The Pharma Innovation Journal 2022; 11(11): 1217-1220

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; 11(11): 1217-1220

www.thepharmajournal.com
Received: 05-09-2022
Accepted: 07-10-2022

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Response of okra (*Abelmoschus esculentus* L.) to foliar application of novel organic liquid nutrients and micronutrients

JM Vashi, AI Patel, BN Chaudhari and CG Intwala

Abstract
A field experiment was carried out, with a view to study the effect foliar application of Novel Organic Liquid Nutrients and Micronutrients on okra (*Abelmoschus esculentus* L.) at Vegetable Research Scheme, Regional Horticultural Research Station of the Navsari Agricultural University, Navsari, Gujarat, India between 2018 to 2021 during *kharif* season. The experiment was conducted in Randomized Block Design with three repetitions. Foliar application of Novel Organic Liquid Nutrients and Micronutrient (Grade IV) was given at 30, 45 and 60 DAS at 0.5, 1.0 and 1.5 percentage level. The results revealed that higher values for yield characters namely, fruit length, fruit girth, number of fruits per plant, weight of pod(g/plant) and fruit yield (t/ha) were recorded higher in T_3 - Novel Organic Liquid Nutrients 1.5%) during all the four years of experiment.

Keywords: Liquid nutrients and micronutrients, fruit length, fruit girth

Introduction
There is a wide variation in types of vegetables grown in India due to extremely varied and diverse physiology and agro – climatic condition. Due to limitation in area it becomes major task to provide food in our country for large population. Therefore, research toward regulation of plant growth as an important factor in improving the yield and quality of vegetable crops. Okra is one of the most important and popular vegetable among different vegetables cultivated in India. In India, okra is cultivated in area of 5.31 lakh ha area and 64.66 lakh MT production. (Anon., 2021) [1]

Latin binomial names for okra are *Abelmoschus esculentus* and *Hibiscus esculentus* (Kumar *et al*.2010) [2], and it is commonly known as bhindi in India. It probably originated in Ethiopia and is widely spread all over tropical, subtropical and warm temperate regions of the world for its fibrous fruits or pods containing round, white seeds. It is among the most heat and drought tolerant vegetables species in the world and will tolerate soils with heavy clay and intermittent moisture but frost can damage the pods. Okra is principally consumed fresh or cooked and is a major source of vitamins A, B, C, minerals, Iron and Iodine and important vegetable source of viscous fiber but it is reportedly low in sodium saturated fat and cholesterol (Moaward *et al*.(1984) [3], Kendall C.W.C. and Jenkins D.J.

A (2004) [4] and Adeboys O.C. and Oputa C.O.(1996) [5]. Okra provides an important source of vitamins, calcium, potassium and other mineral matters which are often lacking in the diet in developing countries Joshua. (2011) [6]. Seven days old fresh okra pods have the highest concentration of nutrients Agbo *et al*. [7]. It is very popular among the farmers because of easy in growing and has wider adaptability range. It has good nutritional value. Besides being a vegetable, it also has medicinal and industrial important. India is the largest producer of okra. It is mainly used for its tender green fruits as vegetable in many countries (Bayer and Kubitzki, 2003) [8]. Okra has a prominent position among vegetable fruits due to its high nutritive and medicinal value, ease of cultivation and wider adaptability to varying weathers (Reddy *et al*. 2012) [9].

Foliar spray of nutrients cause tremendous impact on growth and yield of crop and incorporation of organic nutrient in crop cultivation increases the growth and yield of plant without adversely impact on soil and environment. Novel organic liquid nutrients is a patented product of Navsari Agricultural University, Gujarat, India since year of 2012.It made from banana pseudo stem, which contains sufficient amount of essential macro and micro plant nutrients.(Desai *et al*.2016) [10].

The application of sap saving of about 20 to 40 percent RDF could be achieved without affecting the yields of various crops.

