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Soil fertility status in some soils of Muzaffarnagar District of Uttar Pradesh, India, along with Ganga canal command area

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Surface and subsurface soil samples of Muzaffarnagar district were collected to characterize their chemical properties and accordingly to develop optimum land use plan to realize maximum agricultural productivity. The pH value of study area varied from 6.02 to 8.39 and 6.35 to 8.50 for surface and sub surface, respectively, electrical conductivity from 0.069 to 0.390 and 0.073 to 1.10 dSm^{-1}, organic matter content 7.241 to 15.221 and 3.695 to 10.179 g kg^{-1}, available nitrogen (N) 131.53 to 348.97 and 99.32 to 217.44 kg ha^{-1}, Phosphorus (P) 15.67 to 52.61 and 11.17 to 45.40 P_2O_5 kg ha^{-1}, potassium (K) 79.16 to 436.8 and 47.04 to 399.84 K_2O kg ha^{-1} for surface (0-15 cm) and subsurface soil (15-30 cm). Cationic micronutrients Zn, Cu, Fe and Mn varied from 1.636 to 6.164, 1.024 to 4.282, 0.672 to 5.802 and 0.332 to 2.652, and 113.13 to 11.232, 10.33 to 79.326, 10.272 to 38.572 and 29.578 to 77.882 mg kg^{-1} in surface (0 - 15 cm) and subsurface soil (15-30 cm) respectively. As per soil nutrient index (SNI), the soils of study area were found in low fertility category for nitrogen and medium with respect to phosphorus and potassium. A positive and significant correlation of NPK and micronutrients was found with organic matter content while significant and negative correlations exist between micronutrients and soil pH.

Key word: Soil fertility, organic matter, NPK, micronutrients, surface soil, soil nutrient index.

INTRODUCTION

Soil is one of the most important natural resource of a country and knowledge about its characteristics is essential for developing optimum land use plan for maximizing agricultural production. Soils differ greatly in their morphological, physical, chemical, mineralogical and biological characteristics. Since these characters control the response of soil to management practices, it is essential to have information about these characters of each soil. The knowledge of different macro and micro nutrient and their distribution in the root zone is important. Among the macro and micro nutrient usually applied through chemical fertilizers, nitrogen seems to have the quickest and most pronounced effect thus nitrogen is considered as a potent nutrient element that should not only be converted but carefully regulated. Most of the nitrogen in the soil is associated with organic matter. In this form it is protected from rapid microbial release. Only 2 to 3% nitrogen is mineralized annually under normal condition. Assessment of soil quality generally consist physico-chemical properties and their interaction with one

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another. Variation in nutrient supply is a natural phenomenon and some where it may be sufficient while some where deficient. Within a soil, variability may exist depending upon the hydrological properties of the soil. Since the study is undertaken to the adjoining area of the Ganga canal therefore variability in nutrients in the soils which are far away from Ganga canal is obvious. Therefore both locations will require different management practices to sustain crop productivity and for this full information about the nutrients status is important. Deficiency of essential plant nutrients to different extent in soils of Muzaffarnagar had been reported by Sharma et al. (2003). Deficiencies of many plant nutrients are emerging fastly in intensively cultivated sandy alkaline soils of Haryana (Narwal, 2006). Since the quality of produce is significantly influenced by the nutrient supplying capacity of soils coincidently with time crops and their economic product become significantly suboptimal. Therefore to have sound information about the nutrient status of these soils this study was undertaken.

MATERIALS AND METHODS

The study area falls in Muzaffarnagar district of Western Uttar Pradesh. Ganga canal was considered as base line and on the left hand side (LHS) of Ganga canal from Purkaji to Khatauli was taken as the study area. Each bridge on the canal between these two points (Purkaji to Khatauli) was selected for sampling location. Samples were taken from the distance of 1000, 2000, 3000, 4000, and 5000 m away from canal.

