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RESEARCH ARTICLE

Effect of weed management on nutrient uptake, yield and economics of direct seeded rice (*Oryza sativa* L.)

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Abstract

In direct seeded rice cultivation, weed is the major constraint mainly due to absence of puddling in field. The yield loss due to weed interference is huge, may be up to 100 %. In this perspective, the present experiment was conducted to study the effect weed management on nutrient uptake, grain yield, economics of direct seeded rice. The dry weight and density of weeds were recorded at different growth stages and consequently herbicide efficacy was evaluated. Experimental results revealed that pre-emergence herbicide effectively controlled the germination of grass weeds. Application of bispyribac-sodium as post-emergence following pre-herbicides plus hand weeding effectively reduced the density and biomass accumulation of diverse weed flora in Direct Seeded Rice (DSR). Herbicidal treatment improved the plant height, yield attributes and economics over weedy check. Besides early control of weeds is a better prescription to improve rice yield. Based on the grain yield and Weed Control Index (WCI), it can be concluded that the combined application of pre followed by post plus hand weeding effectively control different weed flushes throughout the crop growth period in DSR.

Keywords: direct seeded rice; economics; herbicide; weeds

Introduction

An estimated 106.19 tonne rice production from an area of 43.95 ha has made India rank second after China among global rice producers. The most common growing method of rice is manual transplanting of seedlings in puddled soils, creating a hard pan below the plough layer. This practice involves both water and human labour resources both of which are becoming increasingly meagre (1). It affects soil health owing to dispersion of soil particles and consequent compaction of the soil (2). In addition, globally the relevance of conventional method of transplanting rice in puddled soil is under scrutiny owing to the threats of climate change. It has a substantial contribution to the greenhouse gases emission, particularly methane (3). These above situations have compelled scientists and researchers towards direct seeded rice cultivation, as a viable alternative to save water and labour. In Indian sub-continent, farmers generally do the direct seeding in dry condition. DSR fields are more species -rich with greater diversity in weed flora than Transplanted Rice (TPR) fields (4). The ingression of annual grasses and perennial sedges presents menace in weed management with continuous direct seeding. Different weed control measures have been practiced previously to minimize weed pressure in DSR (2). Among them, chemical control is the most common which has been proved reliable by several workers for controlling weeds in DSR. Application of herbicides effectively suppresses weeds and provides DSR with a weed-free environment. So, to effectively control the weed problem and to harness the fullest benefit of DSR system, the use of herbicide at a right application rate and time is very important at this time (5).

Materials and Methods

Field experiment was conducted during late *Navarai* season of 2019 at experimental farm of the Department of Agronomy, Annamalai University, Annamalai Nagar to find out the influence of pre and early post-emergence herbicide on weed management in direct sown rice (*Oryza sativa* L.) under wet condition. The soil was clay loam, low in available nitrogen (232.5 kg ha^{-1}), medium in available phosphorus (19.2 kg ha^{-1}) and high in potassium (324.6 kg ha^{-1}), with organic carbon 0.70 % and pH 7.5. The experiment

was laid out in randomized block design (RBD) with nine treatments, each replicated thrice, using the variety of CO-51 as the test variety. The treatments includes T_1- Un-weeded control, T_2- Twice hand weeding @ 15 and 30 Days After Sowing (DAS), T_3- Pre-emergence application of pyrazosulfuron-ethyl 10 % WP @ 200g ha^{-1} @ 7 DAS + one hand weeding @ 30 DAS, T_4- Pre-emergence application of metsulfuron-methyl 10 % + chlorimuron-ethyl 10 % wp @ 20 g ha^{-1} @7 DAS + one hand weeding @ 30 DAS, T_5- Pre-emergence application of pretilachlor 50 % EC @ 1250 mL ha^{-1} @ 7 DAS + one hand weeding @ 30 DAS, T_6- Early post-emergence application of pretilachlor 6 % + pyrazosulfuron-ethyl 0.15 % G @ 15 DAS, T T_7- Early post-emergence application of Bispyribac-sodium 10 % SC @ 300 mL ha^{-1}@ 15 DAS, T_8- Early post-emergence application of pretilachlor 6 % + pyrazosulfuron-ethyl 0.15 % G + one hand weeding @ 30 DAS and T_9- Early post-emergence application of Bispyribac-sodium 10 % SC @ 300 mL ha^{-1}+ one hand weeding @ 30 DAS. The variety was raised under optimum conditions for agronomic practices and plant protection measures in the field. Observation on individual weed count, total weed flora and weed biomass were taken at 30 and 60 (DAS) and the final yield was taken at the time of harvesting.

