E-ISSN: 2618-0618
P-ISSN: 2618-060X

www.agronomyjournals.com
2024; 7(4): 652-655
Received: 22-01-2024
Accepted: 25-02-2024

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Influence of solid organic manures and liquid nutrient source on growth and yield of system of rice intensification (*Oryza sativa* L.)

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DOI: https://doi.org/10.33545/2618060X.2024.v7.i4i.618

Abstract
A field experiment was conducted during *kharif* Season 2023 at Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology & sciences, Prayagraj, Uttar Pradesh, India. To determine the "Influence of Solid organic manures and Liquid nutrient source on growth and yield of System of Rice Intensification". There were 9 treatments each replicated thrice, and the experiment was laid out in Randomized Block Design. The results showed that the treatment 2 (FYM-20 t/ha + Fish Amino Acids-3%) recorded significantly higher plant height(113.39 cm), maximum number of tillers/hill (23.13), higher dry weight (27.03 g), higher panicle length(25.10 cm),maximum number of grains/panicle (114.68), highest grain yield (4.72 t/ha) and higher straw yield (9.32 t/ha), Compared to other treatments. Maximum gross returns (2,38,616.00 INR/ha), Maximum net return (1,71,155.4 INR/ha) and highest benefit cost ratio (2.15) was recorded in treatment 2 (FYM-20 t/ha + Fish Amino Acid-3%) as compared to other treatments.

Keywords: Solid organic manures, liquid nutrient source, growth, yield attribute and yield and economics

Introduction
India has 47.83 million hectare area under rice and production 135.76 million tons and productivity of 4.26 t/ha (USDA 2023) [15]. Uttar Pradesh has an area of 5.70 million hectare, production 15.27 million tons and productivity of 2.67 t/ha (GOI 2022) [6]. Rice is indeed a staple food for over half of the world's population, particularly in Asia, the traditional method of growing rice involves transplanting seedlings into a puddled soil which is common practice in many Asian countries. Rice is a rich source of carbohydrates and provides essential nutrients making it a vital part of the diet for millions of India. It is also used to make beverages such as rice milk and rice wine (sake), Rice husk, a byproduct of rice milling can be used to make biodegradable packaging materials reducing environmental waste. Rice straw can be processed into fibers and used to make textiles and paper products.

FYM provides a more efficient source of plant nutrients. It has the potential to improve soil physical properties and increase crop yield (Debbarma *et al*., 2015) [2]. The use of FYM can also enhance soil physical properties and increased soil organic carbon, nitrogen, phosphorous and potassium levels as well as the chemical characteristics of soils. (Bhatt *et al*., 2023) [1].

In vermicompost the secretions from worms and associated microbes act as growth promoters since it is a nature friendly approach it does not have any adverse impact on the soil of the environment certain metabolites produced by the worms may also be responsible to stimulate plant growth and also helps in preventing plant diseases. (Kamaleshwaram and Elayaraja 2021) [8].

For the supply of nitrogen, poultry manure is a better source than another farmyard manure because it does not contain any available form and soils treated with poultry manure are less likely to be affected by leaching. (Sarker *et al*., 2015) [12]. Poultry manure plays a major role in the growth of the rice crop and increases the immunity of the crop and plant will be able to resist against pests and diseases (Veluri and Singh, 2022) [16].

Panchagavya is an organic manure which is a great source of nutrition it is natural material which is used broadly by agriculture crops, and it also plays a major role in the growth of the rice crop and increases the immunity of the crop and plant will be able to withstand against with pests and diseases (Veluri and Singh, 2022) [16].

FAA could provide array of essential nutrients, vitamins, growth-promoting compounds, and beneficial microorganisms **(**Debbarma and Abraham, 2016) [3].

Jeevamrutham, being rich in beneficial microflora, serves as an effective means to promte plant growth, it is commonly applied as a foliar spray, aiming to boost soil health, enhance biological activity and increase crop productivity (Hiremath and Usha, 2019) [7]. Keeping all the points in view the above fact, the experiment was conducted to find out the Influence of Solid organic manures and Liquid nutrient source on growth and yield System of Rice Intensification."

