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EFFECT OF DIFFERENT INORGANIC FERTLIZERS AND BIO FERTILIZERS ON GROWTH, YIELD AND QUALITY OF OKRA (*Abelmoschus esculentus L. Moench*)

ABSTRACT

This studywas carried out during March – June 2022 onvgetable research farm Department of Horticulture, in Naini Agricultural Institute, SHUATS, Prayagraj. The objective of the experiment was to screen out the best combination of biofertilizer and inorganic manures for growth, yield and quality of okra and to workout the economics. The design of the experiment was randomized block design (RBD) with three replications. The result shows that T_8 75%N + 100%PK + Azotobacter + Azospirillum + PSB was found superior in terms of plant height (9.30cm in 20 days, 30.23cm in 40 days, 43.58cm in 60 days), plant spread (19.94cm^2 in 20 days, 34.64 cm^2 in 40 days, 60.74 cm^2 in 60 days), days to first flowering (33.98 days), days to 50% flowering (42.43days), days to fruit setting (46.95 days), days to first fruit picking (48.68 days), fruit weight (9.83g), length of fruit at marketable stage (13.10cm), girth of fruit (2.02cm), no. of fruit per plant (23.98/plant), no. of seeds per fruit (48.39), fruit yield per plant(g) 235.65g, fruit yield per plot (kg) 7.78kg, fruit yield (t/ha) 19.44, TSS (14.61^{o}Brix), ascorbic acid (21.31 mg/100g). Net economic returns of treatment was highest in T_8 (75%N + 100%PK + Azotobacter + Azospirillum + PSB) Rs.472592.83 with highest cost benefit ratio of (4.27).

Keywords: Inorganic fertilizers,Bio- fertilizers,Okra, Growth, Yield, Quality.

1. Introduction

Bhindi or Okra botanically known as (*Abelmoschus esculentus* L. Moench) belongs to the family Malvaceae having chromosome number of Okra 2n=130. It'sorigin is tropical Africa. Okra seed germinates in 25-35^{o}C but fast germination observed at 35^{o}C Seeds of okra does not germinate below 20^{o}C temperature. Temperature above 42^{o}C cause flower drop.

Its tender green fruits are used as a vegetable and are generally marketed in fresh form, but sometimes in canned or dehydrated form. Major states of cultivation in India are Uttar Pradesh, Bihar, Orissa, West Bengal, Andhra Pradesh, Karnataka and Assam **(Anon., 2011).** West Bengal and Karnataka are major producers of okra. Okra is a good source of vitamin A and C. Vitamin A is high as 88 I. U. and vitamin C 13 mg per 100 gm of edible portion. It is rich source of Calcium, Potassium and other mineral matters. Calcium and Potassium content ranges from 66 mg to 103 mg per 100 gm of edible portion. It contains 89.6% water and the food value per 100 gm of edible portion is carbohydrates 6.4 gm, protein 1.9 gm, fiber 1.2 gm,

magnesium 53 mg, phosphorus 56 mg, sulphur 30 mg, and oxalic acid 8 mg. Rahman and **(Akter., 2012).** Okra is cultivated for its fibrous fruits or pods containing round, white seeds. The fruits are harvested when immature and consumed as a vegetable.

Inorganic fertilizers are industrially manufactured chemicals containing plant nutrients. Nutrient content is higher fertilizers than organic manures and nutrients are released almost immediately.**(T.Yellamanda Reddy and G.H SanjaraReddy., 2016).** Nitrogen impart green colour to plant, encourages vegetative growth. It is present in most of substances of cells. Nitrogen is essential constituent of protean. It is constituent of protoplasmof chlorophyll and coenzyme. It plays an important role in synthesis of Auxin. While Phosphorus can increase the disease resistance, enhance new cell formation and necessary for root development and required for formation and maturity of grain. It is essential constituent for nucleic acid & phytin. The most essential function are energy storage and transfer of energy (ADT and ATP), act as energy currency. Potassium on the other hand helps in stomata regulation, provide disease and drought tolerance in plant. It is responsible for quality products. It is essential for formation and translocation of sugars, helps in chlorophyll formation. It is useful in stress condition because it secretes 60 enzymes.**(Nem Raj Sunda., 2019)**

