Role of organic and inorganic bio-fertilizers in the growth and yield of Okra (*Abelmoschus esculentus* (L) Moench)

Abstract

The present investigation "was carried out at the Department of Horticulture, GocharMahavidhyalaya, Rampur Maniharan, Saharanpur affiliated by CCSU, Meerut, Uttar Pradesh in 2019-20. During the study period various treatments were given to accelerate the flowering growth and vegetative parameters of the selected species *i.e.*Okra (*Abelmoschus esculentus* (L) Moench). All the vegetative and fruit yielding and economic parameters shown the positive correlation with the given treatment and it was observed that the T_{12} (NPK (60:40:40) + Azotobacter + PSB) treatment was the best treatment to gain more output of the selected crop.

Keyword: Biofertilizer, Vegetative parameter, Azotobacteer, economic parameter

Introduction

Okra (*Abelmoschus esculentus*) is a fast growing, heat-loving tropical annual found in the wild along the White Nile, which drains in the south western highlands of Ethiopia. It's usually unbranched with the trunk reaching 6 to 10 feet tall by the end of the season. Leaves are coarse, palmately-veined and covered with a fine bristly pubescence that many find irritating to their skin.Flowers are cream colored and have the general shape and form of a hibiscus blossom except they do not splay out flat. Like other hibiscus blossoms, they remain open only one day. Some okra selections show a definite photo-period response and produce most of their flowers in late summer as the days begin to get shorter.Okra pods are variable, ranging from the typical kinds to short and fat types built on the model of a Cuban cigar to skinny, foot-long, five-sided affairs. While most are green, some have red-pigmented pods.

Latin binomial names for okra are *Abelmoschus esculentus* and Hibiscus esculentus (Kumar et al. 2010), and it is commonly known as bhindi in India, krajiabkheaw in Thailand, okra plant, ochro, okoro, quimgombo, gombo, kopi arab, kacangbendi and bhindi in South East Asia. However, in Middle East it is known as bamia, bamya or bamieh and gumbo in Southern USA, and lady's finger in England. On the other hand, in Portuguese and Angola, okra is known as quiabo, and as quimbombo in Cuba, gombocommun, gombo, gumbo in France, mbamia and mbinda in Sweden, and in Japan as okuraSorapongBenchasri (2012).

Chemical composition Okra contains proteins, carbohydrates and vitamin C, and plays a vital role in human diet. Consumption of young immature okra pods is important as fresh fruits, and it can be consumed in different forms. The composition of okra pods per 100 g edible portion (81% of the product as purchased, ends trimmed) is: water 88.6 g, energy 144.00 kJ (36 kcal), protein 2.10 g, carbohydrate 8.20 g, fat 0.20 g, fibre 1.70 g, Ca 84.00 mg, P 90.00 mg, Fe 1.20 mg, β-carotene 185.00 μg, riboflavin 0.08 mg, thiamin 0.04 mg, niacin 0.60 mg, ascorbic acid 47.00 mg. The composition of okra leaves per 100 g edible portion is: water 81.50 g, energy 235.00 kJ (56.00 kcal), protein 4.40 g, fat 0.60 g, carbohydrate 11.30 g, fibre 2.10 g, Ca 532.00 mg, P 70.00 mg, Fe 0.70 mg, ascorbic acid 59.00 mg, β-carotene 385.00 μg, thiamin 0.25 mg, riboflavin 2.80 mg, niacin 0.20 mg SorapongBenchasri (2012).

MATERIAL AND METHODS

The present study was carried out during 2019 –2020at the Horticulture Research Farm, GocharMahavidhyalaya, RampurManiharan Saharanpur. The details of materials used and research methodology followed during course of present investigation are described as follows:

