EFFECT OF AGRIPRACTICES, PEDILOGICAL AND HYDROLOGICAL FACTORS ON YIELD OF SUGARCANE IN KOM-OMBO, ASWAN

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Abstract

A sample area was selected during the agricultural season 1986 - 1988 over 20 sugarcane fields in old and new lands in Kom Ombo , Aswan governerate on the basis of noticeable differences in cane growth within and among fields of plant and ratoon types. The yield data showed that the average cane yield differed from 24 to 54. 5 TC/F . A step-wise multiple regression analysis was implemnted to quantify the contibution of agronomic, hydrological and pedilogical effect on cane yield and its components.

Low yields of sugarcane in fields in the Kom Ombo area are the result of the combined effect of inadequate agripractices as well as pdeilogical and hydrological constraints. Soil and water variables cause 63. 7 % of the observed yield decline, while agripractices contribute7.6 % of this decline. Stalk height (length) is, the cane yield component , most affected by agronomic and soil variables. It accounts for 57.7 % of the observed decline in cane yield among good, average and poor -yielding fields. Stalk weight causes 6. 01 % of the observed yield differnces

INTRODUCTION

In recent years, problems of different nature affecting the sugarcane yield have been noticed in Aswan governertate, which covers about 20 % of the national

Sugar cane producing countries. Panje 1972, studied the effect of different cultrual methods for sugarcane production in the subtropics of India. Sund and Clements 1974 showed the effect of the saline desert soils and climate on cane production in Iran. Sehgal et. al. 1980 studied the suitability of the soils of Mesopotamon plain for sugarcane cultivation . They showed that soil physical and chemical characteristics affect cane yield . Allam 1982 quantified the effect of the soil, water and agronomic practices on cane yield and sugar in the subtropics. He showed that unfavourable soil physical and chemical properties decrease the potential can yield by and average of 37.5 % Field managemet and agripractieces cause 17 % decrease of the potential yield.

The present studey was intiated to quantify the relationship between (differences in) sugarcane yields and production factors, i. e . agronomic, hydrological and pedilogical variables in the kom Ombo sugarcane fields.

MATERIALS AND METHODS

Twenty cane fields of equal planting periods showing noticeable differences in growth within the same field as well as among fields were selected in Kom Ombo area planted durifng 1986 or ratooned in 1987 and harvested in 1988 . Fourteen fields were in the new land and six fields were in the old lands. These fields represtned all sugarcane ages, plant crop (7 fields) , 6, 5, and 2 fields representing first, secound and third ratoon , respectively. In each field , three sample areas were selected showing good, average and poor cane growth. Crop husbandry and agronomic practices were recorded.

Pits and auger holes were bored to assess the soil factors of the sample areas. These characters include soil structure, depth to water table, ph, salinity, nutrient content (NPK) and trace elements (Fe, Zn, Mn, Cu & Bo) according to the soil chiemical analysis as outlined by Jakson 1985, and Richards 1954.

Yield of cane was measured and relevant growth yield components were recorded at harvest. Yield components included number of millable stalks, height , diameter and weight.

Statistical procedure

Simple factor analysis was carried out and were evaluated by stepwise mul-

tiple linear regression analysis (Draper and Smith 1966), to determine the relative contribution of each variable as affecting cane yield and yield components.

Stepwise multiple regression was implied to relate cane yield on the sample areas (20 cane fields) to the different agronomic and soil factors. These factors are number of ratoon-x1, soil texture - x2 , Water table level - x3 , drainage condition - x4 , Sodium Content - X 5 and Agripractices - x 6.

RESULTS AND DISCUSSION

Twenty cane fields were selected in old lands (6 cane fields) and new lands (14 cand fields) on the basis of observed marked differences in different fields.

Cane yields

I. Among Fields :

Table 1 shows that the average cane yield differed from 24 . 0 to 54. 5 TC / F for different fields. The cane yield average of 41. 0 TC/F was considered for the purpose of the study as the normal yield for the average - yielding fields, above it is described as good - yielding fields , above it is described as good- yielding fields and below it is the poor yielding fields. 13 fields yielded less than 41. 0 TC / F.

The observed agronomic and pedological factors at field sites revealed that :

Soil texture (heavy and coarse) , high water taable level (HWTL), poor drainage conditions, and high sodium content are the main soil constraionts that limet the sugarcane production amdong cane fields. Other agripractices effecting cane yields were.

Numbher of ratoons, weed competiotion , borer infestaion , soil and water management, and crop management.

Some of these factors such as HWTL , drainage, sodium content, borer and weed infestations are correctable limitations and can be improved and corrected. Also measures are available for soil improvement, and agripractices can be generated, adapted and adopted to ensure maximum cane yields.

