African Journal of General Agriculture
Vol. 4, No. 2, June 30, 2008
Printed in Nigeria

1595-6984/2008 $12.00 + 0.00

http://www.asopah.org

AJGA 2007098/4205

Relationships between chewing sugarcane (*Saccharum officinarum L.*) stalk yield and some parameters affected by fertility and weed control treatments at Badeggi, Nigeria

A. K. Gana*[1], J. A. Y. Shebayan[2], V. B. Ogunlela[2] and E. C. Odion[2]

[1]National Cereals Research Institute, P.M.B. 8, Bida Niger State, Nigeria.
[2]Institute of Agricultural Research / Department of Agronomy, Ahmadu Bello University, Zaria

(Received December 3, 2007)

ABSTRACT: Field trials were conducted at the upland sugarcane experimental field of NCRI Badeggi in 2004 - 2005, 2005 - 2006 and 2006 - 2007 wet and dry seasons to determine the relationship with chewing sugarcane stalk yield with some soil chemical properties, weed and sugarcane agronomic characters as being affected by fertility and weed control treatments at Badeggi, in Southern Guinea Savanna of Nigeria. From the results obtained in the three trials, stalk yield (ton/ha) was significantly and positively correlated with soil physico-chemical properties including cation exchange capacity (CEC), organic matter, total percent nitrogen, available phosphorus, exchangeable potassium, percent sand, silt and clay. With the sugarcane agronomic characters, stalk yield (ton/ha) was significantly and positively correlated with chewable stalks per plot at 10MAP, stalk girth (cm) at 10MAP, crop vigour score at 9MAP, tiller count per plot at 3MAP. While on the other hand, the stalk yield was significantly and negatively correlated with the weed cover score and weed dry matter production at 9MAP in the 2004 - 2005, 2005 - 2006 and 2006 - 2007.

Key Words: Chewing sugarcane; stalk yield (ton/ha); Agronomic characters; Guinea savanna.

Introduction

In many crops especially arable ones, yields are mostly dependent on some components or parameters, but direct components of yield vary with crops (Reedy and Reedi, 1986). Contributions by some parameters towards variations in yield are higher and more important than those of other components most probably because of association between yield and its parameters are more direct in some crops than in others. Since most of the characters of economic importance such as yields are complex in inheritance and may involve several related characters, the degree of genotypic and phenotypic correlations of the characters is important.

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) had the greatest influence on cane stalk yield followed by stalk weight. The correlations obtained by Singh *et al*. (1981) with respect to the number of millable cane per stool, stalk length and diameter as well as brix value was positively correlated with yield.

*To whom correspondence should b e addressed.

In Nigeria Oworu (1978) found positive correlation (r = 0.90) between sucrose percent and sugar purity and pol but negatively correlated with percent fibre.
This paper therefore, provides information on relationship between chewing sugarcane stalk yield with soil physico-chemical parameters, sugarcane agronomic characters and weed parameters.

Materials and Methods

Field trials were conducted on the upland sugarcane experimental field of the National Cereals Research Institute Badeggi (Lat. 9°45′N, Long.06°07′E, 70.5 metres above sea level in the Southern Guinea Savanna ecological zone of Nigeria in 2004 - 2007 wet and dry seasons. The soil of the experimental site has been classified as ultisol and sandy loam in texture with bulk density of $1.49m^{-1}$ (Ayotade and Fagade, 1993). It has an average annual rainfall of 1124mm and mean temperature 23°C - 33°C respectively.

Details of physico-chemical properties of the soil and analysis of the cowdung during the periods of experiment are presented in tables 1 -2. The treatments tested consist of seven fertility rates and four weed control measures. The treatment therefore include:- F_0 = control (no cowdung, no inorganic fertilizer, F_1 = 120N - $60P_2O_5$ - $90K_2O$kg/ha alone (NCRI recommended rate for sole sugarcane, F_2 = 10tonnes/ha of air dried cowdung (NCRI recommended rate), F_3 = 10tonnes/ha of air dried cowdung + 120N - $60P_2O_5$ - $90K_2O$kg/ha,), F_4 = 10tonnes/ha of air dried cowdung + 60N - $30P_2O_5$ - $45K_2O$kg/ha,), F_5 = 5tonnes/ha of air dried cowdung + 120N - $60P_2O_5$ - $90K_2O$kg/ha and F_6 = 5tonnes/ha of air dried cowdung + 60N - $30P_2O_5$ - $45K_2O$kg/ha constituted the main plot, while the weed control treatments W_0 = Weedy check, W_1 = hoe weeding at 1, 2, 3, 4, 5, 6 and 9MAP, W_2 = atrazine 2.0kga.i./ha (P.E) + dimethametryne 3.0kga.i./ha (P.E) + Supplementary hoe - weeding at 2, 4, 5, 6 and 9MAP and W_3 = Diuron 2.0kga.i./ha (P.E) + supplementary hoe-weeding at 2, 4, 5, 6 and 9MAP were the sub plot.

