



International Journal of Research in Agronomy

E-ISSN: 2618-0618
P-ISSN: 2618-060X
© Agronomy
NAAS Rating (2026): 5.20
www.agronomyjournals.com
2026; 9(7): 244-249
Received: 17-04-2026
Accepted: 20-05-2026

Prateek Kumar
Ph.D. Scholar, Department of
Agronomy, Naini Agricultural
Institute, Sam Higginbottom
University of Agriculture,
Technology and Sciences
(SHUATS), Prayagraj, Uttar
Pradesh, India

Biswarup Mehera
Professor and Dean, Naini
Agricultural Institute, Sam
Higginbottom University of
Agriculture, Technology and
Sciences (SHUATS), Prayagraj,
Uttar Pradesh, India

Amit Kumar
Ph.D. Scholar, Department of
Agronomy, Naini Agricultural
Institute, Sam Higginbottom
University of Agriculture,
Technology and Sciences
(SHUATS), Prayagraj, Uttar
Pradesh, India

Shashank Singh
Ph.D. Scholar, Department of
Agronomy, Naini Agricultural
Institute, Sam Higginbottom
University of Agriculture,
Technology and Sciences
(SHUATS), Prayagraj, Uttar
Pradesh, India

Soumya
Assistant Professor, Department of
Soil Science and Agricultural
Chemistry, Sam Higginbottom
University of Agriculture,
Technology and Sciences
(SHUATS), Prayagraj, Uttar
Pradesh, India

Corresponding Author:
Prateek Kumar
Ph.D. Scholar, Department of
Agronomy, Naini Agricultural
Institute, Sam Higginbottom
University of Agriculture,
Technology and Sciences
(SHUATS), Prayagraj, Uttar
Pradesh, India

Interactive effect of establishment methods, solid and liquid organic manures on growth of Black rice (*Oryza sativa* L.)

Prateek Kumar, Biswarup Mehera, Amit Kumar, Shashank Singh and Soumya

DOI: <https://www.doi.org/10.33545/2618060X.2026.v9.i7d.5928>

Abstract

A field experiment was conducted in certified organic field SMOF, SHUATS during *Kharif* season (2022 and 2023) to study the impact of establishment methods, solid and liquid organic manures on growth of black rice. The experiment was carried out in split-split plot design replicated thrice with 18 treatments. Treatments comprised of three establishment methods (Conventional and SRI), three solid organic supplements (100% FYM, 100% poultry manure and 100% vermicompost) each in combination with three different liquid organic supplements (3% panchagavya, 3% jeevamrutham and 3% vermiwash, respectively). All three growth parameters viz. plant height, number of tillers and dry weight and two soil parameters *i.e.* pH and EC recorded no significant effect at 20 and 40 DAT. However, in all instances maximum plant height in both the years and pooled was recorded in SRI + Poultry manure + Panchagavya.

Keywords: black rice, organic manure, Vermicompost, poultry manure, panchagavya, growth

