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ORIGINAL ARTICLE

Standardization of Leaf Sampling Time for Sweet Cherry (*Prunus avium* L.) under Temperate Conditions of Kashmir

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ABSTRACT

Seasonal changes in nutrient concentrations of leaf in sweet cherry cv.'s Double (Bigarreau Nepolean) and Misri (Bigarreau Noir Grossa) were investigated. The leaf samples were collected from middle portion of current season's growth from 15th April to 15th August at an interval of 15 days. The leaf N and K contents increased from 15th April to 15th June and thereafter decreased irrespective of the cultivar; while as leaf P and Zn contents decreased throughout the sampling period. However leaf Ca, Mg, Fe and Mn contents increased throughout the sampling season. The leaf S and Cu contents fluctuated throughout the growing season and no definite trend was observed. The leaf samples recorded least variation from 1st June to 15th June for leaf N, P, K, Ca, Mg, Fe, and Zn contents when the leaves were (8.71) to (10.85) weeks old, whereas the time for leaf S, Mn and Cu contents was noticed from 15th June to 1st July, when the leaves were (10.86) to (13.0) weeks old.

Keywords*: Sweet cherry, leaf samples, sampling time, nutrient content*

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INTRODUCTION

Sweet cherry (*Prunus avium* L.) is one of the important stone fruit crop cultivated throughout the temperate regions of world. Sweet cherry belongs to family Rosaceae of genus Prunus. The leading sweet cherry producing countries are USSR, USA, West Germany, Italy, France, Turkey. The total production of sweet cherry in world is about 1872.00 thousand tons. Sweet cherry is distributed worldwide between 35° N and 55° S latitudes which is favourable for its cultivation[1].

Leaf analysis is used to determine the nutrient content in the sample with a view to utilize the data to improve fertilizer use efficiency. The potential role of leaf analysis in fertilizer use includes evaluation of the rates of nutrient inputs needed, checking on nutrient deficiencies and to determine whether the fertilizers applied are utilized by the plants. Therefore, leaf analysis indicates the nutritional status of the crop at the time of sampling. Leaf analysis is the better guide to assess the tree nutrient status than soil analysis, because it predicts about the uptake of nutrients from the soil. Therefore, leaf analysis approach has been proved to be best approach for formation of proper fertilizer schedule [2]. For the correct interpretation, it is essential that sampling is done at prescribed morphological stage of growth and from the correct plant part [3]. As the nutrient status varies in leaf due to several factors like leaf age, its position on shoot, growth flushes, bearing and non-bearing position of the tree, therefore, it is essential to standardize the leaf sampling techniques in fruit crops [4]. Leaf analysis is by for the established method to diagnose true nutritional status and represent an important tool to determine future fertilization [5]. Wide fluctuations in nutrient concentration occurs in tissues during different growth periods, however most suitable leaf position and sampling time are those which give rise to least variation in its mineral concentration [6]. Among various plant parts, leaf was found to be the best part for diagnosis of nutrient status of the plants [7]. Therefore the present was conducted to standardize the leaf sampling time for sweet cherry under temperate conditions of Kashmir.

MATERIALS AND METHODS

The experiment was carried out in the experimental orchard of Division of Fruit Science, Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, Shalimar, Srinagar (J&K). The experimental orchard is located at 34°.75' N latitude and 74°.50' E longitude at an elevation of 1650 meters above sea level. The soil of the experimental orchard is sandy clay loam in texture with pH value of 6.5. The experimental orchard is well drained with mild slope and lies in the temperate zone of Jammu & Kashmir State with mild summers and very cold winters extending from December to March and received an annual rainfall of 776.6 mm. The average maximum monthly temperature ranged from 9.18 to 31.0 °C and average minimum monthly temperature ranged from -4.65 to 17.64 °C.

Collection and preparation of leaf samples

The leaves along with petiole were collected from middle portion of current season's growth from selected trees starting from 15thApril to 15thAugust at 15 days interval from Double and Misri cultivars of sweet cherry as per procedure devised by [8]. The field experiment was carried on 24 selected sweet cherry trees of each cultivar of uniform age, size and vigour divided in 3 blocks of 8 plants each. Leaf samples consisting of 60-80 median matured leaves of current season's growth were taken starting from 15 days after full bloom. The leaves were collected in perforated paper bags and brought directly to the laboratory. The leaf samples were thoroughly washed first with tap water, then by 0.2% liquid detergent. Again washed by 0.1 N HCl and then with distilled water. The washed samples were spread on folds of filter paper for air drying in shade and followed by oven drying at 55±5 °C. The dried leaf samples were ground in stainless steel blade blender and sieved through 1mm sieve and packed in butter paper bags for chemical analysis.

