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**Jitendra Singh Bamboriya**

Department of Soil Science and  
Agricultural Chemistry, S.K.N.  
Agriculture University, Jobner,  
Rajasthan, India

**SR Naga**

Department of Soil Science and  
Agricultural Chemistry, S.K.N.  
Agriculture University, Jobner,  
Rajasthan, India

**Poonam Kumari Yadav**

Department of Soil Science and  
Agricultural Chemistry, S.K.N.  
Agriculture University, Jobner,  
Rajasthan, India

**Sushila Aechra**

Department of Soil Science and  
Agricultural Chemistry, S.K.N.  
Agriculture University, Jobner,  
Rajasthan, India

**Shital Yadav**

Department of Soil Science and  
Agricultural Chemistry, S.K.N.  
Agriculture University, Jobner,  
Rajasthan, India

**Corresponding Author:**

**Jitendra Singh Bamboriya**

Department of Soil Science and  
Agricultural Chemistry, S.K.N.  
Agriculture University, Jobner,  
Rajasthan, India

## Effect of organic manures and biofertilizers on chemical and biological properties of soil in okra [*Abelmoschus esculentus* (L.) Moench] on loamy sand soil

**Jitendra Singh Bamboriya, SR Naga, Poonam Kumari Yadav, Sushila Aechra and Shital Yadav**

### Abstract

The present experiment was conducted at Horticultural Research Farm, SKN College of Agriculture, Jobner, Rajasthan during 2017. The experiment was conducted in a randomized block design with sixteen treatments replicated thrice. The treatments include different organic manures (control, FYM @ 20 t ha<sup>-1</sup>, vermicompost @ 6 t ha<sup>-1</sup> and poultry manure @ 8 t ha<sup>-1</sup>) with biofertilizers (control, Azospirillum, PSB and Azospirillum+ PSB). The results showed that application of FYM @ 20 t ha<sup>-1</sup> recorded the maximum values of soil organic carbon (2.5 mg g<sup>-1</sup>), available nitrogen (127.49 kg ha<sup>-1</sup>); dehydrogenase (15.86 µg TPF/g soil/hr) and alkaline phosphate activity (11.85 µg PNP/g soil/hr) and microbial population (actinomycetes, fungi and bacteria). Among different biofertilizers Azospirillum+ PSB resulted significantly increased all soil parameters (soil organic carbon, available N, P and K content, enzymatic activities and microbial population).

**Keywords:** Organic manures, biofertilizers, okra, enzymatic activity, microbial biomass

### Introduction

Okra (*Abelmoschus esculentus* L.) is one of the most important nutritious vegetable crop having high commercial and food values and grown round the year in India. India is a largest producer of okra in the world with an annual production of 60.73 mt from an area at 5.06 lakh hectare (NHB, 2017) [1].

Being a short duration crop, its growth and yield parameters are largely influenced by appropriate nutrient management practices. Among the various factors affecting successful cultivation of okra, the judicious fertilizer application is one of those. Application of chemical fertilizers to meet the crop nutrient demand is deleterious for both soil and environment (Thirunavukkrasu and Balaji, 2015) [4]. Use of organic manures to meet the nutrient requirement of crop would be an inevitable practice in the years to come for sustainable agriculture since, organic manures generally improves the soil physical, chemical and biological properties along with conserving the water holding capacity of soil resulting in enhanced crop productivity along with maintaining the quality of crop produce (Premsekhar and Rajshree, 2009) [3]. The lost biological activity in the soil, due to excess use of chemical fertilizers, can be restored slowly by incorporating artificially multiplied cultures of beneficial microorganisms in the form of biofertilizers. Integration of organic manures and biofertilizers can improve crop productivity.

Keeping in view the above facts and need of optimum use of organic manures and biofertilizers, an experiment entitled "Effect of organic manures and biofertilizers on chemical and biological properties of soil in okra on Loamy Sand Soil is carried out.

### Materials and Methods

A field experiment was conducted during the *kharif* season of 2017 at the Horticulture farm, S.K.N. College of Agriculture, Jobner (Rajasthan), to evaluate the effect of organic manures and biofertilizers on chemical and biological properties of soil in okra on Loamy Sand Soil. The soil was loamy sand in texture, having slight alkaline reaction (pH 8.1), low in available nitrogen (124.74 kg ha<sup>-1</sup>), medium in available phosphorus (18.84 kg ha<sup>-1</sup>) and potassium (147.50 kg ha<sup>-1</sup>). The experiment was consisted of four levels of organic manures (control, FYM @ 20 t ha<sup>-1</sup>, vermicompost @ 6 t ha<sup>-1</sup> and poultry manure @ 8 t ha<sup>-1</sup>) and four levels

