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Identification of Promising Chewing Cane and Optimising the Doses of N, P and K for Cane Yield and Quality

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Abstract: The field experiments were carried out during 2018 – 2019 and 2019 – 2020 at Sugarcane Research Station, Cuddalore in Split plot Design with three replications. There were six main plot of chewing canes landraces *viz.,* Vengattanpatti, Cuddalore (L_1), Thirukattupalli, Thanjavur (L_2), Thiruvalarcholai, Trichy (L_3), Chinnamanur, Theni (L_4), Melur, Madurai (L_5) and Kalipatty, Salem (L_6), while the sub plot had NPK levels of 50% RDF (F_1), 75% RDF (F_2), 100% RDF (F_3), 125% RDF (F_4) and Farmer practice (F_5). Chewing sugarcane was harvested at 10 months after planting for worship and chewing purpose during the Pongal festival celebration. The maximum mean germination (60%), tiller production (183 on 120 DAP), plant height (167 cm), number of marketable cane (110 no ha^{-1}) and cane yield (178 t ha^{-1}) were recorded with 125% RDF for Vengattanpatti land race. Brix (21.00%), Pol (17.81%), Purity (80.25), CCS (12.56%) and B: C ratios of 5.00 were associated with F_4 and L_1 treatment combinations.

Key words: *Chewing cane, landrace, marketable cane, inorganic fertilizer, cane quality, cane yield.*

Introduction

Sugarcane in general grows under different biophysical (Mandal *et al.* 2005) and pedo-edaphic environments (Ashokkumar and Jagdish Prasad 2010) and that dictates the productivity of cane and sugar recovery and Tamil Nadu is not an exceptional state. However in Tamil Nadu, most of the farmers are cultivating chewing cane their native land races resulted in declined virulence and genetic potential of the land races and in turn poor performed. Introduction of new land races and identification of new clones during the last four decades has not been reviewed. The increase in chewing cane production largely depends on agronomic evaluation and management for higher stalk yield and sugar content and for improved disease resistance. There are number of land races of chewing sugarcane being planted widely in different ecological areas of Tamil Nadu. Six of these land races were collected for conducting this experiment. Since 1967, research has concentrated on developing new land races by crossing the existing strains and importing new ones that adapt well to the different ecological zones of Tamil Nadu.

The traditional chewing cane land races were planted in the Chinnamanur located in Theni district since some thirty to forty years. These came originally from south Tamil Nadu and give high stalk yield (90-100 tonnes ha^{-1}) of good quality. It was classified in the early ripe variety group, but less resistant to diseases than

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Vengattanpatti land race of Cuddalore district. Among the new land races identified and introduced recently, Vengattanpatti land race is being grown throughout the state. It is resistant to many diseases and is tolerant to dry condition. It matures between 10 and 12 months and adapts to a wide range of bio-physical conditions. It fast growing and can yield 80-100 tonnes stalk/ha with good sugar content. This is a variety with early germination, good tillering and non - flowering and has adapted well to the hilly fertile lands of Caper quarry, these factors were included in the design of this experiment.

Materials and Methods

Location and time

The experiments were carried out during 2018-19 and 2019-20 at Sugarcane Research Station, Cuddalore, a lead centre for sugarcane research in Tamil Nadu. The sandy loam of experimental site had sand (56.3 %), silt (24.5 %), clay (19.4 %), bulk density (1.56 mg m^{-3}), pore space (43.80 %), hydraulic conductivity (1.35 cm hr^{-1}), infiltration rate (0.54 cm hr^{-1}), pH 7.3, N 172 kg ha^{-1}, P_20_5 54 kg ha^{-1}, K_2O 132 kg ha^{-1} , EC 0.47 dSm^{-1} with low level of organic carbon (0.45 %) and moisture holding capacity.

Treatments and design

The experimental design was a split-plot design, comprising of six land races and four fertilizer levels along with one check (Farmers practice), with four replications. The treatments were L_1 - Vengattanpatti, Cuddalore, L_2 - Thirukattupalli, Thanjavur, L_3 - Thiruvalarcholai, Trichy, L_4 - Chinnamanur, Theni, L_5 - Melur, Madurai and L_6 - Kalipatty, Salem in main plot while sub plot had NPK levels as F_1 - 50 % RDF, F_2 - 75 % RDF, F_3 - 100 % RDF, F_4 - 125 % RDF and F_5 - Farmers practice.