Methods of analysis of leaf samples

The digestion of the leaf samples for the estimation of nitrogen was carried out in concentrated H_2SO_4 (AR grade) by adding digestion mixture prepared by mixing K_2SO_4:$FeSO_4$. $7H_2O$: $CuSO_4.5H_2O$ in the ratio of 10:1:0.5. For the estimation of leaf P, K, Ca, Mg, S, Cu, Fe, Mn and Zn, the leaf samples were digested in 4:1 nitric acid: perchloric acid mixture. Total N content was determined by Micro-Kjeldahl's Method as out-lined by [9] and results were expressed in percentage on dry weight basis. Total P was determined by using ammonium molybdate- ammonium vandate method. The colour intensity was measured at 420 nm using spectrophotometer as given by [9] . Total K in the extract was determined on the flame photometer as outlined by [9]. Calcium & Magnesium were determined in the extract by versenate titration method described by [9]. Total S in the extract was determined by turbiditimetric method out lined by [9] . Micronutrient cations viz. Cu, Fe, Mn and Zn in the extract were determined on atomic absorption spectrophotometer and results were expressed in parts per million (ppm) on dry weight basis.

Treatments

The experimental design was completely randomized block design (CRBD) and treatments consisted of age of leaf (i.e., 5 months of sampling from April 15th to August 15th). Each treatment comprised of 8 plants and was replicated thrice. The results were tested at 5 per cent level of significance.

RESULT AND DISCUSSION

Macronutrients

Nitrogen

The leaf N content in Double cv. of sweet cherry varied from 1.65 to 2.21% with grand mean of 1.89% during the investigation. It is evident from the data presented in Fig. 1 that mean leaf N content increased from 15th April (1.67%) to 15th June (2.21%) and then decreased non-significantly towards the end of sampling. Similarly in Misri cv. of sweet cherry. the leaf N content followed the same trend at different sampling dates and the leaf N content varied from 1.26 to 1.94 %with grand mean of 1.60%. Maximum value was recorded on 15thJune and from 15thJune onwards, it decreased non-significantly towards the end of leaf sampling date. The increase in leaf N content may be as a result of current absorption and remobilization of accumulated N of previous season. Least variation period in the leaves might be due to least requirement of N by the growing fruits during this period and minimum changes in fully developed leaves. In apple a linear relationship between N accumulated in the tree during previous season and amount of reserve N remobilized for new shoot and leaf growth was observed by [10]. The decreasing trend of leaf N content after 15th June is associated with the growth dilution effect [11] and also may be due to utilization of N by various sinks at various stages of growth and development [12] . The results obtained in present investigation are in accordance with the [13] in sweet cherry who reported that the June to July period is the most suitable for leaf sampling, while as [14] have reported that July to August is suitable period for leaf sampling for sweet cherry. However, the period of sampling is not fixed and may vary under different growing conditions depending on the agro-climatic factors prevailing in the area

[15]. [16] in sweet cherry, cv. "St. Margaret", Sanchez-Alonso [17] in peach and [18] in sweet cherry cv. Stella have also reported that the leaf N content decreased with the advancement of the growing season.

Phosphorous

The leaf P content in Double cv. of sweet cherry ranged from 0.073 to 0.386 % with grand mean of 0.200 % during the study period. The mean leaf P content showed a significant decrease from 15th April to 15th July and again decreased non-significantly towards the end of leaf sampling. The maximum value of mean leaf P (0.386%) was recorded on first leaf sampling date i.e.15th April. The mean minimum leaf P content (0.073%) was recorded on the last date of sampling i.e. 15th August as shown in Fig. 2. However in Misri cv. of sweet cherry, the leaf P content ranged from 0.080 to 0.360 with grand mean of 0.208 per cent. The mean maximum leaf P content (0.360%) was noticed on 15th April. The minimum mean leaf P content (0.080%) was observed towards the end of leaf sampling i.e. on 15th August. Therefore leaf P content in both the cultivars of sweet cherry followed a decreasing trend with the advancement of leaf age. The highest foliar P content in the earlier sampling date might have been due to the reserve sources in plant stored from previous year and not from current uptake. The decline in foliar P content is probably due to the dilution effect of growth as being a highly mobile nutrient in plant systems. The P is also required by the fruits in greater quantities which may act as sinks to it, which result in decline of leaf P content during the rest leaf sampling dates. The least variation period for leaf P content in cv. Double of sweet cherry was observed from 1st June to 15thJune. The present findings are quite consistent with the earlier works of [19] in peach .

