EFFECT OF INTEGRATED WEED MANAGEMENT IN SUGARCANE (*SACCHARUM OFFICINARUM* L.) ON WEED INTENSITY AND CANE YIELD

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ABSTRACT

A field experiment was conducted at Instructional Farm, N. M. College of Agriculture, Navsari Agricultural University, Navsari during 2011-12 to study the "Effect of integrated weed management in sugarcane (*Saccharum officinarum* L.) on weed intensity and cane yield". The experiment results revealed that three hand weeding (HW) at 30, 60 and 90 DAP and two interculturing (IC) at 45 and 90 DAP recorded significantly lower weed density, dry weight of weed and weed control efficiency reflected with higher cane yield resulted in to higher monetary return followed by the treatment having application of metribuzin 1.0 kg/ha as pre-emergence + one HW and IC at 60 DAP or atrazine 2.0 kg/ha as pre-emergence + one HW and IC at 60 DAP.

KEY WORDS: Cane yield, economics, integrated weed management, sugarcane, weed intensity

INTRODUCTION

Sugarcane (*Saccharum officinarum* L.) is an important cash crop occupies an important position in Indian agriculture. Sugar industry is the second largest agro based industry after textile industry located in rural areas in India. Sugarcane crops requires more time (3–5 weeks) to germinate, slow initial crop growth, wider spacing, heavy manuring coupled with irrigation provides congenial condition for weed growth leads to compete with crop plants for nutrients, moisture, light, CO_2 and space. Critical period of weed-crop competition in sugarcane ranged between 30 to 90 DAP (Patel *et al.*, 2006). Among the factors for low productivity, negligence towards weed management is the most important, as the losses due to weeds reported 31 per cent reduction in cane yield compared to weed-free plots (El-Shafai, *et al.*, 2010). For getting higher yield from sugarcane crop, weed management play a vital role. Keeping these points in view, an experiment was, thus, carried out to study the "Effect of integrated weed management in sugarcane (Saccharum officinarum L.) on weed intensity and cane yield".

MATERIALS AND METHODS

The field experiment was conducted during 2011-12 at Instructional Farm, Department of Agronomy, Navsari Agricultural University, Navsari, Gujarat. The total rainfall received during crop growing period was 1266 mm. The experimental soil was clay in texture, low in available nitrogen (254 kg/ha), medium in available phosphorus (23.91 kg/ha), fairly rich in available potassium (427 kg/ha) and slightly alkaline in reaction (pH 8.31). The treatments comprised of

fourteen weed management practices viz., 1) Unweeded control, 2) Three hand weeding (HW) at 30, 60 and 90 days after planting (DAP) and two interculturing (IC) at 45 and 90 DAP, 3) Atrazine 2.0 kg/ha as pre-emergence, 4) Atrazine 2.0kg/ha as pre-emergence + one HW and one IC at 60 DAP, 5) Pendimethalin 1.0 kg/ha as pre-emergence + one HW and IC at 60 DAP, 6) Metribuzin 1.0 kg/ha as pre-emergence + one HW and IC at 60 DAP, 7) Atrazine 2.0 kg/ha as pre-emergence + 2,4-D Na salt 1.0 kg/ha as post-emergence applied at 60 DAP, 8) 2,4-D Na salt 1.0 kg/ha as post-emergence + paraquat 0.5 kg/ha as post-emergence applied at 30 DAP followed by 60 DAP, 9) 2,4-D Amine salt 1.0 kg/ha as post-emergence + paraquat 0.5 kg/ha as post-emergence applied at 30 DAP followed by 60 DAP, 10) 2,4-D Amine salt 1.0 kg/ha as post-emergence + metribuzin 0.5 kg/ha as post-emergence applied at 30 DAP followed by 60 DAP, 11) 2,4-D Amine salt 1.0 kg/ha as post-emergence + atrazine 1.0 kg/ha as post-emergence applied at 30 DAP followed by 60 DAP, 12) Pendimethalin 1.0 kg/ha as pre-emergence + Sunnhemp as a smother crop harvested and mulched at 60 DAP, 13) Metribuzin 1.0 kg/ha as pre-emergence + Sunnhemp as a smother crop harvested and mulched at 60 DAP and 14) Atrazine 1.0 kg/ha as pre-emergence + Sunnhemp as a smother crop harvested and mulched at 60 DAP arranged in randomized block design with three replications.

