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Studies on Growth, Yield and Economics of rice (*Oryza sativa. L*) var. Pusa Basmati-1 as Influenced by Biofertilizers

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A B S T R A C T

A field experiment was conducted during *kharif season* of 2019, at crop research farm of Department of Agronomy at Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj which is non-traditional area of basmati cultivation in North Eastern plains of Eastern Uttar Pradesh with the objective to study the effect of biofertilizers on growth, yield and economics of rice (*Oryza sativa L.*) Var. Pusa Basmati-1 under Randomized block design comprising of 11 treatments of which farmer's practice (T_1) (N:P:K at 100:40:20 kg ha^{-1}) and rest of treatments (T_2-T_{11}) with sole and in combination of biofertilizers (Azotobacter, PSB, Azospirillum, Azolla) along with inorganic fertilizers (RDF N:P:K at 120:60:60 kg ha^{-1}) which are replicated thrice. The experimental results revealed that application of T_9 (RDF + PSB at 2 kg ha^{-1} + Azospirillum at 2 kg ha^{-1}) has recorded highest No. of grains panicle^{-1} (151.93) and No. of panicles hill^{-1} (21.80). Highest Benefit: Cost ratio was recorded by application of T_2 (RDF + Azotobacter at 2 kg ha^{-1}) and the application of T_7 (RDF + *Azotobacter* at 2 kg ha^{-1} + *Azospirillum* at 2 kg ha^{-1}) has recorded significantly maximum grain yield (6.88t ha^{-1}), gross return (Rs.1,92,550 ha^{-1}) and net return (Rs.1,34,470 ha^{-1}).

Introduction

Rice (*Oryza sativa L.*) is the most prominent crop of India as it is the staple food for most of the people of the country. Among the countries which are growing rice, India has the largest area under rice (about 45 million ha) accounting for 29.4 per cent of the global rice area. Of the total area, about 46 per cent is irrigated, 28 per cent is rain fed lowland, 12 per cent is rain fed upland and 14 per cent is flood prone (Budhar *et al.,* 2006). Worldwide, India stands first in rice producing area and second in production after china. In the year 2017, China and India contributed the share of 27.63% and 21.89% of global rice production respectively (FAO 2017).

Basmati rice is unique among other long grain rice varieties and is often referred as *"King of rice"* and is valued for its distinctive long grain, fine aroma and delicious taste.

It is one of the most important agricultural produce that the country exports every year to gross foreign exchange. During the year 2018-2019 (*April-March*), India exported 11.9 million MT of rice, out of which basmati rice exports accounts for 4.4 million MT with 9.72per cent increase in exports when compared to previous year export of 3.9 million MT (APEDA 2019).

Global agriculture is facing a serious consequence of climatic change, increased population pressure and detrimental environmental impacts. Increased population needs more food to live on the earth. 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 are eco-friendly fertilizers, which are living cells of different types of micro-organisms (Bacteria, Fungi, and Algae) which have an ability to mobilize nutritionally important elements from non-usable form. It also improves soil quality and provides yield increments which greatly benefit farmers at very low input cost has engrossed the attention (Kumudha, 2005; Kumudha and Gomathinayagam, 2007).

These microorganisms require organic matter for their growth and activity in soil and provide valuable nutrients to the plant (Saini *et al.,* 2004). Farmyard manure (FYM) acts as a soil conditioner improves physical, chemical and biological properties of the soil and provides congenial conditions for the growth of microbial populations. Therefore, resulting in better yield and grain quality by prolific root growth and greater nutrient accumulation (Adhikari *et al.,* 2005). Nitrogen is most important nutrient with varying organic and inorganic nitrogen sources have significant influence and crucial role on grain quality. Crop productivity and the grain quality can be improved by integrated nutrient management including biofertilizers, organic and chemical sources. Quality parameters of scented rice can be improves by application of biofertilizers alone or in combinations with organic manures (Dixit & Gupta, 2000; Quyen & Sharma, 2003). *Azotobacter* in crop production has manifested its significance in plant nutrition and its contribution to soil fertility through production of growth substances and their effects on the plant has markedly enhanced crop production in agriculture.

Being free living N_2- fixer diazotroph, substances like auxins, cytokinins, and GA can be synthesized by *Azotobacter* genus and these growth materials are the key substances which regulate the enhancement of growth. It improves nutrient uptake and ultimately boost up biological nitrogen fixation by stimulating rhizospheric microbes, protects the plants from phyto-pathogens, Phosphate solubilising bacteria (PSB) has the ability to solubilise and mineralize the residual or fixed phosphorous, enhances phosphorus availability in the soil, produces growth substances like indole acetic acid, and gibberellins hence, increases the phosphate use efficiency (Chhonkar and Tilak, 1997; Gull *et al.,* 2004).