Introduction

Black rice (*Oryza sativa* L.) is a distinctive rice genotype characterized by the presence of a dark black pigmented bran layer surrounding the endosperm. During cooking, the grain develops a characteristic deep purple colour due to its high anthocyanin content. In comparison with conventional white rice, black rice generally requires a longer cooking time and exhibits a relatively sticky texture. Its attractive appearance, unique aroma, and mildly sweet, nutty taste have contributed to its increasing popularity across several Asian countries, including China, Japan, Thailand, and South Korea. Historically, black rice was known as “Forbidden Rice” in ancient China because its cultivation and consumption were restricted to emperors and members of the royal household. According to Budhar and Mani (2008) [3], China accounts for approximately 62% of the world's black rice resources, followed by Sri Lanka (8.6%), Indonesia (7.2%), India (5.1%), the Philippines (4.3%), and Bangladesh (4.1%), while smaller proportions are found in Malaysia, Thailand, and Myanmar. Owing to its high antioxidant activity and remarkable free radical scavenging capacity, black rice is increasingly recognized as a valuable raw material for the development of functional and health-promoting food products (Sui *et al.*, 2016) [21]. The System of Rice Intensification (SRI) has emerged as an innovative rice cultivation approach that improves both grain yield and water-use efficiency. Studies have demonstrated that SRI enhances crop productivity while optimizing the utilization of available water resources (Mazumdar *et al.*, 2016) [14]. Improved crop establishment and management practices under SRI have also been found to suppress weed growth and minimize nutrient losses, particularly nitrogen depletion caused by weed competition, thereby contributing to superior yield attributes and higher productivity (Singh *et al.*, 2021) [19]. Furthermore, Kumar *et al.* (2021) [10] reported significant improvements in growth and yield parameters under SRI compared with conventional rice cultivation methods. The incorporation of alternate wetting and drying (AWD) irrigation within the SRI framework further enhances water-use efficiency and can reduce water consumption by nearly 30-40% relative to traditional flooded rice cultivation systems.

The declining use of organic manures has been associated with adverse effects on soil carbon-to-

Nitrogen ratios, microbial activity, aggregate stability, and nutrient cycling processes (Gandla *et al.*, 2023) [6]. Organic farming systems have been reported to support greater below-ground biodiversity and microbial biomass, thereby improving soil food-web dynamics and overall soil quality when compared with conventional agricultural practices, which often result in soil degradation (Ghadimi *et al.*, 2021) [7]. Consequently, organic manures and biofertilizers have become integral components of sustainable agriculture due to their positive influence on the physical, chemical, and biological characteristics of soil. Their application contributes significantly to maintaining soil fertility, improving nutrient availability, and sustaining agricultural productivity over the long term (Ramesh *et al.*, 2008) [17]. Liquid organic manures are increasingly recognized as effective bio-inputs that enhance crop performance by providing readily available nutrients, beneficial microorganisms, enzymes, and naturally occurring plant growth-promoting compounds. In the present study, Vermiwash, Jeevamrutha, and Panchagavya were applied at 20-day intervals after sowing. These liquid formulations improve nutrient absorption, stimulate beneficial microbial activity in the rhizosphere, and promote vigorous plant growth and development. In addition, regular application of liquid organic manures enhances soil fertility, improves plant resilience against biotic and abiotic stresses, and contributes to higher crop productivity under organic production systems (Golakiya *et al.*, 2019) [8].

Material and Methods

A field experiment was carried out during the kharif seasons of 2022 and 2023 at the Crop Research Farm, Department of Agronomy, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh, India. The experimental site is located at 25.57° N latitude and 87.19° E longitude, with an elevation of 98 m above mean sea level. Black rice was cultivated under two transplanting methods: conventional transplanting with a spacing of 20 cm × 10 cm and the System of Rice Intensification (SRI) method with a spacing of 25 cm × 25 cm.

Under the conventional method, two seedlings per hill were transplanted at a spacing of 20 cm × 10 cm. In contrast, the SRI method involved transplanting single seedlings of 12 days age at a wider spacing of 25 cm × 25 cm. For nursery raising, well-prepared and levelled fields were used to construct raised nursery beds measuring 10 m × 1 m × 0.15 m (length × width × height), with a 30 cm gap maintained between adjacent beds. Pre-germinated seeds were uniformly sown on puddled and finely levelled nursery beds. A thick layer of organic manure was incorporated during nursery bed preparation, and the seeds were subsequently covered with a thin layer of soil.

