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Effect of Integrated Weed Management Practices in Rice (*Oryza sativa*) Under SRI

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Authors' contributions

This work was carried out in collaboration among all authors. 'All authors read and approved the final manuscript.

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ABSTRACT

An experimental study was conducted at the Annamalai University Experimental Farm in Cuddalore District, Tamil Nadu, between February and May 2023. The objective of this work is to chemically manage the developing weeds in rice during vegetative development using the System of Rice Intensification (SRI) technology. Additionally, the study aims to identify the weed flora in the experimental field. In this study, a Randomised Block Design with three replications was employed. The experimental treatments comprised optimal combinations of chemical and mechanical techniques for weed management. The experiment was structured in a randomised block design, consisting of seven treatments, and subsequently reproduced three times. Among the several

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treatments, the application of Penoxsulam + Butachlor @ 2L/ha (PE) on 3 days after transplantation (DAT) for rice, and the use of Conoweeder twice on 25 and 35 DAT (rice), effectively decreased weed density and thus reduced weed biomass. This led to an improvement in crop development and production. The greater plant height, drying matter potential (DMP), and grain yield seen with the application of Penoxsulam + Butachlor @ 2L/ha (PE) on 3 days after transplantation (DAT), and Conoweeder twice on 25 and 35 DAT, may be attributed to the effective management of a weed-free environment, especially during critical growth phases of the crop. Suppression of agricultural weed competition facilitated increased growth and development of rice crop, resulting in elevated grain and straw yield.

Keywords: Butachlor; conoweeder; integrated weed management; penoxsulam; rice; SRI.

1. INTRODUCTION

The global cultivation of rice spans an area of 162 million hectares, with an annual production of around 700 million metric tonnes and an average productivity of 4.3 metric tonnes per year. Rice is farmed in India over a total area of 48.53 million hectares, yielding 112.18 million metric tonnes with an average productivity of 2.31 metric tonnes per hectare. Over 2.2 million hectares of land in Tamil Nadu are dedicated to rice cultivation, yielding 8.65 million metric tonnes with a productivity of 3.93 t ha^{-1} [1]. In order to sustain the rapidly growing population, India's rice production goal for 2035 AD is set at 135 million metric tonnes. This goal can only be accomplished by incrementing rice output by more than 2.0 million metric tonnes year in the next ten years.

In the 1980s, French priest Father Henri de Laulani in Madagascar devised the rice intensification (SRI) system with the aim of identifying sustainable agricultural methods that result in increased productivity, optimal capital and labour utilisation, reduced input costs, and decreased water use. System of rice intensification (SRI) is an abbreviation that stands for "system for rice intensification". The System of Rice Intensification (SRI) is a method of aligning the components of soil, water, light, and plant to enable the plant to reach its maximum capacity, which is often limited when improper methods are employed [2]. With the validation of SRI technique in more than 60 countries, its controversy has diminished, and it is being integrated into the practical agricultural landscape. This approach is now being used by larger-scale farmers and for crops other than rice [3].

Weeds are the most hazardous terrorist, resulting in greater yield losses. It affects the crop from the moment of germination until it is harvested. During the initial phases of crop growth, the majority of the weed flora and its density result in greater losses. Weed control during a critical period of crop weed competition is cost-effective, as it reduces the cost of chemicals and saves time [4]. The Conoweeder assists in the more precise targeting of weeds, thereby reducing herbicide waste and minimising dispersion onto desirable plants [5]. The efficacy of weed management can be enhanced by integrating conoweeder technology with herbicides, particularly for species that are resistant or difficult to eradicate. Conoweeder can minimise the environmental impact by precisely administering herbicides directly to weeds, thereby reducing the overall herbicide usage [6]. Significant cost reductions can be achieved by farmers and agricultural professionals through reduced herbicide usage and reduced labour requirements. A more sustainable agricultural practice is promoted by the reduction of herbicide usage and the targeted application of herbicides, which reduces soil and water contamination [7]. In light of this, the present experiment was conducted to examine the efficacy of integrated plant management practices against the weed flora and the potential of rice production when grown using the SRI approach.