Soil samples were collected from eight locations of Muzaffarnagar district under different cropping pattern. Soil samples from two depth at every location were collected with the help of auger and stored in polythene bags. Collected soil samples were air dried in shade, crushed gently with a wooden roller and then pass through 2.0 mm sieve to obtain a uniform representative sample. Samples were properly labeled with the aluminum tag and stored in polythene bags for analysis. The processed soil samples were analyzed by standard methods for pH and electrical conductivity (1:2 soil water suspensions), organic matter (Walkley and Black, 1934), available nitrogen (Subbiah and Asija, 1956), available phosphorus (Olsen et al., 1954), available potassium (Jackson, 1973) and cationic micronutrients (Fe, Mn , Cu and Zn) in soil samples with extracted with a Diethylene triamine pentaacetate (DTPA) solution (0.005 M) DTPA + 0.01 M $CaCl_2$+ 0.1 M triethanolamine, pH 7.3 as outlined by Lindsay and Norvell (1978). The concentration of micronutrients was determined by atomic absorption spectrophotometer (GBC Avanta PM). All the analysis of soil samples was carried out in the laboratory of Department of Soil Science, SVPUA&Tech, Modipurm , Meerut (U.P), India.

RESULTS AND DISCUSSION

Characteristics of soil

Soil reaction (pH)

Soil samples collected from surface and subsurface of eight different locations from the left hand side of Ganga canal in Muzaffarnagar district were usually found neutral to alkaline in reaction (Table 1). Ramesh et al. (2003) also reported the similar results. They observed that the soil reaction was slightly alkaline to moderately alkaline (black soil) and acidic to moderately acidic (red soils). The pH value for surface soil (0 to 15 cm) and subsurface soil (15 to 30 cm) of different locations ranged from 6.02 to 8.39 and 6.35 to 8.50, respectively. According to classification of soil reaction suggested by Brady (1985), 27 samples were neutral (6.35 to 7.50), 26 samples were mildly alkaline (7.4 to 7.8), 25 samples were moderately alkaline (7.81 to 8.4) and 2 samples were strongly alkaline (8.4 to 9.0). The minimum pH 6.02 was observed in Jouli location, while maximum pH 8.39 was observed in Khatauli at surface (0-15 cm), while minimum pH 6.35 in Jouli and maximum pH 8.50 in Kamheda (TP) at subsurface soil (15-30 cm). The relative high pH of the soils might be due to the presence of high degree of base saturation. Gabhane et al. (2006) observed that, most soils of Vidarbha region of Maharashtra were neutral to moderately alkaline in reaction (pH 7.15 to 8.03). In general pH of the soils increased with depth.

Electrical conductivity

The electrical conductivity of the soils varied from 0.069 to 0.390 and 0.073 to 1.10 (dSm^{-1}) at surface and subsurface of soil (Table 2). On the basis of the limits suggested by Muhar et al. (1963) for judging salt problem of soils, most of the samples (99%) were found normal (EC < 1.0 dSm^{-1}) and remaining 1% samples were found in the category of soluble salt content critical for germination (EC 1 to 2 dSm^{-1}). Sangwan and Singh (1993) also noticed the similar trend, they found that the electrical conductivity varied from 0.6 to 2.5 dSm^{-1} with average value of 1.16 dSm^{-1} and were thus categorised as non-saline in character. The salt content increase with soil depth, the high content of salt may be due to irrigation with saline water.

Organic matter content

The organic matter content of the soils varied from 7.241 to 15.221 and 3.695 to 10.179 g kg^{-1} soil at surface and subsurface (Table 3). The maximum organic matter content 15.221 g kg^{-1} at surface (0 to 15 cm) was found in Kamheda while minimum 7.241 g kg^{-1} in Tajpur. In the subsurface soil maximum organic matter content 10.179 g kg^{-1} was found in Balda and minimum 3.695 g kg^{-1} in Tajpur. Lower organic matter in the area may be due to prevailing high temperature and good aeration in the soil which increases the rate of oxidation of organic matter content. Aggarwal et al. (1990) reported that the organic carbon content of some Aridisols of western Rajasthan ranged from 0.14 to 0.40% in surface soil. Organic carbon was low and generally decreased with depth.

Table 1. pH variability in soil profile at different distance from Ganga canal.

S/N	Locations	Depth (cm)	Soil sampling distance (m) from Ganga canal				
			1000	2000	3000	4000	5000
1	Purkaji	0-15	7.45	7.62	7.25	7.35	8.15
		15-30	7.64	7.74	7.44	8.33	8.46
2	Kamheda (TP)	0-15	7.56	7.56	7.65	7.35	7.40
		15-30	7.98	7.48	7.84	7.45	8.50
3	Balda	0-15	7.35	6.90	7.36	7.09	7.33
		15-30	7.87	7.94	8.11	7.43	7.88
4	Bhopa	0-15	7.20	7.75	6.55	7.20	8.05
		15-30	7.68	8.25	6.93	8.17	8.23
5	Jouli	0-15	7.55	6.02	6.20	6.23	7.74
		15-30	7.92	6.85	7.07	6.35	7.70
6	Janshath	0-15	7.10	7.15	6.72	7.42	7.31
		15-30	7.23	7.74	7.22	7.79	7.62
7	Tajpur	0-15	7.47	7.52	7.93	7.45	7.50
		15-30	7.74	7.86	8.11	7.84	7.77
8	Khatauli	0-15	8.18	7.85	6.98	7.98	8.39
		15-30	8.32	8.02	7.36	8.08	8.17

Table 2. Electrical conductivity (dSm^{-1}) variability in soil profile at different distance from Ganga canal.

