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Yield attributes, yield and economics of different rice varieties under different systems of cultivation for central Telangana zone

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Abstract

A field study was carried out at the Regional Agricultural Research Station, Warangal, during kharif 2021 to assess rice variety performance under different cultivation methods for the central Telangana region. The experimental layout consisted of three main systems—transplanting, wet DSR (drum seeding), and dry DSR—and four sub-plot varieties (RNR 15048, WGL 44, WGL 915, and KNM 118). According to the data, transplanted rice yielded significantly better results for yield-attributing characters and harvest index compared to both direct-seeding techniques. KNM 118 was identified as the top-performing variety in terms of grain yield and panicle weight. While the transplanted system generated the highest gross and net returns, the wet DSR system was more economically efficient, recording the highest B:C ratio.

Keywords: Dry DSR, wet DSR, varieties, grain yield, harvest index

1. Introduction

Rice (*Oryza sativa* L.) serves as the primary dietary staple for nearly 60% of India's population (Biswas *et al.*)^[5]. While India leads globally in terms of rice cultivation area, it ranks second in total production. On an annual basis, the country produces approximately 120 million tonnes of rice across 44 million hectares, maintaining a productivity rate of over two tonnes per hectare. To keep pace with projected population growth by 2025, rice production must increase by an estimated 50–60% (Banerjee *et al.*)^[3]. Within Telangana, rice remains the most significant crop and is grown extensively across all districts during both the kharif and rabi seasons. According to the 2021-22 Agriculture Action Plan from the Department of Agriculture^[1], the state cultivated 42.45 lakh hectares in 2020-21, achieving a total output of 252.63 lakh tons with a productivity of 5948.75 kg/ha.

Most of the world's rice production—around 77%—relies on the traditional puddled-transplanting system (Chakraborty *et al.*; Xu *et al.*)^[7, 33]. However, the high intensity of labor, water, and energy required for this method has rendered it less sustainable and less profitable in modern agriculture (Chakraborty *et al.*; Guruprem *et al.*; Mahajan *et al.*)^[7, 14-, 18]. Because transplanting constitutes nearly a quarter of total labor needs, peak-season shortages frequently cause delays. These delays often result in the use of over-aged seedlings, which exacerbates transplanting shock and ultimately lowers yield. Given these rising costs and labor constraints, shifting from puddled-transplant systems to direct seeding is becoming a necessity. For the purposes of this study, both wet and dry sowing techniques are referred to as direct seeding.

Wet direct seeding is a traditional method of crop establishment that involves broadcasting or sowing sprouted seeds directly into puddled, water-saturated soil (Farooq *et al.*)^[13]. Compared to the conventional transplanting system, wet direct seeding offers several distinct advantages: it eliminates the need for nursery management, simplifies the sowing process, reduces labor dependency, and enhances water-use efficiency (Chauhan *et al.*)^[10]. Furthermore, this practice is associated with lower methane emissions and improved overall profitability. From a physiological and scheduling standpoint, direct-seeded rice often reaches maturity one to two weeks earlier than transplanted crops; this not only mitigates the risk of terminal drought but

also facilitates the timely planting of subsequent rotational crops (Rana *et al.*)^[25].

Here are a few ways to rephrase this final section. These versions focus on a professional, researcher-driven tone that flows logically from the problems of traditional puddling to the specific objectives of your study.

Dry direct seeding (DDS) is a key resource-conservation technique that eliminates the labor-intensive processes of nursery preparation, land puddling, and transplanting. By bypassing these steps, DDS offers significant savings in both time and capital investment. In conventional systems, repeated puddling can damage soil physical properties by breaking down soil aggregates, lowering subsurface permeability, and creating restrictive hard pans at shallow depths. Furthermore, dry direct seeding conserves the substantial volume of water typically required for puddling, which can account for 20% to 40% of the total water used in a transplanted rice cycle.

The success of such establishment methods often depends on cultivar-specific traits, such as morphology and growth rates, which influence overall yield potential. A competitive variety with the right morphological and physiological characteristics can capture and utilize resources more efficiently. Since a single variety may not perform optimally across all establishment techniques, it is essential to evaluate high-yielding rice varieties under these alternative strategies. Consequently, the present investigation was designed to analyze the growth and yield differences of local rice cultivars as influenced by various crop establishment methods.

