RESEARCH ARTICLE

PHYSIO-CHEMICAL PROPERTIES OF SOIL IN KINNOW ORCHARD IN IRRIGATED AREA OF SRIGANGANAGAR DISTRICT IN RAJASTHAN

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Received-02.07.2018, Revised-20.07.2018

Abstract: The experiment was conducted on "Physio-chemical properties of soil in kinnow orchard in irrigated area of sriganganagar district in rajasthan" during April, 2016 to April, 2017. The ninety soil samples with three depths *i.e.*, 0-30, 30-60 and 60-90 cm were collected from thirty kinnow orchards from different five tehsil (suratgarh, Raisinghnagar, sri vijaynagar, sri karanpur and sriganaganagar) of sriganganagar district. The soil samples were analyzed for physio-chemical property of kinnow orchards being grown at farmer's field. The kinnow orchard soils in this investigation were found the results showed that the pH and electrical conductivity of soil samples decreased with increasing soil depth, whereas, reverse trend was observed in calcium carbonate content. The kinnow orchard soils were found low in organic carbon.

Keyword: Orchard, Depth, Soil, L (location), Sample.

INTRODUCTION

India has large arid zones covering an area of 317090 sq km mainly located in the North-West parts of the country Rajasthan alone covers 62 per cent area under arid zone. Fruit cultivation in India is spread over an area of 6.8 million hectares with 92.84 MT fruit production (NHB 2016-17). In Rajasthan, fruit crops cover an area of 46.5 thousand hectares, out of which area under kinnow cultivation is 8821 hectare and production is 189483 tonnes (Rajasthan Agricultural Statistics at a glance) indicated that still there is a scope to increase the area and productivity level of kinnow fruits cultivation in the state. Kinnow mandarin is one of the introduced citrus varieties, occupies a predominant place in the citrus industry of India. Most of the kinnow growing areas are confined to north western arid zones of India. Introduction of kinnow to this area changed the landscape of arid Thar Desert. North western India is characterized by low rainfall with temperature ranging from 5^0C in winter to 48^0C in summer having soil type of old alluvium to sandy. Soils are mainly alkaline with pH ranging from 7.5 to 9.0. The production of high quality fruits of kinnow requires semi-arid and subtropical climate with less than 300 mm rainfall. It can grow successfully in almost all types of soils, but deep sandy loam soils are best suitable for kinnow orchard.

MATERIALS AND METHODS

The investigation entitled "Physio-chemical properties of soil in kinnow orchard in irrigated area of sriganganagar district in rajasthan" was under taken during April 2016 to April 2017. The materials used and the methods followed the course of investigation are described in this chapter

Location

Kinnow orchards under study are located in different villages/chaks of Sriganganagar district comprising a part of Agro climate zone I b (Irrigated north-western plain) of Rajasthan. It is situated between $28°4^1$ to $30°6^1$ north latitude and $72°31^1$ 'to 75° east longitude. It is surrounded by Firozepur district of Punjab in north. Hanumangarh district in east; Bikaner district in south and the international border of the Pakistan in north and north-west.

Characteristics of soil

The soils have developed from alluvial deposit of river Gaggar in the of flood plains of Sriganganagar district and are yellowish brown to light grey, well drained medium soil texture which varies from sandy loam to loam. In the upper layer in some pockets is calcareous but the lower horizons are calcareous in nature with accumulation of concentrations.

SOIL SAMPLING AND ANALYSIS

Collection of soil samples

Soil sample were collected from 30 Kinnow orchards located at different locations of Sriganganagar district. In all one hundred twenty representative of composite soil samples from different depths *viz;* 0-30, 30-60, 60-90 cm were collected. Samples were air dried ground and passed through 2 mm sieve and stored properly labeled polythene bags for analysis. The methods of soil analysis are given in table 2

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Methods of soil analysis

SNo.	Properties	Procedure	Reference
I. Physico-chemical characteristics of soil			
1	Soil reaction (pH_2)	1:2 soil water suspension with the help of pH meter	USDA Handbook No. 60 Richards (1954)
2	Electrical conductivity (EC_2)	1:2 soil water suspension with the help of standard precision conductivity bridge	USDA Handbook No. 60 Richards (1954)
3	Organic carbon (g kg^{-1})	Walkley and Black's rapid titration method	Piper (1950)
4	$CaCO_3$ (g kg^{-1})	Hutchinson rapid titration method	Piper (1950)

RESULTS AND DISCUSSION

Soil reaction (pH_2)

A perusal of data mentioned in table 1 indicates that the pH_2 of study area soil varied from 8.03 (L_{19}) to 8.65(L_3), 7.71(L_{23}) to 8.50 (L_2, L_{10}, L_{14} and L_{15}) and 7.69 (L_{23}) to 8.50 (L_{10}) at 0-30, 30- 60 and 60-90 cm depths of soil with mean value of pH_2 8.44, 8.27 and 8.17, respectively. Mostly the pH of soils at different orchards showed an increasing trend with depth. The same result was found Balpande *et al.* (2007), Kumar (2007) and Bhatnager and Singh (2014) were also reported increasing trend of pH with increasing soil depth.

