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# Effect of different organic sources on soil quality, growth and yield of okra (*Abelmoschus esculentus*)

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ABSTRACT

The present study was carried out during summer season of 2019–20 and 2020–21 at Agricultural Research Station (Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Ratnagiri, Maharashtra), Awashi, Ratnagiri, Maharashtra to investigate the effect of different organic sources on soil quality, growth and yield of okra [*Abelmoschus esculentus* (L.) Moench]. The experiment was laid out in a randomized block design (RBD) having 3 replications with different organic treatments [Control (without organic manure) ($T_1$), 100% recommended dose of nitrogen (RDN) from FYM ($T_2$), 100% RDN from vermicompost ($T_3$), 100% RDN from neem cake powder ($T_4$), 100% RDN from farm compost ($T_5$), 100% RDN from poultry manure ($T_6$), *Jeevamrut* @500 L/ha in three splits at 20, 40, and 60 DAS ($T_7$), and recommended dose of fertilizer (RDF) @100:50:25 N:$P_2O_5$:$K_2O$ kg/ha ($T_8$)]. Konkan Bhendi variety was selected for the study. A maximum okra production was obtained when the prescribed dose (100:50:25 N:$P_2O_5$:$K_2O$ kg/ha) of chemical fertilizer was applied. This treatment was comparable to treatments getting 100% RDN from poultry manure and 100% RDN from neem cake powder. While considering the soil quality, the application of PM and Neem cake powder enhanced the amount of organic matter in the soil and improved the soil's physical and chemical qualities. Poultry manure was observed better source of nutrient management from the perspectives of soil quality, growth, and yield for the production of okra. Production of organic okra contributes greatly to preserving the soil's fertility by enhancing its microbial flora.

**Keywords**: Okra, Organic Sources, Soil quality, Yield

Chemical formulations introduced such as agrochemicals like pesticides in the proper amounts are crucial for food management resources in agriculture to enrich crop quality and meet the world's food demand. On the other side, fertilizers and pesticides have negative effects if utilized in an excessive amount. They have long shelf life in soil and atmosphere and have an impact on a variety of biotic and abiotic variables. Through atmospheric deposition, waste disposal, industrial effluents, and direct application, excessive amounts of agrochemicals, industrial chemicals, trace metals, and urban garbage reaches soil and contaminates it (Chen 2007, Hernadnez 2014, Masindi and Muedi 2018). By preventing the decomposition of SOM and changing nutrient cycling, soil pollution lowers soil health by reducing soil biodiversity and fertility. As a result, it affects agricultural productivity and compromises food safety, particularly when bioconcentrated contaminants infiltrate creatures along the food chain (Edwards 2002).

Organic manures are often made from plants or animals and are good sources of organic matter helps in soil conditioning. Generally organic matter is poor source of nutrients used in large quantities. Despite the fact that manures have a low nutrient content, their application is crucial since it gives a variety of benefits to soil, boosts its health, and functions like soil conditioner. Applying organic manure is essential for a sustainable yield and improving the chemical, physical, and biological qualities of the soil. As a result, using organic sources can help to meet the nutrient needs of a certain crop and maintain the health of the soil (Mathew and Karikari 1995). To reach the nutrient needs of any given crop and maintain the health soil, it is useful to use organic sources (Magdoff 1998). Organic manures (Tisdale *et al.* 1990, Young 1997) also increase the soil's hydraulic conductivity, water retention capacity,

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and rate of water infiltration. Consecutively to boost crop development and output, problematic soils can be improved by applying manures (Akande *et al.* 2003). Poultry manure is abundant in organic matter, which aids in enhancing all properties of soil (Ayeni 2011). Plant height is raised by poultry manure (Aniefiok 2013), however goat manure's application rate boosts okra's growth characteristics, production characteristics, and yield (Awodun 2007). Different plant cakes, or manures of plant origin, aid in boosting crop development and productivity (Frederick 2015). Chemical fertilizers do not maintain soil fertility for an extended time and after repeated usage, soil degradation occurs. Keeping these factors in mind, the current study was carried out to examine the effects of various organic sources on the growth, yield of okra [*Abelmoschus esculentus* (L.) Moench] and soil quality.

