# EFFECT OF BIOFERTILIZERS ON THE SOIL STATUS OF BRINJAL FIELDS

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**Abstract:** Soil status studied through pre-sown and post-harvest soil analysis. The influence of biofertilizer inoculation, viz. *Azotobacter* and Phosphate Solubilising Bacteria (*PSB*) alone and in different combinations with recommended dose of chemical fertilizer (NPK) on Brinjal crop was tested during the Kharif season (2008-09) at agricultural fields (21°35'72.51 N; 78°98'21.32 E) to explore the possibility of reducing doses of chemical fertilizers and for better soil health. The results in brinjal soil revealed that the water holding capacity decreased (7.11%) in Chemical Fertilizer Treatment (CFT) while it increased (9.86 to 14.70%) in Biofertilizer Treatment (BfT). pH increase in the CFT whereas decrease in BfT. Electrical conductivity increased (1.66 to 6.63%) in CFT. Organic carbon decreased (0.02%) in CFT and increased (0.06 to 0.09%) in BfT. Available nitrogen have shown increased level (1.27 to 18.99%) in CFT and BfT. Phosphorous increase in CFT and BfT. Potassium increased (24.38%) in CFT while decreased (13.09 to 14.09%) in BfT alone. *Azotobacter* and PSB were significantly increased in biofertilizer treatment as compare to chemical fertilizer treatment in brinjalfield.

**Keywords**: Biofertilizers, NPK, Organic carbon, Water holding capacity.

**Introduction:** There is an enormous use of chemicals in modern agriculture. Fertilizer consumption has increased about 323 times in India during the period from 1950 to 2012. In Maharashtra (India), NPK consumption was 64.30 kg/ha in 2003-04 and the same is raised up to 163.40 kg/ha in 2010-11. The use of nitrogen fertilizer not only spoils the ground water, soil but also have deleterious effects by the emission of harmful gases [7]. The chemical fertilizers should be replaced with organic farming, organic manures which can play a key role of the conservation of the environment. Applications of higher quantity of fertilizer without considering the crop requirement adversely affect the microbial population and soil health [13], [12].

Soil is a complex system of minerals, organic matter, water and air. The analysis of soil is very important because its equilibrium does not remain constant. Soil testing is a scientific mean for quick characterization of the fertility of soils to assess the nutrient deficient areas and recommend suitable nutrient doses through fertilizers for different cropping systems. Soil pH influences the availability of nutrients to crops and affects microbial population in soils. Soil organic matter is responsible to increase the water holding capacity of farm soil[19].

The "All India Network Project on Bio-fertilizers", initiated by ICAR with a focus on enhancing productivity and supplementing a part of chemical fertilizer needs of crops through inoculation of Bio-fertilizers. Though bio fertilizers cannot replace the chemical fertilizers completely, their application with them can improve soil quality, yield and reduce chemical fertilizers demand up to 35% [16]. Brinjal (*Solanum melongena* L.)is one of the important and major vegetable crops in Saoner Taluka of the Nagpur district (M.S.) with very fragmented attempts of biofertilizer applications. In view of these the present investigation was undertaken to study the nutritional and microbiological status of pre-sown and post-harvest soils with special reference to water holding capacity, pH, electrical conductivity, organic carbon, available NPK, *Azotobacter* and *Bacillus* (PSB). Further, investigations were also expected to achieve higher yield, compensation of half dose by biofertilizers, soil fertility by improving its properties, residual N and microflora.

**Materials and Methods:** The experiments were laid down during Kharif season of 2008-09. The Randomized Block Design with four replications was adopted in field experiments. The brinjal variety Syngenta Green-Crown was given a spacing of 80-85 cm between two plants and 90-100 cm between adjacent lines. Overall the soil of experimental plots was medium-black. The pre-sown soil data was utilized to calculate the proper recommended dose of chemical fertilizer (RDF) in the form of granular urea, single super phosphate and muriate of potash. The RDF for brinjal fields was 75 N: 75 $P_2O_5$: 00 $K_2O$. RDF was calculated as per the ICAR and PKV recommendations. The agronomic practices were followed uniformly.

