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Studies on micronutrient cations in arid irrigated aonla orchard soil profiles in Sikar district of Rajasthan

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Abstract

The present study on distribution of micronutrient cataions in arid irrigated aonla orchard soil profiles in Sikar district of Rajasthan was conducted during March 2007-2008. The study included analysis of soil profiles with respect to micronutrients. The available iron ranged between 2.28 to 6.51 mg kg^{-1}, available zinc between 0.203 to 0.990 mg kg^{-1}, available copper between 0.110 to 0.493 mg kg^{-1} and available manganese between 1.36 to 5.19 mg kg^{-1}. All the micronutrients were found to be low to medium in range in arid irrigated aonla orchard soil profiles in Sikar district of Rajasthan .

Key words: Aonla, Orchards, Micronutrients

Introduction

Aonla is an important fruit crop which has high nutritive and medicinal value. It is one of the richest source of vitamin 'C' ranging from 500 to 1500 mg/100 g pulp. Fruits are also rich in pectin and minerals like iron, calcium, phosphorus. The aonla has been recommended by Ayurveda for balanced diet and sound health and is important ingredient of triphala and chavanprash. Due to multipurpose uses, the demand of aonla fruits is increasing day by day. Because of wide adaptive nature, this fruit crop is mainly grown on dry land and waste land soils where major nutrients are deficient and limited irrigation facilities are available. Its cultivation has become quite popular in arid irrigated regions of Rajasthan, owing to its high nutritive and medicinal value and having higher productivity even in the wasteland. It is also a value added horticultural crop which has bright future prospects for export, particularly to European countries. In Indian fruit industry, poor nutrition is the major cause of low orchard efficiency resulting poor productivity and poor fruit quality. Sufficient information on nutrient management in fruit crops has been generated, but response and requirement of nutrients of perennial fruit crops vary markedly in a particular area depending on soil and climatic conditions and also depend on growth, bearing habit, age, root stock and management practices. Balanced nutrition of fruit crops is paramount importance particularly in arid areas having largely sandy soils of of the orchards for their fertility status is done. For knowing the exact status of mineral nutrition in the fruit trees, survey of the orchards for their fertility status and plant nutrients is done. Studies on nutritional survey of arid fruits in Rajasthan are meagre inspite of their great importance and relevance. With this aim, the present study was undertaken to evaluate the micronutrient fertility status of different orchards in Sikar district of Rajasthan.

Materials and Methods

The present investigation were carried out in Sikar district at the orchards of 8 aonla fruit growers spread over the whole district during the year 2007-2008. Orchards were selected in such a way that these can represent general conditions of area under study. The details of locations and name of the fruit growers are given in table.

S.No.	Name of fruit grower	Village	location
1.	Sh. Balbir Singh	Rashidpura	Rashidpura
2.	Shri Dana Ram	Rehnawa	Rehnawa
3.	Shri Raju Sen	Laxmangarh	Laxmangarh
4.	Shri Puran Mal Shartma	Sargoth	Sargoth
5.	Shri Roopchand Pipaliwal	Pachar	Pachar I
6.	Shri Kana Ram	Pachar	Pachar II
7.	Shri Panna Ram	Pachar	Pachar VI
8.	Govt. Nursery	Palsana	Palsana I

Soil samples were collected from eight fruit orchards, on the basis of variability and orchard performance at different locations of Sikar district. Thereafter, from each selected orchards, three soil profiles, based on soil fertility variation and plant performance were taken up. One hundred ninety two representative composite soil samples at different soil depths viz., 0-15, 15-30, 30-45, 45-60, 60-75, 75-90, 90-105 and 105-120 cm. were collected. After processing, the soil samples were analyzed for micronutrients. The available Fe, Cu, Zn, and Mn were extracted with DTPA solution as per procedure of Lindsay and Norvell (1978) and were determined by atomic absorption spectrophotometry.

Results and discussion

The distribution of DTPA extractable micronutrients as depth wise in 8 aonla fruit orchards in Sikar district of Rajasthan was studied.

