www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.03
TPI 2020; 9(11): 213-217

www.thepharmajournal.com
Received: 15-07-2020
Accepted: 30-08-2020

Sukanya Ghosh
Assistant Professor, SOA, Graphic Era Hill University, Dehradun, Uttarakhand, India

Anita Singh
Associate Professor, SOA, Graphic Era Hill University, Dehradun, Uttarakhand, India

Khushbu Kholiya
Assistant Professor, SOA, Graphic Era Hill University, Dehradun, Uttarakhand, India

Deepak Kholiya
Associate Professor, SOA, Graphic Era Hill University, Dehradun, Uttarakhand, India

Jai Paul
Professor, Department of Soil Science, COA, GBPUA&T, Pantnagar, Uttarakhand, India

Shashank Srivastav
Assistant Professor, SOA, Graphic Era Hill University, Dehradun, Uttarakhand, India

Corresponding Author:
Sukanya Ghosh
Assistant Professor, SOA, Graphic Era Hill University, Dehradun, Uttarakhand, India

Effect of integrated nutrient management on okra (*Abelmoschus esculentus*)

Sukanya Ghosh, Anita Singh, Khushbu Kholiya, Deepak Kholiya, Jai Paul and Shashank Srivastav

Abstract
Nutrient supply to crops is the most limiting factor next to water required in irrigation for crop production. Nutrient management by integrating organic sources along with inorganic fertilizers plays an important role in improving and sustaining crop productivity. Chemical fertilizers contribute about 50% to the increase in vegetable and grain production of our country. Successful nutrient management can optimize crop yields, increase profitability and minimizes nutrient losses. Organic fertilizer improves physical and biological activities of soil but they are relatively low in nutrient content, so large quantities are required for optimum plant growth. Continuous use of inorganic fertilizers alone causes soil degradation, pH imbalance and environmental pollution. So the integrated nutrient management system is an alternative system for sustainable and cost effective management of soil fertility and crop productivity without affecting environment. Application of such combined nutrient sources improved okra fruit yield and other yield attributing characters thereby, providing a profitable income for farmers by practicing this kind of nutrient management system.

Keywords: Integrated nutrient management, okra, vermicompost, FYM, *Azotobacter*

Introduction
In the present scenario of healthy eating habit, organic product is one of the most talked about topic in today's agriculture. Moreover, climate variability are becoming a great concern to the farming community with issues like extreme weather conditions, desertification, water stress with resulting adverse health effects. Excessive use of chemical fertilizers to obtain high yield resulted in several hazards to the soil like mining of micronutrients (Kanwar and Randhawa, 1978) [16], under developed plant characters such as root and shoot systems, reproductive parts (Chandini *et al*., 2019) [7] and nutrient imbalance (Singh *et al*., 1989), ultimately resulting in the poor crop yields. Under such circumstances, adoption of organic agriculture can sustain a well established practice as it restricts its boundary to nutrient exploitation, mining and increases soil organic matter content (Babu *et al.*, 2017) [6].
The International Federation of Organic Agriculture Movements (IFOAM) defines organic agriculture as a production system which can sustain the health of soils, ecosystems and people. It relies on ecological processes, biodiversity and cycles adapted to local conditions, rather than the use of expensive sole chemical inputs with adverse effects. Organic agriculture combines tradition, innovation and science to benefit the shared environment and promote fair relationships and a good quality of life for all those entities involved.
Okra is a rich source of iodine and other vital minerals and vitamins. Mucilage present in okra is polysaccharides i.e galacturonic and glucuronic acids (Singh and Ram, 2018) [32]. Additionally, it has medicinal applications when used as a plasma replacement or blood volume expander and also binds cholesterol and bile acid carrying toxins dumped into it by the liver (Gemede *et al*., 2015) [11]. Okra seed is rich in protein and unsaturated fatty acids such as linoleic acid (Gurbuz, 2003) [14]. It is also a very good source of calcium and potassium.
Many attempts have been made already to enhance the productivity without degrading the nutrient status of the soil using biofertilizers along with organic and inorganic nutrient inputs which have resulted in increasing biological nitrogen fixation, increase availability or uptake of nutrients through phosphate solubilization or increase absorption capacity, stimulation of plant growth, yield and yield attributing characters or by rapid decomposition of organic residues etc. An attempt to review is made to show the effect of integrated nutrient management on yield of okra in present years.