Electrical conductivity (EC_2)

The electrical conductivity of soils is the measure of the total concentration of soluble salts. Data pertaining to electrical conductivity of soils at various depths are presented in Table 2. The data showed that minimum electrical conductivity 0.19 dSm^{-1} 0 - 30 cm depth was recorded in orchards L_7 and L_9 and maximum 0.0.66 dSm^{-1} was recorded in L_{15} orchard with mean value of 0.42 d Sm^{-1}. Data further revealed that at depth 30 to 60 cm the minimum EC 0.12 dSm^{-1} was recorded in orchard L_{30}, whereas, maximum EC 0.58 dSm^{-1} was observed in soil of orchard L_5 with mean value of EC 0.36 dSm^{-1}. A perusal of data indicated that EC of soils at depth 60 to 90 cm varied from 0.11 (L_{27}) to 0.57 (L_{11}) dSm^{-1} with mean value of 0.30 dSm^{-1}. In general, soils of the area are saline in nature. Data pertaining to the electrical conductivity of soils revealed that the electrical conductivity showed irregular trend with increase of soil depth. The result similarly, reported by Kumar (2007) also observed EC in the range of 0.11 to 0.40 dSm^{-1} in aonla orchards of Bikaner district. Jat (2008) also observed decreasing pattern of EC with the increase in soil depth

Calcium carbonate

Calcium carbonate content of soil is a useful parameter to assess the extent of nutrient availability and their release behavior. The perusal of data (Table 3) indicates that the $CaCO_3$ content at depth 0-30 cm varied from 23.50 to 102.50 g kg^{-1}. The minimum calcium carbonate content (23.50 g kg^{-1}) recorded in soils of orchards L_{19}, whereas, maximum (102.50 g kg^{-1}) in orchards L_6 with mean value of 60.35 g kg^{-1}. Similarly, the $CaCO_3$ content at depth 30-60 cm ranged from 30.0 to 106.0 g kg^{-1} with mean value of 67.45 g kg^{-1}. Data further indicates that the minimum $CaCO_3$ content at this depth was noticed in soils of orchards L_{19}, while, maximum in soils of orchard L_6, the $CaCO_3$ content at depth 60-90 cm varied from 43.6 to 125.0 g kg^{-1} with mean value of 72.43 g kg^{-1}. The perusal of data revealed that minimum amount of $CaCO_3$ at this depth was noticed in soils of orchard L_{23}, while maximum $CaCO_3$ in soils of orchard L_2. Data presented in Table 3 indicates that $CaCO_3$ content showed increasing trend with depth. Similarly results recorded by Sharma (2002) also observed irregular trend of calcium carbonate with soil depth in kinnow orchards located at Sriganganagar district, these findings corroborates with present findings and conformation of this result Kumar (2004), Jat (2008), Dhale and Prasad (2009), Bhatnager and Singh (2014).

Organic carbon

The organic carbon content of soils not only plays an important role in increasing cation exchange capacity of soils but also influences directly or indirectly on many important properties of soils. Thus it contributes in maintaining the fertility status of soils.

Data related to soil organic carbon content are presented in Table 4 indicates that the minimum organic carbon content 0.70 g kg^{-1} at depth, 0 to 30 cm was recorded in soils of orchard L_1, L_2, L_3, L_4 and L_5, while maximum 1.80 g kg^{-1} in soils of orchard L_{17} and L_{26} with mean value of 1.17 g kg^{-1}. On the other hand, the organic carbon at depth 30 to 60 cm varied from 0.30 to 0.70 g kg^{-1}. Minimum and maximum organic carbon content at this depth were recorded in soils of orchards L_{14} and L_{18}, L_{26}, L_{29} and L_{30} with the mean value of organic carbon was recorded 0.52 g kg^{-1}, respectively.

