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EFFECT OF DIFFERENT BIO FERTILIZERS ON YIELD OF SPRING RICE (*Oryza sativa* L.) cv. HARDINATH-1 IN RAJAPUR MUNICIPALITY, BARDIYA

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ABSTRACT

A field experiment was carried out at Rajapur, Bardiya Nepal to determine the effect of different biofertilizers on the yield of spring rice (Oryza sativa L.). Five different combinations of biofertilizers and chemical fertilizer viz. T_1 (Azolla + N:P:K @50:15:15 kg ha^{-1}), T_2 (Azotobacter+ N:P:K @50:15:15 kg ha^{-1}), T_3 (Azotobacter +Mycorrhiza + N:P:K @50:15:15 kg ha^{-1}), T_4 (Azotobacter + Phosphorus Solubilizing Bacteria+ Potassium Mobilizing Bacteria+ N:P:K @50:15:15 kg ha^{-1}) and T_5 (Recommended chemical fertilizer i.e. N:P:K @100:30:30 kg ha^{-1}) was used. The experiment was laid out in a simple RCBD design with four replications and 3m×2m individual plot size. The hardinath-1 variety was used for the experiment. Biometrical observations like plant height (99.92 cm), number of tillers (355.62 m^{-2}) were found significantly highest in T_1 (Azolla + NPK@50:15:15 kg ha^{-1}). Similarly, yield attributing characters such as the number of effective tillers (340 m^{-2}), number of filled grains per panicle (114.30), highest panicle length (28.42 cm) was found significantly the highest in T_1 (Azolla + NPK@50:15:15 kg ha^{-1}). The highest grain yield (8.46 ton ha^{-1}), straw yield (12.6 ton ha^{-1}), and harvest index (0.40) were also observed on T_1 (Azolla + NPK@50:15:15 kg ha^{-1}). Benefit cost ratio was also found highest on T_1 (Azolla + NPK@50:15:15 kg ha^{-1}) which was 2.05 incurring the cost of cultivation Rs 72035 per hectare returning the total revenue of Rs 148190 per hectare. The study shows that the application of T_1 (Azolla + NPK@50:15:15 kg ha^{-1}) was the best fertilizer combination for spring rice production as it was superior over other fertilizer combinations in terms of yield and yield attributing characters with the highest benefit cost ratio.

Keywords: Azolla, B:C ratio, Yield attributing characters

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INTRODUCTION

Rice is the major food crop for about 3.5 billion people of the world and it is the staple food of estimated 2.4 billion people of Asia. In Nepal, rice occupies the first position in terms of area, production, and consumption. It supplies about 40% of the food calorie intake and contributes nearly 20% to the agricultural gross domestic product (AGDP) and almost 7% to GDP (CDD, 2015). Nepal depends on foreign countries for fertilizer supply, which is creating negative trade (USAID, 2014). Persistent use of chemical fertilizers subverts the soil ecology, disrupts the environment, degrades soil fertility, and consequently shows harmful effects on human health and contaminates groundwater (Suhag, 2016). The unavailability and high cost of synthetic fertilizer have been constrained for rice production in Nepal.

Biofertilizers can be a supplementary nutrient source for sustainable rice production (Sahoo et al., 2013). It maintains soil fertility, physical, chemical, and biological properties. Biofertilizers once isolated can be easily propagated at low cost unlike chemical fertilizers and are fuel independent, cost-effective, and easily available (Umesha et al., 2018). Integration of biofertilizers along with a reduced dose of recommended synthetic fertilizers can maintain soil productivity and sustainable rice production.