NPK fertilizers given in split doses by top dressing in ring placement. The first application constitutes half dose of N and complete dose of P and K. Second constitutes remaining half dose of N. NPK and biofertilizer applications are not given at the same time. The bioinoculant cultures (*Azotobacter chrochoccum* as AZT and *Bacillus polymyxa* as PSB) were confirmed from the RCOF, Nagpur, Ministry of Agriculture, Govt. of India. The brinjal seedlings were treated with liquid bioinoculant of viable cellcount. Second inoculation of biofertilizers was made by broadcasting near the root zone of plants approximately after a month. The treatments were T-1: 100% RDF of NPK; T-2: 50% RDF of NPK + *AZT* + *PSB;* T-3: 50% RDF of NPK + *AZT;* T-4: *AZT* + *PSB;* T-5: *AZT* and T-6: Control.

The soil samples (pre-sown and postharvest) were collected from the experimental fields (21°35'72.51 N; 78°98'21.32 E) as per the procedure recommended [15]. The soil was analyzed by standard methods for physico-chemical parameters. Water holding capacity[18]; the pH of suspension was measured by digital pH meter. Determination of organic carbonby volumetric method [21], electrical conductivity using standard KCl solution, the available soil N was estimated by alkaline permanganate method [17]. The available P by the method described by [11]. The available K by the method described by [6]. Bacterial cultures of *A. chrococcum* and *B.polymyxa* were preparedin Jensen's and Pikovskaya's medium respectively, with respect to their specifications. Collection and isolation of *Azotobacter* and PSB was performed by using serial dilution of rhizosphere soil suspension whereas, quantitative estimation by the standard plate counting method.

**Results and Discussion**(Table: 1): The water holding capacity (WHC) of pre-sown soil in brinjal field was recorded as 60.87%. Post-harvest soil analysis has shown the maximum (69.82%) WHC in the treatment *AZT* + PSB. It was followed by other treatments and minimum (60.25%) in 100% RDF of NPK. 100% RDF of NPK and control treatments have lost the WHC of soil over biofertilizer treatments. The combined treatments of biofertilizer and NPK have shown moderate increase in the WHC over the pre-sown, i.e. up to 9.86 to 11.88%. It indicates that the biofertilizer adds more organic matter in the soil and create more pore spaces to hold the water. These results are in conformity with [3], [20], [19].

Soil pH may stimulate or inhibit seed germination and growth processes. The pH of pre-sown soil in brinjal field was moderately alkaline and recorded as 8.35. The post-harvest soil analysis has shown the increased (8.39) pH values in 100% RDF of NPK and the combination of NPK + biofertilizers. Biofertilizer treatments recorded reduced pH (8.30) over the pre-sown. Overall the 100% RDF of NPK increases pH more as compare to the combined treatment of NPK + biofertilizers. These findings are in close agreement with [1], [8].

Soil electrical conductivity is mainly depends upon the salinity. The EC of pre-sown soil in brinjal field was recorded as 0.181 $dSm^{-1}$. The post-harvest soil analysis has shown the increased EC values in 100% RDF of NPK (0.193 $dSm^{-1}$) and the combination of NPK + biofertilizers (0.184 $dSm^{-1}$). Biofertilizer treatments recorded reduced (0.149 - 0.164 $dSm^{-1}$) EC over the pre-sown. Overall the 100% RDF of NPK increases EC more as compare to the combined treatment of NPK + biofertilizers. Biofertilizers alone lower EC significantly. It indicates that the chemical fertilizers are responsible for the enhanced salinity of the soil. These findings are in close agreement with [8],[1].

The combined treatments of RDF of NPK + *AZT* + PSB and *AZT* alone have found increased organic carbon by 14.29 to 21.43% over the pre-sown soil. Whereas, the 100% RDF of NPK have lost 4.76% organic carbon as compare to pre-sown condition. The data indicates that the chemical fertilizers are responsible for the reduction of organic carbon from soil, while the biofertilizers adds it. This investigation is in close conformation with [8], [2], [1].

The available N in pre-sown soil of brinjal field was recorded as158 $kgh^{-1}$. The treatments 100% RDF of NPK, *AZT* + PSB + 50% RDF of NPK, 50% RDF of NPK + *AZT, AZT* + PSB, *AZT* alone, and control have shown 1.90%, 13.52%, 18.99%, 2.53%, 1.26% and -34.81% increased N over the pre-sown status respectively. It indicates that the chemical fertilizers as well as biofertilizers contribute towards the residual effect of N. These findings are in close agreement with [4],[2], [10].