Biofertilizers have also become an important component for the crops, it holds a great promise to improve crop yields through better nutrient supplies. Azotobacter and Azospirillum are the two most important non-symbiotic N-fixing bacteria and considered to be very important for fixation of N in non-leguminous crops. Under appropriate conditions, Azotobacter and Azospirillum an enhance plant development and promote the yield of several agricultural/horticultural important crops in different soils and climatic regions **(Jagnow, 1987; Becking, 1992; Okon and Labandera-Gonzalez, 1994).** These beneficial effects of Azotobacter and Azospirillum on plants are attributed mainly to an improvement in root development, an increase in the rate of water and mineral uptake by roots, displacement of fungi and plant pathogenic bacteria and, to a lesser extent, biological N2fixation. **(Okon and Itzigsohn, 1995).** Besides N2fixation, Azotobacter synthesizes and secretes considerable amounts of biologically active substances like B vitamins, nicotinic acid, pentothenic acid, biotin, heteroxins, gibberellins etc. which enhance root growth of plants **(Mishutin, 1970Rao, 1986).** Another important characteristic of Azotobacter association with crop improvement is excretion of ammonia in the rhizosphere in the presence of root exudates, which helps in modification of nutrient uptake by the plants (Narula and Gupta, 1986). The ability of Azospirillum to produce plantgrowth regulatory substances along with N2fixation stimulate growth and thereby productivity. The changes that occur in the plant roots help in transport of minerals and water **(Sarig et al., 1988).**

Several researchers reported that there is no single source of nutrient which can meet the nutrient demand of the crops. Therefore, all the nutrient sources inorganic and biofertilizers should be applied in appropriate combination. Combination of inorganic and biofertilizer contributes to better farm management, minimizing environmental pollution, improving soil productivity, and the production of safe food and feed.

2. Materials and Methods

The experiment was conducted at Vegetable Research Farm,Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology & Sciences, and PRAYAGRAJ (UP) during March – June2022. All the facilities necessary forcultivation, including labour were made available in the department. The design of the experiment wasrandomized block design with three replication and 15 treatments. The data was recorded for the following parameters viz plant height (cm), plant spread (cm^2), days to first flowering, days to 50% flowering, days to first fruit

setting, days to first fruit picking, weight of the fruit (g), length of the fruit at marketable stage (cm), girth of the fruit (cm), no. of seeds per fruit, No. of fruit per plant (g), average yield (kg), total yield (t/ha), TSS (^{o}Brix), ascorbic acid (mg/100g), cost of cultivation (Rs.), gross return (Rs.), Benefit cost ratio.

3. Results and Discussion

The Study on Effect of different inorganic fertilizers and Bio Fertilizers on growth, yield and quality of okra (*Abelmoschus esculentus*) var. TMOH 346 in Prayagraj was carried out at Research Field of Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (U.P.) in the year 2021- 2022. The experiment was conducted in a Randomized Block Design (R.B.D.) with three replications.mean data of all the traits were subjected to statistical analysis and salient features of experimental finding are mentioned below:

3.1 Growth Parameter

Thedifferencesinplantgrowth amongtheplantsmightbedue to influence of various levels of inorganic fertilizers and biofertilizers, soil and environmentalconditions. Nitrogen can impart green colour to the plant, encourage vegetative growth. It is present in most of substances of cells it is essential constitute of protein. It plays an important role in synthesis of auxin. Phosphorus enhances new cell formation and necessary for root development **(Nem Raj Sunda, 2011).**

In table no. 1 Statistical analysis showed that all the traits were found significantFrom the experiment it was observed that T_8 (75%N + 100%PK + Azotobacter + Azospirillum + PSB) shows the maximum plant height 9.30cm in 20 Days, 30.23cm in 40 Days and 43.58cm in 60 days, followed by T_{15} (50% + 100% PK + Azotobacter + Azospirillum + PSB) 9.27cm in 20 days, 29.29cm in 40 Days and 41.81cm in 60 days. The minimum plant height 6.63cm in 20 days 23.22cm in 40 days and 30.58cm in 60 days was found in T_1 RDN (100:80:80) N:P: K.The maximum plant spread 19.94cm^2 in 20 days, 34.64cm^2 in 40 days and 60.74cm^2 in 60 days was observed in T_8 (75%N + 100%PK + Azotobacter + Azospirillum + PSB) followed by T_{15} (50% + 100% PK + Azotobacter + Azospirillum + PSB) 17.67cm^2 in 20 days, 32.87cm^2 in 40 days and 57.08cm^2 in 60 days. The minimum plant spread 13.07cm^2 in 20 days 19.79cm^2 in 40 days and 40.41cm^2 in 60 days was found in T_1 RDN (100:80:80) N:P: K.