Azolla, Phosphate solubilizing bacteria (PSB), Potassium-solubilizing bacteria (KSB), Azotobacter, and Mycorrhiza are potential biofertilizers for rice. Azolla can fix nitrogen at the rate of 20kg ha^{-1}, improve nitrogen use efficiency and yield for rice crops (Yao, et al., 2018). It also suppresses weeds in a paddy field (Biswas et al., 2005). PSB and KSB are capable of solubilizing organic and inorganic phosphorus and inorganic potassium respectively from insoluble compounds helping proper growth and development of the plant. *Azotobacter spp.* can fix nitrogen about 20kg ha^{-1} (Ojha et al., 2015). Mycorrhiza forms mutualistic symbioses with rice plant, they provide the host plant with mineral nutrients and water, in exchange for photosynthetic products (Smith and Read, 2008). Hence, present study was conducted with the main objective to increase the spring rice productivity in a sustainable way via application of reduced chemical fertilizer in combination with biofertilizers thereby increasing the benefit cost ratio of spring rice cultivation.

MATERIALS AND METHODS

The experiment was conducted at Rajapur municipality ward no.4, Bardiya in 2020. Rajapur is located between 81º3’ to 81º41’ longitude and 28º7’ to 28º39’ latitude.

Experimental details

The experiment was laid out on randomized complete block design with 5 treatments and 4 replications. The treatments were The treatments were T_1 (Azolla@ 20 kg ha^{-1}+ N:P:K@ 50:15:15 kg ha^{-1}), T_2 (Azotobacter @1.2*10^8 CFU ml^{-1} + N:P:K@ 50:15:15kg ha^{-1}), T_3 (Azotobacter @ 1.2*10^8 CFU ml^{-1} + Mycorrhiza 2*10^6 @

CFU gm^{-1} + N:P:K@ 50:15:15kg ha^{-1}), T_4 (Azotobacter @1.2*10^8 CFU ml^{-1} + Phosphorus solubilizing bacteria @ 2*10^8 CFU ml^{-1} + Potassium mobilizing bacteria @ 2*10^8 CFU ml^{-1}+ N:P:K@ 50:15:15 kg ha^{-1}) and T_5 (Recommended fertilizer i.e., N:P:K @100:30:30 kg ha^{-1}). Hardinath-1 variety of spring rice was chosen for the experiment. Individual plot size of 3m X 2 m with 150 plants per plot at the spacing of 0.2m X 0.2m was designed.

Application method

Azolla (*Azolla pinnata*) was applied after 7 days of transplanting the inoculum was uniformly broadcasted on the rice field. Whereas, PSB (*Pseudomonas spp*.), KMB (*Acidothiobacillus ferrooxidans),* and Azotobacter (*Azotobacter chroococcum)* were applied at the time of transplanting by dipping the root of seedling for 2 hr in the bacterial solution the root of the seedlings was dipped for 2 hours in the bacterial solution. Mycorrhiza (*Glomus spp*.) powder @15kg/ ha was mixed with well rotten FYM mixture was uniformly spread over the field just after transplanting.

Seed treatment was done using Bavistin @ 2 gm/kg seeds before sowing in the nursery tray. In the control treatment, recommended fertilizer dose of 100:30:30 kg NPK/ha was supplied through the application of urea, diammonium phosphate, and murate of potash. One third ($1/3^{rd}$) split dose of urea were applied as the basal dose during the field preparation. The further two split doses of urea were applied at the time of tillering and panicle initiation.

Biometric observations like plant height and numbers of tillers per square meter were recorded at 30, 45, 60, 75, and 90 days after transplanting. Yield attributing characters like numbers of effective tillers per square meter, length of panicle, number of grains per panicle and sterility percentage, thousand grain weight (TGW), Grain and straw yield, harvest index were recorded at time of harvesting. The benefit-cost ratio was also calculated.

The data were systematically arranged in MS Excel and were subjected to analysis of variance (ANOVA) at 5% significance level using R-studio software and significant data was subjected to DMRT for mean separation with reference to Gomez and Gomez (1984).

