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Influence of Integrated Nutrient Management on Nutrient Content (N, P, and K) and Nutrient Uptake (N, P, and K) of Okra (*Abelmoschus esculentus* (L.) Moench) cv Arka Anamika

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ABSTRACT

The current investigation, designated "Influence of integrated nutrient management on nutrient content (N, P, and K) and nutrient uptake (N, P, and K) of okra (*Abelmoschus esculentus* (L.) Moench) cv Arka Anamika" took place from July to November 2019 at the College of Horticulture, Rajendranagar, Sri Konda Laxman Telangana State Horticultural University. The trial was employed in Randomized Block Design, with ten treatments replicated three times. The investigation revealed that the administration of 75% RDF + 12.5% RDN through FYM + 12.5% RDN through vermicompost + *Azotobacter* + Phosphorus solubilizing bacteria (PSB) i.e. T_7 substantially boosted the quantities of N, P, and K content in the bhindi pod (2.41, 0.67, and 1.9% correspondingly) and the plant (1.9, 0.24, and 1.3% accordingly). Furthermore, treatment T_7 displayed substantially greater overall uptakes of N (63.41 kg/ha), P_2O_5 (11.38 kg/ha), and K_2O (44.92 kg/ha) in comparison with the remaining treatments.

Keywords Okra, INM, Uptake, RDF, Nutrient content, NPK.

INTRODUCTION

Bhindi (*Abelmoschus esculentus* (L.) Moench) is a popular vegetable crop in the nation of India, frequently referred to as lady's finger (Muthaiah *et al.* 2023). It possesses a diploid chromosomal count of 2n=130 and is native to tropical and subtropical Africa (Rao *et al.* 2019). This plant is renowned for its delicious fruits (Singh *et al.* 2014). Okra, which is a member of the Malvaceae family, constitutes one of the most noteworthy *kharif* and summertime vegetable crops (Kotikal *et al.* 2017). It provides an ideal amount of carbohydrates, fibers, vitamins, and protein (Adeboye and Oputa 1996).

India represents the globe's highest producer of okra, covering 0.51 m ha and generating a total of 6.2 million tonnes annually with an average productivity of 12.15 metric tonnes per hectare (as per NHB, 2018-19). West Bengal, Telangana, Bihar, Orissa, Andhra Pradesh, Gujarat, Tamil Nadu Jharkhand, and Karnataka are the main areas of okra production regions

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(Neeraja *et al.* 2022). It covers a total of 12,167 ha in Telangana and has a yearly output of 1,67,256 metric tonnes with a productivity of 13.74 metric tonnes/ha (Telangana State Horticulture Department 2017-18).

Fertilizer application is essential for raising the production of food to meet the appetites of the world's growing population (Panhwar *et al.* 2019). The degree to which fertilizers are used nevertheless fluctuates greatly around the nation. Yet, employing appropriate fertilizers implies a positive impact on plant growth and soil physico-chemical qualities (Laekemariam *et al.* 2016). The sparse application of chemical and organic fertilizers, along with the loss of nutrients chiefly via runoff and leaching, severely restrict the soil's nutrient status (Li *et al.* 2021). A lot of small-scale farmers lack access to chemical fertilizers owing to hefty fertilizer costs, an absence of financing, poor shipping, and other socio-economic problems (Adolph *et al.* 2002). As a result, yields from agriculture remain poor, and in several regions, reducing, placing the existing farming system's viability in danger.

Regularly administration of large amounts of synthetic fertilizers despite natural manures or biofertilizers has culminated in degradation of the soil's condition concerning chemical and physical characteristics, a reduction in soil microbial activity, a decline in soil humus, and greater contamination of soil, water, and air (Aulakh and Ravisankar 2017). The contemporary nutrient administration strategy has turned its attention to the idea of long-term viability and environmentally friendly practices. The combined administration of diverse soil fertility enrichment sources efforts to mitigate the issue of inadequate nutrients while also enhancing their availability (McLennon *et al.* 2021). Several studies have demonstrated how integrated nutrient management and the inclusion of biofertilizers may increase nutrient uptake, particularly for nitrogen. INM enhances macronutrient (NPK) and micronutrient molecule uptake. Furthermore, it may meet plant needs for nutrients and resolve the difficulties associated with nutrient insufficiency without having any adverse effects on the environment or the things we create (Selim and Owied 2017).

