Organic Manure, Phosphate and Potassium Fertilization in Relation to Growth, Productivity and Quality of Sugarcane

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ABSTRACT: The present study was carried out at the private farm, Kom-Ombo-Aswan, Upper Egypt, during the two growth seasons of 2017/2018 and 2018/2019 to study the effect of organic, phosphate and potash fertilization on productivity and quality of sugarcane plant crop (Commercial variety, Giza Taiwan = C 9). The experimental design of this study was a split- split plot design in three replicates for both seasons. Three levels of organic manure (10, 20 and 30 m^3/fed) were randomly assigned in the main plots, three phosphate fertilizer levels (100, 200 and 300 kg of mono super calcium phosphate/fed) were allocated in the sub plots and three potash fertilizer levels (50, 100 and 150 kg in the form of potassium sulphate/fed) were randomly distribution in the sub- sub plots. Net plot size was 4.5 m x 8.0 m in 75 cm spaced trenches. The results revealed that increasing organic manure from 10 to 30 m^3/fed increased productivity of sugarcane. Moreover, increasing the rate of phosphate fertilizer up to 200 kg and potassium sulfate up to 150 kg/fed recorded the highest yield of sugar cane in both seasons under this study.

Keywords: sugarcane, Organic manure, phosphate, potassium, fertilizer, growth, productivity, quality.

INTRODUCTION

Sugarcane (*Saccharum officinarum* L.) is one of the most important field crops in the tropics areas. Indeed, according to FAO (2018), it is grown in not less than 105 countries and covers a total average of about 19 million ha for a world production of about 1.3 billion tons of cane gave about 127 million tons of sugar. Also, sugarcane is the major cash crop after cotton and rice which not only provides major stay to sugar industries, but also raw material to many allied industries for alcohol and chip board manufacturing and a source of employment directly or indirectly (Abdul Ghaffar *et al.,* 2012).In Egypt, the total sugar cane cultivated area reached about 338160 feddans with an average of 47.32 tons/fed (FAO, 2018).

Sugar cane is one of the crops that need to many amounts of nutrients especially organic, phosphorus and potassium element. So, this investigation was conducted to study the role of these elements in sustaining soil fertility for growing sugarcane. However, Organic manure has an important role for sugarcane crop production, where the application of organic manure alone or with in combination inorganic fertilizer significantly increased the number of tillers, millable cane stalks, and yield of sugarcane as compared with control (Bokhtiar *et al*., 2008).Also, Soumare *et al.* (2003) and Jadoon *et al.* (2003) revealed the beneficial effect of combined application of organic and inorganic fertilizer in sustaining soil fertility and yield. Organic farming had beneficial effects on human health, sustainability of soil, water, and environmental resources and crop yields (Singh and Swarup, 2000; Gareau 2004; Thakur and Sharma 2005).

Phosphorus element plays vital role in photosynthesis, root development, tillering and in yield and quality of sugarcane (Meyer and Wood, 2001; Santos *et al*., 2002 and Santos *et al*., 2009). On the other hand, Caione *et al.* (2011) showed that the application of phosphorus in the planting furrow influenced purity, fiber, corrected pol, total recoverable sugar, and ton of sugarcane/ha. The highest yield was obtained with the combination of 200 kg /ha of P_2O_5 in the total area and 100 kg/ha of P_2O_5 applied in the planting furrow (Albuquerque *et al*., 2016).

