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Research Article

WEED DYNAMICS, MORPHO-PHYSIOLOGICAL INDICES AND YIELD OF SUGARCANE (*Saccharum officinarum* L.) AS INFLUENCED BY FERTILIZER LEVELS AND WEED MANAGEMENT

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Abstract- Effect of different fertilizer levels and weed management in sugarcane was laid out during the year 2016–17 and 2017–18 at Navsari Agricultural University, Navsari. Results revealed that the highest cane yield was obtained with treatment F_3 (125 % RDF) and it was remained at par with treatment F_2 (100 % RDF).While sugarcane equivalent yield, LAI, AGR, RGR and NAR was observed highest under the treatment F_3 (125 % RDF) followed by treatment (F_2). The dose of 125% RDF was found economically sounder, as it generated the highest benefit: cost ratio of 2.42. While, the lowest gross B: C ratio of 1.79 was obtained under F_1 (75 % RDF) treatment. All the yield attributes and yield were found higher under the treatment W_2. Consequently, treatment W_2 proved efficient in controlling the weed population, lowest nutrient uptake and dry-matter production at all the growth stages, as evident by the highest weed control efficiency. Treatment W_2 (Three HW at 30, 60 & 90 DAP + Two IC at 45 & 90 DAP) was recorded significantly the highest cane yield of 113.7 t/ha and it was remained at par with treatment W_6. While, the lowest cane yield of 78.4 t/ha were noted under weedy check (W_1). The highest B:C ratio (2.68) were obtained with the treatment W_5 (Pendimethalin 1.0 kg/ha as pre-emergence + gram as an intercrop) followed by treatment W_2 and W_6. While, the lowest B:C ratio (1.75) was obtained under W_1 (Weedy check) treatment.

Keywords- *Weed, Growth analysis, Quality, Nutrient content & uptake, Cane yield*

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Introduction

Sugarcane (*Saccharum officinarum* L.) is an important crop and widely cultivated for cane sugar. Weeds have been a great problem in sugar production. Effect of weeds on the early growth of the plant cannot be compensated at the late stages as it caused substantial reduction in yield and yield components. Heavy infestation of weeds comprising grasses, broad-leaf weeds and sedges poses a big challenge for sugarcane production. Initial slow growth and wider row spacing in sugarcane provides ample opportunity for weeds to easily occupy vacant space between rows and offer serious competition to crop. Good sunshine and intermittent rains during early monsoon provide congenial environment for excessive growth of weeds. Besides nutrient removal, weeds inflict greater reduction in sugarcane yield when compared with other pests. Negligent attitude of farmers towards weed management is the most important among them as the losses due to weeds ranges from 40% reduction in cane yield to total crop failure depending on the spectrum of weeds, planting season, soil type, rainfall, duration and time of weed competition [1]. Nutrient management is an important factor for increasing yields. However, potential of the fertilizer can be harnessed successfully only if the weeds are managed effectively. The N, P and K fertilizers, being mostly imparted are relatively more costly and not used by the farmers in adequate amount resulting in to stagnation or decline in sugarcane productivity over the years [2]. Considering these facts, the present investigation was conducted to evaluate different fertility levels and weed-management practices in sugarcane.

Materials and methods

A field experiment was conducted during 2016-17 and 2017-18 at the research farm of Navsari agricultural University, Navsari (20°57'N latitude, 72°54'E longitude) Gujarat. The soil was clay in texture, having organic carbon (0.38 and 0.42 %), medium in available nitrogen (236 and 242 kg/ha) and phosphorus (23.6 and 21.8 kg/ha), fairly rich in available potassium 152 (433 and 413 kg/ha) and slightly alkaline in reaction (pH 7.9 and 8.1) with normal electrical conductivity (0.36 and 0.38), respectively.

