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Bio-efficacy of Ethoxysulfuron against Broad- leaved Weeds and Sedges in Transplanted Rice

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ABSTRACT

A field experiment was conducted in clay loam soils of Regional Agricultural Research Station, Warangal during *kharif* 2006 to evaluate the bio-efficacy of ethoxysulfuron 60 WG at three doses (15, 17.5 and 20 g a.i/ha) and 15 WG @ 18.75 g. a.i/ha against broad-leaved and sedge weeds in transplanted rice in comparison with Almix (metsulfuron-methyl 10% + chlorimuron-ethyl 10%) 20 WP @ 2 + 2 g. a.i ha^{-1} and 2,4-DEE @ 400 g. a. i ha^{-1}. The results indicated that ethoxysulfuron 60 WG at three concentrations and 15 WG, controlled broad leaved weeds and sedges effectively and increased grain yield of rice significantly compared to weedy check. However, the effect of ethoxysulfuron at all the concentrations was on par with other two weedicides and hand weeding at 20 and 40 DAT both in terms of weed control and grain yield of rice crop. Higher net returns and benefit: cost ratio was obtained with ethoxysulfuron 15 WG @ 18.75 g.a.i ha^{-1} followed by ethoxysulfuron 60 WG @ 17.5 g.a.i ha^{-1} compared to other herbicides and hand weeding.

Key words : Almix, Bio-efficacy, 2, 4-DEE, Ethoxysulfuron, Weed control efficiency, Weed count , Weed drymatter

Rice (*Oryza sativa* L.), a major crop of Andhra Pradesh, suffers badly due to infestation of wide variety of weeds. Unchecked weed competition causes yield losses upto 65% in rice (Subbaiah and Sreedevi, 2000). These weeds can be controlled by adopting either manual/mechanical method or with the use of herbicides. However, the continuous use of a single herbicide or herbicides having the same mode of action may lead to the resistance problem in weeds. Of late, herbicide formulations with low dosage, high efficacy, herbicide mixtures and safened herbicides are showing promise (Moorthy and Saha, 2002). Hence the present investigation was carried out to evaluate ethoxysulfuron 60 WG and 15 WG, a sulfonylurea herbicide against broad-leaved weeds and sedges in transplanted rice.

MATERIAL AND METHODS

A field experiment was conducted during *kharif* 2006 at the Regional Agricultural Research Station, Warangal, Central Telangana Zone, Andhra Pradesh. The soil was clay loam with a P^H of 8.1 and EC of 0.2 d Sm^{-1}, low in organic carbon (0.3%) and available N (267 kg ha^{-1}), medium in available P_2O_5 (30 kg ha^{-1}) and available K_2O (295 kg ha^{-1}). The experiment was laid out in a Randomized Block Design with eight treatments i.e. T_1 -Ethoxysulfuron 60 WG @ 15 g.a.i ha^{-1}, T_2 Ethoxysulfuron 60 WG @ 17.5 g.a.i ha^{-1}, T_3 Ethoxysulfuron 60 WG @ 20 g.a.i ha^{-1}, T_4 Ethoxysulfuron 15 WG @ 18.75 g.a.i ha^{-1}, T_5 Almix (Metsulfuron-methyl 10% + Chlorimuron-ethyl 10%) 20 WP @ 2+2 g.a.i ha^{-1}, T_6 2, 4–DEE @ 400 g.a.i ha^{-1}, T_7 Two hand weedings at 20 and 40 DAT and T_8 weedy check and replicated thrice. Ethoxysulfuron was sprayed at 15 days after transplanting of rice when weeds were at 1-2 leaf stage. Almix 20 WP was sprayed at 20 days after transplanting when weeds were at 2-3 leaf stage and 2, 4 DEE at 25 days after transplanting when weeds were at 3-4 leaf stage. All the herbicides were sprayed with knap sack sprayer using flood jet nozzle with 500 liters water ha^{-1}. The other recommended agronomic management practices were followed to raise the crop. Rice variety 'WGL-32100' was sown on 30-06-2006 and transplanting was done on 14-08-2006 with a spacing of 20 x 15 cm. It was harvested on 20-11-2006. The gross plot size was 5.0 x 4.5 m. Observations like weed count and weed dry matter were recorded at 20, 35 days after spraying chemicals or hand weeding and at flowering. Weed count and weed dry weights were subjected to "x+1 transformation before statistical analysis. Weed control efficiency was calculated by using the formula.

