To study the effect of Integrated Weed Management practices on Weeds parameters of transplanted rice in Chhattisgarh plains

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ABSTRACT

The present experiment entitled **"To study the effect of integrated weed management practices on weeds parameters of transplanted rice in Chhattisgarh plains"** was studied during the 2022, *kharif* season at Agricultural Research Farm BTC, CARS, Bilaspur, Chhattisgarh. A randomized block design with ten treatments and three replications was used. Treatment T5 (untreated control) had the highest weed density and dry weight measurements, whereas treatment T6 (weed-free) had the lowest.The weed index was lowest in T_6 (weed-free). The stage with the highest percentage of weed control efficiency was T6 (Weed-Free), then T10 (Chlorimuron ethyl 10% WP + Metsulfuron methyl 10% WP @ 0.06g ha^{-1} (20 DAT) + mechanical weeding (20 & 40 DAT) by Ambika paddy weeder at all stages.

Keywords: *Rice, Weedicide, Metsulfuron methyl, Bispyribac-Na, Pyrazosulfuron ethyl, weed index.*

1. INTRODUCTION:

More than half of the world's population depends on rice as a major food source. (Kumar Ladha, 2011). More than one-third of the world's population is currently fed by rice. It is an essential food for over two billion people in Asia and 400 million people in Africa and America. More than 50% of the world's population depends on rice, which is grown on 117.48 million hectares and will yield 498.8 million tons in 2019–20. Over 2 billion people are supported by its agriculture. The most significant crop in India is rice, which is grown on 117.47 million ha and yields 121 million tons annually at a productivity of 2390 kg ha^{-1}. (**Anonymous**, 2020). Rice productivity in India is quite low compared to China (6.2 tons per ha) and Japan (6.5 tons per ha). With a growing population, India will need to produce more rice to meet rising demand, which is expected to be 130 million tonnes by 2030.

The most efficient, cheap, and practical method of managing weeds is through the use of herbicides. Due to the extensive weed flora, pre-emergence and post-emergence herbicides are required to manage weeds in aerobic rice. Because some weed seedlings *(Echinochloa spp.)* morphologically resemble rice seedlings, the use of herbicides in transplanting systems becomes more crucial. (Chauhan, 2010). *Echinochloa colona* (L.), *Digitaria sanguinalis* (L.) Scop., *Cyperus rotundus* (L.), *Cyperus difformis* (L.), *Cyperus iria* (L.), *Eclipta alba* (L.) *Hassk.*, and *Ammania baccifera* (L.) make up the majority of the weed flora in transplanted rice fields. (Deepthi *et al.*, 2010).

2. MATERIAL AND METHODS:

This experiment will be carried out on the performance of different herbicides on growth, yield and productivity of low-land rice during *Kharif* season, in 2022 at, agricultural research farm BTC, CARS, Bilaspur, Chhattisgarh.

In the Kharif season of 2022, a rice crop experiment was conducted using the variety TCR Vikram. The experiment followed a Randomized Block Design with ten treatments replicated three times, resulting in a total of 30 plots. The gross plot size was 6.4m×3.0m (19.2 square meters), while the net plot size was 5.6m×2.5m (14 square meters). Spacing between rows and plants was set at 20 cm and 10 cm, respectively. The recommended fertilizer dose applied was 120:60:40 (N: P_2O_5:K_2O). The rice weed parameters are the main findings of this experiment, using a well-designed randomized block setup to minimize biases and ensure reliable results for optimizing rice production.

In the experiment, the dry matter of weeds (in grams per square meter) was measured at four stages: 20,40,60. days after transplanting (DAT), and at harvest. This data provided insights into the weed biomass at various stages of growth. Along with the weed control efficiency (%) was also calculated to evaluate treatments' effectiveness in managing weed growth comparable to the untreated control. The weed index, a numerical value, was used to assess overall weed infestation levels in the experimental plots, considering weed density, frequency, or biomass. High weed infestation can negatively impact crop growth and yield. Monitoring weed infestation helps make informed decisions about weed control measures. By analyzing these parameters, can optimize weed management strategies and enhance crop productivity while minimizing weed-related challenges.

