# *VARIABILITY AND CORRELATION STUDIES IN SELECTED SUGARCANE (Saccharum officinarum L.) CLONES AT TWO LOCATIONS IN NIGERIA*

**BY**

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## DECLARATION

I hereby declare that his thesis has been written by me and that it is a record of my own research work. It has not been presented in any previous application for a higher degree.



---

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## CERTIFICATION

This thesis entitled "Variability and Correlation studies in selected Sugar Cane (*Saccharum officianarum* L.) clones at two locations in Nigeria by Mohammed Ndagi Ishaq meets the regulations governing the degree of Master of Science of Ahmadu Bello University, Zaria and is approved for its contribution to scientific knowledge and literary presentation.

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## DEDICATION

This work is dedicated to my wife, Mrs. Hauwa M. Ishaq and son, Master Dangana M. Ishaq for their patience and endurance throughout the period of this research work.

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## ABSTRACT

Eight selected genetically diversified sugarcane clones were evaluated for two Years (1993 and 1994) at two locations (Badeggi in the Southern guinea savanna and Uyo in the forest agroecology) in Nigeria. The objectives was to study the extent of variability and relationship between the various quantitative and qualitative traits for the purpose of genetic improvement. Significant differences were observed between clones for all traits. Important yield components like stalk height, stalk weight, number of stalks per stool and establishment count showed wide ranges in the magnitude of genotypic coefficient of variation. Genotypic components of variance for these traits also contributed more to be phenotypic variance. Performance data were also used to obtain correlations between the traits studied. Correlation coefficients obtained in all the important yield components were positive and significant except for stalk diameter and leaf width. The correlations revealed that stalk weight, stalk height, number of stalks per stool as well as the establishment count were the major traits contributing to cane yield. Since correlation only measures the mutual association between traits without regard to causation, path analyses which specifies the causes of the association and the association between traits and their importance showed that stalk weight, stalk height, number of stalks per stool had direct effect on cane yield. Stalk diameter showed its effect indirectly through stalk weight and stalk height.

## CHAPTER ONE

## INTRODUCTION

Sugarcane is a vegetatively propagated perenial crop belonging to the family, gramineae which consist of the following species: *Saccharum officinarum* L, *S.barberi* Jesw., *S. sinense* Roxb., *S. spontaneum* L, *S. robustum* Prandes & Jesw. Ex Grassel and *S. elude* Hask. Of all these *S. spontaneum* and *S. robustum* occur wild in nature while the other four are cultivated species (Thulraram, 1987) *Saccharum officinarium* (2n = 80) is characterized by large, juicy stalks, with a high sugar content, disease susceptibility and low vigour (James, 1980). It originated in Northern India and New guinea (Grassel, 1977) and is adapted to tropical and subtropical climates. Its cultivation is restricted to within 35° North and South of the equator. The basic requirement for good cane production are: warm temperature (between 34°C and 38°C) adequate water supply, dry season of 3 to 5 months duration with a rainfall of below 50mm to ensure ripening, and deep, heavy textured soil (Stevenson, 1965).

The greatest single producer of sugar cane in the world today is Brazil, closely followed by Cuba and India. North and Central America produce about 31% of the world's total output, Asia, 27%, South America 25% while Africa produces about 13% of the total world output (Barnes, 1974). The cultivation of sugar cane in West Africa is only a matter of decades. In Nigeria, commercial cane cultivation started about three decades ago (Oguntoyinbo, 1978). Sugar is extracted from sugarcane locally and industrially. It is

also chewed directly or made into manarkoila (crude sugar). By-products like molasses could be used for animal feeds or fermented into alcohol. Also, paper, rope, and sacks can be made from fibre and baggase obtained from the stalk.

Genetic improvement of sugar cane has been embarked upon for several years but the results obtained have not been so spectacular because of the highly polyploid and heterozygous nature of sugarcane which makes genetic analysis difficult (Albert, 1984). All forms of Saccharum, whether commercial or non-commercial carry a considerable store of variability owing to its heterozygosity and high ploidy level. At the National Cereals Research Institute, Badeggi where sugarcane has its national mandate for genetic improvement, a germplasm with wide genetic base is maintained. The collections include exotic materials introduced from different parts of the world and local landaces from Nigeria. This germplasm collection constitutes the bulk of Genetic variability on which improvement endeavours in sugar cane in Nigeria depends. Many of the clones are being screened for adaptability to the agro-ecological condition of the sugarcane growing areas of Nigeria. There is limited information on the agromorphological and quality characteristics of sugarcane clones Nigeria. In addition knowledge of association between these characteristics can provide information on how selection for one can bring about changes in the other unselected character. This study was therefore undertaken to:

(i) Obtain information on the extent of genetic variability for the quantitative and qualitative characters in selected

sugarcane clones in Nigeria.

(ii) Investigate the nature of interrelationships between these characters as aid to selection.

# CHAPTER TWO

## REVIEW OF LITERATURE

### 2.1 Estimates of genetic Variability

According to Burton and DeVane (1953), since sugarcane is asexually propagated, all genetic variabilities is exploitable. The clonal nature suggests broad estimate of genetic variance and covariances for predictive use between clonal stages. Horgarth et al. (1981) found characters with high genetic variability to be stalk number and stool volume. Singh et al. (1983) when studying hybrid populations of sugar cane at clonal stage also found wide ranges of variability for number of stalks per stool, cane yield and sucrose percent in juice. Sahi et al. (1977) found large estimates of genotypic variance for most characters studied including stalk length, stalk diameter, stalk weight when they evaluated twenty early maturing sugarcane varieties.

Singh et al. (1995) observed high genotypic coefficient of variability (GCV) for stalk diameter and stalk yield and also primary components of yield like number of stalks per stool, and stalk weight when evaluating seedlings of five biparental crosses. They however found moderate genotypic variation in number of internodes per stalk. Large amount of phenotypic coefficient of variation (PCV) was also recorded for stalk diameter, yield, number of stalks per stool and leaf Area. Hooda and Singh (1989) found high GCV for single cane weight, stalk height and cane yield. Other traits like stalk diameter and sugar content had moderate GCV. Reedy and Reddi, in their study on forty genotypes in 1986

found high genotypic variance for cane yield and commercial cane sugar yield. For stalk number and stalk weight, about 80% of the total phenotypic variation was due to the genotypic components. They also found stalk length, stalk diameter and sucrose content in juice to register comparatively lower GCV. Battan and Chaudhary (1984) reported that commercial cane sugar percent had the highest genotypic and phenotypic coefficient of variation. Sharma (1986) determined coefficient of variation for quality traits and found sucrose percent and purity percent to be more important for making jaggery (crude sugar cakes) while Brix, sucrose and purity percents to be important for white sugar production. Kang et al. (1990) found that fibre percent were the least important component of cane and sugar yield, when evaluating plant crop and first ratoon of forty-eight sugarcane genotypes.

## 2.2 Correlations

Since most of the characters of economic importance, such as yield, are complex in inheritance and may involve several related characters, the degree of genotypic and phenotypic correlations of the characters is important. These correlations are of practical value since selection is usually concerned with changing two or more traits simultaneously. Studies carried out by Reedy and Reedi (1986) on genotypic and phenotypic correlations of cane yield with four yield components (stalk number per plot, stalk weight, diameter and height) revealed that stalk number per plot had the greatest influence on cane yield, followed by stalk weight. The correlations obtained by Singh et al. (1981) with respect to the

number of millable cane per stool, internode per cane, stalk height, weight and diameter as well as Brix value of the first clonal performance should be based mainly on the number of millable canes, stalk height and brix. Battan et al. (1985) revealed that commercial cane sugar percentages were the most reliable in selecting for high commercial cane sugar genotypes as it correlated positively with cane yield. Balasundaram and Bhagylakshmi (1978) in their studies revealed that stalk yield and its components were significantly and positively correlated with each other and with sucrose and sugar percentage. Also in a study on forty-one experimental Sugarcane clones by Milligam et al. (1990a), Brix and juice purity were found to be highly correlated with sucrose content and with each other and were not affected by crop age.

Oworu (1978), evaluated some Nigerian local sugarcanes and found positive correlation (r = 0.90) between sucrose percent and fibre percent. According to him, the positive correlation between sucrose percent and fibre percent suggest that as sucrose increases fibre production increases. Singh and Singh, (1995) in their studies observed significant correlations between Brix and Sucrose content and between sucrose content and purity when they evaluated twelve sugarcane . Sardual et al. (1983) when evaluated twenty-eight foreign varieties and found millable canes, Polarity percentage, juice purity percent and leaf width to be positively correlated with commercial cane sugar percent. They observed non-significant and negative association between cane length and

diameter. Leaf width and length were also positively associated though their association with other traits was not positive. They found leaf width to be more important as it registered a positive association with cane weight, cane length, cane diameter and yield. It also had positive but non-significant correlation with sucrose percentage. Sankaranarayan and Shumungasundaram (1981) reported a highly significant and positive correlation between brix percent and leaf width among adapted varieties. Singh et al. (1981) found that Brix percent had a positive association with number of millable canes, number of internodes but negative association with stalk height and diameter.

## 2.3 Path Coefficient Analysis

Path coefficients are an excellent means of studying direct and indirect effects of interrelated components of a complex trait. Several studies involving path-coefficient analyses have been conducted in sugarcane. Effect of stalk number, stalk diameter, stalk lenght and stalk weight on cane yield have been reported to be positive and high (Horgarth, 1971; James, 1971; Kang et al., 1983; Gravois, 1988). Kang et al. in 1983, found that at the genetic level, stalk diameter and stalk number had greater effect on tonne per hectare of cane than did stalk height. Miller (1977) determined that stalk number, stalk diameter, stalk height, brix and stalk density in that order were important in increasing sucrose yield with which they had high positive direct effects. James (1971), reported from his path analysis study that stalk number was the most important component of cane yield, followed by

stalk diameter and stalk length. In a study conducted by Nair and Somarajan (1985), path coefficient analysis revealed that millable stalks per plot and single stalk weight were the major trait of sugar yield. According to Milligam et al. (1990b), path coefficient analysis result indicated that cane yield was the most important determinant of sucrose yield; stalk number was however the primary determinant of cane yield. Stalk diameter was more important than stalk length and stalk density in affecting stalk weight, regardless of crop age. Xie et al. (1991) found stalk number to be the most useful trait when selecting for cane and sugar yields on his path-coefficient analysis studies. According to Gravois et al. (1991), path-coefficient analysis revealed that purity percent and brix percent were the main factors in increasing sucrose content.

Nair and Sreenivan (1991) found path-coefficient analysis for number of millable stalk weight to produce negative indirect effect through each other. These two characters together with stalk yield however showed high genotypic variability. According to Kang et al. (1983), path-coefficient analysis indicated that plant height is less important than stalk diameter and stalk number as components of cane yield, but at phenotypic level, all the three components were of equal importance. According to them, from a practical stand point, genetic path-coefficient would be more useful to a breeder than phenotypic path-coefficient in deciding upon more effective selection criteria. Punia et al. (1983) in their studies on forty-one genotypes and five standard checks found

stalk diameter to have low magnitude of direct effect on number of stalks per stool than its indirect effect via cane weight. Cane weight had a very high amount of direct effect on cane yield and its effect via other traits were low. According to Sarvjeet and Khan, (1995), in their study, path analysis showed that number of millable stalks per stool had maximum direct effect on cane yield, followed by stalk weight. The direct contribution of the remaining characters were negligible, however, there was an indirect contribution of stalk height via millable stalk and stalk weight; stalk diameter via stalk weight; internode number via stalk weight which were moderately high. Similar findings was reported for number of millable stalks and stalk weight by Lu (1983).

# CHAPTER THREE

## MATERIALS AND METHODS

### 3.1 Genetic Materials

The genetic materials used in this study consisted of eight diverse sugarcane clones whose origin and morphological characteristics are given in Table 1 below

Table 1: Origin and Morphological Characteristics of the genetic materials.

| Entry | Origin | Characteristics |
|---|---|---|
| BD-04 | Nigeria | Greenish yellow stem, average height of 1.7-2.0m, long internodes, Non-flowering, High tillering, non lodging and smut resistant. |
| Co-997 | India | Stems are, average height Of 1.3-1.5m, short internodes, Heavy flowering, High tillering free trashing, non lodging and smut tolerant. |
| B6604 | West-Indies | Have green stem, average height of 1.8-2.2m,robust stem, long internodes, Sparsely flowering, High tillering, non lodging and moderately smut resistant. |
| OG-08 | Nigeria | Purple stem, average height of 1.2-1.5m, short internodes, Profusely flowering, high tillering, non trashing and smut susceptible. |
| OG-12 | Nigeria | Green stem, average height of 1.5-1.8m, longe internodes, wide leaves, Profusely flowering, high tillering, and smut resistant. |
| LS-21 | Nigeria | Stems are green, average height of 1.8-2.0m, narrow laef blade, Non flowering, High tillering, non lodging, free trashing. |
| OY-09 | Nigeria | Yellow stem, average height of 1.4-1.8m, high brix content, thin stalk, Non-flowering, low tillering, non-lodging, and smut resistant. |

| | | |
|---|---|---|
| Co-957 | India | Yellow stem, short internodes, high brix content, thin stalk, Profusely flowering high tillering, non lodging free trashing and smut susceptible. |

## 3.2 Field Experiments

The experiments were conducted for two years, 1993 and 1994 at two location: Badeggi (9° 45N; 6°07'E) in the Southern guinea savanna and Uyo (4°58'N; 8°.21'E) in the forest zone. At each location in each year the experiments were laid out as randomised complete blocks with three replications. Plots consisted of four rows, 4m long spaced 1m apart. The experimental area was ploughed, harrowed and ridged.

