RESEARCH ARTICLE

Influence of Biofertilizers on the Soil Status of Cotton Field

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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 Cotton crop was tested during the Kharif season of 2007-2008 at agricultural field ($21^0$40'76.97 N; $78^0$96'22.70 E) to explore the possibility of reducing doses of chemical fertilizers and for better soil health. The results in cotton soil revealed that the water holding capacity decreased (7.11%) in Chemical Fertilizer Treatment (CFT) while it increased (3.8 to 12.37%) in Biofertilizer Treatment (BfT). Electrical conductivity increased (1.81 to 4.35%) in CFT. Organic carbon decrease in CFT and increase in BfT. Available nitrogen shown increased level (1.96 to 26.14%) in CFT and BfT. Phosphorous increase (10.87 to 19.52%) in CFT. Potassium increase (3.62%) in CFT while decreased (0.36 to 6.7%) in BfT. *Azotobacter* and PSB were significantly increased in biofertilizer treatment as compare to chemical fertilizer treatment soil.

Key words: Biofertilizers, NPK, Water holding capacity, pH and Organic carbon.

INTRODUCTION

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. The chemical fertilizers should be replaced with organic farming, organic manures which can play a key role of the conservation of the environment, (Jangral and Lakra, 2014). Overuse of chemical fertilizers adversely affects the soil health by changing its physical, chemical and biological properties. Use of natural products like bio-fertilizers in crop cultivation helps in safeguarding the soil health (Panneerselvam *et al*, 2012).

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 chemical and organic 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. (Vengadaramana *et al*, 2012).

Bio-fertilizers containing beneficial bacteria and fungi improve soil characteristics, nutrient availability and crop production. 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 it cannot replace the chemical fertilizers completely, their application with them can improve soil quality, yield and reduce chemical fertilizers demand up to 35%. (Singh and Purohit, 2008). Cotton (*Gossypium hirsutum* L.) is the most important and major fibre crop in the Nagpur district (M.S.) in general and Saoner Taluka in particular 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). Broadly, it was 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 2007-2008. The Randomized Block Design with four replications was adopted in field experiments. The cotton variety Ankur-Jai Bt was given a spacing of 85-90 cm between two plants and 115-125 cm between lines. Overall the soils of experimental plots were 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 cotton field was 125 N: 75 P_2O_5: 25 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 given separately. The bioinoculant cultures (*Azotobacter chroochoccum* as AZT and *Bacillus polymyxa* as PSB) were confirmed from the RCOF, Nagpur, Ministry of Agri. Govt. of India. The delinted cotton seeds were treated with liquid bioinoculant of viable cell count. 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 (No treatment).

The soil samples (pre-sown and postharvest) were collected from the experimental fields ($21^0$40'76.97 N; $78^0$96'22.70 E) as per the procedure recommended by PKV Akola. The soil was analyzed by standard methods for physico-chemical parameters. Water holding capacity (WHC); the pH of suspension was measured by digital pH meter (Elico, Model: E 111). Determination of organic carbon by volumetric method (Walkley, 1947), electrical conductivity using standard KCl solution, the available soil N was estimated by alkaline permanganate method (Subbiah and Asija,1956). Available P by the method described by Olsen (1954). The available K by the method described by Jackson (1958). Bacterial cultures of *A. chroococcum* and *B. polymyxa* were prepared in 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

The water holding capacity (WHC) of pre-sown soil in cotton field was recorded as 66.25%. The post-harvest soil analysis has shown the maximum (69.74%) WHC in the treatment of AZT + PSB. It was followed by other treatments and minimum (61.54%) 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. 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 Volk, *et al*., (1993) and Vengadaramana *et al*. (2012) (Table: 1)