Sterility Percentage

The total number of filled grains was counted from randomly selected 10 panicles (panicle used for determining length). Total unfilled grains were counted and sterility percent was calculated using the following formula.

$$\text{Sterility percent} = \frac{\text{Number of unfilled grains per panicle}}{\text{Total number of grains per panicle}} \times 100$$

Grain and straw yield

The harvested crop was dried, threshed, cleaned, and again sun-dried. Moisture in grains of each plot was measured with the help of a digital moisture meter and grain yield was calculated using the following formula.

Gain yield (kg ha^{-1}) at 14% moisture = $\frac{(100-MC)\times \text{plot yield (kg)} \times 10000\ (\text{m2})}{(100-14) \times \text{net plot area (m2)}}$

MC: Moisture content measured.

Harvest index

Harvest index (HI) was computed by dividing grain yield with the total dry matter yield as per the following formula. To obtain harvest index grain and straw yield was calculated at the same moisture level.

HI% = $\frac{\text{Grain Yield (Economic Yield)}}{\text{Total biomass yield (grain yield+straw yield)}}$

Benefit-cost (B:C) ratio

B: C ratio = $\frac{\text{Gross return}}{\text{Cost of cultivation}}$

Gross return = The per-unit price of grain and straw-based on the local market was multiplied with grain yield and straw yield of each plot to determine gross return and was expressed in NRs ha^{-1} for all replications and treatments

Cost of cultivation = Cultivation cost of crops was calculated based on local charges for different agro-inputs viz., labor, fertilizer, and other necessary materials and was expressed as the total cost of NRs ha^{-1}.

RESULT AND DISCUSSION

Plant height

The combined application of different biofertilizers and chemical fertilizer showed a significant effect on plant height except at 30 DAT and 45 DAT. At 60, 75, and 90 DAT, maximum plant height was observed on T_1 (Azolla + N:P:K@ 50:15:15kg ha^{-1}), which was 75.88 cm, 97.76 cm, and 99.92 cm respectively and all were statistically at par with T_4 (Azotobacter + KMB +PSB+ N:P:K@ 50:15:15kg ha^{-1}), while minimum plant height was seen in T_3 (Azotobacter + Mycorrhiza + N:P:K@ 50:15:15kg ha^{-1}), which was 66.46 cm, 88.58 cm, and 89.19 cm, respectively. This might be due to the slower release of nitrogen by Azolla through nitrogen fixation reducing leaching loss and also due to the suppression of weed density by Azolla mat formation. Swami et al., (2018) reported maximum plant height on the application of Azolla with a reduced dose of chemical fertilizer. Akhtar et al., (2002) also reported maximum plant height on the application of Azolla with a reduced dose of chemical fertilizer.

Table 1. Plant height as influenced by the application of different biofertilizers in combination with chemical fertilizers at Rajapur, Bardiya, 2020

Treatments	30 DAT	45 DAT	60 DAT	75 DAT	90 DAT
Azolla + N:P:K@ 50:15:15kg ha^{-1}	35.32^{a}	55.72^{a}	75.88^{a}	97.76^{a}	99.92^{a}
Azotobacter N:P:K@ 50:15:15kg ha^{-1}	33.33^{a}	50.98^{a}	70.30^{b}	90.63^{c}	93.23^{b}
Azotobacter+ Mycorrhiza+ N:P:K@ 50:15:15kg ha^{-1}	33.00^{a}	52.32^{a}	66.46^{c}	88.58^{c}	89.19^{c}
Azotobacter + PSB + KMB + N:P:K@ 50:15:15kg ha^{-1}	36.22^{a}	56.91^{a}	74.21^{a}	95.99^{ab}	98.83^{a}
Recommended chemical fertilizer	37.21^{a}	56.72^{a}	73.94^{a}	93.78^{b}	97.61^{a}
LSD(P=0.05)	Ns	Ns	3.02***	3.09***	2.51***
SEM±			1.02	0.91	1.01
Grand Mean			72.16	93.34	95.76

Note: LSD: least significant differences, SEM (±): Standard error of mean DAT: Days after transplantation, Treatment means separated by DMRT and columns represented with the same letter (s) are non-significant at 5% level of significance.

