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Efficacy of new herbicide molecules for weed management in wet direct seeded rice

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ABSTRACT

Weeds are one of the major biotic constraints limiting crop production in direct seeded rice and use of effective herbicides improve grain yield besides overcoming labour problem. The field investigation carried out during wet seasons of 2010 and 2011 at Andhra Pradesh Rice Research Institution and Regional Agricultural Research Station, Maruteru on chemical weed management using new molecules in wet direct seeded rice revealed that post emergence application of penoxulam @ 25.0 g ai/ha at 15-20 days after sowing (DAS) controlled the weeds more effectively as that of weed free throughout crop growth period or hand weeding twice at 20 and 40 DAS and recorded lower weed density, weed bio mass, higher weed control efficiency (76.9%), higher number of productive tillers (285 m2) with more panicle weight (5.48 g) and ultimately resulted in higher grain yield (5603 kg/ha) accounting for 28.1% increase over unweedy check and also recorded lowest weed index (0.49). Reduction in grain yield to an extent of 21.9% was observed due to weeds in direct seeded rice in deltaic soils of coastal region during wet season.

Key words: *Direct seeded rice, pre–emergence weedicides, weed control efficiency, weed index*

Rice (Oryza sativa L.) is the most important and extensively grown crop in tropical and subtropical regions of the world as it is the staple food for more than 60% of the world population. Transplanting is the traditional system of rice cultivation and it is in vogue in many rice growing areas and this rice production system, however, requires a large amount of water during puddling and more labour for transplanting. Moreover, the rice transplantings are badly delayed due to late release of canal water and late arrival of monsoon rains for raising rice nurseries in time. Thus the monsoon crop (Kharif) is delayed with consequent effect on rabi rice crop yields due to late planting and reducing the turn around period in the year to take up summer pulse crop in Rice-Rice-Pulse system in coastal delta regions. Direct seeding of rice avoids raising of nursery and transplanting there by reduces labour dependency and cost of production besides reducing crop growing period by 8-10 days. DSR has several advantages over puddle transplanted rice, but weeds are the main biological constraint limiting the production under direct seeded conditions. Weeds cause reduction in grain yield up to 80% and sometimes also results in complete failure of the crop. Weeds in DSR systems are mainly managed by manual weeding and by using herbicides to certain extent. Usage of effective herbicides in DSR improves grain yield besides overcoming the labour problem. Hence, the present study was carried out to suggest effective new herbicide molecules for weed management in wet direct seeded rice.

Field experiments were conducted in wet direct seeded rice at Andhra Pradesh Rice Research Institute & Regional Agricultural Research Station, Maruteru, West Godavari district, Andhra Pradesh, India during wet seasons of 2010 and 2011 to suggest effective and economical method of chemical weed control with new herbicide molecules. The experiment consisting of six treatments viz., Penoxulam @ 22.5 g a.i./ha at 15-20 days after sowing, Penoxulam @ 25 g a.i./ha at

15-20 days after sowing, Pyrazosulfuron-ethyl @ 20 g a.i./ha at 4-7 days after sowing, weed free, two hand weedings at 20 & 40 DAS and Un weeded check was laid out in a Randomised Block Design and replicated thrice. A medium duration rice variety MTU 1075 (Pushyami) was sown in II week of July on a well puddled soil and good crop was raised duly adopting the package of practices recommended for Godavari zone. The data on weed density and weed dry weight were recorded at 40 DAS duly recording weed number / 0.25 m2 area while the data on yield attributes and grain yield were recorded at harvest. Major weed flora found in the experimental plot were *Echinochloa colonum, E. Crusgalli* and *Panicum repens* accounting for 33% in grasses and *Fimbristylis mileaceae, Cyperus iria* among sedges and *Sphenoclea zeylanisea* among the non-grasses. Based on weed density and grain yield, weed control efficiency and weed index were calculated using the formula as suggested by Das T.K. (2011).

$$\textbf{Weed Control Efficiency } (\textbf{WCE}) = \frac{(WD_C - WD_T)}{WD_C} X100$$

Where WD_C is weed density (number /m2) in control plot; WD_T is the weed density (number /m2) in treated plot;

$$\textbf{Weed Index} = \frac{Y_{WF} - Y_T}{Y_{WF}} X\ 100$$

Where Y_{WF} is the crop yield in weed free plot; Y_T is the crop yield in treatment plot for which weed index is to be worked out.

