Original Research Article

EFFICACY OF PROPANIL ON WEEDS, YIELD OF DIRECT SEEDED RICE AND SUCCEEDING CROP

ABSTRACT

A field study was conducted during *Kharif* 2015 and *summer* 2016, at Agricultural Research Station, Dhadesugur, University of Agricultural Sciences, Raichur, Karnataka, India, to study the effect of propanil on control of weeds and grain yield of direct seeded rice. The weeds which were dominant in trials field are *Echinichloa sp. Panicum repens, Leptochloa chinensis, Brachiaria mutica, Digitaria sanguinalis* among grasses, *Eclipta alba*, *Ludwigia parviflora* and *Commelina communis* as broad leaf weeds and *Cyperus sp.* as sedge. Results revealed that, application of Propanil 80% DF @ 4 kg a.i./ha and twice hand weeded check were found significantly superior over the application of Propanil 80% DF @ 3 kg a.i./ha and rest of the treatments. However, application of Oxyfluorfen 23.5% EC @ 240 g a.i./ha and Cyhalofop butyl 10% EC @ 80 g a.i./ha were on par with each other in controlling the weeds in direct seeded rice and increases the grain yield of rice without any phytotoxic effect.

Key words: Dry weight of weeds, weed control efficiency, Grain yield, Propanil

INTRODUCTION

Cereals are the most important part of our diet throughout the world and thus, play 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. There are several reasons for its low productivity but the losses due to weeds are one of the most important. More than one third of the total loss (33%) is caused by weeds alone (**Verma *et al.,* 2015**). Weeds are most severe and widespread biological constraints to crop production in India. Weeds are responsible for heavy yield losses in paddy, to the extent of complete crop failure under severe infestation conditions. Irrespective of the method of paddy establishment, weeds are a major impediment to paddy production due to their ability to compete for resources. In general, weeds problem in transplanted paddy is lower than that of direct seeded paddy because of puddling and stagnation of water in transplanted paddy during early growth stage of crop. But in some cases where continuous standing water cannot be maintained particularly for the first 45 days, weed infestation in transplanted paddy also may be as high as direct seeded paddy. According to **Singh *et al.* (2004)** weeds can reduce the grain yield of dry-seeded paddy (DSR) by 75.8%, wet seeded paddy (WSR) by 70.6% and transplanted paddy (TPR) by 62.6%. Weeds by virtue of their high adaptability and faster growth dominate the crop habitat and reduce the yield potential. Therefore, the present investigation was undertaken to study the effect of early post emergent herbicide for control of major weeds in direct seeded rice.

MATERIAL AND METHODS

A field study was taken during *Kharif*-2015 and *Summer*-2016 on effect of Propanil 80% DF against weeds in Direct Seeded Rice at Agricultural Research

Station, Dhadesugur. The soil of the experimental site was medium deep black and neutral in pH (8.04), EC (0.47 ds/m), medium in organic carbon content (0.41%), low in nitrogen (189 kg/ha), medium in phosphorus (58.5 kg/ha) and potassium (287.5 kg/ha). There are eight treatments *viz*., **T_1:** Propanil 80% DF @ 1.0 kg a.i/ha, **T_2:** Propanil 80% DF @ 2.0 kg a.i/ha, **T_3:** Propanil 80% DF @ 3.0 kg a.i/ha, **T_4:** Propanil 80% DF @ 4.0 kg a.i/ha, **T_5:** Oxyfluorfen 23.5 % EC @ 240 g a.i./ha, **T_6:** Cyhalofop butyl 10 % EC @ 80 g a.i./ha, **T_7:** Hand weeding and **T_8:** Weedy check and replicated thrice. Randomized complete block design was adopted for this experiment. Herbicide was sprayed as per the treatments on 08.08.2015 during *Kharif* 2015 and 29.01.2016 during *Summer* 2016, On 45th days after sowing (DAS), number of weeds (count/m^2) and total dry weight of weeds (g/m^2) were taken in all the treatments. Species wise, weed population were recorded at 45 DAS using quadrates of 1.0 m^2. Further, total dry weight of weeds were recorded at 45 DAS and used for calculating weed control efficiency (WCE). Data on weed population, total dry weight of weeds was analysed statistically **(Gomez and Gomez, 1984).** Weed control efficiency (WCE) = Dry weight of weeds under control plot - Dry weight of weeds under treatments/ Dry weight of weeds under control plot X 100. Grain yield in plot wise recorded and converted to grain yield per hectare basis. Calculated cost benefit ratio for each herbicidal treatment. To see the impact of this herbicide on succeeding crop, the black gram crops was sown after harvesting of the paddy crop from the Propanil 80% DF and other herbicide treated plots which was applied for weed management in direct seeded rice as post-emergent herbicide and data recorded on germination of seed and impact on crop growth and development *viz*. Leaf injury on tips and Leaf surface, Wilting, Vein clearing, Necrosis, Epinasty, Hyponasty, stunted growth etc. after 7, 15 and 21 days after germination (DAG).