S/N	Locations	Depth (cm)	Soil sampling distance (m) from Ganga canal				
			1000	2000	3000	4000	5000
1	(Purkaji)	0-15	0.126	0.191	0.132	0.133	0.189
		15-30	0.101	0.095	0.573	0.230	0.190
2	Kamheda (TP)	0-15	0.284	0.128	0.193	0.135	0.190
		15-30	0.189	0.110	0.092	0.575	0.193
3	Balda	0-15	0.254	0.108	0.145	0.093	0.190
		15-30	0.132	0.187	0.203	0.086	0.083
4	Bhopa	0-15	0.191	0.138	0.187	0.108	0.67
		15-30	0.105	0.081	0.109	0.132	1.10
5	Jouli	0-15	0.282	0.118	0.200	0.190	0.135
		15-30	0.189	0.084	0.095	0.089	0.096
6	Janshath	0-15	0.210	0.124	0.135	0.214	0.196
		15-30	0.289	0.073	0.081	0.091	0.259
7	Tajpur	0-15	0.128	0.211	0.350	0.346	0.39
		15-30	0.125	0.157	0.313	0.226	0.267
8	Khatauli	0-15	0.284	0.209	0.069	0.384	0.376
		15-30	0.248	0.226	0.108	0.101	0.186

Available macronutrients

Nitrogen

Available nitrogen in soils of study area varied from 131.53 to 348.97 and 99.32 to 217.44 kg N ha^{-1} at surface (0 to 15 cm) and subsurface (15 to 30 cm) (Table 4). The maximum available nitrogen 348.94 kg ha^{-1} was found in Bhopa and minimum 131.53 kg ha^{-1} in Tajpur in surface soil (0 to 15 cm) while in subsurface soil (15 to 30 cm) the highest available nitrogen 217.44 kg ha^{-1} was found in Balda and minimum 99.32 kg ha^{-1} in Khatauli location. On the basis of the ratings suggested by Velayutham and Bhattacharyya (2000) 95% samples were rated low (<280 N kg ha^{-1}) while 5% samples were in the medium range (281 to 560 N kg ha^{-1}). Available nitrogen was correlated significantly and positively (r=0.6356) with organic matter (Table 13). Walia et al.

Table 3. Organic matter (g kg^{-1}) variability in soil profile at different distance from Ganga canal.

S/N	Locations	Depth (cm)	Soil sampling distance (m) from Ganga canal				
			1000	2000	3000	4000	5000
1	(Purkaji)	0-15	12.118	13.448	14.630	10.345	11.232
		15-30	8.128	8.128	8.424	6.650	7.684
2	Kamheda (TP)	0-15	13.004	13.891	11.231	12.118	15.221
		15-30	7.389	9.015	6.798	8.424	9.606
3	Balda	0-15	14.778	13.005	12.709	11.970	13.744
		15-30	9.754	8.276	10.197	6.946	9.015
4	Bhopa	0-15	11.970	10.197	12.562	9.310	9.0148
		15-30	7.980	8.424	7.241	6.059	5.468
5	Jouli	0-15	10.936	11.084	11.970	11.232	9.754
		15-30	8.424	8.719	9.0148	7.833	6.502
6	Janshath	0-15	11.231	9.310	10.493	12.414	11.084
		15-30	7.389	6.650	7.537	9.015	6.355
7	Tajpur	0-15	8.128	8.424	7.833	7.241	11.527
		15-30	6.059	7.241	3.695	4.581	5.764
8	Khatauli	0-15	9.606	8.424	12.562	14.926	13.300
		15-30	6.502	5.764	9.015	8.571	6.650

Table 4. Available nitrogen (Kg ha^{-1}) variability in soil profile at different distance from Ganga canal.

