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LONG-TERM EFFECT OF FERTILIZER ON SOIL PHYSICAL PARAMETERS

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ABSTRACT

A trial on long-term effect of fertilizer (*Permanent Manurial* Trial) is being conducted at Birsa Agricultural University, Ranchi research farm since 50 years stating from 1956-67 and still continuing till date. Various soil physical parameters were analyzed and found that plots treated by inorganic fertilizer alone showed adverse effect on bulk density, porosity, water holding capacity and available water after harvest of crop. However, the plot treated organically or with combination of both organic as well as inorganic showed better result on the above physical parameters. Per cent porosity was also determined and found to be highest in FYM treated plot (49.7 %) whereas minimum in nitrogen alone treated plot (37.4%).

Key words : *Soil Physical parameter, Permanent Manurial Trial, Bulk density, Porosity, Water holding capacity, available water and FYM*

An experiment on long-term effect of fertilizer (Permanent Manurial Trial) at Birsa Agricultural University, Ranchi is continued from 1956-57. The experiment is conducted with the treatment of organic and inorganic fertilizer. The soil of the centre is acidic in nature. Area is undulating (plateau) in nature. Continous application of inorganic fertilizers resulted in decline in the pH of the soil. Analysis of post harvest soils of PMT for physical parameters revealed that plots treated with inorganic fertilizer alone had an adverse effect on bulk density, porosity, water holding capacity, void ratio and available water after harvest of crop.

A Vertisol soil from the forest area and four Vertisols from sugarcane fields cultivated for 5, 10, 20, and more than 30 years were evaluated. Significant changes in bulk density take place when a forest soil is subjected to sugarcane cultivation (Armida-Alcudia *et al.,* 2005). Quality work on forest soil was also studied by Vos *et al,* 2005 to examine the changes on bulk density. Osunbitan, *et al,* 2005 studied on tillage effects on bulk density, hydraulic conductivity and strength of a loamy sand soil in southwestern Nigeria.

Carter MR, 2005 worked for Long-term tillage effects for fine sandy loams in the humid climate of Atlantic Canada and found significant changes in bulk density.

Mouazen, 2003 predicted dry bulk density as a function of moisture content, depth and draught which was derived from the regression equation.

Ares *et al,* 2005 worked on the topic of ground-based forest harvesting effects on soil physical properties. Guswa,-A.J (2005) worked for soil-moisture and plant uptake relationship. Li *et al,* 2005 established the relationship for optimization of irrigation scheduling for winter wheat in the North China Plain. Dolling *et al,* 2005 worked on water use and lucern growth in different types of soil.

Dolling *et al.,* 2005 expressed his research view on soil water extraction in the south western Australia as influenced by lucern biomass production.

Keeping in view of above mentioned facts, the present study were formulated to evaluate the changes in soil physical parameters on long term basis after use of different combinations of organic and inorganic fertilizers.

MATERIAL AND METHODS

Present study was planned nearly 50 years back (since 1956-57) and still continuing. Different treatments of fertilizers were applied which is organic, inorganic and combination of both to evaluate the changes in the soil physical parameters as well as soil chemical parameters and also its effect on the yield after a lapse of long periods (more than 50 years). Number of treatments and replications were 14 and 3, respectively. The design was Randomized Block (RBD).

Every year soil samples were collected to analyze soil physical parameters as well as other soil parameters like chemical, physico-chemical etc. Present study included only soil physical parameters and few representative years data were analyzed and depicted in the Tables and Figure.

Gravimetric methods were followed for Bulk density and Water holding capacity.

Pycnometer method was used for particle density.

Porosity was calculated indirectly by the universal well known formula.

Excel software was used for data analysis.

Table-1 : Comparative study of Bulk Density (g/ml) of PMT (Permanent Manurial Trial).

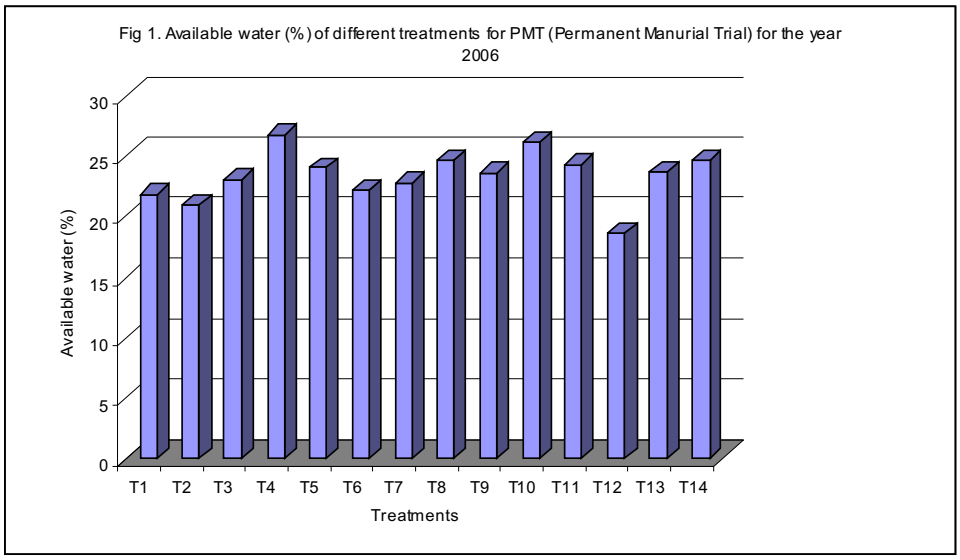
Treatments	1962	1970	1975	1984	2006
Treatement	1.34	1.44	1.55	1.54	1.57
T_1 Control	1.17	1.46	1.53	1.54	1.59
T_2 N			1.52	1.51	1.53
T_3 N PXK.y	1.25	1.43	1.35	1.32	1.33
T_4 FYM			1.45	1.44	1.49
T_5 (N+FYM) + Px/2 + Ky/2	1.33	1.4	1.49	1.51	1.55
T_6 NP	1.28	1.43	1.39	1.36	1.35
T_7 FYM + P(A-X)			1.44	1.43	1.47
T_8 (N + FYM) + P (A-X/2)	1.25	1.36	1.46	1.46	1.48
T_9 NPK	1.22	1.43	1.38	1.34	1.36
T_{10} FYM + P (A-X) + K(B-Y)			1.46	1.44	1.46
T_{11} (N+FYM) + P (A-X/2) + K (B-Y/2)	1.31	1.48	1.51	1.5	1.47
T_{12} L + NPK	1.23	1.36	1.46	1.44	1.45
T_{13} Lime + T10	.....	.....	.....	.....	1.55
Initial	1.44	1.45			

