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Soil Physical Environment in Long Term Fertilizer Experiment on Typic Haplusterts in Sorghum-wheat Cropping Sequence

Prajakta M. Metkari[1], Suresh S. Kharat[2] and Papita H. Gourkhede[3]

Abstract: *A study was conducted to assess the long term effects of fertilizers and FYM on physical properties after 25th cycle of sorghum-wheat cropping sequence in a Vertisol. The combined use of inorganic fertilizers (100% NPK) along with FYM @ 10 t ha^{-1} significantly improved the bulk density, porosity, soil moisture content of TypicHaplustert.*

Key words*: Long term fertilization, FYM, Sorghum-wheat sequence, physical properties.*

INTRODUCTION

The use of NPK fertilizers under intensive farming will not be appropriate, unless they are combined with organic manure to have good soil health.Improvement in structure, porosity, soil moisture content and lowering ofbulk density for sandy clay loam soil were observed under permanent manorial trial (Biswas and Khosla, 1971). Application of combined addition of organics in combination with inorganics were resulted in improvement in soil physical properties on black soil as compared to inorganic alone (Bellaki *et al*., 1998). Sorghum and wheat are the important food grain crops of the Maharashtra. However such information is virtually lacking in typical Vertisols supporting sorghum-wheat crops of Vidarbha region and hence present investigation was carried out.

MATERIALS AND METHODS

The present investigation was undertaken during the year 2011-12 and 2012-13 on the old long- term fertilizer experiment started since 1988, to study the effects of long-term fertilization of Vertisol on soil physical properties of sorghum-wheat cropping sequence at Research Farm, Department of Soil Science and Agricultural Chemistry, Dr. PDKV, Akola. The soil at the start of experiment was Vertisol with slightly alkaline in reaction (8.1), low in organic carbon (4.6 g kg^{-1}), available N (120 kg ha^{-1}) and available phosphorus (8.4kg ha^{-1}) and high in available potassium (358 kg ha^{-1}). There were twelve treatments replicated four times in a randomized block design comprised of varying NPK levels with and without FYM, S and Zn. The details of various treatments in the permanent plot experiment are given in Table 1. FYM containing on an average 0.52, 0.17, 0.56% N,P_2O_5 and K_2O, respectively on dry weight basis was applied in *kharif* season only. The recommended dose of fertilizer was applied @ 100:50:40 and 120:60:60 N,P_2O_5 and K_2O kg ha^{-1} to sorghum and wheat respectively. Half dose of N and full dose of P and K was applied at the time of sowing to sorghum and wheat crops. Remaining half dose of N was applied at 21 days after sowing. The sulphur (though gypsum) was applied to each plot as per the treatments. Zinc (through zinc sulphate) was applied once in two years for wheat crop only. Plot-wise surface (0-15 cm) soil samples were collected after the harvest of sorghum and wheat. The soil samples were processed for physical analysis. The bulk density of soil was estimated by clod coating method (Blake and Hartge, 1986), moisture content by gravimetric method (Khanna and Yadav, 1979). The porosity was estimated from bulk density and particle density

Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, Maharashtra

1. Ph.D Scholar,Dept. of Soil Science and Agricultural Chemistry, Dr. PDKV, Akola, *E-mail: dr.prajaktametkari@gmail.com*
2. Senior Research Assistant, Dr.PDKV, Akola.
3. Assistant Professor, VNMKV, Parbhani.

(Baver, 1949). The data were analysedstastically by the methods described by Panse and Sukhatme (1985).