Sowing of seeds

The seed of okra (*Abelmoschus esculentus*) (L) Moench cv. KashiKranti, evolved at Indian Institute Vegetable Research, Varanasi. Plants are medium tall (about 100 cm). Disease resistant to: Yellow Vein Mosaic Virus (YVMV) and Okra Leaf Curl Virus (OLCV). Fruit colour are dark green, number of fruits per plant are 17-18, fruit length is 8-10 cm and fruit diameter is 1.8 cm. Yield potential is 140 q/ha of green pods. A field experiment was conducted with eighteen treatments namely;ControlT_1, NPK (80:60:60) T_2, NPK(80:60:60)+ AzotobacterT_3, NPK(80:60:60)+Azospirillum T_4, NPK(80:60:60)+ Phosphorus Solubilizing Bacteria (PSB) T_5, NPK (80:60:60) + Azotobacter +PSB T_6, NPK(80:60:60)+ Azospirillum +PSB T_7, NPK(60:40:40) T_8, NPK(60:40:40)+AzotobacterT_9, Nitrogen, Phosphorus and Potassium(NPK) (60:40:40)+ AzospirillumT_{10}, NPK(60:40:40)+PSB T_{11}, NPK(60:40:40)+Azotobacter+PSBT_{12}, NPK(60:40:40)+ Azospirillum +PSB T_{13}, NPK (40:20:20) T_{14}, NPK(40:20:20)+AzotobacterT_{15}, NPK(40:20:20)+Azospirillum T_{16},NPK (40:20:20) + Azotobacter +PSB T_{17}, NPK(40:20:20)+ Azospirillum +PSB T_{18}.

Results and Discussion

The present study was carried out during 2019-2020 to know the effects of organic and inorganic bio fertilizers on the selected crop i.e.okra. In this study, it was observed that the given treatment plays a key role in the overall growth of the plant with a good gain of economy. In this series the following parameters were studied to find out the effects of given treatment.

(i) Days to 50% germination: Germination of the seed is an important factor for the growth of the plant and plays a key role in the growth of plant. During the study period the days to 50% germination of the seed was studied and it was found that the maximum days to 50% germination were recorded 14.02 days under control (T_1) treatment, as no any type of organic and inorganic fertilizer was used under the control treatment, so the rate of germination of the seed was observed very slow. On the other hand, the fastest germination was recorded 7.3 days under T_{17} (NPK(40:20:20)+Azotobacter+PSB) treatment, followed by 8.433 days under T_{18} (NPK(40:20:20)+ Azospirillum +PSB) treatment and 8.6 days under T_{14} (NPK(40:20:20) treatment. **Hussain, *et.al.* (2006)** studied on the "Response of okra cultivars (*Abelmoschusescuelntus*) to different sowing times," and observed that the organic and inorganic bio fertilizers play a key role in the germination of Okra, when exposed in the control environment with a Recommended dose of fertilizers.

(ii) Days to 50% flowering: Flowering on the plant is the first indicator of fruit and much dependent on the fertilizers as the flowers appeared on the plant, its mean the earlier growth of fruits. During the present study, it was observed that the maximum days 45.1 days to 50% flowering were taken under T_1 (NPK(60:40:40)+Azotobacter+PSB) treatment followed by 44.9 days under T_5(NPK(80:60:60)+PSB) treatment, while the minimum days to 50% flowering were taken under 40.68 days under T_{12} (NPK(60:40:40)+Azotobacter+PSB) treatment followed by 42.96 days under T_{17}(NPK(40:20:20)+Azotobacter+PSB) treatment. **Chatterji, *et.al.* (1979)** who studied the effect of application and levels of N (0, 75 and 150kg / ha) and phosphorous and potash (0, 60, 120 kg/ ha) on pusasawani variety in summer season at Varanasi, U.P. It was noticed that the application of only N and P respectively @ 75 and 60 kg / ha showed maximum value of yield and plant height, number of branches, number ofdays taken to first flowering, pod and size of pods per plant. **Mal *et al.* (2014)** assessed the effect of diazotrophs (bio fertilizers –

Azotobacter, Azospirillum, Phosphate Solubilizing Bacteria) and chemical fertilizers that themaximum number of fruits per plant was recorded with FYM @ 10 t per ha + 75 % NPK + vermicompiost.