Numbers of tillers

The application of different biofertilizers in combination with chemical fertilizer dose had a significant effect on the number of tillers. The highest number of tillers was observed at 60 DAT. Tiller mortality was seen after 60 DAT. The highest tiller mortality (20.12%) was observed on T_4 (Azotobacter + KMB +PSB+ 50% NPK) and the lowest tiller mortality (14.57%) was observed T_2 (Azotobacter + 50% NPK). At 30 DAT, numbers of tillers were significantly higher on T_1 (Azolla + 50% NPK) 328.12/m^2 while the minimum number of tillers were observed in T_2 (Azotobacter + 50% NPK) 286.87/ m^2. Similarly, on 45,60,75,90 DAT maximum number of tillers were found on T_1 (Azolla + 50% NPK) which were 399.37 m^{-2}, 434.37 m^{-2}, 378.12 m^{-2} and 355.62 m^{-2} respectively and all were statistically at par with T_3 (Azotobacter + Mycorrhiza + 50% NPK) while minimum number of tillers were observed in T_2 (Azotobacter + 50% NPK) which were 358.75/ m^2, 381.25/ m^2, 305.62/ m^2 and 298.125/ m^2 at 45,60,75,90 DAT, respectively.

Table 2. Numbers of tillers as influenced by the application of different biofertilizers in combination with chemical fertilizers at Rajapur, Bardiya, 2020

Treatments	30 DAT	45 DAT	60 DAT	75 DAT	90 DAT
Azolla + N:P:K@ 50:15:15kg ha^{-1}	328.12^{a}	399.37^{a}	434.37^{a}	378.12^{a}	355.62^{a}
Azotobacter+ N:P:K@ 50:15:15kg ha^{-1}	286.87^{d}	358.75^{d}	381.25^{d}	305.62^{d}	298.12^{d}
Azotobacter+ Mycorrhiza+ N:P:K@ 50:15:15kg ha^{-1}	312.50^{b}	390.00^{ab}	420.62^{ab}	368.12^{ab}	345.62^{ab}
Azotobacter + PSB + KMB + N:P:K@ 50:15:15kg ha^{-1}	305.00^{bc}	383.12^{bc}	408.75^{bc}	348.75^{bc}	326.25^{bc}
Recommended chemical fertilizer	297.50^{cd}	374.37^{c}	396.25^{cd}	329.37^{c}	316.87^{cd}
LSD(P=0.05)	14.05	12.01	17.66	23.52	25.18**
SEM±	3.69	3.55	4.72	4.41	5.62
Grand Mean	306	381.12	408.25	346	328.5

Note: LSD: least significant differences, SEM (±): Standard error of mean, DAT: Days after transplantation, Treatment means separated by DMRT and columns represented with the same letter (s) are non-significant at 5% level of significance

This might be due availability of biologically fixed nitrogen at the tillering phase (Bernhard, 2020). Oyange et al. (2019) also reported the maximum number of tillers on the application of Azolla along with a reduced dose of nitrogen i.e 60 kg Nha^{-1}.