Table 1. Effect of Ethoxysulfuron 60 WG & 15 WG on broad-leaved weeds in transplanted *kharif* rice

Treatment	20 DAS		35 DAS		Flowering	
	Weed count (No.)	Weed dry matter (g m^{-2})	Weed count (No.)	Weed dry matter (g m^{-2})	Weed Count (No.)	Weed dry matter (g m^{-2})
T_1 – Ethoxysulfuron 60 WG @ 15 g.a.i ha^{-1}	4.79 (26.67)	2.65 (6.60)	2.40 (6.00)	1.42 (1.13)	2.22 (4.67)	1.53 (1.70)
T_2 – Ethoxysulfuron 60 WG @ 17.5 g.a.i ha^{-1}	3.20 (14.00)	1.80 (2.87)	3.45 (11.67)	2.36 (5.53)	1.67 (2.67)	1.09 (0.20)
T_3 – Ethoxysulfuron 60 WG @ 20 g.a.i ha^{-1}	4.19 (18.67)	3.16 (9.93)	1.67 (2.00)	1.52 (1.47)	1.94 (3.33)	1.19 (0.47)
T_4 – Ethoxysulfuron 15 WG @ 18.75 g.a.i ha^{-1}	2.42 (6.00)	1.26 (0.67)	1.94 (3.33)	1.56 (1.67)	2.11 (4.33)	1.16 (0.37)
T_5 – Almix (Metsulfuron-methyl 10% + Chlorimuron-ethyl 10%) 20 WP @ 2+2 g.a.i ha^{-1}	4.93 (25.33)	2.67 (7.13)	4.98 (24.00)	4.54 (19.60)	1.24 (0.67)	1.02 (0.03)
T_6 – 2, 4 – DEE @ 400 g.a.i ha^{-1}	3.57 (12.67)	2.04 (3.40)	4.11 (17.33)	1.90 (2.93)	1.72 (3.00)	1.11 (0.27)
T_7 – Two hand weedings at 20, 40 DAT	5.63 (32.33)	1.56 (1.50)	5.18 (26.00)	1.65 (1.73)	1.41 (1.33)	1.44 (1.47)
T_8 – Weedy check	21.21 (474.33)	5.28 (32.13)	16.99 (306.67)	12.13 (148.47)	12.51 (160.0)	8.86 (78.53)
SEm ±	1.55	0.74	1.28	0.52	0.68	0.37
CD (P=0.05)	4.76	2.25	3.91	1.58	2.09	1.13

* Figures in the parentheses are the original values
DAS – Days after spraying
WCE – Weed control efficiency
DAT – Days after transplanting

$$WCE\ (\%) = \frac{WPC - WPT}{WPC} \times 100$$

WCE = Weed Control Efficiency (%)
WPC = Weed population in control plot
WPT = Weed population in treated plot

The economic analysis of each treatment was done on the basis of prevailing market price of different inputs and produces, respectively.

RESULTS AND DISCUSSION

The predominant weed flora comprised of *Ammania baccifera, Commelina benghalensis* and *Marsilia quadnifolia* among broad leaf weeds; *Cyperus difformis* and *Fimbristylis miliacea* among the sedges.

Effect on broad- leaved weeds

The perusal of the data indicated that at 20 ays after spraying (DAS), all the weed control treatments significantly reduced the broad-leaved weeds compared to the weedy check (Table 1). Application of the herbicides i.e., ethoxysulfuron 60 or 15 WG, Almix and 2, 4-DEE was found to be at par with hand weeding. Even though, ethoxysulfuron 15 WG recorded lowest weed count among all the treatments, it was at par with ethoxysulfuron 60 WG at all the three concentrations, Almix and 2,4-DEE. Similarly, all the weed control treatments except the ethoxysulfuron 60 WG @ 20 g a.i ha^{-1} registered significantly lower dry matter of broad-leaved weeds compared to weedy check and they were at par with each other.

