International Journal of Agriculture, Environment & Biotechnology
Citation: IJAEB: 6(4): 611-616 December 2013
DOI Number 10.5958/j.2230-732X.6.4.039

Agronomy

Efficiency of Halosulfuron Methyl (NC-319 75%WDG) on Weed Control in Sugrcane

S. Rathika, C.Chinnusamy and T.Ramesh

Department of Agronomy, Tamil Nadu Agricultural University, Coimbatore - 641 003,India

***E mail:** rathikaselvaraj@gmail.com

Paper No. 159 Received: October 18, 2013 Accepted: November 27, 2013 Published: November 29, 2013

Abstract

Field experiments were conducted at Tamil Nadu Agricultural University, Coimbatore to evaluate the efficiency of halosulfuron methyl for the control of weeds in sugarcane. The treatments consisted of new herbicide formulation halosulfuron methyl (NC-319 75% WDG) in different doses (52.5, 60.0, 67.5, 75.0 and 150 g a.i. ha^{-1}) at 3-4 leaf stages of *Cyperus rotundus* compared with recommended dose of PE atrazine 1.0 kg a.i. ha^{-1} on 3 DAP + hand weeding and earthing up on 60 DAP, hand weeding on 30 DAP and earthing up on 60 DAP respectively and also with unweeded control. The results revealed that the sedge weed density was distinctly lower in application of halosulfuron methyl at all doses. But grass and broad leaved weed density was perceptibly lower in PE atrazine 1.0 kg a.i. ha^{-1} + hand weeding and earthing up on 60 DAP followed by hand weeding on 30 DAP and earthing up on 60 DAP and halosulfuron methyl 60.0 g a.i. ha^{-1}. The lowest total weed dry weight, higher weed control efficiency and cane yield were recorded in PE atrazine 1.0 kg a.i. ha^{-1} + hand weeding and earthing up on 60 DAP followed by hand weeding on 30 DAP and earthing up on 60 DAP and halosulfuron methyl 60.0 g a.i. ha^{-1}. The herbicide doses evaluated in this study did not exhibit residual effect on succeeding crops of pearlmillet, sunflower and cowpea.

Highlights

PE atrazine 1.0 kg a.i. ha^{-1} + hand weeding and earthing up on 60 DAP or EPOE halosulfuron methyl 60.0 g a.i. ha^{-1} registered higher cane yield.

Keywords: Sugarcane, halosulfuron methyl, weed control efficiency, cane yield

Sugarcane (*Saccharum officinarum* L.) is one of the most important cash crops in India and plays a pivotal role in both agricultural and industrial economy of our country. In Tamil Nadu, sugarcane is cultivated in an area of 0.35 million hectares producing around 29.76 million tonnes of sugarcane, with an average productivity of 101 t ha^{-1} (Season and crop report, 2009-10). Major challenges involved in the cultivation of sugarcane to achieve better productivity are nutrient, water and weed management practices. Weed infestation is one of the most dominant constraints in sugarcane production. Especially in Western Zone of Tamil Nadu more than 60% cane is cultivated in red gravel soils and infestation of problem weeds like *Cynodon dactylon and Cyperus rotundus* is also more. Unlike other weeds, problem weeds remove nutrients and extract water from the soil and plants causing heavy losses to agricultural crops. The effect of these problem weeds has been so devasting, the crop yield losses of 10 to 60 per cent have been recorded, leading to complete crop failure and sometimes abandonment of land. Nowadays *Cyperus rotundus* becomes a notorious perennial weed in sugarcane fields in Tamil Nadu. The main reason is that the farmers in

these areas have highly acclimatized to sugarcane cultivation, due to its high remuneration the farmers are not in a position to grow up sugarcane. So continuous monocropping has been practiced, which leads to buildup of *Cyperus rotundus and Cynodon dactylon* population in the cane fields. Considering these situations, this study was undertaken.

Materials and Methods

Field experiments were conducted during 2008-10 at Eastern Block Farm, Tamil Nadu Agricultural University, Coimbatore. The experimental site is located at 11° N latitude, 77° E longitude and at an altitude of 426.7 m above MSL. The experimental soil was sandy clay loam in texture belonging Typic Ustochrepts with alkaline pH; low in organic carbon (0.35 %) and available nitrogen (242.4 kg ha^{-1}), medium in available phosphorus (14.5 kg ha^{-1}) and high in potassium (442.4 kg ha^{-1}). The sugarcane variety Co 86032 was chosen for the study. The treatments comprised of new herbicide formulation halosulfuron methyl (NC-319 75% WDG) in different doses (52.5, 60.0, 67.5, 75.0 and 150 g a.i. ha^{-1}) at 3-4 leaf stages of *Cyperus rotundus* compared with recommended dose of PE atrazine 1.0 kg a.i. ha^{-1} on 3 DAP + hand weeding and earthing up on 60 DAP, hand weeding on 30 DAP and earthing up on 60 DAP respectively and also with unweeded control were studied in randomized block design.

