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# Efficiency of Some Fertilizing Combinations on Growth and Yield in Okra (*Abelmoschus esculentus* L)

**W.M. Al-Joboory, Y.M. Abed[1], A.M. Salah[1] and N.S. Hussen[1]**

*Department of Soil & Water Resources, College of Agriculture, University of Anbar, Iraq*
*[1]Directorate of Agricultural Researches, Ministry of Agriculture, Baghdad, Iraq*
*E-mail: ag.waqas.mahmood@uoanbar.edu.iq*

***Abstract:*** Field trial was conducted at Directorate of Horticulture, Abu Ghreib, Iraq during 2017 season to assess the efficiency of some fertilizer combinations of bio+ organic fertilizers and was compared to chemical fertilizer (urea) for their effect on growth and yield of Okra. Six treatments were involved in trial viz, control (400kg N+280Kg P+200Kg K per hectare), organic fertilizer, organic fertilizer + *Trichoderma*, organic fertilizer+ bacterial inoculum and *Trichoderma*+ bacterial inoculation. The combination of organic +bacterial inoculum fertilizer significantly increased plant height (76.0 cm), branches per plant (6.03), leaves per plant (82.3), fruit per plant (62.0) and plant yield per plant (568.3gm). The organic +bacterial inoculum fertilizer on okra was very efficient. Consequently, this combination could be used to maximize the yield of okra.

***Keywords***: Okra, Biofertilizer, Organic fertilizer, NPK, Growth, Yield

Okra (*Abelmoschus esculentus* L.) belongs to the family (Malvaceae) which is one of the wide spread vegetable crops in Iraq. Recently, scientific studies confirmed chemical fertilizers possessed negative impacts on the ambient environment and makes a serious threat on human health, and fertilizers had direct effect on the soil micro-organisms. Therefore, attempts are made to reduce the use of chemical fertilizers and insecticides and shift bio-organic agricultural technologies where the organic fertilizers and useful micro-organisms are applied to sustain the productivity. The use of the chemical fertilizers increases crop yield, however, it causes more loss of soil quality and results in loss soil fertility and increases water contamination (Rajasekaran et al 2012). Singaravel et al (2008) concluded that application of liquid bio-fertilizers as nitrogen-fixing *Azospirillum* and adding *Phosphobacter* added directly to the soil or sprayed significantly increased in the yield of Okra. Moreover, Nunes et al (2018) found that the low to low distance between plants combined with bio-fertilizer increased yield. Rafique et al (2018) concluded that in Okra, *Azotobacter* spp, *Azospirillum* spp., *Bacillus* spp., *Pseudomonas* spp. and *Rhizobium* spp. inoculations increased yield by 21-23.5. Kumar et al (2018) recorded maximum production with 100% NPK and Azospirillum spp. bio-fertilizer. This study aimed to investigate the effect of some combinations of organic and bio-fertilizers efficiency and comparing it on chemical fertilizer (urea) on Okra growth and yield.

## MATERIAL AND METHODS

The field trial was carried out at Department of Horticulture, Abu Ghreib, Iraq for the season 2017. Soil samples were collected and physical and chemical characters were estimated (Black 1965) (Table 1). Drip irrigation system was established on terraces of 8 m along and 0.6m wide. The space between each two terraces was 0.5m and the experimental area was 2.4 $m^2$. Each plot included eight plants on the both sides of the terrace. The space between each two plants was 0.3 m with 0.2 m as a space between experimental units and blocks to avoid nutrients transferring among treatments. The experiment included 6 treatments: control treatment (To) where fertilizer added as recommended, organic fertilizer (T1), organic and fungal inoculation (T2), organic and bacterial inoculation(T3), only fungal inoculation (T4), and (only bacterial inoculation (T5). Only 50% of the fertilizer dose was added to all treatments except the control where phosphate was added as diammonium phosphate (DAP), potassium was applied as potassium sulfate (K 44%) and urea (N 46%), as 400 Kg N, 280 Kg P, and 200 Kg K, respectively. All fertilizers were applied once when preparing soil for planting, except nitrogen which was added in three parts: at planting, three weeks after planting and at flowering stage. Organic fertilizer was peat moss enhanced by nutrient elements was applied by 1% weight of soil, and the inoculations used were: *Trichoderma* spp. (fungal inoculation) *Pseudomonas fluorescence* + *Azotobacter* spp. (bacterial inoculation). Seeds were inoculated with fungal and bacterial inocula via soaking seeds in solution of these inocula. Local Petra cultivar seeds were planted in mixed silty clay loam on April

the 4th, 2017 and covered with black plastic to reduce weeds growth and evaporation rates. Treatments were randomly distributed relied on one-way system experiment. Data were recorded on plant height, number of branches, number of leaves, plant number of fruits and plant yield. Some chemical and physical properties of the soil of are in Table 1.