The sugarcane variety Co 99004 was planted at 90 cm row spacing and common dose of 125 kg P_2O_5/ha and 125 kg K_2O/ha were applied at planting. While, nitrogen was applied 250 kg/ha in four splits, viz., 15 per cent at time of planting, 30 per cent at 45 DAP, 20 per cent at 90 DAP and 35 per cent before final earthing up i.e. 150 DAP. Adequate irrigations were given to the crop as per recommendations. The crop was managed as per the standard package of practices. The observations on weed flora, dry weight of weeds at 90 DAP (g/m^2) and at final earthing up (kg/ha) as well as cane yield (t/ha) were taken from the net plot. The data related to each parameter of the experiment were statistically analyzed using MSTATC software. The purpose of analysis of variance was to determine the significant effect of treatments on weed. LSD test at 5 per cent probability level was applied when analysis of variance showed significant effect for treatments (Steel and Torrie, 1980). The net realization was calculated by deducting the total cost of cultivation from the gross realization for each treatment. The benefit cost ratio (BCR) was calculated on the basis of the formula given below:

BCR = Net realization (₹ /ha) / Cost of cultivation (₹ /ha)

RESULTS AND DISCUSSION

Weed flora

Predominant weed species found in the experimental field consisted of monocot weeds like *Cyperusrotundus* L., *Eragrostis major*, *Brachiara* spp., *Oryza sativa* L., *Echinochloa colonum* L. and *Phyllanthus moderaspatenia* L.; and *Alternanthera sessilis* L., *Euphorbia hirta* L., *Digera arvensis* Forsk, *Melilotus indica* (L.), *Physalis minima* L. and *Corchorus acutangulus* L. as dicot weeds; and sedges like *Cyperus rotundus* L. and *Cyperus iria* L

Effect on weed population and dry weight of weed

The data on weed population at 45 and 90 DAP presented in Table 1 clearly indicated that significantly lowest total weed population were noted under conventional method than remaining all the treatments. In case of 45 DAP, significantly lowest number of monocot, dicot, sedges and total weeds were recorded under the treatment having three hand weeding (HW) at 30, 60 and 90 days after planting (DAP) and two interculturing (IC) at 45 and 90 DAP except sedges was found lower under the treatments having atrazine 2.0 kg/ha as

pre-emergence + one HW and one IC at 60 DAP and 2,4-D Amine salt 1.0 kg/ha as post-emergence + atrazine 1.0 kg/ha as post- emergence applied at 30 DAP followed by 60 DAP. While in case of 90 DAP, significantly lowest number of monocot, dicot, sedges and total weeds were recorded under the treatment having three hand weeding (HW) at 30, 60 and 90 days after planting (DAP) and two interculturing (IC) at 45 and 90 DAP. These results are in accordance with findings of Singh *et al.* (2008) and Mohanty and Mishra (2011), who observed minimum weed population with conventional hand weeding and interculturing practices over weedy check. Pendimethalin or Metribuzin or Atrazine 1.0 kg/ha as pre-emergence + Sunnhemp as a smother crop harvested and mulched at 60 DAP were also found significantly superior with respect weed population (monocot, dicot, sedges and total weeds) at 45 and 90 DAP over unweeded control except dicot in 90 DAP. This might be due to application of atrazine, pendimethalin and metribuzin as pre-emergence and also profuse growth of smother crop (sunnhemp) suppressed the weed population and their growth. These results are in conformity with those of Gholve *et al.* (1994), who reported that application of pre-emergence weedicide effectively controlled weeds; Buagohain and Medhi (1999) also observed that green manuring significantly reduced weed population than control. Kathiseran (2000) reported that intercropping of sunnhemp suppressed the weed growth.

