The Pharma Innovation Journal 2022; 11(6): 158-163

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; 11(6): 158-163

www.thepharmajournal.com
Received: 16-02-2022
Accepted: 31-03-2022

Merentoshi
M.Sc., Scholar, Department of Soil Science and Agricultural Chemistry, NAI, SHUATS, Prayagraj, Uttar Pradesh, India

Amreen Hasan
Assistant Professor, Department of Soil Science and Agricultural Chemistry, NAI, SHUATS, Prayagraj, Uttar Pradesh, India

Tarence Thomas
Professor, Department of Soil Science and Agricultural Chemistry, NAI, SHUATS, Prayagraj, Uttar Pradesh, India

Arun A David
Associate Professor, Department of Soil Science and Agricultural Chemistry, NAI, SHUATS, Prayagraj, Uttar Pradesh, India

Tarun Kumar
Ph.D.. Scholar, Department of Soil Science and Agricultural Chemistry, NAI, SHUATS, Prayagraj, Uttar Pradesh, India

Jayasree Midde
M.Sc. Scholar, Department of Soil Science and Agricultural Chemistry, NAI, SHUATS, Prayagraj, Uttar Pradesh, India

Corresponding Author:
Amreen Hasan
Assistant Professor, Department of Soil Science and Agricultural Chemistry, NAI, SHUATS, Prayagraj, Uttar Pradesh, India

Impact of different levels of organic and inorganic fertilizers on physico-chemical properties of soil post cultivation of Okra (*Abelmoschus esculentus* L.) Var. Queen Neha

Merentoshi, Amreen Hasan, Tarence Thomas, Arun A David, Tarun Kumar and Jayasree Midde

Abstract

A tremendous obstacles gonna face by globe to feed and clothes an additional 2 billion people by 2050.This work is difficult enough as it is, but there are several extra constraints that make it considerably more difficult. Integrated applications with a well-balanced mix of mineral fertilizer, organic, and biological sources of nutrients are not only complementary, but also synergistic, because organic inputs have favorable effects. In keeping the above fact in view, a field trail was carried out at CRF, SHUATS, and NAI Prayagraj during Rabi season 2021 on Impact of different levels of Organic and Inorganic fertilizers on Physico-chemical properties of soil Post cultivation of Okra (*Abelmoschus esculentus* L.) Var. Queen Neha with nine different treatments which were replicated thrice. It was observed that for post-harvest, soil properties in treatment T_9 (100% RDF @ N_{150} P_{80} K_{70} kg ha^{-1} +100% FYM @ 25 t ha^{-1}) were improved due to organic and inorganic fertilizers. The max. D_b (1.303) (1.309) at 0-15 and 15-30 cm depth, D_p max. Was observed (2.525) (2.539) at 0-15 and 15-30 cm depth values of pore space (42.17%) (37.20%) at 0-15 and 15-30 cm depth, water holding capacity (34.52%) (35.95%) at 0-15 and 15-30 cm depth, pH (7.35) (7.45) at 0-15 and 15-30 cm depth, EC (0.232 dSm^{-1}) (0.203 dSm^{-1}), Organic Carbon (0.523%) (0.498%) at 0-15 and 15-30 cm depth, Available Nitrogen (271.3 kg ha^{-1}) (191.3 kg ha^{-1}) at 0-15 and 15-30 cm depth, Available Phosphorus (23.73 kg ha^{-1}) (22.54 kg ha^{-1})at 0-15 and 15-30 cm depth and Available Potassium (210.3 kg ha^{-1}) (157.3 kg ha^{-}) at 0-15 and 15-30 cm depth. From the trail it can be concluded the treatment T_9 was found to improve soil Physico-chemical properties with respect to other treatments.