**Statistical analysis:** Data were one way analyzed according to RCBD with significant level of 5%.

## RESULTS AND DISCUSSION

**Vegetative Growth traits:** The significant effect of the bio-inoculation, organic and mineral fertilizers was observed on plant growth. The bacterial inoculation with organic fertilizer (T3) showed superiority compared to the other treatments in plant height (76cm) except the fungal bio-fertilizer with organic fertilizer (T2) (74cm), while the lowest average of plant height was in control (67 cm). The treatment of organic fertilizer +bacterial inoculation (T3) recorded the maximum branches per plant (6.03) branches, the followed by T1 and T5 were significantly superior compared to the other treatments. Increase in the branch per plant was 10.4 percent in T3 10.4% as compared.

Bacterial inoculation with organic fertilizer (T3) achieved highest leaves per plant were 82.3 followed by fungal bio-fertilizer with organic fertilizer (T2) (82). The least rate of leaves number per plant was 72.7 and the percentage of increase in the number of leaves was spotted in T3 treatment 13.2% compared to control. Increase of vegetative traits could be attributed to that the bacterial inoculation with organic fertilizer leads to contentious availability of nutrient elements during plant growth stages due to the activity of micro-organisms and their secretion and producing of acids and chelate compounds that stimulate plant growth. Moreover, the dissolution of phosphorus and potassium in soil minerals or in the fertilizer itself, also fixation of its need of aero nitrogen by those organisms in the fertilizer, where the organic bio-fertilizer contains different types of microorganism that fixation nitrogen and dissolving phosphorus which have important roles in the availability of soil nutrients for plant throughout secretion of growth regulators , organic acids and chelate compounds that cause the increase in different elements absorption (Gyaneshwar et al 2002).

**Fruits Number and plant yield:** The combinations of bio-inoculation, organic and urea has significant effects on the quantitative traits, where the organic fertilizers+ bacterial inoculation (T3) had the superiority on the other combinations on fruits per plant where the highest average of this trait was 62 fruit plant$^{-1}$, while the least was 46.3 fruits for the treatment of organic fertilizer (T1). The percent increase

**Table 1.** Chemical and physical properties of the soil

| Character | Unit | Value |
|---|---|---|
| pH | | 7.61 |
| ECe | dS m$^{-1}$ | 3.8 |
| OM | g kg$^{-1}$ | 8.5 |
| Available-N | mg kg$^{-1}$ | 89 |
| Olsen P | mg kg$^{-1}$ | 12 |
| Available-K | mg kg$^{-1}$ | 311 |
| CaCO3 | % | 23 |
| Bulk density | µg m$^{-3}$ | 1.40 |
| Clay | % | 35.0 |
| Silt | % | 54.3 |
| Sand | % | 10.7 |
| Textural class | Silty Clay Loam | |

**Table 2.** Effect of fertilizer combination on vegetable growth characteristics

| Treatments | Plant height (cm) | Number of branches plant$^{-1}$ | Number of leaves plant$^{-1}$ |
|---|---|---|---|
| To | 67.6 | 5.46 | 72.7 |
| T1 | 58.3 | 5.56 | 76.0 |
| T2 | 74.0 | 5.36 | 82.0 |
| T3 | 76.0 | 6.03 | 82.3 |
| T4 | 73.3 | 4.80 | 77.3 |
| T5 | 71.3 | 5.56 | 73.0 |
| LSD (p=0.05) | 2.3 | 0.18 | 7.7 |

**Table 3.** Effect of fertilizer combination on fruits and plant yield

| Treatments | Fruit (fruits plant$^{-1}$) | Yield (gm plant$^{-1}$) |
|---|---|---|
| To | 49.0 | 313.7 |
| T1 | 46.3 | 358.7 |
| T2 | 56.0 | 398.3 |
| T3 | 62.0 | 568.3 |
| T4 | 59.3 | 544.3 |
| T5 | 58.6 | 528.3 |
| LSD (p=0.05) | 1.08 | 8.15 |

of fruit per plant was 33.9% in T3 followed by 62.5% in T1 in comparison to control.

The organic fertilizers+bacterial inoculation treatment (T3) had significant superiority on the other treatments, 568.3 gm per plant, followed by *Trichoderma* (T4) (544.3 gm per plant). Increasing in percentage were 81 and 73.5 for T3 and T4, respectively in comparison to control. The superiority of yield quantitative traits by applying of such fertilizers compared to traditional fertilizers attributed to bio-fertilizers support for nutrition elements to the plant as well as contents of bacterial and fungal leachates stimulate cells division which causes increase in the number of branches. The fertilizers also remain available for long time and improve some soil properties related to plant growth and contain micro-organisms active to increase availability of nutrients for plants where they stabilize nitrogen and dissolve phosphorus to be available in addition to production of plant hormones to increase plant yield (Salantur et al 2006, Egamberdiyeva 2007).

## CONCLUSION

The study illustrated that fertilizer combinations were very effective and efficient especially organic fertilizers+bacterial inoculation to improve okra growth and yield. This combination improved foliar traits like plant height, branches per plant and leaves per plant. Furthermore, this treatment improved fruit per plant and yield. So, this fertilizer could be effectively exploited to fertilize okra.

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