Evaluationof the effect of organic manure, inorganic fertilizer and bio-inoculants on yield attributes and yields of Rice.

Abstract

Nutrient supply is the most limiting factor next to the water for crop production. Sustaining rice production has become a great challenge, particularly in areas where rice productivity declines integrating organic manure, inorganic fertilizers, and bio-inoculants provides a comprehensive approach to improving rice yields and yield attributes while promoting sustainable agricultural practices. This combination optimizes nutrient availability, enhances soil health, and supports long-term productivity and environmental stewardship. The Field experiments were conducted to evaluationof the effect of organic manure, inorganic fertilizer and bio-inoculants on yield attributes and yields of rice. during the kharif season of 2021-22 and 2022-23 at the student's instructional farm, Chandra Shekhar Azad University of Agriculture & Technology, Kanpur. The experiment consists of 18 treatment combinations in randomized block design with three replications consisted of three replicationsconsisted of different combinations of inorganic fertilizer, organic and bio-inoculants in rice. Based on results emanated from the investigation it can be concluded that among the productivity parameters viz: The maximum grain yield (47.38 q ha-1) in 2021-22 and (47.56 ha-1) in 2022-23, straw yield (66.82q ha-1) in 2021-22 and (67.22 ha-1) in 2022-23 and biological yield (114.20q ha-1) in 2021-2022 and (114.78 ha-1) in 2022-23 were recorded in the treatment T_{17} - 100% NPK+ 5 ton ha^{-1} FYM + Azolla (300 kg ha^{-1}) + S (30 kg ha^{-1}) + Zinc (5 kg ha^{-1}) during both years of experimentation. and the Plant growth traits viz: The maximum Panicle length (28.93cm), the maximum Panicle weight (g) (5.86g) and the maximum number of grains/$panicle^{-1}$ (127) and maximum Grains weight/ panicle (4.11) additionally maximum Test weight (g) (24.97g) was associated with the treatment T_{17} -100% NPK+ 5 ton ha^{-1} FYM + Azolla (300 kg ha^{-1}) + S (30 kg ha^{-1}) + Zinc (5 kg ha^{-1}) during the both year of experimentation.

Keywords: Rice,Integrated nutrient management, organic manure, inorganic fertilizer, bio-inoculants,yield attributes.

Introduction

Rice (*Oryza sativa* L.) is the second most significant staple food for over half of the global population, supplying essential carbohydrates, proteins, and vitamins, and serving as a vital source of nutrients due to its daily consumption**(Heinemann, R. J. B., 2005).**Nutrient availability, second only to water, is the most limiting factor for crop production. Maintaining rice production has become increasingly challenging, especially in regions where rice yields are declining despite adherence to recommended nutrient management practices. Integrating organic nutrient sources with inorganic fertilizers may play a crucial role in enhancing and sustaining rice productivity**(Mondal *et al.*, 2016).**As the available

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Comment [GL4]: Delete, remove bold from the citation of authors land area continues to decrease over time, the intensified use of land, combined with insufficient and imbalanced application of chemical fertilizers and minimal or no use of organic manure, has led to a significant decline in soil fertility. This deterioration has resulted in stagnating or even declining crop productivity**(Shormy*et al.*, 2013).**The integrated use of inorganic fertilizers, bio-fertilizers, and farmyard manure appears to be a viable solution to the current issue of unsustainable agriculture. Farmyard manure is a readily available, cost-effective, and time-tested nutrient source for crops, traditionally utilized by farmers. In addition to providing essential macro and micronutrients, it enhances the physical, chemical, and biological properties of the soil. The use of farmyard manure also boosts the effectiveness of bio-inoculants, supplies essential nutrients, improves soil health, and supports sustained yield improvement**(Jobe, 2003).** Biofertilizers and organic sources are cost-effective, environmentally friendly, and provide a sustained supply of both macro and micronutrients to crops over an extended period. Farmyard manure functions as a soil conditioner, enhancing the physical, chemical, and biological properties of the soil, thereby creating favourable conditions for the growth of microbial populations. This leads to vigorous root development, improved nutrient uptake, and ultimately better yield and grain quality**(Adhikari, N. P.,2005).**Nitrogen is the most essential nutrient, and different organic and inorganic nitrogen sources have a significant impact and play a vital role in determining the quality of rice grains**(Dixit and Gupta, 2000; Quyen and Sharma, 2003).**In light of the aforementioned factors, an investigation was carried out in the of eastern Uttar Pradesh. The study evaluated the response of rice varieties to integrated nutrient management to determine if equivalent productivity could be achieved compared to the exclusive use of inorganic sources. The objective of this study was to assess the effects of integrated nutrient management on the yield potential and quality of rice varieties in growing areas.