3. RESULT AND DISCUSSION:

Tables 1, 2, 3, and 4 give data on weed infestation (total weed density), dry matter of weeds, weed index, and weed control effectiveness as influenced by various treatments. At 20 DAT, the significant highest total weed density (10.75) was noted in treatment T_5 (Untreated control), followed by treatment, T_3 (Bispyribac -Na 10% SC @ 20g ha^{-1} (20 DAT)) (10.00) and T_8 (Pyrazosulfuron ethyl 10% WP @ 150g ha^{-1} (3 DAT) + Bispyribac-Na 10% SC @ 20g ha^{-1} (20 DAT)) (8.80). Significant lowest total weed density (0.00) was noted in treatment T_6 (weed-free). At 40 days after transplanting, a significant maximum total weed density (21.50) was noted in treatment T_5 (Untreated control), followed by treatment, T_3 (Bispyribac- Na 10% SC @ 20g ha^{-1} (20 DAT)) (20.00) and T_8 (Pyrazosulfuron ethyl 10% WP @ 150g ha^{-1} (3 DAT) + Bispyribac- Na 10% SC @ 20g ha^{-1} (20 DAT)) (17.60). Significantly lowest total weed density (0.00) was noted in treatment T_6 (weed-free). At 60 days after transplanting, the significant highest total weed density (26.27) was noted in treatment T_5 (Untreated control), followed by treatment, T_3 (Bispyribac-Na 10% SC @ 20g ha^{-1} (20 DAT)) (24.84) and T_8 (Pyrazosulfuron ethyl 10% WP @ 150g ha^{-1} (3 DAT)+ Bispyribac -Na 10% SC @ 20g ha^{-1} (20 DAT)) (21.78). Significantly lowest total weed density (0.00) was noted in treatment T_6 (weed-free). At harvest, the significantly highest total weed density (26.92) was noted in treatment T_5 (untreated control), followed by treatment, T_3 (Bispyribac -Na 10% SC @ 20g ha^{-1} (20 DAT)) (24.97) and T_8 (Pyrazosulfuron ethyl 10% WP @ 150g ha^{-1} (3 DAT) + Bispyribac -Na 10% SC @ 20g ha^{-1} (20 DAT)) (22.91). Significant lowest total weed density (0.00) was noted in treatment T_6 (weed-free). The results of the experiment showed that the total weed density was significantly higher in the untreated control treatment than in the other treatments. This is likely because weeds were not controlled in the untreated control treatment. The data also showed that the total weed population was significantly higher at 20 days after transplanting than at 40 and 60 days after transplanting, and finally at harvest. This is probably because weeds spread more quickly during the early stages of crop growth. Similar outcomes were also noted by Yadav *et al.*, (2009), Kumaran *et al.*, (2015) and Kumar *et al.*, (2018).