The organic carbon content in soils of lower most depth (60 to 90 cm) varied from 0.10 to 0.50 g kg^{-1}. Minimum and maximum organic carbon content at this depth were recorded in soils of orchards L_3 to L_6, L_{10}, L_{19}, L_{20}, L_{23}, L_{25} to L_{29} and L_{24} with the mean

value of organic carbon was recorded 0.19 g kg^{-1} respectively. Organic carbon content showed a regular decreasing trend with soil depth.The same results reported by Bhatnager (2000), Prakash (2001) and Kumar (2007). Balpande *et al.* (2007) and Dhale and Prasad (2009) reported higher organic carbon content in the orchards of Maharashtra. Marathe and Bharambe (2007) observed higher organic carbon content in the soil of regional fruit research station Nagpur.

Table 1. pH_2 in kinnow orchards of Sriganganagar district at different soil depths

	Depths (cm)			
Sample No.	**0-30**	**30-60**	**60-90**	**Mean**
L_1	8.50	8.40	8.25	8.38
L_2	8.60	8.50	8.45	8.52
L_3	8.65	8.40	8.35	8.47
L_4	8.65	8.40	8.35	8.47
L_5	8.55	8.35	8.30	8.40
L_6	8.50	8.35	8.30	8.38
L_7	8.56	8.45	8.35	8.45
L_8	8.48	8.13	8.00	8.20
L_9	8.52	8.10	7.90	8.17
L_{10}	8.39	8.50	8.50	8.46
L_{11}	8.41	8.35	8.05	8.27
L_{12}	8.35	8.28	7.76	8.13
L_{13}	8.54	8.45	8.35	8.45
L_{14}	8.53	8.50	8.38	8.47
L_{15}	8.56	8.50	8.40	8.49
L_{16}	8.54	8.15	7.70	8.13
L_{17}	8.45	8.37	8.32	8.38
L_{18}	8.39	8.35	8.27	8.34
L_{19}	8.03	7.90	7.68	7.87
L_{20}	8.55	8.13	8.10	8.26
L_{21}	8.25	8.05	7.95	8.08
L_{22}	8.19	7.95	7.78	7.97
L_{23}	8.23	7.71	7.69	7.88
L_{24}	8.26	8.00	8.00	8.09
L_{25}	8.52	8.23	8.15	8.30
L_{26}	8.55	8.27	8.30	8.37
L_{27}	8.49	8.33	8.41	8.41
L_{28}	8.19	8.40	8.45	8.35
L_{29}	8.38	8.30	8.23	8.30
L_{30}	8.48	8.31	8.25	8.35
Minimum	**8.03**	**7.71**	**7.69**	**-**
Maximum	**8.65**	**8.50**	**8.50**	**-**
Average	**8.44**	**8.27**	**8.17**	**-**
C.V.	**1.78**	**2.40**	**3.10**	**-**

Table 2. Electrical conductivity (dSm^{-1}) in kinnow orchards of Sriganganagar district at different soil depths

	Depths (cm)			
Sample No.	**0-30**	**30-60**	**60-90**	**Mean**
L_1	0.56	0.56	0.48	0.53
L_2	0.55	0.55	0.46	0.52
L_3	0.53	0.52	0.45	0.50
L_4	0.58	0.51	0.41	0.50
L_5	0.55	0.58	0.47	0.53
L_6	0.57	0.55	0.46	0.53

L_7	0.19	0.17	0.18	0.18
L_8	0.20	0.20	0.21	0.20
L_9	0.19	0.23	0.28	0.23
L_{10}	0.21	0.19	0.16	0.19
L_{11}	0.32	0.30	0.57	0.40
L_{12}	0.24	0.21	0.20	0.22
L_{13}	0.58	0.34	0.15	0.36
L_{14}	0.49	0.33	0.14	0.32
L_{15}	0.66	0.44	0.20	0.43
L_{16}	0.52	0.32	0.13	0.32
L_{17}	0.43	0.21	0.15	0.26
L_{18}	0.39	0.18	0.15	0.24
L_{19}	0.51	0.45	0.42	0.46
L_{20}	0.59	0.56	0.39	0.51
L_{21}	0.53	0.51	0.49	0.51
L_{22}	0.50	0.46	0.45	0.47
L_{23}	0.46	0.45	0.44	0.45
L_{24}	0.49	0.46	0.45	0.47
L_{25}	0.23	0.18	0.15	0.19
L_{26}	0.25	0.20	0.15	0.20
L_{27}	0.44	0.37	0.11	0.31
L_{28}	0.28	0.24	0.20	0.24
L_{29}	0.30	0.30	0.23	0.28
L_{30}	0.25	0.12	0.14	0.17
Minimum	**0.19**	**0.12**	**0.11**	**-**
Maximum	**0.66**	**0.58**	**0.57**	**-**
Average	**0.42**	**0.36**	**0.30**	**-**
C.V.	**35.50**	**41.64**	**50.36**	**-**