2. MATERIALS AND METHODS

The field experiment was conducted in field number C2 of the wetland at the Annamalai University Experimental Farm, Department of Agronomy, Annamalai Nagar. An altitude of +5.79 m above the mean sea level and a distance of 10 km from the Bay of Bengal Sea, the experimental farm is located at 11024’ N latitude and 79044’ E longitude. The greatest temperature during the crop season was recorded to be between 38.9°C and 28.2°C. The minimal temperature fluctuated between 16.8°C and 25.7°C. The relative humidity fluctuated between 62 and 82 percent.

Total rainfall during the crop season was 178.2 mm, which was dispersed over seven rainy days. The experimental field soil had a pH of 7.0 and was composed of clay loam. The soil was high in potassium, medium in available phosphate, and low in available nitrogen. The experiment employed a randomised block design with three replications and seven treatments.

There were seven treatments, viz., T_1 - Weeding with Conoweeder thrice on 15, 25, and 35 DAT, T_2 - Weeding with Conoweeder twice on 15 and 35 DAT, T_3 - Penoxsulam + Butachlor @ 2L/ha (PE) on 3 DAT fb, Conoweeder twice on 25 and 35 DAT, T_4 - Pretilachlor + Pyrazosulfuron ethyl @ 2kg/ha (PE) on 3 DAT fb, Conoweeder twice on 25 and 35 DAT, T_5 - Pretilachlor + Pyrazosulfuron ethyl @ 2kg/ha (PE) on 3 DAT fb, Bispyribac-Na (POE) @ 25g/ha (10 DAT) + Conoweeder on 35 DAT, T_6 - Pretilachlor @ 750g/ha (PE) on 3 DAT fb, Chlorimuron + Metsulfuron @ 8g /ha (POE) on 10 DAT fb Conoweeder on 35 DAT, T_7 - Unweeded control. The paddy seeds were spread by broadcasting at an intensive rate of 8 kilogrammes per hectare. The seeds were treatment with Pseudomonas fluorescens at a dosage of 10 g kg^{-1} per seed and Azospirillum at a dosage of 600 g ha^{-1} per seed for the purpose of nursery cultivation. Using a backpack sprayer equipped with a flood jet nozzle and 600 litres of water per hectare, the prescribed amount of pre- and early-post-emergence herbicides was sprayed according to the treatment schedule in the SRI method of rice farming. All herbicides targeting pre-emergence, early post-emergence, and post-emergence were applied on 3 days after transplantation (DAT) and 10 DAT, respectively, with sufficient soil moisture. During the mechanical weeding of plots, conoweeder was administered on days 15, 25, and 35 after transplantation (DAT). The same pre-emergence herbicides and early post-emergence herbicides were sprayed according to the treatment schedule. To get a reliable conclusion, the weed count data underwent the standard procedures proposed by Gomez and Gomez [8] prior to statistical analysis.

3. RESULTS AND DISCUSSION

3.1 Effect on Weeds

The dominant weed flora in the field experiment consisted of seven rice weed species, three of which are grasses, two of which are sedges, and two of which are broad-leaved weeds. The research revealed that grassy weeds were the most prevalent during the initial phases of crop growth, while sedge weeds and broad-leaved weeds were less prevalent. However, sedges gained control in the later stages. In the experimental field, the dominant weed species were *Echinochloa colonum, Echinochloa crus-galli, and Leptochloa chinensis* among grasses, *Cyperus rotundus* and *Cyperus iria* among sedges, and *Bergia capensis* and *Eclipta alba* among broad-leaved weeds. Similar vegetation flora were reported under transplanted rice by Mohammed et al. [9], Singh et al. [10], and Nath. P et al. [11].

