Indian Journal of Weed Science **50**(1): 18–21, 2018

Print ISSN 0253-8040 Online ISSN 0974-8164

Efficacy of propanil for the mixed weed flora in direct-seeded rice

Tej Pratap* and Rekha

Department of Agronomy College of Agriculture, G.B. Pant University of Agriculture & Technology Pantnagar, Uttarakhand 263145

**Email: drtpsingh2010@gmail.com*

Article information

DOI: 10.5958/0974-8164.2018.00004.7

Type of article: Research article

Received : 21 December 2017
Revised : 2 February 2018
Accepted : 11 February 2018

Key words

Direct-seeded rice
Grain yield
Propanil
Weeds

ABSTRACT

A field experiment was carried out at G.B. Pant University of Agriculture and Technology, Pantnagar, U.S. Nagar, Uttarakhand during rainy season of 2015 and 2016 to evaluate the efficacy of propanil 80% WG against mixed weed flora in direct-seeded rice. The most dominant weeds were: *Echinochloa colona, Echinochloa crus-galli, Leptochloa chinensis, Eleusine indica* and *Digitaria sanguinalis* among grassy weeds; Celosia argentea as broad-leaved weed and *Cyperus* spp. as sedge. Results revealed that propanil 4000 g/ha being on a par with 3000 g/ha was found most effective for controlling grassy as well as broad-leaved weeds as compared to other herbicidal treatments. The lowest weed biomass (11.9 g/m2) and the highest weed control efficiency (73.6%) were also recorded with this treatment. Propanil 4000 g/ha being on a par with 3000 g/h recorded maximum grain yield (4.6 t/ha) which was superior to rest of the herbicidal treatments.

INTRODUCTION

Rice (*Oryza sativa* L.) is the leading cereal of the world, and more than half of the human race depends on rice for their daily sustenance (Chauhan and Johnson 2011). It is grown in an area of 43.95 million ha annually with a production of 104.80 mt, with an average productivity of 2.4 t/ha in India (GoI 2015). The crop is conventionally grown by transplanting in puddled soil with continuous flooding. However, this method requires huge amount of water, labour and energy for land preparation, nursery raising, transplanting and weeding leading to high cost of cultivation. Furthermore, puddling also affects soil health due to the dispersion of soil particles, soil becoming compact and making tillage operations difficult requiring more energy in succeeding crops such as wheat (Singh *et al.* 2002 Hobbs *et al.* 2002). An alternative to puddling and transplanting could be aerobic direct seeding because it requires less inputs in term of water, labour and capital.

The direct-seeded crop also matures earlier (7-10 days) than the transplanted crop, thus allowing timely planting of the succeeding wheat crop (Giri1988, Singh *et al.* 2006). However, weed management is the major challenge in direct-seeded rice (DSR). DSR systems are subjected to much higher weed pressure than puddled transplanted rice (PTR) system (Rao *et al.* 2007) in which weeds are suppressed by first puddling, standing water and transplanted rice seedlings, that provide 'head start' over germinating weed seedlings. In DSR, weeds emerge simultaneously with crop seedlings and grow more quickly in moist soil than in PTR (Khaliq and Matloob 2011) resulting in severe competition for resources to the crop. Therefore, weeds present in the field are main biological constraint to the success of DSR and failure to control of weeds result in yield losses ranging from 50 to 90% (Chauhan and Opena 2012). The traditional methods of weed control in rice include handweeding by hoe or hand pulling but this is becoming less common because of labour scarcity at critical period of weeding and increasing labour costs (Chauhan 2012, Kumar and Ladha 2011). Moreover, seedlings of some grassy weeds such as *Echinochloa crus-galli* (L.) look similar to rice seedlings making hand weeding more tedious and highly labour intensive. Farmer's are very often failing to remove weeds due to un-availability of labours at peak periods. However, adoption of DSR technology usually leads to shift in weed flora composition towards difficult-to-control weeds (Singh *et al.* 2013). In this situation, use of herbicides is becoming more popular in DSR because they are more effective, easy to apply, provide selective control and economical (Walia *et al.* 2012).Keeping this in view, the present investigation was carried out to find out the appropriate dose of propanil 80% WG against mixed weed flora and higher yield of direct-seeded rice.