Irrigation was applied as and when required to maintain optimum soil moisture. Excess water resulting from irrigation or heavy rainfall was drained promptly. Irrigation was discontinued ten days before harvest when the crop attained physiological maturity. Weed management was carried out manually through two hand weeding at 25 and 45 days after transplanting (DAT). Growth observations, including plant height, total number of tillers per hill and dry weight were recorded at 20-day intervals throughout the crop growth period. Organic nutrient requirements were met through the application of farmyard manure (FYM), poultry manure, and vermicompost. Liquid organic formulations such as vermiwash, Jeevamrutha, and Panchagavya were applied at 20-day intervals after sowing. All recommended agronomic and crop management practices were followed throughout the experiment. No significant incidence of pests or diseases was

observed during the crop growth period.

The experimental data collected were subjected to statistical analysis using Fisher's Analysis of Variance (ANOVA) technique, following the procedure described by Gomez and Gomez (1984). Whenever the F-test indicated significance at the 5% probability level, the Critical Difference (CD) was calculated to compare treatment means.

Result and Discussion

Plant height

There was no significant effect of establishment methods combined with application of solid and liquid organic manures at 20 DAT. However maximum plant height was recorded in 30.94, 35.96 and 33.45 cm were recorded in SRI + Poultry manure + Panchgavya.

At 40 DAT significantly higher plant height was recorded in SRI + Poultry manure + Panchgavya having 69.31 and 71.20 cm in first year and pooled. In first year SRI + Vermicompost + Panchgavya, SRI + Poultry manure + Vermiwash and SRI + Vermicompost + Vermiwash were statistically at par with SRI + Poultry manure + Panchgavya. In pooled SRI + Vermicompost + Panchgavya and SRI + Vermicompost + Vermiwash were statistically at par with SRI + Poultry manure + Panchgavya.

SRI's aerobic soil conditions and wide spacing promoted robust root systems and tillering (Dambale *et al.*, 2025 and Biswas *et al.*, 2013) [2, 4], while PM supplied readily mineralizable nitrogen and micronutrients to fuel meristematic expansion, and liquid biostimulants accelerated phytohormone signaling (auxins, gibberellins) for internodal elongation (Khatun *et al.*, 2025) [9]. This combined effect optimizes nutrient uptake efficiency via improved soil microbial consortia and reduced transplant shock Mohanty *et al.* (2014) [15], leading to protracted vegetative growth phases with minimal antagonism between treatments.

Number of tillers

At 20 DAT there was no significant effect of interaction. However, at 40 DAT in 2022 SRI + Poultry manure + Panchgavya was found to be significantly higher having 18.93 tillers/hill. Although, SRI + FYM + Panchgavya, SRI + VC + Panchgavya, SRI + PM + Vermiwash and SRI + VC + Vermiwash recorded statistical parity with SRI + Poultry manure + Panchgavya. Similarly in second year of 60 DAT significantly higher tillers /plant was recorded in SRI + Poultry manure + Panchgavya (22.87 tillers/hill). Further, SRI + VC + Panchgavya, SRI + PM + Vermiwash and SRI + VC + Vermiwash recorded statistical parity with SRI + Poultry manure + Panchgavya.

This integration yielded superior outcomes, with studies confirming higher tiller count from FYM/PM + Panchgavya under SRI versus controls, due to improved soil aeration, humic acid chelation, and microbial N-fixation. Poultry manure's soluble phosphorus and Panchgavya's enzyme activity further optimized source-sink dynamics, as evidenced in SRI-rice trials showing elevated biomass and quality metrics as observed by Aktar *et al.*, 2020 and Rameshwar *et al.*, 2017 [1, 18].

Dry weight

There was no significant effect of combined application of establishment methods, solid and liquid organic manures at 40 DAT. Maximum dry weight was recorded in SRI + Vermicompost + Panchgavya (1.57 g) in first year, in second year SRI + FYM + Jeevamrutha recorded 1.52 g/plant and in pooled SRI + PM + Vermiwash (1.52 g/plant).