Ten setts were planted per row. Each sett, consisting of 3 nodes was cut from unripe whole canes. The setts were laid horizontally in the furrow of the ridges and spread evenly through the whole length of the row. The setts were then lightly covered with soil from the intervening ridges. NPK fertilizer (20:10:10) was applied at the recommended rate of 120kgN/ha, 50kg$P_2O_5$/ha and 50kg$K_2O$/ha at 3 weeks and 3 months after planting. The ridges were moulded up to prevent the canes from lodging and final fertilizer application was done. At the onset of dry season, before the canes matured, supplemental irrigation was applied for Badeggi location for 3 months. Roguing of smutted stands was carried out subsequently when observed. During the dry season fire tracing was done round the whole field to prevent fire hazards.

3.3 **Data Collection**

Data on morphological traits were taken from ten randomly selected plants per plot. However, the total of two inner rows for each plot was harvested for yield. Three to five stalks were cut for laboratory analysis to obtain quality parameters for each clone. Apart from establishment count which was taken at 42 days after planting, other observations were taken at maturity 10 months after planting. The following characters were measured.

- Establishment count:- Total stand count per net plot at 42 days after planting.
- Stalk diameter:- The dimeter of the stalk measured with vernier callipers about the middle of the stalk in cm.
- Stalk height:- The length of the stalk measured with a metre rule from the base to the end of matured cane.
- Single stalk weight:- Weight of a single stalk in grammes.
- Number of stalks per stool:- Number of tillers plus the stand counted for average of ten stools per plot.
- Number of internodes per stalk:- The number of internodes per stalk counted from the base of the stalk to the tip.
- Leaf length:-The length of leaves measured from the base to the tip in cm.
- Leaf width:- The widest part of the whole length of leaf measured in cm.
- Leaf Area:- Calculated as 3/4 of the product of the length and width of the leaf in $cm^2$. (Singh and Sigh, 1995)
- Yield per plot:- The total canes in net plot harvested

and weighed in kg.

- Brix:- Measures the amount of soluble solids present in juice with refractometer in percentage.
- Polarity:- It is the percent sucrose present in juice.
- Purity:- The ratio of brix to polarity expressed in percentage.
- Fibre:- The amount of fibre present in crushed cane also expressed in percentage.
- Juice:- The total amount of juice extracted from crushed cane estimated and expressed in percent.

### 3.4 Statistical Analysis

The linear statistical model used for Randomised Complete Block Design in each environment was:

$$X_{ijk} = \mu + M_{ij} + b_j + e_{ijk}$$

where

$X_{ijk}$ = $K^{th}$ observation made in the $j^{th}$ block on the $i^{th}$ variety.

$\mu$ = Population mean

$M_{ij}$ = effect of the ith variety in the $j^{th}$ block

$b_j$ = effect of the $j^{th}$ block.

$e_{ijk}$ = Components of error of the $k^{th}$ observation in the $j_{th}$ block on the $i^{th}$ treatment.

The statistical model used for the combined analysis was:

$$X_{ijklm} = \mu + B_i + Y_j + L_k + V_l + YL_{jk} + YV_{jl} + LV_{kl} + LVY_{jlk} + e_{ijklm}$$

where

$X_{ijklm}$ = $K^{th}$ observation made in $j^{th}$ year on the $i^{th}$ variety at $m^{th}$ plot. at $l^{th}$ location.

$\mu$ = Population mean:

$B_i$ = effect of the $i^{th}$ variety

$Y_j$ = effect of the $j^{th}$ year

$L_k$ = effect of the $k^{th}$ observation

$V_l$ = effect of $l^{th}$ location

$YL_{jk}$ = effect of $k^{th}$ observation made in jth year

$YV_{jl}$ = effect of $l^{th}$ location on jth year

$LV_{kl}$ = effect of lth location on $k^{th}$ observation

$LVY_{jkl}$= effect of $l^{th}$ location on $k^{th}$ observation made in $j^{th}$ year

$e_{ijklm}$= Components of error effect due to sampling among the varieties in the environments.

i = 1, 2, 3, ..... 8.

j = 1,2.

k = 1,2,3,.....10

l = 1,2.

Table 2: Form of Analysis of Variance and Covariance for each environment.

| Source | df | Ms | EMS | EMCP |
|---|---|---|---|---|
| Rep | r-1 | | | |
| Variety | g-1 | $M_1$ | $\sigma^2_e + r\sigma^2_g$ | $\sigma_{ab} + r\sigma_{gagb}$ |
| Error | (r-1) (g-1) | $M_2$ | $\sigma^2_e$ | $\sigma_{ab}$ |
| Total | rg-1 | | | |

where $M_1$ and $M_2$ = observed mean squares for varieties and error respectively.

r = Number of replications

g = Number of clones

$\sigma^2_g$ = genotypic variance

$\sigma^2_e$ = error variance.

$\sigma_{gagb}$ = genotypic covariance of trait a and b

$\sigma_{ab}$ = error covariance of trait a and b

Table 3: Form of Analysis of Variance and Covariance for the Combined environments

| Source | df | MS | EMS | EMCP |
|---|---|---|---|---|
| Reps | r-1 | | | |
| Years | y-1 | | | |
| Locations | l-1 | | | |
| Years X Locs | (y-1)(l-1) | | | |
| Varieties | g-1 | $M_1$ | $\sigma^2_e+r\sigma^2_{gly}+ry\sigma^2_{gl}+rl\sigma^2_{gy}+rly\sigma^2_g$ | $\sigma_{ab}+r\sigma_{glyaglyb}+ry\sigma_{glaglb}+rl\sigma_{gyagyb}+rly\sigma_{gagb}$ |
| Vars X years | (g-1)(y-1) | $M_2$ | $\sigma^2_e+r\sigma^2_{gly}+rl\sigma^2_{gy}$ | $\sigma_{ab}+r\sigma_{glyaglyb}+ry\sigma_{gyagyb}$ + |
| Vars X locs | (g-1)(l-1) | $M_3$ | $\sigma^2_e+r\sigma^2_{gly}+ry\sigma^2_{gl}$ | $\sigma_{ab}+r\sigma_{glyaglyb}+ry\sigma_{glagl b}$ |
| Vars X years X locs | (g-1)(y-1)(l-1) | $M_4$ | $\sigma^2_e+r\sigma^2_{gly}$ | $\sigma_{ab}+r\sigma_{glyaglyb}$ |
| Error | ly(g-1)(r-1) | $M_5$ | $\sigma^2_e$ | $\sigma_{ab}$ |

Y = Number of years

l = Number of locations

$M_1, M_2, M_3, M_4, M_5$ = observed mean squares for varieties, varieties X Years, Varieties X locations, Varieties X years X locations and error respectively.

$\sigma^2_{gy}$ = Varieties X years Variance

$\sigma^2_{gl}$ = Varieties X Locations Variance

$\sigma^2_{gyl}$ = Varieties X Years X Locations Variance

### 3.5 Estimation of Variance Components

The components of variance were estimated from the expectation of mean squares by equating the observed mean squares to their expectations as follows:

(1) For individual environment

$$\sigma^2_g = \frac{M_1 - M_2}{r} \qquad S.E = \sqrt{(1/r)^2 \left[\frac{2(M_1)^2}{(df+2)} + \frac{2(M_2)^2}{df+2}\right]}$$

$$\sigma^2_e = M_2 ; \qquad S.E = \sqrt{\frac{2(M_2)^2}{df+2}}$$

$$\sigma^2_{ph} = \frac{M_1 - M_2 + M_2}{r}, \qquad S.E = \sqrt{(1/r)^2 \left[\frac{2(M_1)^2}{(df+2)}\right]}$$

(ii) For combined environments of two years and two locations

$$\sigma^2_g = \frac{M_1 + M_4 - M_3 - M_2}{rly} ;$$

$$S.E = \sqrt{(1/rly)^2 \left[\frac{2(M_1)^2}{(df+2)} + \frac{2(M_4)^2}{df+2}\right]}$$

$$\sigma^2_{gy} = \frac{M_2 - M_4}{rl}$$

$$S.E = \sqrt{(1/rl)^2 \left[\frac{2(M_1)^2}{(df+2)} + \frac{2(M_4)^2}{df+2}\right]}$$

$$\sigma^2_{gl} = \frac{M_3 - M_4}{ry}$$

$$S.E = \sqrt{(1/ry)^2 \left[\frac{2(M_1)^2}{(df+2)} + \frac{2(M_4)^2}{df+2}\right]}$$

$$\sigma^2_{gly} = \frac{M_4 - M_5}{r} ;$$

$$S.E = \sqrt{(1/r)^2 \left[\frac{2(M_4)^2}{(df+2)}\right]}$$

Genotypic and Phenotypic Coefficient of variability were estimated by use of the formulae suggested by Burton (1952) and Hanson et al. (1956).

$$GCV\ (\%) = \frac{\sqrt{\sigma^2_g}}{\bar{X}} \times 100$$

$$PCV\ (\%) = \frac{\sqrt{\sigma^2_{ph}}}{\bar{X}} \times 100$$

$\sigma^2_g$ = Varieties variance

$\sigma^2_{ph}$ = Phenotypic variance

$\bar{X}$ = Population mean.

### 3.6 Correlations

The genotypic and phenotypic correlations were calculated from components of variance and covariance using the formulae suggested by Mode and Robinson (1959).

$$\text{Genotypic Correlation } r_{gagb} = \frac{\sigma_{gagb}}{\sqrt{\sigma^2_{ga} \times \sigma^2_{gb}}}$$

Where

$\sigma_{gagb}$ = genotypic covariance of trait a and b

$\sigma^2_{ga}$ = genotypic variance of trait a

$\sigma^2_{gb}$ = genotypic variance of trait b

$$\text{Phenotypic corrl. } r_{ph} = \frac{M_{gagb}}{\sqrt{M_{ga} \times M_{gb}}}$$

Where:

$M_{ga}$ = variety mean square for trait a

$M_{gb}$ = variety mean square for trait b

$M_{gagb}$ = variety mean product for traits a and b.

### 3.7 Path Coefficient Analysis

Path analysis is a standardized partial regression coefficient which measures the direct influence of one variable upon another and permits the separation of the correlation coefficient into components of direct and indirect effects (Dewey and Lu, 1959). The path coefficients were obtained by the simultaneous solution of the following equations, which express the basic

relationship between correlation and path coefficients.

$r_{1,10} = P_{,10} + r_{12} P_{2,10} + r_{13,} P_{3,10} + r_{14,}P_{4,10} + r_{15} P_{5,10} + r_{16,}P_{6,10} + r_{17} P_{7,10}$ $r_{18,}P_{8,10} + r_{19} P_{9,10}$.

$r_{2,10} = P_{2,10} + r_{12} P_{10} + r_{23} P_{3,10} + r_{24,}P_{4,10} + r_{25} P_{5,10} + r_{26,}P_{6,10} + r_{27} P_{7,10}+ r_{28}$ $P_{8,10} + r_{19} P_{9,10}$.

$r_{3,10} = P_{3,10} + r_{13} P_{10,}+ r_{23} P_{2,10} + r_{34} P_{4,10} + r_{35} P_{5,10} + r_{36,} P_{6,10} + r_{37} P_{7,10}$ $r_{38}P_{8,10}$ $+ r_{39} P_{9,10}$.

$r_{4,10} = P_{4,10} + r_{14} P_{10} + r_{24} P_{2,10} + r_{34}P_{3,10} + r_{45} P_{5,10} + r_{46} P_{6,10} + r_{47} P_{7,10} +r_{48} P_{8,10}$ $+ r_{49} P_{9,10}$.

$r_{5,10} = P_{5,10} + r_{15} P_{10} + r_{25} P_{2,10} + r_{35} P_{3,10} + r_{45} P_{4,10} + r_{56}P_{6,10} + r_{57} P_{7,10} + r_{58}$ $P_{8,10} + r_{59} P_{9,10}$.

$r_{6,10} = P_{6,10} + r_{16} P_{10} + r_{26} P_{2,10} + r_{36}P_{3,10} + r_{46} P_{4,10} + r_{56} P_{5,10} + r_{67} P_{7,10} +r_{68} P_{8,10}$ $+ r_{69} P_{9,10}$.

$r_{7,10} = P_{7,10} + r_{17} P_{10} + r_{27} P_{2,10} + r_{37,} P_{3,10} + r_{47} P_{4,10} + r_{57} P_{5,10} + r_{67} P_{6,10}$ $r_{78}P_{8,10}$ $+ r_{79} P_{9,10}$.

$r_{8,10} = P_{8,10} + r_{18} P_{10} + r_{28} P_{2,10} + r_{38} P_{3,10} + r_{48} P_{4,10} + r_{58} P_{5,10} + r_{68} P_{6,10} + r_{78}$ $P_{7,10} + r_{89} P_{9,10}$.