RESULTS AND DISCUSSION

Weed flora in the experimental field

The weeds which were dominant in trials field are *Echinichloa sp. Panicum repens, Leptochloa chinensis, Brachiaria mutica, Digitaria sanguinalis* among grasses, *Eclipta alba*, *Ludwigia parviflora* and *Commelina communis* as broad leaf weeds and *Cyperus sp.* as sedge

Weed density

Grassy weeds: The data on weed density is presented in table 1 and 2. Results revealed that, all the weed management treatments were significantly reduced grassy weeds populations as compared to Oxyfluorfen 23.5% EC @ 240 g a.i./ha and weedy check in *Kharif* 2015 and *Summer* 2016 when observed at 45 DAS in direct seeded rice. Among the herbicidal treatments, application of Propanil 80% DF @ 4 kg a.i./ha was on par with Propanil 80% DF @ 3 kg a.i./ha and twice hand weeded check, found to be significantly superior treatments with recorded lowest population of grassy weeds i.e. *Echinochloa spp. (E. colona, E. crusgalli), Panicum repens, Leptochloa chinensis, Brachiaria mutica* and *Digitaria sanguinalis* at 45 DAS. Further, application of Propanil 80% DF @ 2 kg a.i./ha was the next treatment in terms of controlling grassy weeds after Oxyfluorfen 23.5% EC @ 240 g a.i./ha. These results are conformity with the findings of **Amarasinghe and Marambe (1998).**

Broad leaf weeds: The data on density of broad leaf weeds recorded in *Kharif* 2015 and *Summer* 2016 at 45 DAS in direct seeded rice mentioned in table 1 and 2. Results revealed that, among weed management treatments, application of Propanil 80% DF @ 4 kg a.i./ha, 3 kg a.i./ha, and twice hand weeded check were found superior over Propanil 80% DF @ 2 kg a.i./ha and rest of the treatments. Standard check, Cyhalofop

butyl 10% EC @ 80 g a.i./ha were failed to control broad leaf weeds effectively in direct seeded rice compared to rest of the treatments. These results are conformity with the findings of **Amarasinghe and Marambe (1998).**

Sedges: The data on density of sedges recorded in *Kharif* 2015 and *Summer* 2016 at 45 DAS in direct seeded rice are mentioned in table 1 and 2. Results revealed that, application of Propanil 80% DF @ 4 kg a.i./ha and twice hand weeded check were found superior over Propanil 80% DF @ 3 kg a.i./ha and rest of the treatments. However, application of Oxyfluorfen 23.5% EC @ 240 g a.i./ha and Cyhalofop butyl 10% EC @ 80 g a.i./ha were on par with each other in controlling the sedges. Similar finding also reported by **Amarasinghe and Marambe (1998).**

Dry weight of weeds

The data on dry weight of weeds is presented in table 3. Results revealed that all the weed management treatments were significantly reduced total dry weight of grassy weeds, broad leaf weeds and sedges as compared to weedy check in *Kharif* 2015 and *Summer* 2016 when observed at 45 DAS in direct seeded rice. Among the herbicidal treatments, application of Propanil 80% DF @ 4 kg a.i/ha, 3 kg a.i./ha and twice hand weeded check recorded significantly higher dry weight of weeds over the application of Propanil 80% DF @ 2 kg a.i./ha and rest of the treatments except Oxyfluorfen 23.5% EC @ 240 g a.i./ha. Similarly, application of Propanil 80% DF @ 4, 3 and 2 kg a.i//ha doses were recorded least dry weight. These results are conformity with the findings of **Abeysekera (1999)** stated that, application of tank mixture of quichlorac @ 50 g/ha + propanil @ 1.08 kg/ha controlled effectively the grassy weeds and recorded lower dry weight in wet seeded rice in mid country region of Srilanka. Whereas, higher dry weight of grassy weeds was observed in weedy check treatment. This might be due high weed infestation (Table 1).

