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Research Paper

Periodic Variation in Nitrogen Content of Plum Leaves

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Nitrogen (N), plays a critical role in enhancing fruit buds formation, fruit setting and overall tree vigour. Its deficiency causes reduction in normal and functional leaf surface that ultimately may result in getting fruit of reduced size and inferior quality. Nitrogen requirement of deciduous fruit trees has traditionally been assessed from N concentration in the leaves. To study nitrogen levels on monthly basis in deciduous plum fruit orchard, an experiment was conducted for three years (2014-2016) in Peshawar and Nowshera Districts of KP, Pakistan. Leaf samples were collected from plum orchards (cv. Fazli Manani) of three selected sites (Site I: NIFA, Peshawar, Site II Mera Kachori, Peshawar, Site III: Khushmaqam, Nowshera). Samples in everysite experiment were collected from forty-two trees of uniform age (about six-year-old) and size. These trees were classified into seven treatments; every treatment having two trees replicated thrice. Leaf samples from the orchards were collected from mid-April to mid-November each year during 2014-2016. For this, purpose 12-16 fully matured leaves from different branches of four quadrants were collected and analyzed for nitrogen content. Results showed that Nitrogen content of leaves bit by bit enhanced from April to August and so trend went downward until November in all the sites. the very best N concentrations (2.42, 2.46 and 2.44%) were found within the month of August at NIFA, Mera Kachori and Khushmaqam orchards respectively. Whereas all-time low nitrogen concentrations (1.74, 1.92 and 1.77%) were found within the month of November at NIFA, Mera Kachori and Khushmaqam orchards respectively. it should be recommended that nitrogen application is needed once the dormant season before bud sprout so as to make full the deficiency within the plum.

Key Words: Nitrogen, Plum Leaves, Fazli Manani

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INTRODUCTION

Nitrogen is an essential macronutrient, a higher amount of which is required for the normal plant growth. It is an integral part of plant vitamins & enzymes, and plays a crucial role the synthesis of nucleic & amino acids.It is also required by the plant for their cell division and normal growth of young parts like buds, flowers, twigs, leaves, etc. During growing season, N is depleted from the soil in large amount (Li et al.,2007; Gheysari et al., 2009; Fessehazion et al., 2011Xu., et al 202). Remobilization of large quantity of nitrogen occurs prior to leaves abscission of fruit trees (Masclaux-Daubresse et al., 2010Thitithanaku 2012; Zarate-Valdez2015). Nitrogen stored in fruit trees is not sufficient

for getting higher fruit yield, so it needs to be supplemented in the form of fertilizer in order to balance N level in fruit tissues (Maathuis, 2009Neilsen et al., 2009). Nitrogen also affects the absorption and distribution of other nutrients in plants. By managing nitrogen levels in plant and soil carefully, plant growth & vigour can be enhanced, thus ultimately maximizing the yield potential of fruit trees (Neto *et al.,* 2008).

Nitrogen content in leaves is greatly influenced by the management practices, environmental conditions and various physiological factors. It has been reported that N content of deciduous fruit trees decrease throughout the growth period (Dong et al., 2001; Neilsen et al., 2001 Tan et al 2021)due to its dilution in plant leaves & stems in spring as well as its remobilization from leaves to other plant parts (including fruit) in summer. In deciduous fruit plants, nitrogen concentration in fruits are comparable to that found in foliage (Dong et al., 2001; Neilsen et al., 2001). Malagoli et al., (2005) found that nitrogen presence in presence in fruit trees also enhanced N uptake. The findings of trials conducted on the timing of N fertilizer application on peach have depicted that maximum nutrient uptake was found during the growth period of fruit (Masclaux-Daubresse et al., 2010 ; Maillard A et al 2015).Deciduous trees store nutrients during winter, which are remobilized from the trunk each spring to sustain leaf growth as previously shown for N (Millard and Grelet, 2010). Mature trees rely more on the remobilization of N stores for their growth each spring than do small, juvenile trees (Millard et al., 2006). In evergreen trees, it has been shown that macronutrients such as nitrogen and phosphorus are remobilized from leaves (Cherbuy et al., 2001). This remobilization occurs in summer, after vegetative growth and synchronously with leaf shedding. K remobilization occurs in mid-summer, similar to N and P, and could be attributed to K resorption before leaf shedding or the fulfillment of nutrient demands when soil availability is low (Milla et al., 2005) Different plant species remobilize minerals differently. In order to do so, the apparent remobilization was quantified during the leaf senescence. The current study was designed to assess the pattern of nitrogen from the month of April fruit bearing stage to November leaves drop stage.

