

Weed Dynamics, Yield and Economics of Direct Seeded Rice (*Oryza sativa* L.) as Influenced by Different Herbicides

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Abstract A field experiment was conducted during the *kharif* season of 2011-12 to evaluate the effect of different herbicides on weeds of direct seeded rice with ten treatments in three replications. The major weed species dominant in the experimental field were *Echinochloa* spp. among the grasses, *Cyperus* spp. among the sedges and *Caesulia axillaris*, *Ammanica baccifera*, *Eclipta alba* and *Phyllanthus niruri* among the broad leaf weeds. Application of Carfentrazone ethyl at 35 g ha⁻¹ was effective in reducing the weed density, weed dry matter accumulation and enhancing the weed control efficiency. Carfentrazone ethyl 35 g ha⁻¹ recorded significantly higher growth attributes and yield as compared to all other treatments and was at par with

the application of Carfentrazone ethyl 35 g ha⁻¹ followed by Carfentrazone ethyl 30 g ha⁻¹. Maximum gross returns, net returns and B : C ratio (1.30) was recorded with the application Carfentrazone ethyl 35 g ha⁻¹.

Keywords Weed dynamics, Rice, Yield, Economics.

Introduction

Rice is the world's most important crop and India is the second largest rice producing country in the world. However, heavy weed infestation is the major constraint to the production of direct seeded rice [1, 2] which causes 60—80% reduction in grain yield of rice. Weeds rob light, nutrients and water from the crop. This can be attributed to the simultaneous emergence of weeds and crops and less availability of efficient selective herbicides for control of weeds during initial stages of crop weed competition. Most of the herbicides that are recommended for DSR are applied as pre-emergence to crop to control weeds during the initial period. The weeds that emerge during the later periods of crop growth cycle are not suppressed by any herbicides. Further, continuous use of a single herbicide or group of herbicides with the same mode of action can lead to shift in weed flora and development of resistance to herbicides.

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Carfentrazone ethyl is a new herbicide which inhibits proto porphyrinogen and has a broad spectrum of weed control and is rapidly degraded in the environment. Hence, the present study was carried out to evaluate the efficacy of new herbicide Carfentrazone ethyl in rice along with different pre and post emergence herbicides in managing weeds of direct-seeded rice.

Materials and Methods

A field experiment was carried out during the *kharif* season of 2011-12 at the Agricultural Research Farm, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi (UP). The Agriculture Research Farm, is located at 25°18'N latitude and 88°36'E latitude and at an altitude of 129 meters above the mean sea level in the Northern Gangetic alluvial plains. The soil of the experimental field was gangetic alluvial having sandy clay loam texture with pH 7.4. It was moderately fertile with available nitrogen (210.5 kg ha⁻¹), available phosphorus (28.1 kg ha⁻¹), available potassium (204.5 kg ha⁻¹) and organic carbon (0.54%). The experiment was laid out in randomized block design with three replications and ten herbicidal treatments viz. T₁-Carfentrazone ethyl 15 g ha⁻¹, T₂-Carfentrazone ethyl 20 g ha⁻¹, T₃-Carfentrazone ethyl 25 g ha⁻¹, T₄-Carfentrazone ethyl 30 g ha⁻¹, T₅-Carfentrazone ethyl 35 g ha⁻¹, T₆-Ethoxysulfuron 15 g ha⁻¹, T₇-2,4-D Na salt 500 g ha⁻¹, T₈-Metsulfuron methyl 4 g ha⁻¹, T₉-Pendimethalin 1,000 g ha⁻¹ and T₁₀- Weedy check. All the plots were fertilized with 120 kg N, 60 kg P₂O₅ and 40 kg K₂O ha⁻¹ through Urea, Muriate of Potash and DAP. Half dose of Nitrogen and full dose of P₂O₅ and K₂O were applied as basal before sowing. Remaining doses of nitrogen was top dressed. The requisite quantity of seed at the rate of 100 kg ha⁻¹ for rice was sown. The crop was raised with recommended package of practices. Effective tillers m⁻², 1,000 grain weight (g) and grain yield (kg/ha) were recorded at the time of rice harvest. Biometric observations on weed growth parameters, crop growth attributes and yield were recorded to ascertain significant results. All the herbicides were applied in the experimental plot with the help of foot operated sprayer. The weed management efficacy of the treatments was measured in

terms of weed density (species wise), weed dry matter production and weed control efficiency (%). The weed samples taken out as per treatments were oven dried for about one week and dry weight was recorded. The cost of cultivation was calculated by taking into account the prevailing market price of inputs and operational cost from the farmers field. The significant differences between treatments was compared by critical difference at 5% level of probability.