3.2 Effects on Total Weed Count

An analysis of data on weed population at 30 and 60 days after transplantation (DAT) showed that herbicide-based weed management greatly decreases the weed population compared to an untreated plot. The combination of penoxsulam and butachlor at a rate of 2 litres per hectare (PE) on three days after transplantation (DAT), together with the application of conoweeder twice on 25 and 35 DAT, constitutes a thorough integrated weed management (IWM) approach. The integration of chemical and mechanical weed control strategies is essential for the successful management of weeds in rice farming. A broad spectrum of weed species, including grasses, broad-leaved weeds, and sedges, are efficiently controlled by the systemic herbicide penoxsulam. The mechanism of action is the suppression of primary amino acid synthesis, which is crucial for the growth and development of weeds. Its incorporation into the treatment guarantees efficient management of certain weed species that may manifest after the application. Butachlor is an herbicide used before weeds sprout that specifically attacks weed seeds and seedlings by blocking the production of fatty acids, therefore obstructing their ability to germinate and grow early. Applied at a rate of 2 litres per hectare, it effectively prevents the growth of different weed species, particularly during the crucial first phases of crop development. The present results corroborate the conclusions stated by Jena et al. [12] and Bajwa et al. [13].

3.3 Effect on Weed Biomass

Among the herbicide treatments, the combination of penoxsulam and butachlor at a rate of 2L/ha (PE) on 3 days after transplantation (DAT), and conoweeder twice on 25 and 35 DAT, resulted in a 79.2 percent reduction in weed biomass compared to the control. This indicates the herbicide's efficiency in reducing weed germination and growth (Fig. 1). Penoxsulam is an inhibitor of acetolactate synthase (ALS), which interferes with the production of vital amino acids, resulting in the demise of vulnerable weedplants. Butachlor is a chloroacetanilide herbicide that suppresses the growth and longitudinal extension of developing weed seedlings. Empirical studies have demonstrated that the synergistic use of penoxsulam and butachlor offers comprehensive management of grassy and broad-leaved herbs. The efficacy of this combination is attributed to its complimentary mechanisms of action, which specifically target distinct physiological processes in weeds. The Conoweeder is a manually operated implement that removes weeds from the spaces between crop rows, therefore causing disruption to weed development by mechanical pressure. Application of the Conoweeder on 25 and 35 days after transplantation (DAT) enables prompt elimination of developing weeds prior to their ability to compete with the crop. Experimental research has shown that the combination of mechanical weeding with pre-emergence herbicide treatment leads to a substantial decrease in both weed biomass and density. Implementing the Conoweeder for the physical elimination of weeds improves the overall effectiveness of weed management and decreases the weight of dry weeds. The results presented here corroborate the conclusions established by Yadav et al., [14].

3.4 Effect on Weed Control Index

The "weed control index" (WCI) serves as an indicator of the proportionate distribution of the decrease in weed dry matter production resulting from weed control treatments. When compared to other treatments, the water conversion index (WCI) was greater with penoxsulam + butachlor @ 2 L/ha (PE) on 3 days after transplantation (DAT) and again on 25 and 35 DAT. One possible explanation for this phenomenon is the enhanced dispersion of herbicides on the existing interspacing and the increased management of developing weeds, which leads to the effective suppression of weeds from the initial phases of transplanted rice. The present outcome aligns with the conclusions reported by Wang et al. [15]. The application of penoxsulam + butachlor @ 2 L/ha (PE) at 3 days after

Table 1. Effect of integrated weed management practices on total weed count (m^{-2}), weed biomass ($g\ m^{-2}$) and weed control index on 30 DAT in rice under SRI