2. Materials and Methods

Experimental Site and Soil Characteristics

The present investigation was conducted during the 2021 kharif season at the Regional Agricultural Research Station, located on the Agricultural College campus in Warangal. Geographically, the site is positioned at an altitude of 259 m above mean sea level (18° 07' 911" N latitude and 79° 59' 752" E longitude) within the central Telangana zone. The experimental soil was a clay loam with an alkaline reaction (pH 7.72) and an organic matter content of 0.65%. Initial soil fertility analysis showed available nitrogen at 275 kg ha⁻¹, phosphorus (P) at 75 kg ha⁻¹, and potassium (K) at 256 kg ha⁻¹.

Experimental Design and Treatments

The experiment followed a strip-plot design with 12 treatment combinations replicated three times. The main plots consisted of three crop establishment methods:

- **M1:** Transplanted rice system (15 x 10 cm spacing)
- **M2:** Wet direct-seeded rice via drum seeding (30 x 6-8 cm spacing)
- **M3:** Dry direct-seeded rice (30 cm row spacing)

The sub-plots featured four rice varieties:

- **S1:** RNR 15048 (Telangana Sona)
- **S2:** WGL 44 (Siddi)
- **S3:** WGL 915 (Warangal Rice-1)
- **S4:** KNM 118 (Kunaran Sannalu)

Fertilizer Management

For the transplanted and wet DSR systems, the recommended fertilizer dose was 120:60:40 kg of N:P₂O₅:K₂O ha⁻¹. The full dose of phosphorus (as single super phosphate) and half the dose of potash (as muriate of potash) were applied basally. Nitrogen (as urea) was applied in three equal splits:

- **Transplanted (M1):** At basal, maximum tillering, and panicle initiation.
- **Wet DSR (M2):** At 10 days after sowing (DAS), maximum tillering, and panicle initiation.

For the dry DSR method (M3), a higher fertilizer dose of 150:50:40 kg of N:P₂O₅:K₂O ha⁻¹ was utilized. Phosphorus and half the potash were applied basally. Nitrogen was provided in three equal splits at 30 DAS (maximum tillering), 60 DAS, and panicle initiation, with the remaining half of the potash applied at the final split.

For the wet direct seeding method, sprouted seeds were sown into a thoroughly puddled and levelled field using a drum seeder. The seeder was configured to maintain a spacing of 30 cm between rows and 7 cm between plants within each row, allowing for the simultaneous seeding of six rows per pass.

In the dry direct seeding method, lines were established using a cultivator at 30 cm row spacing, followed by the manual placement of seeds at a spacing of 30 cm x 10 cm. Immediately after sowing, a light irrigation was provided to ensure adequate moisture for seed germination, followed by regular scheduled irrigations. For consistency across the trial, the sowing for both the wet and dry DSR plots, as well as the nursery preparation for the transplanted system, was initiated on 26th August.



Fig 1: Satellite view of the experimental site (Downloaded from Google Earth)

Table 1: Characteristic features of varieties

Characteristics	RNR-15048	WGL-44	WGL-915	KNM-118
Duration	125 days	140-145 days	135 days	125 days
Grain type	Short slender very fine	Medium slender fine	Long bold fine grain	Long slender grain
Resistant	Blast	Gall midge	BPH, Blast	Blast
Average yield	5500-6500 kg ha ⁻¹	7000-8000 kg ha ⁻¹	7500-8000 kg ha ⁻¹	7000-8000 kg ha ⁻¹
Habit	Non lodging Non shattering	Non shattering	Non lodging Non shattering	Less prone to grain shattering and lodging
Release Year	2015	2012	2020	2015

3. Results and Discussion

3.1 Weight of panicle (g)

The data presented in Table 3, indicate weight of panicle as

influenced by different systems of cultivation and varieties and their interaction effect. As per data superior panicle weight was observed with transplanted rice system (M₁) (7.2) which was on

par with wet DSR (M_2) (6.5). The lowest panicle weight was recorded under dry DSR (M_3) (6.1). This might be due to higher dry matter accumulation, higher panicle length and also more number of grains per panicle in transplanted rice. Wet DSR performed superior over the dry DSR which might be due to better crop growth at earlier stages of crop that has resulted in more nutrient uptake and formation of more number of filled grains. The similar results were also reported in findings of Singh *et al.* (2019).