By observing the above aspects the present investigation was carried out to demonstrate the effect of integrated nutrient management on the content and uptake of N, P, and K by the okra plant.

MATERIALS AND METHODS

The present research, named "The impact of integrated nutrient management on nutrient content and nutrient uptake of bhindi (*Abelmoschus esculentus* (L.) Moench) cv Arka Anamika," has been carried out from July to November 2019 at the experimental site at PG Students Investigation Farm, COH, R nagar, Hyderabad, and this can be found in the subtropical zone at a latitude of 17^{o}191 N, longitude 79^{o}231 E, altitude 542.3 m above mean sea level. The treatments include T_1-Control (no use of fertilizers), T_2 -100% Recommended dose of fertilizers, T_3 -75% RDF + 25% RDN through FYM + Azotobacter + Phosphorus solubilizing bacteria (PSB), T_4 -50% RDF + 50% RDN through FYM, T_5 -75% RDF + 25% RDN through vermicompost + Azotobacter + Phosphorus solubilizing bacteria (PSB), T_6 -50% RDF + 50% RDN through vermicompost, T_7 -75% RDF + 12.5% RDN through FYM + 12.5% RDN through vermicompost + Azotobacter + Phosphorus solubilizing bacteria (PSB), T_8 -50% RDF + 25% RDN through FYM + 25% RDN through vermicompost + Azotobacter + Phosphorus solubilizing bacteria (PSB), T_9 -100% RDN through FYM and T_{10} -100% RDN through vermicompost.

Attributes to be noted

(i) Nutrient content in Bhindi pod as well as plant

The N, P, and K contents of bhindi pods as well as the whole plant (excluding pod) have been determined. Table 1 shows the method that was used to assess the above nutrient contents.

(ii) Nutrient uptake by a bhindi pod as well as plant

Uptake of macronutrients (kg/ha) viz., N, P, and K (kg/ha) by bhindi pod as well as the entire plant were calculated by utilizing the following formula.

$$\text{Uptake (kg/ha)} = \frac{\text{Dry matter yield (kg/ha) X Nutrient content (\%)}}{100}$$

Table 1. Techniques used in the chemical assessment of N, P, and K in plants and fruits.

Sl. No.	Nutrient	Method utilized	Reference
1	Total 'N'	Digestion (wet), Di-acid mixture, 1:4 (H_2SO_4 : $HClO_4$), Micro Kjeldahl	Jackson (1973)
2	Total 'P'	Digestion (wet), Di-acid mixture, 4:10 ($HClO_4$: HNO_3), Vanadomolybdo phosphoric acid yellow color	Jackson (1973)
3	Total 'K'	Digestion (wet), Di-acid mixture, 4:10 ($HClO_4$: HNO_3), Flamephotometric	Jackson (1973)

Total uptake of nutrients

The entire uptake of macronutrients (kg/ha) by okra was computed easily by employing a simple method given below Total uptake of nutrient (kg/ha) = Nutrient uptake by bhindi pod + Nutrient uptake by bhindi plant.

RESULTS AND DISCUSSION

Nitrogen content in the pod as well as the plant (%)

Results demonstrated (Table 2) that treatments T_7 and T_5 had increased nitrogen levels in the pod and plant (2.41% and 1.99%, correspondingly). The treatment T_1 control (no fertilizer application) had a low nitrogen content in the pod and plant (1.77% and 1.09%, respectively).

Table 2. Effect of integrated nutrient management on nutrient content (%) in pod as well as plant.

