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Effect of Different Levels of Organic and Inorganic Fertilizers on Soil Properties, Growth and Yield of Radish (*Raphanus sativus* L.) var. Pusa Chetki

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A B S T R A C T

The present investigation entitled "Effect of different levels of organic and inorganic fertilizers on soil properties, growth and yield of Radish (*Raphanus sativus* L.) var. Pusa chetki". Field experiment was conducted at Department of Soil Science and Agricultural Chemistry, Naini Agricultural Institute, Prayagraj – 211007, during rabi 2019 – 2020. The experiment consists of 9 treatments including recommended dose of inorganic fertilizers, FYM, vermicompost, neem cake in different combinations and absolute control. The experiment was laid out in a Randomized Block Design with three replications. The results showed that progressive increase in the level of N P K and organic manures used from different sources in the experiment, the treatment combination (25%NPK + 25% VC + 25% FYM + 25%NC) significantly increased the physical and chemical analysis parameters i.e. Bulk density (Mg/m^3), Particle density (Mg/m^3), Pore space (%), Water retaining capacity (%), Specific gravity, Soil Ph (1:2) w/v, Soil EC (d S/m), Organic carbon (%), Available Nitrogen (Kg/ha), Available Phosphorus (Kg/ha), Available Potassium (Kg/ha) of soil.

Introduction

Radish (*Raphanus sativus* L.) belongs to the family Brassicaceae and it has 2n=18 chromosomes. It is a popular root vegetable in both tropical and temperate regions. It can be cultivated under cover for early production but larger scale production in field is more common in Haryana, West Bengal, Punjab, Bihar, Assam, Madhya Pradesh and other some state of India. In Madhya Pradesh, radish is grown in 10440 ha with a production of 153270 tonnes (Anonymous, 2016-17). Radish is grown for its young tender tuberous root which is consumed either cooked or raw. It is a good source of vitamin-c and minerals like calcium, potassium and phosphorus. It has refreshing and diuretic properties. It is also used for neurological headache, sleeplessness and chronic diarrhoea. The roots are also useful in urinary complaints and piles. The leaves of radish are good source for extraction of protein on a commercial scale and radish seeds are potential source of non-

drying fatty oil suitable for soap making illuminating and edible purposes. Availability of nitrogen is important for growing plants as it is a major indispensable constituent of protein and nucleic acid. The primary goal of integrated nutrient management is to combine old and new methods of nutrient management into ecologically sound and economically viable farming systems that utilize available organic and inorganic sources of nutrients in a judicious and efficient way.

Radish being a short duration and quick growing crop, the root growth should be rapid and uninterrupted. organic, inorganic and biofertilizers are essential (Dhanajaya, 2007). Further, due to higher cost of nitrogenous fertilizers and its ill effect on soil health and water, it is becoming imperative to go for alternative and cheaper sources like organic manures (Kumar *et al.,* 2014).

Materials and Methods

The field experiment was conducted to study the effect of different levels of organic and inorganic fertilizers on soil properties, growth and yield of Radish. The field experiment was carried out during the Rabi season 2019 - 2020 at the research farm of Department of Soil Science and Agricultural Chemistry, Naini Agriculture Institute, Sam Higginbottom University of Agriculture, Technology and Sciences (U.P.) located at 25°.27' N latitude 81°.57' E longitude and 98m above mean sea level. Soil samples were taken from 0-15cm depth of soil randomly prior to tillage operations, air dried and passed through 2 mm sieve. Then the composite sample was taken for mechanical and chemical analysis. Bouyoucos hydrometer method (1957) was used for the mechanical analysis of soil to determine sand, silt and clay percentage in the sample. Chemical analysis of the soil showed a neutral pH (7.14), 0.41 dS/m EC, 0.8% Organic carbon, 254.6 kg/ha Nitrogen, 18.3 kg/ha Phosphorus, and 103.2 kg/ha exchangeable Potassium. Recommended dose of N, P and K (100:80:50 kg N, P_2O_5 and K_2O/ ha) were applied. Full dose of P and K were applied along with 50 per cent of N at the time of planting. The remaining 50 per cent N was applied at time of earthling up. Agro climatically, Prayagraj district represents the subtropical belt of the South East of Uttar Pradesh, and is endowed with extremely hot summer and fairly cold winter.

The maximum temperature of the location ranges between 46 °C - 48 °C and seldom falls below 4 °C - 5 °C. The relative humidity ranges between 20-94%. The average rainfall of this area is around 1100mm annually. The experiment was carried out in RBD (Randomised Block Design) with three replications for each treatment.