## MATERIALS AND METHODS

The present study was carried out during summer season of 2019–20 and 2020–21 at Agricultural Research Station (Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth), Awashi, Ratnagiri, Maharashtra. Treatment includes, Control (without organic manure) ($T_1$); 100% recommended dose of nitrogen (RDN) from FYM ($T_2$); 100% RDN from vermicompost ($T_3$); 100% RDN from neem cake powder ($T_4$); 100% RDN from farm compost ($T_5$); 100% RDN from poultry manure ($T_6$); *Jeevamrut* @500 L/ha in three splits at 20, 40, and 60 days after sowing (DAS) ($T_7$); and recommended dose of fertilizer (RDF) @100: 50: 25 N: $P_2O_5$: $K_2O$ kg/ha ($T_8$). The experiment was laid out in a randomized block design (RBD) with three replications. Urea-N source, SSP-P source, and MOP-K source were the chemical fertilizers used to apply the 100:50:25 N: $P_2O_5$: $K_2O$ kg/ha. The Konkan Bhendi variety was sown with 45 cm × 15 cm spacing on ridges and furrows. The sowing was finished in February during both the year. The detailed chemical composition of various organics used during the experiment is given in Supplementary Table 1.

The representative sample of soil was collected and analysed for initial property. The sample processed to remove the large gravels and stubbles using a wooden mortar and pestle and a 2 mm sieve. The soil of experimental site was lateritic in nature under soil order Alfisol. The region experiences heavy rainfall pre-dominates Fe and Al oxides. Soil has a great ability to fix phosphorus, which results in a low amount of phosphorous availability. Aluminum and manganese toxicity along with deficiency in calcium, magnesium, and potassium were also found in the soil. Standard techniques were used to analyze the chemical characteristics of the soil. The alkaline permanganate (0.32% $KMnO_4$) method was used to estimate available nitrogen (Subbiah and Asija 1965). Because the soil used in the experiment was acidic, Brays No. 1 methodology was applied, utilizing diluted $NH_4F$ for estimating available phosphorus. According to Bray and Kurtz (1945), the quantity of phosphorus in the extract was measured calorimetrically on spectrophotometer at a wavelength of

Table 1 Effect of different sources of organic manure on growth and yield of okra

| Treatment | Plant height (cm) | | | Number of branches | | | Fruit length (cm) | | | Fruit weight (gm) | | | No. of fruits | | | Yield (kg/ha) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2019–20 | 2020–21 | Pooled | 2019–20 | 2020–21 | Pooled | 2019–20 | 2020–21 | Pooled | 2019–20 | 2020–21 | Pooled | 2019–20 | 2020–21 | Pooled | 2019–20 | 2020–21 | Pooled |
| $T_1$ | 57.14 | 53.34 | 55.24 | 1.53 | 2.10 | 1.82 | 10.47 | 8.21 | 9.64 | 6.76 | 5.86 | 6.31 | 7.71 | 6.36 | 7.03 | 6728 | 5536 | 6132 |
| $T_2$ | 68.80 | 63.33 | 66.07 | 2.27 | 2.03 | 2.15 | 13.17 | 8.98 | 11.69 | 8.57 | 7.67 | 8.12 | 11.50 | 10.15 | 10.83 | 13322 | 11535 | 12429 |
| $T_3$ | 67.33 | 67.33 | 67.33 | 2.30 | 2.17 | 2.23 | 10.32 | 8.37 | 9.88 | 6.26 | 5.36 | 5.81 | 11.01 | 9.66 | 10.34 | 9294 | 7669 | 8481 |
| $T_4$ | 79.47 | 73.00 | 76.23 | 1.90 | 2.20 | 2.05 | 11.87 | 8.03 | 9.95 | 9.14 | 8.24 | 8.69 | 15.14 | 13.79 | 14.46 | 19489 | 17249 | 18369 |
| $T_5$ | 65.93 | 63.47 | 64.70 | 2.00 | 2.30 | 2.15 | 9.52 | 7.81 | 8.61 | 8.00 | 7.10 | 7.55 | 9.50 | 8.15 | 8.83 | 10034 | 8532 | 9283 |
| $T_6$ | 79.00 | 72.00 | 75.50 | 2.37 | 2.10 | 2.23 | 11.25 | 9.96 | 10.59 | 10.03 | 9.13 | 9.58 | 13.46 | 12.11 | 12.78 | 18685 | 16595 | 17640 |
| $T_7$ | 69.20 | 67.13 | 68.17 | 2.07 | 2.00 | 2.03 | 10.80 | 9.33 | 9.95 | 7.40 | 6.50 | 6.95 | 14.43 | 12.64 | 13.54 | 14429 | 11704 | 13067 |
| $T_8$ | 84.53 | 81.07 | 82.80 | 2.27 | 2.20 | 2.23 | 13.44 | 8.33 | 10.81 | 10.52 | 9.62 | 10.07 | 15.50 | 13.53 | 14.51 | 22600 | 19419 | 21009 |
| SEM | 3.81 | 3.47 | 3.46 | 0.25 | 0.20 | 0.20 | 0.41 | 0.70 | 0.35 | 0.51 | 0.51 | 0.51 | 1.61 | 1.58 | 1.59 | 2292 | 2031 | 2155 |
| CD ($P$=0.05) | 11.55 | 10.53 | 10.49 | NS | NS | NS | 1.25 | 2.11 | 1.06 | 1.55 | 1.55 | 1.55 | 4.90 | 4.79 | 4.83 | 6952 | 6160 | 6537 |