Micronutrients disorder appears to be the most widespread and frequent problem in crop production worldwide, resulting in severe losses in yield and nutritional values. Micronutrients like, copper (Cu), zinc (Zn) and iron (Fe) are important for proper functioning of biological systems of plant but their deficiency and toxicity lead various disorders. Reports indicated that Zn and Fe deficiency causes remarkable losses in yield of vegetables. Objective of this research was to investigate the best foliar application treatment on overall performance of okra.

Materials and Methods

The experiment was undertaken at the Vegetable Research Scheme, Regional Horticultural Research Station of the Navsari Agricultural University, Navsari, Gujarat, India during *Kharif* season of 2018 to 2021. The experiment was conducted in Randomized block design with three repetition. Details of the treatments are., T_1- Novel Organic Liquid Nutrients 0.5% (30,45 & 60 DAS), T_2- Novel Organic Liquid Nutrients 1.0% (30,45 & 60 DAS), T_3- Novel Organic Liquid Nutrients 1.5% (30,45 & 60 DAS), T_4- Micronutirent Grade IV- 0.5% (30,45 & 60 DAS), T_5- Micronutirent Grade IV-1.0% (30,45 & 60 DAS),T_6- Micronutirent Grade IV-1.5% (30,45 & 60 DAS) and T_7- Control. All the recommended cultural practises and manure and fertilizer was given regularly.

For recording different field observations, five plants of okra from each net plot area were selected randomly in the beginning and tagged with the labels. Plant height was measured with help of meter tape at final harvest, number of fruits per plant of taaged plant count individually and yield (t/ha) were worked out with the yield from net plot area.

Method of analysis of variance technique was followed by Panse and Sukhatme (1985) [11].The treatment differences were inspected by employing 'F' test at five percent level of significance on the basis of null hypothesis. The appropriate standard error of mean (S.Em. ±) was calculated in each case. The critical difference (C.D.) at five percent level of probability was worked out to compare two treatment means, where the treatment effects were found significant under 'F' test. The percentage of co efficient of variation (C.V.%) was also worked out for all the cases.

Results and Discussion

In okra, plant height is one of the most important factor to determine growth. The higher vegetative growth in okra is essential and prerequisite for achieving higher yield. The results shows in (table 2) indicate significant difference where okra plants sprayed with Novel Organic Liquid Nutrients were recorded maximum plant height (158.91 cm) at final harvest stage. Same trend was also observed for of number of branches (2.28) in treatment T_3. This significant difference in vegetative characters were observed might be due to availability of nitrogen in Novel Organic Liquid Nutrients which stimulated higher vegetative growth. Nitrogen as major constituents of chlorophyll, protein and amino acid, their synthesis can accelerate by the adequate supply of nitrogen from Novel Organic Liquid Nutrients. It is also responsible for the cell development and formation and accelerating the synthesis of chlorophyll and amino acid which are associated with major photosynthesis and causes higher formation of meristematic tisuues. These findings are matched with results reported by Annon. (2012) [12], Annon (2014) [13] in banana and Deore *et al.* [14] in chilli.

The data presented in (table 2) revealed that the application of Novel Organic Liquid Nutrients (1.5%) at 30, 45 and 60 DAS recorded maximum pod length (11.66 cm), pod girth (6.60 cm), number pods per plant (18.66), pod weight (228.98 g) and pod yield (7.45 kg/plot and 12.93 t/ha respectively).

The increase in pod characters *viz*., pod length, pod girth, number of pods per plant and pod weight is due to beneficial effect of Novel Organic Liquid Nutrients which provides nutrient supply as well as improves photosynthetic activity and thereby increases the production of carbohydrate accumulation in plant at early stages of crop growth. Another favourable factor for pod characters might be due to good fair amount of micronutrients as well as growth promoting substances provided by Novel Organic Liquid Nutrients which resulted increase in number of pods. Kalariya *et al.* (2018^a) [15]. Furthermore, spraying of water soluble nutrients increases uptake of nutrients and water along with easy availability of nutrients, resulting in more photosynthesis and enhanced food accumulation in edible parts Singhal *et al.* (2015^b) [16].