The size of the experimental plot was 8 m x 5 m with 90cm row spacing. Stem cuttings of the six land races were used as planting material (10 tonnes ha^{-1} for 90 cm row spacing). The stalk was separated from the bunch of whole plant by cutting immediately without de-toping. The growing points (tops) were not separated from the leaf blades (green leaf). Each component was weighed and sampled for chemical analysis.

Extraction of juice

Samples of the stalk from each plot (about 10 kg) were crushed by passing them one time through a 2-roll mill driven by a motor. Extraction rate was expressed as weight of juice as a percentage of the weight of cane stalks. The total soluble solids in the juice (Brix) were determined using a hand refractometer.

Soil analysis

Samples of soil (0-20 cm) were taken from each plot at harvest (10 months after planting). Soil samples were analysed for pH, N, P, K and carbon by standard methods.

Other parameters

Other management practices and measurements such as fertilizer application, cultural practices and pesticide control were carried out according to the crop production guide and practices of the farmers.

Statistical analysis

The data were analysed by Analysis of Variance using the procedure described by Gomez and Gomes (1993). The pooled mean values of land races and treatment in each of the two years were presented in tables.

Results and Discussion

The sugar cane crop was raised during early season planting (December-January 2017). The growth and yield parameters *viz.,* germination, tiller population, marketable cane, cane length, cane girth, single cane weight, cane yield, Brix, pole, purity and economics were recorded and worked out. After harvest of the plant crop, the sugarcane crop was allowed to grow for ratoon. All the crop management practices were adopted as per the recommendation for both plant and ratoon sugarcane crop.

Growth parameters of sugarcane

The result indicated that, Vengettanpatti land race had significantly maximum germination (72.53%) and tiller population (1, 74,560 ha^{-1}). Application of fertilizer (125% of the RDF) recorded the maximum germination (65.12%) and tillers population (1, 75,540 ha^{-1}). Recommended dose of fertilizer (125% RDF) to Vengettanpatti land race gave the maximum germination (78.19) and tillers population (1, 88,180 ha^{-1}).

The maximum cane length (168.52 cm), cane girth (3.42 cm), number of nodes (24.80) and inter-node length (8.65 cm) was recorded in Vengettanpatti land race. Among the sub-plot treatments, 125 RDF ha^{-1} recorded the maximum cane length (173.09 cm), cane girth (3.37 cm), number of nodes (24.45) and inter-node length (8.11 cm) followed by 100% RDF ha^{-1}. Application of 125% RDF ha^{-1} to the Vengettanpatti land race gave the maximum cane length (181.66 cm), cane girth (3.69 cm). (Table 1, 2 and 3)

Table 1. Effect of N, P and K doses on germination and tiller population of chewing cane landraces

Treatments	Germination %					Tiller population (000 ha^{-1})				
	F1	F2	F3	F4	Mean	F1	F2	F3	F4	Mean
L1	64.70	73.98	73.26	78.19	72.53	155.71	178.05	176.31	188.18	174.56
L2	58.32	66.69	66.03	70.48	65.38	139.36	159.35	157.79	168.42	156.23
L3	52.86	60.45	59.85	63.88	59.26	146.75	167.81	166.17	177.35	164.52
L4	50.75	58.03	57.46	61.33	56.89	144.99	165.79	164.17	175.22	162.54
L5	46.99	53.73	53.21	56.79	52.68	142.93	163.44	161.84	172.74	160.24
L6	49.68	56.80	56.25	60.03	55.69	141.79	162.14	160.55	171.36	158.96
Mean	53.88	61.61	61.01	65.12		145.25	166.10	164.47	175.54	
	L	**F**	**L x F**	**F x L**		**L**	**F**	**L x F**	**F x L**	
SEd	0.92	0.78	2.07	2.59		2.48	2.10	5.58	6.98	
CD(p=0.05)	2.74	3.34	3.81	4.77		7.38	9.01	10.26	12.85	

Table 2. Effect of N, P and K doses on cane length and girth of chewing cane land races

Treatments	Cane length (cm)					Cane girth (cm)				
	F1	**F2**	**F3**	**F4**	**Mean**	**F1**	**F2**	**F3**	**F4**	**Mean**
L1	150.32	171.89	170.21	181.66	168.52	3.05	3.49	3.45	3.69	3.42
L2	140.37	160.51	158.93	169.63	157.36	2.86	3.27	3.24	3.46	3.21
L3	144.08	164.75	163.14	174.12	161.52	2.51	2.87	2.84	3.03	2.81
L4	140.81	161.02	159.44	170.17	157.86	2.81	3.21	3.18	3.40	3.15
L5	141.34	161.62	160.03	170.81	158.45	2.82	3.22	3.19	3.41	3.16
L6	142.43	162.87	161.28	172.14	159.68	2.66	3.04	3.01	3.21	2.98
Mean	143.22	163.78	162.17	173.09		2.78	3.18	3.15	3.37	
	L	**F**	**L x F**	**F x L**		**L**	**F**	**L x F**	**F x L**	
SEd	2.45	2.07	5.50	6.89		0.05	0.04	0.11	0.13	
CD (p=0.05)	7.27	8.88	10.12	12.67		0.14	0.17	0.20	0.25	

