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Impact of Agricultural Experiential Learning (AEL) Module in Soil Fertility Evaluation of Malshiras Tahasil of Solapur District (India)

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ABSTRACT

Keywords

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Experiential Learning has been recognized as an important part of the agricultural education process. Through practical experience students apply what they have learned in real situation thus the material becomes understandable and usable. Agricultural education has always emphasized the “learning by doing” theory so when using experiential learning, students must practice in real model and procedures. This study was undertaken in 2016-2017 by Division of Soil Science and Agri. Chemistry, Ratnai College of Agriculture, Akluj, India. In this module of experiential learning students collected 101 soil samples from Malshiras tahsil and analysed physico-chemical and chemical properties of different soils. In physico-chemical analysis average pH 7.86 which is slightly alkaline in reaction, EC-0.544dS/m which safe in soluble salt concentration, O.C-0.47 % is low to medium and CaCO₃. 4.15% which indicates calcareous condition. In general, it showed that the properties like pH, EC, Organic carbon and CaCO₃ contents were found to be decide the availability of nutrients in these soils. For macronutrients from the result average available Nitrogen present about 211.30 Kg/ha, available Phosphorus 11.49 Kg/ha and available Potassium 326.53 Kg/ha which indicates low status of N and P but Potassium content is very high in Malshiras tahsil soils. Thus, it can be concluded that soils of Malshiras tahsil are low to medium in fertility status.

Introduction

The current world population is 7.5 billion as of July 2017 and it going so on. Total cultivable area in the world is about 4.9 billion ha. in 2011 which reported by *Small Planet Institute*. But need of food increases as todays practices which carried out are not sufficient because of that soil health is one of the most important factor for increase productivity of soil. Being important component of geosphere-biosphere system, which provides food, fiber, fodder and shelter to living matter. Soils are a vital natural resource whose proper use greatly determines

the capabilities of life support system and socio-economic development of peoples. Therefore management of soil resource on scientific principles is of prime important (Sarkar *et al.*, 2002).

For this purpose, in Agricultural experiential learning programme 2016-2017, we selected villages from Malshiras tahsils like Mandave, Phondshiras, Gursale, Dahigaon, Umbre-Dahigaon, Chiknevasti-Dahigaon, Pirale, Kadamwadi, Dharpuri, Sadashivnagar (Tal-Malshiras) and Bhagatwadi (Tal-Indapur).

Total 101 samples were analysed for physico-chemical and chemical properties of soil. To know the present status of soil and future productivity, it is essential to know the fertility status. Considerable work on physico-chemical properties of Maharashtra soils was reported. (Bharambe, 2001). Thus, it is necessary to define the areas of deficiency of particular nutrients in a particular areas and crops. Soil test data would be helpful in growing such deficient areas on soil and crop basis. Thus, the details of soil resources using data on various soil properties, focus given on fertility status. Hence, present investigation is useful in judging the deficiencies of various nutrients and helpful for increasing soil fertility status.

Materials and Methods

Physico-Chemical properties in soils were determined by following methods

I. Soil pH - It was determined in 1:2.5 soil water suspension using glass electrode pH meter (Jackson, 1967).

II. Electrical Conductivity - Electrical conductivity was determined in 1:2.5 soil water suspension ratio after settlement of solids using conductivity bridge model and expressed in dS m^{-1} (Jackson, 1967).

III. Organic carbon - Organic carbon of soil was estimated by wet oxidation Method which suggested by Walkely and Black. (Black 1965)

IV. Free Calcium carbonate - It was determined by rapid titration method by using 0.5 N HCl (Black, 1965).

Available macronutrient content in soils were determined by following methods

I. Available nitrogen - Available nitrogen was determined by alkaline potassium

permanganate method as suggested by Subbiah and Asija (1956).

II. Available phosphorus- The Available phosphorus was determined by Olsen's method using 0.5 M sodium bicarbonate (pH 8.5) as an extracting reagent as described by (Chopra and Kanwar, 1976).

III. Available potassium- The Available potassium was determined by soil treated with neutral normal ammonium acetate and the potassium in extract was determined by emission spectroscopy by flame photometer (Jackson, 1967)

Results and Discussion

Status of physico-chemical properties in soils

Soil pH is considered a master variable in soils as it affects many chemical processes. It specifically affects availability of nutrients by controlling the chemical forms of the different nutrients and influencing the chemical reactions they undergo. Soil electrical conductivity is an indirect measurement that correlates very well with several soil physical and chemical properties. Organic carbon might be due to addition of organic matter through either artificially or naturally and its subsequent decomposition whereas decreases with poor management and higher temperature. Calcareous soils are characterized by the presence of calcium carbonate in the parent material and may have a calcic horizon, a layer of secondary accumulation of carbonates (usually calcium or Mg) in excess of 15% calcium carbonate equivalent and at least 5% more carbonate than an underlying layer. Hence such nutrients availability indicated in following table.