Potassium (K)

The study revealed that in Double cv. of sweet cherry, the leaf K content increased from first date of leaf sampling i.e. 15th April and attains a maximum value on 15th June which afterwards decreased further till last sampling date (15thAugust) as given in Fig. 3. The least variation period was recorded from 1st June to 15th June. The leaf K content in Misri cv. of sweet cherry also followed the same trend. The leaf K content varied from 1.21 to 1.90 with grand mean of 1.60% in Double cv. of sweet cherry. On the other hand in Misri cv. of sweet cherry, the K content in foliage varied from 1.16 to 1.93 % with grand mean of 1.58 per cent. The increase in leaf K content on earlier samplings may be due to mobilization from reserve sources in plants and not from current absorption, because higher accumulation of K occurred immediately after bud break. The decrease in leaf K content may be due to the dilution effects of the growth [20], and [21] in sweet cherry in sweet cherry.

Sulphur

In Double cv. of sweet cherry the leaf S content varied from 0.166 to 0.390 % with grand mean of 0.244% during the study period. A perusal of the data on seasonal variation revealed that leaf S content does not followed any definite trend and fluctuated throughout the leaf sampling season. The foliar S content decreased non-significantly. The mean maximum S content was noticed on 15th April (0.390%) and mean minimum S concentration was observed on 15th August (0.166%). Similarly in the Misri cv. of sweet cherry the leaf S concentration also showed same trend along with different leaf sampling dates but significant decrease was recorded. The leaf S content varied from 0.113 to 0.376% with grand mean of 0.227% as presented in Fig. 4. However the least variation in leaf S content was observed from15th June to 1st July in both the cultivars of sweet cherry. The decrease in amount of leaf S content as the leaf approaches senescence is attributed to the fact that this element is readily translocated back in to the woody tissues, with the exception of Ca and Mg, which are not translocated back readily. The above results are in accordance with the earlier observations of [22] for sweet cherry cv. Nepolean, who reported that leaf S contents fluctuated throughout the vegetative cycle.

Calcium

The leaf Ca content in sweet cherry cv. Double varied from 1.54 to 3.19 % with grand mean of 2.24 % during the study period. The data on foliar sampling revealed that the leaf Ca content registered a continuous accumulation throughout the leaf sampling season. Leaf Ca concentration was lowest on first leaf sampling date i.e. 15th April (1.54%) and reached to its maximum value towards the end of sampling i.e. 15thAugust (3.19%). The increase in leaf Ca concentration was continuous and significant and least variation in leaf mineral content was observed from 1stJune to 15thJune. Similarly in Misri cv. of sweet cherry the leaf Ca content varied from 1.40 to 2.62 % with grand mean of 1.97 % during the investigation as shown in Fig. 5. Leaf Ca content showed continuous and significant increase throughout the sampling season. Its concentration increased from first sampling date i.e. 15th April (1.40%) to last leaf sampling i.e. 15th August with leaf Ca content of 2.62 per cent. The gradual increase in leaf Ca content with increase in leaf age might be due to low mobility of Ca in phloem [23].

Magnesium

The leaf Mg content of sweet cherry cv. Double varied from 0.38 to 1.31% with grand mean of 0.88 %. The mean leaf Mg content increased gradually with advancement of leaf age as given in Fig. 6. Similarly in Misri cv. of sweet cherry, the leaf Mg content varied from 0.41 to 1.35% with grand mean of 0.87% and followed an increasing trend with increase in leaf age. The leaf Mg concentration was lowest on first leaf sampling date i.e. 15thApril (0.41%) which increased continuously till last leaf sampling date on 15th August (1.35%) in Misri cv. of sweet cherry. The statistically suitable period for leaf sampling for both cultivars of sweet cherry was identified from 1st June to 15th June, because least variation in leaf Mg content was recorded between this period. The increase in leaf Mg content might be due to the relatively low mobility of Mg in phloem and may be due to low demand by fruits [10].

Copper

The data pertaining to the mean leaf Cu contents in both cv's of sweet cherry fluctuated throughout the sampling season and does not followed any definite trend. The leaf Cu content in Double cv. of sweet cherry varied from 3.61 to 7.34 ppm with grand mean of 5.70 ppm. The mean maximum leaf Cu content was recorded on 15thApril and mean minimum leaf Cu content was observed on 15thAugust as presented in Fig. 7. Similarly the foliar Cu content in Misri cv. of sweet cherry ranged from 3.50 to 7.46 ppm with grand mean of 5.57 ppm. The mean maximum value of leaf Cu was observed (7.10 ppm) on 15thApril which fluctuated and also does not followed any specific trend and mean minimum leaf Cu content was noticed 3.50 ppm on last leaf sampling date i.e. 15th August. However the minimum variation in leaf Cu contents in both cultivars of sweet cherry was observed from 15th June to 1st July. The results obtained and the trend followed by the element may be due to partial mobility of Cu in plant system. The data obtained during the present study on sweet cherry cultivars Double and Misri are supported by the earlier findings of [22].

