International Journal of Chemical Studies 2020; 8(6): 1739-1743

International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
www.chemijournal.com
IJCS 2020; 8(6): 1739-1743

Received: 23-08-2020
Accepted: 03-11-2020

Weed dynamics under semidry rice as influenced by integrated weed management

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DOI: https://doi.org/10.22271/chemi.2020.v8.i6y.11017

Abstract
A field study was carried out during *Kharif*, 2019 at Agricultural Research Station, Rajendranagar, Hyderabad to study the effect of integrated weed management on weed dynamics under semidry rice. The associated weed flora in semidry rice includes *Trianthema portulacastram, Parthenium hysterophorus, Alternanthera sessilis, Digera arvensis, Corchorus capsularis* as broad leaved weeds; *Echinocloa colona* as grass; *Cyperus rotundus* as sedge. Pyrazosulfuron ethyl @ 20 g a.i ha^{-1} PE *fb* chlorimuron ethyl + metsulfuron methyl @ 4 g a.i ha^{-1} + fenoxaprop-p-ethyl @ 60 g a.i ha^{-1} PoE was found effective among all the herbicidal treatments in reducing weed density and dry matter with maximum grain yield and B:C ratio.

Keywords: Weed dynamics, semidry rice, integrated weed management

Introduction
Rice is the most important food crop of the developing world and the staple food of more than half of the world's population. In India, rice is being cultivated by three principal systems *viz.*, transplanting, dry seeding and wet seeding. Among them, irrigated rice is spreading over 26.51 M ha (60.06 %) of total area (Directorate of Economics and Statistics, 2017-18). Irrigated rice requires about 150 ha-cm of water and engagement of labor for transplanting and weeding (Mahajan and Chauhan, 2016) [8]. In this aspect, dry direct seeded rice is gaining importance to reduce the amount of water used in rice cultivation. At present, 23% of rice is direct seeded globally (Rao *et al.*, 2007) [13].
Semidry rice helps to meet the challenges posed by the water and labour shortage. Semidry rice (Dry direct seeded irrigated) is a system associated with upland condition in the early and low land situation at later stages of crop growth. In semidry system, rice is treated as rainfed for about 40-45 days, and when sufficient water is available, it is converted into wet crop (Chatterjee and Maiti, 1985) [3]. It cut down the initial water consumption of 30% by avoiding raising of seedlings in nursery, puddling, and transplanting under puddled soil. Though semidry rice has multiple benefits, it risked severe competition with mono and dicot weeds due to the absence of stagnant water during the initial 4-6 weeks provides congenial conditions for weed growth. Weeds compete with the crop and the extent of yield reduction of rice due to weeds has been estimated up to 95% (Naresh *et al.*, 2011) [9] and 46.0 to 63.1% (Choudhary and Anil, 2018) [4]. Such weeds need to be removed either by labour, mechanically or with suitable herbicide application. Admist shortage of labour and increased cost of mechanization, there is increased reliance on herbicides (Hemalatha *et al.*, 2017) [7]. Herbicides offer economic and efficient weed control if applied at proper dose and stage. However, the continuous use of single herbicide or herbicides having the same mode of action may lead to the weed resistance problem and also weed shifts (Yakadri *et al.*, 2016) [16]. Because of concerns about the evolution of herbicide resistance in weeds shift in weed population, there is a need to integrate herbicide use with other weed control methods.
Under semidry rice system the weed flora changes as different cultivation practices were adopted during the crop growth. To study the changing weed flora under semidry rice system a field experiment was conducted to record the weed dynamics as influenced by the integrated weed management practices.

