Plant Archives Vol. 26, Supplement 2, 2026 pp.71-75 e-ISSN:2581-6063 (online), ISSN:0972-5210

Plant Archives

Journal homepage: http://www.plantarchives.org
DOI Url : https://doi.org/10.51470/PLANTARCHIVES.2026.v26.supplement-2.006

EFFECT OF DIFFERENT GROWING ENVIRONMENTS ON GROWTH AND YIELD OF RICE CROP UNDER VARIOUS ESTABLISHMENT METHODS

Brajendra[1], Sufiya Zoureen[2], R. Gobinath[2], Mangal Deep Tuti[2], Munna Lal[3], Varsha Rani[4] and Anand K. Vishwakarma[5]

[1]ICAR-Central Research Institute for Dryland, Hyderabad, Telangana, India
[2]ICAR-Indian Institute of Rice Research, Hyderabad, Telangana, India
[3]Soil Science RRS Madhopur, RPCAU PUSA Samastipur, Bihar 848125, India
[4]Birsa Agricultural University (BAU), Kanke, Ranchi, Jharkhand, India
[5]Project Coordinator (Sesame & Niger), ICAR- JNKVV Campus, Jabalpur, M.P. 482004, India
*Corresponding author E-mail: akvish16@rediffmail.com
(Date of Receiving : 21-05-2026; Date of Revision : 22-06-2026; Date of Acceptance : 31-07-2026)

ABSTRACT

A field experiment was initiated at the ICAR-Indian Institute of Rice Research farm in the Kharif season of 2024 on a deep black clayey vertisols (Typic pellustert) at the IIRR Rice Research farm, Hyderabad ($17^0 19''$ N latitude, $78^0 23''$ E longitude, 542 m altitude with mean annual precipitation of 750 mm). The increase in plant height of rice crop with different types of establishment methods Direct seeded Rice (DSR), Transplanted Rice (TP) and System of rice Intensification was to the extent of 4.1, 33.8 and 61.6% respectively over control, number of tiller/squares was to the extent of 18.3, 24.5 and 30.6% respectively over control., panicles square meter was to the extent of 22.5, 42 and 45% respectively over control. Among the rice establishment methods, significantly higher grain yield of rice crop (4.60 t ha^{-1}) was observed with Transplanted Rice (TP) method followed by System of rice Intensification method (4.39 t ha^{-1}) and Direct seeded Rice (DSR) method (4.14 t ha^{-1}) compared to control (2.95 t ha^{-1}). The increase in grain yield (t ha^{-1}) of rice crop with different transplanting methods Direct seeded Rice (DSR), System of rice Intensification and Transplanted Rice (TP) was to the extent of 27.4%, 35.1% and 41.5% respectively over control. Among them, significantly higher straw yield of rice crop (5.28 t ha^{-1}) was observed with values recorded in Transplanted Rice (TP) method followed by Direct Seeded Rice (DSR) method (5.50 t ha^{-1}) and System of rice Intensification method (5.28 q ha^{-1}) compared to control (3.93 t ha^{-1}). The increase in straw yield (t ha^{-1}) of rice crop in System of rice Intensification, Direct seeded Rice (DSR) and Transplanted Rice (TP) was to the extent of 7.1%, 11.6% and 17.2% respectively over control.
***Keywords* :** Rice, Establishment methods, Yield.

Introduction

Globally, rice is the most demanded staple crop. Millions in India rely heavily on rice for both nutritional and income sustainability. This triggers its widespread acreage among major cereals in a variety of agro-ecological zones and ecologies. These diverse rice-growing environments include water-logged to rainfed uplands, jhums to deep water, high 8 to arid temperatures, and flood-prone to drylands. Developing efficient soil management techniques requires an understanding of the dynamics of these carbon pools. By using techniques like mechanical weeding, young seedlings, and alternate wetting and drying, the System of Rice Intensification (SRI), for example, has shown great promise in increasing soil carbon stocks. These techniques enhance microbial activity, aeration, and root development, which also helps in enhancing carbon sequestration. Different rice production techniques can significantly influence soil carbon status, stocks and dynamics. According to Smith and collaborators in 2018, agricultural soils changes in SOC are determined by the cumulative contributions of organic carbon (OC) from the crop, and when there are high returns driven by nitrogenous fertilizers and the fallow frequency is low, it can Favor an increase in SOC. Nevertheless, this is a complex and dynamic process in 2013, Saljnikov and collaborators pointed out that 55 to 70% of the carbon in organic residues reaching the soil is lost due to gaseous emissions into the atmosphere, and 5 to 15% is incorporated to the microbial biomass of the soil. The balance between inputs and outputs of organic carbon in the soil constitutes an assessment methodology to identify its functioning as a sink or as a carbon emitter in the ecosystem, allowing the evaluation and comparison of the dynamics of organic carbon in soils under different use and management systems. Collectively, the literature across Asia and temperate rice regions demonstrates that continuous flooded rice paddies have superior SOC stocks compared to upland systems. However, maximizing carbon benefits and soil health relies on sustainable practices: conservation tillage, residue management, organic amendments, and terrain/landscape adaptations. These strategies effectively enhance SOC pools, stabilize carbon, and contribute to both climate mitigation and long-term soil fertility

