Influence of chemical and bio fertilizer on growth and yield of Okra (*Abelmoschus esculentus* L.) Moench

Pankaj Sharma\(^1\), A. K. Sharma, J. P. Singh, Himanshu Kaushik, Rajbeer, Sachin Kumar

\(^1\) J. V. College, Baraut, Baghpat, U. P.
Gochar Mahavidyalaya, Rampur Manihar, Saharanpur, U. P.
Email : hkaushik996@gmail.com

**Abstract**

A field experiment was conducted at the Horticulture Research Farm Department of Horticulture, J. V. College, Baraut, Bhagpat during the year 2011 with the cultivar “Arka Anamica” was done in Randomized Block Design (R.B.D) with three replication. The experiments consisted of 16 treatments viz. N\(_1\) (80:60:60) NPK (Kg./ha), N\(_2\) (60:40:40) NPK (Kg./ha), N\(_3\) (40:20:20) NPK (Kg./ha), B\(_1\) (*Azotobacter*) 7kg/ha, B\(_2\) (Phosphate Soluble Bacteria) 7kg /ha, B\(_3\) (*Azotobacter* + PSB) and B\(_0\) (Control). The Maximum results an different attributes viz. Plant Height (67.30 cm.), No. of leaves per plant (63.95), No. of green pod per branch (3.87), and Area of green pod (48.69 cm\(^2\) ), Days to 50 % germination (7.25) and Days to 50 % flowering (20.06) were recorded under the treatment B\(_3\) where as *Azotobacter* 7 kg/ha + Phosphate Soluble Bacteria 7 kg./ha. Compression to the treatment B\(_1\), where as *Azotobacter* 7kg/ha and better results like, Number of branches per plant (4.58), leaf area (267.57 cm\(^2\) ), Number of green pod per plant (3.87), Fresh weight per green pod (8.11 gm.) and Green pod yield per plot (3382.56gm.) were recorded under the treatment B\(_3\) (*Azotobacter* 7kg/ha + PSB 7kg/ha), followed by N\(_1\) (80:60:60) NPK (Kg.)/ha and minimum results were found under the control.

**Keywords:** Okra, Bio-fertilizers, Inorganic fertilizers

Okra (*Abelmoschus esculentus* L. Moench) is an important fruits vegetable crop of the tropical and subtropical region of the world. In our country due to over population it is not possible to increase the production of okra cultivation but increasing demands may be much and low production barriers can be removed to a considerable extent with adoption of improved production technology to fertilizer okra crop in a specific manner may prove to be one of the improved technology because every plant has its own potentiality on yielding its maximum with proper, nutrition. It is most useful in fevers, catarrhal attics, irritable states of the genitor-urinary organs, such as dysuria gynorrhoeo lecorrhoea and in all cases attended with scalding pain and difficulty in passing urine. According Nandkarni (1972). Among the various nutrients nitrogen and phosphorus are the major elements for the proper growth and development of the plants (N\(_2\)) nitrogen has the quickest and the most pronounced effect on vegetative growth and yields of pods. It enters and regulates many physio-chemical processes of plants activities. Nitrogen functions as a necessary component of biological molecules, protein, amino acids, amides, pyrmydin enzymes and of the vitamins. Bio-fertilizer being one of the major elements is mostly utilized by the plant during growth and development stages. However, the plants generally use the higher amount of phosphorus then other major elements except nitrogen. Although the nutrient like phosphorus promote rapid cell division in various parts of the plants. It encourage cell enlargement in the plant parts due to growth promoting effect. The plants get early flowering, pod formation and maturity as well as therefore, it is quit desirable to determine suitable dose of phosphorus fertilizer for sufficient production on okra pods.