Materials and Methods

A field experiment was carried out during *Kharif,* 2019 at Agricultural Research Station, Rajendranagar, Hyderabad, situated at an altitude of 542.3 m above mean sea level at $17^0$19 'N latitude and $78^0$23' E longitude. The soil of experimental site was loamy sand with soil pH of 8.04, and medium in organic carbon (0.53 %), low in available N (204.47 kg ha^{-1}), P (21.26 kg ha^{-1}) and high in available K (475.78 kg ha^{-1}). The experiment comprised of three pre emergence herbicides pendimethalin (30 % EC) @ 1 kg a.i ha^{-1}, oxyfluorfen (23.5 % EC) @ 200 g a.i ha^{-1} and pyrazosulfuron ethyl (10 % WP) @ 20 g a.i ha^{-1} which were followed by three different post emergence herbicides viz., bispyribac-sodium (10 % SC) @ 25 g a.i ha^{-1}, penoxsulam (1.02 %) + cyhalofop-p-butyl (5.1 %) OD (25+127 g a.i ha^{-1}) and chlorimuron ethyl + metsulfuron methyl (20 % WP) @ 4 g a.i ha^{-1} + fenoxaprop-p-ethyl (9.3 % EC) @ 60 g a.i ha^{-1}. All these treatment combinations (sequential application of pre and post emergence herbicides) were integrated with mechanical weeding at 50 DAS, hand weeding treatment at 20, 40, and 60 DAS and unweeded control. These treatments were replicated thrice in a randomized block design. A short duration rice variety KNM-118 (Kunaram Sannalu) was sown as dry seeds in solid rows at 30 cm spacing. A seed rate of 50 kg ha^{-1} was used. Recommended dose of 120:60:40 kg ha^{-1} of N, P and K were applied uniformly. The entire P_2O_5 and K_2O were applied as basal. The nitrogen was applied in three splits equally at sowing, active tillering and panicle initiation stage. All the herbicides were applied using knapsack sprayer fitted with flat fan nozzle at spray volume of 500 l ha^{-1}. The data on weed density and weed dry weight were recorded with the help of quadrant (0.5m × 0.5m). The weed was showing wide variation and having the value zero, were subjected to the square root transformation of $\sqrt{x+1}$ to make the analysis of variance valid. All the data obtained in the study were statistically analyzed using F-test as suggested by Gomez and Gomez (1984) [6]. Critical difference values at P=0.05 were used to determine the significance of differences between means.

Results and discussion

Weed flora

The dominant weed flora observed in the experimental plot were *Trianthema portulacastram, Parthenium hysterophorus, Alternanthera sessilis, Digera arvensis, Corchorus capsularis,* among broad leaved weeds. *Echinocloa colona* was the dominant weed among grasses and *Cyperus rotundus* was the major sedge. The broad leaved weeds were dominant compared to grasses and sedges. Similar findings showing the predominance of broad leaved weeds was reported by Yogananda *et al.* (2019) [17] in dry direct seeded rice. The upland weed flora *i.e.,* broad leaved weeds were dominant during initial stages of the crop before flooding. After conversion to wet conditions the grasses and sedges were predominant.

Table 1: Weed flora at different observational stages

20 DAS	40 DAS	60 DAS	HARVEST
Trianthema portulacastram	*Alternanthera sessilis*	*Alternanthera sessilis*	*Alternanthera sessilis*
Parthenium hysterophorus	*Parthenium hysterophorus*	*Parthenium hysterophorus*	*Parthenium hysterophorus*
	Trianthema portulacastram	*Digera arvensis*	*Digera arvensis*
		Corchorus capsularis	*Corchorus capsularis*
		Echinocloa colona	*Echinocloa colona*
		Cyperus rotundus	*Cyperus rotundus*

Weed density and dry matter

Lowest broad leaved weed density was recorded in oxyfluorfen @ 200 g a.i ha^{-1} PE applied plots followed by pyrazosulfuron ethyl @ 20 g a.i ha^{-1} PE treated plots. Similar findings were reported by Patel *et al.* (2018) [10]. Highest weed density was recorded with pendimethalin @ 1 kg a.i ha^{-1} PE treated plots. This may be due to poor control of weeds by the pendimethalin herbicide. Similar results were reported by Singh *et al.* (2017) [15]. At 40 DAS, density of grasses and sedges was low compared to the broad leaved weeds. This might be due to the prevalence of upland conditions up to 50 DAS. Broad leaved weeds were dominant up to flooding and thereafter density of sedges and grasses increased. Similar findings were reported by Arya, (2015) and Anitha *et al.* (2010) [2, 1].