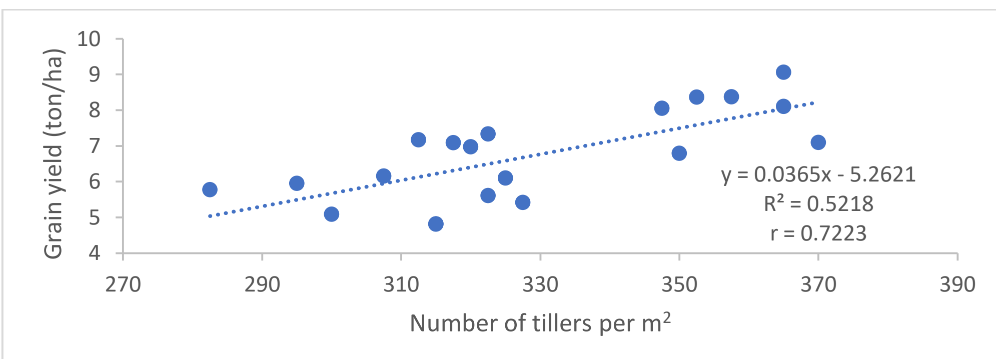

Figure 1. Relationship between the number of tillers per m^2 and grain yield as influenced by the application of different biofertilizers along with chemical fertilizers.

There is a linear relationship between the number of tillers per m^2 and grain yield. The number of tillers per m^2 had only 52.18% contribution to the total grain yield of rice and the remaining contribution was due to other factors. The coefficient of correlation (r = 0.722) indicates a strong positive correlation between the number of tillers per m^2 and grain yield as the number of tillers per m^2 increases.

Yield attributing parameters

Net effective tillers

The combined application of different biofertilizers with chemical fertilizer dose has a significant effect on the number of net effective tillers. The highest number of effective tillers were observed on T_1 (Azolla + N:P:K @ 50:15:15kg ha^{-1}), which was 340.62 per m^2 and the lowest numbers of tillers were observed on T_2 (Azotobacter+ N:P:K@ 50:15:15kg ha^{-1}),) which was 267.5 per m^2. This might be due to the higher number of tillers in T_1 which subsequently resulted in a higher number of effective tillers per m^2. Oyange et al., (2019) also reported similar results with the application of Azolla along with reduced nitrogen dose i.e. 60 N kg per hac. This might be due availability of biologically fixed nitrogen at the tillering phase and may be due to reduced root zone temperature by shading effect of Azolla and increased organic matter content.

Table 3. Different yield attributing parameters as influenced by the application of different biofertilizers in combination with chemical fertilizers in Rajapur, Bardiya, 2022

Treatments	Effective tiller/m^2	Filled grain per panicle	Sterility %	TGW	Panicle length (cm)	Grain yield (ton ha^{-1})	Straw yield (ton ha^{-1})	Harvest index
T_1	340.62^{a}	114.30^{a}	26.22^{a}	21.74	28.42^{a}	8.46^{a}	12.60^{a}	0.402^{a}
T_2	267.50^{d}	95.65^{b}	30.30^{a}	21.14	26.22^{abc}	5.41^{d}	8.98^{c}	0.37^{c}
T_3	316.25^{b}	104.45^{ab}	27.60^{a}	21.69	26.90^{ab}	7.16^{b}	11.26^{a}	0.38^{b}
T_4	303.12^{bc}	97.25^{b}	27.10^{a}	22.52	24.95^{bc}	6.66^{bc}	11.20^{ab}	0.37^{c}
T_5	287.50^{cd}	92.00^{b}	29.05^{a}	22.16	24.17^{c}	5.87^{cd}	9.11^{bc}	0.39^{b}
LSD (0.05)	21.73	14.83*	Ns	Ns	2.29*	1.21**	2.13*	0.00
Sem±	6.32	2.509	0.837	0.193	0.43	0.28	2.81	0.002
Grand Mean	303	100.73	-	21.85	26.13	6.71	10.63	0.38

Note: LSD: least significant differences, SEM (±): Standard error of mean, DAT: Days after transplantation, Treatment means separated by DMRT and columns represented with the same letter (s) are non-significant at 5% level of significance