Weed density and total weed dry weight were taken at 20, 40 and 60 DAHA and weed control efficiency was worked out. The group wise and total weed density was recorded by using 0.25 m^2 quadrate at five places in each plot and expressed as number m^{-2} as suggested by Burnside and Wicks (1965). Weeds present in five quadrates were removed, shade dried and then oven dried at 80 ± 2°C till constant weight was attained. The weed dry weight was recorded and expressed in kg ha^{-1}. The values were subjected to square root transformation (X + 0.5) as described by Bartlett (1947) and analyzed statistically.

Weed control efficiency (WCE) was computed using the formula and expressed in percentage.

$$WCE\ (\%) = \frac{WDC - WDT}{WDC} \times 100$$

Where,

WDC = Weed dry weight in control plot, g m^{-2}

WDT = Weed dry weight in treated plot, g m^{-2}

The yield parameters and yield of sugarcane were recorded at harvest stage. Pearlmillet, sunflower and cowpea were taken as test crops to find out the herbicidal effect on succeeding crops. Gemination count of succeeding crops were taken and expressed as percentage. Yield of succeeding crops were recorded and expressed in kg ha^{-1}. The data were statistically analyzed as per procedure suggested by Gomez and Gomez (1984).

Results and Discussion

Weed flora of the experimental field

Weed flora of the experimental field predominantly consisted of eleven species of broad-leaved weeds, six species of grasses and a sedge weed. The weeds present in the experimental field were *Chloris barbata*, *Cynodon dactylon*, *Digetaria sanguinalis*, *Dactyloctenium aegyptium*, *Panicum repens*, *Setaria verticiliata* under grasses, *Cyperus rotundus* under sedges and *Acalypha indica*, *Amarathus viridis*, *Abutilon indicum*, *Cleome gynandra*, *Corchorus olitorius*, *Datura metal*, *Digera arvensis*, *Parthenium hysterophorus*, *Phyllanthus niruri*, *Phyllanthus madaraspatensis*, *Trianthema portulacastrum* under broad leaved weeds.

Among the grass weeds, *Dactyloctenium aegyptium*, *Cynodon dactylon*, *Chloris barbata*, *Panicum repens* and *Setaria verticiliata* were the dominant ones. *Cyperus rotundus* was the only sedge present. The predominant among broad leaved weeds were *Parthenium hysterophorus*, *Trianthema portulacastrum*, *Corchorus olitorius*, *Digera arvensis*, *Abutilon indicum* and *Datura metel*.

Weed density, dry weight and weed control efficiency

Group wise density of weeds (Table 1)

At all stages, sedge weed density was distinctly lower in application of halosulfuron methyl at all doses (52.5, 60.0, 67.5, 75.0 and 150 g a.i. ha^{-1}). Higher sedge weed density was recorded in unweeded control. This is in corroboration with the findings of Mehar *et al*., (2013).

At 20 DAHA, grass weed density was significantly lower in PE atrazine 1.0 kg a.i ha^{-1} + hand weeding and earthing up on 60 DAP which was on par with hand weeding on 30 DAP and earthing up on 60 DAP. It was followed by halosulfuron methyl 150.0 g a.i. ha^{-1}, halosulfuron methyl 75.0 g a.i. ha^{-1} and halosulfuron methyl 60.0 g a.i. ha^{-1}. The treatment halosulfuron methyl 60.0 g a.i. ha^{-1} was comparable with halosulfuron methyl 67.5 g a.i. ha^{-1}. Grass weed density was significantly lower PE atrazine 1.0 kg

Table 1: Effect of weed management treatments on group wise density of weeds in sugarcane

