

Original Research Article

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Effect of Organic Nutrient Sources on Soil Nutrient Status of Wheat under Rice - Wheat System

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ABSTRACT

The investigation entitled Effect of Organic Nutrient Sources on Soil Health and Productivity of Wheat under Rice-Wheat System was carried out at the Crop Research Centre of Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut, (U.P) during *Rabi* seasons of 2017-18. The experiment consisting seven treatments *viz.* T₁- Control, T₂- 10 t ha⁻¹ FYM, T₃-10 t ha⁻¹ FYM +Cow urine + *Azotobacter*, T₄- 10 t ha⁻¹ Vermicompost, T₅- 10 t ha⁻¹ Vermicompost+ Cow urine + *Azotobacter*, T₆- 7.5 t ha⁻¹ FYM+ Cow urine + *Azotobacter*, T₇- 80 % of RDF of nitrogen through vermicompost + 10 % through neem cake + *Azotobacter* was laid out in randomized block design with three replication. Result show that T₇ (80 % of RDF of nitrogen through vermicompost + 10 % through neem cake + *Azotobacter*) significantly higher the availability of nutrients *viz.* organic carbon and available NPK over the control plot. The nitrogen, phosphorus and potassium content were higher in fertility levels of T₇ and T₅. However, lower BD and pH were recorded with T₇ (80 % of RDF of nitrogen through vermicompost + 10 % through neem cake + *Azotobacter*) plot.

Keywords

Vermicompost,
Organic carbon,
Soil health and
azotobacter

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Introduction

Wheat (*Triticum aestivum* L) belongs to the family Poaceae. It is an annual, self-pollinated long day winter cereal. Wheat is one of the cereal crops which have its own importance due to high nutritional value and premier food grain crops of the country. In India, during green revolution period, intensive agriculture involving exhaustive high-yielding varieties of wheat and it has led to heavy withdrawal of

nutrients from the soil. Nutrient management has played very significant role in providing the physical condition of soil and supply all the nutrients which are required by crop for balanced nutrition. Organic nutrient sources developed as an effective way to decrease environmental damage and increase awareness of food quality from using number of organic nutrient sources and ensure long term food security. Organic nutrients source combine scientific knowledge of ecology and

technology with traditional farming practices based on naturally occurring biological processes. Instead of using synthetic pesticides and water soluble synthetically purified fertilizers, organic farmers are restricted by regulations to natural pesticides and fertilizers. The central idea of organic management is using the natural environment to enhance agriculture productivity. The principal methods of various organic nutrient sources include tillage practices, crop rotations, nitrogen fixing crops, oil seed cake, green manures, and integrated bio controls. Many studies show that organic farming systems can reduce soil erosion and enhance soil fertility.

Materials and Methods

A field experiment was conducted during *rabi* season 2017-18 at chirodi farm of Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut (U.P.) The area situated at a latitude of 29° 40' North and longitude of 77° 42' East with an elevation of 237 m above mean sea level. The soil of the experimental field was well drained, alkaline in reaction (pH 7.25), low organic carbon, sandy loam in texture, low in available nitrogen, medium in available phosphorus and potassium with an electrical conductivity 0.29 d S m⁻¹. The experiment consisting seven treatments *viz.* T₁- Control, T₂- 10 t ha⁻¹ FYM, T₃-10 t ha⁻¹ FYM +Cow urine + *Azotobacter*, T₄- 10 t ha⁻¹ Vermicompost, T₅- 10 t ha⁻¹ Vermicompost+ Cow urine + *Azotobacter*, T₆- 7.5 t ha⁻¹ FYM+ Cow urine + *Azotobacter*, T₇- 80 % of RDF of nitrogen through vermicompost + 10 % through neem cake + *Azotobacter* was laid out in randomized block design with three replication. The required quantities of NPK (120:60:40) were applied in the different treatments by FYM, vermicompost, cow urine, neem seed cake.

