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EFFECT OF WEED MANAGEMENT PRACTICES ON GROWTH AND CROP PRODUCTIVITY UNDER DIFFERENT RICE ESTABLISHMENT TECHNIQUES IN EARLY *AHU* SEASON

Gaurav Kumar[1]*, Anshu Kumar[1], Nirmal Karan[1], Sarat Sekhar Bora[3], Ranjit Kumar Saud[2], Manoj Kumar Chauhan[2], Nawab Tayab Rafique[1], Kuldip Medhi[4] and Milon Jyoti Konwar[3]

[1]Department of Agronomy, Assam Agricultural University, Jorhat - 785 013, Assam, India.
[2]Directorate of Extension Education, Assam Agricultural University, Jorhat - 785 013, Assam, India.
[3]Directorate of Research (Agri.), Assam Agricultural University, Jorhat - 785 013, Assam, India.
[4]Department of Agrometeorology, Assam Agricultural University, Jorhat - 785 013, Assam, India.
*Corresponding author E-mail : gaurav.kumar90797@gmail.com

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ABSTRACT

A field experiment was carried out during the early *ahu* season of 2024–25 at Assam Agricultural University, Jorhat, to evaluate the effects of various rice establishment techniques and weed management practices on the growth, yield, and economics of wet direct-seeded rice. The experiment was laid out in a split-plot design with three replications. The establishment techniques tested were broadcasting, line sowing, and drum seeding, while the weed management practices included a weedy check, a weed-free check, pyrazosulfuron ethyl @ 30 g/ha applied as a pre-emergence herbicide followed by manual weeding at 30 DAS, pyrazosulfuron ethyl @ 30 g/ha (Pre-emergence) followed by fenoxaprop-p-ethyl @ 70 g/ha (post-emergence) and pretilachlor 50 EC @ 750 g/ha (Pre-emergence) followed by bispyribac sodium 10% SC @ 25 g/ha (post-emergence).

The results indicated that drum seeding produced the highest grain yield (37.84 q/ha) and straw yield (58.71 q/ha) compared to line sowing and broadcasting. Among weed management practices, the weed-free check recorded the highest grain (38.71 q/ha) and straw yield (60.11 q/ha), followed closely by pyrazosulfuron ethyl @ 30 g/ha (Pre-emergence) followed by fenoxaprop-p-ethyl @ 70 g/ha (post-emergence), which yielded 35.89 q/ha of grain and 57.07 q/ha of straw. In terms of treatment combinations, drum seeding with a weed-free check achieved the highest grain yield (42.93 q/ha) and straw yield (63.84 q/ha), followed by drum seeding combined with pyrazosulfuron ethyl @ 30 g/ha (Pre-emergence) followed by fenoxaprop-p-ethyl @ 70 g/ha (post-emergence). The combination of drum seeding and pyrazosulfuron ethyl followed by fenoxaprop-p-ethyl resulted in the highest gross return (₹ 94,996/ha) and benefit-cost ratio (1.66), highlighting its economic advantage over other treatments.

Key words : Fenoxaprop-p-ethyl, Drum seeding, Benefit-cost ratio, Harvest index, Direct seeded rice.

Introduction

Rice (*Oryza sativa* L.), a staple crop and the primary food source for an estimated 3.5 billion people globally, contributing up to 50% of the daily caloric intake for Asian populations. More than half of the world's population depends on rice as a staple diet, making it the second most extensively produced cereal crop worldwide (Hasim *et al.*, 2024). India ranks first in area and second in production, with 47.6 million ha under rice cultivation, yielding 1357.55 lakh tonnes (USDA, 2024). Assam, the ninth-largest rice-producing state in India, cultivates rice over 2.54 million ha, accounting for over 90% of the net cropped area and contributing 6.0 million tons with an average yield of 2.6 tons/ha (Deka *et al.*, 2014; Anonymous, 2023).

Transplanting remains the most widely practiced method of rice establishment in India, despite its high-water requirements and labor intensity (Farooq *et al.*, 2011). Moreover, traditional practices such as nursery bed preparation and seedling transplanting not only demand substantial labor and water but also contribute significantly to methane emissions, raising environmental concerns (Negi *et al*., 2024). Direct-seeded rice (DSR), where seeds are sown directly into the field without raising a nursery, has gained popularity as a promising alternative to traditional transplanting. It offers several advantages, including reduced labor requirements, lower water usage, earlier crop maturity, and minimized greenhouse gas emissions (Kumar *et al*., 2016; Kaur *et al*., 2017). Currently, DSR is practiced across approximately 26% of the total rice-growing area in South Asia, with wet seeding being the most widely adopted method (Bhattacharyya *et al*., 2022). Despite these benefits, effective weed management remains a significant challenge in DSR, as unchecked weed infestations can lead to yield losses ranging from 50% to 90% (Singh *et al*., 2016).