Treatments	Weed density (No. m^{-2})											
	20 DAHA				40 DAHA				60 DAHA			
	Sedge	Grass	BLW	Total Weeds	Sedge	Grass	BLW	Total Weeds	Sedge	Grass	BLW	Total Weeds
T_1: Halosulfuron methyl 52.5 g a.i. ha^{-1}	1.10 (0.7)	8.59 (73.3)	7.73 (59.3)	11.57 (133.8)	1.10 (0.7)	11.99 (143.3)	8.89 (78.5)	14.93 (222.5)	1.22 (1.0)	12.97 (167.8)	10.81 (116.3)	16.90 (285.1)
T_2: Halosulfuron methyl 60.0 g a.i. ha^{-1}	0.71 (0.0)	5.98 (35.3)	4.92 (23.8)	7.72 (59.6)	0.71 (0.0)	7.33 (53.5)	6.79 (45.7)	9.98 (99.2)	0.71 (0.0)	8.82 (77.4)	8.22 (67.1)	12.04 (144.5)
T_3: Halosulfuron methyl 67.5 g a.i. ha^{-1}	0.71 (0.0)	6.27 (38.8)	5.15 (26.0)	8.08 (64.8)	0.71 (0.0)	7.52 (56.0)	6.95 (47.8)	10.21 (103.8)	0.71 (0.0)	9.25 (85.1)	8.56 (72.8)	12.59 (157.9)
T_4: Halosulfuron methyl 75.0 g a.i. ha^{-1}	0.71 (0.0)	5.95 (34.9)	4.85 (23.0)	7.64 (58.4)	0.71 (0.0)	8.73 (75.8)	7.54 (56.4)	11.52 (132.2)	0.71 (0.0)	10.03 (100.3)	9.59 (91.5)	13.87 (191.8)
T_5: Halosulfuron methyl 150.0 g a.i. ha^{-1}	0.71 (0.0)	5.75 (32.6)	4.69 (21.5)	7.39 (54.6)	0.71 (0.0)	9.11 (82.5)	8.31 (68.5)	12.31 (151.0)	0.71 (0.0)	11.41 (129.8)	10.35 (106.7)	15.39 (236.5)
T_6: PE atrazine 1.0 kg a.i. ha^{-1} + HW and earthing up on 60 DAP	3.97 (15.3)	2.51 (5.8)	3.35 (10.7)	5.68 (32.3)	4.37 (18.6)	5.08 (25.3)	5.27 (27.3)	8.47 (71.2)	3.05 (8.8)	4.32 (18.2)	3.56 (12.3)	6.31 (39.3)
T_7: HW on 30 DAP and Earthing up on 60 DAP	1.67 (2.3)	2.76 (7.1)	3.87 (14.5)	4.99 (24.4)	4.22 (17.3)	5.76 (32.7)	6.02 (35.8)	9.29 (85.8)	2.95 (8.2)	5.04 (24.9)	4.37 (18.6)	7.22 (51.7)
T_8: UWC	4.34 (18.0)	9.82 (96.0)	8.59 (73.3)	13.71 (188.1)	5.22 (26.7)	13.20 (173.7)	9.62 (92.0)	17.11 (292.4)	5.54 (30.2)	14.01 (195.9)	11.97 (142.8)	19.22 (368.9)
SEd	0.03	0.15	0.12	0.18	0.04	0.16	0.10	0.22	0.03	0.22	0.18	0.27
CD (P=0.05)	0.06	0.30	0.24	0.36	0.08	0.32	0.21	0.44	0.05	0.44	0.36	0.54

Figures in parenthesis are original values, T_1 - T_5: 3-4 leaf stages of *Cyperus rotundus*
DAHA: Days after halosulfuron methyl application, HW - Hand weeding

Table 2: Effect of weed management treatments on total weed dry weight and WCE in sugarcane

Treatments	Total weed dry weight (g/m^2)			Weed Control Efficiency (%)		
	20 DAHA	40 DAHA	60 DAHA	20 DAHA	40 DAHA	60 DAHA
T_1: Halosulfuron methyl 52.5 g a.i. ha^{-1}	8.98(80.1)	14.01(195.8)	18.59(345.0)	33.3	27.2	24.0
T_2: Halosulfuron methyl 60.0 g a.i. ha^{-1}	5.64(31.3)	8.65(74.4)	12.85(164.7)	73.9	72.3	63.7
T_3: Halosulfuron methyl 67.5 g a.i. ha^{-1}	5.90(34.3)	8.97(79.9)	13.63(170.5)	71.4	70.3	62.4
T_4: Halosulfuron methyl 75.0 g a.i. ha^{-1}	5.53(30.1)	10.44(108.4)	15.01(224.4)	74.9	59.7	50.0
T_5: Halosulfuron methyl 150.0 g a.i. ha^{-1}	5.50(29.8)	11.55(132.9)	16.51(272.0)	75.2	50.6	40.1
T_6: PE atrazine 1.0 kg a.i. ha^{-1} + HW and earthing up on 60 DAP	3.42(11.2)	7.18(51.0)	6.73(44.8)	90.7	81.0	90.1
T_7: HW on 30 DAP and Earthing up on 60 DAP	3.27(10.2)	8.17(66.2)	7.80(60.4)	91.5	75.4	86.7
T_8: UWC	10.98(120.1)	16.42(269.0)	21.31(453.7)	-	-	-
SEd	0.14	0.26	0.34	-	-	-
CD (P=0.05)	0.29	0.51	0.68	-	-	-

