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Short communication

STATUS OF NUTRIENTS IN SOILS AND LEAVES OF AONLA ORCHARDS

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The importance of fruits in providing nutrition particularly vitamins and minerals in human diet is well known. The per capita availability of fruits in the country is only 46 g per day as compared to the requirement of 92 g as prescribed by Indian Council of Medical Research. The soil, which provides nutrients to the plants, is considered key source for fruit production. Soils of the study areas were poor in fertility status as they are coarse textured having high pH, soluble salts, high content of $CaCO_3$. The mounting pressure on the nutrient soil resources would cause their deficiency. Hence, the study was carried out in aonla orchards.

Sixty representative composite surface and sub surface soil samples from twenty orchards of Chomu tehsil of Jaipur district (Rajasthsn) were collected and stored in properly labeled plastic bags for analysis. The methodology for leaf sampling suggested by IIHR, Bangalore for aonla was followed. Composite leaf samples (mature leaves) were collected from 25 fruit bearing branches of 8-10 year old plants from each orchard. Samples were air dried ground and stored in properly labeled polythene bags for further analysis work. The available N in the soil samples was determined by alkaline permangnate method (Subbiah and Asija 1956) and available phosphorus by (Olsen *et al.* 1954) method and potassium by flame photometer in normal neutral ammonium acetate extract. Calcium and magnesium were estimated by Versante method and sulphur by turbidimetric (Williams and Steinbergs 1952) in 1% NaCl extract. Plant sample were analyzed for N, P, K Ca, Mg and S by adopting standard procedures (Jackson 1973).

The data (Table1) indicated that $CaCO_3$ content in soils of orchards of showed increasing trend with depth. Increase in the $CaCO_3$ content with depth indicates that the calcium leached down from surface to sub surface soils and accumulated in the form of calcium carbonate as secondary carbonate. Similar results were also observed for arid and semi arid regions by Mediratta *et al.* (1985).

Table 1**:** Physico-chemical characteristics of soils of orchards

Particulars		Depth (cm)		
		0-30	30-45	45 – 60
$CaCO_3$ (g kg^{-1})	Minimum	20.0	35.0	38.0
	Maximum	70.0	80.0	90.0
	Average	40.1	48.0	54.3
Organic carbon (g kg^{-1})	Minimum	1.9	1.8	1.5
	Maximum	4.4	4.2	4.1
	Average	3.4	3.2	2.9
pH (1:2 Soil water suspension)	Minimum	7.60	7.68	7.71
	Maximum	8.61	8.50	8.65
	Average	8.02	8.02	8.04
EC (dS m^{-1})	Minimum	0.12	0.13	0.14
	Maximum	0.91	0.96	0.95
	Average	0.51	0.51	0.50

The calcium carbonate had significant and positive correlation with pH (r=0.612**). On the other hand, the calcium carbonate had significant and negative correlation with organic carbon (r= -0.708**) as reported by Mediratta *et al.* (1985). Organic carbon content showed a regular decreasing trend with soil depth and from 1.5 to 4.4 g kg^{-1}. As per rating given by Muhar (1963), the soils having < 0.50 per cent have been categorized in low organic carbon. The extremely low organic carbon content of these soils could be counted to occasional addition of organic matters, lack of natural vegetation and poor water holding capacity coupled with high temperature resulting in enhanced oxidation of organic matter content. They reported that organic carbon content of soils deceased significantly with $CaCO_3$ (r= -0.708**) and pH (r= -0.717**). The pH of soils showed an irregular trend with depth and varied from 7.60 to 8.65. The results of investigation are in close proximity with the findings of Singh *et al.* (1997). The pH of soils increased significantly with increase of $CaCO_3$

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(r= 0.612**) and decreased significantly with decrease in organic carbon (r = - 0.717**) as reported by Singh *et al.* (1997). Electrical conductivity decreased with increasing soil depth. All soil samples of orchards had electrical conductivity less than 1 dS m^{-1}. The low value of electrical conductivity indicates that the accumulation of the salts in these soils were less. Similar findings were also observed by Ahlawat *et al.* (1985).