Further, at 40 DAT in both the years and pooled SRI + PM + Panchgavya recorded maximum dry weight having 6.27, 6.61 and

6.44 g/plant. The integration of SRI, poultry manure (PM), and Panchgavya profoundly augmented black rice dry matter production via SRI's facilitation of expansive root systems and tillering under aerobic regimes (Rameshwar *et al.*, 2017)^[18], PM's supply of labile organic N (3-5%) and phosphorus for accelerated photosynthetic tissue formation, and Panchgavya's infusion of growth regulators and microbial biofertilizers that elevate chlorophyll fluorescence and starch synthase activity as corroborated by Parmeshwari *et al.*, 2025 and Dekhane *et al.*, 2019^[5, 16].

pH

There was no significant effect of interaction of establishment method, solid and liquid organic manure on pH of soil. However, the plots transplanted with SRI method and treated with poultry manure and Panchgavya in a combination recorded lower pH having 7.82, 7.92 and 7.89.

The slight reduction in soil pH may be attributed to enhance rhizosphere activity, greater root growth, and increased microbial processes under alternate wetting and drying conditions (Sugathas *et al.*, 2025)^[20]. Since the pH remained within the optimum range for rice cultivation, the observed reduction is considered beneficial for nutrient availability and soil biological activity (Lal *et al.*, 2016)^[13]. These findings support the superior soil health and nutrient-use efficiency commonly associated with SRI over conventional transplanted rice. Poultry manure significantly increased soil pH in black rice cultivation due to its alkaline nature, ammonification processes releasing OH⁻ ions during

organic matter decomposition, thereby neutralizing H⁺ acidity in slightly acidic soils as corroborated by Ghadimi *et al.*, 2021, Kumar *et al.*, 2022^[7, 11]. Panchgavya significantly buffered soil pH in black rice cultivation toward optimal neutrality (pH 6.5-7.5) through its organic acid fermentation products (lactic, acetic).

EC

There was no significant effect of interaction on EC. However, in first year SRI + PM + Panchgavya was found to be having the lowest EC. Further, in second year and pooled SRI + VC + Vermiwash was found to be lowest EC having 0.43 and 0.46 dS/m.

The lower EC observed under SRI suggests reduced accumulation of soluble salts in the rhizosphere. Alternate wetting and drying cycles, coupled with greater nutrient uptake by the crop, may have reduced the concentration of dissolved ions remaining in the soil solution. Lower EC is generally associated with improved root-zone conditions and reduced osmotic stress on plants (Kumar *et al.*, 2023)^[12]. Poultry manure is a rich source of micronutrients such as zinc, copper, manganese, iron, and boron, as well as secondary nutrients including calcium, magnesium, and sulfur, making it a valuable organic amendment for soil fertility. This composition, corroborated by Aktar *et al.* (2020)^[1] and supported by Kumar *et al.*, 2023^[10]. This temporal variation aligns with observations where Panchgavya's inherent nutrient salts and microbial activity increase EC through ion mobilization, as reported in studies on its soil application effects (Tamilrasai *et al.*, 2019).

Table 1: Interaction effect of establishment methods, solid and liquid organic manures on plant height

