Indian Journal of Weed Science **53**(1): 81–84, 2021

Print ISSN 0253-8040 Online ISSN 0974-8164

In situ green manuring and herbicide on weed biomass, productivity and profitability of upland rice

Y. Basila*, S. Anitha, Meera V. Menon, K. Sreelakshmi and V.I. Beena

Department of Agronomy, College of Horticulture, Vellanikkara, Thrissur, Kerala 680 656

**Email: basilayoosaf1234@gmail.com*

Article information

DOI: 10.5958/0974-8164.2021.00012.5

Type of article: Research note

Received : 24 September 2020
Revised : 14 January 2021
Accepted : 18 January 2021

Key words
Brown manuring
In situ green manuring
Oxyfluorfen and pyrazosulfuron-ethyl
Upland rice
Weed management

ABSTRACT

Field experiment was conducted at Agronomy Farm, College of Horticulture, Vellanikkara during *Kharif* (rainy season) 2019 to develop cost-effective weed management strategy for upland rice in Kerala. Treatments consisted of brown manuring (cowpea) by application of 2,4-D 1.0 kg/ha at 25 days after sowing (DAS); *in situ* green manuring (cowpea) at 25 DAS; oxyfluorfen 0.15 kg/ha on the day of sowing *fb* hand weeding (HW) at 30 DAS; oxyfluorfen 0.15 kg/ha on the day of sowing *fb* bispyribac-sodium 0.025 kg/ha at 20 DAS; pyrazosulfuron-ethyl 0.03 kg/ha at 6 DAS *fb* HW at 30 DAS; pyrazosulfuron-ethyl 0.03 kg/ha at 6 DAS *fb* bispyribac-sodium 0.025 kg/ha at 20 DAS. Hand weeded control and unweeded control were also maintained. Results revealed that application of oxyfluorfen at 0.15 kg/ha on the day of sowing *fb* hand weeding at 30 DAS recorded lesser weed density and dry matter production, higher grain (2.74 t/ha) and straw (5.89 t/ha) yields and net monetary returns. It was at par with pyrazosulfuron-ethyl 0.03 kg/ha at 6 DAS *fb* hand weeding at 30 DAS.

Rice is one of the most important food crops in Kerala and it is cultivated mainly in three seasons, *viz*. autumn, winter and summer. Rice can be grown in wetland and upland conditions. In Kerala, upland rice cultivation is known as *'Modan'* cultivation and crop is raised during *'Virippu'* season. Upland rice is grown in rainfed, naturally well drained soils with bunded or unbunded fields without surface water accumulation. Moisture stress, weed infestation, poor soil fertility and incidence of pest and diseases are major problems associated with upland rice cultivation. Among these, weeds are considered to be the most serious problem which reduces yield and quality of produce. Low productivity of upland rice is due to severe weed infestation as aerobic soil conditions and alternate wetting and drying favour the weed growth (Kumar and Rana 2013). Arunbabu and Jena (2018) reported loss of 94-97% grain yield in upland rice due to weeds. Weeds are highly competitive for light, space, water and nutrients which cause tremendous yield reduction and increase the cost of production. In upland rice cultivation, entire crop growth period is considered as critical period of weed competition. Hand weeding is the mostly adopted method of weed management in rice and is highly tedious and labour intensive. Chemical method of weed management is most effective and economical. Success of upland rice production depends upon how effectively weeds are managed. Hence effective and timely management of weeds is essential to achieve maximum productivity in upland rice. In this background, a study was conducted to develop cost effective weed management strategy for upland rice in Kerala.