The available P in pre-sown soil was recorded as 7.38 $kgh^{-1}$. The post-harvest soil analysis has shown the maximum P in the treatment *AZT* + PSB + 50% RDF of NPK (20.25 $kgh^{-1}$) and 100% RDF of NPK (16.77 $kgh^{-1}$). The minimum P was observed in *AZT* alone and control treatments. It indicates that the chemical fertilizers as well as combined biofertilizer treatment contribute towards the available P. These results are in close conformity with [14], [8], [2], [1], [10].

The available K in pre-sown soil was recorded as 443$kgh^{-1}$. The post-harvest soil analysis has shown the maximum K in the treatment 100% RDF of NPK (551$kgh^{-1}$). NPK and biofertilizers has shown increased level (6.1 to 9.03%) of K. The other treatments have shown declined level of available K. Similar kind of results are also obtained through the work of [1], [8].

The pre-sown count of *Azotobacter* was $57x10^1$ Cfu/ml, which becomes almost four times more in *AZT* soil treatment alone and in combination. The maximum ($172x10^4$ Cfu/ml) population of *AZT* was reported in the treatment of *AZT* + PSB. This population might have maintained due to the addition of bioinoculants. It has been observed that the value of *Azotobacter* estimation was much higher in its single treatment or in combination with PSB, but shown comparatively lower values in combination with the chemical fertilizers. It suggests that the bacterial population is hampered by chemical fertilizer treatment which may adversely affect the soil fertility. The quantitative estimation of postharvest soils has shown increased population over the straight chemical fertilizer treatment and the control treatment. The maximum count of *Azotobacter* doesn't mean more N fixation because it also requires availability of organic matter in the soil.

The observations in this investigation are also supported by [5], [9].

In brinjal pre-sown soil count of PSB was very low ($301x10^1$ Cfu/ml). The highest estimated value ($191x10^5$ Cfu/ml) of PSB in post-harvest soil was recorded in the treatment of *AZT* + PSB and followed by the treatment 50% RDF of NPK + *AZT* + PSB ($67x10^4$ Cfu/ml). The minimum PSB population was found in control treatment ($83x10^1$ Cfu/ml). These results are in agreement with [22], [1], [10].

Application of chemical fertilizers alone decreases the water holding capacity and organic carbon from the soil and may increase salinity. Application of biofertilizers alone and in dual combination keeps these parameters in favour of soil. Residual effect with reference to N and P remained on higher side in both kinds of fertilizer treatments. Biofertilizer treatment is must to retain the population of beneficial microflora in rhizosphere. The proper application of biorfertilizers can reduce RDF dose of NPK. Integrated and judicious use of inorganic and organic sources of fertilizers is essential for soil fertility in the modern agriculture.

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**Table: 1: Pre-sown and post harvest soil analysis in the Brinjal field.**

| Soil Property | Pre-sown soil | Post-harvest soil | | | | | |
|---|---|---|---|---|---|---|---|
| | | T-1 | T-2 | T-3 | T-4 | T-5 | T-6 |
| WHC(%) | 60.87 | 60.25 | 68.10 | 66.87 | 69.82 | 69.24 | 62.36 |
| pH | 8.35 | 8.39 | 8.36 | 8.38 | 8.30 | 8.31 | 8.27 |
| EC $dSm^{-1}$ | 0.181 | 0.193 | 0.184 | 0.184 | 0.149 | 0.164 | 0.156 |
| OC (%) | 0.42 | 0.40 | 0.48 | 0.49 | 0.51 | 0.51 | 0.44 |
| Available N (kg/ha) | 158 | 161 | 180 | 188 | 162 | 160 | 103 |
| Available P (kg/ha) | 7.38 | 16.77 | 20.25 | 14.43 | 15.67 | 7.12 | 7.10 |
| Available K (kg/ha) | 443 | 551 | 483 | 470 | 385 | 377 | 344 |
| Available *AZT* | $57x10^1$ | $17x10^2$ | $130x10^4$ | $148x10^4$ | $172x10^4$ | $152x10^4$ | $36x10^1$ |
| Available PSB | $301x10^1$ | $387x10^1$ | $67x10^4$ | $204x10^1$ | $191x10^5$ | $67x10^1$ | $83x10^1$ |

WHC= water holding capacity; EC= electrical conductivity; OC= organic carbon.

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