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Research Article

Role of Active Microorganisms on the Evolution of Paddy

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Abstract: The alternative sustainable agriculture is the growing interest among the scientist and farmers. The resulting bad impacts of chemical fertilizers in agriculture turn everyone's focus on EM treated practices in food production. There are very less scientific evidences about EM treated agro products in India. Hence in the present study, an attempt is made to prove the active potentiality of the EMs in paddy growth and yield. In this study, pot culture method was carried out. The soil was obtained from Cauvery delta region. The soil quality analysis was carried out which includes pH, N, P, K, Organic carbon, Soil moisture and other essential micronutrients. Among six groups, the EM treated plants yields more as that of chemical fertilizer treated plants and the soil texture also well maintained. We suggest from our results that the EMs with vermicomposting brings most efficient result in the cultivation of paddy. This combination may be used for larger agricultural practices.

Keywords: Effective micro-organisms, Paddy, Yield, Soil, Organic matters, Nitrogen.

INTRODUCTION

The increased human and livestock population needs more food for their consumption. After the green revolution in India, the farmers are using many chemical fertilizers and pesticides to get more yields in the food crops. The uncontrolled and longtime use of those chemicals makes the soil into infertile condition. And also the application of synthetic products in the soil leads to environmental pollution. The agricultural products produced with the application of chemical fertilizers and pesticides induce many health hazards to the consuming community. Hence, the farmers need to find out alternative agricultural practices without making environmental pollution and health hazards. The misuse and excessive use of chemical fertilizers and pesticides have of often adversely affected the environment and created many problems associated with food safety, quality and human and animal health. There are growing interests on natural farming than the chemical and conventional farming methods (Higa and Parr, 1994). Several studies indicate that there is significant amount of 'residual pesticides' contaminating our food stuff which are produced by the chemical fertilizers for human consumption. Vegetable samples were contaminated 100% with HCH and 50 per cent with DDT (Rao, 1993). Contamination with HCH was 70%, Heptachlore 2 was 45%, Aldrin 45% and DDT 91%. 60% of water samples were found to be contaminated with Aldrin and 50% with DDT which were higher than permissible limits of WHO (Bhatanagar and Mamta, 1993).

Toxic impacts of agro-chemicals on the agricultural ecosystem (soil, flora, fauna and water bodies in farms), on the health of farmers and the consumers of the farm products are more evident all over the world. Nearly 3 million people suffer from 'acute pesticide poisoning' and some 10 to 20 thousand people die of cancer every year from it in the developing countries in the chemically grown food (UNEP/GEMS, 1992).

The microbe plays an important role in agriculture and their usage in agriculture turns many interests among farmers. The microbes are used for a long time in agriculture for composting of

plant wastes, control of insect pests and nitrogen fixation to improve the quality and quantity of farm products. An important consideration in the application of beneficial microorganisms to soils is the enhancement of their synergistic effects (Higa, 1991 and 1994). Microbes are considered to be an alternative to the chemical fertilizers because of their involvement in various plant growth and developmental activities. Modes of action for beneficial microorganisms to promote plant growth include direct parasitism of plant pathogens, competition for space or nutrients, or production of antibiotics, enzymes or plant hormones (Whipps, 2001).

Continuous input of organic matters like crop residues, animal manures, green manures, night soil, and composted organic wastes to soil can improve the soil productivity and fertility. The organic matters can significantly increase the numbers of beneficial soil microorganisms (Higa and Wididana, 199l). Now a days, the term EM (Effective Micro-organisms) are very popular among the farmers. The EM has the potential microbes which are selectively included and used for agriculture and other activities like waste water treatment, pollution prevention etc. Effective Microorganisms (EM) was developed at the University of the Ryukyus, Okinawa, Japan in the early 1980's by a distinguished professor of horticulture, Professor Dr Teruo Higa. He reported that the microorganisms are having capability to positively influence decomposing organic matter and turn them to plant utilizable manure.

