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Comparative Analysis of Leaf Nutrients and Fruit Attributes of Pear Orchard under Central Zone of Punjab

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ABSTRACT: In order to assess how leaf nutrient content affected the fruit yield and quality indicators of the pear cultivar "Patharnakh" in the central zone of Punjab, a study was carried out. The results of the study revealed that 13, 10, 30, and 30% of orchards had insufficient leaf N, P, K, and Cu, respectively. However, higher range of N (56%) and P (60%) was noted in leaf sample collected from the selected orchards. Leaf N and K has shown statistically significant and positive relation with tree spread, fruit size and fruit yield whereas, leaf Ca, Cu, Mn and Fe showed negative correlations with fruit yield in the surveyed orchards but results were statistically non-significant. Likewise, Leaf Ca found positive and significant correlation with tree girth and fruit firmness. The present study had shown positive relationships between fruit quality attributes and leaf mineral concentrations to highlight the importance of fertilizer management which will be help in production good quality pear fruits. Additionally, studies help in fertiliser application dosage estimation.

Keywords: Fruit quality, Leaf nutrients, Pear , cultivar, correlation.

INTRODUCTION

Pear is a popular fruit in the domestic as well as international market owing to its crispy texture, subtle aroma, delicious favour, and rich nutritional compounds (Dave *et al.,* 2017). The cultivation of pear is mainly confined to temperate and sub-tropic regions of Punjab, Himachal Pradesh, Uttar Pradesh, Uttarakhand, Jammu and Kashmir, Haryana, Assam and south India. In Punjab, its cultivation is confined mainly to Amritsar, Tarn-Taran, Gurdaspur, Hoshiarpur, Jalandhar and Patiala districts on an estimate area of 3336 ha with annual production of 78236 MT (Anon 2020-21) and Pear is considered as an important crop in fruit industry of Punjab.Growth and yield of fruit crops is governed by several factors. Among various factors of production, nutrition of pear has received a considerable attention in recent years, because of the role of various nutrients in quality production of fruits and also due to their relationship to physiological disorders and other effects particularly reduced respiration, delayed ripening and increased fruit firmness, thereby extending storage and shelf life of fruits. Deficiency of these nutrients result in decrease of fruit production and poor quality, while excess of nutrients also hamper quality production of fruits because of their antagonistic effects. Imbalance of nutrients causes several disorders which consequently affects the quality and yield of pear. The nutrients in soil and foliage have a considerable effect on yield and quality parameters of fruits because of their role in plant metabolism (Buchloh, 1974; Hansein and Ryugo, 1979; Nijjar, 1990; Mitra *et al.* 1991). Recent advances in the field of nutrition of various fruit crops have proved that leaf analysis is an excellent tool for diagnosing deficiencies and toxicity of various essential elements. All essential elements play a vital role in deciding growth and development of plant. For a particular nutrient, there exists a relationship between its concentration in soil and leaf, as well as quality attributes of fruits. This serves as a guide to obtain maximum productivity of quality fruits. Awasthi *et al.* (1998) found a direct relationship between leaf nutrients with yield and quality of apple. Since little research has been done to determine the impact of nutrients on pear yield and quality characteristics, the nutritional element of pears has not received much attention to date. In order to determine how leaf nutrients relate to pear fruit productivity and quality features, the current study was carried out.

MATERIAL AND METHODS

To conduct this study, 30 orchards of pear cultivar “Pathar Nakh” were selected in pear growing areas of central zone of Punjab. The trees were of uniform age group (15-20 years), vigour and growth. The leaf samples were collected from each orchard following the procedure outlined by Chapman (1964). The leaf samples were washed, dried, ground and digested for analysis. Nitrogen, phosphorus, potassium, calcium and magnesium were estimated by standard procedures outlined by Jackson (1973). While, Nutrients like Ca, Mg, Cu, Zn, Fe and Mn were determined with Atomic Absorption Spectrophotometer method described by

Bradfield and Spencer (1965). Fruit samples were collected as per the procedure of Waller (1980) and were washed and dried for analysis. Fruit length and diameter were measured with digital vernier calliper and fruit weight was recorded in a sensitive monopan balance, while, fruit volume was measured by water displacement method. Fruit firmness and total soluble solids (TSS) were measured with the help of Penetrometer and hand refractometer, respectively. Fruit yield was recorded and total sugar was determined as per the procedure given by A.O.A.C. (1990). Correlation co-efficient (r – values) was as per the procedure outlined by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Properties of the pear orchard soils. The soils were clay loam to silty clay loam in texture with normal electrical conductivity and calcium carbonate content. The pH of soil was slightly acidic to slightly alkaline and ranged from 7.05 to 8.75 with mean value of 7.90. The organic carbon was medium to high in soils and varied from 0.26 to 0.59 %, with mean value of 0.46 %. The available nitrogen ranged from 213.4 to 732.7 kg^{-1} ha with mean value of 469.3 kg^{-1} ha and its status was low to medium while available phosphorus was medium to high and varied from 8.25 to 90.15 kg^{-1} ha with mean value of 59.5 kg^{-1} ha. The available potassium was found in the range of 71.7 to 314.5 kg^{-1} ha, with mean value of 162.3 kg ha.