S/N	Locations	Depth (cm)	Soil sampling distance (m) from Ganga canal				
			1000	2000	3000	4000	5000
1	(Purkaji)	0-15	226.83	236.23	237.57	198.65	210.57
		15-30	186.57	190.59	204.01	155.69	182.54
2	Kamheda (TP)	0-15	190.59	195.96	177.17	187.91	205.36
		15-30	165.09	166.43	155.69	163.75	177.17
3	Balda	0-15	292.59	252.33	244.28	201.33	287.23
		15-30	217.44	158.38	153.01	153.01	182.54
4	Bhopa	0-15	153.01	158.38	220.12	289.92	348.97
		15-30	142.27	139.59	155.69	169.12	212.07
5	Jouli	0-15	163.75	182.54	189.25	166.43	142.27
		15-30	147.64	161.06	166.43	153.01	112.74
6	Janshath	0-15	189.25	150.33	171.8	224.15	174.49
		15-30	159.72	131.53	139.59	166.43	142.23
7	Tajpur	0-15	139.59	131.53	139.59	159.72	166.43
		15-30	126.17	102.00	120.79	139.59	142.27
8	Khatauli	0-15	144.95	163.75	174.49	293.94	217.44
		15-30	99.32	131.54	144.96	180.49	150.33

(1998) reported that available N in the soils of Bundelkhand region accounted for 12 to 42% of total N in the range of 95 to 159 mg N kg^{-1} in surface soil and 51 to 159 mg N kg^{-1} in subsurface horizon. The continuous mineralization of organic matter in surface soils was responsible for the higher values.

Phosphorus

The available phosphorus in soils of the study area varied from 15.67 to 52.61 and 11.17 to 45.40 P_2O_5 kg ha^{-1} at surface (0 to 15 cm) and subsurface (15 to 30 cm) (Table 5). The maximum available phosphorus 52.61 P_2O_5 kg $ha^{-1}$was found in Kamheda (TP) and minimum 15.67 P_2O_5 kg ha^{-1} in Purkaji at surface (0-15 cm) whereas at subsurface maximum 45.40 P_2O_5 kg ha^{-1} was found at Kamheda and minimum 11.17 P_2O_5 kg ha^{-1} at Janshath. On the basis of limits suggested by Muhar et al. (1963) 42.5% samples were rated low (<20 P_2O_5 kg ha^{-1}), 56% medium (20-50 P_2O_5 kg ha^{-1}) and 1.50% high (> 50 P_2O_5 kg ha^{-1}) at surface and subsurface soils.

Table 5. Phosphorus (kg ha^{-1}) variability in soil profile at different distance from Ganga canal.

S/N	Locations	Depth (cm)	Soil sampling distance (m) from Ganga canal				
			1000	2000	3000	4000	5000
1	(Purkaji)	0-15	30.539	33.692	39.998	15.675	20.179
		15-30	13.873	14.774	17.927	11.171	13.423
2	Kamheda (TP)	0-15	38.647	42.701	33.692	38.647	52.611
		15-30	31.440	32.791	17.477	25.585	45.404
3	Balda	0-15	39.998	21.981	21.08	17.927	35.945
		15-30	30.089	15.522	12.072	12.112	17.927
4	Bhopa	0-15	40.449	36.845	40.899	34.593	30.539
		15-30	30.539	27.386	32.098	26.936	17.927
5	Jouli	0-15	30.108	35.944	37.296	34.593	18.828
		15-30	13.423	29.639	30.395	15.225	8.018
6	Janshath	0-15	28.738	17.026	21.531	33.241	29.188
		15-30	13.423	11.170	12.072	17.477	13.873
7	Tajpur	0-15	29.638	29.638	27.837	15.675	37.296
		15-30	19.638	17.927	15.225	8.919	20.134
8	Khatauli	0-15	18.378	17.026	28.287	38.647	38.197
		15-30	15.225	12.522	15.675	32.845	18.378

Potassium

Available potassium (K_2O) in the soils ranged from 79.16 to 436.8 and 47.04 to 399.84 kg ha^{-1} at surface (0 to 15 cm) and subsurface (15 to 30 cm) (Table 6). The maximum available potassium 436.8 kg ha^{-1} was found at Tajpur and minimum 79.16 K_2O kg ha^{-1} in Khatauli at surface soil (0 to 15 cm). Similarly maximum available K_2O 399.84 kg ha^{-1} was found in Tajpur and minimum 47.04 kg ha^{-1} in Khatauli at subsurface. According to Muhar et al. (1963) 25% samples were categorized as low (< 125 kg ha^{-1}), 67.5% medium (125 to 300 kg ha^{-1}) and 2.5 high (> 300 K_2O kg ha^{-1}). A significant and positive correlation (r=+0.3505) was observed between organic matter and available K (Table 13). Meena et al. (2006) observed similar significant and positive correlation between organic carbon and available K (r=0.420). This might be due to creation of favorable soil environment with presence of high organic matter.