The inorganic source of fertilizers was satisfied with Urea, MOP (Muriate of Potash), DAP (Di-ammonium Phosphate) (as N, P, K) and organic source as Farm Yard Manure (FYM), Vermicompost (VC), Neem cake (NC) which had a significant effect on the growth and yield of Radish. The treatment combination was laid out as, T_1-control, T_2-100% NPK, T_3-100%VC, T_4-100%FYM, T_5-100%NC, T_6-50%NPK + 50%VC, T_7-50%NPK + 50%FYM, T_8-50%NPK + 50%NC, T_9-25%NPK + 25%VC + 25%FYM + 25%NC respectively.

Results and Discussion

The initial and final values of physical properties and chemical properties are given below (Table 1–3).

Bulk density (Mg/m^3)

The effect of different levels of NPK and (FYM, VC & NC) showed significant on bulk

density in soil after harvest of radish. The maximum bulk density was recorded highest at T_0 (Control) with value 1.23 and the lowest value 1.11 was recorded at T_9 (25% NPK + 25% VC + 25% FYM + 25% NC). As compared to pre-harvest soil bulk density of 1.30, the bulk density of post-harvest soil decreases.

Decrease in BD might be due to higher accumulation of organic carbon and improvement in soil structure. Similar results were also reported by Moharana *et al.,* (2017), Rudrappa *et al.,* (2006), Kumar *et al.,* (2008), Reddy *et al.,* (2005).

Particle density (Mg/m^3)

The effect of different levels of NPK and (FYM, VC & NC) showed significant on particle density in soil after harvest of radish. The maximum Particle density (gcm^{-3}) of soil was recorded 2.79 Mg m^{-3} in treatment T_9 (25% NPK + 25% VC + 25% FYM + 25% NC) and minimum Particle density (Mg m^{-3}) of soil was recorded 2.22 Mg m^{-3} in treatment T_0 (control). Similar results were also reported byKumar *et al.,* (2008), Reddy *et al.,* (2005) and Ghulam *et al.,* (2016).

Pore space (%)

The effect of different levels of NPK and (FYM, VC & NC) showed significant on % pore space in soil after harvest of radish. The maximum % pore space of soil was recorded 63.22% in treatment T_9 (25% NPK + 25%VC + 25% FYM + 25% NC) and minimum % pore space of soil was recorded 42.3% in treatment T_0 (control). Similar results were also reported by Kumar *et al.,* (2008), Reddy *et al.,* (2005) and Ghulam *et al.,* (2016).

Water retaining capacity (%)

The effect of different levels of NPK and (FYM, VC & NC) showed significant on water retaining capacity (%) in soil after harvest of radish. The maximum water retaining capacity of soil was recorded 67.73% in treatment T_9 (25%NPK + 25%VC + 25%FYM + 25%NC) and minimum water retaining capacity of soil was recorded 53.98% in treatment T_0 (control).

Table.1 Analysis of soil before sowing

Parameters	Results
Sand (%)	70.10
Silt (%)	17.20
Clay (%)	12.70
Texture of soil	Sandy loam
Bulk density (Mg/m3)	1.26
Particle density (Mg/m3)	2.55
Pore space (%)	54.6
Water retaining capacity (%)	62.36
Specific gravity	2.33
Soil colour	Light yellowish brown
pH	7.14
EC (dS/m)	0.41
OC (%)	0.8
Available Nitrogen (kg/ha)	254.6
Available Phosphorus (kg/ha)	18.3
Available Potassium (kg/ha)	103.2

Table.2 Effect of different levels of organic and inorganic fertilizers on physical properties of soil after harvest of Radish

Treatments	Bulk density (Mg/m^3)	Particle density (Mg/m^3)	Pore space (%)	Water retaining capacity (%)	Specific gravity
T1	1.23	2.22	42.23	53.98	2.10
T2	1.11	2.34	45.73	59.10	2.26
T3	1.15	2.41	51.43	64.23	2.26
T4	1.14	2.48	52.46	63.51	2.34
T5	1.14	2.40	52.33	62.36	2.33
T6	1.21	2.75	62.74	66.38	2.44
T7	1.21	2.73	61.46	65.75	2.44
T8	1.19	2.65	59.2	66.33	2.38
T9	1.11	2.79	63.22	67.73	2.48
F- test	S	S	S	S	S
S.Ed. (±)	0.010	0.017	0.836	0.477	0.012
C.D. at 0.5	0.038	0.062	3.003	1.716	0.044

Table.3 Effect of different levels of organic and inorganic fertilizers on chemical properties of soil after harvest of Radish