$r_{9,10} = P_{9,10} + r_{19} P_{10} + r_{29} P_{2,10} + r_{39} P_{3,10} + r_{49} P_{4,10} + r_{59} P_{5,10} + r_{69} P_{6,10} + r_{79}$ $P_{7,10} + r_{89} P_{8,10}$.

$$X = P^2x_{10} + P^2_{1,10} + P^2_{2,10} + P^2_{3,10} + P^2_{4,10} + P^2_{5,10} + P^2_{6,10} + P^2_{7,10} + P^2_{8,10} + P^2_{9,10}+2P_{1,10} r_{12} P_{2,10} +$$
$$2P_{13,10} r_{13} P_{3,10} + 2P_{1,10} r_{15,} P_{5,10} + 2P_{1,10} r_{16}P_{6,10}+$$
$$+2P_{1,10}r_{17}P_{7,10}+2P_{1,10}r_{18,}P_{8,10}+2P_{1,10}r_{19}P_{9,10}+2P_{2,10}r_{23}P_{3,10}+2P_{2,10}r_{24}P_{4,10}+2P_{2,10}r_{25}P_{5,10}+2P_{2,10}r_{26}P_{6,10}+2P_{2,10}r_{27}P_{7,10}$$
$$+2P_{2,10}r_{28}P_{8,10}+2P_{2,10}r_{29}P_{9,10}+2P_{3,10}r_{34}P_{4,10}+2P_{3,10}r_{35}P_{5,10}+2P_{3,10}r_{36}P_{6,10}+2P_{3,10}r_{37}P_{7,10}+2P_{3,10}r_{38}P_{8,10}+2P_{3,10}r_{39}P_{9,10}$$
$$+2P_{4,10}r_{45}P_{5,10}+2P_{4,10}r_{46}P_{6,10}+2P_{4,10}r_{47}P_{7,10}+2P_{4,10}r_{48}P_{8,10}+2p_{4,10}r_{49}P_{9,10}+2P_{5,10}r_{56}P_{6,10}+2P_{5,10}r_{57}P_{7,10}+2P_{5,10}r_{58}P_{8,10}$$
$$+2P_{5,10}r_{59}P_{9,10}+2P_{6,10}r_{67}P_{67,10}+2P_{6,10}r_{68}P_{8,10}$$
$$+2P_{6,10}r_{69}P_{9,10}+2P_{7,10}r_{78}P_{8,10}+2P_{7,10}r_{79}P_{9,10}+2P_{8,10}r_{89}P_{9,10}.$$

The residual effect determines how best the causal factors accounted for the variability of the dependent factor which in this case is the cane yield.

# CHAPTER FOUR

## RESULTS

### 4.1. Mean performance.

The mean performance of the eight Sugar cane clones at the different locations in the two trial years and their performance across the four environments (two years and two locations) are presented in Tables 4 - 8. There were significant differences between clones for all traits. At Badeggi in 1993, B6604 had the highest establishment count, stalk height, stalk weight, leaf length and cane yield per plot, followed closely by Co-997 for cane yield per plot (Table 4).The clone, Co-957 had the lowest cane yield per plot. At Uyo in 1993 (Table 5) significant differences were also observed for all the traits, measured.B6604 also performed better than the other varieties in Uyo in 1993. It had the highest stalk weight, stalk diameter, stalk height, leaf length and cane yield per plot. The clones OG-08 and OG-12 had the lowest cane yield at this location in 1993.

The pattern of performance was different in 1994 at both locations although significant differences were also observed between clones for all traits at the two locations. At Badeggi (Table 6), OG-08, a local variety had the highest cane yield per plot, number of stalks per stool and, number of internodes per stalk.

Table 4: Mean Performance of Eight sugarcane clones grown at Badeggi in 1993

| Clones | Establish-ment Count | Stalk height (cm) | Stalk diameter (cm) | Single stalk weight (g) | No of stalks/ stool | No of inter-nodes/stalk | Leaf length (cm) | Leaf width (cm) | Leaf Area ($cm^2$) | Yield/ Plot (Kg) |
|---|---|---|---|---|---|---|---|---|---|---|
| BD-04 | 34.67abc | 123.00b | 2.54ab | 513.33a | 5.40ab | 15.67b | 120.00abc | 3.70a | 333.87ab | 76.87cd |
| CO-997 | 29.33bc | 113.00b | 2.11de | 380.00cd | 5.40abd | 15.40bc | 120.67abc | 3.90bc | 265.00c | 88.27ab |
| B6604 | 42.33a | 149.67a | 2.21cd | 500.00a | 5.20ab | 13.70cd | 129.67a | 2.96bc | 273.33b | 96.67a |
| OG-08 | 29.33bc | 94.00c | 1.95e | 280.00d | 5.83a | 15.53b | 102.33c | 2.32c | 177.97d | 73.53cd |
| OG-12 | 37.00ab | 114.33b | 2.33bcd | 490.00ab | 5.40ab | 14.57c | 126.67ab | 3.03b | 287.47bc | 82.17bc |
| LS-21 | 35.33abc | 118.67b | 2.45abc | 466.67bc | 4.60bc | 14.30c | 126.33ab | 3.82a | 362.03a | 73.47cd |
| OY-09 | 28.33bc | 107.67bc | 2.56a | 486.67ab | 4.33bc | 13.37d | 130.00a | 3.32ab | 321.40ab | 70.60d |
| CO-957 | 26.00c | 91.67c | 2.14de | 340.00c | 4.90abc | 17.20a | 122.67abc | 2.81bc | 260.23c | 67.50d |

Means followed by similar letter(s) are not significantly different at 5% level of probability (DMRT)

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Table 5: Mean Performance of Eight sugarcane clones grown at Uyo in 1993

| Clones | Establish-ment Count | Stalk height (cm) | Stalk diameter (cm) | Single stalk weight (g) | No of stalks/ stool | No of inter-nodes/ stalk | Leaf length (cm) | Leaf width (cm) | Leaf Area ($cm^2$) | Yield/ Plot (Kg) |
|---|---|---|---|---|---|---|---|---|---|---|
| BD-04 | 15.67cd | 142.67c | 2.20ab | 536.67b | 12.57cd | 16.47c | 137.00d | 3.66ab | 377.80c | 94.53bcd |
| C0-997 | 19.33ab | 14667cb | 2.25ab | 503.33bc | 14.23b | 17.83a | 131.33cd | 3.41ab | 332.50d | 99.60b |
| B6604 | 18.33bc | 165.67a | 2.36a | 633.33a | 14.70b | 15.10abc | 171.67a | 3.44ab | 444.60b | 112.63a |
| OG-08 | 14.00d | 145.33c | 2.25ab | 483.33c | 13.90bc | 15.03bc | 161.00abc | 3.46ab | 419.10bc | 73.53cd |
| OG-12 | 15.00cd | 144.00c | 2.32a | 526.67b | 11.95d | 17.93a | 147.67cd | 3.98a | 440.37b | 88.00d |
| LS-21 | 21.00abc | 158.00ab | 2.33a | 620.00a | 12.90cd | 17.93a | 136.67d | 3.92a | 402.10bc | 97.53bc |
| OY-09 | 22.33a | 148.33c | 2.30a | 506.67c | 13.30c | 17.07ab | 168.00ab | 3.66ab | 460.90a | 93.53bcd |
| CO-957 | 18.00bc | 147.00c | 2.33a | 503.33bc | 15.17a | 17.87a | 145.33cd | 3.57ab | 391.30c | 96.53bcd |

Means followed by similar letter(s) are not significantly different at 5% level of probability (DMRT)

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TABLE 6: MEAN PERFORMANCE OF EIGHT SUGASRCANE CLONES GROWN AT BADEGGI IN 1994

| Clones | Establish-ment Count | Stalk height (cm) | Stalk diameter (cm) | Single stalk weight (g) | No of stalks/ stool | No of inter-nodes/ stalk | Leaf length (cm) | Leaf width (cm) | Leaf Area ($cm^2$) | Yield/ Plot (Kg) |
|---|---|---|---|---|---|---|---|---|---|---|
| BD-04 | 32.33bc | 164.90a | 2.65a | 686.67a | 9.07cd | 17.60ab | 127.60bc | 4.40b | 428.53ab | 107.20ab |
| CO-997 | 30.67bc | 146.73abc | 2.33bc | 476.67ba | 9.73bcd | 17.873ab | 122.00d | 7.19a | 354.23abc | 98.33abc |
| B6604 | 33.67b | 151.23abc | 2.23cd | 406.67c | 9.20bcd | 14.90bcd | 130.50b | 3.35c | 311.50c | 96.20bc |
| OG-08 | 35.00b | 130.97bcd | 2.07d | 380.00c | 12.47a | 20.80a | 127.40bc | 3.76bc | 297.40d | 110.27a |
| OG-12 | 28.33c | 119.77cd | 2.24cd | 346.67c | 10.47bc | 13.87d | 127.60bc | 3.44c | 330.23bc | 86.03c |
| LS-21 | 34.33b | 156.83ab | 2.56a | 620.00ab | 8.27d | 16.83bc | 131.57bc | 4.56b | 449.80a | 109.20a |
| OY-09 | 34.00b | 135.47abcd | 2.47ab | 466.67bc | 10.13bc | 14.70cd | 153.10ab | 3.66c | 427.40ab | 96.33bc |
| CO-957 | 37.67a | 110.90d | 2.30bc | 333.33c | 11.67ab | 17.10b | 125.83cd | 4.33b | 389.33abc | 91.17c |

Means followed by similar letter(s) are not significantly different at 5% level of probability (DMRT)

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TABLE 7: MEAN PERFORMANCE OF EIGHT SUGASRCANE CLONES GROWN AT UYO IN 1994

| Clones | Establish-ment Count | Stalk height (cm) | Stalk diameter (cm) | Single stalk weight (g) | No of stalks/ stool | No of inter-nodes/ stalk | Leaf length (cm) | Leaf width (cm) | Leaf Area ($cm^2$) | Yield/ Plot (Kg) |
|---|---|---|---|---|---|---|---|---|---|---|
| BD-04 | 26.33a | 185.53abc | 2.15b | 283.00a | 18.00a | 15.67cd | 113.10ab | 3.19ab | 268.80abc | 140.07a |
| CO-997 | 25.00ab | 150.53d | 2.15b | 209.33bc | 11.67bc | 14.00d | 99.73b | 2.62bc | 199.70d | 80.60ef |
| B6604 | 23.33bc | 200.63a | 2.16b | 238.33ab | 15.67ab | 21.33abc | 128.03a | 2.80c | 266.70abc | 96.67cde |
| OG-08 | 22.00bc | 173.17c | 1.96bc | 234.33ab | 10.33c | 15.00cd | 116.67ab | 2.53c | 222.93c | 75.20f |
| OG-12 | 25.00ab | 196.00a | 2.62a | 280.00a | 19.67a | 24.00ab | 110.40ab | 3.80a | 314.77a | 104.23bc |
| LS-21 | 26.00a | 198.83a | 2.39ab | 292.33a | 19.67a | 26.00a | 111.97ab | 3.60a | 296.67a | 119.20b |
| OY-09 | 25.00ab | 194.07ab | 2.15b | 275.00a | 13.00bc | 17.67cd | 119.33ab | 2.80bc | 253.27bc | 102.33bcd |
| CO-957 | 24.00abc | 166.10cd | 1.99bc | 209.67bc | 12.67bc | 19.00bcd | 110.60ab | 3.04ab | 285.67ab | 84.60def |

Means followed by similar letter(s) are not significantly different at 5% level of probability (DMRT)

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TABLE 8: MEAN PERFORMANCE OF EIGHT SUGASRCANE CLONES ACROSS TWO YEARS AND TWO LOCATIONS

| Clones | Establish-ment Count | Stalk height (cm) | Stalk diameter (cm) | Single stalk weight (g) | No of stalks/ stool | No of inter-nodes/ stalk | Leaf length (cm) | Leaf width (cm) | Leaf Area ($cm^2$) | Yield/ Plot (Kg) |
|---|---|---|---|---|---|---|---|---|---|---|
| BD-04 | 27.42ab | 154.78abc | 2.39ab | 504.92a | 10.26c | 16.25abc | 124.93b | 3.74ab | 352.25ab | 104.67a |
| CO-997 | 26.92b | 139.23bcd | 2.21bc | 392.33cde | 11.19bc | 16.28abc | 118.48bc | 4.03a | 296.21a | 91.70b |
| B6604 | 29.42a | 166.80a | 2.24bc | 449.58abc | 10.25abc | 16.25abc | 141.47a | 3.14c | 329.03b | 100.54a |
| OG-08 | 25.08b | 135.87cd | 2.06c | 336.08e | 11.88a | 16.59abc | 126.85b | 3.02c | 279.35c | 87.18bc |
| OG-12 | 26.17b | 134.75cd | 2.30ab | 410.83cd | 11.36ab | 17.76ab | 128.08b | 3.56abc | 343.21b | 90.11bc |
| LS-21 | 29.17a | 158.25ab | 2.43a | 499.75ab | 10.19cd | 18.72a | 126.63b | 3.98a | 377.65ab | 99.85a |
| OY-09 | 27.42ab | 146.38abcd | 2.37ab | 433.75bc | 11.10bc | 15.70c | 142.61a | 3.36bc | 365.74ab | 90.70bc |
| CO-957 | 26.42bc | 128.92d | 2.19c | 346.58de | 10.03d | 17.79ab | 126.11ab | 3.44bc | 331.63b | 84.95c |

