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Management of nutsedge in sugarcane by ethoxysulfuron

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ABSTRACT

Field investigion was carried out for two consecutive years 2009-10 and 2010-11 at Pantnagar (Uttarakhand) to study the bio-efficacy of ethoxysulfuron for the control of *Cyperus rotundus* (nutsedge) in sugarcane. Experiment consisted of six treatments, *viz.* doses of ethoxysulfuron 46.87, 56.25 and 60 g/ha, 2,4-D Na salt 1000 g/ha, three hoeing 30, 60 and 90 days after planting (DAP) of sugarcane and untreed control was laid out in randomized block design with three replicions. Ethoxysulfuron and 2,4-D Na salt were applied at 3-4 leaf stage of *Cyperus rotundus*. Among the herbicidal treatments, the lowest weed density as well as dry weight of total weeds was observed with ethoxysulfuron 60 g/ha 3-4 leaf stage of *C. rotundus* at both the stages at 30 and 60 DAA though the differences were non-significant when compared with its lower dose 56.25 g/ha, 30 and 60 DAA and 46.87 g/ha 60 DAA during both the year. Application of ethoxysulfuron 3-4 leaf stage of *C. rotundus* effectively controlled *C. rotundus* and broad-leaved weeds, *viz. Trianthema monogyna, Digera arvensis, Cleome viscosa* and *Ipomoea* spp. This herbicide any rate was not effective against grassy weeds. The highest cane yield was recorded with the execution of three hoeing at 30, 60 and 90 days after planting (DAP). Among the herbicidal trements, ethoxysulfuron 60 g/ ha at 3-4 leaf stage of *C. rotundus* recorded maximum cane yield (82.3 and 86.8 t/ha), although it was at par with its lower dose 56.25 g/ha. The lowest cane yield was recorded with control.

Key words: Bio-efficacy, *Cyperus rotundus,* Herbicide, Hoeing, Nutsedge, Spring-planted Sugarcane

Sugarcane, being a slow growth at atinitial stage and a long duration crop faces severe competition with annual grasses, broad-leaved and perennials weeds like *Cyperus rotundus* between 60 to 120 days of its planting, which causes heavy reduction in cane yield ranging from 40 to 67% (Chauhan and Srivastva 2002, Singh *et al.* 2011). Management practices play an important role in realizing potential yield of sugarcane. Sugarcane, being a widely spaced crop, allows wide range of weed flora to grow profusely in the interspaces between the rows. Frequent irrig ions and fertilizer applicion during early growth stages increase the weed menace by many folds (Singh *et al.* 2008). To escape yield loss and to achieve maximum yield of sugarcane, a weed free environment during the critical period of crop-weed competition is essential which could be achieved by the applicion of effective herbicides (Singh 1980). It is well established fact that cultural method of weed management is most effective to control weeds but in present scenario, timely availability of agricultural labours is a big problem in agriculture and day by day increasing labour charges further increase the cost of cultivion. Therefore, herbicidal control of weeds has been suggested to be economical in sugarcane (Chauhan *et al.* 1994, Sarala *et al.* 2011). Several herbicides have, however been tried in sugarcane but successful control of *Cyperus* spp. could not be achieved. The present investigation was therefore, undertaken to study the bio-efficacy of ethoxysulfuron for control of *Cyperus rotundus* (nutsedge) in sugarcane.

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MATERIALS AND METHODS

A field experiment was conducted during 2009-10 and 2010-11 at N. E. Borlaug Crop Research Center of GBPUA&T, Pantnagar, Uttarakhand to evaluate the bio-efficacy of ethoxysulfuron for the control of *Cyperus rotundus* in sugarcane. Soil of the experimental field was silty loam in texture, medium in organic carbon (0.67%), available phosphorus (29.6 kg/ha) and potassium (176.4 kg/ha) with pH 7.2. Experiment with six treatments comprised of three doses of ethoxysulfuron 46.87 g/ha, 56.25 and 60 g/ha at 3-4 leaf stage of *C. rotundus*, 2,4-D sodium salt 80 WP 1000 g/ha, three hoeing at 30, 60 and 90 days after planting (DAP) of sugarcane crop and untreated control was laid out in randomized block design with three replications. Ethoxysulfuron 15 WG and 2,4-D (Na salt) were applied at 3-4 leaf stage of *C. rotundus* by using Maruti foot sprayer fitted with flat fan nozzle using water volume of 500 liters per hectare. Three budded setts of sugarcane variety *'CoP 90223'* were planted keeping a row spacing of 75 cm on March 3, 2009 and April 9, 2010. Recommended package of practices were adopted to raise the crop. The sugarcane crop was harvested on 7 December, 2009 during first year and 13 December, 2010 during second year. Observations on density and dry weight of weeds were recorded at 30 and 60 days after execution of treatments. Data pertaining to density and dry matter accumulation of total weeds were subjected to log transformation by adding 1.0 to original values prior to statistical analysis.

