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Impact of Organic Farming on Soil Physico- Chemical Properties and Green House Gas Emission

Pragati Pramanik[1*] and Shiv Prasad[2]

[1,2]Centre for Environment Science and Climate Resilient Agriculture Indian Agricultural Research Institute, Pusa Campus, New Delhi-110 012
E-mail: [*]pragati.iari@gmail.com

Abstract—*Organic farming is a system which avoids the use of synthetic inputs and to the maximum extends, depends on crop rotations, crop residues, animal manures, off-farm organic input. It is a unique crop production and management system which promotes and enhances agro-ecosystem health. It is not only productive and low cost system but also resource conserving and sustainable for centuries to come. To assess the impact of organic farming system on soil physico- chemical properties and green house gas (GHG) emission, soil and gas samples were collected from conventional and wheat based organic farming system situated at Behta, Bulandshahar, UP where the farmer has been practicing organic farming since last 10-11 years. Bulk density (BD), soil water content (SWC) and porosity for 0-15cm soil depth in organic wheat field were 1.61 Mg/m^3, 19.52 % and 39.08 % whereas BD, SWC and porosity for 0-15cm soil depth in conventional wheat field were 1.72 Mg/m^3 , 9.46 % and 35.26%, respectively. Upto 15 cm soil depth, penetration resistance (PR) was lower (925 kPa) in organic wheat system as compared to conventional wheat field (1144 kPa). There was not much variation in EC and pH of organic and conventional wheat field. Soil organic carbon was 0.71% in organic field whereas it was only 0.43% in conventional wheat field. In organic field, methane emission was higher (due to application of biogas slurry and organic manure) than nitrous oxide emission but lower than conventional field. Thus, organic farming system improves soil properties and reduces GHG emission.*

Keyword*: organic farming, bulk density, penetration resistance, organic carbon and green house gas emission.*

1. INTRODUCTION

Organic farming is a method of crop management system which primarily aims at cultivating the land and raising crops in such a way that to keep the soil alive and in good health by use of organic wastes like crop, animal and farm wastes, aquatic wastes and other biological materials along with beneficial microbes (biofertilizers) to release nutrients to soils for increased sustainable production in an eco-friendly pollution free environment. Organic farming is meant to minimize environmental and human health impacts by avoiding the use of synthetic fertilizers, chemical pesticides and hormones or antibiotic. Organic farming practices have been associated with improved soil properties through a number of considerations including the addition of soil organic matter, increased earthworm population, biodiversity, soil fertility etc. The impact of organic agriculture on natural resources favors interactions within the agro-ecosystem that is vital for both agricultural production and conservation of nature. Ecological services derived include soil forming and conditioning, soil stabilization, waste recycling, carbon sequestration, nutrients cycling, predation, pollination and habitats. Objective of the present study was to assess the impact of long term organic farming on soil properties and green house gas emission.

2. METHODOLOGY

Farmer's field at Behta village in Bulanshahar district of Uttar Pradesh was selected for the current study (28°39'09"N latitude and 78°01'18"E longitude; 203 m above mean sea level). Organic wheat and vegetable systems are followed in the farmer's field. Organic inputs added into the field are crop residue of previous crop and farm waste. Soil samples were collected from 0 to 15 cm and 15- 30 cm depth from organic and conventional wheat fields. Collected samples were air dried and sieved using 0.5 mm sieve. Further the processed samples were used for estimation of soil organic carbon (Walkley and Black, 1934), EC and pH (1:2 soil water ratio). Bulk density (BD) of 0-15 cm soil layer was measured using a core auger (Blacke and Hartge, 1986). A core auger of 5 cm diameter and 15 cm height was used for this purpose. Soil water content (SWC) was measured simultaneously along with BD using gravimetric method. Penetration reading was taken by using Rimik cone penetrometer (CP 20 model). Gas samples were taken from organic and conventional wheal field at the time of soil sampling and were analysed by using gas chromatography.

3. RESULTS AND DISCUSSION

Bulk density (BD), soil water content (SWC) and porosity for 0-15cm soil depth in organic wheat field were 1.61 Mg/m^3, 19.52% and 39.08% whereas BD, SWC and porosity for 0-15cm soil depth in conventional wheat field were 1.72 Mg/m^3, 9.46% and 35.26%, respectively (Table 1). Upto 15 cm soil

depth, penetration resistance (PR) was lower (925 kPa) in organic wheat system as compared to conventional wheat field (1144 kPa). This supports the view that there is greater potential for soil structural improvement in organically managed soils than conventionally managed (Shepherd *et al*., 2002, Pulleman *et al*., 2004). Organic management contributes to the creation of an ¨enhanced¨ soil structure for crop production (Reganold, 1995; Papadopoulos *et al*., 2006). There was not much variation in EC and pH of organic and conventional wheat field. Soil organic carbon was 0.71% in organic field whereas it was only 0.43% in conventional wheat field (Fig. 1). Schjonning *et al.* (2007) have shown that different land management practices will influence the level of SOM and the length of time the soils are managed can have a positive effect on the SOM level after 5-6 years.

Nitrous oxide (N_2O) and methane (CH_4) are the important greenhouse gases contributing 5% and 15%, respectively towards the enhanced global warming (Watson *et al.*, 1996). Methane (CH_4) and nitrous oxide (N_2O) emission from agriculture is also contributing to the global warming. Keeping in view field sampling for measurement of these greenhouse gases was done. Results showed that in organic field, methane emission was higher (due to application of biogas slurry and organic manure) than nitrous oxide emission but lower than conventional field (Table 1).Thus, organic farming system improves soil properties and reduces GHG emission.

Table 1: Physico- chemical properties and methane and nitrous oxide emission of organic and conventional wheat field

Treatments	Depth (cm)	SWC (%)	BD (mg/m3)	Porosity (%)	EC (dS/m)	pH	N2O-N emission (kg ha-1)	CH4 emission (kg ha-1)
Org. wheat	0-15	19.52	1.61	39.08	0.35	7.7	0.62±0.08	28.4±1.16
Conv. wheat	0-15	9.46	1.72	35.26	0.41	8.05	0.97±0.04	26.8±1.09

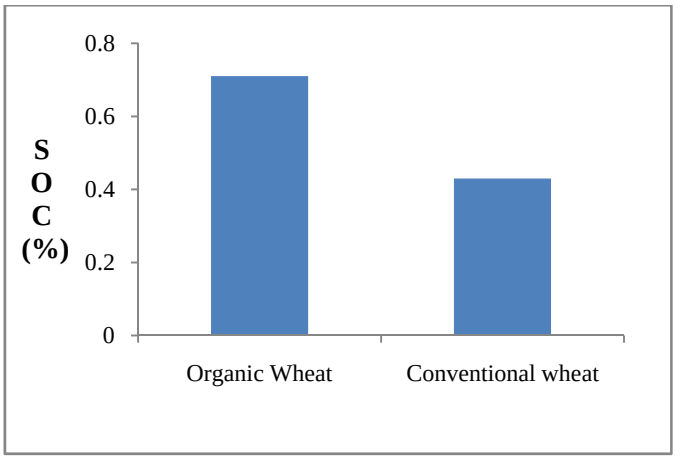

Fig. 1: Soil organic carbon content (SOC %) of organic and conventional wheat field

4. CONCLUSION

Soils under organic management had higher SOC content and good physic- chemical properties than those of the conventionally managed soils. A low PR value indicates better soil structure under organic management system. Low GHG emission from organic field will help to combat the effect of global warming. A comprehensive understanding of the effects of the two management systems on soil physical properties and GHGs emissions are vital for sustainable land management.

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