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Material and Methods

Experimental Site:

The present field experiment was laid out at Student Instructional Farm, Nawabganj, C. S. Azad University of Agriculture & Technology, Kanpur (25.26˚and 26.58˚north latitude and 79.31° and 80.34° east longitude. It is situated at an elevation of 124 meters above the mean sea level in the alluvial belt of Gangetic plains of central Uttar Pradesh.) during the cropping period(2021-2022 and 2022-23).respectively annually coupled with an average high of 38.33°C and low of 27.77°Cduring the cropping. The soil of the experimental site is presented in Table no 1. Prior to experimental crops, composite soil samples were drawn randomly (0-15 cm) depth from 10 places, dried and passed through 2.0 mm sieve and subjected to chemical analyses.

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Experimental Description:

The treatments details were laid down in Table no -2 the treatments were laid out in a Randomized Block Design and replicated thrice with the varietyPB-1509 of rice and three fertility levels: 100% recommended dose of fertilizer (RDF) [N_1]; 50% RDF + 50%

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recommended dose of nitrogen (RDN) as FYM [N_2]; 75% RDF + 25% RDN as FYM [N_3], The experimental field was tilled twice using a tractor-drawn cultivator, followed by leveling and two rounds of puddling with a rotovator in approximately 10 cm of standing water.Subsequently, seedling transplanting was carried out as per the experimental plan. The recommended dose of fertilizers (RDF) applied was 120 kg N ha^{-1}, 60 kg P_2O_5 ha^{-1}, and 60 kg K_2O ha^{-1}. Farmyard manure (FYM) containing 0.51% N was used to supply 25% (6 t ha^{-1}) and 50% (12 t ha^{-1}) of the recommended nitrogen dose (RDN), applied three days before transplanting.The recommended nitrogen dose was provided through inorganic fertilizer and farmyard manure (FYM). Half of the nitrogen, along with the total amounts of phosphorus and potassium, was applied at the time of transplanting. The remaining half of the nitrogen was top-dressed in two equal splits during the active tillering and panicle initiation stages. all treatments were applied to their designated plots according to the scheduled plan. The fertilizer sources used were urea (46% N), diammonium phosphate (18% N, 46% P_2O_5), and muriate of potash (60% K_2O).A seed rate of 30 kg ha^{-1} was used to establish the nursery on June 25th and June 28th in 2012 and 2013, respectively. Two seedlings per hill were transplanted at a spacing of 20 × 10 cm on July 14th and July 26th during the first and second years, respectively. The PB-1509 variety was harvested 130 days after sowing from an area of 20 m².

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Statistical Analysis:

Analysis of variance (ANOVA) was conducted following the procedures outlined for the Randomized Block Design (Gomez & Gomez, 1984), using the SPSS software package (version 23.0; IBM Corp.; Armonk, NY, USA). All graphs were generated in Excel, and mean values were reported with the standard error of the means.