$T_1$, Control (No organic manure); $T_2$, 100% RDN through FYM; $T_3$, 100% RDN through vermicompost; $T_4$, 100% RDN through neem cake powder; $T_5$, 100% RDN through farm compost; $T_6$, 100% RDN through poultry; $T_7$, *Jeevamrut* @500 L/ha in three splits @20, 40 and 60 DAS; $T_8$, RDF @100: 50: 25 kg N: $P_2O_5$: $K_2O$ kg/ha.

660 nm. With neutral normal ammonium acetate, it was extracted. 1:5 was the soil to extractant ratio. Jackson (1973) description of Flame Photometery was used to ascertain the amount of potassium that was readily available in the extract.

The experiment was commenced in the soil with low electrical conductivity and acidic in reaction. The soil was found high in organic carbon and $K_2O$, low in $P_2O_5$ and medium in available N. According to chemical makeup and nitrogen equivalency, manures were applied. The dose was set at 100: 50: 25 N: $P_2O_5$: $K_2O$ kg/ha. According to accepted statistical practices, all observations were meticulously prepared and the entire experimental data set was statistically analyzed (Panse and Sukhatme 1986). The plant samples were digested in $H_2SO_4$ and made colourless by adding 30% $H_2O_2$ and cooled. The digested material was transferred to a 25 ml volumetric flask and the volume was made with distilled water with repeated washing of digestion flasks and determined the total nitrogen content by using Kjeldhal plus apparatus (Tandon 1993). In case of P and K, 0.5 g of plant sample was digested in diacid which was made by mixing nitric and perchloric acids in 9:4 ratios and the final volume was made to 50 ml with distilled water. Total phosphorus was determined by taking a known quantity of diacid extract of the plant to which $HNO_3$ and vanado-molybdate reagent were added. Further, phosphorus was determined colorimetrically by using spectrophotometer at a wavelength of 420 nm (Chopra and Kanwar 1978).

## RESULTS AND DISCUSSION

*Effect of organic sources of manures on growth and yield*: The biometric and yield attributing characteristics of okra as reflected by various sources of organic manures is given in Table 1. Significant variation was recorded in plant height, fruit length, fruit weight, number of fruits/plant and yield during the experimentation.

Among the different treatments, $T_8$ (RDF @100:50:25 kg NPK kg/ha) observed significantly highest plant height (82.80 cm), which was found at par with $T_6$ (100% RDN through PM) and $T_4$ (100% RDN through neem cake powder). The lowest plant height (55.24 cm) was observed in control ($T_0$) treatment.

In case of fruit length, $T_2$ (100% RDN through FYM) found longest fruit length (11.69 cm), which was at found par with $T_8$ (RDF @100:50:25 kg NPK kg/ha) (10.81 cm) followed by $T_6$ (100% RDN through PM) (10.59 cm). The lowest fruit length was recorded in $T_5$ (100% RDN through Farm compost) which was 8.61 cm. The same trends were observed by Ofosu-Anim *et al.* (2006).