Among the varieties, significantly higher weight of panicle was recorded by KNM 118 (S_2) (8.3 gm) which is statistically on par with WGL 44 (S_4) (8.1 gm) over WGL 915 (S_3) (7.0 gm) and least panicle weight was recorded by RNR 15048 (S_1) (3.1 gm). The difference in weight of panicle among the genotypes was probably due to higher leaf area index caused proper utilization of all the available and terrestrial growth resources and better translocation of photosynthates from source to sink had lead to formation of more number of grains per panicle and more panicle length. The results are in accordance with the findings of Kumhar *et al.* (2016) ^[16], Singh *et al.* (2017) ^[29] and Singh *et al.* (2019).

3.2 Length of panicle (cm)

As per the data presented in Table 3. higher length of panicle was recorded with transplanted system of cultivation (M_1) (26.5 cm) and this was on par with wet DSR (M_2) (24.9 cm). The lowest panicle length was observed with dry DSR (M_3) (23.7 cm). Adequate vegetative growth with higher dry matter production and effective portioning to panicles in transplanted and wet DSR system might had resulted in longer length of panicle than dry DSR. The similar results were also reported in findings of Ramulu *et al.* (2019) and Jehangir *et al.* (2021).

In subplots, significantly highest panicle length was recorded in WGL 915 (S_3) (29.4 cm) over KNM 118 (S_4) (24.3 cm), RNR 15048 (S_1) (23.6 cm) and least panicle length was recorded in WGL 44 (S_2) (22.7 cm). The difference in length of panicle among the genotypes mainly influenced by varietal character and their ability to absorb nutrients in competition with weeds. The results are in line with the findings of Kumhar *et al.* (2016) ^[16], Chowhan *et al.* (2017) ^[11], Gewaily *et al.* (2018), Anil and Siddi (2020) ^[2] and Mangaraj *et al.* (2021) ^[20].

3.3 Test weight (1000 seeds in g)

The data pertaining to test weight, which is an important yield attributing character of a crop, is presented in Table 3. The data in table revealed that there was no significant difference in different systems of cultivation of rice, as test weight is mainly influenced by the inherent genetic character and is least affected by the growing conditions and other crop management practices. The results were in accordance with the findings of Barla and Kumar (2011) ^[4], Kanthi *et al.* (2014).

Among the cultivars, significantly higher test weight of 27.2 gm was recorded by WGL 915 (S_3) and it was statistically on par with KNM 118 (S_4) with 25.3 gm. Lowest test weight of 12.4 gm was recorded by RNR 15048 (S_1) and it was close with WGL 44 (S_2) (14.6 gm). The variation in test weight among the genotypes was mainly due to genotypic character which might be affected least with management and environmental conditions. The results are in close conformity with Kumhar *et al.* (2016) ^[16], Chowhan *et al.* (2017) ^[11], Gewaily *et al.* (2018), Dileep *et al.* (2018) ^[12], Anil and Siddi (2020) ^[2] and Mangaraj *et al.* (2021) ^[20].

3.4 Grain yield (kg ha⁻¹)

The grain yield data (kg ha⁻¹) are presented in Table 4. Grain yield serves as a cumulative reflection of various growth and yield-attributing parameters, such as dry matter production, tiller count, panicle density, panicle length and weight, and the number of grains per panicle. The experimental findings revealed that the highest grain yield (6806 kg ha⁻¹) was achieved through the transplanted system (M_1). The wet DSR (M_2) system followed closely, recording a grain yield of 6247 kg ha⁻¹, which was statistically on par with the transplanted method. In contrast, the dry DSR (M_3) system recorded the lowest grain yield at 5058 kg ha⁻¹. Conventional transplanting offered a yield advantage of 8.22% over wet DSR and 25.68% over dry DSR.

The superior performance of the transplanted system can be attributed to enhanced nutrient uptake, which augmented dry matter accumulation and leaf production. This, in turn, supported a higher number of panicle-bearing tillers, increased spikelet counts, and improved grain-filling capacity. Conversely, the lower yields in dry DSR were linked to high weed density and a higher weed index, where intense weed competition and restricted root growth resulted in reduced nutrient uptake and inferior growth characteristics. These observations align with the findings reported by Yadav and Singh (2006) ^[32], Shan *et al.* (2012) ^[28], and Singh *et al.* (2017) ^[29].

