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Research Article

Response of Bio Fertilizers and Cultivars on Growth, Yield and Quality of Rice (*Oryza sativa* L.)

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ABSTRACT

To study the effect of biofertilizers and varieties on growth and yield of rice, an experiment was conducted at Instructional Farm of Department of Agronomy, Faculty of Agriculture, AKS University, Sherganj, Satna (M.P.) during kharif season of 2020-21. The experiment consisted of randomize block design having Factorial arrangement with three replications. In this experiment, 12 treatment combinations including four levels of biofertilizers and treatments were B_1- PSB @ 250 g/ ha, B_2- ZSB @ 250 g/ ha, B_3- KSB @ 250 g/ ha and B_4- Azospirillum 250 ml/ha, while three rice varieties were tested are V_1- IR- 64, V_2- MTU- 1010 and V_3- JR- 503. During the course of the study, it was found that biofertilizers and different varieties significantly affected plant height, number of leaves per plant, number of tillers per hill, length of panicle, number of grains per panicle, number of filled grain per panicle, test weight, grain & stover yield of rice. Higher plant height (80.93 cm), number of leaves per plant (57.20), number of tillers per hill (20.87) at maximum crop growth stage of 90 DAT were recorded under the application of Azospirillum biofertilizer @ 250 ml/ha with rice cultivar of IR-64. Similarly, resulted in highest length of panicle (26.63 cm), number of grains per panicle (167.60), number of filled grain per panicle (153.07), test weight (22.19 g), grain yield/ha (61.46 q/ha) and stover yield/ha (106.68 q/ha) recorded under same treatment combination of Azospirillum biofertilizer @ 250 ml/ha with rice cultivar of IR-64. It was concluded from the results that application of Azospirillum biofertilizer @ 250 ml/ha with rice cultivar of IR-64 improved yield and yield components of rice.

Keywords: *Biofertilizers, Varieties, Azospirillum, Panicle, Test weight, Stover yield.*

INTRODUCTION

Rice is the second most important crop after rice. Rice has a largest growing area and it covers nearly 9 per cent of earth's arable land. Rice provides 35% of total calorie intake by the Asian people.

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Asian countries produce 89 per cent of world's rice, with China and India alone accounting for 55 per cent of production "Rice is Life" for millions of people and staple food for more than half of the world's population. Worldwide, rice is grown on 161 million hectares, with the production of about 713.8 million tones with an average productivity of 4.44 tones/ha (IRRI, 2014). In India, Rice is cultivated on an area of 44 million ha, producing around 108.86 million tones (Annual Report, 2016-17). In M.P. rice is grown in the area of about 15.59 lakh ha with production of 14.62 lakh tons and productivity 989 kg/ha. (GOI, 2017).

Several factors are responsible for low productivity of rice, among them imbalance fertilization and terminal stress are important ones. To enhance the productivity of this crop, use of balanced fertilization by application of NPK along with biofertilizers *viz*., *Azospirillum* spp., zinc solubilizing bacteria (ZSB), phosphorus solubilizing bacteria (PSB), potassium solubilizing bacteria (KSB) are of great importance.

The sole use of inorganic fertilizers with suboptimal doses of organics deteriorates soil fertility leading to a reduction in crop production and its sustainability. For sustainable crop production, it is necessary to use organics and bio-fertilizers consistently leading to improvement in soil biota for the transformation of organics in available nutrients and essential soil enzymes important to crops. Bio-fertilizers are the products containing viable cells of different microorganisms essential for plant growth. Nutrients in the soil are available through elemental transformations, solubilization, fixation, and other mechanisms. Bio-fertilizer helps to supply N and P through fixation and solubilization respectively and acts as a supplement to inorganic fertilizer in an eco-friendly manner. The application of biofertilizer with beneficial microbes improved the leaf chlorophyll, plant nutrient uptake, and grain protein content in rice. Hence, the use of chemical N and P fertilizer can be minimized by 50 percent and improve rice yield with the supplement of 5 ton /ha of bio-organic fertilizer (Gite et al., 2021).

Recently, many early durations dwarf varieties have been evolved with high yield potentials as well as responsiveness to high levels of fertilizer as well as biofertilizers. The present study was planned to estimate the suitable biofertilizer and rice variety and its impact on growth and yield of rice.