From the data revealed that, $T_8$ (RDF @100:50:25 kg NPK kg/ha) showed statistically significant fruit weight (10.07 g), which was observed to be at par with $T_6$ (100% RDN through PM) (9.58 g) and $T_4$ (100% RDN through neem cake powder) (8.69 g). Lowest fruit weight (5.81 g) observed in $T_3$ (100% RDN through vermicompost). The results were observed as earlier found by Ofosu-Anim *et al.* (2006).

$T_8$ (RDF @100:50:25 NPK kg/ha) recorded statistically highest number of fruits (14.51) which was found at par with all treatments except $T_5$ (100% RDN through farm compost) and $T_1$ (control).

$T_8$ (RDF @100:50:25 NPK kg/ha) recorded maximum okra yield 21,009 kg/ha which was found significant over rest of all treatments except treatments receiving $T_6$ (100% RDN through PM) (17,640 kg/ha) and $T_4$ (100% RDN through neem cake powder) (18,369 kg/ha) which was found at par. The lowest yield recorded in $T_0$ (Control) (6,132 kg/ha).

The increase in growth attributes and yield components resulted from improved soil chemical and physical characteristics under different manure application. Crop responded to the improved conditions under manure, especially poultry manure, with an increased yield. The same results were recorded by Bhangoo *et al.* (1988). The significant increase in total yields in manured plots might also be credited to the increased branching. Similarly, the significant differences in fruit length, fruit weight and number of fruits with manured plots compared to the control because of differences in soil structure and fertility. The increase in the water holding capacity and increased availability of nutrients of soil in manured plots might have provided additional support to the okra crop. The results were reported by Tisdale *et al.* (1985) and Agarwal *et al.* (1981) similar as observed by this research.

*Effect of organic sources of manures on content and uptake of okra crop*: The content and uptake of nutrient at harvest of the crop showed significant variation after application of various organic manures. The pooled analysis of nitrogen content was found to be significantly highest by the application of chemical fertilizer @100: 50: 25 N: $P_2O_5$: $K_2O$ kg/ha ($T_8$) which was found on par with the application of 100% RDN through PM ($T_6$). The application of RDF @100:50:25 N: $P_2O_5$: $K_2O$ kg/ha ($T_8$) showed significantly higher P content in okra fruit which was found on par with $T_4$ (100% RDN through neem cake powder); $T_5$ (100% RDN through farm compost) and $T_6$ (100% RDN through PM). The application of RDF @100: 50: 25 N: $P_2O_5$: $K_2O$ kg/ha ($T_8$) found to be significantly higher K content in okra fruit which was observed on par with the $T_4$ (100 % RDN through neem cake powder); $T_6$ (100% RDN through PM) and $T_7$ (*Jeevamrut* @500 L/ha) in three splits at 20, 40 and 60 DAS (Table 2).

The most highly reactive component in soil is nitrogen which impact growth and the natural cycle. The level of soil organic matter increased dramatically as a result of manure treatment, and the soil's organic matter balance improved. Eghball *et al.* (2002) reported a considerably higher soil organic matter level in plots treated with organics. When compared within manured treatments in the current study, PM provided the greater organic matter content. While addition of the organic manure, it might have provided supplemental exchangeable cations such as potassium, calcium, magnesium and ammonium ($NH_4^+$) in the topsoil. The manuring influenced the soil reaction and bulk density. The soil was slightly acidic but the application of organics decreased the acidity as indicated by the increased *p*H.

Table 2 Effect of different of sources organic manures on nutrient content and uptake of okra

