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IMPACT OF ESTABLISHMENT TECHNIQUES AND WEED MANAGEMENT STRATEGIES ON GROWTH, YIELD ATTRIBUTES AND YIELD IN WET DIRECT-SEEDED WINTER RICE

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ABSTRACT

A field experiment was conducted at Assam Agricultural University-Assam Rice Research Institute, Titabar, Assam during *sali* season of 2022 to study the effect of different establishment techniques and weed management practices on growth and yield parameters of wet direct seeded rice (DSR). The layout of the experiment was based on split plot design with three replications. Three establishment techniques and six different weed management practices were taken under consideration. All the growth parameters were recorded at an interval of 30,60,90 DAS and at harvest, respectively. Meanwhile, the yield attributes were recorded just before harvest of the crop. Results revealed that among various establishment techniques, drum seeding technique recorded the highest growth parameters *viz.*, plant height (134.15 cm), no. of tillers/m^2 (310.89), dry matter accumulation/m^2 (877.59 g/m^2) and leaf area index (3.12) along with highest grain (43.07q/ha) and straw yield (68.79q/ha). In respect to various weed management practices. pyrazosulfuron-ethyl @ 30g/ha at 2 DAS *fb* bispyribac-Na @ 25 g/ha at 25 and 45 DAS recorded the highest plant height (134.98 cm), No. of tillers/m^2 (320.67), dry matter accumulation/m^2 (926.94 g/m^2) and leaf area index (3.40) along with highest grain (44.37q/ha) and straw yield (71.80 q/ha) which was next to weed free check at harvest.

Key words : Bispyribac-Na, Direct-seeded rice, Drum seeding, Line sowing, Pyrazosulfuron-ethyl.

Introduction

Rice (*Oryza sativa* L.) holds an indispensable position as one of the world's vital and extensively grown staple foods. It caters to a significant portion of the global population's sustenance. Having originated in Southeast Asia millennia ago, the practice of rice cultivation has undergone a transformative journey, becoming an integral aspect interwoven with the cultural and economic fabric of numerous societies. Its remarkable adaptability to various climatic conditions further solidifies its importance as a crucial crop, ideally suited for growth in both tropical and subtropical regions. The concept of direct seeding for rice is gaining traction as a promising alternative to traditional transplanting methods. This approach involves planting pre-germinated rice seeds directly in the field, either manually or using mechanical equipment, eliminating the need for transplanting seedlings from nursery beds. The adoption of direct-seeded rice has been on the rise due to factors such as increased groundwater depletion, escalating pumping expenses, labour and time constraints, and the desire to mitigate transplanting shock on the crop. Direct-seeded rice (DSR) offers advantages in terms of faster and simpler planting, lower initial production expenses, reduced water requirements, earlier crop maturation by 7 to 10 days, decreased methane emissions into the atmosphere and generally higher yields when

compared to traditional transplanting methods (Dass *et al.*, 2017).

10.8% higher grain yield along with 60.4% lower global warming potential was reported in wet direct seeded rice than that of transplanted rice (Tao *et al.*, 2016). Despite of its numerous benefits, the primary challenge with direct-seeded rice is its effective weed control. Higher weed density is a key challenge in this technique compared to transplanting, as rice and weeds grow together without standing water during early growth stages. To address this concern, embracing noble herbicides or their combinations is necessary. This approach ensures accurate and efficient control of a wide array of weed species in the direct seeding method for rice cultivation.

Materials and Methods

The experiment was conducted at Assam Agricultural University-Assam Rice Research Institute, Titabar, Assam (26º43' N, 94º12' E, 86.6 m above msl) during *sali* season of 2022. The soil was clayey loam with pH 4.97 (acidic), organic carbon 0.56 % (medium), available N 242.41 kg/ha (low), available P_2O_5 24.16 kg/ha (medium) and available K_2O 154.23 kg/ha (medium) with total rainfall received during the growth period was 1043.10 mm. Three establishment techniques *viz.*, broadcasting (M_1), drum seeding (M_2), line sowing (M_3) and six different weed management practices *viz.*, hand weeding at 20, 40 and 60 DAS (W_1), pyrazosulfuron-ethyl @ 30 g/ha at 2 DAS *fb* bispyribac-Na @ 25 g/ha at 25 DAS (W_2), pyrazosulfuron-ethyl @ 30 g/ha at 2 DAS *fb* mechanical weeding at 40 and 60 DAS (W_3), pyrazosulfuron-ethyl @ 30 g/ha at 2 DAS *fb* bispyribac-Na @ 25 g/ha at 25 and 45 DAS (W_4), weed free check (W_5), weedy check (W_6). The layout of the experiment was based on split-plot design with three replications. Recommended dose of 60 kg N/ha as urea, 20 kg P_2O_5/ha through SSP and 40 kg K_2O/ha through MOP was applied uniformly. Half of the N, entire dose of P_2O_5 and K_2O were applied as basal and remaining 50 % of N was applied in two splits *i.e.*, 25 % at active tillering stage and remaining 25% at panicle initiation stage. Numali was taken as the rice variety with a maturation period of 135-140 days. Seed rate of 100 kg/ha was taken for broadcasting, 35 kg/ha for drum seeding and 75 kg/ha for line sowing. Herbicides were applied with knap-sack sprayer delivering a spray volume of 600 litres/ha through flat-fan nozzle. All the growth parameters *viz.*, plant height