Results and Discussion

Nutrient removal by weeds

Application of bispyribac- sodium 10 % SC at 15 DAS registered the highest WCI and least nutrient removal by weeds (Table 1). This might be due to the synergistic and cumulative effect of application of early post-emergence herbicides followed by hand weeding. Crop plus weeds from a non-weeded area will absorb about the same amount of N as that of crop from weed-free plot. Thus, the weeds deprive the nutrients that would have normally been available to the rice crop. As the nutrient removal is increased by weeds on account of higher weed population, adverse effect could be expected on the crop. When the weed growth is effectively checked through herbicides, a reduction in nutrient removal by weeds and increased WCI are natural consequences. The application of bispyribac-sodium 10 % SC recorded the lowest weed index and least nutrient removal by weeds. This indicate the reduction in grain yield was minimum under bispyribac-sodium applied at post-emergence herbicide (6).

Number of panicle m^{-2}

The effect of herbicide treatment on number of panicle m^{-2} was found to be highly significant. Thus, the highest number of panicles was recorded from the plots sprayed with bispyribac-sodium 10 % SC on 15 DAS and it was followed by one hand weeding on 30 DAS which produced 415.42 panicle $m^{-2}$and it wasfollowed by twice hand weeding on 15 and 30 DAS (Table 2). In direct seeded rice yield and yield attributes were tremendously increased due to timely control of weeds in critical period of crop weed competition has enhanced the availability of nutrients, light and moisture to the crop and also increase the crop yield with timely application of these broad-spectrum herbicide combinations has been reported to yield similar results in herbicide use for direct-seeded rice (7).

Thousand grain weight

The results showed that thousand grain weight was not influenced by the treatments. Since thousand grain weight is mainly governed by the inherent genetic makeup of the cultivar, the treatment effect was not reflected over the character.

Grain yield

The data on yield and yield attributes were significantly improved by the application of herbicides in direct seeded rice. Application of Pyrazosulfuron-ethyl 200g ha^{-1}+ Bispyribac-sodium 250 mL $ha^{-1}$was recorded maximum no of panicle, yield and harvest index than all other treatments (Table 2). Application of this combination might have improved the availability of natural resources and critical inputs for establishment of rice crop by reducing the maximum germination of weeds as well as suppressing the weed growth with proper efficient mode of action at initial days of critical crop weed competition. Mode of action of bispyribac-sodium is selective, systemic, post-emergence herbicide and it has been absorbed by foliage and roots. Spraying of bispyribac-sodium efficiently destroyed may be ascribed to the trans-laminar activity of bispyribac -sodium. Bispyribac-sodium is translocated in the plant both by downward movement to the roots and rhizomes and upward movement to the meristem (8); once the bispyribac-sodium arrives in the meristematic region, it attacks EPSP synthase, an enzyme of the tyrosine, phenylalanine and tryptophan; these amino acids are essential to protein synthesis and cell wall formation. This enzyme blockage might have led to massive phytotoxic buildup of shikimic acid and benzoic acid which inhibits respiration, bud development, chlorophyll synthesis and transpiration, leading to eventual death of plants.