Potassium is the nutrient most extracted by sugarcane (Silva *et al*., 2007), especially by ratoon (Korndörfer and Oliveira, 2005) playing important metabolic jobs such tissue turgor regulation, enzyme activation, stomatal opening and closing and transport of carbohydrates (Hawkesford *et al.,* 2012), thus, potassium is important to recover ratoon sugarcane yield (Weber *et al*., 2002). Increases in yield with quadratic adjustments, corroborating those obtained in both forms of application, which 162.4 and 160.9 t/ha with 130 and 150 kg/ha of K_2O, respectively (Otto *et al*., 2010). Also, at the rate of 66 kg/ha of K_2O responsible for the increase of 74 t/ha in the ratoon sugarcane yield (Shukla *et al*., 2009), while Kumar *et al*. (2007) recorded higher yields using 40 kg /ha of K_2O with ratoon sugarcane planted in a clay loam soil. The highest stalks yield recorded in this mechanized cutting system experiment (127.2 t /ha), was attained with 147.5 kg/ha of K_2O, without decreasing the rate of fertilizer recommended by the literature in conventional farming systems (130 kg /ha of K_2O), i.e. with previous straw removal by fire before cutting. The increase in the amount of potassium to the soil is more important to stalk production and quality of ratoon sugarcane (Feltrin *et al*., 2010, Singh *et al*., 2010; Kumar, 2012). The increased availability of potassium in the soil with the application of potassium chloride increased the absorption of this element by the plants, reflecting in stalk yield. The rate of 130 kg /ha of K_2O is the most appropriate for the production of stalks of sugarcane. This rate kept the potassium nutritional status very close to the suitable in the ratoon, enabling the accumulation of K in the stalks at satisfactory levels to give high yield (Pancelli *et al*., 2015).

The aim of this study was to examine the response of the commercial sugarcane variety (C9) to different levels of organic manure, phosphorus, and potassium fertilizers and their effect on productivity of sugarcane.

MATERIALS AND METHODS

The present study was carried out at the private farm, Kom-Ombo-Aswan, Upper Egypt, during the two growth seasons of 2017/2018 and 2018/2019 to study the effect of organic, phosphate and potash fertilization on productivity and quality of the first and the second ratoon sugarcane crop (Commercial variety, Giza Taiwan = C 9). Some physical and chemical analysis of the experimental soil is shown in Table (1) according to Page *et al.* (1982).

Table (1). Some physical and chemical properties of the experimental soil

Parameter	Sample	Unit
Mechanical Analysis		
Clay	51.10	%
Silt	23.00	%
Sand	25.90	%
Textural class	Clay Loam	
PH (1:2 water suspension)	7.98	-
$CaCO_3$	3.10	%
EC (1:2, water extract)	1.41	dS/m
OM	1.65	%
Soluble cations		
Ca^{2+}	2.04	meq/l
Mg^{2+}	4.06	meq/l
Na^{+}	4.49	meq/l
K^{+}	0.71	meq/l
Soluble anions		
HCO^{-}_3	5.40	meq/l
Cl^{-}	7.99	meq/l
SO_4^{2-}	0.89	meq/l
Available nutrients		
Nitrogen (N)	140.5	mg/kg
Phosphorus (P)	4.7	mg/kg
Potassium (K)	100	mg/kg

The experimental design of this study was a split- split plot design in three replicates in both seasons. Three levels of organic manure (10, 20 and 30 m^3fed) were randomly assigned in the main plots, three phosphate fertilizer levels (100, 200 and 300 kg/fed of mono super calcium phosphate, 15.5% P_2O_5) were allocated in sub plots and three potash fertilizer levels (50, 100 and 150 kg/fed from potassium sulphate, 48% K_2O) were randomly distributed in the sub- sub plots. Net plot size was 4.5 m x 8.0 m for 75 cm spaced trenches.

Farm yard manure (FYM) as organic manure was applied with ratoon sugarcane filed preparation (Table 2). Calcium super phosphate (15.5 % P_2O_5) in the form of phosphate fertilizer was applied before the first irrigation in both seasons. While, Potassium Sulphate (48 % K_2O) in the form of potassium fertilizer was applied before the first irrigation in both seasons.