Effect of integrated nutrient management on yield of okra

Ghosh *et al*., 2018 [12] carried out an experiment on response of organic and inorganic nutrient sources on growth and yield of okra (*Abelmoschus esculentus*) in red lateritic soil of Purulia at Horticulture Instructional Farm, Krishi Vigyan Kendra Kalyan during *kharif* 2016. The experiment comprised of seven treatments which were replicated thrice. Number of fruits per plant, fruit length (cm), average fruit weight (g), fruit per plant (kg) and yield (t ha^{-1}) were recorded maximum with treatment T3 (50% vermicompost + 50% NPK). This treatment was followed by application of standard dose of NPK application in okra, which produced 17.03 t ha^{-1} yields of okra. Hybrid okra is a quick growing, heavy feeder and also produces a good pod yield. Thus, it needed fast releasing nutrients that were aptly supported by inorganic fertilizers. Easy availability of nutrients from inorganic fertilizers might be the probable cause of more yields. In order of performance, treatments 50% FYM + 50% NPK (chemical fertilizer) and biochar + 50% NPK (chemical fertilizer) provided statistically same yield of 14.64 and 14.45 t ha^{-1}, respectively. Lower yield of okra in *Azotobacter* and Zinc Solubilizing Bacteria might be due to slow releasing of nutrients in both cases.

Arjun *et al.*, 2018 [4] conducted a field experiment during rainy season of 2017 at the Instructional Farm, A.K.S. University, and Satna (M.P.) to study the effect of integrated nutrient management (INM) on growth, yield and quality of okra (*Abelmoschus esculentus* L. Moench). Twelve treatments were evaluated in randomized block design with three replications. Amongst the INM treatments, 100% RDF + 25 kg $FeSO_4$ ha^{-1} recorded maximum fresh and dry weight of plant including pod yield (145.24 q ha^{-1}). The second best treatment was 100% RDF + 25 kg $ZnSO_4$ ha^{-1} (140.88 q ha^{-1} yield). The lowest values of all the parameters were recorded under 10 t leaf mould ha^{-1}. The study clearly indicated that the efficacy of the inorganic fertilizers was pronounced when they were combined with $FeSO_4$ or $ZnSO_4$ micronutrients. Addition of micronutrients might have enhanced the efficacy of the applied N, P_2O_5 and K_2O thereby, helped in improving the soil conditions for better plant growth, balanced C:N ration and thus increased the synthesis of photosynthates which could be the possible reasons for increasing the pod characters. In other treatments the incorporation of organic manure with 50 to 75% RDF might have solubilizing effect on plant nutrients as well as chelating effect on metallic ions resulting in their appropriate availability in terms of timely requirement, improved soil fertility, mineralization of nutrients, enhanced the efficacy of applied N and P; enhanced the activities of microbes and also release of growth stimulants and many more. Perhaps the efficacy of the inorganic fertilizer might have pronounced when these were applied with micronutrients. The favourable effects of Zn and Fe (applied through $ZnSO_4$ and $FeSO_4$) on fruit yield may be ascribed to their involvement in the synthesis of tryptophan a precursor or the growth-promoting substances and also in many metallic enzyme systems. Their effects may be in maintaining an optimum balance of plant nutrition for better growth as well as favourable effect on retention of flowers in okra. The other bio-parameters which could have helped in increase of yield were synthesis of carbohydrates and their translocation to the potential storage organs through better growth and more number of pods per plant (Reddy *et al*., 2001) [25]. Another favourable factor contributing for better pod characters might be the involvement of organic manures (FYM, VC or leaf moulds) which contained fair amount of macro and micronutrients as well as growth promoting substances which induced better plant growth (Srivastava *et al*., 2009 and Salvi *et al.*, 2010) [39, 27]. The higher pod yield might be due to the higher production of dry matter, height of plant, branches and pods per plant. All these factors are very closely related to the crop yield. Increased foliage might have resulted in production of more photosynthates enhancing the yield potential. The treatment consisting of organic manure alone (20 t FYM ha^{-1}, 5 t VC ha^{-1} and 10 t leaf mould ha^{-1}) registered lower pod yield of okra (122.26 to 128.97 q ha^{-1}) indicating that the use of organics alone was insufficient for fulfilling the requirement of total nutrition of the plants.

