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Effect of weed control practices for growth parameters in direct seeded rice (*Oryza sativa* L.)

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Abstract
Direct seeded rice is considered one of the most effective, sustainable, and economically feasible rice cultivation methods currently in use. The present investigation was undertaken to evaluate the "Effect of weed management practices on production and productivity in direct seeded Rice (*Oryza sativa* L.)" at the Experimental Farm, School of Agriculture Science, LNCT University, Bhopal, (M.P.) during two consecutive years of 2023 and 2024 during *kharif* season. The research employed a Randomized Block Design for the experiment, which included three replications and twelve treatments (T_1 - T_{12}) of weed control. During both years of same season, the highest value of plant height (cm), number of tillers/m^2, dry matter production (g/m^2), leaf area index (LAI), root length (cm), root volume (g/cc) and root dry weight (g/plant) at harvest were recorded with T_9 {Pretilacholr 750 g/ha (2 DAS) fb Bispyribac sodium 20 g /ha (20 DAS)}, respectively.

Keywords: Bispyribac sodium, direct seeded, pretilachlor, rice and weed

Introduction
Rice (*Oryza sativa* L.) is the most crucial and widely grown crop globally. Approximately half of the world's population, particularly in East and Southeast Asia, relies entirely on rice as their primary food source; the annual production of rice exceeds 700 million tons (which includes 470 million tons of milled rice). Asia alone contributes nearly 640 million tons of rice production. The rice sector provides income and jobs for over 50 million households. China and India are the leading rice-producing countries in the world. Although India's harvested area is larger, China's production is greater due to its superior irrigation facilities. Following China and India, the next largest producers of rice are Indonesia, Bangladesh, Vietnam, Myanmar, and Thailand. Rice contributes to 20 percent of the global dietary energy supply; brown rice, which is processed to only remove the husk, contains around 8 percent protein, minimal fats, and is a good source of thiamine, niacin, riboflavin, iron, and calcium.

The traditional method of rice farming involves transplanting seedlings into puddled soils, which necessitates significant amounts of water and labour. Consequently, direct seeding presents an alternative approach to rice cultivation that has several advantages over transplanting, such as reducing the need for puddling. Given the current global scarcity of water and labour, this rice cultivation method conserves resources and serves as a viable replacement for the traditional method. Direct Seeding Rice (DSR) boasts numerous benefits, including water and labour savings by eliminating the puddling, nursery management, and transplanting processes. By completely removing the puddling step, it enhances soil structure, lowers greenhouse gas emissions, allows for timely planting of subsequent wheat crops, and achieves crop diversification with rice maturing 7-10 days earlier (Roy, 2016) [1]. DSR is favoured due to its reduced input requirements. It also provides specific benefits such as lower water needs, labour savings, less drudgery, decreased production costs, quicker crop maturity, improved soil physical conditions for following crops, and lower methane emissions, fitting well into various cropping systems. Higher yields in DSR can also be realized by implementing various agronomic practices, including choosing appropriate cultivars, ensuring optimal sowing timing, maintaining the correct seed rate, and managing weeds and water effectively.

The weed species associated with direct seeded rice differ from those in transplanted rice due to variations in cultivation methods. In direct seeded rice, weeds emerge at the same time as the crop, resulting in increased competition, which makes weed management through herbicides essential (Singh and Singh, 2010) [3]. In this scenario, weeds represent a significant challenge in Direct Seeded Rice (DSR) as they compete for nutrients, light, moisture, and space starting from their emergence and continuing throughout the crop's growing season, while in transplanted rice, weed seeds germinate after the rice seedlings have been established, competing with them. This study will evaluate integrated weed management strategies against traditional practices like hand weeding and mechanical weeding to assess cost savings in weeding while also improving the profitability of weed management practices by reducing reliance on human labour under conditions where labour is scarce, aiming for successful direct seeded rice cultivation, with intercrops considered for effective weed control alongside other mechanical methods. Hence, the main objective of this experiment was to increase the production and productivity of rice in DSR practice with different treatments of weed control.

