

Original Research Article

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Effect of Organic and Inorganic Nutrient Sources on Physical and Chemical Properties of Soil

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ABSTRACT

Keywords

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A field experiment was conducted during rabi season 2014-15 at the research farm of soil science, Allahabad School of Agriculture, laid out in randomized block design on sandy loam soil, containing sand 65.14%, silt 21.12%, and clay 13.74% (Inceptisols). It was observed that for post-harvest soil properties in treatment $N_{80}P_{60}K_{40}$ + vermicompost @ 10 t ha^{-1} were improved significantly due to organic and inorganic use of inputs. Organic carbon 0.67% , available nitrogen $309.83 \text{ kg ha}^{-1}$, phosphorus 28.98 kg ha^{-1} , potassium $188.11 \text{ kg ha}^{-1}$, pore space 50.14% , pH 7.17 were found to be significant and bulk density 1.22 Mg m^{-3} , particle density 2.31 Mg m^{-3} , EC at 0.24 dSm^{-1} were found to be non-significantly improved in this treatment.

Introduction

India is one among the leading oil seed producing countries in the world. Oilseeds form the second largest agricultural commodity after cereals. Mustard is the second important edible oil seed crop after groundnut. It plays an important role in the oil seed economy of the country. Indian mustard (*Brassica juncea* L.) commonly known as raya, rai or lahi is an important oilseed crop among the Brassica group of oilseed in India. It possesses a higher potential of production per unit area than other members of the family Cruciferae. Rape seed and mustard crops are being cultivated in 53 countries spreading over the six continents across the

globe covering an area of 24.2 million hectare. Indians contribution to world and production is 28.3 and 19.8 percent respectively. In India, Toria is cultivated on 6.86 million hectares in Rabi season (Anonymous, 2011). *Brassica juncea* (L.) required cool and moist climate of winter months is the major factor for luxuriant growth and productivity of mustard in these states. The plant reaches about 4-5 feet in height and bears golden yellow coloured flowers. Its tiny, round seeds measuring about 1mm in diameter is encased inside a fruit pod in a similar fashion like green pea pod. Mustard seeds are known by different names

in different places – Sarson, rai or raya, toria or laha (Singh, 2012). Rapeseed-mustard is an important group of edible oil seed crops and contributes around 26.1% of the total oil seed production. Out of 57856 thousand tonnes of rapeseed–mustard seed produced over 30308 thousand ha in the world, India produce 5833 thousand tonnes from 5750 thousand ha⁻¹. Indian mustard [*Brassica juncea* (L.)] contributes about 85% of the total rapeseed–mustard produced in India (Krishna *et al.*, 2005). Rapeseed-mustard is rich in minerals like calcium, manganese, copper, iron, selenium, zinc, vitamin A, B, C and proteins. 100g mustard seed contains 508 kcal energy, 28.09g carbohydrates, 26.08g proteins, 26.08 g total fat and 12.2g dietary fiber (USDA, 2014). The oil and protein of Toria seeds of range from 40 to 48% and 20 to 40%, respectively. The Toria seeds and oil are used as a condiment in preparation of pickles and for flavoring curries and vegetables. The leaves of young plant are used as green vegetable. It is also used for making, medicine, soaps and various lubricants, such as grease. Toria oil contains more of sulphur compounds. In Uttar Pradesh (Toria crop) was grown on an area of 0.64 million hectare with production of 0.53 million tonnes and the productivity of 831 kg ha⁻¹ (Anonymous, 2011).

Nitrogen is the most important nutrient, which determines the growth of the Toria crop and increases the amount of protein, methionine dry matter and the yield. Phosphorus and Potash are known to be efficiently utilized in the presence of Nitrogen. It promotes flowering, setting of siliqua and in increase the size of siliqua and yield. Phosphorus is an element for Toria and mustard. Phosphorus is generally deficient in majority of our Indian soils and need much attention for maintenance of soil fertility. When Phosphorus was applied in conjunction with Nitrogen and Potash, there was significant

