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Effect of different levels of NPK and Vermicompost on Physico-Chemical properties of Soil of okra (*Abelmoschus esculentus* L.) Var. Kashi Kranti

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Abstract
A field study was conducted on the Effect of different levels of NPK and Vermicompost on Physico – Chemical properties of soil of Okra (*Abelmoschus esculentus* L.) Var. Kashi Kranti at the Soil Science & Agricultural Chemistry Research farm of Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj during summer season 2018. The result obtained with treatment T_5-[NPK@ 50% + Vermicompost @ 100%] that showed the highest pH 7.38, EC 0.50 dSm-1. In post soil of NPK fertilizers observations were resulted in significant increase in OC 0.82%, Particle density 2.71 g cm3, Bulk density 1.44 g cm3, Pore space 53.01% and available N 228.44 kg ha-1, P 23.02 kg ha-1, K 144.87 kg ha-1, significant increase in case of Nitrogen (kg ha-1), Phosphorus (kg ha-1), Potassium (kg ha-1) was found to be significant among other treatments in Okra cultivation and soil quality improvement. It was also revealed that the application of NPK with Vermicompost were excellent source for fertilization than fertilizers. The treatment (T_5) also showed greater benefit cost ratio followed by other treatments.

Keywords: Okra, NPK and Vermicompost, Physico-chemical Properties of soil etc.

Introduction
Okra (*Abelmoschus esculentus* L.) commonly known as Bhindi or lady's finger belongs to family malvaceae. It is an annual vegetable crop in tropical and subtropical parts of the world. It is one of the most important nutritious vegetable crops grown round the year in India. Okra is an important fruit vegetable of high commercial and food values. It is primarily valued for its tender, immature green pods in fresh form; however its curry, soups and edible young leaves are also popular. To a limited extent it finds use in canned, dehydrated or frozen forms for off-season consumption by the army at high altitudes and export (Sharma *et al.*, 2015) [5].
India is a largest producer of okra in the world with an annual production of 63.46 MT from an area at 5.32 lakh hectare (5.7% of total vegetable area). The major okra growing states of India are Uttar Pradesh, Bihar, Orissa, West Bengal, Andhra Pradesh, Karnataka and Assam. In Madhya Pradesh it occupies about 26510 hectare with total production of 305910 MT ha-1. Average productivity of okra in India is 11.9 MT ha-1 and highest productivity of okra is in Chhattisgarh (15.5 MT ha-1) (NHB, 2017) [3].
Okra is an important vegetable crop which supplies higher nutrition. The green pods (per 100 g edible portion) of okra contains moisture 89.6 g, carbohydrates 6.4 g, protein 1.9 g, fat 0.2 g, fibre 1.2 g, minerals 0.7 g, calcium 66 mg, magnesium 43 mg, phosphorus 56 mg, potassium 103 mg, Vitamin-A 88 IU, Vitamin-C 13 mg etc.
Vegetables being a protective food play a major role in enriching the diet. Okra is commonly known as lady' finger is one of the popular tropical vegetables grown on a commercial scale throughout India. The productivity of okra is 9.27 t ha-1 against the world average of 6.2 t ha-1.
The requirements of fertilizers in okra are important for the early growth and total yield of fruit. Integrated use of organic and inorganic fertilizers can improve crop productivity. The soil enriched with vermicompost provides additional substances that are not found in chemical fertilizers.

Materials and Methods
The investigation on "Effect of Different Levels of NPK and Vermicompost on Physico - Chemical Properties of Soil of Okra [*Abelmoschus esculentus* L.] Var. Kashi Kranti" comprise

of a field experiment which was carried out at the Soil Science Research Farm, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj during summer season 2018-19. The details about the experiment site, soil and climate is described in this chapter together with the experimental design, layout plan, culture practice, particulars of treatments, planting material and techniques employed for the parameters

The area is situated on the south of Prayagraj on the right side of the river Yamuna on the South of Rewa Road at a distance of about 6 Km from Prayagraj city. It is situated at 25024'23"N latitude, 81050'38"E longitude and at the altitude of 98 meter above the sea level. The maximum temperature of the location reaches up to 46 ^{0}C – 48 ^{0}C and seldom falls as low as 4 ^{0}C – 5 ^{0}C. The relative humidity ranged between 20 to 94 percent. The average rainfall in this area is around 1100 mm annually.

Experiment will be laid out in 3x3 factorial randomized block design with three levels of NPK and Vermicompost plot size was 2x2 m^2 for crop seed rate is 15-20 kg ha^{-1}. Okra sowing was done on in 2-Aug-2018 and the source of NPK and Vermicompost were Urea, SSP, MOP and Vermicompost respectively.