Weed density and dry matter was recorded significantly lower in pyrazosulfuron ethyl @ 20 g a.i ha^{-1} PE *fb* chlorimuron ethyl + metsulfuron methyl @ 4 g a.i ha^{-1} + fenoxaprop-p-ethyl @ 60 g a.i ha^{-1} PoE and comparable with oxyfluorfen @ 200 g a.i ha^{-1} PE *fb* chlorimuron ethyl + metsulfuron methyl @ 4 g a.i ha^{-1} + fenoxaprop-p-ethyl @ 60 g a.i ha^{-1} PoE and oxyfluorfen @ 200 g a.i ha^{-1} PE *fb* bispyribac-sodium @ 25 g a.i ha^{-1} PoE. Pyrazosulfuron ethyl @ 20 g a.i ha^{-1} PE *fb* bispyribac-sodium @ 25 g a.i ha^{-1} PoE, pendimethalin @ 1 kg a.i ha^{-1} PE *fb* chlorimuron ethyl + metsulfuron methyl @ 4 g a.i ha^{-1} + fenoxaprop-p-ethyl @ 60 g a.i ha^{-1} PoE and pendimethalin @ 1 kg a.i ha^{-1} PE *fb* bispyribac-sodium @ 25 g a.i ha^{-1} PoE were less effective in controlling weeds. Among post-emergence herbicidal treatments, significantly higher weed density and dry matter was recorded in penoxsulam + cyhalofop-p-butyl (25+127 g a.i ha^{-1}) treated plots. This may be due to the ineffective control of weeds by the herbicide. Similar findings were reported by Patil *et al.* (2014) [11].

The weed density and dry matter recorded in all the treatments except unweeded control at 60 DAS was less compared to 40 DAS. This was because of imposing mechanical weeding in all the herbicide treated plots at 50 DAS at the time of conversion period. Mechanical weeding effectively controlled the weeds present in inter row but the weeds within the rows were left over. Inaccessibility of the power weeder in the narrow intra row area could not remove weeds and that might have resulted in more weed density. These results are in agreement with Reshma, (2014) [14]. Due to complete removal of weeds in hand weeding treatment at 20 and 40 DAS, lowest weed density was observed in hand weeding treatment. Although the density of broad leaved weeds was recorded highest the density of grasses and sedges were also increased progressively from 40 DAS to 60 DAS. This may be due to the flooding of the crop as ascribed by Anitha *et al.* (2010) [1]. Highest weed density and weed dry matter was found in unweeded control throughout the crop growth period. This may be due to the uncontrolled weed growth as elucidated by Patel *et al.* (2018) [10].

Weed control efficiency

The weed control efficiency was found highest in hand weeding treatment. Among the herbicidal treatments highest weed control efficiency was recorded in pyrazosulfuron ethyl @ 20 g a.i ha^{-1} PE *fb* chlorimuron ethyl + metsulfuron methyl @ 4 g a.i ha^{-1} + fenoxaprop-p-ethyl @ 60 g a.i ha^{-1} PoE. It was found on par with oxyfluorfen @ 200 g a.i ha^{-1} PE *fb* chlorimuron ethyl + metsulfuron methyl @ 4 g a.i ha^{-1} + fenoxaprop-p-ethyl @ 60 g a.i ha^{-1} PoE and oxyfluorfen @ 200 g a.i ha^{-1} PE *fb* bispyribac-sodium @ 25 g a.i ha^{-1} PoE.

Phytotoxicity

Application of pre-emergence herbicide oxyfluorfen @ 200 g a.i ha^{-1} has shown phytotoxicity symptoms on the semidry crop in early stages (15 to 20 days after spraying). The plant has shown symptoms of chlorosis and yellowing of the leaves. As crop growth progressed the phytotoxicity symptoms disappeared. Similar findings were reported by Ramachandiran and Balasubramanian (2012) and Reshma (2014) [12, 14].

Yield

Significantly higher grain yield was recorded in hand weeding treatment at 20, 40 and 60 DAS. It was found on par with the grain yield obtained in pyrazosulfuron ethyl @ 20 g a.i ha^{-1} PE *fb* chlorimuron ethyl + metsulfuron methyl @ 4 g a.i ha^{-1} + fenoxaprop-p-ethyl @ 60 g a.i ha^{-1} PoE. Grain yield recorded from oxyfluorfen @ 200 g a.i ha^{-1} PE *fb* chlorimuron ethyl + metsulfuron methyl @ 4 g a.i ha^{-1} + fenoxaprop-p-ethyl @ 60 g a.i ha^{-1} PoE and oxyfluorfen @ 200 g a.i ha^{-1} PE *fb* bispyribac-sodium @ 25 g a.i ha^{-1} PoE was higher than the other treatments.