Table 3. Calcium carbonate (g kg^{-1}) in kinnow orchards of Sriganganagar district at different soil depths

	Depths (cm)			
Sample No.	**0-30**	**30-60**	**60-90**	**Mean**
L_1	81.00	103.01	117.00	100.34
L_2	80.01	101.52	125.00	102.18
L_3	98.00	103.01	109.91	103.64
L_4	98.01	102.03	105.52	101.85
L_5	93.51	99.53	110.41	101.15
L_6	102.50	106.00	107.53	105.34
L_7	66.82	68.55	76.53	70.63
L_8	67.23	67.32	77.55	70.70
L_9	65.81	69.97	75.36	70.38
L_{10}	67.00	67.51	74.00	69.50
L_{11}	69.54	69.65	80.02	73.07
L_{12}	65.81	68.82	77.35	70.66
L_{13}	38.01	63.03	63.51	54.85
L_{14}	37.52	62.40	62.70	54.21
L_{15}	34.11	64.05	66.60	54.92
L_{16}	37.21	64.40	62.51	54.71
L_{17}	36.33	64.81	64.52	55.22
L_{18}	38.52	63.51	67.31	56.45
L_{19}	23.50	30.00	45.21	32.90

L_{20}	37.01	44.52	46.43	42.65
L_{21}	44.00	43.52	45.00	44.17
L_{22}	40.05	45.51	44.12	43.23
L_{23}	40.51	42.51	43.60	42.21
L_{24}	31.53	43.55	45.71	40.26
L_{25}	70.04	61.41	67.00	66.15
L_{26}	69.52	61.10	62.00	64.21
L_{27}	69.51	61.60	59.81	63.64
L_{28}	70.90	61.11	63.42	65.14
L_{29}	68.51	60.11	62.71	63.78
L_{30}	68.55	59.42	64.50	64.16
Minimum	**23.50**	**30.0**	**43.60**	**-**
Maximum	**102.50**	**106.0**	**125.0**	**-**
Average	**60.35**	**67.45**	**72.43**	**-**
C.V.	**36.94**	**30.09**	**31.93**	**-**

Table 4. Organic carbon (g kg^{-1}) in kinnow orchards of Sriganganagar district at different soil depths

	Depths (cm)			
Sample No.	**0-30**	**30-60**	**60-90**	**Mean**
L_1	0.70	0.51	0.21	0.47
L_2	0.70	0.42	0.10	0.40
L_3	0.70	0.41	0.10	0.40
L_4	0.70	0.43	0.10	0.40
L_5	0.70	0.40	0.10	0.40
L_6	0.81	0.47	0.10	0.43
L_7	0.92	0.45	0.22	0.50
L_8	1.00	0.51	0.21	0.57
L_9	1.12	0.50	0.21	0.60
L_{10}	1.21	0.66	0.11	0.63
L_{11}	1.00	0.57	0.22	0.57
L_{12}	0.92	0.41	0.23	0.50
L_{13}	1.21	0.62	0.30	0.70
L_{14}	1.13	0.30	0.25	0.53
L_{15}	1.54	0.43	0.31	0.73
L_{16}	1.21	0.41	0.21	0.60
L_{17}	1.80	0.61	0.32	0.90
L_{18}	1.21	0.70	0.43	0.77
L_{19}	1.00	0.52	0.11	0.53
L_{20}	1.55	0.62	0.10	0.73
L_{21}	1.42	0.41	0.22	0.67
L_{22}	1.51	0.60	0.21	0.77
L_{23}	1.72	0.55	0.12	0.77
L_{24}	1.12	0.41	0.50	0.67
L_{25}	1.61	0.61	0.10	0.77
L_{26}	1.80	0.70	0.10	0.87
L_{27}	1.13	0.41	0.10	0.53
L_{28}	1.00	0.62	0.10	0.57
L_{29}	1.00	0.70	0.10	0.60
L_{30}	1.61	0.70	0.21	0.83
Minimum	**0.70**	**0.30**	**0.10**	**-**
Maximum	**1.80**	**0.70**	**0.50**	**-**

Average	**1.17**	**0.52**	**0.19**	**-**
C.V.	**29.57**	**21.78**	**54.78**	**-**

CONCLUSION

The pH of soils study area were found neutral to saline nature, normal in electrical conductivity, high in $CaCo_{3,}$ low in organic carbon in kinnow orchard at sriganganagar distict of Rajasthan.

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