increase in the yield of Toria and mustard. Potassium is one of the seventeen elements which are essential for growth and development of plants. Mustard is an important oil seed crop of arid and semi-arid region. Potassium is required for improving the yield and quality of different crops because of its effect on photosynthesis, water use efficiency and plant tolerance to diseases, drought and cold as well for making the balance between protein and carbohydrates (Singh, 2012). One of the most important organic nutrient sources as Vermicompost is a composting process aided by earthworm can consume practically all kinds of organic matter. Vermicompost stores essential plant nutrient and it's nutrient absorbed by plant. It improves physical – chemical properties of soil such as soil porosity, water holding capacity, soil structure, soil aggregation, slow relies of nutrients, permeability, increase in cation exchange capacity, stimulation of soil flora and fauna etc. The composition of Vermicompost is 1.8% N, 2.0% P and 1.6% K (Pawar 2007).

Materials and Methods

The Experiment was conducted during rabi season 2014-2015 on crop research farm of department of Soil Science, Allahabad School of Agriculture, Allahabad, (U.P.) India. The area is situated on the south of Allahabad on the right side of the river Yamuna on the south of Rewa road at a distance of about 6 Km from Allahabad city. It is situated at 25°24'23" N latitude, 81°50'38" E longitude and at the altitude of 98 meter above the sea level.

The treatments consisted of nine combination of organic and inorganic source of fertilizers T₀ (L₀ V₀) control, T₁ (N₀ P₀ K₀ + Vermicompost @ 5 t ha⁻¹, T₂ (N₀ P₀ K₀ + Vermicompost @ 10 t ha⁻¹, T₃ (N₄₀ P₃₀ K₂₀ + Vermicompost 0, T₄ (N₄₀ P₃₀ K₂₀ +

Vermicompost @ 5 t ha⁻¹, T₅ (N₄₀ P₃₀ K₂₀ + Vermicompost @ 10 t ha⁻¹, T₆ (N₈₀ P₆₀ K₄₀ + Vermicompost @ 0, T₇ (N₈₀ P₆₀ K₄₀ + Vermicompost @ 5 t ha⁻¹, T₈ (N₈₀ P₆₀ K₄₀ + Vermicompost @ 10 t ha⁻¹. The trial was laid out in a randomized block design with three replication, plot size was 2 x 2 m for crop seed rate is 15-20 kg ha⁻¹ (*Brassica juncea* L.) Cv. Kranti. Mustard grows in 13th November 2014 and the source of nitrogen, phosphorus, and potassium, were Urea, SSP, MOP, respectively. Basal dose of fertilizer was applied in respective plots according to treatment allocation unifurrows opened by about 5 cm. All the agronomic practices were carried out uniformly to raise the crop. The crop was harvested on 10th March. Soil samples were collected from the soil 0-15 cm depth, air dried kept in an oven at 105^oC for 48 hrs for drying, pass through 2 mm sieve, soils were analysis by using standard procedures as described for pH 1:2 (w/v) (Jakson 1958), EC (dSm⁻¹) (Wilcox 1950), organic carbon (%) (Walkley and Black

1947), available nitrogen kg ha⁻¹ (Subbiah and Asija 1956), phosphorus kg ha⁻¹ (Olsen *et al.*, 1954) and potassium kg ha⁻¹ (Toth and Price 1949). The physical and chemical properties at start of experiment are presented in Tables 1 and 2, respectively.

Results and Discussion

Physical properties of soil (post-harvest)

The results in given Table 3 indicate some of the important parameter on physical properties on mustard crop. Organic and inorganic fertilizers conjunction on bulk density and particle density to be non-significant and on pore space to be significant. The bulk density (Mgm⁻³), particle density (Mgm⁻³) and pore space (%) of post-harvest soil was recorded 1.22, 2.31 and 50.14 with the treatment T₈ respectively. The slight decreased in bulk density, particle density and pore space may be due to tillage operation and increase in plant growth.