20 DAS													
Treatment		2022				2023				Pooled			
		L1	L2	L3	Mean	L1	L2	L3	Mean	L1	L2	L3	MEAN
Conv	M1	24.59	20.14	23.26	22.66	23.03	20.51	22.19	21.91	23.81	20.33	22.72	22.29
	M2	25.93	20.94	24.08	23.65	24.74	20.69	23.97	23.13	25.34	20.82	24.02	23.39
	M3	27.20	22.46	25.77	25.14	26.20	22.14	26.29	24.87	26.70	22.30	26.03	25.01
SRI	M1	28.14	28.00	29.09	28.41	26.58	24.63	27.75	26.32	27.36	26.31	28.42	27.36
	M2	30.94	30.02	26.95	31.30	35.96	31.37	32.32	32.55	33.45	31.70	32.63	32.76
	M3	26.49	30.83	28.48	30.26	33.35	30.40	33.64	32.46	29.92	30.61	33.56	32.03
Mean		27.21	25.39	28.10	0.54	0.46	27.98	24.96	27.69	26.88	28.18	25.34	27.90
F-test		NS				NS				NS			
SEm±		0.84				0.84				0.59			
CD (P=0.05)		-				-				-			
40 DAS													
Treatment		2022				2023				Pooled			
		L1	L2	L3	Mean	L1	L2	L3	Mean	L1	L2	L3	MEAN
Conv	M1	50.90	45.01	49.05	48.32	47.90	47.46	41.96	45.77	49.40	46.24	45.51	47.05
	M2	55.97	50.56	57.00	54.51	57.06	54.27	49.47	53.60	56.52	52.42	53.24	54.06
	M3	58.84	57.77	61.98	59.53	55.52	53.49	60.22	56.41	57.18	55.63	61.10	57.97
SRI	M1	65.29	59.89	62.60	63.26	69.22	58.44	70.83	63.83	68.26	61.17	67.60	65.67
	M2	69.31	60.51	63.87	64.56	73.09	55.72	62.03	63.61	71.20	60.62	65.20	65.72
	M3	68.25	61.00	67.40	65.55	71.70	60.55	70.76	67.67	69.98	63.28	69.08	67.44
Mean		61.76	55.79	60.31	59.28	62.42	54.99	56.89	58.10	62.09	56.56	60.29	59.64
F-test		S				NS				S			
SEm±		1.39				1.39				0.96			
CD (P=0.05)		5.47				-				3.76			

*Conv-Conventional, SRI-System of Rice Intensification, M1-Farm yard manure, M2- Poultry manure, M3-Vermicompost, L1-Panchgavya, L2-Jeevamrut, L3-Vermiwash

Table 2: Interaction effect of establishment methods, solid and liquid organic manures on number of tillers

20 DAS													
Treatment		2022				2023				Pooled			
		L1	L2	L3	Mean	L1	L2	L3	Mean	L1	L2	L3	MEAN
Conv	M1	1.13	1.40	1.13	1.22	1.13	1.33	1.67	1.38	1.13	1.37	1.40	1.30
	M2	1.40	1.60	1.53	1.51	1.60	1.87	1.93	1.80	1.50	1.73	1.73	1.66
	M3	1.40	1.27	1.47	1.38	1.87	1.60	2.27	1.91	1.63	1.43	1.87	1.64
SRI	M1	1.40	1.73	2.00	1.71	2.13	2.07	2.00	2.07	1.77	1.90	2.00	1.89
	M2	1.67	1.73	1.80	1.73	1.67	1.67	2.07	1.80	1.67	1.70	1.93	1.77
	M3	1.77	1.87	1.67	1.77	1.73	1.80	1.87	1.80	1.75	1.83	1.77	1.78
Mean		0.50	0.53	0.59	0.54	0.46	0.47	0.45	0.46	0.48	0.50	0.52	0.50
F-test		NS				NS				NS			
SEm±		0.98				1.05				0.97			
CD (P=0.05)		-				-				-			
40 DAS													
Treatment		2022				2023				Pooled			
		L1	L2	L3	Mean	L1	L2	L3	Mean	L1	L2	L3	MEAN
Conv	M1	9.93	8.00	9.07	9.00	10.67	9.53	10.40	10.20	10.30	8.77	9.73	9.60
	M2	11.27	10.47	12.13	11.29	12.07	9.73	11.40	11.07	11.67	10.10	11.77	11.18
	M3	12.80	11.60	11.93	12.11	11.40	8.40	10.00	9.93	12.10	10.00	10.97	11.02
SRI	M1	16.60	11.93	14.00	14.18	12.27	10.73	14.53	12.51	14.43	11.33	14.27	13.34
	M2	18.93	14.73	16.40	16.69	17.13	13.40	15.20	15.24	18.03	14.07	15.80	15.97
	M3	15.47	13.00	15.20	14.56	15.00	12.47	14.33	13.93	15.23	12.73	14.77	14.24
Mean		14.17	11.62	13.12	12.97	13.09	10.71	12.64	12.15	13.63	11.17	12.88	12.56
F-test		S				NS				NS			
SEm±		1.55				1.54				1.07			
CD (P=0.05)		3.86				-				-			