Total eighteen treatment combinations consisting of three treatment of fertilizer levels F_1: 75% RDF (187.5-93.7-93.7 N:P_2O_5:K_2O kg/ha), F_2: 100% RDF (250-125-125 N:P_2O_5:K_2O kg/ha), F_3: 125% RDF (312.5-156.2-156.2 N:P_2O_5:K_2O kg/ha) and six treatments of weed management W_1: Weedy check, W_2: Three hand weedings at 30, 60 & 90 DAP + Two IC at 45 & 90 DAP, W_3: Atrazine 2.0 kg/ha as a pre emergence + One HW and IC at 60 DAP, W_4: Metribuzin 1.5 kg/ha as pre emergence + One HW and IC at 60 DAP, W_5: Pendimethalin 1.0 kg/ha as pre emergence + Gram as an intercrop, W_6: Pendimethalin 1.0 kg/ha as pre emergence + Sunnhemp as green manure crop harvested and mulched it at 50-60 DAP and incorporated at final earthing up were evaluated in factorial randomized block design with three replications.

A variety of sugarcane 'CoN-9072' was planted on 3rd and 20th December of the year 2016 and 2017, respectively on leveled soil by opening 15 cm deep furrow at 90 cm row spacing. Two eye budded setts obtained from sugarcane variety were used @ 50,000 per hectare.

Two eye budded setts were planted in furrows after treating with 0.1 percent solution each of Emisan and Melathion for control of fungal and insect infestation. All the recommended agronomic practices were followed throughout the cropping period. The crop was harvested on 11th and 25th December of the year 2017 and 2018, respectively.

The required quantities of well decomposed FYM 10 t/ha were calculated for gross plot area and uniformly applied to all the experimental units before planting during both the years. The required quantity of urea, single super phosphate (SSP) and muriate of potash (MOP) for gross plot area were worked out as per treatment. The full quantity of SSP and MOP was applied as basal. Whereas, urea was applied in four splits as 15 percent N at the time of planting, 30 percent N at 45 days after planting, 20 percent N at 90 days after planting and 35 percent N before final earthing-up *i.e*. 150 days after planting fertilizers were manually applied uniformly in all the experimental units during both the years. All the herbicides were applied with the help of manually operated knapsack sprayer fitted with a flat fan nozzle using a volume spray of 600 liters water/ha. However, the intercrops *viz*., gram (cv. GJG-5) and sunnhemp were sown three days after the planting in between the two rows of sugarcane crop. Gram seeds were dibbled manually (two seeds at each spot) in the opened lines of treatment plots keeping the distance of 30 cm apart and 10 cm within the row using the seed rate of 60 kg per hectare. While the sunnhemp seeds were broadcasted between the row using a seed rate of 80 kg per hectare [3-8].

Weed counts were taken by random placing an iron quadrate measuring 1.0 square meter area in each net plot at 45 and 90 days after planting. Periodical counts *i.e*., at 45 and 90 days after planting were made from the same area. The number of monocots (grasses + sedges) and dicots falling within the quadrate were counted and recorded. For dry weight, weed samples were collected twice, first at 90 DAP from 1.0 square meter area and expressed as g/m^2 and second at the time of final earthing up from entire net plot area of each plot and expressed as kg/ha. These samples were sun-dried and then finally dried in the electrical oven at 65 0C for 24 hours. The dry weight of weeds was recorded when samples attained a constant weight and expressed in g/m^2 and weed control efficiency (WCE) and weed index (WI) were calculated by using standard formula.

Observations on growth characters *viz*., yield character *viz*., millable cane length (cm), girth of cane (cm), number of internodes, single cane weight (g), number of millable canes, cane yield (t/ha) and sugarcane equivalent yield (t/ha) were recorded at the time of harvest.

Whole cane samples were taken at the time of harvest and analyzed for quality parameters through standard laboratory procedures. The economics of experiment was worked out on the basis of the cost of cultivation and cane yield at prevailing market prices of the treatments. The uptake of N, P and K by weeds was calculated by multiplying the concentration with their respective dry matter yield (kg/ha). The percent available sugar was calculated as; available sugar (%) = {S – (B – S) x 0.4 x 0.73}, where S and B are sucrose and brix percent in cane juice, respectively. The trend of results was similar during both the years hence; data were subjected to pooled analysis for results and discussion [9-16].

