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Short communication: Soil characteristics in Attock district

Muhammad Yunas[1*], Shahzada Munawar Mehdi[2], Obaid ur Rehman[3], Sarfraz Ahmed[1], Sher Afzal[1] and Bashir Ahmad[4]
[1]Soil and Water Testing Laboratory, Attock, Pakistan.
[2]Soil Fertility Research Institute Punjab, Lahore, Pakistan.
[3]Soil and Water Testing Laboratory, Rawalpindi, Pakistan.
[4]Soil and Water Testing Laboratory, Mandi Bahauddin, Pakistan.
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Abstract

Soil testing for physical and chemical characteristics of a soil is key in assessment of a soil fertility that leads to productivity of a soil. A total of 11231 soil samples from six tehsils of Attock district were collected during five years (2012-17). Samples were analyzed for different parameters like pH, EC (1:10), texture, organic matter, Olsen Phosphorus and NH_4-acetate extractable Potassium. As regards pH, 98% samples ranged between 7.5-8.5 while 97% samples were normal with respect to salinity/sodicity (ECe<4 dSm^{-1} and SAR<15). Similarly 22% samples were light and 78% were medium in texture. Soils (96%) were poor in organic matter (<0.86%) while 99% had available phosphorus <7 mg kg^{-1}. 1362 soil samples were also analyzed for potassium showing poor in 31% samples (<80 mg kg^{-1}) while 69% samples lie in satisfactory to adequate range (81-180 mg kg^{-1}). Depending upon the soil analysis, farmers were guided for fertilizer recommendations according to climate suitability, crop/orchard/vegetable and water/rainfall conditions as being implemented throughout the rain fed conditions of the Punjab by the Directorate of Soil Fertility, Thokar Niaz Beg, Lahore.

Keywords: Soil fertility, salinity, fertilizer recommendations, Attock

The Attock district came into existence in 1908 with global positioning of 33.4620º N latitude and 72.2260º E longitude. District covers an area of 693 thousand hectares with total area sown of 242 thousand hectares in which 211 thousand hectares is un irrigated and 31 thousand hectares is irrigated through different sources like canals, wells, tube wells etc. (Punjab Dev. Statistics, 2016) and divided into six tehsils with 72 union councils consisting of 435 villages. According to 2017 census, total population of the district is about 1.88 million. Whole district is a combination of plains and sub mountain which is interspersed by an irregular hilly system. The most important is of Kala Chitta Hills spreading over a length of 72 km with 19 km in width. Due to low fertility of land and small holdings, the socio-economic condition of people is poor. District Attock has a changeable climate with warm wet summers and cold winter. Maximum temperature in summer reaches up to 50ºC and winter minimum temperature touches -2ºC. The average rainfall in district Attock is 783 mm (Anonymous, 2018).

Soil analysis has been used as an aid to assess soil fertility and plant nutrient management or "Soil Health" and to maximize yield based on the recommendation of fertilizer (Kausar *et al.*, 2016). Soil testing is a better way than deficiency symptoms and plant tissue analysis because it helps in calculating the nutrient need of the plant before crop is planted. It is simpler and less time consuming than other methods (Aamer *et al.*, 2015). In order to maximize agricultural production and conserve land resources, the knowledge about fertility status of the site is very important (Farmanullah *et al.*, 2011). Soil texture as physical property while EC, pH, organic matter and nutrient contents as chemical properties usually indicate fertility and productivity status of a soil (Khattak and Hussain, 2007).

Soil sampling, analysis and the interpretation of the analytical data are the major steps leading to fertilizer recommendations of a soil among the first of three equally important steps in managing the nutrients required by plants. The second is the interpretation of the analytical data leading to the third step, recommendations for nutrient additions, as fertilizers or manures, to optimize crop yields while minimizing any adverse environmental impact from their application. The nutrient additions recommendations to soil is currently based on well- established methods of soil analysis. This will pave the way to upscale the activities concerning Right fertilizer/nutrient at the Right rate at the Right time in the Right place i.e. 4R nutrient stewardship (FAO, 2017). Soil test calibration across disparate locations, however, remains necessary for establishing firm relationship between the level of soil nutrient and crop