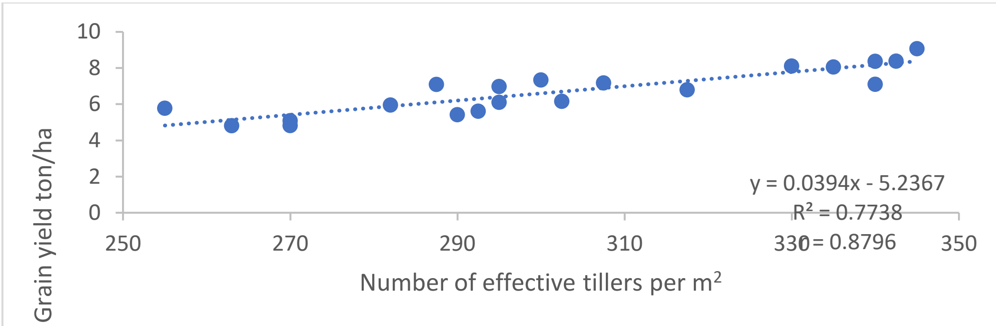

Figure 2. Relationship between the number of effective tillers per m^2 and grain yield as influenced by the application of different biofertilizers along with reduced chemical fertilizers.

There is a linear relationship between the number of effective tillers per m^2 and grain yield. The number of effective tillers per m^2 had only 77.38% contribution to the total grain yield of rice and the remaining contribution was due to other factors. The coefficient of correlation (r = 0.879) indicates a very strong positive correlation between the number of effective tillers per m^2 and grain yield.

Filled grains per panicles and sterility percentage

Filled grains per panicles were significantly influenced by the application of different combinations of biofertilizers with chemical fertilizer. The maximum number of filled grains were observed on T_1 (Azolla + N:P:K@ 50:15:15kg ha^{-1}) which was 114.30 per panicle and was statistically at par with T_3 (Azotobacter+ Mycorrhiza+ N:P:K@ 50:15:15kg ha^{-1})while, the minimum number of the filled grains per panicle was observed on T_5 (Recommended fertilizer dose) which was 92 filled grains per panicle. The highest number of filled grains per panicle and lowest sterility percentage was found on T_1 (Azolla + N:P:K@ 50:15:15kg ha^{-1}). This may be due to longer panicle length of T_1, slow-release of nitrogen, less volatilization, and leaching loss of nitrogen. In addition, increased organic content increases the carbon content of the soil which might result in high filled grain per panicle and low sterility percentage (Ghosh, et al., 2019).

No significant difference was observed among various treatments regarding the sterility percentage. Numerically highest sterility percentage was found in T_2 (Azotobacter + 50% NPK) (30.30%) and the lowest was found on T_1 (Azolla + N:P:K@ 50:15:15kg ha^{-1}) (26.22%).

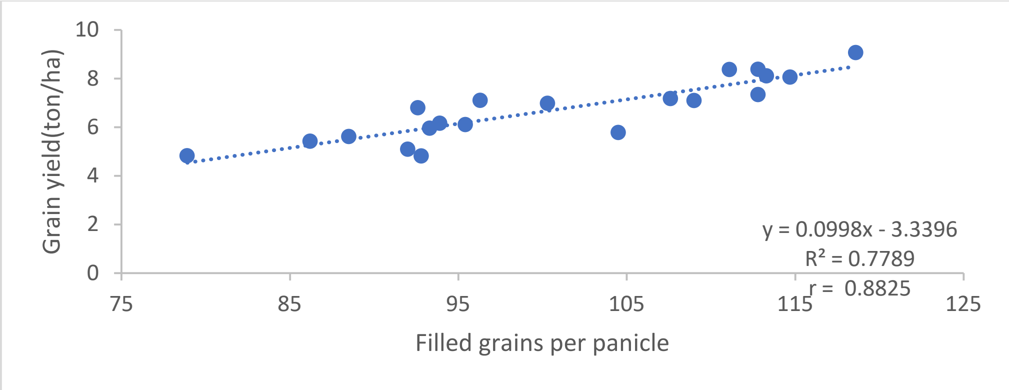

Figure 3. Relationship between filled grains per panicle and grain yield as influenced by the application of different biofertilizers along with reduced chemical fertilizers.

