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Management of Diversified Weed Flora in Dry Direct-Seeded Rice Using Herbicide under different Tillage in Rice-Yellow Sarson Crop sequence in Lateritic Belt of West Bengal

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ABSTRACT: A field study was conducted during *kharif* 2019 and 2020 at the Agricultural Farm of the Palli Siksha Bhavana (Institute of Agriculture), Visva-Bharati, Sriniketan, Birbhum, West Bengal to evaluate the effect of tillage and herbicides on weed growth and the growth and productivity of rice in direct-seeded rice-yellow sarson crop sequence. Two tillage practices *viz.*, zero and conventional tillage in main plot and eight weed management practices *viz.*, oxadiargyl followed by (*fb*) bispyribac-sodium, penoxsulam + cyhalofop-butyl, oxadiargyl *fb* penoxsulam + cyhalofop-butyl, fenoxaprop-p-ethyl + ethoxysulfuron, oxadiargyl *fb* fenoxaprop-p-ethyl + ethoxysulfuron, pendimethalin *fb* bispyribac-sodium, weed free check and unweeded control in sub-plots were assigned in a split-plot design replicated thrice. The Results showed that the sequential application of herbicides oxadiargyl *fb* fenoxaprop-p-ethyl + ethoxysulfuron and oxadiargyl *fb* penoxsulam + cyhalofop-butyl registered 94.9-99.3% control over total weed biomass and also recorded the highest crop growth and biological yield of DSR.

Keywords: Dry direct seeded rice, herbicide combination, tillage, weed management.

INTRODUCTION

Rice (*Oryza sativa* L.) yellow sarson (*Brassica campestris* L. var. yellow sarson) is an important cropping system that is widely followed by farmers in the Indo-Gangetic Plains of India. Rice is grown in 43.6 million hectares (Mha) in India, yielding 118.8 million tonnes (Mt) (39.9% of the total food grain production). The area of rapeseed-mustard is 6.7 Mha with a yield of 9.1 Mt (27.2% of the total oilseed production). In West Bengal, total rice covers 5.4 Mha (12.5% of the total rice area in India) which produces 15.8 Mt (13.3% of the total rice production in India) (Anonymous, 2021). Rice productivity is very low in West Bengal (2.8 t ha^{-1}). One of the main reasons is that only 51.0% area is irrigated. The share of agriculture's water is declining because of increasing domestic and industrial use (Kumar and Ladha 2011; Mahajan *et al.*, 2013). Direct-seeded rice (DSR) is becoming popular among farmers (Ahmed and Chauhan 2014) because it required less water and labour as compared to puddled transplanted rice. Despite all of the advantages of DSR, the most significant biotic constraints are weeds (Pratap *et al.*, 2017). It is very difficult to control the complex weed flora of DSR with a single herbicide. Dependence on a single herbicide year after year may increase the chance of evolution of herbicide resistant biotype and shift in weed flora (Duary, 2008; Jacob *et al.*, 2017). Even the sequential application of herbicides does not ensure complete weed control (Gopal *et al.*, 2010; Chauhan 2011; Chauhan *et al.*, 2015; Sen *et al.*, 2021) due to continuous emergence of weeds in DSR condition (Chauhan, 2012). Keeping all the aforesaid things in view and realizing the importance of the problem, the experiment was conducted under different tillage with varying herbicide combinations to control weed and their effect of rice growth in rice-yellow sarson cropping.