.**Weed control efficiency (WCE)**

The data on weed control efficiency is presented in table 3. Results revealed that, all the weed management treatments are significantly recorded higher weed control efficiency as compared to weedy check in *Kharif* 2015 and *Summer* 2016 when observed at 45 DAS in direct seeded rice. Among the herbicidal treatments, application of Propanil 80% DF @ 4 kg a.i/ha, 3 kg a.i./ha and twice hand weeded check were recorded significantly higher weed control efficiency over Propanil 80% DF @ 2 kg a.i./ha and rest of the treatments except Oxyfluorfen 23.5% EC @ 240 g a.i./ha. Further, application of Propanil 80% DF @ 4, 3 and 2 kg a.i//ha doses were recorded significantly least weed control efficiency. These results are conformity with the findings of **Amarasinghe *et al.* (1999)** stated that, application of quichlorac @ 500 g/ha recorded higher weed control efficiency in wet seeded rice in mid country region of Srilanka. Similarly, lower weed control efficiency was noticed in weedy check treatment (Table 2).

Effect of Propanil 80 % DF on grain yield of direct seeded rice and B:C ratio

Among the weed management treatments, Hand weeding at 15 and 45 days after sowing gave significantly higher grain yield over weedy check. However, application of Propanil 80% DF @ 4 kg a.i/ha was at par with its lower dose i.e. Propanil 80% DF @ 3 kg a.i./ha, found to be significantly superior and on par with recorded higher grain yield followed by twice hand weeding at 15 and 45 days after sowing. Moreover, maximum cost benefit ratio was observed in plots treated with Propanil 80% DF along with twice hand weeded check (Table 4). These results are conformity with the findings of **Abeysekera (1999)** stated that, application of tank mixture of quichlorac @ 50 g/ha + propanil @ 1.08 kg/ha

controlled effectively the grassy weeds in wet seeded rice and resulted in higher grain yield in mid country region of Srilanka. Similar results also reported by **Amarasinghe *et al.* (1999).** Whereas, lower grain and straw yield were recorded in weedy check plot. This is due to the higher infestation of weeds. **Seema, *et al,* (2015)** also stated that, higher grain yield of aerobic rice was recorded in weed control treatments over the un-weeded treatment.

Effect of Propanil 80% DF on succeeding Black gram Crop

The phytotoxicity effect on succeeding black gram in terms of leaf necrosis, chlorosis or wilting was observed at 7, 15 and 21 days after germination (DAG) at all dosages of Propanil 80% DF and other herbicides including untreated control. Results indicated that, there was no phytotoxicity effect (rating 0) noticed in all the plots in both the season (Table 5). Further there was no impact on germination of black gram seed which was sown after harvesting of paddy crop from Propanil 80% DF treated plot in both the season.

Conclusion

On the basis of field study, it can be concluded that, Propanil 80% DF @ 3 kg a.i./ha could be recommended for post-emergence application at 10 to 15 days after sowing of paddy crop to achieve effective control of: *Echinochloa spp. (E. colona, E. crusgalli), Panicum repens, Leptochloa chinensis, Brachiaria mutica* and *Digitaria sanguinalis* among grasses; *Eclipta alba, Ludwigia parviflora* and *Commelina communis* as broad leaf weeds and *Cyperus sp.* as sedge weeds. Further, it produces higher grain yield and benefit cost ratio due to effective control of grasses, sedges as well as broad leaf weeds in paddy crop.

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Table 1: Effect of weed control treatments on weed population (count/m^2) in DSR at 45 DAS (1st season-Kharif 2015)

