IJARSCT

ISSN (Online) 2581-9429

International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)

Impact Factor: 6.252

Volume 2, Issue 3, March 2022

Impact of Biofertilizers on Paddy (*Oryza sativa* L.) Cultivar Jaya

N. B. Pawar*[1] and N. S. Suryawanshi[2]

Mahatma Phule Arts, Science & Commerce College, Panvel, Raigad, Navi Mumbai, India[1]

Research Laboratory, Department of Botany,

K. V. Pendharkar College of Arts, Science and Commerce, Dombivili (E), Mumbai India[2]

*Corresponding Author: nbpawar01@gmail.com

Abstract: *In present study, impact of various biofertilizers on growth parameters (height of the plant & number of tillers) in Paddy (Oryza sativa L. cv. Jaya) was assessed. Randomized block design techniques was followed and was replicated thrice with twelve treatments such as T0: Control (without fertilizer), T1: Chemical fertilizer (19:19:19), T2: Blue Green Algae (BGA), T3: Azospirillum brasilense, T4: Bacillus megaterium, T5: Trichoderma viride, T6: Mycorrhizae, T7: Pseudomonas fluorescens, T8: BGA+Pseudomonas fluorescens,T9: BGA+Mycorrhizae, T10: Azospirillum brasilense+Bacillus megaterium and T11: Azospirillum brasilense+Bacillus megaterium+Pseudomonas fluorescens. Three splitted doses of chemical fertilizers were followed. The results show that all biofertilizers revel significant impact on height and number of tillers in Paddy, Oryza sativa (L. cv. Jaya). Also, combination of biofertilizers (T8 to T11) exhibit enhanced growth parameters than application of sole biofertilizers (T1 to T7). The results suggest that biofertilizers from microorganisms can replace chemical fertilizers to increase crop production. The study recommends that biofertilizers from microorganisms can replace chemical fertilizers to increase crop production. In principle, biofertilizers are less expensive and are more environmentally-friendly than chemical fertilizers.*

Keywords: Biofertilizers, Growth Parameters, *Oryza sativa*, Paddy, Randomized Block Design

I. Introduction

The proper feeding of the rapidly growing populations in developing countries is the most important challenge for mankind. Presently, about 800 million people in the world are suffering from chronic malnutrition due to shortage of suitable foods. In this context, improving agriculture to increase yield of crops without deteriorating the environment should be an ultimate goal. Continuous and excess use of chemical fertilizers and other agrochemicals to increase yield may lead to ground water contamination and depletion of soil nutrients, eventually resulting in reduction of crop yield (FNCA, 2006).

Agriculture plays consequential role in the growth and survival of nations; therefore, maintaining its quantity and quality is essential for feeding the population and economic exports. Over the years, agriculture has undergone various scientific innovations in order to make it more efficient (Ajmal, 2018). Organic farming has emerged as an important priority area globally in view of the growing demand for safe and healthy food and long-term sustainability and concerns on environmental pollution associated with indiscriminate use of agrochemicals (Mishra et al., 2013).

The excessive use of chemical fertilizers and pesticides has generated several environmental problems including the greenhouse effect, ozone layer depletion, and acidification of water. These problems can be tackled by use of biofertilizers and bio-pesticides, which are natural, beneficial, and ecologically and user-friendly. The biofertilizers provide nutrients to the plants, control soilborne diseases, and maintain soil structure. Microbial biofertilizers play a pivotal role in sustainable agriculture. (Rai, 2006).

Biofertilizers are considered as a idealistic and sustainable selected strains of beneficial soil microorganisms cultured in the laboratory and packed in a suitable carrier. They can be used either for seed treatment or soil application to increase crop productivity, stimulate plant growth, improve and restore soil fertility, reduce production costs and the environmental impact associated with chemical fertilization. Biofertilizers accelerate microbial processes which augment the availability of nutrients that can be easily assimilated by plants (Subhash et al., 2016).