MATERIAL AND METHODS

A field experiment was conducted at Agricultural Farm of Palli Siksha Bhavana (Institute of Agriculture), Visva-Bharati, Sriniketan, Birbhum, West Bengal during *kharif* 2019 and 2020. The soil in the experimental field was sandy loam. Two tillage practices *viz.*, zero tillage and conventional tillage in main plot and eight weed management practices *viz.*, oxadiargyl at 90 g ha^{-1} followed by (*fb*) bispyribac-sodium at 25 g ha^{-1}, penoxsulam + cyhalofop-butyl at 80 g ha^{-1}, oxadiargyl at 90 g ha^{-1} *fb* penoxsulam + cyhalofop-butyl at 180 g ha^{-1}, fenoxaprop-p-ethyl +

ethoxysulfuron at 90 +15 g ha^{-1}, oxadiargyl at 90 g ha^{-1} *fb* fenoxaprop-p-ethyl + ethoxysulfuron at 90 + 15 g ha^{-1}, pendimethal in at 1000 g ha^{-1} *fb* bispyribac-sodium at 25 g ha^{-1}, weed free check and unweeded control in sub-plots were assigned in a split-plot design replicated thrice. The crop was fertilized with 80:40:40 kg ha^{-1} of N, P and K. Herbicides were applied with a battery-powered knapsack sprayer equipped with a flat-fan nozzle with 500 *l*/ha of water. The rice variety Cottondora Sannalu (MTU-1010) was taken in the experiment. Weed biomass were recorded by removing weeds present inside 50 cm × 50 cm quadrats from the specified sampling area in each plot, then drying them in a hot air oven at 70° C to determine weed biomass and expressed in g m^{-2}. Rice plant population and number of tillers were counted in 1 m running length and recorded in number m^{-2} and statistically assessed at a 5% level of significance (pooled analysis).

RESULTS AND DISCUSSION

A. Weed growth

Digitaria sanguinalis (L.) Scop., *Ludwigia parviflora* (Jacq.) Raven, *Cyperus iria* (L.) and *Fimbristylis miliacea* (L.) Vahl were the most common weeds of DSR. Malik *et al.* (2021) also observed similar type of weed flora in DSR under lateritic soil of West Bengal. Tillage had no significant effect on weed growth (Table 1). However, the weed biomass was 8.10% higher in conventional tillage than in zero tillage. Tilled soil provided optimum conditions for the growth of weeds (Verhulst *et al.*, 2010) which could be the reason for higher biomass of total weed in conventional tillage.

Among weed management practices, sequential application of herbicides *viz.*, oxadiargyl *fb* fenoxaprop-p-ethyl + ethoxysulfuron recorded 99.3% control over total weed biomass followed byoxadiargyl *fb* penoxsulam + cyhalofop-butyl (94.9%), oxadiargyl *fb* bispyribac-sodium (94.9%) and pendimethalin *fb* bispyribac-sodium (92.4%) (Table 1). Penoxsulam + cyhalofop-butyl and fenoxaprop-p-ethyl + ethoxysulfuron were not effective against the complex weed flora of DSR in absence of pre-emergence herbicide oxadiargyl and therefore these plots recorded higher biomass of total weed. These results are in the line with the findings of Gopal *et al.* (2010); Menon (2019); Pooja and Saravanane (2021).

B. Crop growth

Tillage had no significant effect on plant population, plant height, number of tillers and biological yield of DSR (Table 1). The findings are comparable to those of the study conducted by Yadav and Singh (2006) and Singh *et al.* (2010). Among weed management practices, unweeded control and pendimethalin *fb* bispyribac-sodium treated plot recorded 14.6% reduction in plant population of DSR. Oxadiargyl *fb* bispyribac-sodium was found at par with weed free check and other herbicide treated plots with respect to plant population of DSR. This might be due to sudden rain after application of pre-emergence herbicide. Oxadiargyl offers greater selectivity to rice, compared to pendimethalin as reported by Rana *et al.* (2016); Yogananda *et al.* (2019). Unweeded control recorded the lowest plant height, number of tillers and biological yield of DSR. Weed interference reduced the rice growth (Al Mamun, 2014; Saravanane, 2020; Pavithra *et al.*, 2021). Among herbicide treated plots, oxadiargyl *fb* fenoxaprop-p-ethyl + ethoxysulfuron and oxadiargyl *fb* penoxsulam + cyhalofop-butyl recorded the highest plant height, number of tillers and biological yield of DSR. As compared to fenoxaprop-p-ethyl + ethoxysulfuron, oxadiargyl *fb* fenoxaprop-p-ethyl + ethoxysulfuron registered 9.2% higher biological yield. Similarly, oxadiargyl *fb* penoxsulam + cyhalofop-butyl registered 17.8% higher number of tillers and 40.4% higher biological yield of DSR as compared to penoxsulam + cyhalofop-butyl. Rice biological yield and total weed dry weight at 90 DAS showed negative linear relationship with co-efficient of determination of 0.6193 (Fig. 1). It indicates that weed interference retarded the growth of DSR.