Treatments	Grasses					Broad leaf weeds			Sedges
	Echinichloa sp.	*Panicum repens*	*Leptochloa chinensis*	*Brachiaria mutica*	*Digitaria sanguinalis*	*Eclipta alba*	*Ludwigia parviflora*	*Commelina communis*	*Cyperus sp.*
T_1: Propanil 80% DF @ 1.0 kg a.i/ha	2.00 (1.73)	1.33 (1.53)	1.33 (1.53)	1.00 (1.41)	1.67 (1.63)	1.33 (1.53)	2.00 (1.73)	3.30 (2.07)	7.67 (2.94)
T_2: Propanil 80% DF @ 2.0 kg a.i/ha	0.67 (1.29)	0.33 (1.15)	0.33 (1.15)	0.67 (1.29)	0.33 (1.15)	0.33 (1.15)	0.33 (1.15)	0.67 (1.29)	6.33 (2.71)
T_3: Propanil 80% DF @ 3.0 kg a.i/ha	0.33 (1.15)	0.00 (1.00)	0.00 (1.00)	0.33 (1.15)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	1.00 (1.41)	5.67 (2.58)
T_4: Propanil 80% DF @ 4.0 kg a.i/ha	0.00 (1.00)	0.33 (1.15)	0.00 (1.00)	0.00 (1.00)	0.33 (1.15)	0.00 (1.00)	0.33 (1.15)	0.67 (1.29)	6.33 (2.71)
T_5: Oxyfluorfen 23.5 % EC @ 240 g a.i./ha	6.33 (2.71)	4.33 (2.31)	3.33 (2.08)	4.33 (2.31)	3.33 (2.08)	1.00 (1.41)	3.67 (2.16)	2.33 (1.82)	4.33 (2.31)
T_6: Cyhalofop butyl 10 % EC @ 80 g a.i./ha	0.00 (1.00)	0.00 (1.00)	1.33 (1.53)	0.67 (1.29)	0.33 (1.15)	7.67 (2.94)	4.00 (2.24)	7.00 (2.83)	13.00 (3.74)
T_7: Hand weeding	0.00 (1.00)	0.00 (1.00)	0.33 (1.15)	0.67 (1.29)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	1.67 (1.63)
T_8: Weedy check	11.33 (3.51)	3.33 (2.08)	5.67 (2.58)	7.33 (2.89)	4.00 (2.24)	7.00 (2.83)	4.33 (2.31)	6.67 (2.77)	12.67 (3.70)
CD at 5%	**0.41**	**0.35**	**0.35**	**0.33**	**0.44**	**0.31**	**0.35**	**0.29**	**1.34**

Note: Figures in the parenthesis are square root transformed values (sq. root of x+1) **DAS:** Days after sowing

209 **Table 2: Effect of weed control treatments on weed population (count/m^2) in DSR at 45 DAS (2nd Season -summer 2016)**

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Treatments	Grasses					Broad leaf weeds			Sedges
	Echinichloa sp.	*Panicum repens*	*Leptochloa chinensis*	*Brachiaria mutica*	*Digitaria sanguinalis*	*Eclipta alba*	*Ludwigia parviflora*	*Commelina communis*	*Cyperus sp.*
T_1: Propanil 80% DF @ 1.0 kg a.i/ha	3.33 (2.08)	1.00 (1.41)	3.67 (2.16)	1.67 (1.63)	0.67 (1.29)	1.67 (1.63)	4.33 (2.31)	1.67 (1.63)	5.67 (2.58)
T_2: Propanil 80% DF @ 2.0 kg a.i/ha	1.00 (1.41)	0.00 (1.00)	1.33 (1.53)	0.67 (1.29)	0.33 (1.15)	1.00 (1.41)	1.00 (1.41)	0.67 (1.29)	4.00 (2.24)
T_3: Propanil 80% DF @ 3.0 kg a.i/ha	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	1.00 (1.41)	1.00 (1.41)	1.00 (1.41)	3.67 (2.16)
T_4: Propanil 80% DF @ 4.0 kg a.i/ha	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.33 (1.15)	0.67 (1.29)	1.00 (1.41)	3.33 (2.08)
T_5: Oxyfluorfen 23.5 % EC @ 240 g a.i./ha	4.67 (2.38)	1.67 (1.63)	3.30 (2.07)	3.00 (2.00)	1.67 (1.63)	2.00 (1.73)	2.33 (1.82)	2.00 (1.73)	5.33 (2.52)
T_6: Cyhalofop butyl 10 % EC @ 80 g a.i./ha	0.00 (1.00)	0.00 (1.00)	1.00 (1.41)	0.33 (1.15)	0.00 (1.00)	4.67 (2.38)	10.33 (3.37)	5.33 (2.52)	9.00 (3.16)
T_7: Hand weeding	0.00 (1.00)	0.33 (1.15)	0.00 (1.00)	0.00 (1.00)	0.33 (1.15)	0.00 (1.00)	0.00 (1.00)	1.00 (1.41)	1.00 (1.41)
T_8: Weedy check	8.33 (3.05)	2.67 (1.92)	7.33 (2.89)	4.67 (2.38)	2.00 (1.73)	5.67 (2.58)	9.67 (3.27)	4.67 (2.38)	8.33 (3.05)
CD at 5%	**0.51**	**0.34**	**0.63**	**0.40**	**0.23**	**0.25**	**0.48**	**0.20**	**0.34**

