International Journal of Agriculture and Nutrition 2025; 7(4): 161-164

ISSN Print: 2664-6064
ISSN Online: 2664-6072
NAAS Rating: 4.69
IJAN 2025; 7(4): 161-164
www.agriculturejournal.net
Received: 10-02-2025
Accepted: 19-03-2025

Eklavya Gadkari
Department of Agricultural Sciences, Vikram Dev Agricultural College, Jeypore, Odisha, India

Farhan Parikh
Department of Agricultural Sciences, Vikram Dev Agricultural College, Jeypore, Odisha, India

Madhuri Haldar
Department of Agricultural Sciences, Vikram Dev Agricultural College, Jeypore, Odisha, India

Corresponding Author:
Eklavya Gadkari
Department of Agricultural Sciences, Vikram Dev Agricultural College, Jeypore, Odisha, India

Effect of establishment methods and weed management on direct seeded basmati rice

Eklavya Gadkari, Farhan Parikh and Madhuri Haldar

DOI: https://www.doi.org/10.33545/26646064.2025.v7.i4c.429

Abstract
For centuries, basmati rice has been transplanted by hand into puddled fields—a method that demands roughly 30 to 40 person-days of labour per hectare and consumes 1,200 to 1,500 mm of water per crop season. Direct seeding offers a way to cut both inputs, but its success depends heavily on the establishment method used and the weed management program adopted. This research compared three establishment methods—dry broadcasting, wet drum seeding, and conventional transplanting—under five weed management treatments at Vikram Dev Agricultural College, Jeypore, Odisha, during kharif 2022. The experiment followed a split-plot design with establishment methods in main plots and weed management in subplots. Transplanting produced the highest grain yield (5.13 t ha^{-1}), but wet drum seeding combined with pretilachlor followed by bispyribac-sodium reached 4.61 t ha^{-1}—within 10 percent of the transplanted check. Weed density and dry weight were significantly higher under dry broadcasting than under the other two methods. The sequential herbicide treatment (pretilachlor fb bispyribac-sodium) reduced weed density by 71.4 percent compared to the unweeded control. Labour savings under wet drum seeding were 18.6 person-days ha^{-1} relative to transplanting. These results suggest that wet drum seeding with a pre- and post-emergence herbicide sequence is a viable labour-saving alternative for basmati rice production in eastern India.

Keywords: Establishment methods, weed management, direct seeded rice, basmati, labour saving technology, wet drum seeding, pretilachlor, bispyribac-sodium, dry broadcasting, split-plot design.

Introduction
Basmati rice cultivation in India has remained anchored to the transplanting method for generations, despite its heavy dependence on manual labour and standing water [1]. The system works well when labour is cheap and water abundant, but both resources are shrinking. Across Odisha and neighbouring states, rural-to-urban migration has reduced the agricultural workforce by an estimated 14 percent over the past decade [2], and groundwater tables in rice-growing districts have fallen by 0.3 to 0.8 m per year [3].

Direct seeded rice (DSR) bypasses the nursery-raising and transplanting steps altogether. Seeds are placed directly into the field either by dry broadcasting onto prepared soil, by wet drum seeding into puddled beds, or by mechanical line sowing [4]. DSR can save 20 to 35 percent of irrigation water and reduce labour needs by up to 50 percent compared with transplanting [5]. However, weeds are the main biological constraint in DSR because the crop and weeds germinate simultaneously, and the standing water layer that suppresses weeds in transplanted fields is absent or delayed [6].

Effective weed management in DSR requires a combination of pre-emergence and post-emergence herbicides. Pretilachlor applied within 3 days after sowing (DAS) controls germinating grasses and some broadleaf weeds, while bispyribac-sodium at 15-20 DAS targets later-emerging species including Echinochloa spp. and sedges [7]. Manual weeding remains an option but is rarely feasible at scale given the labour economics of eastern India [8].