Means followed by similar letter(s) are not significantly different at 5% level of probability (DMRT)

Table 9: Quality Parmeters of Eight sugarcane Clones Grown at Badeggi in 1994

| Clones | Brix % | Polarity % | Purity % | Fibre % | Juice % | Moisture % | Commercial Cane Sugar % |
|---|---|---|---|---|---|---|---|
| BD-04 | 17.5 | 12.76 | 72.92 | 11.57 | 88.43 | 70.93 | 12.19 |
| CO-997 | 16.1 | 13.16 | 81.73 | 12.63 | 87.37 | 71.27 | 12.08 |
| B6604 | 19.1 | 14.98 | 78.84 | 10.19 | 89.81 | 70.81 | 13.28 |
| OG-12 | 19.3 | 15.00 | 78.13 | 12.76 | 87.24 | 67.94 | 14.69 |
| OG-21 | 18.0 | 16.49 | 91.60 | 12.02 | 87.98 | 69.98 | 13.80 |
| LS-21 | 18.0 | 13.56 | 75.31 | 10.94 | 89.06 | 71.06 | 13.39 |
| OY-09 | 17.3 | 14.74 | 85.22 | 13.15 | 86.85 | 69.63 | 13.48 |
| CO-957 | 18.0 | 14.50 | 80.54 | 13.60 | 86.40 | 68.40 | 12.29 |

Table 10: Quality Parmeters of Eight sugarcane Clones Grown at Uyo in 1994

| Clones | Brix % | Polarity % | Purity % | Fibre % | Juice % | Moisture % | Commercial Cane Sugar % |
|---|---|---|---|---|---|---|---|
| BD-04 | 10.00 | 7.27 | 72.70 | 17.00 | 83.00 | 73.00 | 9.06 |
| CO-997 | 8.00 | 4.70 | 58.75 | 16.99 | 83.01 | 75.01 | 3.03 |
| B6604 | 11.00 | 10.68 | 97.08 | 17.51 | 82.49 | 71.49 | 10.24 |
| OG-12 | 8.00 | 7.40 | 92.48 | 19.51 | 80.40 | 72.49 | 5.43 |
| OG-21 | 8.00 | 4.85 | 60.62 | 18.07 | 81.91 | 73.91 | 4.10 |
| LS-21 | 12.00 | 10.15 | 84.58 | 16.14 | 83.86 | 12.42 | 13.39 |
| OY-09 | 10.00 | 8.35 | 83.50 | 21.54 | 78.46 | 68.46 | 8.05 |
| CO-957 | 13.00 | 12.75 | 98.08 | 18.87 | 81.87 | 68.87 | 10.69 |

This was followed by LS-21 and BD-04 for cane yield per plot. At Uyo (Table 7), BD-04 had the highest cane yield per plot. It also had the highest stalk weight and establishment count. LS-21 also followed closely in terms of cane yield per plot as in Badeggi and then OG-12. The combined data for the two years and two locations clearly show the superiority of the clone BD-04 over all other clones with respect to cane yield per plot followed closely by B6604.

Seven quality traits were analyzed in the laboratory in 1994 and the results are presented in Tables 9 and 10. Generally higher values were obtained for brix percent at Badeggi than at Uyo. Commercial cane sugar percent (i.e Sugar yield) was also higher at Badeggi than at Uyo. In Badeggi, (Table 9) OG-08 had the highest brix percent (19.3%) as well as Commercial cane sugar percent (14.69%), this was followed closely by B6604 for brix percent but not commercial cane sugar per cent. The clone, Co-997 had the lowest brix percent (16.1%) and also showed the least commercial cane sugar percent. At Uyo (Table 10) Co-957 had the highest brix percent (13.00%) followed by LS-21 (12.00%) and then B6604 (11.00%). Commercial cane sugar percent expression did not follow the same pattern. LS-21 had the highest sugar yield (12.42%), followed by Co-957 and then B6604. Co-997 also had the lowest commercial cane sugar percent at Uyo.

The general mean, with their respective standard errors, range, genotypic and phenotypic coefficient of variation are presented in Tables 11-15. The ranges observed in Badeggi were

wider than that at Uyo. At Badeggi in 1993 (Table 11), wide ranges in the means were observed for stalk height (91.67 - 149-67), stalk weight (280.00 - 520.00), leaf length (102.33-130.00), Leaf area (177.97-362.03) and cane yield per plot (67.50-96.67) while at Uyo (Table 12), wide ranges were observed for stalk height (142.67-165.67), stalk weight (483.33-633.33), Leaf length (131.33-171-67), and Leaf Area (332.50-460.90). In all traits studied, phenotypic coefficient of variation was greater than genotypic coefficient of variation at both Badeggi and Uyo in 1993 and 1994. At Badeggi, relatively higher genotypic coefficient of variation were observed for establishment count (14.32), stalk height (16.55), stalk weight (15.63) number of stalks per stool (19.76), Leaf width (14.14), leaf area (14.75) and cane yield per plot (11.72); while at Uyo, higher genotypic coefficient of variation were observed for establishment count (14.87), stalk height (10.53), stalk weight (13.67), number of stalks per stool (13.51) and number of internodes per stalk (11.94).

Table 11: Mean, Range, Genotypic and Phenotypic Coefficient of Variation for Ten Traits in Eight Sugarcane Clones at Badeggi in 1993

| Traits | Mean | Range | GCV % | PCV % |
|---|---|---|---|---|
| Establishment Count | 32.79 ±1.71* | 26.00-42.33 | 14.32 | 14.71 |
| Stalk diameter | 2.29±0.5 | 1.95-2.56 | 8.85 | 9.61 |
| Stalk height | 114.00±10.15 | 91.67-149.67 | 16.55 | 25.19 |
| Single stalk weight | 434.58±35.74 | 280.00-520.00 | 15.63 | 23.26 |
| No.of Stalks/Stool | 5.13±0.40 | 4.33-5.83 | 19.76 | 21.79 |
| No. of Internodes/ stalk | 14.97±0.68 | 13.36-17.20 | 8.59 | 12.92 |
| Leaf length | 122.29±5.82 | 102.33-130.00 | 9.43 | 13.46 |
| Leaf width | 3.11±0.14 | 2.32-3.82 | 14.14 | 14.34 |
| Leaf Area | 287.66±22.60 | 177.97-362.03 | 14.75 | 22.22 |
| Yield/plot | 78.63±2.07* | 67.50-96.67 | 11.72 | 19.31 |

*Standard error of mean

Table 12: Mean, Range, Genotypic and Phenotypic Coefficient of Variation for Ten Traits in Eight Sugarcane Clones at Uyo in 1993

| Traits | Mean | Range | GCV % | PCV % |
|---|---|---|---|---|
| Establishment count | 17.96±0.75* | 14.00-22.33 | 14.87 | 11.75 |
| Stalk diameter | 2.29±0.06 | 2.20-2.36 | 9.42 | 10.03 |
| Stalk height | 149.71±6.05 | 142.67-165.67 | 10.53 | 11.42 |
| Single stalk weight | 536.18±29.02 | 483.33-633.33 | 13.67 | 15.22 |
| No. of Stalks/Stool | 13.59+0.61 | 11.97-15.17 | 13.51 | 14.31 |
| No. of Internodes/ stalk | 16.90±0.74 | 15.03-17.93 | 11.94 | 12.32 |
| Leaf length | 149.83±4.40 | 131.33-171.67 | 9.01 | 10.33 |
| Leaf width | 3.64±0.11 | 3.41-3.98 | 3.40 | 8.29 |
| Leaf Area | 408.58±17.00 | 332.50-460.90 | 7.65 | 11.17 |
| Yield/plot | 96.51±1.71 | 93.53-112.63 | 7.30 | 9.66 |

*Standard error of mean

Table 13: Mean, Range, Genotypic and Phenotypic Coefficient of variation for Seventeen Traits in Eight Sugarcane Clones at Badeggi in 1994

| Traits | Mean | Range | GCV% | PCV% |
|---|---|---|---|---|
| Establishment count | 33.25±1.16* | 28.33-37-67 | 6.35 | 9.84 |
| Stalk diameter | 2.36±0.04 | 2.07-2.56 | 7.59 | 8.40 |
| Stalk height | 139.98±6.62 | 110.90-167.90 | 11.37 | 13.38 |
| Single stalk weight | 464.58±.33.38 | 333.33-686.67 | 22.11 | 24.14 |
| No.of stalks/stool | 10.13±0.37 | 18.27-12.47 | 12.37 | 13.89 |
| No.of internodes/ stalk | 16.71±0.75 | 16.83-20.80 | 11.09 | 12.63 |
| Leaf length | 131.70±2.07 | 122.00-153.10 | 6.85 | 7.91 |
| Leaf width | 4.34±0.35 | 3.35-7.19 | 20.12 | 22.83 |
| Leaf area | 373.55±21.39 | 297.40-449.80 | 12.53 | 16.20 |
| Brix % | 17.9±0.35 | 16.10-19.30 | 13.13 | 15.57 |
| Polarity % | 14.00±0.43 | 13.16-16.49 | 9.40 | 10.31 |
| Purity % | 12.11±0.41 | 10.19-13-60 | 5.40 | 9.54 |
| Juice % | 87.89±0.41 | 86.40-89.81 | 0.83 | 1.31 |
| Moisture % | 70.01±0.45 | 67.94-71.27 | 1.21 | 1.81 |
| Comm.cane sugar % | 13.15±0.32 | 12.08-14.69 | 4.37 | 6.91 |
| Yield/plot | 99.34±2.45 | 91.17-110.27 | 7.89 | 9.22 |

*Standard error of mean

Table 14: Mean, Range, Genotypic and Phenotypic Coefficient of variation for Seventeen Traits in Eight Sugarcane Clones at Uyo in 1994.

| Traits | Mean | Range | GCV % | PCV % |
|---|---|---|---|---|
| Establishment count | 24.58±0.93* | 22.00-26.33 | 7.25 | 10.71 |
| Stalk diameter | 2.15±0.08 | 1.95-2.39 | 12.08 | 13.05 |
| Stalk height | 183.11±8.73 | 150.53-200.63 | 16.09 | 17.25 |
| Single stalk weight | 252.75±17.09 | 234.33-292.33 | 17.56 | 19.13 |
| No.of stalks/ stool | 15.08±0.98 | 10.33-19.67 | 22.04 | 23.41 |
| No.of Internodes/ stalk | 19.17±1.29 | 14.00-26.00 | 20.61 | 22.15 |
| Leaf length | 113.73±4.65 | 99.73-128.03 | 12.61 | 14.31 |
| Leaf width | 3.04±0.23 | 2.52-3.77 | 18.03 | 21.62 |
| Leaf area | 263.57±22.52 | 199.77-314.77 | 23.52 | 24.17 |
| Brix % | 10.00±0.64 | 8.00-13.00 | 13.68 | 18.00 |
| Polarity % | 8.27±1.00 | 4.70-12.75 | 4.24 | 5.12 |
| Purity % | 80.97±5.47 | 58.75-98-07 | 11.81 | 19.13 |
| Fibre % | 18.11±0.61 | 16.14-21.54 | 6.52 | 9.56 |
| Juice % | 81.88±0.61 | 78.46-83.01 | 0.11 | 2.10 |
| Moisture % | 71.89±0.81 | 68.46-75.01 | 5.11 | 6.13 |
| Comm. cane sugar % | 7.88±1.19 | 3.03-12.42 | 5.78 | 6.21 |
| Yield/plot | 100.36±3.82 | 75.20-140.07 | 20.50 | 23.82 |

*Standard error of mean

Table 15: Mean, Range, Genotypic and Phenotypic Coefficient of variation for Ten Traits in Eight Sugarcane Clones Over two locations and two years.

| Traits | Mean | Range | GCV % | PCV % |
|---|---|---|---|---|
| Establishment count | 27.25±0.59* | 25.08-29.42 | 9.56 | 12.21 |
| Stalk diameter | 2.27±0.03 | 2.19-2.43 | 13.99 | 16.44 |
| Stalk height | 145.62±4.63 | 128.92-166.80 | 19.96 | 21.01 |
| Single stalk height | 421.73±14.91 | 336.08-504.92 | 23.27 | 25.11 |
| No. of stalk/ stool | 10.99±0.33 | 10.03-11.88 | 18.38 | 19.23 |
| No. of Internodes/ stalk | 16.94±0.46 | 15.70-18.77 | 7.23 | 15.49 |
| Leaf length | 129.40±2.21 | 118.48-142.61 | 5.76 | 9.68 |
| Leaf width | 3.53±0.11 | 3.02-3.98 | 13.29 | 17.75 |
| Leaf area | 334.38±10.49 | 279.35-296.21 | 13.73 | 17.70 |
| Yield/plot | 93.71±1.33 | 84.95-104.67 | 14.44 | 15.23 |

*Standard error of mean

In 1994, wide ranges in the means were also observed at Badeggi (Table 13) for stalk height (110.90-167-90), stalk weight (333.33-686.67), Leaf length (122.00-153.10) and leaf area (297.40-449.80). At Uyo (Table 14), wide ranges in the means were observed for stalk height (150.53-200.63), stalk weight (234.33-292.33), leaf length (99.73-128.03), leaf area (199.77-314.77), purity percent (58.75-98.07) and cane yield per plot (75.20-140.07). As was the case in 1993, phenotypic coefficients of variation was higher than the genotypic components. At Badeggi relatively higher genotypic coefficient of variation was observed for stalk height (11.37), stalk weight (25.37), number of stalks per stool (12.37), number of internodes per stalk (11.09), leaf width (25.37), leaf area (12.53) and brix per cent (13.13), while at Uyo higher genotypic coefficient of variation was observed for stalk diameter (12.08), stalk height (16.04), number of internodes per stalk (20.61), leaf length (12.61) leaf width (18.03), leaf area (23.52), brix per cent (13.68) and purity percent (11.81). The ranges for the means for the different traits across the two years and locations (Table 15) were wide for stalk height (128.92-166.80) stalk weight (336.08-504.92), leaf length (118.48-142.61) and cane yield per plot (84.95-104.67). Relatively higher genotypic coefficient of variation was observed for stalk diameter (13.99), stalk height (19.96), stalk weight (23.27), number of stalks per stool (18.38), leaf width (13.29), leaf area (13.73) and cane yield per plot (14.44).