Soil nutrient index

Considering the concept of “Soil Nutrient Index” the soils of study area were found in category of low for nitrogen and Medium for phosphorus and potassium (Table 7).

Available cationic micronutrients

Copper

DTPA-extractable available copper in the surface and subsurface soil of eight different locations was found to be sufficient. The DTPA-extractable Cu (mg kg^{-1} soil) in surface (0 to 15) and sub surface (15 to 30 cm) soils varied from 1.636 to 6.164 and 1.024 to 4.370 mg/kg soil, respectively (Table 8). The maximum available Cu 6.164 mg kg^{-1} soil for surface soil (0 to 15 cm) was found in Belda location and minimum 1.024 mg kg^{-1} soil in Tajpur location. Maximum available Cu 4.370 mg kg^{-1} in soil was found in subsurface soil of Belda location and minimum 1.024 mg kg^{-1} soil in Bhopa (Table 12). Considering the critical limit 0.20 mg/kg soil as suggested by Lindsay and Norvell (1978) all the soil samples of eight different locations were found to be sufficient in available Cu. A decreasing trend in available Cu content with increasing depth was noticed in all eight different locations.

Zn

The available Zn estimated by DTPA in the surface and subsurface soil of eight different locations was found to be sufficient range as per criteria given by Lindsay and Norvell (1978) (Table 12). The minimum and maximum value of available Zn in surface soil and sub surface soil ranged from 0. 458 to 5.80 and 0.332 to 2.65 mg kg^{-1} soil respectively (Table 9). The maximum DTPA extractable available Zn 5.80 mg/kg soil was found in Janshath location and minimum 0.310 mg kg^{-1} soil in Purkaji location for surface soil. In case of sub surface soil maximum DTPA extractable zinc 2.65 mg kg^{-1} and minimum 0.33 mg kg^{-1} was found in Janshath and Khatauli location respectively. As per critical limits suggested by ISSS 24.44% samples were deficient < (0.6 mg kg^{-1}), 35.55% marginal (0.6 to 1.2 mg kg^{-1}) and 40% were sufficient (> 1.2 mg kg^{-1}).

Table 6. Potassium (kg ha^{-1}) variability in soil profile at different distance from Ganga canal.

S/N	Locations	Depth (cm)	Soil sampling distance (m) from Ganga canal				
			1000	2000	3000	4000	5000
1	(Purkaji)	0-15	217.28	221.76	219.52	110.88	133.28
		15-30	172.48	196.00	184.80	97.44	117.60
2	Kamheda (TP)	0-15	181.44	273.28	165.76	169.12	281.12
		15-30	150.08	178.08	133.28	148.96	217.28
3	Balda	0-15	213.92	159.04	153.44	125.44	197.12
		15-30	174.72	125.44	123.2	120.96	131.04
4	Bhopa	0-15	218.4	163.52	229.6	161.28	134.4
		15-30	188.16	107.52	192.64	109.76	104.16
5	Jouli	0-15	208.32	221.76	244.16	240.8	202.72
		15-30	170.24	181.44	194.88	193.76	162.40
6	Janshath	0-15	140	76.16	95.2	148.96	129.92
		15-30	114.24	67.20	73.92	125.44	103.04
7	Tajpur	0-15	197.12	248.64	159.04	133.28	436.8
		15-30	155.68	226.24	140.00	119.84	399.84
8	Khatauli	0-15	98.56	89.6	105.28	165.76	112
		15-30	61.60	47.04	87.36	135.60	96.32

Table 7. Nutrient index and fertility status class of study area soils.

S/N	Name of nutrient	Percent sample			Nutrient Index		Fertility status class
		Low	Medium	High	Observed	Proposed	
1	Nitrogen	95.00	5.00	Nil	1.05	<1.5	Low
2	Phosphorus	42.50	56.00	1.50	1.56	>2.5	Medium
3	Potassium	28.75	68.75	2.50	1.75	1.5-2.5	Medium

Table 8. DTPA-extractable copper (mg kg^{-1}) variability in soil profile at different distance from Ganga canal.

