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Effect of FYM, N, P fertilizers and biofertilizers on germination and growth of paddy (*Oryza sativa*. L)

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ABSTRACT

Biofertilizers are becoming increasingly popular in many countries and for many crops, but very few studies on their effect on growth in seedling stage have been conducted in rice. The experiments were conducted under laboratory conditions due to organic manure, fertilizers and bio fertilizers were observed in all experiments. The treatments such as organic manure, chemical fertilizers and Biofertilizers alone and in combination were applied. The growth parameters viz. germination percentage, root length, shoot length, fresh weight and dry weight were measured. Similarly the pigment contents such as chlorophyll-a, b, total chlorophyll and carotenoid were also measured at seventh day after sowing. All the parameters were higher in combined application of Biofertilizers than in single application and other treatments including control.

Keywords: FYM; N; P; biofertilizers

1. INTRODUCTION

Today, global agriculture is at crossroads as a consequence of climatic change, increased population pressure and detrimental environmental impacts. Increased population needs more food to live on the earth. Indian agriculturalist are in a position to increase our food production within the available cultivated land. Application of commercial fertilizers to soil is more expensive and also resulted in soil degradation. New mechanism must be found to ensure food security through sustainable crop production systems that supply adequate nutrition, without harming the agro ecosystem (Panwar and Vijayaluxmi, 2005). Biofertilizers have attracted greater attention particularly in developing countries like India as a substitute for costly chemical fertilizers. They can be applied to seed, root or in order to soil mobilize the availability of nutrients by their biological activity and turn the soil health in general. Bio fertilizers provide eco-friendly ortganic agro input and are more cost effective then chemical fertilizers (Amutha *et al*.,2014).

Biofertilizers are living cells of different types of microorganism (bacteria, algae, fungi), which have an ability to mobilize nutritionally important elements from non-usable form. These microorganisms require organic matter for their growth and activity in soil and provide valuable nutrients to the plant (Saini *et al.,* 2004). Biofertilizers are ecofriendly fertilizer, which improve soil quality and provide yield increments. It greatly benefit farmer with only very small input cost (Kumudha, 2005; Kumudha and Gomathinayagam, 2007).Use of biofertilizer and organic manure in agriculture is becoming popular nowadays not only in order to minimize the cost of chemical fertilizers but also to reduce the adverse effects of chemical fertilizers on soil and plant environment and to ensure more crop productivity (Viyas, 1988).

In recent years, rice has emerged as the principal stable food crop in the most part of Tamilnadu. Growing two or more crops per year involves the heavy removal of plant nutrients, from the soil nitrogen being the key input limiting rice production. To produce a ton of grain the rice crop takes up an average of 20 kg N ha^{-1} from the soil over a period of 3-5 months. To sustain the rice productivity at present levels, the N removed in harvested product or lost from the system must be obtained from organic manures (Satheesh and Balasubramanian, 2003).Hayman (1975) suggested that the inoculation of nitrogen fixing bacteria increased the growth of crops . Bopaiah and Abdul Khader (1989) have reported that the biofertilizer inoculation increased the plant height, weight and NPK status of the plant compared with the uninoculated control. Similar results were made due to the application of biofertilizers in various crops such as blackgram by Neelamegam *et al.* 2007,Lentil by Kumar and Chandra .,2008,Chikpea by Nishita and Joshi.,2010 , Maize by Singh *et al.,*2012 and Guava by Sahu *et al*.,2014.So the present investigation has been carried to find out the germination ,growth and pigment contents of rice due to the application of various organic manures, fertilizers and Bio fertilizers.

2. MATERIALS AND METHODS

The experimental Seed Paddy (*Oryza sativa* L.) was obtained from Tamil Nadu Rice Research Institute, Aduthurai, Tanjavur district of Tamil Nadu, India. Healthy seeds of paddy were chosen and used for laboratory experiments. The fertilizers such as Urea, Di-Ammonium Phosphate (DAP), *Azospirillum brasilense* and *Bacillus megaterium* were purchased from Authorized Private Agro Centres, Mayiladuthurai. The Farm Yard Manures (FYM) was collected from local villages.