Keywords: Okra, growth, yield, organic, inorganic

Introduction

Okra (*Abelmoschus esculentus* L.) is a common tropical, subtropical, and mild temperate fruit vegetable crop. In India, it is planted for its soft pods, which are cooked and eaten as a vegetable during the summer and monsoon seasons (Chattopadhyay *et al*., 2011) [7]. Okra is a fast-growing annual that has risen to prominence among Indian vegetables due to its immature fruits, which are used as a cooked vegetable, and dried seeds, which contain up to 20% protein (Lyngdoh *et al*., 2013). Okra (*Abelmoschus esculentus* L.) originated in Ethiopia (Sathish&Eswar, 2013) [20]. Okra (*Abelmoschus esculentus*) belongs to the Malvaceae family and is one of the most well-known and commonly used species (Naveed *et al*., 2009) [16]. West Bengal is the leading state in terms of okra production and area, with 77.40 thousand hectares and 913.32 thousand tonnes respectively. Andhra Pradesh has the highest production at 17.40 t ha^{-1}. The environment of Uttar Pradesh is favourable for okra, which has a total area of 22.64 million hectares and a yield of 303.05 million tonnes in 2018-19. (NHB data base 2018-19) [17]. 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 is considered economically significant due to its nutritional value, which has the potential to increase food security (FAO, 2018) [9]. Crop's importance grows as a result of its numerous applications. The dry seed has an excellent grade edible oil content of 13-22 percent and a protein content of 20-24 percent. Per 100 g edible portion, the green fruits include 88.6 g of water, 36 kcal of calories, 2.1 g of protein, 8.2 g of carbohydrate, 0.2 g of fat, 1.7 g of fibre, Ca 84 mg, P 90 mg, Fe 1.2 mg, beta carotene 185 micrograms, riboflavin 0.08 mg, thiamin 0.04 mg, niacin 0.6 mg, and ascorbic acid (Habtamu *et al*., 2014) [11]. Fresh pods also contain about 30% of the required vitamin C

(16–29 mg), 10%–20% folate (46–88 mg), and about 5% of vitamin A (14–20 RAE) levels. (Gemede *et al*., 2014) [10].

Organic fertiliser releases a variety of micro and macro nutrients that aid plant growth. Organic fertilisers improved soil physical qualities and provided vital plant nutrients for increased plant growth, protected soil from erosion, provided a cementing ingredient for good aggregate soil formation, and loosen the soil. FYM helps to maintain agricultural systems by enhancing nutrient recycling and providing all necessary nutrients, as well as improving soil physical and biological qualities (Abou El-Magd*et al*., 2006) [1]. The effects of fertilizer on the growth and yield of okra had been reported in various studies (Agbede and AAdekiya, 2012) [2], (Uka *et al*., 2013) [24]. Although FYM is a regularly utilised organic manure, it is in short supply. Vermicomposting is an excellent way to recycle large amounts of farm waste (Sanjay-Swami, 2012). Only organic manure or organic manure coupled with inorganic fertilisers, on the other hand, increases soil microbial growth (Kaur *et al*., 2005) [13]. The organic manure FYM not only feeds the plants, but it also enhances the soil structure by glueing soil particles together.

Among the cultural methods for higher crop production, nitrogen plays a significant role. However, applying inorganic fertilisers to farming soils without first determining their nutrient status might result in increased soil acidity, especially when nitrogen fertilisers are used (Akande *et al*., 2010). Phosphorus has the ability to influence crop fruiting and development, and it is regarded as a key to life because it is directly engaged in the majority of biological processes. Phosphorus is involved in a variety of physiological processes and aids in the intake of nutrients by encouraging root growth and ensuring a good pod yield (Das *et al*., 2014) [8]. Potassium is the third important plant nutrient. Potassium is a necessary macronutrient for plant growth and plays an important role in the activation of various metabolic processes such as protein synthesis, photosynthesis, enzyme activation, and disease and insect resistance, among others (Rehm and Schmitt, 2002) [19] Potassium plays an important part in osmotic regulation, stomata opening and closing, as well as fruit colour, flavour, and size (Bhende *et al*., 2015) [5].

FYM manure, either alone or in conjunction with chemical fertilizers, increased soil organic C and total NPK status. Organic manure improves the soil's cation exchange capacity, water retention capacity, and phosphate availability, as well as its fertilizer usage efficiency and microbial population. It also minimizes nitrogen losses owing to sluggish nutrient release (Tadesse *et al*., 2013) [22]. In irrigated systems, FYM + inorganic NPK applications lowers bulk density, increased soil organic carbon and hydraulic conductivity, and improved soil structure and microbial communities (Bhattacharya *et al*., 2007) [4].

