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Comparative Study on Effect of Chemical and Bio-Fertilizer on Growth, Development and Yield Production of Paddy crop (*Oryza sativa*)

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Abstract: ***A comparative study has been done to investigate the effects of chemical fertilizer and bio-fertilizer on the growth and yield production. Rice was planted in pots containing clay soil and were watered and maintained regularly over an 80 day period. The study was conducted to assess the potential of biofertilizer as viable alternatives to chemical fertilizer. It was discovered that treatment with biofertilizer produced plants height with the highest yield of rice. Plants treated with inorganic fertilizers (chemical fertilizer) produced the lowest yields and lowest plant height compared to the bio fertilizer treatments. Highest plant height 91.8 cm at 105 days, number of grain average value 893 grain and increase percentage yield 14.77% over the control with bio fertilizer treated plant. Chemical fertilizer treated plant was recorded plant height 84.7 cm at 105 days, number of grain average value 610 grain and increase yield percentage 7.98% over the control.***

Keyword: Chemical fertilizer, Bio-fertilizer, Yield Production and Rice.

1. Introduction

India is one leading producer of rice in Asia (Tony Cisse, 2005). Rice crop has been under cultivation from time immemorial, being grown under varying climatic in different parts of the country. Agriculture is one of the most important factors contributing to the economic growth of India. Out of the 329 million hectares of India's geographical area, about 114 million hectares are under cultivation (Raghuwanshi, 2012). Fertilizers come in two types - they are either chemical or biofertilizers. Increasingly high inputs of chemical fertilizers during last 150 years have not only left soils degraded, polluted and less productive but have also posed severe health and environmental hazards. Organic farming methods (such as the use of biofertilizers) would solve these issues and make the ecosystem healthier. Biofertilizers play a very significant role in improving soil fertility by fixing atmospheric nitrogen, both, in association with plant roots and without it, solubilise insoluble soil phosphates and produces plant growth substances in the soil. They are in fact being promoted to harvest the naturally available, biological system of nutrient mobilization (Venkatashwarlu, 2008). The role and importance of biofertilizers in sustainable crop production has been reviewed by several authors (Biswas et al. 1985; Wani and Lee, 1995; Katyal et al. 1994).

In addition, microbial inoculants can be used as an economic input to increase crop productivity; fertilizer doses can be lowered and more nutrients can be harvested from the soil. Biofertilizer is defined as a substance which contains living micro-organisms and is known to help with expansion of the root system and better seed germination. A healthy plant usually has a healthy rhizosphere which should be dominated by beneficial microbes. Conversely, in unhealthy soil, dominated by pathogenic microbes, optimum plant growth would not be possible. Biofertilizers differ from chemical and organic fertilizers in the sense that they do not directly supply any nutrients to crops and are cultures of special bacteria and fungi. The production technology for biofertilizers is relatively simple and installation cost is very low compared to chemical fertilizer plants.

Bio-fertilizers containing beneficial bacteria and fungi improve soil chemical and biological characteristics, phosphate solutions and agricultural production (El-Habbasha et al., 2007; Yosefi et al., 2011). Microbiological fertilizers are important to environment friendly sustainable agricultural practices (Bloemberg et al., 2000).) The Biofertilizer includes mainly the nitrogen fixing, phosphate solubilizing and plant growth promoting microorganisms (Goel et al., 1999).

2. Materials and Methods

Comparative study of chemical and bio- fertilizers was carried out for Paddy growth and yield production under Department of Botany at the University of Allahabad, Allahabad (U.P.) INDIA during the monsoon (Kharif) season of year 2013. Rice plant seeds (Kiron variety) in 2 Pot nursery was prepared and watering them once daily. After that fill 15 pots to the same level with ploughed soil. After 25 day, pick 45 healthy seedlings of similar height from the nursery and transplanted at the rate of 3 seedling in per pot. The experiment was laid out in a 15 pot with four replications. NPK, Biofertilizer (BGA, Azolla), respectively. All the fertilizers were applied in the pot, NPK used was after transplanting and N used in three split. NPK apply on 35 days of paddy plant to five pots for chemical fertiliser treatment. Biofertilizer used in before paddy transplanting. The experiment consisted of the following treatments:

5 Pot control (no treatment),
5 Pot used in chemical fertilizer and
5 Pot used in biofertilozer (BGA, Azolla).

The treatment effect was recorded on the growth parameters and yield of paddy crop. I have taken plant height every 10 days from 25 to 105 days after transplanting (DAT). After 110 days, remove the plants by cutting off roots. Measure the dry mass of the plants after removing roots, count and record the number of grains on each plant.