The healthy seeds of paddy were surface sterilized with 0.1% mercuric chloride for 2 minutes and washed thoroughly with distilled water and then with tap water. The plastic cups were filled with soil mixed with organic manure (FYM), fertilizers (urea and DAP) and bio fertilizers plastic cups (2:1:1 ratio). The sterilized seeds of paddy were sown equispacially. The seeds were irrigated uniformly with tap water. The seeds grown in the plastic cup without any fertilizer application were treated as control. They were allowed to grow for a week. Three replicates were maintained for this experiment in similar environmental condition. The following treatments were given in the field experiment.T_0 - Control, T_1 - Organic manure (FYM) – 2 tons/ha, T_2 - Urea (Nitrogen) – 50 kg/ha,T_3 - DAP (Di Ammonium Phosphate) – 50 kg/ha, T_4 - *Azospirillum brasilense* – 2 kg/ha, T_5 - *Bacillus megaterium* – 2 kg/ha and T_6 - *Azospirillum brasilense* + *Bacillus megaterium* – 4 kg/ha .

Germination percentage

The number of seeds germinated in each treatment was counted on 7^{th} day after sowing. The total germination percentage was calculated by using the following formula.

$$\text{Germination percentage} = \frac{\text{Total number of seeds germinated}}{\text{Total number of seeds sown}} \times 100$$

2.1. Root length and shoot length

Twenty seedlings were randomly selected from each treatment to record the seedling growth. The root length and shoot length of on 7^{th} day old paddy seedlings were measured by using a centimeter scale and the values were recorded.

2.2. Fresh weight and dry weight of seedlings

Ten seedlings were randomly selected from each treatment. Their fresh weight was recorded by using single pan electrical balance. The same seedlings were packed in brown pocket cover and they were kept in a hot air oven at 80°C for 24 hrs. After kept them in a dessicator for some time, their dry weight was also taken by using an electrical single pan balance.

2.3. Chlorophyll (Arnon, 1949)

Five hundred mg of fresh leaf material was ground with the help of mortar and pestle with 10 ml of 80 per cent acetone.The homogenate was centrifuged at 800 rpm for 15 minutes. The supernatant was saved. The residue was re-extracted with 10 ml of 80 per cent acetone. The supernatant was saved and the absorbance values were read at 645 nm and 663 nm in a UV-Spectrophotometer (Hitachi). The chlorophyll a, chlorophyll b and total chlorophyll contents were estimated and expressed in mg/g fresh weight basis.

$$\text{Chlorophyll a} = (0.0127) \times (\text{OD } 663) - (0.00269) \times (\text{OD } 645)$$

$$\text{Chlorophyll b} = (0.0029) \times (\text{OD } 645) - (0.00488) \times (\text{OD } 663)$$

$$\text{Total chlorophyll} = (0.0202) \times (\text{OD } 645) + (0.00802) \times (\text{OD } 663)$$

2.4. Carotenoid (Kirk and Allen, 1965)

The same plant extract used for chlorophyll estimation was used for carotenoid estimation. The acetone extract was read at 480 nm in UV-Spectrophotometer. The carotenoid content was calculated by using the following formula.

$$\text{Carotenoid} = (\text{OD } 480) - (0.114) \times (\text{OD } 663) - (0.638) \times (\text{OD } 645).$$

3. RESULT AND DISCUSSION

India is an Agricultural country Indian population has already crossed 100 crores and it ranks second position in the world. The food production should be increased with the geomentrically growing population. In India, there is a constant pressure on crop production from available cultivable land with limited water resources in order to keep face with the food requirements for an ever-increasing population. Application of suitable fertilizers is one of the ways to attain the maximum crop yield. Chemical fertilizer is the major supplier of nutrients besides organic and green manures. The use of chemical fertilizers has been kingpin of modern agriculture. This undoubtedly boosted the food production but at the same time, it shows the negative effects on physico-chemical properties of soil, nitrogen transformation, macro and micronutrient uptake and nutritional composition (Mahesh and Hosmani, 2004).