Rice (*Oryza sativa* Linnaeus, 1753) is staple food for more than two billion people in Asia and few hundred million in Africa and Latin America (Qureshi et al., 2018). The production of rice globally exhibited a fluctuating trend in the past few years. In 2014-15, the global production of rice was 479 million tonnes (Shinde, 2017). India is world's second largest rice producer and consumer next to China. India has 43.79 million hectares (ha) total area under rice with production of 109.70 million tonnes and productivity of 2494 kg/ha. In Maharashtra state, rice is cultivated over an area about 14.66 lakh/ha with production about 34.19 lakh tonnes having productivity 1.84 tonnes/ha. Major Rice growing districts in Maharashtra are Thane, Ratnagiri, Raigad, Sindhudurg, Kolhapur and Nashik (Patil et al., 2020).

Rice contributes to the major dietary energy for body. The nutrient content of rice contains proteins (6.81 g/100 g), lipids (0.55 g/100 g), carbohydrates (81.68 g/100 g), fiber (2.8 g/100 g), energy (370 kcal) and water (10.46 g/100 g) (Rohman et al., 2014). Rice can be used as a source of staple food, starch, rice bran, rice bran oil, flaked rice, puffed rice, parched rice and rice husk. Rice is excellent source of complex carbohydrates with low fat, low salt and no cholesterol. It is also a great source of proteins, vitamins and minerals (Chaudhari et al., 2018; Pawar et al., 2021).

In light of the literature survey, it is urgent to monitor impact of biofertilizers on the growth parameters in paddy. Hence in present study, impact of various biofertilizers on Paddy (*Oryza sativa* L.) Cultivar Jaya was studied to assess grwth parameters like height of the plant and number of tillers. This study is expected to provide baseline data for the future assessment of other types of biofertilizers on *Oryza sativa* for monitoring and assessment of other parameters.

II. Materials and Methods

The present study was conducted at research farm of Rayat Shikshan Sanstha's Mahatma Phule A. S. C. College, Panvel, Dist. -Raigad (Maharashtra) (Lat 18°,59'40" E & 73° 06'50" N) during kharif season of 2014-15 and 2015-16, for two successive years on same site. Standard protocols of FNCA (2006) and Rai (2006) were followed for present investigation. The study involves 12 treatments including control and was laid in a Randomized block design in three replications with a plot size of 1 X 1 m. During rainy season, in the month of June, 21th days old seedlings were transplanted at a spacing of 15cm. Rainy season environment favours the facilitated sowing, establishment and growth of seedlings.

Seeds of Paddy (*Oryza sativa* L.) var Jaya were procured from stations such as Khar Land Research Station, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Panvel Dist. Raigad. (Maharashtra) Raigad. Biofertilizers such as *Azospirillum brasilense* (Agrosun); *Bacillus megaterium* (Biostila); *Pseudomonas fluorescens* (Remonas), *Trichoderma viride* (Bhparistricho), Blue green algae, and Mycorrhizae (Reap Mycorrhiza) were purchased from Agharkar Research Institute Gopal Ganesh Agarkar Road, Pune, Maharashtra. The chemical fertilizer (19:19:19-Paras) were collected from authorized private Agro Centre, Panvel. Following biofertilizer treatments were designed to study the response of paddy by Soil treatment method.

T0	Control	Untreated
T1	Chemical fertilizer(19:19:19)	50 kg/ha-1
T2	BGA	10Kg/h-1
T3	*Azospirillum brasilense*	2 kg/ha-1
T4	*Bacillus megaterium*	2 kg/ha-1
T5	*Trichoderma viride*	2 kg/ha-1
T6	Mycorrhiyzae	2 kg/ha-1
T7	*Pseudomonas fluorescens*	2 kg/ha-1
T8	BGA+ *Pseudomonas fluorescens*	4 kg/ha-1
T9	BGA+ Mycorrhizae	4 kg/ha-1
T10	*Azospirillum brasilense +Bacillus megaterium*	4 kg/ha-1
T11	*Azospirillum brasilense +Bacillus megaterium +Pseudomonas fluorescens*	6 kg/ha-1