EM contains selected species of microorganisms including predominant populations of lactic acid bacteria and yeasts, and smaller numbers of photosynthetic bacteria, actinomycetes and other types of organisms (Higa and Wididana, 1991). The effective microorganisms (EM) are revitalizes the agricultural land, enhances the plant health, growth and yield of paddy rice (Lin, 199l). There are several studies have been reported about the EMs potential of plant growth and yield. Most of the Asian countries has been successfully utilizing the EMs for their agricultural industry. In India, the use of EM not very much popular and there is a lack suitable scientific reports. Especially, the south Indian farmer's are not much aware about EM and its benefits. South Indian farmers mostly cultivate the paddy as a main plantation. Rice is the most important crops in the world especially in Asian countries. Rice is cultivated in over 100 countries around the world and is a staple food for about half of the world population. Rice accounts for over 22% of global energy intake (Kainuma, 2004).

Hence, the present study has the following objectives, 1) To compare the phenotypic characteristics of EM treated and non-treated *Oryza sativa L.* 2) To determine the pH, N, P, K content and other major parameters related to the plant growth of the soil in EM treated and non-treated soil and 3) To determine the weight and yield of EM treated and non-treated rice plants.

MATERIALS AND METHODS

Source Materials

The rice seeds, Effective Microorganisms (EMs) and NPK fertilizers were purchased from a local agricultural shop in Chidambaram, Tamil Nadu, India.

Soil Preparation

The study was conducted in Annamalai University, Chidambaram, Tamil Nadu, India. The pot culture method was carried out in agricultural site of Annamalai University with 36 pots.

EM Preparation

Stock EM solution was diluted in the ratio of 1:1000 (EM: Distilled Water). The EM was applied by spraying to the targeted plant.

Seed Preparation

The seeds were soaked in distilled water and the seeds floating on the surface of water were removed. The seeds were soaked for overnight and planted on the pots on the day after.

Experimental Design

There pots were divided into six groups and each group has six pots. The experiment was carried out for 16 weeks. Group I: Control (The control group plants were not received any additives). Group II: Normal chemical fertilizer (NPK). These plants received synthetic chemical fertilizers as per the recommendations of Tamil Nadu Agricultural Department. Group III: EM 1% alone. These plants received only the EM solution which was diluted in distilled water as 1:1000. Group IV: EM 1% + poultry manure. These group plants received 1% EM solution and poultry manure (1 kg of poultry manure was mixed with 1 litre of 1% EM solution). Group V: EM 1% + vermicompost. These group plants received 1% EM solution and vermicompost (1 kg of vermicompost was mixed with 1 litre of 1% EM solution). Group VI: EM 1% + molasses. These group plants received 1% EM solution and molasses obtained from sugar industry (1 kg of molasses was mixed with 1 litre of 1% EM solution).

Soil Analysis

The soil used for all experiments were analysed for its physico-chemical parameters on 0 day and 16th week by the standard protocols (Van Reeuwijk, 2002 & APHA, 1995). At the 16th week, the height of the plant, weight of rice, number of buds and other observation were recorded.

Statistical analysis

The data were statistically analyzed using ANOVA followed by DMRT and the values are expressed as mean ± S.D. The values were considered statistically significant if the p-value was less than 0.05.

RESULTS AND DISCUSSIONS

Environmental protection is getting more important for the purpose of sustainable agriculture. This is the time to replace the chemical fertilizers with to protect the environment and human

health (Levai *et al.*, 2006). Nitrogen and phosphorus are essential nutrients for plant growth and development which are obtained by the application of organic matter (Ghosh *et al.*, 2004).

The effect of organic amendments and EM application was also seen on physical characteristics of soil. The saturation percentage of the soil was significantly increased with EM application and the higher soil saturation is found when the EMs combined with vermicompost manure. The soil parameters such as pH and some of the nutrients were given in the Table 1, 2 & 3. The soil pH was 4.7 on 0 day of the experiment. But it was neutralized in all the EM treated and chemical fertilizer group of plant. The group V pH (7.3 ± 0.2) was almost near to the neutral level. The Soil moisture level, organic carbon, N, Fe, Ca and other micronutrient levels also increased in EM treated groups when compared with control and NPK treated group plants. The plant development data are given in Table 4. The yield of paddy is more in EM + Vermicompost treated plants than the other groups.