Table 3. Effect of N, P and K doses on number of nodes/cane and length of internode of chewing cane land races

Treatments	Number of nodes/cane					Inter-node length (cm)				
	F1	F2	F3	F4	Mean	F1	F2	F3	F4	Mean
L1	22.12	25.30	25.05	26.73	24.80	7.72	8.82	8.74	9.32	8.65
L2	18.35	20.98	20.78	22.17	20.57	6.15	7.03	6.96	7.43	6.89
L3	20.62	23.58	23.35	24.92	23.12	6.43	7.35	7.28	7.77	7.21
L4	20.71	23.68	23.45	25.03	23.22	6.65	7.60	7.52	8.03	7.45
L5	21.11	24.14	23.91	25.52	23.67	6.73	7.70	7.63	8.14	7.55
L6	18.49	21.14	20.94	22.35	20.73	6.59	7.54	7.46	7.97	7.39
Mean	20.24	23.14	22.91	24.45		6.71	7.67	7.60	8.11	
	L	**F**	**L x F**	**F x L**		**L**	**F**	**L x F**	**F x L**	
SEd	0.35	0.29	0.78	0.97		0.11	0.10	0.26	0.32	
CD (p=0.05)	1.03	1.25	1.43	1.79		0.34	0.42	0.47	0.59	

Yield parameter and yield of sugarcane

Vengettanpatti land race had significantly maximum individual cane weight (1.76 kg), marketable canes (1, 17,890 ha^{-1}) and cane yield (158.98 t ha^{-1}) followed by Melur land race (Table 4). Application of 125% RDF ha^{-1} recorded significantly maximum individual cane weight (1.76 kg), millable canes (1, 16,540 ha^{-1}) and cane yield (162.30 t ha^{-1}). Application of 125 % RDF ha^{-1} to Vengettanpatti land race gave the individual cane weight (1.90 kg), marketable canes (1, 27,090 ha^{-1}) and cane yield (171.38 t ha^{-1}) of chewing sugarcane. Durai and Devaraj (2003) reported higher cane and sugar yield with the application of FYM + 100 % NPK + *Azospirillum* whereas Kathiresan (2004) observed higher cane and sugar yield with the application of 75% RDN + soil inoculation of *Azospirillum* and *Azotobacter*. Bokhtiar and Katsutoshi (2005) *et al.* reported that application of 150 kg N ha^{-1} in three equal splits through soil application produced significantly higher cane yield (6.2% and 6.5% for plant and ratoon crops, respectively), yield parameters and CCS% compared to recommended use of N application. Ahmed *et al.* (2009) found that, increasing the N-fertilizer rates from 160 to 200 and 240 kg ha^{-1} led to an increase in millable cane yields.

Table 4. Effect of N, P and K doses on individual cane weight and marketable cane of chewing cane land races

Treatments	Individual cane weight (kg)					Marketable cane (000/ha)				
	F1	F2	F3	F4	Mean	F1	F2	F3	F4	Mean
L1	1.57	1.80	1.78	1.90	1.76	105.16	120.25	119.07	127.09	117.89
L2	1.47	1.68	1.67	1.78	1.65	91.09	104.16	103.14	110.09	102.12
L3	1.51	1.72	1.71	1.82	1.69	98.33	112.44	111.34	118.84	110.24
L4	1.45	1.66	1.65	1.76	1.63	96.02	109.80	108.73	116.05	107.65
L5	1.40	1.60	1.59	1.69	1.57	94.36	107.90	106.84	114.03	105.78
L6	1.36	1.55	1.54	1.64	1.52	93.64	107.08	106.03	1113.17	104.98
Mean	1.46	1.67	1.65	1.76		96.43	110.27	109.19	116.54	
	L	**F**	**L x F**	**F x L**		**L**	**F**	**L x F**	**F x L**	
SEd	0.02	0.02	0.06	0.07		1.65	1.40	3.70	4.64	
CD (p=0.05)	0.07	0.09	0.10	0.13		4.90	5.98	6.81	8.53	

Quality parameter and sugar yield of sugarcane

Vengettanpatti land race recorded the maximum Brix (20.67%), Pole (18.12%), Purity (87.66) and CCS (12.48%) Melur land race (Table 5, 6 and 7). Application of 125% RDF ha^{-1} recorded the maximum Brix (20.64%), Pole (18.12%), Purity (90.19) and CCS (12.49 %). Sonawane and Sabale (2000) reported that application of 250 kg nitrogen through urea and 50 kg N through press mud gave positive response for brix, pol, CCS per cent and sugar yield.

