

**Effect of Organic, Inorganic and Biofertilizers  
on growth, yield and quality traits of okra  
[*Abelmoschus esculentus* (L.) Moench.]**

**SUMMARY  
of  
THESIS**

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## SUMMARY

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Okra (*Abelmoschus esculentus* (L) Moench.) belongs to the family of Malvaceae. It is an annual vegetable crop grown in tropics and sub-tropics of the world, much resembling the cotton plant in habit .It is grown throughout the country except in the mountainous regions . Spring – summer and rainy season ( Kharif ) are the main cropping seasons in the central and northern plains . It is also known as lady's finger or bhindi, originated in tropical Africa. Because of its richness in nutrition, taste, medicinal and industrial value, okra is one of the most popular vegetable in all sections of people.

- Okra is cultivated for its fibrous fruits or pods containing round, and circular seeds. The fruits are harvested when immature and eaten as a vegetable. Usually 90-100 days are required for the production of Okra. Kharif and rabi employ the production of okra. Warm and humid atmosphere is favourable for the development of Okra crop.
- All parts of okra (Lady's finger) like fresh leaves, buds, flowers, pods, stems and seeds can be used for different purposes and hence, it is a multipurpose crop in terms of its uses. It is one of the essentially consumable crop of the India; immature and tender pods can be consumed as the boiled and fried vegetables or could be utilized as it may be added to salads, soups and stews.
- Okra fruit can also be utilized in several ways. It is the best source of iodine and calcium. The vitamin and mineral rich okra is prized vegetable in the Indian sub –continent . The roots and stems are used for clarification of sugarcane juice before it is converted into jaggery and brown sugar . The medicinal values of okra are associated with genito urinary disorder, spermatorrhoea and chronic dysentery. Its ripe and tender seeds are roasted, ground and used as a substitute for coffee in some countries.
- The edible oil (greenish yellow) has a pleasant taste and odour , and is high in unsaturated fats such as oleic acid and linoleic acid. Okra provides an important source of vitamins, calcium, potassium and other minerals which are

often lacking in the diet in developing countries. Okra Contains forskolin (diterpinoid), which is being used to treat several diseases which includes - hypertension, glaucoma, asthma, congestive heart failure and certain type of cancer's.

- Okra [*Abelmoschus esculentus* (L.) Moench.] is a herbaceous annual and export oriented vegetable crop grown in the kharif and rabi seasons, and it is reported to show good response to different plant nutrients. Being native of tropical Africa, it is widely cultivated in India. Uttar Pradesh, Assam, Bihar, Orissa, Maharashtra, West Bengal and Karnataka are important okra producing states.
- Growth quality and quantity can be improved by the use of essential nutrients because it manages to improve the utilization of important inputs that could be in any form either chemical physical or bio methods.
- Improvement of soil fertility through the application of fertilizers has become an essential factor that enables the world to feed billions of people of its population.
- Soil fertility is usually maintained by the application of organic and inorganic fertilizers and there is also an improvement in the physical and biological properties of the soils.
- Indiscriminate use of inorganic fertilizers has resulted in decreased nutrient uptake, poor quality of vegetables and deterioration of soil health. Okra produces fruit for a long time and needs balanced and sufficient supply of nutrients for higher yield and better quality. Inadequate or imbalanced nutrient supply is one of the major constraints in harvesting higher yields.
- Seed is the important basic input in agriculture and quality seed is very important in crop establishment too. Hence, production of healthy crop depends on many factors of seed and agronomic aspects of cultivation.
- Fertilizers play a crucial role to meet nutrient requirement of the crop. Persistent nutrient depletion is posing a greater threat to the sustainable agriculture. Therefore, there is an urgent need to reduce the usage of chemical

fertilizers and in turn increase the usage of organics, which are needed to improve the yield and quality levels.

- Vermicompost, besides being a rich source of micronutrients acts as chelating agent and regulates the availability of metallic micronutrients to the plants and increases the plant growth and yield. Organic waste from different sources helps in boosting up vegetable crop growth and yield as it contains most of the nutrients essential for plant growth and hence it responds well to the application of both organic manures and inorganic fertilizers. Of late, biofertilizers are gaining importance due to their low cost, non-residual toxicity and capacity to enrich soil fertility in addition to high returns under favorable conditions. Organic manures are known to supply the major nutrients, and micronutrients, apart from improving soil properties and fertility.
- Therefore, there is a need to work the requirement of inorganic fertilizers in conjunction with organic manures and biofertilizers for increased seed yield and quality of okra.
- Development of technology is needed for the fulfillment of plant nutrients through organic resources and their application in a balanced way for maintaining soil productivity. Organic farming proves many advantages for soil as well as it improves plant and animal health.

The use of organic manures as a means of maintaining and increasing soil fertility has been advocated some of these materials have also been found to control pathogens.

The use of inorganic fertilizers can improve crop yields, soil PH, total nutrient content and nutrient availability most especially in the tropics where soils are adversely affected by sub-optimal soil fertility and erosion causing deterioration of the nutrient status and changes in population of soil organisms .