Basmati cultivars add another layer of complexity: their tall stature and thin culms make them poor competitors against weeds compared with semi-dwarf high-yielding varieties [9]. Whether basmati can perform satisfactorily under DSR with chemical weed management hasn't been well documented for the Jeypore region of Odisha. This research was therefore undertaken to (i) compare the performance of three crop establishment methods for basmati rice, (ii) evaluate five weed management treatments within each method, and (iii) assess the labour and water savings achievable through direct seeding.

Material and Methods

Research Area Description

The experiment was conducted during kharif 2022 (June-November) at the research farm of Vikram Dev Agricultural College, Jeypore, Odisha (18.86°N, 82.57°E; altitude 580 m). The area falls under the Eastern Ghat Agro-Climatic Zone with a sub-humid tropical climate. Annual rainfall averages 1,480 mm, with 82 percent concentrated between June and September. The experimental soil was a clay loam (Vertisol) with pH 6.4, organic carbon 0.61 percent, available N 245 kg ha^{-1}, available P_2O_5 18.3 kg ha^{-1}, and available K_2O 204 kg ha^{-1}.

Material

The basmati cultivar Pusa Basmati 1509 was used as the test variety. Herbicides tested were pretilachlor 50 EC (Rifit, Syngenta) applied pre-emergence at 0.75 kg ha^{-1}, bispyribac-sodium 10 SC (Nominee Gold, Bayer) at 25 g ha^{-1} post-emergence, fenoxaprop-p-ethyl 6.9 EC at 60 g ha^{-1} combined with ethoxysulfuron 15 WDG at 18.75 g ha^{-1} post-emergence, and manual weeding at 20 and 40 DAS. A weedy check served as the control.

Field Experimental Design

The experiment used a split-plot design with three replications. Main plots comprised three establishment methods: M1 - dry broadcasting at 80 kg ha^{-1} seed rate, M2 - wet drum seeding at 60 kg ha^{-1} on puddled soil, and M3 - transplanting 25-day seedlings at 20 × 15 cm spacing. Subplots comprised five weed management treatments: W1 - unweeded control, W2 - manual weeding at 20 and 40 DAS, W3 - bispyribac-sodium at 25 g ha^{-1} (20 DAS), W4 - fenoxaprop + ethoxysulfuron (20 DAS), and W5 - pretilachlor pre-emergence followed by bispyribac-sodium post-emergence. Each subplot measured 5 m × 4 m.

Methods

Weed density and dry weight were recorded at 45 and 90 DAS using a 0.5 m² quadrat at two random spots per subplot. Crop growth was measured as plant height, tiller count, and dry matter accumulation at 30-day intervals. Yield components—panicles m^{-2}, grains per panicle, 1000-grain weight—were recorded at maturity. Grain yield was determined from the net plot and adjusted to 14 percent moisture. Water use was tracked through field inflow meters, and labour input was logged for each operation. Data were analysed using split-plot ANOVA in OPSTAT, with means separated by LSD at p=0.05.

Results

Table 1: Weed density and dry weight at 90 DAS under different establishment methods and weed management treatments in basmati rice (kharif 2022)

	M1-Dry Broadcast	M2-Wet Drum	M3-Trans-plant	M1-DW (g m^{-2})	M2-DW (g m^{-2})	M3-DW (g m^{-2})
Unweeded	134.7	98.3	72.6	112.8	78.4	54.3
Manual weed.	28.4	19.6	14.2	21.7	14.8	9.6
Bispyribac	46.3	32.1	24.7	38.9	26.4	18.1
Fenox+Ethoxy	52.8	37.6	28.3	44.2	30.1	21.7
Preti fb Bispy	38.5	24.8	18.6	30.4	18.7	12.9
LSD (0.05) M	7.4			6.1		
LSD (0.05) W	9.8			8.3		

Weed density was consistently highest under dry broadcasting and lowest under transplanting across all weed management treatments. The unweeded control under dry broadcasting recorded 134.7 plants m^{-2} at 90 DAS, compared with 72.6 under transplanting. The sequential herbicide treatment (pretilachlor fb bispyribac-sodium) reduced weed density by 71.4 percent in dry broadcasting, 74.8 percent in wet drum seeding, and 74.4 percent in transplanting relative to the unweeded control.