Materials and Methods

Experimental site

A field experiment was initiated at the ICAR-Indian Institute of Rice Research farm in the Kharif season of 2024 on a deep black clayey vertisols (Typic pellustert) at the IIRR Rice Research farm, Hyderabad ($17^0 19''$ N latitude, $78^0 23''$ E longitude, 542 m altitude with mean annual precipitation of 750 mm). The plot selected for the purpose was A-3, A-5 and B-7. The plot detailed characteristics features are given in the table. Initial and post-harvest soil samples were collected prior to the beginning of the studies and depicted in the table. All the agronomic parameters under different rice establishment methods were recorded. The experimental site was medium land and altitude. In addition, the soils are predominantly vertisols with pH of 8.2 to 8.5. The experimental plot had assured irrigation facility coupled with uniform topography and good drainage facility. Hyderabad's climate is tropical characterized by dry, hot summers and mild winters.summer temparatures can be very high exceeding 40cThe warmest month is May, while the coolest is January. Long-term weather data indicated a mean maximum temperature of 30.57˚C, a mean minimum temperature of 21.22˚C, and an average rainfall of 595 mm. More than three-fourth of the total rainfall is received through south-west monsoon during July to September.

Sowing and transplanting

The rice crop was sown on first week of July 2024, using a seeding rate of 30 kg ha^{-1}. Seedlings were transplanted on July 30th with a spacing of cm between rows and 15 cm within rows.

Treatment Field Details of the experiment

Parameter	TP	DSR	SRI
DAS	18-06-2024	Sown 04-07-2024	04-07-2024
DAP	23-07-2024	27-07-2024	27-07-2024
DAH	13-11-2024	11-12-2024	12-11-2024
Plot Size	7 × 6 m = 42 m²	20 × 15 m	4.5 × 10.45 m
No. of Rows	26	-	-
No. of Hills	20	-	-
Variety 1	BPT-5204	- BPT-5204	BPT-5204
DESIGN OF THE EXPERIMENT	RBD	RBD	RBD

The recommended fertilizer dosage of 120:80:40 kg/ha (N: P_2O_5: K_2O) was applied. Fertilizers used in experiment Urea - Urea is an organic solid nitrogenous fertilizer. It contains about 46% N. DAP (Di Ammonium Phosphate)-It is a water soluble phosphatic fertilizer containing 18% N, 46% P_2O_5. MOP (Muriate of Potash) =It contains 60% K_2O which is highest among all potassic fertilizers. Fertilizers were applied according to recommended doses. Half of the N and the full doses of P and K were mixed into the soil during rice transplanting. The remaining half of the N was applied in two equal doses during the tillering and panicle initiation stages.Upon reaching physiological maturity, the rice crop was harvested. Each plot's harvested crop was bundled and tagged accordingly. The harvested crop was then transported to the threshing area, where it was sun-dried for at least 10-12 days before threshing. The materials obtained after threshing were weighed to determine the biological yield. After winnowing and cleaning, the economic yield was recorded for each plot. The straw yield was calculated by subtracting the grain yield from the biological yield. Samples of both grains and straw were collected from each genotype, properly labelled, and taken to the laboratory for post-harvest analysis.

Experimental design

The research was designed in a Randomized Block Design (RBD), arranged in three replications and treatments included the growing environment of rice which is transplanted, puddled rice. And three replications and four treatments (Control, TP, SRI and DSR) for the field A3 (a) & for B7(a) field.