Table 1: Pre-sown and post harvest soil analysis in the Cotton field

Soil Property	Pre-sown soil	Post-harvest soil					
		T-1	T-2	T-3	T-4	T-5	T-6
WHC (%)	66.25	61.54	69.54	67.82	69.74	68.77	66.14
pH	7.82	7.89	7.84	7.85	7.41	7.43	7.39
EC dSm^{-1}	0.276	0.288	0.281	0.285	0.276	0.270	0.271
OC (%)	0.54	0.52	0.68	0.61	0.66	0.76	0.55
Available N (kg/ha)	153	193	187	172	159	156	151
Available P (kg/ha)	20.24	23.82	24.19	22.44	21.70	12.88	10.12
Available K (kg/ha)	552	572	550	561	548	515	516
Available *AZT*	$33x10^1$	$160x10^1$	$150x10^4$	$132x10^4$	$186x10^5$	$181x10^5$	$67x10^1$
Available PSB	$270x10^1$	$288x10^1$	$86x10^4$	$145x10^1$	$202x10^5$	$212x10^1$	$90x10^1$

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

The pH of pre-sown soil in cotton field was recorded as 7.82. The post-harvest soil analysis has shown the increased pH values in 100% RDF of NPK and the combination of NPK + biofertilizers. Biofertilizer treatments recorded reduced pH over the pre-sown, it was 7.41. 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 Katkar *et al* (2006) and Arbad *et al*, (2008).

Soil electrical conductivity is mainly depends upon the salinity. The EC of pre-sown soil in cotton field was recorded as 0.276 dSm^{-1}. The post-harvest soil analysis has shown the increased EC values in 100% RDF of NPK and the combination of NPK + biofertilizers. Biofertilizer treatments recorded reduced EC over the pre-sown, it was 0.270 dSm^{-1}. 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 Katkar *et al,* (2006) and Arbad *et al*, (2008).

The combined treatments of RDF of NPK + AZT + PSB and AZT alone have found increased organic carbon by 12.96 to 25.93% over the pre-sown soil in cotton. Whereas, the 100% RDF of NPK have lost 7.70% organic carbon over the 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 Katkar et al (2006), Barabde *et al*, (2008), and Arbad *et al*, (2008).

The available nitrogen in pre-sown soil of cotton field was recorded as153 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 26.14%, 22.22%, 12.42%, 3.92%, 1.96% and -1.31% 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 Jadhav *et al* (1987), and Nirphal *et al*, (2011).The available P in pre-sown soil of cotton field was recorded as 20.24 kgh^{-1}. The post-harvest cotton soil analysis has shown the maximum P in the treatment AZT + PSB + 50% RDF of NPK (24.19 kgh^{-1}) and 100% RDF of NPK (23.82 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 phosphorous. These results are in close conformity with Rachewad *et al.* (1992), Arbad *et al.* (2008) and Nirphal *et al.* (2011).The available K in pre-sown soil of cotton field was recorded as 552 kgh^{-1}. The post-harvest cotton soil analysis has shown the maximum K in the treatment 100% RDF of NPK (572 kgh^{-1}) and 50% RDF of NPK + *AZT* (561 kgh^{-1}). The other treatments have shown declined level of available potassium. Similar results are also obtained through the work of Arbad *et al*, (2008) and Katkar *et al* (2006).

In cotton pre-sown soil *Azotobacter* count was very low (33x10^1 Cfu/ml) whereas the maximum count after harvest (186x10^5 Cfu/ml) in AZT + PSB treatment as well as in *AZT* alone (181x10^5 Cfu/ml). This population might have maintained due to the addition of bioinoculants. Similarly the treatments of AZT + PSB + 50% RDF of NPK and AZT + 50% RDF of NPK estimated higher values. The quantitative estimation of postharvest soils has shown increased population over the straight chemical fertilizer treatment and the control treatment. 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 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 Jadhav *et al* (1987), Manickam and Venkataraman, (1992).