Materials and Methods

The present experiment was conducted to evaluate the "Effect of weed management practices on production and productivity in direct seeded Rice (*Oryza sativa* L.)" at the Experimental Farm, School of Agriculture Science, LNCT University, Bhopal, (M.P.) during two consecutive years of *kharif* season 2023 and 2024. The experiment was laid out in Randomized Block Design with three replications and twelve treatments *i.e.* T_1 (Control), T_2 {Hand Weeding (20 and 40 DAS)}, T_3 {Mechanical weeding (20 and 40 DAS)}, T_4 (Brown manuring), T_5 {Pretilacholr 750 g/ha (2 DAS)}, T_6 {Quintrione 300 g/ha (20 DAS)}, T_7 {Pretilacholr 750 g/ha (2 DAS) fb Quintrione 300 g/ha (20 DAS)}, T_8 {Sodium-bispyribac 20 g /ha (20 DAS)}, T_9 {Pretilacholr 750 g/ha (2 DAS) fb Sodium-bispyribac 20g/ha (20 DAS)}, T_{10} {Oxadiarygyl 80 g/ha (2 DAS)}, T_{11} {Oxadiarygyl 80g/ha (2 DAS) fb Quintrione 300g/ha (20 DAS) } and T_{12} {Oxadiarygyl 80 g /ha (2 DAS) fb Sodium-bispyribac 20g/ha}. During the study, the observations were recorded on plant height (cm), number of tillers/m^2, dry matter production (g/m^2), leaf area index (LAI), root length (cm), root volume (g/cc) and root dry weight (g/plant) at harvesting stage in five tagged plants.

Statistical analysis

The Department of Mathematics Statistics at CCS HAU in Hisar, Haryana, developed the OPSTAT software for data analysis at 5% of significance. From this, to examined the growth data gathered during the experiment.

Results and Discussion

The growth parameters during the both years of *kharif* season, significantly affected by the different treatments of weed control practices (Table-1 and Figure-1 & 2). The results of growth parameters are given below with appropriate discussion.

During two years (2023 and 2024) of *Kharif* season, the highest height of plant (64.98 cm and 61.58 cm), number of tillers/m^2 (307.96 and 309.52), dry matter (970.95 g and 961.14 g), leaf area index (3.34 and 3.47), root length (32.36 cm and 33.52 cm), root volume (10.41 g/cc and 9.92 g/cc) and root dry weight (1.30 g and 1.53 g) significantly recorded with T_9 {Pretilacholr 750 g/ha (2 DAS) fb Sodium salt of bispyribac (Sodium-bispyribac) 20 g /ha (20 DAS)}.

In this research, the impact of various treatments on plant height was assessed, revealing distinct variations among the treatments. The treatments that included different management practices of weeds resulted in greater heights when compared to the control group (Singh *et al*., 2024) [4]. Plants that were cultivated using integrated management practices exhibited a significant quantity of tillers. In many instances, the number of tillers is determined by the plant's genetic makeup passed down through generations (Shah *et al*., 2025; Singh *et al*., 2024) [2, 4].

The enhanced performance resulted from the synergistic application of these herbicides, which promote plant health and provide essential nutrients while improving the biological activity of the soil. Consequently, this results in sufficient and balanced herbicide application during the plant growth periods when all inputs are needed in appropriate amounts. The rise in dry weight may be attributed to the sufficient nutrient availability associated with T_9 (Teja *et al*., 2015) [7]. The IAI in this study investigated how various practices impact, which is essential for promoting robust vegetative growth and yield. The findings indicated that the number of leaves increased positively when pre-emergence type of herbicides was applied as compared to control (Ramachandıran and Balasubramaman, 2024) [6].

The various dosages of herbicides and other control practices for root length in DSR rice, it is frequently observed that plants exhibit greater root length and volume when herbicides application incorporated. This enhancement in root dry weight can improve yield and productivity. These root parameters were recorded with the application of a standard dosage of Pretilacholr 750 g/ha (2 DAS) fb Sodium-bispyribac 20g/ha (20 DAS). Significant variations in root parameters were noted across the twelve treatments that utilized different practices of weed control. The treatments that incorporated both types of hercicides resulted in longer root and highest weight, likely due to enhanced nutrient availability due less effect of weeds to plants, which promoted cell division and overall root growth compared to control. Similar results have also been studies by Teja *et al*. (2015) [7] and Chakraborti *et al*. (2017) [5].

Table 1: Effect of weed management practices on growth parameters in direct seeded rice

Treatments	Plant height (cm)		Number of tillers/m^2		Dry matter (g/m^2)		Leaf area index		Root length (cm)		Root volume (g/cc)		Root dry weight (g/plant)	
	2023	2024	2023	2024	2023	2024	2023	2024	2023	2024	2023	2024	2023	2024
T_1	46.21	43.78	218.98	220.09	784.99	777.06	2.37	2.47	23.01	23.12	7.40	7.05	2.48	2.49
T_2	50.17	47.53	237.75	238.96	852.27	843.66	2.58	2.68	24.98	25.10	8.04	7.66	2.70	2.70
T_3	53.59	50.78	253.97	255.26	910.42	901.22	2.76	2.86	26.69	26.82	8.58	8.18	2.88	2.89
T_4	48.31	45.78	228.95	230.10	820.70	812.42	2.48	2.58	24.05	24.17	7.74	7.38	2.60	2.60
T_5	57.46	54.44	272.28	273.65	922.66	913.34	2.95	3.06	28.61	28.75	9.20	8.77	3.09	3.09
T_6	54.81	51.94	259.77	261.08	908.72	899.54	2.81	2.92	27.29	27.43	8.78	8.37	2.94	2.95
T_7	61.03	57.82	289.20	290.66	954.67	945.03	3.14	3.25	30.39	30.54	9.77	9.32	3.28	3.29