Conclusions

It was concluded that application of pyrazosulfuron ethyl @ 20 g a.i ha^{-1} PE *fb* chlorimuron ethyl + metsulfuron methyl @ 4 g a.i ha^{-1} + fenoxaprop-p-ethyl PoE @ 60 g a.i ha^{-1} *fb* mechanical weeding at 50 DAS found most effective and economical in controlling weeds under semidry rice system of cultivation.

Table 2: Effect of integrated weed management practices on weed density, weed biomass and WCE at 20 DAS in semidry rice

T. No	Treatments	Weed density (no./m^2)			Weed biomass (g/m^2)	WCE (%)
		Grasses	Sedges	BLW		
T_1	Pendimethalin @ 1 kg a.i ha^{-1} as PE *fb* bispyribac-sodium @ 25 g a.i ha^{-1} as PoE at 2-4 leaf stage of weeds *fb* MW at 50 DAS.	1.00 (0.00)	1.00 (0.00)	6.56 (42.33)	2.31 (4.34)	63.41
T_2	Pendimethalin @ 1 kg a.i ha^{-1} as PE *fb* penoxsulam + cyhalofop-p-butyl (25+127 g a.i ha^{-1}) as PoE at 2-4 leaf stage of weeds *fb* MW at 50 DAS.	1.00 (0.00)	1.00 (0.00)	6.73 (44.33)	2.27 (4.19)	64.64
T_3	Pendimethalin @ 1 kg a.i ha^{-1} as PE *fb* chlorimuron ethyl + metsulfuron methyl @ 4 g a.i ha^{-1} + fenoxaprop-p-ethyl @ 60 g a.i ha^{-1} at 2-4 leaf stage of weeds *fb* MW at 50 DAS.	1.00 (0.00)	1.00 (0.00)	6.48 (41.00)	2.22 (4.01)	66.22
T_4	Oxyfluorfen @ 200 g a.i ha^{-1} as PE *fb* bispyribac-sodium @ 25 g a.i ha^{-1} as PoE at 2-4 leaf stage of weeds *fb* MW at 50 DAS.	1.00 (0.00)	1.00 (0.00)	3.22 (9.67)	1.49 (1.23)	89.66
T_5	Oxyfluorfen @ 200 g a.i ha^{-1} as PE *fb* penoxsulam + cyhalofop-p-butyl (25+127 g a.i ha^{-1}) as PoE at 2-4 leaf stage of weeds *fb* MW at 50 DAS.	1.00 (0.00)	1.00 (0.00)	3.36 (10.33)	1.44 (1.12)	90.56
T_6	Oxyfluorfen @ 200 g a.i ha^{-1} as PE *fb* chlorimuron ethyl + metsulfuron methyl @ 4 g a.i ha^{-1} + fenoxaprop-p-ethyl @ 60 g a.i ha^{-1} at 2-4 leaf stage of weeds *fb* MW at 50 DAS.	1.00 (0.00)	1.00 (0.00)	3.51 (11.33)	1.52 (1.33)	88.81
T_7	Pyrazosulfuron ethyl @ 20 g a.i ha^{-1} as PE *fb* bispyribac-sodium @ 25 g a.i ha^{-1} as PoE at 2-4 leaf stage of weeds *fb* MW at 50 DAS	1.00 (0.00)	1.00 (0.00)	5.41 (28.67)	1.80 (2.29)	80.66
T_8	Pyrazosulfuron ethyl @ 20g a.i ha^{-1} as PE *fb* penoxsulam + cyhalofop-p-butyl (25+127 g a.i ha^{-1}) as PoE at 2-4 leaf stage of weeds *fb* MW at 50 DAS.	1.00 (0.00)	1.00 (0.00)	5.47 (29.33)	1.77 (2.15)	81.84
T_9	Pyrazosulfuron ethyl @ 20 g a.i ha^{-1} as PE *fb* chlorimuron ethyl + metsulfuron methyl @ 4 g a.i ha^{-1} + fenoxaprop-p-ethyl @ 60 g a.i ha^{-1} at 2-4 leaf stage of weeds *fb* MW at 50 DAS.	1.00 (0.00)	1.00 (0.00)	5.13 (25.33)	1.83 (2.39)	79.82
T_{10}	Mechanical weeding at 20, 40, and 60 DAS.	1.52 (1.33)	1.90 (2.67)	8.24 (67.33)	3.25 (9.71)	18.13
T_{11}	Hand weeding at 20, 40, and 60 DAS.	1.52 (1.33)	1.52 (1.33)	8.11 (65.00)	3.28 (9.84)	17.00
T_{12}	Unweeded control.	2.24 (4.00)	1.90 (2.67)	9.15 (82.67)	3.58 (11.86)	0.00
	SE(m) ±	0.08	0.08	0.34	0.13	
	CD (p=0.05)	0.23	0.23	1.01	0.37	
	CV %	11.4	11.4	10.0	10.6	