**MATERIALS AND METHODS**
The field experiment was conducted at Horticultural Research Farm Department of Horticulture, J.V. (P.G.) College, Baraut Baghpat during 2011 with Sixteen treatments $B_0$ N$_0$ (Control), $B_0$ N$_1$. (80: 60: 60 Kg (N.P.K per ) , $B_0$ N$_2$.60: 40: 40 kg (N.P.K per ha.), $B_0$ N$_3$. 40: 20: 20 kg (N.P.K per ha.), $B_1$ N$_0$ -Azotobacter 7kg/ha, $B_1$ N$_1$. Azotobacter 7kg/ha + 80: 60: 60 Kg (N.P.K per ) ,$B_1$ N$_2$. Azotobacter 7kg/ha + 60: 40: 40 kg (N.P.K per ha.), $B_1$ N$_3$. Azotobacter 7kg/ha + 40: 20: 20 kg (N.P.K per ha.), $B_2$ N$_0$. PSB 7kg/ha., $B_2$ N$_1$. PSB 7kg/ha. + 80: 60: 60 Kg (N.P.K per ha), $B_2$ N$_2$. PSB 7kg/ha. + 60: 40: 40 kg (N.P.K per ha.), $B_2$ N$_3$. PSB 7kg/ha. + 40: 20: 20 kg (N.P.K per ha.), $B_3$ N$_0$. PSB+Azoto 7kg/ha., $B_3$ N$_1$. PSB+Azoto 7kg/ha. + 80: 60: 60 Kg (N.P.K per ha), $B_3$ N$_2$. PSB+Azoto 7kg/ha. + 60: 40: 40 kg (N.P.K per ha.), $B_3$ N$_3$. PSB+Azoto 7kg/ha. + 40: 20: 20 kg (N.P.K per ha.) were evaluated in Randomized Block Design (RBD) with three replications.

The seed of okra was sown in the beds first week of March. Full dose of phosphorus, potash and $\frac{1}{2}$ dose of Nitrogen was applied as basil dose while remaining $\frac{1}{2}$ dose of nitrogen were applied at two split doses first at 30 days after planting and second at the time of pod formation on top dressed. The source of nitrogen, phosphorus and potash were urea, single super phosphate and muret of potash. The use of Azotobacter and PSB half dose were applied at the time of planting and half dose of Azotobacter and PSB at 30 days after planting. The observation with regard to the growth and yield components was recorded from the five randomly selected plants. The mean vale of the recorded data was considered as the actual value of the respective character. The first observation were recorded at 30 days after planting and there after observation were recorded at a regular interval of 30 days up to 90 after planting. The mean data of the all selected plants analyzed statistically.

RESULTS AND DISCUSSION

EFFECT OF CHEMICAL FERTILIZERS

Chemical fertilizer is an important constituent of many chemicals compounds in the plots especially amino acids which play a vital role in regulation of growth and development of plants, the various phase of plant growth like germination, shoot growth flowering, fruit set and maturity of the fruit are also greatly influenced by the endogenous levels of growth hormones. But these plant processes can be considerably modified by the exogenous application of the growth regulating chemicals. Chemical fertilizer has the quickest and the most pronounced effect on vegetative growth and yield of pods. It enters and regulates many, physiochemical process of plant activities. Chemical fertilizer function as a necessary components of biological molecules, protein, amino acid, amides, pyrimidine, co-enzymes, and some of the vitamins. The number of days taken for 50% flowering (Table 1) shows that application of Chemical fertilizer decreased the days to 50% flowering period significantly. The maximum numbers of days were respect for the 50% flowering with unfertilized control, whereas highest dose of Chemical fertilizer (NPK) application required. More days required for 50% flowering. This may be due fact that high doses of Nitrogen fertilizer encourages vigorous growth and thus initialize early flowering. These results confirm the findings of Jalal and Ghaffoor (2002). Plant height increased significantly with the application of chemical fertilizer at 25.92: 19.44: 19.44 g/plot over control at 25.92: 19.44: 19.44, 19.44: 12.96: 12.96 and 12.96: 6.48: 6.48 g/plot increased 53.36, 57.70 and 65.80 per cent plant height at harvest.

The significant increase in plant height may be due cumulative effects of improvement in plant growth due more availability of chemical fertilizer. Plant height increased at a slow rate up to 60 DAS, there after, it increased at a faster rate up to 100 DAS. The number of branches increased significantly by the application of chemical fertilizer at 25.92: 19.44: 19.44, 19.44: 12.96: 12.96 and 12.96: 6.48: 6.48 g/plot at all the growth stages. Maximum number of branches per plant found at higher level of chemical fertilizer. The parameter number of leaves per plant and leaf area was influenced significantly by the application of
Table 1. Effect of chemical and bio fertilizer on growth and yield of Okra (Abelmoschus esculentus L. Moench).

