

Bio-Efficacy of Pyrazosulfuron Ethyl 10% Wp against Weeds in Transplanted Rice

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Abstract

An experiment was conducted during Kharif 2012 and 2013, at Agricultural Research Station, Dhadesugur, University of Agricultural Sciences (UAS), Raichur, Karnataka, India, to evaluate the phytotoxicity and bio-efficacy of pyrazosulfuron ethyl 10% WP (5, 10, 15 and 20g a.i./ha as spray) against the weeds in transplanted rice. Sprays of Saathi (Market Sample) @ 15g a.i./ha, Pretilachlor 50% EC @ 500 ml a.i./ha, hand weeding at 15 and 40 days after planting (weed free check) and a weedy check (untreated check) were also maintained. The dominant weeds were *Echinochloa colona*, *Panicum repens*, *Cynodon doctylon*, *Ludwigia parviflora*, *Leptochloa chinensis* and *Cyperus* sp. Application of pyrazosulfuron ethyl 10% WP at 20g a.i./ha was most effective in controlling the associated weeds and increasing the grain yield of rice without any phytotoxic effect.

Keywords: Bio-efficacy; Dry weight; Grain yield; Phytotoxicity; Weeds

Introduction

Agriculture has been a forefront agenda at national and international level for food security and management of natural resources. Cereals are the most important part of our diet throughout the world and thus, play a major role in our food security. Among cereals, rice has been staple food for more than 60 per cent of the world population, providing energy for about 40% of the world population where every third person on earth consumes rice every day in one form or other (Datta and Khushi, 2002). Therefore, crop paddy (*Oryza sativa* L.) is an important crop which is extensively grown in tropical and subtropical regions of the world. It is cultivated in area of 44.0 million hectares with an annual production of 104.3 million tons in India. Its production has been found to be distributed as 91.5 million tons in kharif and 12.8 million tons in rabi season. However, its productivity in India is very low ($2.37t\ ha^{-1}$) as compared to other rice growing countries like Japan ($6.35t\ ha^{-1}$), Australia ($6.22t\ ha^{-1}$), Spain ($6.16t\ ha^{-1}$), Egypt ($5.0t\ ha^{-1}$) and China ($5.2t\ ha^{-1}$).

Weeds are the major cause of yield reduction in rice. Hand weeding is the traditional weed control measure and still being the most popular in rice. However, due to high labour cost, non-availability of labour and huge time requirement for manual weeding, farmers are inevitable to go for other alternative mea-

asures like chemical weed control. Many herbicides are being used successfully for weed control in transplanted rice as pre-emergence spray. New herbicides are available in the market and use of herbicides of different composition is desirable to reduce the problem of residue buildup, shift in weed problem (Rajkhowa., *et al.* 2006) and development of herbicide resistance in weeds (Rao, 1999, Saha., *et al.* 2006) [9,10,12]. The recent trend of herbicide use is to find out an effective weed control measure by using low dose high efficiency herbicides which will not only reduce the total volume of herbicide use but also the application become easier and economical (Pal and Banerjee, 2007) [7]. The herbicide pyrazosulfuron ethyl 10% WP has both foliar and soil activity (Rajkhowa., *et al.* 2006). It is generally recommended as a pre-emergence herbicide in transplanted rice (Angiras and Kumar, 2005) [1]. Studies on bio-efficacy and phytotoxicity of pyrazosulfuron ethyl 10% WP for pre-emergence weed control in transplanted rice are scanty. The present experiment was therefore undertaken to study the bio-efficacy and phytotoxicity of pyrazosulfuron ethyl 10% WP in pre-emergence control of major weeds in transplanted rice and to determine an optimum dosage of application that can be recommended to rice growing farmers.