Observations recorded

Soil properties

The soil samples collection initial, tillering, jointing and harvest stages of wheat were used for following attributes:

Soil analysis

Sample preparation

The soil samples were taken up to 15cm depth from each plot. The samples were air dried, grinded, sieved (2 mm sieve) and used for the following soil chemical analysis.

Method of analysis

Chemical attributes

Soil pH

Soil pH was determined by glass electrode pH meter taking 1:2.5 (soil : water) suspensions after stirring it for 30 minutes, method as described by Jackson (1973).

Electrical conductivity

Electrical conductivity was determined in 1:2.5 soil-water extract using solu-bridge Conductivity meter method and expressed as dSm⁻¹ (Jackson, 1973).

Organic carbon

It was estimated by Walkley and Black's (1965) rapid titration method as described by Jackson (1973). In this method, organic matter is oxidized with chromic acid (1 N potassium dichromate + concentrated sulphuric acid). The unconsumed potassium dichromate is back titrated against standardized 0.5 N ferrous ammonium sulphate.

Available N

Available nitrogen in soil was estimated by alkaline KMnO_4 method where the organic matter in soil would be oxidized with hot alkaline KMnO_4 solution. The ammonia evolved during oxidation will be distilled and trapped in boric acid mixed indicator solution. The amount of the amount of NH_3 trapped will be estimated by titrating with standard acid (Subbiah and Asija, 1956).

Available P

Available phosphorus was extracted with 0.5 M sodium bicarbonate (NaHCO_3) at pH 8.5 (Olsen's reagent) and the amount of P in the extract will be estimated by using ascorbic acid as reducing agent and blue color intensity will be measured by using spectrophotometer at wave length of 660 nm (Olsen *et al.*, 1954).

Available K

Available K in soil was extracted with 1N neutral normal ammonium acetate as an extractant, (Hanway and Heidel, 1952) and K in the extract was determined by Flame photometer.

Statistical analysis

The experiment was laid out in Randomized Block Design (RBD). Standard error of Mean in each case and critical difference only for significant cases were calculated at 5% levels of probability as under.

$$\text{Standard error of mean} = \frac{\sqrt{\text{EMSS}}}{R}$$

Where, SEm_{\pm} = Standard error of mean
EMSS = Error mean sum of square
R = Number of replication on which the observation is based.

The data obtained would be subjected to statistical analysis as outlined by Gomez and Gomez (1984). The treatment means will be compared using transformed means. The level of significance used in "F" test was given at 5 per cent. Critical difference values are given in the table at 5 percent level of significance, wherever the "F" test was significant at 5 per cent level.

$$CD = \frac{\sqrt{2 \times \text{Error mean square}}}{r} \times t_{0.05}$$

Where, CD = Critical difference
r = Number of replications of the factor for which C.D. is to be calculated.
 $t_{0.05}$ = Value of percentage point of 't' distribution for error degree of freedom at 5 per cent level of significance

Results and Discussion

Soil EC and pH in different treatments at harvest stage shown Table-1. EC of soil (0-15 cm) varied from 0.20 to 0.26 d Sm^{-1} . Highest Electrical conductivity (EC) was recorded in soil sample with the application of 10 t ha^{-1} Vermicompost + Cow urine + *Azotobacter* in T_5 . The minimum soil EC (0.20 dSm^{-1}) was recorded in control. The pH of soil (0-15 cm) varied from 7.0 to 7.6. Highest soil pH was recorded in control and this was at par with T_5 , where the application of 10 t ha^{-1} Vermicompost+ Cow urine + *Azotobacter*. The minimum soil pH (7.0) was recorded in T_7 treatment. At tillering, jointing and harvesting stage of wheat crop, Maximum organic carbon (percentage) observed with the application of T_7 (80 % of RDF of nitrogen through vermicompost + 10 % through neem cake + *Azotobacter*) while, lower under control. Higher content of organic carbon in soil may be due to increased yield of roots and plant residues and external application of organic manures. Similar trend of finding were reported by Pandey *et al.*, (2006).

