies were conducted on two varieties of apple viz Red Delicious and Benoni. Four healthy trees of each cultivar were selected which were of uniform age and vigor, and uniform cultural practices were given to whole orchard. Leaves were collected at 15-days interval (1st and 15th of each month form may 1 to October-1. Fifty leaves along with petiole were collected from middle portion of current seasoned growth from all the compass sides of the trees in paper bags.
The collected leaves were brought to laboratory in same day in ice boxes to prevent enzymatic degradation and were thoroughly washed first with tap water then dipped in 0.1N HCl, distilled water and finally in double distilled water. The samples after air drying were oven dried at $68^0$ c till constant weight and ground in steel Wiley mill.

### 2.3 Analysis of nutrients
Nitrogen was determined by micro kjeldhal method. One gram of processed sample was taken in the digestion tube along with digestion mixture containing 10:1: 0.5 $K2SO_4$: $CuSO_4$: $FeSO_4$. The 10ml of concentrated $H_2SO_4$ was added and tube was kept in the digestion block at $390^0$C for saturation. After digestion saturation extract was made to cool and proper distillation was carried out.
For the analysis of P, K, Ca and Mg and micronutrients, 0.5gm of powdered leaf sample was

taken in 100ml flask and was digested in di-acid mixture of nitric acid and perchloric acid in 9:4 ratio. The flask was placed in hot plate at 115-118$^0$ c for digestion. The digested sample was filtered and was diluted with double distilled water to make a volume of 50ml. The leaf P(%) was determined by using ammonium molybedate: ammonium vanadate (Chapman and Pratt, 1961). The colour intensity was measured at 440 nm spectrophotometer. While as K(%) and Ca(%) were determined with flame photometer technology (Jackson, 1967) while Mg(%) was determined by using Atomic Absorption Spectro-photophotometer. However boron was analysed through spectrophotometer.

### 2.3 Statistical analysis
The statistical method by Gomez and (1983) were followed to analyze and interpret the data. The experimental design was RBD factorial and the test of significance was made with 5% level of significance.

## 3. Results and Discussion
### 3.1 Average leaf macro –nutrient contents in two varieties
The cultivars i.e. Red Delicious and Benoni significantly affected the concentration of macro nutrients in the leaves except potassium concentration which remained unaffected by the effect of cultivar. N, Ca and Mg content in Red Delicious leaves was recorded to be 1.64%,1.487%,0.564% a compare to 1.42%,1.44%.0and 0.369*% in Benoni leaves respectively. The variation in macro and micro nutrient content in two cultivars of apple may primarily be attributed to the genotypic effect as nutrient status of leaves varies due to several factors e.g. growth flushes [1]. Verma and Bhandari [2] also recorded different nutrient concentration in different cultivars of apple.

### 3.2 Seasonal variation of nutrients
#### 3.2.1 Primary nutrients (N, P, K)
The sampling date's significantly affected the leaf nitrogen concentration in apple leaves irrespective of the cultivar. Nitrogen content of leaves followed definite trend. During initial growth period, the leaf nitrogen content increased from May-1 to May-15 (Fig-1), then decreased on June 1 and again increased till July 1. Towards the end of the season it decreased to reach to its minimum value of 0.833% on October 1. The least variation period for leaf nitrogen content was recorded from July 15 to august 15. A similar trend was recorded for leaf phosphorus and leaf potassium content, which were higher in earlier sampling dates and decreased with the advancement of growing season. The stability period with respect to leaf phosphorus and potassium content was observed from July 1 to august 1. The leaf phosphorus content varied from 0.24% to 0.136% during the study period (Fig-2). While as potassium content varied from 0.272% to 0.393 % during the sampling period (Fig-3). May 15 recorded highest leaf nitrogen concentration however; phosphorus and potassium were observed highest on June 15.

