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Evaluation of different weed management practices on growth, yield and economics of transplanted rice (*Oryza sativa* L.)

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Abstract

A field experiment was conducted in farmer's field in Thiruvennainallur village, Villupuram District, Tamil Nadu, India during *Navarai* season of 2021 in order to evaluate the different weed management practices on growth and yield of rice under transplanted conditions. The experiment was laid out in a randomized block design, having fourteen treatments and replicated thrice. Treatment consists of hand weeding, butachlor, pretilachlor, pyrazosulfuron ethyl, bispyribac sodium, fenoxaprop –p– ethyl, Triafamone + ethoxy sulfuron, metsulfuron methyl + chlorimuron ethyl and penoxsulam + cyhalofop butyl were used as herbicides. Comparing with all treatments, hand weeding twice performed better in this experiment. Among the different herbicides tried out, pre emergence application of pyrazosulfuron ethyl 10% WP @ 0.15 g/ha *fb* post emergence application of bispyribac sodium 10% SC @ 0.25 l/ha recorded the highest weed control efficiency (85.68, 81.36 %), crop resistance index (14.36, 10.89 %), leaf area index (3.21, 5.90), number of grain (100.98), number of filled grains (89.19) with net income (₹ 40,229) and benefit cost ratio (1.63).

Key words : Weed management practices transplanted rice. *Oryza sativa* L.

Rice is the Asian population's primary staple food crop. More than 90% of the world's rice is cultivated and consumed in Asia. More than half of the world's population depends on rice for food and consumes more than 50 kilograms per capita per year. Globally, 782 million tonnes of rice were produced from 167 million hectares of land, with over 90 per cent being consumed directly[15]. Rice contributes around 10 per cent of the agricultural GDP and its production generates 3.5 billion man days of employment[4].

Because of climate change, rice is

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grown in a variety of environments to boost output. Even though new ecosystems are developing recently, the most common and established technique of cultivating rice under irrigation is transplantation. The main obstacle to rice production is weeds. Diverse weed flora infestations in transplanted rice result in a 33–45% decrease in production[1]. Weeds cause a 57 per cent yield loss in transplanted rice and an 82 per cent yield loss in direct seeded rice, resulting in a $4.20 billion monetary loss per year[2]. Weed infestation, species richness, density, dry matter accumulation and duration of association significantly affects rice grain production[13].

A variety of issues, including low plant population, high input costs, lack of competent personnel, and shortage of water, have restricted rice output by transplanting. When skilled labor is employed to transplant rice seedlings, there is a lack of skilled labor throughout the transplanted seedlings period, which leads to a low plant population and ultimately a low rice production[12]. Using herbicides to control weeds selectively and economically after transplanting can help rice to have a favorable start to its rapid development and competitive edge. For the successful control of weeds in transplanted rice, a number of pre- and post-emergence herbicides have been found[10]. This laborious process can be avoided by using a variety of pre-emergence (PE) and early post-emergence (PoE) applied broad-spectrum herbicides[14].

The study was carried out at the farmer's field in Thiruvennainallur village, Villupuram District, Tamil Nadu, India. The experiment field situated at 11°52' North latitude and 79°22' East longitude with a height of 53.19 meters above sea level during the growing *Navarai* season of 2021. The experiment was laid out in a randomized block design, having fourteen treatments and replicated thrice. Treatment consists of hand weeding, pre emergence herbicide application of butachlor, pretilachlor and pyrazosulfuron ethyl and post emergence herbicide of bispyribac sodium, fenoxaprop – p – ethyl were used as solo herbicide. As a mixed herbicide, Triafamone + ethoxy sulfuron used as early post emergence, metsulfuron methyl + chlorimuron ethyo and penoxsulam + cyhalofop butyl were used as post emergence herbicides. T_1 – Hand weeding on twice (20 and 40 DAT), T_2 – PE of Butachlor 50% EC @ 2.5 l ha^{-1} *fb* PoE of Bispyribac sodium 10% SC @ 0.25 l ha^{-1}, T_3 – PE of Pretilachlor 37% EW @ 1.5 l ha^{-1} *fb* PoE of Bispyribac sodium 10% SC @ 0.25 l ha^{-1}, T_4 – PE of Pyrazosulfuron ethyl 10% WP @ 0.15 g ha^{-1} *fb* PoE of Bispyribac sodium 10% SC @ 0.25 l ha^{-1}, T_5 – PE of Butachlor 50% EC @ 2.5 l ha^{-1} *fb* PoE of Fenoxaprop-p-ethyl 6.9% EC @ 0.81 kg ha^{-1}, T_6 – PE of Pretilachlor 37% EW @ 1.5 l ha^{-1} *fb* PoE of Fenoxaprop-p-ethyl 6.9% EC @ 0.81 kg ha^{-1}, T_7 – PE of Pyrazosulfuron ethyl 10% WP @ 0.15 kg ha^{-1} *fb* PoE of Fenoxaprop-p-ethyl 6.9% EC @ 0.81 kg ha^{-1}, T_8 – PE of Butachlor 50% EC @ 2.5 l ha^{-1} *fb* hand weeding on 40 DAT, T_9 – PE of Pretilachlor 37% EW @ 1.5 l ha^{-1} *fb* hand weeding on 40 DAT, T_{10}–PE of Pyrazosulfuron ethyl 10% WP @ 0.15 kg ha^{-1} *fb* hand weeding on 40 DAT, T_{11} – EPoE of Triafamone 20% + Ethoxysulfuron 10% WG @ 0.22 kg ha^{-1} *fb* hand weeding on 40 DAT, T_{12} – PoE of Metsulfuron methyl 10.1% + Chlorimuron ethyl

