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EVALUATION OF INFLUENCE OF OXYGENATED PEPTONE ON MICROBIAL POPULATION IN RHIZOSPHERE SOIL OF BRINJAL (*SOLANUM MELONGENA* L. CV. AJAY)

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The experiments were carried out in P.G. Research Centre, Department of Botany, Tuljaram Chaturchand College, Baramati (M.S.) India using pot culture method under organic farming condition to study the influence of oxygenated peptone on microbial population in rhizosphere soil of brinjal (*Solanum melongena* L. cv. Ajay). Oxygenated peptone supplies oxygen, peptone and silicate based inert filler compound to soil when applied in soil at the depth of 10 cm, buried and watered. The treatment increased the number of colonies of heterotrophic bacteria, non symbiotic nitrogen fixing bacteria and soil fungi. The treatment led to increase in the population of useful micro-organisms carrying out the functions like PO_4 solublization (*Bacillus subtilis, Aspergillus fumigatus,* and *Penicillium notatum),* nitrogen fixation (*Azotobacter chroococcum*) and acting as biocontrol agents (*Trichoderma viridae, Paecilomyces lilacinus).* In addition, the treatment was found to be useful to decrease in the population of pathogenic micro-organisms like *Mucor indicus* (causing rots) and *Alternaria alternate* (causing leaf spots). It seems that soil application of oxygenated peptone is useful to the growth of beneficial aerobic soil microbes and it hampers growth of pathogenic anaerobic soil microbes. This is indication of soil health. It is concluded that soil application of oxygenated peptone improves the soil micro-climate and thereby soil health. So, oxygenated peptone can be used for soil amendment.

Keywords : Brinjal; Microflora; Oxygenated peptone; Rhizosphere soil.

Introduction

The region where the soil and root make contact is called as rhizosphere. The microbial population on and around the roots is considerably higher than that of root-free soil. The differences are both qualitative and quantitative. Bacteria in rhizosphere are predominating and their growth is enhanced by nutritional substances released from plant e.g. amino acids, vitamins and other nutrients. The growth of plants is influenced by the products of microbial metabolism that are released into soil. The micro-organisms present in the soil play a very vital role in the metabolism of nutrients obtained from organic and inorganic sources. To sustain the fertility status of soil, the maintenance of appropriate status of soil micro flora is very essential.

Biofertilizers are ready to use live formulations of beneficial micro-organisms. When applied to seed, root or soil, they mobilize the availability of nutrients by their biological activity in particular and help to build up the microflora and in turn the soil health. However, microbial inoculants differ in their effectiveness under varying environmental conditions. This is the major constraint for their successful use in the field.

Soil application of oxygenated peptone is interesting under this condition. It supplies oxygen slowly and steadily for 40-50 days. The plant releases about 30% of the photosynthate in the soil by the way of root exudates to attract soil micro-organisms towards the rhizosphere so that they will carry out the specific functions as required by the plant. The roots are fixed in the soil and so there are limitations for attracting the soil micro-organisms from the soil pockets away from the rhizosphere. The role of oxygenated peptone is crucial here. It attracts the micro-organisms from different soil pockets by providing peptone as nitrogen source and oxygen for respiration. Thus soil application of oxygenated peptone is a natural process of microbial inoculation and it goes with organic farming system[1]. So in the present investigation, an attempt is done to evaluate the influence of oxygenated peptone on microbial population in the rhizosphere soil of brinjal.

Material and Methods

The experiments were conducted in P.G. Research Centre, Department of Botany, Tuljaram Chaturchand College, Baramati (M.S.) India during 2007-2009 using pot culture method. The earthen pots (40 x 40 cm) were filled with soil and vermicompost (10:1 kg / pot). Oxygenated peptone (containing 100 mg / g of oxygen, 650 mg / g of peptone and 250 mg / g silicate based inert filler compound) was applied to the soil @ 2 g / pot at the depth of 10 cm, buried and watered. 21 DAS seedlings of brinjal (*Solanum melongena* L. cv. Ajay) were grown in these pots. Non-treated plants were kept as control and watered equally. Rhizosphere soil samples were collected from vicinity of roots of ten treated and ten control plants on 60th DAS and mixed thoroughly. Samples were collected in sterile polythene bags and were brought to laboratory for analysis of microbial population. All the experiments were done in five replicates and data are expressed as mean ± S.D. Statistical comparisons were made by means of student's t-test and $p < 0.05$ is considered as significant. Heterotrophic bacteria, non-symbiotic nitrogen fixing bacteria and soil fungi were isolated from rhizosphere soil of brinjal by using serial soil dilution method on nutrient agar medium, Ashby's Mannitol agar medium and Czapek-Dox agar medium respectively and observed daily for appearance of colony and number of colonies and colony forming unit per gram soil. Bacterial colonies were identified on the basis of colony characters, Gram staining and catalase test with the help of authentic literature such as Alexander[2] and fungal colonies were identified on the basis of mycelium and reproductive organs produced with the help of authentic literature[3].