MATERIALS AND METHODS

A field experiment was conducted during rainy season of 2015 and 2016 at G.B. Pant University of Agriculture & Technology, Pantnagar to evaluate the bio-efficacy of propanil 80% WG as post-emergence against mixed weed flora in direct seeded rice. The soil of the experimental site was silty clay loam in texture, medium in organic carbon (0.66%), available phosphorus (27.5 kg/ha) and potassium (243.5 kg/ha) with pH 7.3. Treatments consisted of four doses of propanil 80% WG, *viz*; 1000, 2000, 3000 and 4000 g /ha, oxyflurofen 23.5% EC 240 g/ha and cyhalofop-butyl 10% EC 80 g/ha as standard checks as well as twice hand weeding at 15 and 30 DAS and weedy check. The treatments were laid out in a randomized block design with three replications. All the doses of propanil 80% WG were applied at 12 days after sowing (DAS). However, standard checks, oxyfluorfen 23.5% EC and cyhalofop-butyl 10% EC were applied at two days after sowing with the help of knapsack sprayer fitted with flat-fan nozzle by using 375 litre water/ha. Observations on weed density and weed biomass were recorded at 45 and 75 days after application of treatments. Data pertaining to density and dry weed biomass were subjected to square root transformation ($\sqrt{x+1}$) prior to statistical analysis because big variations were recorded in the data of weed density and weed biomass. Finally weed control efficiency was calculated on the basis of weed biomass recorded at 45 and 75 days after application. Yield attributes and yield (t/ha) of rice were recorded at the time of harvesting. Since propanil 80% WG was the testing molecule and it is not available in the local market, therefore, its sale price is not known. Thus economic analysis part of this research article could not be included.

RESULTS AND DISCUSSION

Effect on weed density

Common weed species infesting the experimental site during both the years were *Echinochloa colona*, *Echinochloa crus-galli*, *Eleusine indica* and *Digitaria sanguinalis* among grasses, *Celosia argentea* as broad leaf weed and *Cyperus* spp. as sedge (**Table 1** and **2**). Among different categories of weeds, sedge was recorded in higher density followed by grassy and broad-leaf weeds at 45 and 75 days after application (DAA) (**Table 1** and **2**). During both the years, density and weed dry biomass at 45 and 75 DAA were significantly reduced by all the weed control treatments over the weedy check. Application of propanil 4000 g/ha being at par with its lower dose 3000 g/ha caused significant reduction in the density of grassy weeds, *viz. E. colona, E. crus-galli, L. chinensis* and *D. sanguinalis* as compared to rest of the herbicidal treatments. The lowest density of *C. argenta* was also recorded with propanil 4000 and 3000 g/ha at 45 and 75 DAA over rest of the herbicidal treatments. All the herbicidal treatments controlled the density of *C. argentea* except cyhalofop-butyl 80 g/ha. All the herbicidal treatments were on a par with each other in reducing the density of *Cyperus* spp. At 45 and 75 DAA, total weed density was significantly reduced by propanil 4000 g/ha which was at par with its lower dose 3000 g/ha and significantly lower than rest of the herbicidal treatments. The effective control of weeds by

Table 1. Weed density as influenced by propanil at 45 DAA in direct-seeded rice (pooled data of 2015 and 2016)