10.1% WP @ 0.20 kg ha^{-1} *fb* hand weeding on 40 DAT, T_{13} – PoE of Penoxsulam 1.02% + Cyhalofop-butyl 5.1% OD @ 2 l ha^{-1} *fb* hand weeding on 40 DAT and T_{14} – Unweeded Control.

For this experiment, the rice variety ADT 37 was chosen and it was transplanted at a 15 × 10 cm spacing. Urea, single super phosphate and murate of potash were combined to use a fertilizer dosage of 120:40:40 NPK kg/ha. The nitrogen and potassium were applied in four equal split viz., basal, tillering, panicle initiation and heading stage. The phosphorus was applied as a basal. A need-based plant protection was taken based on the economic threshold of pests and diseases. The gross and net plot sizes were 5.0 × 4.0 m and 4.45 × 3.7 m respectively.

Weed control efficiency and crop resistance index was calculated by using the formula derived by Mani *et al*.,[6] and Mishra and Mishra[7].

$$WCE\ (\%) = \frac{\text{Weed population in control plot - Weed population in treated plot}}{\text{Weed population in control plot}} \times 100$$

$$CRI = \frac{\text{Crop dry weight in treated plot}}{\text{Crop dry weight in control plot}} \text{ X } \frac{\text{Weed dry weight in control plot}}{\text{Weed dry weight in treated plot}}$$

The various biometric observations like weed parameters and plant samples and the data were computed subjected to statistical scrutiny. The experimental data were analyzed by using SPSS Statistical tool. Wherever, the treatment difference were found significant F test, critical difference were worked out at five per cent probability level and the values are furnished in respective tables.

Weed parameters like weed control efficiency and crop resistance index were recorded on 30 and 60 DAT. Among the different weed management practices tried out, hand weeding on 20 and 40 DAT recorded the highest weed control efficiency of 88.90 and 83.50 per cent in 30 and 60 DAT. It is possible that prompt weed removal by uprooting causes a decrease in the number of weeds and a rise in the weed control efficiency by producing less weed population. Phukan and Deka[9] also concluded the similar conclusions.

Among the different herbicide tried out, pre emergence application of pyrazosulfuron ethyl 10% WP @ 0.15 g/ha *fb* post emergence application of bispyribac sodium 10% SC @ 0.25 l/ha with weed control efficiency of 85.68 and 81.36 per cent. It was followed by pre emergence application of Pretilachlor 37% EW @ 1.5 l ha^{-1} *fb* post emergence application of Bispyribac sodium 10% SC @ 0.25 l ha^{-1} with weed control efficiency of 83.86, 79.81 per cent. The lowest weed control efficiency was observed in pre emergence application of Butachlor 50% EC @ 2.5 l ha^{-1} *fb* post emergence application of Fenoxaprop-p-ethyl 6.9% EC @ 0.81 kg ha^{-1} treatment with 48.19, 56.94 per cent. This may be caused by the combined effect of herbicides applied before and during emergence, which reduces dry matter and overall weed density. Comparable outcomes matched with the results provided by Venkatesh *et al.*[16].

Among the different weed management practices tried out, hand weeding twice on 20

and 40 DAT recorded the highest crop resistance index with 16.90, 12.48 per cent on 30 and 60 DAT. Pre emergence application of pyrazosulfuron ethyl 10% WP @ 0.15 g/ha *fb* post emergence application of bispyribac sodium 10% SC @ 0.25 l/ha recorded the crop resistance index of 14.36, 10.89 per cent on 30 and 60 DAT. The lowest crop resistance index was observed in unweeded control with 1.00. This may be caused due to the lowest number of weeds with the lowest weed DMP and the highest dry matter production seen in these treatments, which raised the crop resistance index values. Mondal *et al.*[8] also observed similar findings.