At 35 days after spraying also, the significant effect of the herbicides and hand weeding was registered over weedy check with respect to the weed count and dry matter of the broad-leaved

Table 2. Effect of Ethoxysulfuron 60 WG & 15 WG on count and dry weight of sedges in transplanted *kharif* rice.

Treatment	20 DAS		35 DAS		Flowering	
	Weed count (No.)	Weed dry matter (g m^{-2})	Weed count (No.)	Weed dry matter (g m^{-2})	Weed Count (No.)	Weed dry matter (g m^{-2})
T_1 – Ethoxysulfuron 60 WG @ 15 g.a.i ha^{-1}	1.14 (0.33)	1.06 (0.13)	1.0 (0)	1.0 (0)	0.0	0.0
T_2 – Ethoxysulfuron 60 WG @ 17.5 g.a.i ha^{-1}	1.0 (0)	1.0 (0)	1.0 (0)	1.0 (0)	0.0	0.0
T_3 – Ethoxysulfuron 60 WG @ 20 g.a.i ha^{-1}	1.0 (0)	1.0 (0)	1.0 (0)	1.0 (0)	0.0	0.0
T_4 – Ethoxysulfuron 15 WG @ 18.75 g.a.i ha^{-1}	1.0 (0)	1.0 (0)	1.0 (0)	1.0 (0)	0.0	0.0
T_5 – Almix (Metsulfuron-methyl 10% + Chlorimuron-ethyl 10%) 20 WP @ 2+2 g.a.i ha^{-1}	2.09 (5.0)	1.82 (3.47)	2.63 (8.67)	3.31 (12.67)	0.0	0.0
T_6 – 2, 4 – DEE @ 400 g.a.i ha^{-1}	2.66 (7.33)	2.81 (7.07)	2.03 (3.33)	1.27 (0.67)	0.0	0.0
T_7 – Two hand weedings at 20, 40 DAT	1.61 (2.33)	1.28 (0.80)	1.77 (3.33)	1.0 (0)	0.0	0.0
T_8 – Weedy check	5.64 (56.0)	3.74 (17.27)	7.86 (62.67)	7.42 (57.27)	59.6 (7.78)	124.8 (11.2)
SEm ±	1.37	0.61	0.61	0.60	—	—
CD (P=0.05)	1.93	1.87	1.87	1.83	—	—

* Figures in the parentheses are the original values
DAS – Days after spraying
DAT – Days after transplanting

weeds. The lowest weed count and dry matter was found in ethoxysulfuron 60 WG @ 20 g.a.i ha^{-1} followed by ethoxysulfuron 15 WG @ 18.75 g.a.i ha^{-1} but they were at par with other herbicidal treatments and hand weeding. Similar trend was observed at flowering as well.

Effect on sedges

Practically no sedge population was recorded in ethoxysulfuron 60 WG & 15 WG sprayed plots at 20, 35 DAS and flowering except with ethoxysulfuron 60 WG @ 15 g.a.i/ha at 20 DAS (Table 2). The other two herbicides (Almix and 2, 4-DEE) were also significantly superior to weedy check both at 20 and 35 DAT with respect to the sedge population. All the herbicidal treatments were at par with hand weeding. Similar trend was observed in sedge weed dry matter at 20 and 35 DAS except 2,4-DEE at 20 DAS which was at par with weedy check. At flowering, no sedge weeds were recorded in all the treatments except in weedy check. Earlier, Saini and Angiras (2002) reported the superior performance of ethoxysulfuron in controlling both broad-leaved weeds and sedges in direct seeded puddle rice.

Weed control efficiency

The weed control efficiency (WCE) of broad-leaved weeds ranged from 99.6 to 97.1 % in different weed control treatments (Table 3). Highest WCE was recorded with Almix (99.6%) which was closely followed by hand weeding twice at 20 and 40 DAT (99.2 %). However, ethoxysulfuron at 60 or 15 WG and 2,4-DEE were also equally efficient with respect to the weed control efficiency of broad-leaved weeds and it was 100% in all the treatments at flowering with respect to sedges.