The field experiment was conducted at Agronomy Farm, College of Horticulture, Vellanikkara located at 10° 31¹ N latitude and 76° 13¹ E longitude at an altitude of 40.3 m above Mean Sea Level (MSL)on sandy loam soil during *Kharif* 2019. Treatments consisted of brown manuring (cowpea 20 kg/ha) by application of 2,4-D 80 WP 1.0 kg/ha at 25 DAS; *in situ* green manuring (cowpea 20 kg/ha) at 25 DAS; oxyfluorfen 23.5 EC 0.15 kg/ha on the day of sowing *fb* HW at 30 DAS; oxyfluorfen 23.5 EC 0.15 kg/ha on the day of sowing *fb* bispyribac-sodium 10 SC 0.025 kg/ha at 20 DAS; pyrazosulfuron-ethyl 10 WP 0.03 kg/ha at6 DAS *fb* HW at 30 DAS; pyrazosulfuron-ethyl 10 WP 0.03 kg/ha at 6 DAS *fb* bispyribac-sodium 10 SC 0.025 kg/ha at 20 DAS, hand weed in and unweeded control, were replicated thrice in a randomized block design. *'Vaisakh'*, medium duration (117-125 days) rice variety was selected as seed material. A local variety of cowpea was used for *in situ* green manuring and brown manuring. Plot size adopted was 5m × 4m and seeds were dibbled at a spacing of 20×10 cm.

Fertilizers were applied as urea, rajphos (phosphatic fertilizer) and murate of potash at the rate of 50: 35: 35 N, P and K kg/ha. Pre-emergence application of oxyfluorfen at 0.64 kg/ha was done on the day of sowing. Pyrazosulfuron-ethyl at 0.30 kg/ha was sprayed at 6 DAS. Post-emergence application of bispyribac-sodium 0.25 kg/ha was done at 20 DAS. Herbicide application was done with knap-sack sprayer fitted with a flood-jet nozzle using 500 L water per ha as spray volume. For *in situ* green manuring, cowpea plants were uprooted and placed between the rows. Brown manuring was done by spraying of 2,4-D at 1.0 kg/ha at 25 days after sowing. Weed observations were recorded at 20 and 45 DAS. Biometric observations on crop were recorded at 30, 60 DAS and at harvest. Yield and yield attributes were recorded at harvest. Weed density, weed dry matter production, number of tillers/hill, number of hills/m² and number of panicles/hill were estimated by placing quadrate with size of 1m² in four spots at random in each plot. Grain and straw yields were recorded from each plot after harvesting, threshing and winnowing. Benefit: cost ratio was calculated by dividing the gross returns with cost of cultivation. Gross returns was calculated from grain yield and straw yield from the respective treatments. Prevailing price for grain and straw in the market were considered. Cost of cultivation from each treatment was calculated by taking into account field preparation cost, input cost, labour cost extra treatment cost *etc*. and it was expressed in rupees per ha. Data obtained from the experiment were analysed statistically by applying "analysis of variance" as per randomized block design with the help of online statistical package "OP" stat. In some of the treatments sedges were absent, square root transformation was done and original values for sedge density were given in parenthesis.

Weed flora

Twenty-two weed species were identified in the experimental field (grasses-6, Broad Leaf Weeds (BLWs) -15 and sedge-1). Among grassy weeds, *Setaria* spp., *Digitaria sanguinalis, Echinochloa colona, Eleusine indica, Panicum maximum* and *Brachiaria* spp. were dominant. *Alternanthera bettzickiana, Lindernia crustacea, Mollugo disticha, Ludwigia perennis, Ageratum conyzoides, Mitracarpus hirtus, Euphorbia hirta, Euphorbia geniculata, Scoparia dulcis, Phyllanthus amarus, Cleome burmannii, Commelina benghalensis, Catharanthus pusillus, Trianthema portulacastrum* and *Hemidesmus indicus* were identified as broad-leaf weeds and *Cyperus iria* was only sedge identified in the experimental field.

Weed density

All the weed management practices recorded significantly lower total weed density as compared to unweeded check. Weed density at 20 and 45 DAS were influenced significantly by various treatments **(Table 1)**. Lowest weed density was recorded by the application of oxyfluorfen *fb* HW at 30 DAS due to timely application of pre-emergence herbicides and hand weeding resulted in less weed infestation. Application of oxyfluorfen 0.15 kg/ha followed by HW at 20 DAS recorded minimum number of grass, broad leaf weeds and sedges at all stages of observation in aerobic rice (Reshma *et al.* 2015). Highest weed density was recorded in unweeded control (Bhurer *et al*. 2013).

