Original Research Article

Response of organic manures and rice residues on physical soil health parameters

ABSTRACT

The trial carried on topic "Response of organic manures and rice residues on soil physical health parameters" for the two repeated years, start from *Rabi* seasons of the years 2021-22 at research farm, department of soil science and agricultural chemistry. Total 54 soil samples were taken from the site from different depths *i.e.*, 0-15 cm and 15-30 cm. Among nine treatments, during field experimentation, the conjunctive use of NPK and different organic manures [FYM, vermicompost, rice residues and jeevamrutha] levels, together come with best results significantly. The excavated soil sample from experimental site before conducting research operation, mentioned that, the land topography range was nearly levelled with 1-3% slope. Soil is of sandy loam texture. Significantly, with regard to physical soil parameters, cumulative mean value for bulk density 1.31 Mg m^{-3}, percent pore space 49.25 %, particle density 2.55 Mg m^{-3} and percent maximum water holding capacity 43.27 %, physical properties were found to be significant in terms soil health. This study includes awareness about the role about importance of physical properties for maintaining soil health.

Key words: FYM, vermicompost, rice residues, jeevamrutha, soil health, cumulative *etc.*

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Introduction

Soil testing makes complete nutrient control possibility fertilizer experiments are being patterned to determine economically optimum rates of nutrients application high yields with low production costs per unit are a must in modern farming. However, the capacity of

soil to produce is limited and limits to production and set by intrinsic characteristics, agroecological setting **(Deshmukh *et al.*, 2020)**. Soil is the most valuable natural resource. It is at the heart of terrestrial ecology, but it is finite and non-renewable **(Mustafa *et at.* 2011 a, b,)**. As we have to meet the changes of this century, new understandings and new technologies will be needed to protect the environment and at the same time, produce food and biomass to support society **(Brady and Weil 2004)**. The Indo-Gangetic Plains (IGP) with about 13% geographical coverage of India produces nearly 50% of food grains to feed 40% of the total population of India. The IGP is an important agricultural region of the country with total area of about 44 m ha^{-1} represented by well classified agro-ecological sub-regions **(Vilayutham *et al.* 1999)** and covers the states of Punjab, Haryana, Delhi, Uttar Pradesh, Bihar, West Bengal and parts of a few other states.

Physical properties play an important role in determining soil's suitability for agricultural, environmental and engineering uses. The supporting capability; movement, retention and availability of water and nutrients to plants; ease in penetration of roots, and flow of heat and air are directly associated with physical properties of the soil. Physical properties also influence the chemical and biological properties. The most pertinent physical properties of soil relevant to its use as a medium for plant growth **(Hillel 1971).**

Soil aggregate stability is a fundamental property that determines its productivity through influencing a wide range of soil properties, including carbon stabilization, soil porosity, water infiltration, aeration, water retention, hydraulic conductivity, resistance to erosion and degradation **(Six *et al.* 2000).**

This demand systematic appraisal of our soil resources with respect to their extent, distribution, characteristics, behaviour and use potential, which is a very important for developing an effective land use system for augmenting agricultural production on sustainable basis **(Gajbhiye 2018)**.

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METHODOLOGY

Site details

The field experiment which was carried out at the research farm of soil science and agricultural chemistry, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj during in *rabi* season 2021-22. The maximum temperature of the

location ranges between 46.0-48^{0}C and seldom falls below 4^{0}C-5^{0}C. The relative humidity ranges between 20-94%. The average rainfall of this area is around 1100 mm annually. The experiment was laid out in randomized block design (RBD) with 9 treatments. The treatments have been replicated three times. The different treatments were employed randomly in each replication.

Soil Sampling and laboratory testing

Soil sampling was done with the standard sampling tools from two depths *i.e.* 0-15cm and 15-30 cm. Analysis of the soil samples were under the methods, the physical parameters include bulk density, particle density, pore space, water holding capacity.

