ABSTRACT

In Modern agriculture, use of chemical is essential for sustainable yield but these are not eco friendly. Indiscriminate use of chemical fertilizers has developed disturbances in the soil reaction, development of nutritional imbalance in plants, increased susceptibility to pests and diseases. The problem is so intensive that, in many agricultural land of our country less than one crore of micro organisms have been found in one gram of soil and this produce polluted soil which cause environments destabilization making the cost production high. This study proved that combined effect of biofertilizers increased the biochemical and germination percentage in Oryza sativa L. variety Ambai-16.

KEY WORDS: Biofertilizers, eco-friendly, chemical fertilizers.

INTRODUCTION:

India, the second largest population country, mostly depends on agriculture for living. Agriculture primarily depends on soil, which is a living body, because it consists of micro flora such as bacteria, actinomycetes, fungi and algae. In tropical and subtropical agricultural land, normally there are ten crores of microorganisms in one gram of soil. Among the ten crores of microorganisms, only 5-7% is harmful, while the rest are beneficial in nature and extremely useful in agriculture (Chowdhury and Mukherjee, 2006).

Indiscriminate use of chemical fertilizers has developed disturbances in the soil reaction, development of nutrient imbalances in plants, increased susceptibility to pests and diseases, reduction in legume root nodulation and plant mycorrhizal associations, decrease in soil life and environmental hazards such as water pollution and soil humus reduction. One of the major effects of such activities is gradual decrease in the number of useful microorganisms in agricultural soil. The problem is so intensive that, in many agricultural land of our country less than one crore of microorganisms have been found in one gram of soil (Chowdhury and Mukherjee, 2006). Because of these reasons, not only the soil is polluted through environment destabilization but the yield of agricultural produce also fluctuating alarmingly. In such a situation biofertilizers play a major role. Authors have reported that biofertilizers harvest atmospheric nitrogen and make it available directly to the plant (Ganachitra, 2000).

Plant Materials:

Biofertilizers used in the experiments were Azospirillum, Mycorrhizae and Phosphobacterium.

Oryza sativa L. Var. Ambai-16 was taken for investigation.

Sample collection and soil nutrient analysis:

Collection of seeds:

The seeds of Oryza sativa L. Var. Ambai-16 was obtained from Tamil Nadu Agricultural University, Coimbatore.

Collection of biofertilizers:

The biofertilizers selected for the study were (Azospirillum, Mycorrhizae and Phosphobacterium) collected from Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India.

Pesticide treatment:

The viable seeds were surface sterilized with 0.1% mercuric chloride for 1-2 minutes and then repeatedly washed with sterilized distilled water to remove any trace of mercuric chloride.

Soil analysis:

Soil samples were collected from the experimental field and analysed in soil testing laboratory for nitrogen, phosphorus and potassium (Black, 1957).

The pH of the soil was determined using pH meter (Systronic model 321) and the mean values were calculated.

Experimentation:

The treated seeds were sown in eight experimental pots. One of the pot was used control without any fertilizers. The remaining seven pots were treated as experimental pots in which 50 gm of seeds inoculated with biofertilizers (Mono, dual and combined types). Irrigation was done at regular intervals without causing any physical damages.

The experiment was started from the appearance of the third leaf stage which is the experimental stage and it was completed till the senescence of 3 leaf. The experimental were repeated three times. The different inoculations were as follows: Control, Azospirillum, Mycorrhizae, Phosphobacterium, Azospirillum + Mycorrhizae, Azospirillum + Phosphobacterium, Mycorrhizae + Phosphobacterium, Azospirillum + Mycorrhizae + Phosphobacterium

Germination percentage:

The number of seeds germinated, were counted to find out the germination percentage. It was calculated using the formula

\[
\text{Germination Rate} = \frac{\text{(Number of seeds germinated)}}{\text{(Number of seeds sown)}} \times 100
\]

The germination rate is expressed in Percentage (%).

Experiments were conducted after the formation of the third leaf (0 day) up to senescence stage.

Biochemical studies:

Extraction and estimation of Chlorophyll and Carotenoid were done by Arnon, 1949 method.

RESULTS:

Seed germination (Oryza sativa L. Var. Ambai-16):

The result on the seed germination percentage of Oryza sativa L. Var. Ambai-16 was presented in Table 1.

