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Soil Fertility Status as Influenced by Cropping System in Submountain Zone of Lower Shiwalik Hills in Punjab

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ABSTRACT

The present study was conducted to access the effect of cropping system under irrigated and rainfed condition on fertility status of the soil. The soil samples (0-15 cm) were collected from four villages, i.e Jhandiankalan, Mehndrikhurd, Samlah and fatehgarhviran. The results from chemical analysis of samples revealed that the pH of 100% samples from was lied between 6.5-8.7 and EC from 100% samples lied below 0.8 dS/m. Soil samples in irrigated system were high in SOC category, whereas none of the soil sample in rainfed system had SOC in this category. Similarly, available P, K and DTPA extractable available Cu, Zn and Fe were low in soils from maize-wheat system as compared to rice-wheat system soils.

Key Words: Maize-wheat, Nutrient content, Micro-nutrient status, Rice-wheat.

INTRODUCTION

The sub mountain zone of Punjab consist parts of Hoshiarpur, Ropar, Nawanshaher, Pathankot and Patiala. This zone is characterized with undulating topography and hilly terrain with problems such as soil erosion, lack of soil moisture, frequent floods, droughts, low fertility status of soil and deep underground water. The maize-wheat is the second dominant cropping system after rice-wheat cropping system. Rice-wheat cropping system was cultivated over an area of ~2.6 mha that constituted ~78% of gross cropped area of the Punjab (Benbi and Brar, 2009), on the other hand, maize-wheat cropping sequence was followed over an area of about 0.126 mha area.

Benbi *et al* (2012) reported that the contrasting moisture regimes under rice-wheat and maize-wheat cropping systems lead to decomposition of organic matter at variable rates. The soil organic carbon pool was also affected by the indigenous carbon input in the form of root and leaf biomass and farmyard manures. The magnitude of carbon sequestration and nutrient release in soil after its mineralization was mainly driven by the quality of the soil organic matter (SOM). The climate, cropping system and soil management interventions such as manures and fertilizer application, extent of soil tillage and soil moisture also affected the soil organic carbon status of the soil (Regmi *et al*, 2002). The present investigation was carried out to access the effect of cropping system on fertility status of the soils under rice-wheat and maize-wheat cropping systems.

MATERIALS AND METHODS

The study region is situated in villages Jhandian, Samlah, Mehndrikhurd and Fatehgarhviran of district Ropar (Punjab). The soil of villages Jhandiankalan, Mehndrikhurd and Samlah are under Maize-wheat cropping system with rainfed condition, while soil of the village Fatehgarhviran is under rice-wheat cropping system with irrigated condition. Rice crop was fertilized with 125-160 kg N ha-1, 30-40 kg P2O5 ha-1, 20-30 kg K2O ha−1 (in soil with low potassium status), while maize crop was fertilized with 90-130 kg N and 25-35 kg P2O5 ha-1 and farmyard manure was applied at 6 Mg ha1 before transplanting rice or seeding maize, once in two years. Wheat was fertilized at 90-130 kg N and 50-65 kg P2O5 ha−1 and 20-30 kg K2O

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Table 1. Effect of cropping systems on chemical properties, available macro-nutrients and DTPA extractable micro-nutrient status of soil.

Cropping system	pH	EC (dS m-1)	OC (%)	Available (Kg/Acre)		DTPA extractable micro-nutrient (mg/kg)			
				P	K	Mn	Cu	Fe	Zn
Rainfed Eco-system (Maize-wheat system)	7.54a	0.21b	0.42b	10.90b	126.38b	6.48a	0.72b	5.61b	0.96b
Irrigated Eco-system (Rice-wheat system)	7.82a	0.39a	0.64a	13.31a	138.28a	4.90b	1.35a	16.92a	1.53a

Different letters in each column show significant differences at < 0.05 probability level.

ha−1 (in soil with low potassium status). In addition 25 kg Zinc sulphate (21% Zn) was also applied to rice in Zinc deficient soils and 10 kg Zinc sulphate (21% Zn) was applied to maize in Zinc deficient soils.

Surface soil samples (0-15 cm depth) were collected from 100 sites under different land-uses at four villages. Soil samples were collected in the month of May after the harvesting of wheat. Soil samples were collected randomly from 4-5 places with the help of soil augur and then composited. Soil samples were air dried and sieved through 2 mm sieve for chemical analysis. The soil samples were analyzed for pH (1:2 soil: water suspension), electrical conductivity (EC, 1:2 soil: water supernatant), soil organic carbon (SOC) (rapid titration method of Walkley and Black (1934)), available P (Olsen et al, 1954), available K (Mervin and Peech, 1950) and micro-nutrients viz. zinc (Zn), copper (Cu), iron (Fe) and manganese (Mn) were determined using DTPA (Diethylene Tri-amine Penta Acetic acid) extract (Lindsay and Norvell, 1978). Mean comparison was made using Duncan Multiple Range Test when the F-test was found significant.

RESULTS AND DISCUSSION

The results revealed that pH and EC were higher in the irrigated rice-wheat system as compared to rainfed system (Table-1). The soil organic carbon was significantly higher in the rice-wheat system as compared to rainfed system; it might be due to addition of higher root biomass in irrigated system. Similarly, available P and available K were significantly higher in the irrigated system than rainfed system. This was mainly due to higher use of phosphoric and potassic fertilizers. In case of Mn, higher number of soil samples lied under Mn deficient category (less than 3.5 mg kg-1) in rice-wheat cropping than that in maize-wheat, but Mn deficiency in wheat depends upon the permeable nature of soils coupled with greater solubility of Mn (Singh et al, 2006). The higher uptake under intensive cultivation in case of rice-wheat system might be another reason for the low Mn content in Irrigated system.

All the soil samples had DTPA-Cu above critical value of 0.2 mg kg-1 representing optimal Cu supplying capacity of soils for optimal crop growth. The data further revealed that irrigated rice-wheat system has higher number of soils under sufficient Zn category as compared to rainfed system might be due to addition of Zn fertilizers. The maize-wheat and rice-wheat cropping system had DTPA-Fe concentration more than critical value of 4.5 mg kg-1, but the concentration was significantly higher in rice-wheat system as compared to maize-wheat system. The higher soil moisture in the irrigated rice-wheat system provides favourable micro environment for higher solubility and availability of DTPA extractable Fe.

CONCLUSION

The pH, EC and SOC were higher in the irrigated rice-wheat system as compared to rainfed system. The available P, K, DTPA extractable Fe, Zn and Cu were higher in the irrigated system than rainfed system, while available Mn content was lower in irrigated system than rainfed system. It has also been observed that intensive cultivation has led to bulid up of SOC in soils under irrigated system.

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