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Maruthi B
Department of Vegetable Science, SKLTSHU, College of Horticulture, Rajendranagar, Hyderabad, Telangana, India

Hanuman Nayak M
Department of Horticulture, Vegetable Research Station, SKLTSHU, Rajendranagar, Hyderabad, Telangana, India

Kiran Kumar A
Department of Horticulture, SKLTSHU, College of Horticulture, Rajendranagar, Hyderabad, Telangana, India

Corresponding Author:
Maruthi B
Department of Vegetable Science, SKLTSHU, College of Horticulture, Rajendranagar, Hyderabad, Telangana, India

Effect of Integrated nutrient management on quality attributes of okra [*Abelmoschus esculentus* (L.) Moench] cv. Arka Anamika

Maruthi B, Hanuman Nayak M and Kiran Kumar A

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Abstract
The present investigation was conducted to evaluate the quality attributes of okra [*Abelmoschus esculentus* (L.) Moench] cv. Arka Anamika" during Kharif season from July to November 2019 at College of Horticulture, Rajendranagar, Sri Konda Laxman Telangana State Horticultural University. The experiment was laid out in Randomized Block Design with 10 treatments viz., T_1 -Control (no use of fertilizers), T_2 -100% Recommended dose of fertilizers (RDF), 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. These treatments were replicated thrice.The quality of the okra pod was significantly affected with different INM treatments. The ascorbic acid (22.09 mg/100g) content of fruit was found higher in the treatment T_{10} consisted of 100% RDN through vermicompost. Lower crude fibre (9.4%) was recorded in treatment consisted of 100% RDF which was on par with treatment T_7 (9.5%) consisting of 75% RDF + 12.5% RDN through FYM + 12.5% RDN through vermicompost + *Azotobacter* + Phosphorus solubilizing bacteria [PSB]. Maximum crude protein was also obtained in treatment T_7 (14.1%).

Keywords: okra, quality, ascorbic acid, crude fibre and crude protein

Introduction
Okra [*Abelmoschus esculentus* (L.) Moench] is an important vegetable crop commonly known as lady's finger and locally known as bhendi in India with diploid chromosome number of 2n=130 and native to tropical and subtropical Africa. It is valued for its tender fruits. Okra is one of the most important kharif and summer season vegetable crop, belongs to the family Malvaceae. It is the rich source of carbohydrate, fibre, proteins and vitamins [1]. India is the largest producer of okra which occupies an area of 0.51 million hectares with an annual production of 6.2 million tonnes and productivity of 12.15 metric tonnes per hectare [2]. The major okra producing states are Andhra Pradesh, West Bengal, Bihar, Orissa, Gujarat, Jharkhand, Telangana, Karnataka and Tamil Nadu. In Telangana, It occupies an area of 12,167 hectares with an annual production of 1,67,256 metric tonnes and productivity of 13.74 metric tonnes per hectare [3]. The dried stems and roots of okra are used for clarification of sugarcane juice in gur or jaggery manufacture in India. Fully ripen fruits and stem containing crude fibre are used in the paper industry. It is an excellent source of iodine which is useful for the treatment of goiter. Okra pods are useful for treatment against genito-urinary disorders, spermetorrhoea and chronic dysentery. Fruits are also dried or frozen for use during off-season. Dried fruit contain 13-22% edible oil and 20-24% protein and used for refined edible oil. Dry fruit skin and fibre are used in the manufacture of paper, card board and fibres. It has been reported that 100 g of fresh okra pod contains 89.6% moisture, 103 mg of potassium, 90 mg of calcium, 43 mg of magnesium, 56 mg of phosphorus, 18 mg of vitamin C and metals such as Iron and Aluminium [4]. It is general observation that maximum ascorbic acid, crude protein and minimum crude fibre containing okra pods have better acceptable quality and hence these parameters were analysed to know the effect of INM treatments on quality of okra pods during the course of present investigation.

Materials and Methods

A field experiment was conducted during Kharif season from July to November 2019 at College of Horticulture, Rajendranagar, Sri Konda Laxman Telangana State Horticultural University. The experiment was laid out in Randomized Block Design with 10 treatments viz., T_1 - Control (no use of fertilizers), T_2 -100% Recommended dose of fertilizers (RDF), 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. These treatments were replicated thrice. Observations were recorded on quality attributes like,

(i). Ascorbic acid (mg/100g)

2, 6 - dichlorophenol indophenol visual titration method as described by [5] was adopted for its determination.

The ascorbic acid (vitamin C) content of the sample was calculated by adopting the following equation

$$\frac{\text{Titre value} \times \text{Dye factor} \times \text{Volume made up} \times 100}{\text{Aliquot of extract taken for estimation} \times \text{Weight of sample taken for estimation.}}$$

(ii). Crude fibre content (%)

Crude fibre content was determined by the method suggested by [6].

$$\text{Crude fibre (\%)} = \frac{W_2 - W_3}{W_1} \times 100$$

Where,

W_1 = Initial weight of sample

W_2 = Weight of refluxed sample

W_3 = Weight of ignited sample

(iii). Crude protein content (%)

Per cent nitrogen concentration was estimated by digesting with sulphuric acid using hydrogen peroxide to remove black colour. Estimation of nitrogen was done by kjeldahl method. Protein content in the pods was calculated by multiplying nitrogen concentration (%) by the factor 6.25 [6].

