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Patil PA
Ph.D., Agriculture Officer, Department of Agronomy, Pulses and Castor Research Station, NAU, Navsari, Gujarat, India

Virdia HM
Professor and Head, Department of Agronomy, N.M. College of Agriculture, NAU, Navsari, Gujarat, India

Parmar VT
Agriculture Officer, College of Agriculture, NAU, Bharuch, Gujarat, India

Patel VD
Agriculture Officer, College of Agriculture, NAU, Waghai, Gujarat, India

Patel DK
Agriculture Officer, Cotton Wilt Research Station, NAU, Hansot, Gujarat, India

Corresponding Author:
Patil PA
Ph.D., Agriculture Officer, Department of Agronomy, Pulses and Castor Research Station, NAU, Navsari, Gujarat, India

Effect of weed management on weeds and yield of sugarcane (*Saccharum* Hy. sp.) under South Gujarat condition

Patil PA, Virdia HM, Parmar VT, Patel VD and Patel DK

Abstract
A field experiment was conducted to study the effect of integrated weed management in sugarcane (*Saccharum* Hy. Sp.) under south Gujarat condition during the year 2019-20 and 2020-21.at Main Sugarcane Research Station, Navsari Agricultural University, Navsari revealed that lowest weed population, lowest dry weight of weed (57.94 kg/ha), and higher cane yield (114.25 ton/ha) were secured under treatment of 3 hand weeding at 30, 60 and 90 DAP + 2 IC at 45 and 90 DAP followed by post emergence application of either 2,4-D 80% WP @ 1.0 kg/ha and paraquat 24% SL @ 0.5 kg/ha or halosulfuron methyl 75% WG 90 g/ha as post-emergence applied at 45 DAP followed by IC and HW @ 90 DAP was beneficial for securing higher cane yield and economic returns under south Gujarat condition.

Keywords: *Saccharum*, paraquat, halosulfuron methyl, weed population, weed management

Introduction
Sugarcane (*Saccharum* Hy. sp.) is one of the most important industrial cash crops in both tropical and subtropical region of the world and a major export product of many developing countries. Sugarcane cultivation in India dates back to the Vedic period. The earliest mention of sugarcane cultivation is found in Indian writings of the period 1400 to 1000 B.C. It is a principal raw material for sugar industry as world's 75% sugar comes from sugarcane (Anon., 2013) [1]. It is the main source of sugar, jaggery (gur) and brown sugar (khandsari). Crushed by-products of sugarcane industry like bagasse and molasses also have important uses. Molasses is used in distilleries for the manufacturing of citric acid, ethyl, alcohol *etc.* Press mud is generally used for soil amendment. The upper green part of sugarcane is also used as a fodder for cattle feeding. Owing to its versatile utility and vast capability to meet the demands of human population, it is rightly called as 'Wonder cane'.

A sugarcane crop 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. Weeds compete with crop plants for nutrients, moisture, light, CO_2 and space. Weeds compete throughout the life cycle of main crop but it is more sensitive to presence of weeds at a specific period during its life cycle. It is known as critical period of weed crop competition. During this, period weeds cause maximum yield losses. Critical period of weed-crop competition in sugarcane ranged between 30 to 90 DAP (Patel *et al*., 2006) [2].

After estimation of critical period of weed crop competition, weed control is very essential to harvest maximum yield. Weeds can be controlled manually, mechanically, biologically and chemically. Manual weeds control is laborious, time consuming and expensive than chemical weed control. Mechanical weed control may damage crop plants. Chemical weed control by use of herbicides is one of the methods currently used to control weeds relatively efficient and economical. The effectiveness and relatively low cost of herbicides has resulted in management systems which are reliant upon their continued availability, and has led to almost a total exclusion of non-herbicidal methods of weed control (Little *et al.*, 2006) [3]. Herbicides have little effect on crop growth in comparison with the effects of competition from weeds. They may cause some damage to sugarcane so they must be evaluated for their effects on crop and weeds before giving recommendation for their use (Turner *et al.*, 1990) [4]. Chemical weeding under such circumstances thus may form an excellent alternative to manual weeding.

Continue use of metribuzin and 2, 4-D in sugarcane field the population of grassy and broad-leaved weeds has been decreased whereas, the population of *Cyperus* species has increased

tremendously. *Cyperus rotundus* population has been reported to be 60-80% of total weed flora in sugarcane field in India (Raskar 2004; Roshan *et al.*, 2006) [5, 6].