Hand weeding twice on 20 and 40 DAT recorded highest leaf area index of 3.25, 5.92 on 30 and 60 DAT. It was on par with Pre emergence application of pyrazosulfuron ethyl 10% WP @ 0.15 g/ha *fb* post emergence application of bispyribac sodium 10% SC @ 0.25 l/ha recorded leaf area index of 3.21 and 5.90 on 30 and 60 DAT. It was followed by pre emergence application of Pretilachlor 37% EW @ 1.5 l ha^{-1} *fb* post emergence application of Bispyribac sodium 10% SC @ 0.25 l ha^{-1} with leaf area index of 3.18 and 5.86 on 30 and 60 DAT. Unweeded control recorded the lowest leaf area index of 1.82 and 3.31 on 30 and 60 DAT. Comparing hand weeding twice with Pyrazosulfuron ethyl @ 10% WP *fb* Bispyribac sodium @ 10% SC, leaf area index was increased 1.25 per cent and 0.34 per cent in 30 and 60 DAT respectively. According to Leghari *et al.*[5], the effectiveness of this treatment could be attributed to better weed control during the critical period of crop growth and provided the weed-free environment that favored higher crop nutrient uptake. It also directly reflected maximum growth characters were responsible for higher LAI.

Hand weeding twice on 20 and 40 DAT significantly recorded the highest number of grains $panicle^{-1}$ with 101.23 and number of filled grains of 89.67 grains $panicle^{-1}$. It was on par with pre emergence application of pyrazosulfuron ethyl @ 10% WP PE *fb* post emergence application of bispyribac sodium @ 10% SC with number of grains $panicle^{-1}$ of 100.98 with number of filled grains of 89.19 grains $panicle^{-1}$. The unweeded control plot recorded the least grains $panicle^{-1}$ of 75.23 and filled grains $panicle^{-1}$ of 60.27. Comparing hand weeding twice on 20 and 40 DAT with Pre emergence application of pyrazosulfuron ethyl @ 10% WP *fb* post emergence application of bispyribac sodium @ 10% SC, number of grains $panicle^{-1}$ increased 0.25 per cent and 34.56 per cent increased grains $panicle^{-1}$ while comparing hand weeding twice with unweeded control. Comparing hand weeding twice with unweeded control, number of filled grains was increased by 29.22 filled grains $panicle^{-1}$. This might be the result of the application of pre-emergence herbicides to control weeds during the germination stage and post-emergence herbicides to significantly reduce weeds at later stages of emergence. This reduces crop weed competition for the crop growth factor, which in turn promotes efficient photosynthetic activity and results in higher filled grains under this treatment. Gowda *et al.*[3] similarly opined the similar results.

The highest gross income was recorded in hand weeding twice with ₹ 1,06,357 and it was followed by T_4–Pre emergence application of Pyrazosulfuron ethyl @ 10% WP *fb* post

Table-1. Effect of different weed management practices on weed, growth and yield parameters of rice

Treat-ment	Weed control efficiency* (Per cent)		Crop resistance Index*		Leaf area Index		Number of grains	Number of filled grains	Cost of cultiva-tion	Gross income	Net income	Benefit cost ratio
	30 DAT	60 DAT	30 DAT	60 DAT	30 DAT	60 DAT						
T_1	88.90	83.50	16.90	12.48	3.25	5.92	101.23	89.67	68782	106357	37575	1.55
T_2	62.20	67.68	4.13	5.03	2.68	5.35	90.14	83.29	64570	89951	25381	1.39
T_3	83.86	79.81	11.16	10.65	3.18	5.86	98.01	88.74	64372	101791	37419	1.58
T_4	85.68	81.36	14.36	10.89	3.21	5.90	100.98	89.19	63850	104079	40229	1.63
T_5	48.19	56.94	2.45	2.51	2.22	4.85	84.01	78.9	62205	84207	22002	1.35
T_6	54.35	58.22	2.94	2.69	2.31	4.90	85.27	80.54	62008	84741	22733	1.37
T_7	50.25	57.52	2.64	2.57	2.28	4.87	84.87	79.78	61486	84406	22920	1.37
T_8	54.89	59.63	3.11	2.84	2.45	4.97	85.36	80.81	64770	84886	20116	1.31
T_9	66.73	70.86	5.32	5.70	2.88	5.43	92.21	84.78	64572	93530	28958	1.45
T_{10}	82.28	77.43	9.47	9.61	3.16	5.83	97.12	88.34	64050	99389	35339	1.55
T_{11}	81.16	77.16	8.65	8.51	3.12	5.81	97.01	87.38	66507	99290	32783	1.49
T_{12}	63.65	69.57	4.70	5.47	2.85	5.41	92.11	84.39	64032	91941	27909	1.44
T_{13}	62.44	67.90	4.46	5.18	2.72	5.38	91.47	83.86	66082	91516	25434	1.38
T_{14}	0.00	0.00	1.00	1.00	1.82	3.31	75.23	60.45	58782	54563	-4219	0.93
S. Ed					0.10	0.17	2.19	1.19				
C.D					0.21	0.34	4.50	2.45				