S/N	Locations	Depth (cm)	Soil samples distance (m) in Ganga canal				
			1000	2000	3000	4000	5000
1	(Purkaji)	0-15	3.46	3.676	3.932	3.128	3.224
		15-30	3.034	3.064	3.662	2.832	2.182
2	Kamheda (TP)	0-15	3.644	3.822	3.464	3.562	3.844
		15-30	3.004	3.206	3.042	1.732	3.262
3	Balda	0-15	6.164	4.224	3.468	2.872	6.024
		15-30	4.230	2.262	2.542	2.152	4.370
4	Bhopa	0-15	3.682	3.436	3.962	2.468	2.278
		15-30	2.028	1.928	2.038	1.540	1.024
5	Jouli	0-15	3.072	3.748	5.104	4.644	2.184
		15-30	2.256	2.794	4.282	3.544	1.904
6	Janshath	0-15	4.008	1.984	3.108	4.278	3.312
		15-30	2.428	1.564	2.188	3.560	2.414
7	Tajpur	0-15	1.838	2.366	1.8	1.636	2.428
		15-30	1.802	1.832	1.360	1.316	1.854
8	Khatauli	0-15	2.508	2.648	2.826	4.954	3.178
		15-30	1.300	1.746	2.016	3.332	2.040

Table 9. DTPA-extractable zinc (mg kg $^{-1}$) variability in soil profile at different distance from Ganga canal.

S/N	Locations	Depth (cm)	Soil samples distance (m) in Ganga canal				
			1000	2000	3000	4000	5000
1	(Purkaji)	0-15	1.538	1.644	1.906	0.738	1.31
		15-30	0.516	0.974	1.250	0.384	0.476
2	Kamheda (TP)	0-15	1.344	1.36	0.784	0.702	1.74
		15-30	0.822	0.842	0.378	0.368	1.124
3	Balda	0-15	1.902	1.598	0.956	1.36	1.634
		15-30	1.422	0.822	0.63	1.022	1.202
4	Bhopa	0-15	4.268	2.016	5.202	1.772	1.646
		15-30	1.728	1.036	2.172	1.204	0.974
5	Jouli	0-15	0.768	1.648	2.248	1.876	0.73
		15-30	0.526	0.732	1.652	0.972	0.454
6	Janshath	0-15	4.99	0.458	1.016	5.802	1.784
		15-30	2.268	0.612	0.36	2.65	0.762
7	Tajpur	0-15	1.258	1.02	0.76	0.748	1.338
		15-30	0.712	0.646	0.572	0.484	0.842
8	Khatauli	0-15	0.672	0.68	1.15	1.636	1.242
		15-30	0.332	0.444	0.720	0.804	0.954

Table 10. DTPA-extractable iron (mg kg $^{-1}$) variability in soil profile at different distance from Ganga canal.

S/N	Locations	Depth (cm)	Soil samples distance (m) in Ganga canal				
			1000	2000	3000	4000	5000
1	Purkaji	0-15	34.268	38.536	57.8	11.232	25.41
		15-30	24.480	29.550	33.564	10.334	20.044
2	Kamheda (TP)	0-15	41.64	70.782	26.26	41.506	77.6
		15-30	22.326	30.060	16.598	22.028	36.084
3	Balda	0-15	70.42	58.212	56.724	51.034	66.416
		15-30	56.136	39.430	39.816	26.286	44.426
4	Bhopa	0-15	72.026	52.034	82.66	26.582	28.45
		15-30	36.402	29.480	48.242	17.538	19.558
5	Jouli	0-15	39.44	91.9	113.13	72.824	16.074
		15-30	24.750	66.430	79.326	49.082	11.350
6	Janshath	0-15	50.308	28.798	45.9	68.95	48.036
		15-30	34.962	20.052	20.624	47.870	30.190
7	Tajpur	0-15	24.636	26.358	24.51	11.768	27.03
		15-30	18.566	13.156	18.640	12.362	8.858
8	Khatauli	0-15	35.7	28.362	37.79	88.99	47.38
		15-30	24.502	19.038	24.984	41.780	25.956

Fe

The DTPA- extractable available Fe in the surface and subsurface soil of eight different locations was found to be high. The DTPA extractable iron in surface (0 to 15 cm) as well as subsurface (15 to 30 cm) varied from 11.232 to 113.30, 10.334 to 79.33 mg kg^{-1} soil respectively (Table 10). The highest as well as lowest values of available Fe for surface as well as subsurface soils were found at Jouli and Purkaji locations for surface soil. According to the critical limit 4.5 mg/kg soil as purposed by Lindsay and Norvell (1978) all the surface soil sample and sub surface samples were sufficient in available Fe (Table 12). The amount of available Fe decreased with an increasing soil depth. On the basis of critical limit suggested by Indian Society of Soil Science 3.33% samples were marginal (4.5 to 9.0 mg kg^{-1}) and 96.66% were sufficient (> 9.0 mg kg^{-1}).