MATERIALS AND METHODS

The experiment was carried out at Instructional Farm, Faculty of Agriculture, AKS University, Satna (M.P.) during *kharif* season 2020-21. The experiment was conducted in randomize complete block design having Factorial concept with three replications. Different biofertilizers and rice varieties will be allocated to the plots as per treatments. Seed rate used as 30 kg/ha for transplanting with 20.0 cm row to row distance. The treatments were B_1- PSB @ 250 g/ ha, B_2- ZSB @ 250 g/ ha, B_3- KSB @ 250 g/ ha and B_4- *Azospirillum* 250 ml/ha, while three rice varieties were tested are V_1- IR- 64, V_2- MTU- 1010 and V_3- JR- 503. The gross and net plot size was 4.40 m x 3.20 m and 4.0 m x 3.0 m, respectively. The fertilizers grades were applied as per treatments. Whole dose of P and K was applied as basal dose at the time of transplanting. Full recommended dose of phosphorus and potassium at the rate of 80 kg P_2O_5 /ha and 60 Kg K_2O /ha, respectively and half dose of nitrogen @ 120 kg/ha was uniformly applied to each plot (except control plots) as basal dose before transplanting. Remaining half dose of nitrogen was applied as basal dose at the time of sowing and remaining half dose of nitrogen was applied in two equal splits at 30 and 60 DAT i.e., at tillering and panicle initiation stage. All the other agronomic practices were applied uniformly to all the treatments. The experiment will be consisting of the following factors along with their respective levels.

RESULTS AND DISCUSSION

Data regarding plant height, number of leaves per plant and number of tillers per hill are

reported in (Table 1). Statistical analysis of the data revealed that maximum plant height (80.72 cm), number of leaves per plant (55.98) and number of tillers per hill (19.33) at maximum crop growth stage of 90 DAT were recorded in plots treated with the application of *Azospirillum* 250 ml/ha. Rice cultivar of IR-64 gave maximum plant height (76.87 cm), number of leaves per plant (51.50) and number of tillers per hill (16.57). The interaction effect between various sources of biofertilizer and rice cultivars was found to be significant and maximum plant height (80.93 cm), number of leaves per plant (57.20), number of tillers per hill (20.87) at maximum crop growth stage of 90 DAT were recorded under the application of *Azospirillum* biofertilizer @ 250 ml/ha with rice cultivar of IR-64.

The growth parameters recorded periodically have exhibited interesting architectural variation due to different biofertilizers. Growth and development of rice, which is characterized by determine growth habit of crop were studied periodically. The vegetative and reproductive development of the crop culminating into economic yield was the terminal outcomes of growth, which was affected by continuously interaction acquiring between environment and plant physiological process.

Application of biofertilizers in soil showed slightly more plant height and plant dry matter than their application. This could be because of application at their higher amount (population), which probably allowed their better establishment in rhizosphere leading to more benefits. The application of *Azospirillum* treatments performed better in terms of plant height, number of tillers, number of leaves at different intervals. This could be attributed to supply of additional N through N_2 fixation activities of the inoculated *Azospirillum* biofertilizer. The positive effects of application of *Azospirillum* in rice on growth attributes have also been reported by Ghetiya et al. (2018), Navsare et al. (2018). Further, *Azospirillum* is known to produce plant growth hormones such as gibberilic acid, indole acetic acid and cytokinin which might have favoured the growth of rice.

The differences in growth characters due to varieties may be attributed to their inherent characteristics and adaptability to soil and climatic conditions. The results are in close Conformity with the findings of Hussain et al. (2018). The marked variation in growth between varieties could be ascribed to their differential genetic milieu and capabilities to exploit available growth inputs (above and below ground) for overall growth and development. In fact, the growth parameters among the varieties are genetically governed. Such type of observations among the rice varieties have also been reported by Prafull Kumar et al. (2015) and Para et al. (2018).

Data regarding length of panicle, number of grains per panicle, number of filled grain per panicle, test weight, grain & stover yield of rice are reported in Table 1 and maximum values were observed when crop fertilized with application of *Azospirillum* biofertilizer @ 250 ml/ha with rice cultivar of IR-64. Statistical analysis of the data revealed that highest length of panicle (26.63 cm), number of grains per panicle (167.60), number of filled grain per panicle (153.07), test weight (22.19 g), grain yield/ha (61.46 q/ha) and stover yield/ha (106.68 q/ha) were recorded under the treatment combination of *Azospirillum* biofertilizer @ 250 ml/ha with rice cultivar of IR-64.

The yield of crop largely depends upon the source-sink relationship i.e. mobilization of photosynthates from the synthesis sites and temporary storage organs towards the developing grains. The different components of sources are leaf area, number of leaves, number of tillers before anthesis and that of sink are number of panicles/ plant, length of panicle, number of grains/ panicle and 1000- grain weight. Significant variation was observed on the number of grains per panicle of rice when the crop was fertilized with different sources of biofertilizers.

