

Studies on integration of tillage and herbicides for weed control in sugarcane

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Abstract : Field experiments were conducted at Sugarcane Research Station, Cuddalore, Tamil Nadu during 1995-96 and 1996-97, to integrate tillage and herbicides to control weeds with special reference to *Cyperus rotundus* in sugarcane. The results revealed that the preplant application of glyphosate @ 2 kg ha⁻¹ (with 2% ammonium sulphate) plus three disc harrowings followed by pre-emergence application of atrazine 1 kg or alachlor 1.5 kg ha⁻¹ + hand weeding at 60 DAP recorded 92% weed control efficiency and increased the cane population (50%), cane yield (91%) and sugar yield (86.6%) over farmers method of three disc harrowings and hand weeding twice at 30 and 60 DAP.

Keywords : Sugarcane, *C. rotundus*, Tillage, Herbicides, Weed control.

Introduction

Sugarcane, being a long duration crop with slow initial growth habit, faces acute problem from weeds. Yield losses due to the presence of weeds were estimated as 12 to 83 per cent (Kanwar *et al.* 1992). However, the growth during its germination phase, sugarcane takes more time to cover the interspaces and hence, a weed free environment during the germination and tillering phases are important for getting higher yield (Ponnusamy *et al.* 1996).

Due to continuous use of atrazine for many years, the population of seed germinated broad leaved and grassy weeds, was reduced while the population of *C. rotundus* steadily increased. It was reported that *C. rotundus* reduced tillering of sugarcane by 40 to 50 per cent (Ponnusamy *et al.* 1996), millable cane population by 34.6 per cent (Kuntohartono *et al.* 1995) and cane yield 85 by per cent (Turner, 1985). The sugar cane setts take about 30 to 35 days for completion of germination, whereas the *C. rotundus* starts emerging within two to three days after planting of cane and occupies the inter space within two weeks. Hence, the emerging shoots of sugar cane have to compete with the already established *C. rotundus*. A study was therefore, undertaken to develop an integrated method of weed control with special reference to *C. rotundus* in sugarcane.

Materials and Methods

Field experiments were conducted at Sugarcane Research Station, Cuddalore, Tamil Nadu, during 1995-96 and 1996-97 using the sugarcane variety Co 8021 maturing in 330 days. The soil of

the experimental area was sandy loam in texture with a pH of 7.2 and an EC of 0.3 dSm⁻¹. The experiments were laid out in split plot design, replicated thrice, with the tillage practices viz

M₁ : Farmers' practice of three disc harrowings

M₂ : Disc ploughing + two disc harrowings

M₃ : Pre-plant application of glyphosate 2 kg ha⁻¹ (with 2% ammonium sulphate) at 20 days before planting (DBP) + 3 disc harrowings and

M₄ : Pre-plant application of glyphosate 2 kg + 2,4-D Na salt 1 kg ha⁻¹ at 20 DBP + 3 disc harrowings.

in main plots and weed control methods viz.

S₁ : PE atrazine 1 kg ha⁻¹ + HW (hand weeding) at 60 DAP

S₂ : PE alachlor 1.5 kg ha⁻¹ + HW at 60 DAP

S₃ : PE atrazine 1 kg ha⁻¹ fb PoEDS glyphosate 2 kg ha⁻¹ (with 2% ammonium sulphate) at 30 DAP

S₄ : PE alachlor 1.5 kg ha⁻¹ fb PoEDS glyphosate 2 kg ha⁻¹ (with 2% ammonium sulphate) at 30 DAP

S₅ : PE atrazine 1 kg ha⁻¹ fb PoEDS glyphosate 2 kg + 2,4-D 1 kg ha⁻¹ at 30 DAP

S₆ : PE alachlor 1.5 kg ha⁻¹ fb PoEDS glyphosate 2 kg + 2,4-D 1 kg ha⁻¹ at 30 DAP.

S₇ : Hand weeding at 30 and 60 DAP and

S₈ : Unweeded check.

(PE = Pre-emergence application; PoEDS = Post-emergence directed spray; fb = followed by)

The post-emergence herbicides (glyphosate and 2,4-D Na salt) were applied as directed spray

Table 1. Effect of tillage and weed control practices on total weed population (No m^{-2}), weed control efficiency and cane population in sugarcane (mean of two plant crops).