However, jointing stage the maximum organic carbon (%) observed with the application of 10 t ha⁻¹ Vermicompost+ Cow urine + *Azotobacter* while, lower under control. Available nitrogen (kg ha⁻¹) in soil as affected by different treatments at different stages is presented in Table-2. The available nitrogen in soil decline gradually with the advancement of crop growth in all the treatments. At tillering stage, available nitrogen in soil under different treatments ranged from 148.2 to 185.9 kg ha⁻¹. The maximum available nitrogen (185.9 kg ha⁻¹) statistically at par with T₅, T₃, T₆, and significantly higher than the remaining treatments was found in T₇ (80 % of RDF of nitrogen through vermicompost + 10 % through neem cake + *Azotobacter*). Minimum available nitrogen (148.2 kg ha⁻¹) was recorded in control (T₁), which was significantly lower than the remaining treatments. The available nitrogen at tillering stage was recorded more than the jointing and

harvesting stage for each treatment. At jointing stage, the available N was varied from 140.1 kg ha⁻¹ to 155.4 kg ha⁻¹. The maximum available nitrogen (155.4 kg ha⁻¹) was recorded in T₇ (application of 80 % of RDF of nitrogen through vermicompost + 10 % through neem cake + *Azotobacter*) was statistically at par to T₅, T₃ T₄ and T₆ and significantly higher than all remaining treatments. Available nitrogen was comparatively higher than the harvesting stage and lower than the tillering stage. At harvesting stage, the available nitrogen was varied from 128.5 kg ha⁻¹ to 149.9 kg ha⁻¹. The maximum available nitrogen (149.9 kg ha⁻¹) significantly higher than the remaining treatments was found in T₅. The minimum and significantly lower available nitrogen than the other treatments (128.5 kg ha⁻¹) was found under control followed by T₂. Similar result also reported by Guan *et al.*, (2011) [3] and Bitew and Alemayehu (2017) [1].

Table.1 Initial Status of soil

pH (1:2.5 soil : water)	EC (1:2.5 soil : water) dSm ⁻¹	Organic Carbon	Available N	Available P	Available K
7.25	0.29	0.41 %	143 kg ha ⁻¹	12.7 kg ha ⁻¹	135.3 kg ha ⁻¹

Table.1 Effect of organic nutrient sources on EC and pH at harvest stage in surface soil

Treatments	EC (dSm ⁻¹)	Soil pH
T ₁ (Control)	0.20	7.6
T ₂ (10 t ha ⁻¹ FYM)	0.22	7.4
T ₃ (10 t ha ⁻¹ FYM + Cow urine + <i>Azotobacter</i>)	0.24	7.3
T ₄ (10 t ha ⁻¹ Vermicompost)	0.23	7.2
T ₅ (10 t ha ⁻¹ Vermicompost + Cow urine + <i>Azotobacter</i>)	0.26	7.5
T ₆ (7.5 t ha ⁻¹ FYM + Cow urine + <i>Azotobacter</i>)	0.23	7.1
T ₇ (80 % of RDF of nitrogen through vermicompost + 10 % through neem cake + <i>Azotobacter</i>)	0.25	7.0
SEm±	0.01	0.2
CD (P=0.05)	0.03	0.7

Table.2 Effect of organic nutrient sources on organic carbon (%) and available NPK (kg ha⁻¹) at different stage in surface soil