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212 **Note:** Figures in the parenthesis are square root transformed values (sq. root of x+1) **DAS:** Days after sowing

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Table 3: Assessment of weeds dry weights (g/m^2) from different herbicidal treatments in DSR at 45 DAS

Treatments	Weed dry weight (g/m^2)									
	Grasses		BLW		Sedges		Total		WCE (%)	
	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016
T_1: Propanil 80% DF @ 1.0 kg a.i/ha	6.34	6.88	4.96	4.70	5.41	3.75	16.72	15.34	62.93	57.48
T_2: Propanil 80% DF @ 2.0 kg a.i/ha	3.26	2.71	1.36	1.67	4.30	2.50	8.93	6.88	82.42	80.92
T_3: Propanil 80% DF @ 3.0 kg a.i/ha	2.03	1.04	0.90	2.08	4.08	1.97	7.02	5.10	84.44	85.87
T_4: Propanil 80% DF @ 4.0 kg a.i/ha	1.58	1.03	1.11	1.75	3.98	2.08	6.67	4.86	85.20	86.52
T_5: Oxyflourfen 23.5 % EC @ 240 g a.i./ha	15.63	9.78	5.90	4.38	2.94	3.33	24.47	17.49	45.74	51.51
T_6: Cyhalofop butyl 10 % EC @ 80 g a.i./ha	3.85	1.46	12.70	15.03	8.84	8.57	25.38	25.06	43.72	30.51
T_7: Hand weeding	1.81	2.72	1.24	0.75	2.04	1.17	5.09	4.64	88.72	87.13
T_8: Weedy check	21.76	17.52	14.50	12.30	8.84	6.26	45.10	36.07	--	--
CD at 5%	**1.43**	**1.68**	**1.77**	**2.04**	**1.88**	**1.10**	**3.24**	**4.58**	--	--

DAS: Days after sowing

Table 4: Effect of Propanil 80% DF on the grain yield of Direct seeded rice

Treatments	Grain Yield (q/ha)*		C:B ratio	
	2015	2016	2015	2016
T_1: Propanil 80% DF @ 1.0 kg a.i/ha	57.38	52.3	1:1.15	1:1.35
T_2: Propanil 80% DF @ 2.0 kg a.i/ha	60.88	58.12	1:1.98	1:1.84
T_3: Propanil 80% DF @ 3.0 kg a.i/ha	62.48	58.90	1:2.23	1:2.41
T_4: Propanil 80% DF @ 4.0 kg a.i/ha	62.12	59.12	1:2.19	1:2.34
T_5: Oxyfluorfen 23.5 % EC @ 240 g a.i./ha	56.61	49.43	1:0.92	1:1.05
T_6: Cyhalofop butyl 10 % EC @ 80 g a.i./ha	55.35	50.12	1:1.05	1:1.33
T_7: Hand weeding	60.21	58.11	1:2.00	1:2.33
T_8: Weedy check	51.67	45.62	1:0.68	1:0.82
CD (P=0.05)	**4.10**	**5.41**	-	-

*Mean of 3 replications

Table 5: Phytotoxicity effect on growth parameters of succeeding crop black gram as influenced by the application of Propanil 80% DF (Mean data of 2015 and 2016)

Treatments	Phytotoxic effect (%)*			Germination percent
	7 DAG	15 DAG	21 DAG	
T_1: Propanil 80% DF @ 1.0 kg a.i/ha	0.0	0.0	0.0	93.0
T_2: Propanil 80% DF @ 2.0 kg a.i/ha	0.0	0.0	0.0	92.0
T_3: Propanil 80% DF @ 3.0 kg a.i/ha	0.0	0.0	0.0	93.6
T_4: Propanil 80% DF @ 4.0 kg a.i/ha	0.0	0.0	0.0	92.0
T_5: Oxyfluorfen 23.5 % EC @ 240 g a.i./ha	0.0	0.0	0.0	91.6
T_6: Cyhalofop butyl 10 % EC @ 80 g a.i./ha	0.0	0.0	0.0	92.6
T_7: Untreated	0.0	0.0	0.0	93.6

*Mean of 3 replications DAG: Days after germination