Treatment	Total weeds at 90 DAP (No m^{-2})					Weed control efficiency (%)					Cane population ($'000 \text{ ha}^{-1}$)				
	M ₁	M ₂	M ₃	M ₄	Mean	M ₁	M ₂	M ₃	M ₄	Mean	M ₁	M ₂	M ₃	M ₄	Mean
S ₁	217	217	22	26	121	20.5	20.5	92.0	90.5	55.9	89.7	99.0	130.0	119.1	109.5
S ₂	219	216	22	30	122	19.8	20.8	92.0	89.0	55.4	90.7	94.5	126.0	118.1	107.5
S ₃	168	160	14	15	89	38.5	41.4	94.8	94.5	67.3	86.4	95.7	109.1	102.5	98.4
S ₄	165	151	14	16	87	39.6	44.7	94.8	94.2	68.3	86.9	91.9	111.5	104.2	98.6
S ₅	159	160	13	15	87	41.8	41.4	95.2	94.5	68.2	81.8	87.5	115.1	103.0	96.9
S ₆	150	149	19	15	83	45.1	45.4	93.0	94.5	69.5	84.0	88.3	112.5	104.0	97.2
S ₇	241	237	24	38	135	11.7	13.2	91.2	86.1	50.6	86.6	91.2	110.9	97.5	96.5
S ₈	273	253	75	86	172	-	7.3	72.5	68.5	-	73.3	74.3	87.5	85.0	80.0
Mean	199	193	25	30	-	-	29.3	90.7	89.0	-	84.9	90.3	112.9	104.3	-
For M					SED										
for S					0.01										
For S at M					0.03										
For M at S					0.02										
					0.04										
					0.08										
					0.08										
					SED										
					0.24										
					2.35										
					4.71										
					4.94										
					CD (P=0.05)										
					7.13										
					4.82										
					9.64										
					11.27										

using the hand operated knapsack sprayer fitted with WFN 60 flood jet nozzle covered by a spray hood. A spray volume of 500 l ha^{-1} of solution was used. The hand weeding operations were carried out manually at 30 and 60 DAP. All other recommended package of practices were followed. Population of weed species present in quadrates ($50 \text{ cm} \times 50 \text{ cm}$) from two spots were recorded and the weed control efficiency was worked out. The data on cane yield and quality parameters were recorded at harvest. The mean data of two plant are taken for discussion.

Results and Discussion

Total weed population

The species in the experimental field revealed that the sedge, *C. rotundus* was the predominant weed species found up to 82 per cent and the annual grasses and broad leaved weeds constituted 18 per cent of the total weed population. Pre-plant application of glyphosate with three disc harrowings (M₃) significantly recorded lower weed population of 25 weeds m^{-2} . The reduction in the weed population was 87.4 per cent (Table 1). Among the weed control methods, the PE atrazine or alachlor followed by PoEDS glyphosate or PoSED glyphosate + 2,4-D (S₃, S₄, S₅ and S₆) decreased the population of weeds to the tune of 49.4 per cent. But the combination of pre-plant glyphosate 2 kg ha^{-1} and disc harrowings, PE atrazine or alachlor and PoEDS glyphosate or glyphosate + 2,4-D reduced the weeds up to 94.6 per cent. This may be attributed to the better control of *C. rotundus* plants and tubers by pre-plant application of glyphosate.

Cane Population

Pre-plant application of glyphosate with three disc harrowings (M₃) recorded significantly higher cane population of $1,12,900 \text{ ha}^{-1}$ (Table 1) which was 33 per cent higher than the farmers practice of

Table 2. Effect of tillage and weed control practices on yield and quality of sugarcane (mean of two plant crops).