Material and Method

Impact of different levels of Organic and Inorganic fertilizers on Physico-chemical properties of soil Post cultivation of Okra (*Abelmoschus esculentus* L.) Var. Queen Neha during the Zaid season, trail was conducted at the Central Research Farm, Sam Higginbottom University of Agriculture, Technology and Science, Prayagraj (2021).

Experimental Design and Treatments: A (RBD) was utilized to conduct the study, which included varying levels of FYM and NPK. The plot is 2m x 2m in size.

Table 1: Treatment details

Treatment	Treatment combination
T_1	Absolute control
T_2	@ 0% NPK+50%FYM
T_3	@ 0% NPK+ 100%FYM
T_4	@ 50% NPK+ 0%FYM
T_5	@ 50% NPK+50%FYM
T_6	@ 50% NPK+100%FYM
T_7	@ 100% NPK+0%FYM
T_8	@ 100% NPK+50%FYM
T_9	@ 100% NPK+100%FYM

Urea, SSP, MOP, and FYM were used as NPK sources (0.5 percent N_2, 0.2 percent P_2O_5, and 0.5 percent K_2O). In each plot, a dose of fertilizer was administered according to the treatment allocation, with uniform furrows opened by roughly 5 cm.

Results and Discussion

Table 2: Impact of different levels of Organic and Inorganic fertilizers on Physical properties of soil post-harvest of Okra

Treatment/depth (cm)	D_b (Mg m^{-3})		D_p (Mg m^{-3})		Pore space (%)		Water holding capacity (%)	
	0-15	15-30	0-15	15-30	0-15	15-30	0-15	15-30
T_1	1.281	1.289	2.518	2.526	39.32	32.12	31.57	32.17
T_2	1.284	1.290	2.519	2.528	40.42	34.34	32.18	32.88
T_3	1.287	1.292	2.521	2.529	41.25	36.58	32.12	32.74
T_4	1.289	1.294	2.519	2.531	39.84	33.48	31.89	33.42
T_5	1.291	1.296	2.523	2.535	40.40	37.12	33.22	33.08
T_6	1.295	1.299	2.522	2.536	41.86	40.36	32.19	34.87
T_7	1.297	1.301	2.524	2.538	39.18	37.59	31.22	34.75
T_8	1.301	1.304	2.523	2.537	41.29	36.66	31.62	34.47
T_9	1.303	1.309	2.525	2.539	42.17	37.20	34.52	35.95
F-test	NS	NS	NS	NS	S	S	S	S
S.E+M	-	-	-	-	0.11	0.10	0.08	0.13
C.D.@5%	-	-	-	-	0.69	0.42	0.86	1.06