Results and Discussion

Weed parameters

Weed flora: Predominant weed species were observed at experimental site which consisting of narrow leaved weeds *Cynodon dactylon* L., *Sorghum halepense* L., *Dactyloctenium aegyptium* L., *Brachiaria ramosa* L., *Echinochloa crusgalli* L., *Echinochloa colonum* L. and broad leaved weeds were *Portulaca oleracea* L., *Phyllanthus moderaspatenia* L., *Alternanthera sessilis* L., *Eclipta alba* (L.) Hassk, *Euphorbia hirta* L., *Centella asiatica* Urb., *Digera arvensis* Forsk, *Melilotus indica* (L.) All., *Operculina turpenthum* L., *Physalis minima* L., *Hibiscus* spp., *Corchorus acutangulus* L., *Abutilos indicum* L. and *Medicago sativa* L. While *Cyperus rotundus* L. was the only predominant sedge weed observed in the experimental fields.

Effect of fertilizer levels

The data pertaining to weed density are given in [Table-1]. It was observed that the effect of fertilizer levels on total weed population at 45 and 90 DAP was found to be non-significant during study and also dry weight of weed did not differ significantly due to different fertilizer levels at 90 DAP and at final earthing up.

(ii) Effect of weed management: At 45 DAP, total weeds density (33.4, 48.8 and 41.1 m^{-2}) was recorded significantly lower under treatment W_2 (Three HW at 30, 60 & 90 DAP + Two IC at 45 & 90 DAP) during both the year as well as in pooled analysis. However, treatment W_1 (Weedy check) recorded significantly higher number of total weeds (82.1, 96.3 and 89.2 m^{-2}) during both years as well as in the pooled analysis, respectively. At 90 DAP, total number of weeds (43.6, 50.4 and 47.0 m^{-2}) were also recorded lower under the treatment W_2 (Three HW at 30, 60 & 90 DAP + Two IC at 45 & 90 DAP) which was followed by treatment W_5 and W_6 during both the years as well as in pooled analysis. However, W_1 (Weedy check) recorded significantly highest number of total weeds (99.9, 106.3 and 103.1 m^{-2}). In general, the weeds population was recorded in the chronological manner of $W_2<W_5<W_6<W_4<W_3<W_1$ [Table-1]. These results are in accordance with the findings of [3] who observed minimum weed population with conventional hand weeding practices over weedy check. Treatment W_5 and W_6 were also found significantly superior with respect weed population (Total weeds) at 45 and 90 DAP over W_1 during both the years except dicot weeds at 90 DAP in W_4 during second year. This might be due to application of Pendimethalin as pre-emergence and also profuse growth of intercrops (gram and sunnhemp) suppressed the weed population and their growth. These results are in conformity with those of [4] who reported that application of pre-emergence weedicide effectively controlled the weeds; also observed marked reduction in dicot weeds at 45 and 90 DAP when intercropped with gram; [5] also reported that intercropping of sunnhemp suppressed the weed growth. These result also in conformity with [6] and [7].

Dry weight of weeds (22.9 and 283.4 g/m^2) at 90 DAP and at final earthing up was recorded significantly lower under the treatment W_2 (Three HW at 30, 60 & 90 DAP + Two IC at 45 & 90 DAP) during pooled analysis which was found statistically at par with treatment W_5 only at 90 DAP. However, all the weed management treatments were found in the order of $W_2<W_6<W_5<W_4<W_3<W_1$ during pooled analysis [Table-1].

Results clearly indicated that the highest weed control efficiency (69.2 %) were recorded with treatment W_2 (Three HW at 30, 60 & 90 DAP + Two IC at 45 & 90 DAP) followed by W_6 and W_5 during pooled analysis. The data presented in [Table-1] showed the influence of various weed management treatments on weed competition index. Treatment W_6 (Pendimethalin 1.0 kg/ha as pre-emergence + Sunnhemp as a green manure crop harvested and mulched it at 50-60 DAP and incorporated at final earthing up) and W_5 (Pendimethalin 1.0 kg/ha as pre-emergence + Gram as a intercrop) recorded the lower weed competition index (3.95 and 5.74 %) found most effective in controlling the weeds, after the treatment W_2 during both the years and in pooled analysis, respectively [Table-3]. These results were as per expectation as conventional method and Pendimethalin 1.0 kg/ha as pre-emergence + intercrops (gram or 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 supported by [8], [2] and [3].

