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Effect of available nutrients on yield and quality of pear fruit Bartlett in Kashmir Valley India

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Abstract

Pear is one of the most important commercial crops grown in the Kashmir valley of India. A study was conducted during 2008 to find out the effect of available nutrients on yield and quality parameters of pear cultivar "Bartlett" which revealed that nitrogen, phosphorus and potassium exhibited significant and positive relationship with fruit length (0.882, 0.856, and 0.482 mm, respectively), diameter (0.869, 0.794 and 0.458 mm, respectively), weight (0.876, 0.825 and 0.439 g, respectively), volume (0.908, 0.806 and 0.404, Cm^3 respectively) and yield (0.908, 0.764 and 0.702 kg $tree^{-1}$, respectively) however, only nitrogen and phosphorus showed similar relationship with total sugars (0.833 and 0.838 % respectively). The calcium indicated significant and negative relationship with fruit diameter (-0.433) and yield (-0.589), while as it showed significant and positive correlation with fruit firmness (0.442) only. The sulphur revealed significant and positive relationship with fruit length (0.440), diameter (0.434), TSS (0.482) and yield (0.729) whereas zinc, copper, iron and manganese exhibited significant and positive relationship with fruit length (0.889, 793, 0.671 and 0.619, respectively), diameter (0.875, 0.807, 0.653 and 0.576, respectively) weight (0.881, 0.784, 0.669 and 0.615, respectively), volume (0.885, 0.832, 0.692 and 0.572, respectively) TSS (0.858, 0.761, 0.735 and 0.609, respectively), total sugars (0.853, 0.890, 0.705 and 0.517, respectively) and yield (0.777, 0.618, 0.789 and 0.701, respectively). It is therefore suggested that nutrients have effect on quality and yield of pear fruits.

Key words

Kashmir valley, Nutrients, Pear, Cultivor 'Bartlett'

Introduction

Pear is one of the most commonly grown fruits in the world. Due to its wider adoptability under different agro-climatic conditions, it is grown in different parts of the world. Early developments in its cultivation took place in Greece and Rome around 200-300 B.C. It is widely grown in China, Italy, Spain, USA, former USSR, Turkey and Germany. In India, pear occupies third place in temperate fruits in area and production and can be grown from foot hills to high hills experiencing 500 to 1500 chilling hours (Rathore, 1991). Due to very high chilling requirements, the superior cultivars of *Pyrus*

communis are confined to high hills of Jammu and Kashmir, Himachal Pradesh and Uttranchal, whereas, some low chilling cultivars are quite successful in the northern plains of India. The Jammu and Kashmir has a very good potential for the cultivation of pear. The various cultivars growing in the valley are Kings Pear, Vicar of Winkfield, Beurre-de-Amanlis, Bartlett, Monarch, Devoe, Flemish Beauty, Red Bartlett, China Pear and Fertility (Farooqui and Happa, 1990). Among these China pear and Bartlett cultivars are growing commercially on large area. In Jammu and Kashmir, the area under fruits is 2.95 lakh ha with a production of 16.30 lakh metric tones and pear ranks second after apple in fresh fruits with an annual production of 45.86 thousand metric tones from an area of about 12.10 thousand ha (Anonymous, 2008).

Nutrition plays an important role in maintaining the quality and production of fruits. The nutrition of pome fruits has received a considerable attention in recent years because of their role in high production of quality fruits as well as their relationship to physiological disorders and other effects like reduced respiration, delayed ripening and increasing fruit firmness, thereby extending the storage and shelf-life of fruits (Buchloh, 1974). Balanced nutrition of fruit crops through judicious application of fertilizers, manures etc. is quite essential for improving quantity as well as quality of fruits. The nutrients available to plants depends upon many factors like climate, plant species, rootstock type, soil type, nutrients in the soil, soil moisture, pH, humus content, soil oxygen content and base saturation. In fruit crops, nutrient imbalances may manifest themselves in quality characteristics of the fruits or otherwise normal appearing trees. The information regarding the effect of available nutrient status on yield and quality parameters of pear is lacking. A study has therefore, been conducted in Kashmir valley to ascertain the relationship between available nutrients in soil and yield as well as quality parameters of pear cultivar "Bartlett".

Materials and Methods

Twenty one pear orchards having "Bartlett" cultivar of uniform age group (15-20 years) at different locations of Kashmir valley were selected for this study. Twenty one composite soil samples from these 21 orchards were collected, processed and analysed for various physico-chemical characteristics and available nutrients by standard procedures outlined by Jackson (1973) and Piper (1966). The fruit samples consisting of 10 fruits were collected from 21 orchards as per the procedure of Waller (1980). They were washed, dried and analysed. The fruit length and diameter were measured with digital vernier calliper, while fruit weight was recorded in a sensitive monopan balance. The fruit volume was measured by water displacement method and fruit firmness with the help of penetrometer. The total soluble solids (TSS) was determined with hand refractometer and total sugars as per A.O.A.C. (1990). The fruit yield was recorded also. Simple coefficients of correlation (r – values) were worked out between available nutrients in soil and yield as well as quality parameters of pear fruit as per the procedure outlined by Gomez and Gomez (1984).