DTPA extractable Iron: The extractable iron in soils ranged from 2.28 to 6.51 mg kg^{-1} which showed a regular decreasing trend with increasing depths. It is evident that 50 per cent soil samples drawn from surface soil depth of aonla orchards were deficient and remaining 50 per cent were sufficient in DTPA extractable iron in the present study. The deficient to sufficient status of iron found in the soil might be due to calcareousness, low organic carbon content, light textured coarse sandy soils. Lal and Biswas (1973) observed that available iron content ranged from 0.3 to 5.6 ppm in Rajasthan soils and it was low i.e. 2 ppm in the desert soils, whereas, similar observations were reported by Kumawat (2005) and Rohitash (2007). These finding are in conformity to the results of present investigation.

DTPA extractable zinc: The DTPA extractable zinc content in the soils ranged from 0.203 to 0.990 with the mean value of 0.587 of all the soil depths. Taking 0.60 mg kg^{-1} as critical limit given by Tandon, 1992, 50 per cent soil samples drawn from surface soil depth of aonla orchards were deficient and remaining 50 per cent were sufficient in with respect to available zinc content and also showed a regular decreasing trend with increase in depth. The deficiency of zinc in soils might be due to the presence of quartz, feldspar or the exchange complex being such as to have sites saturated with Ca/ Mg under alkaline soil reaction. Calcareous nature and low organic matter are some of the other properties where low levels of zinc are anticipated. These results are in accordance with the findings of Bhatnagar and Chandra (2003), Kumawat (2005) and Rohitash (2007).

DTPA extractable copper: It is evident that the DTPA extractable copper content of soil depths ranged from 0.110 to 0.493 mg kg^{-1} with their mean value 0.238 mg kg^{-1}. The copper content showed a regular decreasing trend with increase in depth. The 50 per cent soil samples drawn from surface soil depth of aonla orchards were deficient and remaining 50 per cent were sufficient in with respect to available copper content. The deficient to sufficient available copper status of orchard soil might be due to high pH, calcareousness, lower organic carbon and light textured coarse sandy soils. The present results are in accordance with those reported by Baser and Lodha (1971) who reported that available copper status in sandy soils of Rajasthan varied from 0.05 to 2.38 ppm. Similar types of results have also been reported by Bhatnagar and Chandra (2003) who reported available copper status in sandy soils of Rajasthan varied from 0.08 to 0.51 ppm.

DTPA extractable manganese: The data presented on DTPA extractable manganese content of orchard soils showed a regular decreasing trend with increase in depths. The DTPA extractable manganese content in the soils ranged from 1.36 to 5.19 mg kg^{-1} with their mean value of 3.00 of all the soil depths. Twenty five per cent soil samples of aonla were found deficient and remaining 75 per cent were sufficient in respect to DTPA extractable manganese. Results of DTPA extractable manganese in all the orchards clearly indicate that deficiency of manganese in the aonla orchards is now coming. The deficiency of DTPA extractable manganese might be due to the presence of high $CaCO_3$ content and low organic carbon content. These results are in accordance with those reported by Bhatnagar and Chandra (2003) and Kumawat (2005).

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Table 1. DTPA Extractable Iron (mg kg^{-1}) in Aonla Orchards at Different Soil Depths in Sikar District