*Conv-Conventional, SRI-System of Rice Intensification, M1-Farm yard manure, M2- Poultry manure, M3-Vermicompost, L1-Panchgavya, L2-Jeevamrut, L3-Vermiwash

Table 3: Interaction effect of establishment methods, solid and liquid organic manures on dry weight

20 DAS													
Treatment		2022				2023				POOLED			
		L1	L2	L3	Mean	L1	L2	L3	Mean	L1	L2	L3	MEAN
Conv	M1	1.29	1.54	1.53	1.46	1.35	1.44	1.34	1.37	1.32	1.49	1.44	1.42
	M2	1.33	1.52	1.49	1.45	1.29	1.36	1.53	1.40	1.31	1.44	1.51	1.42
	M3	1.54	1.43	1.40	1.46	1.41	1.40	1.39	1.40	1.47	1.42	1.40	1.43
SRI	M1	1.47	1.44	1.56	1.49	1.48	1.52	1.31	1.44	1.48	1.48	1.43	1.46
	M2	1.38	1.39	1.53	1.43	1.33	1.47	1.50	1.43	1.36	1.43	1.52	1.43
	M3	1.57	1.53	1.43	1.51	1.40	1.31	1.36	1.36	1.49	1.42	1.40	1.44
Mean		1.43	1.48	1.49	1.47	1.38	1.42	1.40	1.40	1.40	1.45	1.45	1.43
F-test		NS				NS				NS			
SEm±		0.09				0.06				0.06			
CD (P=0.05)		-				-				-			
40 DAS													
Treatment		2022				2023				Pooled			
		L1	L2	L3	Mean	L1	L2	L3	Mean	L1	L2	L3	MEAN
Conv	M1	5.56	5.14	5.32	5.34	5.70	5.42	5.46	5.53	5.63	5.28	5.39	5.43
	M2	6.01	5.12	5.60	5.58	6.15	5.27	5.74	5.72	6.08	5.20	5.67	5.65
	M3	5.58	5.15	5.34	5.36	5.72	5.30	5.48	5.50	5.65	5.23	5.41	5.43
SRI	M1	5.72	5.21	5.50	5.47	5.92	5.68	5.64	5.75	5.82	5.45	5.57	5.61
	M2	6.27	5.86	6.26	6.13	6.61	6.01	6.40	6.34	6.44	5.94	6.33	6.24
	M3	6.29	6.04	6.15	6.16	6.44	6.18	6.30	6.31	6.37	6.11	6.23	6.23
Mean		5.90	5.42	5.69	5.67	6.09	5.64	5.84	5.86	6.00	5.53	5.77	5.77
F-test		NS				NS				NS			
SEm±		0.14				0.13				0.13			
CD (P=0.05)		-				-				-			

*Conv-Conventional, SRI-System of Rice Intensification, M1-Farm yard manure, M2- Poultry manure, M3-Vermicompost, L1-Panchgavya, L2-Jeevamrut, L3-Vermiwash

Table 4: Interaction effect of establishment methods, solid and liquid organic manures on pH and EC