Iron

The leaf Fe content varied from 99.4 to 216.8 ppm with grand mean of 167.4 ppm and registered a continuous but non-significant increase in Fe content in leaf from first sampling date. i.e., 15thApril till last leaf sampling i.e., 15th August in Double cv. sweet cherry as shown in Fig. 8. Similarly in Misri cv. of sweet cherry which also exhibited a same trend in leaf Fe content and varied from 91.5 to 211.9 % with grand mean of 161.4 per cent. The minimum leaf Fe was recorded on 15thApril (91.5 ppm) which increased continuously and attained maximum value on 15thAugust (211.9 ppm). Mean leaf Fe content accumulated significantly throughout the study period and least variation in leaf Fe content was noticed on 1st June to 15th June for both cultivars of sweet cherry. The continuous increase in leaf Fe content might be due to low mobility, less demand of sinks and thereby retention in plant tissues. The present findings are in accordance with the findings of [22]**.**

Manganese

As evident from Fig. 9, the leaf Mn content followed an increasing trend throughout the growing period in both cultivars of sweet cherry. In Double cv. of sweet cherry the leaf Mn content varied from 21.80 ppm to 68.59 ppm with grand mean of 43.85 ppm. The leaf Mn content in Double cv. of sweet cherry was minimum (21.80 ppm) on first date of sampling i.e. 15th April and registered a maximum value of 68.59 ppm at the last sampling date i.e. 15thAugust. A similar trend was noticed in Misri cv. of sweet cherry in which leaf Mn content varied from 25.87 ppm to 62.86 ppm with grand mean of 42.88 ppm. The minimum value of leaf Mn was recorded on 15th April which later on increased continuously till 15th August with the advancement of leaf age. In both cv.'s of sweet cherry the leaf Mn increased non-significantly throughout the growing season and the perusal of data on seasonal variation of leaf Mn indicated that the least variation period was recorded from 15th June to 1st July.

The accumulation of Mn in leaves might be due to low mobility and less requirement by the fruits as compared to other elements. The present findings are justified by the early observations [15].

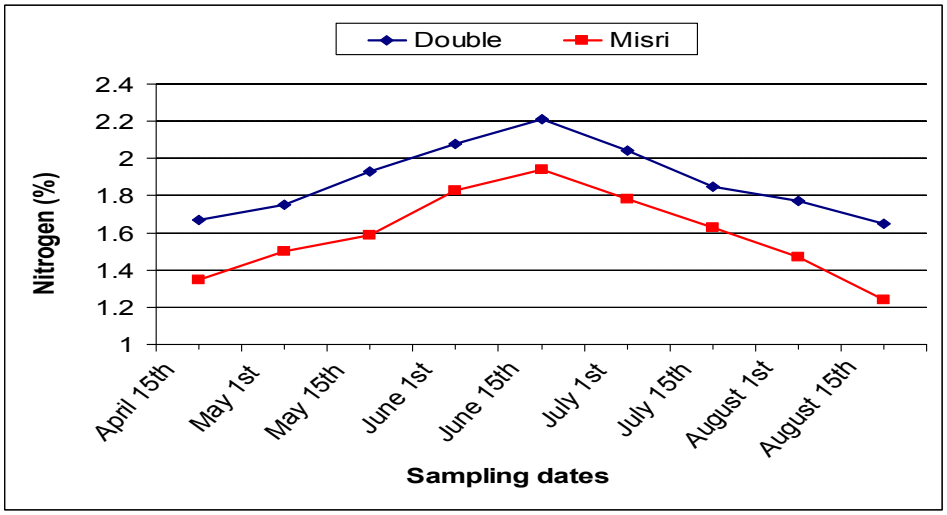

Fig. 1 : Leaf N content of sweet cherry leaves cv. Double and Misri as influenced by time of sampling (per cent dry weight)