Results and Discussion

Weather parameters and initial soil characterization during the course of investigation

A field experiment was initiated at the ICAR-Indian Institute of Rice Research farm in the Kharif season of 2024 on a deep black clayey vertisols (Typic pellustert) at the IIRR Rice Research farm, Hyderabad ($17^0 19''$ N latitude, $78^0 23''$ E longitude, 542 m altitude with mean annual precipitation of 750 mm). The plot selected for the purpose was A-3, A-5 and B-7. The plot detailed characteristics features are given in the table. Initial and post-harvest soil samples were collected prior to the beginning of the studies and depicted in the table. All the agronomic parameters under different rice establishment methods were recorded. Hyderabad's climate is tropical characterized by dry, hot summers and mild winters, summer temperatures can be very high exceeding 40c. The warmest month is May, while the coolest is January. Long-term weather data indicated a mean maximum temperature of 30.57˚C, a mean minimum temperature of 21.22˚C, and an average rainfall of 595 mm. More than three-fourth of the total rainfall is received through south-west monsoon during July to September**.**

The experimental site was medium land and altitude. In addition, the soils are predominantly vertisols with pH of 7.8 to 8.5. The soil s was categorized primarily in the sandy clay loam soil textural class. Most of the major nutrient's parameters analyzed prior to the laying of the experiment were low or medium in status.

Table 1: Weather Parameters During Kharif of 2024.

Month/ Week	Temp Min	Temp Max	Temp Avg	RH (I)	RH (II)	Rainfall (mm)	Sunshine (hr)
July	28.2	34.2	30.25	67	46	0.0	2.6
Aug	22	28.5	25.2	71	46	0.0	2.6
Sept	21	34	27.5	88	66	13.98	4.2
Oct	12.5	28	20.2	88	57	57.01	
Nov	21.0	26.5	23.7	83	58	0	3.5

Agronomic performance and yield attributes in different rice establishment methods Plant height

The data presented in table (2) reveal that the plant height of rice crop significantly affected by different types of rice establishment methods and varied from 73.0 to 118 (cm). Among the different types of rice establishment methods, significantly higher plant height of rice crop (118 cm) was observed with System of rice Intensification method followed by Transplanted Rice (TP) method (97.7 cm) and Direct seeded Rice (DSR) method (76.0 cm) compared to control (73 cm). The increase in plant height of rice crop with Direct seeded Rice (DSR), Transplanted Rice (TP) and System of rice Intensification was to the extent of 4.1, 33.8 and 61.6% respectively over control. These results are in conformity with earlier reported by Kale *et al*. (2021), Rathod *et al*. (2021) and Parmar *et al*. (2022).

No. of tillers/square meter

The data presented in table (2) revealed that the number of tiller/ square meter of rice crop significantly affected by different types of rice establishment methods and that varied from 229 to 299. Among them, significantly increased number of tiller/ square meter of rice crop (299) was observed with Transplanted Rice (TP) method followed by System of rice Intensification method (285) and Direct seeded Rice (DSR) method (271) compared to control (229). The increase in number of tiller/ square meter in Direct seeded Rice (DSR), System of rice Intensification and Transplanted Rice (TP) was to the extent of 18.3, 24.5 and 30.6% respectively over control. These results are in conformity with earlier reported by Bharamappanavara *et al*. (2020), Kale *et al*. (2021) and Gorlapalli *et al*. (2022).

Panicles per m^2

The data presented in table (2) revealed that the panicles square meter of rice crop significantly affected by different types of establishment methods varied from 157.8 to 228.0. Among them, significantly increased panicles square meter of rice crop (228.0) was observed with Direct seeded Rice (DSR) method followed by (224) System of rice Intensification method and Transplanted Rice (TP) method (193.3) compared to control (157.8). The increase in panicles square meter of rice crop in Transplanted Rice (TP), System of rice Intensification and Direct seeded Rice (DSR) was to the extent of 22.5, 42 and 45% respectively over control. These results are in conformity with earlier reported by Patel *et al*. (2025) and Kumar *et al*. (2025)

SPAD Value

The data presented in table 4.2 revealed that the SPAD Value of rice crop significantly affected by different types of establishment methods varied from 38.3 to 43.6. Among them, significantly higher SPAD Value of rice crop (43.6) was observed with Transplanted Rice (TP) followed by System of rice Intensification method (42.0) and Direct seeded Rice (DSR) method (40.2) compared to control (38.6). The increase in SPAD Value in Direct seeded Rice (DSR), System of rice Intensification and Transplanted Rice (TP) was to the extent of 4.9, 9.7 and 13.8% respectively over control. These results are in conformity with earlier reported by