Morpho-physiological indices

Effect of fertilizer levels

Physiological parameters *viz*., LAI, AGR, RGR and NAR were presented in [Table-2] and [Table-3]. At 90 and 180 days after planting, treatment F_3 (125 % RDF) recorded the highest LAI (0.540 and 2.86) followed by treatment F_2 (100 % RDF). Significantly the lowest LAI was recorded under F_1 (0.428 and 2.21), respectively. This might be due to a greater number of tillers and millable canes per hectare which produce more leaf area resulted in higher LAI. Significantly the lowest LAI was recorded under treatment F_1 (75% RDF) at all periodical stages during both the years. This may be due to lower number of tillers and millable cane per unit area resulted in lower leaf area leads to lower LAI. However, at 270 and 360 DAP, LAI (4.75 & 3.84) was found higher under the treatment F_3 (125 % RDF) and it remained at par with treatment F_2 (100 % RDF) during pooled analysis. It was also observed that LAI was increased up to 270 DAP, but then after it was decreased at harvest. This was due to senescence of older leaves reported by Patel (2004). The AGR of dry matter per plant did not differ significantly during all the growth periods due to different fertilizer levels during experimentation.

Table-1 *Effect of fertilizer levels and weed management on different weed parameters*

Treatments	Weed density/m² at 45 DAP						Weed density/m² at 90 DAP						Dry weight at 90 DAP (g/m²)	Dry weight at final earthing up (kg/ha)	WCE (%)	Wi (%)
	Total weed population						Total weed population									
	2016-17		2017-18		Pooled		2016-17		2017-18		Pooled					
Fertilizer levels (F)																
F_1	7.09	(51.3)	8.11	(66.5)	7.60	(58.9)	7.80	(61.8)	8.39	(71.6)	8.10	(66.7)	33.7	524.1	-	-
F_2	7.76	(62.7)	8.50	(73.8)	8.13	(68.2)	8.41	(72.8)	8.60	(75.3)	8.50	(74.1)	33.7	497.8	-	-
F_3	7.30	(53.8)	8.01	(64.3)	7.65	(59.1)	7.96	(64.2)	8.61	(74.6)	8.28	(69.4)	35.8	493.9	-	-
SEm ±	0.27		0.22		0.17		0.23		0.16		0.14		0.93	14.2	-	-
CD(P=0.05)	NS		NS		NS		NS		NS		NS		NS	NS	-	-
Weed management (W)																
W_1	8.95	(82.1)	9.74	(96.3)	9.35	(89.2)	9.89	(99.9)	10.29	(106)	10.0	(103)	58.0	943.1	0	31.0
W_2	5.80	(33.4)	7.01	(48.8)	6.40	(41.1)	6.63	(43.6)	7.13	(50.4)	6.88	(47.0)	22.9	283.4	69.2	0
W_3	6.91	(47.4)	7.96	(63.0)	7.43	(55.2)	8.71	(75.6)	9.15	(83.6)	8.93	(79.6)	36.6	521.1	42.4	17.2
W_4	6.95	(48.4)	7.65	(58.6)	7.30	(53.5)	8.36	(70.0)	9.05	(81.7)	8.70	(75.8)	35.0	495.6	45.9	16.1
W_5	8.04	(64.6)	8.64	(74.3)	8.34	(69.4)	7.42	(54.8)	7.71	(59.1)	7.57	(56.9)	26.4	403.3	56.1	5.74
W_6	7.65	(59.7)	8.22	(68.2)	7.93	(63.9)	7.34	(53.8)	7.86	(61.8)	7.60	(57.8)	27.6	384.9	58.3	3.95
SEm ±	0.38		0.31		0.24		0.32		0.23		0.20		1.32	20.1	-	-
CD(P=0.05)	1.08		0.88		0.69		0.92		0.65		0.55		3.71	56.8	-	-
Interaction (W x F)																
SEm ±	0.65		0.53		0.42		0.55		0.39		0.34		2.28	34.9	-	-
CD(P=0.05)	NS		NS		NS		NS		NS		NS		NS	NS	-	-
CV %	15.3		11.2		13.2		11.9		7.95		10.0		16.2	16.9	-	-