Table 5. Effect of N, P and K doses on cane yield and CCS of chewing cane landraces

Treatments	Cane yield (t ha^{-1})					CCS (%)				
	F1	F2	F3	F4	Mean	F1	F2	F3	F4	Mean
L1	141.81	162.16	160.57	171.38	158.98	12.53	12.50	12.51	12.53	12.48
L2	128.06	146.43	145.00	154.76	143.56	12.50	12.53	12.96	12.47	12.54
L3	131.44	150.30	148.82	158.84	147.35	12.49	12.52	12.45	12.48	12.43
L4	134.09	153.33	151.82	162.04	150.32	12.53	12.50	12.51	12.53	12.48
L5	135.99	155.51	153.98	164.35	152.46	12.50	12.53	12.96	12.47	12.54
L6	134.38	153.66	152.16	162.40	150.65	12.49	12.52	12.45	12.48	12.43
Mean	134.29	153.56	152.06	162.30		12.51	12.51	12.64	12.49	
	L	**F**	**L x F**	**F x L**		**L**	**F**	**L x F**	**F x L**	
SEd	2.30	1.95	5.15	6.46		0.19	0.16	0.43	0.54	
CD(p=0.05)	6.82	8.33	9.48	11.88		NS	NS	NS	NS	

Table 6. Effect of N, P and K doses on brix and purity of chewing cane landraces

Treatments	Brix (%)					Purity (%)				
	F1	**F2**	**F3**	**F4**	**Mean**	**F1**	**F2**	**F3**	**F4**	**Mean**
L1	20.82	20.82	20.71	20.75	20.67	92.22	88.29	87.85	91.17	87.66
L2	20.65	20.69	21.41	20.58	20.54	92.40	88.46	91.53	88.01	87.83
L3	20.62	20.66	20.55	20.59	20.51	92.43	88.49	88.04	91.37	87.86
L4	20.82	20.82	20.71	20.75	20.67	92.22	88.29	87.85	91.17	87.66
L5	20.65	20.69	21.41	20.58	20.54	92.40	88.46	91.53	88.01	87.83
L6	20.62	20.66	20.55	20.59	20.51	92.43	88.49	88.04	91.37	87.86
Mean	20.69	20.72	20.89	20.64		92.35	88.42	89.14	90.19	
	L	**F**	**L x F**	**F x L**		**L**	**F**	**L x F**	**F x L**	
SEd	0.32	0.27	0.70	0.89		1.37	1.16	3.01	3.86	
CD(p=0.05)	NS	NS	NS	NS		NS	NS	NS	NS	

Table 7. Effect of N, P and K doses on pole and B: C ratio of chewing cane landraces

Treatments	Pole (%)					B : C ratio				
	F1	F2	F3	F4	Mean	F1	F2	F3	F4	Mean
L1	18.21	18.18	18.16	18.19	18.12	3.17	3.25	3.17	3.41	3.25
L2	18.13	18.17	18.80	18.08	18.04	2.61	2.69	2.96	2.82	2.77
L3	18.11	18.15	18.06	18.09	18.02	2.90	2.98	2.90	3.12	2.98
L4	18.12	18.18	18.16	18.19	18.12	2.81	2.89	2.81	3.03	2.88
L5	18.13	18.17	18.80	18.08	18.04	2.74	2.82	3.11	2.96	2.91
L6	18.11	18.15	18.06	18.09	18.02	2.71	2.79	2.72	2.93	2.79
Mean	18.15	18.17	18.34	18.12		2.82	2.90	2.94	3.04	
	L	**F**	**L x F**	**F x L**						
SEd	0.28	0.24	0.62	0.78						
CD(p=0.05)	NS	NS	NS	NS						

Post harvest soil analysis

At harvest, soil pH and organic carbon of the soil did not significantly differ among the treatments and their interactions. (Table 8 and 9)