Nitrogen fertilizer was added in the form of ammonium nitrate (33.5%N) as a side dressing at the rate of (200 kg N/fed) in three equal doses, the first dose was applied after month from the first irrigation, the second after 2 weeks from the first one, and the third dose was applied after a month from the second dose in the first and second seasons. Cane length (cm), number of tillers/plant, number of internodes/plant, cane diameter (cm), cane weight (g), total cane yield (ton/fed), total soluble solid (TSS %), sucrose %, and sugar yield (t/fed) were determined in both seasons.

All obtained data were statistically analyzed according to the technique of analysis of variance (ANOVA) for the split-split plot design as published by Gomez and Gomez (1984). Least Significant Difference (LSD) method was used to test the differences between treatment means at 5% level of probability. Correlations of the traits obtained from the experiment were computed using Costat program. All the statistical analyses were performed using CoStat V 6.4 (2005) for Windows.

Table (2). Composition of farm yard manure (FYM)

Determination	FYM
Moisture (%)	64.00
Organic matter (%)	33.30
Total N (%)	1.90
Total P (%)	1.01
Total K (%)	1.99
PH	6.53
EC (dS/m)	1.40
Fe (mg/kg)	27.90
Zn (mg/kg)	59.00
Mn (mg/kg)	29.00
Cu (mg/kg)	12.50

RESULTS AND DISCUSSION

Results presented in Table (3) showed the effect of organic manure (FYM), phosphorus fertilizer, potassium fertilizer levels and their interaction on plant attributes of the ratoon sugarcane during 2017/2018 and 2018/2019 seasons. With respect to the effect of the three levels of organic manure, the results in the same Table indicated that using organic manure at the rate of 30 m^3/fed recorded the highest mean values of cane length (cm), number of internode/plants, number of tillers/plant and cane diameter (cm) in both seasons. Meanwhile, the lowest ones were obtained with the lowest rate of FYM (10 m^3/fed). This increase in these traits may be due to the role of organic manure in availability of nutrients in soil and enhancing soil properties. These results are in confirmed with those obtained by Singh and Swarup (2000), Gareau (2004), Thakur and Sharma (2005) and Bokhtiar *et al*. (2008), they indicated that using organic manure increased plant attributes.

Results pointed that increasing P- fertilizer levels significantly affected cane length (cm), number of internodes/plant, number of tillers/plant and cane diameter (cm) in the both seasons. Whereas, fertilizing sugarcane plants with 300 kg of mono super calcium phosphate/fed recoded the highest value of cane length (cm), number of internode/plants, number of tillers/plant and cane diameter (cm) as compared with the other levels in both seasons, while the lowest level (100 kg mono super calcium phosphate/fed) gave the lowest ones during both seasons. The differences among levels of phosphorus under study

could be due to the role of P in plant and soil. These results are in agreement with those recorded by Meyer and Wood (2001), Santos *et al*. (2002), Santos *et al*. (2009) and Albuquerque *et al*. (2016), they revealed that increasing P-fertilizer levels caused significant increase in plant characters.

Results cleared that increasing K- fertilizer levels significantly affected cane length (cm), number of internodes/plant, number of tillers/plant and cane diameter (cm) in both seasons. Whereas, fertilizing sugarcane plants with 150 kg of potassium sulphate/fed recoded the highest value of cane length (cm), number of internodes/plant, number of tillers/plant and cane diameter (cm) as compared with the other levels in both seasons, while the lowest level (50 kg potassium sulphate/fed) gave the lowest ones during the two seasons. The differences among levels of K- fertilizer under this study could be due to the role of K in plants and soil. These results are in harmony with those obtained by Feltrin *et al*. (2010), Singh *et al*., (2010), Kumar (2012) and Pancelli *et al*. (2015).

Results in the same Table cleared that all the first order of the interaction between studied factors Organic manure, P- levels and K- levels were significant in both seasons. This shows that organic act dependently on cane length, number of internodes/plant, number of tillers/plant and cane diameter during both seasons of this study.