Figures in parenthesis are means of original value that is transformed by √(X+1) and given outside parenthesis

Table 3: Effect of integrated weed management practices on weed density, weed biomass and WCE at 40 DAS in semidry rice

T. No	Treatments	Weed density (no./m^2)			Weed biomass (g/m^2)	WCE (%)
		Grasses	Sedges	BLW		
T_1	Pendimethalin @ 1 kg a.i ha^{-1} as PE *fb* bispyribac-sodium @ 25 g a.i ha^{-1} as PoE at 2-4 leaf stage of weeds *fb* MW at 50 DAS.	1.00 (0.00)	1.00 (0.00)	7.23 (52.20)	4.77 (21.80)	77.76
T_2	Pendimethalin @ 1 kg a.i ha^{-1} as PE *fb* penoxsulam + cyhalofop-p-butyl (25+127 g a.i ha^{-1}) as PoE at 2-4 leaf stage of weeds *fb* MW at 50 DAS.	1.52 (1.33)	4.86 (22.67)	8.35 (69.00)	6.18 (37.19)	62.06
T_3	Pendimethalin @ 1 kg a.i ha^{-1} as PE *fb* chlorimuron ethyl + metsulfuron methyl @ 4 g a.i ha^{-1} + fenoxaprop-p-ethyl @ 60 g a.i ha^{-1} at 2-4 leaf stage of weeds *fb* MW at 50 DAS.	1.00 (0.00)	1.00 (0.00)	7.17 (51.00)	4.41 (18.50)	81.13
T_4	Oxyfluorfen @ 200 g a.i ha^{-1} as PE *fb* bispyribac-sodium @ 25 g a.i ha^{-1} as PoE at 2-4 leaf stage of weeds *fb* MW at 50 DAS.	1.00 (0.00)	1.00 (0.00)	5.34 (27.53)	3.55 (11.60)	88.17
T_5	Oxyfluorfen @ 200 g a.i ha^{-1} as PE *fb* penoxsulam + cyhalofop-p-butyl (25+127 g a.i ha^{-1}) as PoE at 2-4 leaf stage of weeds *fb* MW at 50 DAS.	1.52 (1.33)	4.32 (17.67)	8.04 (64.50)	5.92 (34.11)	65.20

T_6	Oxyfluorfen @ 200 g a.i ha^{-1} as PE *fb* chlorimuron ethyl + metsulfuron methyl @ 4 g a.i ha^{-1} + fenoxaprop-p-ethyl @ 60 g a.i ha^{-1} at 2-4 leaf stage of weeds *fb* MW at 50 DAS.	1.00 (0.00)	1.00 (0.00)	5.06 (24.70)	3.28 (9.78)	90.02
T_7	Pyrazosulfuron ethyl @ 20 g a.i ha^{-1} as PE *fb* bispyribac-sodium @ 25 g a.i ha^{-1} as PoE at 2-4 leaf stage of weeds *fb* MW at 50 DAS	1.00 (0.00)	1.00 (0.00)	6.73 (44.70)	4.15 (16.30)	83.37
T_8	Pyrazosulfuron ethyl @ 20g a.i ha^{-1} as PE *fb* penoxsulam + cyhalofop-p-butyl (25+127 g a.i ha^{-1}) as PoE at 2-4 leaf stage of weeds *fb* MW at 50 DAS.	1.90 (2.67)	4.28 (17.33)	7.83 (60.60)	5.50 (30.01)	69.38
T_9	Pyrazosulfuron ethyl @ 20 g a.i ha^{-1} as PE *fb* chlorimuron ethyl + metsulfuron methyl @ 4 g a.i ha^{-1} + fenoxaprop-p-ethyl @ 60 g a.i ha^{-1} at 2-4 leaf stage of weeds *fb* MW at 50 DAS.	1.00 (0.00)	1.00 (0.00)	4.84 (22.43)	3.11 (8.70)	91.13
T_{10}	Mechanical weeding at 20, 40, and 60 DAS.	2.12 (3.50)	3.85 (14.00)	8.66 (74.40)	7.92 (62.01)	36.75
T_{11}	Hand weeding at 20, 40, and 60 DAS.	1.00 (0.00)	1.00 (0.00)	4.15 (16.40)	2.69 (6.27)	93.61
T_{12}	Unweeded control.	2.07 (3.33)	5.12 (25.33)	11.18 (124.20)	9.89 (98.03)	0.00
	SE(m) ±	0.08	0.17	0.43	0.33	
	CD (p=0.05)	0.25	0.51	1.26	0.97	
	CV %	10.8	11.3	10.5	11.2	