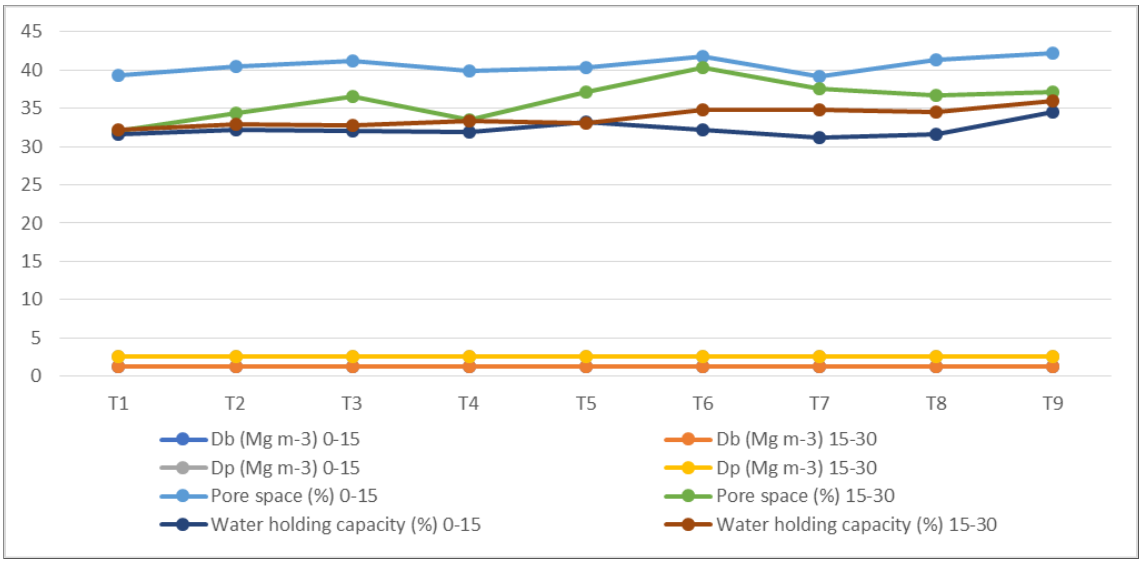

Fig 1: Impact of different levels of Organic and Inorganic fertilizers on Physical properties of soil post-harvest of Okra

D_b: The data presented in the table 2 shows the D_b(Mg m^{-3}) of soil as influenced by application of different levels of Organic and Inorganic fertilizers. The response D_b (Mg m^{-3}) of soil was found to be Non-significant in by application of different levels of Organic and Inorganic fertilizers. The max. D_b (Mg m^{-3}) of soil was recorded (1.303) (1.309) Mg m^{-3}at 0-15 and 15-30cm depth respectively in treatment T_9(100% RDF @ N_{150} P_{80} K_{70} kg ha^{-1} +100% FYM @ 25 t ha^{-1})and min. D_b (Mg m $^{-3}$) of soil was recorded (1.281)(1.289) Mg m^{-33} at 0-15 and 15-30cm depth respectively in treatment T_1(control).

D_p: The data presented in the table 2 shows the D_p (Mg m^{-3}) of soil as influenced by application of different levels of Organic and Inorganic fertilizers. The response D_p (Mg m^{-3}) of soil was found to be Non-significant in by application of different levels of Organic and Inorganic fertilizers. The max. D_p (Mg m^{-3}) of soil was recorded (2.525) (2.539) Mg m^{-3} at 0-15 and 15-30 cm depth respectively in treatment T_9 (100% RDF @ N_{150} P_{80} K_{70} kg ha^{-1} +100% FYM @ 25 t ha^{-1}) and min. D_p (Mg m $^{-3}$) of soil was recorded (2.518) (2.526) Mg m^{-3} at 0-15 and 15-30cm depth respectively in treatment T_1 (control).

Percent Pore Space: The data presented in the table 2 shows the Pore space (%) of soil as influenced by application of different levels of Organic and Inorganic fertilizers. The response Pore space (%) of soil was found to be significant in by application of different levels of Organic and Inorganic fertilizers. The max. Pore space (%) of soil was recorded (42.17) (37.20) % at 0-15 and 15-30 cm depth respectively in treatment T_9 (100% RDF @ N_{150} P_{80} K_{70} kg ha^{-1} +100% FYM @ 25 t ha^{-1}) and min. Pore space (%) of soil was recorded (39.32) (32.12) % at 0-15 and 15-30cm depth respectively in treatment T_1 (control).

Water Holding Capacity (%): The data presented in the table 2 shows the Water Holding Capacity (%) of soil as influenced by application of different levels of Organic and Inorganic fertilizers. The response Water Holding Capacity (%) of soil was found to be significant in by application of different levels of Organic and Inorganic fertilizers. The max. Water Holding Capacity (%) of soil was recorded (34.52) (35.95)% at 0-15 and 15-30 cm depth respectively in treatment T_9 (100% RDF @ N_{150} P_{80} K_{70} kg ha^{-1} +100% FYM @ 25 t ha^{-1}) and min. Water Holding Capacity (%) of soil was recorded (31.57) (32.17)% at 0-15 and 15-30cm depth respectively in treatment T_1 (control).