Location of orchards	Soil depths (cm)								
	0-15	15-30	30-45	45-60	60-75	75-90	90-105	105-120	Mean
Rashidpura	2.50 ±0.34	2.47 ±0.10	2.46 ±0.09	2.44 ±0.08	2.41 ±0.08	2.38 ±0.08	2.32 ±0.08	2.28 ±0.51	2.41 ±0.24
Rehnawa	4.24 ±0.05	4.22 ±0.05	4.20 ±0.05	4.16 ±0.07	4.12 ±0.06	4.08 ±0.06	4.04 ±0.06	3.99 ±0.37	4.13 ±0.17
Laxmangarh	3.34 ±0.04	3.32 ±0.86	3.29 ±0.05	3.22 ±0.07	3.20 ±0.07	3.16 ±0.06	3.10 ±0.07	3.05 ±0.35	3.21 ±0.34
Sargoth	3.83 ±0.04	3.81 ±0.05	3.78 ±0.77	3.71 ±0.00	3.72 ±0.07	3.67 ±0.07	3.63 ±0.06	3.60 ±0.40	3.72 ±0.32
Pachar – I	4.65 ±0.05	4.62 ±0.04	4.58 ±0.05	4.54 ±0.04	4.49 ±0.06	4.47 ±0.06	4.41 ±0.84	4.71 ±1.70	4.56 ±0.68
Pachar – II	5.37 ±0.04	5.35 ±0.04	5.32 ±0.04	5.31 ±0.00	5.23 ±0.84	5.18 ±0.05	5.14 ±0.05	5.07 ±0.42	5.25 ±0.35
Pachar – VI	6.51 ±0.10	6.48 ±0.10	6.48 ±0.08	6.44 ±0.07	6.38 ±0.07	6.35 ±0.06	6.30 ±0.03	6.25 ±0.38	6.40 ±0.17
Palsana – I	6.08 ±0.06	6.06 ±0.06	5.99 ±0.08	5.97 ±0.08	5.89 ±0.09	5.86 ±0.09	5.81 ±0.09	5.77 ±0.32	5.93 ±0.17
Mean	4.56	4.54	4.51	4.47	4.43	4.39	4.34	4.34	

± indicates standard deviation, Deficient – 50%, Sufficient – 50%

Table 2. DTPA Extractable Zinc (mg kg^{-1}) in Aonla Orchards at Different Soil Depths in Sikar District

Location of orchards	Soil depths (cm)								
	0-15	15-30	30-45	45-60	60-75	75-90	90-105	105-120	Mean
Rashidpura	0.357 ±0.021	0.340 ±0.024	0.313 ±0.021	0.293 ±0.025	0.270 ±0.028	0.237 ±0.033	0.233 ±0.017	0.203 ±0.025	0.281 ±0.057
Rehnawa	0.560 ±0.051	0.537 ±0.056	0.520 ±0.057	0.497 ±0.056	0.470 ±0.054	0.440 ±0.059	0.413 ±0.057	0.387 ±0.058	0.478 ±0.080
Laxmangarh	0.413 ±0.017	0.393 ±0.021	0.370 ±0.029	0.347 ±0.033	0.313 ±0.025	0.293 ±0.025	0.283 ±0.025	0.260 ±0.037	0.334 ±0.058
Sargoth	0.653 ±0.045	0.630 ±0.043	0.603 ±0.039	0.577 ±0.042	0.550 ±0.036	0.530 ±0.036	0.513 ±0.039	0.493 ±0.039	0.569 ±0.067
Pachar – I	0.850 ±0.043	0.827 ±0.047	0.810 ±0.050	0.797 ±0.048	0.773 ±0.045	0.750 ±0.043	0.730 ±0.043	0.707 ±0.045	0.780 ±0.065
Pachar – II	0.953 ±0.033	0.933 ±0.033	0.913 ±0.033	0.897 ±0.029	0.873 ±0.033	0.857 ±0.042	0.840 ±0.037	0.817 ±0.033	0.885 ±0.056
Pachar – VI	0.530 ±0.057	0.503 ±0.042	0.483 ±0.042	0.460 ±0.185	0.440 ±0.037	0.420 ±0.045	0.397 ±0.046	0.517 ±0.061	0.469 ±0.091
Palsana – I	0.990 ±0.016	0.973 ±0.012	0.953 ±0.012	0.927 ±0.017	0.903 ±0.021	0.880 ±0.024	0.843 ±0.026	0.770 ±0.086	0.905 ±0.077
Mean	0.663	0.642	0.621	0.599	0.574	0.551	0.532	0.519	

± indicates standard deviation, Deficient – 50%, Sufficient – 50%

Table 3. DTPA Extractable Copper (mg kg^{-1}) in Aonla Orchards at Different Soil Depths in Sikar District