*Email: soilscientist2002@gmail.com

response to fertilizer in the real-life field situations (Dey, 2016). Soil fertility status of Attock, Rawalpindi and Gujrat have shown that soils are deficient in organic matter and available phosphorus and fertilizer recommendations/application based on soil tests are pre requisite for higher crop yields (Obaid *et al.*, 2010). Soil testing provides very useful information about the changing productivity and fertility level of the soils from time to time (Amrit, 2016). Nutrient wise fertilizer offtake and use in 2016-17 of District Attock was NPK @ 5856: 1013: 0 Tons ha^{-1} which was very low as compared to other districts (NFDC, 2017).

Table 1: Soil salinity/sodicity

EC (dS m^{-1})	Soil pH	Remarks
< 4.0	7.0 – 8.1	Normal,
>4.0	7.0– 8.5	Saline soil
>4.0	> 8.5	Saline-sodic soil
< 4.0	> 8.5	Sodic soil

Table 2: Soil texture

SP%	Texture
19	Sandy
20-30	Sandy loam
31-45	Loam
46-60	Clay loam
>60	Clay

Table 3: Soil fertility

Soil fertility	Organic matter (%)	Available P (mg kg^{-1})	Available K (mg kg^{-1})
Poor	< 0.86	0-7	< 80
Satisfactory	0.87-1.29	8-15	81-180
Adequate	> 1.29	> 15	>180

For this purpose, an attempt has been made to characterize the soil fertility and salinity status of district Attock and hence a step forward for judicious use of fertilizer by following recommendations based on soil analysis.

Composite soil samples under advisory service from the whole district were collected during previous five years (2012-13 to 2016-17) from 0-15 cm and 15-30 cm depth for crops and vegetables while, 0-15 cm, 15-30 cm, 30-60 cm, 60-90 cm, 90-120 cm and 120-150 cm depths from fruit orchards. Samples were air dried, crushed and passed through 2 mm sieve before storing into plastic bottles. A total number of 11231 prepared soil samples were analyzed for physical and chemical properties from six tehsils of Attock district. Electrical conductivity (EC) was measured through 1:10 soil and water suspension while pH and texture were recorded by making soil saturated paste. Organic matter content and available phosphorus were determined by using methods as mentioned by Malik *et al.*, 1984. The criteria used for classification of different characteristics is presented in table 1 soil salinity/sodicity, table 2 soil texture and table 3 soil fertility.

The number of soil samples analysed during the year 2012-17 are presented in table 4.

As higher number of soil samples were collected from tehsil Jand, Hazro and Fateh Jang, respectively, which shows a general progress of the farmers from these tehsils and a higher scope for the progress of crop productivity in tehsil Pindi Gheb, Hassan Abdal and Attock as to boost up agricultural activities.

As for as soil salinity is concerned, the data in table 5 showed that almost 97 percent soils of the district Attock are normal and each tehsil has more than 90 percent normal soil so can be used for agricultural purposes hence depicting a huge scope of commercial farming in the district.

The results are same as presented by Obaid *et al.*, (2010) and data showed 99.60% of the soil samples analysed in district attock were free from salinity/sodicity. Out of total, all soil samples were normal (97.6%) with no hazard of salinity (Sohail *et al.*, 2001). The electrical conductivity of more than 99 percent soil samples from Rawalpindi district were normal (Mahmood *et al.*, 1998). The data of soil in vegetable growing areas of Peshawar are none saline (Sajida *et al.*, 2010). On the basis of EC, maximum area had normal soil (86.76 percent) in Sargodha district however there were some patches of salinity in all tehsils which was 13.28 percent of total samples analysed

Table 4: Total Number of soil samples analysed during 2012-17

Year	Attock	Hazro	Hasan Abdal	Fateh Jang	Jand	Pindi Gheb	Total
2012-13	226	248	125	247	214	82	1142
2013-14	493	1409	338	1098	1142	338	4818
2014-15	144	519	162	416	903	198	2342
2015-16	286	491	102	273	394	108	1654
2016-17	93	309	161	87	465	160	1275
Total	**1242**	**2976**	**888**	**2121**	**3118**	**886**	**11231**