Azospirillum is recognized as a dominant soil microbe, mainly present in cereal plants which inhabit both root cells as well as surrounding of roots forming symbiotic relation and increasing N- fixing potential ranging of 20-40 kg ha^{-1} in the rhizosphere. Up to 25-30% quantity of nitrogen fertilizer can be saved by the use of the *Azospirillum* inoculation. Azolla is a free-floating fresh water fern, by the symbiotic association with Anabaena azollae that resides inside the dorsal lobes of Azolla leaves which fixes atmospheric N and potentially supplying a substantial amount of N to the rice crop

(Moore 1969). Azolla can fix 22– 40 kg N ha^{-1} within 30 days (Peoples *et al.*, 1995). Without additional requirements of land and water it can be grown concurrently with irrigated rice (Singh and Singh 1990; Mian and Kashem 1995).

Materials and Methods

A field experiment was conducted during *kharif* season of 2019, at Crop research farm of Department of Agronomy at Sam Higginbottom University of Agriculture, Technology, and Sciences, Prayagraj which is located at 25° 24' 42" N latitude, 81° 50' 56" E longitude and 98 m altitude above the mean sea level (MSL). To assess the effect of biofertilizers on growth and yield of rice (*Oryza sativa L.).*

The experiment was laid out in Randomized Block Design comprising of 11 treatments which are replicated thrice. Each treatment net plot size is 3m x3m. First treatment (T_1) is categorize as farmer practice 100 kg N ha^{-1} through urea and DAP, 40 kg ha^{-1} P_2O_5 through DAP and 20 kg ha^{-1} K_2O through Muriate of Potash.

Rest of the treatments applied with recommended dose of fertilizers (RDF) 120 kg ha^{-1} through urea and DAP, 60 kg ha^{-1} through DAP and 60 $kgha^{-1}$ through Muriate of Potash in addition with biofertilizers like *Azotobacter*, Phosphate-solubilizing bacteria (PSB), *Azospirillum*, Azolla when applied as sole and in combinations as follows, (T_2) RDF + *Azotobacter* at 2 kg ha^{-1}, (T_3) RDF + PSB at 2 kg ha^{-1}, (T_4) RDF + *Azospirillum* at 2 kg ha^{-1}, (T_5) RDF + Azolla at 2 tonnes ha^{-1}, (T_6) RDF + *Azotobacter* at 2 kg ha^{-1} + PSB at 2 kg ha^{-1}, (T_7) RDF + *Azotobacter* at 2 kg ha^{-1} + *Azospirillum* at 2 kg ha^{-1}, (T_8) RDF + *Azotobacter* at 2 kg ha^{-1} + Azolla at 2 tonnes ha^{-1}, (T_9) RDF + PSB at 2 kg ha^{-1} + *Azospirillum* at 2 kg ha^{-1}, (T_{10}) RDF + PSB at 2 kg ha^{-1} + Azolla at 2 tonnes ha^{-1}, (T_{11}) RDF + *Azospirillum* at 2 kg ha^{-1} + Azolla at 2 tonnes ha^{-1}. Soil application of *Azotobacter*, Phosphate solubilizing bacteria(PSB), *Azospirillum* was done by inoculating the microbial culture as per aforesaid dosages in 8 tonnes ha^{-1} of Farm yard manure (FYM) for each treatment and incubated for mass multiplication for a fortnight (a period of two weeks). Azolla is grown in separate cultivation pits and is introduced to main field on the 4th day after transplanting

The seedlings of rice var. Pusa Basmati-1 are transplanted after application of basal doses of fertilizers with biofertilizers between spacing 22.5 cm row to row. Except azolla rest of the biofertilizers are applied during land preparation, nitrogen fertilizer was applied at three split doses half of the nitrogen fertilizer was applied as basal dose and rest parts are divided equally and applied 30 and 48 days after transplanting. The rice crop was harvested treatment wise at harvesting maturity stage.

After harvesting, grains were separated from each net plot and were dried under sun for three days. Later winnowed, cleaned and weight of the grain per net plot value, the grain yield per ha was computed and expressed in tonnes per hectare. After complete drying under sun for 10 days straw yield from each net plot was recorded and expressed in tonnes per hectare.