Weed dry weight

Weed dry matter production at both stages of crop were found significant **(Table 2)**. At 20 DAS hand weeded control recorded lesser dry matter

Table 1. Effect of treatments on weed density(no. /m²) at 20 and 45 DAS

Treatment	Weed density at 20 DAS (no./m²)				Weed density at 45 DAS (no./m²)			
	Grass	Broad-leaf weeds	*Sedges	Total weed density	Grass	Broad-leaf weeds	*Sedges	Total weed density
Brown manuring (cowpea) by application of 2,4-D 1.0 kg/ha at 25 DAS	100.66	128.66	5.42(28.7)	259.00	79.00	13.66	1.00(0.00)	92.667
In situ green manuring (cowpea) at 25 DAS	65.33	145.00	4.08(15.7)	226.00	53.33	62.66	2.15(3.66)	120.33
Oxyfluorfen 0.15 kg/ha on the day of sowing *fb* HW at 30 DAS	31.66	22.00	2.01(4.0)	58.00	19.66	24.66	1.00(0.00)	44.33
Oxyfluorfen 0.15 kg/ha on the day of sowing *fb* bispyribac-sodium 0.025 kg/ha at 20 DAS	68.33	50.66	1.00(0.0)	119.00	19.33	32.33	2.30(4.33)	56.00
Pyrazosulfuron-ethyl 0.03 kg/ha at 6 DAS *fb* HW at 30 DAS	133.00	70.66	1.00(0.0)	210.33	39.66	19.00	1.00(0.00)	58.66
Pyrazosulfuron-ethyl 0.03 kg/ha at 6 DAS *fb* bispyribac-sodium at 20 DAS	153.00	144.33	1.00(0.0)	297.33	120.66	42.33	1.00(0.00)	163.00
Hand weeded control (15, 30 and 45 DAS)	15.66	39.33	2.23(4.0)	59.00	2.33	73.33	1.73(2.00)	76.00
Unweeded control	238.00	239.00	5.14(26.0)	503.00	77.66	90.66	1.27(0.66)	169.00
LSD (p=0.05)	33.87	26.52	1.06(8.0)	41.14	19.00	12.14	0.25(0.93)	40.50

*Transformed values are given in parentheses

production which was at par with application of oxyfluorfen on the day of sowing *fb* HW at 30 DAS and application of oxyfluorfen *fb* bispyribac-sodium at 20 DAS. At 45 DAS hand weeded control recorded lesser dry matter production, which was on par with application of oxyfluorfen on the day of sowing *fb* HW at 30, oxyfluorfen on the day of sowing *fb* bispyribac-sodium at 20 DAS and pyrazosulfuron-ethyl at 6 DAS *fb* HW at 30 DAS.

Weed control efficiency

Higher weed control efficiency (WCE) was recorded with the application of oxyfluorfen on the day of sowing *fb* HW at 30 DAS (92.60% at 20 DAS and 98.58% at 45 DAS). Significantly lowest weed index (WI) was recorded by application of oxyfluorfen on the day of sowing *fb* HW at 30 DAS (5.02%) followed by pyrazosulfuron-ethyl at 6 DAS *fb* HW at 30 DAS (10.35%). Higher WCE and lower WI by these treatments might be due to reduction in weed biomass by broad spectrum action of herbicide and also timely control of weeds by HW at 30 DAS. Porwal (1999) revealed that application of oxyfluorfen at 0.2 kg/ha recorded higher WCE (96.5%). Priya *et al*. (2017) suggested oxyfluorfen application 250 g/ha *fb* hand weeding at 45 DAS can reduces weed density, weed dry matter and increases grain and straw yield in transplanted rice. Mondal *et al.* (2005) reported that application of pyrazosulfuron-ethyl as pre-emergence can effectively control all types of weeds in transplanted rice. *In situ* green manuring and brown manuring resulted in reduction in weed dry matter production and high WCE at early stages of crop growth as compared to unweeded control and it might be due to smothering effect of cowpea could reduce the weed infestation, but it was not effective as herbicide application.