The data from total villages, pH range 7.00 and 8.60 with mean value of 7.86 was

observed in Mandave (MMH3) and Chikanewasti-Dahigaon (MCD3) & Gursale (MGD3) village respectively. Out of 101 samples, 27 per cent samples were categorized under Neutral and 73 per cent were alkaline in reaction. The relative high content of pH might be due to fact that these soils were developed from basaltic parent material, which are rich in basaltic cations. Gajbe *et al.*, (1976) observed that pH of soils from Marathwada region ranges between 7.00 to 9.20. Similar results were reported by Aage *et al.*, (2007) and Jibhakate *et al.*, (2009). The electrical conductivity of these soils were ranged from 0.130 to 1.190 dSm⁻¹ with an average value of 0.544 dSm⁻¹. The lowest value of EC was recorded in village Kadamwadi (MK3), while highest EC was observed in village Sadashivnagar (MS2).

From total samples 92 percent samples were categorized under safe in EC. The low EC content of these soils might be due to leaching of salts. Padole and Mahajan (2003) revealed that EC of Swell Shrink soils of Vidharbha region were ranged from 0.13 to 1.54 dSm⁻¹. Similar findings were reported by Bharambe and Ghonsikar, (1985) and Puri *et al.*, (2009).

The data on per cent organic carbon content revealed that the per cent organic carbon content ranges from 0.15 to 1.95 per cent with the mean value of 0.47 percent. The lowest value of organic carbon content was recorded from Gursale and Pirale (MG4 & MPB3) village whereas, the high content of per cent organic carbon observed in Chikanewasti-Dahigaon (MCD1) village. Out of 101 samples 55, 35 and 10 per cent were categorized in low, medium and high content in per cent organic carbon respectively. The high content of organic carbon might be due to addition of organic matter through either artificially or naturally and its subsequent decomposition whereas, low to medium content of organic carbon in soils

resemblance with poor management and higher temperature. (Waiker *et al.*, 2004). The calcium carbonate content in these soils were ranged from 0.72 to 12.00 per cent with a mean value of 4.15 per cent. The lowest value (0.72 percent) of percent CaCO₃ content was recorded in Chikanewasti-Dahigaon (MCD5) while the highest (12.00 percent) CaCO₃ content observed in Dahigaon (MD4). Among 101 samples, 55 per cent were categorized in non-calcareous, 43 per cent samples were categorized in calcareous soils whereas 2 per cent samples were in highly calcareous in nature. These values indicated that the soils were non-calcareous to calcareous in nature. Puri *et al.*, (2009) reported the status of free CaCO₃ content ranged from 0.43 to 7.04 per cent. These results were in confirmity with the results of Padole and Mahajan, (2003) and Jibhakate *et al.*, (2009).

Status of Available N, P, and K in soils

The N, P and K are the key nutrient, which are required for plant metabolism. Due to imbalance supply of faulty management practices there is decrease in availability of these nutrients. Hence wide spread deficiency or unavailability of nutrients in soils of tahsils undertaking for study.

The data on status of N, P and K in soils of Malshiras tahsil showed in above table. The available N content of these soils were ranged from 40.32 to 409.5 Kg ha⁻¹ with a mean value of 211.30 Kg ha⁻¹. The lowest N content was observed in soils of Mandave(MM1) village whereas the highest N content were recorded in soils of Sadashivnagar (MS2). Out of 101 soil samples, 80 percent in low, 19 percent medium and 1 per cent in high available N content. The variation in available N content in soils could be attributed to the differences in their physiography as well as differential cultivation and management practices.