Table 1.Yield data on 20 sample field areas planted with cv. GZ 54-C9 in Kom Ombo during 1986 - 88

Field No.	Yield (TC / F)	Soil	Crop Type
1	31.19 *	New	First Ratoon
2	38.84 *	New	Plant crop
3	43.13 *	New	Plant crop
4	36.00 *	New	Plant crop
5	33.50 *	New	Plant crop
6	36.70 *	old	First Ratoon
7	24.00 *	old	Second Ratoon
8	36.58 *	old	Third Ratoon
9	39.48 *	old	Second Ratoon
10	40.26 *	old	Second Ratoon
11	30.26 *	old	Third Ratoon
12	34.23 *	New	First Ratoon
13	45.80	New	Plant Crop
14	41.10	New	Plant Crop
15	47.10	New	Plant Crop
16	54.50	New	First Ratoon
17	53.50	New	Second Ratoon
18	45.56	New	First Ratoon
19	30.40 *	New	Second Ratoon
20	49.10	New	First Ratoon

1 . New : Cultivated after 1961 ; old cultivated before 1961 .

*The cane yield average of 41 Ton / Feddan was considered as the average yield fields , above it is good fields and below it is considered the poor - yielding fields.

II - Within Fields

Yield variation within fields was more pronounced than among fields (i.e. fields No. 1, 2, 3, 4, 6, 9, 10, 12, 18, and 19). The yeild average was 20.2 TC/F for the poor area of field No. 2 as compared to 61. 5 TC/F for the good area of the same field.

Yield variation within the same field reflects mainly a poor agripractices as well as poor soil and water management . The unevern growth (wavey) appearance within the same field can be due to one or a combination of the following:

Un - levilled soil surface, water logging , salinity areeas, soil competition , weed competetion , exess soil moisture, higth level of water table, and Light soil texture.

The wide variation in productivity of cane yield among different fields varying from 24 to 54. 5 TC / F and within the same field varying from 20.2 to 61.5 TC/ F (site 2) demonstrate the high potentiality to increase yields in the kom Ombo area to more than the present average of 41 TC/F, if the cane - Soil - water relationships are kept at an optimum for sugarcane growth provided that good field agripractices and management are carried out properly.

1 - Soil Texture Effect :

It is well known that sugarcane needs well - drained loam soils, free of salinity and having optimum physical environments. Moderately heavy and medium deep (1-2 m) loams are better suited than heavy (clay), light (sand) and shalow soils sehgal *et . al* . 1980). The results of the 20 cane fields indicate that deep loamy soil profiles are the most productive soils shown from Table 2. Soil texture is the main factor that affects cane yield between fields. These results show that loamey soils, silty clay silty clay leam and clay leam are the most productive sites while clay sandy and sandy soils are less productive. The differences in yield within the same texture is due to the interaction of other soil factors (water table level, Drainage and number of ratoons). This is affected also by the depth of the different layers .

2 - Water Table level (WTL) :

Table 3. shows the bad effect of high WTL on cane yields for sample areas 4, 5, 6, 7, 8, and 12 where the average yields and WTL are shown as compared to sample areas 2, 9, 10, 13, 15, 16, 18, 19 , and 20 .

Table 2. Effect of soil texture on cane yield.

Texture	Total Fields & (Field No.)	Yield Rang (Ton / F.)	Yield Average (Ton / F.)
C 1	2 : (1 & 11)	30.6 - 31.2	30.9
C1/C1/ L	2 : (1 & 14)	41.1 - 43.3	42.2
C 1 / L	2 : (2 & 9)	38.8 - 39.5	39.2
Si L S	2 : (6 & 13)	36.7 - 45.8	41.3
Si / C1 /L	2 : (10, 15,16&17)	40.3 - 54.4	48.2
L	1 : (20)	-------	49.1
S / C1 / L	1 : (18)	-------	47.1
S / L	3 : (5, 12 & 19)	40.4 - 34.2	32.6
S	3 : (4, 7 & 8)	24 - 36.8	32.3

C1 . Clay, L = Loam, Si = Silt & S = Sand

Table 3. Effect of water table level on cane yield.

WTL (cm)	State & total No. of Fields	Fields no	(Ave) Yield (Ton/F)
150	Good 9 Fields Average Yield	2 - 9 - 10 13 - 15 - 16 18 - 19 - 20	38.8 - 39.5 - 40.3 45 - 47.1 - 5405 45.6 - 30.4 - 49.1 (42.9)
100 - 120	Average 5 Fields Average Yield	3 - 11 - 14 17 - 1	43.1 - 30.6 - 41.1 53.5 - 31.2 (39.9)
80	Bad 6 Fields Average Yield	4 - 5 - 6 7 - 8 - 12	36 - 33.5 - 36.7 24 - 36.6 - 34.3 (37.0)

3 - Drainage :

The results given in Table 4 below , show that the drianage condtion affects the cane yield. This effect is very pronounced within each field and between different fields other factors correlated with drainage, include water table level and soil texture .