Singh, 2018 [36] conducted a field experiment during *kharif* season of 2010 to study the effect of INM on growth, yield and quality of okra var. Prabhani Kranti. Application of 10 t FYM, 120 kg each of N and P_2O_5 ha^{-1} were found significantly superior in yield and quality of okra over their respective preceding levels. Addition of 10 t FYM ha^{-1} resulted in maximum green pod yield (78.20 q ha^{-1}). The highest level of N and P_2O_5 (120 kg ha^{-1}) also augmented the above parameter up to the same extent. The higher yield may be due to significant increases in growth parameters under highest nutrient levels which translocated increased photosynthetic towards the reproductive organ (sink) (Varma, 2010 and Singh, 2010) [43, 35].

Sati *et al*., 2018 carried out an investigation to examine the effect of on growth and yield of okra at Vegetable Research Centre of G.B. Pant University of Agriculture and Technology, Pantnagar, Uttarakhand in summer seasons of 2016 and 2017 with fourteen treatments containing different combinations of organic and inorganic sources of nitrogen replicated thrice. The findings of two year investigation revealed that the performance of okra crop was significantly influenced by various treatments. Among all treatments, T_6 (RDN- 75% through neem coated urea + 25% through vermicompost) was found best with respect to plant growth and yield which could be attributed to the neem oil coating and slow nutrient releasing property of neem coated urea which could have thereby reduced the nutrient losses and maintained the availability of nutrients for a longer time that resulted in better growth parameters thus increasing the marketable green pod yield (Perera and Nanthakumaran, 2015) [24].

Sagar and Bala, 2018 [26] conducted i an experiment comprising 7 treatment combination having four organic sources of nutrients *viz*. FYM, NPK, *Azotobacter* and PSB given alone or in combination in a randomized block design with three replications. FYM, *Azotobacter* and phosphate solubilizing bacteria (PSB) was applied as seed treatment before sowing. The treatment (T_5) i.e. NPK(100:50:50 kg ha^{-1}) + PSB (7.5kg ha^{-1}), showed the significant superiority in number of fruit per plant (12.51),length of fresh fruit (21.15 cm), average weight of fresh fruit (13.79 gm), yield of fruit per plant (180.47 gm) and yield of fruit per hectare (132.26 q ha^{-1}). The yield may be increased due to favorable action of bio inoculants that provided nutrients in proportion (Akabani *et al*., 2003 and Zaide and Kaleem, 2008) [2, 44].

Abha *et al*., 2019 [1] conducted a field experiment at Horticultural Research Farm Babasaheb Bhimrao Ambedkar University, Lucknow (U.P.) during *rabi* season of 2018-19 to study the effect of various organic manures on growth and yield of okra [*Abelmoschus esculentus* (L.) Moench]. The maximum fruit length (7.12 cm), fruit weight (11.53 g) and

number of fruits per plant (8.33) and yield (139.03 g) were recorded with treatment 2.5 t VC + 2.5 t poultry manure ha^{-1} and followed by the treatment of FYM @ 10 t ha^{-1} + poultry manure @ 2.5 t ha^{-1} respectively. The higher fruit weight and yield in these treatments might be due to accelerated mobility of photosynthetic from the source to the sink as influenced by the growth hormone, released or synthesized due to the organic sources of fertilizers (Susan, 1995 and Mal *et al*., 2014) [40, 18].