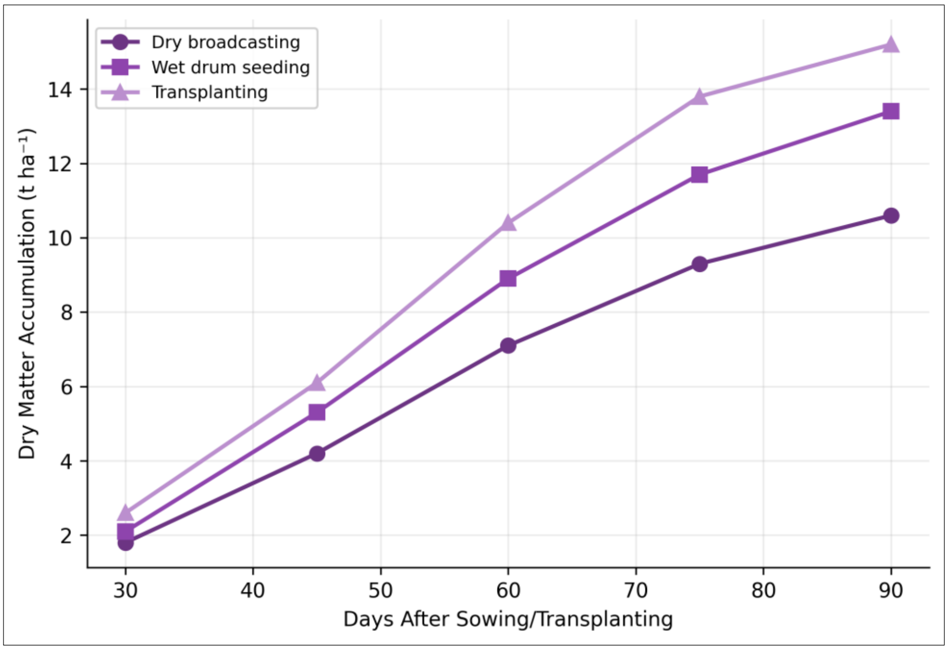

Fig 1: Dry matter accumulation (t ha^{-1}) over crop growth stages under three establishment methods for basmati rice

Transplanting maintained a consistent dry matter advantage over both direct-seeded methods throughout the season (Figure 1). However, the gap between wet drum seeding and transplanting narrowed from 24 percent at 30 DAS to 12 percent at 90 DAS, indicating that the drum-seeded crop partially compensated through higher tiller production at later stages.

Table 2: Grain yield (t ha⁻¹) of basmati rice under different establishment methods and weed management treatments

Weed Management	Dry Broadcast	Wet Drum Seeding	Trans- planting	Mean
Unweeded	1.47	2.14	2.87	2.16
Manual weeding	3.86	4.87	5.13	4.62
Bispyribac-Na	3.21	4.23	4.68	4.04
Fenox + Ethoxy	2.98	3.96	4.41	3.78
Preti fb Bispy	3.54	4.61	4.92	4.36
Mean	3.01	3.96	4.40	-
LSD (0.05): M = 0.31; W = 0.28; M×W = 0.49				

Transplanting produced the highest mean grain yield (4.40 t ha⁻¹), followed by wet drum seeding (3.96 t ha⁻¹) and dry broadcasting (3.01 t ha⁻¹). Within wet drum seeding, the sequential herbicide treatment (4.61 t ha⁻¹) was statistically at par with manual weeding (4.87 t ha⁻¹) and only 10.1 percent below the transplanted + manual weeding combination (5.13 t ha⁻¹).