3.2 Earliness parameter

Khan et al., (2013) reported the difference in days to flowering might be due to the genetic variation among the treatments. The early flowering may be attributed to the genetic makeup of the cultivar. Regarding the nitrogen fertilizer treatments, the higher doses of N delayed blooming. This may be due to the fact that excessive supply of N promotes luxuriant and succulent vegetative growth dominating the reproductive phase. As P enhances development of reproductive parts stimulates blooming and fruit setting, therefore minimum days to flowering were recorded in plot fertilized with lowest dose of N (100 kg ha-1) combined with phosphorus and potassium. The results are in line with that of who reported that

number of days to flowering was reduced by P and increased by N in okra. Thedifferencesindays to first fruit settingamongtheplantsmightbeduetoexpression to the growing soil and environmentalconditions. This may be due to the continued release of nutrients during the growing period of crop **(Gurjar et al., 2022)**. The faster and more vegetative growth results in early flowering as well as early picking of fruits. Days to first pickings and productive span were significantly affected with the application of different fertilizer treatments. This increase might have been on account of combined effect of chemical fertilizers and biofertilizers, which favourably influenced flowering and fruit and ultimately resulted in increased productive span. These findings are in agreement with the results of **(Kanzariya et al., 2010).** The least number of days to flowering 33.98 days was observed in T_8 (75%N + 100%PK + Azotobacter + Azospirillum + PSB) followed by T_{15} (50% + 100% PK + Azotobacter + Azospirillum + PSB) 34.21 days. The maximun number of days was found in T_1 RDN (100:80:80) N:P:K 51.26days (table no. 2).The least number of days to 50% flowering 42.43 days was observed in T_8 (75%N + 100%PK + Azotobacter + Azospirillum + PSB) followed by T_{15} (50% + 100% PK + Azotobacter + Azospirillum + PSB) 44.23 days. The maximun number of days was found in T_1 RDN (100:80:80) N:P:K 64.51days (table no. 2).The least number of days to first fruit setting 46.95 days was observed in T_8 (75%N + 100%PK + Azotobacter + Azospirillum + PSB) followed by T_{15} (50% + 100% PK + Azotobacter + Azospirillum + PSB) 49.05 days. The maximun number of days was found in T_1 RDN (100:80:80) N:P:K 69.76 days (table no. 2).The least number of days to first fruit picking 48.68 days was observed in T_8 (75%N + 100%PK + Azotobacter + Azospirillum + PSB) followed by T_{15} (50% + 100% PK + Azotobacter + Azospirillum + PSB) 51.38 days and the maximun number of days was found in T_1 RDN (100:80:80) N:P:K 72.66 days (table no. 2).

3.3 **Yield parameter**

Increase in yield attributes fruit weight(g), length of fruit at marketable stage(cm), girth of fruit(cm), no. of fruit per plant, fruit yield per plant(g), fruit yield per plot (kg), fruit yield (t/ha) might occur due to increased photosynthetic area and translocation of photosynthates in plants which subsequently accelerated the formation of more number of large sized fruits with more number of seeds/ fruits resulting in increase in fruit weight. The increase in fresh fruits weight of okra due to bio-fertilizer application could be attributed to easy solubilization effect of released plant nutrient leading to improve nutrient status and water holding capacity of the soil. The results obtained were in agreement with the findings of **(Premsekhar and Rajashree 2009).**The maximum number of fruits per plant 23.98 was observed in T_8 (75%N + 100%PK + Azotobacter + Azospirillum + PSB) followed by T_{15} (50% + 100% PK + Azotobacter + Azospirillum + PSB) 22.82 and the minimun was found in T_1 RDN (100:80:80) N:P:K 15.71 (table no. 2).The maximum length of the fruit 13.10 cm was observed in T_8 (75%N + 100%PK + Azotobacter + Azospirillum + PSB) followed by T_{15} (50% + 100% PK + Azotobacter + Azospirillum + PSB) 11.80cm and the minimum length of the fruit was found in T_1 RDN (100:80:80) N:P:K 7.40cm (table no. 2).The maximum weight of the fruit 9.83g was observed in T_8 (75%N + 100%PK + Azotobacter + Azospirillum + PSB) followed by T_{15} (50% + 100% PK + Azotobacter + Azospirillum + PSB) 8.23g and the minimum weight of the fruit was found in T_1 RDN (100:80:80) N:P:K 6.06g (table no. 2).The maximum girth of the fruit 2.02cm was observed in T_8 (75%N + 100%PK + Azotobacter + Azospirillum + PSB) followed by T_{15} (50% + 100% PK + Azotobacter + Azospirillum + PSB) 1.90cm and the minimum girth of the fruit was found in T_1 RDN (100:80:80) N:P:K 1.20cm (table no. 2).The maximum number of seeds per fruit 48.39 was observed in T_8 (75%N + 100%PK + Azotobacter + Azospirillum + PSB) followed by T_{15} (50% + 100% PK +