Table 1 : Effect of establishment techniques and weed management practices on growth parameters of *sali* rice.

Treatment	Plant height (cm)	No. of tillers/m²	Leaf area Index	Dry matter accumulation (g/m²)
Establishment techniques				
Broadcasting	124.05	279.90	3.08	858.40
Drum seeding	134.15	310.89	3.12	877.59
Line sowing	128.85	297.28	3.11	867.38
SEm ±	1.16	0.79	0.02	2.19
CD (P = 0.05)	4.55	3.12	NS	8.59
Weed management practices				
Hand weeding at 20, 40 and 60 DAS	127.42	293.11	3.04	906.27
Pyrazosulfuron-ethyl @ 30g /ha at 2 DAS *fb* bispyribac-Na @ 25 g/ha at 25 DAS	123.43	287.25	2.83	896.12
Pyrazosulfuron-ethyl @ 30g/ha at 2 DAS *fb* mechanical weeding at 40 and 60 DAS	131.43	305.12	3.24	916.44
Pyrazosulfuron-ethyl @ 30g/ha at 2 DAS *fb* bispyribac-Na @ 25 g/ha at 25 and 45 DAS	134.98	320.67	3.40	926.94
Weed free check	138.56	332.23	3.46	936.78
Weedy check	118.26	237.78	2.66	624.20
SEm ±	1.18	1.25	0.01	3.47
CD (P=0.05)	3.39	3.62	0.04	10.01

DAS: days after sowing; *fb*: followed by.

(cm), No. of tillers/m^2, dry matter accumulation/m^2 and leaf area index were recorded at an interval of 30,60,90 DAS and at harvest, respectively. Meanwhile, the yield attributes *viz*., panicle/m^2, panicle length (cm), filled grains/panicle, test weight (g) was recorded just before harvest of the crop. The data recorded in the experiment for each parameter were subjected to analysis of variance for split-plot design (SPD) given by Panse and Sukhatme (1954).

Results and Discussion

Among the establishment techniques, drum seeding (M_2) technique recorded the highest growth parameters *viz*., plant height (134.15 cm), No. of tillers/m^2 (310.89), dry matter accumulation/m^2 (877.59 g/m^2) and leaf area index (3.12) at harvest which was followed by line sowing (M_3) and broadcasting (M1) (Table 1). This might be due to uniform spacing between the seeds, leading to notably elevated plant densities. Additionally, the profound root penetration facilitated efficient nutrient absorption, thereby promoting higher plant growth. Similar findings were reported by Chandrasekhararao *et al*. (2013), Nayak *et al*. (2014) and Sudharani *et al*. (2019). Meanwhile, among different weed management practices, pyrazosulfuron-ethyl @ 30g/ha at 2 DAS *fb* bispyribac-Na @ 25 g/ha at 25 and 45 DAS (W_6) recorded the highest plant height (134.98 cm), No. of tillers/m^2 (320.67), dry matter accumulation/m^2 (926.94 g/m^2) and leaf area index (3.40) which was next to weed free check (W_5) at harvest (Table 1). This might be due to effective suppression of weed population density with the pre-emergence herbicide during seedling stage and successive reduction of weed population during later growth stages by using post-emergence herbicide twice, thus maintaining a suitable environment for optimum crop growth. Similar findings were recorded by Rao *et al*. (2019), Mahbub *et al*. (2022), Krishna and Prathiba (2023).