Each treatment was accommodated in a plot area of $15m^2$ (5 x 3m) and each plot contained 6 rows of chewing sugarcane. Bida Local or Ajax was the chewing sugarcane variety that was used for the experiment. Air dried cowdung was incorporated into the soil manually using short handle hoe a month before establishing the trial. While the inorganic fertilizer was applied split at planting (½N - $½P_2O_5$ - $½K_2O$ base application) and at 6MAP during earthing up half ½N - $½P_2O_5$ - $½K_2O$ was applied. Pre-emergence herbicides were applied a day after planting, while the post - emergence was applied at 5 weeks after planting (WAP). Herbicides were applied using knapsack (CP_3) sprayer in a spray volume of 250L/ha. The supplementary hoe - weeding was carried out at 2, 4, 5, 6 and 9MAP using short handle hoe. Harvesting was done at 10MAP using cutlass. The sugarcane stalks from the net plot were tied into bundles and weighed on 50kg scale.

The data collected for correlation matrix (r) were weed cover score 9MAP. The weed cover score was collected using score scale of 0 - 10, 0 = clean, weed free plot, 10 = weedy plot, completely weed cover. Weed dry matter production ton/ha 9MAP, Crop vigour score 9MAP. Crop vigour score was collected using score scale of 0 - 10, 0 = sicky, diseased plants, 10 = healthy, very greenish plant. Stalk length 9MAP, number of chewable stalks per plot 10MAP, Stalk girth (cm) 10MAP, tiller count per plot 3MAP and stalk yield (ton/ha). Soil samples per treatment were collected after each harvest. The data collected were analysed using M-stat to run the correlation matrix (r).

Results and Discussion

Sugarcane stalk yield (ton/ha) was significantly and positively correlated with soil physico-chemical parameters including cation exchange capacity (CEC), organic matter, total percent nitrogen, available phosphorus, exchangeable potassium, percent sand, percent silt and percent clay in 2004 - 2005, 2005 - 2006 and 2006 - 2007 wet and dry season (r = 0.420*, 0.493* and 0.497*), 0.399*, 0.409* and 0.497*, 0.403*, 0.490* and 0.523**, 0.435*, 0.449* and 0.523**, 0.478*, 0.509** and 0.516**, 0.407*, 0.484* and 0.496*, 0.401*, 0.410* and 0.428*, 0.423*, 0.399* and 0.405*) (Tables 3 - 5).

Table 1: Physico-chemical characteristics of soil taken from experimental sites before the establishment of the trial

Soil properties 0 - 25cm depth	Badeggi 2004
Physical properties	
Sand (%)	91.00
Silt (%)	8.00
Clay (%)	1.00
Textural class	Sandy
Chemical properties	
pH in water	6.2
Organic carbon (%)	0.50
Organic matter (%)	1.10
Total nitrogen (%)	0.039
Available phosphorus (ppm)	8.95
Exchangeable cation (cmol / kg^{-1})	
K	0.35
Mg	0.29
Ca	1.00
Na	0.16
CEC (cmol / kg^{-1})	5.85

Table 2: Laboratory analysis of cowdung component

	Percent (%)		
	2004-2005	2005-2006	2006-2007
Nitrogen	0.313	0.314	0.315
Phosphorus	0.26	0.26	0.26
Potassium	0.34	0.34	0.35
Organic	15	16	16

Source: Cowdung from the cow market behind Gwadebe New Market - Bida

The significant positive correlation between stalk yield (ton/ha) and soil physico-chemical properties proved those parameters to be the major elements and soil ameliorative agents thereby improving the sugarcane growth for higher stalk yield (ton/ha). According to Little (1997) and Makinde and Alabi (2000), N, P and K are the three major elements needed by the plant. These parameters are therefore very important to be considered especially when evaluating the possibility of obtaining the potential yield from sugarcane from a sandy poor soil.