Table 5 Soil Salinity of the soil samples analysed

Tehsil	Normal	Saline	S. Sodic	Sodic	Total	Tehsil Wise % Age			
						Normal	Saline	S. Sodic	Sodic
Attock	1147	4	0	91	1242	92.4	0.3	0.0	7.3
Hazro	2842	0	11	123	2976	95.5	0.0	0.4	4.1
Hassan Abdal	888	0	0	0	888	100.0	0.0	0.0	0.0
Fateh Jang	2095	25	0	1	2121	98.8	1.2	0.0	0.0
Jand	3104	12		2	3118	99.6	0.4	0.0	0.1
Pindi Gheb	886	0	0	0	886	100.0	0.0	0.0	0.0
Total	10962	41	11	217	11231				
%Age	97.6	0.4	0.1	1.9	100				

Table 6: pH of the soil samples analysed

Tehsil	<7.5	7.5-8.5	>8.5	Total	Tehsil Wise % Age		
					<7.5	7.5-8.5	>8.5
Attock	19	1128	95	1242	1.5	90.8	7.6
Hazro	0	2840	136	2976	0.0	95.4	4.6
Hassan Abdal	0	888	0	888	0.0	100.0	0.0
Fateh Jang	0	2121	0	2121	0.0	100.0	0.0
Jand	10	3106	2	3118	0.3	99.6	0.1
Pindi Gheb	0	886	0	886	0.0	100.0	0.0
Total	29	10969	233	11231			
%Age	0.3	97.7	2.0	100			

Table 7: Soil texture of the soil samples analysed

Tehsil	Light	Medium	Heavy	Total	Tehsil Wise % Age		
					Light	Medium	Heavy
Attock	236	1006	0	1242	19.0	81.0	0.0
Hazro	479	2497	0	2976	16.1	83.9	0.0
Hassan Abdal	22	866	0	888	2.5	97.5	0.0
Fateh Jang	0	2121	0	2121	0.0	100.0	0.0
Jand	1667	1451	0	3118	53.5	46.5	0.0
Pindi Gheb	99	787	0	886	11.2	88.8	0.0
Total	2503	8728	0	11231			
%Age	22.3	77.7	0.0	100			

Table 8: Organic matter content of the soil samples analysed

Tehsil	Poor	Satisfactory	Adequate	Total	Tehsil Wise % Age		
					Poor	Satisfactory	Adequate
Attock	1159	65	18	1242	93.3	5.2	1.4
Hazro	2784	169	23	2976	93.5	5.7	0.8
Hassan Abdal	841	47	0	888	94.7	5.3	0.0
Fateh Jang	2041	74	6	2121	96.2	3.5	0.3
Jand	3100	17	1	3118	99.4	0.5	0.0
Pindi Gheb	878	8	0	886	99.1	0.9	0.0
Total	10803	380	48	11231			
%Age	96.2	3.4	0.4	100			

(Kausar *et al.*., 2016).

The pH of soil samples analysed is presented in table 6, which depicts that more than 97 percent soil samples of the district and more than 90 percent soil in all tehsils have pH within rage of 7.5- 8.5, indicating that soil is normal and can support optimum nutrient uptake if nutrient availability is made possible by soil fertility management practices.

Similar results were found by Obaid *et al.*., (2010) as these soils are good for agriculture but pH towards higher side i.e., >8.2 has some limitation for high value crops. The results of the study on overall basis indicated that 97.14 percent samples have normal pH while 2.85 percent has sodic soils (Kausar *et al.*, 2016).

The analysis data of soil texture is shown in table 7. Data revealed that 78 percent soils of the district are medium in texture i.e. sandy loam, loam and clay loam while 22 percent soils fall in category of light texture i.e. sandy soil. Data also shows that 05 tehsils are dominant with medium textured soil while tehsil Jand bears light textured soil in most of the areas. This variability of texture in the district compute that almost all types of crops, vegetables and fruits, which need good aeration and perforation of soil may be grown commercially.