Results and Discussion

Productivity parameters:

The data presented in Table 3 and Figure1 indicate that, among the Yield attributes parameters:straw yield (q ha^{-1}) and biological yield (q ha-1) significantly increase due to the application of NPK, Zinc, Sulphur, FYM, Azolla. Grain yield varied from 22.16 to 47,38 qha^{-1}in 2021-22 and 22.56 to 47.56 qha^{-1} in 2022-23, straw yield varied from 36.12to 66.82q ha^{-1}in 2021-2022 and 36.24 to 67.22 q ha^{-1}in 2022-23 and biological yield varied from 58.28to 114.20q ha^{-1}in 2021-22 and 58.80 to 114.78 ha^{-1} in 2022-23 on pooled basis.The maximum grain yield (47.38 q ha^{-1}) in 2021-22 and (47.56 ha^{-1})in 2022-23, straw yield (66.82q ha^{-1}) in 2021-22 and (67.22 ha^{-1})in 2022-23 and biological yield (114.20q ha^{-1}) in 2021-2022 and (114.78 ha^{-1}) in 2022-23 were recorded in the treatment T_{17} - 100% NPK+ 5 ton ha^{-1} FYM + Azolla (300 kg ha^{-1}) + S (30 kg ha^{-1}) + Zinc (5 kg ha^{-1})during the second year (2022-23) of experimentation.The minimum grain yield (22.16 qha^{-1}) in 2021-22 and (22.56 qha-1) in 2022-23, straw yield (36.12qha^{-1}) in 2021-22 and (36.24 qha^{-1}) in 2022-23 and biological yield (58.28q ha^{-1}) in 2021-22 and (58.80 qha^{-1}) in 2022-23 was recorded in the treatment T_1 [control]. during the first year (2021-22) of experimentation. The increase in seed and stover yields under adequate nutrient supply can largely be attributed to the

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combined effects of a higher number of spikelets per ear, grains per ear, and 100-grain weight (in grams). This improvement is a result of enhanced translocation of photosynthates from the source to the sink, leading to an overall increase in yield. The rise in productivity with sufficient nutrient supply is primarily due to the enhancement of yield attributes, which ultimately results in a greater grain yield. Additionally, the application of farmyard manure (FYM) significantly increased the grain, straw, and biological yields of wheat compared to the controls.The application of Azolla significantly increased both grain and straw yields of rice compared to conditions without Azolla. Furthermore, inoculating Azolla led to a further significant increase in both grain and straw yields. This enhancement is likely due to the bio-inoculant's ability to fix atmospheric nitrogen, thereby improving the supply of other nutrients to the plants and ultimately boosting both grain and straw yields of rice. These results also confirm the findings of (**Said H. Marzouk *et al.* 2024)**, and (**Razavipour, T. *et al.* 2018)**. The integrated nutrient application did not significantly affect the harvest index. The harvest index ranged from 37.42% to 41.49% in 2021-22 and from 36.76% to 41.44% in 2022-23, on a pooled basis. The highest harvest index of 41.44% was observed with the treatment T_{17}—100% NPK + 5 tons ha^{-1} FYM + Azolla (300 kg ha^{-1}) + S (30 kg ha^{-1}) + Zinc (5 kg ha^{-1}) during the second year (2022-23) of the experiment. Conversely, the lowest harvest index of 36.76% was also recorded with the same treatment, T_{17}, during the second year of experimentation.

Plant growth traits:

The data in Table 3demonstrate that, among the yield attribute parameters, panicle length (cm), the number of grains per panicle, grain weight (g) per panicle, and test weight (g) significantly increased as a result of the application of NPK, zinc, sulfur, FYM, and Azolla. A significant increase in these parameters was observed due to the application of nitrogen, zinc, sulfur, FYM, and Azolla. Additionally, growth parameters showed a consistent increase over time. Panicle length varied from (19.66 to 28.00cm) in 2021-22 and (20.33 to 28.93cm) in 2022-23, and Panicle weight (g) varied from (2.13 to 5.16g) in 2021-22 and (2.16 to 5.86g) in 2022-23, Number of grains/panicle^{-1} varied from (56 to 124) in 2021-22 and (59 to 127) in 2022-23, Grains weight/ panicle varied from (1.10 to 3.15) in 2021-22 and (1.15 to 4.11)in 2022-23 and Test weight (g) varies from (20.15 to 24.63) in 2021-22 and (20.24 to 24.97) in 2022-23 on a pooled basis. Maximum Panicle length (28.93cm), the maximum Panicle weight (g) (5.86g) and the maximum number of grains/panicle^{-1} (127) and maximum Grains weight/ panicle (4.11) additionally maximum Test weight (g) (24.97g) was associated with the treatment T_{17} -100% NPK+ 5 ton ha^{-1} FYM + Azolla (300 kg ha^{-1}) + S (30 kg ha^{-1}) + Zinc (5 kg ha^{-1}) during the second year (2022-23) of experimentation. The minimum Panicle length (19.66 cm), the Minimum Panicle weight (g) (2.13 g), the Minimum number of grains/panicle^{-1} (56) and the Minimum Grains weight/ panicle (1.10) additionally Minimum Test weight (g) (20.15 g)was associated with the treatment T_1 [control] during the first year (2021-22) of experimentation.An increase in nitrogen dose within a certain range resulted in improvements in LAI, plant height, the number of tillers, net photosynthetic rate, transpiration rate, and grain yield. Furthermore, nitrogen treatment significantly enhanced the grain length and width of head

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rice, while ear length was not significantly affected.Zinc application significantly increased the number of tillers, panicles, plant height, 1000-grain weight, percentage of filled grains, and grain yield in rice. Among the various zinc application methods, soil application of ZnSO□.H□O resulted in the highest increase in total nitrogen percentage, total potassium percentage, and available zinc content in both grain and straw. However, the total phosphorus percentage decreased significantly. Zinc content in the soil after harvesting was also significantly influenced by zinc application. Organic materials, such as FYM, and their continuous use have a strong impact on soil productivity and nitrogen dynamics within the soil–plant system. The application of Azolla compost, based on soil weight, resulted in the highest grain yield. This increase in grain yield may be attributed to the efficient absorption of nitrogen and other nutrients facilitated by Azolla, which enhanced the production and translocation of assimilates from source to sink. Overall, Azolla compost can be considered a beneficial management practice in rice production, especially under water-deficit conditions. The consequences of the current investigation are additionally in concurrence with the investigation of (**Zhang, J.*et al.* 2020**), (**Razavipour, T. *et al.* 2018)** and (**Ghoneim, A. M. 2016).**

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Conclusion:

Globally use of organic fertilizer plays a crucial role in enhancing soil health, improving nutrient availability, and supporting sustainable agriculture worldwide.The current study revealed the advantages of nitrogen, Zinc, Sulphur, FYM, and Azolla with recommended doses of nitrogen phosphorous and potassium for achieving higher growth parameters and productivity by rice crop. use of nitrogen, Zinc, Sulphur, FYM, and Azolla yield attributes and yield of rice crop. In conclusion, it can be concluded that the treatment T_{17}(100% NPK+ 5 ton ha^{-1} FYM + Azolla (300 kg ha^{-1}) + S (30 kg ha^{-1}) + Zinc (5 kg ha^{-1}) is the best option for increasing the productivity of rice crop.