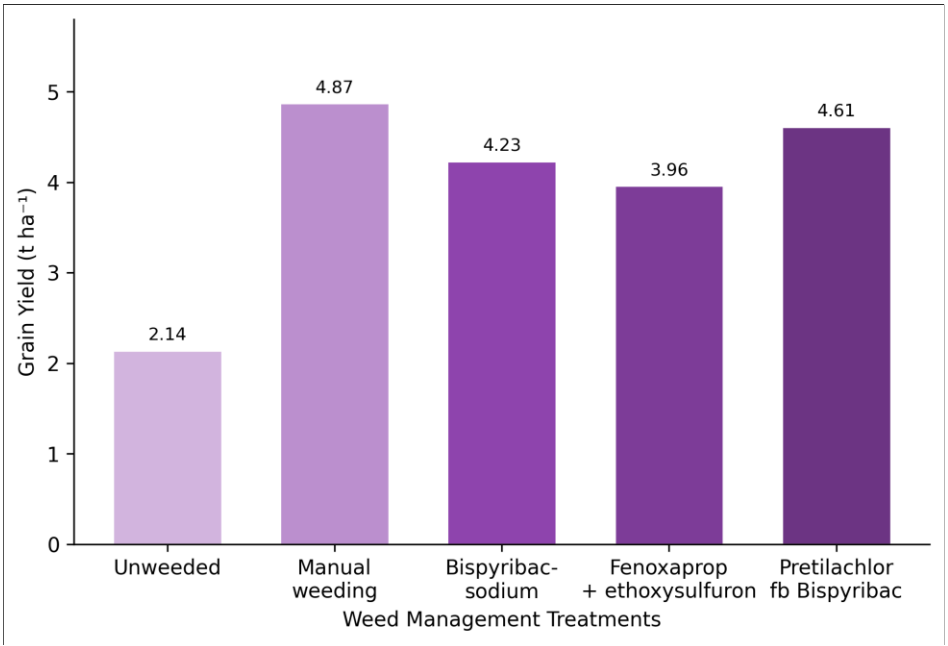

Fig 2: Grain yield (t ha⁻¹) across weed management treatments averaged over three establishment methods

Discussion

The yield penalty associated with direct seeding compared to transplanting is well documented across rice-growing regions [4, 5]. In this trial, the penalty was 10 percent for wet drum seeding and 32 percent for dry broadcasting when averaged across weed management treatments. Dry broadcasting suffered most because seeds placed on the soil surface face uneven germination, poor root anchorage, and intense weed competition from the outset [6]. Wet drum seeding, by contrast, places seed into puddled soil at uniform spacing and depth, resulting in better crop establishment and a more competitive canopy.

The sequential herbicide program (pretilachlor fb bispyribac-sodium) delivered the best chemical weed control across all three establishment methods. Pretilachlor provided early-season grass suppression, and bispyribac-sodium—a broad-spectrum acetolactate synthase inhibitor—controlled later emerging sedges and broadleaf weeds that escaped the pre-emergence barrier [7]. This two-step approach mirrors findings from Punjab and Haryana, where sequential herbicide applications are now standard practice in DSR [10].

From a labour perspective, wet drum seeding saved 18.6 person-days ha⁻¹ relative to transplanting (23.4 vs 42.0 person-days ha⁻¹), primarily by eliminating nursery raising and manual transplanting. Water use was 21 percent lower under wet drum seeding than transplanting (1,084 vs 1,374 mm), because the puddled-field phase was shorter and the crop relied on soil moisture for initial establishment rather than continuous flooding [3].

The practical message for basmati growers in eastern India is that switching from transplanting to wet drum seeding with pretilachlor followed by bispyribac-sodium can save labour and water at the cost of a modest (about 10%) yield reduction—a trade-off that may be economically favorable when labour costs exceed ₹350 per person-day [8].

Conclusion

This research showed that crop establishment method strongly influences weed pressure, water use, and grain yield in basmati rice at Jeypore, Odisha. Transplanting remained the highest-yielding option at 4.40 t ha^{-1} (mean across weed treatments), but wet drum seeding combined with sequential herbicide application came within 10 percent of this benchmark at 4.61 t ha^{-1} while saving nearly 19 person-days ha^{-1} of labour and 290 mm of irrigation water.

Dry broadcasting, although the cheapest to establish, suffered a 32 percent yield penalty and the highest weed infestation, making it unsuitable for basmati varieties that compete poorly with weeds. Wet drum seeding strikes a better balance between input savings and yield security.