Table 3. Effect of Ethoxysulfuron 60 WG & 15 WG on WCE (%), grain yield and economics of transplanted *kharif* rice

Treatment	Weed control efficiency (%) at flowering		Grain yield (kg ha^{-1})	Gross returns (₹ ha^{-1})	Net returns (₹ ha^{-1})	B:C ratio
	Broad-leaved weeds	Sedges				
T_1 Ethoxysulfuron 60 WG @ 15 g.a.i ha^{-1}	97.08	100	4910	44,190	25,090	1:1.31
T_2 Ethoxysulfuron 60 WG @ 17.5 g.a.i ha^{-1}	98.33	100	6104	54,936	35,586	1:1.83
T_3 Ethoxysulfuron 60 WG @ 20 g.a.i ha^{-1}	97.92	100	5857	52,713	32,863	1:1.65
T_4 Ethoxysulfuron 15 WG @ 18.75 g.a.i ha^{-1}	97.29	100	6383	57,447	37,847	1:1.93
T_5 Almix (Metsulfuron-methyl 10% + Chlorimuron-ethyl 10%) 20 WP @ 2+2 g.a.i ha^{-1}	99.58	100	5513	49,617	29,817	1:1.51
T_6 2, 4 – DEE @ 400 g.a.i ha^{-1}	98.13	100	4729	42,561	23,611	1:1.25
T_7 Two hand weedings at 20, 40 DAT	99.17	100	6176	55,584	32,084	1:1.37
T_8 Weedy check	—	—	2856	21,204	2,704	1:0.15
SEm ±	—	—	593	—	—	—
CD (P=0.05)	—	—	1800	—	—	—

Price (₹ kg^{-1}): Grain: 9.0; Cost of one hand weeding (/ha): 2,500/-

Phytotoxicity

There were no phototoxic symptoms observed on rice at any stage of the growth due to the application of herbicides in the study.

Grain yield

Significantly higher grain yield was recorded in all the weed control treatments including the application of ethoxysulfuron 60 WG or 15 WG or Almix or 2, 4-DEE and hand weeding compared to weedy check (Table 3). Among all the treatments, highest yield (6383 kg ha^{-1}) was realized with ethoxysulfuron 15 WG @ 18.75 g.a.i ha^{-1} followed by hand weeding at 20 & 40 DAT (6176 kg ha^{-1}) and ethoxysulfuron 60 WG @ 17.5 g.a.i ha^{-1} (6104 kg ha^{-1}). There was a 123 % increase in grain yield with ethoxysulfuron 15 WG @ 18.75 g.a.i ha^{-1} followed by 116% in hand weeding and 114% in ethoxysulfuron 60 WG @17.5 g.a.i ha^{-1} over weedy check treatment. It might be due to higher weed control efficiency in the above treatments, which provided a favourable environment for growth and development of the crop. These findings are in agreement with Saini and Angiras (2002), Saha *et al.,* (2003) and Sattar *et al*., (2005) in rice.

Economics

Higher returns (gross and net) and benefit: cost ratio was recorded in all the weed control treatments over weedy check (Table 3). Among the herbicides, ethoxysulfuron15 WG @ 18.75 g.a.i/ha gave the maximum returns and benefit: cost ratio due to excellent control of sedges and broad- leaved weeds with out any adverse effect on crop growth. Ethoxysulfuron 60 WG @ 17.5 g.a.i ha^{-1} was found to be the next best treatment. Lower net returns and benefit: cost ratio were recorded with 2, 4-DEE and hand weeding.

From the results it can be concluded that ethoxysulfuron 15 WG @ 18.75 g.a.i ha^{-1} followed by 60 WG @ 17.5 g.a.i ha^{-1} effectively controlled broad-leaved and sedge weeds in transplanted rice during *kharif* season. However, both the formulations of ethoxysulfuron were found to be on a par with Almix and 2, 4-DEE.

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