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Ph (1:2.5)	7.9
EC (dSm^{-1})	0.3
Organic carbon (g kg^{-1})	4.5
Available N (kg ha^{-1})	210
Available P (kg ha^{-1})	12.8
Available K (kg ha^{-1})	198
Available DTPA Zn (kg ha^{-1})	0.55

Table no-1 Physico-chemical characteristics of the experimental field

Symbol	Treatment combination
T_1	Control
T_2	100% NPK
T_3	50%NPK + 5 ton ha^{-1}FYM
T_4	75% NPK + 5 ton ha^{-1} FYM
T_5	100% NPK + 5 ton ha^{-1}FYM
T_6	50%NPK + 5 ton ha^{-1} FYM + Azolla (300 kg ha^{-1})
T_7	75% NPK + 5 ton ha^{-1} FYM + Azolla (300 kg ha^{-1})
T_8	100% NPK + 5 ton ha^{-1} FYM + Azolla (300 kg ha^{-1}) + Sulfur (30 kg ha^{-1})
T_9	50% NPK + 5 ton ha^{-1} FYM + Azolla (300 kg ha^{-1}) + Sulfur (30 kg ha^{-1})
T_{10}	75 % NPK + 5 ton ha^{-1}FYM + Azolla (300 kg ha^{-1}) + Sulfur (30 kg ha^{-1})
T_{11}	100 % NPK + 5 ton ha^{-1}FYM + Azolla (300 kg ha^{-1}) + Sulfur (30 kg ha^{-1})
T_{12}	50% NPK+ 5 ton ha-1 FYM + Azolla (300 kg ha-1) + Zinc (5 kg ha-1)
T_{13}	75% NPK+ 5 ton ha-1 FYM + Azolla (300 kg ha-1) + Zinc (5 kg ha-1)
T_{14}	100% NPK+ 5 ton ha-1 FYM + Azolla (300 kg ha-1) + Zinc (5 kg ha-1)
T_{15}	50% NPK+ 5 ton ha-1 FYM + Azolla (300 kg ha-1) + Sulfur (30 kg ha-1) + Zinc (5 kg ha-1)
T_{16}	75% NPK+ 5 ton ha-1 FYM + Azolla (300 kg ha-1) + Sulfur (30 kg ha-1) + Zinc (5 kg ha-1)
T_{17}	100% NPK+ 5 ton ha-1 FYM + Azolla (300 kg ha-1) + Sulfur (30 kg ha-1) + Zinc (5 kg ha-1)
T_{18}	5 ton ha-1 FYM + Azolla (300 kg ha-1) + Sulfur (30 kg ha-1) + Zinc (5 kg ha-1)