The data was computed and analysed by following statistical method of Gomez and Gomez (1984). The benefit: cost ratio was worked out after price value of grain with straw and total cost included in crop cultivation. After thorough field preparation initial soil samples were taken to analyse for available major nutrients. Nitrogen (N), phosphorous (P), potassium (K), sulphur (S), organic carbon (OC), pH and soluble salts.

The type of soil in experimental field is sandy clay. The pH of the experimental field was

7.3, EC of 0.29 dSm^{-1}, organic carbon was 0.46%. The N status of the experimental field was low (215 kg ha^{-1}), medium in available P (12 kg ha^{-1}) while available K status was in higher range (232 kg ha^{-1}). Growth parameters viz. plant height (cm), No.of tillers $hill^{-1}$, dry matter accumulation g $hill^{-1}$ were recorded manually on five randomly selected representative plants from each plot of each replication separately as well as yield and yield attributing character viz. grain yield t ha^{-1}, straw yield t ha^{-1}, No. of panicles $hill^{-1}$, No. of grains $panicle^{-1}$ and Test weight (g) were recorded as per the standard method. The oxidizable organic carbon was determined by Walkley and Black (1934), pH by pH meter and ECe by electrical conductivity bridge with glass electrode in a 1:2.5 soil water suspension (Jackson 1973). Soil texture by the Bouyoucos Hydrometer Method (Gee and Baudev, 1986). Available nitrogen was determined by Subbiah and Asija (1956), Available phosphorus was determined by Olsen *et al.,* (1954) and available potash was determined by Flame photometric method, Jackson (1973).

Results and Discussion

Effect on growth parameters

It is evident from Table 1 that plant height measured increased with advancement in crop growth. The treatment T_{11} (RDF + *Azospirillum* at 2 kg ha^{-1} + Azolla at 2 tonnes ha^{-1}) recorded maximum height of 16.29, 69.25, 115.67 cm in all 3 stages i.e., tillering stage (20DAT), P.I (Panicle Initiation) stage (60DAT), harvesting stage (100 DAT) respectively. At harvesting stage maximum plant height was measured in T_{11} and treatments T_6, T_7 and T_8 were found statistically at par to T_{11}. The highest plant height in treatment T_{11} may be ascribed due to the continuous supply of nutrients through out all growth stages with beneficial association between biofertilizers (azolla and *Azospirillum*) along with chemical fertilizers. Leaching losses of nutrients must have been minimized by use of biofertilizers, which have ability to mobilize nutritionally important elements from non-usable form to usable forms. According to Tien *et al.,* (1979), in addition to its high N fixation, *Azospirillum* is known to synthesize growth substances such as IAA and other auxines and vitamins B which might have also helped in growing the plant height. T_7 (RDF + *Azotobacter* at 2 $kgha^{-1}$ + *Azospirillum* at 2 $kgha^{-1}$) plants at tillering stage and P.I stage, produced more number of tillers of 13.73 and 27.87 respectively.

At harvesting stage maximum number of tillers (19.53) are produced by T_{11} (RDF + *Azospirillum* at 2 kg ha^{-1} + Azolla at 2 tonnes ha^{-1}) plants and T_6, T_7 are statistically at par to maximum. Higher nutrient supply converts carbohydrates into protein which in turn elaborated into protoplasm which increased the number of tillers. Nitrogen also increases the proportion of protoplasm to cell wall material and leads to several consequences; one of them being an increase in size of cell which expressed morphologically increase growth attributes Arnon, I. (1953). The results were in accordance to Fakir *et al.,* (2007) and Razie *et al.,* (2008) and Prasad and Singh (1984).

They reported that the combined effect of inoculation of biofertilizers in rice with application of N increased number of tillers, growth, nutrient uptake and yield of rice. Irrespective of varietal differences higher the nitrogen available; greater was the number of tillers (Amin *et al.,* 2006). The treatment T_2 (RDF + Azotobacter at 2 kg ha^{-1}) recorded maximum dry matter accumulation of 102.82 (g) at the harvesting stage and except T_3, T_9, T_{10} rest all other treatments are found statistically at par to maximum dry matter accumulation. The application of biofertilizers had increased the formation and development of numerous root branching, root hairs, and primary and secondary lateral roots which enhanced the nutrient uptake capacity of roots. Due to the release of growth hormones by the bacteria and also by nitrogen fixation have probably shown effect on the root system as well as more root colonization and root proliferation. The increased uptake of nitrogen from the soil might have correspondingly increased the biomass to some extent (Gopalswamy and Vidhyasekaran 1988) and (Hartmann *et al.*, 1983).