Treatments	Nutrient content in pod (%)			Nutrient content in plant (%)		
	N%	P%	K%	N%	P%	K%
T_1	1.77	0.47	1.19	1.09	0.10	0.08
T_2	2.36	0.64	1.85	1.93	0.23	1.28
T_3	2.26	0.59	1.76	1.86	0.21	1.25
T_4	2.01	0.51	1.53	1.58	0.15	1.18
T_5	2.30	0.62	1.79	1.92	0.22	1.27
T_6	2.08	0.55	1.59	1.70	0.18	1.21
T_7	2.41	0.67	1.90	1.99	0.24	1.30
T_8	2.21	0.57	1.68	1.78	0.19	1.24
T_9	1.85	0.47	1.48	1.43	0.12	1.06
T_{10}	1.90	0.49	1.49	1.50	0.13	1.11
SEm ±	0.05	0.02	0.03	0.04	0.00	0.02
CD at 5%	0.14	0.05	0.10	0.11	0.01	0.07

Phosphorus (P) content in the bhindi pod as well as plant (%)

The findings indicated that (Table 2) the treatments T_7 and T_5 had increased phosphorus content in the bhindi pod and plant (0.67% and 0.24%, correspondingly). The treatment T_1 control (no fertilizer application) had the smallest phosphorus level in the bhindi pod and plant (0.47% and 0.10%, respectively).

Potassium (K) content in the okra pod as well as plant (%)

Findings revealed (Table 2) that treatment T_7 exhibited higher potassium levels in the pod and plant (1.90% and 1.30%, respectively), which was comparable to treatment T_2. Treatment T_1 control (no fertilizer application) reported the lowest levels of potassium in pod and plant (1.19% and 0.08%, respectively).

Uptake of N, P, and K by a pod as well as plant and total nutrient uptake

Nitrogen uptake (kg/ha)

Treatment T_7 exhibited the greatest mean of N uptake (23.82 kg/ha) by okra pod as well as okra plant (39.57 kg/ha), which was close to treatment T_2. While treatment T_1 (no fertilizer administration) achieved the least N uptake (11.03 kg/ha) by pod and by okra plant (10.99 kg/ha). Treatment T_7 had a higher average value for total nitrogen uptake (63.41 kg/ha), which was comparable to treatment T_2 (61.17 kg/ha). Treatment T_1 had the least total N uptake (22.02 kg/ha) by the okra plant (Table 3).

Phosphorus (P) uptake (kg/ha)

The present data exhibited that T_7 noted significantly higher uptake of P (6.62 kg/ha) by bhindi pod and was at par with T_2 (6.44 kg/ha) followed by T_5 (6.0 kg/ha), T_3 (5.63 kg/ha) and T_8 (5.24 kg/ha). The comparatively least uptake of P (2.71 kg/ha) by okra pod was recorded under the T_1. Regarding P uptake by

Table 3. Effect of integrated nutrient management on nitrogen uptake (kg/ha) by pod, plant, and total nitrogen uptake.

Treatments	Nitrogen uptake by pod (kg/ha)	Nitrogen uptake by the plant (kg/ha)	Total nitrogen uptake (kg/ha)
T_1	11.03	10.99	22.02
T_2	23.05	38.11	61.17
T_3	21.67	33.47	55.15
T_4	17.51	24.70	42.24
T_5	22.40	37.74	60.15
T_6	18.69	27.36	46.06
T_7	23.82	39.57	63.41
T_8	20.32	29.53	49.85
T_9	14.69	18.87	33.55
T_{10}	15.47	22.34	37.81
SEm ±	0.41	0.73	1.04
CD at 5%	1.22	2.16	3.10

the bhindi plant, T_7 recorded substantially the highest uptake of P (4.76 kg/ha) by the okra plant followed by treatment T_2 (4.5 kg/ha), T_5 (4.29 kg/ha), T_3 (3.75 kg/ha) and T_8 (3.13 kg/ha). A relatively low uptake of P (1.0 kg/ha) by the plant was registered under treatment T_1 (no use of fertilizers). A substantially larger total P uptake (11.38 kg/ha) by the plant was noticed in T_7 and was on par with treatment T_2 (10.96 kg/ha), followed by treatments T_5 (10.31 kg/ha), T_3 (9.38 kg/ha), and T_8 (8.36 kg/ha). Treatment T_1 showed the least total P uptake (3.71 kg/ha).