Table 2: Nutrients status of soils of aonla orchards

Nutrients status		Depth (cm)		
		0-30	30-45	45 – 60
Available nitrogen (mg kg^{-1})	Minimum	55.4	54.1	47.6
	Maximum	120.2	118.6	115.1
	Average	92.3	89.1	86.3
Available phosphorus (mg kg^{-1})	Minimum	7.5	7.0	6.9
	Maximum	13.7	12.9	12.8
	Average	10.8	10.3	10.0
Available potassium (mg kg^{-1})	Minimum	55.1	52.7	50.1
	Maximum	166.7	163.0	153.5
	Average	104.4	100.1	91.3
Available calcium (mg kg^{-1})	Minimum	502.2	503.6	507.6
	Maximum	698.1	698.8	699.7
	Average	613.2	615.8	617.7
Available magnesium (mg kg^{-1})	Minimum	228.0	224.6	224.1
	Maximum	330.9	330.9	332.9
	Average	278.0	278.2	278.4
Available sulphur (mg kg^{-1})	Minimum	8.5	8.5	8.0
	Maximum	18.0	17.5	17.0
	Average	12.4	11.9	11.6

The data indicated that the distribution of available nutrients showed a regular decreasing trend with increasing soil depth except calcium and magnesium. Both these nutrients showed an increase with increasing soil depths. The available N contents in these soils were low, whereas, the available P and K contents were rated as low to medium and medium, respectively. The low available N may be due to scanty natural vegetation, low organic carbon, low precipitation and prevailing high temperature which aggravates the problem of organic matter oxidation. Similar findings were also reported by Rajan *et al.* (2005). Available nitrogen had significant and positive correlations with organic carbon, phosphorus, calcium, magnesium, and sulphur, while it had significant and negative correlation with calcium carbonate and pH (Table 3).

Similar findings were reported by Sharma *et al.* (1990). Available phosphorus had significant positive correlations with organic carbon (r= 0.760**), nitrogen (r= 0.692**) and sulphur (r = 0.628**), while it had significant negative correlation with calcium carbonate (r= -0.764**), pH (r= -0.791**). The available potassium content of orchards soils had significant positive correlations with organic

Table 3: Correlation coefficient between soil characteristics

	OC	pH	EC	N	P	K	Ca	Mg	S
$CaCO_3$	-0.708**	0.612**	-0.117	-0.687**	-0.764**	-0.650**	0.658**	0.287*	-0.632**
OC		-0.717**	-0.162	0.768**	0.760**	0.712**	-0.650**	-0.490**	0.676**
pH			0.223	-0.655**	-0.791**	-0.432**	0.570**	0.520**	-0.547**
EC				-0.150	-0.061	0.011	0.068	0.279*	0.096
N					0.692**	-0.250	0.312*	0.378**	0.521**
P						-0.219	0.135	-0.146	0.628**
K							-0.739**	-0.365**	0.774**
Ca								0.735**	-0.569**
Mg									-0.252*