Furthermore, the significantly higher yield in wet DSR compared to dry DSR may be due to optimized plant-to-plant spacing, better light interception, and rapid seedling establishment. These results are consistent with the findings of Mandhata Singh and Singh (2010) ^[19].

Among the tested genotypes, KNM 118 (S_4) recorded the significantly highest grain yield (6617 kg ha⁻¹), which was statistically on par with WGL 44 (S_2) at 6244 kg ha⁻¹. These were followed by WGL 915 (S_3) at 5943 kg ha⁻¹, while RNR 15048 (S_1) produced the lowest yield (5343 kg ha⁻¹). The lower productivity in certain genotypes was likely due to reduced dry matter production, fewer tillers, lower test weights, and smaller panicle dimensions with fewer filled grains. These results conform to the research of Hussain *et al.* (2014), Kumhar *et al.* (2016) ^[16], and several others, including Mangaraj *et al.* (2021) ^[20].

3.5 Straw yield (kg ha⁻¹)

The data regarding straw yield (expressed in kg/ha) are detailed in Table 4. Analysis of the results indicates that the highest straw yield of 7692 kg/ha was achieved using the transplanted rice system (M_1). This result was statistically on par with the wet DSR (M_2) system, which produced 7153 kg/ha. In contrast, the dry DSR (M_3) system recorded the lowest straw yield at 5992 kg/ha. The observation of straw yield patterns suggests that both conventional transplanting and wet DSR significantly outperformed dry DSR. This superiority is likely attributed to enhanced dry matter accumulation and a higher tiller density per unit area. These gains were further supported by improved nutrient absorption from the soil, which accelerated metabolic rates, increased light interception, and boosted photosynthetic activity. Consequently, these factors led to greater plant height and a higher leaf area index compared to the dry DSR cultivation method. These findings are consistent with the research reported by Shan *et al.* (2012) ^[28], Kanthi *et al.* (2014), and Singh *et al.* (2017) ^[29].

Perusal of data on straw yield revealed that, significantly higher straw yield was recorded in KNM 118 (S_4) (7543) which is

statistically on par with WGL 44 (S_2) (7159), closely followed by WGL 915 (S_3) (6832) and least straw yield was recorded in RNR 15048 (S_1) (6250). Higher straw yield in WGL 44 might be due to efficient utilization of resources to produce higher dry matter production, more number of tillers and maximum leaf area production. In RNR 15048 lower number of tillers and lower dry matter resulted in poor straw yield. The results are in line with the findings of Hussain *et al.* (2014), Kumhar *et al.* (2016) [16], Harish *et al.* (2017) [15], Chandrika *et al.* (2017) [9], Dileep *et al.* (2018) [12], Chandra *et al.* (2019) [8], Anil and Siddi (2020) [2], Mangaraj *et al.* (2021) [20].

3.6 Harvest index (%)

The harvest index was not significantly influenced either by different systems of cultivation or varieties and even the interaction effect remained non significant as presented in Table 4. The results were supported by Barla and Kumar (2011) [4], Lavanya and Mallareddy (2019) [17].

Transplanted rice system recorded 46.87% harvest index closely followed by wet DSR as 46.55% and 45.67% for dry DSR system which was found to be non significant.

Among genotypes, similar trend was observed like systems of cultivation. KNM 118 recorded 46.58% of harvest index closely followed by 46.53% for WGL 44 and WGL 915 with 46.41%. Lowest harvest index was observed in RNR 15048 which was recorded as 45.95%. Harvest index among all the varieties was found to be statistically non significant.

3.7 Cost of cultivation

The data pertaining to cost of cultivation is presented in Table 2. The data shows that highest mean cost of cultivation was recorded with transplanted rice system (M_1) as 51158 Rs ha⁻¹ and it is followed with dry DSR system (M_3) with 44006 Rs ha⁻¹ where as wet DSR (M_2) recorded 40410 Rs ha⁻¹. Highest cost of cultivation is mainly due to more expenditure incurred towards nursery management and transplanting operation in transplanted rice system whereas dry DSR incurred more expenditure than wet DSR due to weeding operation.

Among varieties, RNR 15048 (S_1) and WGL 44 (S_2) recorded highest cost of cultivation of 45438 Rs ha⁻¹ followed by KNM 118 (S_4) and WGL 915 (S_3) observed similar cost of cultivation which is recorded as 44961 Rs ha⁻¹. The variation in cost of cultivation was due to variation in seed cost.

