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Analyses on soil bulk density of rice field in Gilan province in the north of Iran

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Abstract: In a rice field, the environmental variations in soil conditions, for example crop rotation and management practices, affect soil properties and microorganisms. This case study conducted in Gilan province[13,952 sq km (5,387 sq mi) in the north of Iran] shows a variety of soil management practices, chemically, semi-chemically, conventionally and organically managed soils from one crop season up to five crop seasons and over. These involved different inputs of organic materials into soils which might therefore be predicted to modify microbial population. Many parameters of soil characteristics were investigated, including soil PH, organic matter, available phosphorus, bulk density, moisture content and soil texture. The results clearly showed that soil physical and chemical characteristics significantly varied organic matter, silt, and sand particles.

In addition, the population of celluloytic microbes significantly differed between chemically and organically managed field. The celluloytic microbes significantly differed between chemically and organically managed field. The celluloytic microbes also decreased with increasing soil depth.

Keywords: soil bulk, cellulolytic microbes, rice field, principal component analysis PCA.

Introduction

Rice is a major production and food of Iran. The agricultural export production statistics was clearly revealed that export values depended on arem rice around 65% in 2007 and its tendency has been growing dramatically[1] .This results in the expanding of rice cultivation land use. Although the huge amount up to 64.76% of the total land use are paddy fields[2],figure1.

Due to a variety of topography and suitable climate, tarem from Gilan province is well known and has a high quality. the soil health, determined by physical, chemical, and especially biological parameters of the soil.

Figure 1.Rice paddies, Gilan province.

Methodology

The study was conducted in Gilan province, the northeast of Iran along the Caspian sea, seven meters below sea (37°. 15′N, 49°3′6) 300 ton annual production of rice, humidtiy between 62% to 97% ..

. The study site has a mean annual rainfall of 3,542.80 mm and a mean annual temperature of 27.5°c, with a minmum of 11.2°c in Oct. and a maximum of 30.4°c in July Gilan province also showed a variety of soil management practices; chemically, semi – chemically, conventionally and organically managed soils, which were started to operate since only one crop season up to five crop seasons and over.

At each soil sample, the soil surface later (0-5cm) and subsoil (10-15 cm) were taken and transported to the laboratory on ice, and also stored at -20°c in dark plastic bags. For chemical and physical analyses, the collected soil samples were air dried and then ground and sieved through a 0.5 cm mesh.

Soil bulk density was determined by using the core method. Soil texture (mass of sand silt – clay sized particles) was determined by using a hydrometer. Freshly, sieved samples were weighed onto dried aluminum tray, heated at 110°c for 50 hr, and reweighed to determine the moisture lost. A 10 g portion of each sample was mixed with water at a ration of 1:5 and 1:10 and then soil pH was determined after 1 hr by using pH –meter with a glass combination electrode. The available phosphors (pi) was extracted by Bray II and measured by spectrophotometry. Organic carbon (C_{org}) was followed by Walkley and Black metho[3,4,5,6,7].

Cellulolytic microbes were counted at 28°c after 8 days incubation on Mandels – Reese metium with carboxmethylcellulose (Sigma) as the sole carbon source and sprayed with Congo red to show clear zone around the colonies [8,9,10]. All the experiments were carried out in triplicate. The content of organic matter in upper 0-5 cm was high (1.88-2.60%)[11,12].

Results and Discussions

In table 1, the average values of soil chemical and physical variables before rice cultivation are given. The analyzer showed that the soil contents of clay, silt, sand and organic matter differed significantly among the sampling areas at 0.05 significance level ($p<0.05$). Especially, organic matter rate differed clearly in the chemically and organically managed areas. Low and high organic matter rates were recorded in organic and semi-chemical fields. The content of organic matter in upper 0-5 cm was high (1.88-2.60%).

Most of the tested physical and chemical soil variables during post harvest differed significantly and was similar to them that were before rice cultivation period (table 2).

The average values of organic matter were 2.87%, 2.89%, 1.73% and 1.36% under organic, young

organic, semi – chemical and chemical practices, respectively.

Cellulolytic microbes are very important in the elemental cycle and in the plant nutrition of paddy fields. All of the top soil samples had higher counts of celluloytic microbes than the subsoil samples of cellulolyic microbes than the subsoil samples[13,14].. The content of cellulolyic microbes ranged from (3.03±1.27) × 10^4 to (2.58±0.76)× (3:86±1.07)× 10^4 CFU dry soil in organic management field, from (4.7 ± 1.3)× 10^4 to (3:86±0.76)10^4 CFU $-g^{-1}$ dry soil in chemical practice fields (Table 3).