2.1 Field Experiments

1	Season	Kharif (2014-15 & 2015-16)
2	Crop	**Paddy -15**(*Oryzasativa*L.)
3	Variety	Jaya
4	Plot size	1 × 1 m
5	Total number of plots	12x3=36
6	Net Experimental plot area	36 m^2
7	Crop duration	135-140
8	Date of sowing	26.06.2014-15 & 21.07.2015-16
9	Date of transplanting	16.07.2014 &12.07.2015
10	Date of harvesting	24.10.2014 &16.10.2015
11	Design	Randomized Block Design
12	Number of Treatments	12
13	Number of replications	03

2.2 Preparation of Nursery Plot

In a nearby agriculture farm, in a separate plot, the rice nursery was raised in a well tilled plot. Plot was irrigated 15 days before of sowing seeds to hasten germination of Kharif annual weeds. Plot was ploughed for soil turning and followed by cross ploughing with cultivator. The seed of Paddy (var Jaya) was treated with the fungicide Captan@ 3 g/kg seed. Treated seeds were soaked in water for 12 hrs and stored in wet gunny bags in dark for 24 hrs to hasten sprouting & sprouted seeds were sown by broadcasting. Germinated seeds were irrigated regularly to develop into seedlings of good quality.

2.3 Transplantation of Seedlings

Experimental plot was arranged in random block design with three replicates. Seedlings were uprooted from the nursery plot on the day of transplanting and twenty one days old seedlings were transplanted at 20 cm x 15 cm spacing during both the years with five seedlings per hill. Before transplantation, first dose of chemical fertilizer (NPK-19:19:19) were applied in T1 subplot as basal application. Remaining half dose of chemical fertilizer was applied in two split doses at tillering and panicle initiation stages. Recommended dose of BGA were broadcasted to standing water in T2 subplot after 5th days of seedling transplantation. The mixture of various biofertilizers as per recommended dose were incorporated in the soil at the time of seedling transplantation. Plants without treatments are considered as control (T0). Gap filling was carried out ten days after transplanting in order to ensure uniform plant population.

To study the effect of various biofertilizer treatments on the growth of Paddy, following observations were recorded on at 30^{th}, 60^{th}, 90^{th} DAT (Days after transplantation) and at harvest stage. Three hills per plot were selected randomly in the net plot and tagged for recording observations at four stages.

- **Plant height** (cm): Plant height (cm) of randomly selected three hills was measured from ground level to the tip of the longest upper leaf in case of juvenile plants and for mature plants. It was measured from ground level to the tallest panicle of the hill.
- **Total number of tillers/hill:** Total numbers of tillers were counted at 30^{th}, 60^{th} and 90^{th} days after transplanting (DAT) and harvest from the randomly selected three hills and calculated their means as total number of tillers/hill.

For present investigation, data was analysed by using statistical procedures of Panse and Sukhatme (1967).

III. Results and Discussion

The results of the field experiments conducted during 2014-15 and 2015-16 on effect of bio fertilizers on growth of paddy (*Oryza sativa* L.) var. Jaya are presented with appropriate headings in (Fig. 1 & 2 & Table 1 & 2).

3.1 Plant Height

Plant height was determined from five randomly selected plants from each treatment and control at 30, 60, 90 DAT and at harvesting. The data pertaining to plant height influenced by different bio fertilizer treatments are presented in Table 1. and Fig 1. Results show that plant height increases progressively with the growth of paddy crop and the increase being more rapid up to flowering stage (90 DAT).

Highest mean plant height of T11 (*Azospirillum brasilense*+*Bacillus megaterium*+*Pseudomonas fluorescens*) treatment was recorded was 32.29, 37.21 and 34.75 cm at 30 DAT; 63.51, 70.14 and 66.82 cm at 60 DAT; 74.58, 76.15 and 75.37 cm at 90 DAT and 75.68, 79.94 and 77.81 cm at harvest during the year 2014, 2015 and on pooled data, respectively.