Materials and Methods

The collection of leaf samples was carried out from three orchards of plum cv. Fazli Manani, located at two districts of KP i.e. Peshawar and Nowshera. Leaves samples were collected from three orchards two in district Peshawar and one orchard in district Nowshera, leaves samples were collected from forty-two (42) trees of almost same size and age (about six years old).No fertilizer treatment was applied fertilizers and other management practices were applied to orchards by the owner of the orchards according to his plan. These trees were divided into 7 treatments for identification such that each treatment comprised of 2 trees replicated thrice leaves samples were collected from the same trees for three years. Distance among the trees was maintained at 20 feet. Collection of leaf samples was carried out at regular intervals (one month) from mid-April to mid-November for three successive years i.e. from 2014 to 2016. For this purpose, collection of fully matured leaves (12-16) from various branches of four quadrants of trees was carried out. The samples, after packing and labelling properly, were shifted to NIFA, Peshawar for the analysis of their N content in the laboratory. All the samples were washed separately using tap water and then rinsed using distilled water. The leaf samples were then dried, firstly in open air and then in the oven at 70^{o}C. Each leaf sample, after grinding in stainless steel grinder, was stored in plastic bags and labelled properly prior to further analysis.

Location 1 = NIFA, Peshawar
Location 2 = Mera Kachori, Peshawar
Location 3 = Khushmaqam, Nowshera

Total N was measured with the Kjeldahl method. developed by Bremner and Mulvaney (1982). 0.5g of grinded leaves sample was taken in a digestion tube. 2 grams of digestion mixture K_2SO_4:$CuSO_4$: Se (100:10:1) and 10mL of conc. H_2SO_4 was added to it. In order to mix the content the tube was thoroughly swirled and was placed in oven. Distillate was titrated against 0.1 N HCL, appearance of the pink colour was the end point.

Statistical Analysis

The procedures of Steel and Torrie (1984) were followed for statistical analysis of the data.

Results and Discussion

Plum leaf samples collected from three sites on monthly basis (mid-April to mid-November) during 2014-2016 were taken to the laboratory for their nitrogen determination. Analytical results regarding the nitrogen concentrations in plum leaves are presented in Tables 1, 2 and 3. It is evident from the data that, at all the three sites, nitrogen content in plum leaves gradually increased from April to August, after which a declining trend was noted till November. The highest nitrogen concentrations (2.42%, 2.46% and 2.44%)were recorded during the month of August at the experimental sites (NIFA, Mera Kachori and Khushmaqam, respectively).Whereas the lowest values of nitrogen contents (1.74%, 1.92% and 1.77%) were observed during the month of November at all the respective sites. This decline may be attributed to the abscission layer formation between the twigs and petiole that is a natural process by which deciduous trees minimize transpiration losses so that plants may be able to survive in extreme weather.

The trends of N variation in the leaves of plum trees at all the studied sites are presented in Figures 1, 2 and 3. It is evident that leaves N content reached to minimum level in November each year at all the sites. This fall in N content after the month of August may be due to remobilization of considerable amount of nitrogen from leaves to perennial organs prior to leaf abscission, along with several other factors like environmental conditions, physiological factors, etc. (Millard et al., 2006, Millard and Grelet, 2010). Similar pattern of seasonal N content in plum leaves was found as it gradually increased N content of plum leaves from April to August. This duration coincided with the start of fruit development. After that nitrogen content in plum leaves showed declining trend till the month of November at all the three sites. It may be described in terms of nitrogen dilution in various growing organs in spring season. Nitrogen translocation from leaves to fruit seemed to happen during last stages of fruit development. Remobilization of nitrogen from leaves to storage tissues also takes place in the fall season (Dong et al., 2001; Neilsen et al., 2001). Malagoli et al., (2005)).At the beginning of spring season, N contents in young leaves were recorded to be 2.1% that reached to 2.4% in the month of August (Fig. 1). These nitrogen contents suggested strong N consumption related to new growth of vegetative parts as well as N demand by the inflorescence & flowering and the earlier growth stage of fruit setting (Connell *et al*., 2002; Nieto *et al*., 2006). Around the start of the autumn season, the deciduous fruit trees translocate nitrogen contents to their other parts. It implies that there is low nitrogen demand (Bravo*et al*., 2005; Nieto *et al*., 2006). In May/June, when the fruit is matured, a new gradual increase inleaf nitrogen content (with values of around 2.4%) through August was found. Alike findings for the warmer north-western province have been reported by Bravo *et al*. (2005). It has been noted by Maillard A(2015)that there exists a strong interest in the seasonal variations of N contents in leaves and woody parts as they provide the required materials for new flush of growth in spring. The variations in N contents of deciduous trees during late summer & autumn have also been reported by Tan BZ(2021). They reported that decrease in leaves N content during the autumn is a common phenomenon in deciduous fruit trees.