The interaction between the primary nutrients and the cultivars was significant. A non significant increase in leaf nitrogen content of Benoni leaves was recorded from July 15 to August 15 however a more stable period was recorded from July 15 to August 1. Red Delicious leaves also showed a least variation period of July 15 to august 15 for leaf nitrogen concentration. The leaf nitrogen content of Benoni leaves varied from 0.486% to 1.952% while in Red Delicious leaves, it varied form 1.25% to 2.142% (Fig-1). The phosphorus content of Benoni as well Red Delicious leaves stabilized from June 15 to august 1 and varied from 0.124 % to 0.170 % and 0.104% to 0.270% during the entire sampling period in Benoni and Red Delicious leaves respectively. Where as July 1 to august 1 and July 1 to august 15 was recorded to be the least variation period for potassium content in Benoni and Red Delicious respectively.

In general leaf nitrogen, phosphorus and potassium content decreased along the apple tree vegetative cycle (Fig-1, Fig-2, Fig-3). Which may be probably due to dilution effect with leaf growth [3] and can also be attributed to the nutrient redistribution to other plant organs until the end of the cycle [4] Higher levels of nitrogen phosphorus and potassium on the earlier sampling dates may be due to mobilization of these nutrients from reserve source in plant taken up through the roots [5] rather than from recent absorption [6]. Deciduous fruit and nut trees exhibit annual patterns of nutrient recycling with the perennial tyissues, as well as mechanisms for recycling nutrients from their annual organs [7]. Cheng and Fuchigami [8] in apple reported a linear relationship between nitrogen accumulated in the tree during previous season and amount of reserve nitrogen mobilized for new growth. Furthermore, the decreasing trend of nitrogen at the end of the growing season may be due to remobilization of primary nutrients in the plant prior to leaf fall [9]. Similar results were reported by Ragini *et al.,* (2015) [3] in litchi and Kumbargire *et al.,* (2016) [4] in banana.

The least variation period observed in the middle leaves of the current seasoned growth of apple trees from July 15 to august 15 for nitrogen and July 1 to august 1 for phosphorus and potassium might be attributed to least requirement of these nutrients during this period and minimum changes in fully developed leaves. Boyonton *et al*., [10] observed that nutrient content of apple leaves follows stability from June to august.

#### 3.2.2 Secondary nutrients (Ca and Mg)
The calcium and magnesium content of apple leaves were also significantly affected by leaf sampling dates (Fig-4 and Fig-5) and followed an increasing trend throughout the sampling period. The stability period with respect to calcium content was recorded from July 1 –august 15 while magnesium content stabilized from June 15 to July 15.the interaction effect of calcium, magnesium and cultivars was also significant. Both Benoni and Red Delicious showed an increasing trend from may 1 to October 1 for calcium and magnesium content of leaves. The leaf calcium varied from 0.587% (may1) to 2.112% (October 1) in Benoni leaves and in Red Delicious leaves, it varied from 0.637% May 1) to2.362% (October 1) and a stability period of July 15 to august 15 was found in both cultivars of apple. For magnesium content, a variation in concentration was recorded from 0.420% to 0.624% in Red Delicious leaves form may 1 to September 15 and May 1 to October 1 respectively ( Fig-4)

The secondary nutrients i.e. calcium and magnesium were observed lower during first sampling date i.e. on May1 and increased with increasing leaf age recording maximum levels on October 1 in calcium and on September 15 in case of magnesium. The increasing trend of calcium and magnesium might be attributed to limited mobility of the elements in the phloem [3]. Shear and Faust [11] attributed the increasing trend of Calcium to the deposition of calcium as calcium pectate in middle lamella and replacement of starch deposits by calcium oxalate crystals which help in sequestering calcium in the leaves otherwise it would have been available to the fruit as there is high leaf to fruit competition for calcium ion. The increase in magnesium content may also be attributed to decrease in potassium content of leaves as these ions are

strong antagonists and situation of ionic balance is created, thus the cat ion magnesium accumulated at the expense of potassium decrease [12]. Decrease in magnesium content during October may be due to lower soil temperature which alters root activity and in turn affect cat ion absorption [13]. The nutrient stability period during july-1 to july-15 and June 15 to august 15 were recorded for calcium and magnesium content in leaves of apple trees respectively.