T_8	59.85	56.71	283.64	285.07	922.86	913.54	3.08	3.19	29.80	29.95	9.59	9.14	3.22	3.23
T_9	64.98	61.58	307.96	309.52	970.95	961.14	3.34	3.47	32.36	33.52	10.41	9.92	3.49	3.51
T_{10}	56.72	53.74	268.80	270.16	950.24	940.64	2.91	3.03	28.24	28.38	9.09	8.66	3.05	3.06
T_{11}	62.79	59.49	297.54	299.04	962.01	952.29	3.23	3.35	31.26	31.42	10.06	9.59	3.38	3.37
T_{12}	60.24	57.08	285.49	286.93	931.40	921.99	3.09	3.21	30.00	30.14	9.65	9.20	3.24	3.25
SE(m)±	0.73	0.80	3.55	4.05	10.09	10.00	0.04	0.05	0.45	0.53	0.12	0.14	0.04	0.05
CD (5%)	2.15	2.37	10.48	11.95	29.81	29.53	0.12	0.15	1.35	1.58	0.35	0.43	0.14	0.15

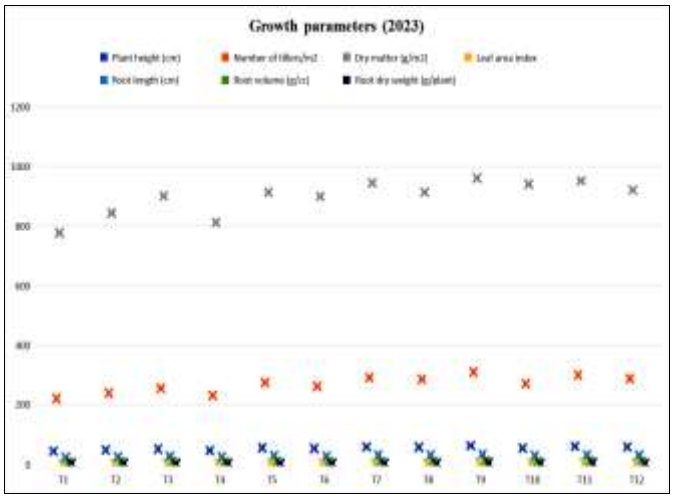

Fig 1: Effect of weed management practices on growth parameters in direct seeded rice during kharif season of 2023

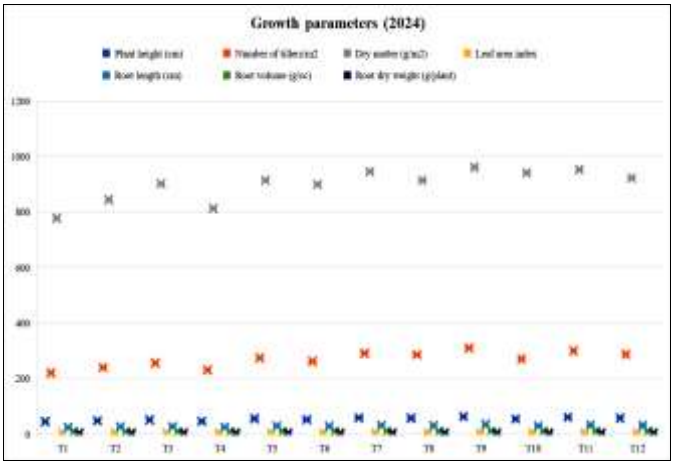

Fig 2: Effect of weed management practices on growth parameters in direct seeded rice during kharif season of 2024

Conclusion

The pre and post emergence herbicides both are essential for weed control result in better growth and development of plants. Different herbicides combinations as compare to control or single application on quantitative trait showed clear differences among the treatments. Treatments containing two types of herbicides responsible for higher yield as compared to control (T_1). Therefore, effect of treatment T_9 {Pretilacholr 750 g/ha (2 DAS) fb Sodium-bispyribac 20g/ha (20 DAS)} with mechanical practices provides better yield without much impact on the environment during both seasons of *kharif* (2023 and 2024). This treatment is therefore useful in the Bhopal region of Madhya Pradesh for commercial farming.

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