Table 2: Cost of cultivation (Rs ha⁻¹) of rice varieties as influenced by different systems of cultivation

	S_1	S_2	S_3	S_4	Mean
M_1	51783	51783	50533	50533	51158
M_2	40485	40485	40385	40385	40410
M_3	44046	44046	43966	43966	44006
Mean	45438	45438	44961.33	44961.33	

Table 3: Panicle weight, panicle length and test weight of rice varieties as influenced by different systems of cultivation

Treatments	Weight of panicle (g)	Length of panicle (cm)	Test weight (1000 seeds in g)
Main plot treatments			
M_1 : Transplanted rice	7.2	26.5	20.6
M_2 : Wet direct seeded rice (Drum seeder)	6.5	24.9	19.8
M_3 : Dry direct seeded rice	6.1	23.7	19.2
S.Em ($\pm$)	0.2	0.5	0.7
CD (P=0.05)	0.8	1.9	NS
Sub plot treatments			
S_1 : RNR 15048	3.1	23.6	12.4
S_2 : WGL 44	8.1	22.7	14.6
S_3 : WGL 915	7.0	29.4	27.2

3.8 Gross returns

The gross returns (Rs ha⁻¹) for different systems of cultivation and varieties is presented in the Table 5.

The result disclosed highest gross returns with transplanted rice system (M_1) which was recorded as 148779 Rs ha⁻¹ and it is on par with wet DSR system (M_2) with 136741 Rs ha⁻¹ where as 111128 Rs ha⁻¹ is recorded as lowest gross returns with dry DSR system (M_3). Transplanted rice system fetched 12038 Rs ha⁻¹ higher gross returns than wet DSR and 37651 Rs ha⁻¹ higher gross returns than dry DSR. Lower gross returns is mainly attributed to low grain and straw yield obtained and evaluated based on their MSP (minimum support price) or market price. This was supported by Yadav and Singh (2006) [32], Singh and Singh (2010) [19] and Bhardwaj *et al.* (2018).

Among the sub plot treatments, highest gross return was observed with KNM 118 (S_4) (144773 Rs ha⁻¹) which was on par with WGL 44 (S_2) (136709 Rs ha⁻¹). The lowest gross return was recorded with RNR 15048 (S_1) (117229 Rs ha⁻¹) which is closely followed with WGL 915 (S_3) which was recorded as 130154 Rs ha⁻¹. Higher gross returns in KNM 118 was ascribed to higher grain and straw yields obtained. The findings are in close conformation with Barla and Kumar (2011) [4], Singh *et al.* (2017) [29], Chandra *et al.* (2019) [8], Prashanthi *et al.* (2020), Anil and Siddi (2020) [2] and Mangaraj *et al.* (2021) [20].

3.9 Net returns

The data presented in Table 5. regarding net returns reflects similar trend as to that of gross returns where transplanted rice system (M_1) which recorded 97621 Rs ha⁻¹ as net returns is highest and it is on par with wet DSR system (M_2) with 96306 Rs ha⁻¹. The lowest net return was recorded with dry DSR system (M_3) as 67122 Rs ha⁻¹. Net return is obtained by deducting cost of cultivation from gross returns. High cost of cultivation in transplanted rice system has resulted narrow edge over wet DSR system in respect of net returns. This findings are supported by Yadav and Singh (2006) [32], Singh and Singh (2010) [19] and Bhardwaj *et al.* (2018).

Similar trend was observed among varieties, where KNM 118 (S_4) (99812 Rs ha⁻¹) recorded higher net return and it is on par with WGL 44 (S_2) with 91271 Rs ha⁻¹. The lowest net return was recorded in RNR 15048 (S_1) (71791 Rs ha⁻¹) which is on par with WGL 915 (S_3) recorded as 85192 Rs ha⁻¹. The similar results were documented by Barla and Kumar (2011) [4], Singh *et al.* (2017) [29], Chandra *et al.* (2019) [8], Prashanthi *et al.* (2020), Anil and Siddi (2020) [2] and Mangaraj *et al.* (2021) [20].