To address this challenge, the use of advanced herbicides or their combinations is essential to ensure effective and targeted control of diverse weed species in direct-seeded rice. With this objective in mind, the present study was conducted to evaluate different weed management practices and establishment techniques aimed at minimizing weed infestation, while simultaneously enhancing rice productivity under wet direct-seeded conditions.

Materials and Methods

The research was conducted during the early *ahu* season of 2024 at ICR Farm, Assam Agricultural University, Jorhat, Assam. The soil was sandy loam with a pH level of 5.56 (acidic), organic carbon content at 0.64 % (medium), available nitrogen at 316.53 (medium), available phosphorus at 19.60 (low), available potassium at 137.64 (medium). A total of 476.30 mm of rainfall was recorded during the growth period. The experiment followed a split-plot design with three replications, evaluating three establishment methods namely broadcasting, line sowing and drum seeding and five different weed management practices *viz.*, weedy check (W_1), weed-free check (W_2), pyrazosulfuron ethyl @ 30 g/ha (Pre-emergence) followed by manual weeding at 30 DAS (W_3), pyrazosulfuron ethyl @ 30 g/ha (Pre-emergence) followed by fenoxaprop-p-ethyl @ 70 g/ha (Post-emergence) (W_4) and pretilachlor 50 EC @ 750 g/ha (Pre-emergence) followed by bispyribac sodium 10% SC @ 25 g/ha (Post-emergence) (W_5). The recommended nutrient dose included 40 kg N/ha through urea, 20 kg P_20_5/ha through SSP and 20 kg K_20/ha through MOP was applied uniformly. Where half of the N, entire dose of P_2O_5 and K_2O were applied as basal dose and remaining 50 % of N was applied in two split doses i.e., 25% at active tillering stage and 25 % at panicle initiation stage. The rice variety chosen was Dishang with a maturation period of 90-95 days. Seed rate of 100 kg/ha was taken for broadcasting, 75 kg/ha for line sowing and 35 kg/ha for drum seeding. Herbicides were applied with knap-sack sprayer with a flat-fan nozzle, delivering a spray volume of 600 litres/ha. Plant samples in the experimental plots were recorded at 30, 60 DAS and at harvest to analyze the growth characteristics, yield attributes and yield in wet-direct seeded rice. Growth characteristics, yield attributes and yield such as plant height, no. of tillers, no. of panicles/m^2, panicle length, panicle weight, no. of grains/panicle, no. of filled grains/panicle, test weight, grain yield, straw yield and harvest index were recorded at these intervals. The recorded data were subjected to analysis of variance (ANOVA) for split-plot design (SPD) as per Panse and Sukhatme (1954). The harvest index, which represents the ratio of economic yield to biological yield, was calculated using the formula provided by Sharma and Mittra (1988).

$$\text{Harvest index (\%)} = \frac{\text{Economical yield}}{\text{Biological yield}} \times 100$$

Results and Discussion

Drum seeding consistently outperformed other establishment methods, recording the highest values for growth and yield-attributing traits across all stages. The uniform seed-to-seed spacing achieved with drum seeding resulted in higher plant density, better root penetration and efficient nutrient uptake, ultimately enhancing plant growth and yield. Superior performance in terms of the number of panicles/m^2 (255.85), panicle length (22.34 cm), number of filled grains per panicle (92.64), panicle weight (5.29 g), test weight, grain yield (37.84 q/ha), straw yield (58.71 q/ha) and harvest index (37.63) was observed under drum seeding, followed by line sowing and broadcasting. The favourable environmental conditions created by uniform plant spacing under drum seeding facilitated improved nutrient translocation from source to sink, leading to higher productivity. These findings are consistent with those of Jeet *et al*. (2021), Padma *et al*. (2023), Mir *et al*. (2023).

Among the weed management practices, the weed-free check exhibited the highest yield-attributing traits and yield due to effective weed suppression during the critical period of crop-weed competition. This ensured better resource availability for the crop, promoting higher photosynthate translocation and grain filling. The weed-

Table 1 : Effect of establishment techniques and weed management practices on plant **h**eight (cm) and no. of tillers/m² of early *ahu* rice.

Treatments	Plant height			No. of tillers/m²		
	30 DAS	60 DAS	At harvest	30 DAS	60 DAS	At harvest
Establishment techniques (M)						
M_1	24.19	53.38	82.60	127.30	229.95	238.11
M_2	24.62	58.90	90.08	151.15	242.85	253.96
M_3	25.20	61.35	92.69	157.37	253.48	268.98
S. Em (±)	0.392	0.398	0.669	1.37	2.26	1.77
CD (P=0.05)	NS	1.561	2.626	5.38	8.85	6.95
Weed management practices (W)						
W_1	23.76	53.93	83.61	114.58	184.89	190.57
W_2	25.76	62.54	94.30	169.47	272.42	289.24
W_3	24.32	56.71	86.20	138.32	245.45	249.68
W_4	24.99	58.32	89.11	156.28	256.02	273.60
W_5	24.52	57.87	88.21	147.70	251.68	265.33
S. Em (±)	0.45	0.64	0.98	1.93	3.34	2.87
CD (P=0.05)	NS	1.87	2.86	5.64	9.75	8.37
Interaction (M x W)	NS	NS	NS	**NS**	**NS**	**S**

Table 2 : Effect of establishment techniques and weed management practices on yield attributing characters of early *ahu* rice.