There is a linear relationship found between filled grains per panicle and grain yield. The filled grain per panicle had only 77.89 % contribution to the total grain yield of rice and the remaining contribution was due to other factors. The coefficient of correlation (r = 0.8825) indicates a very strong positive correlation between filled grains per panicle and grain yield.

Thousand-grain weight (TGW)

Thousand-grain weight was found non-significant at 5% significance level among the various combination of treatments. The highest TGW was observed on T_4 (Azotobacter + PSB + KMB + N:P:K@ 50:15:15kg ha^{-1})) viz. 22.522 gm and the lowest TGW was found on T_2 (Azotobacter+ N:P:K@ 50:15:15kg ha^{-1}) viz. 21.14 gm.

Panicle length

Panicle length was significantly influenced by the application of the biofertilizers along with chemical fertilizers. The highest panicle length was found on T_1 (Azolla + N:P:K@ 50:15:15kg ha^{-1}) which was 28.425 cm and it was statistically at par with T_2 (Azotobacter + 50% NPK) and T_3 (Azotobacter+ Mycorrhiza+ N:P:K@ 50:15:15kg ha^{-1})), while the lowest panicle length was found on T_5 (recommended dose of fertilizer) which was 24.175 cm. The longest panicle length was found on T_1 (Azolla + N:P:K@ 50:15:15kg ha^{-1}). Fatemeh et al. (2015) also reported maximum panicle length on application Azolla compost (8 tons per ha) along with different chemical fertilizers.

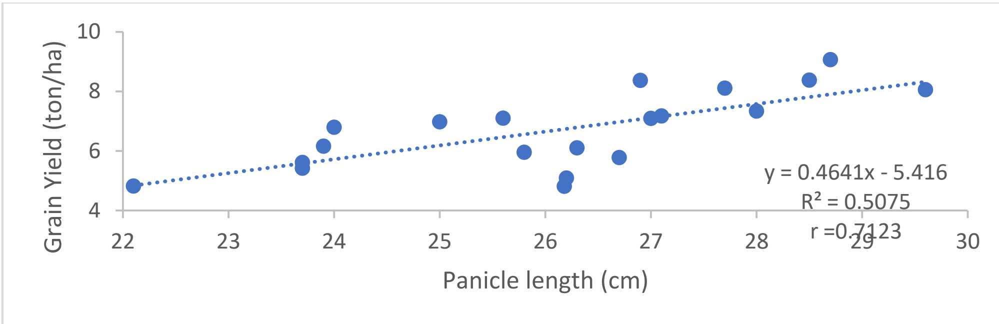

Figure 4. Relationship between panicle length and grain yield as influenced by the application of different biofertilizers along with reduced chemical fertilizers.

There is a linear relationship between panicle length and grain yield. The panicle length had only 50.75 % contribution to the total grain yield of rice and the remaining contribution was due to other factors. The coefficient of correlation (r = 0.7123) indicates a strong positive correlation between panicle length and grain yield.

