Research Article

Effect of Water Hyacinth Compost, Vermicompost and Chemical Fertilizers on Water Transmission Characteristics of a Typic Ustifluvents

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Abstract

A field experiment having split plot design with three replications was conducted during 2015-16 at Mandan Bharti Agriculture College, Agwanpur, Saharsa, Bihar to assess the effect of inorganic fertilizer, water hyacinth compost and vermicompost on infiltration rate and hydraulic conductivity. Soil fertility management includes four levels of NPK *viz*., 0, 50%, 100% and 150% NPK as main plot treatment and four levels of organic source such as no organics, vermicompost, water hyacinth compost and vermicompost + water hyacinth compost as sub plot treatment. The experimental site was located between 25°52'50" north latitude and 86°48'62" east longitude in an agro-climatic zone-II of Bihar having hot moist sub-humid climate. Wheat *cv*. DBW-14 was grown as test crop during the reported period of 2015-16. Water hyacinth compost, vermicompost alone or incombination with different levels of NPK fertilizers *viz*., 0, 50, 100 and 150 per cent recommended doses were applied. Different doses of fertilizers in terms of N, P_2O_5 and K_2O were applied @120:60:40 kg ha^{-1}, respectively. Incorporation of water hyacinth compost and vermicompost increased the infiltration rate. The maximum increase in infiltration rate was registered in vermicompost + water hyacinth compost treatment. The increasing dose of NPK fertilizer had no remarkable change in infiltration rate of soil. All the treatments significantly increased the hydraulic conductivity over control as well as cumulative infiltration.

Keywords: Organic sources, Chemical fertilizer, Hydraulic conductivity, Infiltration rate, wheat

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Introduction

Soil and water are the vital natural resources used in the crop production. Efficient management of soil and water will be required a greater control of infiltration in the soil. Increased infiltration control would help to solve such wide ranging problems as upland flooding, pollution of surface and ground water declining water tables and wastage of useful water [1]. The measurement of infiltration of water into the soil is an important indication concerning the efficiency of irrigation and drainage, optimizing the availability of water to plants growth and metabolism, improving the yield of crops and minimizing erosion. Water infiltration rate in the organic amendment soil have initially increased by simulation of microbial activity, which has enhanced the stability of soil aggregates. The rate of infiltration is affected by different chemical, biological and physical properties like organic matter content, biological activity, earthworm, soil sealing, crusting and compaction [2]. Addition of organic matter increases soil organic carbon content which is directly or indirectly affects physical properties of soil and processes like aggregation, water holding capacity, infiltration rate and hydraulic conductivity [3].

Methods and Materials

A field experiment was under taken during *rabi* season 2015-16 in light textured sandy loam soil of Mandan Bharti Agriculture College, Agwanpur, Saharsa in split plot design with four levels of NPK in main plot and four levels of organic sources in sub-plot treatment with four replications. The experimental site was located in between 25°52"50' North latitude and 86°48"62' East longitude in agro-climatic zone-II of Bihar having hot moist sub-humid climate. Wheat (*cv*. DBW-14) was grown as test crop during the reported period of 2015-16. Water hyacinth compost @ 10 t ha^{-1}, vermicompost alone or incombination with different levels of NPK fertilizer *viz*., 0, 50, 100 and 150 per cent of recommended dose were applied. Different doses of fertilizer in terms of N, P_2O_5 and K_2O were applied @120:60:40kg ha^{-1}, respectively. Nitrogen, phosphorus and potash were applied in the form of urea, SSP and MOP, respectively. Water hyacinth compost and vermicompost were applied before sowing of wheat. Agronomic and crop management practices followed were those recommended by Bihar Agricultural University, Sabour, Bhagalpur. Saturated hydraulic conductivity was estimated using the core samples, which were saturated with water for 24 hrs

following the constant head method [4]. Infiltration characteristics of the soil were determined in situ by a double ring infiltrometer.