4.2. Estimates of variance Components

The estimates of the phenotypic, genotypic and environmental variances for the ten traits are presented in Tables 16-21. The percentage contribution of the different sources of variance to the total variance is presented in Table 22.

Establishment count: The individual year analysis revealed that the major component of the phenotypic variance was attributable to genotypic variance at Uyo and environmental variance at Badeggi in 1993, while in 1994, the major component of the phenotypic variance was attributable to environmental variance at both locations. In the combined analysis, the main effect of varieties, locations, and years were significant. VarietyX year X location interaction variance was significant and greater than variety x location interaction variance which was also significant. Variety x year and variety x location interactions variances gave negative estimates. The percentage contribution to the total varince of each effect shows that the main effect of locations contributed more to the total variation(35.65%).

Stalk diameter: Estimates of variance observed for stalk diameter was generally low in all the individual environment analyses as well as the combined. In 1993, genotypic variance contributed more to the phenotypic variance at both locations than environmental variance. Genotypic variance equally contributed more to the phenotypic variance in 1994 at both locations. The combine analysis shows that the main effect of varieties, years and locations as well as year x location interaction variances were

significat. Though variety x year interaction variace was higher than variety x location variance, which was also higher than variety x year x location interaction variance, they were all non-significant . The highest percentage contribution to the total variance was by the main effect of varieties (32.64%).

Stalk height: At Badeggi and Uyo in 1993 (Tables 17 and 18) estimates of gonotyic variance were higher than the environmental variance, while at both locations in 1994, environmental variance contributed more to the phenotypic variance. The combined analysis shows that only the main effect of years and varieties and the interaction effect of year x location were significant. The variety x year interaction variance was higher than variety x year x location interaction variance which in turn was higher than variety x location interaction variance. They were however nonsignificant. The highest percentage variation was contributed by year x location interaction variance(33.61%)

Single stalk weight:- At Badeggi in 1993, genotypic variance contributed more to the phenotypic variance than environmental variance, while at Uyo environmental variance contributed more to the Phenotypic variance. In 1994 however, genotypic variance contributed more to the phenotypic variance than the environmental variance at both Badeggi and Uyo. In the Combined analysis of variance, all the main effects and their interaction variance were significant except variety x year x location interaction variance.Variety x location interaction variance was however higher variety x year variance. Variety x location interaction variance

however contributed more to the total variance( 33·61%)

Number of stalks per stool: Low estimates of variance components were observed at both locations in 1993 and the major component of the phenotypic variance was attributable to environmental variance. In 1994 the genotypic variance component contributed more to the phenotypic variance at both locations. Combined analysis show that all main effects were significant.The interaction variances of variety x year x location was higher than variety x location and were both significant. Only variety x year interaction variance was nonsignificant.The highest percentage contribution to the total variance was given by locations effect (40.68%).

Number of internodes per stalk:- Low estimates of variance component were also observed at both locations in 1993 and the major components of the phenotypic variance was contributed by environmental variance. In 1994, components of environmental variance contributed more to the phenotypic variance at Badeggi, but at Uyo genotypic components of variance contributed more to the phenotypic variance. In the combined analysis , all main effects were significant. Variety x year x location interaction variance was higher than variety x location interaction variance and were both significant.Variety x year and year x location variances were nonsignificant. Variety x year x location interaction variance however contributed more to the total variance(30.31%).

Table 16: Estimates of Variance Components for Ten Traits in Eight Sugar-Cane Clones at Badeggi In 1993.

| Traits | Genotypic Variance | Phenotypic Variance | Environmental Variance |
|---|---|---|---|
| Establishment Count | 22.05±5.03* | 45.32±3.51 | 23.26±2.11 |
| Stalk diameter(cm) | 0.04±0.001 | 0.063±0.02 | 0.008±0.002 |
| Stalk height (cm) | 55.76±2.13 | 88.44±8.72 | 0.22.±0.04 |
| Single stalk weight (g) | 4611.96±41.81 | 14832.73±37.61 | 1022.83±36.13 |
| No. of stalks/stool | 0.376±0.1 | 1.251±0.11 | 0.75±0.44 |
| No. of internodes/stalk | 0.82±0.2 | 4.03±0.72 | 3.74±0.19 |
| Leaf length (cm) | 90.37±3.71 | 260±5.35 | 170.92±13.11 |
| Leaf width (cm) | 0.19±0.3 | 0.34±0.11 | 0.15±0.05 |
| Leaf Area ($cm^2$) | 1800.29±1192 | 5886.00±14.96 | 4085.72±24.05 |
| Yield/plot (kg) | 84.98±2.64 | 119.22±5.41 | 34.24±11.13 |

* Standard error of variance components.

Table 17: Estimates of Variance Components for Ten Traits in Eight Sugar-Cane Clones at Uyo in 1993

| Traits | Genotypic Variance | Phenotypic Variance | Environmental Variance |
|---|---|---|---|
| Establishment Count | 7.13±1.23* | 11.68±2.14 | 4.45±1.57 |
| Stalk diameter (cm) | 0.60±0.03 | 0.82±0.03 | 0.27±0.01 |
| Stalk height (cm) | 134.19±4.15 | 258.33±12.15 | 124.52±19.22 |
| Single stalk weight (g) | 5431.95±39.01 | 1216.25±55.01 | 6736.31±34.89 |
| No. of stalks/stool | 0.66±0.235 | 03.17±0.07 | 2.95±0.64 |
| No. of internodes/stalk | 0.84±011 | 4.45±0.73 | 4.34±0.64 |
| Leaf length (cm) | 182.29±12.34 | 336.85±12.14 | 154.55±5.21 |
| Leaf width (cm) | 0.15±0.063 | 0.26±0.021 | 0.09±0.03 |
| Leaf Area ($cm^2$) | 976.00±21.93 | 3290.00±21.93 | 2314.19±14.24 |
| Yield/plot (kg) | 49.66±5.19 | 73.01±6.94 | 23.35±8.26 |

* Standard error of variance components.

Table 18: Estimates of Variance Components for Ten Traits in Eight Sugar-Cane Clones at Badeggi in 1994

| Traits | Genotypic Variance | Phenotypic Variance | Environmental Variance |
|---|---|---|---|
| Establishment Count | 4.46±1.08* | 15.15±3.76 | 10.71±3.78 |
| Stalk diameter (cm) | 0.32±0.03 | 0.47±0.017 | 0.015±0.005 |
| Stalk height (cm) | 253.37±11.25 | 603.97±12.11 | 350.60±13.16 |
| Single stalk weight (g) | 13495.24±46.40 | 22408.93±39.92 | 8913.69±20.68 |
| No. of stalks/stool | 1.57±0.09 | 2.68±0.91 | 0.75±0.44 |
| No. of internodes/stalk | 3.43±0.8 | 7.98±1.43 | 4.45±1.57 |
| Leaf length (cm) | 81.30±7.65 | 115±13.52 | 34.36±4.25 |
| Leaf width (cm) | 1.21±0.06 | 2.19±0.52 | 0.98±0.05 |
| Leaf Area ($cm^2$) | 2191.96±10.91 | 5852.37±19.34 | 3660.42±21.02 |
| Yield/plot (kg) | 61.45±7.24 | 109.47±11.91 | 48.02±3.84 |

* Standard error of variance components.

Table 19: Estimates of Variance Components for Ten Traits in Eight Sugar-Cane Clones At Uyo In 1994

| Traits | Genotypic Variance | Phenotypic Variance | Environmental Variance |
|---|---|---|---|
| Establishment Count | 2.29±0.07* | 6.64±0.95 | 6.93±2.45 |
| Stalk diameter (cm) | 0.20±0.02 | 0.58±0.09 | 0.05±0.008 |
| Stalk height (cm) | 124.39±13.91 | 735.13±11.66 | 610.72±18.26 |
| Single stalk weight (g) | 364.85±16.12 | 991.18±21.65 | 337.33±16.54 |
| No. of stalks/stool | 11.05±0.84 | 18.72±3.42 | 7.67±2.71 |
| No. of internodes/stalk | 15.60±1.24 | 28.89±4.26 | 13.29±4.40 |
| Leaf length (cm) | 118.82±2.11 | 181.61±13.09 | 63.79±11.21 |
| Leaf width (cm) | 0.49.0.02 | 0.69±0.01 | 0.43±0.05 |
| Leaf Area ($cm^2$) | 186.32±14.21 | 4143.18±20.68 | 4056.86±21.13 |
| Yield/plot (kg) | 423.35±12.88 | 540.14±16.28 | 116.79±10.08 |

* Standard error of variance components.

Table 20: Estimates of Variance Components for Ten Traits in Eight Sugar-Cane Clones Across Two Years and Two Locations.

| Traits | Genotype X Location Variance | Genotype X Year Variance | Genotype X Year X Location Variance |
|---|---|---|---|
| Establishment Count | -3.10±0.06* | -4.44±0.96 | 13.90±0.92 |
| Stalk diameter (cm) | 0.064±0.003 | 0.11±0.001 | -0.13±0.06 |
| Stalk height (cm) | 9.90±0.83 | 210.04±16.51 | 56.92±9.72 |
| Single stalk weight (g) | 65496±16.87 | 1830.99±10.91 | 1497.5±16.35 |
| No. of stalks/stool | 21.80±0.08 | 10.35±0.02 | 34.24±0.95 |
| No. of internodes/stalk | 11.33±0.07 | 3.21±0.99 | 24.49±0.36 |
| Leaf length (cm) | 25.91±7.08 | 18.93±4.65 | 46.66±2.03 |
| Leaf width (cm) | 0.65±0.03 | -0.33±0.01 | 0.38±0.03 |
| Leaf Area ($cm^2$) | 82.18±9.35 | 112.68±2.33 | 14.74±5.68 |
| Yield/plot (kg) | 163.28±11.13 | 145.95±6.53 | 137.13±18.09 |

* Standard error of variance components.

Table 21: MEAN SQUARES ESTIMATES FROM THE COMBINED ANALYSIS OF EIGHT CLONES OF SUGARCANE GROWN IN TWO LOCATIONS OVER TWO YEARS

| Source of variation | DF | MEAN SQUARES ESTIMATES | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Establish-ment Count | Stalk diameter (cm) | Stalk Height (cm) | Stalk Weight (cm) | No. of Stalks/ Stool | No. of Internodes/ Stalk | Leaf Length (cm) | Leaf Width (cm) | Leaf Area ($cm^2$) | Yield/ Plot (kg) |
| Replication | 2 | 8.03 | 0.001 | 3170.68 | 563.14 | 5.79 | 2.22 | 94.78 | 0.04 | 342.22 | 132.47 |
| Years | 1 | 266.67* | 0.034 | 24031.84* | 38178.38** | 251.23** | 96.40** | 284.02 | 2.42* | 3378.44* | 24330.22** |
| Locations | 1 | 3432.04** | 0.249 | 275.07 | 63757.04** | 1078.03** | 16.16* | 546.74** | 3.51* | 2335.44** | 4479.38** |
| Year x Locations | 1 | 260.04* | 0.268** | 38459.36** | 616642.04** | 72.98* | 11.60 | 2414.68** | 19.98** | 728.75** | 658.44* |
| Varieties | 7 | 125.88* | 0.181* | 13327.94** | 47816.07** | 14.02* | 23.13* | 833.12* | 1.68* | 1065.52** | 2100.96** |
| Varieties x Years | 7 | 34.12 | 0.090 | 2520.28 | 15446.07** | 11.15 | 11.93 | 153.07 | 1.16 | 736.32* | 405.57* |
| Varieties x Locations | 7 | 125.92* | 0.072 | 1074.01 | 16502.26* | 13.90* | 19.17* | 322.08* | 1.75* | 319.33* | 961.55* |
| Varieties x Years x locations | 7 | 152.73 | 0.025 | 2460.87 | 11516.30 | 21.98* | 39.93* | 408.51* | 1.55* | 243.24 | 265.68 |
| Error | 84 | 11.04 | 0.029 | 3531.63 | 7023.77 | 3.25 | 6.46 | 158.55 | 0.41 | 199.01 | 277.25 |