Maintenance of weed free condition throughout growth or during critical stages resulted in less weed density during both the years of study and registered lowest mean weed density of 3.6 (Table 1). Among the herbicides, penoxulam @ 25 g ai/ha at 15-20 DAS recorded lowest mean weed density of 32.2 g/m^2 and all the herbicides proved significantly superior over unweeded check (234.8 g/m^2). Similarly, weed dry wt/ m2 at 40 DAS was lowest with weed free treatment (28.0 g/m^2) and two hand weedings at 20 & 40 DAS (37.0 g/m^2). Among the herbicides, post emergence application of penoxulam @ 22.5 g/ha recorded relatively less dry weight of weeds (54.0 g/m^2) compared to pyrazosulfuran ethyl @ 20 g ai/ha at 4-7 DAS (60.0 g/m^2). Effective control of weeds with pre emergence application of pyrazfsulfuron ethyl or post emergence application of penoxulam might have resulted in lower weed density and weed dry matter at 40 DAS over un weeded check and proved as effective as weed free or two hand weedings at 20 and 40 DAS. Yakadri et al.(2015) reported lowest weed density and highest WCE with pre–e–application of pyrazosulfuran ethyl@20 g/ha followed by hand weeding at 40 DAS in drum seeded rice.

A perusal of data on WCE in Table 2 revealed that maximum weed control efficiency was recorded with weed free treatment during both the years of study and also lowest mean WCE (96.1%) while the WCE with 2 hand weedings was 78.6%. Post e- application of penoxulam or pre – e – application of pyrazosulfuran ethyl were equally effective as that of hand weeding (78.6%) and recorded WCE of 76.0% and 75.9% respectively. Prasad et al. (2015) also reported similar results with penoxulam in transplanted paddy where in penoxulam @ 25.0 g ai/ha at 15-20 days after transplanting controlled weeds effectively and recorded higher weed control efficiency over weedy check. Mondal *et al.*(2015) reported that proponil 36% EC @

Table 1. Weed dry matter and weed dry weight as influenced by different weed management practices in wet direct seeded rice

	Weed No. /m2 at 40 DAS			Weed dry wt /m2 at 40 DAS		
Treatments	2010	2011	Mean	2010	2011	Mean
Penoxulam @ 22.5 g a.i./ha 15-20 days after sowing.	41	32.2	36.6	19	89.92	54
Penoxulam @ 25 g a.i./ha 15-20 days after sowing.	30	34.4	32.2	26	87.97	57
Pyrazosulfuron-ethyl @ 20 g a.i./ha 4-7 days after sowing	37	34.5	35.8	18	101.81	60
Weed free	0	7.1	3.6	0	55.21	28
Two hand weedings at 20 & 40 DAS	23	32.9	28.0	14	59.00	37
Un weeded check.	380	89.5	234.8	364	195.23	280
CD (P<0.05)	69	0.70	35.0	77.60	15.29	46
CV %	54	12.12	33.0	70.1	10.33	40

6.6 kg/ha was more effective against edges and recorded higher WCE over bispyribac sodium in wet direct seeded rice (P:61).

The numbers of productive tillers /m2 and panicle weight at harvest were significantly influenced by weed management practices (Table 3). Highest number of productive tillers was recorded with weed free treatment during both the years and also mean (313 m^2) followed by two hand weedings at 20 & 40 DAS (303 /m^2) while significantly lower number of productive tillers were observed in un weeded check (239 /m^2). All the herbicides recorded more or less equal number of productive tillers /m^2 and it ranged from 278 to 285 m^2 and all were significantly superior over un weeded check and at par with post – e – application of penoxilam @ 22.5 and 25.0 g ai/ha at 15-20 DAS. Weed free environment due to effective control of weeds either with manual weeding or application of herbicides might have favoured good crop growth and resulted in higher number of productive tillers /m^2 at harvest.

Panicle weight at harvest also varied significantly with different weed management practices (Table 3). Two hand weedings at 20 & 40 DAS (5.55 g) and weed free (5.49 g) treatment recorded more or less equal panicle weight and both were significantly superior over un weeded check (3.86 g). Among the herbicides, penoxulam @ 25.0 g ai/ha registered relatively higher mean panicle weight (4.57 g) followed by pyrazosulfuran ethyl @ 20 g ai/ha at 4-7 DAS (4.54 g wt). More number of productive tillers with heavier panicles due to application of butachlor in Wet Direct Seeded Rice was reported by Subbaiah (2005).

