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RESEARCH PAPER

Efficiency evaluation of post - emergence herbicide metamitron 70 SC and ethofumesate 50 SC on weed control and productivity in sugarbeet

S. RATHIKA
Department of Agronomy, Tamil Nadu Agricultural University, COIMBATORE (T.N.) INDIA
(Email : rathikaselvaraj@gmail.com)

Abstract : Field experiments were conducted at Tamil Nadu Agricultural University, Coimbatore to evaluate the efficiency of metamitron 70 SC and ethofumesate 50 SC for the control of weeds and to increase the productivity in sugarbeet. The treatments consisted of two doses of new herbicide formulation metamitron 70 SC (2.00 and 4.00 kg ha^{-1}) and ethofumesate 50 SC (1.00 and 2.00 kg ha^{-1}) at two weed leaf stage, two doses of metamitron 70 SC (3.50 and 7.00 kg ha^{-1}) and ethofumesate 50 SC (0.99 and 1.98 kg ha^{-1}) in three splits at 2, 4-6 and 8-10 weed leaf stages, combination of ethofumesate 50 SC and metamitron 70 SC in two doses (0.50 + 0.98 and 1.00 + 0.98 kg ha^{-1}) at two weed leaf stage compared with recommended dose of PE pretilachlor (50 EC 0.50 kg ha^{-1}) and unweeded control. The results revealed that the lowest total weed dry weight and higher weed control efficiency were recorded in pre emergence application of Pretilachlor 50 EC 0.50 kg ha^{-1} followed by Metamitron 70 SC 7.00 kg ha^{-1} in three splits. There was not any phytotoxic symptom observed in sugarbeet in any of the herbicides at different doses. The yield parameters and root yield of sugarbeet were higher in PE pretilachlor 50 EC 0.50 kg ha^{-1}. However, it was at par with application of metamitron 70 SC in three splits at both doses (3.50 or 7.00 kg ha^{-1}).

Key Words : Sugarbeet, Metamitron, Ethofumesate, Weed control efficiency, Root yield

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INTRODUCTION

Sugarbeet (*Beta vulgaris* var *vulgaris* var *altissima* Doll L.) is a sugar producing commercial root crop and globally important cash crop grown in temperate countries. It contributes 30 per cent of world sugar supplies (FAO, 1999). Sugarbeet is a potential competitive crop with sugarcane in dry areas due to less water consumption per amount of sugar produced (Mohamed-Mrini Senhaji and Pimentel, 2001).

Owing to the potential of sugarbeet as a raw material for the production of sugar and ethanol, the tropical sugarbeet hybrids are introduced in India recently. The ethanol potential of the sugarbeet crop is about 7000 to 10000 litres per hectare, which was relatively higher than the ethanol production from the sugarcane.

Sugarbeet is not a very competitive crop. Weeds growing in association with the sugarbeet crop reduce the vegetative potential of the crop, which ultimately results in substantial yield losses. So weed control is mandatory. Several herbicides are effective against weeds of sugarbeet. However, there is always a possibility of development of resistant biotype of weeds for continuous use of same herbicide. This necessitates bio-efficacy evaluation of various new herbicides and method of application of herbicide for effective weed control in sugarbeet. Hence, this study was undertaken.

MATERIAL AND METHODS

Field experiments were conducted during 2008 and 2009 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 (0.36 and 0.38%) and available nitrogen (235.5 and 240.6 kg ha^{-1}), medium in available phosphorus (13.2 and 15.5 kg ha^{-1}) and high in potassium (476.0 and 436.3 kg ha^{-1}) during 2008 and 2009, respectively. The sugarbeet variety PAC 6008 and Cauvery were chosen for the study. Treatments comprised of two doses of new herbicide formulation metamitron 70 SC (2.00 and 4.00 kg ha^{-1}) and ethofumesate 50 SC (1.00 and 2.00 kg ha^{-1}) at two weed leaf stage, two doses of metamitron 70 SC (3.50 and 7.00 kg ha^{-1}) and ethofumesate 50 SC (0.99 and 1.98 kg ha^{-1}) in three splits at 2, 4-6 and 8-10 weed leaf stages, combination of ethofumesate 50 SC and metamitron 70 SC in two doses (0.50 + 0.98 and 1.00 + 0.98 kg ha^{-1}) compared with recommended dose (0.50 kg ha^{-1}) of PE pretilachlor 50 EC, respectively and also with unweeded control were studied in Randomized Block Design.