Table.1 Physical properties of soil (pre- sowing)

Particulars	Results	Method employed
Sand (%)	65.14	Bouyoucous hydrometer (1952)
Silt (%)	21.12	
Clay (%)	13.74	
Texture class	Sandy loam	
Bulk density Mgm ⁻³	1.47	Graduated measuring cylindrical (Black 1965)
Particle density Mgm ⁻³	2.52	Graduated measuring cylindrical (Black 1965)
Pore space (%)	51.68	Graduated measuring cylindrical (Black 1965)
Soil EC (dSm ⁻¹) at 27 ^o C of 1:2 soil	0.26	Digital conductivity meter (Wilcox 1950)
Water suspension		
Soil pH (1:2) soil water suspension (w/v)	7.69	Digital pH meter (Jackson 1958)

Table.2 Chemical properties of soil (pre- sowing)

Particulars	Results	Method employed
Organic carbon	0.38	Rapid titration method (Walkley and Black 1947)
Available nitrogen (kg ha ⁻¹)	221.81	Alkaline permanganate method (Subbiah and Asija 1956)
Available Phosphorus (kg ha ⁻¹)	20.55	Colorimetric method (Olsen <i>et al.</i> , 1954)
Available Potassium (kg ha ⁻¹)	121.01	Flam photometric method (Toth and Price, 1949)

Table.3 Effect of different levels of organic and inorganic nutrient sources on physical and chemical properties after harvest mustard crop

Treatment combination	Bd (gcm ³)	Pd (gcm)	Pore space (%)	pH (1:2 w/v)	EC (dSm ⁻¹)	N (kg ha ⁻¹)	P ₂ O ₅ (kg ha ⁻¹)	K ₂ O (kg ha ⁻¹)	Organic Carbon (%)
T ₀ =L ₀ V ₀	1.33	2.73	46.81	7.77	0.19	261.96	21.99	135.79	0.42
T ₁ =L ₀ V ₁	1.28	2.62	46.81	7.44	0.20	281.88	22.89	154.93	0.48
T ₂ =L ₀ V ₂	1.25	2.41	50.01	7.37	0.20	295.50	26.28	167.15	0.53
T ₃ =L ₁ V ₀	1.30	2.41	46.94	7.47	0.20	270.35	22.89	145.00	0.44
T ₄ =L ₁ V ₁	1.31	2.52	46.81	7.43	0.21	291.31	25.38	161.12	0.51
T ₅ =L ₁ V ₂	1.23	2.62	50.14	7.27	0.23	304.93	28.08	180.62	0.62
T ₆ =L ₂ V ₀	1.28	2.33	44.72	7.50	0.22	276.64	23.79	148.93	0.46
T ₇ =L ₂ V ₁	1.25	2.31	50.01	7.20	0.23	300.74	27.18	175.62	0.56
T ₈ =L ₂ V ₂	1.22	2.31	50.14	7.17	0.24	309.83	28.98	188.11	0.67
Mean	1.27	2.47	48.04	7.40	0.21	288.12	25.45	161.91	0.52
C.D.at 5%	0.13	0.35	8.78	0.25	0.013	5.18	0.74	4.71	0.05

Chemical properties of soil (post-harvest)

The results in given Table 3 indicate some of the important parameter on physical properties on mustard crop. Organic and inorganic fertilizers in conjunction on EC was found non-significant and pH, Organic carbon (%), available nitrogen (kg ha⁻¹), available phosphorus (kg ha⁻¹), available potassium (kg ha⁻¹) was found significant. EC (dSm⁻¹), Organic carbon (%), available nitrogen (kg ha⁻¹), available phosphorus (kg ha⁻¹), available potassium (kg ha⁻¹) was recorded 0.24, 0.67, 309.83, 28.98, 188.11 respectively in the treatment T₈ that was significantly higher as compared to other treatment combination.

pH was recorded 7.17 in the treatment T₈ that were significantly lower as compared to other treatment combination. The slight decreased in soil pH and increased in soil EC (dSm⁻¹), Organic carbon (%), available nitrogen (kg ha⁻¹), available phosphorus (kg ha⁻¹), available potassium (kg ha⁻¹) may be due to increase in levels of organic and inorganic fertilizer and plant growth, which is turn increased the plant residues into soil.

It may be concluded from trial that the various level of NPK, and Vermicompost used from different sources in the experiment, the treatment combination T₈ (N₈₀P₆₀ K₄₀ Kg ha⁻¹, and vermicompost @ 10 t ha⁻¹) was found to be the best, for improvement in physical and chemical properties of soil.

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