Pod yield per plant (g) and Pod yield (kg/plot and t/ha) also found higher with Novel Organic Liquid Nutrients (1.5%) due to higher number of branches and plant height due to higher vegetative growth and thereby more number of pods per plant. This might be due to Novel Organic Liquid Nutrients contain macro and micronutrients and bio-parameters which could have helped in increase due to synthesis of carbohydrates and their translocation to the important organs through better growth and higher yield. The results of present investigation are also corroborated with the findings of Manani (2019) [17], Patel *et al.*(2017) [18] in green gram, Naik (2006) [19] in indian bean, Patel *et al.*(2020) [20] in cabbage, Shah(2019) [21] in sweet potato, Patil and Kolambe [22] in garlic and Salunkhe *et al.* [23] in onion and Champaneri *et al.* (2021) [24] in indian bean.

Table 1: Nutritional and biochemical composition of Novel Organic Liquid Nutrients

Chemical		Biochemical	
Parameters	**Mean**	**Parameters**	**Content**
N	0.062%	Total phenol	48.0 to 49.1 mg/100 ml
P	0.018%	Urease activity	63 to 81 U/ml/min
K	0.180%	Gibberellic acid	110.2 to 205.0 mg/l
Ca	0.031%	Cytokinin	137.8 to 244.3 mg/l
Mg	0.092%	Microbe	Population
S	0.010%	Total viable count	1065×10^3 CFU/ml
Mn	5.73 ppm	PSB	1025×10^2 CFU/ml
Cu	0.40 ppm	*Rhizobium*	285×10^2 CFU/ml
Zn	2.92 ppm	*Azotobacter*	460×10^2 CFU/ml
Fe	109.3 ppm	Fungal count	1200

Table 2: Effect of foliar application of Novel Organic Liquid Nutrients and Micronutrient on growth and yield attributes ok okra.

Treatments	Plant height at harvest (cm)	Number of branches	Pod length (cm)	Pod girth (cm)	Number of pods per plant	Pod weight (g)	Pod yield kg/plot	Pod yield t/ha
T1	112.03	1.38	9.80	5.41	14.74	169.50	5.77	10.01
T2	148.46	1.60	11.25	6.27	17.63	214.99	6.94	12.06
T3	158.91	2.28	11.66	6.60	18.66	228.98	7.45	12.93
T4	109.71	1.32	9.49	5.17	14.36	161.01	5.36	9.31
T5	130.71	1.50	10.40	5.77	15.91	184.70	5.47	9.50
T6	138.92	1.60	10.89	6.04	16.98	199.75	6.27	10.88
T7	99.68	1.20	9.06	4.88	13.22	146.17	4.83	8.39
S.Em.±	3.52	0.05	0.14	0.07	0.31	3.95	0.15	0.27
C.D. at 5 %	9.95	0.14	0.39	0.19	0.89	11.15	0.43	0.75
C.V. %	10.68	10.95	5.20	4.69	7.44	8.38	8.84	8.84
S.Em.± (Y x T)	7.91	0.10	0.31	0.16	0.68	9.02	0.31	0.53
C.D. at 5 % (Y x T)	NS	NS	NS	NS	NS	NS	NS	10.01

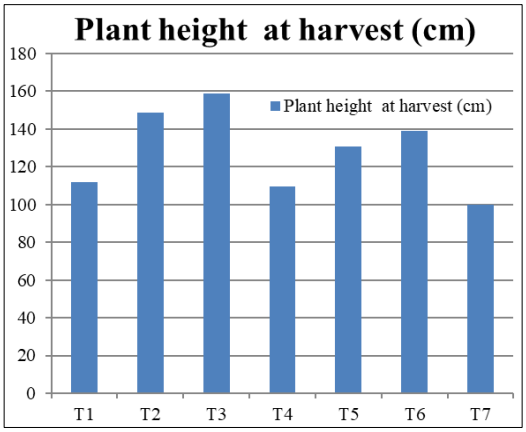

Fig 1: Effect of Novel Organic Liquid Nutrients and Micronutrients on okra height at harvest.