RESULTS AND DISCUSSION

Effect on weeds

The major weed flora in experimental field comprised of *Cyperus rotundus*, *Echinochloa* spp., *Digitaria sanguinalis*, *Dactyloctenium aegyptium*, *Trianthema monogyna*, *Digera arvensis* and *Ipomoea* spp. in both the years. Besides these, *Brachiaria reptans* and *Cleome viscosa* were also observed as major weeds during 2010. All the weed control treatments caused significant reduction in the dry weight of *Cyperus rotundus* and density and dry weight of total weeds over untreated control during both the year. The highest reduction in the density and dry weight of total weeds was recorded with the execution of three hoeing at 30, 60 and 90 days after planting (DAP). Among the herbicidal treatments, the lowest weed density and dry weight of total weeds were observed with ethoxysulfuron 60 g/ha, though the differences were non-significant when compared with its lower dose of 56.25 30 at 60 DAA and 46.87 g/ha at 60 DAA during both the years. Application of ethoxysulfuron of all the doses effectively controlled the *C. rotundus* and broad-leaved weeds, *viz. Trianthema monogyna, Digera arvensis, Cleome viscosa* and *Ipomoea* spp. This herbicide was not found effective against grassy weeds such as *Echinochloa* spp., *Digitaria sanguinalis*, *Dactyloctenium aegyptium* and *Brachiaria reptans*.

Yield parameters

All the weed control treatments showed significantly positive influence on cane length, number of millable canes and cane yield over unweeded control. Cane girth indices showed non-significant differences among all the treatments. The highest cane length (277 cm) was recorded with three hoeing at 30, 60 and 90 DAP which was significantly superior than 2,4 -D Na salt 80 WP 1000 g/ha and was at par with different doses of ethoxysulfuron except unweeded control which recorded lowest cane length (225 cm). Significantly more millable canes were recorded under three hoeing at 30, 60 and 90 DAP which remained statistically at par with all herbicidal treatments. Among the tested herbicides, ethoxysulfuron 60 g/ha recorded the highest cane length (272 cm), number of millable canes (70.55 thousand/ha) and cane yield (84.55 t/ha) during both the years. This might be due to effective weed control with application of ethoxysulfuron 60 g/ha which resulted increased yield promoting tributes. These results were in agreement with the findings of Singh *et al.* (2011). Pel *et al.* (2013) also reported that all the weed control treatments favourably influenced the yield tributing characters such as number of millable canes, cane length and cane diameter except unweeded check. The highest cane yield (102.0 and 108.3 t/ha) was recorded with three hoeing 30, 60 and 90 DAP during 2009 and 2010. Among the herbicidal treatments, application of ethoxysulfuron 56.25 and 60 g/

Table 1. Weed density (no./m^2) at 30 DAA as influenced by ethoxysulfuron in sugarcane

Treatment	*C. rotundus*		*Echinochloa* spp.		*D. sanguinalis*		*B. reptans*		*D. aegyptium*		*T. monogyna*		*D. arvensis*		*C. viscosa*		*Ipomoea* spp.	
	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010
Ethoxysulfuron	2.34	2.60	2.60	2.60	2.00	2.65	0.0	1.81	1.27	0.54	1.07	0.54	1.07	0.54	0.0	1.07	0.0	0.0
(46.87 g/ha)	(10)	(13)	(13)	(13)	(7)	(13)	(0)	(5)	(4)	(1)	(3)	(1)	(3)	(1)	(0)	(3)	(0)	(0)
Ethoxysulfuron	1.80	2.12	2.81	2.87	1.80	2.21	0.0	1.27	1.07	0.54	1.07	0.0	0.54	0.0	0.0	0.54	0.0	0.0
(56.25 g/ha)	(5)	(8)	(16)	(17)	(5)	(9)	(0)	(4)	(3)	(1)	(3)	(0)	(1)	(0)	(0)	(1)	(0)	(0)
Ethoxysulfuron	1.07	1.81	2.53	2.69	2.12	2.34	0.0	1.07	0.73	0.54	0.54	0.0	0.00	0.0	0.0	0.0	0.0	0.0
(60.00 g/ha)	(3)	(5)	(12)	(15)	(8)	(11)	(0)	(3)	(3)	(1)	(1)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
2,4-D Na salt	3.74	3.49	2.74	2.90	2.00	2.41	0.0	1.27	1.27	1.07	1.59	1.07	0.54	0.0	0.0	0.54	0.0	0.54
(1000 g/ha)	(43)	(32)	(15)	(17)	(7)	(12)	(0)	(4)	(4)	(2)	(7)	(3)	(1)	(0)	(0)	(1)	(0)	(1)
Three hoseings at	2.81	2.94	1.07	0.54	0.00	1.07	0.0	0.0	0.54	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30, 60 and 90 DAP	(16)	(19)	(3)	(1)	(0)	(3)	(0)	(0)	(1)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Untreated control	4.53	4.27	2.70	2.87	2.12	2.34	0.0	1.46	1.07	1.81	3.34	3.18	2.53	2.21	0.0	1.27	1.27	1.07
	(92)	(71)	(15)	(17)	(8)	(11)	(0)	(5)	(3)	(5)	(28)	(24)	(12)	(9)	(0)	(4)	(4)	(3)
LSD (P=0.05)	0.94	0.61	0.92	0.87	0.73	NS	0.0	NS	2.06	NS	1.70	0.98	1.22	0.89	0.0	NS	0.84	NS