Conclusion

It may be inferred from the current study that nitrogen contents in the leaves of plum trees gradually increase from April to August, after that the trend goes downward till November at all the three sites under study i.e. NIFA, Mera Kachori & Khushmaqam. Maximum leaves N content were recorded during August while the least in November. The declining trend of leaves N content may be attributed to the formation of abscission layer between the petiole and twigs that is a natural phenomenon of trees survival during unfavourable weather conditions by reducing transpiration losses. It implies that nitrogen application after dormant season prior to bud formation may be suggested in order to replenish nitrogen deficiency in plum.

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Table 1: Nitrogen content (%) of plum leaves on monthly basis (April to November) during 2014-2016 at NIFA

Treatments	April	May	June	July	August	September	October	November
T_1	2.12 b	2.15 c	2.17 c	2.25 c	2.22 c	2.13 c	1.84 b	1.57 c
T_2	2.30 a	2.31 ab	2.35 ab	2.36 ab	2.36 b	2.29 b	1.96 ab	1.83 a
T_3	2.31 a	2.36 ab	2.37 ab	2.37 ab	2.38 b	2.37 ab	2.00 ab	1.70 ab
T_4	2.31 a	2.28 b	2.32 b	2.32 ab	2.43 ab	2.41 a	1.98 ab	1.81 a
T_5	2.25 a	2.27 b	2.35 ab	2.35 ab	2.57 a	2.43 a	2.09 a	1.86 a
T_6	2.31 a	2.40 a	2.41 a	2.42 a	2.50 a	2.40 a	2.04 a	1.69 ab
T_7	2.29 a	2.32 ab	2.31 ab	2.41 a	2.48 ab	2.38 a	2.11 a	1.72 ab
Mean	2.27 b	2.30 b	2.33 b	2.35 b	2.42 a	2.34 b	2.00 c	1.74 d

Values in each column indicated by similar letters are not significantly different at P<0.05

Table 2: Nitrogen content (%) of plum leaves on monthly basis (April to November) during 2014-2016 at Mera Kachori

Treatments	April	May	June	July	August	September	October	November
T_1	2.28 b	2.25 bc	2.25 bc	2.29 bc	2.25 c	2.24 c	1.97 b	1.83 c
T_2	2.44 a	2.36 ab	2.33 ab	2.38 ab	2.49 ab	2.34 b	2.12 a	1.87 c
T_3	2.34 b	2.35 ab	2.37 ab	2.42 a	2.46 ab	2.33 b	2.11 a	1.91 b
T_4	2.34 b	2.36 ab	2.37 ab	2.37 ab	2.48 ab	2.43 a	2.16 a	1.96 b
T_5	2.33 b	2.39 a	2.42 a	2.46 a	2.55 a	2.35 b	2.16 a	2.01 a
T_6	2.36 b	2.40 a	2.45 a	2.46 a	2.52 a	2.38 b	2.21 a	1.94 b
T_7	2.29 b	2.37 ab	2.34 ab	2.37 ab	2.50 a	2.36 b	2.12 a	1.91 c
Mean	2.34 b	2.35 b	2.36 b	2.39 ab	2.46 a	2.35 b	2.12 c	1.92 d

Values in each column indicated by similar letters are not significantly different at P<0.05

Table 3: Nitrogen content (%) of plum leaves on monthly basis (April to November) during 2014- 2016 at Khushmaqam