Materials and Methods

The experiment was carried out during *kharif* season 2023 at Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, SHUATS, Prayagraj (U.P) on the topic "Influence of Solid organic manures and Liquid nutrient source on growth and yield System of Rice Intensification (*Oryza sativa* L.)" The experiment is laid out in Randomized Block Design with three replications and nine treatments, having three soild organic manures (Farmyard manure, *Vermicompost* and Poultry manure) and three liquid nutrient source (*Panchagavya*, Fish Amino Acids and *Jeevamrutham*). *Panchagavya* was prepared by mixing five products of cow in 5:4:3:2:1 ratio *viz*, cow dung, cow urine, cow milk, curd and ghee. Fish amino acids was prepared in the ratio of 1:1, with fish waste and jaggery. *Jeevamrutham* was prepared by using cow dung, cow urine, jaggery and pulse flour. The Basmati rice variety *Pusa basmati*-1121 was sown. The data recorded on different aspects of crop such as, growth, yield attributes and yield as per standarad procedure. Economics was worked out on the prices of materials requried for research. The data were statistically analyzed for various characters as described by Gomez and Gomez (1976) [5].

Results and Discussion

Growth Parameters

Plant Height

Significant and Higher plant height (113.39 cm) was recorded in treatment 2 (FYM-20 t/ha + Fish Amino Acids-3%). However, treatment 1 (FYM-20 t/ha + Panchagavya-3%), treatment 4 (*Vermicompost*-3.33 t/ha+panchagavya-3%), treatment 5 *(Vermicompost*-3.33 t/ha + Fish Amino Acids-3%), treatment 7 (Poultry manure-3.3 t/ha + *Panchagavya*-3%) and treatment-8 (Poultry manure-3.3 t/ha+ Fish Amino Acids-3%) were found to be statistically at par with treatment 2 (FYM-20 t/ha + Fish Amino Acids-3%), significant and higher plant height was recorded with FYM-20 t/ha may be due to well composed manure can provide a slow release of nutrients for plants, which enhances cell division and various metabolic processes that leads to increased plant height. These findings are similar with Singh *et al*., (2018) [14]. Further, increase in plant height with application of Fish Amino Acids-3% may be due to Role of FAA are beneficial plants and microorganisms as they contain a variety of nutrients and amino acids, encouraging protein synthesis and fostering overall growth these findings are similar with Wilson and Debbarma (2022) [17] in Foxtail millet.

Number of Tillers /hill

Significant and Maximum number of tillers /hill (23.13) was recorded in treatment 2 (FYM-20 t/ha + Fish Amino Acids-3%). However, treatment-1 (FYM-20 t/ha + *Panchagavya*-3%) and treatment 5 (*Vermicompost*-3.33 t/ha + Fish Amino Acids-3%) were found to be statistically at par with treatment 2 (FYM-20 t/ha + Fish Amino Acids-3%), significant and Maximum number of tillers/hill was recorded with FYM-20 t/ha may be due to Farmyard manure likely boosted crop plants to capture sunlight and getting nutrients, leading to a higher photosynthesis rate. These findings are similar with Puli *et al.*, (2016) [11].

Further, Maximum number of Tillers/hill was recorded with application of FAA-3% may be due to application of Fish Amino Acids is likely to stimulate increased tillering in plants due to its rich nutrient and amino acids, supporting robust growth and development but also promotes cell division, These findings are similar with Wilson and Debbarma (2022) [17] in Foxtail millet.

Plant Dry weight (g)

Significant and higher plant dry weight (27.03 g) was recorded in treatment 2 (FYM-20 t/ha + Fish Amino Acids-3%). However, treatment 4 (*Vermicompost*-3.33 t/ha + *Panchagavya*-3%), treatment 5 (*Vermicompost*-3.33 t/ha + Fish Amino Acids-3%) and treatment 8 (Poultry Manure-3.3 t/ha + Fish Amino Acids-3%) were found to be statistically at par with treatment 2 (FYM-20 t/ha + Fish Amino Acids-3%).

Significant and maximum plant dry weight was recorded with FYM-20 t/ha may be due to stimulation effect of Farmyard manure might help in improved physical characteristics of the soil, soil productivity and supplying the extra nutrients needed for plants to uptake, thus encourages enhancing Vegetative growth resulted in increased plant dry weight. These findings are similar with Debbarma *et al.*, (2020**)** [4] in wheat**.** Further, higher Plant dry weight was recorded with application of FAA-3% may be due to it contains a rich quantity of amino acid which induces protein synthesis of plant resulted in increased plant dry weight. These findings are similar with Debbarma *et al.*, (2015) [2].

Yield Parameters

Panicle length (cm)

Significant and higher panicle length (25.10 cm) was recorded in treatment 2 (FYM-20 t/ha + Fish Amino Acids-3%) However treatment 1 (FYM-20 t/ha + Panchagavya-3%), treatment 4 (*Vermicompost*-3.33 t/ha+panchagavya-3%), treatment 5 *(Vermicompost*-3.33 t/ha + Fish Amino Acids-3%), treatment 7 (Poultry manure-3.3 t/ha + *Panchagavya*-3%) and treatment 8 (Poultry manure-3.3 t/ha+ Fish Amino Acids-3%) was found to be statistically at par with treatment 2 (FYM-20 t/ha + Fish Amino Acids-3%).