Grain yield

Grain yield and straw yield in upland rice were influenced significantly by various weed management practices **(Table 3)**. Hand weeded control recorded higher grain yield closely followed by oxyfluorfen on the day of sowing *fb* HW at 30 DAS and pyrazosulfuron-ethyl at 6 DAS *fb* HW at 30 DAS. The increased grain yield might be due to reduction in weed density, weed dry matter production, WI and higher WCE which contributed to better growth and yielding attributing characters. Application of oxyfluorfen on the day of sowing *fb* HW at 30 DAS recorded highest number of tillers per hill and number of hills/m². Hand weeded control recorded highest grain yield and was at par with pre-emergence application of oxyfluorfen 150 g/ha in transplanted rice (Abraham *et al*. 2010). According to Saini (2003), pyrazosulfuron application resulted in higher grain yield due to improved growth and yield parameters due to minimum weed growth. Weed competition resulted in 78.05% yield reduction in upland rice and it might be due to heavy infestation of weeds. Lowest grain yield of 1075 kg/ha was recorded by weeded control in direct seeded upland rice (Roy 2016). *In situ,* green manuring recorded 57.89% and brown manuring recorded 72.23% higher grain than unweeded control but it was not effective as herbicide treatments. Oxyfluorfen on the day of sowing *fb* HW at 30 DAS recorded highest straw yield which was found at par with pyrazosulfuron-ethyl at 6 DAS *fb* hand weeding at 30 DAS and hand weeded control. It might be due to effective control of all types of weeds from initial stage of crop growth and lead to better crop growth.

Application of oxyfluorfen on the day of sowing *fb* HW at 30 DAS recorded highest gross return, net return and B:C ratio which was closely followed by pyrazosulfuron-ethyl at 6 DAS *fb* HW at 30 DAS and unweeded control recorded lowest B:C ratio **(Table 3)**. It might be due to better weed management, which decreased the weed dry matter production and increased WCE and resulted in better growth and yield parameters of upland rice. Higher gross return and reduced cost of cultivation in both the treatments resulted in higher B:C ratio. Reshma *et al*. (2015)

Table 2. Effect of treatments on weed dry matter production, weed control efficiency (WCE) and weed index (WI)

Treatment	Weed dry matter production (g/m²)		WCE (%)		WI (%)
	20 DAS	45 DAS	20 DAS	45 DAS	
Brown manuring (cowpea) by application of 2,4-D 1.0 kg/ha at 25 DAS	23.00	117.66	71.02	53.99	62.81
In situ green manuring (cowpea) at 25 DAS	11.00	84.00	86.14	67.53	65.33
Oxyfluorfen 0.15 kg/ha on the day of sowing *fb* HW at 30 DAS	5.87	3.60	92.60	98.58	5.02
Oxyfluorfen 0.15 kg/ha on the day of sowing *fb* bispyribac-sodium 0.025 kg/ha at 20 DAS	9.07	31.53	88.56	87.76	12.81
Pyrazosulfuron-ethyl 0.03 kg/ha at 6 DAS *fb* HW at 30 DAS	29.33	6.66	63.05	97.39	10.35
Pyrazosulfuron-ethyl 0.03 kg/ha at 6 DAS *fb* bispyribac-sodium at 20 DAS	34.66	120.00	56.33	52.66	42.34
Hand weeded control (15, 30 and 45 DAS)	5.80	3.33	92.55	98.69	0.00
Unweeded control	79.40	256.33	0.00	0.00	78.04
LSD (p=0.05)	11.02	29.18	18.88	28.46	7.93

Table 3. Effect of treatments on grain yield, straw yield, harvest index, cost of cultivation, gross return, net return and B:C ratio

Treatment	Grain yield (t/ha)	Straw yield (t/ha)	HI (%)	Cost of cultivation (x10^3 `/ha)	Gross returns (x10^3 `/ha)	Net returns (x10^3 `/ha)	B:C ratio
Brown manuring (cowpea) by application of 2,4-D 1.0 kg/ha at 25 DAS	1.09	1.74	0.39	36.77	45.88	9.11	1.24
In situ green manuring (cowpea) at 25 DAS	1.00	2.21	0.30	36.40	48.14	11.74	1.32
Oxyfluorfen 0.15 kg/ha on the day of sowing *fb* HW at 30 DAS	2.74	5.89	0.31	44.68	130.31	85.63	2.91
Oxyfluorfen 0.15 kg/ha on the day of sowing *fb* bispyribac-sodium 0.025 kg/ha at 20 DAS	2.51	4.21	0.37	40.05	107.60	67.55	2.68
Pyrazosulfuron-ethyl 0.03 kg/ha at 6 DAS *fb* HW at 30 DAS	2.58	5.88	0.30	43.94	126.20	82.26	2.87
Pyrazosulfuron-ethyl 0.03 kg/ha at 6 DAS *fb* bispyribac-sodium at 20 DAS	1.66	4.10	0.29	39.31	84.38	123.69	2.14
Hand weeded control (15, 30 and 45 DAS)	2.88	5.41	0.34	59.00	129.27	70.27	2.19
Unweeded control	0.63	0.943	0.40	35.00	25.92	-9.08	0.74
LSD (p=0.05)	0.47	1.30	0.07	-	-	-	-