RESULT AND DISCUSSION

The effect of long term fertilization and manuring with continuous cropping system on bulk density was found to be significant. The data presented in Table 2. showed significantly highest reduction in bulk density of soil due to application of 100% NPK + FYM @ 10 t ha^{-1} treatments after sorghum (1.301, 1.299 Mg m^{-3}) as well as wheat crops (1.300,1.297 Mg^{-3}) in the respective years of experimentation.The pooled data of the year of experimentation revealed that, significantly lowest i.e. 1.300 and 1.299 Mg m^{-3} bulk density of soil was recorded in 100% NPK + FYM @ 10 t ha^{-1} treatment but it was at par with alone addition of FYM @10 t ha^{-1} (1.317, 1.318 Mg m^{-3}) and 100% NPK + Zn @ 2.5 kg ha^{-1} (1.359, 1.361 Mg m^{-3}) treatments after *kharif* sorghum and wheat *rabi*.The reduction in bulk density in the treatment of integrated use of chemical fertilizers and organic manures may be attributed to better aggregation (Singh, 2000) and improvement in soil structure and more pore space caused due to increase in soil organic matter. (Selvi, 2005). Similar reduction in bulk density of soil due to application of FYM with 100% NPK were also observed by Bellaki *et al*. (1998). Highest bulk density was observed in control plot (1.58 Mg m^{-3}). Reduction in bulk density in treatments receiving only NPK could be attributed to the biomass production with consequent increase in organic matter content soil (Bhardwaj and Omanwar, 1992). Effect of various long term treatments showed significant influence on soil porosity of soil of experiment.The data presented in Table 3. Showed significantly highest the soil porosity of soil due to application of 100% NPK + FYM @ 10 t ha^{-1} treatment after sorghum (50.52, 50.98%) as well as wheat crops (50.95, 51.04%) in respective years of experimentation.The pooled data of the year of experimentation revealed that, significantly highest i.e. 50.95 and 51.00 % porosity of soil was recorded in 100% NPK + FYM @ 10 t ha^{-1} treatment in sorghum and wheat crop.The application of 100% NPK along with FYM resulted significant increase in the porosity of soil. It might be due to higher percentage of organic carbon content and proliferation of biotic activity could be the possible reason for such effect. Soil biota influenced the soil properties through formation of stable aggregates, development of organo-mineral complexes by improving macro porosity(Mali 201).Application of 100% NPK + FYM @ 10 t ha^{-1} (T_{10}) resulted improvement in soil porosity (50.95, 51.00%) in pooled mean data. However this treatment found at par with 100% NPK + Zn @ 2.5 kg ha^{-1} FYM @ 10 t ha^{-1} and 150% NPK. This might be due to improvement in soils macro and micro-pores as a result of improvement in organic matter status of soil due to better crop growth and root biomass (Jadhao 2014). Continuous cropping with 100% N alone and without manures and fertilizers (control) resulted substantial decrease in soil porosity as a result of poor crop growth under these treatments (Biswas and Khosala 1971, Bellaki and Badanur 1997). Effect of various long term treatments showed significant influence on moisture content of soil of experimentation. The data presented in Table 4

Table 1
Treatment Details

Tr.	*Treatment details*	*N, P_2O_5 & K_2O rate (kg ha^{-1})*		
		Sorghum	*Wheat*	*Fertilizer source*
T_1	50% NPK	50:25:20	60:30:30	Urea, SSP, MOP
T_2	75% NPK	75:37.5:30	90:45:45	Urea, SSP, MOP
T_3	100% NPK	100:50:40	120:60:60	Urea, SSP, MOP
T_4	100% NPK-S Free	100:50:40	120:60:60	Urea, DAP,MOP
T_5	150% NPK	150:75:60	180:90:90	Urea, SSP, MOP
T_6	100% NP	100:50:00	120:60:00	Urea, SSP
T_7	100% N	100:00:00	120:00:00	Urea
T_8	100% NPK + Zn @ 2.5 kg ha^{-1}	100:50:40	120:60:60	Urea, SSP, MOP, $ZnSO_4$
T_9	100% NPK +S @ 37.5 kg ha^{-1}	100:50:40	120:60:60	Urea, DAP MOP, Gypsum
T_{10}	100% NPK + FYM @ 10 t ha^{-1}	100:50:40	120:60:60	Urea, SSP,MOP
T_{11}	FYM @ 10 t ha^{-1}	10 t ha^{-1}	No manure, no fertilizer application	Well decomposed FYM
T_{12}	Control	-	-	-

Table 2
Bulk Density of soil as influenced by long term manure and fertilizers application under sorghum-wheat cropping sequence