Visual scoring for control of weeds and phytotoxic symptoms (yellowing/ chlorosis/ stunting / scorching) in sugarbeet were done on 45 days after sowing (DAS) based on score scale (0-10). Weed population and total dry matter production (TDMP) were taken at 45 DAS and weed control efficiency was worked out. The total weed count was recorded by using 0.25 m^2 quadrate at four places in each plot and expressed as number m^{-2} as suggested by Burnside and Wicks (1965). Weeds present in four 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.

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

where,

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

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

Five roots were randomly selected from the net area of each plot, the length and girth of the individual root was taken and the mean was expressed in cm. Fresh root yield per hectare was calculated based on the net plot yield and expressed in t ha^{-1}.

RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Weed flora of the experimental field:

Weed flora of the experimental field predominantly consisted of twelve 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*, *Echinchloa crusgalli* under grasses, *Cyperus rotundus* under sedges and *Acalypha indica*, *Abutilon indicum*, *Boerhaavia diffusa*, *Convolvulus arvensis*, *Corchorus olitorius*, *Datura metal*, *Digera arvensis*, *Parthenium hysterophorus*, *Phyllanthus niruri*, *Phyllanthus madaraspatensis*, *Trianthema portulacastrum*, *Vernonia cinerea* under broad leaved weeds.

Table 1 : Visual scoring for weed control rating and phytotoxic symptoms in sugarbeet at 45 DAS

Treatments	Weed control rating		Phytotoxic symptoms*	
	2008	2009	2008	2009
T_1 - Metamitron 3.5 kg/ha	8.5	8.0	0	0
T_2 - Metamitron 7.0 kg/ha	8.5	8.5	0	0
T_3 - Metamitron 2.0 kg/ha	7.0	8.0	0	0
T_4 - Metamitron 4.0 kg/ha	7.0	8.5	0	0
T_5 - Ethofumesate 0.99 kg/ha	6.0	6.5	0	0
T_6 - Ethofumesate 1.98 kg/ha	6.0	6.5	0	0
T_7 - Ethofumesate 1.00 kg/ha	6.0	6.0	0	0
T_8 - Ethofumesate 2.00 kg/ha	6.0	6.0	0	0
T_9 - Pretilachlor 0.50 kg/ha	8.0	8.0	0	0
T_{10} - Ethofumesate 1.0 kg/ha + Metamitron1.4 kg/ha	2.0	2.0	0	0
T_{11} - Ethofumesate 2.0 kg/ha + Metamitron1.4 kg/ha	2.5	2.5	0	0
T_{12} - Unweeded control	0	0	0	0

* No phytotoxic symptoms on crop were observed in all the treatments

Weed control rating : 0 - No control, 1 - Very poor control, 2 - Poor control, 3 - Poor to deficient control, 4 - Deficient control, 5 - Deficient to moderate control, 6 - Moderate control, 7 - Satisfactory control, 8 - Good control, 9 - Good to excellent control, 10 - Complete control.

Among the grass weeds, *Dactyloctenium aegyptium, Cynodon dactylon, Chloris barbata, Panicum repens and Echinchloa crusgalli* were the dominant ones. *Cyperus rotundus* was the only sedge present. The predominant broad leaved weeds were *Parthenium hysterophorus, Boerhaavia diffusa, Corchorus olitorius, Digera arvensis, Trianthema portulacastrum* and *Datura metal*.