Figures in parenthesis are means of original value that is transformed by √(X+1) and given outside parenthesis

Table 4: Effect of integrated weed management practices on weed density, weed biomass and WCE at 60 DAS in semidry rice

T. No	Treatments	Weed density (no./m^2)			Weed biomass (g/m^2)	WCE (%)
		Grasses	Sedges	BLW		
T_1	Pendimethalin @ 1 kg a.i ha^{-1} as PE *fb* bispyribac-sodium @ 25 g a.i ha^{-1} as PoE at 2-4 leaf stage of weeds *fb* MW at 50 DAS.	1.00 (0.00)	2.81 (7.00)	5.44 (28.67)	4.47 (18.99)	90.49
T_2	Pendimethalin @ 1 kg a.i ha^{-1} as PE *fb* penoxsulam + cyhalofop-p-butyl (25+127 g a.i ha^{-1}) as PoE at 2-4 leaf stage of weeds *fb* MW at 50 DAS.	1.52 (1.33)	2.88 (7.33)	6.02 (35.33)	5.31 (27.66)	86.16
T_3	Pendimethalin @ 1 kg a.i ha^{-1} as PE *fb* chlorimuron ethyl + metsulfuron methyl @ 4 g a.i ha^{-1} + fenoxaprop-p-ethyl @ 60 g a.i ha^{-1} at 2-4 leaf stage of weeds *fb* MW at 50 DAS.	1.00 (0.00)	2.77 (6.67)	5.31 (27.33)	3.85 (13.92)	93.03
T_4	Oxyfluorfen @ 200 g a.i ha^{-1} as PE *fb* bispyribac-sodium @ 25 g a.i ha^{-1} as PoE at 2-4 leaf stage of weeds *fb* MW at 50 DAS.	1.41 (1.00)	1.96 (3.00)	4.24 (17.00)	3.62 (12.17)	93.91
T_5	Oxyfluorfen @ 200 g a.i ha^{-1} as PE *fb* penoxsulam + cyhalofop-p-butyl (25+127 g a.i ha^{-1}) as PoE at 2-4 leaf stage of weeds *fb* MW at 50 DAS.	1.00 (0.00)	2.14 (3.67)	5.84 (33.33)	4.80 (22.27)	88.85
T_6	Oxyfluorfen @ 200 g a.i ha^{-1} as PE *fb* chlorimuron ethyl + metsulfuron methyl @ 4 g a.i ha^{-1} + fenoxaprop-p-ethyl @ 60 g a.i ha^{-1} at 2-4 leaf stage of weeds *fb* MW at 50 DAS.	1.00 (0.00)	1.91 (2.67)	4.20 (16.67)	3.32 (10.01)	94.99
T_7	Pyrazosulfuron ethyl @ 20 g a.i ha^{-1} as PE *fb* bispyribac-sodium @ 25 g a.i ha^{-1} as PoE at 2-4 leaf stage of weeds *fb* MW at 50 DAS	1.91 (2.67)	1.00 (0.00)	5.26 (26.67)	3.91 (14.43)	92.78
T_8	Pyrazosulfuron ethyl @ 20g a.i ha^{-1} as PE *fb* penoxsulam + cyhalofop-p-butyl (25+127 g a.i ha^{-1}) as PoE at 2-4 leaf stage of weeds *fb* MW at 50 DAS.	1.49 (1.33)	2.08 (3.33)	5.67 (31.33)	4.79 (21.99)	88.99
T_9	Pyrazosulfuron ethyl @ 20 g a.i ha^{-1} as PE *fb* chlorimuron ethyl + metsulfuron methyl @ 4 g a.i ha^{-1} + fenoxaprop-p-ethyl @ 60 g a.i ha^{-1} at 2-4 leaf stage of weeds *fb* MW at 50 DAS.	1.00 (0.00)	1.72 (2.00)	3.91 (14.33)	2.97 (7.83)	96.08
T_{10}	Mechanical weeding at 20, 40, and 60 DAS.	2.08 (3.33)	2.58 (5.67)	7.74 (59.67)	9.19 (83.96)	57.97
T_{11}	Hand weeding at 20, 40, and 60 DAS.	1.00 (0.00)	1.00 (0.00)	3.69 (12.67)	2.12 (3.57)	98.21
T_{12}	Unweeded control.	2.38 (4.67)	5.32 (27.33)	12.64 (160.67)	14.16 (199.77)	0.00
	SE(m) ±	0.08	0.15	0.40	0.32	
	CD (p=0.05)	0.25	0.43	1.16	0.86	
	CV %	10.5	10.7	11.8	10.4	