Dry weights of weed at 90 DAP and at final earthing up were significantly influenced by various weed management treatments. Three hand weeding (HW) at 30, 60 and 90 days after planting (DAP) and two interculturing (IC) at 45 and 90 DAP recorded the lowest dry weight of weed (63 g/m^2 at 90 DAP) and (1432 kg/ha at final earthing up) (Table 2). While, highest dry weight of weed, i.e. 583 g/m^2 at 90 DAP and 7072 kg/ha at final earthing u) recorded under unweeded control. Most of all the integrated weed management treatments found effective to reduce the dry weight of weeds as compared to unweeded control. These results were as per expectation as conventional method and different herbicide application as pre-emergence and post-emergence and pre-emergence + intercrop (sunnhemp) check weed growth up to 90 DAP and late emerged weeds flush may be smothered by intercrop and vigorous sugarcane crop growth. These results are in accordance with the results obtained by Mishra *et al.* (2003), Singh *et al.* (2003) and Mohanty and Mishra (2011).

Cane yield

Cane yield found significantly higher under the treatment three hand weeding (HW) at 30, 60 and 90 days after planting (DAP) and two interculturing (IC) at 45 and 90 DAP (134.4 t/ha), which was remained on par with the treatments of application of metribuzin 1.0 kg/ha as pre-emergence + one HW and IC at 60 DAP (128.4 t/ha) and atrazine 2.0 kg/ha as pre-emergence + one HW and one IC at 60 DAP (123.9 t/ha) and pendimethalin 1.0 kg/ha as pre-emergence + one HW and IC at 60 DAP (118.5 t/ha) as compared to the unweeded control treatment having lowest cane yield (63.8 t/ha) (Table 2). The increased in yield with these treatments was because of the fact that weed growth remained low from the initial crop growth stages, markedly improved yield attributes. This confirms the results of Singh and Kaur (2003) and Mohanty and Mishra (2011). This is also clear from the negative correlation between most of the growth and yield attributes and dry matter of weeds at final earthing up.

The lower dry weight yield of sunnhemp was observed in the treatment having application of metribuzin 1.0 kg/ha as pre-emergence + sunnhemp as a smother crop harvested and mulched at 60

DAP and atrazine 1.0 kg/ha as pre-emergence + sunnhemp as a smother crop harvested and mulched at 60 DAP due to detrimental effect of metribuzin and atrazine on the germination as well as growth of sunnhemp (Table 2).

Economics

Three hand weeding (HW) at 30, 60 and 90 days after planting (DAP) and two interculturing (IC) at 45 and 90 DAP obtained higher net realization (207.63 x103 ₹ /ha) followed by the treatments of application of metribuzin 1.0 kg/ha as pre-emergence + one HW and IC at 60 DAP (198.81 x103 ₹ /ha) and atrazine 2.0 kg/ha as pre-emergence + one HW and one IC at 60 DAP (187.37 x103 ₹ /ha) (Table 2). However, B:C ratio was found more or less similar among these three best treatments. These results are in partially accordance with those of Patel (2000) and Gholve *et al.* (2001).

CONCLUSION

Based on the results of the field experimentation, it seems quite logical to conclude that potential cane production and economic weed management can be achieved in sugarcane by three hand weeding (HW) at 30, 60 and 90 DAP and two interculturing (IC) at 45 and 90 DAP. However, under scarcity of labours, an application of metribuzin 1.0 kg/ha or atrazine 2 kg/ha as pre-emergence with 500 lit water/ha + one hand weeding and interculturing at 60 DAP is the best option.

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Table 1: Effect of integrated weed management on dry weight of weeds, weed control efficiency and growth parameters of sugarcane.

