

Original Research Article

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Effect of Different Levels of NPK and FYM on Physico-Chemical Properties of Soil of Okra [*Abelmoschus esculentus* L.] Var. Parbhani Kranti

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ABSTRACT

The field experiment was conducted during *kharif* (rainy) season of 2019 on “Effect of different levels of NPK and FYM on physico-chemical properties of soil of Okra (*Abelmoschus esculentus* L.) var. Parbhani Karanti” on Central Research Farm Department of Soil Science and Agricultural Chemistry, SHUATS, Prayagraj. The soil of experiment area falls in order *Inceptisol* and soil texture was sandy loam (sand % 61.20, silt % 23.20 and clay % 14.6). There were 9 treatments combination replicated thrice in 3 x 3 factorial randomized block design. It was observed that for post harvest, soil properties in treatment T₈- (100% RDF @ N₁₀₀ P₆₀ K₅₀ kg ha⁻¹ +100% FYM @ 25 t ha⁻¹) were improved significantly due to organic and inorganic use of inputs. The maximum values of pore space (60.1 %), water holding capacity (63.63 %), organic carbon (0.62 %), available nitrogen (297.56 kg ha⁻¹), available phosphorus (26.35 kg ha⁻¹) and available potassium (202.55 kg ha⁻¹) was with treatment T₈- (100% RDF @ N₁₀₀ P₆₀ K₅₀ kg ha⁻¹ +100% FYM @ 25 t ha⁻¹). The combination of T₈- (100% RDF @ N₁₀₀ P₆₀ K₅₀ kg ha⁻¹ +100% FYM @ 25 t ha⁻¹) showed slight decrease in pH (6.8), bulk density (1.18 Mg m⁻³) and particle density (2.50 Mg m⁻³), the same treatment EC (0.33 dS m⁻¹) was slightly increase in post harvest soil. It may be concluded from trial that the various level of NPK and FYM used from different sources in the experiment, the treatment T₈ - (100% RDF @ N₁₀₀ P₆₀ K₅₀ kg ha⁻¹ +100% FYM @ 25 t ha⁻¹) was found to be the best, for improvement in physical and chemical properties of soil.

Keywords

Okra, NPK and FYM, Physico-chemical Properties of Soil etc

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Introduction

Okra [*Abelmoschus esculentus* L.] is an important fruit vegetable crop cultivated in tropical, subtropical and mild temperate parts of the world and belongs to the family *Malvaceae*. In India, it is grown during summer and rainy seasons for its tender pod, which are cooked and consumed as a vegetable (Chattopadhyay *et al.*, 2011). Okra

(*Abelmoschus esculentus* L.) originated in Ethiopia (Sathish & Eswar, 2013). Okra (*Abelmoschus esculentus*) is one of the most widely known and utilized species of the family *Malvaceae* (Naveed *et al.*, 2009). Okra is most popular in India, Nigeria, Sudan, Pakistan, Ghana, Egypt, Benin, Saudi Arabia, Mexico and Cameroon. Largest area and production is in India followed by Nigeria. Total area under okra in India is reported to

be 528.37 thousand hectare, production 6145.97 thousand tonnes and productivity 11.5 t ha⁻¹ in 2018-19. West Bengal is the leading state of area and production of okra, which has area 77.40 thousand hectare and production 913.32 thousand tonnes. Highest productivity is 17.40 t ha⁻¹ of Andhra Pradesh. Uttar Pradesh climate is good for okra that in total area 22.64 thousand hectare and production is 303.05 thousand tonnes in 2018-19 (NHB data base 2018-19).