Beneficial microorganisms are applied in various agricultural and environmental problems with considerable success, because it is difficult to consistently reproduce their beneficial effects. Effective Microorganisms (EM) contains live cultures of microorganisms derived from fertile soils in nature and useful for crop production. E.M. mostly contains *Lactobacillus*, photosynthetic bacteria, yeasts and other beneficial microorganisms (Yamada *et al.*, 2003 and Zachariah, 2002). EM has been used with considerable success to improve soil quality and growth, yield and quality of crops (Xu 2000).

The reports reveals that during early stages of leaf growth, synthesis of chlorophyll, proteins and structural compounds is high resulting in high catabolic rates to support energy needs by the plants. Inoculation of effective microorganism can increase the available nutrition for plant roots and improve photosynthesis. The increase of N and other micronutrients in the present study indicates that the inoculated EM works efficiently for the plant growth. The synthesis and degradation of the photosynthetic pigments has the close relationship with the plants growth and their adaptation to different environments (Beadle, 1993). Chlorophyll *a* and *b* content were increased in when the EMs are inoculated (Chrispaul *et al.*, 2010). The increase of Chlorophyll may directly increase the synthesis of proteins (Hendry *et al.*, 1987). The Nitrogen content is increased in the present study which is an essential biomolecule for the synthesis of nucleic acids, coenzymes and proteins (Sharma *et al.*, 1995).

The microorganisms, when applied in the correct manner, improve the rhizosphere by transforming the microflora and microfauna (Higa, 1998). Effective microorganisms consist of mixed cultures of naturally- occurring beneficial microorganisms that can enhance soil quality and the growth and yield of crops in organic farming systems (Higa, 1991). Effective Microorganisms solution contain a mixture if five genera of organisms namely, Actinomycetes, Ray fungi, Photosynthetic bacteria, Yeast and Lactic acid bacteria (Higa, 1994). Research (Parr *et al.*, 1997) illustrates the different methods of applying EM in crop production, all of which reports beneficial results of using this solution in a wide range of environment. Also the EM can stimulate seed germination and early growth of food crops (Sangakkara and Higa, 1994) and create a more favourable root surface- rhizosphere for crop plants that improve plant growth and protection (Sangakkara, 1996). Microorganisms enhance the efficiency of organic systems (Dobereiner, 1994). The yield of rice was increased when EM is applied with recommended rates of fertilizers. Wheat grain yield was also increased with EM treated plants (Poonyarit *et al.*, 1993). Karim *et al.* (1993) also reported that yield of wheat increased directly by the addition of EM, manure and N fertilizer.

In the present study, the yield of rice is increased significantly in all EM treated groups. It may be due to the action of beneficial microbes present in the EM solution. The present observations are coincided with many other scientific investigations. Microorganisms present in the rhizosphere play important roles in ecological fitness of their plant host. The microbes in rhizosphere are thought be in the involvement plant protection, growth promotion, production of antibiotics, geochemical cycling of minerals and plant colonization. There are several reports that the plants release attractants and repellants through their root to soil. Interactions between roots and microorganisms in soil surrounding roots may influence N_2 mineralization and cycling. Nitrogen fixation was the major mechanism for the enhancement of plant growth by *Azospirillum*. Incorporation of atmosphere nitrogen into the host plant by *Azospirillum* was evaluated mainly by the acetylene reduction assay (ARA)

In conclusion, the application of EM with organic manure presents the better yield and also improves the soil chemical nature as suitable for the plant growth. The EM along with vermicompost brings excellent yield in rice plant.

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CONFLICTS OF INTEREST

"The authors declare no conflict of interest".