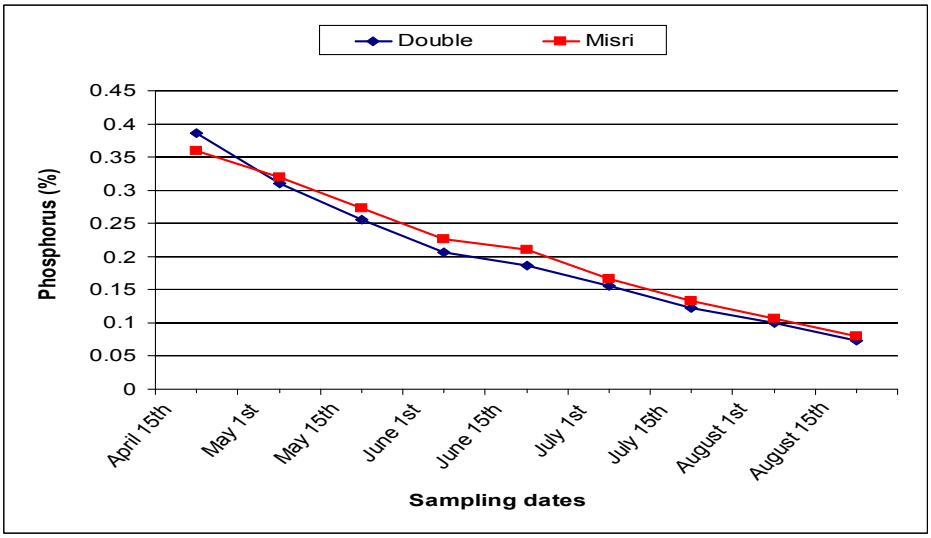

Fig. 2 : Leaf P content of sweet cherry leaves cv. Double and Misri as influenced by time of sampling (per cent dry weight)

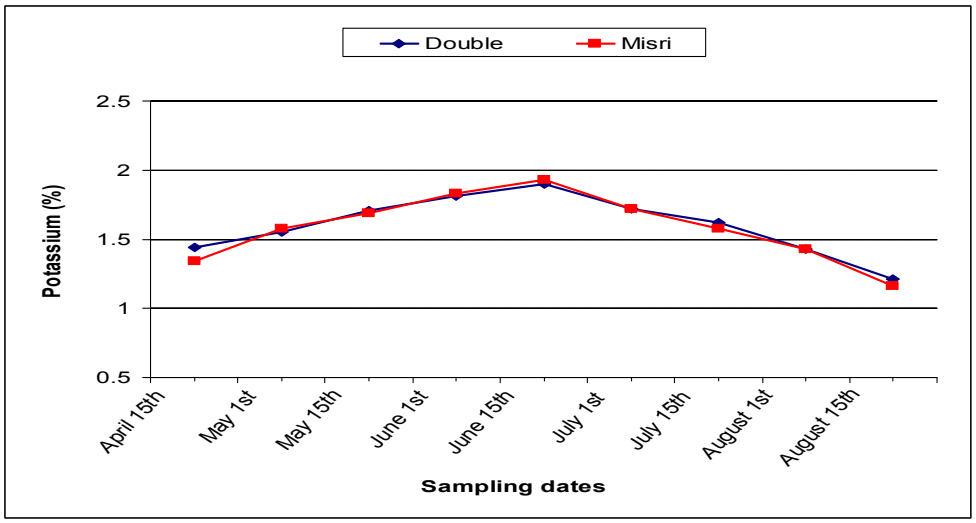

Fig. 3 : Leaf K content of sweet cherry leaves cv. Double and Misri as influenced by time of sampling (per cent dry weight)