Note: Figure in parenthesis refers to original value and outside the parenthesis indicates (√X+0.5) transformed value

Table-2 *Effect of fertilizer levels and weed management on leaf area index and absolute growth rate*

Treatments	Leaf area index				Absolute growth rate (g/plant/day)		
	90 DAP	180 DAP	270 DAP	360 DAP	90-180 DAP	180-270 DAP	270-360 DAP
Fertilizer levels (F)							
F_1	0.428	2.21	4.32	3.39	1.01	2.07	1.69
F_2	0.466	2.51	4.61	3.74	1.04	2.11	1.74
F_3	0.540	2.86	4.75	3.84	1.04	2.15	1.74
SEm ±	0.07	0.03	0.07	0.07	0.017	0.025	0.028
CD (P=0.05)	0.020	0.09	0.20	0.20	NS	NS	NS
Weed management (W)							
W_1	0.363	2.37	4.22	3.27	0.94	1.96	1.66
W_2	0.558	2.67	4.86	3.96	1.11	2.20	1.80
W_3	0.443	2.55	4.62	3.72	1.00	2.08	1.68
W_4	0.464	2.44	4.50	3.61	1.02	2.10	1.70
W_5	0.520	2.50	4.69	3.79	1.05	2.14	1.74
W_6	0.521	2.63	4.48	3.59	1.07	2.16	1.76
SEm ±	0.010	0.05	0.10	0.10	0.024	0.036	0.040
CD (P=0.05)	0.028	0.13	0.29	0.28	0.067	0.101	NS
Interaction (W x F)							
SEm ±	0.017	0.08	0.18	0.17	0.04	0.062	0.070
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS
CV %	8.93	7.84	9.47	11.5	9.71	7.21	9.91

Table-3 *Effect of fertilizer levels and weed management on relative growth rate and net assimilation rate*

Treatments	Relative growth rate (g/g/day)			Net assimilation rate (g/dm²/day)		
	90-180 DAP	180-270 DAP	270-360 DAP	90-180 DAP	180-270 DAP	270-360 DAP
Fertilizer levels (F)						
F_1	0.0110	0.0052	0.0178	0.0545	0.0308	0.0169
F_2	0.0112	0.0054	0.0182	0.0551	0.0313	0.0172
F_3	0.0115	0.0054	0.0189	0.0559	0.0327	0.0179
SEm ±	0.00015	0.00010	0.00038	0.00074	0.00068	0.00035
CD (P=0.05)	NS	NS	NS	NS	NS	NS
Weed management (W)						
W_1	0.0106	0.0051	0.0172	0.0536	0.0295	0.0162
W_2	0.0119	0.0059	0.0194	0.0575	0.0336	0.0184
W_3	0.0109	0.0051	0.0178	0.0538	0.0307	0.0168
W_4	0.0113	0.0050	0.0183	0.0549	0.0316	0.0173
W_5	0.0112	0.0055	0.0185	0.0554	0.0319	0.0175
W_6	0.0115	0.0057	0.0186	0.0556	0.0323	0.0176
SEm ±	0.00021	0.00014	0.00054	0.00104	0.00096	0.00050
CD (P=0.05)	0.00058	0.00041	NS	NS	NS	NS
Interaction (W x F)						
SEm ±	0.00036	0.00025	0.00094	0.00210	0.00199	0.00105
CD (P=0.05)	NS	NS	NS	NS	NS	NS
CV %	7.80	11.4	12.5	8.03	12.8	12.1

Table-4 *Effect of fertilizer levels and weed management on quality parameters of sugarcane*