The continuous and excess use of chemical fertilizers over a longer period of time has resulted in deterioration of soil health and causes less productivity (Yadav and Lourduraj, 2005).

The effect of fertilizers and biofertilizers on germination studies of paddy was presented in Table 1. The highest percentage of germination (99), root length (10.843 cm/seedling) and shoot length (13.548 cm/seedling), fresh weight (3.128 g/seedling) and dry weight (1.255 g/seedling) was observed in paddy crop grown in combined bio fertilizer application.

The lowest germination percentage (88), root length (6.654 cm/seedling), shoot length (9.532 cm/seedling), fresh weight (1.516 g/seedling) and dry weight (0.380 g/seedling) was recorded in paddy crop grown without fertilizer application. In present study, all the treatments with fertilizers and biofertilizers registered higher germination percentage compared to control samples. The maximum, seed germination was observed in combined biofertilizer (*Azospirillum* + Phosphobacteria) treatment. These findings are in agreement with the results of Kumudha and Gomathinayagam (2007) in *Albizia labbek* and Ram *et al*., (2014) in *Triticum aestivum* seedlings with biofertilizers treatment. Enhancement of seed germination might be attributed to the role of biofertilizers *Azospirillum* and phosphobacteria in enhancing the availability of nitrogen and phosphorus in the soil and making of available to the germinating seed with consequent enhancement in the metabolic activity resulting in higher germination (Copper, 1979 and Ram *et al*.,2011).

The effect of fertilizers and biofertilizers on photosynthetic pigments of paddy was presented in Table 2. The highest content of chlorophyll a (0.821 mg/g fr. wt.), chlorophyll-b (0.671 mg/g fr. wt.), total chlorophyll (1.598 mg/g fr. wt.) and carotenoid (0.721 mg/g fr. wt.) were recorded in paddy crop grown in soil treated with *Azospirillum* and *Bacillus*. Similarly, the lowest chlorophyll a, chlorophyll b, total chlorophyll and carotenoid content (0.378, 0.262, 0.640 and 0.359 mg/g fr. wt. basis) were recorded in paddy crop grown without fertilizers .Chlorophyll a, b and total chlorophyll content is an indicative of photosynthetic and metabolic activity. The disappearance of chlorophyll is the one of the most prominent phenomenon of an advanced age and rate of chlorophyll degradation. It is considered a reliable criteria of age related deterioration and loss of essential plant metabolites (Ahuja and Malik, 1977; Chopade *et al.,* 2007). Chlorophyll is the molecule that absorbs sunlight and uses its energy to synthesis carbohydrates from CO_2 and water. The catabolic products *viz.,* proteins, glycosides, tannins, carotenoids etc. are the secondary metabolites. It has been proved that chlorophyll play an important role in the ATP generation and prevention of essential plant constituents (Kokate *et al.,* 1998). The presence or absence of chlorophyll in plant greatly affects the production of secondary metabolites and other essential plant constituents. The chlorophyll degradation supports the fact of contamination of plant tissue with pollutants (Singh *et al.,* 1999).

4. CONCLUSION

It may be concluded that the chemical fertilizers are increase the plants growth and yield as well as soil depletion in long term usage. Similarly the organic manures and Biofertilizers are increasing the plants productivity comparable with chemical fertilizers without any harmful effects in the soil. While the combined application of Biofertilizers along with organic manures for the cultivated crops to improve their productivity as well as soil health.

Table 1. Effect of fertilizers and biofertilizers on germination studies of 7th day old paddy (Oryza sativa L.) seedlings.