Total area under okra in World is reported to be 2020528 hectare and production 9872826 tonnes in 2018. Okra is valued for its edible green pods (fruits), a capsule that contains many seeds. However, its leaves are also eaten as a vegetable. Okra seeds are used as a non-caffeinated substitute for coffee and also as a source of seed oil (FAO, 2018). Okra is said to be of economic importance because of its nutritional value that has the potential to improve food security (FAO, 2018). The significance of crop further enhances due to its multiple uses. The dry seed contains 13-22 percent good quality edible oil and 20-24 percent protein. The green fruits contain water 88.6 g, energy 36 kcal, protein 2.1 g, carbohydrate 8.2 g, fat 0.2 g, fiber 1.7g, Ca 84 mg, P 90 mg, Fe 1.2 mg, beta carotene 185 micro gram, riboflavin 0.08 mg, thiamin 0.04 mg, niacin 0.6 mg and ascorbic acid 47 mg per 100 g edible portion (Habtamu *et al.*, 2014). Fresh pods also contain about 30% of recommended levels of vitamin C (16–29 mg), 10–20% of folate (46–88 mg) and about 5% of vitamin A (14–20 RAE) (Gemede *et al.*, 2014).

The main challenge before India is to increase the production of quality food in a sustainable manner and feeding the country's large population and increasing the income of the farmer. The requirements of fertilizers in okra are important for the early growth and total production of fruit yield. Use of organic and

inorganic fertilizers can improve crop productivity (Mal *et al.*, 2013). Organic fertilizer released all type of micro and macro nutrients that helps to plant elongation. Organic fertilizers improved soil physical properties and supplied of essential plant nutrients for higher growth of plant, protect soil against erosion, supply the cementing substance for desirable aggregate soil formation and loosen the soil. Application of FYM sustains cropping system through better nutrient recycling and provides all necessary nutrients, thereby improving the physical and biological properties of soil (Abou El-Magd *et al.*, 2006).

The effects of fertilizer on the growth and yield of okra had been reported in various studies (Agbede and AAdekiya, 2012), (Uka *et al.*, 2013). In the experiment conducted by (Firoz *et al.*, 2009) on the relative effects of inorganic and organic fertilizer on the growth of okra, it was observed that both fertilizer types produced significantly higher value for plant height, fresh weight, leaf area and dry weight compared to the control without fertilizer.

Nitrogen plays a major role among cultural practices for increased crop production. However, blanket application of inorganic fertilizer to farmland soils without adequate knowledge of the nutrient status, often leads to increased soil acidity, particularly when nitrogen fertilizers are applied (Akande *et al.*, 2010).

Phosphorus can influence fruiting and fruit developments of crops and regarded as key of life because it is directly involved in most living process. Phosphorus is a key constituent of ATP which transforms energy to the plant. Phosphorus take part in various physiological process and helps in nutrients uptake by promoting root growth and their by ensuring a good pod yield (Das *et al.*, 2014).

Potassium plays a unique role in osmotic regulation, opening and closing of stomata and improves the color, flavours and size of fruits (Bhende *et al.*, 2015).

Application of FYM and poultry manure or in combination with chemical fertilizers improved the soil organic C, total NPK status. However, only organic manure or combined applications of organic manure with inorganic fertilizers increase soil microbial growth (Kaur *et al.*, 2005). The organic manure FYM not only provides nutrient to the plant but also improves the soil texture by binding effect of soil aggregates. Organic manure increases cation exchange capacity, water holding capacity and phosphate availability of the soil beside improving the fertilizer use efficiency and microbial population of soil, it reduces nitrogen losses due to slow release of nutrients (Tadesse *et al.*, 2013). FYM plus inorganic NPK applications in irrigated systems resulted in reduced bulk density, higher soil organic carbon and hydraulic conductivity and improved soil structure and microbial communities (Bhattacharya *et al.*, 2007).

Materials and Methods

The investigation on Effect of Different Levels of NPK and FYM on Growth and Yield of Okra [*Abelmoschus esculentus* L.] var. Parbhani Karanti comprise of a field experiment which was carried out at the Soil Science Research Farm, Sam Higginbottom University of Agriculture, Technology and Science, Prayagraj during *kharif* season on 22th July to 18th October (2019-20).

