

## Chemical Control of Water Hyacinth (*Eichhornia crassipes*) in Natural Water Bodies

Dharam Bir Yadav and Ashok Yadav

CCS Haryana Agricultural University Regional Research Station, Karnal-132 001 (Haryana), India

Water hyacinth [*Eichhornia crassipes* (Mart.) Solms.] is a serious weed infesting most of the water bodies in India. It hinders the day-to-day activities in the water bodies and affects aesthetic value and the aquatic life as well. Under heavy infestation, water bodies are rendered unfit for use by animals and fish farming turns uneconomic. Mechanical or manual weeding is cumbersome and bulbs left in the soil again regenerate (Gopal, 1987). Herbicides could be suitable alternative to discourage or eliminate its regeneration. However, there is growing need for suitable herbicide(s) with no harmful effects to aquatic life. Hence, present study was undertaken to find out the suitable herbicide(s) for effective management of this menace weed. A multi-locational experiment was conducted in district Karnal, Haryana, India during 2007, 2008 and 2009 to evaluate different herbicides against *E. crassipes* in various community ponds/road-side ditches. Different herbicidal treatments along with untreated check were employed against this weed at three locations (Uchani, Sagga and Ror Majra). The experiment was conducted in randomized block design with three locations each serving as one replication. The plot size was 5.0 x 5.0 m. Herbicides were sprayed at active vegetative stage of the weed (completely covering the water surface) on 24 July 2007, 26 July 2008 and 5 August 2009 with knapsack sprayer fitted with hollow cone nozzle using a spray volume of 1000 l/ha. For spraying the plots from outside banks of water bodies, a lance of longer length was installed on the spray pump. Barriers of rope nets were used to mark the plots and also to discourage the possible movement of weed. Besides this a buffer of 1.5 m was also kept after each plot. Based on the results achieved in the first year, few treatments were modified in the succeeding years. Per cent weed control using 0-100 scale (where, 0=no mortality and 100= complete mortality) was recorded at 30, 45 and 60 days after treatment (DAT).

Among the herbicidal treatments, 2, 4-D amine, 2, 4-D ester, 2, 4-D Na-salt and paraquat were found very effective against *E. crassipes* in all the three years (Table 1). During 2007, the maximum control was provided by 2, 4-D amine followed by 2, 4-D ester, 2, 4-

D Na-salt and paraquat each at 1000 g/ha. There was no regeneration under different treatments of 2, 4-D over time upto 60 DAT and 2, 4-D amine was the best followed by its ester and Na-salt formulation during both the years. Glyphosate 1000-2000 g/ha, metsulfuron 4 g/ha, metsulfuron+chlorimuron 4 g/ha and carfentrazone 20 g/ha did not provide satisfactory control (8-32% at 30 DAT) of water hyacinth. Even there was further reduction in the control levels recorded upto 60 DAT and the weed regenerated under these treatments.

During 2008 and 2009, 95-96% control was observed at 30 DAT achieved under 2, 4-D amine 1500 g/ha (95-96%) followed by paraquat 2000 g/ha (93-96%), 2,4-D ester 1000 g/ha (82-85%) and 2, 4-D amine 1000 g/ha (82-85%) (Table 1). Under all these treatments, per cent control increased over time recorded up to 60 DAT (88-99%) indicating gradual degeneration of remaining plant parts. 2, 4-D amine 1500 g/ha and paraquat 2000 g/ha provided almost complete control (>98%) of weed at 60 DAT. However, probable longer persistence of paraquat put a question mark on its suitability particularly in water bodies and it needs further research on the subject. Glyphosate 2000-4000 g/ha provided only 12-50% control of water hyacinth at 30 DAT. Glufosinate 20-40 g/ha did not provide any control and metsulfuron 10-15 g/ha was also not much effective (22-45% control). Further, there was further reduction in the control levels of these herbicides recorded upto 60 DAT and the weed regenerated. Contrary to this, glyphosate has been reported effective against this weed by Singh and Vats (1993) and Singh (1995). Poor efficacy of glyphosate in the present study could be due to presence of soil particles/dust on the leaf surface of the weed which might have adsorbed the chemical and hampered its absorption.