Results and Discussion

Bulk density (Mg m^{-3})

The data presented in shows the Bulk density (Mgm^{-3}) of soil as influenced by NPK and Vermi compost. The effect Bulk density (Mgm^{-3}) of soil was found to be significant in levels of NPK and Vermicompost. The maximum Bulk density (Mg m^{-3}) of soil was recorded 1.44 Mg m^{-3} in treatment T_5 (@50%NPK+100% and minimum Bulk density (Mgm^{-3}) of soil was recorded 1.14Mgm^{-3} in treatment T_0 (control). Similar results were also reported by Attigah *et al*., (2013) [1]

Particle density (Mg m^{-3})

The data presented in shows the Particle density (Mg m^{-3}) of soil as influenced by NPK and Vermi compost. The effect Particle density (Mg m^{-3}) of soil was found to be non-significant in levels of NPK and Vermicompost. The maximum Particle density (Mg m^{-3}) of soil was recorded 2.71 Mg m^{-3} in treatment T_5 (@50%NPK+100% Vermicompost) and minimum Particle density (Mg m^{-3}) of soil was recorded 2.40 Mg m^{-3} in treatment T_0 (control). Similar results were also reported by Attigah *et al*., (2013) [1]

Pore space (%)

The data presented in shows the % Pore space of soil as influenced by NPK and Vermicompost. The effect of soil pore space was found to be significant in levels of NPK and Vermicompost. The maximum soil pore space was recorded 53.01% in treatment T_5 (@50%NPK+100%Vermi compost) and minimum soil pore space was recorded 40.02% in treatment T_0 (Control).Similar results were also reported by Attigah *et al*., (2013) [1]

Soil pH (1:2) w/v

The data presented in shows the pH of soil as influenced be NPK and Vermicompost. The effect of soil pH was found to be significant in levels of N P K and Vermicompost. The maximum soil pH was recorded 7.25 in treatment T_5 (@ 50% NPK @ +100% Vermicompost) and minimum soil pH was ecorded 7.07 in treatment T_0 (Control). Similar results were also reported by Takase *et al.* (2011) [6].

EC (dS m^{-1})

The data presented in shows the EC (dS m^{-1}) of soil as influenced by NPK and Vermicompost. The effect of EC (dS m^{-1}) of soil was found to be non-significant in levels of NPK and Vermicompost. The maximum EC (dS m^{-1}) of soil was recorded 0.50 dS m^{-1} in treatment T_5 (@50%NPK+100% Vermicompost) and minimum EC (dS m^{-1}) of soil was recorded 0.48 dS m^{-1} in treatment T_0 (control). Similar results were also reported by Takase *et al.* (2011) [6].

% Organic carbon

The data presented in shows the % Organic carbon in soil as influenced by NPK and Vermicompost. The % Organic carbon in soil increased significantly with the increase in levels of NPK and Vermicompost. The maximum % Organic carbon in soil was recorded 0.82% in treatment T_5 (@50%NPK+100% Vermicompost) which was significantly higher than any other treatment combination and the minimum % Organic carbon in soil was recorded 0.58% in treatment T_0 (control). Legumes have potential to improve soil nutrients status through biological nitrogen fixation and incorporation of biomass in to the soil as green manure. Similar findings were recorded by Kumar *et al.* (2008) [2].

Available Nitrogen (Kg ha^{-1})

The data presented in shows the available Nitrogen in soil as influenced by NPK and Vermicompost. The available Nitrogen in soil increased significantly with the increase in levels of NPK and Vermicompost. The maximum available Nitrogen in soil was recorded 229.44 (Kg ha^{-1}) in treatment T_5 (@50%NPK+100% Vermicompost) which was significantly higher than any other treatment combination and the minimum available Nitrogen in soil was recorded 207.13 (Kg ha^{-1}) in treatment T_0 (control).Similar findings were also recorded by Salvi *et al.*, (2015) [4].

Available Phosphorus (Kgha^{-1})

The data presented in shows the available Phosphorus in soil as influenced by NPK and Vermicompost. The available Phosphorus in soil increased significantly with the increase in levels of NPK and Vermicompost. The maximum available Phosphorus in soil was recorded 23.02 (Kg ha^{-1}) in treatment T_5 (@50%NPK+100% Vermicompost) which was significantly higher than any other treatment combination and the minimum available Phosphorus in soil was recorded 15.00 (Kg ha^{-1}) in treatment T_0 (control).Similar findings were also recorded by Salvi *et al*., (2015) [4].

Available Potassium (Kgha^{-1})

The data presented shows the available Potassium in soil as influenced by NPK and Vermicompost. The available Potassium in soil increased significantly with the increase in levels of NPK and Vermicompost. The maximum available Potassium in soil was recorded 147.87 (Kgha^{-1}) in treatment T_5 (@50% NPK+100% Vermicompost) which was significantly higher than any other treatment combination and the minimum available Potassium in soil was recorded 115.98 (Kg ha^{-1}) in treatment T_0 (control).Similar findings were also recorded by Salvi *et al*., (2015) [4].