Treatment	April	May	June	July	August	September	October	November
T_1	2.14 c	2.23 c	2.27 b	2.29 c	2.26 b	2.15 c	1.81 c	1.61 c
T_2	2.24 b	2.35 b	2.39 a	2.44 a	2.49 a	2.3s3 ab	1.90 ab	1.80 ab
T_3	2.26 b	2.36 b	2.38 a	2.41 ab	2.46 a	2.28 b	1.92 ab	1.74 b
T_4	2.36 a	2.33 b	2.37 a	2.39 b	2.45 a	2.30 ab	2.06 a	1.80 ab
T_5	2.42 a	2.42 a	2.40 a	2.49 a	2.53 a	2.39 a	2.00 a	1.88 a
T_6	2.42 a	2.38 a	2.39 a	2.38 b	2.48 a	2.33 ab	2.04 a	1.78 ab
T_7	2.35 a	2.39 a	2.35 a	2.42 a	2.46 a	2.32 ab	1.99 a	1.85 a
Mean	2.31 b	2.35 ab	2.36 ab	2.40 a	2.44 a	2.30 b	1.96 c	1.77 d

Values in each column indicated by similar letters are not significantly different at P<0.05

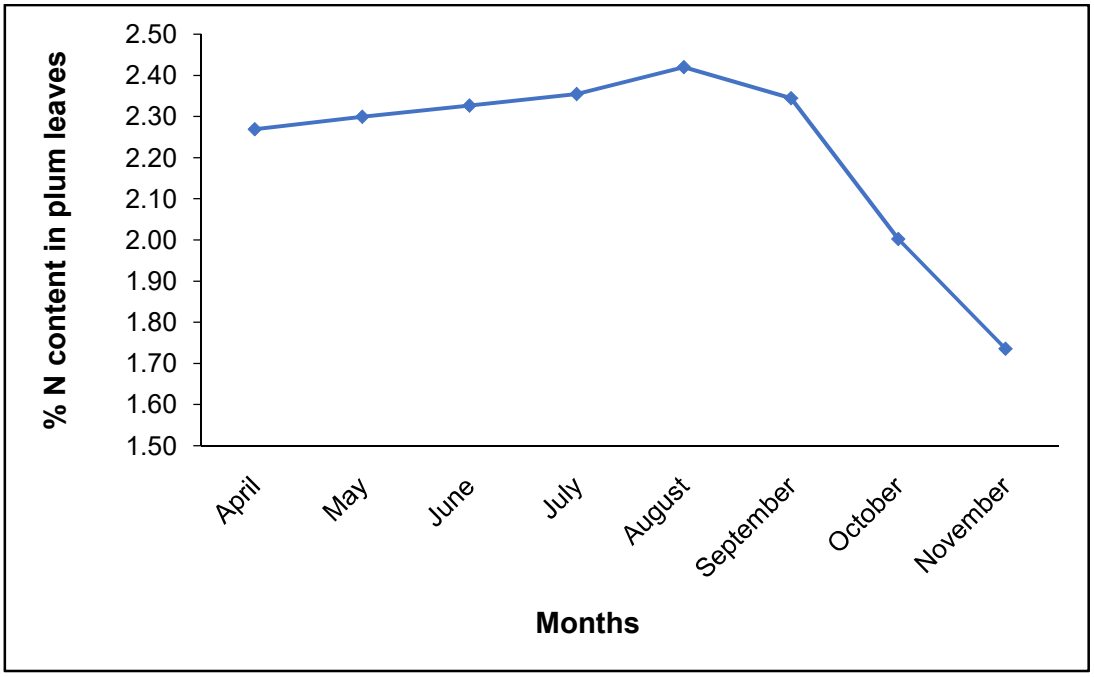

Figure 1: Trend of nitrogen content (%) of plum leaves from April to November (during 2014-2016) at NIFA