Results and Discussion

The effect of soil application of oxygenated peptone on microbial population of rhizosphere soil of brinjal is depicted in Table 1. The total number of colonies of heterotrophic bacteria was 52 with 86.6 x 10^4 CFU / g soil in control rhizosphere soil while oxygenated peptone treated rhizosphere soil showed 84 colonies with 140x10^4 CFU/g soil showing an increase of 61.5%. Non-symbiotic nitrogen fixing bacteria showed 18 colonies with 30 x 10^4 CFU/g soil in control rhizosphere soil while the treated rhizosphere soil showed 34 colonies with 56.6x10^4 CFU/g with an increase of 88.8%. Soil fungi showed 11 colonies with 18.3 x 10^4 CFU/g soil in control rhizosphere soil while the treated rhizosphere soil showed 12 colonies with 20x 10_4 CFU / g soil exhibiting an increase of 9.0. The colonies of *Bacillus subtilis* isolated on NA medium, colonies of *Azotobacter chroococcum* isolated on Ashby's mannitol agar medium and the colonies of soil fungi isolated on Czapek-Dox agar medium are well observed in Fig.1. Results recorded in Table 2 and observed in Fig. 2 showed the effect of soil application of oxygenated peptone on the population of soil fungi isolated from rhizosphere soil of brinjal. The fungi like *Aspergillus fumigatus, Penicillium notatum, Trichoderma viridae* and *Paecilomyces lilacinus* showed positive increase in their population in rhizosphere soil of brinjal treated with oxygenated peptone while the population of *Mucor indicus* and *Alternaria alternata* showed decrease in treated rhizosphere soil over control.

The number of colonies as well as population of *Bacillus subtilis* increased by soil application of oxygenated peptone. The supply of oxygen by oxygenated peptone might be helpful for the growth and multiplication of this aerobic bacterium exhibiting increase in the population. It has a natural fungicidal activity and so it is employed as a biological control agent. It secretes various organic and inorganic acids which act on insoluble phosphates and convert them into soluble phosphates in the rhizosphere. The bacteria are found to be more efficient in the secretion of organic acids. Addition of organic manures helps in increasing the solublizing power of the bacteria[4]. *Azotobacter chroococcum* is an aerobic, non-symbiotic nitrogen fixing bacterium. It fixes atmospheric nitrogen in the rhizosphere. Besides nitrogen fixation, it produces Thymine, Riboflavin, Nicotine, Indole Acetic Acid and Gibberellin and some substances which check the growth of the plant pathogens. Hence, it also acts as a biological control agent[5]. Soil application of oxygenated peptone supplies organic nitrogen to *Azotobacter chroococcum,* which enhances its nitrogen fixing ability.

Soil fungi are useful to decompose cellulose, lignin and pectin present in the soil in the form of plant and animal residues which form the humus. The fungal mycelium helps the soil particles to bind together and thus the soil structure is improved. In the present investigation, there is higher density of microbial biomass as a result of soil application of oxygenated peptone. This is supported by the work of Agele *et al.*[6], who hypothesized that low input system involving reduced tillage methods and mineral fertilizer and / or live stock manure use would support a higher density of microbial biomass, soil aggregation, organic carbon and total nitrogen and hence improve the soil quality. According to Antwerpen *et al.*[7], the soil micro-organisms have the potential to be important

Table 1. Effect of soil application of oxygenated peptone on microbial population of rhizosphere soil of brinjal (*Solanum melongena* L. cv. Ajay) at 60th DAS.