Azotobacter + Azospirillum + PSB) 42.31 and the minimum number of seeds per plant was found in T_1 RDN (100:80:80) N:P:K 26.64 (table no. 2).The maximum number of seeds per fruit 48.39 was observed in T_8 (75%N + 100%PK + Azotobacter + Azospirillum + PSB) followed by T_{15} (50% + 100% PK + Azotobacter + Azospirillum + PSB) 42.31 and the minimum number of seeds per plant was found in T_1 RDN (100:80:80) N:P:K 26.64(table no. 2).).The maximum fruit yield per plant (g) was observed in T_8 (75%N + 100%PK + Azotobacter + Azospirillum + PSB) 235.65g followed by T_{15} (50% + 100% PK + Azotobacter + Azospirillum + PSB) 187.86g and the minimum fruit yield per plant (g) was found in T_1 RDN (100:80:80) N:P:K 95.19g(table no. 2) .The maximum fruit yield per plot (kg) was observed in T_8 (75%N + 100%PK + Azotobacter + Azospirillum + PSB) (7.78kg) followed by T_{15} (50% + 100% PK + Azotobacter + Azospirillum + PSB) (6.20kg) and the minimum fruit yield per plot (kg) was found in T_1 RDN (100:80:80) N:P:K 95.(3.14kg) (table no. 2).The total yield per hectare varies from 19.44 to 7.85 t/ha. The maximum yield tonnes per hectare of okra was recorded in T_8 (75%N + 100%PK + Azotobacter + Azospirillum + PSB) (19.44t/ha)whereas minimum average yield per hectare was recorded in T_1 RDN (100:80:80) N:P:K (7.85 t/ha) (table no. 2).

3.4 Qualityparameter

The maximum vitamin C (mg/100g) 21.31 was observed in T_8 (75%N + 100%PK + Azotobacter + Azospirillum + PSB) followed by T_{15} (50% + 100% PK + Azotobacter + Azospirillum + PSB) 19.86 and the minimum vitamin C was recorded in T_1 RDN (100:80:80) N:P:K 16.09 (table no. 3).The maximum TSS (□ Brix) was recorded in T_8 (75%N + 100%PK + Azotobacter + Azospirillum + PSB) (14□ Brix) followed by T_{15} (50% + 100% PK + Azotobacter + Azospirillum + PSB) (13.91□ Brix) and the minimum TSS (□ Brix) was recorded in T_1 RDN (100:80:80) N:P:K (11.30□ Brix)(table no. 3Significantly, the maximum net returns per hectare was obtained by T_8 (75%N + 100%PK + Azotobacter + Azospirillum + PSB) Rs.47,2592.83 with cost benefit ratio of 4.27 and minimum net returns per hectare was obtained in T_1 RDN (100:80:80) N:P:K Rs.123415.05 with 1.10 cost benefit ratio (table no. 3).