Weed management practices exerted significant influence on grain yield (Table 3). The highest grain yield of 5871 kg/ha during 2010 and 5550 kg/ha during 2011 was recorded with weed free treatment and two hand weedings at 20 & 40 DAS respectively. Significantly lower grain yield was registered with un weeded check during both the years of study and also mean (4400 kg/ha) and reduction in grain yield was to the tune of 21.9% over un weeded check. Saha 2005 reported that un controlled weeds reduces yield by 96 and 61 % in wet and dry seeded rice respectively.

Table 2. Weed control efficiency and weed index as influenced by weed management practices in wet direct seeded rice

Treatments	Weed Control Efficiency (%)			Weed index		
	2010	2011	Mean	2010	2011	Mean
Penoxulam @ 22.5 g a.i./ha 15-20 days after sowing.	89.2	64.0	76.6	6.66	2.78	4.72
Penoxulam @ 25 g a.i./ha 15-20 days after sowing.	92.1	61.6	76.9	2.46	-1.48	0.49
Pyrazosulfuron-ethyl @ 20 g a.i./ha 4-7 days after sowing	90.3	61.5	75.9	3.84	0.00	1.92
Weed free	100.0	92.1	96.1	-	-	-
Two hand weedings at 20 & 40 DAS	93.9	63.2	78.6	1.11	-2.78	0.84
Unweeded check.	-	-	-	27.29	16.11	21.70

Table 3. Yield attributes and grain yield as influenced by weed management practices in wet direct seeded rice

	Productive tillers /m2			Panicle weight (g)			Grain yield (kg/ha)			Mean Per cent increase over control
Treatments	2010	2011	Mean	2010	2011	Mean	2010	2011	Mean	
Penoxulam @ 22.5 g a.i./ha 15-20 days after sowing.	287	273	280	3.58	5.25	4.42	5480	5250	5365	21.9
Penoxulam @ 25 g a.i./ha 15-20 days after sowing.	304	266	285	3.65	5.48	4.57	5726	5480	5603	27.3
Pyrazosulfuron-ethyl @ 20 g a.i./ha 4-7 days after sowing	295	261	278	3.68	5.40	4.54	5645	5400	5523	20.3
Weed free	314	311	313	3.90	5.40	4.65	5871	5400	5636	28.1
Two hand weedings at 20 & 40 DAS	306	299	303	3.80	5.55	4.68	5806	5550	5678	29.0
Un weeded check.	276	202	239	3.18	4.53	3.86	4269	4530	4400	-
CD (P<0.05)	27	24	26	0.74	0.34	0.54	615	340	478	-
CV %	6.0	6.0	6	13.6	4.3	8.95	7.5	4.3	6	-

Among the herbicides, post – e – application of penoxulam @ 25.0 g ai/ha at 15-20 DAS registered higher yield during both years and mean of two years (5603 kg/ha) than its application at 22.5 g ai/ha and proved as effective as weed free treatment (5636 kg/ha) and 2 hand weedings at 20 & 40 DAS (5678 kg/ha). Bharathalakshmi et al (2015) reported higher grain yield with pre emergence application of anilophos @ 1.2 lt/ha at 3.5 DAS in wet direct seeded rice. Spraying of finoxaprop ethyl or cyhalofop butyl along with metsulfuran methyl + chlorimum ethyl or bispyribac sodium as post emergence were found effective for broad spectrum weed control and higher grain yield in direct seeded rice. (Syama and Prameela, 2015). Bandara et al. (2015) confirmed that oxyfluorofen @ 150 g/ha applied at 3 or 4 DAS controlled weeds effectively and gave grain yield on par with pretilachlor.

Yield advantage with different weed management practices over weedy check inturns of weed index (Table 2) indicated that lowest weed index (0.84) was recorded with two hand weedings at 20 & 40 DAS while highest WI was with un weeded check (21.7) which reveal minimum and maximum yield variation with the treatments compared to weed free treatment. Amiong the herbicides, penoxulam @ 25 g ai/ha recorded weed index of 2.46 and – 1.48 during 2010 and 2011 respectively with a mean value of 0.49 and proved as effective as two hand weedings at 20 & 40 DAS. Pre – e – application of pyrazosulfuron ethyl was also effective as that of two hand weedings at 20 & 40 DAS and recorded a mean weed index of 1.92.

Overall, the field studies conducted for two consecutive wet seasons indicated that a post – emergence application of penoxulam a new herbicide molecule @ 25 g ai/ha at 15-20 DAS or pre emergence application of pyrozosulfuran ethyl @ 20 g a.i/ha at 4-5 DAS can be recommended for effective control of weeds and realizing higher grain yields in wet direct seeded rice.

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