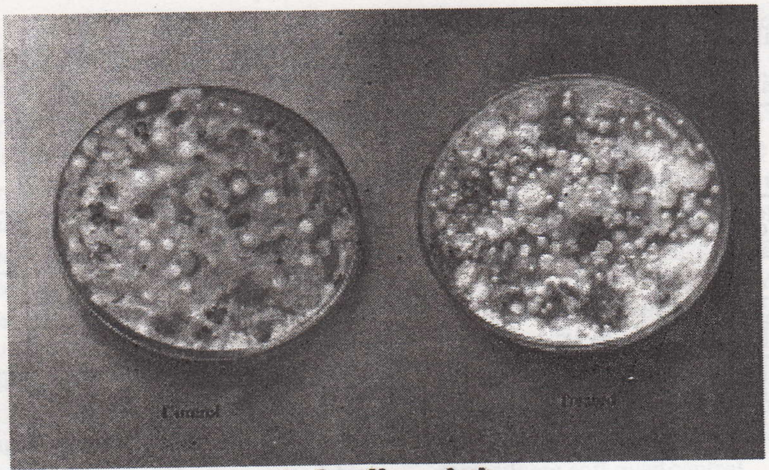
Types of Organism	Total no. of colonies			Colony forming units (CFU) / g soil		
	Control	Treated	Increase (%)	Control	Treated	Increase (%)
Heterotrophic bacteria	52.0 ± 1.5	84.0** ± 1.5	61.5	86.6 x 10^4	140 x 10^4	61.5
Non symbiotic nitrogen fixing bacteria	18.0 ± 1	34.0** ± 1	88.8	30 x 10^4	56.6 x 10^4	88.8
Fungi	11.0 ± 0.5	12.0* ± 0.5	9.0	18.3 x 10^4	20 x 10^4	9.0

Data are mean values (n=5) followed by ± standard deviation. Statistical comparisons are made by means of Student's 't' test and $p < 0.05$ is considered as significant. '*' and '**' represent significance at $p < 0.05$ and $p < 0.01$, respectively.

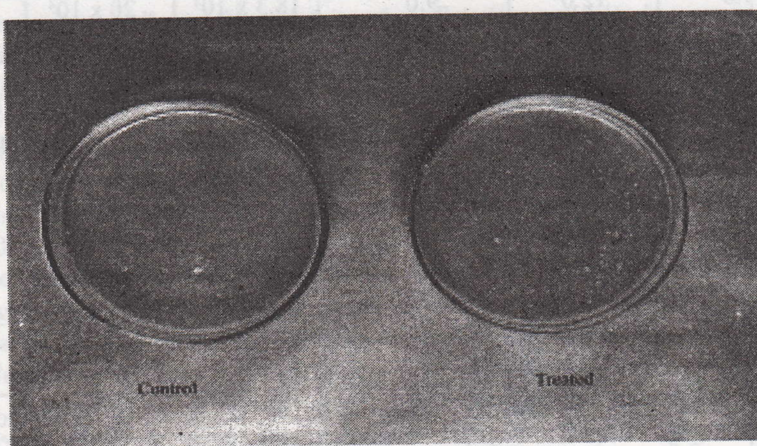
Table 2. Effect of soil application of oxygenated peptone on soil fungi isolated from rhizosphere soil of brinjal (*Solanum melongena* L. cv. Ajay) at 60th DAS.

Name of fungi	Number of colony			Diameter of colony (cm)		
	Control	Treated	Increase (%)	Control	Treated	Increase (%)
Aspergillus fumigatus	2.0 ± 0.01	2.0 ± 0.01	-	± 0.1 1.0	1.6** ± 0.1	60.0
Penicillium notatum	0 ±0.01	2.0** ±0.01	200.0	-	1.8 ±0.01	-
Rhizopus stolonifer	3.0 ± 0.05	3.0 ± 0.05	-	0.8 ± 0.01	0.8 ± 0.01	-
Mucor indicus	3.0 ± 0.05	1.0* ± 0.01	- 66.6	0.6 ± 0.01	0.4* ± 0.01	- 33.3
Trichoderma viridae	2.0 ± 0.01	3.0* ± 0.05	50.0	1.5 ± 0.1	2.2* ± 0.1	46.6
Paecilomyces lilacinus	0	1.0** ± 0.01	100.0	-	0.4 ± 0.01	-
Alternaria alternata	1.0 ± 0.01	0	- 100.0	0.2 ± 0.01	-	-