Table.1 Status of Physico-Chemical properties in soils of Malshiras tahsil from Solapur district, India

Sr.No.	Sample no.	pH	EC (dSm ⁻¹)	Org. carbon (%)	Free CaCO ₃ (%)
1	MM1	8.01	0.495	0.63	5.25
2	MM2	7.40	0.500	0.30	3.80
3	MM3	7.10	0.700	0.37	5.40
4	MM4	7.20	0.455	0.46	6.00
5	MM5	7.30	0.750	0.66	5.50
6	MP1	7.30	0.760	0.58	1.87
7	MP2	7.90	0.282	0.39	3.12
8	MP3	7.50	0.470	0.48	2.50
9	MP4	7.60	0.510	0.55	2.00
10	MP5	7.40	0.370	0.72	5.00
11	MG1	7.33	0.735	0.27	7.76
12	MG2	7.40	0.730	0.28	7.70
13	MG3	7.79	0.650	0.49	5.75
14	MG4	7.20	0.690	0.15	1.87
15	MG5	7.90	0.940	0.75	2.10
16	MG6	7.30	0.590	0.27	7.67
17	MG7	7.40	0.680	0.85	8.50
18	MG8	7.40	0.730	0.27	7.76
19	MG9	7.78	0.650	0.49	5.75
20	MD1	7.50	0.470	0.48	2.50
21	MD2	7.40	0.370	0.72	5.00
22	MD3	7.38	0.760	0.58	1.87
23	MD4	7.65	0.570	0.55	12.0
24	MD5	7.95	0.280	0.39	3.12
25	MUD1	7.90	0.510	0.37	4.50
26	MUD2	7.60	0.550	0.55	7.20
27	MUD3	7.60	0.870	0.65	8.25
28	MUD4	7.90	0.280	0.39	3.12

29	MUD5	7.75	0.400	0.19	4.25
30	MCD1	7.40	0.850	1.95	2.00
31	MCD2	7.80	0.800	1.20	1.52
32	MCD3	8.60	0.860	0.38	6.21
33	MCD4	8.50	0.550	0.81	12.15
34	MCD5	7.50	0.480	0.60	0.72
35	MDD1	7.60	0.490	0.19	2.50
36	MDD2	7.30	0.350	0.28	2.50
37	MDD3	8.30	0.440	0.25	1.25
38	MDD4	7.79	0.650	0.18	5.75
39	MDD5	8.20	0.420	0.30	1.50
40	MGD1	8.30	0.750	0.56	5.00
41	MGD2	8.50	0.760	0.52	4.00
42	MGD3	8.60	0.780	0.51	4.00
43	MGD4	8.40	0.740	0.52	5.00
44	MGD5	8.30	0.150	0.53	3.00
45	MB1	8.50	0.740	0.52	5.00
46	MB2	8.20	0.520	0.45	3.50
47	MB3	8.40	0.130	0.54	2.00
48	MB4	8.00	0.230	0.37	2.50
49	MB5	8.50	0.380	0.22	3.00
50	MPP1	8.40	0.740	0.52	5.20
51	MPP2	8.30	0.140	0.53	2.00
52	MPP3	8.00	0.230	0.36	2.50
53	MPP4	8.20	0.520	0.42	3.50
54	MPP5	8.50	0.380	0.22	3.00
55	MUDH1	7.70	0.730	0.25	4.25
56	MUDH2	8.50	0.740	0.20	4.20
57	MUDH3	8.40	0.130	0.54	2.00
58	MUDH4	8.00	0.230	0.37	2.50
59	MUDH5	8.60	0.380	0.22	3.00
60	MPB1	7.60	0.730	0.25	4.25

61	MPB2	7.90	0.720	0.20	4.20
62	MPB3	7.50	0.750	0.15	4.50
63	MPB4	7.20	0.770	0.25	4.80
64	MPB5	7.40	0.750	0.50	4.50
65	MK1	8.50	0.240	0.50	5.00
66	MK2	8.20	0.520	0.45	3.50
67	MK3	8.40	0.130	0.54	2.00
68	MK4	8.00	0.300	0.37	2.50
69	MK5	8.50	0.380	0.22	3.00
70	MK6	8.40	0.740	0.52	5.20
71	MK7	8.20	0.520	0.42	3.50
72	MK8	8.30	0.140	0.53	2.00
73	MK9	8.00	0.230	0.36	2.50
74	MK10	8.50	0.380	0.20	3.00
75	MD1	8.20	0.520	0.45	3.50
76	MD2	8.50	0.740	0.52	5.00
77	MD3	8.40	0.130	0.54	2.00
78	MD4	8.00	0.230	0.37	2.50
79	MD5	8.50	0.380	0.22	3.00
80	MPY1	8.54	0.740	0.52	5.00
81	MPY2	8.58	0.380	0.22	3.00
82	MPY3	8.25	0.520	0.45	3.50
83	MPY4	8.58	0.740	0.52	5.00
84	MPY5	8.00	0.230	0.37	2.50
85	MS1	7.70	1.080	0.19	0.75
86	MS2	8.30	1.190	0.76	2.00
87	MS3	7.20	0.450	0.97	3.20
88	MS4	7.68	0.460	0.79	4.50
89	MS5	7.24	0.860	1.13	8.50
90	MMH1	8.02	0.490	0.53	6.00
91	MMH2	7.20	0.400	0.20	4.00
92	MMH3	7.00	0.600	0.30	4.00