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 25°24'23"N latitude, 81°50'38"E longitude and at the altitude of 98 meter above the sea level. The maximum temperature of the

location reaches up to 46°C – 48°C and seldom falls as low as 40°C – 50°C. The relative humidity ranged between 20 to 94 percent. The average rainfall in this area is around 1100 mm annually.

The Experiment was laid out in a 3 x 3 Factorial Randomized Block Design (FRBD) (Fisher R. A. 1958) with 9 treatments and 3 replications. The treatment consisted of all combination, 3 levels of NPK fertilizer 0% @ N₀ P₀ K₀ kg ha⁻¹, 50% @ N₅₀ P₃₀ K₂₅ kg ha⁻¹ and 100% @ N₁₀₀ P₆₀ K₅₀ kg ha⁻¹ and 3 levels of FYM 0%, 50% and 100% @ 0 t ha⁻¹, 12.5 t ha⁻¹ and 25 t ha⁻¹. The recommended dose of fertilizers *i.e.* nitrogen, phosphorous and potassium (100%) and FYM (100%) was applied in the ratio of 100:60:50 kg ha⁻¹ and FYM 25 t ha⁻¹, respectively. The source of nitrogen was through urea (46% N), phosphorus through single super phosphate (16% P₂O₅), potassium through muriate of potash (60% K₂O) and FYM (0.5% N₂, 0.2% P₂O₅, and 0.5 % K₂O). Dose of fertilizer was applied in respective plots according to treatment allocation uniform furrows opened by about 5 cm. The plant distance R x R = 45 cm and P x P = 30 cm, and seed rate 8- 10 kg ha⁻¹. All the agronomic practices were carried out uniformly to raise the crop.

Results and Discussion

Bulk density (Mg m⁻³)

The data presented in shows the Bulk density (Mg m⁻³) of soil as influenced by N P K fertilizers and FYM. The response Bulk density (Mg m⁻³) of soil was found to be non-significant in levels of N P K and FYM. The maximum Bulk density (Mg m⁻³) of soil was recorded 1.31 Mg m⁻³ in treatment T₀ (control) and minimum Bulk density (Mg m⁻³) of soil was recorded 1.18 Mg m⁻³ in treatment T₈ (100% RDF @ N₁₀₀ P₆₀ K₅₀ kg ha⁻¹ + 100% FYM @ 25 t ha⁻¹). Similar results were also

reported by Yadav *et al.*, (2019) and Ola *et al.*, (2017).

Particle density (Mg m^{-3})

The data presented in shows the particle density (Mg m^{-3}) of soil as influenced by N P K fertilizers and FYM. The response particle density (Mg m^{-3}) of soil was found to be non-significant in levels of N P K and FYM. The maximum particle density (Mg m^{-3}) of soil was recorded 2.62 Mg m^{-3} in treatment T_0 (control) and minimum particle density (Mg m^{-3}) of soil was recorded 2.50 Mg m^{-3} in treatment T_8 (100% RDF @ $N_{100} P_{60} K_{50} \text{ kg ha}^{-1} + 100\% \text{ FYM @ } 25 \text{ t ha}^{-1}$). Similar results were also reported by Ola *et al.*, (2017).

% Pore space

The data presented in shows the % Pore space of soil as influenced by N P K fertilizers and FYM. The response % Pore space of soil was found to be significant in levels of N P K and FYM. The maximum % Pore space of soil was recorded 60.1 % in treatment T_0 (control) and minimum % Pore space of soil was recorded 47.15 % in treatment T_8 (100% RDF @ $N_{100} P_{60} K_{50} \text{ kg ha}^{-1} + 100\% \text{ FYM @ } 25 \text{ t ha}^{-1}$). Similar results were also reported by Lakra *et al.*, (2017) and Salvi *et al.*, (2015).