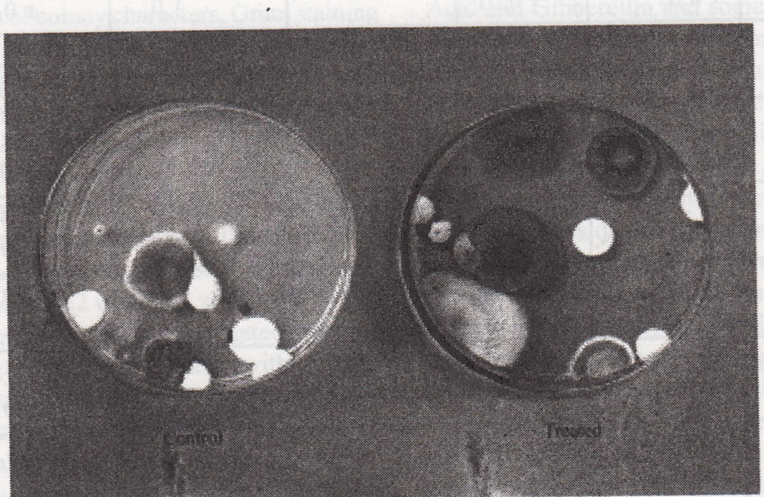
Data are mean values (n=5) followed by ± standard deviation. Statistical comparisons are made by means of Student's 't' test and $p < 0.05$ is considered as significant. '*' and '**' represent significance at $p < 0.05$ and $p < 0.01$, respectively.



A. *Bacillus subtilis*



B. *Azotobacter chroococcum*



C. Soil fungi

Fig.1. Soil microbes isolated from oxygenated peptone treated rhizosphere soil of brinjal *(Solanum melongena* L. cv. Ajay) at 60th DAS.