Weed control rating:

Good weed control rating was resulted in PE pretilachlor 50 EC 0.50 kg ha^{-1} followed by metamitron 70 SC 7.00 kg ha^{-1} in three splits and metamitron 70 SC 3.50 kg ha^{-1} in three splits (Table 1). Whereas, satisfactory weed control rating was observed in metamitron 70 SC 4.00 kg ha^{-1} and metamitron 70 SC 2.00 kg ha^{-1} at two weed leaf stage. Besides these treatments, moderate weed control rating was resulted in the treatments *viz*., ethofumesate 50 EC 0.99 kg ha^{-1} in three splits, ethofumesate 50 EC 1.98 kg ha^{-1} in three splits, ethofumesate 50 EC 1.0 kg ha^{-1} and ethofumesate 50 EC 2.0 kg ha^{-1} at two weed leaf stage. The treatments *viz*., ethofumesate 0.5 kg ha^{-1} + metamitron 0.98 kg ha^{-1} and ethofumesate 1.0 kg ha^{-1} + metamitron 0.98 kg ha^{-1} at two weed leaf stage were recorded poor weed control rating. This is in corroboration with the findings of Rapparini (2006) in sugarbeet.

Phytotoxicity symptom:

There was not any phytotoxic symptoms in sugarbeet in any of the herbicides at different doses were observed during both the years (Table 1). Streibig (1986) stated that among the binary mixtures of herbicides lenacil and ethofumesate (or) metamitron and ethofumesate were less phytotoxic in oats. Sugarbeet were more tolerant to ethofumesate than desmedipham (Eshel *et al.*, 2006).

Weed density:

There was no significant difference on sedge weed density due to the different herbicidal treatments during both the years (Table 2).

Grass and broad leaved weed density were perceptibly lower in PE pretilachlor 50 EC 0.50 kg ha^{-1} and comparable with metamitron 70 SC 7.00 kg ha^{-1} in three splits. Grasses density in metamitron 70 SC 7.00 kg ha^{-1} in three splits was at par with same herbicide at 3.50 kg ha^{-1} in three splits.

Table 2 : Effect of weed management treatments on weed density, total weed dry weight and WCE at 45 DAS in sugarbeet