Therefore, adequate drainage, water table depth contol , soil imbrovement and good agromomic practices are required for maximum production of sugarcane in KOm - Ombo area as well as in other sugar cane producing regions in Egypt.

4 . Soduim Cation Content (Nat me / 100g)

Sodium ions Na + affects osmotic pressure of soil solution , soil physical properties and ultimately plant production. High clay contents compiled with high exchangeable soduim adversely affect cane growth and yield . The degree of adverse effects depends on the nature of the complementry ions, variety , age of ratoons and climatic conditions.

The results given in Table 5 shows the effect of different Na+ content in different fields on can yield . This effect is clear among and within fields. Fields No. 5,7 & 8 are sandy soil. It can be seen if soluble Na + is 3 me / 100 g soil , Good to high cane Yield can be obtained . The lower tha Na+ ion content the higher is the cane Yield.

5 . Soil PH and ECe

Results show that the soil PH range between 8 . 0 and 8 . 5 which is tolerated by sugtarcane. The electrical conductivity of the soil paste (ECe) for all fields is less than 1.0 mmhos / cm . An ECe value of about 4 mmohs is the threshold above which yields of most sugarcane varities are adversely affected.

Table 4. The drainage condition effect on the cane yield.

Drainage Condition	Drain Type	Field No.	Yield (TC / F)
Good	Tile Drain	1	31.2
	Tile Drain	2	38.8
	Tile Drain	10	40.3
	Tile Drain	13	45.8
	Tile Drain	15	47.1
	Open	3	43.1
	Open	20	49.1

			24.2
Bad	Tile	9	39.5
	Tile	11	30.6
	Tile	12	34.2
	Tile	14	41.1
	Open	4	36.0
	Open	5	33.5
	Open	6	36.7
	Open	7	24.0

			34.9

Table 5. Effect of Na + ion content on cane Yield

Field No	Na + ion conten me / 100 g soil	Yield
16	0.7	54.5
17	0.8	53.5
3	1.6	43.1
13	1.6	45.8
18	1.6	45.6
15	1.7	49.1
20	2.6	49.1
14	2.8	41.1
10	4.2	40.30
6	4.3	36.70
9	4.3	39.42
12	4.3	34.20
4	5.0	36.0
1	6.8	31.2
2	7.8	38.8
19	9.0	30.4
11	9.1	30.60

Agronomic factors affecting cane yields :

i -Number of ratoon

The fields were classified according to sequence of ratoon and their average yields were recorded as shown in Table 6.

Table 6. Number of ratoon and average yields

Number of Ratoon Total	No . of Fields	(Range Ton / F)	AV. Yield Ton/ F	F / No.
Plant crop	7	33.5 - 47 .1	40.8	2.3.4.5.13.14.15
First Ratoon	6	31.2 - 54.5	41.9	1,6,12,16,18,20
Second Ratoon	5	24.0 - 53.5	37.5	7,9,10,17,19
Third Ratoon	2	30.6 - 36. 6	33.6	8.4

It can be seen from Table 6 that the highest yield was obtained at the first ratoon . This is natural and universal with sugarcane. The rapid decline of cane yield for the second and third ratoons is and outcome of the interaction of other factors such as variety, weed competition and field management . Ratoons are prone to adverse effects more than plant cane as was stated earlier.

ii - Weed Infestation

Weeds compete with cane for water , nutrition and light. Weed effect can be seen within the same field as well as among different fields.

iii - Borer Infestation

Yield losses due to borer infestation may reach up to 10 % of the total cane yield . Borer infestaion was recorded for field No. 2 (38. 8 T/F) and field No. 7 (24 Ton F). Table 1.

iv - Field Managment

Good soil and crop management are necessary , if high yields of cane and sugar to be obtained . This is a must, hence sugarcane is a perennial crop and needs proper management to maintain a healthy environment.

Effect of Agronomic, hydrological and Pedilogical factors on cane yield .

The stepwise multiple linear regression analysis showed that the effcet of the six independent variables on cane yield was highly significant . However, certain independed variables exerted very little effect on cane yield Table 7.

Soil texture (X2) alone accounted for 63 . 78 % of the variation in cane yield among and within fields. Including agripractices (X6) gave and addition in explained variation of 7.6 % . However, the four other factors (i.e. number of ratoon - X, WTL-X3 , drainage condition - x4 and sodium content-x5) did not significantly imrove the explantion of variation in cane yield .