Materials and Methods

An experiment was conducted during Kharif 2012 and 2013 at Agricultural Research Station, Dhadesugur, University of Agricultural

Sciences (UAS), Raichur, Karnataka, India, (situated at 15.6' N latitude and 76.8' E longitude with an altitude of 358 m above mean sea level). The soil was deep black clay in texture having a pH of 8.1, organic Carbon 0.21%, total N 160 kg/ha, available P 26.0 kg/ha and available K 486 kg/ha. The experiment was laid out in a randomized block design with eight treatments, viz. T₁- Pyrazosulfuron ethyl 10% WP at 5g a.i./ha, T₂-Pyrazosulfuron ethyl 10% WP at 10g a.i./ha, T₃- Pyrazosulfuron ethyl 10% WP 15g a.i./ha, T₄-Pyrazosulfuron ethyl 10% WP at 20g a.i./ha, T₅- Saathi at 15g a.i./ha, T₆- Pretilachlor 50% EC @ 500 ml a.i./ha T₇- weed free check (weeding at 15 days after sowing) and T₈- weedy check (Untreated check) and replicated thrice. The rice variety used was 'BPT-5204' of 150 days duration. The crop was transplanted during 1st week of August in both the years. The test herbicide pyrazosulfuron ethyl 10% WP at 4 different doses along with standard herbicide Saathi and Pretilachlor were sprayed at early pre-emergence stage (3 Days After transplanting) with the spray volume of 500 l/ha using knapsack sprayer with flat fan nozzle. An area was selected randomly at two spots by making a quadrat of 0.25 m². Weed species were counted from that area and density was expressed in number per m². The collected weeds were first sun-dried and then kept in an electric oven at 7000C till the weight became constant and weed biomass was expressed as g/m². As wide variation existed in data, number and biomass of weeds were transformed through square-root method before analysis of variance. Comparison of treatment means for significance at 5% level was done using the critical differences as suggested by Gomez and Gomez (1984) [4]. Weed control efficiency (WCE) was worked out using the formula as suggested by Mani, *et al.* 1973 and Gill and Vijayakumar, 1969 [3,6]. In transplanted paddy, five plants were randomly selected in each plot of each replication and were tagged for the purpose of recording observations on growth parameters viz., plant height and number of productive tillers per hill at harvest. Yield parameters viz., panicle length, test weight and number of filled grains per panicle. Similarly, paddy from each net plot in each replication was harvested and dried. The grains after threshing were weighed and recorded as grain yield per net plot. Further, this net plot grain yield was converted to grain yield per hectare.

Results and Discussion

Effect on weeds, weed control efficiency and total dry weight of weeds

In the experimental plots, the dominant weeds were *Echino-*

chloa colona, *Panicum repens*, *Cynodon doctylon*, *Ludwigia parviflora*, *Leptochloa chinensis* and *Cyperus* sp. All the herbicides showed effective control of all categories of dominant weeds resulting in less weed dry matter and higher weed control efficiency as compared to untreated check (Table 1 & 1a). The number of dominant broad-leaved, grass and sedge weeds was gradually decreased with the increase of doses of tested herbicide pyrazosulfuron ethyl 10% WP in all the three dates of observation. Better weed control was observed with application of pyrazosulfuron ethyl 10% WP at 20g a.i./ha of the tested herbicide. Lower weed biomass at 15 days after herbicide application was recorded with pyrazosulfuron ethyl 10% WP at 20g a.i./ha. Angiras and Kumar (2005) also found that broadcast application of pyrazosulfuron-ethyl at 15 g/ha mixed with sand at 150 kg/ha was effective to control weeds in rice which resulted in significantly lower weed density and biomass without any phytotoxic effect on rice plant [1]. Pyrazosulfuron-ethyl at 20 and 25 g/ha significantly reduced weed density and total weed biomass of *Cyperus iria*, *Echinochloa colona* etc. when applied at 3 to 10 days after transplanting (Chopra and Chopra 2003). None of tested doses was phytotoxic to rice when applied alone [2].