The higher plant height of 31.17, 36.13 and 33.65 cm at 30 DAT; 62.60, 68.943 and 65.773 cm at 60 DAT; 73.42, 75.38 and 74.40 cm at 90 DAT and 73.97, 77.24 and 75.61 cm at harvest was recorded with T10 (*Azospirillum brasilense* +*Bacillus megaterium*) treatment followed by T9 (BGA+Mycorrhiyzae) and T8 BGA+ *Pseudomonas fluorescens* at harvest during the year 2014, 2015 and on pooled data, respectively.

Lowest plant height (pooled data) 27.68, 51.76, 58.1 and 59.52 at 30, 60, 90 DAT and at harvest respectively were noted during 2014 and 2015 under T0 treatment. T1 treatment also showed better value of plant height at all stages of paddy as compare to control. The mono inoculation treatment T3 have recorded the maximum plant height (Pooled data values) 31.54, 60.25, 66.68 and 68.15 at 30, 60, 90 DAT and at harvest respectively, at all the growth stages. It was on par with the treatment T2, T4, T5 and T6 while it was significantly superior over the treatments T0 (Control) at all the growth stages. Treatment T9 recorded the second highest plant height and it was followed by T6, T8 and T7.

3.2 Number of Tillers Per Hill

The average number of tiller per hill recorded at 30 DAT, 60 DAT, 90 DAT and at harvest are recorded and presented in Table 2 and Fig 3. Results shows that the number of tillers per hill increased considerably from 30 to 90 DAT and there after a gradual decline was observed from 90 to harvest stage. It is apparent from the data that different bio fertilizer treatments (alone, dual and combined form) showed significant effect on tiller production per hill at all the growth stages.

Also use of *Azospirillum brasilense*+*Bacillus megaterium*+*Pseudomonas fluorescens* (T11) significantly increased the number of tillers per hill and found superior over dual treatment (T8, T9, and T10) and alone application of BGA, *Azospirillum brasilense*, *Bacillus megaterium*, *Trichoderma viride*, Mycorrhiyzae and *Pseudomonas fluorescens* which was statistically at par with each other at all the growth stages of crop.

The highest number of tillers per hill of T11 treatment was recorded to be 8.29, 12.28 and 10.29 at 30 DAT; 12.33,16.06 and 14.20 at 60 DAT; 14.81,17.51 and 16.16 at 90 DAT and 14.16, 16.48 and 15.32 at harvest during the year 2014, 2015 and on pooled data, respectively and par with T10 and T8. Among the mono inoculation biofertilizer treatments, T7 treatment significantly recorded maximum number of tillers per hill (6.14, 10.76 and 13.44 at 30,60 and 90 DAS in both years and pooled data resp.) which was followed by T6, T2,T3, T5, and T4. The minimum number of tillers per hill were recorded in T0 treatment at 30 DAT, 60 DAT, and 90 DAT and at harvest. The treatment T1 showed significantly better results as compare to control (T0).

III. Conclusion

Treatments T8 (BGA+*Pseudomonas aeruginosa*), T9 (BGA+Mycorrhizae), T10 (*Azospirillusum brasilense*+*Bacillus magisterium*) and T11 (*Azospirillusum brasilense* +*Bacillus megaterium* +*Pseudomonas fluorescens*) revels more enhanced effects on height and number of tillers in paddy. Biofertilizers such as *Azospirillum brasilense, Bacillus megaterium* and *Pseudomonas fluorescens* show positive impact on growth parameters of paddy. The highest crop performance was recorded in the combined biofertilizer application. The results indicated that use of biofertilizer would be a great substitute of the inorganic fertilizers. The study recommends that biofertilizers from microorganisms can replace chemical fertilizers to increase crop production. In principle, biofertilizers are less expensive and are more environmentally-friendly than chemical fertilizers. Application of combination of biofertilizers in intensive agricultural practices may witness the great increases in crop yields and food production in developed countries.