Likewise, the stalk yield was significantly and positively correlated with number of chewable stalks at 9MAP, stalk girth (cm) at 10MAP, crop vigour score at 9MAP and tiller count per plot at 3MAP (the agronomic characters) (r = 0.957**, 0.975** and 0.986**, 0.868**, 0.884** and 0.924**, 0.825**, 0.859** and 0.875**, 0.830**, 0.884** and 0.894**, 0.860**, 0.872** and 0.885**) in the three trials (Tables 3 - 5). This indicate these agronomic characters as yield attributes and determinants. This result confirm the correlation study by Pan *et al*. (2006) who recorded significantly positive correlation of chewing sugarcane stalk yield (ton/ha) with growth or agronomic parameters.

Table 3: Correlation matrix (r) between stalk yield and various parameters as affected by fertility rates and weed control treatments at Badeggi, 2004-2005 wet and dry seasons

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	1.000	0.420*	0.399*	0.403*	0.435*	0.478*	0.407*	0.401*	0.399*	0.581**	0.611**	0.459*	-0.402*	-0.410*	0.957**	0.868**	0.825**	0.830**	0.860**
2		1.000	0.952**	0.471*	0.800**	0.872**	0.268	0.400*	0.143	0.431*	0.104	0.063	0.032	0.006	0.369	0.227	0.191	0.162	0.438*
3			1.000	0.247	0.143	0.836**	0.305	0.397	0.166	0.102	0.061	0.005	0.060	0.036	0.304	0.161	0.188	0.086	0.445*
4				1.000	0.285	0.294	0.273	0.342	0.124	0.195	0.199	0.187	-0.042	-0.051	0.009	0.098	0.187	0.193	0.405*
5					1.000	0.962**	0.225	0.319	0.122	0.178	0.066	0.049	0.047	0.012	0.203	0.243	0.150	0.231	0.435*
6						1.000	0.096	0.206	0.106	0.141	0.098	0.067	0.113	0.036	0.134	0.190	0.125	0.165	0.425*
7							1.000	0.435*	0.073	0.054	0.103	0.188	-0.062	-0.004	0.086	0.145	0.169	0.086	0.054
8								1.000	0.514**	0.06	0.026	0.034	-0.087	-0.004	0.151	0.117	0.669**	0.104	0.188
9									1.000	0.075	0.018	0.011	-0.064	-0.183	0.096	0.083	0.028	0.099	0.685**
10										1.000	0.754**	0.955**	-0.482*	-0.564**	0.644**	0.964**	0.871**	0.216	0.296
11											1.000	0.497*	-0.413*	-0.571**	0.368	0.432*	0.771**	0.575**	0.350
12												1.000	-0.553**	-0.534**	0.354	0.955**	0.976**	0.911**	0.655**
13													1.000	-0.432*	-0.441*	0.088	-0.094	-0.089	-0.398
14														1.000	-0.425*	0.485*	-0.572**	-0.011	-0.398

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
15															1.000	0.073	0.684**	0.795**	0.906**
16																1.000	0.132	0.935**	0.424*
17																	1.000	0.932**	0.743**
18																		1.000	0.873**
19																			1.000

1. → Stalk yield (ton / ha) 2. → Cation exchange capacity (CEC) 3. → Percent organic matter (OM) 4. → Total nitrogen (N)
5. → Available phosphorus (P) 6. → Exchangeable potassium (K) 7. → Percent sand 8. → Percent silt 9. → Percent clay
10. → Percent reducing sugar(RS) 11 → Percent Fibre 12. → Percent brix 13 → Weed cover score at 9MAP 14 → Weed dry matter production(ton/ha at10MAP) 15. → Number of chewable stalks/plot at 10MAP 16. → Stalk length (cm) at 9MAP 17. → Stalk girth (cm) at 10MAP
18. → Crop vigour score at 9MAP 19. → Tiller count at 3MAP.
* → Significant at 5%, ** → Highly significant at 1%, MAP → Months after planting

Table 4: Correlation matrix (r) between stalk yield and various parameters as affected by fertility rates and weed control treatments at Badeggi, 2005-2006 wet and dry seasons