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3. Result

The result were found highest plant height 91.8 cm at 105 days, number of grain average value 893 grain and increase percentage yield 14.77% over the control with bio fertilizer treated plant. Chemical fertilizer treated plant was recorded plant height 84.7 cm at 105 days, number of grain average value 610 grain and increase yield percentage 7.98% over the control. The number of grains on a single plant was the highest for treatment with Bio fertilizer compared to Chemical fertilizer treatment. Final heights of plants height, number of grain value average and increase yield percentage undergoing chemical fertilizer treatment were lowest compared to bio fertilizer treatments.

Table 1: Mode of Treatments: Chemical fertilizer and Bio fertilizer:

Treatment	*Pot No.*	*Control*	*Chemical Fertilizer*	*Biofertilizer*
No Treatment (Pot Control)	1	-	-	-
	2	-	-	-
	3	-	-	-
	4	-	-	-
	5	-	-	-
Chemical Fertilizer (NPK)	6	-	+	-
	7	-	+	-
	8	-	+	-
	9	-	+	-
	10	-	+	-
Biofertilizer (BGA)	11	-	-	+
	12	-	-	+
	13	-	-	+
	14	-	-	+
	15	-	-	+

Table 2: Use of chemical fertilizer and bio fertilizer of the effect of Rice Plant height in (cm)

Treatment	*Pot No.*	*25 Day*	*35 Day*	*45 Day*	*55 Day*	*65 Day*	*75 Day*	*85 Day*	*95 Day*	*105 Day*
No Treatment (Pot Control)	1	21.0	27.5	39.0	50.5	55.6	60.5	66.0	73.5	78.5
	2	23.5	28.0	40.0	52.5	58.0	60.5	64.5	77.5	79.0
	3	23.5	30.5	40.0	50.5	56.0	59.0	63.5	68.0	75.0
	4	25.0	33.0	42.5	52.0	58.0	62.5	66.5	77.0	79.5
	5	24.0	31.0	40.5	53.0	56.5	58.5	65.0	76.5	81.5
Chemical Fertilizer (NPK)	6	23.0	35.0	43.0	55.5	66.5	67.0	74.0	80.5	81.0
	7	22.0	33.0	44.0	53.5	67.0	69.5	70.0	85.0	87.5
	8	23.0	28.0	40.5	54.0	65.5	66.6	69.0	81.5	85.0
	9	24.0	35.5	48.0	58.5	68.5	71.5	73.0	84.0	83.0
	10	22.5	37.0	47.0	64.5	74.0	75.5	78.0	87.5	87.0
Bio fertilizer (BGA)	11	25.0	38.5	54.0	72.5	74.0	85.0	89.5	91.5	96.5
	12	26.5	39.0	54.4	71.5	74.0	76.3	80.2	83.0	82.0
	13	26.5	38.0	52.0	65.4	73.0	82.3	95.0	91.5	94.0
	14	27.2	38.5	54.5	74.0	76.4	82.5	85.0	87.5	91.0
	15	28.0	37.5	54.0	74.5	77.0	83.5	84.5	91.5	95.5

Note:

- Pots numbered 1-5 were not treated with fertiliser, Pot 6-10 were treated with chemical fertilizer, Pot 11-15 were treated with biofertilizer.
- Height is measured from the base of the plant to the tallest part of the plant.

Table 3: Mean heights of rice plants (cm) treated with chemical fertilizer and biofertilizer.