Weed control efficiency (100%) was higher in hand weeding treatment (Table 2). Pyrazosulfuron ethyl 10% WP at 20g a.i./ha given higher weed control efficiency (76.88, 87.39 and 91.33% at 15, 30 and 60 DAA, respectively) when applied at 3 days after sowing. It was closely followed by the application of Pyrazosulfuron ethyl 10% WP at 15g a.i./ha (72.31, 79.44 and 86.02% at 15, 30 and 60 DAA, respectively) and Saathi at 15g a.i./ha (72.13, 79.06 and 86.29% at 15, 30 and 60 DAA, respectively).

Further, total dry weight of weeds (14.42, 9.46 and 7.48 g/m² at 15, 30 and 60 DAA, respectively) was lower with application of Pyrazosulfuron ethyl 10% WP at 20g a.i./ha. It was closely followed by the application of Pyrazosulfuron ethyl 10% WP at 15g a.i./ha (17.79, 14.48 and 12.68 g/m² at 15, 30 and 60 DAA, respectively) and Saathi at 15g a.i./ha (17.56, 14.56 and 10.93 g/m² at 15, 30 and 60 DAA, respectively). Overall result showed that the tested herbicide pyrazosulfuron ethyl 10% WP at 20g a. i./ha was comparatively more effective against broad-leaved, grassy and sedge weeds.

Effect on growth parameters of transplanted paddy

Significantly taller plants and more number of productive tillers per hill were observed in weed free treatment and which was on par in the treatment with the application of Pyrazosulfuron ethyl 10% WP @ 20g a.i./ha (82.2 cm and 25.1, respectively), Pyrazosulfuron ethyl

Treatment details	<i>Echinichloa colona</i>			<i>Panicum repens</i>			<i>Cynodon doctylon</i>		
	15 DAA	30 DAA	60 DAA	15 DAA	30 DAA	60 DAA	15 DAA	30 DAA	60 DAA
T ₁ : Pyrazosulfuron ethyl 10% WP @ 5g a.i./ha	6.31 (2.70)	5.51 (2.54)	4.91 (2.42)	5.72 (2.59)	5.28 (2.49)	4.93 (2.42)	5.50 (2.55)	4.92 (2.42)	4.51 (2.34)
T ₂ : Pyrazosulfuron ethyl 10% WP @ 10g a.i./ha	5.96 (2.64)	5.28 (2.50)	4.59 (2.36)	5.24 (2.50)	4.78 (2.40)	4.51 (2.35)	5.20 (2.48)	4.62 (2.41)	4.28 (2.27)
T ₃ : Pyrazosulfuron ethyl 10% WP @ 15g a.i./ha	5.15 (2.47)	4.31 (2.30)	3.83 (2.20)	4.22 (2.28)	3.87 (2.21)	3.35 (2.08)	4.17 (2.22)	3.91 (2.20)	3.41 (2.08)
T ₄ : Pyrazosulfuron ethyl 10% WP @ 20g a.i./ha	4.36 (2.31)	3.53 (2.12)	3.26 (2.06)	3.41 (2.10)	3.02 (1.99)	2.73 (1.92)	3.67 (2.10)	3.30 (2.05)	2.84 (1.94)
T ₅ : Saathi (Market Sample) @ 15g a.i./ha	5.13 (2.47)	4.34 (2.30)	3.85 (2.20)	4.34 (2.31)	4.00 (2.24)	3.51 (2.12)	4.27 (2.28)	3.87 (2.20)	3.51 (2.12)
T ₆ : Pretilachlor 50% EC @ 500 ml a.i./ha	5.64 (2.57)	4.86 (2.41)	4.50 (2.33)	4.83 (2.41)	4.40 (2.32)	3.74 (2.17)	5.05 (2.45)	4.34 (2.28)	4.16 (2.24)
T ₇ : Weed free check	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)
T ₈ : Weedy check	8.69 (3.11)	8.96 (3.15)	9.63 (3.26)	7.34 (2.88)	8.17 (3.02)	8.81 (3.13)	6.73 (2.77)	7.35 (2.85)	8.28 (3.02)
S.Em +	0.05	0.06	0.04	0.07	0.08	0.06	0.06	0.05	0.06
CD at 5%	0.16	0.18	0.14	0.21	0.25	0.20	0.18	0.15	0.18

DAA: Days after application

Table 1: Effect of Pyrazosulfuron ethyl 10% WP on different weed population (count/m²) in transplanted paddy (Pooled data of Kharif 2012 and 2013).