| Treatment | N (%) | | | P (%) | | | K(%) | | | N uptake ( kg/ha) | | | P uptake ( kg/ha) | | | K uptake ( kg/ha) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2019–20 | 2020–21 | Pooled | 2019–20 | 2020–21 | Pooled | 2019–20 | 2020–21 | Pooled | 2019–20 | 2020–21 | Pooled | 2019–20 | 2020–21 | Pooled | 2019–20 | 2020–21 | Pooled |
| $T_1$ | 0.67 | 0.64 | 0.66 | 0.35 | 0.36 | 0.36 | 0.90 | 0.91 | 0.91 | 5.37 | 4.13 | 4.75 | 2.88 | 2.38 | 2.63 | 7.16 | 6.00 | 6.59 |
| $T_2$ | 0.71 | 0.70 | 0.71 | 0.40 | 0.41 | 0.41 | 0.99 | 0.99 | 0.99 | 11.44 | 9.70 | 10.57 | 6.33 | 5.71 | 6.03 | 15.90 | 13.64 | 14.76 |
| $T_3$ | 0.70 | 0.71 | 0.71 | 0.39 | 0.42 | 0.40 | 1.04 | 1.04 | 1.04 | 7.84 | 6.55 | 7.20 | 4.35 | 3.86 | 4.12 | 11.51 | 9.50 | 10.50 |
| $T_4$ | 0.73 | 0.74 | 0.74 | 0.44 | 0.45 | 0.44 | 1.09 | 1.11 | 1.10 | 17.14 | 15.55 | 16.35 | 10.19 | 9.28 | 9.74 | 25.43 | 23.56 | 24.50 |
| $T_5$ | 0.70 | 0.73 | 0.72 | 0.40 | 0.45 | 0.43 | 0.97 | 1.03 | 1.00 | 8.49 | 7.47 | 7.99 | 4.87 | 4.65 | 4.77 | 11.66 | 10.48 | 11.10 |
| $T_6$ | 0.75 | 0.77 | 0.76 | 0.42 | 0.43 | 0.43 | 1.06 | 1.08 | 1.07 | 16.97 | 15.63 | 16.32 | 9.37 | 8.47 | 8.93 | 23.52 | 21.52 | 22.53 |
| $T_7$ | 0.71 | 0.75 | 0.73 | 0.39 | 0.42 | 0.41 | 1.05 | 1.06 | 1.05 | 12.26 | 10.44 | 11.38 | 6.86 | 5.86 | 6.37 | 18.20 | 14.94 | 16.58 |
| $T_8$ | 0.82 | 0.86 | 0.84 | 0.48 | 0.47 | 0.47 | 1.16 | 1.13 | 1.15 | 22.17 | 20.03 | 21.14 | 12.75 | 11.20 | 11.99 | 31.69 | 26.18 | 28.89 |
| SEM± | 0.02 | 0.03 | 0.03 | 0.02 | 0.02 | 0.01 | 0.04 | 0.05 | 0.03 | 2.20 | 2.18 | 2.19 | 1.18 | 1.17 | 1.18 | 3.19 | 2.79 | 2.93 |
| CD (*P*=0.05) | 0.08 | 0.10 | 0.08 | 0.05 | 0.05 | 0.04 | 0.11 | NS | 0.10 | 6.68 | 6.61 | 6.65 | 3.59 | 3.56 | 3.56 | 9.69 | 8.46 | 8.88 |

$T_1$, Control (No organic manure); $T_2$, 100% RDN through FYM; $T_3$, 100% RDN through vermicompost; $T_4$, 100% RDN through neem cake powder; $T_5$, 100% RDN through farm compost; $T_6$, 100% RDN through poultry; $T_7$, *Jeevamrut* @500 L/ha in three splits @20, 40 and 60 DAS; $T_8$, RDF @100: 50: 25 kg N: $P_2O_5$: $K_2O$ kg/ha.

Magdoff (1998) reported that, organic matter is a reservoir of nutrients and exhibits a high CEC and buffers the soil against *p*H changes. Manured soils recorded a significant decrease in bulk density. The decrease in bulk density of the manured soils might be attributed to the increase in OM content of the soil. Young (1997) stated that, the addition of organics lowers bulk density, improves structure and increase a balance between fine and coarse pores. The manuring increases the water holding capacity, infiltration rate and hydraulic conductivity of soil because of the increase in SOM (Cross and Fischbach 1972, Hafez 1974).

On the other hand, the nutrient uptake, the pooled mean of N, P and K uptake was observed significantly higher with the application of 100:50:25 N: $P_2O_5$: $K_2O$ kg/ha through chemical fertilizer which was observed to be on par with the treatment receiving 100% RDN through neem cake powder and 100% RDN through PM.