Conclusion

Based on the results on the present investigation entitled “Effect of different inorganic fertilizers and bio fertilizers on growth, yield and quality of Okra (*Abelmoschus esculentus*)” it was concluded that T_8 75%N + 100%PK + Azotobacter + Azospirillum + PSB was found superior in terms of plant height (cm), plant spread($cm^{2)}$, days to first flowering, days to 50% flowering, days to fruit setting, days to first fruit picking, fruit weight(g), length of fruit at marketable stage(cm), girth of fruit(cm), no. of fruit per plant, fruit yield per plant(g), fruit yield per plot (kg), fruit yield (t/ha), TSS (^{0}Brix), ascorbic acid (mg/100g). Net economic returns of treatment was highest in T_8 (75%N + 100%PK + Azotobacter + Azospirillum + PSB) Rs.472592.83 with highest benefit cost ratio of (4.27).

Table 1: Effect of different inorganic fertilizers and bio fertilizers on growth parameter of okra

(TMOH 346)

Treatment	Plant height (cm)			Plant spread (cm^2)		
	20 DAS	**40 DAS**	**60 DAS**	**20 DAS**	**40 DAS**	**60 DAS**
T_1	6.63	23.22	30.58	13.07	19.79	40.41
T_2	7.12	27.05	36.33	14.90	27.16	48.86
T_3	7.34	27.17	37.08	15.10	26.81	49.30
T_4	7.37	26.70	34.67	14.02	22.44	44.75
T_5	7.73	27.80	37.16	15.75	28.47	50.31
T_6	9.23	29.27	41.34	17.41	31.54	55.97
T_7	9.17	29.10	40.32	16.64	29.48	55.77
T_8	9.30	30.23	43.58	19.94	34.64	60.74
T_9	7.93	25.80	36.09	14.75	26.51	46.92
T_{10}	7.71	25.51	35.23	14.57	25.59	46.17
T_{11}	7.58	27.10	35.18	14.23	24.48	45.56
T_{12}	7.43	27.65	37.62	15.34	28.13	49.67
T_{13}	9.06	29.03	38.41	16.03	29.16	53.67
T_{14}	7.84	27.85	38.10	16.19	28.88	52.61
T_{15}	9.27	29.29	41.81	17.67	32.87	57.08
F-Test	S	S	S	S	S	S
SE(d) $\pm$	0.54	0.61	0.65	0.25	0.63	0.5
$CD_{0.05}$	1.10	1.24	1.34	0.52	1.3	1.03
C.V.	8.22	2.71	1.81	1.98	2.82	1.22

Table 2: Effect of different inorganic fertilizers and bio fertilizers on earliness and yield parameter of

okra (TMOH 346)

Treatment	Days to first flowering	50% flowering	Days to first fruit setting	Days to first fruit picking	No. of fruit per plant	Fruit length (cm)	Fruit weight (g)	Fruit girth (cm)	No. of seeds per plant	Fruit yield (g)	Fruit yield (kg)	Fruit yield (t/ha)
T_1	51.26	64.51	69.76	72.66	15.71	7.40	6.06	1.20	26.64	95.19	3.14	7.85
T_2	42.83	53.54	58.20	61.09	19.86	9.68	7.54	1.49	33.83	149.72	4.94	12.35
T_3	42.03	52.68	56.82	59.83	20.48	9.92	7.58	1.54	34.43	155.15	5.12	12.80
T_4	46.77	57.82	62.34	65.15	19.21	8.13	7.09	1.23	29.97	136.16	4.49	11.23
T_5	38.58	48.69	53.24	56.35	20.76	11.19	7.71	1.71	37.22	159.96	5.28	13.20
T_6	34.84	44.17	49.56	51.61	22.69	11.58	8.16	1.87	40.30	185.11	6.11	15.27
T_7	37.20	46.86	51.11	54.01	21.64	11.48	8.06	1.85	39.82	174.31	5.75	14.38
T_8	33.98	42.43	46.95	48.68	23.98	13.10	9.83	2.02	48.39	235.65	7.78	19.44
T_9	43.73	54.39	58.83	61.54	20.20	9.55	7.45	1.44	32.97	150.56	4.97	12.42
T_{10}	44.74	55.62	59.84	63.28	19.69	9.16	7.37	1.39	31.90	145.08	4.79	11.97
T_{11}	45.52	56.43	60.98	63.57	19.63	8.92	7.24	1.33	31.12	142.04	4.69	11.72
T_{12}	40.94	51.38	55.90	59.04	20.26	10.98	7.66	1.64	35.75	155.11	5.12	12.80
T_{13}	38.12	48.00	52.40	55.15	21.37	11.45	7.89	1.81	39.06	168.54	5.56	13.90
T_{14}	38.44	48.35	52.60	55.46	20.58	11.31	7.82	1.77	38.47	161.01	5.31	13.28
T_{15}	34.21	44.23	49.05	51.38	22.82	11.80	8.23	1.90	42.31	187.86	6.20	15.50
F-Test	S	S	S	S	S	S	S	S	S	S	S	S
SE(d) $\pm$	0.57	0.57	0.62	0.59	0.14	0.20	0.06	0.03	0.71	1.90	0.06	0.15
$CD_{0.05}$	1.18	1.18	1.28	1.21	0.29	0.42	0.14	0.07	1.45	3.90	0.12	0.32
C.V.	1.72	1.37	1.37	1.24	0.84	2.46	1.10	2.64	2.40	5.26	1.45	1.45