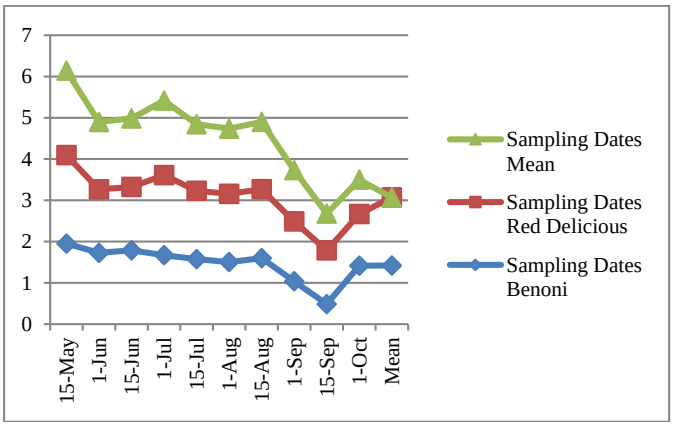


**Fig 1:** Periodical variation of N concentration (%) in apple leaves

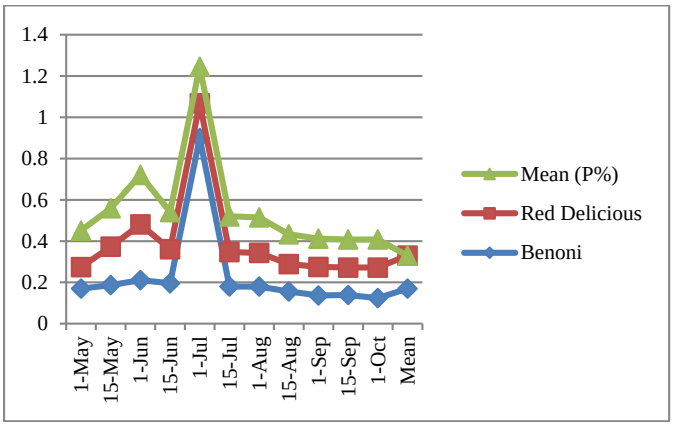


**Fig 2:** Periodical variation of P concentration (%) in apple leaves

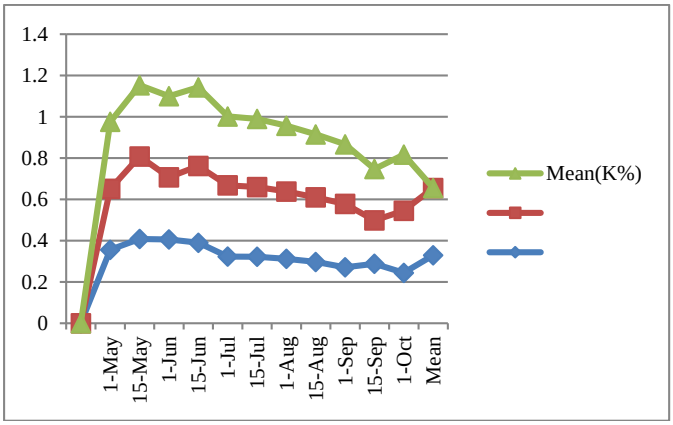


**Fig 3:** Periodical variation of Potassium concentration (%) in apple leaves

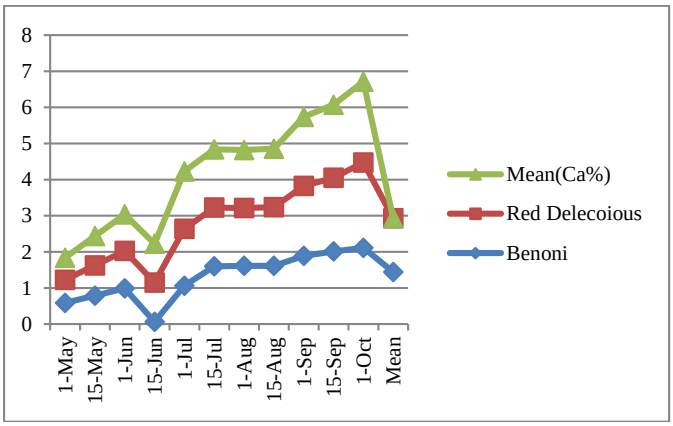


**Fig 4:** Periodical variation of Ca concentration (%) in apple leaves

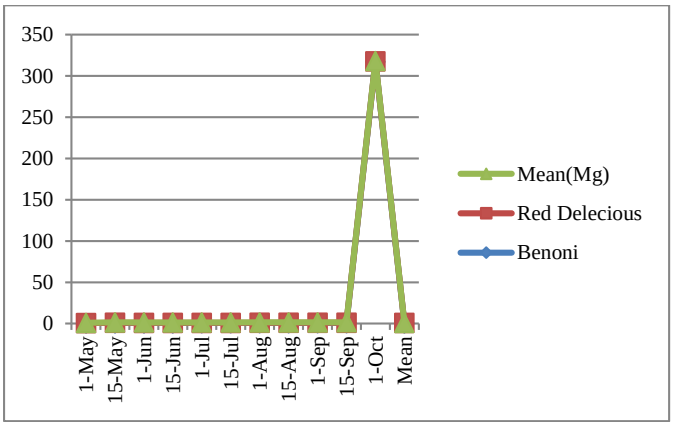


**Fig 5:** Periodical variation of Mg concentration (%) in apple leaves

## 4. Conclusion

Our studies indicated that leaves should be sampled in the month of July or in the first fortnight of August for proper diagnosis of macro and micronutrients in the apple trees. However for accurate diagnosis of phosphorus and potassium, in both the cultivars and for magnesium in Benoni leaves should not be sampled after July.

## 5. References

1. Robinson AD. Principles and approaches used in plant analysis. Proceedings of National Workshop Plant Analysis Report. 1981, 34-37.
2. Verma KS, Bhandari AR. Standardisation of leaf sampling techniques for macro-nutrients elements in temperate peaches. Indian Journal of Horticulture. 1990; 47(2):140-153.
3. Ragini K, Prabhakar M, Kumari N, Rajeev K, Rajendra PS. Temporal and axial variation for primary nutrient concentration in leaves of litchi. The Bioscan. 2015; 10(3):1145-1148.
4. Kumbargire GA, Swamy GSK, Kalatippi AS. Influence of diatomaceous earth as source of silicon on leaf nutrient status and yield attributing characters of banana cv. Grand Naine. The Bioscan. 2016; 11(1):435-438.