TABLE 22: PERCENTAGE CONTRIBUTION OF SOURCES OF VARIATION TO THE TOTAL VARIATION FOR EIGHT SUGARCANE CLONES GROWN IN TWO LOCATIONS OVER TWO YEARS

| Source of variation | Establish-ment count | Stalk diameter (cm) | Stalk height (cm) | Stalk weight (g) | No.of stalks/ stool | No.of inter-nodes/ stalk | Leaf length (cm) | Leaf width (cm) | Leaf area ($cm^2$) | Yield/ plot (kg) |
|---|---|---|---|---|---|---|---|---|---|---|
| Replications | 0.63 | 0.21 | 0.83 | 0.29 | 0.58 | 0.36 | 0.05 | 0.65 | 1.88 | 0.29 |
| Years | 9.78 | 4.44 | 8.16 | 19.73 | 12.06 | 7.62 | 11.21 | 12.61 | 13.29 | 18.10 |
| Locations | 35.65 | 10.72 | 5.41 | 5.23 | 40.68 | 15.20 | 1.48 | 13.78 | 11.42 | 30.98 |
| Years X locations | 10.50 | 10.00 | 40.54 | 7.04 | 3.41 | 1.31 | 30.12 | 21.15 | 8.22 | 9.89 |
| Varieties | 8.91 | 32.64 | 15.26 | 17.46 | 4.95 | 8.42 | 41.11 | 12.27 | 22.52 | 14.90 |
| Varieties X Years | 10.2 | 8.41 | 7.81 | 7.09 | 6.18 | 13.50 | 1.01 | 9.76 | 17.18 | 7.03 |
| Varieties X locations | 7.62 | 13.47 | 11.88 | 33.61 | 13.34 | 20.00 | 7.10 | 13.18 | 12.15 | 9.78 |
| Varieties X Years X locations | 14.11 | 9.52 | 7.74 | 4.20 | 17.72 | 30.31 | 3.86 | 11.69 | 10.68 | 6.34 |
| Error | 2.61 | 10.59 | 2.37 | 5.35 | 1.08 | 3.28 | 4.06 | 4.91 | 2.66 | 2.69 |

Leaf length:- In 1993, components of environmental variance contributed more to the phenotypic variance at Badeggi while at Uyo, components of genotypic variance contributed more to the phenotypic variance. In 1994 however, the major components of phenotypic variance was attributable to genotypic variance at both locations. The combined analysis shows that the main effect of location and varieties were significant. The interaction of variety x year x location variance was higher than variety x location interaction varience and were both significant. Highest percent contribution was given by the main effect of varieties(41.11%)

Leaf width:- Components of variance was generally low for all individual environments as well as the combined. Genotypic components of variance contributed more to the phenotypic variance in all the individual environments. The ocmbined analysis show that the main effects were all significant. Variety x location interaction variance was higher than variety x year x location and were both significant, but variety x year was lower and nonsignificant. Though year x location gave the highest contribution to the total variation(21.15%), the contributions by various effects were generally low.

Leaf Area:- The individual analyses show that the phenotypic variance components was mostly attributable to environmental variance at both Badeggi and Uyo in 1993 and 1994. In the combined analysis, all variances for main effects and their interactions were significant except variety x year x location interaction variance.The main effects of varieties however contributed more to

the total variance(22.52%).

Cane Yield per plot:-Analyses show that genotypic components of variance contributed more to the phenotypic variance at Badeggi and Uyo in 1993 and 1994. In the Combined analysis, all main effects and their interactions were significant except variety x year x location interaction variance which was nonsignificant. Variety x location interaction variance was higher variety x year interaction variance which was in turn higher than variety x year x location iteraction variance. The highest percentage contribution to the total variance was observed in locations(30.98%).

## 4.4 Correlations

The estimates of genotypic and phenotypic correlations among the ten traits are presented in table 23 - 27. Generally, genotypic correlations were higher in magnitude than the phenotypic correlations.

At Badeggi in 1993 (Table 23), both genotypic and phenotypic correlations were positive and significant between establishment count and cane yield per plot; between stalk diameter and stalk height, stalk weight, leaf width, leaf area; between stalk height and stalk weight, leaf width, leaf area, cane yield per plot; between stalk weight and leaf length, leaf width, leaf area, cane yield per plot; between leaf length and leaf width, leaf area; between leaf width and leaf area. Only genotypic correlation was positive and significant between establishment count and stalk height and stalk weight; between stalk height and leaf length; between number of stalks per stool and cane yield per plot; and

between leaf length and cane yield per plot.

At Uyo in 1993 (Table 24), both genotypic and phenotypic correlations were positive and significant between establishment count and cane yield per plot; between stalk diameter and stalk height, leaf area; between stalk height and stalk weight, number of stalks per stool, cane yield per plot; between stalk weight and cane yield per plot; between number of stalks per stool and cane yield per plot. However, only genotypic correlation was positive and significant between establishment count and stalk height; between stalk diameter and stalk weight; between stalk height and leaf length. Significant but negative phenotypic correlation was obtained between number of stalks per stool and leaf width. At Badeggi in 1994 (Table 25), both genotypic and phenotypic correlations were positive and significant between establishment count and cane yield per plot; between stalk diameter and stalk height, stalk weight, leaf area; between stalk height and stalk weight, leaf area, cane yield per plot; between number of stalks per stool and cane yield per plot. Significant and positive genotypic correlation was obtained between establishment count and number of stalks per stool; between stalk height and number of stalks per stool; between stalk weight, number of internodes per stalk and leaf width; and between leaf area and cane yield per plot.

At Uyo in 1994 (Table 26), positive and significant genotypic and phenotypic correlations were obtained between establishment count, stalk diameter, and stalk weight; between stalk diameter

and, leaf width; between stalk height and number of stalks per stool, leaf length, and leaf area; between stalk weight and number of stalks per stool, leaf area, cane yield per plot; between number of stalks per stool leaf width, and cane yield per plot; between leaf width and leaf area. Significant negative correlation was obtained between stalk diameter and number of stalks per stool.

The combined analysis (Table 27) showed both genotypic and phenotypic correlations to be positive and significant between establishment count and number of stalks per stool, leaf area, cane yield per plot; between stalk diameter and stalk weight, leaf width, leaf area; between stalk height and stalk weight, number of

Table 23: Genotypic and Phenotypic Correlations Coefficients Among Ten Traits in Eight Sugarcane Clones at Badeggi in 1993

| | Establishment count | Stalk diameter (cm) | Stalk height (cm) | Single stalk/ weight (g) | No. of stalks/ stool | No. of internodes stalk | Leaf length (cm) | Leaf width (cm) | Leaf Area ($cm^2$) | Yield/ Plot (kg) |
|---|---|---|---|---|---|---|---|---|---|---|
| Establishment count | | 0.168<br>0.142 | 0.413*<br>0.366 | 0.685**<br>0.419 | 0.113<br>0.082 | 0.313<br>0.290 | 0.056<br>0.020 | 0.090<br>0.180 | 0.214<br>0.132 | 0.614**<br>0.597** |
| Stalk diameter | | | 0.615**<br>0.409** | 0.819**<br>0.732** | -0.134<br>-0.105 | 0.109<br>0.075 | 0.214<br>0.399 | 0.746**<br>0.783** | 0.523**<br>0.682** | 0.236<br>0.214 |
| Stalk height | | | | 0.714**<br>0.560** | 0.319<br>0.251 | -0.300<br>-0.021 | 0.408*<br>0.357 | 0.506*<br>0.472* | 0.593**<br>0.464* | 0.556**<br>0.566** |
| Single stalk weight | | | | | -0.110<br>-0.021 | -0.134<br>-0.034 | 0.529**<br>0.450** | 0.736**<br>0.729** | 0.692**<br>0.664** | 0.566**<br>0.438* |
| No of Stalks/ stool | | | | | | 0.120<br>0.096 | -0.130<br>-0.033 | 0.102<br>0.004 | 0.132<br>0.016 | 0.268<br>0.407* |
| No of internodes/ stalk | | | | | | | -0.006<br>-0.097 | 0.020<br>0.009 | 0.136<br>0.065 | -0.216<br>-0.102 |
| Leaf length | | | | | | | | 0.512*<br>0.469* | 0.685**<br>0.752** | 0.513**<br>0.324 |
| Leaf width | | | | | | | | | 0.612**<br>0.879** | 0.294<br>0.074 |
| Leaf Area | | | | | | | | | | 0.358<br>0.246 |
| Yield/plot | | | | | | | | | | |

Upper and lower values represents genotypic and phenotypic correlation coefficients respectively
* Significant at 5% level
** Significant at 1% level

Table 24: **Genotypic and Phenotypic Correlations Coefficients Among Ten Traits in Eight Sugarcane Clones at Uyo in 1993**

| | Establishment count | Stalk diameter (cm) | Stalk height (cm) | Single stalk/ weight (g) | No. of stalks/ stool | No. of internodes stalk | Leaf length (cm) | Leaf width (cm) | Leaf Area ($cm^2$) | Yield/ Plot (kg) |
|---|---|---|---|---|---|---|---|---|---|---|
| Establishment count | | 0.111<br>0.090 | 0.429*<br>0.362 | 0.123<br>0.203 | 0.345<br>0.280 | 0.255<br>0.105 | 0.167<br>0.085 | -0.039<br>-0.029 | 0.159<br>0.048 | 0.529**<br>0.480** |
| Stalk diameter | | | 0.536**<br>0.458** | 0.498*<br>0.403 | -0.123<br>-0.074 | -0.052<br>-0.046 | 0.253<br>0.308 | 0.396<br>0.413 | 0.456*<br>0.520** | 0.259<br>0.243 |
| Stalk height | | | | 0.685**<br>0.619** | 0.525**<br>0.457* | 0.314<br>0.205 | 0.368*<br>0.261 | -0.131<br>0.017 | 0.328<br>0.208 | 0.654**<br>0.426* |
| Single stalk weight | | | | | -0.009<br>-0.101 | -0.123<br>-0.035 | 0.526*<br>0.320 | 0.138<br>0.047 | 0.290<br>-0.245 | 0.496*<br>0.623** |
| No of Stalks/ stool | | | | | | 0.109<br>0.027 | 0.234<br>0.161 | -0.312<br>-0.501* | -0.245<br>-0.186 | 0.496*<br>0.623** |
| No of internodes/ stalk | | | | | | | -0.319<br>-0.538 | 0.251<br>0.154 | 0.184<br>-0.373 | 0.246<br>0.141 |
| Leaf length | | | | | | | | -0.069*<br>-0.105* | 0.645**<br>0.803** | 0.295<br>0.248 |
| Leaf width | | | | | | | | | 0.615**<br>0.505** | 0.348<br>0.249 |
| Leaf Area | | | | | | | | | | 0.179<br>0.053 |
| Yield/plot | | | | | | | | | | |

Upper and lower values represents genotypic and phenotypic correlation coefficients respectively
* Significant at 5% level; ** Significant at 1% level.

Table 25: Genotypic And Phenotypic Correlations Coefficients Among Ten Traits in Eight sugarcane Clones at Badeggi in 1994

| | Establishment count | Stalk diameter (cm) | Stalk height (cm) | Single stalk weight (g) | No. of stalks/ stool | No. of internodes /stalk | Leaf length (cm) | Leaf width (cm) | Leaf Area ($cm^2$) | Yield/ Plot (kg) |
|---|---|---|---|---|---|---|---|---|---|---|
| Establishment count | | 0.204<br>0.164 | 0.296<br>0.282 | 0.211<br>0.145 | 0.513*<br>0.314 | 0.213<br>0.157 | -0.09<br>-0.018 | -0.196<br>-0.165 | -0.131<br>-0.158 | 0.446**<br>0.252** |
| Stalk diameter | | | 0.782**<br>0.635** | 0.910**<br>0.816** | -0.019<br>-0.589** | 0.135<br>0.025 | 0.149<br>0.244 | 0.261<br>0.152 | 0.534**<br>0.748** | 0.269<br>0.305 |
| Stalk height | | | | 0.653**<br>0.788** | 0.424*<br>0.342* | 0.348<br>0.320 | 0.110<br>0.170 | 0.123<br>0.131 | 0.523**<br>0.446* | 0.615**<br>0.460* |
| Single Stalk weight | | | | | -0.253<br>-0.475* | 0.468*<br>0.369 | 0.296<br>0.127 | 0.423*<br>0.268 | 0.619**<br>0.578** | 0.768*<br>0.571** |
| No of Stalks/ stool | | | | | 0.264<br>0.362 | -0.314<br>-0.202 | -0.156<br>-0.059 | -0.096<br>-0.491 | 0.523**<br>0.643** | |
| No of internodes/ stalk | | | | | | -0.256<br>-0.305 | 0.389<br>0.309 | 0.115<br>0.040 | 0.442<br>0.656** | |
| Leaf length | | | | | | | -0.251<br>-0.368 | 0.368<br>0.481 | 0.412<br>0.247 | |
| Leaf width | | | | | | | | 0.059<br>0.104 | 0.158<br>0.120 | |
| Leaf Area | | | | | | | | | 0.423*<br>0.269 | |
| Yield/plot | | | | | | | | | | |

Upper and lower values represent genotypic and phenotypic correlation coefficients respectively
* Significant at 5% level ** Significant at 1% level.