Figure 1: Field experiments on Paddy ((*Oryza sativa* L.) var. Jaya

ACKNOWLEDGEMENTS

Encouragement and support provided by Prin. Dr. Ganesh A. Thakur, Principal, Mahatma Phule Arts, Science and Commerce College, Panvel, Dist.–Raigad, Navi Mumbai - 410 206 is gratefully acknowledged. Authors are thankful to Prin. Dr. Suryakant Lasune, K. V. P. College, Dombivli for providing laboratory facilities for the present work. Special thanks to Prof. Dr. Prabhakar R. Pawar and Mr. Anil G. Rokade for providing technical assistance during field experiments.

REFERENCES

[1]. Ajmal M et al (2018). Biofertilizer as an Alternative for Chemical Fertilizers. J. Agri. Sci. 7(1): 1-7.

[2]. FNCA. (2006). Biofertilizer Manual. FNCA Biofertilizer Project Group, Forum for Nuclear Cooperation in Asia (FNCA), March 2006. pp. 138. ISBN: 4-88911-301-0 C0550.

[3]. Mishra D., Rajvir S., Mishra U. & Kumar S. S. (2013). Role of bio-fertilizer in organic agriculture: a review. Research Journal of Recent Sciences. 2: 39-41.

[4]. Panse V. G. & P. V. Sukhatme. (1967). "Statistical Methods for Agricultural Workers," 2nd Edition, Indian Council of Agricultural Research, New Delhi, 1967.

[5]. Patil S. D., Kusalkar D. V., Patil H. M. & Bhoite K. D. (2020). Seasonal incidence of insect pests on rice and impact of various abiotic factors on their incidence. J Pharma Phytochem. 9: 1869-1872.

[6]. Pawar Prabhakar R., Mhatre Ramesh P. and Supnekar Santosh P. (2021). Preliminary survey of major insect pests of rice (Oryza sativa L.) from Panvel, Navi Mumbai, India. Intern. J. Zool. Invest. 7 (1): 22-31. https://doi.org/10.33745/ijzi.2021.v07i01.003.

[7]. Qureshi S. P., Belurkar Y., Mehar P., Kodape D. & Selokar M. (2018). Study of diseases on rice (*Oryza sativa*) in major growing field of Bhandara District. Intern J Agricul Sci. 10: 5573-5575.

[8]. Rai M. K. (2006). Handbook of Microbial Biofertilizers. Food Products Press, An imprint of The Haworth Press, Inc., 10 Alice Street, Binghamton, NY 13904-1580. ISBN 13: 978-1-56022-269-9.

[9]. Shinde A. A. (2017). Rice production in Konkan region -An economic analysis. Ph. D. Thesis submitted to Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth Dapoli, Ratnagiri, Maharashtra, pp. 206.

[10]. Subhash R., S. Triveni & K. Damodarachari. (2016). Biofertilizers for Sustainable Production in Oil Seed Crops. Journal of Agriculture and Veterinary Sciences. 3(6): 435-444.

Table 1: Effect of bio fertilizers on plant height at successive growth stages of paddy (*Oryza sativa* L. cv. *jaya*) by RBD method