Meena *et al*., 2019 conducted a field experiment was at Horticulture Research Farm-II, Babasaheb Bhimrao Ambedkar University, Lucknow to assess the influence of organic manures and biofertilizers on growth, yield and quality of okra (*Abelmoschus esculentus* L. Moench). Results revealed that the maximum number of fruit per plant (17.63), fruit yield ha^{-1} (19.56 t ha^{-1}), fruit fresh weight (15.53 g) were recorded at harvest with RDF + vermicompost treatment. The minimum values of yield attributes and yield were recorded in control treatment. The reason for increase in yield and yield attributing traits might be solublization effect of plant nutrients by the addition of RDF and vermicompost as evidenced by increase in the uptake of N, P, K, Ca, Mg etc. (Kumar, 2017) [17].

Mishra *et al*., 2020 [21] conducted a field experiment at the instructional farm of Krishi Vigyan Kendra, Jajpur, Odisha during 2016 and studied the effect of integrated nutrient management on disease and pest incidence and yield of okra (*Abelmoschus esculentus* (L.) Moench) variety Pusa A-4. The experiment was laid out in randomized block design (RBD) with three replications and twelve treatments. Maximum number of fruits per plant 15.02 was recorded in T_7 (RDF (75%) + (25%) N through neem oil cake). Fruit yield per hectare varied significantly and was maximum with T_7 (10.49 ton) and was minimum with T_{11} (25% N through FYM + 25% N through vermicompost + 25% N through poultry manure + 25% N through neem oil cake) (7.30 ton). T_7 (10.49 ton) and T_5 (RDF (75%) + (25%) N through vermicompost) (9.85 ton) and T_{10} (RDF (50%) + (25%) N through FYM + (25%) N through neem oil cake) (9.65 ton) were at par with each other. Increase in yield might be due to combined application of inorganic fertilizers and organic fertilizers through neem oil cake proved to be very significant in reducing incidence of disease and pests (Mallick and Lal (1989), Tripathy *et al*., 2009 and Godase and Patel (2001) [19, 41, 13]. Thus, neem cake application, as a whole might have increased allocation of photosynthates in the plant system, which might have resulted in higher number of fruits per plant and fruit weight in okra. The neem cake apart from improving the soil condition, also built up favorable C/N ratio with appreciably higher content of nutrients (Dahama, 2003) [9] and their ready availability due to its slow release for a prolonged period could be possible reasons for influence on green fruit yield in okra.

Singh *et al*., 2020 [31] carried out a field experiment was to investigate the effect of INM on growth, yield and quality of okra (*Abelmoschus esculentus* L. Moench) cv. Kashi Pragati". during August to October 2014 at Vegetable Research Field, Sam Higginbottom University of Agriculture Technology and Sciences, Prayagraj. Different levels and combination of biofertilizers and inorganic manures was applied to assess the vegetative growth, yield and quality characteristics of Okra. There was significant difference among the treatments where maximum yield of fruits was observed in T_{12} (*Azotobactor* + PSB + N100:P50:K50) followed by T_{11} (PSB + N100:P50:K50), while the minimum yield of fruits was observed in T_1 (microbial inoculants 0 + N60:P30:K30). This finding agreed with Tyagi *et al*. (2016) [42] who reported that FYM increased soil fertility and *Azotobactor* increased microbial population in the soil for which yield of fruits (q/ha) improved.