Significant and higher panicle length was recorded with FYM-20 t/ha may be due to it provides essential nutrients to plants, promoting healthier growth, improves soil structure, water retention and biological activity which contribute to longer panicle length. These findings are similar with Setia et al., (2023) [13]. Further, higher panicle length was recorded with application of FAA-3% may be due to application of fish amino acids as an organic nutrient probably enhanced the vital components within plant cells, leading to a quicker cell division and cell elongation resulted in increased panicle length. These findings are similar with Debbarma *et al*. (2015) [2].

Number of grains/panicle

significantly higher number of grains/panicle (114.68) was recorded in treatment-2 (FYM-20 t/ha + Fish Amino Acids-3%), However treatment 5 (*Vermicompost*-3.33 t/ha + Fish Amino Acids-3%) and treatment-8 (Poultry manure-3.3 t/ha+ Fish Amino Acids-3%) was found to be statistically at par with treatment 2 (FYM-20 t/ha + Fish Amino Acids-3%) significant and higher number of grains/panicle was recorded with FYM-20 t/ha may be due to continuous provision of nutrients in balanced quantities throughout the different growth stages facilitates the plants in assimilating ample amount of photosynthesis might leading to increased plant dry matter production and high nutrients resulted in production of more panicles with a greater number of filled grains. These findings are similar with Singh *et al*., (2018) [14]. Further higher number of grains/panicle was recorded with FAA-3% may be due to optimized nutrient balance in the soil, fostering improved plant growth and generating more resources for producing additional grains/panicle. These findings are similar with Wilson and Debbarma (2022) [17] in Foxtail millet.

Grain yield (t/ha)

Significantly Highest grain yield (4.72 t/ha) was recorded with treatment-2 (FYM-20 t/ha + Fish Amino Acids-3%) among all the treatments. Significant and highest grain yield was recorded with FYM-20 t/ha might be due to FYM acts as a natural nutrient booster for rice plants by improving the growth of plants by enriching the soil with essential nutrients and enhancing its overall quality resulted higher grain yield. These findings are similar with Singh *et al*., (2018) [14]. Further highest grain yield was recorded with FAA-3% may be due to rapid absorption and utilization of nitrogen, phosphorous, potassium and other micronutrients enhanced metabolic process and boosted cellular activity and division which ultimately increased grain yield. These findings are similar with Priyanka *et al*., (2019) [10] in green gram.

Straw yield (t/ha)

Significant Higher Straw yield (9.32 t/ha) was recorded in treatment-2 (FYM-20 t/ha + Fish Amino Acids-3%), However, treatment-1 (FYM-20 t/ha + Panchagavya-3%), treatment 5 (Vermicompost-3.33 t/ha + Fish Amino Acids-3%), treatment 7 (Poultry Manure-3.3 t/ha + *Panchagavya*-3%) and treatment 8 (Poultry manure-3.3 t/ha+ Fish Amino Acids-3%) were found to be statistically at par with treatment 2 (FYM-20 t/ha + Fish Amino Acids-3%) Significant and higher straw yield was recorded with the application of FYM-20 t/ha may be due to Organic manure decompose in a way that release nutrients where plants can utilize them directly, and provide essential nutrients to plants when they breakdown, there by promoting healthier and more vigorous crop growth results in increased straw yield. These findings are similar with Medha and Debbarma (2023) [9]. Further Higher straw yield was recorded with application of FAA-3% may be due to spraying of fish amino acid on the leaves had a beneficial and combined, boosting the yield of straw resulted in higher straw yield. These findings are similar with Debbarma *et al*., (2015) [2].

Economics

The maximum gross return (2,38,616.00 INR/ha), net return (1,62,791.40 INR/ha) and benefit cost ratio (2.15) was also recorded in treatment 2 (FYM-20 t/ha + Fish Amino Acids-3%). Higher benefit cost ratio was recorded with the application of FYM-(20 t/ha**)** might be due to slow release, excellent and balanced nutrient supply by throughout the growing life cycle of the plant, relatively increases the grain and straw yield of the crop, which increases the gross return as well as net return ultimately increase the benefit cost ratio. Similar result was reported by Medha and Debbarma (2023) [9]. Further Maximum benefit cost ratio was observed with the application of Fish Amino Acids-(3%) may be due to FAA composed of amino acids which induces protein synthesis, and also acts a source of nitrogen and micronutrients thus enhances nutrient uptake, promote root development, and better nutrient cycling which enhanced plant growth, improved yield attributes ultimately increases gross return as well as net return resulted in increased benefit cost ratio.