of biofertilizers (control, *Azospirillum*, PSB and *Azospirillum* + PSB) in randomized block design. Okra variety 'Arka Anamika' was sown at 60 cm × 45 cm row and plant to plant spacing on 28<sup>th</sup> July, 2017 with a seed rate of 15 kg/ha. The half dose of nitrogen and full dose of phosphorus and potassium was applied as per treatments at sowing time and the remaining dose of nitrogen through urea was applied in two equal splits at 30 and 45 DAS. All the biometrical observation on soil was observed as per the standard practices. Statistical analysis of the data was done as per the standard analysis of variance technique for the experimental design (Panse and Sukhatme, 1985)<sup>[2]</sup>.

## Results and Discussion

### Effect of Organic manures

Among the different organic manures, FYM @ 20 kg ha<sup>-1</sup> significantly increased soil parameters like soil organic carbon (2.5 mg g<sup>-1</sup>), available nitrogen (127.49 kg ha<sup>-1</sup>), dehydrogenase (15.86 µg TPF/g soil/hr) and alkaline phosphate activity (11.85 µg PNP/g soil/hr). This treatment was also superior in actinomycetes (38.81 x10<sup>4</sup> CFU g<sup>-1</sup> soil), fungal (26.11 x10<sup>4</sup> CFU g<sup>-1</sup> soil) and bacterial (56.14 x10<sup>6</sup> CFU g<sup>-1</sup> soil) population at flowering stage whereas the maximum values of available phosphorus (24.37 kg ha<sup>-1</sup>) and potassium (156.82 kg ha<sup>-1</sup>) content were recorded under vermicompost @ 6 kg ha<sup>-1</sup> (Table 1). Application of FYM might have helped the soil to improve the nutrient status, water holding capacity, physical, chemical and biological properties which in turn helped better absorption of nutrients and expression of better biometrical parameters. The FYM has always been one of the principal means of replenishing soil losses. It supplies soil organic matter (SOM) which is an

indicator of life, soil health and even its production capacity. FYM also provided room for better establishment of inoculated microorganisms along with accumulation of excess humus content. Conjoint application of FYM and biofertilizers might have acted complementary and supplementary to each other and resulted in adequate and slow, but steady supply of nutrients resulting in better parameters.

### Effect of Biofertilizers

Combined application of *Azospirillum*+ PSB recorded the maximum soil organic carbon (2.37 mg g<sup>-1</sup>); available nitrogen (124.75), phosphorus (23.72) and potassium (153.94 kg ha<sup>-1</sup>) content in soil. Dehydrogenase (16.17 µg TPF/g soil/hr) and alkaline phosphate (11.93 µg PNP/g soil/hr) activity and microbial population at flowering time also increased with *Azospirillum*+ PSB treatments (table 2). The inoculation of *Azospirillum* might have enhanced the fixing the atmospheric nitrogen and increased the solubility and mobility of the nitrogen which may have added further nitrogen in the soil. The *Azospirillum* bacteria present in biofertilizers are reported to produce a variety of growth-promoting substances, including IAA, gibberellins and B vitamins (Hedge *et al.* 1999)<sup>[5]</sup>. Addition of higher amount of PSB might have prevented the fixation of phosphorus in the soil and ensure steady supply throughout the growth period that helped in better root growth, higher solubility and availability and better uptake of soil phosphorus by the okra plants by contributing organic acid and growth hormone like auxin and cytokinin which might have mobilize the soil phosphorus.