In cotton pre-sown soil count of PSB was very low (270x10^1 Cfu/ml). The highest estimated value (202x10^5 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 (86x10^4 Cfu/ml). The minimum PSB population was found in control treatment (90x10^1 Cfu/ml) and 100% RDF of NPK (288x10^1 Cfu/ml). These results are in agreement with Wani *et al*., (2002) and Nirphal *et al*., (2011).

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.

REFERENCE

Arbad BK, Syed Ismail DN Shinde and RG Pardeshi (2008) Effect of integrated nutrient management practices on soil properties and yield in sweet Sorghum in vertisol. An Asian J. of Soil Sci. 3(2): 329-332.

Barabde NP, Ghive D, Pote S R, Deshmukh A and HH Dickey (2008) Nutrient availability, microbial properties, yield of Sorghum as influenced by different organics and in combination with inorganic fertilizer. J. soils and Crops 18 (1): 234-239.

Jadhav AS, Shaikh AA. Nimbalkar CA and Harinarayan F (1987) Synergistic effects of bacteria fertilizers in economizing nitrogen use in pearl millet. Millets News Letter 6; 14-15.

Jackson ML (1958) Soil Chemical Aanalysis. Prentice-Hall, Inc., Englewood Cliffs, NJ.

Jangral Jyoti and Hamit Lakra (2014) Impact of Fertilizers on the Environment Sustainability Development and Agriculture. GE-Int. J. of Management Research 2 (2), 160-166.

Katkar RN, Turkhede AB and Wankhade ST (2006) Residual effect of organic manures and inorganic fertilizers on soil properties and seed cotton yield: PKV Res. J. 30 (1), 36-41.

Manickam TS and Venkataraman CR (1992) Effect of continuous application of manures and fertilizers on some of the physical properties of the soil: II under irrigated condition. *Madras Agri. J*., 59: 508-512.

Nirphal SM, Rasal PH, Kalbhor HB, Jadhav SW (2011) Effect of *Azotobacter* and *Bacillus polymyxa* Enriched Organic Manures on Biochemical Properties of Soil*. J. Agric. Res. Technol,* 36 (2) : 313-316

Olsen SR, Cole CV, Watanabe FS and Dean LA (1954) Estimation of available phosphorus in soils by extraction with sodium bicarbonate. *USDA Circular 939*: 1-19. Gov. Printing Office, Washington D.C.

Panneerselvam P, Selvakumar G and Ganeshamurthy AN (2012) Microbial consortium- A speciality bioinoculant for sustainable vegetable production. Biofertilizer News Letter 20(2) 0971-7390.

Rachewad SN, Raut RS, Malewar GU and Ganure CK (1992) Effect of phosphatesolubilizing biofertilizers on biomass production and uptake of phosphorus by sunflower. *J Maharashtra Agric. Univ*. 17 (3): 480 -481.

Singh Tanuja and Purohit S S (2008) *Biofertilizer technology.* Agrobios (India) Publishing co., Jodhapur. 2-3.

Subbiah BV and Asija GL (1956) A rapid procedure for the determination of available nitrogen in soils. *Curr. Sci*., 25: 259-260.

Sundara Rajan S (2001) Practical manual of Plant Ecology and Plant Physiology, 1st ed, Anmol Publications PVT LTD, New Delhi (India) pp10.

Vengadaramana A and Jashothan PTJ (2012)Effects of organic fertilizers on the water holding capacity of soil in different terrains of Jaffna peninsula in Sri Lanka. *J. Nat. Prod. Plant Resour,* 2(4): 500-503.

Volk VV, Ullery CH (1993) Dep of Soil Sci. Oregon state Univ. Coruallis, 50p.

Walkley A (1947) A critical examination of a rapid method for determining organic carbon in soils: Effect of variations in digestion conditions and of inorganic soil constituents. *Soil Sci*. 63: 251-263.

Wani SP and Lee KK (2002) Population dynamics of nitrogen fixing bacteria associated with pearl millet (*P. americanum* L.), In biotechnology of nitrogen fixation in the tropics, University of Pertanian, Malaysia, 21-30.