Table 2- Details of treatments

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Treatments		Yield Studies							
		2021-22				**2022-23**			
		Grain yield (q ha^{-1})	**Straw yield (q ha^{-1})**	**Biological yield (q ha^{-1})**	**Harvest Index (%)**	**Grain yield (q ha^{-1})**	**Straw yield (q ha^{-1})**	**Biological yield (q ha^{-1})**	**Harvest Index (%)**
T_1	Control	22.16	36.12	58.28	37.42	22.56	36.24	58.80	36.76
T_2	100% NPK	23.82	38.47	62.29	37.88	24.12	38.00	62.12	38.37
T_3	50% NPK + 5 ton ha^{-1} FYM	25.42	42.51	67.93	38.02	24.50	42.15	66.65	38.43
T_4	75% NPK + 5 ton ha^{-1} FYM	27.80	43.98	71.78	38.24	28.80	44.00	72.80	38.64
T_5	100% NPK + 5 ton ha^{-1} FYM	30.12	47.09	77.21	38.59	31.12	47.00	78.12	38.83
T_6	50%NPK + 5 ton ha^{-1} FYM + Azolla (300 kg ha^{-1})	32.44	50.17	82.61	38.73	32.42	50.00	82.42	39.04
T_7	75% NPK + 5 ton ha^{-1} FYM + Azolla (300 kg ha^{-1})	40.18	61.90	101.68	39.52	40.81	62.30	103.01	39.84
T_8	100% NPK + 5 t ha^{-1} FYM + Azolla (300 kg ha^{-1}) + S (30 kg ha^{-1})	44.52	64.22	108.74	40.94	44.47	64.68	109.15	40.74
T_9	50% NPK + 5 t ha^{-1} FYM + Azolla (300 kg ha^{-1}) + S (30 kg ha^{-1})	35.19	57.71	92.90	38.90	35.90	57.00	92.90	39.34
T_{10}	75 % NPK + 5 t ha^{-1} FYM + Azolla (300 kg ha^{-1}) + S(30 kg ha^{-1})	42.79	62.78	105.57	40.53	42.88	62.98	105.86	40.41
T_{11}	100 % NPK + 5 t ha^{-1} FYM + Azolla (300 kg ha^{-1}) + S (30 kg ha^{-1})	45.92	65.00	110.92	41.28	45.27	65.00	110.27	40.83
T_{12}	50% NPK+ 5 ton ha^{-1} FYM + Azolla (300 kg ha^{-1}) + Zinc (5 kg ha^{-1})	38.30	60.16	98.46	39.01	38.08	61.00	99.08	39.56
T_{13}	75% NPK+ 5 ton ha^{-1} FYM + Azolla (300 kg ha^{-1}) + Zinc (5 kg ha^{-1})	43.28	63.00	106.28	40.61	43.00	63.42	106.42	40.51
T_{14}	100% NPK+ 5 ton ha^{-1} FYM + Azolla (300 kg ha^{-1}) + Zn (5 kg ha^{-1})	43.25	65.78	112.03	41.40	46.00	66.65	112.65	41.05
T_{15}	50% NPK+ 5 t ha^{-1} FYM + Azolla (300 kg ha^{-1}) + Sulfur (30 kg ha^{-1}) + Zinc (5 kg ha^{-1})	38.90	61.50	100.80	39.27	39.90	62.20	102.20	39.62
T_{16}	75% NPK+ 5 t ha^{-1} FYM + Azolla (300 kg ha^{-1}) + Sulfur (30 kg ha^{-1}) + Zinc (5 kg ha^{-1})	43.68	63.89	107.57	40.72	43.68	64.00	107.68	40.56
T_{17}	100% NPK+ 5 ton ha^{-1} FYM + Azolla (300 kg ha^{-1}) + S (30 kg ha^{-1}) + Zinc (5 kg ha^{-1})	47.38	66.82	114.20	41.49	47.56	67.22	114.78	41.44
T_{18}	5 t ha^{-1} FYM + Azolla (300 kg ha^{-1}) + S (30 kg ha^{-1}) + Zn (5 kg ha^{-1})	22.38	36.82	59.20	37.80	22.88	37.28	60.16	38.03
CD		4.99	6.69	11.49	1.37	4.98	6.70	11.51	1.29
SEm (±)		1.73	2.38	3.98	0.47	1.72	2.32	3.98	0.44

Table no -3: Effect of organic manure, inorganic fertilizer and bio-inoculants on grain yield, straw yield, total biological yield and harvest index of rice during 2021-22 and 2022-23.