Table 1. Protocols for different soil physical parameters

S. No.	Particulars	Scientist Name	Methods	Unit
		PHYSICAL PROPERTIES		
1.	Bulk density	Black (1965)	Pycnometer	Mg m^{-3}
2.	Particle density	Black (1965)	Pycnometer	Mg m^{-3}
3.	Pore space	Black (1965)	-	(%)
	Water holding capacity	Muthuval *et al.* (1992)	Graduated measuring cylinder	(%)

Results and discussions

Soil bulk density

The maximum bulk density was found in 2021-22 and 2022-23 at different depth at 0-15 cm and 15-30 cm were in T_1 were 1.36 Mg m^{-3}and 1.35 Mg m^{-3} found to be significant followed by in T_9 *i.e.*,1.29 Mg m^{-3} and 1.37 Mg m^{-3}, minimum was found T_6 *i.e.*,1.25 and 1.34 Mg M^{-3}. The maximum bulk density in year 2022-23 were found in T_1 were 1.32 Mg m^{-3}and 1.37 Mg m^{-3} found to be significant followed by in T_9 *i.e.*, 1. 27 Mg m^{-3} and 1.36 Mg m^{-3}, minimum was found T_6 *i.e.*, 1.24 and 1.34 Mg m^{-3} respectively. Higher bulk density may be due to less organic matter in T_1. Similar results were reported by **(Ahad *et al.*, 2015)**.

Soil particle density

The maximum particle density of soil were found in treatment T_6 *i.e.,* the particle density was 2.57 Mg m^{-3} at 0-15 cm depth and 2.59 Mg m^{-3} at 15-30 cm depth during 2021-

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22 while in 2022-23, it was 2.55 Mg m^{-3} at 0-15 cm depth and 2.58 Mg m^{-3} at 15-30 cm depth of soil, in comparison with T_1 where minimum values of the result were found *i.e.* 2.51 Mg m^{-3} at 0-15 cm depth and 2.53 Mg m^{-3} at 15-30 cm depth of soil during 2022 while in 2023 it was 2.50 Mg m^{-3} and 2.52 Mg m^{-3} at both 0-15 cm and 15-30cm depth of soil, respectively. Higher Particle density was found due to lack of incorporation of FYM, vermicompost, jeevamrutha and rice residue and organic matter. Similar results were reported by **(Chaudhari *et al.*, 2013)**.

Soil porosity

As showed that maximum pore space (%) of soil in treatment T_6 *i.e.*, 49.88 and 49.4 % at 0-15 and 15-30 cm of soil depth during 2022 and for 2023 it was 49.70 and 49.18 % at soil depth 0-15 and 15-30 cm, respectively. The minimum values of the result were found be significant in treatment T_1, which was 46.66 and 44.66 % at 0-15 and 15-30 cm of soil depth during 2021-22 while during year 2022-23 it was 47.33 and 46.99 % at soil depth 0-15 and 15-30 cm respectively. There is almost a linear increase in porosity with increase in doses of FYM, vermicompost, jeevamrutha and rice residue. Similar results were reported by **(Ahad *et al.*, 2015)**.

Soil water holding capacity

As observed maximum water holding capacity (%) of soil found in treatment T_6 *i.e.*, which was 44.37% at 0-15 cm depth and 42.99 % at 15-30 cm soil depth during 2022 while during 2023 it is observed as 44.27 % at 0-15 cm and 42.41 % at 15-30 cm soil depth. Timely the minimum values of the result were found in treatment T_1 which was 37.12 % at 0-15 cmand 37.32 % at 15-30 cm soil depth during 2021-22 similarly, 37.12 % and 36.32 % at 0-15 and 15-30 cm soil depth during 2022-23, respectively. There is increase in water holding capacity with increase in doses of FYM, vermicompost, jeevamrutha and rice residue. Similar results were reported by **(Das *et al.*, 2018).**

Conclusion

It revealed from the trial that application of farm yard manure and vermicompost with inorganic fertilizers in treatment T_6 was found best in Since the results is based on one season physical properties. The T_1 shows the poor physical condition where FYM, vermicompost, jeevamrutha and rice residue was applied in least amount. This concludes

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that use of FYM, vermicompost has improved the physical health of soil which leads to overall better health of soil.