Table- 1: Physico-chemical characteristics of pear orchard soils of Kashmir valley

S. No.	Location	Altitude (m a.m.s.l.)	Texture	pH (1:2.5)	EC (dSm^{-1})	$CaCO_3$ (%)	Organic carbon (%)
			High altitude (1840 – 2100 amsl)				
1	Chararsharief	2100	Silty clay loam	6.10	0.10	6.4	2.36
2	Pakherpora	2020	Loam	6.26	0.16	6.6	1.95
3	Footlipra	2000	Loam	6.28	0.25	6.6	2.04
4	Kamrazipora	1920	Silty clay loam	6.35	0.12	7.4	1.87
5	Kanigam	1880	Loam	6.39	0.24	7.6	1.32
6	Tujan	1850	Clay loam-silty clay loam	6.41	0.15	8.0	1.65
7	Adijan	1840	Loam	6.40	0.21	8.2	1.28
			Mid altitude (1730 – 1800 amsl)				
8	Drabagam	1800	Silty clay loam	6.52	0.15	8.4	1.78
9	Pombay	1800	Loam	6.61	0.35	8.6	1.27
10	Astanpora	1790	Loam	6.54	0.14	8.4	2.21
11	Rajpora	1780	Silty clay loam	6.65	0.42	8.8	1.82
12	Tral	1760	Clay loam	6.69	0.37	9.6	1.45
13	Nawpora	1750	Loam	6.40	0.25	9.6	1.14
14	Pirpora	1730	loam	6.75	0.35	9.8	1.52
			Low altitude (1520 – 1690 amsl)				
15	Wakura	1690	Silty clay loam	6.92	0.27	6.8	1.61
16	Zazna	1640	Silty clay loam	7.20	0.31	7.0	1.09
17	New Thead	1620	Silty clay loam	7.32	0.16	7.0	1.46
18	Manzgam	1580	Silty clay loam	7.36	0.44	7.4	1.19
19	Khanda	1580	Silty clay loam	6.94	0.24	7.6	1.72
20	Handwara	1560	Clay loam	7.62	0.36	7.8	0.92
21	Pohru	1520	Clay loam	7.76	0.29	8.2	0.66

Table- 2: Value of available nutrients of pear orchard soils of Kashmir valley (India)

Nutrient*	Mean	Range
Nitrogen*	353.25	207.87 – 439.49
Phosphorus*	34.25	21.06 – 41.66
Potassium*	401.70	318.08 – 474.88
Calcium*	4766.92	4390.40 – 4995.20
Magnesium*	638.51	586.88 – 676.48
Sulphur*	24.51	22.40 – 26.88
Zinc**	1.28	0.54 – 1.82
Copper**	2.00	1.14 – 2.80
Iron**	48.50	29.60 – 76.00
Manganese**	43.06	25.40 – 54.40

* = kg ha^{-1}; ** = mg ha^{-1} Values are means of 21 samples.

Table- 3: Fruit yield and quality parameters of pear fruit in Kashmir valley (India)

Quality parameter	Mean	Range
Length (mm)	77.60	61.43 – 84.15
Diameter (mm)	55.16	46.75 – 58.76
Weight (g)	116.33	81.00 – 131-00
Volume (cm^3)	97.16	69.20 – 111.00
Firmness (lb $sq.inch^{-1}$)	19.71	12.76 – 22.75
TSS (%)	12.09	9.3 – 13.5
Total sugars (%)	5.29	4.16 – 5.82
Yield (kg $tree^{-1}$)	98.71	72.00 – 132.00

Values are means of 21 samples.

Table- 4: Correlation coefficients of soil nutrient content with pear fruit yield and quality in Kashmir valley (India)

Nutrient	Length	Diameter	Weight	Volume	Firmness	Total soluble solids	Total sugars	Yield
Nitrogen	0.882*	0.869*	0.876*	0.908*	0.211	0.883*	0.833*	0.908**
Phosphorus	0.856*	0.794*	0.825*	0.806*	0.287	0.796*	0.838*	0.764*
Potassium	0.482*	0.450*	0.439*	0.404	-0.259	0.509*	0.398	0.702*
Calcium	-0.354	-0.433*	-0.310	-0.426	0.442*	-0.397	-0.389	-0.589*
Magnesium	-0.063	-0.098	-0.023	0.074	0.375	-0.126	-0.016	-0.275
Sulphur	0.440*	0.434*	0.422	0.426	-0.199	0.482*	0.396	0.729*
Zinc	0.889*	0.875*	0.881*	0.885*	0.416	0.858*	0.853*	0.777*
Copper	0.793*	0.807*	0.784*	0.832*	0425	0.761*	0.890*	0.610*
Iron	0.671*	0.653*	0.669*	0.692*	0.259	0.735*	0.705*	0.789*
Manganese	0.619*	0.576*	0.615*	0.572*	-0.120	0.609*	0.517*	0.701*

* Significant at 5 % level.