Arunkumar and Rvichandran (2020) [5] studied the effect of integrated nutrient management on growth and yield attributes of bhendi variety Arka Anamika. The highest yield per plot (5.20 kg) in T_9 (FYM (6.25 t/ha) + sheep and goat manure (1.25 t ha^{-1}) + poultry manure (1.25 t ha^{-1}) + vermicompost (1.25 t ha^{-1}) + RDF) followed by T_7 (FYM (12.5 t ha^{-1}) + poultry manure (2.5 t ha^{-1}) + RDF) (4.80 kg). T_{10} (control) recorded the lowest yield of 3.20 kg. The estimated yield per hectare also showed similar trend where T_9 recorded the yield of 5.60 t ha^{-1} followed by T_7 with 5.2 t ha^{-1} and T_{10} registered the lowest yield of 3.60 t ha^{-1}. Organic manure have the ability to supply nutrients and also improve soil fertility by activating soil microbial load and nutrient recycling which led to increased up take of NPK, reduced nutrient losses, improvied fertilizer use efficiency and sustained cropping system (Gruhn *et al*., 2000) [15]. Application of organic manure might have accelerated vigorous growth thus increaseing yield of okra plant. Poultry manure application helped in easy solubilisation of nutrient leading to nutrient availability to plant and high yield (Onwu *et al*., 2014) [23]. Application of sheep and goat manures may improve soil nutrient status, sustainable production of crops and soil chemical properties (Sanni *et al*., 2015) [28]. Vermicompost can improve the quality of soil by enhancing microbial load, it helps in nutrient recycling and production of plant growth regulator.

Akter *et al*., 2020 [3] conducted a field experiment of okra (*Abelmoschus esculentus* (L.) Moench) was in Gazipur under Agro–ecological Zone 28 during *kharif* 2015 to study the effects of tillage depth and nutrient management on growth and yield of okra and to find out the suitable fertilizer dose for maximizing the yield of okra. Irrespective of tillage, a highly significant variation was observed for fruit yield due to different fertilizer management packages. The highest green edible fruit yield (14.96 t ha^{-1}) was recorded from M2 ($N_{125}P_{22.5}K_{61}S_{15}Zn_{2.19}B_{0.75}$ kg ha^{-1} all from chemical fertilizer) where 125% STB fertilizer dose was applied, which was statistically identical to M3 (IPNS based dose) but significantly higher over rest of the treatments. The lowest fruit yield (7.83 t ha^{-1}) was obtained from M4 (native fertility), which was significantly lower than all other treatments. The yield benefit over M4 was 51.7, 91.1 and 87.6% for M1 ($N_{100}P_{18}K_{49}S_{12}Zn_{1.75}B_{0.60}$ kg ha^{-1} all from chemical fertilizer), M2 and M3, respectively. An almost similar trend of results was observed for yield parameters as growth factors. The interaction effect between tillage depth and nutrient management on the fruit yield of okra appeared to be statistically non significant. The beneficial effects of compost in improving physical and chemical properties of soil as well as its growth hormonal activities might have contributed to increase the yield. Naidu *et al*. (2000) [22] reported a significant increase in microbes in soil with application manures. The significantly higher yield of okra due to application of fertilizer may be due to early vegetative growth, earliness in flowering and fruiting as well as individual fruit weight. Higher yield response due to organic manure (compost) is ascribed to improvement in physical and biological properties of soil resulting in better supply of nutrients, which leads to luxuriant crop growth and yield. Despite of up to certain yield benefit, deeper tillage may not

be suitable for crop cultivation over the years because it may erode soils and ruins the physical environments threatening to sustainable agriculture and soil health (Shil *et al*., 2015) [37].

Dutta *et al*., 2020 [10] conducted a field experiment in farmers' field of Karbi, Anglong, Assam in the year 2016-17 and 2017-18 to study the effect of organic sources of inputs on growth, yield and economics of okra (*Abelmoschus esculentus* L.). Results revealed that FYM @ 5 t ha^{-1} + vermicompost @ 1 t ha^{-1} + seed treatment with *Azotobacter* and PSB @ 7.5 g each per 100g + soil application of rock phosphate @ 13k g ha^{-1} (T_3) showed significantly higher values of yield (80.58 q ha^{-1}) than T_4 (control). The increase in yield might have been due to the higher values of various yield attributing parameters namely average fruit weight, average fruit length, average fruit girth, and fruits produced per plant. These in turn might be due to biofertilizer treatment where apart from increasing the availability of nitrogen and phosphorous in soil, the nitrogen fixers and phosphorous solubilizers also increased their translocation from root to flower (Singh and Singh, 2009) [34]. Higher yield in T_3 might also be due to the additive effect of biofertilizers which might have facilitated better soil conditions like improved soil fertility, nitrogen fixation, phosphate solubilization, which ultimately enhanced the activities of other microbes and release of other growth stimulants as well (Choudhary *et al*., 2015) [8].