At 20 days after transplanting, the significant highest total Weed dry weight (19.65) was noted in treatment T_5 (untreated control), followed by treatment, T_3 (Bispyribac -Na 10% SC @ 20g ha^{-1} (20 DAT)) (17.97) and T_8 (Pyrazosulfuron ethyl 10% WP @ 150g ha^{-1} (3 DAT)+ Bispyribac -Na 10% SC @ 20g ha^{-1} (20 DAT)) (15.39). Significantly lowest total Weed dry weight (0.24) was noted in treatment T_6 (weed-free). At 40 days after transplanting, the significant highest total Weed dry weight (38.84) was noted in treatment T_5 (untreated control), followed by treatment, T_3 (Bispyribac -Na 10% SC @ 20g ha^{-1} (20 DAT)) (34.82) and T_8 (Pyrazosulfuron ethyl 10% WP @ 150g ha^{-1} (3 DAT)+ Bispyribac -Na 10% SC @ 20g ha^{-1} (20 DAT)) (29.65). Significantly lowest total Weed dry weight (0.22) was noted in treatment T_6 (weed-free). At 60 days after transplanting, the significant highest total weed dry weight (42.49) was noted in treatment T_5 (untreated control), followed by treatment, T_3 (Bispyribac -Na 10% SC @ 20g ha^{-1} (20 DAT)) (39.65) and T_8 (Pyrazosulfuron ethyl 10% WP @ 150g ha^{-1} (3 DAT)+ Bispyribac -Na 10% SC @ 20g ha^{-1} (20 DAT)) (34.29). Significantly lowest total weed dry weight (0.22) was noted in treatment T_6 (weed-free). At harvest, the significantly highest total weed dry weight (42.80) was noted in treatment T_5 (untreated control), followed by treatment, T_3 (Bispyribac -Na 10% SC @ 20g ha^{-1} (20 DAT)) (37.15) and T_8 (Pyrazosulfuron ethyl 10% WP @ 150g ha^{-1} (3 DAT)+ Bispyribac -Na 10% SC @ 20g ha^{-1} (20 DAT)) (33.98). Significantly lowest total weed dry weight (0.22) was noted in treatment T_6 (weed-free). According to the experiment's findings, the untreated control treatment's total dry weight of weed was much higher than that of the other treatments. This can be attributable to the untreated control's lack of weed management efforts. Additionally, the total dry weight of the weeds was noticeably higher at day 20 than it was at day 40, day 60, and day harvest. This is likely because weeds tend to grow more vigorously during the early stages of crop growth. These outcomes are consistent with the findings of Veeraputhiran and Balasubramanian (2010) and Subramanyam *et al.* (2007).

The data presented in Table 3 regarding Weed index, clearly shows that, the significantly highest Weed index (53.27) was noted in treatment T_5 (untreated control), followed by treatment, T_3 (Bispyribac -Na 10% SC @ 20g ha^{-1} (20 DAT)) (25.61) and T_8 (Pyrazosulfuron ethyl 10% WP @ 150g ha^{-1} (3 DAT)+ Bispyribac -Na 10% SC @ 20g ha^{-1} (20 DAT)) (19.57). A significant lowest Weed index (0.00) was noted in treatment T_6 (weed-free). The results show that integrated weed management approaches utilizing herbicides, hand weeding and mechanical weeding applied at crucial stages can most effectively minimize yield losses from weeds in transplanted rice. The use of residual herbicides in combination with subsequent hand or mechanical weeding proved more effective in reducing weed indices compared to herbicide-only treatments. Similar results were also observed by Negalur *et al*. (2017).

At 20 days after transplanting, the highest Weed Control Efficiency (%) (98.74) was noted in treatment T_6 (weed free), followed by treatment, T_{10} (chlorimuron ethyl 10% WP + metsulfuron methyl 10% WP @ 0.06g ha^{-1} (20 DAT) + mechanical weeding (20 & 40 DAT) by Ambika paddy weeder) (82.19) and T_9 (Chlorimuron ethyl 10% WP + Metsulfuron methyl 10% WP @ 0.06g ha^{-1} (20 DAT) + Mechanical weeding (40 DAT) by Ambika paddy weeder) (73.40). Significantly lowest total weed control efficiency (%) (0.00) was noted in treatment T_5 (untreated control). At 40 days after transplanting, the highest Weed Control Efficiency (%) (99.43) was noted in treatment T_6 (Weed free), followed by treatment, T_{10} (Chlorimuron ethyl 10% WP + Metsulfuron methyl 10% WP @ 0.06g ha^{-1} (20 DAT) + Mechanical weeding (20 & 40 DAT) by Ambika paddy weeder) (83.34) and T_9 (Chlorimuron ethyl 10% WP + Metsulfuron methyl 10% WP @ 0.06g ha^{-1} (20 DAT) + mechanical weeding (40 DAT) by Ambika paddy weeder) (74.22). Significantly lowest total Weed Control Efficiency (%) (0.00) was noted in treatment T_5 (untreated control). At 60 days after transplanting, the highest weed control efficiency (%) (99.47) was noted in treatment T_6 (weed free), followed by treatment, T_{10} (chlorimuron ethyl 10% WP + metsulfuron methyl 10% WP @ 0.06g ha^{-1} (20 DAT) + mechanical weeding (20 & 40 DAT) by Ambika paddy weeder) (87.03) and T_9 (chlorimuron ethyl 10% WP + metsulfuron methyl 10% WP @ 0.06g ha^{-1} (20 DAT) + mechanical weeding (40 DAT) by Ambika paddy weeder) (77.17). Significantly lowest total weed control efficiency (%) (0.00) was noted in treatment T_5 (untreated control). At harvest, significant maximum weed control efficiency (%) (99.49) was observed in treatment T_6 (weed free), followed by treatment, T_{10} (chlorimuron ethyl 10% WP + metsulfuron methyl 10% WP @ 0.06g ha^{-1} (20 DAT) + mechanical weeding (20 & 40 DAT) by Ambika paddy weeder) (86.85) and T_9 (chlorimuron ethyl 10% WP + metsulfuron methyl 10% WP @ 0.06g ha^{-1} (20 DAT) + mechanical weeding (40 DAT) by Ambika paddy weeder) (73.88). Significant lowest Total