Results and Discussion

Properties of the pear orchard soils:The soils were clay loam to silty clay loam in texture with normal electrical conductivity (EC) and calcium carbonate ($CaCO_3$) content (Table 1). The pH of soil was slightly acidic to slightly alkaline and ranged from 6.10 to 7.76 with mean value of 6.75. The organic carbon was medium to high in soils and varied from 0.66 to 2.36 % with mean value of 1.54 %. The available nitrogen ranged from 207.87 to 439.49 kg ha^{-1} with mean value of 353.25 kg ha^{-1} and its status was low to medium (Table 2). The available phosphorus in the pear orchard soil was medium to high and varied from 21.06 to 41.66 kg ha^{-1} with mean value of 34.25 kg ha^{-1}. The available potassium was found in the range of 318.08 to 474.88 kg ha^{-1} with mean value of 401.70 kg ha^{-1}. The soils were high in available potassium. The exchangeable calcium and magnesium ranged from 4390.40 to 4995.20 and 586.88 to 676.48 kg ha^{-1} with mean value of 4766.92 and 638.51 kg ha^{-1}, respectively and both were high in soils under study. The available sulphur varied from 22.40 to 26.88 kg ha^{-1} with mean value of 24.51 kg ha^{-1} and it was observed medium in soils. The DTPA-extractable zinc and copper was found in the range of 0.54 to 1.82 and 1.14 to 2.80 mg kg^{-1} with mean value of 1.28 and 2.00 mg kg^{-1}, respectively. The DTPA-extractable zinc was low to high while copper was medium to high. The DTPA extractable iron and manganese were found in the range of 29.60 to 76.00 and 25.40 to 54.40 mg kg^{-1} with mean value of 48.50 43.06 mg kg^{-1} and both the nutrients were observed high in the soils under study.

Fruit quality parameters: Length, diameter and weight of the fruits ranged from 61.43 to 84.15 mm, 46.75 to 58.76 mm and 81.00 to 131.00 g with mean values of 77.60 mm, 55.16 mm and 116.33 g, respectively (Table 3). Volume, firmness and total soluble solids ranged from 69.20 to 111.00 cm^3, 12.76 to 22.75 lb sq^{-1} inch and 9.3 to 13.5% with mean values of 97.16 cm^3, 19.71 lb sq^{-1} inch and 12.09%, respectively. Total sugars ranged from 4.16 to 5.82% with mean value of 5.29% and yield $tree^{-1}$ ranged from 72.00 to 132.00 kg with mean value of 98.71 kg.

Relationship of available nutrients with fruit quality and yield: Available nitrogen revealed significant and positive relationship with fruit length, diameter, weight, volume, TSS, total sugars and yield (Table 4). This could be due to its effect on cell division and cell elongation leading to development of large and efficient leaf area, stimulation of buds, flower initiation, flower formation and fruit set with significant increase in yield and quality attributes. These results are supported by the findings of Kumar and Chandel (2004). The available phosphorus exhibited significant and positive relationship with fruit length, diameter, weight, volume, TSS, total sugars and

yield. This could be attributed to its role as essential constituent of cell and its organelles and in plant metabolism. These are in line with the observations of Jookla *et al.* (1984) and Kumar and Chandel (2004). The available potassium showed significant and positive correlation with fruit length, diameter, weight, total soluble solids and yield. This is because of its role in plant metabolism and is known as quality nutrient. These results are in conformity with the findings of Farooqui *et al.* (2004) and Kumar and Chandel (2004).

The available calcium revealed significant and negative relationship with fruit diameter and yield, whereas, it revealed significant and positive correlation with fruit firmness only. This can be due to the need of calcium for synthesis of pectic substances, which enhances the fruit firmness (Bhat *et al.,* 2009). The relationship of available magnesium was found non-significant with fruit yield and quality parameters. A significant and positive correlation of available sulphur was exhibited with fruit length, diameter, TSS and yield. This is due to its role as an activator of enzymes, constituent of amino acids etc. and in cell division. (Mostafa and Abd el-Kader, 2006; Mansour *et al.,* 2008). The DTPA-extractable zinc, copper, iron and manganese revealed positive and significant relationship with fruit length, diameter, weight, volume, TSS, total sugars and yield (Jeyabaskaran and Pandey, 2008). This could be due to their role in plant metabolism especially as activators of enzyme systems leading to quality production. (Mann *et al.,* 1984; Mamgain *et al.,* 1998; Singh *et al.,* 2003 and Jeyabaskaran and Pandey, 2008).

Plant nutrition is one of the key factors influencing the yield and quality of crop plants. All essential elements play a vital role in deciding the growth and development of the plants (Rathore, 1991). For a particular nutrient, there exists a relationship between its concentration in soil as well as in plants and yield as well as quality attributes of fruits. This serves as a guide to obtain maximum productivity of quality of fruits. Awasthi *et al.* (1998) found a relationship of available nutrients with yield and quality of apple. Thus, it can be concluded that nutrients in the soil have effect on the yield and quality parameters of pear fruit under study.

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