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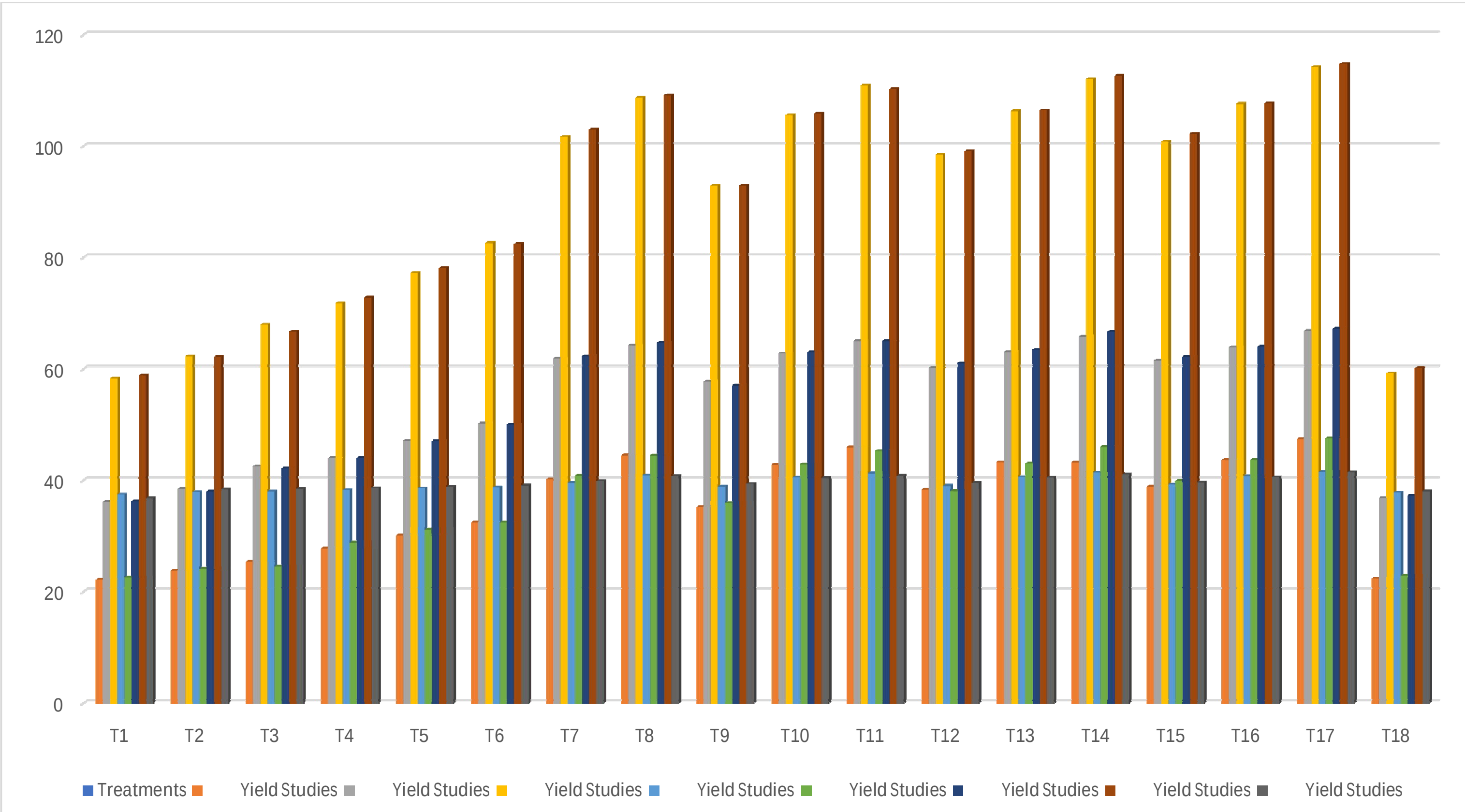

Figure no -1: Effect of organic manure, inorganic fertilizer and bio-inoculants on grain yield, straw yield, total biological yield and harvest index of rice during 2021-22 and 2022-23