Leaf nutrients. Leaf nitrogen, phosphorus and potassium content of pear ranged from 1.68 to 2.80, 0.09 to 0.21 and 0.85 to 1.35 %, with mean value of 2.12, 0.16 and 1.10 %, respectively as shown in Table 1. Calcium and magnesium concentration in foliage of "Pathar nakh" cultivar of pear was found in the range of 1.28 to 4.59 and 0.25 to 0.84 % with mean value of 2.22 and 0.45 %, respectively. Zinc, copper, iron and manganese content in leaf varied from 11.7 to 50.28, 3.9 to 10.1, 182.6 to 355.3 and 64.0 to 235.6 ppm, with mean value of 26.18, 7.30, 266.3 and 106.72 ppm respectively.

Table 1: Concentration of leaf nutrient in pear cultivar "Pathar nakh" in Central zone of Punjab.

Nutrient	Range	Mean*	LSD	±SED
Nitrogen (%)	**1.68-2.80**	**2.12**	0.1	0.05
Phosphorus (%)	**0.09-0.21**	**0.16**	0.06	0.03
Potassium(%)	**0.85-1.35**	**1.1**	0.1	0.05
Calcium (%)	**1.28-4.59**	**2.22**	0.27	0.13
Magnesium(%)	**0.25-0.84**	**0.45**	0.11	0.06
Copper (ppm)	**3.9-10.1**	**7.3**	1.2	0.6
Zinc (ppm)	**11.70-50.28**	**26.18**	3.9	1.9
Manganese (ppm)	**64.0-235.6**	**106.72**	11.7	5.8
Iron (ppm)	**182.8-355.3**	**266.3**	**18.6**	**9.3**

Fruit quality parameters. Length and diameter of fruit varied from 5.54 to 7.11 and 5.28 to 6.87 cm respectively. Weight and density of pear fruit ranged from 113.1 to 181.0 g and 0.980 to 1.06 m/v, respectively, where as firmness and TSS ranged from 14.38 to 19.16 lb.p.s.i and 9.7 to 12.3 %. Acidity and juice content in pear fruit ranged from 0.18 to 0.30 and 57.85 to 52.45 % and yield ranged from 134.6 to 260.5 kg tree , in 30 orchards.

Table 2 : Quality parameters and yield of pear fruits.

Parameter	Range	Mean*	LSD	±SED
Length (cm)	5.54-7.11	6.37	0.1	0.05
Diameter (cm)	5.28-6.87	6.09	0.03	0.03
Weight (g)	113.1-181.5	152.64	13.9	6.9
Density (m/v)	0.980-1.06	1.002	N/A	0.02
Firmness (lbs)	14.38-19.16	16.92	N/A	1.35
TSS (brix)	9.7-12.3	11.07	N/A	1.1
Acidity (%)	0.18-0.30	0.23	0.05	0.03
Juice content(%)	57.85-52.45	54.81	N/A	2.85
Yield (Kg/tree)	134.6-260.5	195.2	12.9	6.4

Relationship of leaf nutrients with fruit quality and yield. Fruit length, diameter, weight, volume, TSS, acidity, and yield showed a positive and substantial association with leaf nitrogen (Table 3 and Fig. 1). This may be because nitrogen is a crucial component of cells and has an impact on cell division and elongation, which promotes the growth and development of large leaf areas, the stimulation of buds, the beginning of flowers, and the setting of fruit with a marked increase in yield and enhancement of quality attributes through photosynthetic activity. This is supported with the findings observed by Kumar *et al.* (2007). Additionally, Rader *et al.* (1985) found that nitrogen fertiliser increases peach size. Leaf phosphorus was shown to significantly and favourably correlate with fruit length, diameter, firmness, density, and yield. This may be explained by its function as a crucial component of cells and their parts, in plant metabolism, and in the transmission of energy. These findings agree with those made by Singh *et al.* (2007); Kumar *et al.* (2005). Fruit length, diameter, weight, density, TSS, acidity, and yield showed positive and significant relationships with leaf potassium content (Table 3). This might be as a result of its function in plant metabolism. It is also referred to as a quality nutrient due to its influence on fruit characteristics via the activation of enzymes,