Potassium (K) uptake (kg/ha)

The elucidated data showed that treatment T_7 noticed significantly higher uptake of K by bhindi pod, plant, and total uptake (18.87, 26.07, and 44.92 kg/ha), respectively, and found to be best of all the 10 treatments under investigation. Relatively lower uptake of K by pod, plant, and total uptake (7.37, 8.06, and 15.44 kg/ha), respectively were registered under the treatment T_1.

The mixed impact of both inorganic and organic sources assisted in getting rapidly mineralized into usable form and enhanced the activity of microbes, causing a rise in nutrient uptake. The administration of chemical fertilizers together with natural manure promoted nutrient uptake by the okra plants during harvest. The generation of organic acids could improve the accessibility of nutrients in the integrated nutrient management system. Organic acids like these could impact the pH of the soil, raising the availability of nutrients, which results in enhanced nutrient uptake by the plants of okra at harvest. In general, the lowest values in total nutrient uptake were observed in treatment T_1 (Absolute control), which received no organic or inorganic fertilizer dose. The findings revealed that plant biomass and fruit output pushed the total nutrient intake pattern. Furthermore, it might be because of appropriate nutrition availability for greater growth, leading to improved uptake levels (Abusaleha 1992).

Overall, the results obtained coincided with the findings of Prabhu *et al.* (2002), Singh *et al.* (2004), Dademal and Dongale (2004), Phonglosa *et al.* (2015), and Salvi *et al.* (2015) in Bhindi.

CONCLUSION

The higher percentage of N in the pod (2.41%) and plant (1.99%), P_2O_5 in the pod (0.67%) and in the plant (0.24%), and K_2O in the pod (1.90%) and in the plant (1.30%) were found in treatment T_7. Different INM treatments exhibited a substantial impact on the levels of N, P_2O_5, and K_2O content in the pod and plant. The treatment with 75% RDF + 12.5% RDN through FYM + 12.5% RDN through vermicompost + *Azotobacter* + Phosphorus solubilizing bacteria (PSB) showed a significant rise in total nutrient uptake values of N (63.41 kg/ha), P_2O_5 (11.38 kg/ha), and K_2O (44.92 kg/ha) by okra plant.

REFERENCES

Abusaleha (1992) Effect of different sources and forms of nitrogen on the uptake of major nutrients in okra. *Ind J Hortic* 49 (2): 192-196.

Adeboye OC, Oputa CO (1996) Effects of galex on growth and fruit nutrient composition of okra (*Abelmoschus esculentus* (L.) Moench). *Life J Agric* 18 (2): 1-9.

Adolph B, Butterworth J, Satheesh PV, Reddy S, Reddy GNS, Karoshi V, Indira M (2002) Soil fertility management in semi-arid India: Its role in agricultural systems and the livelihoods of poor people. Natural Resources. Institute UK.

Aulakh CS, Ravisankar N (2017) Organic farming in Indian context: A perspective. Agricult Res J 54 (2) : 149. https://doi.org/10.5958/2395-146x.2017.00031.x

Dademal AA, Dongale JH (2004) Effect of manures and fertilizers on growth and yield of okra and nutrient availability in lateric soil of Kokan. J Soils Crops 14 (2): 262-268.

Jackson ML (1973) Soil Chemical Analysis, Prentice-Hall of India. Pvt Ltd, New Delhi.