Tr.	Treatment Details	Bulk Density (Mg m^{-3})					
		Sorghum			Wheat		
		2011-12	2012-13	Pooled	2011-12	2012-13	Pooled
T_1	50 % NPK	1.49	1.49	1.49	1.49	1.49	1.49
T_2	75 % NPK	1.43	1.43	1.43	1.43	1.43	1.43
T_3	100 % NPK	1.43	1.40	1.42	1.44	1.40	1.42
T_4	100 % NPK-S	1.48	1.49	1.48	1.48	1.49	1.49
T_5	150 % NPK	1.37	1.38	1.38	1.38	1.38	1.38
T_6	100 % N P	1.45	1.46	1.46	1.46	1.46	1.46
T_7	100 % N	1.53	1.53	1.53	1.53	1.53	1.53
T_8	100 % NPK + Zn @ 2.5 kg ha^{-1}	1.36	1.36	1.35	1.36	1.38	1.36
T_9	100 % NPK + S @ 37.5 kg ha^{-1}	1.42	1.42	1.42	1.42	1.42	1.42
T_{10}	100 % NPK + FYM @ 10 t ha^{-1}	1.30	1.29	1.30	1.30	1.29	1.29
T_{11}	FYM @ 10 t ha^{-1}	1.31	1.31	1.31	1.31	1.31	1.31
T_{12}	Control	1.57	1.58	1.58	1.58	1.58	1.58
SE (m) ±		0.023	0.023	0.023	0.024	0.023	0.024
CD at 5 %		0.066	0.067	0.066	0.071	0.068	0.070
Initial value		1.36					

Table 3
Porosity of soil as influenced by long term manure and fertilizers application under sorghum-wheat cropping sequence

Tr.	Treatment Details	Soil porosity (%)					
		Sorghum			Wheat		
		2011-12	2012-13	Pooled	2011-12	2012-13	Pooled
T_1	50 % NPK	43.66	43.54	43.60	43.64	43.52	43.58
T_2	75 % NPK	45.91	45.86	45.89	45.90	45.82	45.86
T_3	100 % NPK	45.71	47.12	46.42	45.66	47.10	46.38
T_4	100 % NPK-S	44.00	43.66	43.83	43.87	43.64	43.75
T_5	150 % NPK	47.97	47.87	47.92	47.92	47.87	47.90
T_6	100 % N P	44.99	44.80	44.90	44.92	44.77	44.85
T_7	100 % N	42.01	42.01	42.01	41.98	41.96	41.97
T_8	100 % NPK + Zn @ 2.5 kg ha^{-1}	48.79	48.65	48.72	48.68	48.60	48.64
T_9	100 % NPK + S @ 37.5 kg ha^{-1}	46.41	46.27	46.34	46.30	46.23	46.26
T_{10}	100 % NPK + FYM @ 10 t ha^{-1}	50.92	50.98	50.95	50.95	51.04	51.00
T_{11}	FYM @ 10 t ha^{-1}	50.25	50.39	50.32	50.24	50.30	50.27
T_{12}	Control	40.41	40.12	40.26	40.29	40.05	40.17
SE (m) ±		0.86	0.88	0.87	0.93	0.89	0.91
CD at 5 %		2.49	2.53	2.51	2.69	2.58	2.64

Table 4
Moisture content soil as influenced by long term manure and fertilizers application under sorghum- wheat cropping sequence

Tr.	Treatment Details	Soil moisture (%)					
		Sorghum			Wheat		
		2011-12	2012-13	Pooled	2011-12	2012-13	Pooled
T_1	50 % NPK	18.03	51.53	19.78	20.62	21.42	21.02
T_2	75 % NPK	18.27	22.13	20.20	21.31	21.60	21.46
T_3	100 % NPK	18.56	23.38	20.97	22.62	22.69	22.65
T_4	100 % NPK-S	18.70	23.03	20.86	22.32	22.09	22.21
T_5	150 % NPK	19.27	23.45	21.36	23.74	23.44	23.59
T_6	100 % N P	19.39	22.50	20.94	22.23	22.62	22.42
T_7	100 % N	19.47	22.03	20.75	21.33	21.42	21.37
T_8	100 % NPK + Zn @ 2.5 kg ha^{-1}	18.53	23.85	21.19	23.54	22.91	23.22
T_9	100 % NPK + S @ 37.5 kg ha^{-1}	19.30	24.11	21.70	24.10	23.57	23.84
T_{10}	100 % NPK + FYM @ 10 t ha^{-1}	20.05	25.68	22.86	24.57	24.07	24.32
T_{11}	FYM @ 10 t ha^{-1}	20.36	26.43	23.40	25.37	24.84	25.11
T_{12}	Control	17.84	22.65	20.24	21.24	21.51	21.37
SE (m) ±		0.90	1.27	1.08	1.08	1.12	1.10
CD at 5 %		2.59	3.65	3.12	3.12	3.24	3.18

