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EFFECT OF BIOFERTILIZERS ON THE SOIL STATUS OF TURMERIC 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 Turmeric crop was tested during the Kharif season (2007-08) at agricultural fields (21041'03.84 N; 78092'85.14 E) to explore the possibility of reducing doses of chemical fertilizers and for better soil health. The results in Turmeric soil revealed that the water holding capacity increased (7.96%) in Chemical Fertilizer Treatment (CFT) while it increased (12.22 to 24.18 %) in Biofertilizer Treatment (BfT). pH increase in the CFT whereas decrease in BfT. Electrical conductivity increased (1.09 to 3.28%) in CFT whereas it decreased (3.83 to 5.74%) in BfT. Organic carbon decreased (6.06%) in CFT and increased (15.15 to 57.58%) in BfT. Available nitrogen have shown increased level (27.42 to 66.13%) in CFT. Phosphorous increase in CFT and BfT. Potassium increased (11.23%) in CFT while decreased (3.30 to 8.18%) in BfT alone. Azotobacter and PSB were significantly increased in biofertilizer treatment as compare to chemical fertilizer treatment in Turmeric field.

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

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. According to Jangral and Lakra, (2014) 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. Applications of higher quantity of fertilizer without considering the crop requirement adversely affect the microbial population and soil health(Phillips, 1972; Panneer selvamet 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 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 (Vengadaramanaet al, 2012).

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%. (Singh and Purohit, 2008).Turmeric (Curcuma longa L.) family Zingiberaceae, is one of the important spice 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). A further investigation 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 2007-08. The Randomized Block Design with four replications was adopted in field experiments. Turmeric (Curcuma longa L.) variety Waigaon was given a spacing of 40 to 45 cm between two plants and 70 to 80 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 turmeric fields was 300 N: 150 P2O5: 50 K2O. 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 chrochoccumas AZT and Bacillus polymyxaas PSB) were confirmed from the RCOF, Nagpur, Ministry of Agriculture, Govt. of India. The turmeric seed-rhizomes 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.

The soil samples (pre-sown and postharvest) were collected from the experimental fields (21041’03.84 N; 78092’85.14 E) as per the procedure recommended by PKV Akola and described by Rai (2002). The soil was analysed by standard methods for physico-chemical parameters. Water holding capacity (Sundara Rajan, 2001); the pH of suspension was measured by digital pH meter. 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). The available P by the method described by Olsen (1954).The available K by the method described by Jackson (1958). 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.

RESULT & DISCUSSION:

The water holding capacity (WHC) of pre-sown soil in Turmeric field was recorded as 56.32%. The post-harvest soil analysis has shown maximum WHC (69.94%) in the treatment Azotobacter + PSB and Azotobacter alone (65.62%). The minimum WHC was found in the treatments 100% RDF of NPK (60.80%). 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 12.22 to 13.78%. 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 Biswas, et al, (1971), Volk, et al., (1993) and Vengadaramanaet al., (2012).

Soil pH may stimulate or inhibit seed germination and growth processes. The pH of pre-sown soil in Turmeric field was moderately alkaline and recorded as 8.47. The post-harvest soil analysis has shown the increased (8.70) pH values in 100% RDF of NPK and the combination of NPK + biofertilizers. Biofertilizer treatments recorded reduced pH (8.35 to 8.43) 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 Arbadet al, (2008) and Katkaret al (2006).

Soil electrical conductivity is mainly depends upon the salinity. The EC of pre-sown soil in Turmeric field was recorded as 0.366 dSm-1. The post-harvest soil analysis has shown the increased EC values in 100% RDF of NPK (0.378 dSm-1) and the combination of NPK + biofertilizers (0.372 dSm-1). Biofertilizer treatments recorded reduced (0.352 - 0.345 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 Katkaret al, (2006) and Arbadet al, (2008).

The combined treatments of RDF of NPK + Azotobacter + PSB and Azotobacter alone have found increased organic carbon by 15.15 to 57.58% over the pre-sown soil in Turmeric. Whereas, the 100% RDF of NPK have lost 6.06% organic carbon over the pre-sown condition. The value of organic carbon in control treatment has not shown any significant trend. 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 Katkaret al (2006), Barabdeet al, (2008), and Arbadet al, 2008).

The available N in pre-sown soil of turmeric field was recorded as 124 kgh-1. The post-harvest soil analysis has shown the maximum N in the treatment 100% RDF of NPK (206 kgh-1) and Azotobacter + PSB + 50% RDF of NPK (195 kgh-1). The minimum N was observed in Azotobacter alone (125 kgh-1) and control (116 kgh-1). It indicates that the chemical fertilizers as well as biofertilizers contribute towards the residual effect of N. These findings are in close agreement with Pawar. et al (1996), Gulhane (2003), Barabdeet al, (2008), and Nirphalet al, (2011).

The available P in pre-sown soil of Turmeric field was recorded as 9.64 kgh-1. The maximum phosphorous in post-harvest soil was observed in Azotobacter + PSB + 50% RDF of NPK (25.55 kgh-1), 100% RDF of NPK (17.18 kgh-1), 50% RDF of NPK + Azotobacter (21.02 kgh-1), Azotobacter + PSB (16.02 kgh-1). The minimum available P recorded in the treatment Azotobacter alone (7.49 kgh-1) and control (7.25 kgh-1) at post-harvest situation. It indicates that the chemical fertilizers as well as combined biofertilizer treatment contribute towards the available P. These results are in close conformity with Rachewadet al. (1992), Katkaret al. (2006), Barabdeet al. (2008), Arbadet al. (2008) and Nirphalet al. (2011).