Location of orchards	Soil depths (cm)								
	0-15	15-30	30-45	45-60	60-75	75-90	90-105	105-120	Mean
Rashidpura	0.177 ±0.039	0.167 ±0.031	0.157 ±0.031	0.143 ±0.026	0.153 ±0.026	0.143 ±0.026	0.133 ±0.012	0.120 ±0.008	0.149 ±0.032
Rehnawa	0.190 ±0.041	0.173 ±0.029	0.163 ±0.021	0.153 ±0.021	0.143 ±0.012	0.137 ±0.017	0.137 ±0.009	0.127 ±0.009	0.153 ±0.030
Laxmangarh	0.193 ±0.029	0.183 ±0.029	0.167 ±0.012	0.153 ±0.009	0.147 ±0.005	0.137 ±0.005	0.130 ±0.000	0.120 ±0.000	0.154 ±0.029
Sargoth	0.177 ±0.012	0.163 ±0.017	0.150 ±0.008	0.140 ±0.008	0.130 ±0.000	0.123 ±0.005	0.120 ±0.000	0.110 ±0.000	0.139 ±0.023
Pachar – I	0.333 ±0.012	0.313 ±0.012	0.297 ±0.009	0.280 ±0.008	0.257 ±0.009	0.237 ±0.009	0.217 ±0.009	0.190 ±0.014	0.265 ±0.047
Pachar – II	0.367 ±0.040	0.350 ±0.043	0.333 ±0.045	0.313 ±0.045	0.293 ±0.045	0.273 ±0.045	0.250 ±0.043	0.220 ±0.043	0.300 ±0.064
Pachar – VI	0.493 ±0.012	0.467 ±0.012	0.443 ±0.009	0.420 ±0.008	0.407 ±0.012	0.377 ±0.017	0.357 ±0.017	0.330 ±0.016	0.412 ±0.054
Palsana – I	0.430 ±0.016	0.410 ±0.016	0.383 ±0.017	0.363 ±0.009	0.330 ±0.008	0.300 ±0.008	0.270 ±0.008	0.243 ±0.012	0.341 ±0.064
Mean	0.295	0.278	0.262	0.246	0.233	0.216	0.202	0.183	

± indicates standard deviation, Deficient – 50%, Sufficient – 50%

Table 4. DTPA Extractable Manganese (mg kg^{-1}) in Aonla Orchards at Different Soil Depths in Sikar District

Location of orchards	Soil depths (cm)								
	0-15	15-30	30-45	45-60	60-75	75-90	90-105	105-120	Mean
Rashidpura	1.84 ±0.05	1.69 ±0.09	1.62 ±0.08	1.57 ±0.09	1.51 ±0.09	1.46 ±0.10	1.42 ±0.11	1.37 ±0.12	1.56 ±0.17
Rehnawa	1.94 ±0.02	1.71 ±0.18	1.64 ±0.20	1.57 ±0.21	1.51 ±0.21	1.48 ±0.61	1.42 ±0.22	1.36 ±0.23	1.58 ±0.33
Laxmangarh	2.25 ±0.81	2.19 ±0.00	2.11 ±0.00	2.04 ±0.01	1.99 ±0.01	1.93 ±0.02	1.89 ±0.03	1.81 ±0.02	2.03 ±0.32
Sargoth	2.84 ±0.02	2.76 ±0.02	2.70 ±0.02	2.64 ±0.02	2.59 ±0.02	2.52 ±0.01	2.49 ±0.02	2.44 ±0.03	2.62 ±0.13
Pachar – I	3.46 ±0.02	3.40 ±0.01	3.33 ±0.03	3.27 ±0.03	3.21 ±0.02	3.15 ±0.02	3.10 ±0.01	3.01 ±0.04	3.24 ±0.15
Pachar – II	3.80 ±0.03	3.70 ±0.05	3.63 ±0.82	3.56 ±0.05	3.52 ±0.06	3.45 ±0.04	3.39 ±0.03	3.32 ±0.01	3.55 ±0.33
Pachar – VI	5.19 ±0.02	5.09 ±0.07	5.01 ±0.08	4.95 ±0.07	4.90 ±0.08	4.84 ±0.09	4.78 ±0.10	4.73 ±0.11	4.94 ±0.17
Palsana – I	4.76 ±0.80	4.66 ±0.82	4.60 ±0.01	4.55 ±0.03	4.50 ±0.02	4.43 ±0.03	4.26 ±0.14	4.31 ±0.00	4.51 ±0.44
Mean	3.26	3.15	3.08	3.02	2.97	2.91	2.84	2.79	

± indicates standard deviation, Deficient – 25%, Sufficient – 75%