The control showed the lowest seed germination of 63.33 ± 4.51%. In mono inoculations of biofertilizers treatment the minimum percentage of seed germination was recorded in Mycorrhizae (69.00 ± 2.00%). In dual inoculations Azospirillum + Mycorrhizae showed minimum germination (73.67 ± 4.04%) and Azospirillum + Phosphobacterium showed maximum germination percentage (76.67 ± 4.73%). The combined biofertilizers treatment showed (92.67 ± 4.04%) maximum percentage of seed germination when compared to all other treatments.

Table 1: Response of biofertilizers on the percentage of seed germination in Oryza sativa L. Var. Ambai-16

<table>
<thead>
<tr>
<th>Biofertilizer</th>
<th>Germination % of seed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>63.33 ± 4.51</td>
</tr>
<tr>
<td>Mycorrhizae</td>
<td>69.00 ± 2.00</td>
</tr>
<tr>
<td>Azospirillum</td>
<td>72.00 ± 3.61</td>
</tr>
<tr>
<td>Phosphobacterium</td>
<td>72.67 ± 3.06</td>
</tr>
<tr>
<td>Mycorrhizae + Azospirillum</td>
<td>73.67 ± 4.04</td>
</tr>
</tbody>
</table>
Biofertilizers are “Microbial inoculants” which fix atmospheric nitrogen and used to improve several crop plants. They are the product containing living cells of different microorganisms which have ability to mobilize nutritionally important element from non-usable to usable form through biological process.

Biofertilizers based on renewable energy source are a cost effective supplement to chemical fertilizers and can help to economise on the high investment needed for fertilizer use as far as nitrogen and phosphorus are concerned (Kushare et al., 2009).

Seed germination percentage was investigated in the seeds inoculated with biofertilizers and uninoculated control. Highest germination percentage was found in combined inoculation than in the other inoculations and control. The seed germination of black gram was generally favoured more by biofertilizer than green manure soil amendments (Nealamegam et al., 2007). Biofertilizer inoculation influenced the seed germination to an appreciable level compared with control. Highest germination percentage was found in combination for dual inoculation (Rhizobium and Vesicular arbuscular mycorrhizas) with single super phosphate (SSP) (Pandey et al., 2003).

Inoculation of Vicia faba with Mycorrhizae had positive effect due to stimulatory effect on growth may be due to availability of phosphorus which enhances the metabolic processes such as photosynthesis, starch synthesis, glycolysis and synthesis of fats and proteins (Jan et al., 2009). Mycorrhizal fungi interact with a wide range of other soil organism in the root, rhizosphere and in the bulk soil. (Boby et al., 2007).

Treatments of Azospirillum and Azotobacter plus 100% Urea resulted in significant increase in total chlorophyll. The chlorophyll content decreased during senescence stage due to the loss of greenness as the plant matures. The beneficial effects of bacterial inoculation on increased chlorophyll content might have been due to the supply of higher amount of nitrogen to the growing tissue and organs supplied by Nitrogen fixing Azospirillum and Azotobacter (Chandrasekhar et al., 2005).

All the inoculated Chrysanthemum plants showed superior chlorophyll content compared to control (Singh et al., 2008). All Arbuscular mycorrhizal fungi inoculation significantly enhanced chlorophyll content by 50% to 60% over control (Ghosh et al., 2008).

Carotenoids are the accessory pigments in photosynthetic systems and give characteristic colour to plant parts, particularly flowers and fruits (Sadasivam and Manickam, 2008). Earlier Bahadur et al., (2006) in Broccoli and Chinese cabbage also noticed increased in the carotenoid content respectively with combined use of organic manures and seedling inoculation in Vesicular arbuscular mycorrhizae (VAM) or Azotobacter. The arbuscular mycorrhizae inoculated plants showed significant increase in carotenoid content than the non-mycorrhizal plants (Paneerselvam and Thamizhiniyan, 2008). The combined treatment of micronutrients and Rhizobium inoculates increase the carotenoid content in Glycine max (Murugesan, 2008). The carotenoid content increased in the tomato plants treated with Azotobacter and Phosphobacterium (Selvarathi, et al., 2010).

Increased carotenoid content under Azotobacter and acid content with Vesicular Arbuscular Mycorrhizae (VAM) may be due to production and synthesis of hormones and vitamins (Vitamin B12, and other vitamins) with enhanced enzymatic activity in organic amended and microbial soil of nitrogen (Selvakumar et al., 2009).

In the present study, combined inoculation of fertilizers showed more significant result than other inoculations. It is related with the findings of Selvakumar et al., 2009.

CONCLUSION:
In this investigation the combined effect of Azospirillum, Phosphobacterium and Mycorrhizae in Oryza sativa is more significant when compared to control and other inoculations.

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