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Effect of Herbicides on Dry Seeded Rice *(Oryza sativa* L.) and Associated Weeds

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In India irrigated, upland, rainfed low lands and deep water rice occupy 20.5, 6.0, 13.0 and 4.0 m ha area producing 60.0, 5.5, 16.0 and 3.0 mt with 2.9, 0.9, 1.2 and 0.8 t ha^{-1} productivity, respectively (Singh, 2002). Direct seeding of rice is labour saving, ensures timely sowing and early maturity of the crop, reduces accumulation of toxic substances and improves soil physical conditions for the following crop with less emission of methane (Mohanty *et al.,* 2001). The key issue with this system is the management of weeds like *Echinochloa* spp., *Cyperus* spp., etc. The extent of yield loss due to weeds in direct seeded rice varied from 40-100% (Choubey *et al.,* 2001). Weed control in direct seeded rice can be accomplished by cultural and mechanical methods, which are labour intensive and reduce the benefit : cost ratio. Chemical method of weed control may be best suited as it can take care of weeds right from the beginning of crop growth. Keeping this in view, the present study was undertaken to find out the effective doses and stage of application of various herbicides.

A field experiment was conducted in the D_2 block at Crop Research Centre, GBPUA & T, Pantnagar, district U. S. Nagar, Uttaranchal, during **kharif** season of 2002. The soil of the experimental site was loam in texture with pH 7.6. The treatments consisted of cyhalofopbutyl at 80, 100, 120 g ha^{-1}, quinclorac at 125, 187.5, 250 g ha^{-1}, clefoxydim at 50,75,100 g ha^{-1}, all applied at 15 DAS; pretilachlor at 0.5, 0.75, 1.0 kg ha^{-1} and pendimethalin at 1.0 kg ha^{-1}, both applied at 2 DAS, compared with weedy and weed-free checks. The experiment was laid out in randomized block design replicated three times. Herbicides were applied at spray volume of 600 l ha^{-1}. Rice variety Sarjoo 52 at 50 kg seed ha^{-1} was sown in rows 20 cm apart during the third week of June.

The weed species infesting the experimental plot were *Echinochloa colona* (30.8%), *E. crusgalli* (15.8%), *Caesulia axillaris* (10.3%), *Ischaemum rugosum* (26.4%), *Commelina diffusa* (7.6) and others (8.9%). The highest density of weeds in weedy check was recorded at 60 days stage (Table 1), thereafter; it decreased subsequently at later stages of crop growth. Weed emergence was highest during first 0-30 days stage (84.6%). The highest doses of cyhalofopbutyl, quinclorac and clefoxydim were more effective than their lower doses in reducing the density and dry weight of weeds. Application of pretilachlor at 1.0 kg ha^{-1} had less weed density and dry weight than other herbicides.

Total weed dry matter production was recorded highest at harvesting stage in weedy check (Table 1). Highest rate of dry matter production (18.0 g m^{-2} day^{-1}) was during 30-60 days stage and during this period there would have been severe crop-weed competition.

The highest grain yield (6281 kg ha^{-1}) was recorded in weed-free treatment and lowest in weedy check (85 kg ha^{-1}). Uncontrolled weed growth caused 98.6% reduction in grain yield of rice, which was due to more crop-weed competition in weedy plots than rest of the treatments. Pendimethalin at 1.0 kg ha^{-1} produced significantly more grain yield than other herbicidal treatments. Cyhalofopbutyl at 120 g ha^{-1}, quinclorac at 250 g ha^{-1} and pretilachlor at 1.0 kg ha^{-1} were at par with each other with respect to grain yield. Clefoxydim at 100 g ha^{-1} was superior to clefoxydim at 50 and 75 g ha^{-1} with respect to grain yield.

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Table 1. Effect of treatments on total weed density (No. m^{-2}), total dry matter of weeds (g m^{-2}) and grain yield at different stages of crop growth

Treatment (g ha^{-1})	Stage of application (DAS)	Weed density stages (DAS)				Weed dry matter stages (DAS)				Grain yield (kg ha^{-1})
		30	60	90	Harvest	30	60	90	Harvest	
Cyhalofopbutyl (80)	15	3.70 (42)	4.39 (81)	3.62 (37)	3.49 (32)	3.18 (23.6)	5.18 (198)	6.37 (588)	6.57 (720)	1227
Cyhalofopbutyl (100)	15	3.56 (35)	3.72 (41)	3.39 (29)	3.31 (27)	2.97 (20.6)	5.03 (155)	5.50 (247)	6.30 (557)	1712
Cyhalofopbutyl (120)	15	3.21 (24)	3.31 (27)	3.21 (24)	2.65 (13)	2.64 (13.4)	4.56 (94.7)	5.10 (165)	5.51 (248)	3509
Quinclorac (125)	15	3.59 (36)	3.67 (39)	3.41 (29)	3.44 (30)	3.07 (22.6)	5.20 (182)	6.18 (487)	6.08 (445)	896
Quinclorac (187.5)	15	3.41 (29)	3.31 (27)	3.30 (27)	3.36 (28)	2.76 (18.3)	4.92 (137)	5.50 (247)	5.99 (401)	2331
Quinclorac (250)	15	3.04 (19)	2.97 (19)	3.03 (20)	2.12 (8)	2.39 (12.9)	4.58 (98.4)	5.15 (176)	4.79 (120)	3163
Clefoxydim (50)	15	3.75 (43)	3.86 (47)	3.67 (39)	3.44 (32)	3.97 (54.1)	6.40 (603)	6.37 (596)	6.81 (915)	831
Clefoxydim (75)	15	3.49 (32)	3.60 (36)	3.36 (28)	3.30 (27)	3.35 (28.7)	5.36 (214)	5.95 (394)	6.53 (692)	875
Clefoxydim (100)	15	3.03 (20)	3.19 (24)	2.81 (16)	2.72 (15)	2.43 (11.7)	5.12 (168)	5.65 (293)	5.90 (367)	2331
Pretilachlor (500)	2	3.57 (36)	3.98 (53)	3.39 (29)	2.99 (20)	2.42 (14.9)	5.39 (221)	6.29 (540)	6.71 (830)	2237
Pretilachlor (750)	2	3.08 (21)	3.73 (41)	3.03 (20)	2.81 (16)	2.29 (9.9)	4.59 (102)	5.85 (350)	6.43 (625)	2366
Pretilachlor (1000)	2	2.65 (13)	2.87 (17)	2.74 (15)	2.31 (9)	1.95 (7.0)	4.49 (93)	5.34 (210)	5.89 (363)	3133
Pendimethalin (1000)	2	2.88 (17)	3.21 (24)	3.21 (24)	2.44 (11)	2.10 (8.5)	4.27 (70.7)	4.71 (111)	3.95 (52.2)	5405
Weed-free	-	0	0	0	0	0	0	0	0	6281
Weedy	-	4.35 (77)	4.51 (91)	3.80 (44)	3.68 (40)	4.39 (80.5)	6.43 (621)	6.70 (824)	7.08 (1198)	85
C. D. at 5%	-	0.34	0.28	0.29	0.42	1.01	0.39	0.30	0.21	750

*Original values are given in parentheses by (x+1) transformation before analysis; DAS–Days after sowing.