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Plant height cm.</th>
<th>Number of branches per plant</th>
<th>Number of leaves per plant</th>
<th>Leaf area (cm²)</th>
<th>Lenght of internodes (cm)</th>
<th>Days at 50% flowering</th>
<th>Numb er of green pod per branches</th>
<th>Numb er of green pod per plant</th>
<th>Fresh weight of per pod (g)</th>
<th>Area of per green pod (cm²)</th>
<th>Green pod yield per plot</th>
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</thead>
<tbody>
<tr>
<td>Chemical Fertilizers</td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>N1</td>
<td>64.75</td>
<td>4.17</td>
<td>50.18</td>
<td>251.48</td>
<td>2.74</td>
<td>21.78</td>
<td>3.32</td>
<td>13.90</td>
<td>7.72</td>
<td>47.47</td>
<td>2575.39</td>
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<tr>
<td>N2</td>
<td>61.55</td>
<td>3.83</td>
<td>45.04</td>
<td>246.58</td>
<td>2.63</td>
<td>21.68</td>
<td>3.05</td>
<td>11.84</td>
<td>7.48</td>
<td>47.11</td>
<td>2125.52</td>
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<td>N3</td>
<td>60.02</td>
<td>3.65</td>
<td>41.91</td>
<td>243.73</td>
<td>2.68</td>
<td>22.35</td>
<td>2.97</td>
<td>10.63</td>
<td>7.04</td>
<td>46.60</td>
<td>1796.04</td>
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<td>Bio-fertilizers</td>
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<td>B0</td>
<td>53.96</td>
<td>3.33</td>
<td>27.41</td>
<td>231.93</td>
<td>2.90</td>
<td>22.44</td>
<td>3.39</td>
<td>8.58</td>
<td>6.90</td>
<td>43.83</td>
<td>1427.03</td>
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<tr>
<td>B1</td>
<td>66.28</td>
<td>4.01</td>
<td>50.60</td>
<td>249.93</td>
<td>2.67</td>
<td>20.26</td>
<td>3.39</td>
<td>13.31</td>
<td>7.68</td>
<td>48.27</td>
<td>2450.10</td>
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<td>B2</td>
<td>61.31</td>
<td>3.67</td>
<td>40.54</td>
<td>238.60</td>
<td>2.54</td>
<td>20.32</td>
<td>2.81</td>
<td>10.06</td>
<td>7.45</td>
<td>47.43</td>
<td>1796.31</td>
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<tr>
<td>B3</td>
<td>67.30</td>
<td>4.58</td>
<td>63.95</td>
<td>268.57</td>
<td>2.61</td>
<td>20.06</td>
<td>3.87</td>
<td>17.40</td>
<td>8.11</td>
<td>48.69</td>
<td>3382.56</td>
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<td>Control</td>
<td>39.00</td>
<td>2.00</td>
<td>25.00</td>
<td>220.00</td>
<td>3.00</td>
<td>27.80</td>
<td>1.83</td>
<td>3.64</td>
<td>6.51</td>
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<td>0.382</td>
<td>0.037</td>
<td>0.344</td>
<td>1.848</td>
<td>0.016</td>
<td>0.176</td>
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<td>0.085</td>
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<td>CD at 5%</td>
<td>1.104</td>
<td>0.108</td>
<td>0.996</td>
<td>5.338</td>
<td>0.047</td>
<td>0.510</td>
<td>0.068</td>
<td>0.288</td>
<td>0.245</td>
<td>1.363</td>
<td>62.587</td>
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</tbody>
</table>


The tendency of chemical fertilizer in increasing number of leaves and then leaf area was consistently up to 100 DAS. It was 100 per cent higher in number of leaf and 143.08 per cent high in leaf area with 25.92: 19.44: 19.44 N/plot over control. The maximum number of leaves and leaf area was recorded at 100 DAS with 25.92: 19.44: 19.44 g N/plot. The improvement in these parameters was probably due to vigorous plant growth (plant height and number of branch) and timely increased per plant and leaf area per plant. The variation in number of leaves and leaf area by the application of chemical fertilizer were also observed by Arora 1991, and Som kuwar (1997).