Treatments	Pol (%) juice	Purity co efficient (%)	Pol (%) cane	C.C.S. (%)	C.C.S. (t/ha)	Fiber (%)
Fertilizer levels (F)						
F_1	17.6	87.8	15.7	12.9	10.9	13.2
F_2	18.0	89.8	16.0	12.6	13.3	13.3
F_3	18.3	91.7	16.4	13.2	14.5	13.2
SEm ±	0.27	1.36	0.25	0.24	0.30	0.24
CD (P=0.05)	NS	NS	NS	NS	0.83	NS
Weed management (W)						
W_1	17.0	85.1	15.2	11.3	8.90	13.7
W_2	18.4	91.8	16.4	13.6	15.4	13.1
W_3	17.7	88.3	15.8	12.9	12.1	13.3
W_4	18.0	90.2	16.1	12.9	12.3	13.6
W_5	18.2	91.0	16.3	13.3	14.3	12.6
W_6	18.4	92.1	16.4	13.2	14.4	13.2
SEm ±	0.39	1.93	0.35	0.36	0.42	0.33
CD (P=0.05)	NS	NS	NS	NS	1.18	NS
Interaction (W x F)						
SEm ±	0.36	1.79	0.32	0.40	0.72	0.79
CD (P=0.05)	NS	NS	NS	NS	NS	NS
CV %	9.12	9.12	9.12	11.9	13.7	10.7

Table-5 *Effect of fertilizer levels and weed management on nutrients content and uptake by weed*

Treatments	Nutrient content of weed (%)			Nutrient uptake by weed (kg/ha)		
	N content (%)	P content (%)	K content (%)	N uptake (kg/ha)	P uptake (kg/ha)	K uptake (kg/ha)
Fertilizer levels (F)						
F_1	1.21	0.385	1.57	6.55	2.06	8.40
F_2	1.17	0.382	1.57	5.80	1.98	7.77
F_3	1.22	0.369	1.64	6.07	1.77	8.05
SEm ±	0.022	0.010	0.026	0.23	0.11	0.27
CD (P=0.05)	NS	NS	NS	NS	NS	NS
Weed management (W)						
W_1	1.26	0.407	1.63	11.9	3.82	15.3
W_2	1.15	0.360	1.52	3.26	1.01	4.28
W_3	1.24	0.392	1.61	6.44	2.04	8.40
W_4	1.20	0.378	1.62	5.93	1.87	7.98
W_5	1.19	0.354	1.57	4.82	1.43	6.30
W_6	1.16	0.381	1.60	4.46	1.46	6.11
SEm ±	0.031	0.014	0.036	0.32	0.16	0.39
CD (P=0.05)	NS	NS	NS	0.90	0.45	1.10
Interaction (W x F)						
SEm ±	0.073	0.035	0.11	0.55	0.28	0.67
CD (P=0.05)	NS	NS	NS	NS	NS	NS
CV %	11.1	15.9	9.6	22.0	34.9	20.4

The magnitudes of AGR in 125% RDF (F_3) were highest at 90 to 360 days during both the seasons. This might be due to the rate of dry matter production per plant was remained almost same with all the fertilizer levels at all the stages. Moreover, pooled data of relative growth rate and net assimilation rate as affected by different treatments are presented in [Table-3]. The mean RGR and NAR in terms of dry matter accumulated were maximal during 90-180 days of crop age and mean RGR and NAR values did not differ significantly due to different fertilizer levels at all periodical stages. The highest RGR and NAR value was noted under the treatment of 125% RDF (F_3). While treatment (F_1) recorded lower during all the periodical stages during pooled analysis.