Results and Discussion

Weed parameters

The major weed flora observed in the experimental field were *Echinochloa* spp., *Dactyloctenium aegypticum* among grasses, *Cyperus* spp. among sedges, *Caesulia axillaris*, *Ammanica baccifera*, *Eclipta alba* and *Phyllanthus niruri* among broad leaved weeds. The composition of grasses, broad-leaved and sedge weeds was 37.7%, 32.0% and 30.1% respectively (Table 1). Relative composition of different weed species in weedy check revealed that the composition of narrow leaved weeds was higher in comparison to broad leaved weeds and sedges. These findings are in close collaboration with the earlier findings [3, 4] who also reported dominance of grassy weeds over other species in direct seeded rice. All the herbicidal treatments significantly reduced the weed density compared to weedy check. Carfentrazone ethyl 35 g ha⁻¹ caused a significant reduction in the total density and dry matter accumulation by weeds when compared with weedy check and was at par with the application of Carfentrazone ethyl 30 g ha⁻¹ followed by Metsulfuron 4 g ha⁻¹ and 2,4-D 500g ha⁻¹. Pre-emergence application of Pendimethalin 1.0 kg ha⁻¹ did not allow grassy weeds. Pre emergence application of Pendimethalin controlled only grasses, few broad-leaf weeds but not sedges, as also reported by Yaduraju and Mishra [5]. Among herbicides, application of Carfentrazone ethyl 35 g ha⁻¹ was superior in controlling BLW weed compared to other herbicide treatments. The highest weed density and dry matter accumulation was recorded in weedy check. The better performance of this treatment could be attributed to the reduced weed competition and sup-

Table 1. Effect of different herbicides on weed density, weed dry matter accumulation and weed control efficiency during 2011-12.

Treatments	<i>Echinochloa</i> spp.	<i>Dactyloctenium aegypticum</i>	<i>Cyperus</i> spp.	<i>Caesulia axillaris</i>	<i>Ammanica baccifera</i>	<i>Eclipta-alba</i>	<i>Phyllanthus niruri</i>	Weed control efficiency (%)	Weed dry weight (g/m ²)
W ₁	5.15 (26.00)	1.68 (2.33)	6.49 (41.67)	3.08 (9.00)	9.33 (3.14)	1.58 (2.00)	1.58 (2.00)	37.30	122.51
W ₂	4.30 (18.00)	1.33 (1.35)	6.04 (36.00)	2.86 (7.67)	2.80 (7.33)	1.35 (1.33)	1.47 (1.67)	43.73	109.94
W ₃	3.94 (15.00)	0.67 (1.08)	6.07 (35.00)	2.80 (7.33)	2.55 (5.00)	1.22 (1.00)	1.35 (1.33)	46.58	104.37
W ₄	3.85 (14.33)	0.33 (0.91)	5.90 (34.33)	2.74 (7.00)	2.42 (5.33)	1.22 (1.00)	1.08 (0.67)	49.37	98.93
W ₅	3.76 (13.67)	0.00 (0.71)	5.87 (34.00)	2.68 (6.67)	2.27 (4.67)	1.22 (1.00)	0.91 (0.33)	49.91	97.88
W ₆	5.18 (26.33)	3.00 (1.87)	5.85 (33.67)	3.14 (9.33)	3.39 (11.00)	1.58 (2.00)	1.87 (3.00)	33.13	130.67
W ₇	5.52 (30.00)	2.67 (1.78)	5.73 (32.33)	3.44 (11.33)	3.29 (10.33)	1.22 (1.00)	1.68 (2.33)	35.10	126.81
W ₈	4.95 (24.00)	3.00 (1.87)	5.46 (29.33)	3.76 (13.67)	3.19 (9.67)	1.35 (1.33)	1.78 (2.67)	31.26	134.31
W ₉	5.08 (25.33)	1.78 (2.67)	5.73 (32.33)	3.29 (10.33)	3.24 (10.00)	1.68 (2.33)	1.78 (2.67)	41.47	114.36
W ₁₀	6.60 (43.00)	2.20 (4.33)	7.49 (55.67)	4.67 (21.33)	4.10 (16.33)	1.87 (3.00)	2.04 (3.67)	0.00	195.41
SEm±	0.88	0.37	0.97	0.55	0.55	0.38	0.31	–	1.58
CD at 5%	2.60	1.10	2.87	1.63	1.62	1.13	0.93	–	4.70

pression of late emerged weeds by application of Carfentrazone ethyl effectively.