*Effect of organic sources of manures on properties of the soil*: Data concerning to the physicochemical property of soil under okra crop as affected by various sources of organics is presented in Table 3. The significant variation was recorded in soil reaction but it was not able to affect electrical conductivity and soil organic carbon content.

The experiment lasted for two years, and the results consistently revealed that adding organic sources caused the soil *p*H to rise again. The results reflected that the application of various organic sources showed significant effect on the *p*H of the soil, which was immediately restored by applying 100% RDN through farm compost in $T_5$, which was found to be on par with FYM, vermicompost as well as chemical fertilizer RDF @100:50:25 N: $P_2O_5$: $K_2O$ kg/ha in $T_8$. The electrical conductivity and organic carbon didn't showed any significant result with the application of different organics.

The application of organics significantly influenced the available nitrogen, phosphorus and potassium of soil (Supplementary Table 2). The result revealed that, the $T_4$ receiving 100% RDN through neem cake powder found to be significantly higher in available nitrogen than the other treatments except in the $T_6$ (100% RDN through PM) which was found at par with each other. The available phosphorus and available potassium of soil was significantly influenced by the application of $T_6$ (100% RDN through PM) which was found on par with the FYM, vermicompost and also with the RDF @100: 50: 25 N: $P_2O_5$: $K_2O$ kg/ha through chemical fertilizer.

From the present investigation, it is observed that, recommended dose (100: 50: 25 NPK kg/ha) through inorganic fertilizer recorded maximum okra yield and found at par with treatments receiving 100% RDN through poultry manure and 100% RDN through neem cake powder. Infact, increased soil organic matter by the application of neem cake powder, and poultry manure improved both physical and chemical properties of soil compared with inorganic fertilizer alone. From soil quality, growth and yield point of view, poultry manure was identified as a better source of nutrient management for okra production.

Table 3 Effect of different sources of organic manures on properties of the soil

| Treatment | *p*H | | | EC (dS/m) | | | Organic carbon (g/kg) | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2019–20 | 2020–21 | Pooled | 2019–20 | 2020–21 | Pooled | 2019–20 | 2020–21 | Pooled |
| $T_1$ | 5.80 | 5.69 | 5.75 | 0.10 | 0.11 | 0.10 | 8.1 | 8.2 | 8.2 |
| $T_2$ | 5.90 | 5.89 | 5.89 | 0.10 | 0.12 | 0.11 | 10.3 | 9.9 | 10.1 |
| $T_3$ | 5.90 | 5.94 | 5.95 | 0.12 | 0.12 | 0.12 | 9.6 | 10.9 | 10.3 |
| $T_4$ | 5.80 | 5.78 | 5.78 | 0.12 | 0.11 | 0.12 | 9.5 | 9.9 | 9.7 |
| $T_5$ | 6.00 | 5.97 | 5.99 | 0.12 | 0.11 | 0.12 | 9.5 | 9.5 | 9.5 |
| $T_6$ | 5.70 | 5.83 | 5.75 | 0.14 | 0.12 | 0.13 | 9.3 | 9.4 | 9.4 |
| $T_7$ | 5.80 | 5.88 | 5.84 | 0.12 | 0.12 | 0.12 | 9.3 | 8.7 | 9.0 |
| $T_8$ | 6.00 | 5.86 | 5.92 | 0.13 | 0.12 | 0.12 | 8.9 | 8.8 | 8.9 |
| SEM± | 0.05 | 0.07 | 0.04 | 0.01 | 0.01 | 0.01 | 0.04 | 0.05 | 0.04 |
| CD (*P*=0.05) | 0.15 | NS | 0.13 | NS | NS | NS | NS | NS | 0.12 |

$T_1$, Control (No organic manure); $T_2$, 100% RDN through FYM; $T_3$, 100% RDN through vermicompost; $T_4$, 100% RDN through neem cake powder; $T_5$, 100% RDN through farm compost; $T_6$, 100% RDN through poultry; $T_7$, *Jeevamrut* @500 L/ha in three splits @20, 40 and 60 DAS manure; $T_8$, RDF @100: 50: 25 kg N: $P_2O_5$: $K_2O$ kg/ha.