Treatments	2008						2009					
	Weed density (No. m^{-2})				Total weed dry weight (g m^{-2})	WCE (%)	Weed density (No. m^{-2})				Total weed dry weight (g m^{-2})	WCE (%)
	Sedge	Grass	BLW	Total			Sedge	Grass	BLW	Total		
T_1 - Meta 3.5 kg/ha	4.14 (17.1)	4.54 (20.6)	2.72 (7.4)	6.72 (45.1)	6.55 (42.85)	83.7	4.40 (19.4)	5.98 (35.8)	4.09 (16.7)	8.48 (71.9)	8.77 (76.93)	77.8
T_2 – Meta 7.0 kg/ha	4.18 (17.5)	4.25 (18.1)	2.41 (5.8)	6.43 (41.4)	6.17 (38.09)	85.5	4.44 (19.7)	5.81 (33.7)	3.75 (14.1)	8.22 (67.5)	8.42 (70.88)	79.6
T_3 – Meta 2.0 kg/ha	4.27 (18.2)	6.07 (36.9)	4.31 (18.6)	8.58 (73.7)	8.67 (75.17)	71.3	4.35 (18.9)	6.75 (45.6)	5.32 (28.1)	9.63 (92.8)	10.06 (101.15)	70.9
T_4 – Meta 4.0 kg/ha	4.36 (19.0)	5.24 (27.5)	3.77 (14.2)	7.79 (60.7)	7.47 (55.84)	78.7	4.42 (19.5)	6.32 (39.9)	5.17 (26.7)	9.28 (86.1)	9.60 (92.13)	73.5
T_5 –Etho 0.99 kg/ha	4.35 (18.9)	6.75 (45.6)	8.46 (71.5)	11.66 (136.0)	12.01 (144.16)	45.1	4.43 (19.6)	7.38 (54.4)	8.82 (77.8)	12.32 (151.8)	12.86 (165.46)	52.4
T_6 – Etho 1.98 kg/ha	4.29 (18.4)	6.59 (43.4)	8.33 (69.4)	11.45 (131.2)	11.62 (135.14)	48.5	4.36 (19.0)	7.01 (49.2)	8.67 (75.1)	11.97 (143.3)	12.27 (150.47)	56.7
T_7 – Etho 1.00 kg/ha	4.32 (18.7)	7.67 (58.8)	8.71 (75.9)	12.39 (153.4)	12.81 (164.14)	37.4	4.35 (18.9)	7.91 (62.5)	9.15 (83.7)	12.85 (165.1)	13.29 (176.66)	49.1
T_8 – Etho 2.00 kg/ha	4.22 (17.8)	7.40 (54.7)	8.43 (71.1)	11.98 (143.6)	12.28 (150.78)	42.5	4.38 (19.2)	7.77 (60.3)	8.92 (79.5)	12.61 (154.0)	13.16 (173.31)	50.1
T_9 - Preti 0.50 kg/ha	4.25 (18.1)	4.15 (17.2)	2.28 (5.2)	6.36 (40.5)	6.07 (36.86)	86.0	4.45 (19.8)	5.35 (28.6)	3.55 (12.6)	7.81 (61.0)	8.01 (64.05)	81.6
T_{10} - Etho 1.0 kg/ha + Meta .4 kg/ha	4.38 (19.2)	10.93 (119.5)	10.12 (102.5)	15.53 (241.2)	15.91 (253.26)	3.5	4.32 (18.7)	12.14 (147.3)	11.45 (131.2)	17.24 (297.2)	18.49 (341.78)	1.6
T_{11} - Etho 2.0 kg/ha +Meta 1.4 kg/ha	4.36 (19.0)	10.85 (117.7)	9.96 (99.3)	15.36 (236.0)	15.67 (245.44)	6.4	4.39 (19.3)	11.98 (143.6)	11.65 (135.8)	17.28 (298.7)	18.37 (337.53)	2.8
T_{12} – UWC	4.40 (19.4)	11.06 (122.3)	10.29 (105.8)	15.73 (247.5)	16.20 (262.38)	-	4.52 (20.4)	12.30 (151.3)	11.76 (138.4)	17.61 (310.1)	18.64 (347.31)	-
SEd	0.17	0.32	0.24	0.33	0.48	-	0.16	0.26	0.19	0.41	0.43	-
CD (P=0.05)	NS	0.64	0.48	0.66	0.95	-	NS	0.52	0.38	0.82	0.86	-

Figures in parenthesis are original values Meta – Metamitron, Etho – Ethofumesate, Preti – Pretilacholor, UWC – Unweeded control

Higher grass and broad leaved weed density were recorded in unweeded control during both the years. This corroborates with the findings of Giannopolities and Strouthopoulos (2006) in sugarbeet.

In both the years, total weed density was laudably lower in PE pretilachlor 50 EC 0.50 kg ha^{-1} and was comparable with that in metamitron 70 SC at 7.00 and 3.5 kg ha^{-1} in three splits. Unweeded control recorded significantly higher total weed density. This falls in line with the findings of Paradowski and Praczyk (2005) in sugarbeet.

Total weed dry weight:

Total weed dry weight was conspicuously lower in PE pretilachlor 50 EC 0.50 kg ha^{-1}, metamitron 70 SC at 7.00 and 3.5 kg ha^{-1} in three splits which were at par with each other during both the years (Table 2). The possible reason is due to reduced weed population and weed growth. Similar results have been reported earlier by Rapparini (2006) in sugarbeet.

Weed control efficiency (WCE):

Weed control efficiency was higher in pretilachlor 50 EC at 0.50 kg ha^{-1} (86.0 and 81.6% during 2008 and 2009, respectively) and it was followed by metamitron 70 SC 7.00 kg ha^{-1} in three splits (85.5and 77.8%) and metamitron 70 SC 3.50 kg ha^{-1} in three splits (83.7 and 77.8%) during 2008 and 2009, respectively. Besides these treatments, more than 70 per cent of WCE was recorded in metamitron 70 SC 4.00 kg ha^{-1} and metamitron 70 SC 2.00 kg ha^{-1} at two weed leaf stage. Weed control efficiency was lower in ethofumesate 0.5 kg ha^{-1} + metamitron 0.98 kg ha^{-1} (3.5 and 1.6%) and it was followed by ethofumesate 1.0 kg ha^{-1} + metamitron 0.98 kg ha^{-1} (6.4 and 2.8%) during 2008 and 2009, respectively. This is due to reduced weed population and weed growth resulted in increased weed control efficiency.