Yield and yield attributes

Grain yield was significantly influenced with different combinations of biofertilizers with chemical fertilizers. The maximum yield (6.88 t ha^{-1}) was observed with T_7 (RDF + *Azotobacter* at 2 kg ha^{-1} + *Azospirillum* at 2 kg ha^{-1}). The effect of biofertilizers had significant influence on grain yield at production increased 15.4 per cent over farmer practices (T_1) when compared with treatment T_{11} (RDF + *Azospirillum* at 2 $kgha^{-1}$ + Azolla at 2 tonnes ha^{-1}) with lowest yield of biofertilizers and chemical fertilizers combination. Treatments T_2, T_3, T_4, T_5 and T_6 were found statistically at par to maximum (T_7). Kumari *et al.,* (2000) reported that increase N level brought about significant increase in grain yield. Inoculation of biofertilizers increases the grain yield of rice (Gopalswamy and Vidhyasekaran, 1988) and Jayaraman (1990). The increase in yield due to biofertilizers inoculates may not be solely due to N fixation or phosphate solubilisation, but because of several other factors such as release of growth promoting substances, control of plant pathogen, proliferation of beneficial organism in the *Azotobacter* and PSB. These findings are in accordance with Kundu and Gaur (1984). Datta *et al.,* (1982) and Mudenoor (2002) observed that the response to mixed culture inoculation is more than that for single culture, showing the synergistic effect of two types of organism.The significant response was mainly due to the supply of two major nutrients N and P.

The application of biofertilizers had also significantly influenced the straw production of the rice crop. T_2 (RDF + *Azotobacter* at 2 kg ha^{-1}) gained maximum straw yield and treatments T_3, T_6, T_7, T_{10}, T_{11} were found statistically at par to maximum. Straw yield also exhibited similar trend as that of grain yield of rice.

Due to application of nitrogen with bio fertilizers and synthetic fertilizers remarkably increased the tillering rice resulted in significant improvement in straw yield Devasenamma *et al.,* (1999). The increase in straw yield might be because more amount of nitrogen availability through bio fertilizers. Nitrogen is known to promote tillering, improve length and width of leaves, which inturn increase the dry matter and are responsible for increase in straw yield. Gopalswamy *et al.*, (1989) also reported that the straw yield of rice increased by soil application of biofertilizers. T_9 (RDF + PSB at 2 kg ha^{-1} + *Azospirillum* at 2 kg ha^{-1}) recorded maximum number of grains per panicle with $T_{2,}$ T_8, and T_{11} are at par to T_9. Solubilizers of inorganic phosphates in the soil (PSB) make them available to the crop and resulted in better number of grains per panicle. It also produces a phytohormone. IAA which increased its capacity of nutrient extraction from the soil Datta *et al.,* (1982). Number of panicle per hill shown the same trend as number of grain per panicle, T_9 (RDF + PSB at 2 kg ha^{-1} + *Azospirillum* at 2 kg ha^{-1}) with maximum (21.8) and T_4 (RDF + *Azospirillum* at 2 kg ha^{-1} + Azolla at 2 tonnes ha^{-1}) with minimum (15.07).

Table.1 Effect of Biofertilizers on growth parameters of rice var. 'Pusa Basmati-1' at harvest

S.No	T.no	Treatments	Plant height (cm)	No. of tillers hill^{-1}	Dry matter accumulation (g hill^{-1})
1	T_1	Farmers practice	103.53	13.53	100.14
2	T_2	RDF + Azotobacter at 2kg ha^{-1}	105.33	16.00	102.82
3	T_3	RDF + PSB at 2 kg ha^{-1}	105.73	16.33	85.58
4	T_4	RDF + Azospirillum at 2 kg ha^{-1}	104.80	15.60	99.12
5	T_5	RDF + Azolla at 2 tonnes ha^{-1}	107.40	16.20	93.90
6	T_6	RDF + Azotobacter at 2 kg ha^{-1} + PSB at 2 kg ha^{-1}	109.20	16.93	97.70
7	T_7	RDF + Azotobacter at 2 kg ha^{-1} + Azospirillum at 2 kg ha^{-1}	112.53	18.33	95.20
8	T_8	RDF + Azotobacter at 2 kg ha^{-1} + Azolla at 2 tonnes ha^{-1}	109.93	15.20	95.43
9	T_9	RDF + PSB at 2 kg ha^{-1} + Azospirillum at 2 kg ha^{-1}	99	15.80	91.21
10	T_{10}	RDF + PSB at 2 kg ha^{-1} + Azolla at 2 tonnes ha^{-1}	103.47	14.80	88.35
11	T_{11}	RDF + Azospirillum at 2 kg ha^{-1} + Azolla at 2 tonnes ha^{-1}	115.67	19.53	101.40
		SEm (±)	2.36	1.02	3.56
		CD (P 0.05)	*6.97	*3.00	*10.50