Table 3: Effect of different inorganic fertilizers and bio fertilizers on quality parameter economic parameters of okra (TMOH 346)

Treatment	Ascorbic acid (mg/100g)	TSS (^{o}Brix)	Total cost of cultivation (Rs. ha-1	Net return (Rs. ha-1)	B:C
T_1	16.09	11.30			
T_2	17.07	12.81	112190.60	123415.05	1.10
T_3	17.40	13.08	110241.60	260310.12	2.36
T_4	15.87	12.23	110136.60	273853.13	2.49
T_5	17.59	13.25	110286.60	226710.14	2.06
T_6	19.29	13.80	110361.60	285545.67	2.59
T_7	19.17	13.74	110511.60	347626.33	3.15
T_8	21.31	14.61	110406.60	321017.25	2.91
T_9	16.89	12.68	110631.60	472592.83	4.27
T_{10}	16.77	12.55	108067.60	264564.44	2.45
T_{11}	16.66	12.41	107962.60	251101.16	2.33
T_{12}	17.50	13.17	108112.60	243440.77	2.25
T_{13}	18.52	13.51	108187.60	275707.65	2.55
T_{14}	17.89	13.40	108337.60	308795.93	2.85
T_{15}	19.86	13.91	108232.60	290257.83	2.68
F-Test	S	S	108457.60	356504.81	3.29
SE(d) $\pm$	0.32	0.08			
$CD_{0.05}$	0.66	0.18			
C.V.	2.22	0.83			

References:-

Anal, P. M., Luikham, E., Munsi, P., & Meitei, W. I. (2018). Growth, Productivity and Quality of Okra (Abelmoschus esculentus L.) cv. PrabhaniKranti and Nutrient Balance in Soil under Chemical Fertilizers, Organic Manures and Biofertilizers in Sub-Tropical Condition. *International Journal of Current Microbiology and Applied Sciences*, *7*(10), 1686-1696.

Bhushan, A., Bhat, K. L., & Sharma, J. P. (2013). Effect of Azotobacter and inorganicfertilizers on fruit and seed yield of okra cv. Hisar Unnat. *Agricultural Science Digest-A Research Journal*, *33*(2), 135-138.

Choudhary, K., More, S. J., &Bhanderi, D. R. (2015). Impact of biofertilizers and chemical fertilizers ongrowth and yield of okra (Abelmoschus esculentus L. Moench). *The ecoscan*, *9*(1&2), 67-70.

DAR. (2004). Rhizobium biofertilizer. *The Result of Research of Agricultural Research, Golden Jubilee*, 114-118.

El-Shaikh, K. A. A., Hosseny, M. H., & Mohamed, H. (2018). Effect of bio and chemical fertilization on yield and fruit quality of okra (*Abelmoschus esculentus* (L.) under Sohag condition. *Journal of Sohag Agriscience (JSAS)*, *3*(1), 1-17.

El-Shaikh, K. A. A., Mohamed, M. S., &Hamadly, K. S. H. (2018). Effect of Bio-and Mineral Fertilization and Number of Pickings on Seed Production of Okra (Abelmoschus esculentus (L.) Moench). *Journal of Sohag Agriscience (JSAS)*, *3*(2), 23-36.