The experimental data collected were subjected to statistical analysis of variance and test of significance through the procedure appropriate to the Randomized Block Design as described by [7]. The critical difference was worked out for comparison of treatment where the "F" test was found significant at 5 per cent level of significance. Summary table along with S.Em and C.D. were worked out and presented in Table-1.

Results and Discussion

The quality of fruit was judged on many chemical parameters, here only three aspects were considered i.e. ascorbic acid (mg/100 g), crude protein (%) and crude fibre (%) in okra pods. The quality of the okra pod was significantly affected with different integrated nutrient management treatments. The highest content of ascorbic acid (22.09 mg/100g) recorded in treatment T_{10} consisted of 100% RDN through vermicompost and was at par with the treatment T_1 (21.15 mg/100g) and T_9 (20.42 mg/100g), The minimum ascorbic acid content (17.40 mg/100g) was recorded under the treatment T_6. The increase in vitamin C content with organic manures might be due to physiological influence of vermicompost and farm yard manure on the activity of number of enzymes.

Lower crude fibre (9.40 %) was obtained from the treatment fed with 100% recommended dose of fertilizers (RDF) (T_2) and was statistically at par with T_7 (9.52%). The maximum crude fibre of pod (11.01 %) was found in treatment T_1 (no use of fertilizers). Application of organic form of nitrogen in combination with inorganic form reduced the crude fibre content. This might be due to easy availability of nitrogen leading to balanced C:N ratio, enhancing the vegetative growth resulting in high photosynthesis activity [8].

The maximum percentage (15.05 %) of crude protein was observed in treatment T_7 (75% RDF + 12.5% RDN through FYM + 12.5% RDN through vermicompost + *Azotobacter* + Phosphorus solubilizing bacteria [PSB]) and was at par with T_2 (14.89%), T_5 (14.37%) and T_3 (14.18%). The minimum percentage of crude protein (11.12%) was observed in treatment T_1 (no use of fertilizers). Protein content was increased significantly by the application of different organic manures with fertilizers [9].

Conclusion

In the present investigation supplementation of FYM, vermicompost and biofertilizers along with reduced level of chemical fertilizers increased the percentage of crude protein and reported lower crude fibre % where as sole application of vermicompost enhanced the ascorbic acid content (mg/100 g).

Acknowledgement

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Table 1: Effect of integrated nutrient management on quality attributes of okra

Treatments	Ascorbic acid (mg/100g)	Crude fibre (%)	Crude protein (%)
T_1	21.15	11.01	11.12
T_2	19.53	9.40	14.89
T_3	17.41	10.04	14.18
T_4	18.36	10.52	12.33
T_5	18.43	10.01	14.37
T_6	17.40	10.29	13.00
T_7	19.43	9.52	15.05
T_8	17.47	10.23	13.80
T_9	20.42	10.70	11.61
T_{10}	22.09	10.66	11.92
SEm ±	0.59	0.20	0.30
CD at 5%	1.77	0.60	0.90

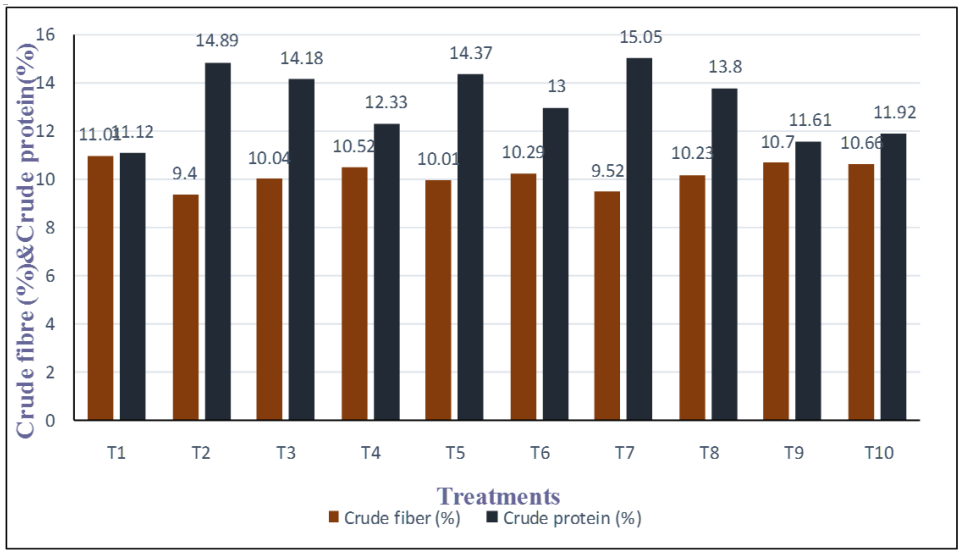

Fig 1: Effect of INM on crude protein (%) and crude fibre (%)

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