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CAUSE-EFFECT RELATIONSHIP OF CANE AND SUGAR YIELD COMPONENTS IN SUGARCANE

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Abstract: The cause and effect relationship of cane and sugar yield components studied in the plant crop performance of 48 hybrid varieties revealed that circumference of cane, number of millable canes per plot and length of cane had high direct contributions for cane yield. Pol percentage at 12th month had maximum direct effect on CCS percentage. Among the two components contributing to sugar yield, cane yield had maximum contribution rather than CCS percentage, thereby suggesting that increasing the cane yield through its components like circumference of cane, number of millable canes or length of cane, the sugar yield can also be increased, through correlated response.

INTRODUCTION

Phenotypic association between variables may be genetically controlled or they may be brought about by environmental influence or by the direct influence of one variable on another by correlated common causes. Further, selection for a trait in one direction may cause an undesired diminution of another trait by direct or indirect effect through a third variable. Path analysis devised by Wright (1921) is useful in the statistical analysis of cause and effect in a system of correlated variables. In this study components having direct and indirect contributions for cane and sugar yields were assessed by path analysis.

MATERIALS AND METHODS

Forty eight hybrid clones of sugarcane were evaluated as a plant crop in a randomised block design with three replications at the Sugarcane Research Station, Thiruvalla, Kerala. The data on cane yield, sugar yield and yield and quality components such as number of millable canes per plot, weight of cane, length of cane, length of internode, number of internodes, circumference of cane, extraction per cent at 12th month and brix, po! and CCS percentages at 12th month were collected. The genotypic correlations of cane yield, sugar yield and other components were calculated following Kempthorne (1957). The direct and indirect effects of components on cane yield, CCS percentage and sugaryield were estimated following Dewey and Lu (1959). For the study of cause-effect relationship number of millable canes per plot, weight of cane, length of cane, number of internodes, length of internode and circumference of cane were considered as components of cane yield, extraction per cent at 12th month and brix and pol percentages at 12th month as components of CCS percentage and the cane yield and CCS percentage at the 12th month as components of sugar yield.

RESULTS AND DISCUSSION

The direct and indirect effects of six components on cane yield, three components on CCS percentage and two components on sugar yield along with their respective genotypic correlation coefficients are presented in Tables 1, 2 and 3. The path diagram with path coefficients (direct effects) and the genotypic correlations are presented in Fig 1. The circumference of cane had maximum direct effect on cane yield (1.16), followed by number of millable canes per plot (0.93) in agreement to the reports of Miller and James (1974) and Kang *et al.* (1983). The circumfernce of

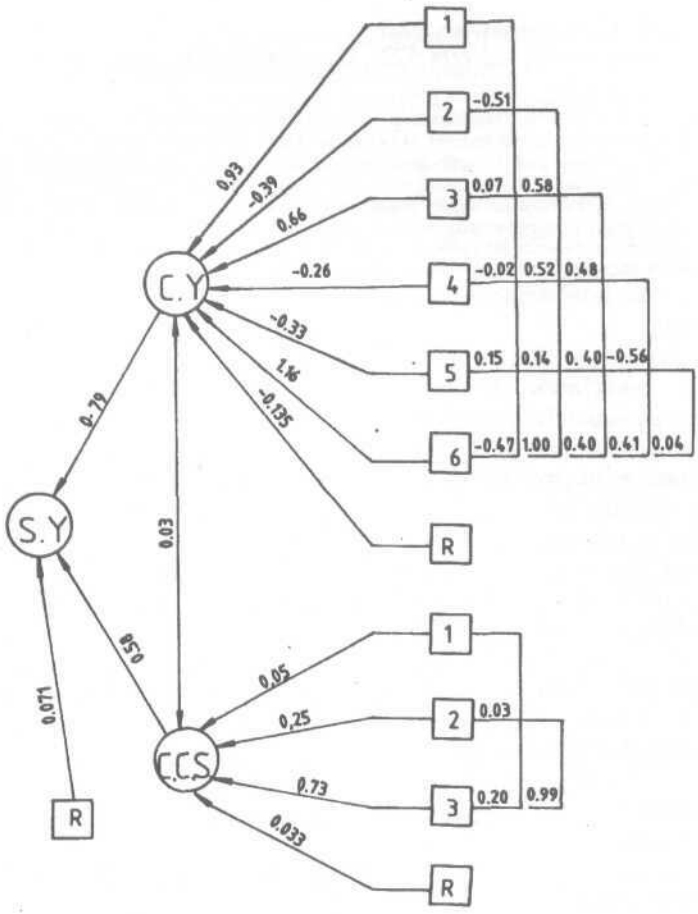

Fig. 1. Path diagram of cane yield, CCS and sugar yield

Direct effects shown in arrows and correlations shown in steps

CY Cane yield per plot
- 1 Number of milliable canes per plot
- 2 Weight of cane
- 3 Length of cane
- 4 Number of internodes
- 5 Length of internodes
- 6 Circumference of cane