**Table 1:** Effect of organic manures and biofertilizers on organic carbon N, P and K content of soil.

| S. No.                    | Treatment                             | Organic carbon content (mg g <sup>-1</sup> ) | Available N (kg ha <sup>-1</sup> ) | Available P <sub>2</sub> O <sub>5</sub> (kg ha <sup>-1</sup> ) | Available K <sub>2</sub> O (kg ha <sup>-1</sup> ) |
|---------------------------|---------------------------------------|----------------------------------------------|------------------------------------|----------------------------------------------------------------|---------------------------------------------------|
| <b>A. Organic Manures</b> |                                       |                                              |                                    |                                                                |                                                   |
| 1                         | Control                               | 2.08                                         | 116.05                             | 18.71                                                          | 146.05                                            |
| 2                         | FYM @ 20 t ha <sup>-1</sup>           | 2.50                                         | 127.49                             | 21.35                                                          | 150.03                                            |
| 3                         | Vermicompost @ 6 t ha <sup>-1</sup>   | 2.29                                         | 120.08                             | 24.37                                                          | 156.82                                            |
| 4                         | Poultry manure @ 8 t ha <sup>-1</sup> | 2.36                                         | 123.42                             | 22.88                                                          | 153.32                                            |
|                           | S.Em.±                                | 0.03                                         | 1.30                               | 0.51                                                           | 1.13                                              |
|                           | CD (P=0.05)                           | 0.09                                         | 3.75                               | 1.48                                                           | 3.25                                              |
| <b>B. Bio-Inoculants</b>  |                                       |                                              |                                    |                                                                |                                                   |
| 1                         | Control                               | 2.25                                         | 118.08                             | 19.19                                                          | 147.98                                            |
| 2                         | <i>Azospirillum</i>                   | 2.31                                         | 122.77                             | 21.56                                                          | 152.50                                            |
| 3                         | PSB                                   | 2.30                                         | 121.44                             | 22.83                                                          | 151.80                                            |
| 4                         | <i>Azospirillum</i> + PSB             | 2.37                                         | 124.75                             | 23.72                                                          | 153.94                                            |
|                           | S.Em.±                                | 0.03                                         | 1.30                               | 0.51                                                           | 1.13                                              |
|                           | CD (P=0.05)                           | NS                                           | 3.75                               | 1.48                                                           | 3.25                                              |

**Table 2:** Effect of organic manures and biofertilizers on enzymatic activity and rhizospheric microbial population of soil.

| S. No.                    | Treatment                             | Dehydrogenase activity (µg TPF/g soil/hr) | Alkaline phosphatase activity (µg PNP/g soil/hr) | Actinomycetes (x10 <sup>4</sup> CFU g <sup>-1</sup> soil) | Fungi (x10 <sup>4</sup> CFU g <sup>-1</sup> soil) | Bacteria (x10 <sup>6</sup> CFU g <sup>-1</sup> soil) |
|---------------------------|---------------------------------------|-------------------------------------------|--------------------------------------------------|-----------------------------------------------------------|---------------------------------------------------|------------------------------------------------------|
| <b>A. Organic Manures</b> |                                       |                                           |                                                  |                                                           |                                                   |                                                      |
| 1                         | Control                               | 14.89                                     | 10.77                                            | 17.98                                                     | 16.70                                             | 25.27                                                |
| 2                         | FYM @ 20 t ha <sup>-1</sup>           | 15.86                                     | 11.85                                            | 38.81                                                     | 26.11                                             | 56.14                                                |
| 3                         | Vermicompost @ 6 t ha <sup>-1</sup>   | 15.75                                     | 11.42                                            | 36.19                                                     | 24.67                                             | 55.52                                                |
| 4                         | Poultry manure @ 8 t ha <sup>-1</sup> | 15.66                                     | 11.33                                            | 30.48                                                     | 22.89                                             | 50.44                                                |
|                           | S.Em.±                                | 0.14                                      | 0.15                                             | 1.07                                                      | 0.58                                              | 1.42                                                 |
|                           | CD (P=0.05)                           | 0.41                                      | 0.44                                             | 3.09                                                      | 1.66                                              | 4.11                                                 |
| <b>B. Bio-Inoculants</b>  |                                       |                                           |                                                  |                                                           |                                                   |                                                      |
| 1                         | Control                               | 14.72                                     | 10.52                                            | 15.91                                                     | 18.90                                             | 35.11                                                |
| 2                         | <i>Azospirillum</i>                   | 15.69                                     | 11.47                                            | 34.57                                                     | 23.42                                             | 49.47                                                |
| 3                         | PSB                                   | 15.58                                     | 11.45                                            | 34.08                                                     | 22.49                                             | 48.06                                                |
| 4                         | <i>Azospirillum</i> + PSB             | 16.17                                     | 11.93                                            | 38.91                                                     | 25.56                                             | 54.71                                                |
|                           | S.Em.±                                | 0.14                                      | 0.15                                             | 1.07                                                      | 0.58                                              | 1.42                                                 |
|                           | CD (P=0.05)                           | 0.41                                      | 0.44                                             | 3.09                                                      | 1.66                                              | 4.11                                                 |

### Conclusion

On the basis of one year field experimentation, it seems quite logical to conclude that soil organic carbon content, available nitrogen content, enzymatic activities and rhizospheric microbial population (actinomycetes, fungi and bacteria) increased with application of FYM 20 t ha<sup>-1</sup>. However, available phosphorus and potassium content increased with application of vermicompost 6 t ha<sup>-1</sup>. Among biofertilizers treatments seed inoculation with *Azospirillum* and PSB was superior in all soil parameters.

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