pH													
Treatment		2022				2023				Pooled			
		L1	L2	L3	Mean	L1	L2	L3	Mean	L1	L2	L3	MEAN
Conv	M1	7.49	7.19	7.37	7.35	7.57	7.01	7.10	7.23	7.53	7.10	7.23	7.29
	M2	7.87	7.55	7.62	7.68	7.92	7.57	7.68	7.72	7.89	7.56	7.65	7.70
	M3	7.45	7.25	7.33	7.34	7.78	7.54	7.60	7.64	7.61	7.40	7.46	7.49
SRI	M1	7.35	7.17	7.30	7.27	7.17	7.12	7.10	7.13	7.31	7.11	7.20	7.21
	M2	7.11	7.27	7.16	7.18	7.18	7.35	7.20	7.24	7.09	7.11	7.24	7.15
	M3	7.12	7.19	7.29	7.20	7.02	7.14	7.10	7.09	7.21	7.17	7.10	7.16
Mean		7.40	7.27	7.35	7.34	7.44	7.29	7.30	7.34	7.44	7.24	7.31	7.33
F-test		NS				NS				NS			
SEm±		0.15				0.14				0.12			
CD (P=0.05)		-				-				-			
EC													
Treatment		2022				2023				Pooled			
		L1	L2	L3	Mean	L1	L2	L3	Mean	L1	L2	L3	MEAN
Conv	M1	0.66	0.57	0.63	0.62	0.64	0.59	0.62	0.62	0.65	0.58	0.63	0.62
	M2	0.86	0.69	0.74	0.76	0.81	0.62	0.72	0.72	0.84	0.66	0.73	0.74
	M3	0.79	0.62	0.64	0.68	0.76	0.64	0.73	0.71	0.77	0.63	0.69	0.70
SRI	M1	0.58	0.48	0.53	0.52	0.58	0.48	0.50	0.52	0.57	0.48	0.52	0.52
	M2	0.46	0.53	0.52	0.55	0.59	0.51	0.47	0.49	0.55	0.52	0.54	0.56
	M3	0.65	0.49	0.50	0.57	0.52	0.55	0.43	0.58	0.63	0.49	0.46	0.58
Mean		0.68	0.55	0.62	0.62	0.67	0.57	0.62	0.62	0.68	0.56	0.62	0.62
F-test		NS				NS				NS			
SEm±		0.05				0.05				0.03			
CD (P=0.05)		-				-				-			

*Conv-Conventional, SRI-System of Rice Intensification, M1-Farm yard manure, M2- Poultry manure, M3-Vermicompost, L1-Panchgavya, L2-Jeevamrut, L3-Vermiwash

Conclusion

Transplanting black rice seedlings along with application of solid organic manure of Poultry manure and Panchgavya recorded significantly higher growth attributes in black rice.

