

Long Term Effect of Organics and Fertilizers on Some Physical Parameters of Soil on Vertisols Under Sorghum Wheat Sequence

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ABSTRACT

The study on long term effect of organics and fertilizers on physical properties of soil conducted at Cropping System Research at PDKV Akola revealed that application of 50 % recommended NPK through fertilizers + 50 % N through FYM lead to better improvement in the physical properties of soil viz, water retention, hydraulic conductivity, bulk density, porosity and mechanical composition, percent water stable aggregates > 0.25 mm. MWD and GMD. The study also revealed that FYM along with fertilizers, helped in improving soil physical properties rather than fertilizers alone and fertilizer in combination with wheat straw and green manures.

I. INTRODUCTION

Vertisols and associated soils viz. Inceptisols and Entisols are major soils in Traditional agricultural areas of peninsular India Challa et al, (1995) reported that Entisols are dominant soils in Maharashtra covering 36.6 % followed by Inceptisols (30.57 %), Vertisols (26.2 %), Alfisols (5.96%) and Molisols (0.06%) of the total geographical area (30.7 m ha). The vertisols that comes under the classification typic chromusters of the semi-arid tropics represents a major resource for cropping but are mostly under utilized because of their typical physicochemical properties and management problems. In spite of the fact that vertisols possess certain unique management problems but they are potentially productive if managed properly. Therefore, the present investigation was undertaken to study the effect of organics and fertilizers alone and in combination in a long term experiment on some physical parameters viz, water retention, saturated hydraulic conductivity, bulk density, porosity and mechanical composition, % water stable aggregates > 0.25 mm. MWD and GMD

II. MATERIALS AND METHODS

A long term field experiment was conducted at Cropping System Research, Dr. Panjabrao Deshmukh Krishi Vidyapeeth Akola to study the soil physical parameters under each treatment plot from experimental site after 14 years of experimentation involving continuous use of manures and fertilizers for Jowar (*Kharif*) and Wheat (*rabi*) with twelve treatments replicated four times in Randomized Block Design. The treatments details regarding organics and fertilizer doses are given in table 1.

The NPK nutrients were applied in the form of urea single super phosphate and muriate of potash respectively. The calculated doses of these fertilizers were added at the time of sowing. Entire dose of phosphorus and potassium was given as a basal dose. While nitrogen was applied in two split doses, half at the time of sowing and remaining half dose one month after the sowing.

The calculated doses of FYM, green manure [Subabul] Wheat straw were added to the respective treatment plots in combination with other nutrients [NPK] and were thoroughly mixed with the soil using hand implements. Manures were applied once in a year at the start of the monsoon but NPK doses were applied twice in a year, first to *kharif* sorghum and then again to wheat crop grown in sequence as per treatment. The bulk density of soil was determined by clod coating technique. Moisture retention at 1/3 and 15 bar and AWC was determined by using pressure plates and membrane apparatus. Hydraulic conductivity was determined by constant head method. Textural class of soil was assigned using textural triangle as described by Singh (1980). The data contained were subjected to statistical analysis by following the procedure given by Panse and Sukhatme (1985). The results were presented in tables 2,3 and 4

III. RESULTS AND DISCUSSION

Data pertaining to mechanical composition of soil [Table 2] under different treatments for percent sand, silt and clay were found statistically significant, whereas textural class for soil under different treatments of organics and fertilizers was found clay only. This indicates that soil textural class remain unchanged under long term effects of organics and fertilizers.

Bulk density values [Table 2] were found statistically significant under different treatments of organic and fertilizers and it varied over a range of 1.35 to 1.59 mg m⁻² with lowest values under the treatment of 50 % recommended NPK through fertilizer + 50 % N through FYM (T6). Venkatesh et al (1992) reported lower

value for bulk density under continuous use of fertilizers and manure. Where as soil porosity was found highest [48. 95 %] under treatment [T6]

The values for water retention at 1/3 bar and 15 bar and available water capacity [AWC] [Table 3] were found statistically significant under long term effect of organics and fertilizers. The values for water retention at 1/3 bar and 15 bar varied respectively between 28.40 and 37.48 percent and 14.86 and 19.81 percent with AWC between 1.85 and 2.42 cm 15 cm soil depth AWC values were found greater under the treatment of 50 % NPK through fertilizers combined with 50 % N through FYM (T 6) as compared to 100 % NPK through fertilizers alone (T 5) as well as control (T 1). This shows that use of organics in combination with the fertilizers helps in increasing AWC of Soil. The use of FYM with fertilizers was found statistically superior over the use of the wheat straw and green manures in respect of AWC Biswas et al (1971) reported similar effect of soil water content.

Water transmission properties particularly the hydraulic conductivity values [Table 3] showed that it was found statistically significant and it varied from 0.304 to 1.79 cm ha⁻¹ with the highest value of 1.79 cm ha under use of FYM combined with fertilizers application [T 6 and T 7] as compared to other treatments Increase in hydraulic conductivity due to use of manures and fertilizers was reported by Ingole [1969]

The data pertaining percent water stable aggregates > 0.25 mm, mean weight diameter and geometric mean diameter [Table 4] under different treatments were found statistically significant and values for these varied respectively from 55.53 to 77.49 % 0.60 to 0.89 mm and 0.58 to 0.76 mm. Highest value of percent water stable aggregates was observed as 77.49 % under 50 % NPK combined with 50 % N through FYM (T6) Showing combined use of NPK and FYM is beneficial in respect of increasing percent water stable aggregates of size > 0.25 mm Ingole (1969) observed increase in soil aggregates due to a long term application of manures and fertilizers.