Sugarbeet:

Yield parameters and yield:

In both the years, the yield parameters *viz.*, root length, root girth and root weight were higher in PE pretilachlor 50 EC 0.50 kg ha^{-1}, metamitron 70 SC at 7.00 and 3.5 kg ha^{-1} in three splits which were at par with each other. Unweeded control recorded significantly lower yield parameters (Table 3).

The root yield was significantly higher in PE pretilachlor 50 EC 0.50 kg ha^{-1} (109.2 and 103.7 t ha^{-1} during 2008 and 2009, respectively). However, it was comparable with metamitron 70 SC 7.00 kg ha^{-1} in three splits (107.5 and 102.9 t ha^{-1}) and the same herbicide at 3.50 kg ha^{-1} in three splits (106.2 and 100.7 t ha^{-1}) during 2008 and 2009, respectively. The root yield was distinctly lower in unweeded control (54.8 and 49.5 t ha^{-1} during 2008 and 2009, respectively). This corroborates with the findings of Deuber *et al.* (2006) in beetroot.

Conclusion:

From the study it could be concluded that pre emergence application of pretilachlor 50 EC at 0.50 kg ha^{-1} or metamitron 70 SC 3.50 kg ha^{-1} in three splits at 2, 4-6 and 8-10 weed leaf stages offered better weed control and higher productivity of sugarbeet.

Table 3 : Effect of weed management treatments on yield parameters and root yield (t ha^{-1}) in sugarbeet

Treatments	2008				2009			
	Yield parameters			Root yield (t ha^{-1})	Yield parameters			Root yield (t ha^{-1})
	Root length (cm)	Root girth (cm)	Root weight (g)		Root length (cm)	Root girth (cm)	Root weight (g)	
T_1–Meta 3.5 kg/ha	42.7	36.9	1373	106.2	40.5	35.3	1268	100.7
T_2–Meta 7.0 kg/ha	43.6	38.2	1408	107.5	41.5	37.6	1302	102.9
T_3–Meta 2.0 kg/ha	39.1	33.3	1198	95.8	37.2	32.6	1086	91.5
T_4–Meta 4.0 kg/ha	41.2	35.4	1267	99.4	39.5	34.8	1155	94.6
T_5–Etho 0.99 kg/ha	34.6	30.8	909	79.3	33.9	30.2	821	74.1
T_6–Etho 1.98 kg/ha	36.0	31.3	987	87.6	34.5	30.4	875	82.0
T_7–Etho 1.00 kg/ha	32.6	29.5	842	67.3	32.2	28.7	763	62.5
T_8–Etho 2.00 kg/ha	33.8	30.3	877	75.1	32.8	29.6	781	71.3
T_9–Preti 0.50 kg/ha	44.2	38.6	1465	109.2	41.9	37.9	1373	103.7
T_{10}–Etho1.0 kg/ha + Meta1.4 kg/ha	30.6	28.3	724	60.4	28.2	26.6	646	54.6
T_{11}–Etho2.0 kg/ha + Meta1.4 kg/ha	30.9	28.2	757	58.8	28.6	26.4	615	52.3
T_{12}–UWC	29.5	27.6	675	54.8	27.7	26.0	569	49.5
S.E.$\pm$	0.8	0.9	54	3.7	0.6	0.8	58	3.3
C.D. (P=0.05)	1.6	1.8	108	7.4	1.2	1.6	115	6.6

Meta - Metamitron, Etho - Ethofumesate, Preti - Pretilacholor, UWC - Unweeded control

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