revealed that oxyfluorfen 0.15 kg/ha *fb* HW at 20 DAS resulted in higher net income and B:C ratio in aerobic rice. Rana *et al.* (2018) observed application of pyrazosulfuron-ethyl at different doses recorded higher net return and B:C ratio as compared to weed free and weedy check.

Result of the study indicated that application of either oxyfluorfen 23.5 EC at 0.15 kg/ha on the day of sowing or pyrazosulfuron-ethyl 10 WP at 0.03 kg/ha on 6 DAS followed by one hand weeding at 30 DAS can be recommended as cost-effective weed management in upland rice.

REFERENCES

Abraham CT, Prameela P and Lakshmi MP. 2010. Efficacy of oxyfluorfen for weed control in transplanted rice. *Journal of Crop and Weed* **6**(2): 67–71.

Arunbabu T and Jena SN. 2018. Weeds and progressive weed management techniques in rice (*Oryza sativa*. L.): a review. *Bulletin of Environment, Pharmacology and Life Sciences***7**(2): 108–117.

Bhurer KP, Yadav DN, Ladha JK, Thapa RB and Pandey K. 2013. Effect of integrated weed management practices on performance of dry direct seeded rice (*Oryza sativa* L.). *Agronomy Journal of Nepal* **3**: 53–63.

Kumar S and Rana SS. 2013. Bio-efficacy of bispyribac-sodium for weed control in direct seeded rice. *Pesticide Research Journal* **25**(2): 123–127.

Mondal DC, Hossain A and Duary B. 2005. Effect of pyrazosulfuron-ethyl on weeds and yield of transplanted rice under lateritic belt of West Bengal. *Indian Journal of Weed Science* **37**(3&4): 263–264.

Poddar R, Ghosh RK, Paul T and Bera S. 2014. Weed management through oxyfluorfen in direct seeded rice and its impact on soil micro-organisms and succeeding crops. *Annals of Agricultural Research* **35**(3): 337–342.

Porwal MK. 1999. Weed management through herbicides in direct drilled upland rice in rainfed situations of southern Rajasthan. *Indian Journal of Weed Science* **31**(3&4): 196–198.

Priya RS, Chinnusamy C, Arthanari PM and Janaki P. 2017.Pre-emergence herbicide of oxyfluorfen on weed control in transplanted rice. *International Journal of Chemical Studies* **5**(5): 271–275.

Rana A, Rana MC, Rana SS, Sharma N and Kumar S. 2018. Weed control by pyrazosulfuron-ethyl and its influence on yield and economics of transplanted rice. *Indian Journal of Weed Science* **50**(4): 309–314.

Reshma RS, Pillai PS and Sansamma G. 2015. Efficacy and economics of weed management strategies in aerobic rice (*Oryza sativa* L.). *Current Advances in Agricultural Sciences* **7**(1): 73–75.

Roy JBB. 2016. *Weed dynamics and yield of direct seeded upland rice (Oryza sativa* L.*) under integrated weed management practices*. M.Sc. (Ag) thesis, Orissa University of Agriculture and Technology, Bhubaneswar, 87p.

Saini JP. 2003. Efficacy of pyrazosulfuron-ethyl against mixed weed flora in transplanted rice. *Pesticide Research Journal* **15**(2): 157–159.

Sunil CM, Shekara BG, Ashoka P, Murthy KNK, Mahantesh V and Madhukumar V. 2011. Effect of integrated weed management practices on nutrient uptake in aerobic rice. *Research on Crops* **12**(3): 629–632.