Treatment details	<i>Ludwigia parviflora</i>			<i>Leptochloa chinensis</i>					
	15 DAA	30 DAA	60 DAA	15 DAA	30 DAA	60 DAA	15 DAA	30 DAA	60 DAA
T ₁ : Pyrazosulfuron ethyl 0% WP @ 5g a.i./ha	5.50 (2.55)	5.18 (2.48)	4.66 (2.37)	5.84 (2.61)	5.41 (2.52)	4.98 (2.43)	6.94 (2.81)	6.10 (2.66)	5.38 (2.52)
T ₂ : Pyrazosulfuron ethyl 10% WP @ 10g a.i./ha	5.01 (2.45)	4.62 (2.37)	4.21 (2.28)	5.29 (2.50)	4.90 (2.42)	4.37 (2.30)	5.95 (2.63)	5.40 (2.53)	4.90 (2.43)
T ₃ : Pyrazosulfuron ethyl 10% WP @ 15g a.i./ha	3.94 (2.17)	3.71 (2.16)	3.32 (2.07)	4.44 (2.33)	4.05 (2.25)	3.53 (2.13)	5.18 (2.47)	4.65 (2.37)	4.08 (2.25)
T ₄ : Pyrazosulfuron ethyl 10% WP @ 20g a.i./ha	3.28 (2.06)	2.96 (1.98)	2.65 (1.90)	3.57 (2.13)	2.98 (1.99)	2.70 (1.91)	4.44 (2.32)	4.26 (2.28)	3.84 (2.18)
T ₅ : Saathi (Market Sample) @ 15g a.i./ha	4.06 (2.24)	3.79 (2.18)	3.49 (2.12)	4.51 (2.34)	4.20 (2.28)	3.71 (2.16)	5.39 (2.52)	4.81 (2.41)	4.11 (2.26)
T ₆ : Pretilachlor 50% EC @ 500 ml a.i./ha	5.64 (2.57)	4.86 (2.41)	4.50 (2.33)	4.83 (2.41)	4.40 (2.32)	3.74 (2.17)	5.05 (2.45)	4.34 (2.28)	4.16 (2.24)
T ₇ : Weed free check	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)
T ₈ : Weedy check	8.69 (3.11)	8.96 (3.15)	9.63 (3.26)	7.34 (2.88)	8.17 (3.02)	8.81 (3.13)	6.73 (2.77)	7.35 (2.85)	8.28 (3.02)

S.Em +	0.05	0.06	0.04	0.07	0.08	0.06	0.06	0.05	0.06
CD at 5%	0.16	0.18	0.14	0.21	0.25	0.20	0.18	0.15	0.18

DAA: Days after application

Table 1a: Effect of Pyrazosulfuron ethyl 10% WP on different weed population (count/m²) in transplanted paddy (Pooled data of Kharif 2012 and 2013)

Treatment details	Total dry weight of weeds (g/m ²)			Weed control efficiency (%)		
	15 DAA	30 DAA	60 DAA	15 DAA	30 DAA	60 DAA
T ₁ : Pyrazosulfuron ethyl 10% WP @ 5g a.i./ha	22.82	19.36	16.48	64.47	71.90	80.50
T ₂ : Pyrazosulfuron ethyl 10% WP @ 10g a. i./ha	21.02	16.83	14.32	67.29	76.55	83.38
T ₃ : Pyrazosulfuron ethyl 10% WP @ 15g a. i./ha	17.79	14.18	12.68	72.31	79.44	86.02
T ₄ : Pyrazosulfuron ethyl 10% WP @ 20g a.i./ha	14.42	9.46	7.48	76.88	87.39	91.33
T ₅ : Saathi (Market Sample) @ 15g a.i./ha	17.56	14.56	10.93	72.13	79.06	86.29
T ₆ : Pretilachlor 50% EC @ 500 ml a.i./ha	20.18	16.52	12.38	68.10	76.58	85.41
T ₇ : Weed free check	--	--	--	100.0	100.0	100.0
T ₈ : Weedy check	64.26	68.42	83.46	--	--	--
S.Em +	1.04	1.70	1.15	1.58	2.77	1.68
CD at 5%	3.14	5.10	3.45	4.75	8.33	5.04