control of cell hydration, water economy, etc. These outcomes are consistent with Kumar *et al*. (2007). These findings concur with those of Awasthi *et al.* (1998), who found that peach fruit weight rose with an increase in potassium application rate up to 700 g/tree. Only a positive and substantial association between leaf calcium and fruit firmness was found. This may be as a result of its function in producing pectic compounds, which provide cell walls strength and hence improve fruit firmness. In addition to being a component of chromosomes, calcium serves as an enzyme cofactor and is crucial for cellular structure. Kumar *et al.* (2007) also reported on similar findings. Fruit length and yield showed a favourable and substantial association with leaf zinc. This may be as a result of its function, namely, as an enzyme activator and auxin precursor in plant metabolism. Additionally, it aids in the activation of enzymes that are crucial for both protein synthesis and glucose metabolism. These findings, along with those of Singh *et al.* (2007); Babu and Yadav (2005), are supported by these results. Leaf copper was shown to positively correlate with fruit length, diameter, and density. This could be because of how it affects plant metabolism. The production of proteins, the use of coenzymes in several processes, lignification, and electron transport all depend on copper. The research of Singh *et al.* (2007) provides evidence for this. Fruit length, diameter, weight, juice, and fruit hardness all showed favourable relationships with iron concentration in the pears' foliage. This can be due to its role in plant metabolim. These findings are in line with the results of Jeyabaskaran and Pandey (2008); Veleais *et al.* (1998). Leaf manganese level in pear revealed positive relationship with fruit length, diameter, weight, juice anf fruit firmness. This can be due to its involvement in physiological processes of plants, leading to quality production. It is essential for enzyme activation involved in respiration, nitrogen fixation, protein synthesis, carbohydrate synthesis and synthesis of chlorophyll. This is supported by Babu and Yadav (2005) and Singh *et al.* (2005).

Table 3: Correlation of Leaf Nutrients with Fruit Quality.

Leaf nutrient(%)	Fruit length	Fruit breath	Fruit weight	Fruit juice	Fruit firmness	Fruit density	Fruit TSS	Fruit Acidity
N	0.56*	0.38*	0.29	-0.41*	-0.23	0.13	0.36	0.18
P	0.31	0.38	-0.16	-0.10	0.06	0.14	-0.07	-0.13
K	0.91*	0.58*	0.89	-0.32	-0.20	0.62*	0.49	0.15
Ca	0.20	0.29	0.18	0.10	0.55*	0.04	0.08	0.23
Mg	0.67	0.70*	0.24	-0.27	-0.09	0.25	0.21	0.27
Cu	0.22	0.15	-0.08	-0.06	-0.26	0.06	-0.15	-0.21
Zn	0.49*	0.40	-0.09	-0.26	-0.02	-0.20	0.07	-0.14
Mn	0.07	0.05	0.12	0.05	0.10	-0.02	-0.04	-0.07
Fe	0.07	0.02	0.14	0.08	0.14	-0.06	-0.07	-0.09

*, Significant at 5 per cent level; **, Significant at 1 per cent level

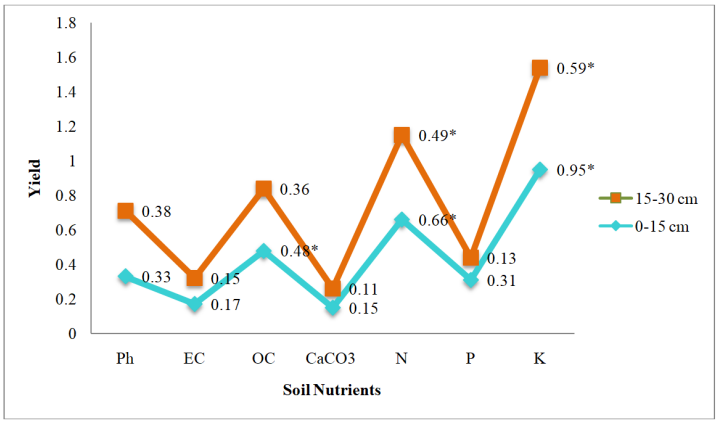

Fig. 1. Correlation between Leaf Nutrient and Fruit Yield.

CONCLUSION

One of the main elements affecting the production and quality of agricultural plants is plant nutrition. The growth and development of plants are determined by all necessary ingredients (Rathore, 1991). There is a correlation between a nutrient's content in the soil and in plants and the fruit production as well as its qualitative characteristics. This may be used as a guide to have the best quality and fruit yield possible. According to Awasthi *et al.* (1998), there is a correlation between apple yield and quality. The production and quality indices of the pear fruit under study are therefore affected by the nutrients in the soil.

FUTURE SCOPE

The relationship between leaf nutrients and pear fruit quality indicators will aid Punjab in producing more pear fruit of higher quality.

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Conflicts of Interest. None.

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