But its use is constrained by acidity, scarcity, nutrient imbalance and it is no longer within the reach of poor-resource farmers due to its high cost. When excessively used, it also has a depressing effect on yield. This causes a reduction in number of fruits, delays and reduces fruit setting .

Biofertilizers are useful substitutes to inorganic fertilizers which improves the soil quality. According to the nutrient status of the compost obtained from municipal solid waste and sewage sludge was eminent.

Biofertilizers are known to play a number of vital roles in soil fertility, crop productivity and production in agriculture as they are eco-friendly and cannot at any cost replace chemical fertilizers that are indispensable for getting maximum crop yields. Some of the important functions or roles of biofertilizers in agriculture are they supplement chemical fertilizers for meeting the integrated nutrient demand of the crops. Besides being environmentally safe, it increases crop yield and quality.

Keeping in view the above facts in mind and considering the importance of the crop, following investigation has been designed under the title “ **Effect of Organic, Inorganic and Biofertilizers on growth, yield and Quality traits of Okra [*Abelmoschus esculentus* (L) Moench.]”**

### **Objectives**

- To find out the effect of organic fertilizers on growth, yield and quality traits of okra.
- To investigate the effect of inorganic fertilizers on growth, yield and quality traits of okra.
- To assess the effect of biofertilizers on growth, yield and quality traits of Okra.
- To study the combined effect of organic, inorganic and biofertilizers on growth yield and quality traits of okra.

The experiment consisted of 16 treatments combinations of organic, inorganic and biofertilizers were tested on okra. The recommended dosage of fertilizers with combinations of organic and inorganic fertilizers as well as biofertilizers were incorporated in the 48 plots whereas apart from these three plots only constituted either of vermicompost (V.C.), farmyard manure (FYM) and , neemcake. biofertilizers such as Azotobacter (Azo), Phosphate Solubilizing Bacteria (PSB) and vesicular Arbuscular Mycorrhizae (VAM).

The field Experiment was carried out in randomized block design with three replications. The these three treatments combinations were T<sub>1</sub>(control), T<sub>2</sub>(Farm yard manure), T<sub>3</sub>(Vermicompost), T<sub>4</sub> (Neemcake), T<sub>5</sub>(50% RDF + Farmyard Manure), T<sub>6</sub> (50%RDF + Vermicompost), T<sub>7</sub> (50% RDF+Neemcake), T<sub>8</sub>(75% RDF + FYM), T<sub>9</sub> (75% RDF + Vermicompost) ,T<sub>10</sub> (75% RDF + Neemcake), T<sub>11</sub> (50% RDF+Azotobacter), T<sub>12</sub>(50%RDF+PSB), T<sub>13</sub> (50%RDF+VAM), T<sub>14</sub>(75% RDF+Azotobacter), T<sub>15</sub>(75%RDF+PSB), T<sub>16</sub> (75% RDF + VAM ). Twenty number of plants were accommodated in each plot .

The okra (Kashi Pragati ) a standard variety was chosen for the work and it was first identified by the Indian Institute of Vegetable Research in the year 2002 , The plant type is short intermodal with approximately 120-140 cm of height , the fruit colour is dark green while number of ridges on fruits are around 5 , number of fruit per plant is generally in the range of 20-25 coming to the fruit, the fruit length is around 11-13 cm while fruit weight and fruit diameter 10-12gm and 1.15-1.40 cm .The used crop variety is disease resistant to YVMV (Yellow vein mosaic virus) and OLCV .

The seeds of okra were preferably applied 30 cm apart and the ridges were made 60 cm apart in order to provide more care as it is spring-summer crop. However efforts were made grow kharif season to access its performance under the Lucknow condition.

Five plants were selected at random and labelled in each net plot for recording the observations on vegetative growth parameters viz., Days to germination (50%), days to germination (100%), plant height (cm) stem diameter (cm) , number of branches per plant, number of leaves, number of nodes per plant, intermodal length (cm). And in flowering , fruiting and yield parameters data recorded on viz ., days to first flowering , days to 50 % flowering , number of fruits per plant , fruit weight (g) , fruit length (cm), fruit diameter (cm), days to first picking , fruit yield per plant (kg) , fruit yield per hectare (q/ha), and number of seeds per fruit.

The days taken days to germination of fruit initiation to half grown in each selected plants of plots were recorded from the date of sowing and expressed as days to germination 50%.For only PSB it took minimum days. when no any treatment combination is used that is in the control treatment which took maximum number of day followed by neemcake treatment. The second combination which gave the best

result 75% RDF and Azotobacter . 100 % germination was observed around 10-11 days of sowing, with the T<sub>15</sub> ( 75 % RDF + PSB )100 % germination was observed earlier after T<sub>14</sub>( 75 % RDF + Azotobacter ) during both the years of experimentation ( 2016-2017 and 2017-18) .

Branches, nodes and leaves are the manifestation of morphological, physiological, biochemical and growth parameters and are considered to be resulted from the trapping and conversion of solar energy efficiency.

Branches on plants have indicated the number of fruits to be more .The data on number of branches per plant at 30, 60,and 90 DAS as influenced by application of organics, inorganic and biofertilizers. However, plants applied with 75 %RDF + PSB treatment recorded numerically more number of branches followed by 75 % RDF + Azotobacter and 75% RDF + Vermicompost.