Materials and Methods

A field experiment was conducted during the year 2019-20 and 2020-21 at at Main Sugarcane Research Station, Navsari Agricultural University, Navsari entitled "Effect of integrated weed management in sugarcane (*Saccharum* Hy. Sp.) under south Gujarat condition". The soil of the experimental plot was clay in texture low in organic carbon. Medium available N (310.34 kg/ha) and available P (38.05 kg/ha) but high available K (303.86 kg/ha) during the first year. While Low, medium and high rating for available nitrogen (230.79 kg/ha), phosphorus (34.89 kg/ha) and potassium (375.33 kg/ha) during the second year study. The soil was found slightly alkaline with normal electric conductivity during the year 2019-20 and 2020-21, respectively.

Twelve weed management treatments *viz*., *viz.,* T_1: Unweeded control, T_2: Metribuzin 70% WP @ 1.0 kg/ha as pre-emergence + IC and HW at 45 DAP, T_3: Metribuzin 70% WP @ 1.0 kg/ha as pre-emergence + Halosulfuron methyl 75% WG @ 90 g/ha as post-emergence applied at 45 DAP, T_4: Metribuzin 70% WP @ 1.0 kg/ha as pre-emergence +Halosulfuron methyl 75% WG 90 g/ha as post-emergence applied at 45 DAP + IC and HW @ 90 DAP, T_5: Metribuzin 70% WP @ 1.0 kg/ha as pre-emergence + 2, 4-D 80% WP @ 1 kg/ha and Paraquat 24% SL @ 0.5 kg/ha applied at 45 DAP, T_6: Metribuzin 70% WP @ 1.0 kg/ha as pre-emergence +2,4-D 80% WP @ 1 kg/ha and Paraquat 24% SL @ 0.5 kg/ha applied at 45 DAP + IC and HW at 90 DAP, T_7: Metribuzin 70% WP @ 1.0 kg/ha as pre-emergence + Chlorimuron ethyl +Metsulfuran Methyl 20% WP @ 49 a.i.g/ha at 45 DAP, T_8: Metribuzin 70% WP @ 1.0 kg/ha as pre-emergence + Chlorimuron ethyl + Metsulfuran Methyl 20% WP @ 49 a.i.g/ha at 45 DAP+ IC and HW @ 90 DAP, T_9: Glyphosate 41% SL @ 1 kg/ha at 20 DAP + HW at 60 DAP + IC and HW at 90 DAP, T_{10}: Pendamethalin 30% EC @ 1.0 kg/ha as pre-emergence + 2 IC and HW at 45 and 90 DAP, T_{11}: Pendamethalin 30% EC @ 1.0 kg/ha as pre-emergence + Sunhemp as intercrop sowing at planting (smother crop) and mulched at 45 DAP, T_{12}: 3 HW at 30, 60 and 90 DAP + 2 IC at 45 and 90 DAP were evaluated in randomized block design with three replications. The crop was fertilized with recommend dose of 250-125-1250 kg NPK/ha. Herbicide spraying was done through a flat fan nozzle attached with the hood of sprayer.

Results and Discussion

Effect on weeds

The experimental field was infested by number of weed species. Among monocot weeds *viz*., *Echinochloa crusgalli* (L.) Beauv, *Digitaria sanguinalis* (L.) Scop., *Sorghum halepense* (L.) Pers., *Cynodon dactylon* (L.) Pers. and *Bracharia* spp.; dicot weeds, *viz*., *Amaranthus viridis* L., *Alternanthera sessilis*, *Digera arvensis* Forsk, *Convolvulus arvensis* L., *Trianthema portulacastrum*, *Euphorbia hirta* L., *Euphorbia maduraspti*ensis and *Physalis minima* L. and sedges *Cyperus rotundus* (L.) observed in unweeded control plot during the course of experimentation.