(iii)Total yield per Hectare (q): Total yield is the output of the plant and the present study clearly shown the positive effects of organic and inorganic bio fertilizers on selected species, it was observed that the maximum days 122.33 q/ha under T_{12} (NPK(60:40:40)+Azotobacter+PSB) treatment followed by 118.287 q/ha under T_{18} (NPK(40:20:20)+ Azospirillum +PSB) treatment, while the minimum yield was observed 89.173 q/ha under control (T_1) treatment followed by 113.433 q/ha under T_2 (NPK (80:60:60) treatment. This result supports the finding obtained by **Bambal*et. al*. (1998)**reported that application of Azotobactor + Azospirillum + 100% Recommended Dose of Fertilizers (RDF) significantly increased yield., This finding is in agreement with the findings of **Dhawale, *et al*.(2010)** Who reported that significantly maximum plant height of the plant (215.46 cm) and number of branches (3.97) were recorded at 100 Days. The treatment T5 produced significantly maximum fruit yield per plant (0.124 kg) and fruit yield per ha (26.99 tones).

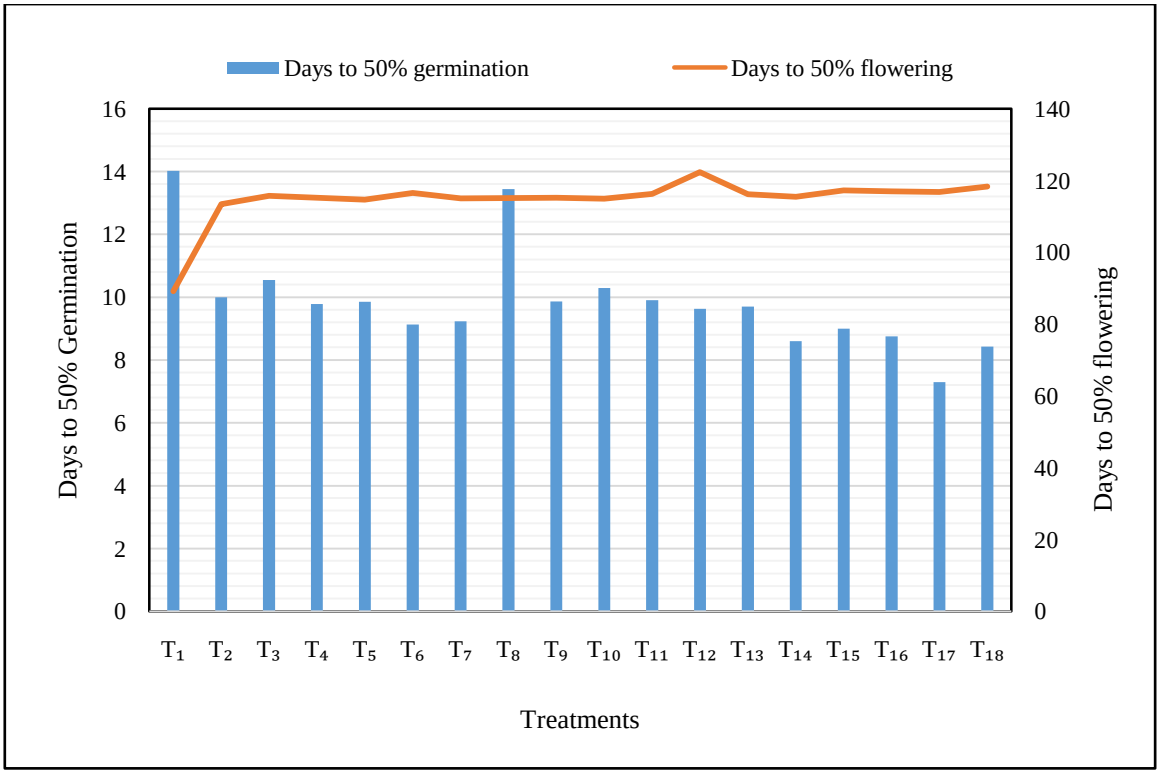
(iv)Total Cost of cultivation: Total cost of cultivation is the sum up of the expenditure to grow the crop till fruiting on the plant. In this study total expenditurewas recorded highestRs. 51721.7 per hectare under T_6 (NPK (80:60:60) + Azotobacter + PSB) T_7 (NPK (80:60:60) + Azospirillum +PSB) treatment followed by Rs. 51,665.7 per hectare under T_5 (NPK (80:60:60) + PSB) treatment, while the lowest cost was recorded Rs. 45,315 per hectare under T_1 (control) treatment followed by Rs. 47,757.3 per hectare under T_{14} (NPK(40:20:20) treatment. **Khadlag, R.R. (2008)** studied on "Influence of organic, inorganic and bio fertilizers on growth, yield quality and economics of okra ". The results indicated that application of RDF recorded the Influence of organic, inorganic and bio fertilizers on growth, yield quality and economics of okra.