Table-2 : Comparative study of Porosity (%) of PMT (Permanent Manurial Trial).

Treatement	1962	1970	1975	1982	2006
T_1 Control	48.12	42.63	45.79	38.80	40.1
T_2 N	43.06	38.34	48.79	38.00	37.4
T_3 N PXK.y	-	-	-	-	42.2
T_4 FYM	48.42	37.80	42.40	43.50	49.7
T_5 (N+FYM) + Px/2 + Ky/2	-	-	-	-	44.1
T_6 NP	45.26	45.62	42.63	40.20	41.3
T_7 FYM + P(A-X)	42.79	39.67	40.30	41.70	49.4
T_8 (N + FYM) + P (A-X/2)	-	-	-	-	44.6
T_9 NPK	41.96	43.56	49.41	42.20	44.0
T_{10} FYM + P (A-X)+K(B-Y)	45.07	38.07	45.42	42.70	48.8
T_{11} (N+FYM) + P (A-X/2)+K (B-Y/2)	-	-	-	-	45.1
T_{12} L + NPK	45.34	39.57	42.79	42.60	48.0
T_{13} Lime + T10	41.44	41.38	42.26	46.71	45.1
T_{14} L + N	-	-	-	-	41.4

Table-3 : Comparative study of Water holding capacity (%) of PMT (Permanent Manurial Trial).

Treatement	1962	1970	1975	1982	2006
T_1 Control	43.3	31.78	37.77	33.18	29.59
T_2 N	43.7	38.28	40.34	39.30	28.62
T_3 N PXK.y	-	-	41.75	40.75	32.49
T_4 FYM	41.0	35.51	44.93	47.21	45.38
T_5 (N + FYM) + Px/2 + Ky/2	-	-	42.93	44.25	35.43
T_6 NP	38.3	37.42	38.77	36.25	31.00
T_7 FYM + P(A-X)	40.6	31.32	44.38	48.80	44.18
T_8 (N + FYM) + P (A-X/2)	-	-	42.97	45.16	36.49
T_9 NPK	38.1	33.92	40.06	40.53	35.28
T_{10} FYM + P (A-X)+K(B-Y)	41.4	40.48	44.99	49.27	44.25
T_{11} (N+FYM) + P (A-X/2)+K (B-Y/2)	-	-	42.48	44.48	37.14
T_{12} L + NPK	39.1	31.64	41.19	42.43	39.87
T_{13} Lime + T10	46.2	33.80	40.99	43.85	37.07
T_{14} L + N	-	-	-	-	32.37



RESULTS AND DISCUSSION

Through analytical data, it was observed that the plots treated by inorganic fertilizer alone showed adverse effect on bulk density, porosity, water holding capacity and available water after harvest of crop (Table-1, 2 and 3). However, the plot treated organically or with combination of both organic as well as inorganic showed better result on the above physical parameters. The lowest bulk density (1.33 Mg m^{-3}) was observed in case of FYM treated plots whereas maximum (1.59 Mg m^{-3}) was observed in case of N alone treated plots (Table-1). Available water was found highest in FYM treated plot (26.69%) as compare to lime + NPK treated plot which was only 18.52% (Fig.-1). Per cent porosity was also determined and found to be highest in FYM treated plot (49.7 %) whereas minimum in nitrogen alone treated plot (37.4%) (Table-2). Similar trend was also observed in water holding capacity which is well depicted in the Table 3. Water holding capacity was increased in those plots which were treated with either sole FYM or in combinations of FYM with other fertilizer sources. However, the plots which were treated inorganically showed comparatively lower water holding capacity on long term basis.

Therefore it is concluded that Organic supplement to the soil results better soil physical health as compare to inorganic fertilizer. Higher value of bulk density might be a reason of decrease in crop yield. On the basis of present study it can be concluded that Deep ploughing (chiseling) along with organic supplements may be recommended for the improvement of soil aeration.

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