Treatments		Yield attributes									
		2021-22					2022-23				
		Panicle length (cm)	**Panicle weight (g)**	**Number of grains panicle^{-1}**	**Grains weight / panicle**	**Test weight (g)**	**Panicle length (cm)**	**Panicle weight (g)**	**Number of grains panicle^{-1}**	**Grains weight / panicle**	**Test weight (g)**
T_1	Control	19.66	2.13	56	1.10	20.15	20.33	2.16	59	1.15	20.24
T_2	100% NPK	22.80	3.30	85	2.20	21.46	22.92	3.60	86	2.28	21.82
T_3	50% NPK + 5 ton ha^{-1} FYM	23.10	3.40	87	2.22	21.62	23.31	3.68	87	2.36	2198
T_4	75% NPK + 5 ton ha^{-1} FYM	23.50	3.50	89	2.22	21.91	23.62	3.70	90	2.41	22.32
T_5	100% NPK + 5 ton ha^{-1} FYM	24.00	3.61	92	2.31	22.12	24.52	3.81	92	2.52	22.46
T_6	50%NPK + 5 ton ha^{-1} FYM + Azolla (300 kg ha^{-1})	24.80	3.70	93	2.31	22.26	24.92	3.90	93	2.68	22.58
T_7	75% NPK + 5 ton ha^{-1} FYM + Azolla (300 kg ha^{-1})	25.50	4.11	103	2.58	23.18	25.50	4.40	105	2.91	23.38
T_8	100% NPK + 5 t ha^{-1} FYM + Azolla (300 kg ha^{-1}) + S (30 kg ha^{-1})	26.00	4.52	118	2.79	23.88	26.12	4.98	118	3.58	23.72
T_9	50% NPK + 5 t ha^{-1} FYM + Azolla (300 kg ha^{-1}) + S (30 kg ha^{-1})	24.80	3.80	95	2.32	22.52	25.00	4.12	96	2.75	22.92
T_{10}	75 % NPK + 5 t ha^{-1} FYM + Azolla (300 kg ha^{-1}) + S(30 kg ha^{-1})	25.50	4.15	109	2.59	23.20	25.72	4.68	108	2.98	23.49
T_{11}	100 % NPK + 5 t ha^{-1} FYM + Azolla (300 kg ha^{-1}) + S (30 kg ha^{-1})	26.50	4.72	120	2.83	23.97	26.50	5.20	119	3.74	23.94
T_{12}	50% NPK+ 5 ton ha^{-1} FYM + Azolla (300 kg ha^{-1}) + Zinc (5 kg ha^{-1})	25.00	3.90	100	2.41	22.74	25.21	4.12	100	2.82	23.12
T_{13}	75% NPK+ 5 ton ha^{-1} FYM + Azolla (300 kg ha^{-1}) + Zinc (5 kg ha^{-1})	25.60	4.20	111	2.74	23.45	25.96	4.72	112	3.12	23.51
T_{14}	100% NPK+ 5 ton ha^{-1} FYM + Azolla (300 kg ha^{-1}) + Zn (5 kg ha^{-1})	27.00	4.73	121	2.98	24.12	28.00	5.72	121	3.98	23.97
T_{15}	50% NPK+ 5 t ha^{-1} FYM + Azolla (300 kg ha^{-1}) + Sulfur (30 kg ha^{-1}) + Zinc (5 kg ha^{-1})	25.00	4.01	102	2.45	22.94	25.50	4.28	103	2.90	23.21
sT_{16}	75% NPK+ 5 t ha^{-1} FYM + Azolla (300 kg ha^{-1}) + Sulfur (30 kg ha^{-1}) + Zinc (5 kg ha^{-1})	25.80	4.23	115	2.76	23.74	26.00	4.92	116	3.31	23.62
T_{17}	100% NPK+ 5 ton ha^{-1} FYM + Azolla (300 kg ha^{-1}) + S (30 kg ha^{-1}) + Zinc (5 kg ha^{-1})	28.00	5.16	124	3.15	24.63	28.93	5.86	127	4.11	24.97
T_{18}	5 t ha^{-1} FYM + Azolla (300 kg ha^{-1}) + S (30 kg ha^{-1}) + Zn (5 kg ha^{-1})	22.00	3.28	83	1.95	21.00	22.00	3.58	84	1.96	21.20
CD		NS	0.68	17.36	0.34	3.26	NS	0.66	18	0.45	3.33
SEm (±)		1.44	0.23	5.84	0.11	1.10	1.43	0.22	5.9	0.15	1.12
CV		10.13	5.65	5.61	4.62	4.65	9.90	5.03	5.67	5.11	4.72

Table no 4: Effect of Organic manure, Inorganic fertilizer and Bio-inoculants on panicle length, panicle weight, number of grains panicle^{-1}, grains weight/panicle and test weight of rice during 2021-22 and 2022-23.