2, 4-D amine and 2, 4-D ester each at 1000 g/ha provided 88-93% control of *E. crassipes* upto two months after application. Efficacy of 2, 4-D Na 1000-2000 g/ha was slightly low against the weed (70-87%). 2, 4-D amine 1500 g/ha and paraquat 2000 g/ha resulted in almost complete control (>98%) of the weed, but longer persistence of paraquat may put question mark on its suitability particularly in water bodies. Glyphosate 1000-

Table 1. Per cent control of *Eichhornia crassipes* with different herbicidal treatments

Treatments	Dose (g/ha)		Per cent control of <i>Eichhornia. crassipes</i>								
	2007	2008/ 2009	30 DAT			45 DAT			60 DAT		
			2007	2008	2009	2007	2008	2009	2007	2008	2009
Glyphosate	1000	-	25.0 (18.3)	-	-	21.6 (15.0)	-	-	19.9 (11.7)	-	-
Glyphosate	2000	2000	33.2 (30.0)	19.9 (11.7)	22.6 (15.0)	33.2 (30.0)	19.9 (11.7)	22.8 (15.0)	29.9 (25.0)	16.6 (8.3)	18.4 (10.0)
Glyphosate	-	4000	-	40.1 (41.7)	45.2 (50.3)	-	39.2 (40.0)	43.3 (47.0)	-	31.0 (35.0)	39.8 (41.0)
Paraquat	1000	1000	52.7 (63.3)	50.8 (60.0)	53.1 (64.0)	53.7 (65.0)	50.8 (60.0)	53.8 (65.0)	53.7 (65.0)	50.8 (60.0)	53.8 (65.0)
Paraquat	-	2000	-	75.3 (93.3)	79.5 (96.3)	-	81.4 (96.7)	78.7 (96.0)	-	85.7 (98.3)	87.3 (99.3)
2, 4-D Ester	-	400	-	39.2 (40.0)	41.7 (44.3)	-	39.2 (40.0)	39.2 (40.0)	-	36.2 (35.0)	39.2 (40.0)
2, 4-D Ester	-	600	-	-	51.0 (60.3)	-	-	53.8 (65.0)	-	-	57.1 (65.0)
2, 4-D Ester	1000	1000	60.1 (75.0)	64.7 (81.7)	67.2 (85.0)	63.5 (80.0)	67.2 (85.0)	69.8 (88.0)	65.9 (83.3)	70.1 (88.3)	72.3 (90.7)
2, 4-D Na	1000	1000	55.9 (68.3)	53.8 (65.0)	52.5 (63.0)	54.8 (66.7)	56.8 (70.0)	58.9 (68.0)	56.8 (70.0)	59.0 (70.0)	56.8 (70.0)
2, 4-D Na	-	2000	-	61.1 (76.7)	63.8 (80.3)	-	63.4 (80.0)	66.4 (84.0)	-	64.7 (81.7)	69.2 (87.3)
2, 4-D Amine	-	600	-	38.2 (38.3)	40.8 (42.7)	-	37.2 (36.7)	39.2 (40.0)	-	35.2 (33.3)	36.4 (35.3)
2, 4-D Amine	1000	1000	66.3 (83.3)	64.7 (81.7)	67.2 (85.0)	67.4 (85.0)	67.4 (85.0)	70.1 (88.3)	72.0 (90.0)	71.6 (90.0)	75.8 (93.0)
2, 4-D Amine	-	1500	-	77.1 (95.0)	78.7 (96.0)	-	81.4 (96.7)	84.0 (98.3)	-	85.7 (98.3)	86.7 (99.0)
Glufosinate-ammonium	-	20	-	0.0 (0.0)	0.0 (0.0)	-	0.0 (0.0)	0.0 (0.0)	-	0.0 (0.0)	0.0 (0.0)
Glufosinate-ammonium	-	40	-	4.3 (1.7)	8.6 (3.3)	-	4.3 (1.7)	11.3 (4.0)	-	0.0 (0.0)	0.0 (0.0)
Metsulfuron-methyl	4	-	34.1 (31.7)	-	-	30.9 (26.7)	-	-	28.8 (23.3)	-	-
Metsulfuron-methyl	-	10	-	27.7 (21.7)	30.0 (25.0)	-	28.9 (23.3)	30.0 (25.0)	-	25.3 (18.3)	26.5 (20.0)
Metsulfuron-methyl	-	15	-	42.1 (45.0)	42.1 (45.0)	-	42.1 (45.0)	42.1 (45.0)	-	37.2 (36.7)	37.3 (36.7)
Metsulfuron-methyl+chlorimuron	4	-	22.6 (15.0)	-	-	22.6 (15.0)	-	-	18.0 (10.0)	-	-
Carfentrazone	20	-	16.6 (8.3)	-	-	16.6 (8.3)	-	-	12.9 (5.0)	-	-
Untreated check	-	-	0.0 (0.0)	0.0 (0.0)	(0.0)	0.0 (0.0)	0.0 (0.0)	0.0	0.0 (0.0)	0.0 (0.0)	0.0
LSD (P=0.05)			6.9	5.4	4.4	6.5	6.6	3.9	5.4	7.9	6.0

Original figures in parentheses were subjected to angular transformation ( $\sin^{-1} \sqrt{X}$ ) before statistical analysis. DAT—Days after treatment.

4000 g/ha, glufosinate-ammonium 20-40 g/ha, metsulfuron+chlorimuron 4 g/ha, metsulfuron 4-15 g/ha and carfentrazone 20 g/ha did not provide satisfactory control of water hyacinth.

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