Table 3: Impact of different levels of Organic and Inorganic fertilizers on Chemical properties of soil post-harvest of Okra

Treatment/depth (cm)	pH		EC (dS m^{-1})		OC (%)	
	0-15	15-30	0-15	15-30	0-15	15-30
T_1	7.24	7.36	0.161	0.141	0.501	0.475
T_2	7.26	7.38	0.173	0.162	0.504	0.478
T_3	7.27	7.37	0.174	0.154	0.508	0.479
T_4	7.28	7.41	0.187	0.158	0.511	0.483
T_5	7.25	7.40	0.194	0.177	0.515	0.485
T_6	7.29	7.38	0.181	0.161	0.518	0.489
T_7	7.31	7.43	0.212	0.184	0.519	0.491
T_8	7.33	7.42	0.221	0.192	0.521	0.494
T_9	7.35	7.45	0.232	0.203	0.523	0.498
F-test	NS	NS	S	S	S	S
S.E+M			0.65	0.76	0.24	0.18
C.D.@5%			1.97	2.54	1.68	1.45

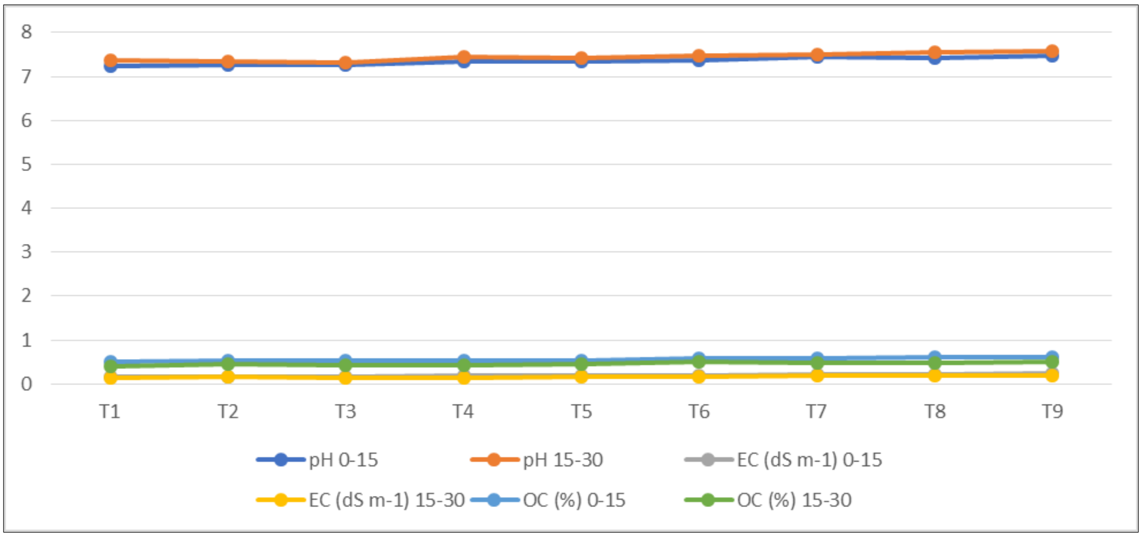

Fig 2: Impact of different levels of Organic and Inorganic fertilizers on Chemical properties of soil post-harvest of Okra.

pH: The data presented in the table 3 shows the pH of soil as influenced by application of different levels of Organic and Inorganic fertilizers. The response pH of soil was found to be Non-significant in by application of different levels of Organic and Inorganic fertilizers. The max. pH of soil was recorded (7.35) (7.45) at 0-15 and 15-30 cm depth respectively in treatment T_9 (100% RDF @ N_{150} P_{80} K_{70} kg ha^{-1} +100% FYM @ 25 t ha^{-1}) and min. pH of soil was recorded (7.24) (7.36) at 0-15 and 15-30cm depth respectively in treatment T_1 (control).

EC (dSm^{-1}): The data presented in the table 3 shows the EC (dSm^{-1}) of soil as influenced by application of different levels of Organic and Inorganic fertilizers. The response EC (dSm^{-1}) of soil was found to be significant in by application of different levels of Organic and Inorganic fertilizers. The max. EC (dSm^{-1}) of soil was recorded (0.232) (0.203) dSm^{-1} at 0-15 and 15-30 cm depth respectively in treatment T_9 (100% RDF @ N_{150} P_{80} K_{70} kg ha^{-1} +100% FYM @ 25 t ha^{-1}) and min. EC (dSm^{-1}) of soil was recorded (0.161) (0.141) dSm^{-1} at 0-15 and 15-30cm depth respectively in treatment T_1 (control).