Treatments	OC			N			P			K		
	Tillering	Jointing	At harvest	Tillering	Jointing	At harvest	Tillering	Jointing	At harvest	Tillering	Jointing	At harvest
T ₁ (Control)	0.48	0.47	0.44	148.2	140.1	128.5	9.2	7.5	6.6	145.3	128.2	111.9
T ₂ (10 t ha ⁻¹ FYM)	0.49	0.51	0.47	169.0	137.3	133.4	13.4	12.7	10.5	171.0	158.2	140.0
T ₃ (10 t ha ⁻¹ FYM + Cow urine + <i>Azotobacter</i>)	0.52	0.53	0.50	179.3	148.4	141.6	13.8	11.4	11.9	185.5	169.6	142.2
T ₄ (10 t ha ⁻¹ Vermicompost)	0.49	0.50	0.47	170.2	144.5	139.8	13.1	12.6	10.5	180.2	168.0	139.4
T ₅ (10 t ha ⁻¹ Vermicompost + Cow urine + <i>Azotobacter</i>)	0.51	0.55	0.51	182.6	151.7	149.9	14.5	13.9	12.3	189.8	177.4	159.7
T ₆ (7.5 t ha ⁻¹ FYM + Cow urine + <i>Azotobacter</i>)	0.49	0.51	0.49	171.7	145.5	140.8	13.4	11.8	10.9	182.3	160.6	140.5
T ₇ (80 % of RDF of nitrogen through vermicompost + 10 % through neem cake + <i>Azotobacter</i>)	0.51	0.54	0.52	185.9	155.4	149.8	15.3	14.2	12.6	194.5	186.2	155.4
SEM±	0.02	0.02	0.02	5.6	4.7	3.7	0.4	4	0.4	5.8	5.4	4.6
CD (P=0.05)	0.05	0.06	0.05	16.5	14.0	10.9	1.2	1.2	1.0	17.2	15.9	13.5

Available phosphorus evident from the Table 2 that the available phosphorus in soil decline gradually with the advancement of crop growth in all the treatments. At tillering stage, available phosphorus in soil under different treatments varied from 9.2 to 15.3 kg ha⁻¹. The maximum available phosphorus (15.3 kg ha⁻¹) was recorded in T₇. The minimum available phosphorus (9.2 kg ha⁻¹) was recorded T₁. At jointing stage, available phosphorus in soil under different treatments varied from 7.5 to 14.2 kg ha⁻¹. The maximum available phosphorus (14.2 kg ha⁻¹) found was in T₇. The minimum available phosphorus (7.5 kg ha⁻¹) found was in T₁. At harvesting stage, available phosphorus in soil under different treatments varied from 6.6 to 12.6 kg ha⁻¹. The maximum available phosphorus (12.6 kg ha⁻¹) was in T₇ followed by T₅. Minimum available phosphorus (6.6 kg ha⁻¹) was found in T₁. Highest available phosphorus at maximum tillering, jointing and harvest stage could be ascribed to higher organic matter content in this treatment, which may reduce the fixation of phosphate by providing protective cover on sesquioxides and chelating cations responsible for fixation by Singh *et al.*, (2008) [6] and Kumar *et al.*, (2015) [5] also reported similar results. Available potassium (kg ha⁻¹) in soil as affected by different treatments at various stages of wheat is presented in Table 2. The available potassium in soil decline gradually with the advancement of crop growth in all the treatments. At tillering stage, available potassium in soil under different treatments varied from 145.3 to 194.5 kg ha⁻¹. The maximum available potassium (194.5 kg ha⁻¹), statistically *at par* to T₅ T₃, T₄ and T₆ and significantly higher than the remaining treatments was found in T₇. The minimum available potassium (235.0 kg ha⁻¹) was found under control which was significantly lower than all the other treatments. At jointing stage, available potassium in soil under different treatments varied from 128.2 to 186.2 kg ha⁻¹.

The maximum available potassium (186.2 kg ha⁻¹) was recorded in T₇ which was statistically *at par* to T₅ and higher than the remaining treatments. Minimum available potassium (128.2 kg ha⁻¹) found under control. The improvement in K was might be due to slow and steady supply of potassium due to solubilization effect of organic acid produced during decomposition processes by Singh *et al.*, (2008) [6].

In conclusion, Soil properties mainly organic carbon content and available soil nutrients nitrogen, phosphorus and potassium after harvest of wheat was significantly higher an application of 80 % of RDF of nitrogen through vermicompost + 10 % through neem cake + *Azotobacter*.

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