Water holding capacity %

The data presented in shows the water holding capacity % of soil as influenced by N P K fertilizers and FYM. The response water holding capacity % of soil was found to be significant in levels of N P K and FYM. The maximum water holding capacity % of soil was recorded 63.63 % in treatment T_8 (100% RDF @ $N_{100} P_{60} K_{50} \text{ kg ha}^{-1} + 100\% \text{ FYM @ } 25 \text{ t ha}^{-1}$) and minimum water holding capacity % of soil was recorded 45.53 % in treatment T_0 (control). Similar results were

also reported by Salvi *et al.* (2015).

pH (1:2) W/V

The data presented in shows the pH of soil as influenced by N P K fertilizers and FYM. The response pH of soil was found to be significant in levels of N P K and FYM. The maximum pH of soil was recorded in treatment 7.26 T_0 (control) and minimum pH of soil was recorded 6.88 in treatment T_8 (100% RDF @ $N_{100} P_{60} K_{50} \text{ kg ha}^{-1} + 100\% \text{ FYM @ } 25 \text{ t ha}^{-1}$). Similar results were also reported by Bhambhu *et al.*, (2016) and Solangi *et al.*, (2015).

EC (dS m^{-1})

The data presented in shows the EC (dS m^{-1}) of soil as influenced by N P K fertilizers and FYM. The response EC (dS m^{-1}) of soil was found to be significant in levels of N P K and FYM. The maximum EC (dS m^{-1}) of soil was recorded 0.32 dS m^{-1} in treatment T_8 (100% RDF @ $N_{100} P_{60} K_{50} \text{ kg ha}^{-1} + 100\% \text{ FYM @ } 25 \text{ t ha}^{-1}$) and minimum EC (dS m^{-1}) of soil was recorded 0.28 dS m^{-1} in treatment T_0 (control). Similar results were also reported by Salvi *et al.*, (2015) and Ray *et al.*, (2005).

Organic carbon %

The data presented in shows the organic carbon % in soil as influenced by N P K fertilizers and FYM. The Organic carbon % in soil increased significantly with the increase in levels of N P K and FYM. The maximum organic carbon % in soil was recorded 0.62 % in treatment T_8 (100% RDF @ $N_{100} P_{60} K_{50} \text{ kg ha}^{-1} + 100\% \text{ FYM @ } 25 \text{ t ha}^{-1}$) which was significantly higher than any other treatment combination and the minimum organic carbon % in soil was recorded 0.39 % in treatment T_0 (control). Similar results were observed by Salvi *et al.* (2015) and Lakra *et al.* (2017).

Table.1 Treatment combination of different levels of N P K and FYM for okra trial

Treatment	Treatment combination	Symbol
T ₀	Control (Absolute control)	I ₀ + F ₀
T ₁	0% RDF + 50% FYM @ 12.5 t ha ⁻¹	I ₀ + F ₁
T ₂	0% RDF + 100% FYM @ 25 t ha ⁻¹	I ₀ + F ₂
T ₃	50% RDF @ N ₅₀ P ₃₀ K ₂₅ kg ha ⁻¹ + 0% FYM @ 0 t ha ⁻¹	I ₁ + F ₀
T ₄	50% RDF @ N ₅₀ P ₃₀ K ₂₅ kg ha ⁻¹ + 50% FYM @ 12.5 t ha ⁻¹	I ₁ + F ₁
T ₅	50% RDF @ N ₅₀ P ₃₀ K ₂₅ kg ha ⁻¹ + 100% FYM @ 25 t ha ⁻¹	I ₁ + F ₂
T ₆	100% RDF @ N ₁₀₀ P ₆₀ K ₅₀ kg ha ⁻¹ + 0% FYM @ 0 t ha ⁻¹	I ₂ + F ₀
T ₇	100% RDF @ N ₁₀₀ P ₆₀ K ₅₀ kg ha ⁻¹ + 50% FYM @ 12.5 t ha ⁻¹	I ₂ + F ₁
T ₈	100% RDF @ N ₁₀₀ P ₆₀ K ₅₀ kg ha ⁻¹ + 100% FYM @ 25 t ha ⁻¹	I ₂ + F ₂