Grain yield, Straw yield, and Harvest index

Grain yield among various treatments was significantly influenced by the application of biofertilizers along with chemical fertilizer. The highest grain yield was found on T_1 (Azolla+ 50% NPK) which was 8.468 ton ha^{-1} followed by T_3 (Azotobacter+ Mycorrhiza+ N:P:K@ 50:15:15kg ha^{-1}) which was 7.164 ton ha^{-1}. While lowest yield was found on T_2 (Azotobacter+ 50% NPK) which was 5.411ton ha^{-1}. The straw yield was significantly influenced by the application of biofertilizers along with a reduced dose of chemical fertilizer. The highest straw yield was found on T_1 (Azolla+ N:P:K@ 50:15:15kg ha^{-1})which was 12.600 ton ha^{-1} which was statistically at par with T_3 (Azotobacter+ Mycorrhiza+ N:P:K@ 50:15:15kg ha^{-1}) while, the minimum straw yield was found on T_2 (Azotobacter+ N:P:K@ 50:15:15kg ha^{-1}) which was 8.988 ton ha^{-1}. This might be due to the production of different phytohormones and vitamins by Azolla which promoted plant growth and result in higher straw and grain yield. Also, the solubilization of micronutrients (Zn, Fe, and Mn) and making them available to the plant might have resulted in better plant performance under T_1 (Azolla+ N:P:K@ 50:15:15kg ha^{-1}) treatment. The highest straw and grain yield with maximum harvest index was found on T_1 (Azolla + N:P:K@ 50:15:15kg ha^{-1}). Ali et al., (1998) also reported the highest straw and grain yield on the application of Azolla + 30kg N ha^{-1}. This might be due to improvement in nitrogen uptake and increased nitrogen use efficiency in presence of Azolla. Increased nitrogen use efficiency in presence of Azolla was reported from different countries (Kumariainghe and Eskew, 1993).

Harvest index was significantly influenced by the application of biofertilizers along with chemical fertilizer. The highest harvest index was found on T_1 (Azolla+ N:P:K@ 50:15:15kg ha^{-1}) which was 0.402 while, the lowest harvest index was found on T_5 (Recommended Fertilizer dose) which was 0.375.

Economic analysis

Benefit-cost ratio (B:C Ratio)

Table 4. Benefit cost ratio incurred application of different biofertilizers in combination with chemical fertilizers in Rajapur, Bardiya, 2020

Treatments	Total cost	Revenue	B:C
T_1 (Azolla + N:P:K@ 50:15:15kg ha^{-1})	72035	148190	2.05
T_2 (Azotobacter+ N:P:K@ 50:15:15kg ha^{-1})	63417	94692.5	1.49
T_3 (Azotobacter+ Mycorrhiza+ N:P:K@ 50:15:15kg ha^{-1})	66017	125370	1.89
T_4 (Azotobacter + PSB + KMB + N:P:K@ 50:15:15kg ha^{-1})	65917	116235	1.76
T_5 (Recommended chemical fertilizer)	65841	102813	1.56

Cost of cultivation was found highest in T_1(Azolla+N:P:K@ 50:15:15kg ha^{-1}) which was Rs. 72305 and the lowest cost of cultivation was found in T_2 (Azotobacter+ N:P:K@ 50:15:15kg ha^{-1}) which was Rs 63417. While the highest revenue was found in T_1 (Azolla+N:P:K@ 50:15:15kg ha^{-1}) which was Rs. 148190 and the lowest revenue was found in T_2 (Azotobacter+ N:P:K@ 50:15:15kg ha^{-1}) which was Rs 94692.5 and the benefit: the cost was found highest in T_1 (Azolla+N:P:K@ 50:15:15kg ha^{-1}) which was 2.057 and lowest was found on T_2 (Azotobacter+ N:P:K@ 50:15:15kg ha^{-1}) which was 1.493.

B: C ratio was found highest on T_1 (Azolla + N:P:K@ 50:15:15kg ha^{-1}). Though the cost of cultivation was highest, the maximum yield of T_1 counterbalances it resulting maximum B: C ratio.

CONCLUSION

The effect of different biofertilizers has a significant effect on the yield of spring rice. It is concluded that the application of different biofertilizers along with chemical fertilizer was vital in enhancing the yield of spring rice. Azolla + 50% N:P:K was superior in terms of plant height, no. of tillers, effective tillers, filled grains per panicle, panicle length, grain yield, straw yield, and harvest index. Overall study shows that the application (Azolla + N:P:K@ 50:15:15kg ha^{-1}) was the best combination as it was superior over other biofertilizers combinations with the highest B: C ratio. So, the spring rice productivity can be enhanced via the adoption of Azolla + N:P:K@ 50:15:15kg ha^{-1})in fertilizer management practice at Rajapur, Bardiya.

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