Effect of weed management

At 90 DAP, significantly higher LAI (0.558) was recorded under treatment W_2 followed by treatment W_6 during pooled analysis. At 180 DAP, treatment W_2 recorded significantly higher LAI (2.67) and it was remained at par with treatment W_6 and W_3. However, at 270 and 360 DAP, treatment W_2 recorded significantly higher LAI (4.86 and 3.96) which was found at par with treatment W_5 and W_3. While treatment W_1 recorded lower LAI during all the periodical stages [Table-2]. This might be due to a greater number of tillers and millable canes per unit area which produce more leaf area resulted in higher LAI. As far as AGR was concern at 90-180 and 180-270 DAP, significantly higher (1.11 and 2.20 g/plant/day) AGR value was recorded under the treatment W_2, which was remained at par with W_6, and W_5 during in pooled analysis. However, weed management practices did not affect significantly on the AGR value during 270-360 days during experimentation.

RGR (0.0119 g/g/day) at 90-180 days was significantly higher under treatment W_2, which was remained at par with W_6, and W_4 during pooled analysis. While at 180-270 DAP, significantly higher (0.0059 g/g/day) RGR value was observed under W_2, which was remained at par with W_6 and W_5 during pooled studies and this happened due to more leaf area and greater interception of sunlight increase the photosynthetic activity which resulted in to higher dry matter production per plant [Table-3]. However, weed management practices did not affect significantly on the RGR during 270-360 days during both the years and in pooled analysis. Weedy check (W_1) recorded significantly the lowest RGR values during all the periodical stages. At all periodical stages, NAR value did not differ significantly due to different weed management practices during pooled analysis. Treatment (W_2) noted numerically higher values of NAR and weedy check (W_1) recorded significantly lower values of NAR during pooled analysis.

Quality parameter

The data presented in [Table-4] showed that various fertilizer and weed management treatments had no significant effect on Pol (%) juice, Purity co efficient (%), Pol (%) cane, C.C.S (%) and Fiber (%). Commercial cane sugar (CCS t/ha) was markedly affected due to the different fertilizer levels. Application of 125 % RDF (F_3) recorded significantly higher commercial cane sugar (14.5 t/ha) which was followed by treatment F_2 during pooled analysis. As far as weed management was concern, significantly higher commercial cane sugar yield (15.4 t/ha) were obtained with treatment W_2, which was found statistically at par with treatment W_6 and W_5 during pooled analysis.

Nutrient content and uptake by weed

Nutrient content by weed: Variations in nutrient content due to different fertilizer levels and weed management were found to be non-significant [Table-5]. This might be due to fertilizer had no much pronounce effect on weed flora and dry matter accumulation by weeds.

Nutrient uptake by weed

Effect of fertilizer levels: Different fertilizer levels were found to be non-significant with respect to uptake of nutrients.

Effect of weed management: Treatment W_2 recorded significantly the lowest uptake of nitrogen (3.26 kg/ha) followed by treatment W_6 and significantly the highest nitrogen uptake (11.9 kg/ha) by weeds were recorded with W_1 (Weedy check). Lower uptake of Phosphorus (1.01 kg/ha) by weeds was recorded under the treatment W_2 (Three HW at 30, 60 & 90 DAP + Two IC at 45 & 90 DAP) and it was found at par with treatment W_5 and W_6 during pooled analysis. However, significantly the highest potassium uptake (15.3 kg/ha) was noted under treatment W_1. While treatment W_2 recorded significantly the lowest potassium uptake (4.28 kg/ha) followed by treatment W_6. Nutrients depletion was decreased with the adoption of weed control programme, which might be due to lower dry matter production under these treatments. These result also in conformity with [6] and [7].

Yield parameter and economics

Effect of fertilizer levels

The higher cane yield (109.4 t/ha) and sugarcane equivalent yield (112.1 t/ha) were recorded under the treatment 125 % RDF (F_3) followed by treatment 100 % RDF (F_2) during pooled analysis, respectively [Table-6]. While, treatment F_1 (75 % RDF) was recorded significantly the lower cane yield (84.5 t/ha) and sugarcane equivalent yield (86.6 t/ha), respectively than the rest of all the treatments during pooled analysis. The increased cane yield in fertilizer levels (F_2) and (F_3) could be due to positive and significant correlation with number of millable cane per hectare, plant height, millable cane length, single cane weight and number of internodes per cane during both the years. However, higher dose of N promoting growth parameters might be due to fact that the net assimilation rate of the N fed to plants was accelerated due to increase in chlorophyll content and the absorbed N helped in the formation of food reservoir due to higher photosynthetic activity, which increases the growth character. Further, P also influences the cellular activity in the roots and leaves which resulted in increased yield. Similarly, the increased in growth and yield attributes may be due to the uncourageous effect of potassium on root development, formation of carbohydrates, regulation of water and translocation of photosynthates. These findings are in accordance with findings of [9], [10] and [11].