Table 1. Effect of weed control treatments on nutrient uptake by weeds (kg ha^{-1})

Treatments	N (kg ha^{-1})	P (kg ha^{-1})	K (kg ha^{-1})
T1- Un-weeded control	40.13	14.56	27.53
T2- Twice hand weeding @ 15 and 30 DAS	17.68	6.96	12.55
T3- Pre-emergence application of pyrazosulfuron-ethyl 10 % WP @ 200g ha-1 @ 7 DAS + one hand weeding @ 30 DAS	33.74	10.99	22.32
T4- Pre-emergence application of metsulfuron-methyl 10 % + chlorimuron-ethyl 10 % WP @ 20 g ha^{-1} @7 DAS + one hand weeding @ 30 DAS	32.31	10.42	21.38
T5- Pre-emergence application of pretilachlor 50 % EC @ 1250 ml ha-1 @ 7 DAS + one hand weeding @ 30 DAS	33.10	10.63	21.90
T6- Early post-emergence application of pretilachlor 6 % + pyrazosulfuron-ethyl 0.15 % G @ 15 DAS	36.59	11.26	24.71
T7- Early post-emergence application of Bispyribac-sodium 10 % SC @ 300 ml ha-1@ 15 DAS	37.58	11.73	25.37
T8- Early post-emergence application of pretilachlor 6% + pyrazosulfuron-ethyl 0.15 % G + one hand weeding @ 30 DAS	19.62	8.82	13.75
T9- Early post-emergence application of Bispyribac-sodium 10 % SC @ 300 ml ha-1+ one hand weeding @ 30 DAS	14.67	4.93	11.48
S.Ed	0.85	0.32	0.51
CD (p=0.05)	1.74	0.65	1.03

Table 2. Effect of weed control treatments on number of panicles m^{-2}, thousand grain weight, grain yield, straw yield

Treatments	Number of panicles (m^{-2})	Thousand grain weight	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})
T_1- Un-weeded control	216.90	16.41	2289.7	4721.3
T_2- Twice hand weeding @ 15 and 30 DAS	403.79	16.69	5287.37	7546
T_3- Pre-emergence application of pyrazosulfuron-ethyl 10 % WP @ 200g ha^{-1} @ 7 DAS + one hand weeding @ 30 DAS	385.64	16.51	4654.81	6795
T_4- Pre-emergence application of metsulfuron-methyl 10 % + chlorimuron-ethyl 10 % wp @ 20 g ha^{-1} @7 DAS + one hand weeding @ 30 DAS	352.38	16.58	4784.34	6986
T_5- Pre-emergence application of pretilachlor 50 % EC @ 1250 ml ha^{-1} @ 7 DAS + one hand weeding @ 30 DAS	346.09	16.53	4701.2	6832
T_6- Early post-emergence application of pretilachlor 6 % + pyrazosulfuron-ethyl 0.15 % G @ 15 DAS	318.53	16.48	3804.76	6437
T_7- Early post-emergence application of Bispyribac-sodium 10 % SC @ 300 ml ha^{-1}@ 15 DAS	312.34	16.46	3633.85	6211
T_8- Early post-emergence application of pretilachlor 6 % + pyrazosulfuron-ethyl 0.15 % G + one hand weeding @ 30 DAS	385.64	16.60	5045.92	7307
T_9- Early post-emergence application of Bispyribac-sodium 10 % SC @ 300 ml ha^{-1}+ one hand weeding @ 30 DAS	415.42	16.72	5674.91	7865
S.Ed	6.64	NS	90.71	111.9
CD (p=0.05)	13.49		184.16	227.19

Straw yield

Straw yield was significantly influenced under weed control treatments. The highest straw yield was recorded with Bispyribac-sodium 10 % SC @ 15 DAS + one hand weeding on 30 DAS. The lowest straw yield was recorded in weedy plots. This was due to the highest infestation of weeds. In DSR, weed control during the initial 30 to 45 days are very crucial, owing to the slow growth of plants and poor canopy coverage as reported in previous scientific studies (4, 7).