Treatment	Weed density at 45 DAA (no./m^2)							
	E. *colona*	*E. crus-galli*	*E. indica*	*L. chinensis*	*D. sanguinalis*	*C. argentea*	*Cyperus* spp.	Total
Propanil (1000 g/ha)	3.7(12.0)	3.1(8.7)	3.3(10.0)	3.3(10.0)	2.1(4.0)	3.3(10.0)	5.0(27.3)	9.1(82.0)
Propanil (2000 g/ha)	3.4(11.2)	2.9(7.3)	2.8(7.3)	2.7(6.7)	1.8(2.7)	2.8(7.3)	4.9(23.3)	8.0(65.8)
Propanil (3000 g/ha)	2.8(7.2)	2.0(3.3)	2.3(4.7)	1.8(3.3)	1.4(1.3)	2.1(4.0)	4.3(18.0)	6.4(42.0)
Propanil (4000 g/ha)	2.3(4.8)	1.6(2.0)	1.7(2.7)	1.4(1.3)	1.2(0.7)	1.6(2.0)	4.0(15.3)	5.3(28.7)
Oxyflourfen (240 g/ha)	3.3(9.6)	3.9(16.7)	2.9(7.3)	2.7(6.7)	2.7(7.3)	4.0(15.3)	5.3(28.0)	9.5(90.9)
Cyhalofop-butyl (80 g/ha)	4.5(19.2)	5.2(30.7)	3.8(14.7)	2.8(8.0)	2.8(7.3)	5.2(26.0)	5.4(29.3)	11.6(135.2)
Hand weeding at 15 and 30 DAS	2.1(4.0)	1.8(2.7)	1.6(2.0)	1.0(0.0)	1.0(0.0)	1.7(2.7)	2.7(9.3)	4.0(20.7)
Weedy check	6.1(39.2)	7.0(48.7)	4.8(22.0)	8.9(80.0)	4.3(18.0)	6.7(56.0)	6.0(36.0)	17.3(299.9)
LSD (p=0.05)	0.5	0.8	0.3	0.8	0.3	0.5	1.5	0.4

Values within parentheses are original. Data are subjected to square root transformation ($\sqrt{x+1}$) DAA-Days after application

Table 2. Weed density as influenced by propanil at 75 DAA in direct-seeded rice (pooled data of 2015 and 2016)

Treatment	Weed density at 75 DAA (no./m^2)								
	Dose g/ha	*E. colona*	*E. crus-galli*	*E. indica*	*L. chinensis*	*D. sanguinalis*	*C. argentea*	*Cyperus* spp.	Total
Propanil (1000 g/ha)	1000	3.3(10.7)	2.9(8.0)	2.9(8.0)	3.0(8.0)	2.2(4.0)	3.1(8.7)	4.6(24.0)	8.4(71.4)
Propanil (2000 g/ha)	2000	2.8(8.0)	2.6(6.0)	2.5(6.0)	2.6(6.0)	1.6(2.0)	2.6(6.0)	4.5(19.3)	7.3(53.3)
Propanil (3000 g/ha)	3000	2.0(4.0)	1.8(2.7)	1.6(2.0)	1.5(2.0)	1.0(0.0)	1.8(2.7)	3.9(14.7)	5.3(28.1)
Propanil (4000 g/ha)	4000	1.6(2.0)	1.2(0.7)	1.0(0.0)	1.2(0.7)	1.0(0.0)	1.0(0.0)	3.2(9.3)	3.6(12.7)
Oxyflourfen (240 g/ha)	240	3.3(10.0)	3.8(16.0)	2.6(6.0)	2.9(8.0)	2.8(11.3)	3.8(14.0)	5.0(25.3)	9.5(90.6)
Cyhalofop butyl (80 g/ha)	80	4.2(16.7)	4.3(23.3)	2.8(7.3)	2.9(8.0)	2.4(5.3)	4.9(23.3)	5.1(26.0)	10.4(109.9)
Hand weeding at 15 & 30 DAS	-	1.5(2.0)	1.2(0.7)	1.0(0.0)	1.2(0.7)	1.0(0.0)	1.6(3.3)	1.7(2.7)	3.1(9.4)
Weedy check	-	6.0(36.7)	6.3(40.0)	4.2(17.3)	6.4(42.7)	4.4(19.3)	8.1(73.3)	5.7(32.0)	16.1(261.3)
LSD (p=0.05)	-	0.7	0.4	0.7	0.9	0.5	0.6	2.0	1.7

Table 3.Weed dry weight and WCE as influenced by propanil at 45 and 75 DAA in direct-seeded rice (pooled data of 2015 and 2016)