This means that about 64 % of the variation in cane Yield is due to the soil texture and about 8 % of that variation can be attributed to the agripractices. All other agronomic, and soil factors only contributed about 5 % of the Yield differences among and within fields. The remainder 23 % of the variation in cane Yield may be due to the soil physio-chemical conditions, irrigation and disease control.

Yield components .

Cane Yield can be expressed as follos :

Yield = No. of stalkes/ F x, Stalk height X1 , Stalk diameter X2 Stalk weight X4 = TC / F

Table 7. Relative contribution (R^2 %) of some agronomic and soil factors in observed cane yields of the sample areas.

Agronomic soil factors	The best prediction equation	(R^2 %)
Accepted varibles		
Soil Texturre x 2		63.78 **
Agro practices x 6	TC/F = 23.16 + 4 . 44 x 2+7. 597 x6	7.60 **
Removed variables		

No. of Ratoons x1		
Water Table x3		5.65
Drain Condition x4		
Sodium Content x5		
All Variables	Y = 25.98+0.0235 X 1 + 3.802 X 2	77.03 **
	- 1. 738 X 3+1. 50 X 4 -. 544 X 5	
	- 7. 226X6	
	TC/ F = 23 . 16 + 4 . 44 X 2	71.38 **
X2 + X6	+ 7 . 597 X 6	

R^2 ** : coefficient of Determination.

* * : Significant at 1 % level of probability

The stepwise analysis of Yield components show that these four studied independent variables have a highly significant effect on cane Yield among and within fields. However , no. of stalkes / F and stalk diametr exerted very little effect on cane Yield (Table 8) . This is expected, hence both of these characters are less influenced by the environment and have a high repeatabilty . Also, there is only one variety planted in Kom - Ombo and the number of stalk / plant and the stalk diameter are varietal characters.

Stalk height (length) alone accounted for 77. 57 % of the variation in yield (TC/F) . Including weight gave and addition in explained variation of 6. 01 % all of which caused significant improvement. This is explained by the fact that stalk hight is more prone to environmental changes (especially , soil texture , irrigation , drainage and temperature), also it is less repeatable over seasons and location . The stalk weight is the outcome of the : height X density, thus it varies according to hte stalk height. Besides density is environment - depentdent factor that is extremely effected by solution concentrations and moisture tensions of the soils.

Table 8. The Relative Contribution (R^2 %) of some yield components in observed cane yield of the sample areas.

Yield Components	The best prediction equation Cane Yield as function of Yield components	(R^2 %)
Accepted varibles Stalk height x 1 Removed variables Stalk weight x2 Stalk Diameter x3 No. of Stalk x4 All variables	TC/F = 1. 897+9 . 82 X 1+ 8 . 16 X4 Y = 1.6099 + 1027 X 1 - 1 737 X 2 - .0316 X 3 + 18 . 416 X 4	77.57 ** 0.39 6.01 ** 83.97 **
X2 + X6	TC/F = 1. 897+9 . 82 X 1+ 8 . 16 X4	83.58 **

R^2 ** : coefficient of Determination.

* * : Significant at the 0.01 level of probability.

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تأثير العمليات الزراعية وميكانيكية المياه على محصول قصب السكر فى كوم امبو واسوان

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– اختيرت عينة من التربة خلال الموسم الزراعى ١٩٨٦ – ١٩٨٨ من ٢٠ حقل قصب السكر م الأرض القديمة والجديدة فى كوم امبو محافظة اسوان على أساس الفروق بين الحقول النباتية النامية بين وداخل الحقول ومظهر الخلفات .

وأوضحت البيانات أن محصول القصب اختلف من ٢٤ الى ٥ر٥٤ ٪ طن / فدان واوضح تحليل الإنحدار المتعدد المرحلى أهمية المساهمة النسبية لكل من العمليات الزراعية وتأثير العمليات الحيوية بالتربة وحركة المياة على محصول القصب ومكوناته . ويرجع انخفاض محصول قصب السكر فى حقول كوم امبو الى التأثير المركب للعمليات الزراعية الكثيرة كما يرجع الى تغيير تأثير الأراضى وتأثير المياه وتأثير التربة والماء ساهم بـ٧ ر ٦٣ ٪ من إنخفاض المحصول بينما تساهم العمليات الزراعية بـ٧٦ ٪ من هذا الإنخفاض .طول النبات اكثر تأثيراً بالعمليات الزراعية والتغيرات بالتربة وقدرت هذه الإنخفاضات بحوالى ٧ ر ٥٧ ٪ من الإنخفاض فى المحصول بين الحقول العالية والمنخفضة فى متوسط المحصول كما يسبب وزن عود القصب إنخفاضاً قدره ١. ر ٦ ٪ بين الفروق الملحوظة للمحصول .