OC (%): The data presented in the table 3 shows the OC (%) of soil as influenced by application of different levels of Organic and Inorganic fertilizers. The response OC (%) of soil was found to be significant in by application of different levels of Organic and Inorganic fertilizers. The max. OC (%) of soil was recorded (0.523) (0.498)% at 0-15 and 15-30 cm depth respectively in treatment T_9 (100% RDF @ N_{150} P_{80} K_{70} kg ha^{-1} +100% FYM @ 25 t ha^{-1}) and min. OC (%) of soil was recorded (0.501) (0.475)% at 0-15 and 15-30cm depth respectively in treatment T_1 (control).

Table 4: Impact of different levels of Organic and Inorganic fertilizers on Macronutrients on soil post-harvest of Okra

Treatment/depth (cm)	Available Nitrogen (kg ha^{-1})		Available Phosphorus (kg ha^{-1})		Available Potassium (kg ha^{-1})	
	0-15	15-30	0-15	15-30	0-15	15-30
T_1	233.15	163.93	22.14	21.26	189.7	149.3
T_2	236.33	165.54	22.63	21.61	198.6	150.7
T_3	243.35	173.3	22.46	21.53	202	147.3
T_4	249.44	179.6	22.71	21.60	203	151.7
T_5	250.31	176.5	22.75	21.64	205.3	152.3
T_6	258.4	180.5	22.49	21.82	205.6	153.6
T_7	262.2	184.3	23.56	22.63	206.7	155.6
T_8	264.42	182.6	23.48	22.67	208	157.3
T_9	271.3	191.3	23.73	22.54	210.3	157.3
F-test	S	S	S	S	S	S
S.E+M	0.24	0.20	0.12	0.08	0.24	0.18
C.D.@5%	1.68	1.45	0.96	0.64	0.78	0.62

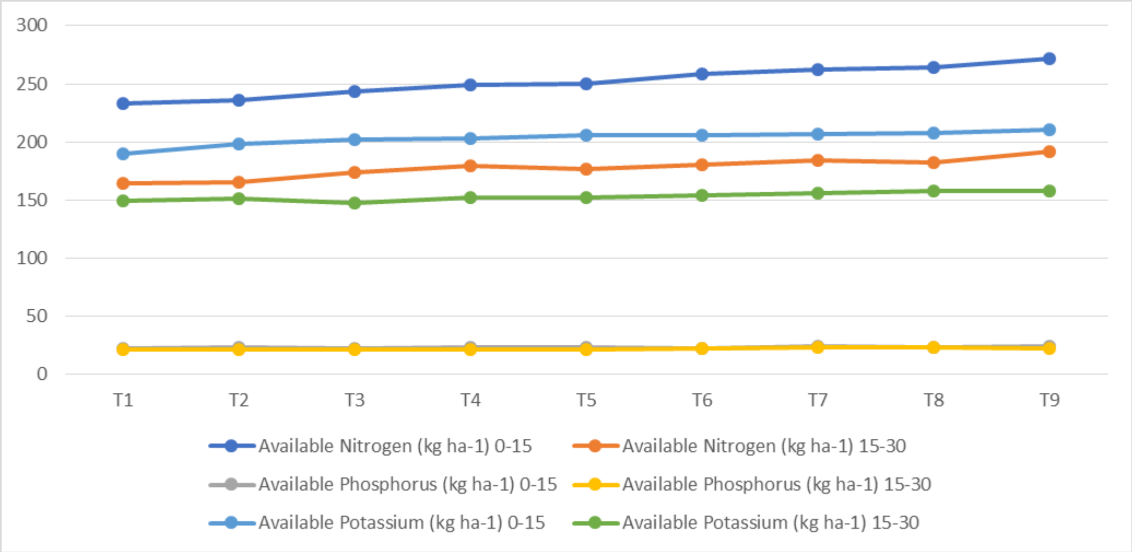

Fig 3: Impact of different levels of Organic and Inorganic fertilizers on Macronutrients on soil post-harvest of Okra