Treatments	Total weed count (m^{-2})	Weed biomass ($g\ m^{-2}$)	WCI
T_1 - Weeding with Conoweeder thrice on 15, 25 and 35 DAT	6.62 (43.45)	10.69 (113.94)	76.86
T_2 - Weeding with Conoweeder twice on 15 and 35 DAT	6.64 (43.68)	10.84 (117.07)	75.92
T_3 - Penoxsulam + Butachlor @ 2L/ha (PE) on 3 DAT fb, Conoweeder twice on 25 and 35 DAT	3.46 (11.48)	7.74 (59.40)	90.68
T_4 - Pretilachlor + Pyrazosulfuron ethyl @ 2kg /ha (PE) on 3 DAT fb, Conoweeder twice on 25 and 35 DAT	5.07 (25.21)	8.40 (70.15)	86.35
T_5 - Pretilachlor + Pyrazosulfuron ethyl @ 2kg /ha (PE) on 3 DAT fb, Bispyribac-Na (POE) @ 25g /ha (10 DAT) + Conoweeder on 35 DAT	5.09 (25.43)	8.53 (72.28)	84.72
T_6 - Pretilachlor @ 750g /ha (PE) on 3 DAT fb, Chlorimuron + Metsulfuron @ 8g /ha (POE) on 10 DAT fb Conoweeder on 35 DAT	6.22 (38.17)	9.16 (83.34)	80.86
T_7 - Unweeded control	10.10 (101.53)	16.92 (285.89)	-
S.Ed	0.14	0.24	-
CD (P = 0.05)	0.31	0.53	-

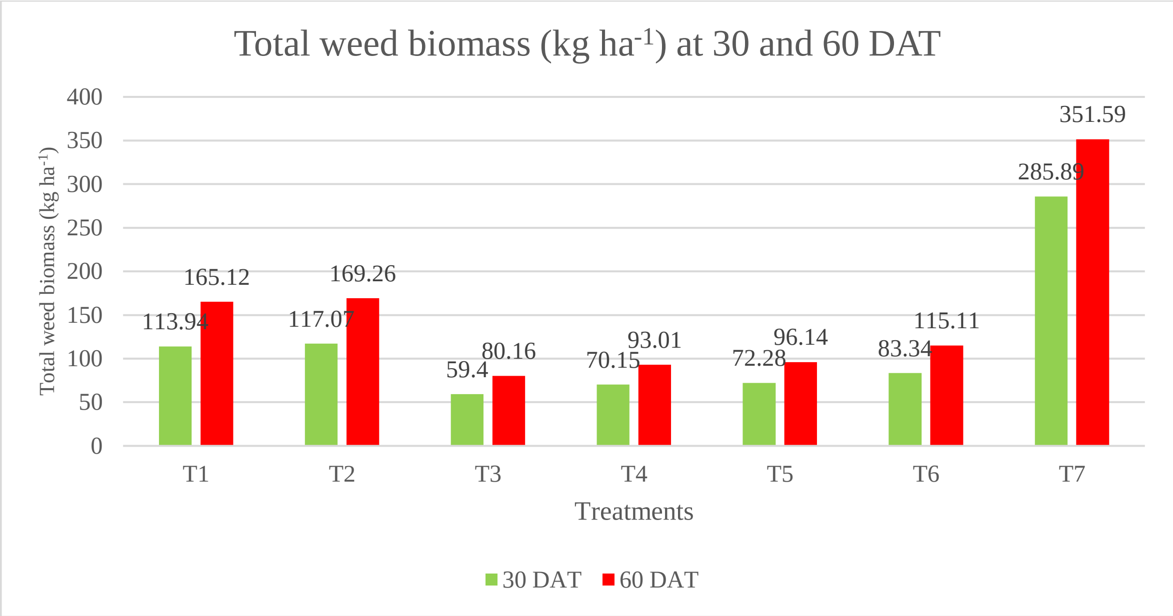

Fig. 1. Effect of integrated weed management practices on total weed biomass (kg ha^{-1}) at 30 and 60 DAT

transplantation (DAT) and conoweeder twice at 25 and 35 DAT showed superior results in the herbicide efficiency index (HEI) compared to the unweeded control. This suggests that the administration of these treatments is more effective in controlling weed growth. These findings were consistent with the results reported by Tanveer et al. [16] and Zhang et al. [17].