Significantly the highest weed population (Table-1) of monocot, dicot, and sedge were noted under unweeded control (T_1) at all the growth stages of sugarcane. All the weed management treatments significantly reduced the population of weeds compared to unweeded control. At all the different stages of plant growth, T_{12} (3 HW at 30, 60 and 90 DAP + 2 IC at 45 and 90 DAP) treatment recorded significantly the lowest weed population. It was remained statistically similar with treatment T_4 and T_6 during both the years for monocot, dicot as well as sedges at 45 DAP. Weed population at 60 DAP was found treatment T_{12} has lowest number of monocot, dicot and sedges weed. Which was found statistically at par with the treatments T_3, T_4, T_5 and T_6 during both the years. However, maximum number of monocot weeds were recorded under the treatment T_1 (unweeded control) during the individual year and the treatment T_{11} (Pendamethalin 30% EC @ 1.0 kg/ha as pre-emergence + Sunnhemp as intercrop sowing at planting (smother crop) and mulched at 45 DAP) recorded statistically at par values of monocot weed population at 60 DAP. While treatment T_3, T_4 and T_6 for sedges as well as treatment T_4 and T_6 for dicot. Weed population at 90 DAP was significantly influenced by various weed manangement treatments. Among the different treatment tried, treatment T_{12} (3 HW at 30, 60 and 90 DAP + 2 IC at 45 and 90 DAP) recorded significantly the lowest number of monocot, dicot as well as sedges weed per sq.m. as compared to rest of the treatments. It remained at par with the treatments T_3, T_4, and T_6 during both years in case of monocot, while in case of dicot it remained at par with treatments T_4 and T_6. Whereas sedges weed population it remained at par the treatments T_3 and T_4 during both the years. While weed population at harvest treatment T_{12} was found lower number of monocot, dicot and sedges per sq.m. It remained at par with T_3, T_4, and T_6 during both the years in case of monocot and sedges as well as treatment T_4 and T_6 for dicot. These results are in accordance with the findings of Singh *et al.* (2008) [13] who observed minimum weed population with conventional hand weeding practices over weedy check. This might be due to application of metribuzin 70% WP @ 1.0 kg/ha as pre-emergence effectively work by absorbing through roots and germinating weed shoots at initial stage thereby suppressed the weed population and their growth. The post emergence weedicide effectively controls the late germinating weeds by their mode of action. This was in agreement with findings of Jayabal and Chokalingam (1990) [7], Patel (2000) [8] also observed marked reduction in dicot weeds at 45 and 90 DAP; these results are in conformity with Patel (2004) [9] and Bhullar *et al.* (2006) [10] who reported that application of pre-emergence weedicide effectively controlled the weeds; these result also in conformity with Mansuri *et al.* (2014) [11].

Dry weight of weeds at 30 DAP was recorded lower under the treatment T_{12} (Three HW at 30, 60 and 90 DAP + Two IC at 45 and 90 DAP) during both the years as well as in pooled data which was found statistically at par with the treatments T_2, T_3, T_4, T_5, T_6, T_8 and T_9 in pooled analysis. Dry weight of weeds at 45 DAP was recorded significantly lower under the treatment T_{12} during both the years as well as in pooled analysis which was found statistically at par with the treatments T_4 and T_6 during the first year of experimentation. While, in the second year study it remained at par only with the treatment T_4 only. Dry weight of weeds at 60 DAP was recorded significantly lower under the treatment T_{12} during both the years as well as in pooled data which was found at par with the treatment T_4, and T_6 during both the years. Dry weight of weeds at 90 DAP was recorded significantly lower under the treatment T_{12} during both the years as well as in

pooled data which was found statistically at par with the treatments T_3, T_4 and T_6 during both the years of experimentation. While, in the pooled analysis study it remained at par only with the treatment T_4. Dry weight of weeds at harvest was recorded significantly lower under the treatment T_{12} during both the years as well as in pooled data which was found statistically at par with the treatments T_4 and T_6 during both the years of experimentation. These results are supported by Ndarubu *et al.* (2000), Patel (2000) [8], Bhullar *et al.* (2006) [10], Singh *et al.* (2008) [13], Mohanty and Mishra (2011) [14].

Table 1: Weed population at 30 DAP as influenced by different treatments of weed management