Treatments	No. of panicles/m²	Panicle length (cm)	Panicle weight (g)	No. of grains /panicle	No. of filled grains /panicle	Test weight (g)
Establishment techniques (M)						
M_1	209.00	19.02	4.15	85.58	78.80	20.22
M_2	244.65	20.73	4.86	93.97	86.37	20.74
M_3	255.85	22.34	5.29	96.28	92.64	20.98
S. Em (±)	1.65	0.39	0.08	0.59	0.61	0.42
CD (P=0.05)	6.49	1.52	0.32	2.32	2.41	NS
Weed management practices (W)						
W_1	175.65	18.73	3.81	86.76	74.31	19.39
W_2	272.21	22.32	5.36	97.64	96.62	21.53
W_3	238.65	20.34	4.69	89.86	82.33	20.28
W_4	251.32	21.11	5.06	93.10	89.75	21.08
W_5	244.65	20.98	4.91	92.35	85.66	20.95
S. Em (±)	2.67	0.37	0.10	1.02	0.96	0.50
CD (P=0.05)	7.80	1.08	0.31	2.99	2.80	1.46
Interaction (M x W)	NS	NS	NS	NS	S	NS

free check recorded the highest values for grain yield (38.71 q/ha) and straw yield (60.11 q/ha). Pyrazosulfuron-ethyl 10% WP at 30 g/ha (pre-emergence) followed by fenoxaprop-p-ethyl at 70 g/ha (post-emergence) also showed high yield-attributing characteristics with comparable results observed for pretilachlor 50 EC at 750 g/ha (pre-emergence) followed by bispyribac-sodium 10% SC at 25 g/ha (post-emergence) (Rao *et al.*, 2017; Singh *et al.*, 2017; Khaliq *et al.*, 2019). Conversely, the weedy check resulted in significantly lower values for all yield parameters due to intense competition for essential resources, which stunted crop growth and reduced yield. Similar results were reported by Kumar *et al.* (2018), Jehangir *et al.* (2021), Pratap *et al.* (2021).

The combination of drum seeding with a weed-free check achieved the highest grain yield (42.93 q/ha) and straw yield (63.84 q/ha), followed closely by drum seeding paired with pyrazosulfuron-ethyl and fenoxaprop-p-ethyl application. These combinations reduced weed

Table 3 : Effect of establishment techniques and weed management practices on yield attributing characters of early *ahu* rice.

Treatments	Grain yield (q/ha)	Straw yield (q/ha)	Harvest index (%)
Establishment techniques (M)			
M_1 Broadcasting	27.70	49.35	34.15
M_2 Line sowing	31.56	54.15	35.13
M_3 Drum seeding	37.84	58.71	37.63
S. Em (±)	0.25	0.39	-
CD (P=0.05)	0.99	1.53	-
Weed management practices (W)			
W_1 Weedy Check	20.25	46.05	29.03
W_2 Weed free	38.71	60.11	37.93
W_3 Pyrazosulfuron ethyl 10% WP @ 30g/ha (Pre-emergence) *fb* manual weeding (30 DAS)	32.49	51.96	36.96
W_4 Pyrazosulfuron ethyl 10% WP @ 30g /ha (Pre-emergence) *fb* fenoxaprop-p-ethyl @ 70 g/ha (post-emergence)	35.89	57.07	37.17
W_5 Pretilachlor 50 EC @ 750g /ha (pre-emergence) *fb* bispyribac sodium 10% SC @ 25.0 g/ha (post- emergence)	34.54	55.15	37.06
S. Em (±)	0.31	0.72	-
CD (P=0.05)	0.91	1.85	-
Interaction (M x W)	S	S	-

competition, improved nutrient uptake, and optimized growing conditions, contributing to enhanced crop performance and higher productivity. Similar findings have been reported by Singh *et al*. (2010) and Chhokar *et al*. (2014).

Conclusion

Direct-seeded rice (DSR) offers a practical and sustainable alternative to traditional transplanting by reducing labor, saving water and allowing faster crop maturity. However, to achieve better yields, effective weed management is essential. Drum seeding, combined with timely and efficient weed control, ensures healthier crop growth and improved productivity, making DSR a reliable choice for future rice farming.

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