*Data not statistically analyzed

emergence application of Bispyribac sodium @ 10% SC with gross income of ₹ 1,04,079. Pre emergence application of Pretilachlor @ 37% EW *fb* post emergence application of Bispyribac sodium @ 10% SC with gross income of ₹ 1,01,791. The least gross income was recorded in unweeded control with ₹ 54,563. Pre emergence application of Pyrazosulfuron ethyl @ 10% WP *fb* post emergence application of Bispyribac sodium @ 10% SC recorded the highest net income of ₹ 40,229 and it was followed by hand weeding on twice (20 and 40 DAT) with net income of ₹ 37,575. It was followed by Pre emergence application of Pretilachlor @ 37% EW *fb* post emergence application of Bispyribac sodium @ 10% SC with net income of ₹ 37,419. Among the different weed management tried out in rice, the highest benefit cost ratio observed in pre emergence application of Pyrazosulfuron ethyl @ 10% WP *fb* post emergence application of Bispyribac sodium @ 10% SC with 1.63. It was followed by pre emergence application of Pretilachlor @ 37% EW *fb* post emergence application of Bispyribac sodium @ 10% SC with benefit cost ratio of 1.58 and followed by hand weeding on twice (20 and 40 DAT) with benefit cost ratio of 1.55. Unweeded control recorded the negative benefit cost ratio of 0.93. Even while hand weeding produced the highest grain and straw yields as well as gross income twice, the treatment is more expensive due to the rising cost of labor and results in lower net income and benefit cost ratios. This outcome coincided with the findings of Singh *et al.*[11].

From this experiment, when there is a scarcity of labour during critical period of the crop, the best option to obtain higher yield of rice by controlling of weeds through the application of pre emergence application of pyrazosulfuron ethyl 10% WP @ 0.15 g/ha *fb* post emergence application of bispyribac sodium 10% SC @ 0.25 L/ha recommended for the farmer to enhance of rice productivity.

References :

1. Duary, B., K.C. Teja and U. Soren (2015). *Indian Journal of Weed Science 47*(4): 349-352.
2. Gharde, Y., P.K. Singh, R.P. Dubey and P.K. Gupta (2018). *Crop Protection 107:* 12-18.
3. Gowda, P.T., C. Shankaraiah, A.C. Jnanesh, M. Govindappa and K.N.K. Murthy (2009). *Journal of Crop and Weed*, *5*(1): 321-324.
4. Kumar, A., R.K.P. Singh, K.M. Singh, and J.S. Mishra, (2018). *Indian Journal of Agricultural Sciences 88*(2): 314-9.
5. Leghari, S.J., U.A. Leghari, G.M. Laghari, M. Buriro, and F.A. Soomro, (2016). *Journal of Crop and Weed*, *6*(1): 59-69.
6. Mani VS, ML Malla, KC Gautam, and B. Das (1973). *PANS 23:* 17–18.
7. Mishra, M. and A. Misra, (1997). *Indian Journal of Weed Science 29*(1 and 2): 39-42.
8. Mondal, D., A. Ghosh, P. Bandopadhyay, and R. Ghosh, (2018). *Journal of Hill Agriculture*, *9*(1): 49-54.
9. Phukan, J. and J. Deka, (2021). *Indian Journal of Weed Science*, *53*(1): 36–40.
10. Rao, A.N. and H. Matsumoto, (2017). Weed management in rice in the Asian

Pacific region. Asian-Pacific Weed Science Society (APWSS); *The Weed Science Society of Japan,* Japan and *Indian Society of Weed Science,* India.

11. Singh, A., D.P. Nandal, and S.S. Punia, (2017). *International Journal Current Microbiology Applied Science, 6*(4): 900-905.
12. Singh Pratap, V., S.P. Singh, V.C. Dhyani, A. Banga, A. Kumar, K. Satyawali, and N. Bisht (2016). *Indian Journal of Weed Science 48*(3): 233-246.
13. Travlos, I.S., Cheimona, N., Roussis, I. and D. J. Bilalis, (2018). *Frontiers in Environmental Science 6:* 11.
14. Umkhulzum, S.F., M. Ameena, and P.S. Pillai, (2018). *Indian Journal of Weed Science 50*(4): 395-398.
15. United State Department of Agriculture–Economic Research Service (USDA-ERS). (2022). Rice Sector at a Glance. https:/ /www.ers.usda.gov/topics/crops/rice/rice-sector-at-aglance. Accessed: August 8, 2022.
16. Venkatesh, B., Y.S. Parameswari, M. Madhavi and T.R. Prakash (2021). *Indian Journal of Weed Science*, *53*(2): 179-181.