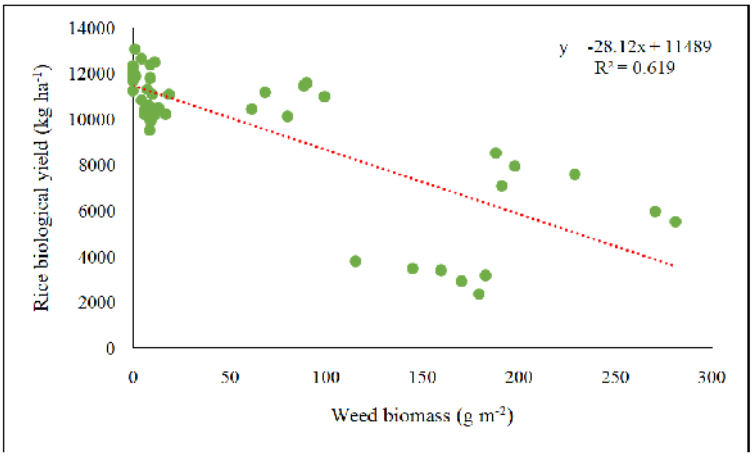

Fig. 1. The relationship between biological yield of rice and total weed biomass at 90 DAS.

Table 1: Effect of treatments on weed biomass and growth of rice (pooled analysis).

Treatment	Total weed biomass (g m^{-2}) at 90 DAS	Crop growth			
		Plant population (No. m^{-2})	Plant height (cm)	Tiller (No. m^{-2})	Biological yield (kg ha^{-1})
Tillage practices					
Zero tillage	5.84 (34)	40	97.0	314	9618
Conventional tillage	6.14 (37)	41	97.9	315	9868
LSD (P=0.05)	0.74	2	4.8	32	252
Weed management practices					
Oxadiargyl *fb* bispyribac-sodium	2.84 (8)	40	100.5	334	10236
Penoxsulam + cyhalofop-butyl	15.01 (225)	43	96.9	281	7127
Oxadiargyl *fb* penoxsulam + cyhalofop-butyl	2.99 (8)	43	102.1	342	11967
Fenoxaprop-p-ethyl + ethoxysulfuron	9.02 (81)	43	98.5	328	10988
Oxadiargyl *fb* fenoxaprop-p-ethyl + ethoxysulfuron	1.18 (1)	44	102.0	362	12102
Pendimethalin *fb* bispyribac-sodium	3.58 (12)	35	97.4	314	10416
Weed free check	0.71 (0)	41	98.0	362	11921
Unweeded control	12.59 (158)	35	84.2	191	3189
LSD (P=0.05)	0.50	4	4.2	34	650
*Figures within parentheses indicate original values and the data were transformed to √(X + 0.5) before analysis					

CONCLUSION

Thus, based on two year of experiment it can be concluded that sequential application of oxadiargyl *fb* fenoxaprop-p-ethyl + ethoxysulfuron and oxadiargyl *fb* penoxsulam + cyhalofop-butyl under zero or conventional tillage may be recommended for effective management of complex weed flora and higher productivity of rice in direct-seeded rice-yellow sarson cropping sequence in lateritic soils of West Bengal.

FUTURE SCOPE

Because herbicide use and tillage practices have a significant and vital role in influencing the microbial status of soil, more research should be done on this aspect in the field with different crops and cropping systems under different agro-climatic conditions.

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Conflict of Interest. None.

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