Treatments	pH (1:2) w/v	EC (dS/m)	OC (%)	Available Nitrogen (kg/ha)	Available Phosphorus (kg/ha)	Available Potassium (kg/ha)
T1	7.3	0.21	0.32	239.15	15.93	116.53
T2	7.25	0.33	0.65	259.54	18.16	122.1
T3	7.22	0.43	0.77	259.38	19.68	134.24
T4	7.07	0.43	0.77	274.28	18.08	134.99
T5	7.17	0.42	0.75	269.07	19.81	135.62
T6	7.06	0.56	1.10	285.80	20.92	169.82
T7	7.12	0.56	1.06	281.59	19.81	169.90
T8	7.11	0.53	1.12	284.35	21.87	165.90
T9	7.03	0.61	1.15	287.46	22.76	174.85
F- test	S	S	S	S	S	S
S.Ed. (±)	0.014	0.012	0.052	1.635	0.640	1.428
C.D. at 0.5	0.050	0.044	0.186	5.874	2.299	5.129

Specific gravity

The effect of different levels of NPK and (FYM, VC & NC) showed significant on specific gravity (g cm^{-3}) in soil after harvest of radish. The maximum specific gravity of soil was recorded 2.48 in treatment T_9 (25% NPK + 25% VC + 25% FYM + 25% NC) and minimum specific gravity of soil was recorded as 2.10 in treatment T_0 (control).

Soil pH

The pH of soil increased significantly & progressively with the increasing levels of N, P, K and with the levels of inorganics (FYM,

Vermicompost & Neem cake) were found to be significant. The highest pH (7.30) was recorded with treatment T_1 (Control) followed by treatmentT_2 (100% NPK), (7.25); whereas the lowest value was observed with treatment combination T_9 (25% NPK + 25%VC + 25% FYM + 25% NC) (7.03). The decrease in soil pH may be due to formation of bicarbonate and ammonium nitrate by the application of urea that reacts with H^+ ions which caused reduction in acidity. Similar findings were reported by Roshan *et al.,* (2014) and by Ojha *et al.,* (2009)

Soil EC (ds/m)

The EC of soil increased significantly & progressively with the increasing levels of N, P, K and with the levels of inorganics (FYM, Vermicompost & Neem cake) were found to be significant. The highest EC (0.61) was recorded with treatmentT_9 (25% NPK + 25%VC + 25% FYM + 25% NC) followed by treatmentT_6 (50% NPK + 50% VC), (0.56); whereas the lowest value was observed in treatment T1 control (0.21). Roshan *et al.,* (2014), Ojha *et al.,* (2009) and Takase *et al.,* (2011).

Organic carbon (%)

The maximum organic carbon of soil was recorded 1.15% in treatment T_9 (25%NPK + 25%VC + 25%FYM + 25%NC) and minimum organic carbon of soil was recorded as 0.32% in treatment T_0 (control). Similar findings have also been reported by Moharana *et al.,* (2017), Rudrappa *et al.,* (2006), Ghulam *et al.,* (2016) and Kumar *et al.,* (2008)

Available Nitrogen (kg/ha)

The maximum available nitrogen of soil was recorded 287.46 kg/ha in treatment T_9 (25%NPK + 25%VC + 25%FYM + 25%NC) and minimum available nitrogen of soil was recorded as 239.15 kg/ha in treatment T_0 (control).

The application of organic or inorganic fertilizers is widely known to ameliorate soil N status Ajebesone *et al.,* (2011). The increase in available N may be due to application of VC, FYM and NC which is the major source of nitrogen and the soil physic-chemical characteristics are very much benefited by VC, FYM and NC. The increased in available N have also been reported by Ojha *et al.,* (2009) and Ghulam *et al.,* (2016).

Available Phosphorus (kg/ha)

The maximum available phosphorus of soil was recorded 22.76 kg/ha in treatment T_9 (25% NPK + 25% VC + 25% FYM + 25% NC) and minimum available phosphorus of soil was recorded as 15.93 kg/ha in treatment T_0 (control). Das *et al.,* (1991) reported that application of FYM, VC and NC resulted in tremendous increase in available P status of soil which might be attributed to the build-up of available P owing to the formation of fulvic acid and other chelating agents which form soluble complexes with native P in soils. The increased in available P have also been reported by Ojha *et al.,* (2009) and Ghulam *et al.,* (2016).

Available Potassium (kg/ha)

The maximum available potassium of soil was recorded 174.85 kg/ha in treatment T_9 (25%NPK + 25%VC + 25%FYM + 25%NC) and minimum available potassium of soil was recorded as 116.53 kg/ha in treatment T_0 (control). The increase in available K may be due to higher application of NPK along with FYM, VC and NC which is advantageous as improved soil physical properties, also due to availability of more nutrients as compared to their individual effects reported by Ojha *et al.,* (2009) and Ghulam *et al.,* (2016).

On the basis of the results obtained in the present investigation, it might be concluded that application of 25%NPK + 25%VC + 25%FYM + 25%NC (T_9) followed by 50%NPK + 50%VC (T_6) shown significant effects on soil, growth and yield of Radish.

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