MATERIALS AND METHODS

The study was conducted with eight selected sugarcane clones viz. I 61-90, I 344-90, BO. 91, I 155-91, I 209-91, I 41-92, I 153-92, I 216-92 and standard Isd 16. Individual clone was planted in row 20m long in three replications. Application of recommended dose of fertilizers and normal cane management practices were done. The cane samples were collected randomly from three replications for chemical analysis.

The chemical analyses for sucrose percent and reducing sugars percent were started from 15th of September, 1999; then 15th of every month and continued upto 15th March, 2000. The cane juice was clarifiedwith basic lead sub-acetate. Brix and pol were determined with Brix hydrometer and automatic Polarimeter (Anon. 1970). The juice was analysed for sucrose percent and reducing sugars percent using a formula given by Mathur (1978).

For statistical analyses of data, following two probabilistic regression models were used.

$$Y_{1ij}=\beta_{10}+\Sigma\beta_{1i}d_{ij}+\beta_{19}t_j+\beta_{110}t_j^2+\beta_{111}r_j+e_{1j} \quad \text{.......(i)}$$

$$r_{2ij}=\beta_{20}+\Sigma\beta_{2i}d_{ij}+\beta_{29}t_j+\beta_{210}t_j^2+e_{2j} \quad \text{.......(ii)}$$

Where, Y's are the sucrose per cent; r's are the reducing sugars; d's are the dummy variables for clones; b's are the regression co-efficients; t's are the number of month [beginning with 1 for the month of September and ending with 7 (considering cumulative figure) for March [1 stands for total number of days between 15th of any two consecutive months]; e's are independent random normal variables with mean zero and constant variance s2; the summation (å) is over i; i=1, 2, ..., 8 and j=1, 2, ..., 63; di=1 for the i-th clone and di=0 for any clone other than i-th clone. When all d's are simultaneously set equal to zero, the equation of variety Isd 16 will arise. The two deterministic models are :

$$\hat{Y}_{1i}=b_{10}+\Sigma b_{1i}d_i+b_{19}t+b_{110}t^2+b_{111}r \quad \text{.......(iii)}$$

$$\hat{r}_{2i}=b_{20}+\Sigma b_{2i}d_i+b_{29}t+b_{210}t^2 \quad \text{.......(iv)}$$

Where b's are the estimators for β's and $\hat{Y}$ and $\hat{r}$ are the estimators for Y and r. Consider the model (iii) and when all d_i=0, the model reduces to

$$\hat{Y}_1=b_{10}+b_{19}t+b_{110}t^2+b_{111}r \quad \text{.......(v)}$$

which is an equation for variety Isd 16. When d_i=1, the model reduces to

$$\hat{Y}_{1i}=b_{10}+b_{1i}+b_{19}t+b_{110}t^2+b_{111}r \quad \text{.......(vi)}$$

which is an equation for the i-th clone. Now, (vi) - (v) is yielding $b_{1i}=\hat{Y}_{1i}-\hat{Y}_1$.

Hence if b1i is significant, the estimate Y1i and Y1 will be significantly different which signifies that the variety Isd 16 and the i-th clone are significantly different in sucrose percent. Similar is the case for reducing sugars. In these deterministic equations [(iii) and (iv)], when t is put equal to 1, it will estimate sucrose content in equation (iii) and reducing sugars in equation (iv) for 15th of September. When t is put equal to 2, it will estimate sucrose content in equation (iii) and reducing sugars in equation (iv) for 15th of October.

Similar is the case for other months. For any other value of t, say t=4.72, it will estimate sucrose content in equation (iii) and reducing sugars in equation (iv) for a day in the 1st week of January or say t=6.14, it will estimate sucrose content in equation (iii) and reducing sugars in equation (iv) for a day in the 3rd week of February.

The overall F-test for testing a null hypothesis (all regression co-efficients) of the type

$H_0 : \beta_1 = \beta_2 = \beta_3 = ... = \beta_k = 0$ or $R=0$ against an alternative

H_a : Atleast one of the β co-efficients is non-zero or $R \neq 0$

Test statistic $F = \dfrac{SSB/k}{SSE/(N-k-1)}$, **df=k and N-k-1**

Where, $R^2 = SSB/TSS$, R= Multiple correlation co-efficient

TSS= Total sum of squares, SSB= Regression sum of squares

SSE= Residual sum of squares

F-test for testing a null hypothesis (a few of the regression co-efficients) type :

$H_0 : \beta_{g+1} = \beta_{g+2} = ... = \beta_k = 0$ against an alternative

H_a : Atleast one of the β parameters under test is non-zero.