Treatments	Germination percentage	Root length (cm/seedling)	Shoot length (cm/seedling)	Fresh weight (g/seedling)	Dry weight (g/seedling)
T0 – Control	88 (± 2.640)	6.654 (± 0.199)	9.532 (± 0.285)	1.516 (± 0.045)	0.380 (± 0.011)
T1 – Farm yard manure	92 (± 2.760)	7.282 (± 0.218)	10.810 (± 0.324)	1.793 (± 0.0537)	0.412 (± 0.012)
T2 – Urea	96 (± 2.880)	8.541 (± 0.256)	11.728 (± 0.351)	2.122 (± 0.063)	0.811 (± 0.024)
T3 – Di-Ammonium phosphate	94 (± 2.820)	8.872 (± 0.266)	11.310 (± 0.339)	2.000 (± 0.060)	0.742 (± 0.022)
T4 – Azospirillum brasilense	98 (± 2.880)	9.428 (± 0.282)	12.322 (± 0.369)	2.342 (± 0.070)	0.924 (± 0.027)
T5 – Bacillus megaterium	96 (± 2.880)	8.732 (± 0.261)	11.525 (± 0.345)	2.133 (± 0.063)	0.766 (± 0.022)
T6 – Azospirillum brasilense + Bacillus megaterium	99 (± 2.970)	10.843 (± 0.325)	13.548 (± 0.406)	3.128 (± 0.093)	1.255 (± 0.037)

± Standard deviation

Table 2. Effect of fertilizers and biofertilizers on chlorophyll content of 7th day old paddy (Oryza sativa L.) seedlings.

Treatments	Photosynthetic pigments (mg/g fr. wt. basis)			
	Chlorophyll 'a'	Chlorophyll 'b'	Total chlorophyll	Carotenoid
T0 – Control	0.378 (± 0.011)	0.262 (± 0.007)	0.640 (± 0.019)	0.359 (± 0.010)
T1 – Farm yard manure	0.421 (± 0.012)	0.348 (± 0.010)	0.769 (± 0.023)	0.383 (± 0.011)
T2 – Urea	0.589 (± 0.017)	0.411 (± 0.012)	1.000 (± 0.030)	0.492 (± 0.014)
T3 – Di-Ammonium phosphate	0.532 (± 0.015)	0.402 (± 0.012)	0.934 (± 0.028)	0.485 (± 0.014)
T4 – Azospirillum brasilense	0.746 (± 0.022)	0.553 (± 0.016)	1.299 (± 0.038)	0.532 (± 0.015)
T5 – Bacillus megaterium	0.580 (± 0.017)	0.529 (± 0.015)	1.109 (± 0.033)	0.520 (± 0.015)
T6 – Azospirillum brasilense + Bacillus megaterium	0.821 (± 0.024)	0.671 (± 0.020)	1.598 (± 0.047)	0.721 (± 0.216)

± Standard deviation

References

[1] Ahuja, I. and C.P. Mallik, 1977. Effect of *Brassino steroida* and *Paleobutrazole* on chlorophyll content in development of *Brassic tuornefortii*. *J. Plant Sci. Res.,* 13: 31-34.

[2] Amudha R, Karunakaran S, Dhanasekaran S, Hemalatha K, Monika R , Shanmugapriya. Pand Sornalatha T 2014. Isolation and mass production of Biofertilizers (*Azotobacto*r and *Phosphobacter*) *International Journal of latest research andtechnology*. vol (3) P79-81.

[3] Arnon, D.I., 1949. Copper enzymes in isolated chloroplasts polyphenol oxidase in *Beta vulgaris*. *Plant Physiol.,* 24: 1-15.

[4] Bopaiah, B.M. and K.B. Abdul Khader, 1989. Effect of biofertilizer on growth of black pepper. *Indian J. Agri. Sci.,* 59(10): 682-683.

[5] Chopade, A.R., N.S. Naikwade, A.V. Nalawade, V.B. Shinde and K.B. Burade, 2007. Effects of pesticides on chlorophyll content in leaves of medicinal plants. *Poll. Res.,* 26(3): 491-494.

[6] Copper, R., 1979. Bacterial fertilizers in the Soviet Unions. *Soil Fert.,* 22: 327-333.

[7] Hayman, D.S., 1975. Influence of phosphate and VA-mycorrhiza on crop species under field condition. *Plant Soil,* 43: 489.