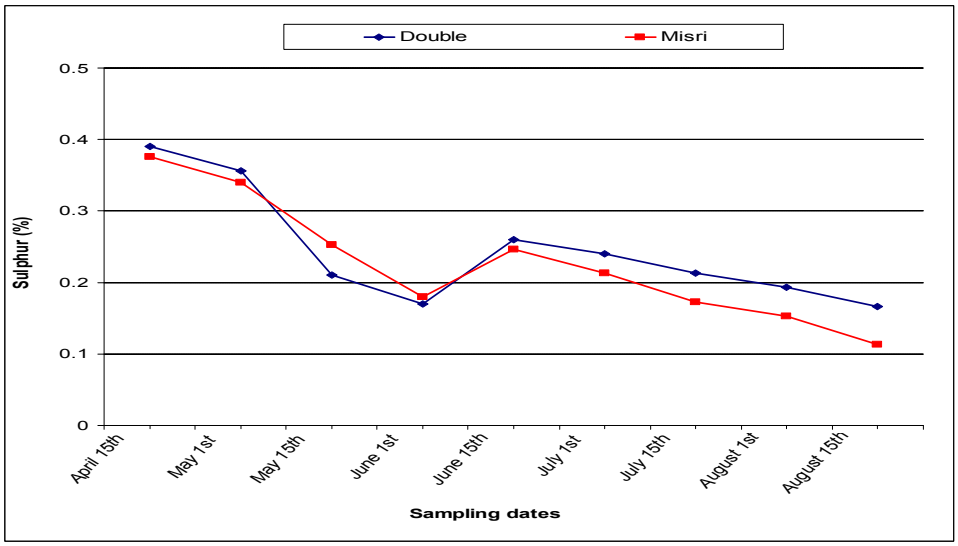

Fig. 4 : Leaf S content of sweet cherry leaves cv. Double and Misri as influenced by time of sampling (per cent dry weight)

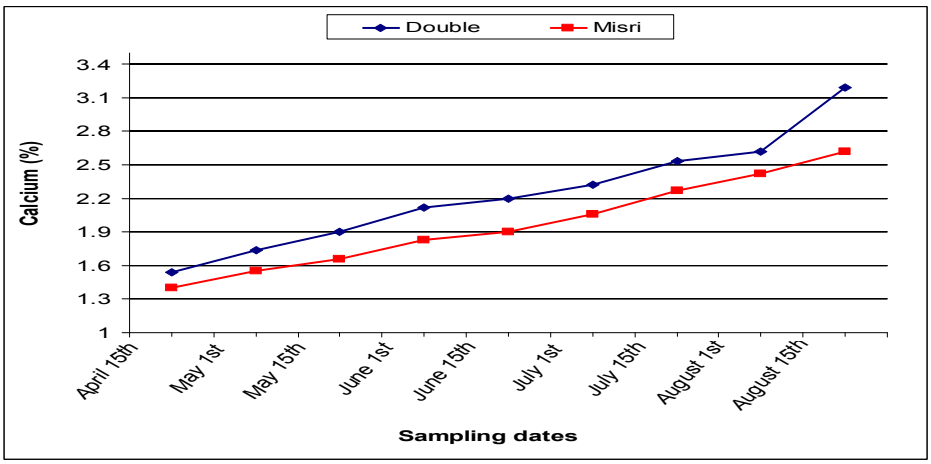

Fig. 5 : Leaf Ca content of sweet cherry leaves cv. Double and Misri as influenced by time of sampling (per cent dry weight)

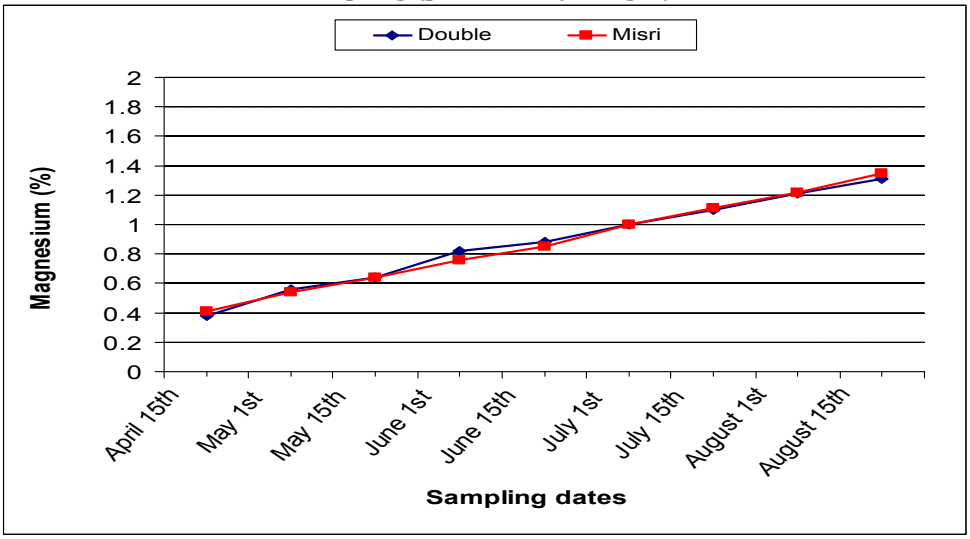

Fig. 6 : Leaf Mg content of sweet cherry leaves cv. Double and Misri as influenced by time of sampling (per cent dry weight)