(v) Cost Benefit Ratio: Cost benefit ratio is the ration between cost and benefit and give a clear idea about the profit or income from the selected crop. The best cost benefit ratio is 1:3.3 between the cost and benefit was found under T_{12} (NPK (60:40:40) + Azotobacter + PSB) treatment followed by 1:3.1 under T_{10} (NPK (60:40:40) + Azospirillum) treatment, while the C: B ratio was recorded 1:2.6 under T_1 (control) treatment. Philip, et al. (2010) carried out a study on the economic parameters of okra and found that the selected species of Okra shown the positive impact of the given

treatment and found a good economic correlation with the given treatment and the findings.

Table 1: Effects of organic and inorganic fertilizers on selected crop during 2019-20

Treatments		Days to 50% germination	Days to 50% flowering	Total yield per Hectare (q)	Total Cost of cultivation	Cost Benefit Ratio
Control	T_1	14.027	45.1	89.173	45315	01:02.6
NPK (80:60:60)	T_2	10	44.02	113.433	51615.7	01:02.9
NPK(80:60:60)+ Azotobacter	T_3	10.55	44	115.74	51665.7	01:03.0
NPK(80:60:60)+Azospirillum	T_4	9.78	43.9	115.24	51665.7	01:03.0
NPK(80:60:60)+PSB	T_5	9.857	44.9	114.687	51665.7	01:02.9
NPK(80:60:60)+Azotobacter +PSB	T_6	9.133	44.23	116.55	51721.7	01:03.0
NPK(80:60:60)+ Azospirillum +PSB	T_7	9.233	44.07	114.987	51721.7	01:03.0
NPK(60:40:40)	T_8	13.447	44.02	115.107	49685.8	01:03.1
NPK(60:40:40)+ Azotobacter	T_9	9.86	43.42	115.167	49735.8	01:03.1
NPK(60:40:40)+Azospirillum	T_{10}	10.29	43.58	114.893	49735.8	01:03.1
NPK(60:40:40)+PSB	T_{11}	9.903	43.58	116.307	49735.8	01:03.1
NPK(60:40:40)+Azotobacter +PSB	T_{12}	9.627	40.68	122.333	49791.8	01:03.3
NPK(60:40:40)+ Azospirillum +PSB	T_{13}	9.7	43.2	116.147	49791.8	01:03.0
NPK(40:20:20)	T_{14}	8.6	43.05	115.48	47757.3	01:03.1
NPK(40:20:20)+Azotobacter	T_{15}	9	43.71	117.257	47810.3	01:03.1
NPK(40:20:20)+Azospirillum	T_{16}	8.75	43.07	116.987	47810.3	01:03.1
NPK(40:20:20)+Azotobacter +PSB	T_{17}	7.3	42.96	116.817	47863.3	01:03.0
NPK(40:20:20)+ Azospirillum +PSB	T_{18}	8.433	43.04	118.287	47863.3	01:03.1



Graph-1: Treatments

Conclusion

The present study is based on the given bio-fertilizers and their impact on the selected species of Okra. During the study period various treatments were given and found that all the given treatments have played a major role to enhance the quality and quantity of the fruit. As the Okra is very popular vegetable and cooked by each and every family and some of the peoples are very keen to serve and eat this vegetable. Keeping the fact of uses and popularity in mind the study was designed to minimize the use of chemical fertilizers and to promote the use of bio-fertilizers. The replacement of chemical fertilizers will be definitely beneficial to the soil health as well as to the local public as they are taking this vegetable as food. Beside this the farmers can earn more economy by using the given practices.

Conference disclaimer:

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Figure added by reviewers

Fig. 1 Example of location on the satellite map of the experimental field. Unfortunately, the very

limited information on the location of the experimental field does not allow obtaining a better map (which also allows the visualization of the plots corresponding to the 17 treatments plus the control).

Figure 2: Researcher in the Farm of Okra during the study period

Figure 3: Measurement of Okra by Researcher during the study