Test statistic $F = \dfrac{(SSB_1 - SSB_2)/(k-g)}{SSE_2/[N-(k+1)]}$

Where, SSE_1=Sum of squared errors for the reduced* model

SSE_2= Sum of squared errors for the complete** model

k-g=No. of β parameters specified in H_0

k+1= No. of β parameters in the complete model

N=Sample size

and v_1=k-g=degree of freedom (df) for the numerator

v_2=N-(k+1)= degree of freedom (df) for the denominator

Rejection region : $F > F_\alpha$ [McClave and Benson (1985)]

* Reduced model : $y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + ... + \beta_g x_g + e$

** Complete model : $y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + ... + \beta_g x_g + \beta_{g+1} x_{g+1} + \beta_{g+2} x_{g+2} + ... + \beta_k x_k + e$

RESULTS AND DISCUSSION

The two regression equations (Table 1) were determined which were explained 88 % of the variability in sucrose by the variety and clones, number of months and reducing sugars and 77 % of the variability in reducing sugars by the variety and clones, number of months with highly significant multiple correlation co-efficient. Almost all the partial regression co-efficients of dummy variables for equation (iii) being negative and highly significant revealed that the clones corresponding to them were significantly lower in sucrose and reducing sugars than the variety Isd 16 except the clone I 344-90 which is consistant with Isd 16. In case of equation (iv), 50 % of the partial regression co-efficients being negative and insignificant showed that the clones corresponding to them were consistantly lower than Isd 16 in reducing sugars.

Table 1. Effects of variety and clones, number of month, reducing sugars on sucrose content and reducing sugars in cane.

Independent variables	Co-efficients of equation (iii) for sucrose content (Y)	Co-efficients of equation (iii) for reducing sugars (Y)
Intercept	6.7039965 **	1.14698 **
d_1 (clone I 61-90)	-1.0671311 **	-0.0686 ns
d_2 (clone I 344-90)	-0.2488512 ns	-0.1043 ns
d_3 (clone BO-91)	-1.3287463 **	-0.0214 ns
d_4 (clone I 155-91)	-0.9070091 **	0.26143 **
d_5 (clone I 209-91)	-0.7139883 **	0.00143 ns
d_6 (clone I 41-92)	-0.88842 **	0.15857 *
d_7 (clone I 53-92)	-0.7120524 **	0.16857 *
d_8 (clone I 216-92)	-1.0068166 **	0.18000 *
t (month)	1.9018461 **	-0.2850 **
t^2 (month^2)	-0.2098767 **	0.02321 **
r (reducing sugars)	-1.2081619 **	-
$100R^2$	88.83 %	77.63 %
R	0.9425 **	0.8811 **

* indicates significant at 5 % level of significance.

**indicates significant at 1 % level of significance.

However, the number of months was found to have quadratic effect (Table 1) on sucrose [equation (iii)] and reducing sugars [equation (iv)] but in sign of the regression co-efficients, one equation was reverse of the other which revealed that with the increase of the number of months, sucrose increased and reducing sugars decreased. As the reducing sugars decreased with time increased, sucrose was linearly increased since sucrose was a linear (positive) function of reducing sugars. Corresponding to the variety and to each clone, one regression equation was determined (Table 2). They were different in case of intercept only.

Table 2. Estimated regression equations for sugarcane variety and eight clones.