Table 1: Effect of NPK and Vermicompost on physical parameters of soil in Okra

Treatment	bulk density (Mg m^{-3})	Particle density (Mg m^{-3})	Pore space (%)
T_0	1.14	2.40	40.02
T_1	1.35	2.48	42.28
T_2	1.40	2.62	46.32
T_3	1.30	2.60	47.84
T_4	1.35	2.55	47.94
T_5	1.44	2.71	53.01
T_6	1.36	2.39	47.00
T_7	1.30	2.55	48.80
T_8	1.32	2.61	47.73
F- test	S	NS	S
S. Em+	0.036	0.078	0.468
C.D. (P= 0.05)	0.074	0.166	0.992

Table 2: Effect of NPK and Vermicompost on chemical parameters of soil in Okra

Treatment	pH (1:2) w/v	EC (dSm^{-1})	Organic carbon (%)	Nitrogen (Kg ha^{-1})	Phosphorus (Kg ha^{-1})	Potassium (Kg ha^{-1})
T_0	7.07	0.250	0.58	207.13	15.00	115.98
T_1	7.12	0.370	0.64	208.44	15.60	123.05
T_2	7.25	0.400	0.70	212.45	16.50	127.83
T_3	7.08	0.440	0.64	213.44	18.00	131.11
T_4	7.24	0.400	0.64	218.15	18.58	127.57
T_5	7.38	0.500	0.82	228.44	23.02	146.87
T_6	7.10	0.480	0.65	222.13	20.10	139.85
T_7	7.14	0.440	0.73	225.16	21.86	144.27
T_8	7.08	0.410	0.71	219.18	20.20	134.57
F- test	S	S	S	S	S	S
S. Em+	0.013	0.029	0.015	1.588	0.228	2.240
C.D. (P= 0.05)	0.028	0.062	0.032	3.367	0.483	4.749

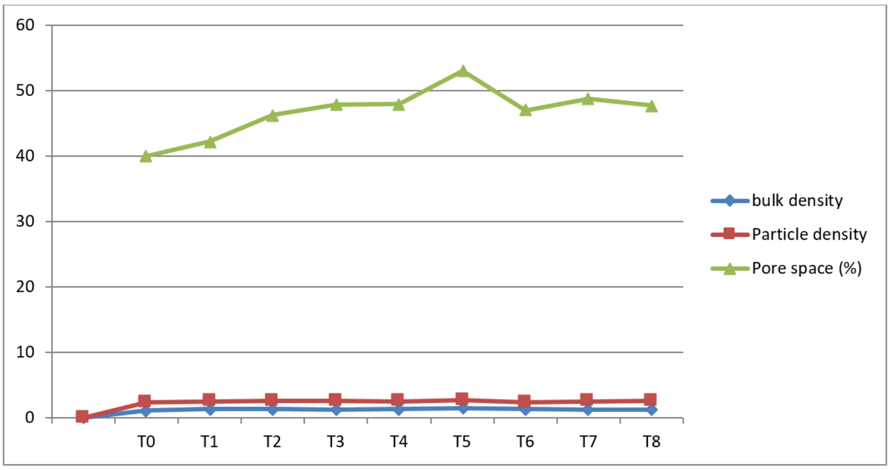

Fig 1: Effect of NPK and Vermicompost on physical parameters of soil in Okra

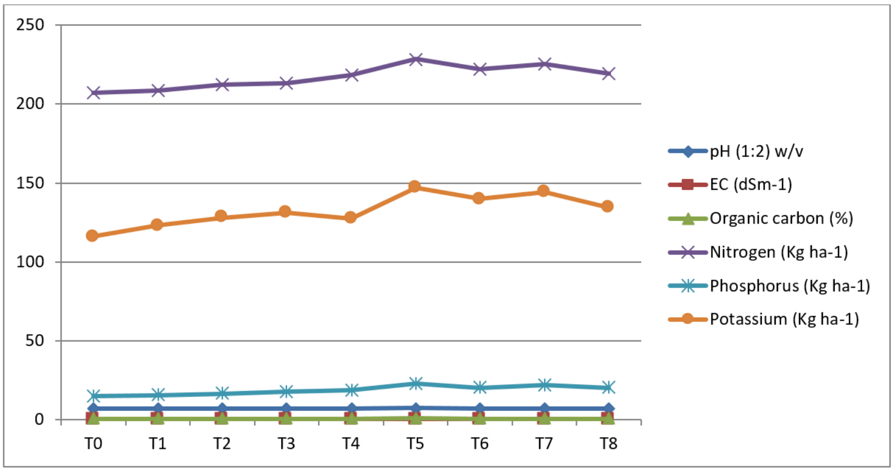

Fig 2: Effect of NPK and Vermicompost on chemical parameters of soil in Okra

Conclusion

In the present investigation, it was apparent that application of NPK and Vermicompost fertilizer in treatment T_5 [@ 50% NPK +100% Vermicompost] was found on physical and chemical parameters of soil such as bulk density, particle density, % pore space, EC, pH, Organic carbon, Available NPK than other treatment combinations. Buk density, Particle density and EC are significant. Thus it can be concluded that different levels of NPK and Vermicompost fertilizer improved soil available nutrient, increased soil available nitrogen, phosphorus, potassium and electrical conductivity. However, pH of soil increase and also among the treatments T_5 recorded the best treatment which increased the availability of nutrient and influenced on physical properties of soil as well.

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