Mean weight diameter value of 0.89 mm was found highest under 50 % NPK combined with 50 % N through fertilizers+ 50 % N through FYM [T 6] Geometric Mean diameter value of 0.76 mm was found highest under same treatment i.e. [T 6]

Table :1 Details of Treatment

Treat.	Kharif (Sorghum)	Rabi (Wheat)
T1	Control	Control
T2	50% recommended NPK dose through fertilizers	50 % recommended NPK dose through fertilizers
T3	50 % recommended NPK dose through fertilizers	100 % recommended NPK dose through fertilizers
T4	75 % recommended NPK dose through fertilizers	75 % recommended NPK dose through fertilizers
T5	100 % recommended NPK dose through fertilizers	100 % recommended NPK dose through fertilizers
T6	50 % recommended NPK dose through fertilizers + 50 % through FYM	100 % recommended NPK dose through fertilizers
T7	75 % recommended NPK dose through fertilizers + 25 % N through FYM	75 % recommended NPK dose through fertilizers + 25 % N
T8	50 % recommended NPK dose through fertilizers + 50 N through crop residues (wheat straw)	100 % recommended NPK dose through fertilizers+ 50 N
T9	75 % recommended NPK dose through fertilizers + 25 N through fertilizers through drop residues (wheat straw)	75 % recommended NPK dose through fertilizers
T10	50 % recommended NPK dose through fertilizers + 50 N through green organic matter [<i>Leucaena loppings</i>]	100 % recommended NPK dose through fertilizers
T11	75 % recommended NPK dose through fertilizers +25 N through green organic matter [<i>Leucaena loppings</i>]	75 % recommended NPK dose through fertilizers
T12	Farmer's practice(50:25:00 kg h ⁻¹ NPK)	Farmer's practice(40 : 25: 12.5 kg ha ⁻¹ NPK)

Table : 2 Mechanical composition of soil under long term effect of organic and fertilizers in sorghum - wheat sequence on vertisols

Treatment	Mechanical Composition (%)			Textural Class	Bulk Density	Porosity (%)
	Clay	Silt	Sand			
T ₁	47.06	22.35	30.14	Clay	1.59	39.71
T ₂	47.06	22.35	30.14	Clay	1.49	43.58
T ₃	47.61	22.42	29.66	Clay	1.48	44.05
T ₄	48.01	24.54	27.24	Clay	1.47	44.20
T ₅	49.01	25.53	25.24	Clay	1.45	44.90
T ₆	49.92	22.58	30.24	Clay	1.35	48.95
T ₇	47.98	23.56	28.25	Clay	1.37	48.01
T ₈	50.02	27.61	22.28	Clay	1.40	47.11
T ₉	48.98	24.51	22.26	Clay	1.42	46.41
T ₁₀	48.00	24.61	27.27	Clay	1.39	47.25
T ₁₁	53.90	30.61	15.27	Clay	1.41	46.50
T ₁₂	47.00	22.61	30.25	Clay	1.51	42.71
SE (m) +	3.52	0.06	0.02	-	0.008	0.30
CD at 5 %	9.88	0.19	0.08	-	0.02	0.86

Table : 3 Water retention and transmission properties of soil under long term effect of organic and fertilizers in sorghum -wheat sequence on vertisols

Treatment	Water Retention at	AWC	Bulk	Hydraulic
	Conductivity			
	1/3 Bar	15 Bar		
T ₁	28.80	14.86	1.85	0.304
T ₂	28.84	16.04	1.90	0.403
T ₃	29.39	16.63	2.23	0.605
T ₄	30.1	17.14	1.89	0.605
T ₅	30.95	17.88	1.90	0.779
T ₆	37.78	19.81	2.42	1.791
T ₇	37.13	19.49	2.42	1.791
T ₈	32.62	17.94	2.05	0.826
T ₉	32.61	17.77	2.10	0.808
T ₁₀	34.77	18.97	2.22	1.871
T ₁₁	33.89	18.51	2.17	1.330
T ₁₂	28.40	15.74	1.91	0.357
SE (m) +	00.16	0.18	0.10	0.14
CD at 5 %	0.46	0.28	0.29	0.40

Table :4 Aggregate stability and indices of soil structure under long term effect of organic and fertilizers in sorghum -wheat sequence on vertisols

Treatment	% WSA > 025 (mm)	MWD (mm)	GMD (mm)
T ₁	55.53	0.60	0.58
T ₂	61.90	0.77	0.66
T ₃	69.97	0.75	0.70
T ₄	72.81	0.75	0.73
T ₅	68.80	0.62	0.72
T ₆	77.49	0.89	0.76
T ₇	71.48	0.59	0.71
T ₈	71.13	0.84	0.68
T ₉	56.13	0.77	0.64
T ₁₀	67.53	0.76	0.66
T ₁₁	70.09	0.84	0.74
T ₁₂	59.14	0.84	0.68
SE (m) +	3.76	0.03	0.01
CD at 5 %	10.57	0.08	0.03

The experiment established the beneficial effect of organic manures i.e. FYM in combinations with fertilizers over important physical properties of soil. The treatment 50 % NPK through fertilizers + 50 % N through FYM resulted in better improvement in soil physical properties.

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