Conclusion

In conclusion, the findings stated by various authors emphasized the role and importance of an integrated nutrient management system *i.e.* organic and inorganic nutrient sources as a management strategy that can bring increased harvest and sustainability to the okra crop cultivation practice. Organic fertilizers have more benefits in the long run compared to inorganic fertilizer as it improves physical, biological, and chemical properties of a soil. But these nutrients may not be as easily available to the plants for uptake. But application of inorganic fertilizer gives immediate and fast containing necessary nutrients for plant uptake however; excessive use of inorganic fertilizers in agriculture can lead to soil deterioration, soil acidification and environment pollution. The integrated soil nutrient management system is an alternative approach for the sustainable and cost effective management of soil and crop productivity and is characterized by reduced reliance on inorganic fertilizers and combined use of inorganic fertilizers with organic manures which enhance soil properties as well crop yield and economic returns. So, it is an alternative way for sustainable soil fertility and productivity.

References

1. Abha R, Meena ML, Singh R, Mandal RK. Effect of various organic manures on growth and yield of okra [*Abelmoschus esculentus* (L.) Moench]. Journal of Pharmacognosy and Phytochemistry. 2019; 8(6):1203-1205.
2. Akabani WB, Dris R, Togun AO. Influence of compost and nitrogen fertilizer on growth, nutrient uptake and fruit yield of tomato (*Lycopersicon esculentum*). Crop Research. 2003; 26:98-105.
3. Akter M, Shil NC, Ahmad S. Effects of tillage and nutrient management on yield of okra (*Abelmoschus esculentus* (L.) Moench). Thai Journal of Agricultural Science. 2020; 53(2):97-108.
4. Arjun MA, Singh T, Shukla M, Namdeo K. Integrated nutrient management on growth, yield and quality of okra (*Abelmoschus esculentus* L. Moench). Annals of Plant and Soil Research. 2018; 20(4):344-348.
5. Arunkumar K, Ravichandiran D. Effect of integrated nutrient management on growth and yield of bhendi (*Abelmoschus esculentus* L.). The Pharma Innovation Journal. 2020; 9(8):281-284.
6. Babu S, Singh R, Avasthe RK, Yadav GS. Organic farming: Problems and prospects in northeast india. training manual on integrated farming system approaches for sustainable hill agriculture under changing climatic scenario, Joint Director ICAR Research Complex for NEH Region, Tripura Centre, Lembucherra, 2017, 67-77.
7. Chandini R, Kumar R, Kumar PO. Research Trends in Environmental Sciences. Akinik Publications, New Delhi, 2019; II(1):69-86.
8. Choudhary K, More SJ, Bhanderi DR. Impact of biofertilizers and chemical fertilizers on growth and yield of okra (*Abelmoschus esculentus* L.). The Ecoscan. 2015; 9(1-2):67-70.
9. Dahama AK. Organic farming for sustainable agriculture. *Agrobios* (India), Jodhpur, India, 2003.
10. Dutta S, Kalita N, Maibangsa S. Effect of organic source of nutrients in growth and yield parameters of Okra (*Abelmoschus esculentus* L.) in Karbi Anglong district of Assam. International Journal of Chemical Studies. 2020; 8(5):1910-1913.
11. Gemede HF, Ratte N, Hakki GD, Woldegiorgis AZ, Beyene F. Nutritional quality and health benefits of okra (*Abelmoschus esculentus*): A Review. Journal of Food Processing and Technology. 2015; 6(6):1-6.
12. Ghosh C, Biswas P, Mahato S, Rana DK, Mahato B. Effect of integrated nutrient management on growth and yield of okra (*Abelmoschus esculentus*) in red lateritic soil of Purulia, West Bengal. SATSA Mukhaptra Annual Technical Issue. 2018; 22:96-102.
13. Godase SK, Patel CB. Studies on the influence of organic manures and fertilizer doses on the intensity of sucking pests (*Amrasca biguttula biguttula* (Ishida) and Aphid (*Aphis gossypii* Glover) infesting brinjal. Plant Protection Bulletin. 2001; 53:10-12.
14. Gurbuz I, Ustun O, Yesilada E, Sezik E, Kutsal O. Antiulcerogenic activity of some plants used as folk remedy in Turkey. The Journal of Ethnopharmacology. 2003; 88:93-97.
15. Gruhn P, Goletti F, Montague Y. Integrated nutrient management, soil fertility and sustainable agriculture: Current issues and future challenges. Food, Agriculture, and the Environment Discussion, 2000, 32p.
16. Kanwar JS, Randhawa NS. Micronutrient research in soils and plants in India: A review. ICAR Technical Bulletin. 1978; 50:1-60.
17. Kumar V, Saikia J, Barik N. Influence of organic, inorganic and biofertilizers on growth, yield, quality, and economics of okra [*Abelmoschus esculentus* (L). Moench] under Assam condition. International Journal of Current Microbiology and Applied Sciences. 2017; 6(12):2565-2569.
18. 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
19. Mallick SN, Lal IB. Efficiency of neem oil cake and fertilizer mixture against okra fruit borer. Pestology.