Table 1. physical and chemical parameters of the soil before rice cultivation period (mean values ± standard deviation)

Variables	*Depth(cm)*	*organic*	*Young organic*	*Semi-Chemical*	*Chemical*	*Significance level*
Clay(%)	0-5	20.62±2.71	28.29±8.18	17.51±2.42	16.34±1.65	0.000*
	10-15	21.05±2.23	28.89±7.57	18.50±2.77	15.50±1.70	0.000*
Silt(%)	0-5	18.77±7.38	23.88±9.77	47.89±9.10	29.02±2.23	0.000*
	10-15	22.09±7.64	23.92±5.66	45.05±8.57	32.12±5.66	0.000*
Sand(%)	0-5	60.61±6.76	47.83±9.11	34.60±8.13	54.64±3.00	0.000*
	10-15	56.86±7.75	47.19±7.12	36.46±7.32	52.37±5.73	0.000*
pH 1:5	0-5	5.21±0.43	5.22±0.35	5.14±0.14	5.10±0.14	0.817
	10-15	5.40±0.41	5.12±0.21	5.20±0.16	5.08±0.10	0.046*
pH 1:10	0-5	5.43±0.43	5.43±0.36	5.32±0.10	4.97±0.95	0.256
	10-15	5.45±0.38	5.29±0.22	5.28±0.17	5.27±0.14	0.377
Pi(ppm)	0-5	17.75±11.79	11.32±4.49	27.25±21.97	17.35±9.76	0.118
	10-15	14.69±10.09	12.89±7.16	18.40±18.48	13.47±8.81	0.764
OM(%)	0-5	2.59±0.79	2.60±0.36	1.88±0.44	2.03±0.23	0.008*
	10-15	2.55±0.82	2.37±0.40	1.48±0.42	1.91±0.24	0.001*
Db(g/cm^3)	10-15	1.50±0.14	1.71±0.11	1.54±0.06	1.62±0.07	0.000*
MC(%)	10-15	8.77±2.97	10.88±3.95	16.25±3.03	14.01±1.38	0.000*

Pi: available phosphorus, OM: organic matter, Db: bulk density, MC: soil moisture content. Data are means of nine replicates. * Significance level >0.95.

Table 2. Physical and chemical parameters of soil.

Variables	*Depth(cm)*	*organic*	*Young organic*	*Semi-Chemical*	*Chemical*	*Significance level*
Clay(%)	0-5	24.39±4.83	26.61±5.64	26.22±5.51	20.59±3.47	0.056
	10-15	23.18±4.71	28.33±5.30	25.62±5.59	22.10±7.39	0.129
Silt(%)	0-5	16.89±7.08	30.67±10.39	37.56±11.70	19.33±12.08	0.001*
	10-15	17.78±7.10	31.78±9.77	41.56±7.13	24.44±12.44	0.000*
Sand(%)	0-5	58.72±4.59	42.72±11.91	36.22±13.69	60.08±11.35	0.000*
	10-15	59.04±6.05	39.89±8.92	32.83±3.96	53.46±13.10	0.000*
pH 1:5	0-5	5.73±0.52	5.41±0.30	5.07±0.19	5.18±0.29	0.002*
	10-15	5.91±0.50	5.54±0.46	5.34±0.17	5.32±0.14	0.005*
pH 1:10	0-5	5.81±0.47	5.54±0.28	5.28±0.23	5.40±0.30	0.013*
	10-15	5.97±0.56	5.62±0.29	5.59±0.47	5.54±0.23	0.114
Pi(ppm)	0-5	18.57±11.33	15.80±8.98	7.18±4.16	10.89±7.10	0.031*
	10-15	12.53±7.90	10.08±5.32	5.45±4.01	9.15±5.48	0.099
OM(%)	0-5	2.93±0.61	3.04±0.59	1.88±0.41	1.51±0.40	0.000*
	10-15	2.80±0.62	2.74±0.56	1.58±0.36	1.21±0.24	0.000*
Db(g/cm^3)	10-15	1.40±0.29	1.49±0.26	1.47±0.23	1.59±0.08	0.391
MC(%)	10-15	12.76±10.50	15.31±8.69	11.63±6.11	8.33±3.20	0.294

Pi: available phosphorus, OM: organic matter, Db: bulk density, MC: soil moisture content.
Data are means of nine replicates. * Significance level >0.95.

Table 3. celluloytic microbes [colony forming unit(CFU) g^{-1} dry soil (mean values ± standard devation)

			Significance level
organic	*Depth(cm)*	*Chemical*	
3.036.1.62 ±5.64× 10^4	0-5	4.69±1.27× 10^4	0.270
2..33±1.05× 10^4	10-15	3.85±76.39× 10^4	0.000*
32.80±1.35× 10^4	Average	19.33±12.08	0.000*
		4.27±1.11× 10^4	

Significance level > o.95

Conclusions

Organically managed soils are more stable systems with larger soil health. Soil organic matter, silt and sand particles could be used as good indicators reflecting differences in soil quality between organically and chemically managed fields in Gilan province. The soil contents of clay, silt, sand and organic matter were significantly varied and markedly differed between before rice cultivation and after harvest season. In organic and young organic fields, soil organic matter contents increased 0.33 g kg after harvest period while, these contents of semi – chemical and chemical fields were decreased. Soil organic matter significantly influenced soil fertility and grain yield. The decline in soil organic matter is the major cause of yield decline.

Therefore, organic management practices could improve soil fertility and productivity of rice field. Analyses also – show the important influences in soil biota and process, especially soil cellulolytic microbes in the subsoil samples (10-15cm).

Acknowledgments

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