NDVI Value

The data presented in table-2 revealed that the NDVI Value of rice crop significantly affected by different types of establishment methods varied from 0.36 to 0.54. Among them, significantly higher values recorded in NDVI Value of rice crop (0.54) was observed with Transplanted Rice (TP) followed by System of rice Intensification method (0.38) and Direct seeded Rice (DSR) method (0.38) compared to control (0.36). The increase in NDVI Value of rice crop with different transplanting methods Direct seeded Rice (DSR), System of rice Intensification and Transplanted Rice (TP) was to the extent of 33, 33 and 50% respectively over control. These results are in conformity with earlier reported by Patel *et al*. (2025) and Kumar *et al*. (2025)

Table 2: Effect of different growing environments on various agronomic parameters in different rice establishment methods

Treatments	Plant Height (cm)	No. of Tillers/ square meter	panicles per m^2	SPAD Value	NDVI Value
Control	73.0	229	157.8	38.3	0.36
Transplanted Rice (TP)	97.7	281	193.3	43.6	0.54
Direct seeded Rice (DSR)	76.0	271	221.9	40.2	0.48
System of rice Intensification (SRI)	118.0	285	224.0	42.0	0.48
Sem (±)	3.136	7.81	5.94	1.15	0.012
CD (0.05)	7.675	19.11	14.54	2.81	0.031
CV (%)	4.21%	3.53%	3.62%	3.43%	3.29%

Grain and Straw yield variations in different rice establishment methods

Grain Yield

The data presented in table (3) revealed that the grain yield (t ha^{-1}) of rice crop significantly affected by different types of establishment methods and that varied from 2.95 to 4.60 (t ha^{-1}). Among the rice establishment methods, significantly higher grain yield of rice crop (4.60 t ha^{-1}) was observed with Transplanted Rice (TP) method followed by System of rice Intensification method (4.39 t ha^{-1}) and Direct seeded Rice (DSR) method (4.14 t ha^{-1}) compared to control (2.95 t ha^{-1}). The increase in grain yield (t ha^{-1}) in Direct seeded Rice (DSR), System of rice Intensification and Transplanted Rice (TP) was to the extent of 27.4%, 35.1% and 41.5% respectively over control. These results are in conformity with earlier reported by Srilatha *et al*. (2019), Sahoo *et al*. (2022) Tuli *et al*. (2022), Zoureen *et al*. (2025) and Patel *et al*. (2025)

Straw Yield

The data presented in table (3) revealed that the straw yield (t ha^{-1}) of rice crop significantly affected by different types of establishment methods and that varied from 3.93 to 5.28 (t ha^{-1}). Among them, significantly higher straw yield of rice crop (5.28 t ha^{-1}) was observed with values recorded in Transplanted Rice (TP) method followed by Direct seeded Rice (DSR) method (5.50 t ha^{-1}) and System of rice Intensification method (5.28 q ha^{-1}) compared to control (3.93 t ha^{-1}). The increase in straw yield (t ha^{-1}) of rice crop in System of rice Intensification, Direct seeded Rice (DSR) and Transplanted Rice (TP) was to the extent of 7.1%, 11.6% and 17.2% respectively over control. These results are in conformity with earlier reported by Srilatha *et al*. (2019), Sahoo *et al*. (2022) Tuli *et al*. (2022), Zoureen *et al*. (2025) and Kumar *et al*. (2025)

Table 3 : Effect of different growing environments on grain and straw yield of rice in different rice establishment methods

Method	Grain Yield (t/ha)	Straw Yield (t/ha)
Control	2.95	3.93
TP	4.60	5.78
DSR	4.14	5.50
SRI	4.39	5.28
Sem (±)	0.266	0.215
CD (0.05)	0.651	0.525
CV (%)	7.96%	4.89%

References

Bharamappanavara, M., Siddaiah, A. M., Ponnuvel, S. *et al*. (2020). Mapping QTL hotspots associated with weed competitive traits in backcross population derived from *Oryza sativa* L. and *O. glaberrima* Steud. *Scientific Reports*, **10**, 22103. https://doi.org/10.1038/s41598-020-78675-7

Gorlapalli, A., Kallakuri, S., Sreekanth, P. D., Patil, R., Bandumula, N., Ondrasek, G., Admala, M., Gireesh, C., Anantha, M. S., Parmar, B. *et al*. (2022). Characterization and prediction of water stress using time series and artificial intelligence models. *Sustainability*, **14**, 6690. https://doi.org/10.3390/su14116690