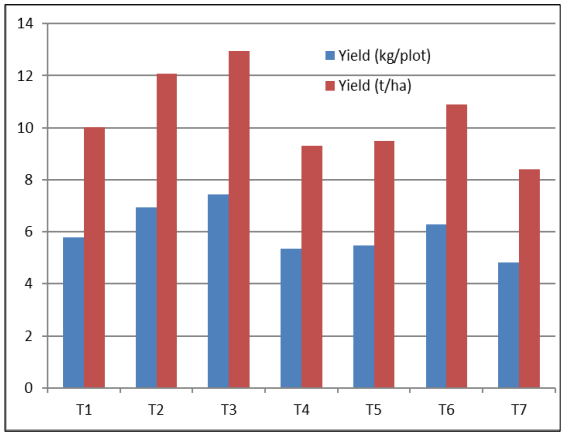

Fig 2: Effect of Novel Organic Liquid Nutrients and Micronutrients on okra yield.

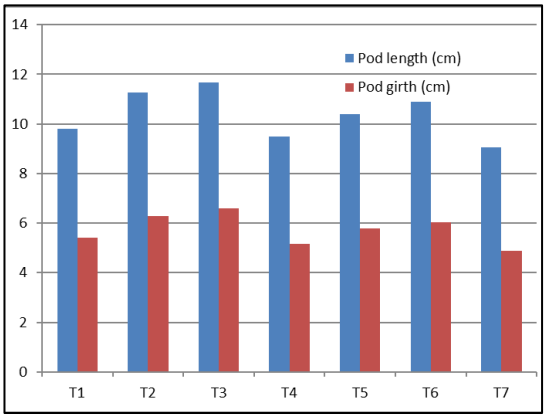

Fig 3: Effect of Novel Organic Liquid Nutrients and Micronutrients on okra pod length and girth

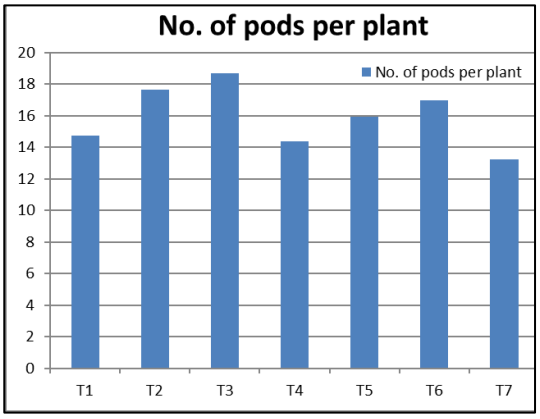

Fig 4: Effect of Novel Organic Liquid Nutrients and Micronutrients on number of pods per plant

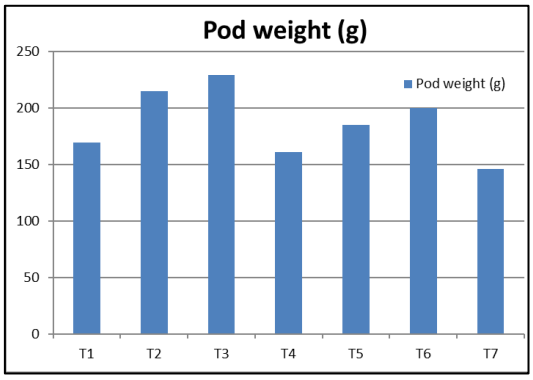

Fig 5: Effect of Novel Organic Liquid Nutrients and Micronutrients on pod weight (g)

Conclusion

The study investigated the response of okra to foliar application of Novel Organic Liquid Nutrients n on growth and yield characters of okra. Among the all treatments, T_3 - Novel Organic Liquid Nutrients 1.5% (30,45 & 60 DAS) were found best.

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