Table 11. DTPA-extractable manganese (mg kg^{-1}) variability in soil profile at different distance from Ganga canal.

S/N	Locations	Depth (cm)	Soil samples distance (m) in Ganga canal				
			1000	2000	3000	4000	5000
1	Purkaji	0-15	21.64	21.696	34.2	10.998	11.89
		15-30	15.224	15.990	16.620	7.882	8.468
2	Kamheda (TP)	0-15	33.024	33.578	30.214	22.642	38.03
		15-30	20.422	22.046	21.640	15.042	26.116
3	Balda	0-15	38.572	34.252	23.92	19.472	29.378
		15-30	23.780	23.448	19.798	17.180	21.018
4	Bhopa	0-15	27.138	20.864	29.08	19.564	10.272
		15-30	18.920	16.656	24.298	16.218	9.442
5	Jouli	0-15	22.530	35.812	24.380	26.432	24.492
		15-30	13.052	29.578	14.560	18.512	17.244
6	Janshath	0-15	32.57	16.9	18.852	45.046	22.11
		15-30	20.680	10.480	14.944	30.248	20.308
7	Tajpur	0-15	27.042	19.286	28.624	17.486	18.932
		15-30	20.422	13.442	20.588	10.250	12.630
8	Khatauli	0-15	25.256	15.040	51.442	21.398	33.614
		15-30	16.854	13.256	37.210	14.420	23.042

Table 12. Class of cationic from study area soils.

SN	Name of nutrient	Percent sample			Critical Limit(mg kg^{-1})		
		Deficient	Marginal	Sufficient (%)	Deficient	Marginal	Sufficient
1	Copper	-	-	100	< 0.2	0.2 - 0.4	> 0.4
2	Zinc				< 0.6	0.6 -1.2	> 1.2
3	Fe	-		100	< 4.5	4.5 - 9.0	> 9.0
4	Mn	-		100	< 3.5	3.5 - 7.0	> 7.0

Table 13. Correlation studies between OM to available N, total N, available P, K, and Cu, Fe, Mn, Zn under different locations (all values of different locations).

Locations	OM to macronutrient and micronutrient							
	Av. N	Total N	Av. P	Av. K	Zn	Cu	Fe	Mn
OM	0.6356	0.6773	0.7014	0.3505	0.4473	0.7686	0.6941	0.6265

Mn

The DTPA extractable available Mn in the surface and subsurface soil in eight different locations is sufficient to high since are well above the critical limit (1.0 mg/kg) as proposed by Lindsay and Norvell (1978).

The maximum and minimum DTPA extractable Mn in surface and sub surface varied from 10.272 to 51.442 and 7.882 to 37.230 mg kg^{-1} soil (Table 11). The maximum available Mn content 51.442 mg kg^{-1} soil was found in Khatauli location and minimum 10.272 mg kg^{-1} soil in Bhopa for surface soil (0 to 15 cm). Maximum extractable Mn content 37.23 mg kg^{-1} in subsurface was found in soil of Khatauli location and minimum 7.882 mg kg^{-1} in Purkaji.

According to critical limit 1.0 mg/kg purposed by Lindsay and Novell (1978) and (3.5 to 7.0 mg kg^{-1}) suggested by Indian Society of Soil Science all the soils were sufficient in available Mn (Table 12).

Relationship among available NPK, micronutrient with organic carbon and pH in soil at different locations

Correlation among the soil properties of eight different location soils of Muzaffarnagar district were work out (Tables 13 and 14). The organic matter was positively and significantly related with N, P, K and cationic micronutrients. A significantly and positive correlation of

Table 14. Correlation study between pH to DTPA extractable micronutrients under different locations (all value of different locations).

Locations	pH to DTPA extractable micronutrients			
	Zn	Cu	Fe	Mn
pH	-0.3779	-0.41601	-0.57899	-0.37915

organic matter with available nitrogen (r=+0.6356) and total nitrogen (r=+0.6773) was found. Similarly a positive and significant correlation was also observed between organic matter and available phosphorus (r=+0.7.14) and potassium (r=+0.3505).