Table 1; Influence of Solid organic manures and Liquid nutrient source on growth and yield of System of Rice Intensification.

Treatment No	Treatments	Plant height (cm) At 100 DAT	Number of tillers/hill	Plant dry weight (g/plant) AT 100 DAT
1.	FYM-20 t/ha + *Panchagavya*-3%	108.60	21.27	21.93
2.	FYM-20 t/ha + Fish Amino Acids – 3%	113.39	23.13	27.03
3.	FYM-20 t/ha + *Jeevamrutham*-3%	99.20	18.63	21.00
4.	*Vermicompost*-3.33 t/ha + *Panchagavya*-3%	106.53	16.00	25.07
5.	*Vermicompost*-3.33 t/ha + Fish Amino Acids-3%	109.24	20.40	24.97
6.	*Vermicompost*-3.33 t/ha + *Jeevamrutham*-3%	102.31	16.20	20.30
7.	Poultry Manure-3.3 t/ha + *Panchagavya*-3%	109.07	19.07	22.90
8.	Poultry Manure-3.3 t/ha + Fish Amino Acids-3%	111.31	18.07	24.53
9.	Poultry Manure-3.3 t/ha + *Jeevamrutham*-3%	97.00	18.40	22.67
	F-test	S	eS	S
	SEm(±)	3.27	0.98	0.92
	CD (P=0.05)	9.82	2.94	2.75

Table 2: Influence of Solid organic manures and Liquid nutrient source on growth and yield of System of Rice Intensification.

S. No.	Treatments	Panicle length (cm)	Number of grains/panicle	Grain yield (t/ha)	Straw yield (t/ha)
1.	FYM-20 t/ha + *Panchagavya*-3%	24.09	97.40	4.14	8.72
2.	FYM-20 t/ha + Fish Amino Acids – 3%	25.10	114.68	4.72	9.32
3.	FYM-20 t/ha + *Jeevamrutham*-3%	22.96	95.63	3.75	8.41
4.	*Vermicompost*-3.33 t/ha + *Panchagavya*-3%	23.33	97.50	3.76	8.53
5.	*Vermicompost*-3.33 t/ha + Fish Amino Acids-3%	24.50	110.76	4.00	9.01
6.	*Vermicompost*-3.33 t/ha + *Jeevamrutham*-3%	20.84	90.99	3.13	7.83
7.	Poultry Manure-3.3 t/ha + *Panchagavya*-3%	24.20	102.73	3.89	9.00
8.	Poultry Manure-3.3 t/ha + Fish Amino Acids-3%	24.82	113.35	3.80	9.07
9.	Poultry Manure-3.3 t/ha + *Jeevamrutham*-3%	21.80	95.69	3.63	7.95
	F-test	S	S	S	S
	SEm(±)	0.69	2.97	0.11	0.26
	CD (p=0.05)	2.07	8.91	0.34	0.77

Table 3: Influence of organic manures and liquid nutrient source on economics of rice.

S No	Treatments	Cost of Cultivation (INR/ha)	Gross Returns (INR/ha)	Net Returns (INR/ha)	B:C ratio
1	FYM-20 t/ha + *Panchagavya* – 3%	75818.30	210276.00	134457.70	1.77
2	FYM-20 t/ha + Fish Amino Acids – 3%	75824.60	238616.00	162791.40	2.15
3	FYM-20 t/ha + *Jeevamrutham*-3%	75815.30	191388.00	115572.70	1.52
4	*Vermicompost*-3.33 t/ha + *Panchagavya*-3%	80368.30	192074.00	111705.70	1.39
5	Vermicompost-3.33 t/ha + Fish Amino Acids-3%	80374.60	204218.00	123843.40	1.54
6	*Vermicompost*-3.33 t/ha + *Jeevamrutham*-3%	80365.30	161204.00	80838.70	1.01
7	Poultry Manure-3.3 t/ha + *Panchagavya*-3%	68818.30	199030.00	130211.70	1.89
8	Poultry Manure-3.3 t/ha + Fish Amino Acids-3%	68824.60	194926.00	126101.40	1.83
9	Poultry Manure-3.3 t/ha + *Jeevamrutham*-3%	68815.30	184920.00	116104.70	1.69

Conclusion

It is concluded that in Rice with the Combination of FYM-20 t/ha along with Fish Amino Acids-3% (treatment-2) recorded highest grain yield and benefit cost ratio.

Acknowledgement

I am very thankful to all the faculty members of Department of Agronomy, SHUATS, Prayagraj (U.P) for support and Guidance throughout my research.

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