Treatment	Weed dry weight (g/m^2)									
	45 DAA				WCE	75 DAA				WCE
	Grasses	BLW	Sedges	Total	(%)	Grasses	BLW	Sedges	Total	(%)
Propanil (1000 g/ha)	8.5(72)	3.8(14)	9.9(99)	13.6(186)	65.2	10.2(104)	4.0(16.1)	10.9(120)	15.5(240)	55.3
Propanil (2000 g/ha)	8.4(71)	3.2(10)	9.5(90)	13.0(171)	68.0	9.9(98)	3.6(13.2)	10.9(118)	15.2(230)	57.1
Propanil (3000 g/ha)	6.0(37)	2.3(5)	8.6(87)	11.3(129)	75.9	7.5(57)	2.6(6.9)	10.2(103)	12.9(167)	68.9
Propanil (4000 g/ha)	5.6(31)	1.8(3)	8.9(80)	10.7(115)	78.6	6.7(45)	2.0(4.2)	9.6(93)	11.9(142)	73.6
Oxyflourfen (240 g/ha)	9.8(97)	7.6(58)	10.1(102)	16.1(258)	51.6	12.1(147)	6.7(44.4)	11.5(133)	18.0(324)	39.6
Cyhalofop butyl (80 g/ha)	11.6(134)	5.4(29)	9.9(99)	16.2(262)	50.9	12.7(162)	6.0(36.2)	12.4(153)	18.7(351)	34.5
Hand weeding at 15&30 DAS	4.8(23)	2.3(5)	5.5(30)	7.6(58)	89.1	4.8(23)	3.1(9.65)	7.8(61)	9.7(94)	82.5
Weedy check	13.2(174)	4.9(24)	18.4(337)	23.1(535)	-	14.1(200)	8.1(65.9)	16.5(271)	23.2(537)	-
LSD (p=0.05)	2.1	0.7	1.2	1.5	-	1.9	0.8	0.7	0.8	-

Values within parentheses are original. Data are subjected to square root transformation ($\sqrt{x+1}$) DAA-Days after application

propanil can be explained by its mode of action as it is an inhibitor of photosynthesis at photosytem II by binding to D1 proteins of the photosystem II complex in chloroplast thylakoid membrane. Thus, herbicide bind at this protein which blocks electron transport and stops CO_2 fixation and production of energy needed for plant growth. Blocking electron transport in PS II systems promotes the formation of highly reactive molecules that initiate a chain of reactions causing lipid and protein membrane destruction resulted in membrane leakage allowing cells and cell organelles to dry and rapidly disintegrate. Significantly the lowest biomass of grassy and broad leaf weeds and the highest weed control efficiency (78.6 and 73.6%) were recorded with propanil 4000 g/ha which was on a par with its lower dose of 3000 g/ha and statistically superior over rest of the herbicidal treatments at both the stages of observations (**Table 3**). Among the herbicidal treatments, the maximum total dry weed mass and the lowest weed control efficiency was recorded with oxyfluorfen 240 g/ha and cyhalofop-butyl 80 g/ ha. Similar results were also reported by Harding *et al.* (2012).

Table 4. Effect of propanil 80% WG on yield attributing characters and yield of direct-seeded rice (pooled data of 2015 and 2016)

Treatment	No. of tillers /m^2	No. of grains/ panicle	Wt. of grains/ panicle (g)	1000-grain wt. (g)	Yield (t/ha)
Propanil (1000 g/ha)	193	100.8	1.7	21.9	2.8
Propanil (2000 g/ha)	213	105.0	2.5	22.1	3.1
Propanil (3000 g/ha)	243	115.9	3.0	23.9	4.4
Propanil (4000 g/ha)	258	116.5	3.1	24.6	4.6
Oxyflourfen (240 g/ha)	177	93.0	0.4	21.0	3.5
Cyhalofop butyl (80 g/ha)	163	91.5	0.3	21.2	2.4
Hand weeding at 15&30 DAS	263	120.0	2.9	24.2	4.3
Weedy check	57.3	42.5	1.6	19.2	1.7
LSD (p=0.05)	16.9	9.6	0.3	1.5	1.1

DAA-Days after application

Effect on crop

Pooled data revealed that average number of tillers/m^2, number of grains/panicle, weight of grains/ panicle; 1000-grain weight and grain yield were improved significantly by all the herbicidal treatments over weedy check (**Table 4**). These yield attributes were superior in plots treated with propanil 4000 g/ha (closely followed by its lower dose 3000 g/ha) as compared to rest of the herbicidal treatments. Among the herbicidal treatments, the highest grain yield of rice (4.6 t/ha) was recorded with propanil 4000 g/ha being on a par with its lower dose of 3000 g/ha and twice hand weeding at 15 and 30 DAS. On an average, uncontrolled weeds in weedy check plots caused yield reduction to the extent of 63.0 and 61.4 % when compared with propanil 4000 and 3000 g/ha. The lowest grain yield of 2.4 t/ha was recorded with cyhalofop-butyl 80 g/ha as compared to rest of the herbicidal treatments. These results are also in conformity with the findings of Abbassi *et al*. (2012).