Data regarding soil organic matter is presented in table 8. Almost 96 percent of the soils in the district were poor in organic matter while 3 percent soils have satisfactory and only 1 percent soils bear up to adequate level (>1.25%). Overall, all tehsils have soil more than 90 percent with deficient organic matter. Organic matter is considered as lifeblood of the soil so low content of organic matter justify the need for recovery of this source through some sustainable and productive management. The low nutrient concentration might be due to losses through leaching as these soils were found sandy in nature or due to rapid decomposition at some locations (Ashraf *et al.*, 2015). The results are in line with other scientists as data revealed that 93 percent soil samples were deficient in organic matter and 7 percent were satisfactory (Sohail *et al.*, 2001). Similarly, the data showed that 91 percent soils in Attock district were poor and only 7.82 percent were satisfactory with respect to organic matter (Rehman *et al.*, 2010).

Available phosphorus (P) status in soils of the district Attock is described in table 9. Data regarding soil available phosphorus clearly explains that 99 percent soil of the district are deficient in available P, hence addition of P nutrient into soil for each crop is mandatory. Secondly, the P deficiency prevails at almost more than 98 percent soils of all tehsils. So maximum benefit from phosphatic fertilizers can be achieved if used at the time of sowing. These fertilizers have residual effect and subsequent crops are benefitted if full dose of phosphatic fertilizer is applied to the previous crop which utilizes only 18-20 percent of P. A large quantity of well rotten farm yard manure may be applied or green manuring should be done to increase the efficiency of phosphate fertilizers (Rehman *et al.*, 2000).

1362 soil samples were also analyzed for available potassium presented in table 10 showing 31 percent poor while 69 percent samples lie in satisfactory to adequate

Table 9: Available phosphorus of the soil samples analysed

Tehsil	Poor	Satisfactory	Adequate	Total	Tehsil Wise % Age		
					Poor	Satisfactory	Adequate
Attock	1226	16	0	1242	98.7	1.3	0.0
Hazro	2936	40	0	2976	98.7	1.3	0.0
Hassan Abdal	875	13	0	888	98.5	1.5	0.0
Fateh Jang	2121	0	0	2121	100.0	0.0	0.0
Jand	3117	1	0	3118	100.0	0.0	0.0
Pindi Gheb	886	0	0	886	100.0	0.0	0.0
Total	11161	70	0	11231			
%Age	99.4	0.6	0.0	100			

Table 10: Available potash of the soil samples analysed

Tehsil	Poor	Satisfactory	Adequate	Total	Tehsil Wise % Age		
					Poor	Satisfactory	Adequate
Attock	39	46	5	90	43.3	51.1	5.6
Hazro	73	242	7	322	22.7	75.2	2.2
Hassan Abdal	24	166	8	198	12.1	83.8	4.0
Fateh Jang	14	147	24	185	7.6	79.5	13.0
Jand	207	246	3	456	45.4	53.9	0.7
Pindi Gheb	72	39	0	111	64.9	35.1	0.0
Total	429	886	47	1362			
%Age	31.0	65.0	4.0	100			

range. Tehsil wise comparison of K status shows that tehsil Hasan Abdal, Hazro and Fateh Jang have soils more than 75 percent with sufficient K while tehsil Attock, Jand and Pindi Gheb have more than 40 percent soils with deficient K which indicates the natural K status in soil however continuous cropping may ask to maintain the K adequate status by adding through sources. The nutrient index value of Chakwal soil in respect of soil organic matter and phosphorus were poor whereas satisfactory for potassium (Khalid *et al.*, 2012).

By focusing on the characteristics of soil analysis, data shows that over all district has normal soil in view point of salinity and pH however soil fertility status is low due to low OM contents and available P which can be built up by different sources like farmyard manure, green manure (Guara, Dhancha, Sesbania *etc.*) and poultry manure which can also improve soil structure and water holding capacity. The fertility status can be boosted by adopting practices e.g., site specific fertilizer recommendations, regular additions of organic manures and appropriate agronomic practices (Denis *et al.*, 2017). The 4R concept i.e. Right fertilizer at Right rate at Right time in Right place may also be helpful in low fertility soil for optimum crop growth.

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