Weed Control Efficiency (%) (0.00) was noted in treatment T_5 (untreated control). The weed-free treatment (T_6) achieved nearly 100% weed control efficiency at all stages, highlighting its effectiveness though it is not practically feasible. It serves as an ideal to aim for through optimized weed management. The results show that integrating herbicides with mechanical weeding can significantly improve weed control and help achieve higher weed control efficiencies compared to herbicide-only treatments. A timely, multi-pronged weed management approach is needed for season-long weed suppression in transplanted rice. The present findings were observed in accordance with those of Priyanka Kabdal *et al.* (2014) and Madhulika Singh and Paikra (2014).

4. CONCLUSION:

The results showed that maintaining a weed-free environment in treatment T_6 (weed-free) was the most effective approach for managing weeds in transplanted rice. At all stages, it consistently noticed the lowest weed total density, dry weight, and index, along with the maximum weed control efficiency. On another hand, the untreated control T_5 had the highest weed infestation it increases total weed density and weed dry weight. This led to the maximum weed index, indicating the highest crop loss due to weeds.

The integrated treatments were moderately effective in controlling weeds compared to the weed-free treatment, but significantly better than the untreated control. Overall, maintaining a weed-free field through herbicide application or manual weeding proved to be the most successful weed management strategy for maximizing rice yield. However, integrated approaches that combine herbicides with mechanical weeding can also provide effective weed control with lower costs compared to the weed-free option.

In conclusion, ensuring a weed-free environment either chemically or manually is the optimal approach for controlling weeds in transplanted rice. However, integrated weed management strategies that integrate herbicides and mechanical weeding can provide a practical alternative, balancing yield goals with economic considerations for farmers.

5. RESEARCH GAPS:

• The study evaluated only a limited number of integrated weed management treatments. Further combinations of herbicides, mechanical and cultural methods could be tested to develop more effective and economical integrated approaches.

• In this experiment only one variety of rice was used. Different varieties may respond differently to various weed management techniques.

• Some observations like weed density, dry weight and weed index was also recorded. More comprehensive weed data including weed flora, frequency, intensity, etc. would provide a nuanced understanding of weed dynamics over time.

6. FUTURE SCOPE:

• Evaluating integrated treatments including different dose and application times of herbicides, manual and mechanical weeding at various stages.

• Testing the response of high yielding rice varieties to integrated weed management.

• Monitoring detailed weed parameters and weed shifts over years under different treatments to formulate adaptive weed management strategies.

• Investigating the impact of integrated weed management on soil health, nutrient uptake, crop water use efficiency and environmental indicators.

• Exploring the feasibility of innovative weed management techniques like mechanical weeders, bioherbicides, allelopathy, etc.