4. CONCLUSION

Based on the experiment results, it concluded that pre-emergence application with conoweeding of Penoxsulam + Butachlor @ 2 L/ha (PE) on 3 DAT fb, Conoweeder twice on 25 and 35 DAT (T_3) in rice is the most effective weed control method for obtaining a lower total weed count, weed biomass and higher weed control index.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

I hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Directorate of Economics and Statistics. Department of Agricultural cooperation and farmer's welfare. Ministry of Agriculture and Farmer's Welfare, Govt. of India, Delhi, India; 2021.
2. Toungos NV, Thuy NTT, Tuyet TTA, Kristiansen P. Investigating the resistance of barnyard grass populations to pretilachlor in direct-seed rice in the Central Region of Vietnam. African J. Agri. Res. 2018;18(7):542-554.
3. Uphoff N. SRI 2.0 and beyond: Sequencing the protean evolution of the System of Rice Intensification. Agronomy. 2023;13(5):1253.
4. Korav S, Dhaka AK, Ram S, Premaradhya N, Chandramohan Reddy G. A study on crop weed competition in field crops. J. Pharmacogn. Phytochem. 2018;7(4):3235-3240.
5. Roy A, Banerjee M, Malik GC. Cultivation method and weed management practices in rice (*Oryza sativa* L.). J. Pharmaco. and Phytochem. 2020;9(6S):440-456.
6. Sivakumar B, Kumar AP, Parasuraman P, Sivagamy. Growth, yield and economics of irrigated finger millet as influenced by system of finger millet intensification (SFI) practices in north eastern zone of Tamil Nadu. J. Pharmaco. and Phytochem. 2019;8(3):660-663.

7. Mohanty S, Chengappa PG, Hedge M, Ladha JK, Baruah S, Kannan E. Manjunatha AV. (Eds.). The future rice strategy for India. Klumer Academic. 2020;517-537
8. Gomez KA, Gomez AA. Statistical procedures for agricultural research. J. Wiley and Sons, New York; 1984.
9. Mohammed M, Sood R, Singh S. Effectiveness of integrated weed management strategies on weed flora and rice yield. J. Crop Improv. 2022;36(4):565-584.
10. Singh G, Singh B. Impact of weed species on rice productivity and efficacy of herbicide applications. Field Crops Res. 2023;290(1):108588.
11. Nath P, Sharma R, Pandey A. Comparative study of grassy, Sedgy, and broad-leaved weeds in rice fields and their management practices. Weed Science. 2024;72(1):45-58.
12. Jena S, Mehta R, Singh H. Butachlor: A comprehensive review on its use in rice and environmental concerns. Pest. Biochem. Physio. 2019;15(3):1-10.
13. Bajwa AA, Farooq M, Khan MA. Penoxsulam for the control of *Echinochloa* species and other grass weeds in rice. J. Environ. Sci. Health., Part B. 2020; 55(6):487-495.
14. Yadav N, Sevanthi AC, Pandey R, Chinnusamy V, Singh AK, Singh NK. Physiological response and agronomic performance of drought tolerance mutants of Aus rice cultivar Nagina 22 (*Oryza sativa* L). Field Crops Res. 2024;290(1):108760.
15. Wang J, Tang W, Wu C, Yan D, Li X. Efficacy of penoxsulam plus butachlor for controlling barnyardgrass (*Echinochloa crus-galli*) and other weeds in rice fields. Weed Tech. 2021;35(4): 597-604.
16. Tanveer A, Khaliq A, Matloob A. Mechanisms of herbicide resistance in weeds and associated molecular bases: A review. Environ. Sci. and Pollution Res. 2019;26(1):32687-32700.
17. Zhang H, Liu W, Li Y, Jiang J. Synergistic interactions between penoxsulam and butachlor in controlling major rice weeds. Pest Management Sci. 2020;76(10):3229-3236.

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