Treatments	Weed counts/m² at 30 DAP																	
	Monocot				Dicot				Sedges				Total					
	2019-20		2020-21		2019-20		2020-21		2019-20		2020-21		2019-20		2020-21		Pooled	
T_1	(2.85)	7.67	(2.61)	6.33	(2.86)	7.67	(2.91)	8.00	(3.34)	10.67	(3.44)	11.33	(5.01)	26.00	(5.11)	25.67	(5.12)	25.83
T_2	(2.47)	5.67	(2.54)	6.00	(2.67)	6.67	(2.73)	7.00	(3.18)	9.67	(3.29)	10.33	(4.74)	22.00	(4.88)	23.33	(4.81)	22.67
T_3	(2.41)	5.33	(2.55)	6.00	(2.54)	6.00	(2.60)	6.33	(3.12)	9.33	(3.13)	9.33	(4.60)	20.67	(4.70)	21.67	(4.65)	21.17
T_4	(2.41)	5.33	(2.48)	5.67	(2.48)	5.67	(2.61)	6.33	(3.02)	8.67	(3.13)	9.33	(4.49)	19.67	(4.67)	21.33	(4.59)	20.50
T_5	(2.41)	5.33	(2.54)	6.00	(2.61)	6.33	(2.68)	6.67	(3.13)	9.33	(3.24)	10.00	(4.63)	21.00	(4.81)	22.67	(4.72)	21.83
T_6	(2.41)	5.33	(2.54)	6.00	(2.48)	5.67	(2.61)	6.33	(3.02)	8.67	(3.06)	9.00	(4.49)	19.67	(4.67)	21.33	(4.58)	20.50
T_7	(2.54)	6.00	(2.54)	6.00	(2.73)	7.00	(2.79)	7.33	(3.19)	9.67	(3.28)	10.33	(4.81)	22.67	(4.90)	23.67	(4.86)	23.17
T_8	(2.48)	5.67	(2.48)	5.67	(2.60)	6.33	(2.67)	6.67	(3.13)	9.33	(3.24)	10.00	(4.67)	21.33	(4.78)	22.33	(4.72)	21.83
T_9	(2.48)	5.67	(2.55)	6.00	(2.68)	6.67	(2.68)	6.67	(3.18)	9.67	(3.29)	10.33	(4.74)	22.00	(4.85)	23.00	(4.79)	22.50
T_{10}	(2.61)	6.33	(2.61)	6.33	(2.80)	7.33	(2.85)	7.67	(3.34)	10.67	(3.38)	11.00	(4.98)	24.33	(5.05)	25.00	(5.00)	24.67
T_{11}	(2.54)	6.00	(2.54)	6.00	(2.80)	7.33	(2.80)	7.33	(3.29)	10.33	(3.34)	10.67	(4.92)	23.67	(4.95)	24.00	(4.93)	23.83
T_{12}	(2.35)	5.00	(2.41)	5.33	(2.41)	5.33	(2.48)	5.67	(2.96)	8.33	(3.07)	9.00	(4.38)	18.67	(4.52)	20.00	(4.46)	19.33
SEm ±	0.110		0.099		0.096		0.102		0.139		0.152		0.140		0.137		0.107	
CD (P=0.05)	NS		NS		NS		NS		NS		NS		NS		NS		NS	
CV%	7.68		6.54		6.27		6.56		7.60		8.12		5.14		4.70		4.95	
	Year								Interaction (YxT)									
SEm ±	NS								0.136									
CD (P=0.05)									NS									
Data transformed to square root (√X+0.5) transformation. Figure in parentheses are transformed values.																		

Effect on crop

Various weed management practices have marked effect on cane yield (t/ha) during both the years of experimentation and treatment T_{12} (Three HW at 30, 60 and 90 DAP + Two IC at 45 and 90 DAP) recorded significantly the highest cane yield during both the years of experimentation as well as in pooled, respectively, which was found at par with treatments T_3, T_4, T_5 and T_6 during both the years as well as in pooled analysis. While, the lowest cane yield noted under unweeded control (T_1) during both the years as well as in pool, respectively. The increase in yield with treatment T_{12} was 63 percent over control treatment (T_1), respectively. This is an agreement with the findings of Kabir *et al.*, (2000) [15], Bhullar *et al.* (2006) [10], Singh *et al.* (2008) [13], Mohanty and Mishra (2011) [14], Singh *et al.* (2016) [16], Krishnaprabu (2020) [17] and Maurya *et al.* (2020) [18].

Table 2: Weed population at 45 DAP as influenced by different treatments of weed management