3.10 Benefit cost ratio

The benefit cost ratio obtained is presented in Table 5. where highest B:C ratio was recorded for wet DSR system (M_2) with 2.38, which is on par with transplanted rice system (M_1) which recorded 1.91. The lowest B:C ratio of 1.53 was

S ₄ : KNM 118	8.3	24.3	25.3
S.E.m (±)	0.2	0.9	0.9
CD (P=0.05)	0.7	3.2	3.0
Interaction			
Sub plot treatment at same level of main plot treatment			
S.E.m (±)	0.6	3.1	1.2
CD (P=0.05)	NS	NS	NS
Main plot treatment at same/different level of sub plot treatment			
S.E.m (±)	0.5	2.8	1.3
CD (P=0.05)	NS	NS	NS

Table 4: Grain yield (kg ha⁻¹), straw yield (kg ha⁻¹) and harvest index of rice varieties as influenced by different systems of cultivation

Treatments	Grain yield (kg ha ⁻¹)	Straw yield (kg ha ⁻¹)	Harvest index (%)
Main plot treatments			
M ₁ : Transplanted rice	6806	7692	46.87
M ₂ : Wet direct seeded rice (Drum seeder)	6247	7153	46.55
M ₃ : Dry direct seeded rice	5058	5992	45.67
S.E.m (±)	271	241	0.29
CD (p=0.05)	1065	946	NS
Sub plot treatments			
S ₁ : RNR 15048	5343	6250	45.95
S ₂ : WGL 44	6244	7159	46.53
S ₃ : WGL 915	5943	6832	46.41
S ₄ : KNM 118	6617	7543	46.58
S.E.m (±)	190	197	0.13
CD (p=0.05)	656	683	NS
Interaction			
Sub treatment at same level of main treatment			
S.E.m (±)	507	520	0.33
CD (p=0.05)	NS	NS	NS
Main treatment at same/different level of sub treatment			
S.E.m (±)	567	565	0.43
CD (p=0.05)	NS	NS	NS

Table 5: Gross, Net returns and B-C ratio of rice varieties as influenced by different systems of cultivation

Treatments	Gross return (Rs ha ⁻¹)	Net return (Rs ha ⁻¹)	B-C ratio
Main plot treatments			
M ₁ : Transplanted rice	148779	97621	1.91
M ₂ : Wet direct seeded rice (Drum seeder)	136741	96306	2.38
M ₃ : Dry direct seeded rice	111128	67122	1.53
S.E.m (±)	5795	5795	0.13
CD (P=0.05)	22756	22756	0.52
Sub plot treatments			
S ₁ : RNR 15048	117229	71791	1.59
S ₂ : WGL 44	136709	91271	2.03
S ₃ : WGL 915	130154	85192	1.90
S ₄ : KNM 118	144773	99812	2.24
S.E.m (±)	4108	4108	0.08
CD (P=0.05)	14215	14215	0.29
Interaction			
Sub plot treatment at same level of main plot treatment			
S.E.m (±)	12451	12451	0.27
CD (P=0.05)	NS	NS	NS
Main plot treatment at same/different level of sub plot treatment			
S.E.m (±)	12241	12241	0.27
CD (P=0.05)	NS	NS	NS

4. Conclusion

In conclusion, the transplanted rice system (M₁) demonstrated superior yield-attributing characteristics and grain productivity. This performance is attributed to optimal plant spacing, which facilitated improved light interception, and the puddling process, which effectively suppressed weed growth while ensuring better nutrient availability. These factors collectively promoted higher tiller counts, greater dry matter accumulation, and efficient translocation to the grain sink. Among the evaluated varieties,

KNM 118 (S₄) consistently outperformed the other genotypes in all yield attributes and total productivity. This superiority suggests a higher genetic capacity for nutrient uptake, competitive resource utilization, and efficient biomass production. Notably, the interaction effect between cultivation systems and rice varieties was found to be non-significant regarding yield-attributing characters. From an economic perspective, while the transplanted system generated the highest gross and net returns, the wet DSR system achieved the most

favorable benefit-cost (B:C) ratio. The lower B:C ratio in the transplanted system was primarily due to high labor costs associated with manual transplantation, whereas the higher costs in the dry DSR system were driven by intensive weeding requirements. Consequently, the wet DSR system provides a more cost-effective alternative. Within the tested varieties, KNM 118 recorded the highest gross returns, net returns, and B:C ratio, underscoring its potential for maximizing economic efficiency in this region.

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