Among weed management options, the sequential application of pretilachlor (pre-emergence) followed by bispyribac-sodium (post-emergence) was the most effective chemical treatment and statistically comparable to two manual weedings. For eastern Indian basmati systems where labour is scarce and costly, this herbicide combination paired with wet drum seeding offers a practical pathway to reduce production costs without large yield sacrifices.

References

1. Mahajan G, Chauhan BS. Transplanting rice in Asia: Status and challenges. Field Crops Research. 2017;204:190-198.
2. Chand R, Srivastava SK, Singh J. Changes in rural labour markets and their implications for agriculture. Economic and Political Weekly. 2017;52(47):47-54.
3. Humphreys E, Kukal SS, Christen EW. Halting the groundwater decline in northwest India: Which crop technologies will be winners? Advances in Agronomy. 2010;109:155-217.
4. Kumar V, Ladha JK. Direct seeding of rice: Recent developments and future research needs. Advances in Agronomy. 2011;111:297-413.
5. Bhushan L, Ladha JK, Gupta RK. Saving of water and labour in rice-wheat systems with no-tillage and direct seeding. Agronomy Journal. 2007;99(5):1288-1296.
6. Rao AN, Johnson DE, Sivaprasad B. Weed management in direct-seeded rice. Advances in Agronomy. 2007;93:153-255.
7. Khaliq A, Matloob A, Shafiq HM. Weed control in direct-seeded rice using bispyribac-sodium and pretilachlor. Philippine Journal of Crop Science. 2012;37(1):34-43.
8. Sarangi SK, Maji B, Singh S. Economics of direct-seeded rice versus transplanted rice in salt-affected lowlands. Journal of the Indian Society of Coastal Agricultural Research. 2018;36(2):84-91.
9. Singh VP, Singh G, Singh SP. Effect of weed management practices on basmati rice under direct seeding. Indian Journal of Weed Science. 2015;47(2):119-124.
10. Mahajan G, Ramesha MS, Kaur R. Evaluation of herbicides for weed management in dry direct-seeded rice in Punjab. Indian Journal of Agronomy. 2016;61(4):410-416.
11. Chauhan BS, Johnson DE. Relative importance of shoot and root competition in dry-seeded rice systems. Weed Research. 2010;50(6):564-572.
12. Dixit A, Varshney JG. Assessment of post-emergence herbicides in direct-seeded rice. Indian Journal of Weed Science. 2008;40(3-4):144-148.
13. Walia US, Bhullar MS, Nayyar S. Sequential application of herbicides in direct-seeded rice under Punjab conditions. Indian Journal of Weed Science. 2012;44(4):217-222.
14. Singh S, Ladha JK, Gupta RK. Evaluation of mulching, intercropping with *Sesbania* and herbicide use for weed management in dry-seeded rice. Crop Protection. 2007;26(4):518-524.
15. Pathak H, Tewari AN, Sankhayan S. Direct-seeded rice: Potential, performance and problems. Current Science. 2011;101(9):1171-1177.
16. Gathala MK, Ladha JK, Kumar V. Tillage and crop establishment affects sustainability of South Asian rice-wheat system. Agronomy Journal. 2011;103(4):961-971.
17. Farooq M, Siddique KHM, Rehman H. Rice direct seeding: Experiences, challenges and opportunities. Soil and Tillage Research. 2011;111(2):87-98.
18. Yadav DB, Yadav A, Punia SS. Evaluation of bispyribac-sodium for weed control in transplanted and direct seeded rice. Indian Journal of Weed Science. 2009;41(3-4):161-164.
19. Prasad R, Shivay YS, Kumar D. Agronomic management of basmati rice in the Indo-Gangetic plains. Agricultural Reviews. 2017;38(4):259-272.
20. Senapati BK, Swain SK, Nayak BR. Direct-seeded rice in Odisha: Prospects and constraints. Oryza. 2019;56(3):316-323.
21. Mohanty S, Nayak AK, Bhaduri D. Resource conservation technologies for direct-seeded rice in eastern India. International Journal of Ecology and Environmental Sciences. 2020;2(4):126-133.