The available K in pre-sown soil was recorded as 819kgh-1. The post-harvest soil analysis has shown the maximum K in the treatment 100% RDF of NPK (911kgh-1). NPK and biofertilizers has shown increased level (1.71 to 6.72%) of K. The other treatments have shown declined level of available K. Similar kind of results are also obtained through the work of Arbadet al, (2008),Katkaret al (2006),Gulhane (2003) and (Barabdeet al, 2008).

The pre-sown count of Azotobacter was 77x101 Cfu/ml, which becomes almost four times more in AZT soil treatment alone and in combination. The maximum (168x104 Cfu/ml) population of

AZT was reported in the treatment of AZT alone. 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 Jadhavet al (1987), Manickam and Venkataraman, (1992).

In turmeric pre-sown soil count of PSB was very low (247x101Cfu/ml). The highest estimated value (242x104Cfu/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 (140x104Cfu/ml). The minimum PSB population was found in control treatment (190x101Cfu/ml). These results are in agreement with Waniet al., (2002), Arbadet al, (2008) and Nirphalet al., (2011).

CONCLUSION:

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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REFERENCES:

Arbad B. K., Syed Ismail, D. N. Shinde and R. G. Pardeshi (2008). Effect of integrated nutrient management practices on soil properties and yield in sweet Sorghum in vertisol; An Asian J. of Soil Sci. Vol. 3(2): 329-332.

Barabde, N.P., Ghive D., Pote S. R., Deshmukh, A. and H.H. 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.

Biswas,T. D., B. K .Khosla (1971) Proc. Int. Symp. On Soil Fert.Eval.India;1:831-842.

Gulhane P. D., 2003. Effect of organic manures along with biofertilizer on yield of rainfed Sorghum. A thesis (V/557: unpublished) is submitted to Dr.PanjabraoDeshmukh Agriculture University, Akola.

Jadhav, A. S., A. A. Shaikh, C. A. Nimbalkar and F. Harinarayan.1987, Synergistic effects of bacteria fertilizers in economizing nitrogen use in pearl millet.Millets News Letter. 6; 14-15.

Jackson, M. L. (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 (ISSN: 2321-1709). Vol.2 (2), 160-166.

Katkar,R. N., A. B. Turkhede and S. T. Wankhade; (2006). Residual effect of organic manures and inorganic fertilizers on soil properties and seed cotton yield: PKV Res.J.vol.30 (1),36-41.

Manickam, T. S. and Venkataraman, C. R. (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, S. M., P. H. Rasal, H. B. Kalbhor, S. W. Jadhav. (2011). Effect of Azotobacter and Bacillus polymyxa Enriched Organic Manures on Biochemical Properties of Soil.J. Agric. Res. Technol., 36 (2) : 313-316

Olsen, S. R., C. V. Cole, F. S. Watanabe, and L. A. Dean.(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., G. Selvakumar and A.N. Ganeshamurthy,(2012). Microbial consortium- A speciality bioinoculant for sustainable vegetable production. Biofertilizer News Letter.,Vol 20(2). ISSN 0971-7390.

Pawar, K. B., H. B. Kalbhor, B. K. Khonde and P.L. Patil. (1996). Study of combined effect of Azotobacterand Azospirillum with nitrogen on yield of Sorghum.J. Maha. Agric. Univ. 21 (3) : 403-406.

Phillips, J. (1972): The problem in the use of chemical fertilizer. In the careless technology (Eds. Forvar and J.P. Multon), London Tomstacey : 549.

Rachewad, S. N., R. S. Raut; G. U. Malewar; C. K. Ganure.(1992). Effect of phosphate solubilizing biofertilizers on biomass production and uptake of phosphorus by sunflower.J. Maharashtra Agric. Univ. 17 (3): 480 -481.

Rai, M. M., (2002). Principal of soil science, Fourth Ed., Macmillan India Ltd.

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

Subbiah, B. V. and G. L. Asija.(1956). A rapid procedure for the determination of available nitrogen in soils.Curr. Sci., 25: 259-260.

SundaraRajan, S., (2001). Practical manual of Plant Ecology and Plant Physiology, 1sted, Anmol Publications PVT. LTD, New Delhi (India), pp10.

Vengadaramana, A., Jashothan, P. T. J., (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, V. V., CH Ullery. (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, S .P. and Lee K. K., (2002). Population dynamics of nitrogen fixing bacteria associated with pearl millet (P. americanumL.), In biotechnology of nitrogen fixation in the tropics, University of Pertanian, Malaysia, 21-30.

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

Soil Property	Pre-sown soil	Post-harvest soil					
		T-1	**T-2**	**T-3**	**T-4**	**T-5**	**T-6**
WHC (%)	56.32	60.80	64.08	63.20	69.94	65.62	61.80
pH	8.47	8.70	8.57	8.51	8.35	8.43	8.45
EC dSm^{-1}	0.366	0.378	0.372	0.370	0.352	0.345	0.365
OC (%)	0.33	0.31	0.52	0.42	0.42	0.38	0.31
Available N (kg/ha)	124	206	195	158	138	125	116
Available P (kg/ha)	9.64	17.18	25.55	21.02	16.02	7.49	7.25
Available K (kg/ha)	819	911	833	874	752	792	766
Available *AZT*	$77x10^1$	$81x10^2$	$180x10^3$	$134x10^4$	$151x10^4$	$168x10^4$	$92x10^1$
Available PSB	$247x10^1$	$380x10^1$	$140x10^4$	$101x10^1$	$242x10^4$	$72x10^1$	$190x10^1$

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