Table.2 Physical analysis of soil before sowing of Okra (*Abelmoschus esculentus L.*)

Particulars	Results	Method employed
Sand (%)	61.20	Bouyoucos Hydrometer method (1927)
Silt (%)	23.20	
Clay (%)	14.6	
Textural class	Sandy loam	
Bulk density (Mg m ⁻³)	1.32	
Particle density (Mg m ⁻³)	2.61	
Pore Space (%)	46.98	Graduated Measuring Cylinder (Muthuval <i>et al.</i> , 1992)
Soil Moisture (%)	21.05	
Water Holding Capacity	47.12	

Table.3 Chemical analysis of soil before sowing of Okra (*Abelmoschus esculentus L.*)

Parameters	Method employed	results
Soil pH (1:2)	Digital pH meter (Jackson 1958)	7.3
Soil EC (dS m ⁻¹)	Digital conductivity meter (Wilcox 1950)	0.27
Organic Carbon (%)	Repid titration method (Walkley and Black, 1947)	0.42
Available Nitrogen (Kg ha ⁻¹)	Alkaline permanganate method (Subbaih and Asija, 1956)	276.43
Available Phosphorus (Kg ha ⁻¹)	Calorimetric Method (Olsen <i>et al.</i> , 1954)	16.51
Available Potassium (Kg ha ⁻¹)	Flame photometric method (Toth and Price, 1949)	169.11

Table.4 Effect of different levels of NPK and FYM on Physical parameters of soil in Okra

Treatment	Bulk density (Mg m ⁻³)	Particle density (Mg m ⁻³)	Pore space (%)	Water holding capacity %
T ₀	1.31	2.62	47.15	45.53
T ₁	1.29	2.60	49.35	47.20
T ₂	1.28	2.59	50.09	53.24
T ₃	1.27	2.57	52.66	49.80
T ₄	1.25	2.56	55.31	54.27
T ₅	1.24	2.55	56.73	58.50
T ₆	1.26	2.52	57.73	55.68
T ₇	1.20	2.52	58.35	57.72
T ₈	1.18	2.50	60.1	63.63
F- test	NS	NS	S	S
S. Em _±	0.01	0.00	0.13	0.34
C.D. at 5%	0.02	0.01	0.38	1.03

Table.5 Effect of different levels of NPK and FYM on Chemical parameters of soil in Okra

Treatment	pH (1:2) w/v	EC (dS m ⁻¹)	Organic carbon (%)	Nitrogen (kg ha ⁻¹)	Phosphorus (kg ha ⁻¹)	Potassium (kg ha ⁻¹)
T ₀	7.26	0.28	0.39	216.50	14.69	131.14
T ₁	7.23	0.29	0.43	223.18	15.41	151.99
T ₂	7.09	0.30	0.47	232.48	16.67	173.20
T ₃	7.07	0.30	0.45	236.76	15.76	154.29
T ₄	7.01	0.31	0.48	247.39	17.31	171.84
T ₅	7.00	0.31	0.56	260.72	21.83	186.31
T ₆	6.98	0.32	0.49	277.73	19.68	163.51
T ₇	6.97	0.32	0.54	284.26	23.37	182.38
T ₈	6.88	0.33	0.62	297.56	26.35	202.55
F – test	S	S	S	S	S	S
S. Em _±	0.01	0.13	0.01	0.40	0.31	0.35
C.D. at 5%	0.02	0.40	0.02	1.20	0.93	1.06

Fig.1 Effect of different levels of NPK and FYM on Physical parameters of soil in Okra