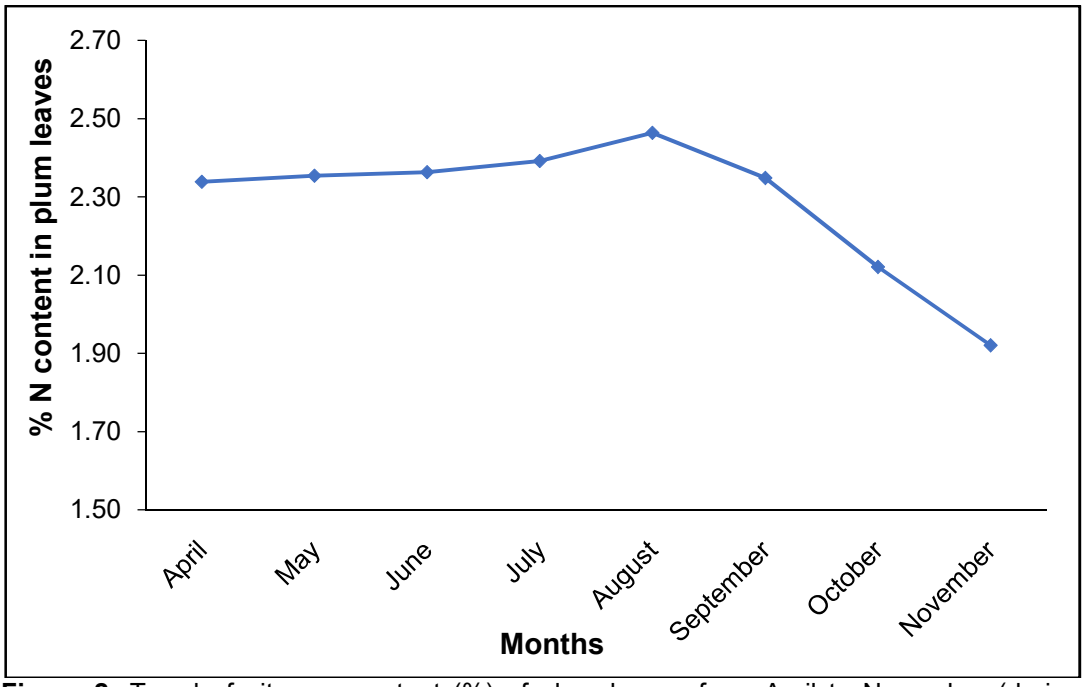

Figure 2: Trend of nitrogen content (%) of plum leaves from April to November (during 2014-2016) at Mera Kachori.

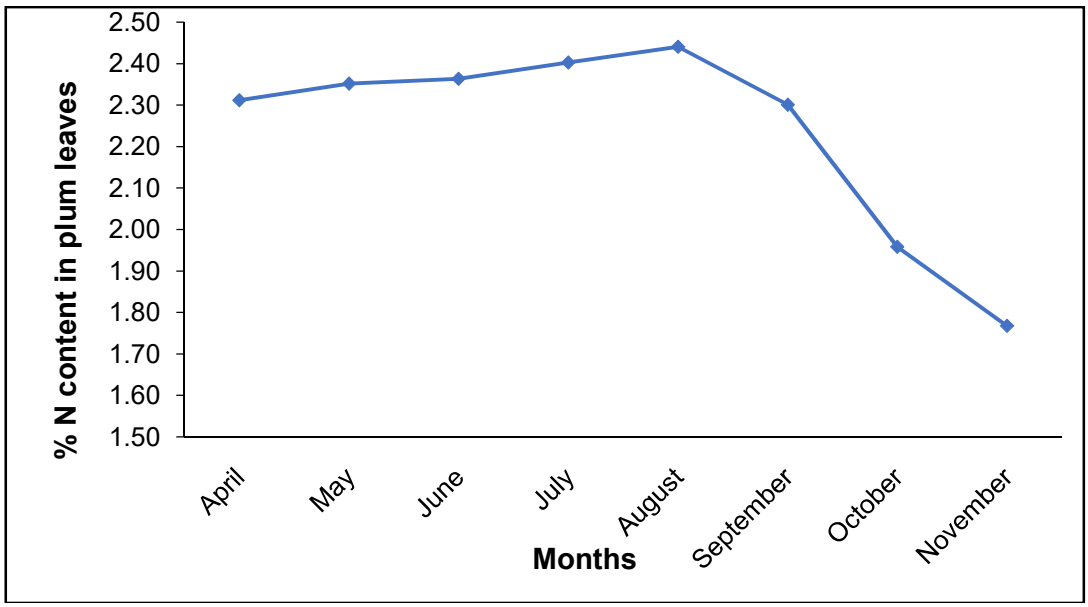

Figure 3: Trend of nitrogen content (%) of plum leaves from April to November (during 2014-2016) at Khushmaqam