Treatments	Weed counts/m² at 45 DAP																	
	Monocot				Dicot				Sedges				Total					
	2019-20		2020-21		2019-20		2020-21		2019-20		2020-21		2019-20		2020-21		Pooled	
T_1	(4.10)	16.33	(4.02)	15.67	(4.18)	17.00	(4.06)	16.00	(3.18)	9.67	(3.13)	9.33	(6.59)	43.00	(6.44)	41.00	(6.52)	42.00
T_2	(3.38)	11.00	(3.08)	9.00	(3.44)	11.33	(3.39)	11.00	(2.68)	6.67	(2.26)	4.67	(5.43)	29.00	(5.01)	24.67	(5.22)	26.83
T_3	(2.79)	7.33	(3.08)	9.00	(2.68)	6.67	(2.86)	7.67	(1.77)	2.67	(1.85)	2.98	(4.14)	16.67	(4.49)	19.65	(4.31)	18.16
T_4	(2.34)	5.00	(2.80)	7.33	(2.04)	3.67	(2.54)	6.00	(1.34)	1.33	(1.57)	2.03	(3.24)	10.00	(3.98)	15.37	(3.61)	12.68
T_5	(2.97)	8.33	(3.24)	10.00	(2.97)	8.33	(2.97)	8.33	(1.95)	3.33	(2.01)	3.64	(4.53)	20.00	(4.74)	21.97	(4.63)	20.99
T_6	(2.41)	5.33	(2.86)	7.67	(2.20)	4.33	(2.61)	6.33	(1.46)	1.67	(1.66)	2.29	(3.44)	11.33	(4.10)	16.29	(3.77)	13.81
T_7	(2.97)	8.33	(3.13)	9.33	(2.80)	7.33	(3.53)	12.00	(3.02)	8.67	(2.41)	5.33	(4.98)	24.33	(5.21)	26.67	(5.09)	25.50
T_8	(2.97)	8.33	(3.19)	9.67	(2.79)	7.33	(3.19)	9.67	(2.34)	5.00	(2.04)	3.67	(4.60)	20.67	(4.85)	23.00	(4.72)	21.83
T_9	(3.29)	10.33	(3.29)	10.33	(3.29)	10.33	(3.27)	10.33	(2.60)	6.33	(2.19)	4.33	(5.24)	27.00	(5.05)	25.00	(5.14)	26.00
T_{10}	(3.97)	15.33	(3.89)	14.67	(3.89)	14.67	(3.89)	14.67	(3.06)	9.00	(2.65)	6.67	(6.28)	39.00	(6.03)	36.00	(6.16)	37.50
T_{11}	(3.29)	10.33	(3.58)	12.33	(3.29)	10.33	(3.67)	13.00	(3.02)	8.67	(2.60)	6.33	(5.46)	29.33	(5.67)	31.67	(5.56)	30.50
T_{12}	(2.12)	4.00	(2.61)	6.33	(1.95)	3.33	(2.27)	4.67	(1.34)	1.33	(1.39)	1.44	(3.03)	8.66	(3.60)	12.44	(3.31)	10.55
SEm ±	0.11		0.09		0.09		0.12		0.13		0.14		0.092		0.111		0.186	
CD (P=0.05)	0.32		0.27		0.27		0.36		0.39		0.42		0.27		0.32		0.58	
CV%	6.15		4.95		5.42		6.68		9.83		11.53		3.36		3.88		3.64	
	Year								Interaction (YxT)									
SEm ±	NS								0.102									
CD (P=0.05)									NS									
Data transformed to square root (√X+0.5) transformation. Figure in parentheses are transformed values.																		

Table 3: Weed population at 60 DAS as influenced by different treatments of weed management

Treatments	Weed counts/m² at 60 DAP															
	Monocot				Dicot				Sedges				Total			
	2019-20		2020-21		2019-20		2020-21		2019-20		2020-21		2019-20		2020-21		Pooled	
T_1	(5.27)	27.50	(4.81)	22.70	(4.77)	22.33	(4.55)	20.33	(2.80)	7.33	(2.73)	6.95	(7.59)	57.17	(7.10)	49.99	(7.34)	53.58
T_2	(4.18)	17.23	(4.14)	16.65	(3.97)	15.33	(3.89)	14.67	(2.26)	4.67	(2.10)	3.94	(6.14)	37.23	(5.98)	35.26	(6.06)	36.24
T_3	(3.49)	11.65	(3.13)	9.34	(3.33)	10.67	(3.18)	9.67	(1.77)	2.67	(1.39)	1.48	(5.05)	24.98	(4.57)	20.49	(4.81)	22.74
T_4	(3.19)	9.68	(3.08)	9.00	(2.61)	6.33	(2.96)	8.33	(1.58)	2.00	(1.36)	1.36	(4.30)	18.01	(4.38)	18.69	(4.34)	18.35
T_5	(3.58)	12.33	(3.12)	9.35	(3.39)	11.00	(3.19)	9.67	(1.87)	3.00	(1.77)	2.65	(5.18)	26.33	(4.70)	21.67	(4.94)	24.00
T_6	(3.39)	11.00	(3.13)	9.33	(2.6)	6.67	(2.86)	7.67	(1.68)	2.33	(1.37)	1.39	(4.53)	20.00	(4.34)	18.39	(4.44)	19.20
T_7	(4.49)	19.70	(4.26)	17.65	(4.1)	16.67	(4.06)	16.00	(2.34)	5.00	(2.19)	4.32	(6.47)	41.37	(6.20)	37.97	(6.34)	39.67
T_8	(3.89)	14.69	(4.03)	15.71	(3.89)	14.67	(3.70)	13.33	(1.95)	3.33	(1.87)	3.01	(5.76)	32.69	(5.70)	32.05	(5.73)	32.37
T_9	(4.10)	16.32	(4.10)	16.34	(3.93)	15.00	(4.10)	16.33	(2.04)	3.67	(2.04)	3.65	(5.96)	34.99	(6.07)	36.32	(6.01)	35.66
T_{10}	(4.85)	23.21	(4.41)	19.03	(4.20)	17.33	(4.14)	16.67	(2.67)	6.67	(2.41)	5.33	(6.89)	47.21	(6.44)	41.02	(6.66)	44.11
T_{11}	(4.60)	20.81	(4.30)	18.23	(4.18)	17.00	(4.26)	17.67	(2.41)	5.33	(2.27)	4.65	(6.60)	43.14	(6.40)	40.55	(6.50)	41.85
T_{12}	(3.08)	9.00	(2.67)	6.69	(2.18)	4.33	(2.61)	6.33	(1.58)	2.00	(1.23)	1.00	(3.97)	15.33	(3.81)	14.03	(3.89)	14.68
SEm ±	0.20		0.16		0.17		0.14		0.070		0.084		0.15		0.16		0.11	
CD (P=0.05)	0.60		0.48		0.51		0.42		0.20		0.25		0.45		0.47		0.32	
CV%	8.82		7.58		8.39		6.77		5.80		7.67		4.70		5.08		4.89	
	Year								Interaction (YxT)							
SEm ±	NS								0.157							
CD (P=0.05)									NS							
Data transformed to square root (√X+0.5) transformation. Figure in parentheses are transformed values.																