Number of leaves per plant differed significantly due to application of organic, inorganic nutrients and biofertilizers. Plants supplied with T<sub>15</sub> (75 %RDF + PSB ) recorded significantly higher number of leaves per plant.

Stem diameter is also a significant parameter, From each plot five plants were chosen for the calculation of the girth the strongest girth was found in cms again obtained by the combination of 75%RDF and PSB, 75%RDF and Azotobacter showed sort of equivalent results followed by 75 % RDF + Vermicompost. The weakest result was given by the control treatment followed by neemcake.

The internodal length was calculated with the help of the scale and the distance between the two consecutive nodes were calculated like other experimentation in this also significant results were found in 75 %RDF with PSB .

The maximum fruit weight was obtained with the combination of 75 %RDF and PSB while the second best combination was achieved by 75% RDF and Azotobacter.. Similar results were obtained in the case of fruit diameter and fruit length.

Fruit yield per plant, fruit yield per plot, fruit yield per hectare were the three parameters which were compared in this experiment the highest fruit yield was obtained in the year 2016-2017 and 2017 -18 both were obtained maximum in 75 %RDF and PSB although this is an average workout 75 % RDF and Azotobacter also

showed a good result followed by 75 % RDF + Vermicompost. The least of all results were found to be in control.

Yield is polygenic in nature and is influenced by several factors (internal and external) throughout the crop growth period. The number of fruits per plant and the branches, number of nodes per fruit are the major yield components that determine the fruit yield. Among the nutrient treatments, 75 % RDF + PSB, recorded highest number of fruits per plant.

Increase in number of fruits per plant is due to production of more number of flowers, higher per percentage of fruit set and reduced shedding of flowers and fruits and resulted in increased fruit. It is might be due to increase in the levels of fertilizers along with organic manure and biofertilizers (phosphate solubilizing bacteria) influenced significantly fruit yield and its components.

In the present study, days to 50 per cent flowering was not significantly influenced by combined application of inorganic and organic manures. The application of recommended dose of fertilizer + Phosphate solubilizing bacteria recorded less number of days to 50 per cent flowering followed by 75 % RDF + Azotobactor. And 75 % RDF +Vermicompost and so on. Whereas T<sub>1</sub> (control) and treatment T<sub>4</sub>(Neemcake) took more number of days to 50 per cent flowering. The induction of early flowering due to the application of PSB and azotobactor was mainly described to the process of bio regulators, which have an influence on early flower initiation.

It is relevant to mention here that adequate supply of nitrogen to plants not only promotes the synthesis of food but also its subsequent partitioning in sink. The application of nitrogen favoured the metabolic and auxin activities in plant and ultimately resulted in increased fruit size, number of fruits per plant, fruit weight and yield per hectare . Ascorbic acid content in mg/100 g was recorded highest content in the treatment T<sub>15</sub> (75% RDF +PSB). It means that combined application of different biofertilizers specially phsoahate solubilizing Bacteria helped in the maximum yield in ascorbic acid content and total soluble solids was recorded in treatment T<sub>15</sub>(75% RDF +PSB).

As far as as biochemical aspects are concerned , data were recorded on T.S.S. (<sup>0</sup>Brix), ascorbic acid (mg/100g), total sugars (%), reducing sugar (%), and non-reducing sugar (%) , respectively .

Total soluble solids were pooled out in the okra plant which were treated with organic, inorganic and biofertilizers, total soluble solids were found to be higher in the plants which were harvested from the plot which were supplemented with 75% RDF +PSB and also the second treatment which showed good result was 75 % RDF + Azotobacter followed by 75 % RDF + Vermicompost. Same results were obtained in ascorbic acid and sugars .

The overall results obtained from the present investigation clearly shows that among various combinations of organic , inorganic and biofertilizers , the treatment combination T<sub>15</sub> ( 75 % RDF + PSB ) responds good followed by T<sub>14</sub>( 75 % RDF + Azotobacter) and T<sub>9</sub>( 75 % RDF + Vermicompost ). And the control treatment having no fertilizers combination revealed the poor results followed by the Neemcake treatment when used separately in T<sub>4</sub>.

Therefore , for producing good quality of okra fruits and requisite yield and to fulfil the demand of organic market without deteriorating the soil health , it is advised that the application of 75 % recommended dose of fertilizers along with PSB , azotobacter , vermicompost respectively can be followed .

### **Future Line of work**

In continuation of the present investigation, the following future line of work can be taken up for producing higher quality seed in okra.

1. Studies are to be initiated to find out the appropriate strains, rates and time of inoculation of N<sub>2</sub> fixers and P-solubilizers under diverse agro - climatic conditions for promoting fruit yield and quality potentiality of okra.
2. Long - term studies on Biofertilizers and other sources of nutrients need to be initiated to develop integrated nutrient management schedule for higher fruit yield and seed quality in okra.
3. Studies on varying doses and time of application of micronutrients are to be taken up for further investigation.
4. Research on residual effect of various organic sources under different environments and management practices need to be initiated.