## REFERENCES


Akande M O, Oluwatoyinbo F I, Adediran J A and Buari K. 2003. Soil amendments affect the release of P from rock phosphate and the development and yield of okra. *Journal of Vegetable Crop Production* **9**(2): 3–9. https://doi.org/10.1300/J068v09n02_02

Aniefiok I A. 2013. Effects of poultry manure and plant spacing on the growth and yield of waterleaf (*Talinum fructicosum* L. Juss). *Journal of Agronomy* **12**(3): 146–52.

Awodun M A. 2007. Effect of goat manure and urea on soil, growth and yield of okra. *International Journal of Agricultural Research* **2**(7): 632–36. https://doi.org/10.3923/ijar.2007.632.636 3

Ayeni L S. 2011. Integrated plant nutrition management: A panacea for sustainable crop production in Nigeria. *International Journal of Soil Sciences* **1**: 19–21.

Bhangoo M S, K S Day, Sudanagunta W R and Petrucci V E. 1988. Application of poultry manure: Influences of Thompson seedless grape production and soil properties. *Horticulture Sciences* **23**(6): 1010–12.

Bray R H and Kurtz L T. 1945. Determination of total, organic, and available forms of phosphorus in soils. *Soil Science* **59**: 39–45.

Chen J. 2007. Rapid urbanization in China: A real challenge to soil protection and food security. *Catena* **69**(1): 1–15.

Chopra S L and Kanwar J S. 1978. Analytical Agricultural Chemistry, pp. 344. Kalyani Publisher, Ludhiana, Punjab.

Cross D E and Fischbach P E. 1972. Water intake rates and a silt loam soil with various manure applications. *American Society of Agricultural Engineering* **16**(2): 282–84

Edwards C A. 2002. Assessing the Effects of environmental pollutants on soil organisms, communities, processes and ecosystems. *European Journal of Soil Biology* **38**: 225–31. https://doi.org/10.1016/S1164-5563(02)01150-0

Eghball B D, Ginting C A, Shapiro J S Schepers and Bauer C J. 2002. Manure As carbon source for soil improvement and crop production: Site-specific application. *(In) Proceedings Great Plains Soil Fertility Conference,* pp. 22–28, 5–6 March 2002. Denver, Colorado.

Frederick E N. 2015. Management of root-knot nematode (*Meloidogyne* spp.) on okra [*Abelmoschus esculentus* (L.) Moench] with aqueous sesame seed extract. *International Journal of Agronomy and Agricultural Research* **6**: 24–31.

Hafez A A R. 1974. Comparative changes in soil physical properties induced by ad-mixtures of manure from various domestic animals. *Soil Science* **118**: 53–59.

Hernandez Soriano M C .2014. *Environmental Risk Assessment of Soil Contamination*. InTech. DOI: 10.5772/57086.

Jackson M L. 1973. Soil Chemical Analysis, pp. 498. Prentice Hall of India Private limited, New Delhi, India

Mathew I P and Karikari S K. 1995. *Horticulture Principles and Practices*, pp. 80–84. Macmillan Education Ltd., London and Basingtroke.

Magdoff F. 1998. Building soils for better crops: Organic matter management, Ohio Agronomy Guide, *Bulletin 672*.

Masindi V and Muedi K L 2018. Environmental contamination by heavy metals. *Heavy Metals*. InTech. DOI: 10.5772/intechopen.76082

Ofosu-Anim J, Blay E T and Frempong M E. 2006. Effects of organic manure on okra [*Abelmoschus esculentus* (L.) Moench] production. *Journal of Applied Horticulture* **8**(2): 155–58.

Panse V G and Sukhatme P V. 1986. *Statistical Methods for Agricultural Workers*. ICAR, New Delhi.

Subbaiah B V and Asija G L. 1956. A rapid procedure for the estimation of available nitrogen in soil. *Current Science* **25**: 259.

Tisdale S L, Nelson W L and Beaton J W. 1990. *Soil Fertility and fertilizers*, pp. 369–655. Macmillan Publishing Company, New York.

Tandon H L S. 1993. Methods of Analysis of Soils, Plants, Water and Fertilizers. Fertiliser Development and Consultation Organisation, New Delhi.

Young A. 1997. *Agroforestry for Soil Management*, pp. 98–100. CAB International Wallingford Oxan OX10 8DE, UK.