Table-6 *Effect of fertilizer levels and weed management on yield component and yield of sugarcane*

Treatments	Cane yield (t/ha)	Cane equivalent yield (t/ha)	B:C ratio
Fertilizer levels (F)			
F_1	84.5	86.6	1.79
F_2	105.1	107.4	2.36
F_3	109.4	112.1	2.42
SEm ±	1.47	1.47	-
CD (P=0.05)	4.16	4.15	-
Weed management (W)			
W_1	78.4	78.4	1.75
W_2	113.7	113.7	2.52
W_3	94.1	94.1	2.07
W_4	95.3	95.3	2.08
W_5	107.2	121.4	2.68
W_6	109.2	109.2	2.48
SEm ±	2.08	2.08	-
CD (P=0.05)	5.88	5.87	-
Interaction (W x F)			
SEm ±	3.61	3.60	-
CD (P=0.05)	10.2	10.2	-
CV %	8.88	8.65	-

Treatment receiving a higher level of fertilizer (F_3: 125 % RDF) registered maximum B:C ratio of 2.42 followed by treatment F_2 with B:C ratio of 2.36. While, the lowest gross B: C ratio of 1.79 was obtained under F_1 (75 % RDF) treatment.

Effect of weed management

Weed management practices have marked effect on cane yield [Table-6] during experimentation. Treatment W_2 (Three HW at 30, 60 & 90 DAP + Two IC at 45 & 90 DAP) was recorded significantly the highest cane yield of 113.7 t/ha and it was remained at par with treatment W_6 during pooled analysis. While, the lowest cane yield of 78.4 t/ha were noted under weedy check (W_1). This might be due to W_2, W_6 and W_5 treatments-controlled weeds effectively, reduced the competition by weeds to a greater extent and thus helped in faster growth and development of sugarcane crop, resulting in higher value of all yield attributing characters. It is also clear from the significant positive correlation between cane yield and sugarcane plant height, millable cane length and number of millable cane per meter row length. These results were supported by [12] and [7]. Undoubtedly, higher sugarcane equivalent yield (121.4 t/ha) was observed under treatment W_5 (Pendimethalin 1.0 kg/ha as pre-emergence + Gram as an intercrop) followed by treatment W_2 (113.7 t/ha) during pooled studies. While, significantly the lower sugarcane equivalent yield (78.4 t/ha) were recorded under W_1 (Weedy check) during both the years of investigation. It clearly indicated that intercrop gram very well compensated the reduction in the sugarcane yield. These results are in accordance with the finding of [6,7]. The highest B:C ratio (2.68) were obtained with the treatment W_5 (Pendimethalin 1.0 kg/ha as pre-emergence + gram as an intercrop) followed by treatment W_2 and W_6. While, the lowest B:C ratio (1.75) was obtained under W_1 (Weedy check) treatment.

Conclusion

It can be concluded that application of 100% RDF *i.e.*, 250:125:125 kg NPK/ha + pre emergence application of Pendimethalin 1.0 kg/ha with gram as an intercrop was found beneficial for securing higher cane yield, weed control efficiency and economic returns under south Gujarat condition

Application of research: Fertilizer and Weed management

Research Category: Agronomy

Abbreviations: DAS: Days after sowing, DAP: Days after planting, HW: Hand Weeding, IC: Inter culturing, RDF: Recommended dose of fertilizer, HA: Hectare, C.C.S: Commercial cane sugar

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Study area / Sample Collection: Research farm of Navsari agricultural University, Navsari

Cultivar / Variety / Breed name: Sugarcane (*Saccharum officinarum* L.)

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