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Table 2. Treatment combination of taramira

TREATMENT	TREATMENT COMBINATION
T_1	[NPK @ 25 % + FYM @ 25 % + @ R @ 25 % + Zn @ 25 %]
T_2	[NPK @ 50 % + FYM @ 50 % + @ R @ 50 % + Zn @ 50 %]
T_3	[NPK @ 100 % + FYM@ 100 % + @ R @ 100 % + Zn @ 100 %]
T_4	[NPK @ 25 % + VC @ 25 % + @ R @ 25 % + Zn @ 25 %]
T_5	[NPK @ 50 % + VC @ 50 % + @ R @ 50 % + Zn @ 50 %]
T_6	[NPK @ 100 % + VC @ 100 % + @ R @ 100 % + Zn @ 100 %]
T_7	[NPK @ 25 % + JM @ 25 % + @ R @ 25 % + Zn @ 25 %]
T_8	[NPK @ 50 % + JM @ 50 % + @ R @ 50 % + Zn @ 50 %]
T_9	[NPK @ 100 % + JM @ 100 % + @ R @ 100 % + Zn @ 100 %]

Note: RDF, FYM, vermicompost (VC), rice residue (R), and jeevamrutha (JM)

RDF = NPK @ 100% (40:20:20 + Zn 25 kg ha^{-1})

FYM @ 10 t ha^{-1} @ VC 4 t ha^{-1}

R @ 5 t ha^{-1}

JM @ 500 ltr ha^{-1}

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Table 3. Response of organic manure and rice residue on physical soil properties

S. No.	Soil bulk density (Mg m^{-3})				Soil particle density (Mg m^{-3})				Soil porosity (%)				Soil water holding capacity (%)			
	2021-22		2022-23		2021-22		2022-23		2021-22		2022-23		2021-22		2022-23	
	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm
T_1	1.31	1.36	1.32	1.37	2.51	2.53	2.50	2.52	46.66	44.66	47.33	46.99	37.12	37.04	37.12	36.32
T_2	1.28	1.35	1.28	1.35	2.55	2.55	2.53	2.56	47.87	45.87	48.54	47.2	38.04	37.45	38.04	39.71
T_3	1.26	1.35	1.25	1.35	2.53	2.54	2.51	2.55	48.41	47.07	49.07	48.08	41.11	40.59	41.11	42.58
T_4	1.24	1.34	1.23	1.34	2.55	2.57	2.50	2.52	47.73	45.73	48.4	47.06	39.25	38.88	39.25	40.65
T_5	1.26	1.35	1.25	1.34	2.54	2.56	2.52	2.55	49.61	48.61	49.28	48.51	43.72	42.72	43.72	43.82
T_6	1.25	1.34	1.24	1.34	2.57	2.59	2.55	2.58	49.88	49.44	49.70	49.18	44.27	42.99	44.37	43.41
T_7	1.26	1.35	1.24	1.35	2.51	2.52	2.51	2.54	48.09	47.76	49.01	48.95	40.61	40.27	40.61	41.85
T_8	1.29	1.36	1.28	1.36	2.53	2.57	2.54	2.55	49.05	48.59	48.25	47.00	42.31	42.25	42.31	42.31
T_9	1.29	1.37	1.27	1.36	2.52	2.56	2.53	2.56	48.34	47.34	48.67	48.00	40.54	40.11	40.54	41.94
F- test	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
S. Em. (±)	**0.018**	**0.020**	**0.018**	**0.025**	**0.038**	**0.033**	**0.037**	**0.041**	**0.68**	**0.83**	**0.72**	**0.74**	**0.54**	**0.74**	**0.55**	**0.73**
C. D. @ 5 %	**0.055**	**0.060**	**0.055**	**0.077**	**0.115**	**0.101**	**0.113**	**0.125**	**2.05**	**2.50**	**2.18**	**2.24**	**1.64**	**2.24**	**1.67**	**2.20**

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