Treatment	25 Day	35 Day	45 Day	55 Day	65 Day	75 Day	85 Day	95 Day	105 Day
No Treatment	23.4	30.0	40.4	51.7	56.82	60.2	65.1	74.5	78.7
Chemical	22.9	33.7	44.5	57.2	68.3	70.02	72.8	83.7	84.7
Bio fertilize	26.64	38.3	53.78	71.58	74.88	81.92	86.84	89.0	91.8

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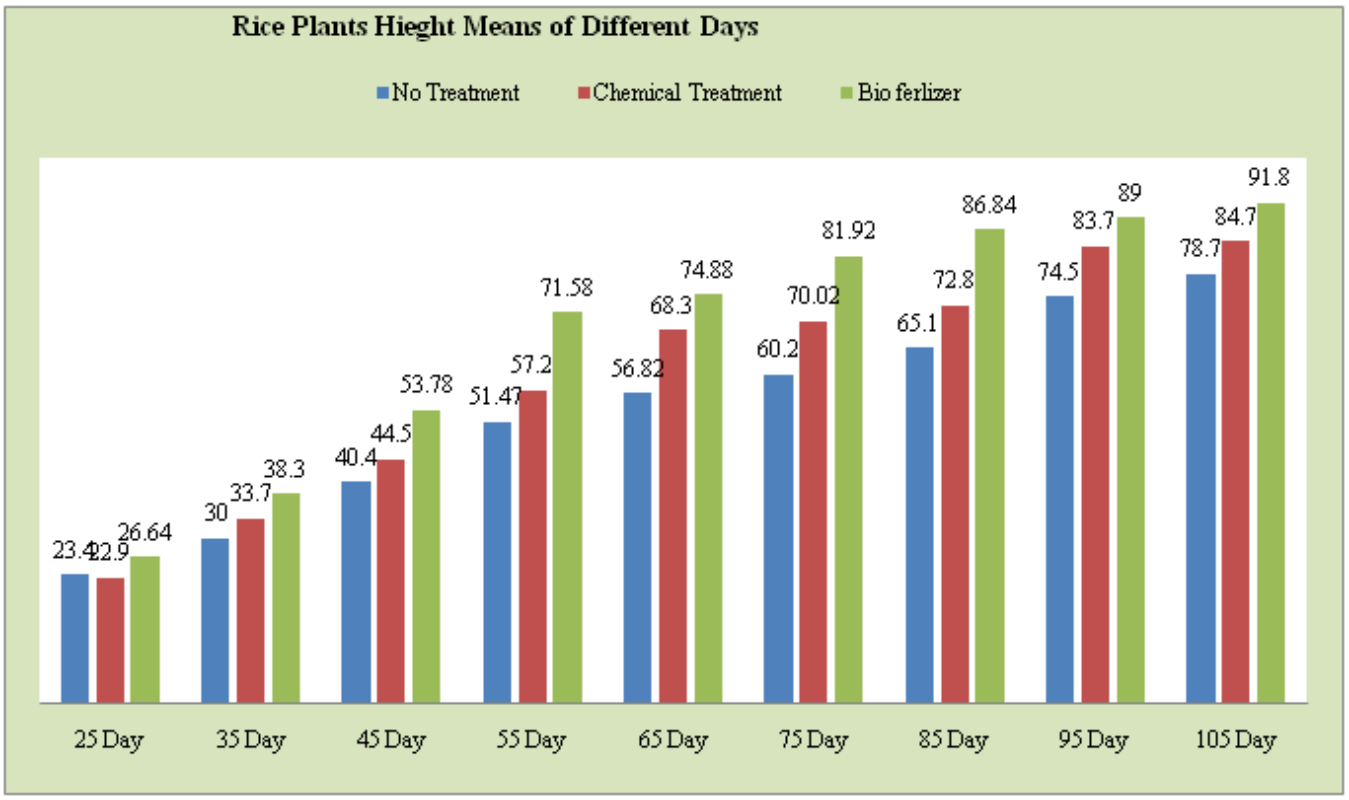