Figures in parenthesis are means of original value that is transformed by √(X+1) and given outside parenthesis

Table 5: Effect of integrated weed management practices on grain yield (kg ha^{-1}) and economics of semidry rice

T. No	Treatments	Grain yield (kg ha^{-1})	Gross Returns (Rs.)	Net returns (Rs.)	B:C ratio
T_1	Pendimethalin @ 1 kg a.i ha^{-1} as PE *fb* bispyribac-sodium @ 25 g a.i ha^{-1} as PoE at 2-4 leaf stage of weeds *fb* MW at 50 DAS.	3131	69278	34263	1.98
T_2	Pendimethalin @ 1 kg a.i ha^{-1} as PE *fb* penoxsulam + cyhalofop-p-butyl (25+127 g a.i ha^{-1}) as PoE at 2-4 leaf stage of weeds *fb* MW at 50 DAS.	2737	60202	23500	1.64
T_3	Pendimethalin @ 1 kg a.i ha^{-1} as PE *fb* chlorimuron ethyl + metsulfuron methyl @ 4 g a.i ha^{-1} + fenoxaprop-p-ethyl @ 60 g a.i ha^{-1} at 2-4 leaf stage of weeds *fb* MW at 50 DAS.	3146	69887	34335	1.97
T_4	Oxyfluorfen @ 200 g a.i ha^{-1} as PE *fb* bispyribac-sodium @ 25 g a.i ha^{-1} as PoE at 2-4 leaf stage of weeds *fb* MW at 50 DAS.	3556	77893	43190	2.24
T_5	Oxyfluorfen @ 200 g a.i ha^{-1} as PE *fb* penoxsulam + cyhalofop-p-butyl (25+127 g a.i ha^{-1}) as PoE at 2-4 leaf stage of weeds *fb* MW at 50 DAS.	2853	62732	26342	1.72
T_6	Oxyfluorfen @ 200 g a.i ha^{-1} as PE *fb* chlorimuron ethyl + metsulfuron methyl @ 4 g a.i ha^{-1} + fenoxaprop-p-ethyl @ 60 g a.i ha^{-1} at 2-4 leaf stage of weeds *fb* MW at 50 DAS.	3592	78679	43439	2.23
T_7	Pyrazosulfuron ethyl @ 20 g a.i ha^{-1} as PE *fb* bispyribac-sodium @ 25 g a.i ha^{-1} as PoE at 2-	3255	72041	37778	2.10

	4 leaf stage of weeds *fb* MW at 50 DAS				
T_8	Pyrazosulfuron ethyl @ 20g a.i ha^{-1} as PE *fb* penoxsulam + cyhalofop-p-butyl (25+127 g a.i ha^{-1}) as PoE at 2-4 leaf stage of weeds *fb* MW at 50 DAS.	2969	65713	29763	1.83
T_9	Pyrazosulfuron ethyl @ 20 g a.i ha^{-1} as PE *fb* chlorimuron ethyl + metsulfuron methyl @ 4 g a.i ha^{-1} + fenoxaprop-p-ethyl @ 60 g a.i ha^{-1} at 2-4 leaf stage of weeds *fb* MW at 50 DAS.	3823	83765	48965	2.41
T_{10}	Mechanical weeding at 20, 40, and 60 DAS.	2591	57187	19817	1.53
T_{11}	Hand weeding at 20, 40, and 60 DAS.	4048	88139	43269	1.96
T_{12}	Unweeded control.	1648	36562	3692	1.11
	SE(m) ±	172.48			
	CD (p=0.05)	505.80			
	CV %	9.6			

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