Table 4: Weed population at 90 DAS as influenced by different treatments of weed management

Treatments	Weed counts/m² at 90 DAP															
	Monocot				Dicot				Sedges				Total			
	2019-20		2020-21		2019-20		2020-21		2019-20		2020-21		2019-20		2020-21		Pooled	
T_1	(5.40)	28.68	(5.18)	26.34	(5.76)	32.69	(5.58)	30.64	(3.98)	15.34	(3.57)	12.29	(8.79)	76.71	(8.35)	69.27	(8.57)	72.99
T_2	(4.41)	19.01	(4.36)	18.57	(5.08)	25.33	(4.81)	22.67	(3.24)	10.00	(2.86)	7.67	(7.40)	54.34	(7.02)	48.91	(7.21)	51.63
T_3	(3.48)	11.67	(2.97)	8.34	(4.02)	15.70	(3.84)	14.39	(2.04)	3.67	(1.46)	1.66	(5.61)	31.04	(4.98)	24.39	(5.30)	27.72
T_4	(3.37)	11.08	(2.85)	7.65	(3.13)	9.33	(2.67)	6.68	(2.12)	4.00	(1.34)	1.33	(4.97)	24.41	(4.02)	15.66	(4.49)	20.04
T_5	(3.89)	14.66	(3.72)	13.33	(4.14)	16.68	(3.93)	15.02	(2.74)	7.00	(2.34)	4.98	(6.23)	38.34	(5.82)	33.33	(6.02)	35.83
T_6	(3.44)	11.33	(2.98)	8.37	(3.18)	9.67	(2.73)	7.02	(2.27)	4.67	(1.85)	2.98	(5.11)	25.66	(4.33)	18.36	(4.72)	22.01
T_7	(4.63)	20.99	(4.53)	20.01	(5.12)	25.96	(4.91)	23.79	(3.38)	11.02	(3.08)	9.01	(7.64)	57.97	(7.30)	52.82	(7.47)	55.40
T_8	(4.05)	16.06	(4.01)	15.64	(4.55)	20.35	(4.38)	18.67	(2.90)	8.01	(2.54)	5.98	(6.69)	44.42	(6.39)	40.28	(6.54)	42.35
T_9	(4.22)	17.34	(4.10)	16.33	(4.88)	23.31	(4.45)	19.37	(3.08)	9.00	(2.73)	6.98	(7.08)	49.66	(6.57)	42.68	(6.83)	46.17
T_{10}	(5.01)	24.74	(4.79)	22.43	(5.38)	28.52	(5.24)	26.99	(3.76)	13.68	(3.39)	10.99	(8.20)	66.94	(7.80)	60.41	(8.00)	63.67
T_{11}	(4.71)	21.69	(4.55)	20.26	(5.14)	26.00	(5.08)	25.35	(3.58)	12.33	(3.28)	10.28	(7.78)	60.02	(7.51)	55.89	(7.64)	57.96
T_{12}	(2.96)	8.37	(2.66)	6.65	(2.68)	6.67	(2.27)	4.67	(1.77)	2.67	(1.22)	1.00	(4.25)	17.71	(3.58)	12.32	(3.91)	15.01
SEm ±	0.183		0.122		0.179		0.176		0.130		0.093		0.188		0.143		0.12	
CD (P=0.05)	0.54		0.36		0.53		0.52		0.38		0.27		0.55		0.42		0.34	
CV%	7.69		5.44		7.01		7.34		7.74		6.51		4.89		4.04		4.52	
	Year								Interaction (YxT)							
SEm ±	NS								0.167							
CD (P=0.05)									NS							
Data transformed to square root (√X+0.5) transformation. Figure in parentheses are transformed values.																