Figures in parenthesis are original values
T_1 - T_5: Application of herbicides at 3-4 leaf stages of *Cyperus rotundus*
DAHA: Days after halosulfuron methyl application, HW - Hand weeding

a.i. ha^{-1} + hand weeding and earthing up on 60 DAP and it was followed by hand weeding on 30 DAP and earthing up on 60 DAP, halosulfuron methyl 60.0 g a.i. ha^{-1} and halosulfuron methyl 67.5 g a.i. ha^{-1} at 40 DAHA. The similar trend was recorded at 60 DAHA. Higher grass weed density was recorded in unweeded contr]ol at all stages.

Broad leaved weed density was perceptibly lower in PE atrazine 1.0 kg a.i. ha^{-1}+ hand weeding and earthing up on 60 DAP followed by hand weeding on 30 DAP and earthing up on 60 DAP, halosulfuron methyl 150.0 g a.i. ha^{-1}, halosulfuron methyl 75.0 g a.i. ha^{-1}, halosulfuron methyl 60.0 g a.i. ha^{-1} and halosulfuron methyl 67.5 g a.i. ha^{-1} at 20 DAHA. Lower density of broad leaved weeds were recorded in PE atrazine 1.0 kg a.i. ha^{-1} + hand weeding and earthing up on 60 DAP and it was followed by hand weeding on 30 DAP and earthing up on 60 DAP, halosulfuron methyl 60.0 g a.i. ha^{-1} and halosulfuron methyl 67.5 g a.i. ha^{-1} during 40 and 60 DAHA. The treatments, halosulfuron methyl 60.0 g a.i. ha^{-1} and halosulfuron methyl 67.5 g a.i. ha^{-1} were on par with each other at all the stages. Higher broad leaved weed density was recorded in unweeded control at all stages.

Total weed density was laudably lower in PE atrazine 1.0 kg a.i. ha^{-1} + hand weeding and earthing up on 60 DAP followed by hand weeding on 30 DAP and earthing up on 60 DAP, halosulfuron methyl 150.0 g a.i. ha^{-1}, halosulfuron methyl 75.0 g a.i. ha^{-1} and halosulfuron methyl 60.0 g a.i./ ha at 20 DAHA. The treatment halosulfuron methyl 60.0 g a.i. ha^{-1} was comparable with halosulfuron methyl 67.5 g a.i. ha^{-1} at 20 DAHA. However, at 40 and 60 DAHA, the total weed density was significantly lower with PE atrazine 1.0 kg a.i. ha^{-1} + hand weeding and earthing up on 60 DAP and it was followed by hand weeding on 30 DAP and earthing up on 60 DAP and halosulfuron methyl 60.0 g a.i. ha^{-1}. At all stages, unweeded control recorded significantly higher total weed density. This falls in line with the findings of Suryavanshi *et al*., (2012) and Mehar *et al*., (2013) in sugarcane.

Total weed dry weight (Table 2)

Total weed dry weight was conspicuously lower in hand weeding on 30 DAP and earthing up on 60 DAP which was comparable with PE atrazine 1.0 kg a.i. ha^{-1} + hand weeding and earthing up on 60 DAP. It was followed by halosulfuron methyl 150.0 g a.i. ha^{-1}, halosulfuron methyl 75.0 g a.i. ha^{-1}, halosulfuron methyl 60.0 g a.i. ha^{-1} and halosulfuron methyl 67.5 g a.i. ha^{-1}. But at 40 and 60 DAHA, total weed dry weight was lower in PE atrazine 1.0 kg a.i. ha^{-1} + hand weeding and earthing up on 60 DAP followed by hand weeding on 30 DAP and earthing up on 60 DAP and halosulfuron methyl 60.0 g a.i. ha^{-1}. The treatment halosulfuron methyl 60.0 g a.i. ha^{-1} was on par with halosulfuron methyl 67.5 g a.i. ha^{-1}. Total weed dry weight was distinctly higher in unweeded control. Similar trend were observed at 60 DAHA. Kadam *et al*., (2011) also reported that pre emergence herbicides like atrazine was effective for weed control in sugarcane.