Farmer practice - 100 kg N through urea and DAP, 40 kg P2O5 through DAP and 20 kg K2O through MOP, RDF- 120 kg N through urea and DAP, 60 kg P2O5 through DAP and 60 kg through MOP, DAP- Di-ammonium phosphate, MOP- Muriate of Potash, RDF- Recommended dose of fertilizers, *Significant at $P < 0.05$;

Table.2 Effect of Biofertilizers on yield and yield attributing characters of rice var. 'Pusa Basmati-1'

S. No	T. No	Treatment	No. of grains panicle^{-1}	No. of panicles hill^{-1}	Grain Yield (t ha^{-1})	Straw Yield (t ha^{-1})
1	T_1	Farmers practice	136.60	16.13	4.52	9.23
2	T_2	RDF + Azotobacter at 2 kg ha^{-1}	143.07	16.93	6.71	12.37
3	T_3	RDF + PSB at 2 kg ha^{-1}	134.73	18.20	5.73	11.67
4	T_4	RDF + Azospirillum at 2 kg ha^{-1}	138.80	15.67	5.92	10.17
5	T_5	RDF + Azolla at 2 tonnes ha^{-1}	136.53	19.47	5.93	10.47
6	T_6	RDF + Azotobacter at 2 kg ha ^{1}+ PSB at 2 kg ha^{-1}	126.67	17.47	6.36	12.07
7	T_7	RDF + Azotobacter at 2 kg ha^{-1} + Azospirillum at 2 kg ha^{-1}	139.27	21.73	6.88	11.72
8	T_8	RDF + Azotobacter at 2 kg ha^{-1}+ Azolla at 2 tonnes ha^{-1}	141.60	17.00	5.56	10.67
9	T_9	RDF + PSB at 2 kg ha^{-1} + Azospirillum at 2 kg ha^{-1}	151.93	21.80	5.41	10.40
10	T_{10}	RDF + PSB at 2 kg ha^{-1} + Azolla at 2 tonnes ha^{-1}	139.93	16.60	5.39	11.17
11	T_{11}	RDF + Azospirillum at 2 kg ha^{-1} + Azolla at 2 tonnes ha^{-1}	143.27	15.07	5.52	11.97
		SEm (±)	3.93	1.46	0.40	0.57
		CD (P 0.05)	*11.60	*4.30	*1.19	*1.68

Farmer practice - 100 kg N through urea and DAP, 40 kg P2O5 through DAP and 20 kg K2O through MOP, RDF- 120 kg N through urea and DAP, 60 kg P2O5 through DAP and 60 kg through MOP, DAP- Di-ammonium phosphate, MOP- Muriate of Potash, RDF- Recommended dose of fertilizers, *Significant at P < 0.05; NS- Non Significant at P > 0.05

Table.3 Effect of Biofertilizers on economic of rice var. 'Pusa Basmati-1'

S.No	T.No	Treatment	Cost of cultivation# (x 10^3 ha^{-1})	Gross return (x 10^3 ha^{-1})	Net return (x 10^3 ha^{-1})	Benefit:Cost ratio
1	T_1	Farmers practice	54.46	126.47	71.99	2.32
2	T_2	RDF + *Azotobacter* at 2 kg ha^{-1}	56.11	187.88	131.77	3.34
3	T_3	RDF + PSB at 2 $kgha^{-1}$	56.11	160.44	104.33	2.85
4	T_4	RDF + *Azospirillum* at 2 kg ha^{-1}	56.44	165.67	109.23	2.93
5	T_5	RDF + Azolla at 2 tonnes ha^{-1}	56.71	165.95	109.24	2.92
6	T_6	RDF + *Azotobacter* at 2 kg ha^{-1} + PSB at 2 kg ha^{-1}	57.76	178.08	120.32	3.08
7	T_7	RDF + *Azotobacter* at 2 kg ha^{-1} + *Azospirillum* at 2 kg ha^{-1}	58.09	192.55	134.47	3.31
8	T_8	RDF + *Azotobacter* at 2 kg ha^{-1} + Azolla at 2 $tonnesha^{-1}$	58.36	155.81	97.45	2.67
9	T_9	RDF + PSB at 2 kg ha^{-1} + *Azospirillum* at 2 kg ha^{-1}	58.09	151.48	93.39	2.60
10	T_{10}	RDF + PSB at 2 kg ha^{-1} + Azolla at 2 tonnes ha^{-1}	58.36	150.92	92.56	2.58
11	T_{11}	RDF + *Azospirillum* at 2 kg ha^{-1} + Azolla at 2 tonnes ha^{-1}	58.69	154.47	95.89	2.63
		SEm (±)		11.34	11.34	0.20
		CD (P 0.05)		*33.45	*33.46	*0.58