Treatments	Weed Population / m^2 at 45 DAP				Weed Population/ m^2 at 90 DAP			
	Mono-cots	Dicots	Sedges	Total	Monocots	Dicots	Sedges	Total
Un-weeded control	*5.94 **(35.33)	7.27 (52.85)	1.85 (3.43)	9.57 (91.61)	7.97 (63.6)	7.73 (59.8)	3.51 (12.3)	11.65 (135.70)
Three hand weeding (HW) at 30, 60 and 90 days after planting (DAP) and two interculturing (IC) at 45 and 90 DAP	2.77 (7.67	3.44 (11.85)	1.20 (1.43)	4.58 (20.95)	3.82 (14.6)	3.67 (13.5)	1.92 (3.7)	5.64 (31.80)
Atrazine 2.0 kg/ha as pre-emergence	3.96 (15.67)	4.15 (17.19)	1.33 (1.77)	5.88 (34.63)	4.57 (20.9)	5.67 (32.1)	2.39 (5.7)	7.66 (58.70)
Atrazine 2.0kg/ha as pre-emergence + one HW and one IC at 60 DAP	3.65 (13.33	3.72 (13.85)	1.05 (1.10)	5.32 (28.28)	4.99 (24.9)	4.67 (21.8)	2.30 (5.3)	7.21 (52.00)
Pendimethalin 1.0 kg/ha as pre-emergence + one HW and IC at 60 DAP	4.04 (16.33	4.22 (17.85)	1.20 (1.43)	5.97 (35.61)	5.68 (32.3)	5.43 (29.5)	2.59 (6.7)	8.28 (68.50)
Metribuzin 1.0 kg/ha as pre-emergence + one HW and IC at 60 DAP	3.32 (11.00	3.58 (12.80)	1.33 (1.77)	5.06 (25.57)	4.11 (16.9)	4.34 (18.8)	2.07 (4.3)	6.32 (40.00)
Atrazine 2.0 kg/ha as pre-emergence + 2,4-D Na salt 1.0 kg/ha as post-emergence applied at 60 DAP	5.03 (25.33	6.67 (44.52)	1.33 (1.77)	8.46 (71.62)	7.09 (50.3)	7.99 (63.8)	2.77 (7.7)	11.04 (121.80)
2,4-D Na salt 1.0 kg/ha as post-emergence + paraquat 0.5 kg/ha as post-emergence applied at 30 DAP followed by 60 DAP	4.51 (20.37	5.55 (30.85)	1.45 (2.10)	7.30 (53.32)	6.21 (38.6)	6.72 (45.1)	2.70 (7.3)	9.54 (91.00)
2,4-D Amine salt 1.0 kg/ha as post-emergence + paraquat 0.5 kg/ha as post-emergence applied at 30 DAP followed by 60 DAP	4.32 (18.70	5.28 (27.85)	1.76 (3.10)	7.05 (49.65)	6.05 (36.6)	6.49 (42.1)	2.70 (7.3)	9.27 (86.00)
2,4-D Amine salt 1.0 kg/ha as post-emergence + metribuzin 0.5 kg/ha as post-emergence applied at 30 DAP followed by 60 DAP	4.20 (17.64)	4.57 (20.85)	1.45 (2.10)	6.37 (40.59)	5.94 (35.3)	5.96 (35.5)	2.88 (8.3)	8.89 (79.10)
2,4-D Amine salt 1.0 kg/ha as post-emergence + atrazine 1.0 kg/ha as post- emergence applied at 30 DAP followed by 60 DAP	4.08 (16.67)	4.38 (19.19)	1.05 (1.10)	6.08 (36.96)	5.56 (30.9)	5.92 (35.1)	2.70 (7.3)	8.56 (73.30)
Pendimethalin 1.0 kg/ha as pre-emergence + Sunnhemp as a smother crop harvested and mulched at 60 DAP	5.42 (29.33)	6.60 (43.52)	1.76 (3.10)	8.71 (75.95)	7.27 (52.9)	7.99 (63.8)	3.27 (10.7)	11.29 (127.40)
Metribuzin 1.0 kg/ha as pre-emergence + Sunnhemp as a smother crop harvested and mulched at 60 DAP	4.66 (21.67)	5.96 (35.52)	1.33 (1.77)	7.68 (58.96)	6.53 (42.6)	7.15 (51.1)	2.77 (7.7)	10.07 (101.40)
Atrazine 1.0 kg/ha as pre-emergence + Sunnhemp as a smother crop harvested and mulched at 60 DAP	4.87 (23.67)	6.23 (38.85)	1.45 (2.10)	8.04 (64.62)	7.32 (53.6)	7.04 (49.5)	3.00 (9.0)	10.59 (112.10)
SEm ±	1.02	1.63	0.12	1.94	1.64	1.63	0.38	2.23
CD (P=0.05)	2.84	4.54	0.43	5.40	4.60	4.54	1.04	6.19