1989; 13:6-7.
20. Meena DC, Meena ML, Kumar S. Influence of organic manures and biofertilizers on growth, yield and quality of okra (*Abelmoschus esculentus* L. Moench). Annals of Plant and Soil Research. 2019; 21(2):130-134.
21. Mishra B, Sahu GS, Tripathy P, Mohanty S, Pradhan B. Effect of integrated nutrient management on disease and pest incidence and yield of okra (*Abelmoschus esculentus* (L.) Moench). International Journal of Chemical Studies. 2020; 8(3):2117-2121.
22. Naidu AK, Kushwah SS, Dwivedi YC. Performance of organic manures, bio and chemical fertilizers and their combinations on microbial population of soil, growth and yield of okra. JNKVV Research Journal. 2000; 33:34-38.
23. Onwu AC, Abubakar JR, Unah PO. Effect of poultry manure on growth, yield of Okra and soil properties in Makurdi, North Central Nigeria. International Journal of Agricultural and Food Science. 2014; 4(1):9-12.
24. Perera KIM, Nanthakumaran A. Technical feasibility and effectiveness of vermicomposting at household level. Tropical Plant Research. 2015; 21:51-57.
25. Reddy VC, Yogannada SB, Mallikarjun SS, Chandrakumar BT, Ravindrababu ST, Raghavendra KK. Influence of urban compost and sewage sludge on growth and yield of bhendi. South Indian Horticulture. 2001; 49:151-154.
26. Sagar V. Effect of integrated nutrient management on growth and quality characters of okra (*Abelmoschus esculentus* (L.) Moench cultivar Kashi Mohini (VRO-3). Chemical Science Review and Letters. 2018; 7(28):1005-1011.
27. Salvi VG, Shinde M, Dhane SS, Sawant P. Effect of integrated nutrient management on yield and quality of okra grown on lateritic soils of Konkon. Journal of Maharashtra Agricultural Universities. 2010; 35(3):466-469.
28. Sanni KO, Adenubi OO. Influence of goat and pig manure on growth nd yield potential of okra (*Abelmoschus esculentus* L. Moench) in Ikorodu AgroEcological Zone of Nigeria. World Rural Observations. 2015; 7(4):1-6.
29. Sati UC, Raghav M, Singh DK, Singh S, Singh DK, Singh DK. Integrated nitrogen management in okra under *Tarai* conditions of Uttarakhand. International Journal of Chemical Studies. 2018; 6(1):1118-1122.
30. Singh D, Leelawathi CR, Surup S. Responses of crops to micronutrients fertilization. Indian Agricultural Statistical Research Institute, New Delhi. Research Bulletin. 1989; 1:1-36.
31. Singh A, Prasad VM, Srivastva R, Bahadur V. Effect of integrated nutrient management on growth, yield and quality of okra (*Abelmoschus esculentus* L. Moench) cv. Kashi Pragati. Journal of Pharmacognosy and Phytochemistry. 2020; 9(2):1978-1984.