Figure 1: Mean heights of rice plants over a 80 day period in centimet

Table 4: No. of grains per pot of Rice plant

Treatment	*Pot No*	*No. of grains*	*Average no of grain*
No Treatment (Pot Control)	1	271	244
	2	222	
	3	145	
	4	189	
	5	395	
Chemical Fertilizer (NPK)	6	594	610
	7	670	
	8	480	
	9	617	
	10	691	
Bio-fertilize (BGA)	11	910	893
	12	791	
	13	1009	
	14	989	
	15	769	

Table 5: Weight of 1000 grain (gm) of Rice plant:

Treatment	Wt. of 1000 grains (gm)	Percentage Yield	Increase % Yield
No Treatment (Pot Control)	19.650	100	0.00
Chemical Fertilizer	21.220	107.98	7.98
Bio - fertilize	22.553	114.77	14.77

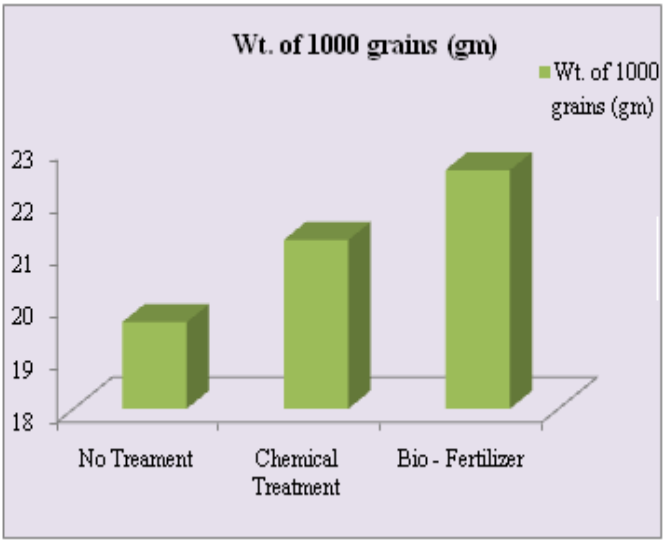

Figure 3: Wt of 1000 grain (gm) of rice plant

4. Discussion

I have treatment with chemical fertilizers did not produce plants with the highest yield and growth possibly because of the lack of organic matter in the soil to retain nutrients (Chen J.H., 2006). The uptake or accumulation of the macronutrients like N, P and K is the direct reflection of the rice yield production. Bio-fertilizer application had effects of the growth and development of rice production compared with chemical fertilizer treatments. Elshanshorey (1995) also reported that bio-fertilizers increased nutrient concentration and uptake by cereal crops, which lead towards luxurious growth and better crop development. The Biofertilizer were better than chemical fertilizer in terms of increasing the number of N-fixing bacteria in the BGA. These results

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indicate that microbial population of soil can be increased by applying organic matter and their effectiveness can be increased by inoculation with biofertilizer. The grain qualities of all the plants were less than chemical treated pot, due to early harvesting of plants before they reached maturity. However, plants treated with biofertilizer had the highest percentage grain yield possibility due to the earliest grain development. Chemical fertilisers had the lowest percentage grain yield and the latest grain development compared to biofertilizer treatments. Nitrogen seems to be an important factor for growth of plants, as indicated in the experiment. It could also be due to biofertilizer having the highest nitrogen fixation compared to the Biofertilizer.

In no treatment condition plant height was noticed on 25 day as 23.4cm, on 35 day 30.0 cm, on 45 day 40.4, on 55 day 51.7 cm, on 65 day 56.82 cm, on 75 day 60.2, on 85 day 65.1cm, on 95 day 74.5 cm, on 105 day 78.7 cm was measured.
In chemical treatment (NPK) it was noticed that plant height 33.7 cm in 25 day, on 35 day 44.5 cm, on 45 day 44.5 cm, on 55 day 57.2 cm. on 65 day 68.3 cm, on 75 day 70.02 cm, on 85 day 72.8 cm, on 95 day 83.7 cm, on 105 day 84.7 cm was measured.

In treatment with bio-fertilizer it was found that plant height 26.64 cm in 25 day, on 35 day 38.3 cm, on 45 day 53.78 cm, on 55 day 71.58 cm, on 65 day 74.88 cm, on 75 day 81.92 cm, on 85 day 86.84 cm, on 95 day 89.0 cm, on 105 day 91.8 cm was measured.