[8] Kirk, J.T.O. and R.L. Allen, 1965. Dependence of chloroplast pigments synthesis on protein synthetic effects of acitilione. *Biochem. Biophys. Res. Cann.,* 27: 523-530.

[9] Kokate, C.K., S.B. Golbale and Purohit, 1998. Textbook of pharmacognosy, Nirali Prakashan, Pune, pp. 17-18.

[10] Kumar. R, and Chandra.R2008. Influence of PGPR and PSB on *Rhizobium leguminosarum* Bv., viciae strain competition and symbiotic performance in lentil. *World J Agric.,Sci.vol*., 4 p- 297- 301.

[11] Kumudha, P. and M. Gomathinayagam, 2007. Studies on the effect of biofertilizers on germination of *Albizia lebbek* (L.) Benth. seeds. *Adv. Plant Sci.,* 20(11): 417-421.

[12] Kumudha, P., 2005. Studies on the effect of biofertilizers on the germination of *Acacia nilotica* Linn. seeds. *Adv. Plant Sci.,* 18(11): 679-684.

[13] Mahesh, M.K. and S.P. Hosmani, 2004. Morphological changes and nutrient uptake in some cultivars of rice treated with Bavistin. *J. Ecotoxicol. Environ. Monitoring,* 14: pp. 195-198

[14] Neelamegam, P., K. Malarvizhi, S. Sreelaja and G. Christopher, 2007. Effect of biofertilizers on seed germination and early seedling growth of blackgrams. *Ecobiol.,* 20(2): 111-115.

[15] Nishita G and Joshi N,C 2010 Growth and yield response of chick pea (Cicer arietinum) to seed inoculation with Rhizobium *Sp. Nat., Sci*.,. 8 :-232-236.

[16] Panwar, J.D.S. and Vijayluxmi, 2005. In : Biological nitrogen fixation in pulses and cereals. Development in physiology, biochemistry and molecular biology of plants (Editor: Bandana Bose and A. Hemantaranjan) Published by New India Publishing Agency, New Delhi, pp. 125-158.

[17] Ram.M Dawari. R and Sharma.N 2011. Effect of organic manures on basmati rice (*Oryza sativa* L)under organic forming of rice – wheat cropping system. *Int.,Journal of Agricultural and crop sciences*. 3(3): 76-84.

[18] Ram.M Dawari. R and Sharma.N. 2014. Direc,residual and cumulative effects of organic manures andbiofertilizers on yields, NPK uptake, grain yield and economics of wheat (*Triticum aestivum* L) under organic forming of rice-wheat cropping system. 9(1)p-16-30.

[19] Sahu.K Dikshit.Nand Sharma.G 2014. Effect ofchemical fertilizers ,organic and biofertilizers on growth, yield,and soil nutrient statis of Guava.Int., *Journal of research in Environ.,sci, and research*.Vol 4(4) 111-113.

[20] Saini, V., R. Berwal, J. Sharma and A. Singh, 2004. Biofertilizers: current status and perspectives in agriculture. *Poll. Res.,* 23(4): 665-676.

[21] Satheesh, N. and N. Balasubramanian, 2003. Effect of organic manure on yield and nutrient uptake under rice-rice cropping system. *Madras Agric. J.,* 90(1-3): 41-46.

[22] Singh A. Poonam and Ghose. A.K 2012. Assesment and Identification of phosphate solubulizing microbes as potential biofertilizer.*Asian journal of experimental biology*. Vol3(4)p 790-798.

[23] Singh, O.P., T.P. Singh and A.L. Yadav, 1999. Variability and co-heritability and estimates for agronomical and quality traits in *Opium poppy* (*P. somniferum* L.). *Sci. Cult.,* 64(3-4): 107-109.

[24] Viyas, S.C., 1988. Non-target effect of agricultural fungicides. CRC Press Inc, Boca Raton, p. 71.

[25] Yadav, B.K. and A.C. Lourduraj, 2007. Effect of organic manuers applied to rice crop on microbial population and enzyme activity in post harvest soil. *J. Ecobiol.,* 20(2):139-144.

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