Economics

The treatment, Bispyribac-sodium 10 % SC @ 15 DAS + one hand weeding on 30 DAS (T_9) registered the highest gross income of Rs. 94956.25 ha^{-1} and net income of Rs. 49260.89 ha^{-1}. This was followed by twice hand weeding on 15 and 30 DAS (T_2) and the treatment pretilachlor 6 % + pyrazosulfuron-ethyl 0.15 % G @ 15 DAS + one hand weeding (T_8) were next in controlling weeds. Un-weeded control recorded the least gross income of Rs. 40236.25 ha^{-1} and net income of Rs.1264.13 ha^{-1}. The economic efficiency and viability of crop cultivation are mainly the outcome of yield of crops with larger management costs (9). Higher crop productivity with lesser cost of the cultivation could result in better economic parameters like higher net returns and B:C. Adoption of different weed management practices significantly influenced the gross returns, net returns and B:C. The effectiveness of any production system is ultimately evaluated based on its economics. Economics analysis is the basic consideration in determining which treatment gives the highest return while marginal analysis indicates the relative contribution of additional expenditures.

Conclusion

The better control of weeds was reason for achieving the higher growth and yield attributes thus helped in recording higher grain and straw yield and less weeding cost when compared to other weed management practices contributed primarily for the better economic indices net income and B:C invested by the treatment bispyribac-sodium 10 % SC @ 15 DAS followed by one hand weeding on 30 DAS.

Authors' contributions

BS carried out the experiments and recorded the observation. AK pooled and analysed the data and tabulated. AV involved in drafting and aligned the article. DD calculated the yield economics of the experiment. SS drafted and aligned the article coordination. All authors read and approved the final manuscript.

Compliance with ethical standards

Conflict of interest: Authors do not have any conflict of interests to declare.

Ethical issues: None

References

1. Bouman BAM, Yang X, Wang H, Yang X, Zhao J, Wang Z, et al. Performance of aerobic rice varieties under irrigated conditions in North China. In: Proceedings of 12th International Soil Conservation Organization Conference; 2022; Beijing, China. p. 175-81. https://doi.org/10.1016/j.fcr.2005.08.015
2. Chauhan BS, Ngoc STT, Doung D, Ngoc PL. Effect of pretilachlor on weedy rice and other weeds in wet-seeded rice cultivation in South Vietnam. Plant Prod Sci. 2012;17(4):315-20. https://doi.org/10.1626/pps.17.315
3. Pathak H. Greenhouse gas mitigation in Indian agriculture. Ann Agric Res. 2013;34:99-105. https://doi.org/10.1002/ghg.1528
4. Chauhan BST, Migo PR, Westman D, Johnson E. Post-dispersal predation of weeds in rice fields. Weed Res. 2010;50:553-60. https://doi.org/10.1111/j.1365-3180.2010.00807.x
5. Choudhary SK, Marahtta S, Chaudhary M. Performance of dry direct seeded rice and weeds on *Sesbania* brown manuring as compared to farmers practice and chemical control weeds. Int J Appl Sci Biotechnol. 2018;6(3):265-9. https://doi.org/10.3126/ijasbt.v6i3.21181
6. Veeraputhiran R, Balasubramanian R. Evaluation of new post emergence herbicides for transplanted rice. In: Proc. National Conference on Challenges in Weed Management in Ecosystem Present Status and Future Strategies; 2013; Coimbatore, India. p. 175.
7. Priya RS, Chinnusamy C, Arthanari PM, Janaki P. Bio-efficacy of new herbicide combination (bispyribac-sodium 4 % + metamifop 10 %

SE) on weed control, economics and profitability of direct seeded rice. Int J Chem Stud. 2017;5(4):2349-8528. https://doi.org/10.9734/bjast/2017/34088

8. Rao S, Kumar JH, Venkataramulu M, Reddy PR. Evaluation of different herbicides in direct seeded rice (*Oryza sativa* L.). Int J Curr Microbiol Appl Sci. 2019;(12):790-8. https://doi.org/10.20546/ijcmas.2019.812.103

9. Ghosh D, Singh K, Redu Das A. Weed management through herbicides application in direct seeded rice and yield modeling by artificial neural network. Spanish J Agric Res. 2016;14(2):1003-10. https://doi.org/10.5424/sjar/2016142-8773

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