Weed control efficiency (WCE) (Table 2)

Weed control efficiency was higher in hand weeding on 30 DAP and earthing up on 60 DAP (91.5%) followed by PE atrazine 1.0 kg a.i. ha^{-1} + hand weeding and earthing up on 60 DAP (90.7 %) at 20 DAHA. But, at 40 and 60 DAHA, the highest WCE was recorded in PE atrazine 1.0 kg a.i. ha^{-1} + hand weeding and earthing up on 60 DAP (81.4 and 90.1%) followed by hand weeding on 30 DAP and earthing up on 60 DAP (75.4 and 86.7%). Among the halosulfuron methyl application, higher WCE was recorded with halosulfuron methyl 150.0 g a.i. ha^{-1} (75.2%) followed by halosulfuron methyl 75.0 g a.i. ha^{-1} (74.9%) and halosulfuron methyl 60.0 g a.i. ha^{-1} (73.9%) at 20 DAHA. However, WCE was higher in halosulfuron methyl 60.0 g a.i. ha^{-1} (72.3 and 63.7%) at 40 and 60 DAHA. This is due to reduced weed population and weed dry weight resulted in increased weed control efficiency. Weed control efficiency was lower with halosulfuron methyl 52.5 g a.i. ha^{-1} at all stages.

Sugarcane

Yield parameters and yield of sugarcane (Table 3)

The highest yield attributes and cane yield were obtained with PE atrazine 1.0 kg a.i. ha^{-1} + hand weeding and earthing up on 60 DAP followed by hand weeding on 30 DAP and earthing up on 60 DAP. Among the halosulfuron methyl application, higher yield attributes and cane yield were recorded with halosulfuron methyl 60.0 g a.i. ha^{-1} and it was comparable with halosulfuron methyl 67.5 g a.i. ha^{-1}. This might be due to effective weed control, the crop enjoyed favorable environment and good soil aeration. It enhanced the uptake of nutrients which resulted in significant increase in yield attributing characters and yield. Lower yield attributes and cane yield were resulted in unweeded control. The results are in agreement with the findings of Singh *et al*., (2011) and Suganthi *et al*.,(2013).

Table 3: Effect of weed management treatments on yield attributes and cane yield (t ha^{-1}) in sugarcane

Treatments	Yield attributes					Cane yield (t ha^{-1})
	NMC (1000 ha^{-1})	Cane length (m)	Cane girth (cm)	No. of Internodes $cane^{-1}$	Single cane weight (kg)	
T_1: Halosulfuron methyl 52.5 g a.i./ha	90.2	1.61	2.35	17.8	0.92	82.8
T_2: Halosulfuron methyl 60.0 g a.i./ha	108.7	2.01	2.64	21.2	1.15	101.1
T_3: Halosulfuron methyl 67.5 g a.i./ha	107.2	1.96	2.60	20.4	1.12	100.3
T_4: Halosulfuron methyl 75.0 g a.i./ha	99.6	1.80	2.50	18.8	1.05	92.7
T_5: Halosulfuron methyl 150.0 g a.i./ha	98.0	1.77	2.48	18.4	1.01	90.3
T_6: PE atrazine 1.0 kg a.i./ha + HW and E.up on 60 DAP	120.6	2.38	2.82	23.4	1.32	115.2
T_7: HW on 30 DAP and E.up on 60 DAP	112.7	2.20	2.78	21.9	1.24	108.1
T_8: UWC	82.2	1.42	2.21	16.2	0.81	74.2
SEd	3.6	0.07	0.06	0.7	0.03	3.3
CD (P=0.05)	7.2	0.15	0.12	1.4	0.06	6.6

T_1 - T_5: Application of herbicides at 3-4 leaf stages of *Cyperus rotundus*, HW - Hand weeding, E.up – Earthing up

Table 4: Residual effect of herbicides on germination (%) and yield (kg ha^{-1}) of succeeding crops