Table 8. Effect of N, P and K doses on pH and EC in post harvest soil

Treatments	Soil pH					EC (dSm^{-1})				
	F1	F2	F3	F4	Mean	F1	F2	F3	F4	Mean
L1	6.21	7.10	7.03	7.50	6.96	0.97	0.98	0.96	0.97	0.95
L2	6.15	7.03	6.96	7.43	6.89	0.93	0.94	0.92	0.93	0.93
L3	6.24	7.13	7.06	7.54	6.99	0.93	0.94	0.92	0.92	0.92
L4	6.29	7.19	7.12	7.60	7.05	0.92	0.93	0.94	0.93	0.91
L5	6.06	6.93	6.86	7.32	6.79	0.82	0.84	0.83	0.84	0.84
L6	6.05	6.92	6.85	7.31	6.78	0.85	0.84	0.81	0.83	0.84
Mean	6.16	7.05	6.98	7.45						
	L	**F**	**L x F**	**F x L**		**L**	**F**	**L x F**	**F x L**	
SEd	0.11	0.09	0.24	0.30		0.01	0.01	0.02	0.03	
CD(p=0.05)	NS	NS	NS	NS		NS	NS	NS	NS	

Table 9. Effect of N, P and K on nitrogen and phosphorus in post harvest soil

Treatments	N ($kg\ ha^{-1}$)					P ($kg\ ha^{-1}$)				
	F1	F2	F3	F4	Mean	F1	F2	F3	F4	Mean
L1	213.6	212.4	215.6	215.8	214.36	42.31	44.56	41.56	44.61	43.26
L2	213.6	214.5	215.3	206.0	212.36	39.54	40.21	38.52	38.57	39.21
L3	219.2	216.5	217.4	221.1	218.56	35.62	35.21	35.24	36.45	35.63
L4	214.3	217.5	215.6	214.0	215.36	38.12	37.24	37.12	36.52	37.25
L5	212.3	214.2	215.4	213.6	213.89	41.25	42.12	41.35	40.28	41.25
L6	213.2	214.5	213.2	209.4	212.70	37.62	39.28	39.41	38.29	38.65
Mean	214.2	214.9	215.4	213.3		39.08	39.79	38.88	39.17	
	L	**F**	**L x F**	**F x L**		**L**	**F**	**L x F**	**F x L**	
SEd	5.36	5.47	5.39	5.34		0.99	1.02	1.13	1.12	
CD(p=0.05)	NS	NS	NS	NS		NS	NS	NS	NS	

Table 10. Effect of N, P and K doses on potassium and organic carbon content in post harvest soil

Treatments	K (kg ha^{-1})					OC %				
	F1	F2	F3	F4	Mean	F1	F2	F3	F4	Mean
L1	165.32	162.35	163.42	165.91	164.25	0.61	0.69	0.69	0.73	0.68
L2	166.24	164.25	165.25	167.02	165.69	0.59	0.67	0.67	0.71	0.66
L3	172.24	172.54	172.65	172.81	172.56	0.56	0.64	0.64	0.68	0.63
L4	169.34	168.47	169.25	170.22	169.32	0.59	0.67	0.67	0.71	0.66
L5	168.32	169.25	170.12	167.99	168.96	0.60	0.68	0.68	0.72	0.67
L6	169.25	168.45	167.54	167.76	168.25	0.57	0.65	0.65	0.69	0.64
Mean	168.45	167.55	168.04	168.62		0.59	0.67	0.66	0.71	
	L	**F**	**L x F**	**F x L**		**L**	**F**	**L x F**	**F x L**	
SEd	3.39	3.45	3.65	3.54		0.01	0.01	0.02	0.03	
CD(p=0.05)	NS	NS	NS	NS		NS	NS	NS	NS	

Economics

Vengettanpatti land race recorded the maximum B: C ratio of 3.25. Among the nutrient management, application of 125 % RDF ha^{-1} had maximum B: C ratio of 3.04. The highest B:C ratio of 3.41 was registered with application of 125% recommended dose of fertiliser to Vengettanpatti land race treatment.

Conclusion

Sugarcane (chewing type) was cultivated in a wide range of soil textures from loamy sand to clay loam in Tamil Nadu State. Most of the cultivars had good quality of cane. Among the cultivars, Vengettanpatti land race with application of 125% recommended dose of fertilizer gave the maximum cane length (181.66 cm), cane girth (3.69 cm), number of nodes (26.73), inter-node length (9.32 cm), individual cane weight (1.90 kg), marketable canes (1,27,090 ha^{-1}), cane yield (171.38 t ha^{-1}), Brix (20.64%), Pole (18.12%), Purity (90.19) and CCS (12.49%) than other treatments..

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