On the basis of two years study, it can be inferred that post-emergence application of propanil 3000 g/ha could be a standard dose in direct-seeded rice for effective control of weeds and higher grain yield.

REFERENCES

Abbassi SJ, Yaaghoubi B, Baghestani MA, Majidi Fd. 2012. Effect evaluation of rice (*Oryza sativa* L.) general herbicide on yield and yield component in intermission flooded conditions. *International Research Journal of Applied and Basic Sciences* **3**: 450–460

Chauhan BS. 2012. Weed ecology and weed management strategies for dry-seeded rice in Asia. *Weed Technology* **26**: 1–13.

Chauhan BS and Johnson DE. 2011. Growth response of direct seeded rice to oxadiazon and bispyribac-sodium in aerobic and saturated soils. *Weed Science* **59**: 119–122.

Chauhan BS and Opena J. 2012. Effect of tillage systems and herbicides on weed emergence, weed growth, and grain yield in dry-seeded rice systems. *Field Crops Research* **137**: 56–69.

Giri GS. 1998. Effect of rice and wheat establishment techniques on wheat grain yield. pp. 65–68. In: *Proceedings of Rice-Wheat Research Project Workshop*. Eds. Hobbs PR and Bhandari Raj. India.

GoI. 2015. Government of India, Ministry of Agriculture, Department of Agriculture & Cooperation, Directorate of Economics & Statistics. pp. 84-85.

Harding SS, Taylor DR, Jalloh AB, Mahmood N, Dixon CA, Johnson SD. 2012. Evaluation of the Efficacy of different rates of herbicides on weed growth and grain yield of two rice varieties in two rice ecologies in sierra leone. *American Journal of Experimental Agriculture* **4**: 607-615.

Hobbs PR, Singh Y, Giri GS, Lauran JG and Duxbery JM. 2002. Direct-seeding and reduced tillage options in the rice-wheat systems of the Indo-gangetic plains of South Asia. pp. 201-215. In. *Direct-seeding in Asian Rice systems. Strategic Research Issues and Opportunities*. (Eds. Pandey S, Mortimer M, Wade L, Tuong TP and Hardy B). International Rice Research Institute, Philippines.

Khaliq A and Matloob A. 2011. Weed crop competition period in three fine rice cultivars under direct-seeded rice culture. *Pakistan Journal of Weed Science Research* **17**: 229–243.

Kumar V and Ladha JK. 2011. Direct-seeding of rice: Recent developments and future research needs. *Advance in Agronomy* **111**: 297–413.

Rao AN, Johnson DE, Sivaprasad B, Ladha JK and Mortimer AM. 2007.Weed management in direct-seeded rice. *Advances in Agronomy* **93**: 153–255.

Singh YG, Singh VP, Singh P, Shrivastava RSI, Saxena A, Mortimer M, Johnson DE and White JL. 2002. Effect of different establishment methods on rice-wheat and the implication of weed management in Indo-Gangetic Plains. pp. 188–192. In: *Proceedings of the International Workshop on Herbicide Resistance Management and Zero Tillage in Rice-Wheat Cropping System*, 4-6 March 2002. Department of Agronomy, CCS Haryana Agricultural University, Hisar, India.

Singh S, Bhusan L, Ladha KK, Gupta RK, Rao AN and Sivprasad B. 2006. Weed management in dry-seeded rice (*Oryzasativa* L.) cultivated on furrow irrigated raised bed planting system. *Crop Protection* **25**: 487–495.

Singh VP, Singh SP, Dhyani VC, Tripathi N, Banga A, Yadav VR.2013.Effect of establishment methods on shifting of weed flora in rice-wheat cropping system. p. 494. In: *Proceeding 24th Asian-Pacific Weed Science Society Conference"* October 22-25, 2013 Bandung, Indonesia.

Walia US. Walia SS, Sidhu AS and Nayyar S. 2012. Bioefficcay of pre- and post-emergence herbicides in direct-seeded rice in Central Punjab. *India Journal of Weed Science* **44**: 30–33.