I have found weight of 1000 grain of rice plant were found in no treatment condition as 19.650g, and chemical fertilizer treatment were found in 21.220g, whereas with the bio-fertilizer treatment were as 22.553g. The grain yield increased by Bio Fertilizer in this research work 14.77% and chemical treated plant grain yield increase 7.98%.

5. Conclusion

Bio fertilizer has more effective than chemical fertilizer to induce rice plant growth and yield production. Their effects exhibited through increasing plant height and growth and development of rice production. The highest yield was obtained from treatment with Biofertilizer. There is indication from the experiment that plants grown with Biofertilizer overall produced higher growth rates and yield compared with Chemical fertilizer. The experiment could have been conducted on actual growth rate and yield of the plants. In a controlled potted experiment as carried out here, many factors had to be carefully controlled; otherwise growth and yield of plants would be affected. This experiment has indicated that using Biofertilizer resulted in high growths of the plant and yield. This experiment has indicated that using Bio-fertilisers resulted in high growths of the plant and yield.The grain yield increased by Bio Fertilizer in this research work 14.77% and chemical treated plant grain yield increase 7.98%.

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References

[1] Biswas, B.C. Yadav, D.S., and Satish Maheshwari, 1985. Bio-fertilizers in Indian Agriculture. Fertilizer News 30(10): 20-28.
[2] Bloemberg GV, Wijfijes AHM, Lamers GEM, Stuurman N and Lugtenberg BJJ (2000). Simulataneous imaging of Pesudomonas flourescens WCS 3655 populations expressing three different autofluorescent proteins in rizosphere: new perspective for studying microbial communities. Molecular Plant Microbe Interaction 13 1170–6.
[3] Chen J.H. (2006) The Combined Use of Chemical and Organic Fertilizers and/or Biofertilizer for Crop Growth and Soil Fertility
[4] Elshanshorey A.A. (1995). Interaction of Azotobactor Chroococcum, Azospirillum brasilense and Streptomyces mutabilis in relation to their effect wheat development.]. Agri. Crop Sci., 175 (2): 119-127.
[5] El-Habbasha SF, Hozayn M, Khalafallah MA (2007). Integration effect between phosphorus levels and biofertilizers on quality and quantity yield of faba bean (Vicia faba L.) in newly cultivated sandy soils. Research Journal of Agriculture and Biological Science 3(6) 966-971.
[6] Goel AK, Laura RDS, Pathak G, Anuradha G and Goel A (1999). Use of bio-fertilizers: potential, constraints and future strategies review. International Journal of Tropical Agriculture 17 1–18.
[7] Katyal, J.C., Das, S.K., Korwar, G.R. and Osman. M 1994. Technology for Mitigation stresses: Alternate land uses. Stressed Ecosystems and Sustainable Agriculture eds. Pp. 291-305 (Virmani S.M., Katyal J.C., Eswaran H and Abrol I.P eds. Publisher)
Raghuwanshi. R. (2012), Opportunities and challenges to sustainable agriculture in India, NEBIO, Vol.3, No.2, pp. 78-86.
[8] Tony Cisse K , 2005. Techniques for organic paddy cultivation. Indigenous Agriculture News, 4:1-4.
[9] Venkatashwarlu, B. 2008. Role of bio-fertilizers in organic farming:Organic farming in rain fed agriculture: Central institute for dry land agriculture, Hyderabad.pp. 85-95.
[10] Wani, S.P. and Lee, K.K. 1995. Microorganisms as biological inputs for sustainable agriculture in Organic Agriculture (Thampan, P.K.ed.) Peekay Tree Crops Development Foundation, Cochin, India. Pp-39-76.
[11] Yosefi K, Galavi M, Ramrodi M, Mousavi SR, 201. Efect of bio-phosphate and chemical phosphorus fertilzer acompanied with micronutrient foliar aplication on growth, yield and yield components of maize (Single Cros 704). Australian Journal of Crop Science, 5(2):175-180.

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