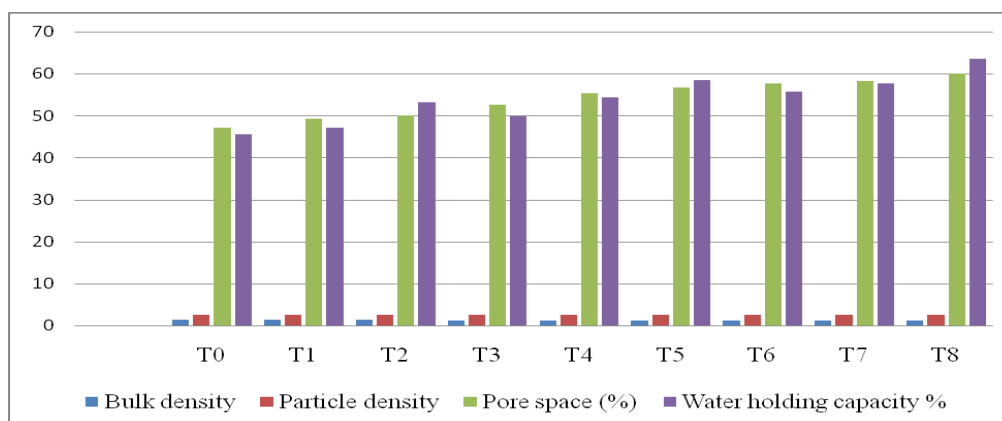


Fig.2 Effect of different levels of NPK and FYM on Chemical parameters of soil in Okra

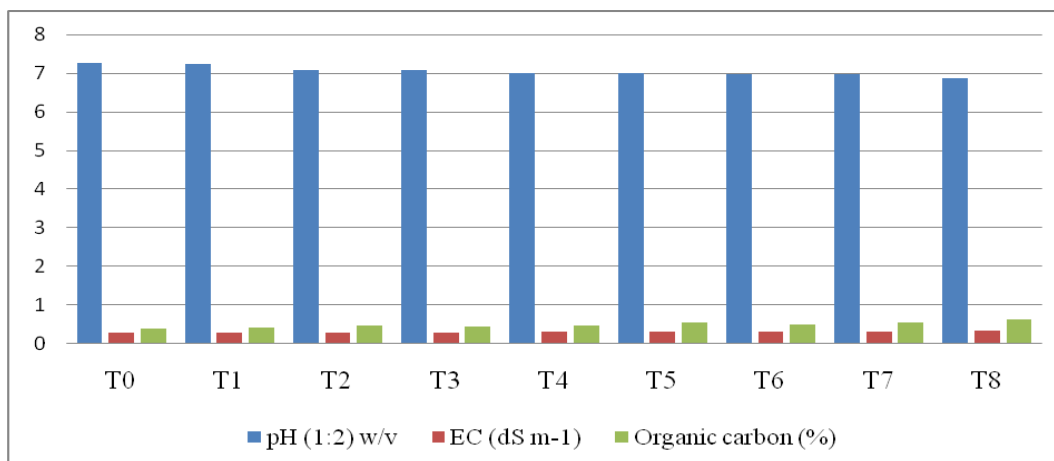
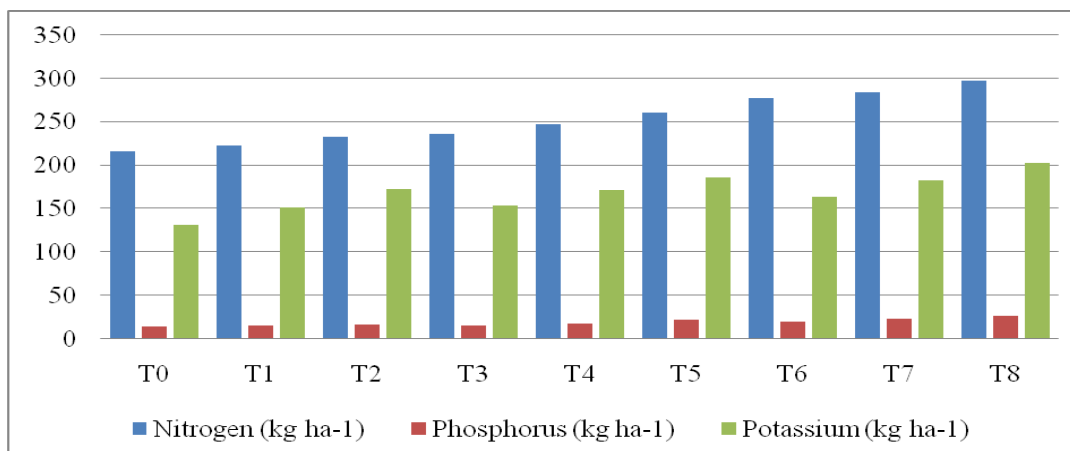