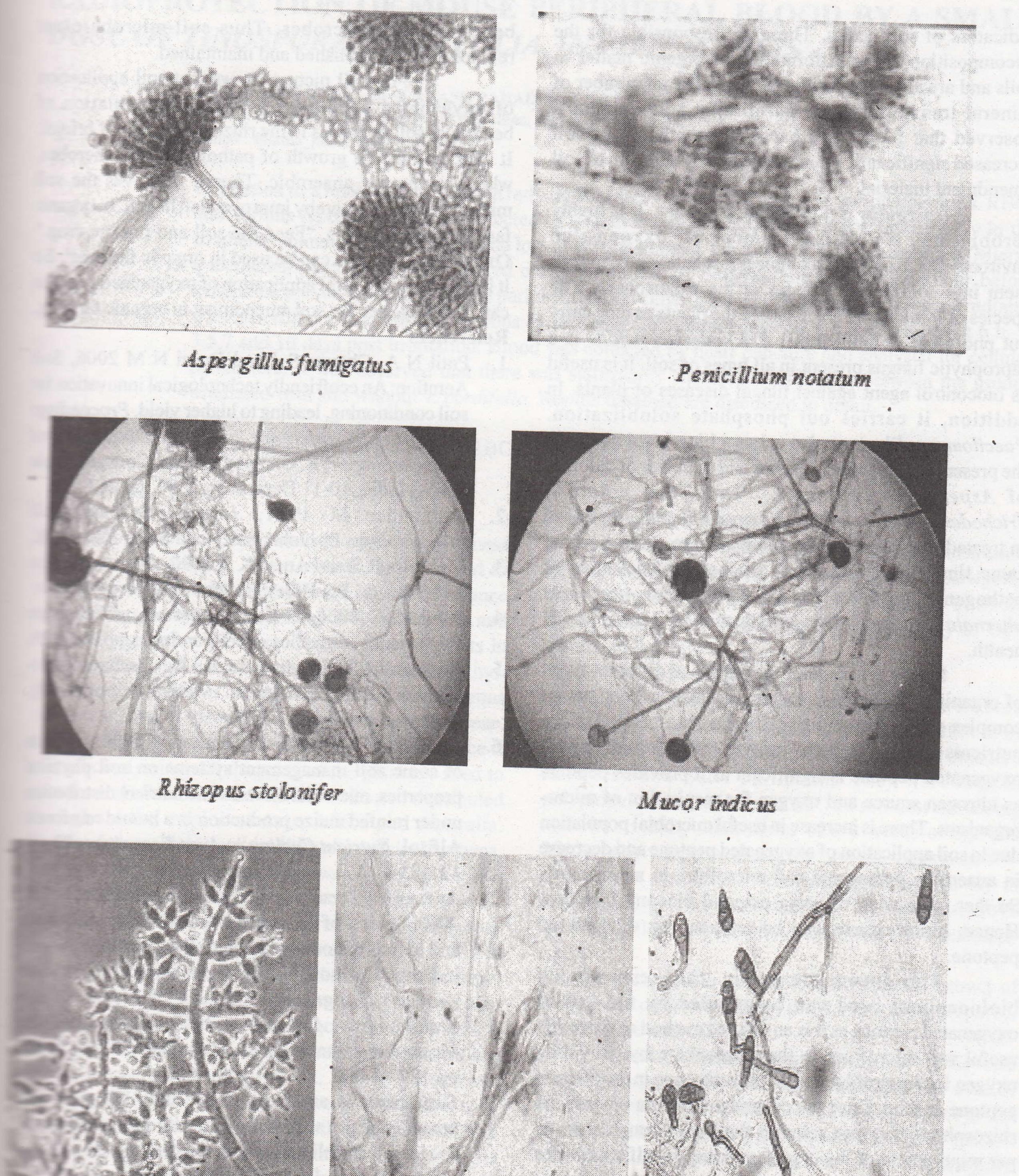


Fig. 2. Soil fungi isolated from oxygenated peptone treated rhizosphere soil of brinjal (*Solanum melongena* L. cv. Ajay) with DAS on Czapek-Dox agar medium. (Magnification : 10x40X)

indicators of soil health. These are responsible for the decomposition and transformation of organic matter in soils and are also responsible for a significant number of mineral transformations. Surulirajan and Kandhari[8] observed that fungal and bacterial population of soil increased significantly over the control by addition of soil amendment material.

Aspergillus is a filamentous fungus. It is highly aerobic and is found in almost all oxygen-rich environments. It acts on insoluble phosphates and converts them into soluble phosphates in the rhizosphere. The species of *Penicillium* are useful to the plants as they carry out phosphate solublization[4]. *Trichoderma viridae* is a saprophytic fungus present in all types of soil. It is useful as biocontrol agent against fungal diseases of plants. In addition, it carries out phosphate solublization. *Paecilomyces lilacinus* also act as a biocontrol agent. In the present investigation, number and diameter of colonies of *Aspergillus fumigatus, Penicillium notatum, Trichoderma viridae* and *Paecilomyces lilacinus* increased in treated rhizosphere soil as compared to control. At the same time, the number and diameter of colonies of pathogenic fungi like *Mucor indicus* and *Alternaria alternata* decreased. This is indication of improved soil health.

Soil is the home of thousands of different types of organisms including micro-organisms. They act on complex organic matter and release a wide range of micro nutrients useful for plant growth. Soil application of oxygenated peptone is significant as it provides peptone as nitrogen source and oxygen for respiration of micro-organisms. There is increase in useful microbial population due to soil application of oxygenated peptone and decrease in anaerobic pathogenic soil microflora in natural way. So ther is no need of using external biocontrol agents. Hence, bioinoculants can be replaced by oxygenated peptone.

The inconsistency in the response of bioinoculants used can be avoided by the use of oxygenated peptone as it is an assured method of attracting useful soil microflora to the rhizosphere by providing oxygen for respiration and soluble nitrogen in the form of peptone as food. Once the desired microflora reaches the rhizosphere, the plant releases the food through roots as per requirement of the organism doing specific work for the plant. This is followed by an increase in population of beneficial soil microbes. Thus soil-microbe-plant relationship is established and maintained.

The overall picture shows that soil application of oxygenated peptone increases the population of beneficial soil microbes in the rhizosphere soil of brinjal. It also inhibits the growth of pathogenic soil microbes, which are mostly anaerobic. Thus it improves the soil micro-climate and thereby improves soil health. In organic farming, the theme is, "Feed the soil and not the crop." Oxygenated peptone can be used in organic farming[1]. So it is concluded that soil application of oxygenated peptone can be safely used for soil amendment in organic farming.

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