Kotikal YK, Shashank PR, Patil S, Allolli TB (2017) Diversity of noctuid moths associated with major vegetable crops in Karnataka. *J Entomol Res* 41(2): 187- 192. https://doi.org/10.5958/0974-4576.2017.00030.5

Laekemariam F, Kibret K, Mamo T, Karltun E, Gebrekidan H (2016) Physiographic characteristics of agricultural lands and farmers' soil fertility management practices in Wolaita zone, Southern Ethiopia. *Environm Syst Res* 5(1): 1-15. https://doi.org/10.1186/s40068-016-0076-z

Li C, Wang X, Qin M (2021) Spatial variability of soil nutrients in seasonal rivers: A case study from the Guo River Basin, China. *Plos One* 16(3): e0248655. https://doi.org/10.1371/journal.pone.0248655

McLennon E, Dari B, Jha G, Sihi D, Kankarla V (2021) Regenerative agriculture and integrative permaculture for sustainable and technology driven global food production and security. Agron J 113(6): 4541-4559. https://doi.org/10.1002/agj2.20814

Muthaiah G, Elangovan D, Mottaiyan P, Ravishankar KV (2023) Comprehensive transcriptome analysis in okra (*Abelmoschus esculentus* L. Moench): Analysis of LncRNA and transcription factors involved in abiotic stress. *Russian J Pl Physiol* 70(3): 47.

National Horticulture Board (2018-2019) Indian Horticulture Database, Ministry of agriculture and farmers welfare, Government of India, Gurgaon, Haryana.

Neeraja S, Srinivas J, Joshi V, Nikhil BSK, Sathish G (2022) Correlation and path analysis studies in okra (*Abelmoschus esculentus* L.) genotypes. *Biolo Forum – An Int J* 14(4): 1097-1106.

Panhwar QA, Ali A, Naher UA, Memon MY (2019) Fertilizer management strategies for enhancing nutrient use efficiency and sustainable wheat production. In Organic Farming, pp 17-39. Woodhead Publishing. https://doi.org/10.1016/b978-0-12-813272-2.00002-1

Phonglosa A, Bhattacharyya K, Ray K, Mandal J, Pari A, Banerjee H, Chattopadhyay A (2015) Integrated nutrient management for okra in an inceptisol of Eastern India and yield modeling through artificial neural network. *Scientia Horticulturae* 187 (5-13): 1-9. https://doi.org/10.1016/j.scienta.2015.02.037

Prabhu T, Narwadkar PR, Sajindranath AK, Bhore MR (2002) Effect of integrated nutrient management on yield and quality of okra (*Alelmoschus esculentus* (L.) Moench) cv. Parbhani Kranti. *Gujarat J Appl Hortic* 2 (2): 28-33.

Rao SR, Nongsiang RH, Devi MK (2019) Okra-an important vegetable crop of India.

Salvi VG, Minal SS, Bhure MH, Khanvilkar (2015) Effect of integrated nutrient management on soil fertility and yield of okra in coastal region of Maharashtra, *Asian J Soil Sci* 10 (2): 201-209. https://doi.org/10.15740/has/ajss/10.2/201-209

Selim MM, Owied AJA (2017) Genotypic responses of pearl millet to integrated nutrient management. Biosci Res 14(2):156–169.

Singh P, Chauhan V, Tiwari BK, Chauhan SS, Simon S, Bilal S, Abidi AB (2014) An overview on okra (*Abelmoschus esculentus*) and it's importance as a nutritive vegetable in the world. *Int J Pharm Biol Sci* 4(2): 227-233.

Singh TR, Singh S, Singh SK, Singh MP, Srivastava BK (2004) Effect of integrated nutrient management on crop nutrient uptake and yield under okra-pea-tomato cropping system in a mollisol. *Ind J Hortic* 61 (4): 312-314.

Telangana State Horticulture Department (2017-18). http://horticulture.tg.nic.in/assets/APofHorticulturecropsof2017-18- opencrops.xls.