Weed control efficiency

Among the herbicidal treatments, highest weed control efficiency was recorded with the application of Carfentrazone ethyl at 30 g ha⁻¹ (49.91%) and was at par with the application of Carfentrazone ethyl 35 g ha⁻¹ (49.37%). This may be due to the fact that the use of Carfentrazone ethyl herbicide provided effective weed control. In general, it was observed that the control of weeds increased with increase in dose of Carfentrazone ethyl. Pendimethalin 1.0 kg ha⁻¹ as pre-emergence was effective in controlling grassy weeds during the crop emergence period.

Crop parameters

The maximum grain (3.75) and straw yield (4.88) were recorded with the application of Carfentrazone

ethyl 35g ha⁻¹ and was at par with the application of Carfentrazone ethyl 30 g ha⁻¹ treatment. All the weed control treatments resulted significantly higher rice grain yield over the weedy check. Weedy check recorded the lowest rice yield (1.64). Higher values of yield can be attributed to better partitioning of photosynthesis from source to sink as a result of lower crop -weed competition and better weed suppression due to favorable growing conditions [6].

Economics

Data revealed that application of Carfentrazone ethyl 35 g ha⁻¹ recorded significantly higher gross returns, net returns and B : C ratio (1.30) and was at par with the treatment Carfentrazone ethyl 30 g ha⁻¹ (1.29) (Table 2). This was due to lesser cultivation cost in the treatments. This reports that the management of weeds by herbicides resulted in lower competition for resources needed for growth that enhanced the

Table 2. Effect of different herbicides on growth attributes, yield and economics of direct seeded rice during 2011-12.

Treat-ments	Plant height (cm)	Tillers plant ⁻¹	Crop dry weight (g m ⁻²)	Grain yield (t ha ⁻¹)	Straw yield (kg ha ⁻¹)	Harvest index (%)	Gross return (Rs ha ⁻¹)	Net return (Rs ha ⁻¹)	B : C ratio
W ₁	79.33	3.27	138.0	3.16	4.12	43.40	42399.00	20874.9	0.97
W ₂	81.33	3.53	142.07	3.52	4.43	44.27	46931.72	25294.8	1.17
W ₃	82.67	3.60	144.8	3.73	4.81	43.67	49928.88	28179.46	1.26
W ₄	82.37	3.67	145.07	3.71	4.67	44.27	49428.76	27566.84	1.29
W ₅	82.30	3.77	145.93	3.75	4.88	43.45	50298.96	28324.54	1.30
W ₆	78.67	3.20	136.43	2.60	3.23	44.59	34635.28	13564.36	0.64
W ₇	79.87	3.10	137.49	3.02	3.86	43.89	40361.68	19181.68	0.90
W ₈	80.67	3.23	138.16	3.04	3.83	44.25	40589.24	19849.24	0.96
W ₉	78.17	3.07	131.22	2.86	3.68	43.73	38271.12	17048.2	0.80
W ₁₀	75.50	2.63	117.27	1.64	2.12	43.61	22057	1516.08	0.07
SEm±	0.71	0.16	1.93	0.068	0.084	—	—	—	—
CD at 5%	2.11	0.48	5.72	0.19	0.23	—	—	—	—

crop to growth better as evidenced by increased yield attributes.

Conclusion

On the basis of this study, it can be concluded that Carfentrazone ethyl 35 g ha⁻¹ or 30 g ha⁻¹ is the optimum dose in rice for effective management of broad spectrum weeds and to achieve higher yield of rice and economic returns.

References

- Rao AN, Johnson DE, Sivaprasad B, Ladha JK, Mortimer AM (2007) Weed management in direct-seeded rice. *Adv in Agron* 93 : 153—255.
- Chauhan BS, Johnson DE (2010) The role of seed ecology in improving weed management strategies in the tropics. *Adv in Agron* 105 : 221—262.
- Rao AS, Ratnam M, Reddy TY (2008) Weed management in direct seeded semi-dry rice. *Ind J Weed Sci* 40 : 153—156.
- Singh S, Singh H, Narwal S, Malik RK (2003) Evaluation of alone and tank mixture of Akmix + Butachlor for control of weeds in transplanted rice. *Ind J Weed Sci* 35 : 24—26.
- Yaduraju NT, Mishra JS (2004) Weed management in rice with special orientation to export, pp 111—115. In SAARC RICE EXPO 2004, Maharashtra Chamber of Commerce and Industry and Rice Exporters Association of Pakistan, Mumbai, India.
- Thakur R, Shushama M, Upasani RR, Pal SK, Singh MK (2011) Impact of integrated weed management on dry matter partitioning and productivity of direct seeded rice. *SAARC J Agric* 9 : 37—43.