

Research Article

Evaluation of Tillage and Sowing Method on *Kharif* Aerobic Rice

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Abstract

A field trial was conducted during 2022-23 to 2025-26 in *kharif* seasons at the Main Rice Research Centre, Soil and Water Management Research Unit, Navsari Agricultural University, Navsari, Gujarat to study the evaluation of tillage and sowing method on *kharif* aerobic rice. The experiment was laid out in split plot design with main plot as four tillage practices-T₁: Single pass cultivator with planking, T₂: Double pass cultivator with planking, T₃: Single pass rotary tillage and T₄: No tillage and sub plot as two sowing method of S₁: Wet seeded aerobic rice and S₂: Dry seeded aerobic rice which were replicated four times. The study aimed to found suitable tillage practice with sowing method using direct seeded rice which gave higher aerobic rice yield, reduce cost and economically beneficial. The experimental results showed that the maximum plant height, number of panicles, panicle length, test weight, rice yields were recorded with no tillage practices compared to other tillage practices. Likewise, sowing method by using wet seeded rice (by soaking the seed in water for 24 hrs and place in shade for 12 hrs before sowing) found better in increasing growth and yield parameters further, this method gave highest rice yield compared to dry seeded rice. The higher net return and lower cost of cultivation was also recorded with no tillage practices following method of sowing with wet seeded rice. Hence, the study suggests that under *kharif* aerobic rice cultivation farmers may adopt no tillage practices with method of sowing using wet seeded rice (by soaking the seed in water for 24 hrs and place in shade for 12 hrs before sowing) for higher rice yield and economic return.

1. Introduction

Rice is one of the important cereal crops and main staple food of India. Traditionally, rice cultivation method used is transplanting of nursery grown seedlings into puddled field which require higher amount of water and labours, further in recent times the rural labour shifted to the industrial sector, leading labour scarcity at the time of transplanting and higher wages delayed transplantation [1]. It resulted in yield reductions. Transplanting of rice is widely adopted method of crop establishment in the irrigated rice systems of Asia. However, but it is costly, labour intensive and give physical strain to labours [2]. Puddled transplanted rice consumes about 20-40% of the total water for crop growing and create difficulties in seed bed preparation for rabi crops in rotation. Puddling promotes formation of hard pan which effects rooting of next crop [3]. Use of tractors for ploughing, consume higher quantities of fissile fuels that add to costs and also emitting greenhouse gases and contributing to global warming [4]. It also deteriorates soil physical properties by destroying soil aggregates, hard pan at shallow depth and lowering permeability in the subsurface layer [5]. Tillage is one of the important practices in agriculture, that improve soil properties, loose upper layer of soil check weeds and coordinates situations viz., water storage and fertilizer retention which

create suitable soil ecological conditions for plant growth and development [6–8]. Another experiment also revealed that tillage contribute upto 20% and affects the sustainable use of soil resources through its influence on soil properties [9]. It also reported that repeated tillage practices affect overall soil [10]. Recently crop establishment methods and resources conservation tillage play vital role in addressing soil health problems, timely harvesting to maintain time between rice and next crop and reduce cost of land preparation. This conservation tillage viz., zero tillage and unpuddled transplanting found to be beneficial in improving soil health, crop productivity, saving water and increase income. No tillage practice measured under conservation tillage, improve the soil's water supply and fertilizer supply capacity, and promote crop root growth and nutrient absorption, thereby increasing crop yield and forming suitable soil [11–13]. Rice yield was lower in no-tillage than in conventional tillage system, but did not show any significant differences [14]. No-tillage increased rice yield through soil quality improvement along time [15]. In this context, crop establishment sowing method, such as direct seeding, alternate wetting and drying is viable options to transplanting methods offering significant benefits in terms of resources conservation and improved resources use efficiency [16]. Direct seeding includes dry and sprouted seeds under unpuddled conditions which provides early field availability compared to transplanting. Direct seeded rice offers economic benefit through crop intensification which may increase profitability with saving of labour, energy and water [17, 18]. Hence, the present investigation has been carried out to provide potential advantage associated with the effect of tillage practices and sowing method on growth, yield and economics of rice.

2. Materials and Methods

A field trial was conducted during the *kharif* season of 2022-23 to 2025-26 at Main Rice Research Centre Farm, Navsari Agricultural University, Navsari, Gujarat. The soil of experimental field was clayey in texture, medium in organic carbon, low in nitrogen, medium in phosphorus, higher in potassium, medium in zinc and slightly alkaline in reaction. The experiment was laid out in split plot design and replicated four times with main plot as tillage practices: T₁- Single pass cultivator with planking, T₂- Double pass cultivator with planking, T₃- Single pass Rotary tillage and T₄-No tillage and sub plot as sowing method: S₁- Wet seeded aerobic rice and S₂- Dry seeded aerobic rice. The rice variety GNR-8 was planted on fortnight of June with line spacing 30 cm direct sowing using 50 kg ha⁻¹ seed material and harvested in fortnight of October in *kharif* season. Recommended dose of fertilizer for rice 100:30:00 NPK kg ha⁻¹ was applied in three splits viz., 40% dose of nitrogen through urea as basal, 40% at tillering stage and 20% at panicle initiation stage after sowing. Full dose of phosphorus through SSP were applied as basal dose. The other cultural operation, irrigations and plant protection measures were given as common practices as per the recommendation for the rice. Yield and yield attributes of different treatments were recorded at the time of harvest and computed. All the data recorded during the study period were statistically analyzed by using standard methods as suggested [19].