Results and discussion

The effect of water hyacinth compost, vermicompost alone or incombination with NPK fertilizers has been presented in **Table 1**. The data revealed that all the treatments significantly increased the hydraulic conductivity. The hydraulic conductivity varied from 0.0207 (cm hr^{-1}) to 0.0308 (cm hr^{-1}) under different treatments. It markedly increased over control under different NPK treatments. Incorporation of the water hyacinth compost and vermicompost also increased the hydraulic conductivity and the order of effectiveness was water hyacinth compost + vermicompost (0.0308 cm hr^{-1}) > water hyacinth compost (0.0294 cm hr^{-1}) > vermicompost (0.0254 cm hr^{-1}) > no manure (0.0227 cm hr^{-1}). Improvement of hydraulic conductivity may be due to more organic matter content which increased biological activities, improved soil aggregation and optimum pore value as well as the effective connectivity of the pores [5]. Also reported beneficial effect of organic manure on hydraulic conductivity of soil compared with fertilizer NPK, alone use of organic manure along with mineral fertilizers improved physical properties of soil through increased soil aggregation, improved aggregate stability, increased saturated hydraulic conductivity for sustaining soil quality [6, 7]. The infiltration rate varied from 0.37 (cm hr^{-1}) to 0.64 (cm hr^{-1}) under different treatment combination (**Table 2**). It increased from 0.47 (cm hr^{-1}) to 0.50 (cm hr^{-1}) and 0.50 (cm hr^{-1}) under 50% NPK and 150% NPK treatment, respectively. Water hyacinth compost and vermicompost incorporated treatments increased the infiltration rate from 0.43 to 0.64 cm hr^{-1} (20.93%). Increase in infiltration rate in 100% NPK + water hyacinth compost + vermicompost treatment may be due to increase in soil organic carbon, rooting density and the attendant improvement in aggregation and soil structure resulting in higher porosity and pore continuity [8]. The maximum increase in infiltration rate was recorded in the treatment receiving water hyacinth compost and vermicompost. The relative effectiveness was in the order of water hyacinth compost + vermicompost > water hyacinth compost > vermicompost > no manure. The increase in infiltration rate may be due to increase in micro pores and macro pores in the soil resulting from better aggregation by cementing of soil organic carbon and favourable living of soil organisms [9]. The mean cumulative infiltration in 276 minute without NPK was recorded 5.07 cm which increased by the application of all levels of NPK. This might be due to better aggregation and increase in macro pores by the treatment. The data show that the relative effectiveness of organic matter treatments on cumulative infiltration in 276 minute was in the order: water hyacinth compost + vermicompost (5.67 cm) > water hyacinth compost (5.52 cm) > vermicompost (5.53 cm) > no manure (5.20 cm).

Table 1 Effect of vermicompost, water hyacinth compost and chemical fertilizers on hydraulic conductivity (cm hr^{-1}) in soil

Fertilizer Level	Organic Sources				
	Control	Vermicompost	Water hyacinth compost	Vermicompost + water hyacinth compost	Mean
No NPK	0.37	0.59	0.47	0.48	0.47
50% NPK	0.52	0.50	0.39	0.59	0.50
100% NPK	0.36	0.47	0.48	0.38	0.42
150% NPK	0.43	0.50	0.46	0.64	0.50
Mean	0.42	0.51	0.45	0.52	

Table 2 Effect of vermicompost, water hyacinth compost and chemical fertilizers on infiltration rate (cm hr^{-1}) in soil

Fertilizer Level	Organic Sources				
	Control	Vermicompost	Water hyacinth compost	Vermicompost + water hyacinth compost	Mean
No NPK	0.0207	0.0248	0.0309	0.0337	0.0275
50% NPK	0.0205	0.0257	0.0308	0.0285	0.0271
100% NPK	0.0245	0.0281	0.0305	0.0339	0.0292
150% NPK	0.0222	0.0233	0.0256	0.0273	0.0245
Mean	0.0227	0.0254	0.0294	0.0308	

Maximum cumulative filtration in 276 minute (6.8 cm) was recorded in the treatment 100% NPK + water hyacinth compost + vermicompost. The result is also supported [10]. Incorporation of bulky organic manure increased cumulative infiltration due to declining trend in bulk density, thereby reducing mechanical impedance which in turn

influenced the percolation rate. [11] and [12] also reported in the increment of cumulative infiltration with the application of organic manures. All the treatments significantly increased the hydraulic conductivity over control. These results are in confirmation with the results [13] and [14].

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