Table 26: Genotypic and Phenotypic Correlations Coefficients Among Ten Traits in Eight Sugarcane Clones at Uyo in 1994.

| | Establishment count | Stalk diameter (cm) | Stalk height (cm) | Single stalk weight (g) | No. of stalks/ stool | No. of internodes /stalk | Leaf length (cm) | Leaf width (cm) | Leaf Area ($cm^2$) | Yield/ Plot (kg) |
|---|---|---|---|---|---|---|---|---|---|---|
| Establishment count | | 0.496*<br>0.510* | 0.356<br>0.222 | 0.493*<br>0.461* | 0.356<br>0.229 | 0.289<br>0.127 | 0.115<br>0.105 | 0.326<br>0.484* | 0.396<br>0.315 | 0.406*<br>0.317 |
| Stalk diameter | | | 0.465*<br>0.344 | 0.598**<br>0.624** | -0.526**<br>-0.547** | 0.419*<br>0.310 | -0.164<br>0.084 | 0.461*<br>0.690** | 0.304<br>0.602** | 0.315<br>0.394 |
| Stalk height | | | | 0.345<br>0.287 | 0.691**<br>0.576** | 0.420*<br>0.393 | 0.492*<br>0.518** | 0.468*<br>0.321 | 0.423*<br>0.541** | 0.529<br>0.395 |
| Stalk weight | | | | | 0.546**<br>0.476* | -0.123<br>-0.159 | 0.234<br>0.141 | 0.325<br>0.576** | 0.461**<br>0.533** | 0.583**<br>0.523** |
| No of Stalks/ stool | | | | | | 0.361<br>0.469* | -0.211<br>-0.109 | 0.513*<br>0.441* | 0.342<br>0.154 | 0.759**<br>0.688** |
| No of internodes/ stalk | | | | | | | -0.021<br>-0.190 | 0.121<br>0.300 | 0.396<br>0.464* | 0.413*<br>0.230 |
| Leaf length | | | | | | | | -0.048<br>-0.053 | 0.259<br>0.437* | 0.179<br>0.138 |
| Leaf width | | | | | | | | | 0.641**<br>0.848** | 0.513*<br>0.381 |
| Leaf Area | | | | | | | | | | 0.421*<br>0.306 |
| Yield/plot | | | | | | | | | | |

Upper and lower values represent genotypic and phenotypic correlation coefficients respectively
* Significant at 5% level; ** Significant at 1% level.

Table 27: Genotypic and Phenotypic Correlation Coefficients Among Ten Traits in Eight sugarcane clones over two Years and two Locations.

| | Establishment count | Stalk diameter (cm) | Stalk height (cm) | Single stalk weight (g) | No. of stalks/ stool | No. of internodes /stalk | Leaf length (cm) | Leaf width (cm) | Leaf Area ($cm^2$) | Yield/ Plot (kg) |
|---|---|---|---|---|---|---|---|---|---|---|
| Establishment. count | | 0.246<br>0.123 | 0.152<br>0.031 | 0.368*<br>0.238 | 0.621**<br>0.415** | 0.321*<br>0.127 | 0.291*<br>0.175 | 0.148<br>0.072 | 0.391**<br>0.268* | 0.258*<br>0.314* |
| Stalk diameter | | | 0.493**<br>0.256 | 0.753**<br>0.592** | -0.356**<br>-0.249** | 0.135<br>0.006 | 0.247<br>0.071 | 0.345*<br>0.286* | 0.551**<br>0.397** | 0.208<br>0.312 |
| Stalk height | | | | 0.436**<br>0.529** | 0.346<br>0.245 | 0.308**<br>0.521** | 0.396**<br>0.529** | 0.434**<br>0.209 | 0.623**<br>0.405** | 0.793**<br>0.634** |
| Single Stalk weight | | | | | -0.234<br>-0.468* | -0.153<br>-0.081 | 0.480**<br>0.369** | 0.109<br>0.206 | 0.347*<br>0.189* | 0.853**<br>0.699** |
| No of Stalks/ stool | | | | | | -0.386*<br>-0.291* | -0.181<br>-0.125 | 0.241<br>0.009 | 0.289*<br>0.365* | 0.692**<br>0.537** |
| No of internodes/ stalk | | | | | | | -0.300*<br>-0.196 | 0.317*<br>0.291* | 0.319*<br>0.249 | -0.356*<br>-0.423** |
| Leaf length | | | | | | | | -0.293*<br>-0.119 | -0.106<br>-0.234 | 0.315*<br>0.264 |
| Leaf width | | | | | | | | | -0.342*<br>-0.312* | -0.345*<br>-0.255 |
| Leaf Area | | | | | | | | | | 0.445**<br>0.398** |
| Yield/plot | | | | | | | | | | |

Upper and lower values represent genotypic and phenotypic correlation coefficients respectively
* Significant at 5% level; ** Significant at 1% level.

Table 28: Genotypic and Phenotypic Correlation Coefficients Between Morphological and Quality Traits in Eight Sugarcane Clones Grown at two locations in 1994

| | BRIX % | POLARITY % | PURITY % | FIBRE % | JUICE % | MOISTURE % | COMMERCIAL CANE SUGAR % |
|---|---|---|---|---|---|---|---|
| Establishment count | 0.240<br>0.700** | 0.104<br>0.124 | 0.527**<br>0.510 | 0.533**<br>0.196 | -0.381*<br>-0.087* | -0.230<br>-0.623** | 0.314<br>0.731** |
| Stalk diameter. | 0.900**<br>0.656** | 0.545**<br>0.034 | -0.260<br>-0.470** | -0.141<br>-0.432* | 0.643**<br>0.462** | 0.554**<br>0.338* | 0.284<br>0.350* |
| Stalk height | 0.696**<br>0.237 | 0.382*<br>0.645** | -0.784**<br>-0.157 | -0.383*<br>-0.514** | 0.510**<br>0.539** | 0.639**<br>0.290 | 0.576**<br>0.516** |
| Single Stalk weight | 0.259<br>0.005 | 0.158<br>0.021 | -0.171<br>-0.510** | -0.196<br>-0.422 | 0.679**<br>0.442** | 0.680**<br>0.420** | 0.432*<br>0.306* |
| No of Stalks/Stool | 0.030<br>0.249 | -0.517**<br>-0.201 | 0.530**<br>0.196 | 0.747**<br>0.464** | 0.501**<br>0.466** | 0.806**<br>0.535** | -0.775**<br>-0.285 |
| No of internodes/ Stalk | 0.535**<br>0.514** | 0.34**<br>0.466** | 0.745**<br>0.203 | -0.602**<br>-0.495** | 0.782**<br>0.490** | 0.740**<br>0.285 | -0.051<br>-0.557** |
| Leaf length | 0.622**<br>0.424* | 0.591**<br>0.800** | 0.662**<br>0.537** | 0.944**<br>0.306** | -0.659**<br>-0.282 | -0.563**<br>-0.511** | 0.746**<br>0.526** |
| Leaf width | 0.724**<br>0.518** | -0.443*<br>-0.725** | -0.384*<br>-0.519** | -0.250<br>-0.351* | 0.546**<br>0.352** | 0.328*<br>0.423* | -0.381*<br>-0.436* |
| Leaf Area | 0.317<br>0.447* | 0.730**<br>0.095 | -0.029<br>-0.015 | 0.846**<br>0.149 | 0.637**<br>0.173 | -0.697**<br>-0.482** | 0.312<br>0.597** |
| Yield/plot | -0.027<br>-0.176 | 0.299<br>0.135 | -0.178<br>-0.370 | -0.888**<br>-0.445* | 0.823**<br>0.461** | 0.452**<br>0.274 | 0.932**<br>0.428* |

Upper and lower values represent genotypic and phenotypic correlation coefficient. respectively.
* significant at 5% level; ** Significant at 1% level.

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internodes per stalk, leaf length, leaf area, cane yield per plot; between stalk weight and leaf length, cane yield per plot; between number of stalks per stool and leaf area as well as cane yield per plot; between number of internodes per stalk and leaf width; between leaf area and cane yield per plot. Negative and significant genotypic and phenotypic correlations were obtained between number of stalks per stool and number of internodes per stalk; between number of internodes per stalk and cane yield per plot; between leaf width and leaf area. Only genotypic correlation was however positive and significant between establishment count and stalk weight, number of internodes per stalk, leaf length; between stalk diameter and stalk height; between stalk weight and leaf area as well as number of internodes per stalk and leaf area. Similarly between leaf length and cane yield per plot. Significant negative genotypic correlation was obtained between stalk diameter and number of stalks per stool; between number of internodes per stalk and leaf length; between leaf width and cane yield per plot.

Correlations between morphological and quality traits, are presented in Table 28. Significant positive genotypic correlation were obtained between establishement count, purity percent and fibre percent; between stalk diameter and brix percent, polarity percent, juice percent and moisture percent; between stalk height and brix percent, polarity, juice percent, moisture percent and commercial cane sugar; between number of stalks per stool and purity percent, fibre percent, juice percent and moisture percent; between number of internodes per stalk and brix percent, polarity,

purity percent, juice percent and moisture parameter; and commercial cane sugar percent.

Significant negative correlation were obtained between establishment count and juice percent; between stalk height and purity percent and fibre percent; between number of stalks per stool polarity and commercial cane sugar; between number of internodes per stalk and fibre percent; between leaf length juice percent and moisture percent; between leaf width polarity, purity percent and commercial cane sugar percent; between leaf area and moisture percent and between yield per plot and fibre percent phenotypic correlations generally followed the same pattern as genotypic correlations.

Estimates of correlation coefficients among seven quality traits is presented on Table 29. Both genotypic and phenotypic correlations were positive and significant between brix and polarity percents; between polarity and purity percent, between purity and commercial cane sugar percents; between juice and moisture percents. Significant and negative estimates were obtained between purity and moisture percent. Only genotypic correlation was positive and significant between brix and commercial cane sugar percents.

4.4 Path Analyses.

The genotypic correlation coefficients of cane yield with other traits were further partitioned into direct and indirect effects through path analyses and the results are presented in Tables 30-34. The results for 1993 at Badeggi (Table 30) indicate

that stalk height, stalk weight, stalk diameter, leaf width and leaf area had positive direct effect on cane yield while establishment count, number of stalks per stool, number of internodes per stalk and leaf length had negative direct effect. Stalk weight gave the highest direct effect (0.523). Stalk diameter also show high indirect effect (0.428) through stalk weight. The result of the analyses for Uyo (Table 31) shows stalk height, stalk weight, number of stalks per stool to have high direct effect on yield. Leaf area however shows negative direct effect (-0.325). The highest positive effect was shown by stalk height (0.469). Stalk weight also showed high indirect effect through stalk height (0.321). Moderate indirect effect was also shown by stalk diameter through stalk height (0.251). Other indirect effect were low. The result of the 1994 analysis for Badeggi (Table 32) indicate a high direct effect of stalk weight (0.614), number of stalks per stool (0.314), and leaf area (0.315) on cane yield. Although stalk height and stalk diameter had negative effects on yield, they showed high indirect effects through stalk weight (0.401 and 0.559 respectively). Leaf area also showed high indirect effect through stalk weight (0.380). At Uyo (Table 33) high direct effects were observed for number of stalks per stool (0.619) and leaf area (0.346). Stalk diameter and stalk height showed negative effect on yield but showed high indirect effect through stalk weight.

Table 30: Direct and Indirect Effects of Cane Yield of yield components and other characters at Badeggi in 1993

| | Establishment count | Stalk diameter | Stalk height | Single stalk weight | No. of stalks /stool | No. of internodes /stalk | Leaf length | Leaf width | Leaf Area |
|---|---|---|---|---|---|---|---|---|---|
| Establishment count | **-0.026** | 0.043 | 0.185 | -0.358 | -0.025 | 0.346 | -0.014 | 0.014 | 0.065 |
| Stalk diameter | -0.004 | **0.258** | 0.276 | 0.428 | -0.029 | -0.003 | -0.055 | 0.118 | -0.158 |
| Stalk height | -0.012 | 0.159 | **0.449** | -0.373 | -0.069 | 110.009 | -0.105 | 0.080 | 0.179 |
| Single Stalk weight | -0.018 | 0.211 | -0.321 | **0.523** | 0.024 | 0.004 | -0.136 | 0.116 | -0.209 |
| No of stalks/stool | -0.003 | 0.034 | 0.143 | 0.057 | **-0.219** | 0.004 | 0.034 | -0.016 | 0.039 |
| No of Internodes/ Stalk | 0.008 | 0.028 | 0.135 | 0.070 | 0.001 | **-0.033** | 0.002 | 0.003 | 0.041 |
| Leaf length | -0.002 | 0.055 | 0.183 | -0.277 | 0.028 | 0.000 | **-0.258** | 0.081 | 0.207 |
| Leaf width | -0.002 | 0.192 | 0.227 | -0.385 | 0.022 | 0.001 | -0.132 | **0.158** | 0.184 |
| Leaf Area | -0.006 | 0.136 | 0.266 | -0.362 | 0.029 | -0.005 | -0.177 | 0.097 | **0.302** |

Residual effect = 0.023
The figures in bold ink are the direct effect.