**** = Figure out side parenthesis indicates*** $\sqrt{x}$ ***transformed value***

***** = Figure in parenthesis indicates original value***

Table 2: Effect of integrated weed management on yield attributes, cane yield and economics of sugarcane.

Treatment	Dry Weight At 90 DAP (g/m^2)	Dry Weight At Final Earth-ing up (kg/ha)	Weed Control Effici-ency (%)	Weed Index (%)	Cane Yield (t/ha)	Cost of Cultiv-ation ($x10^3$ ₹ /ha)	Net Returns $x10^3$ ₹ /ha)	B:C Ratio
Un-weeded control	583	7072	-	52.49	63.8	127.96	38.00	0.30
Three hand weeding (HW) at 30, 60 and 90 days after planting (DAP) and two interculturing (IC) at 45 and 90 DAP	63	1432	78.60	-	134.4	141.76	207.63	1.46
Atrazine 2.0 kg/ha as pre-emergence	180	3604	49.92	18.69	109.3	129.84	154.24	1.19
Atrazine 2.0kg/ha as pre-emergence + one HW and one IC at 60 DAP	143	2891	56.27	7.82	123.9	134.64	187.37	1.39
Pendimethalin 1.0 kg/ha as pre-emergence + one HW and IC at 60 DAP	195	3699	45.42	11.84	118.5	134.62	173.35	1.29
Metribuzin 1.0 kg/ha as pre-emergence + one HW and IC at 60 DAP	132	3160	69.61	4.43	128.4	135.08	198.81	1.47
Atrazine 2.0 kg/ha as pre-emergence + 2,4-D Na salt 1.0 kg/ha as post-emergence applied at 60 DAP	327	6126	31.62	13.87	115.7	130.49	170.41	1.31
2,4-D Na salt 1.0 kg/ha as post-emergence + paraquat 0.5 kg/ha as post-emergence applied at 30 DAP followed by 60 DAP	257	4657	72.55	19.14	108.7	129.36	153.13	1.18
2,4-D Amine salt 1.0 kg/ha as post-emergence + paraquat 0.5 kg/ha as post-emergence applied at 30 DAP followed by 60 DAP	242	4196	75.50	17.08	111.4	129.43	160.26	1.24
2,4-D Amine salt 1.0 kg/ha as post-emergence + metribuzin 0.5 kg/ha as post-emergence applied at 30 DAP followed by 60 DAP	235	4054	76.89	15.89	113.0	129.96	163.89	1.26
2,4-D Amine salt 1.0 kg/ha as post-emergence + atrazine 1.0 kg/ha as post- emergence applied at 30 DAP followed by 60 DAP	222	3895	39.37	13.69	116.0	129.74	171.83	1.32
Pendimethalin 1.0 kg/ha as pre-emergence + Sunnhemp as a smother crop harvested and mulched at 60 DAP	360	6737	55.96	26.18	99.1 (156.00)**	134.20	123.69	0.92
Metribuzin 1.0 kg/ha as pre-emergence + Sunnhemp as a smother crop harvested and mulched at 60 DAP	265	4907	60.00	20.38	106.9 (52.14)**	134.66	143.51	1.07
Atrazine 1.0 kg/ha as pre-emergence + Sunnhemp as a smother crop harvested and mulched at 60 DAP	303	5407	35.03	27.95	96.8 (118.27)**	133.40	118.33	0.89
SEm ±	21.51	352.42	-	-	6.44	-	-	-
CD (P=0.05)	59.6	1024.4	-	-	17.92	-	-	-

***** Data presented in parenthesis indicates dry weight of sunnhemp (kg/ha)***

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