Table 5: Weed population at harvest as influenced by different treatments of weed management

Treatments	Weed counts/m² at harvest															
	Monocot				Dicot				Sedges				Total			
	2019-20		2020-21		2019-20		2020-21		2019-20		2020-21		2019-20		2020-21		Pooled	
T_1	(5.03)	25.13	(4.85)	23.00	(5.48)	29.70	(5.45)	29.42	(2.61)	6.35	(2.41)	5.33	(7.84)	61.19	(7.63)	57.76	(7.74)	59.47
T_2	(3.97)	15.35	(4.01)	15.72	(4.57)	20.59	(4.49)	19.77	(2.28)	4.79	(2.11)	4.00	(6.41)	40.73	(6.32)	39.49	(6.37)	40.11
T_3	(2.79)	7.34	(2.86)	7.67	(3.44)	11.50	(3.49)	11.71	(1.86)	2.96	(1.77)	2.67	(4.70)	21.80	(4.75)	22.05	(4.73)	21.92
T_4	(2.55)	6.01	(2.73)	6.99	(2.61)	6.43	(2.72)	6.93	(1.78)	2.69	(1.68)	2.33	(3.94)	15.14	(4.09)	16.26	(4.01)	15.70
T_5	(3.53)	12.01	(3.02)	8.67	(3.67)	13.02	(3.67)	13.02	(2.12)	4.00	(1.87)	3.00	(5.43)	29.03	(5.02)	24.69	(5.23)	26.86
T_6	(2.73)	7.00	(2.74)	7.00	(2.67)	6.63	(2.86)	7.72	(1.88)	3.03	(1.77)	2.67	(4.14)	16.66	(4.22)	17.39	(4.18)	17.03
T_7	(4.25)	17.70	(4.26)	17.71	(4.57)	20.45	(4.60)	20.78	(2.27)	4.69	(2.20)	4.33	(6.58)	42.84	(6.58)	42.83	(6.58)	42.83
T_8	(3.76)	13.67	(3.24)	10.01	(3.59)	12.50	(3.29)	10.42	(2.12)	4.00	(1.95)	3.33	(5.53)	30.17	(4.92)	23.76	(5.22)	26.97
T_9	(3.83)	14.39	(3.60)	12.77	(3.34)	10.73	(2.74)	7.02	(2.20)	4.35	(2.04)	3.67	(5.45)	29.47	(4.87)	23.46	(5.16)	26.46
T_{10}	(4.65)	21.49	(4.67)	21.34	(3.63)	12.67	(3.19)	9.73	(2.55)	6.00	(2.27)	4.67	(6.36)	40.16	(6.02)	35.74	(6.19)	37.95
T_{11}	(4.53)	20.00	(4.38)	18.69	(4.60)	20.73	(4.68)	21.47	(2.35)	5.08	(2.20)	4.33	(6.80)	45.80	(6.71)	44.50	(6.76)	45.15
T_{12}	(2.20)	4.33	(2.34)	5.01	(2.04)	3.67	(2.34)	5.00	(1.68)	2.37	(1.58)	2.00	(3.30)	10.38	(3.53)	12.01	(3.41)	11.19
SEm ±	0.21		0.18		0.22		0.19		0.10		0.08		0.23		0.17		0.14	

CD (P=0.05)	0.61	0.54	0.64	0.56	0.30	0.25	0.67	0.50	0.41
CV%	9.87	8.94	10.26	9.16	8.13	7.33	7.18	5.48	6.41
	Year				**Interaction (YxT)**				
SEm ±	NS				0.202				
CD (P=0.05)					NS				
Data transformed to square root (√X+0.5) transformation. Figure in parentheses are transformed values.									