93	MMH4	7.40	0.500	0.40	6.00
94	MMH5	7.20	0.600	0.88	6.00
95	MSS1	7.30	0.760	0.52	2.75
96	MSS2	7.50	0.470	0.98	8.25
97	MSS3	7.90	0.370	0.72	5.00
98	MSS4	7.45	0.880	0.63	4.25
99	MSS5	7.60	0.840	0.30	5.00
100	MSS6	7.90	0.370	0.72	5.00
101	MSS7	7.30	0.760	0.32	2.75
MEAN		7.86	0.544	0.47	4.15

pH				EC (dSm ⁻¹)				Organic Carbon (%)				CaCO ₃ (%)			
Mean	< 6.5 acidic	6.5 to 7.5 normal	> 7.5 Alkaline	Mean	< 0.8 Safe	0.8 to 2.5 Normal	> 2.5 unsafe	Mean	< 0.5 Low	0.5 to 0.75 Medium	> 0.75 High	Mean	< 5 Non Calc.	5 to 10 Calcareous	> 10 Highly Calc.
7.86	Nil	27	74	0.544	92	8	Nil	0.47	55	36	10	4.15	55	44	2

Table.2 Status of available N, P and K in soils of Malshiras tahsil from Solapur distret, India

Sr. No.	Sample No.	N (Kg ha ⁻¹)	P (Kg ha ⁻¹)	K (Kg ha ⁻¹)
1	MM1	40.32	10.20	454.2
2	MM2	175	12.20	345
3	MM3	162	14.10	377
4	MM4	174.4	8.77	317
5	MM5	189	16.00	347
6	MP1	409.5	21.68	308
7	MP2	279	13.77	280
8	MP3	341	19.13	327
9	MP4	220	5.00	281
10	MP5	270	7.14	716
11	MG1	180	8.60	380
12	MG2	189	9.60	382
13	MG3	222	7.60	572
14	MG4	280	9.18	425
15	MG5	339	9.40	414
16	MG6	189	8.81	403
17	MG7	122.5	7.65	582
18	MG8	189	8.67	380
19	MG9	222	7.60	572
20	MD1	341	19.13	327
21	MD2	270	7.14	716
22	MD3	409	21.68	308
23	MD4	220	5.00	281
24	MD5	273	13.77	280

25	MUD1	124	10.20	448
26	MUD2	220	5.00	281
27	MUD3	112	20.6	403.2
28	MUD4	273	13.77	280
29	MUD5	118	10.29	425
30	MCD1	145	10.20	362
31	MCD2	281	8.12	145
32	MCD3	172	11.40	372
33	MCD4	200	25.02	302.21
34	MCD5	290	14.18	180
35	MDD1	117	10.21	246
36	MDD2	135	5.90	243
37	MDD3	199	21.68	301.6
38	MDD4	153	7.60	572.18
39	MDD5	142	20.68	363.2
40	MGD1	240	14.20	259
41	MGD2	230	16	255
42	MGD3	220	18	260
43	MGD4	210	17.60	256
44	MGD5	200	33	240
45	MB1	210	17.40	256
46	MB2	202	23	240
47	MB3	212	32	235
48	MB4	190	15	260
49	MB5	185	4.50	280
50	MPP1	220	17.5	256.50
51	MPP2	220	3.20	230
52	MPP3	190	14	260

53	MPP4	210	23	240
54	MPP5	185	4.50	280
55	MUDH1	210	10.20	284
56	MUDH2	200	10.14	300
57	MUDH3	212	3.20	235
58	MUDH4	190	15	200
59	MUDH5	185	4.50	280
60	MPB1	220	10.20	284
61	MPB2	200	10.14	300
62	MPB3	350	15	150
63	MPB4	121	10	100
64	MPB5	280	13	150
65	MK1	210	17.40	256
66	MK2	202	2.30	240
67	MK3	212	3.20	335
68	MK4	190	15	260
69	MK5	135	4.50	280
70	MK6	220	17.5	256
71	MK7	210	2.30	240
72	MK8	220	3.20	230
73	MK9	100	14	260
74	MK10	185	4.50	280
75	MD1	202	2.30	240
76	MD2	210	1.74	256
77	MD3	212	3.20	235
78	MD4	190	11.5	260
79	MD5	185	4.50	280
80	MPY1	210	1.74	256