• Identifying the most economical and sustainable weed management approach by factoring in economic, environmental and social dimensions.

Table 1. Effect of integrated weed management practices on total weed density at 20, 40, 60 and at harvest

Tr. No.	Treatment Details	Total weed density			
		20 DAT	40 DAT	60 DAT	At harvest
T1	Pyrazosulfuron ethyl 10% WP @ 20g ha^{-1} (3 DAT) + Mechanical weeding (20 DAT) by Ambika paddy weeder.	6.40	12.80	16.88	17.95
T2	Pyrazosulfuron ethyl 10% WP @ 20g ha^{-1} (3 DAT) + Hand weeding (20 DAT).	5.05	10.11	14.76	16.40
T3	Bispyribac -Na 10% SC @ 20g ha^{-1}(20 DAT).	10.00	20.00	24.84	24.97
T4	Bispyribac -Na 10% SC @20g ha^{-1} (20 DAT) + Mechanical weeding (40 DAT) by Ambika paddy weeder.	7.60	15.20	20.01	21.39
T5	Untreated control	10.75	21.50	26.27	26.92
T6	Weed free	0.00	0.00	0.00	0.00
T7	One mechanical weeding (20 DAT) by Ambika paddy weeder + one hand weeding (40 DAT)	3.95	7.90	10.68	12.30
T8	Pyrazosulfuron ethyl 10% WP @ 150g ha^{-1} (3 DAT) + Bispyribac -Na 10% SC @ 20g ha^{-1} (20 DAT).	8.80	17.60	21.78	22.91
T9	Chlorimuron ethyl 10% WP + Metsulfuron methyl 10% WP @ 0.06g ha^{-1} (20 DAT) + Mechanical weeding (40 DAT) by Ambika paddy weeder.	3.18	6.35	8.49	8.90
T10	Chlorimuron ethyl 10% WP + Metsulfuron methyl 10% WP @ 0.06g ha^{-1} (20 DAT) + Mechanical weeding (20 & 40 DAT) by Ambika paddy weeder	2.18	4.35	5.07	5.18
	SEm±	**1.07**	**2.14**	**1.81**	**2.30**
	CD (0.05)	**3.18**	**6.35**	**5.37**	**6.83**

Table 2. Effect of integrated weed management practices on Total Weed dry weight at 30, 60 and 90 DAS

Tr. No.	Treatment Details	Total Weed dry weight (g/m^2)			
		20 DAT	**40 DAT**	**60 DAT**	**At harvest**
T_1	Pyrazosulfuron ethyl 10% WP @ 20g ha^{-1} (3 DAT) + Mechanical weeding (20 DAT) by Ambika paddy weeder.	10.65	20.85	22.14	23.35
T_2	Pyrazosulfuron ethyl 10% WP @ 20g ha^{-1} (3 DAT) + Hand weeding (20 DAT).	9.03	17.61	17.98	19.99
T_3	Bispyribac -Na 10% SC @ 20g ha^{-1}(20 DAT).	17.97	34.82	39.65	37.15
T_4	Bispyribac -Na 10% SC ha^{-1} (20 DAT) + Mechanical weeding (40 DAT) by Ambika paddy weeder.	12.76	25.07	29.19	27.73
T_5	Untreated control	19.65	38.84	42.49	42.80
T_6	Weed free	0.24	0.22	0.22	0.22
T_7	One mechanical weeding (20 DAT) by Ambika paddy weeder + one hand weeding (40 DAT)	7.15	13.84	13.51	14.71
T_8	Pyrazosulfuron ethyl 10% WP @ 150g ha^{-1} (3 DAT) + Bispyribac -Na 10% SC @ 20g ha^{-1} (20 DAT).	15.39	29.65	34.29	33.98
T_9	Chlorimuron ethyl 10% WP + Metsulfuron methyl 10% WP @ 0.06g ha^{-1} (20 DAT) + Mechanical weeding (40 DAT) by Ambika paddy weeder.	5.24	10.03	9.73	11.17
T_{10}	Chlorimuron ethyl 10% WP + Metsulfuron methyl 10% WP @ 0.06g ha^{-1} (20 DAT) + Mechanical weeding (20 & 40 DAT) by Ambika paddy weeder	3.46	6.47	5.50	5.63
	SEm±	**0.58**	**1.15**	**1.29**	**1.14**
	CD (0.05)	**1.72**	**3.42**	**3.84**	**3.39**