5. Smith PF. Mineral analysis of plant tissues. Annual Review of Plant Physiology. 1962; 13:81-108.

6. Cameron SH, Muller SH, Wallace A, Sartori E. Influence of age of leaf, season of growth and fruit production on the size and fruit production on the size and inorganic composition of Valencia orange leaves. Proceeding of American Society for Horticultural Science. 1952; 60:42-50.
7. Bollard EG. The use of trached sap in the study of apple tree nutrition. Journal of experimental Botany. 1953; 4:363-368.
8. Therios I, Taraksi C, Christaki S, Dimassi TK, Sfakiotakis E, Porlingisis J. Seasonal variation of mineral composition of kiwifruit (*Actinidia delicious*) in North Greece. Acta Horticulturae, 1997; 444:261-265.
9. Uriu K, Crane JC. Mineral element changes in pistachio leaves. J of Amer. Soc. For Hort. Sci. 1977; 102(2):155-158.
10. Cheng L, Fuchigami LH. Growth of young apple trees in relation to reserve nitrogen and carbohydrates. Tree Physiol. 2002; 18:1297-303.
11. Clark CJ, Smith GS. Seasonal changes in mineral nutrient content of persimmon leaves. Scientia Horticulture. 1990; 42:85-97.
12. Boyonton D, Cain JC, Geuwe JV. Incipient magnesium deficiency in some New York apple orchards. Proceedings of the American Society for Horticultural Sciences. 1943; 44:15-24.
13. Shear CB, Faust M. Nutritional ranges in deciduous tree fruits and nuts. Horticultural Reviews, 1980; 2:142-163.
14. Loue A. Maize nutrition: Cation requirement and potash demand. Potash Review. 1964; 9: 1-14.
15. Melich A, Reed JF. Characterisation of the plant factor in the cation requirement and contents on plants. Proceedings of Soil Science Society of America. 1948; 13:399-401.