Available Nitrogen (kg ha^{-1}): The data presented in the table 3 shows the Available Nitrogen (kg ha^{-1}) of soil as influenced by application of different levels of Organic and Inorganic fertilizers. The response Available Nitrogen (kg ha^{-1}) of soil was found to be significant in by application of different levels of Organic and Inorganic fertilizers. The max. Available Nitrogen (kg ha^{-1}) of soil was recorded (271.3) (191.3) kg ha^{-1} at 0-15 and 15-30 cm depth respectively in treatment T_9 (100% RDF @ N_{150} P_{80} K_{70} kg ha^{-1} +100% FYM @ 25 t ha^{-1}) and min. Available Nitrogen (kg ha^{-1}) of soil was recorded (233.15) (163.93) kg ha^{-1} at 0-15 and 15-30cm depth respectively in treatment T_1 (control).

Available Phosphorus (kg ha^{-1}): The data presented in the table 3 shows the Available Phosphorus (kg ha^{-1}) of soil as influenced by application of different levels of Organic and Inorganic fertilizers. The response Available Phosphorus (kg ha^{-1}) of soil was found to be significant in by application of different levels of Organic and Inorganic fertilizers. The max. Available Phosphorus (kg ha^{-1}) of soil was recorded (23.73) (22.54) kg ha^{-1} at 0-15 and 15-30 cm depth respectively in treatment T_9 (100% RDF @ N_{150} P_{80} K_{70} kg ha^{-1} +100% FYM @ 25 t ha^{-1}) and min. Available Phosphorus (kg ha^{-1}) of soil was recorded (22.14) (21.26) kg ha^{-1} at 0-15 and 15-30cm depth respectively in treatment T_1 (control).

Available Potassium (kg ha^{-1}): The data presented in the table 3 shows the Available Potassium (kg ha^{-1}) of soil as influenced by application of different levels of Organic and Inorganic fertilizers. The response Available Potassium (kg ha^{-1}) of soil was found to be significant in by application of different levels of Organic and Inorganic fertilizers. The max. Available Potassium (kg ha^{-1}) of soil was recorded (210.3) (157.3) kg ha^{-1} at 0-15 and 15-30 cm depth respectively in treatment T_9 (100% RDF @ N_{150} P_{80} K_{70} kg ha^{-1} +100% FYM @ 25 t ha^{-1}) and min. Available Potassium (kg ha^{-1}) of soil was recorded (189.7) (149.3) kg ha^{-1} at 0-15 and 15-30cm depth respectively in treatment T_1 (control).

Conclusion
The results showed that application of different levels of Organic and Inorganic fertilizers improved the physico-chemical properties of soil after harvest of Cow pea. The best results were obtained from treatment T_9 (100% FYM with 100%NPK). From the above results it can be concluded that application of $N_{150}P_{80}K_{70}$ kg ha^{-1} and FYM 25 t ha^{-1}improved the physico-chemical properties.

References

1. Abou El-Magd MM, El-Bassiony AM, Fawzy ZF. Effect of organic manure with or without chemical fertilizers on growth, yield and quality of some varieties of broccoli plants. Journal of Applied Sciences Research. 2006;2:791-798.
2. Agbede TM, Adekiya AO. Effect of wood ash, poultry manure and NPK fertilizer on soil and leaf nutrient composition, growth and yield of okra (*Abelmoschus esculentus*). Emir. J Food Agric. 2012. 24 (4): 314-321.
3. Akande MO, Oluwatoyinbo FI, Adediran JA, Buari KW, Yusuf IO. Soil amendments affect the release of P from rock phosphate and the development and yield of okra. J of Veg. Crop Production. 2003;9(2):3-9.
4. Bhattacharyya R, Chandra S, Singh R, Kundu S, Srivastva A, Gupta H. Long-term farm yard manure application effects on properties of a silty clay loam soil under irrigated wheat-soybean rotation. Soil Till. Res. 2007;94:386-396.
5. Bhende SK, Deshmukh HK, Nimbolkar PK, Dewangan RK, Nagone AH. Effect of phosphorus and potassium on quality attributes of okra cv. Arka Anamik. Int. J Environ Sci. 2015;6(2):225-231.
6. Bouyoucous GJ. The hydrometer as a new method for the mechanical analysis of soils. Soil Sci. 1927;23:393-395.
7. Chattopadhyay A, Dutta S, Chatterjee S. Seed yield and quality of okra as influenced by sowing dates. African Journal of Biotechnology. 2011;10(28):54615467.
8. Das AK, Prasad B, Singh R. Response of chemical fertilizer and vermicompost on okra (*Abelmoschus esculentus* L.) cv. Prabhanikranti. The Asian J of Horti. 2014;9(2):372-376.
9. FAO. The state of food and agriculture (Food and Agriculture Organization of the United Nations, 2018.
10. Gemede HF, Ratta N, Haki GD, Woldegiorgis AZ, Beyene F. Nutritional quality and health benefits of okra (*Abelmoschus esculentus*): a review. Food Sci. Qual. Manage. 2014;33:87-96.