showed significantly highest soil moisture content due to application of FYM @ 10 t ha^{-1} treatment after sorghum (20.36, 26.43%) as well as wheat crops (25.37, 24.84%) during respective years of experimentation and the lowest was observed in absolute control. The pooled data of experimentation revealed that, significantly highest i.e. 23.40 and 25.11% moisture of soil was recorded in FYM @ 10 t ha^{-1} addition treatment and it was at par with 100% NPK + FYM @ 10 t ha^{-1} (22.86, 24.32%), 150% NPK (21.36,23.59%), 100% NPK + Zn @ 2.5 kg ha^{-1} (21.19, 23.22%) and 100% NPK + S @ 37.5 kg ha^{-1} (21.70, 23.84%). FYM @ 10 t ha^{-1} reported significantly highest soil moisture (23.40%) over all the other treatments. However lowest moisture content was reported in absolute control (20.24%) and was found at par with all the other treatments under study of sorghum. Similar trend was also observed after wheat crop. Continuous application of FYM alone significantly increased the moisture content of soil over all the treatments under sorghum and wheat. Higher moisture content in soil may be due to higher organic carbon more pore space and good soil aggregation and due to ability of FYM to hold water as well as increased porosity of soil (Khaini and More 1984). It may be concluded that long term application of FYM @ 10 t hai1 in combination with recommended dose to sorghum (100: 50: 40 kg ha^{-1}) and wheat (120: 60: 60kg ha^{-1}) significantly improved the physical properties in *Typic Haplustert* under semi-arid conditions.

REFERENCES

Baver. L.D. (1949), Practical Values for physical analysis of soil. Soil Sci. **68**: 1-14.

Bellakki, M.A. and V.P. Badanur, (1997), Long-term effect of integrated nutrient management on properties of Vertisol under dryland agriculture. J. *Indian Soc. Soil. Sci.* **45**(3): 438-442.

Bellakki, M.A; V.P. Badanur and R.A. Setty, (1998), Effect of long term integrated nutrient management on some important properties of a Vertisol. J. *Indian Soc. Soil Sci*. **46(**2): 176-180.

Biswas, T. D. and B. K. Khosla (1971), Bulding up of organic, matter status of the soil by long term manuring and its relation to soil physical properties proc. Inst. Symp. soilfert. Evaln. New Delhi. 1: 831.

Blake, G.R. and K.H. Hartge, (1986), Bulk density. In: Methods of Soil Analysis, Part-I, Klute, A. (Ed.). American Society of Agronomy Inc. and Soil Science Society of America Inc. Madison, Wisconsin, USA, pp. 371-373.

Bharadwaj V. and Omanwar, P.K. (1992), *J. Indian Soc. Soil Sci.* **40**: 553-555.

Jadhav S.D., V.K. Kharche, Muneshwarsingh, D.B. Tamgadge, D.V. Mali, R.N. Katkar, R. H. Wanjari, B. A. Sonune. (2014), Research bulletin on Long term Fertilization to Sorghum-wheat cropping sequence on soil fertility, Crop productivity and sustainability in Vertisol.

Khaini, K. N. and D. A. More, (1984), Long term effect of tiliage operation and farm yard manure application on soil properties and crop yield in a Vertisol. *J. Indian soc. Soil Sci*. **32**: 392-393.

Khanna S S & Yadav, D. A. (1979), Practical manual for introductory courses in soil. pp. 45-49.H. A. U. Hissar.

Mali D.V., V.K. Kharche, S. D. Jadhao, R. N. Katkar, N.M. konde, S.M. Jadhao, B.A. Sonune (2015), Effect of long term fertilization and manuring on soil quality and productivity under sorghum-wheat sequence in inceptisol. *Indian Journal of Agricultural sciences* 85(5): 695-700 (May).

Panse, V.G. and P.V. Sukhatme, (1985), Statistical Methods for Agricultural Workers. ICAR, New Delhi.

Selvi, D., P. Santhy and M. Dhakshinamoorthy, (2005), Effect of inorganics alone and in combination with farmyard manure on physical properties and productivity of VerticHaplustepts under long term fertilization. *J. IndianSoc. Soil Sci.,* **53**(3): 302-307.

Singh, A. K. *et al*. (2000), *Indian J Agron*. **45**: 217-222.