Figures in parentheses indicate original values which were transformed to $\log_e$ (x+1)

Table 2. Weed density (no./m^2) at 60 DAA as influenced by ethoxysulfuron in sugarcane

Treatment	*C. rotundus*		*Echinochloa* spp.		*D. sanguinalis*		*B. reptans*		*D. aegyptium*		*T. monogyna*		*D. arvensis*		*C. viscosa*		*Ipomoea* spp.	
	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010
Ethoxysulfuron (46.87 g/ha)	1.80 (5)	1.8 (5)	3.48 (32)	3.22 (25)	2.00 (7)	2.81 (16)	0.0 (0)	1.39 (5)	1.87 (4)	1.13 (1)	1.07 (3)	0.54 (1)	1.07 (3)	0.0 (0)	0.0 (0)	1.07 (3)	0.54 (1)	0.0 (0)
Ethoxysulfuron (56.25 g/ha)	0.0 (0)	0.0 (0)	3.30 (27)	3.08 (21)	2.21 (9)	2.62 (13)	0.0 (0)	1.93 (7)	1.07 (5)	0.0 (0)	0.0 (0)	0.0 (0)	0.54 (1)	0.0 (0)	0.0 (0)	0.54 (1)	0.0 (0)	0.0 (0)
Ethoxysulfuron (60.00 g/ha)	0.54 (1)	0.0 (0)	3.38 (29)	3.14 (23)	2.33 (11)	2.69 (15)	0.0 (0)	1.39 (5)	1.80 (3)	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)
2,4-D Na salt (1000 g/ha)	2.92 (19)	2.53 (12)	3.44 (31)	3.18 (24)	2.21 (9)	2.87 (17)	0.0 (0)	1.39 (5)	0.73 (5)	1.07 (3)	1.27 (4)	1.07 (3)	0.54 (1)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)
Three hoeings at 30, 60 and 90 DAP	1.01 (3)	1.27 (4)	0.54 (1)	1.07 (3)	0.0 (0)	0.54 (1)	0.0 (0)	0.0 (0)	0.73 (0)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)	0.54 (1)	0.0 (0)
Untreated control	3.80 (45)	3.37 (29)	3.38 (29)	3.30 (27)	2.53 (12)	2.69 (15)	0.0 (0)	2.00 (7)	1.27 (5)	1.39 (9)	2.53 (12)	2.32 (9)	1.59 (7)	0.0 (0)	0.0 (0)	1.80 (5)	1.80 (5)	1.59 (7)
LSD (P=0.05)	0.98	0.78	0.83	0.63	0.92	0.69	0.0	1.17	NS	NS	1.18	1.08	1.72	0.0	0.0	1.43	1.09	1.08

Figures in parentheses indicate original values which were transformed to $\log_e$ (x+1)

Table 3. Weed dry weight (g/m^2) as influenced by ethoxysulfuron in sugarcane

Treatment	Dose (g/ha)	30DAA						60 DAA					
		2009			2010			2009			2010		
		C. rotundus	Total	WCE (%)	*C. rotundus*	Total	WCE (%)	*C. rotundus*	Total	WCE (%)	*C. rotundus*	Total	WCE (%)
Ethoxysulfuron	46.87	1.36 (2.9)	3.91 (49)	57.5	1.46 (3.3)	4.04 (55.7)	47.7	0.79 (1.2)	4.48 (86.8)	39.8	0.83 (1.3)	4.63 (101.2)	31.3
Ethoxysulfuron	56.25	0.83 (1.3)	3.84 (46)	60.1	1.06 (1.9)	3.96 (51.4)	51.7	0.53 (0.7)	4.41 (81.1)	43.7	0.00 (0)	4.52 (90.4)	38.7
Ethoxysulfuron	60.00	0.53 (0.7)	3.78 (42.8)	62.9	0.74 (1.1)	3.86 (46.3)	56.5	0.18 (0.2)	4.40 (80.6)	44.1	0.00 (0)	4.49 (88.5)	40.0
2,4-D Na salt	1000.0	2.80 (15.5)	4.17 (63.9)	44.6	2.66 (13.3)	4.23 (67.9)	36.2	1.44 (3.2)	4.57 (95.7)	33.6	1.39 (3)	4.62 (100.4)	31.9
Three hoeings at 30, 60 and 90 DAP	-	1.13 (2.1)	1.31 (2.7)	97.6	1.19 (2.3)	1.39 (3)	97.2	0.41 (0.5)	0.69 (1)	99.3	0.41 (0.5)	0.83 (1.3)	99.1
Untreated control	-	3.69 (39.2)	4.76 (115.3)	-	3.36 (27.9)	4.68 (106.5)	-	2.84 (16.2)	4.98 (144.1)	-	2.61 (12.6)	5.00 (147.4)	-
LSD (P=0.05)	-	0.29	0.32	-	0.21	0.23	-	0.33	0.35	-	0.28	0.37	-