11. Habtamu FG, Negussie R, Gulelat DH, Ashagrie ZW, Fekadu B. Nutritional quality and health benefits of okra (*Abelmoschus esculentus*). Food Science and Quality Management, 2014, 33. ISSN 2224-6088.
12. Jackson ML. Soil chemical analysis, Second edition Indian Reprint, prentice hall of India, New Delhi, 1958, 498P.
13. Kaur K, Kapoor KK, Gupta AP. Impact of organic manure with and without mineral fertilizers on soil chemical and biological properties under tropical conditions. Journal Nutri. Soil Sci. 2005;168:117-122.
14. Mal B, Mahapatra P, Mohanty S, Mishra HN. Growth and yield parameters of okra (*Abelmoschus esculentus*) influenced by Diazotrophs and chemical fertilizers. Journal of Crop and Weed. 2013;9(2):109-112.
15. Muthuval P, Udayasoorian C, Nateson R, Ramaswami PP. Elucidated the Laboratory manual on soil analysis for physical and chemical characteristic of soil, Introduction to soil analysis. Laser typesetting and offset printing by scroll DP, 68, D. B. Road, R. S. Puram, Coimbatore – 641002, 1992.
16. Naveed A, Khan AA, Khan IA. Generation mean analysis of water stress tolerance in okra (*Abelmoschus esculentus* L.). Pak. J Bot. 2009;41:195-205.
17. NHB. National Horticulture Database – 2017-18. National Horticulture Board Government of India, Gurgaon, India, 2018- 19. www.nhb.gov.in.
18. Olsen SR, Cole CV, Watnahe FS, Dean LA. Estimation of available phosphorus in soils by extraction with sodium bicarbonate U.S. Deptt. Agr.Circ, 1954, 939pp.
19. Rehm G, Schmitt M. Potassium for crop production. Retrieved February 2, 2011, from Regents of the University of Minnesota, 2002.
20. Sathish D, Eswar A. A Review on: *Abelmoschus esculentus* (Okra). Int. Res J Pharm. App Sci. 2013;3(4):129-132.
21. Subbiah BV, Asija GL. a rapid procedure for the estimate of Available nitrogen in soil current sciences. 1956;25:259-260.
22. Tadesse T, Dechassa N, Bayu W, Gebeyehu S. Effects of Farmyard Manure and Inorganic Fertilizer Application on Soil Physico-Chemical Properties and Nutrient Balance in Rain-Fed Lowland Rice Ecosystem. American Journal of Plant Sciences. 2013;4:309-316.
23. Toth SJ, Prince AL. Estimation of Cation Exchange Capacity and exchangeable Ca, K, and Na content of soil by flame photometer technique. Soil Sci. 1949;67:439-445.
24. Uka UN, Chukwuka KS, Iwuagwu M. Relative Effect of Organic and Inorganic Fertilizers on the Growth of Okra [*Abelmoschus esculentus* (L.) Moench]. Journal of Agricultural Sciences. 2013;58(3):159-166.
25. Walkley A, Black IA. Critical examination of rapid method for determining organic carbon in soils, effect of variance in digestion conditions and of inorganic soil constituents. Soil sci, 1947, 632-251.
26. Wilcox LV. Electrical conductivity, Amer Water works Assoc. J. 1950;42:775-776.