Similar trends were also observed in yield attributes and yield. Drum seeding treatment (M_2) gave the highest yield attributing characters *viz*., number of panicles/m^2 (271.61), number of filled grains/panicle (118.56), panicle weight (5.84g), test weight (24.03g), grain (43.07 q/ha)

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

Treatment	No. of panicles /m^2	No. of filled grains /panicle	Panicle weight (g)	Test weight (g)	Grain yield (q/ha)	Straw yield (q/ha)
Establishment techniques						
Broadcasting	257.45	111.72	4.32	23.66	32.62	60.64
Drum seeding	271.61	118.56	5.84	24.03	43.07	68.79
Line sowing	266.50	114.28	5.06	23.71	36.90	65.54
SEm ±	1.21	0.32	0.13	0.17	0.29	0.60
CD (P=0.05)	4.76	1.25	0.50	NS	1.14	2.36
Weed management practices						
Hand weeding at 20, 40 and 60 DAS	277.55	114.67	4.92	23.40	37.27	63.57
Pyrazosulfuron-ethyl @ 30g /ha at 2 DAS *fb* bispyribac-Na @ 25 g/ha at 25 DAS	268.78	108.45	4.59	23.17	34.47	59.07
Pyrazosulfuron-ethyl @ 30g/ha at 2 DAS *fb* mechanical weeding at 40 and 60 DAS	283.89	118.78	5.22	24.07	41.48	68.31
Pyrazosulfuron-ethyl @ 30g/ha at 2 DAS *fb* bispyribac-Na @ 25 g/ha at 25 and 45 DAS	289.44	123.22	5.57	24.73	44.37	71.80
Weed free check	294.89	126.67	5.88	25.40	47.50	75.11
Weedy check	176.55	97.33	4.27	22.01	20.06	52.09
SEm ±	1.58	0.29	0.10	0.23	0.37	0.40
CD (P = 0.05)	4.57	0.82	0.30	0.66	1.07	1.15

DAS: days after sowing, *fb* : followed by.

and straw yield (68.79q/ha) among the various establishment techniques and was followed by line sowing (M_3) and broadcasting (M_1) (Table 2). This might be due to extended and more favourable environmental conditions throughout the crop growth phase which enhanced opportunities for overall growth and development of the crop. Furthermore, there was a greater efficiency in the translocation of nutrients from source to sink, which ultimately culminated in the maximization of the yield. Similar findings were reported by Larry *et al*. (2012) and Rana *et al*. (2014). On the other hand, pyrazosulfuron-ethyl @ 30g/ha at 2 DAS *fb* bispyribac-Na @ 25 g/ha at 25 and 45 DAS (W_6) recorded the highest yield attributing characters *viz*., number of panicles/m^2 (289.44), number of filled grains/panicle (123.22), panicle weight (5.57g), test weight (24.73g), grain (44.37q/ha) and straw yield (71.80 q/ha) among the various weed management practices next to weed free check (W_5) (Table 2). This might be due to efficient suppression of weed growth during the critical period of crop-weed competition, ultimately maximizing the yield attributing characters and overall yield. These were in conformity with the findings of Mahbub *et al*. (2022) and Mukherjee *et al*. (2022).

However, significant interaction effect was observed between the establishment techniques and weed management practices. Combination of drum seeding along with weed free check (M_2W_5) gave the highest filled grains/panicle, grain and straw yield. It was followed by the treatment combination of drum seeding along with pyrazosulfuron-ethyl @ 30 g/ha at 2 DAS *fb* bispyribac-Na @ 25 g/ha at 25 and 45 DAS (M_2W_4), which was statistically at par with line sowing along with weed free check (M_3W_5). This might be due to higher uptake of available nutrients and minerals from the soil under weed free congenial environment throughout the critical growth stages of crop with the timely application of herbicides, which favoured better partitioning of the dry matter to reproductive parts of the crop, thus enhancing yield attributing characters and yield. Similar findings were reported by Hasan *et al*. (2010) and Parameswari *et al*. (2014).

Conclusion

Among the different establishment techniques, drum seeding exhibited higher growth parameters, yield attributing characters and overall yield which was followed by line sowing. Meanwhile, pyrazosulfuron-ethyl @ 30g/ha at 2 DAS *fb* bispyribac-Na @ 25 g/ha at 25 and 45 DAS gave the higher growth parameters, yield attributing characters and overall yield next to weed free check within the different weed management practices. It may be concluded that the combination of drum seeding along with pyrazosulfuron-ethyl @ 30g/ha at 2 DAS *fb* bispyribac-Na @ 25 g/ha at 25 and 45 DAS can enhance growth parameters, yield attributing characteristics and overall yield of wet direct seeded winter rice.

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