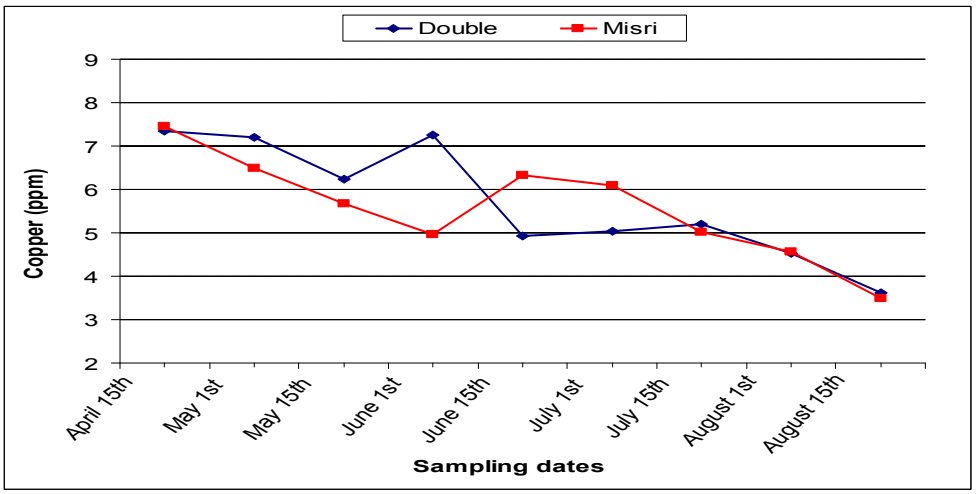

Fig. 7 : Leaf Cu content of sweet cherry leaves cv. Double and Misri as influenced by time of sampling (ppm dry weight)

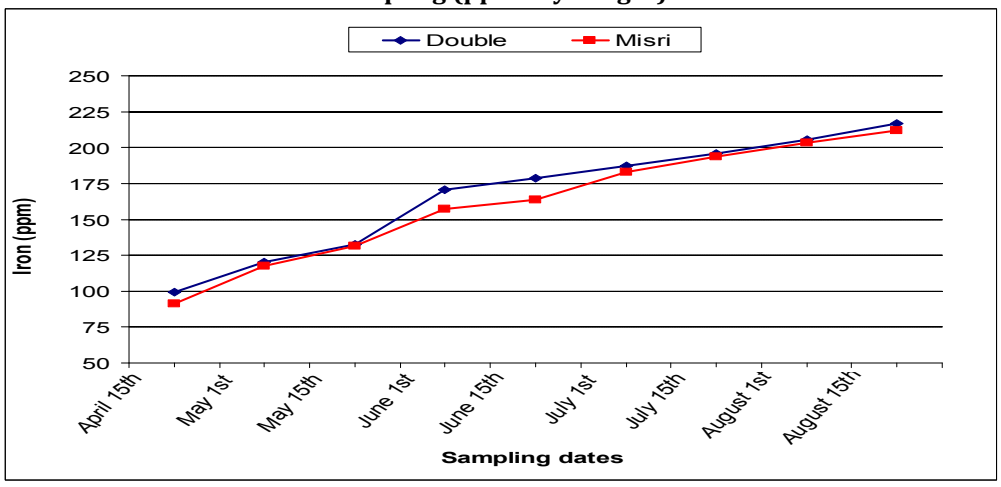

Fig. 8 : Leaf Fe content of sweet cherry leaves cv. Double and Misri as influenced by time of sampling (ppm dry weight)

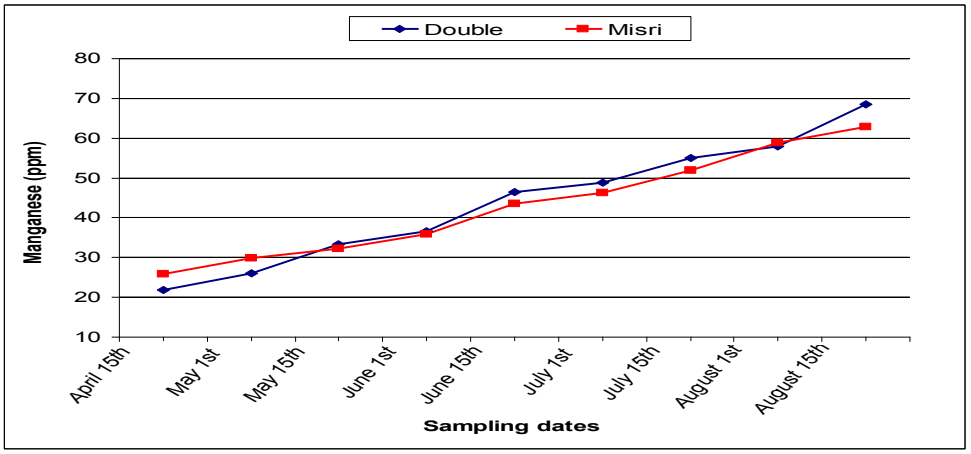

Fig. 9 : Leaf Mn content of sweet cherry leaves cv. Double and Misri as influenced by time of sampling (ppm dry weight)