Figures in parentheses indicate original values which were transformed to $\log_e$ (x+1)

ha being statistically similar resulted in significantly higher cane yield compared to ethoxysulfuron 46.87 g/ha 2,4-D Na salt during 2009 and 2010, respectively. The higher cane yield under these treatments might be due to higher weed control efficiency with higher cane length and higher number of millable cane per hectare. Singh *et al.* (2011) and Suganthi *et al.* (2013) observed higher cane length number of internodes and cane weight with weed free situations.

Weed control efficiency

Highest weed control efficiency of 97.6 and 97.2% was recorded with three hoeing at 30, 60 and 90 DAP 30 DAA and 99.3 and 99.1% at 60 DAA during 2009 and 2010, respectively. This might be due to effective weed control which resulted in lower weed dry weight. In herbicidal treatments, application of ethoxysulfuron 60 g/ha recorded higher weed control efficiency of 62.9 and 56.5% in three hoeing at 30 DAA and 44.1 and 40.0% at 60 DAA during 2009 and 2010, respectively. This was also comparable with ethoxysulfuron 56.25 g/ha where a weed control efficiency of 60.1 and 51.7% at 30 DAA and 43.7 and 38.7% at 60 DAA was recorded, respectively during both the years. Highest cane yield was recorded with three hoeing at 30, 60 and 90 DAP followed by ethoxysulfuron 60 g/ha (82.3 and 86.8 t/ha). This can be attributed to effective control of weeds by hoeing which provide more soil aeration, enhanced uptake of nutrients by crop coupled with improvement

Table 4. Yield at tributes and yields of sugarcane as influenced by ethoxysulfuron

Treatment	Dose (g/ha)	Cane length (cm)		Cane girth (cm)		No. of millable canes (x10^3 `/ha)		Cane yield (t/ha)		Weed Index (%)
		2009	2010	2009	2010	2009	2010	2009	2010	
Ethoxysulfuron	46.87	256	258	8.5	8.5	60.5	63.5	69.2	72.3	32.7
Ethoxysulfuron	56.25	260	267	8.6	8.7	64.5	67.2	76.8	80.6	25.1
Ethoxysulfuron	60.00	271	274	8.8	8.8	68.6	72.5	82.3	86.8	19.6
2,4-D Na salt	1000	251	255	8.4	8.3	56.0	58.0	68.3	70.0	34.2
Three hoeings at 30, 60 and 90 DAP	-	274	280	8.9	9.3	90.4	96.4	102.0	108.3	00.0
Untreated control	-	215	235	6.7	7.8	38.6	40.0	47.5	48.7	54.2
LSD (P=0.05)	-	21	23	NS	NS	13.83	11.07	6.8	7.2	-

in growth and yield contributing characters. Similiar results have also been reported by Almubarak *et al.* (2012). Chauhan and Srivastava (2002) recorded increase in cane yield up to 52% in weed free conditions due to better crop environment. This might be due to effective control of weeds, which provide congenial environment for the crop. Similar results were also obtained by EI- Shafai *et al.* (2010).

The weed index was zero by three hoeing at 30, 60 and 90 DAP whereas, in herbicidal treatments, it was lower in treatments of ethoxysulfuron at 60 g/ha, which recorded weed index of 19.6%. Kalayarasi (2012) also reported lower weed index in herbicide applied plots when compared to unweeded control. This might be due to effective control of weeds, which enhanced the yield of the crop in three hoeing at 30, 60 and 90 DAP and ethoxysulfuron at 60 g/ha (Table 4).

It can be concluded the application of ethoxysulfuron at 60 g/ha or 56.25 g/ha at 3-4 leaf stages of *C. rotundus* was found more effective for controlling this weed as well as broad-leaf weeds, *viz. Trianthema monogyna, Digera arvensis, Cleome viscosa* and *Ipomoea* sp.

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