Gurjar, R. P. S., Goyal, A. K., Kishor, S., & Singh, A.Response of Integrated Nutrient Management on Growth, Yield and Benefit: Cost Ratio of Okra [Abelmoschus esculentus (L.) Moench].*Biological Forum – An International Journal* 14(2): 1269-1272(2022)

Khan, M. A., Sajid, M., Hussain, Z., Rab, A., Marwat, K. B., Wahid, F. I., & Bibi, S. (2013). How nitrogen and phosphorus influence the phenology of okra. *Pakistan Journal of Botany*, *45*(2), 479-482.

Kanzariya, H. R., Kapadiya, P. K., Tank, A. K., Giriraj, J., & Kacha, H. L. (2010). Effect of chemical fertilizers and biofertilizer on growth, yield and quality of okra (Abelmoschus esculentus (L.) Moench) cv. Gujarat Okra-2. *Haryana Journal of Horticultural Sciences*, *39*(1/2), 165-168.

Khetran, R., Kasi, M.A., Agha, S.A., Shagufta, F., Ali, J., (2016)., Effect of different doses of NPK fertilizers on growth of okra *(Abelmoschus esculentus (L) Moench) Int. J. Adv. Res. Biol. Sci. 3(10): 213-218*

Kumar, A., Pal, A. K., Mauriya, S. K., Yadav, K. S., & Kumar, R. (2018). Impact of different NPK levels and biofertilizers on growth and seed parameters in okra. *Journal of Pharmacognosy and Phytochemistry*, *7*(1), 2375-2377.

Kumar, V., Saikia, J., & Barik, N. (2017). 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*, *6*(12), 2565-2569.

Mazid, M., & Khan, T. A. (2015). Future of bio-fertilizers in Indian agriculture: an overview. *International Journal of Agricultural and Food Research*, *3*(3).

Mal, B., Mahapatra, P., Mohanty, S., & Mishra, H. N. (2013). Growth and yield parameters of okra (Abelmoschus esculentus) influenced by Diazotrophs and chemical fertilizers. *Journal of Crop and weed*, *9*(2), 109-112.

Meena, D. C., Meena, M. L., & Kumar, S. A. N. J. A. Y. (2019). Influence of organic manures and biofertilizers on growth, yield and quality of okra (Abelmoschus esculentus L. Moench). *Annals of Plant and Soil Research*, *21*(2), 130-134.

Muthukumar, R., Selvakumar, R., (2017) Olericulture A. Introduction to Olericulture, Glaustas Horticulture, *2nd Edition; 251-254*

Nuruzzaman M., Ashrafuzzaman M., Islam M. Zahurul, Islam M. Rafiqul., (2001) Field efficiency of biofertilizers on the growth of okra *(Abelmoschus esculentus (L.) Moench)., J. Plant Nutr. Soil Sci. 2003, 166, 764±770*

Premsekhar, M., & Rajashree, V. (2009). Influence of bio-fertilizers on the growth characters, yield attributes, yield and quality of tomato. *American-Eurasian Journal of Sustainable Agriculture*, *3*(1), 68-70

Rahman, M. A., & Ferdousi, A. (2012). Effect of npk fertilizers on growth, yield and yield attributes of okra (Abelmoschus esculentus (L.) Moench.). *Bangladesh Journal of Botany*, *41*(2), 131-134.

Sajid, M., Khan, M. A., Rab, A., Shah, S. N. M., Arif, M., Jan, I., ... &Mukhtiar, M. (2012). Impact of nitrogen and phosphorus on seed yield and yield components of okra cultivars. *J. Anim. Plant Sci*, *22*(3), 704-707.

Singh, A., Agrawal, M., & Marshall, F. M. (2010). The role of organic vs. inorganic fertilizers in reducing phytoavailability of heavy metals in a wastewater-irrigated area. *Ecological Engineering*, *36*(12), 1733-1740.

Thriveni, V., Mishra, H. N., Pattanayak, S. K., Sahoo, G. S., & Thomson, T. (2015). Effect of inorganic, organic fertilizers and biofertilizers on growth, flowering, yield and quality attributes of bitter gourd, Momordicacharantia L. *International Journal of Farm Sciences*, *5*(1), 24-29.

Vessey, J. K. (2003). Plant growth promoting rhizobacteria as biofertilizers. *Plant and soil*, *255*, 571-586.