Table 32: Direct and Indirect Effects on Cane Yield of yield components and other characters in Sugar Cane at Badeggi in 1994

| | Establishment count | Stalk diameter | Stalk height | Single stalk weight | No. of stalks /stool | No. of internode /stalk | Leaf length | Leaf width | Leaf Area |
|---|---|---|---|---|---|---|---|---|---|
| Establishment count | **-0.006** | -0.033 | -0.152 | 0.130 | -0.161 | 0.027 | 0.007 | -0.038 | 0.046 |
| Stalk diameter | 0.002 | **-0.164** | -0.401 | 0.559 | -0.006 | 0.017 | 0.003 | 0.051 | 0.187 |
| Stalk height | 0.022 | -0.128 | **-0.513** | 0.401 | -0.138 | 0.044 | 0.002 | 0.024 | 0.184 |
| Single Stalk weight | 0.001 | -0.149 | -0.335 | **0.614** | 0.079 | 0.059 | -0.006 | 0.082 | 0.217 |
| No of stalks/stool | 0.003 | -0.003 | -0.218 | -0.155 | **0.314** | 0.033 | 0.066 | -0.030 | 0.034 |
| No of Internodes/ Stalk | 0.001 | -0.002 | -0.178 | 0.287 | -0.083 | **0.125** | 0.005 | 0.076 | 0.040 |
| Leaf length | -0.001 | -0.024 | 0.056 | 0.182 | 0.100 | -0.032 | **-0.019** | -0.049 | 0.129 |
| Leaf width | -0.001 | -0.043 | -0.063 | 0.260 | 0.049 | 0.049 | 0.005 | **0.195** | 0.021 |
| Leaf Area | 0.001 | 0.089 | -0.268 | 0.380 | -0.030 | 0.014 | 0.007 | 0.012 | **0.351** |

Residual effect = 0.038.
The figures in bold ink are the direct effect.

Table 33: Direct and Indirect Effects on Cane Yield of yield components and other characters in Sugar Cane Clones at Uyo in 1994

| | Establishment count | Stalk diameter | Stalk height | Single stalk weight | No. of stalks /stool | No. of internode /stalk | Leaf length | Leaf width | Leaf Area |
|---|---|---|---|---|---|---|---|---|---|
| Establishment count | **-0.061** | -0.102 | -0.170 | 0.305 | 0.080 | -0.056 | 0.002 | -0.069 | 0.137 |
| Stalk diameter | -0.030 | **-0.205** | -0.222 | 0.370 | 0.118 | 0.082 | -0.002 | -0.055 | 0.105 |
| Stalk height | -0.022 | -0.095 | **-0.478** | 0.314 | 0.155 | -0.082 | 0.006 | -0.099 | 0.146 |
| Single Stalk weight | -0.030 | -0.123 | -0.165 | **0.225** | 0.323 | 0.024 | 0.003 | 0.069 | -0.160 |
| No of stalks/stool | -0.022 | -0.108 | 0.330 | 0.138 | **0.619** | -0.070 | -0.003 | -0.108 | 0.118 |
| No of Internodes/ Stalk | 0.176 | -0.086 | 0.201 | -0.076 | 0.081 | **-0.195** | -0.003 | -0.026 | 0.137 |
| Leaf length | -0.007 | 0.034 | -0.235 | 0.145 | 0.047 | 0.004 | **0.013** | 0.010 | 0.090 |
| Leaf width | -0.020 | -0.054 | -0.228 | 0.201 | 0.115 | -0.024 | 0.001 | **-0.211** | 0.222 |
| Leaf Area | -0.024 | -0.062 | -0.202 | 0.285 | 0.077 | -0.077 | 0.033 | -0.135 | **0.346** |

Residual effect = 0.019.
The figures in bold ink are the direct effect.

# CHAPTER FIVE

# DISCUSSION

## 5.1 Mean Performance

The differential performance of the sugar cane clones in different locations and in different years for all the characters measured in this study is indicative of the presence of genotype x environment interactions for these characters. The wide ranges in values obtained and the magnitudes of the genotypic coefficients of variation is suggestive of the presence of an appreciable amount of genetic variability for these characters in these clones.

Singh et al.(1983;1987) in their report also obtained similar results when studying hybrid populations at clonal stage and made similar conclusions in their studies.

## 5.2 Estimates of variance components

In plant breeding, the variability which exist within a given population is very important as it indicates the presence of heritable characters, most especially additive genetic variance which could be exploited in crop improvement programme. To the breeder, the presence of variability in a population indicates a sure source of improvement. Knowledge of the size of variety x environment interavtion is of value for predicting gains in selection experiments and also determining the number of years, locations or both that are required to reach a desired level of precision in selection (Allard and Bradshaw, 1964). The effect of variety x environment interactions are the results of either changes in variety rank or magnitude across environments. The

percentage contribution of different sources of variations and their interactions to the total variation shows clearly the sgnificance of each source of variation or their interactions on different traits. High percentage contribution to the total variation indicates that the environment or interactions of environments has strong effect on the trait.

In this study, all characters exhibited considerable variation as shown by the magnitudes of their between genotypic and phenotypic variances. In most cases, genotypic components of variance were larger in magnitude than those for environmental components for some traits. This implies that these characters are highly heritable and a high response from selection for these characters would result increase in cane yield. Significant variance due to locations, years or their interactions suggest that appropriate breeding programmes should allow for the developement of a number of varieties,each particularly adapted to a specific environment. The significant second order interactions observed for some traits indicates that variety x year effects were inconsistent or variety x location effects were inconsistent. This implies that more years or locations would be needed to test for the traits concerned. Negative estimates obtained for some variety x environment variances has been attributed to large significant differences between environments. It follows that meaningful evaluation for the affected traits can be done in selected environment of intended use. Similar results where obtained by Robinson et al. (1959), Obilana et al. (1979), Lukhele and Obilana

Since yield is a complex character highly influenced by environmental fluctuations, a direct selection for yield could be difficult. It would have been desirable to have one or more traits in which indirect selection for cane yield could be practised. The result of this study showed that high correlated responses for cane yield could be obtained when selection is practiced for establishment count, stalk weight, stalk height and number of stalks per stool since these characters had high and positive correlations with the yield. Improvement in these traits would therefore lead to simultaneous increase in cane yield, though the effectiveness of this would depend on their genetic control. Reddy and Reddi (1986); Kang and Miller (1990) also obtained similar result in their studies.

Strong positive associations observed between juice percent and stalk weight, stalk height, number of stalks per stool and number of internodes per stalks showed that improvement in these traits would subsequently lead to increase in juice present in the cane and thus higher yield of sugar. Negative correlations between important characters may lead to selection of cultivars with undesirable characters. If a negative association between characters is due to pleiotropic effects it would be very difficult to obtain the desired combinations while if linkage is involved, special breeding programmes are needed to break this linkage (Pandey and Gritton (1975). Though brix percent was negatively correlated with yield, its positive association with other traits could mean that possibility of improving it would be through

selection for these traits. The negative association observed between juice and fibre percents was interesting as it is indicative that the less the fibre content in the stalk, the higher the sucrose yield. It was not surprising that fibre percent also showed negative association with commercial cane sugar percent as higher fibre percent would lead to low sucrose yield.

## 5.4 Path Analysis

Path analyses is a standardized partial regression coefficient which measures the direct influence of one variable upon another, and permit the separation of the correlation coefficients into components of direct and indirect effects (Dewey and Lu, 1959). Path analysis specifies the causes of correlations and measures their relative importance. The correlation coefficients of cane yield and its components were therefore partitioned into direct and indirect effects through path analyses. The low residual effect obtained in all the environments as well as in the combined analysis shows that most of the variations in cane yield was accounted for by these components. The stalk weight and number of stalks per stool which had significant and positive correlations also showed high positive direct effect toward yield. This implies that when other factors are held constant, a direct selection for these traits would automatically lead to increase in cane yield. Though the 1994 results showed high negative effect of stalk height on cane yield, there was a high positive indirect effect through stalk weight and number of stalk per stool. Similar reports were

also given by Singh et al. (1995); Reddy and Reddi (1986) in their studies. Though stalk diameter showed positive association with cane yield, path analysis revealed a negative direct effect, but high positive effects through stalk weight and stalk height which showed that improvement in these traits would be through indirect selection for stalk weight and stalk height.

Juice and commercial cane sugar percents had high direct effect on cane yield which shows the importance of these traits in a selection programme for sugar yield. Fibre percent showed negative direct effect but its high indirect effect through juice and moisture percents are positive but moderately low which shows that the lower the fibre content the higher the sugar yield.

## CHAPTER SIX

## SUMMARY AND CONCLUSIONS

An appreciable variety x environment interactions was observed from the differential performance of the clones in different locations in different years in all the characters studied. Wide ranges in the magnitude of genotypic coefficient of variation is also an indication of presence of genetic variability for the characters in these clones. Genotypic components of variances for stalk height, stalk weight, number of stalks per stool, leaf area and cane yield per plot had influence in the expression of these traits and therefore considered to be a good scope for the improvement of these traits. Generally, genotypic coefficients of correlations were observed to be higher than phenotypic coefficients and thus indicate that phenotypic expression was lessened under the influence of the environments. Since a direct selection for cane yield can be difficult and expensive, an indirect selection for stalk height, stalk weight, number of stalk per stool and establishment count could result in appreciable increase in cane yield. Brix percent, though an important quality trait in sugar yield was negatively correlated with cane yield, its positive association with yield components could mean that by means of special breeding strategy, increase in brix percent may subsequently lead to increase in yield. Partitioning the correlations observed into direct and indirect effects shows that the main cause of cane yield were stalk weight, number of stalks per stool and stalk height in that order. From the results of this studies, it can be concluded that; stalk weight, number of stalks

per stool and stalk height are the major characters contributing to cane yield and indirect selection for these characters could lead to increase in cane yield. It was observed from this studies that due to environmental fluctuations, negative estimates were obtained in variety x environment intractions.

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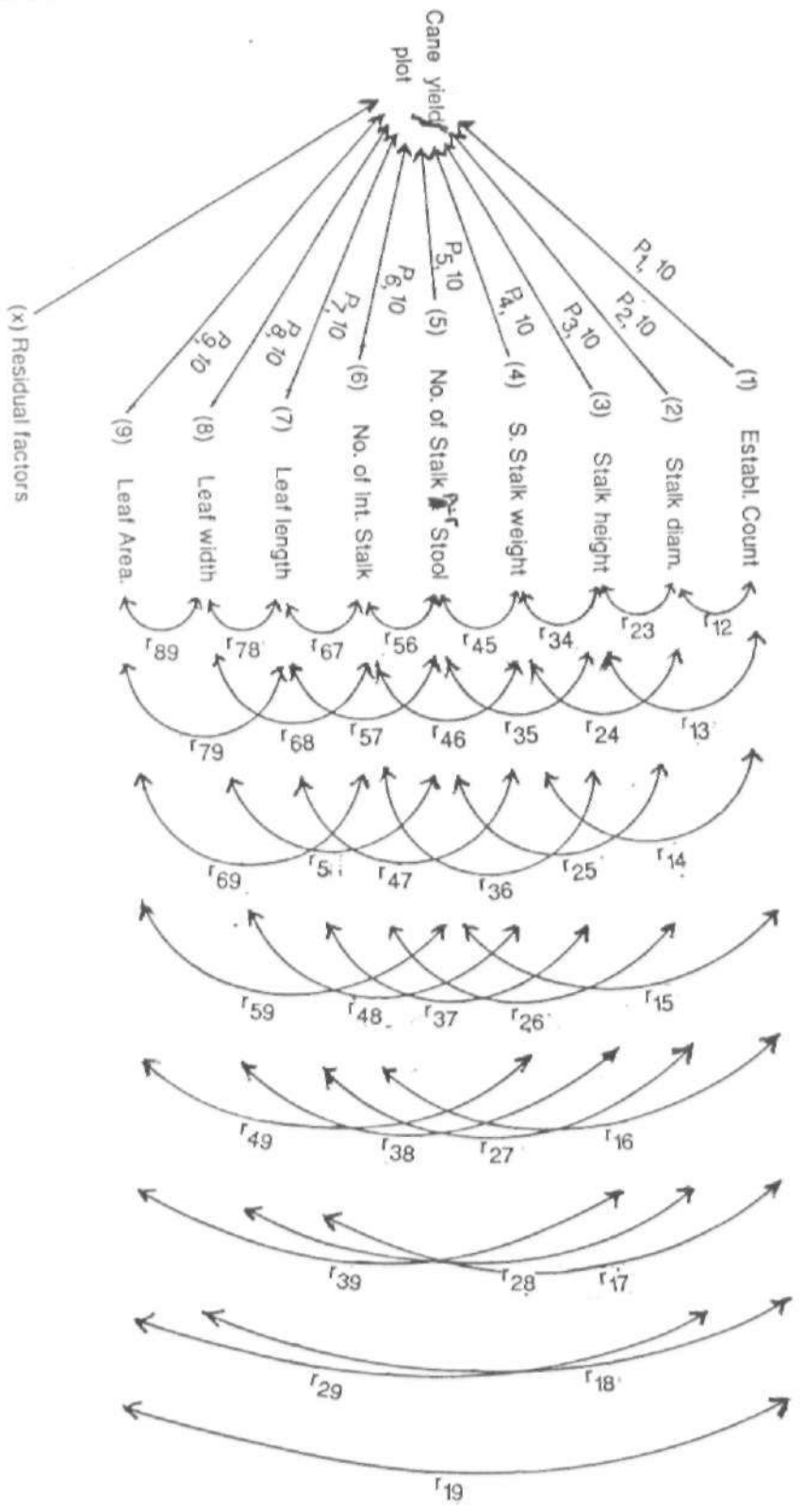
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Path analyses diagram