The respective increase in these parameters were 80.88 and 284.70 percent with 25.92: 19.44: 19.44gm NPK/plot over no fertilizations. It was also observed that lowest dose of chemical fertilizer significantly improved the number of green pods per branches and total number of green pods per plant at all the stages. The favourable effect of increased level of Nitrogen fertilizer on number of green pods per branches and per plant may be described to the availability of higher amount of nitrogen as well nutrients through at growth period. The green pod yield increased significantly with successive increase in fertilizer level up to 25.92: 19.44:19.44g/plot. Maximum pod yield 2575.39g per plot was recorded with 25.92: 19.44: 19.44 g NPK/plot followed by 2125.52 g with 19.44: 12.96: 12.96 g NPK/plot and 1796.06 g with 12.96: 6.48: 6.48 g NPK/plot. Expressed in percentage term, the increase in green pod yield and at 100 DAS with chemical fertilizer level i.e. 25.92: 19.44: 19.44, 19.44: 12.96: 12.96 and 12.96: 6.48: 6.48 g NPK/plot were 578.73, 468.17 and 393 per cent over control. The improvement in the green pod yield due to increasing levels of chemical fertilizer was brought...
about mainly due to the beneficial effect of fertilizer levels at various parameters i.e. plant height, leaf area, number of levels, number of green pods per branches and per plant. High green pod yield with higher doses of fertilizer application were also reported by Kurup, (1997), Reddy, (1984), Verma et al., (1974) and Sharma and Parsad (1973).

**EFFECT OF BIO-FERTILIZERS**

The bio-fertilizer application had significant increase in plant height as all the growth stages. The height dose of bio-fertilizer (B3) resulted taller plants as compared to remaining dose of height. This may be due to better availability of nutrients at higher levels consequently increased plant height. As frequently number of branches per plant significantly improved number of branches per plant. Maximum number of branches per plant was observed at higher dose of bio-fertilizer over control at all the growth stages. The number of leaves per plant and leaf area per plant increased significantly with increased bio-fertilizer levels over control. The per cent increase in number of leaves over control were PSB, Azotobacter and Azoto+PSB at 100 DAS was recorded, similarly, 3.02,7.76 and 15.79 per cent increase in leaf area at harvest was observed. The possible region in increased leaf area and number of leaves over control better plant height and more number of branches per plant. These results are in close conformity with the finding of Randhawa (1962) and Majanbu (1968).

The favourable effect of Bio Fertilizer in promotion of aforesaid growth parameters might be due to the fact that bio-fertilizer play a key role in energetic metabolism and biosynthetic reaction as a component of ATP, DNA, NADP and RNA which governs cell multiplication resulting in rapid plant growth. The stimulating effect of bio-fertilizer on the growth performance of crop might also be due to the rapid availability of nutrient from the soil to the plant as well as to micro-organism responsible for nitrogen fixation. Days taken for germination and 50% flowering were significantly delayed in control plots. It was observed that bio-fertilizer application recorded minimum days for germination as well as 50% flowering. Days to 50% flowering tended to be early with increasing levels of Bio-fertilizer due to the facts that Bio-fertilizer play a key role in energetic metabolism, and biosynthetic reaction as a component of ATP, DNA, NADP and RNA, which governs cell multiplication resulting in rapid completion of vegetative growth which return delayed to 50% flowering and maturity. In the present investigation application of Bio-fertilizer significantly improved various yield contributing characters viz. number of pods per branches, fresh weight of green pod, area of green pods and number of pods per plant (Table 1). The number of pods per plant at harvest increased significantly with Bio-fertilizer levels (B3) to the level of 7.30, 36.37 and 80.73 per cent invested over, B2, B1 and B3 over control. As regard fresh weight of green pod and are of were green pods 7.97,11.30 and 17.53 and 9.24, 10.13 and 11.08 per cent increase due to B2, B1 and B3 over control at 100 DAS. The fresh weight of green pods (g) yield at various growth stages were significantly higher with the application of Bio-fertilizer at B2, B1 and B3 levels over control. The addition of Bio-fertilizer (B2, B1 and B3) the pod yield 1796.31, 2450.10 and 3382.56 g per plot over control at 100 DAS. Increased in pod yield of okra due to Singh and Naik (1990), Sundaram et al., (1969) and Reddy, (1984).

**REFERENCES**