** Significant at P=0.0, ** Significant at P=0.01*

\carbon (r= 0.712**), sulphur (r = 0.774**), while it had significant and negative correlation with calcium carbonate (r= -0.650**), pH (r= -0.432**), calcium (r = -0.739**) and magnesium (r = -0.365**). Available potassium content showed non-significant relationship with nitrogen and phosphorus (Gathala, 2004). The calcium content of soils increased significantly with increase of $CaCO_3$ (r= 0.658**), pH (r=0.570**), nitrogen (r=0.312*) and available magnesium (r= 0.735**), while, it decreased significantly with decrease in organic carbon (r = - 0.650**), available potassium (r= -0.739**), available sulphur (r= -0.569**). Magnesium of soils increased significantly with increase of $CaCO_3$ (r= 0.287*), pH (r=0.520**), (r=0.279*), nitrogen (r=0.378*) and available calcium (r= 0.735**), while, it to decreased significantly with decrease in organic carbon (r = - 0.490**), available potassium (r= -0.365**), available sulphur (r= -0.252*) as reported by Gathala *et al.* (2004). Available sulphur had significant positive correlations with organic carbon (r= 0.676**), nitrogen (r= 0.521**), phosphorus (r=0.628**) and potassium (r= 0.774**), while it had significant negative correlation with calcium carbonate (r= -0.632**), pH (r= -0.547**), calcium (r= -0.569**) and magnesium (r= -0.252*) as reported by Gathala *et al.* (2004).

Table 4: Nutritional status of aonla leaves.

	Minimum	Maximum	Average
Nitrogen (%)	0.25	1.59	0.73
Phosphorus (%)	0.49	0.95	0.67
Potassium (%)	0.76	1.60	1.11
Calcium (%)	1.27	2.84	2.05
Magnesium) (%)	0.16	0.59	0.36
Sulphur (%)	0.14	0.59	0.32

Data presented in (Table 4) revealed that the nitrogen content of aonla leaf varied from 0.25 to 1.59 per cent while phosphorus content of aonla leaf varied from 0.49 to 0.95 per cent. The potassium content of aonla leaves varied from 0.76 to 1.60 per cent. The minimum and maximum values Ca content were 1.27 and 2.84 per cent, respectively. Magnesium content of leaves varied from 0.16 to 0.59 per cent. This might be due to sufficient magnesium status of orchard soils. The sulphur content of aonla plants varied between 0.14 and 0.59 per cent with a mean value of 0.32 per cent. The low concentration of nitrogen and potassium in these plants might be due to low N, K and S status of soils. Similar findings were also reported by Rajan *et al.* (2005). Nitrogen content in plant leaves was significantly and positively correlated with phosphorus (r =0.778**), calcium (r =0.794**), magnesium (r=0.594**), sulphur (r=0.651**). Phosphorus content in leaves was significantly and positively correlated with potassium (r=0.608**), calcium (r =0.702**).Similar results were observed by Singh et al. (1997). Potassium in aonla leaves was significantly influenced by the nitrogen (r=0.738**), phosphorus (r=0.608**), calcium (r=0.730**), magnesium (r=0.469*), sulphur (r=0.820**). These findings were in close agreement with the results of Gathala *et al.* (2004). Data (table 5) showed calcium content had highly significant and positively correlated with nitrogen (r=0.794**), phosphorus (r=0.702**), potassium (r=0.730**), sulphur (r=0.579**). Furthermore, magnesium had significant and positive correlation with nitrogen (r=0.594**), potassium (r=0.469*) and sulphur (r=0.479*). Sulphur content in leaves was significantly and positively correlated with nitrogen (r=0.651**), potassium (r=0.820**), calcium (r =0.579**) and magnesium (r=0.479*).These results are closely associated with the findings by Arora *et al.* (1992).

Table 5: Correlation coefficient between nutrient content in aonla leaves

Nutrients	P	K	Ca	Mg	S
N (%)	0.778**	0.738**	0.794**	0.594**	0.651**
P (%)		0.608**	0.702**	0.302	0.373
K (%)			0.730**	0.469*	0.820**
Ca (%)				0.426	0.579**
Mg (%)					0.479*

** Significant at P=0.05, ** Significant at P=0.01*

On the basis of results it may be concluded that all the major nutrients like N, P, K and sulphur decreased with the increase in soil depth. Calcium and magnesium content in soils showed increasing trend with depth. Organic carbon content in these soils has been decreased with soil depth. Leaf samples of aonla plants were found deficient to sufficient in N and K While, all leaf samples were sufficient in P, whereas, Ca, Mg, and S in leaves were falls under low range.

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