3. Results and Discussion

3.1. Growth and yield attributes

3.1.1. Tillage practice

The pooled results of growth and yield attributes of rice are presented in Table 1. The results revealed that the plant height, number of panicle m⁻², panicle length and test weight were significantly influenced due to various tillage practices. The plant height was significantly recorded taller with no tillage (T₄) and single pass rotary tillage (T₃) and remained at par with one another as compared to rest of the treatment. Further, no tillage practice (T₄) recorded significantly higher number of panicle m⁻², panicle length and test weight. The treatment (T₄) and (T₂) found equally effective in counting number of panicle m⁻². According to [20] observed that number of effective tillers, spike length and 1000 grain weight was maximum under zero tillage and at par with the unpuddled transplanted rice. The number of panicle m⁻² was higher in no tilled drill seeded rice [21].

Table 1: Effect of different treatments on growth and yield attributes of rice (pooled)

Treatment	Plant height (cm)	Panicle m ⁻²	Panicle length (cm)	Test weight (g)
Main plot: Tillage practices				
T ₁ : Single pass cultivator with planking	122.0	195	19.1	24.56
T ₂ : Double pass cultivator with planking	123.6	204	21.8	25.59
T ₃ : Single pass rotary tillage	125.4	200	20.3	24.53
T ₄ : No tillage	129.7	211	23.8	26.12
S. Em. ±	1.54	2.41	0.42	1.21
C.D.at 5%	4.77	7.28	1.30	3.69
C.V. %	6.83	8.27	7.17	5.15
Sub plot: Sowing method				
S ₁ : Wet seeded aerobic rice	129.1	209	22.1	25.51
S ₂ : Dry seeded aerobic rice	121.3	196	20.4	24.89
S. Em. ±	1.22	2.11	0.21	0.48
C.D. at 5 %	3.70	6.44	0.65	NS

3.1.2. Sowing method

All the growth as well as yield attributes except test weight were affected significantly due to sowing method. In all the cases, sowing with wet seeded aerobic rice (S₁) recorded higher values as compared to dry seeded aerobic rice (S₂). A study by [22] observed that panicle/m², panicle length and weight were recorded higher with wet DSR (drum seeding).

3.2. Grain and straw yield

3.2.1. Tillage practice

The results pertaining to grain and straw yield of rice crop are presented in Table 2. The results showed that the grain yield of rice were significantly influenced due to different tillage practices. Significantly higher grain yield was recorded with no tillage (T_4) system and found at par with the single pass rotary tillage (T_3). The rice yield was statistically at par with zero tillage when compared to conventional tillage system in direct seeding rice [23]. Straw yield was significantly affected due to tillage practices, no tillage practices (T_4) registered significantly higher straw yield in comparison to the rest of the tillage practices. Moreover [24], reported that direct seeded zero tillage gave at par yield as compared to transplanted rice. The more yield mainly due to a greater number of tillers m^{-2} .

Table 2: Effect of different treatments on rice yield (pooled) and economics

Treatment	Grain yield (kg ha ⁻¹)	Straw yield (kg ha ⁻¹)	Cost of cultivation (Rs ha ⁻¹)	Gross realization (Rs ha ⁻¹)	Net realization (Rs ha ⁻¹)
Main plot: Tillage practices					
T_1 : Single pass cultivator with planking	4276	5248	74241	113923	39682
T_2 : Double pass cultivator with planking	4416	5392	75843	117496	41653
T_3 : Single pass rotary tillage	4344	5480	80390	116632	36242
T_4 : No tillage	4554	5758	69992	122355	52363
S. Em. $\pm$	71	54	-	-	-
C.D. at 5 %	225	171	-	-	-
C.V. %	7.41	6.74	-	-	-
Sub plot: Sowing method					
S_1 : Wet seeded aerobic rice	4509	5622	75157	120665	45508
S_2 : Dry seeded aerobic rice	4286	5317	74362	114538	40176
S. Em. $\pm$	43	55	-	-	-
C.D. at 5 %	130	168	-	-	-

3.2.2. Sowing method

The results presented in Table 2 indicated that grain yield of rice affected significantly due to method of sowing. Sowing with wet seeded aerobic rice (S_1) performed better than dry seeded aerobic rice (S_2). Rice yields were noted higher with sowing with wet seeded rice (S_1) found superior than sowing with dry seeded rice (S_2). Grain and straw yield of rice was observed significantly higher with wet DSR (drum seeding) followed by dry converted wet rice (line sowing) SRI method [22].

3.3. Economics

Based on rice yields, the economics was calculated and presented in Table 2. Among various tillage practice, no tillage (T_4) recorded higher gross return (Rs. 122355 ha⁻¹) and net return (Rs.52363 ha⁻¹) over rest of the tillage practices. This may be due to higher yield attributes resulting in higher grain and straw yield and lower cost of cultivation in no tillage practice. Singh [25] reported that zero tillage had lower cost of cultivation than conventional tillage. Sowing method under wet seeded aerobic rice (S_1) recorded higher net return (Rs.45508 ha⁻¹) over dry seeded aerobic rice. This indicates that these methods required less inputs and lower expenses than dry seeded rice. Wet DSR (drum seeding) gave highest gross returns, net returns and benefit cost ratio [22].

4. Conclusion

It can therefore be concluded that in *kharif* aerobic rice, sowing of rice with no tillage practices under sowing method under wet seeded rice by soaking the seed in water for 24 hrs and place in shade for 12 hrs before sowing for achieving higher rice yield and net return.

Article Information

Data Availability: The datasets generated and/or analyzed during the current study are available from the corresponding author upon reasonable request.

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Author Contributions: D.A.P. - Methodology, Investigation, Data Curation, Formal Analysis, Writing – Original Draft, Writing – Review & editing; M.R.G. - Investigation, Data Curation; P.B.P. - Conceptualization, Methodology, Resources, Supervision, Project Administration; V.R.N. - Resources, Project Administration; P.M.M. - Resources, Project Administration.

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