CCS Commercial cane sugar percentage
- 1 Extraction per cent at 12th month
- 2 Brix at 12th month
- 3 Pol at 12th month

SY Sugar yield per plot

R Residual effect

Table 1. Direct and indirect effects of the components on cane yield in the plant crop of sugarcane

Sl. No.	Components	Direct Effects	Indirect effects via						Total correlation
			Number of miilable canes per plot	Weight of cane	Length of cane	Number of inter-nodes	Length of inter-nodes	Circum-ference of cane	
1	Number of miilable canes per plot	0.93	-	0.20	0.04	0.01	-0.06	-0.55	0.57
2	Weight of cane	-0.39	-0.48	-	0.38	-0.13	0.06	1.16	0.48
3	Length of cane	0.66	0.06	-0.23	-	-0.12	-0.17	0.47	0.67
4	Number of internodes	-0.26	-0.02	-0.20	0.32	-	0.24	0.48	0.56
5	Length of internode	-0.33	0.14	-0.55	0.26	0.14	-	-0.05	0.11
6	Circumference of cane	1.16	-0.44	-0.39	0.27	-0.11	-0.02	-	0.47

Residual effect -0.135

Table 2. Direct and indirect effects of the components on CCS percentage in the plant crop of sugarcane

Sl. No.	Components	Direct effects	Indirect effects via			Total correlation
			Extraction % at 12th month	Brix at 12th month	Pol at at 12th month	
1	Extraction % at 12th month	0.05	-	0.01	0.15	0.21
2	Brix at 12th month	0.25	0.01	-	0.72	0.98
3	Pol at 12th month	0.73	0.01	0.025	-	0.99

Residual effect 0.033

Table 3. Direct and indirect effects of the components on sugar yield in the plant crop of sugarcane

Sl. No.	Components	Direct effects	Indirect effects via		Total correlation
			Cane yield per plot	CCS % of 12th month	
1	Cane yield per plot	0.79	-	0.02	0.81
2	CCS percentage at 12th month	0.58	0.03	-	0.61

Residual effect 0.071

cane exerted negative indirect effect (-0.44) through number of millable canes per plot which in turn had high negative indirect effect through circumference of cane (-0.55). Therefore, for increasing the cane yield a compromise between number of millable canes and circumference of cane is necessary during selection programme (Kang *et al.*, 1983).

Length of cane is the third major component exerting maximum positive direct effect on cane yield (0.66), in agreement to the results of Hoods *et al.* (1979). Contrary to this, a negative direct effect of length of cane on cane yield was reported by Mariotti (1973). Eventhough the weight of cane and number of internodes exerted negative direct effects, they had a very high positive indirect effect on cane yield through circumference of cane and length of cane, the two components which had high positive direct effects on cane yield, indicating that selection based on circumference of cane and length of cane will be effective in increasing the yield of cane.

Among the three components CCS percentage, the pol percentage at 12th month had maximum positive direct effect (0.73) in conformity to the results of Bhide (1969) and Kang *et al.* 1983). The brix percentage at 12th month, which had low positive direct effect (0.25) exerted very high positive indirect effect through pol percentage at 12th month (0.72), suggesting that by increasing the pol percentage, sugar recovery (CCS percentage) can be increased. The extraction per cent at 12th month exerted low positive direct effect on CCS percentage at 12th month (0.05).

Among the two components of sugar yield, the cane yield exerted high positive direct effect (0.79) on sugar yield rather than CCS percentage in agreement to the results of Lu (1984).

However, the high positive contribution of CCS percentage on sugar yield than cane yield reported by Kang et al. (1983) is contrary to the results of this study. The residual effects were low indicating that most of the genetic variability for cane and sugar yield were accounted by the model used for the study of cause and effect relationships.

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