Among the cationic micronutrients copper was related much strongly with organic matter (r=+(0.7686) followed by iron (r=+0.6941), manganese (r=+0.6265) and Zinc (r=+0.4447359) .These association showed that available copper, iron, zinc and manganese in these soil are largely influenced by organic matter.

The relationship between available micronutrients and soil pH were also worked out. The soil pH was significantly and negatively correlated with all the cationic micronutrients .Among the micronutrients studied Fe was found related much strongly with soil pH (r=-0.579) followed by Cu (r=-0.416), Mn (r=-0.379) and Zn (r=-0.3779).

Conclusion

Soil chemical composition of the study area did not followed a particular pattern with increasing distance from Ganga Canal which may be due to variation in management practices, cropping sequence and their yield potential. Study area was dominated by sugarcane, wheat, rice and fodder crops. About sixty seven percent area is under sugar cane. Physico-chemical characteristics and nutrient status of soil in Muzaffarnagar district of Uttar Pradesh as discussed previously indicates that soil of study area were neutral to strongly alkaline in reaction and non saline in nature. Nutrient status regarding to the available macro and micro nutrient in surface (0 to 15 cm) and subsurface (15 to 30 cm) depth of soil indicate that soils are low in available N and medium in available P and K in surface and subsurface soil and in general sufficient in available Zn, Cu, Fe and Mn in the surface and subsurface layer of the profiles.

REFERENCES

Aggarwal RK, Kumar P, Sharma BK (1990). Distribution of nitrogen in some Aridisols. J. Indian Soc. Soil Sci. *38:430-433*.

Brady NC (1985). The nature and properties of soils, 8th Edition Macmillan Publishing Co. Inc., New York.

Gabhane VV, Jadhao VO, Nagdeve, MB (2006). Land evaluation for land use planning of a micro watershed in Vidarbha region of Maharashtra. J. Indian Soc. Soil Sci. 54:307-315.

Jackson ML (1973). Soil chemical analysis, Prentice Hall of Index Pvt .Ltd, *New Delhi*, India, p. 498.

Lindsay WL, Norvell WA (1978). Development of DTPA soil test for zinc, iron, manganese and copper. Soil Sci. Soc. Am. J. 42:421-428.

Meena HB, Sharma RP, Rawat US (2006). Status of macro and micro nutrient in some soils of Tonk district of Rajasthan. J. Indian Soc. Soil *Sci.* 54:508-512.

Muhar GR, Datta NP, Shankara SN, Dever, F, Lecy, VK , Donahue, RR (1963). Soil testing in India. *USDA Mission to India*.

Narwal RP (2006). Annual progress report of AICRP on micro and secondary nutrients and pollutants elements in soils and plants. *CCSHAU, Hissar*. p. 85.

Olsen SR, Cole CV, Watanabe FS, Dean LA (1954). *Estimation of Available Phosphorus in Soils by Extraction with Sodium Bicarbonate*. USDA Circ. 939. United States Department of Agriculture, Washington D.C.

Ramesh K, Prasad VB, Rao MS (2003). Physical nature and fertility status if soils of Singarayakonda Madal in Prakasam district of Andhra Pradesh, *Andhra.* Agric. J. 50 (122) 54-55.

Sangwan BS, Singh K (1993). Vertical distribution of Zn, Mn, Cu and Fe in the semi-arid soils of Haryana and their relationship with soil properties. *J.Indian Soc. Soil Sci.* 41: 463-467.

Sharma RP, Singh M, Sharma JP (2003). Correlation studies on micronutrient vis- a vis soil properties in some soils of Nagpur district in semi- arid region of Rajasthan. J. Indian Soc. Soil Sci. 51:522 -527.

Subbiah BV, Asija, GL (1956). A rapid procedure for the determination of available nitrogen in soil. Curr. Sci. 1956;25:259–260

Velayutham M, Bhattacharyya T (2000). Soil resources management from natural resource management for agriculture production in India. p. 103

Walia CS, Narayan A, Uppal KS, Rao YS (1998). Distribution of various forms of nitrogen and C: N ratio in some land form of Bundelkhand region of Uttar Pradesh. J. Indian Soc. Soil Sci. 46:193-198.

Walkley AJ, Black IA (1934). Estimation of soil organic carbon by the chromic acid titration method. Soil Sci. 37:29-38