Treatment	30 DAT			60 DAT			90 DAT			At harvesting		
	2014	2015	PD	2014	2015	PD	2014	2015	PD	2014	2015	PD
T0-Control	25.296	30.081	27.688	47.976	55.553	51.765	57.227	58.798	58.014	59.674	59.373	59.521
T1-Chemical fertilizer	29.483	35.121	32.291	58.886	61.384	60.135	67.836	71.783	69.834	68.223	74.166	71.195
T2-BGA	27.833	34.613	31.223	58.781	60.314	59.548	64.089	67.521	65.801	66.667	67.393	67.026
T3-Azospirillum brasilense	27.941	35.146	31.543	59.952	60.563	60.256	67.916	65.453	66.685	68.093	68.227	68.156
T4-Bacillus megaterium	27.098	33.606	30.348	55.315	60.616	57.963	64.493	67.336	65.915	66.441	68.013	67.201
T5-Trichoderma viride	26.926	33.352	30.141	55.063	60.523	57.793	63.496	65.673	64.585	66.543	64.346	65.441
T6-Mycorrhiyzae	26.663	33.436	30.051	58.396	61.833	60.115	67.167	65.296	66.225	66.231	65.654	65.943
T7-Pseudomonas fluorescens	27.706	34.361	31.033	61.076	62.403	61.744	68.271	65.853	67.068	70.575	71.513	71.041
T8-T2+T7	30.081	33.582	31.832	60.804	68.146	64.475	72.485	73.376	72.928	72.631	75.956	74.296
T9-T2+T6	30.406	35.733	33.071	62.293	69.385	65.836	72.372	74.975	73.675	73.685	76.791	75.235
T10-T3+T4	31.173	36.131	33.651	62.603	68.943	65.773	73.423	75.384	74.403	73.976	77.243	75.614
T11-T3+T4+T7	32.296	37.211	34.753	63.513	70.143	66.828	74.584	76.158	75.371	75.687	79.941	77.811
SEm ±	0.319	0.847	0.583	0.667	0.795	0.734	0.965	1.539	1.252	0.558	0.484	0.521
CD at 0.05 %	0.904	2.398	1.651	1.888	2.251	2.069	2.731	4.354	3.542	1.580	1.371	1.475
C.V.%	0.161	0.356	0.258	0.164	0.181	0.172	0.205	0.324	0.263	0.116	0.099	0.108

Table 2: Effect of different biofertilizers on number of tillers at successive growth stages of paddy (*Oryza sativa* L. cv. *jaya*) by RBD method

Treatments	Number of tillers/hill											
	30 DAT			60 DAT			90 DAT			At harvesting		
	2014	2015	PD	2014	2015	PD	2014	2015	PD	2014	2015	PD
T0- Control	4.201	6.396	5.298	6.661	8.742	7.721	9.816	10.92	10.36	9.971	10.68	10.32
T1- Chemi. fertilizer	4.566	8.201	6.383	7.783	11.83	9.808	11.40	13.93	12.66	10.16	13.82	11.99
T2- BGA	3.736	7.871	5.803	6.572	10.01	8.291	10.66	13.40	12.03	10.02	14.06	12.04
T3- *Azospirillum*	4.023	7.226	5.625	7.764	9.583	8.671	10.52	12.01	11.26	10.37	11.49	10.93
T4- *Bacillus*	4.046	6.696	5.371	6.792	10.49	8.641	10.19	11.22	10.70	9.353	12.39	10.87
T5- *Trichoderma*	4.106	6.712	5.408	8.071	10.15	9.111	9.906	12.01	10.96	9.743	11.74	10.74
T6- *Mycorrhizae*	4.133	6.856	5.495	8.523	10.92	9.721	11.83	12.60	12.22	10.78	16.09	13.39
T7- *Pseudomonas*	4.321	7.973	6.146	10.50	11.02	10.76	12.43	14.46	13.44	11.20	15.24	13.22
T8- T2+ T7	4.503	10.54	7.521	10.82	13.90	12.36	13.72	15.87	14.79	11.12	15.59	13.35
T9- T2+ T6	4.703	8.936	6.827	11.53	12.75	12.14	13.70	17.04	15.37	12.93	17.29	15.11
T10- T3+T4	6.581	11.94	9.261	11.29	15.31	13.30	13.71	16.46	15.09	13.74	14.86	14.30
T11- T3+T4+T7	8.296	12.28	10.29	12.33	16.06	14.24	14.81	17.51	16.16	14.16	16.48	15.32
SE m ±	0.313	0.308	0.311	0.574	0.469	0.522	0.283	0.261	0.272	0.622	0.552	0.587
CD at 0.05 %	0.886	0.873	0.881	1.624	1.328	1.476	0.801	0.739	0.775	1.761	1.563	1.662
C.V.%	0.948	0.526	0.737	0.915	0.577	0.746	0.343	0.271	0.307	0.808	0.563	0.686