32. Singh S, Ram RB. Effect of organic, inorganic and biofertilizers on biochemical aspects of Kashi Pragati a standard cultivar of okra (*Abelmoschus esculentus* L.). Journal of Entomology and Zoology Studies. 2018; 6(4):262-264.
33. Singh AP, Sakal R, Sinha RB. Effect of changing cropping pattern and fertility levels on crop yields and micronutrient status of soil after five cycles of crop rotation. Annals of Agril. Res. 1989; 10(4):361-367.
34. Singh A, Singh JN. Effect of biofertilizers and bio regulators on growth, yield and nutrient status of strawberry cv. Sweet Charlie. Indian Journal of Horticulture. 2009; 66(2):220-224.
35. Singh SP. Effect of nitrogen, phosphorus and FYM levels on growth and yield attributes in okra [*Abelmoschus esculentus* (L.) Moench]. Progressive Agriculture. 2010; 6(1):15-20.
36. Singh H, Yadav RR, Singh RP, Bareliya PK, Bharti AK, Kumar P. Influence of integrated nutrient management on growth, yield and quality of okra (*Abelmoschus esculentus* (L.) Moench). Plant Archives. 2018; 18(1):1144-1146.
37. Shil NC, Rahman MA, Mondol ATMAI, Alam MJ, Begum RA. Effects of tillage methods and residue management on soil properties and yield of potato–maize–T. aman rice cropping pattern, pp. 9–17. *In*: Annual Research Report 2014–2015. Division of Soil Science, Bangladesh, 2015.
38. Agricultural Research Institute, Gazipur, Bangladesh.
39. Srivastava BK, Singh MP, Singh S, Shrivastava S, Shahi UP. Effect of integrated nutrient management on the performance of the crop under brinjal-pea-okra cropping system. Indian Journal of Agricultural Sciences. 2009; 79(2):91-93.
40. Susan SC. Effect of organics and inorganics and biofertilizers on growth, yield and quality of onion. Thesis, M. Sc. (Horti.). Tamil Nadu Agricultural University, Coimbatore, 1995, 89p.
41. Tripathy P, Maity TK, Patnaik HP. Fruit constituents of okra cultivars and the incidence of *Earias vitella* (FAB) as influenced by the integrated nutrient management system. SAARC Journal of Agriculture. 2009; 7(2):82-90.
42. Tyagi SK, Shukla A, Mittoliya VK, Sharma ML, Khire AR, Jain YK. Effect of integrated nutrient management on growth, yield and economics of okra (*Abelmoschus esculentus* (L). Moench) under Nimar valley conditions of Madhya Pradesh. International Journal of Tropical Agriculture. 2016; 34(2):415-419.
43. Varma VC. Effect of nitrogen and phosphorus potassium and farmyard manure on seed production of okra [*Abelmoschus esculentus* (L.) Moench]. Progressive Agriculture. 2010; 6(2):130-133.
44. Zaide KK, Kaleem M. Growth, yield and economics of wheat (*Triticum aestivum*) as influenced by biofertilizers with nitrogen levels. International Journal of Agricultural Sciences. 2008; 4(2):475-476.