Table 6: Periodical dry weight of weeds as influenced by different treatments of weed management

Treatments	Dry weight of weeds (g/m^2) at								
	30 DAP			45 DAP			60 DAP		
	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled
T_1	97.24	95.62	96.43	190.52	195.62	193.07	262.55	242.36	252.46
T_2	83.20	86.25	84.73	152.01	154.14	153.07	179.53	161.14	170.34
T_3	79.89	83.17	81.53	87.49	90.55	89.02	117.28	110.21	113.75
T_4	78.19	81.51	79.85	66.43	67.84	67.13	76.97	74.00	75.49
T_5	80.93	83.84	82.38	120.20	121.48	120.84	132.31	128.22	130.26
T_6	81.86	81.88	81.87	73.68	73.08	73.38	78.11	76.36	77.23
T_7	84.21	86.98	85.60	108.10	128.98	118.54	195.84	186.68	191.26
T_8	81.85	84.85	83.35	97.47	112.72	105.10	151.89	155.48	153.69
T_9	82.82	85.51	84.17	143.70	151.64	147.67	163.63	157.14	160.39
T_{10}	87.12	88.76	87.94	171.41	174.94	173.18	236.94	220.41	228.67
T_{11}	85.59	88.33	86.96	133.52	158.72	146.12	212.22	199.85	206.03
T_{12}	76.89	80.23	78.56	48.52	49.60	49.06	60.25	55.62	57.94
SEm ±	3.50	3.18	2.37	9.21	7.22	5.85	6.22	7.25	4.77
CD (P=0.05)	NS	NS	6.75	27.01	21.17	16.69	18.23	21.26	13.62
CV%	7.28	6.44	6.87	13.74	10.14	11.97	6.92	8.52	7.72
	Year	**Interaction (YxT)**		**Year**	**Interaction (YxT)**		**Year**	**Interaction (YxT)**	
SEm ±	NS	3.35		NS	8.27		NS	6.75	
CD (P=0.05)		NS			NS			NS	

Table 7: Periodical dry weight of weeds as influenced by different treatments of weed management

Treatments	Dry weight of weeds at					
	90 DAP (g/m^2)			Harvest (kg/ha)		
	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled
T_1	401.69	387.26	394.47	297.34	297.26	297.30
T_2	285.98	255.72	270.85	183.01	176.91	179.96
T_3	108.97	94.89	101.93	112.48	107.08	109.78
T_4	96.50	78.92	87.71	88.84	81.25	85.04
T_5	193.95	173.27	183.61	119.06	127.00	123.03
T_6	106.21	90.13	98.17	90.44	84.55	87.49
T_7	314.41	280.84	297.62	208.67	195.72	202.20
T_8	203.69	188.59	196.14	142.70	144.46	143.58
T_9	259.01	231.13	245.07	161.04	148.27	154.66
T_{10}	382.10	366.91	374.51	260.09	216.21	238.15
T_{11}	348.97	312.84	330.91	255.51	202.50	229.01
T_{12}	80.23	68.79	74.51	60.26	55.62	57.94
SEm ±	12.20	10.03	7.90	11.44	10.27	7.69
CD (P=0.05)	35.78	29.40	22.52	33.56	30.14	21.93
CV%	9.12	8.24	8.74	12.02	11.63	11.84
	Year	**Interaction (YxT)**		**Year**	**Interaction (YxT)**	
SEm ±	NS	11.17		NS	10.87	
CD (P=0.05)		NS			NS	

Table 8: Cane yield of sugarcane as influenced by different treatments of weed management

Treatments	Cane yield (t/ha)		
	2019-20	2020-21	Pooled
T_1	68.00	72.00	70.00
T_2	81.00	88.00	84.50
T_3	105.90	108.40	107.15
T_4	107.50	113.80	110.65
T_5	102.40	107.80	105.10
T_6	106.00	110.90	108.45
T_7	79.80	84.30	82.05
T_8	91.00	99.60	95.30
T_9	89.70	98.40	94.05

T_{10}	76.60	80.50	78.55
T_{11}	74.00	78.60	76.30
T_{12}	113.00	115.50	114.25
SEm ±	4.91	4.55	3.35
CD (P=0.05)	14.40	13.34	9.54
CV%	9.32	8.16	8.73
Interaction (YxT)			
SEm ±	4.73		
CD (P=0.05)	NS		

Conclusion

Result from the two years of experimentation, shows that to reduced weed population by application of pre emergence weedicide metribuzin 70% WP @ 1.0 kg/ha and should be followed by post emergence application of either 2,4-D 80% WP @ 1.0 kg/ha and paraquat 24% SL @ 0.5 kg/ha or halosulfuron methyl 75% WG 90 g/ha as post-emergence applied at 45 DAP followed by IC and HW @ 90 DAP was beneficial for securing higher cane yield and economic returns under south Gujarat condition.

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