Fig.3 Effect of different levels of NPK and FYM on chemical parameters of soil in Okra



Available Nitrogen (Kg ha⁻¹)

The data presented in shows the available nitrogen in soil as influenced by N P K fertilizers and FYM. The available nitrogen in soil increased significantly with the increase in levels of N P K and FYM. The maximum available nitrogen in soil was recorded 297.56 (Kg ha⁻¹) in treatment T₈ (100% RDF @ N₁₀₀ P₆₀ K₅₀ kg ha⁻¹ +100% FYM @ 25 t ha⁻¹) which was significantly higher than any other treatment combination and the minimum available nitrogen in soil was recorded 216.50 (Kg ha⁻¹) in treatment T₀ (control). Similar results were observed by Bhambhu *et al.* (2016).

Available Phosphorus (Kg ha⁻¹)

The data presented in shows the available phosphorus in soil as influenced by N P K fertilizers and FYM. The available phosphorus in soil increased significantly with the increase in levels of N P K and FYM. The maximum available phosphorus in soil was recorded 26.35 (Kg ha⁻¹) in treatment T₈ (100% RDF @ N₁₀₀ P₆₀ K₅₀ kg ha⁻¹ +100% FYM @ 25 t ha⁻¹) which was significantly higher than any other treatment combination and the minimum available phosphorus in soil was recorded 14.69 (Kg ha⁻¹) in treatment T₀ (control). Similar results were observed by Yadav *et al.* (2019).

Available Potassium (Kg ha⁻¹)

The data presented in shows the available potassium in soil as influenced by N P K fertilizers and FYM. The maximum available potassium in soil was recorded 202.55 (Kg ha⁻¹) in treatment T₈ (100% RDF @ N₁₀₀ P₆₀ K₅₀ kg ha⁻¹ +100% FYM @ 25 t ha⁻¹) which was significantly higher than any other treatment combination and the minimum available potassium in soil was recorded 131.14 (Kg ha⁻¹) in treatment T₀ (control). Similar results were observed by Bhambhu *et al.* (2016).

It was concluded from trial that the different levels of N P K and FYM used for okra, the treatment combination T₈ – [100% N P K @ N₁₀₀P₆₀K₅₀ kg ha⁻¹ + 100% FYM @ 25 t ha⁻¹] was found to be the best treatment physico-chemical properties of soil. The slight decrease in soil pH 6.8, bulk density 1.18 Mg m⁻³ and particle density 2.50 Mg m⁻³ has resulted due to the application of T₈ @100% RDF @ N₁₀₀ P₆₀ K₅₀ kg ha⁻¹ + @100% FYM @ 25 t ha⁻¹). While maximum pore space 60.1 %, water holding capacity 63.63%, organic carbon 0.62 %, available nitrogen 297.56 kg ha⁻¹, available phosphorus 26.35 kg ha⁻¹ and available potassium 202.55 kg ha⁻¹, found with application of T₈ @100% RDF @ N₁₀₀ P₆₀ K₅₀ kg ha⁻¹ + @100% FYM @ 25 t ha⁻¹). It was also revealed that the application of NPK with FYM were excellent source for fertilization than fertilizers alone. It can be concluded that combined application of FYM and inorganic NPK fertilizers improved the physico-chemical properties of soil.

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