81	MPY2	185	4.50	280
82	MPY3	202	2.30	240
83	MPY4	210	1.74	236
84	MPY5	190	15	260
85	MS1	136	3.75	381
86	MS2	532	22.89	223
87	MS3	341	23	627
88	MS4	296	15.18	582.8
89	MS5	327.7	24.49	352.4
90	MMH1	45	8.00	275
91	MMH2	172	12.70	310
92	MMH3	170	18	340
93	MMH4	175	11.77	317
94	MMH5	190	10	290
95	MSS1	208	8.67	375
96	MSS2	216	8.26	515
97	MSS3	270	7.40	480
98	MSS4	236	8.76	380
99	MSS5	210	8.90	444
100	MSS6	50	7.14	716
101	MSS7	208	8.76	403
MEAN		211.30	11.49	326.53

N (kg ha ⁻¹)				P (kg ha ⁻¹)				K (kg ha ⁻¹)			
Mean	< 250 Low	250 to 500 Medium	> 500 High	Mean	< 10 Low	10 to 25 Medium	> 25 High	Mean	< 150 Low	150 to 300 Medium	> 300 High
211.30	81	19	1	11.49	48	50	3	326.53	2	53	46

Table.3 Nutrient Index values for the soil samples

Characteristics	Nutrient Index Value	Remarks
Nitrogen	1.21	Low
Phosphorus	1.53	Medium
Potassium	2.44	Medium

Patil *et al.*, (1994) reported that losses due to leaching and denitrification resulted in low amount of available N in soil. The available phosphorus content in these soils were varied from lowest P (1.74 Kg ha⁻¹) in Dharpuri (MD2), Phondshiras (MPY1,MPY4) to 33 Kg ha⁻¹ with a mean value of 11.49 Kg ha⁻¹. These results clearly showed that 48 per cent low, 50 per cent medium and 2 per cent high that is soils of Malshiras tahsil were low to medium in P content. The large range may be due to variation in soil properties and their high P fixing capacity, which prevents to come into readily available form in soil solution. These results were confirmity with Adat (2010) and Puri, (2009). The large range may be due to variation in soil properties and their high P fixing capacity, which prevents to come into readily available form in soil solution.

The available potassium contents in these soils were ranged from 100 to 716 Kg ha⁻¹ with an average value of 326.53 Kg ha⁻¹ K. The lowest value of K was recorded in soils of Pirale (MPB4) while highest value of K content was recorded in Phondshiras (MP5) and Dahigaon (MD2) village respectively. Out of 101 samples 2, 52 and 46 percent samples were categorized in low, medium and high in K content respectively. The value indicated that the soils of Malshiras tahsil were medium to high K content. These results were in confirmity with results of Patil and Sonar, (1994) reported that the available K content in soils of Maharashtra was varied from 224 to 909 Kg ha⁻¹. Similar results were reporte by Waghmare, (2009)

Soil Nutrient Index of soils of Malshiras tahsil

Considering “Soil Nutrient Index” soils of Malshiras tahsil were found in category ‘Low’ fertility status for nitrogen, ‘Medium’ for phosphorous and ‘Medium’ with respect to potassium. The values worked out from nutrient index for nitrogen, Phosphorous and Potassium were 1.21, 1.53 and 2.44 respectively, against the nutrient index values < 1.50 for low, 1.50 to 2.50 for medium and > 2.50 for high fertility status.

The present investigation was carried by students of Agricultural Experiential Learning Module to study chemical properties and available nutrient status from the soils of Malshiras tahsil of Solapur district. The soils were neutral to alkaline in reaction with average pH 7.86, The soils were categorized as safe in respect of electrical conductivity with mean of 0.544dS/m which safe in soluble salt concentration, O.C-0.47 % which shows low to medium and CaCO₃ 4.15% which indicates calcareous condition. In general, it showed that the properties like pH, EC, Organic carbon and CaCO₃ contents were found to be decide the availability of nutrients in these soils. In chemical properties, macronutrients from the result, average available Nitrogen present about 211.30 Kg/ha which shows low availability of Nitrogen, available Phosphorus 11.49 Kg/ha and available Potassium 326.53 Kg/ha which indicates low to medium status of P but Potassium content is medium to high in Malshiras tahsil soils. Thus according to soil nutrient index, it can be concluded that soils

of Malshiras tahsil are low to medium in fertility status.

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