References

- Aktar S, Salam MA, Uddin MR, Rahman MS, Talukder FU, Imran S. Influence of weeding regime and integrated nutrient management on the yield performance of transplant Aman rice (cv. BRRI Dhan49). *Rev Food Agric*. 2020;1(2):42-9.
- Biswas PK, Tohiduzzaman, Roy TS. Screening of rice varieties responsive to system of rice intensification (SRI) in boro season. *Bangladesh Agron J*. 2013;16(1):51-60.
- Budhar MN, Mani AK. A case study of SRI technology adoption in North Western Agro Climatic Zone of Tamil Nadu. In: *Extended Summaries of National Symposium on System of Rice Intensification (SRI) in India: Policies, Institutions and Strategies for Scaling Up*; Coimbatore; 2008. p. 51-3.
- Dambale AS, Goswami J, Patil SS, Bisarya D, Shinde RS, Kurmi K, et al. Agronomic performance of black rice under an organic ecosystem of North East India. *Indian J Agric Res*. 2025;59(11):1717-22.
- Dekhane S, Jadhav KP, Patel DJ. Response of nutrient management practices through organic substances on rice var. GR-11 in North Konkan coastal zone of Maharashtra. *Int J Horticult Agric Food Sci*. 2019;3(4):191-3.
- Gandla SK, Mehera B, Kumar P. Effect of organic manures on growth and yield of rice varieties (*Oryza sativa* L.) and yield validation using SPSS model. *Int J Environ Clim Change*. 2023;13(8):206-13.
- Ghadimi M, Sirousmehr A, Ansari MH, Ghanbari A. Organic soil amendments using vermicomposts under inoculation of N₂-fixing bacteria for sustainable rice production. *PeerJ*. 2021. doi:10.7717/peerj.10833.
- Golakiya PD, Kaswala AR, Dubey PK, Sisodiya RR, Neethu TM. Panchgavya: Cow-based bio-enhancers and botanicals for organic farming. *Int J Chem Stud*. 2019;7(3):2741-6.
- Khatun L, Nime J, Alam MM, Saha CK. Co-digestion of poultry droppings with maize cob for bioenergy and bio-fertilizer production. *Fuel*. 2025;386:134140.
- Kumar GS, Mehera B, Kumar P. Effect of organic manures on growth and yield of rice varieties (*Oryza sativa* L.) and yield validation using SPSS model. *Int J Environ Clim Change*. 2023;13(8):206-13.
- Kumar R, Raj M, Lal K, Ranjan A. Impact of SRI components on growth and productivity of conventional transplanted rice. *Biol Forum Int J*. 2021;13(3):196-9.
- Kumar RM, Chintalapati P, Rathod S, Singh V, Kuchi S, Mannava PBBBB, et al. Comparison of system of rice intensification applications and alternatives in India: Agronomic, economic, environmental, energy, and other effects. *Agronomy*. 2023;13:2492. doi:10.3390/agronomy13102492.
- Lal B, Nayak AK, Gautam P, Tripathi R, Shahid M, Panda BB, et al. System of Rice Intensification: A Critical Analysis. *Research Bulletin No. 9*. Cuttack: ICAR-National Rice Research Institute; 2016. p. 52.
- Mazumdar A, Aswin GA, Bhatt D. Utilization of black rice and red rice in value added products: A review. *Proteins*. 2022;8:0-3.
- Mohanty TR, Maity SK, Roul PK, Sahoo KC. Studies on yield, economics and energetics of rice (*Oryza sativa* L.) in relation to crop establishment methods and nutrient management practices. *Int J Bioresour Stress Manag*. 2014;5(4):495-501.
- Parmeshwari OP, Sharma R, Kumawat N, Sharma R, Singh G. Effect of vermiwash, Panchagavya and Jeevamrit on growth, yield and quality of cluster bean [*Cyamopsis tetragonoloba* (L.) Taub]. *Int J Res Agron*. 2025;8(7):1141-

- 4.
17. Ramesh P, Panwar NR, Singh AB, Ramana S. Effect of organic manures on productivity, soil fertility and economics of soybean-durum wheat cropping system under organic farming in Vertisols. *Indian J Agric Sci.* 2008;78(4):351-4.
18. Rameshwar JP, Saini K, Upadhyay RG. Effect of liquid manures on the growth and yield of rice through SRI system under organic conditions. *Int J Trop Agric.* 2017;35(4):981-8.
19. Singh AK, Yadav RS, Kumar D, Kumar S, Kumar G. Outcomes of yield attributes, yield and economics of rice (*Oryza sativa* L.) through various planting methods and weed management practices. *Int J Curr Microbiol Appl Sci.* 2021;7(9):103-12.
20. Sugathas S, Chandrasekara C, Neththasinghe A, Thennakoon N, Ariyaratna M, et al. Response of soil pH and electrical conductivity to climate, soil type, and water source, and their effect on rice grain yield in Sri Lankan lowlands. *Circ Agric Syst.* 2025;5:e017. doi:10.48130/cas-0025-0014.
21. Sui X, Zhang Y, Zhou W. Bread fortified with anthocyanin-rich extract from black rice as nutraceutical sources: Its quality attributes and in vitro digestibility. *Food Chem.* 2016;196:910-6.
22. Tamilarasi M, Esakkiammal B, Chairman K, Rajan D. Effect of Panchagavya on growth and yield parameters of chilli (*Capsicum annuum*). *J Emerg Technol Innov Res.* 2019;6(6):427-35.