The results indicated that the effect of *Azospirillum* on yield attributing characters of rice was found to be significant during the experimental year under study. This could mainly be ascribed to the increased availability

of the nitrogen to the plants through biological nitrogen fixation in rhizosphere by *Azospirillium* caused by the better root development due to more availability of P due to activity of PSB. Thus, the greater availability of nitrogen might have helped in vigorous plant growth, resulting in more dry matter accumulation and ultimately better flowering and ear head development. The increased yield probably may be resulted due to stimulation in germination and thereby increases in plant biomass by the nitrogen fixed by the *Azospirillum*. The results obtained here are in close agreement with the finding of Jat et al. (2018), Malo et al. (2018) and Meena et al. (2019). The grain and straw yield are usually in positive correlation with the number of microorganisms which produce plant nutrients in soil (Aditya et al., (2018) and Chakravarthy et al. (2020). *Azospirillum* provides growth promoting substances like indole acetic acid, vitamin B and antifungal substances which increases cell division and cell elongation in crops that might be resulted in increasing the grain and straw yield of rice (Singh, 2017, Aditya et al., 2018 & Maheta et al., 2020).

The marked increase in most of the yield attributes in variety IR- 64 could be ascribed to overall improvement in crop growth as evident from higher dry matter accumulation at successive stages as well as concentration and uptake of nutrients. These subscribes greater availability of photosynthates and nutrients matching with demand for initiation and growth of each reproductive structures. The yield-attributing characters were found to deviate up to significant extent due to different varieties. This type of variations may be owing to variations in the genetic buildup of the varieties. In fact, it is very difficult the inherit all the desirable characters in one variety although efforts are being made in this direction. Such type of variability in the yield-attributing characters in the rice varieties have been reported by many research workers *viz*., Prafull Kumar et al. 2015 and Para et al. 2018. The wide variations in productivity parameters among the rice varieties have also been observed by many researchers Joseph et al. (2019), Afsana et al. (2020) and Arun et al. (2020).

Table 1: Effect of Biofertilizers and Varieties on Growth and Yield of Rice

Treatment	Plant height (cm)	Number of leaves per plant	Number of tillers per hill	Length of panicle (cm)	Number of grains per panicle	Number of filled grain per panicle	Test weight (g)	Grain yield (q/ha)	Stover yield (q/ha)
	Effect of biofertilizers								
B_1	79.86	52.00	17.29	25.39	161.53	146.40	20.15	42.00	86.21
B_2	74.29	48.67	13.93	23.76	152.71	141.18	19.61	31.77	73.85
B_3	63.79	42.98	11.62	22.18	136.24	127.78	18.78	24.33	53.89
B_4	80.72	55.98	19.33	26.06	166.16	151.49	21.18	54.38	98.65
S. Em±	2.29	1.17	0.48	0.27	3.26	4.00	0.36	1.84	4.10
CD	6.72	3.44	1.41	0.79	9.55	11.72	1.05	5.39	12.03
	Effect of varieties								
V_1	76.87	51.50	16.57	24.87	157.45	145.30	20.36	41.41	83.06
V_2	75.52	50.28	15.37	24.43	155.97	141.35	19.82	39.07	77.85
V_3	71.60	47.93	14.70	23.75	149.07	138.48	19.61	33.88	73.54
S. Em±	2.64	1.35	0.55	0.31	3.76	4.61	0.41	2.12	4.74
CD	7.76	3.97	1.62	0.91	11.03	13.54	1.21	6.23	13.89
	Interaction effect between biofertilizers and varieties								
B_1V_1	80.36	52.53	17.73	25.59	163.07	147.33	20.28	43.51	87.65
B_1V_2	77.98	50.40	14.87	24.37	156.40	142.87	19.80	32.75	75.08
B_1V_3	68.20	45.87	12.80	22.90	142.73	137.93	19.18	27.93	62.83
B_2V_1	80.93	57.20	20.87	26.63	167.60	153.07	22.19	61.46	106.68
B_2V_2	80.25	52.20	17.40	25.56	161.27	146.47	20.18	43.23	87.45
B_2V_3	75.12	49.07	13.60	23.87	154.67	141.47	19.61	31.66	73.71
B_3V_1	66.07	43.73	11.67	22.37	141.07	126.73	18.74	24.19	49.54
B_3V_2	80.64	56.13	18.80	25.90	166.87	150.73	20.76	57.18	100.67
B_3V_3	78.97	51.27	16.73	25.01	160.27	145.40	19.99	39.25	83.52
B_4V_1	69.76	46.53	13.33	23.04	147.07	139.20	19.42	30.91	72.74
B_4V_2	57.10	39.33	10.40	21.28	124.93	118.67	18.43	20.87	49.29
B_4V_3	80.58	54.60	18.33	25.66	164.00	150.67	20.58	44.50	88.60
S. Em±	1.32	0.68	0.28	0.15	1.88	2.31	0.21	1.06	2.37
CD	2.74	1.40	0.57	0.32	3.90	4.79	0.43	2.20	4.91

CONCLUSION

It was concluded from the results that maximum plant height (80.72 cm), number of leaves per plant (55.98) and number of tillers per hill (19.33) at maximum crop growth stage of 90 DAT were recorded in plots treated with the application of *Azospirillum* 250 ml/ha.

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Conflict of Interest

The author(s) declares no conflict of interest.

Author Contribution

Both author contributed equally to establishing the topic of the research and design experiment.

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