DAA: Days after application.

Table 2: Effect of Pyrazosulfuron ethyl 10% WP on total dry weight of weeds (g/m²) and weed control efficiency in transplanted paddy (Pooled data of Kharif 2012 and 2013).

10% WP @ 15g a. i./ha (81.6 cm and 23.3, respectively) and Saathi (Market Sample) @ 15g a.i./ha (79.5 cm and 22.4) compared to other weed control treatments. Similar results were noticed by Rathour, *et al.* 2015, Kamdi, *et al.* 2014 and Prasad, *et al.* 2014) [5,8,11]. Whereas, shorter plants and less number of productive tillers per hill were recorded in the weedy check treatment (Table 3).

Effect on yield and yield parameters of transplanted paddy

Similarly, significantly higher grain and straw yield were observed in weed free treatment and which was on par with the application of Pyrazosulfuron ethyl 10% WP @ 20g a.i./ha (6266 and 7465 kg/ha, respectively), Pyrazosulfuron ethyl 10% WP @

15g a. i./ha (6013 and 7216 t/ha, respectively) and Saathi (Market Sample) @ 15g a. i./ha (5898 and 7105 kg/ha, respectively) compared to other weed control treatments. Similar trend was recorded with respect to yield parameters of paddy. Pyrazosulfuron-ethyl at 20 and 25 g/ ha provided grain yield statistically similar to weed free treatment (Chopra and Chopra 2003) [2]. Whereas, lower grain and straw yield were recorded in weedy check plot. This is due to the high infestation of weeds.

It is therefore, recommended that pyrazosulfuron ethyl 10% WP at 20g a.i./ha can safely be used for controlling all three categories of weeds in transplanted rice as well as to get higher grain yield of rice.

Treatment details	Plant height (cm)	Number of productive tillers per hill	Panicle length (cm)	Number of filled grains per panicle	1000 grain weight (g)	Grain yield (kg/ha)	Straw yield (kg/ha)
T ₁ : Pyrazosulfuron ethyl 10% WP @ 5 g a. i./ha	70.5	19.2	20.4	261	17.1	5556	6714

T ₂ : Pyrazosulfuron ethyl 10% WP @ 10 g a. i./ha	72.4	20.6	20.3	263	18.1	5683	6836
T ₃ : Pyrazosulfuron ethyl 10% WP @ 15 g a. i./ha	81.6	23.3	22.2	270	17.2	6013	7216
T ₄ : Pyrazosulfuron ethyl 10% WP @ 20 g a. i./ha	82.2	25.1	23.1	275	18.2	6266	7465
T ₅ : Saathi (Market Sample) @ 15g a. i./ha	79.5	22.4	21.6	268	17.5	5898	7105
T ₆ : Pretilachlor 50% EC @ 500 ml a. i./ha	73.2	21.7	21.2	265	18.5	5795	6973
T ₇ : Weed free check	85.4	26.6	24.5	279	17.1	6424	7611
T ₈ : Absolute Control (Untreated check)	65.6	14.7	18.4	212	16.2	4183	5029
S.Em +	1.83	1.20	0.86	5.30	1.18	177	171
CD at 5%	5.48	3.60	2.58	15.9	3.53	530	508

DAA: Days after application.

Table 3: Effect of weed control treatments on growth, yield and yield parameters of transplanted paddy (Pooled data of Kharif 2012 and 2013).

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