Farmer practice - 100 kg N through urea and DAP, 40 kg P_2O_5 through DAP and 20 kg K_2O through MOP, RDF- 120 kg N through urea and DAP, 60 kg P_2O_5 through DAP and 60 kg through MOP, DAP- Di-ammonium phosphate, MOP- Muriate of Potash, RDF- Recommended dose of fertilizers. , *Significant at $P < 0.05$; NS- Non Significant at $P > 0.05$. #Data not subjected to statistical analysis

The treatments T_3, and T_5 were found to be at par with maximum. According to Khorshidi*et al.,* (2011) the highest number of panicles produced with the combination between nitrogen and bacteria *Azospirillum lipoferum*. This finding is with the agreement of Devasenamma *et al.,* (1999) and Nayak *et al.,* (1986).

The statistical analysis on test weight was found to be non-significant. However, highest test weight (31.50g) was recorded with treatment T_5 (RDF+ Azolla at 2 tonnes ha^{-1}). The data showed non-significant difference in harvest index. However, T_7 (RDF+ *Azotobacter* at 2 $kgha^{-1}$+ *Azospirillum* at 2 $kgha^{-1}$) recorded highest value of (36.98%) and lowest value (31.47%) was recorded with T_{11} (RDF + *Azospirillum* at 2 $kgha^{-1}$ + Azolla at 2 tonnes ha^{-1}). A superior value of harvest index indicates more efficient translocation of metabolites from source to sink.

Economics

Among the different combination of nutrient source highest gross return (Rs.1, 92, 550 ha^{-1}) and maximum net return (Rs.1, 34,470 ha^{-1}) recorded by (T_7) RDF + *Azotobacter* at 2 kg ha^{-1} + *Azospirillum* at 2 kg ha^{-1}. Higher benefit cost ratio of 3.34 was recorded from nutrient applied (T_2) RDF + *Azotobacter* at 2 kg ha^{-1}. The yield advantage through application of *Azotobacter* with more proportional increase in cost of cultivation which has been statistically superior over other treatments but treatment with biofertilizers proved to be far better than the farmer practices and the conjoint use of RDF with biofertilizers is capable of sustaining higher rice productivity, improving nutrients status and profitability on long term basis. Thus recommended for farmers.

As Basmati rice exports are increasing year by year, and earning huge revenue and boosting our economy. There is a need to meet the demand of this scented rice variety not only in quantitative manner but in qualitatively too, because quality control is the major aspect in exports and imports. Cultivating exportable products with sole use of chemical fertilizers will directly affect the quality, subsequently exports and its market value.

Experiment results revealed that basmati rice responded well to balanced use of chemical fertilizers along with the biofertilizers when applied solely and in combinations. Therefore, the treatment (T_7) RDF + *Azotobacter* at 2 kg ha^{-1} + *Azospirillum* at 2 kg ha^{-1} proved to gain significantly higher yield than sole fertilizer application. They also reduces the damage caused due to continuous usage of chemical fertilizers, improves the soil fertility, enhances the soil micro fauna, and reduces the input costs of farmers. It is our duty to create awareness on soil depletion, health hazards and encourage farmers to use biofertilizers, to save our natural resources and environment.

In spite, the treatment (T_7) RDF + Azotobacter at 2 kg ha^{-1} + Azospirillum at 2 kg ha^{-1} proved to gain significantly higher grain yield, as the economics are the paramount importance in the farmers point of view the treatment (T_2) RDF + Azotobacter at 2 kg ha^{-1} has gained more B: C ratio and concluded that it beneficial for farmers.

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