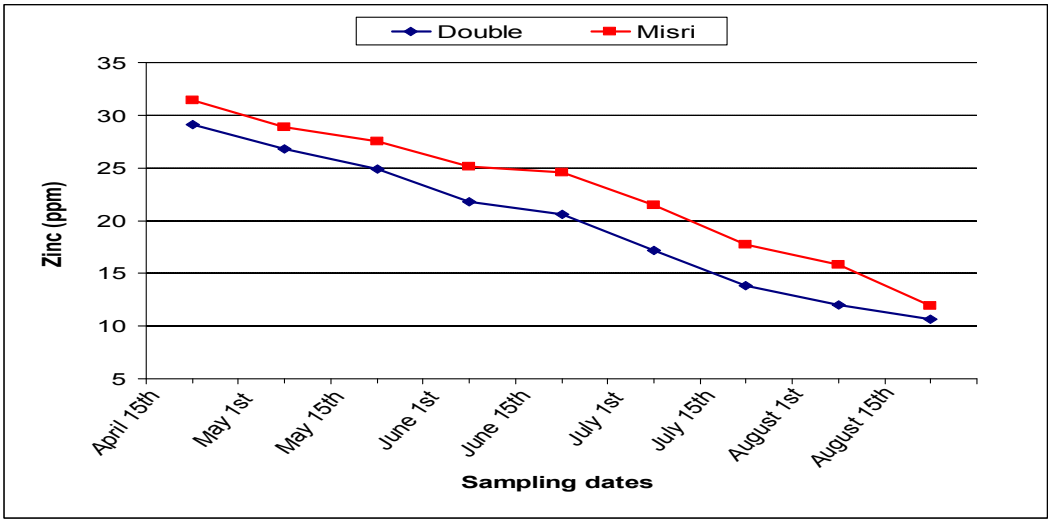

Fig. 10 : Leaf Zn content of sweet cherry leaves cv. Double and Misri as influenced by time of sampling (ppm dry weight)

Zinc

The foliar Zn concentrations in both cultivars of sweet cherry followed a definite pattern and decreased throughout the sampling season as depicted in Fig. 10. The leaf Zn content in Double cv. of sweet cherry varied from 10.66 ppm to 29.15 ppm with grand mean of 19.66 ppm and maximum Zn content of 29.15ppm was found on first leaf sampling i.e. 15thApril, thereafter decreased with increase in leaf age and lowest leaf Zn content was recorded on last leaf sampling date i.e. 15th August (10.66ppm). A similar trend was observed in leaf Zn content in Misri cv. of sweet cherry which decreased from first sampling date i.e. 15thApril (31.40 ppm) and reached its least value at the last leaf sampling date i.e. 15th August(11.95ppm) with grand mean of 22.72 ppm. Therefore leaf Zn content decreased significantly throughout the sampling period. The period of least variation in foliar Zn content was recorded from 1stJune to 15th June in both cultivars of sweet cherry. The maximum concentration of leaf Zn during the early leaf samplings might be due to the greater accumulation of Zn, which occurs between leaf emergence and fruit set [21] and also due to growth of young leaves, where xylem is differentiating actively usually have higher auxin levels, which decrease with increase in leaf age, hence Zn content in leaves decreases as the season progresses. The present data recorded is in accordance with the findings of [17] in sweet cherry and [12] in apricot.

CONCLUSION

The leaf analysis revealed that in Double and Misri cultivars of sweet cherry, the least variation for leaf N, P, K, Ca, Mg, Fe and Zn content was observed between 1st June to 15th June, when the leaves were 8.71 to 10.85 weeks old, while as, the minimal variation for leaf S, Cu and Mn contents was recorded between 15th June to 1st July, when the leaves were 10.85 to 13.0 weeks old. Therefore, the suitable time for leaf sampling in sweet cherry under temperate conditions of Kashmir is from 1st June to 15th June when least variation among most of the nutrients in leaves of both cultivars was observed. Regarding the seasonal variation of nutrients in sweet cherry it had been observed that foliar N and K contents increased from 15th April to 15th June and then decreased till last date of sampling. The leaf P and Zn contents followed decreasing trend throughout the leaf sampling, while as, the leaf Ca, Mg, Fe and Mn contents increased throughout the sampling season. However, the leaf S and Cu contents fluctuated and exhibited an irregular trend throughout the leaf sampling.

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