Variety or Clone	Regression equations	
	Sucrose (Y)	Reducing sugars (Y)
Variety Isd 16	$6.704+1.902t-0.20997t^2-1.2082r$	$1.147-0.285t+0.0232t^2$
Clone I 61-90	$5.637+1.902t-0.20997t^2-1.2082r$	$1.078-0.285t+0.0232t^2$
Clone I 344-90	$6.455+1.902t-0.20997t^2-1.2082r$	$1.043-0.285t+0.0232t^2$
Clone BO-91	$5.375+1.902t-0.20997t^2-1.2082r$	$1.126-0.285t+0.0232t^2$
Clone I 155-91	$5.797+1.902t-0.20997t^2-1.2082r$	$1.408-0.285t+0.0232t^2$
Clone I 209-91	$5.990+1.902t-0.20997t^2-1.2082r$	$1.148-0.285t+0.0232t^2$
Clone I 41-92	$5.816+1.902t-0.20997t^2-1.2082r$	$1.306-0.285t+0.0232t^2$
Clone I 153-92	$5.992+1.902t-0.20997t^2-1.2082r$	$1.316-0.285t+0.0232t^2$
Clone I 216-92	$5.697+1.902t-0.20997t^2-1.2082r$	$1.327-0.285t+0.0232t^2$

From these equations, values were calculated which showed the trend of sucrose (Table 3) and reducing sugars (Table 4) with times (month) i.e. For each clone and variety how the sucrose was increasing or reducing sugars were decreasing beginning from the 1st row (beginning of September) and reached to a maximum or minimum (asterisk rows).

Table 3 . Trend values of sucrose content in cane with the change of months.

(Date) of Month (Number)	Sucrose content of variety and clones.								
	Isd 16	I 61-90	I 344-90	BO-91	I 155-91	I 209-91	I 41-92	I 153-92	I 216-92
(15-09-1999) of September (1)	7.3265	6.3429	7.2032	6.0229	6.1042	6.6113	6.2464	6.4103	6.1021
(15-10-1999) of October (2)	8.8589	7.8752	8.7355	7.5552	7.6365	8.1437	7.7788	7.9427	7.6344
(15-11-1999) of November (3)	9.9152	8.9316	9.7919	8.6116	8.6929	9.2000	8.8351	8.9990	8.6907
(15-12-1999) of December (4)	10.4955	9.5119	10.3722	9.1919	9.2732	9.7803	9.4154	9.5794	9.2711
(07-01-1999) of January (4.72) *	10.6186	9.6350	10.4953	9.3150	9.3963	9.9034	9.5385	9.7025	9.3942
(15-01-2000) of January (5)	10.5999	9.6162	10.4765	9.2962	9.3775	9.8847	9.5198	9.6837	9.3754
(15-02-2000) of February (6)	10.2282	9.2446	10.1049	8.9246	9.0059	9.5130	9.1481	9.3120	9.0037
(15-03-2000) of March (7)	9.3805	8.3969	9.2572	8.0769	8.1582	8.6653	8.3004	8.4644	8.1561

* indicates the row giving the maximum sucrose content for each clone.

Table 4 . Trend values of reducing sugars in cane with the change of months.

(Date) of Month (Number)	Reducing sugars of variety and clones.								
	Isd 16	I 61-90	I 344-90	BO-91	I 155-91	I 209-91	I 41-92	I 153-92	I 216-92
(15-09-1999) of September (1)	0.8852	0.8162	0.7812	0.8642	1.1462	0.8862	1.0442	1.0542	1.0652
(15-10-1999) of October (2)	0.6698	0.6008	0.5658	0.6488	0.9308	0.6708	0.8288	0.8388	0.8498
(15-11-1999) of November (3)	0.5008	0.4318	0.3968	0.4798	0.7618	0.5018	0.6598	0.6698	0.6808
(15-12-1999) of December (4)	0.3782	0.3092	0.2742	0.3572	0.6392	0.3792	0.5372	0.5472	0.5582
(15-01-2000) of January (5)	0.3020	0.2330	0.1980	0.2810	0.5630	0.3030	0.4610	0.4710	0.4820
(15-02-2000) of February (6) and	0.2722	0.2032	0.1682	0.2512	0.5332	0.2732	0.4312	0.4412	0.4522
(19-02-2000) of February (6.14) *	0.2717	0.2027	0.1677	0.2507	0.5327	0.2727	0.4307	0.4407	0.4517
(15-03-2000) of March (7)	0.2888	0.2198	0.1848	0.2678	0.5498	0.2898	0.4478	0.4578	0.4688

* indicates the row giving the minimum reducing sugars for each clone.

Hence, it could be concluded that any variety or clone might show different sucrose and reducing sugars percent but the time of yielding maximum sucrose percent was the same. Similar result arose for reducing sugars percent.

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