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	1.000	0.493*	0.409*	0.490*	0.449*	0.509**	0.484*	0.410*	0.405*	0.628**	0.597**	0.585**	-0.415*	-0.430*	0.975**	0.884**	0.859**	0.884**	0.872**
2		1.000	0.953**	0.841**	0.911**	0.921**	0.283	0.631**	0.214	0.506**	0.101	0.139	0.211	0.092	0.377	0.243	0.436*	0.134	0.593**
3			1.000	0.379	0.203	0.891**	0.613**	0.624**	0.543**	0.254	0.054	0.262	0.202	0.121	0.365	0.304	0.471*	0.202	0.526**
4				1.000	0.431*	0.481*	0.519**	0.680**	0.539*	0.211	0.119	0.219	-0.108	-0.093	0.213	0.138	0.240	0.264	0.513**
5					1.000	0965**	0.681**	0.570**	0.684**	0.205	0.056	0.251	0.236	0.072	0.413*	0.194	0.337	0.236	0.662**
6						1.000	0.192	0.414*	0.212	0.231	0.089	0.110	0.226	0.073	0.169	0.218	0.247	0.333	0.541**
7							1.000	0442*	0.123	0.074	0.100	0.273	-0.393	-0.075	0.263	0.169	0.268	0.273	0.122
8								1.000	0.599**	0.085	0.021	0.279	-0.864**	-0.091	0.095	0.194	0.732**	0.314	0.293
9									1.000	0.10	0.016	0.159	-	-	0.191	0.148	0.207	253	0.712

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
										0			0.080	0.046					**
1										1.00	0.686	0.087	-	-	0.798	0.972	0.936	0.244	0.331
0										0	**	7**	0.532	0.584	**	**	**		
													**	**					
1											1.000	0.884	-	-	0.651	0.461	0.943	0.777	0.913
1												**	0.649	0.579	**	*	**	**	**
													**	**					
1												1.000	-	-	0.371	0.966	0.948	0.931	0.775
2													0.560	0.867		**	**	**	**
													**	**					
1													1.000	-	-	-	-0.182	-	-
3														0.561	0.462	0.134		0.117	0.473
														**					*
1														1.000	-	-	-	-	-
4															0.581	0.491	0.580	0.186	0.445
															**	*	**		*
1															1.000	0.120	0.703	0.818	0.937
5																	**	**	**
1																1.000	0.176	0.726	0.553
6																		**	**
1																	1.000	0.941	0.883
7																		**	**
1																		1.000	0.911
8																			**
1																			1.000
9																			

1. →Stalk yield (ton / ha) 2. → Cation exchange capacity (CEC) 3. → Percent organic matter (OM)4. → Total nitrogen (N)
5. → Available phosphorus (P) 6. → Exchangeable potassium (K)7. → Percent sand 8. → Percent silt 9. → Percent clay
10.→Percent reducing sugar(RS) 11→Percent Fibre 12.→Percent brix 13→Weed cover score at 9MAP 14→Weed dry matter production(ton/ha at10MAP) 15. → Number of chewable stalks/plot at 10MAP 16. → Stalk length (cm) at 9MAP 17. → Stalk girth (cm) at 10MAP
18. → Crop vigour score at 9MAP 19. → Tiller count at 3MAP
* → Significant at 5%, ** → Highly significant at 1%, MAP → Months after planting

Table 5: Correlation matrix (r) between stalk yield and various parameters as affected by fertility rates and weed control treatments at Badeggi, 2006-2007 wet and dry seasons

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	1.000	0.497*	0.417*	0.523**	0.523**	0.516**	0.496*	0.428*	0.431*	0.787**	0.517**	0.674**	-0.485*	-0.509**	0.986**	0.924**	0.875**	0.894**	0.885**
2		1.000	0.985**	0.974**	0.982**	0.966**	0.695**	0.791**	0.344	0.537**	0.095**	0.225	0.386	0.141	0.478*	0.352	0.544**	0.212	0.637**
3			1.000	0.563**	0.273	0.897**	0.780**	0.835**	0.616**	0.456*	0.050	0.288	0.390	0.179	0.388	0.355	0.659**	0.294	0.627**
4				1.000	0.777**	0.835**	0.640**	0.756**	0.453*	0.572**	0.114	0.249	-0.339	-0.099	0.478	0.396	0.553**	0.871**	0.995**
5					1.000	0.968**	0.726**	0.634**	0.788**	0.390	0.052	0.288	0.396	0.459*	0.488**	0.366	0.601**	0.242	0.969**
6						1.000	0.223	0.625**	0.276	0.580**	0.089	0.218	0.412*	0.140	0.494*	0.143	0.573**	0.340	0.676**
7							1.000	0.457*	0.213	0.114	0.092	0.282	0.462*	-0.111	0.274	0.367	0.253	0.373	0.281
8								1.000	0.614**	0.125	0.020	0.288	-0.967**	-0.131	0.319	0.017	0.878**	0.312	0.295
9									1.000	0.120	0.013	0.167	-0.194	-0.127	0.194	0.986**	0.216	0.264	0.513**
10										1.000	0.598**	0.880**	-0.661**	0.592**	0.812**	0.734**	0.941**	0.953**	0.424*
11											1.000	0.896**	-0.596**	0.522**	0.720**	0.968**	0.948**	0.945**	0.953**
12												1.000	-0.589**	0.899**	0.387	0.204	0.959**	0.935**	0.831**
13													1.000	-0.570**	-0.594**	-0.493*	-0.230	-0.293	-0.480*