Treatment	Cane yield (t ha ⁻¹)					CCS%					Sugar yield (t ha ⁻¹)				
	M ₁	M ₂	M ₃	M ₄	Mean	M ₁	M ₂	M ₃	M ₄	Mean	M ₁	M ₂	M ₃	M ₄	Mean
S ₁	93.1	104.0	164.0	156.5	129.5	13.74	13.42	13.42	13.45	13.51	12.79	11.04	21.99	21.10	17.48
S ₂	93.4	105.1	165.6	157.3	130.3	13.91	13.39	13.45	13.39	13.43	13.00	14.07	22.26	21.06	17.59
S ₃	85.3	99.1	154.8	148.1	121.8	13.62	13.76	13.25	13.48	13.51	11.62	13.63	20.50	19.97	16.43
S ₄	85.0	100.8	155.4	148.6	122.4	13.55	13.39	13.51	13.63	13.52	11.52	13.51	20.96	20.25	16.56
S ₅	86.0	100.1	155.8	149.7	122.9	13.63	13.40	13.81	13.59	13.61	11.77	13.41	21.46	20.34	16.75
S ₆	86.9	103.3	155.8	150.4	123.3	13.35	13.57	13.51	13.30	13.45	11.60	13.61	21.18	19.97	16.59
S ₇	86.2	98.3	142.6	139.8	116.7	13.73	13.54	13.40	13.17	13.46	11.83	13.30	19.11	18.39	15.66
S ₈	64.2	78.8	109.3	106.0	89.6	13.57	13.44	13.52	13.06	13.40	8.71	10.59	11.79	13.85	11.98
Mean	85.0	98.4	150.6	144.5	-	13.64	13.49	13.49	13.38	-	11.60	13.27	20.28	19.36	-
For M	SED	1.99	4.53			SED	0.08				SED	0.79			
For S	CD (P=0.05)	2.13	4.26			CD (P=0.05)	0.11	NS			CD (P=0.05)	0.19	2.50		
For S at M		4.20	8.81				0.23	NS				0.37	0.38		
For M at S		4.22	8.85				0.23	NS				0.86	0.76		

three disc harrowings (M₁). Among the weed control methods PE atrazine or alachlor followed by hand weeding at 60 DP (S₁ and S₂) recorded significantly higher cane population of 1,09,500 ha⁻¹ respectively. The treatments S₃, S₄, S₅ and S₆ though had higher weed control efficiency, registered lower cane population as compared to S₁ and S₂ due to the phytotoxic effect of PoEDS of glyphosate. But the integration of pre-plant glyphosate with three disc harrowings. PE atrazine or alachlor followed by hand weeding at 60 DAP (M₃S₁, M₃S₂) recorded 1.30.300 and 1,26,000 canes ha⁻¹ which was 50.5 and 45.5 per cent, respectively, higher than the farmers practices of three disc harrowings and hand weeding at 30 and 60 DAP (M₁S₇). The increase in cane population in these treatments were due to better control of weeds in general and *C. rotundus* in particular which helped the canes to tiller profusely by the efficient use of nutrients, water and other resources. This corroborates with the findings of Kuntohartono *et al.* (1995) and Ponnusamy *et al.* (1996).

Cane yield and quality

Cane yield is the ultimate goal of any management practice. Pre-plant application of glyphosate followed by three disc harrowings (M₃) recorded the highest cane yield of 150.6 t ha⁻¹ which was 77.2 per cent higher over farmers' practice of three disc harrowings (M₁). Among the weed control methods, PE atrazine or alachlor followed by hand weeding at 60 DAP (S₁ and S₂) recorded significantly higher than hand weeding at 30 and 60 DAP (S₇).

Combined effect of pre-plant glyphosate + 3 harrowings, PE atrazine or alachlor + hand weeding at 60 DAP (M₃S₁ and M₃S₂) recorded 81.6, 82.3 per cent higher cane yield over farmers practice of three disc harrowings and hand weeding twice (M₁S₇). However, the Commercial Cane Sugar (CCS)

percentage was not influenced by any of the treatments studied.

Sugar yield

The pre-plant application of glyphosate with three disc harrowings (M_3) recorded the highest sugar yield of 20.28 t ha⁻¹ which was 74.8 per cent higher than the farmers' practice of three disc harrowings (M_1). Regarding weed control methods, the PE atrazine or alachlor followed by hand weeding (S_1 and S_2) recorded significantly higher sugar yield of 17.48 and 17.59 t ha⁻¹, which was 11.6 and 12.3 per cent higher respectively over hand weeding at 30 and 60 DAP (S_3) (Table 2). The combined effect of pre-plant glyphosate with three disc harrowings, PE atrazine or alachlor + hand weeding at 60 DAP (M_3S_1 , M_3S_2) recorded 85.9 to 88.2 per cent higher sugar yield over farmer's method of three disc harrowings and hand weeding (M_1S_3).

Pre-plant application of glyphosate 2 kg ha⁻¹ controlled the weed population by 94.6 per cent. Combined effect of pre-plant glyphosate

with three disc harrowings, PE atrazine or alachlor followed by hand weeding at 60 DAP not only reduced the weed flora but also increased the cane population, cane yield and sugar yield to the tune of 50, 80 and 88 per cent, respectively.

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(Received : September 2001 ; Revised : April 2002)