Treatments	Pearlmillet		Sunflower		Cowpea	
	Germination (%)	Grain yield (kg ha^{-1})	Germination (%)	Seed yield (kg ha^{-1})	Germination (%)	Seed yield (kg ha^{-1})
T_1: Halosulfuron methyl 52.5 g a.i./ha	95	2820	98	1307	88	804
T_2: Halosulfuron methyl 60.0 g a.i./ha	95	2825	97	1312	89	808
T_3: Halosulfuron methyl 67.5 g a.i./ha	98	2798	96	1305	91	793
T_4: Halosulfuron methyl 75.0 g a.i./ha	97	2772	94	1291	92	785
T_5: Halosulfuron methyl 150.0 g a.i./ha	98	2759	91	1275	90	781
T_6: PE atrazine 1.0 kg a.i./ha + HW and E.up on 60 DAP	95	2842	96	1318	92	831
T_7: HW on 30 DAP and E.up on 60 DAP	100	2803	94	1315	90	815
T_8: UWC	94	2742	97	1265	86	762
SEd	5.1	86	4.2	56	3.6	38
CD (P=0.05)	NS	NS	NS	NS	NS	NS

T_1 - T_5: Application of herbicides at 3-4 leaf stages of *Cyperus rotundus*, HW - Hand weeding, E.up – Earthing up

Effect of herbicides on succeeding crops (Table 4)

Even higher doses of test herbicide did not show any phytotoxicity in sugarcane. Hence, there was no residual effect on succeeding crops like pearlmillet, sunflower and cowpea by the herbicides. Germination of residual crops ranges between 94 to 100 percentage in pearlmillet, 91 to 98 percentage in sunflower and 86 to 92 percentage in cowpea. But there was no significant difference among the treatments on germination count as well as yield of succeeding crops. Similar results were obtained by Punia *et al*., (2011) in cluster bean and Suganthi *et al*., (2013) in sugarcane.

Conclusion

From the study it could be concluded that in sugarcane pre-emergence application of atrazine 1.0 kg a.i. ha^{-1} on 3 DAP + hand weeding and earthing up on 60 DAP or hand weeding on 30 DAP and earthing up on 60 DAP or halosulfuron methyl 60.0 g a.i. ha^{-1} at 3-4 leaf stages of *Cyperus rotundus* offered better weed control enhanced yield attributes which resulted in higher cane yield. The test herbicides did not show any phytotoxic effect on succeeding crops even at higher doses.

References

Bartlett, M.S. 1947. The use of transformation. *Biometrics,* **3:** 1-2.

Burnside, O.C. and G.A. Wicks. 1965. Effect of herbicides and cultivation treatments on yield components of dryland sorghum in Nebraska. *Agronomy Journal* **57:** 21-24.

Gomez, K.A. and A.A.Gomez. 1984. Statistical procedure for Agricultural Research. An International Rice research Institute Book. A Wiley-Interscience Publication, Johan Wiley and Sons, Inc.

Kadam,B.S., M.M. Suryavanshi, D.M. Veer, K.B. Patil, S.M. More and R.B. Khot. 2011. Influence of weed management practices on cane yield and weed intensity of ratoon crop of sugarcane (CO 86032). *Co-op. Sugar* **42**: 41-46.

Mehar. C., S. Samar, B.Dharam, S. Narendar and K. Vijay. 2013. Halosulfuron methyl: A new post emergence in India for effective control of Cyperus rotundus in sugarcane and its residual effect on succeeding crops. *Sugar Tech*nology **15:**214-218.

Punia, S.S., S.Singh and D.Yadav. 2011. Bioefficacy of imazethapyr and chlorimuron – ethyl in cluster bean and their residual effect on succeeding crops. *Indian Journal of Weed science* **43**: 48-53.

Season and crop report. 2009-10, Department of Economics and Statistics, Tamil Nadu.

Singh, W., R.Singh, R.P. Malik and R.Metha. 2011. Effect of planting density and weed management options on weed dry weight and cane yield of spaced transplanted sugarcane (Saccharum officinarum L.) after wheat harvest in sub-tropical India. *Indian Journal of Weed Science* **43**: 97-100.

Suganthi, M., P.Muthukrishnan, C.Chinnusamy, M.Mohammed Amanullah and N.Sakthivel. 2013. Efficiency of low dose herbicides and their combination on weed biomass and productivity of sugarcane. *Journal of Agronomy* **12**(2): 104-108.

Suryavanshi, M., Kadam, B.S.,Veer, D.M., Kudtarkar,U.S.,More,S.M. and Gaikawad,B.G. 2012. Influence of weed management practices on cane yield, quality and weed density of ratoon sugarcane. ***In:*** Proceedings of the Biennial Conference on Weed Threat to Agriculture, Biodiversity and Environment. April, 19-20, 2012, Kerla Agricultural University, Thrissur, India, p. 108.