Table 3. Effect of integrated weed management practices on Weed index

Tr. No.	Treatment Details	Weed index
T_1	Pyrazosulfuron ethyl 10% WP @ 20g ha^{-1} (3 DAT) + Mechanical weeding (20 DAT) by Ambika paddy weeder.	12.89
T_2	Pyrazosulfuron ethyl 10% WP @ 20g ha^{-1} (3 DAT) + Hand weeding (20 DAT).	10.03
T_3	Bispyribac -Na 10% SC @ 20g ha^{-1}(20 DAT).	25.61
T_4	Bispyribac -Na 10% SC ha^{-1} (20 DAT) + Mechanical weeding (40 DAT) by Ambika paddy weeder.	13.82
T_5	Untreated control	53.27
T_6	Weed free	0.00
T_7	One mechanical weeding (20 DAT) by Ambika paddy weeder + one hand weeding (40 DAT)	9.50
T_8	Pyrazosulfuron ethyl 10% WP @ 150g ha^{-1} (3 DAT) + Bispyribac sodium 10% SC @ 20g ha^{-1} (20 DAT).	19.57
T_9	Chlorimuron ethyl 10% WP + Metsulfuron methyl 10% WP @ 0.06g ha^{-1} (20 DAT) + Mechanical weeding (40 DAT) by Ambika paddy weeder.	8.11
T_{10}	Chlorimuron ethyl 10% WP + Metsulfuron methyl 10% WP @ 0.06g ha^{-1} (20 DAT) + Mechanical weeding (20 & 40 DAT) by Ambika paddy weeder	7.09

Table 4. Effect of integrated weed management practices on Weed Control Efficiency (%)

Tr. No.	Treatment Details	Weed Control Efficiency (%)			
		20 DAT	40 DAT	60 DAT	At harvest
T_1	Pyrazosulfuron ethyl 10% WP @ 20g ha^{-1} (3 DAT) + Mechanical weeding (20 DAT) by Ambika paddy weeder.	45.96	46.41	48.14	45.40
T_2	Pyrazosulfuron ethyl 10% WP @ 20g ha^{-1} (3 DAT) + Hand weeding (20 DAT).	54.48	54.76	57.95	53.26
T_3	Bispyribac- Na 10% SC @ 20g ha^{-1}(20 DAT).	8.31	10.35	6.62	13.17
T_4	Bispyribac -Na 10% SC @20g ha^{-1} (20 DAT) + Mechanical weeding (40 DAT) by Ambika paddy weeder.	35.43	35.60	31.59	35.16
T_5	Untreated control	0.00	0.00	0.00	0.00
T_6	Weed free	98.74	99.43	99.47	99.49
T_7	One mechanical weeding (20 DAT) by Ambika paddy weeder + one hand weeding (40 DAT)	63.86	64.47	68.41	65.58
T_8	Pyrazosulfuron ethyl 10% WP @ 150g ha^{-1} (3 DAT) + Bispyribac -Na 10% SC @ 20g ha^{-1} (20 DAT).	21.76	23.72	19.38	20.60
T_9	Chlorimuron ethyl 10% WP + Metsulfuron methyl 10% WP @ 0.06g ha^{-1} (20 DAT) + Mechanical weeding (40 DAT) by Ambika paddy weeder.	73.40	74.22	77.17	73.88
T_{10}	Chlorimuron ethyl 10% WP + Metsulfuron methyl 10% WP @ 0.06g. ha^{-1} (20 DAT) + Mechanical weeding (20 & 40 DAT) by Ambika paddy weeder	82.19	83.34	87.03	86.85

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