Kale, R. R., Durga Rani, C. V., Anila, M., Mahadeva Swamy, H. K., Bhadana, V. P., Senguttuvel, P. *et al*. (2021). Novel major QTLs associated with low soil phosphorus tolerance identified from the Indian rice landrace, Wazuhophek. *PLoS ONE*, **16**(7), e0254526. https://doi.org/10.1371/journal.pone.0254526

Kale, R. R., Anila, M., Mahadeva Swamy, H. K., Bhadana, V. P., Durga Rani, C. V., Senguttuvel, P., Subrahmanyam, D., Hajira, S. K., Rekha, G., Ayyappadass, M., *et al*. (2021). Morphological and molecular screening of rice germplasm lines for low soil P tolerance. *Journal of Plant Biochemistry and Biotechnology*, **30**, 275–286.

Kumar, V., Kumar, A., Kumar, U., Naseem, M., Brajendra and Lal, M. (2025). Field evaluation of rice (*Oryza sativa* L.) genotypes for resistance against brown spot disease (*Drechslera oryzae*). *Acta Scientific Agriculture*, **9**(10), 1–8.

Parmar, B., Vishwakarma, A., Padbhushan, R., Kumar, A., Kumar, R., Kumari, R., Yadav, B. K., Giri, S. P., Kaviraj, M. and Kumar, U. (2022). Hedge and alder-based agroforestry systems: Potential interventions to carbon sequestration and better crop productivity in Indian Sub-Himalayas. *Frontiers in Environmental Science*, **10**, 858948. https://doi.org/10.3389/fenvs.2022.858948

Patel, M. K., Meena, R., Singh, Y. V., Meena, R., Lal, M. and Brajendra. (2025). Effect of phosphorus and bio-organics on yield and nutrient uptake by mung bean [*Vigna radiata* (L.) Wilczek] in an Inceptisol of Varanasi. *The Journal of Rural and Agricultural Research*, **25**(2), 69–73.

Patel, M. K., Meena, R., Singh, Y. V., Meena, R., Lal, M. and Brajendra. (2025). Enhancing mung bean [*Vigna radiata* (L.) Wilczek] growth with phosphorus and bio-organics in an Inceptisol. *The Journal of Rural and Agricultural Research*, **25**(2), 74–77.

Rathod, S., Saha, A., Patil, R., Ondrasek, G., Gireesh, C., Anantha, M. S., Rao, D. V. K. N., Bandumula, N., Senguttuvel, P., Swarnaraj, A. K., *et al*. (2021). Two-stage spatiotemporal time series modelling approach for rice yield prediction & advanced agroecosystem management. *Agronomy*, **11**, 2502. https://doi.org/10.3390/agronomy 11122502

Sahoo, S., Mukhopadhyay, P., Sinha, A. K., Bhattacharya, P. M., Rakesh, S., Kumar, R., Padbhushan, R., Bijay-Singh, Parmar, B., Vishwakarma, A., Kumar, A., Yadav, B. K., Bhushan, S., Kumar, A., Kaviraj, M. and Kumar, U. (2022). Yield, nitrogen-use efficiency, and distribution of nitrate-nitrogen in the soil profile as influenced by irrigation and fertilizer nitrogen levels under zero-till wheat in the eastern Indo-Gangetic plains of India. *Frontiers in Environmental Science*, **10**, 970017. https://doi.org/10.3389/fenvs.2022.970017

Srilatha, P., Yousuf, F., Methre, R., Vishnukiran, T., Agarwal, S., Poli, Y., Reddy, M. R., Vidyasagar, B., Shanker, C., Krishnaveni, D., *et al*. (2019). Physical interaction of RTBV ORFI with D1 protein of *Oryza sativa* and Fe/Zn homeostasis play a key role in symptoms development during rice tungro disease to facilitate the insect-mediated virus transmission. *Virology*, **526**, 117–124.

Tuti, M. D., Rapolu, M. K., Sreedevi, B., Bandumula, N., Kuchi, S., Bandeppa, S., Saha, S., Parmar, B., Rathod, S., Ondrasek, G., *et al*. (2022). Sustainable intensification of a rice–maize system through conservation agriculture to enhance system productivity in southern India. *Plants*, **11**, 1229. https://doi.org/10.3390/plants11091229

Zoureen, S., Brajendra, Gobinath, R., Tuti, M. D., Lal, M., Rani, V., Sinha, S. K. and Kumar, A. (2025). Effect of different growing environments on available macro and micro nutrient in soil under various establishment methods. *The Journal of Rural and Agricultural Research*, **25**(2), 64–68.