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1														1.000	-	-	-	-	-
4															0.593**	0.240	0.663**	0.379	0.685**
1															1.000	0.343	0.759**	0.898**	0.958**
5																			
1																1.000	0.254	0.953**	0.664**
6																			
1																	1.000	0.951**	0.902**
7																			
1																		1.000	0.954**
8																			
1																			1.000
9																			

1. →Stalk yield (ton / ha) 2. → Cation exchange capacity (CEC) 3. → Percent organic matter (OM)4. → Total nitrogen (N)
5. → Available phosphorus (P) 6. → Exchangeable potassium (K)7. → Percent sand 8. → Percent silt 9. → Percent clay
10.→Percent reducing sugar(RS) 11→Percent Fibre 12.→Percent brix 13→Weed cover score at 9MAP 14→Weed dry matter production(ton/ha at10MAP) 15. → Number of chewable stalks/plot at 10MAP 16. → Stalk length (cm) at 9MAP 17. → Stalk girth (cm) at 10MAP
18. → Crop vigour score at 9MAP 19. → Tiller count at 3MAP
* → Significant at 5%, ** → Highly significant at 1%, MAP → Months after planting

However, the stalk yield was significantly and negatively correlated with weed cover score and weed dry matter production (ton/ha) at 9MAP (R= -0.402*, -0.415* and -0.485**, 0.410*, -0.430* and -0.501**). This confirm the high vulnerability of sugarcane especially chewing sugarcane to weeds with consequent reduction in stalk yield. The relationship observed rather indicates that weed parameters indicated will be useful in differentiating the response of chewing sugarcane var. Bida Local or Ajax to weeds.

Conclusion

Correlation study is very important as it measured the degree of associations between two or more characters and also been quite useful information on effective selection programme. From the results of this study, it can be concluded that significant and positive correlation between stalk yield (ton/ha) with soil physico-chemical parameters, agronomic characters and weed parameters are therefore very important to be considered in selection programme and also in determining possibility of obtaining optimum yield from chewing sugarcane especially for this ecology.

References

Battan, K. R., Chaudhary, B. S. and Kadian, S. P. (1985). Studies on Correlation and Path Coefficient Analysis in Sugarcane. *Agric. Sc. Digest India 5:87 - 89.*

Little, I. P. (1997). The fate of nitrogen fertilizer added to red gladatial soil its implications with respect to soil acidity. *Australian Journal of Soil Research 33:863 - 800.*

Makinde, E. A. and Alabi, B. S. (2000). Influence of fertilizer type on weed control and the performance on maize melon intercrop. *Nigerian Journal of Weed Science 13:33 - 37.*

Oworu, O. O. (1978). Preliminary evaluation of the agronomic potentials of some Nigerian local sugarcane clones *Proc*. Inter symp. On sugarcane in Nigeria August - Sept. 1978. Pp 81-91.

Pan, D. E., Chen, G. S., Dengy, Y. L., Goa, Y. and Zhivily, Y. F. (2006). Agronomic and quality character of different chewing cane cultivars. *Proc*. of international sympossium on Technologies to Improve Sugarcane Production in Developing Countries. Guili P. R. pp 159 - 165.

Reedy, C. R. and Reedi, M. V. (1981). Degree of genetic determination, correlation and genotype and phenotypic path analysis in cane and sugar yield in sugarcane. *Indian J. Genetic 46(3):550 - 570.*

Singh, H. N., Singh, S. B. and Singh, T. K. (1981). Selection parameters in sugarcane. *Indian Journal Agric. Sc.* 51:562 - 569.