Table (3). The ratoon sugarcane attributes as affected by organic manure, phosphorus and potassium fertilizers in both seasons

Treatments	Cane length (cm)		Number of Internodes/plant		Number of tillers/plant		Cane diameter (cm)	
	2017/018	2018/019	2017/018	2018/19	2017/018	2018/019	2017/018	2018/019
A) Organic manure (FYM) (m^3/fed)								
10	293.6	289.4	18.8	19.7	4.6	4.6	2.3	2.3
20	306.0	299.4	19.7	20.5	5.0	4.8	2.6	2.6
30	304.2	299.7	20.5	21.3	5.2	5.1	2.6	2.6
LSD at 0.05	5.2	8.1	0.6	0.5	0.2	0.4	0.1	0.1
B) P- fertilizer levels (kg of mono super calcium phosphate/fed)								
100	296.4	289.9	19.2	19.9	4.7	4.7	2.5	2.5
200	301.4	295.8	19.9	20.8	5.0	4.9	2.5	2.5
300	306.0	302.8	20.0	20.9	5.0	4.9	2.6	2.6
LSD at 0.05	3.2	3.3	0.5	0.4	0.3	0.3	0.1	0.1
C) K- fertilizer levels (kg potassium sulphate/fed)								
50	295.7	291.6	18.3	19.1	4.5	4.4	2.3	2.3
100	303.0	297.4	19.9	20.8	5.0	4.9	2.6	2.6
150	305.1	299.6	20.8	21.7	5.2	5.1	2.7	2.7
LSD at 0.05	4.1	4.3	0.7	0.7	0.4	0.4	0.2	0.1
Interaction:								
A x B	*	*	*	*	*	*	*	*
A x C	*	*	*	*	*	*	*	*
B x C	*	*	*	*	*	*	*	*
A x B x C	ns	ns	ns	ns	ns	ns	ns	ns

* and ns: significant and not significant at 0.05 level of significant, respectively.

Table (4) showed the effect of organic manure (FYM), phosphorus fertilizer, potassium fertilizer levels and their interaction on yield attributes (cane weight (kg), total cane yield (ton/fed), total soluble solid (TSS%), sucrose (%), and sugar yield (t/fed) of ratoon sugarcane during 2017/2018 and 2018/2019 seasons.

The results in the same Table revealed that using organic manure at the rate of 30 m^3 recorded the highest mean values of cane weight (kg), total cane yield (t/fed), total soluble solid % (TSS), sucrose (%), and sugar yield(t/fed) in both seasons. While, the lowest ones obtained with the lowest rate of FYM (10 m^3/fed). The increase in these traits may be due to the role of organic manure in availability nutrients in soil and enhancing soil properties. These results are in agreement with those obtained by Singh and Swarup (2000), Gareau (2004), Thakur and Sharma (2005) and Bokhtiar *et al*. (2008), they indicated that using organic manure increased plant attributes and its quality of sugarcane.

Results indicated that increasing P- fertilizer levels significantly affected cane weight (kg), total cane yield (ton/fed), total soluble solid (TSS), sucrose (%), and sugar yield (t/fed) during both seasons. However, fertilizing sugarcane plants with 300 or 200 kg of mono super calcium phosphate/fed recorded the highest value of cane weight (kg), total cane yield (ton/fed), total soluble solid (TSS), sucrose (%), and sugar yield (t/fed) as compared with the other levels in both seasons, while the lowest level (100 kg from mono super calcium phosphate/fed) gave the lowest ones during both seasons. The differences among levels of phosphorus under study could be due to the role of P in plant and soil. These results are in harmony with those recorded by Meyer and Wood (2001), Santos *et al*. (2002), Santos *et al*. (2009) and Albuquerque *et al*. (2016) they indicated that increasing P- fertilizer levels caused significant increase in crop characters.

Results cleared that increasing K- fertilizer levels significantly affected yield characters and quality of sugarcane in the both seasons. However, fertilizing sugarcane plants by 150 kg of potassium sulphate/fed recoded the highest value of cane weight (kg), total cane yield (ton/fed), total soluble solid (TSS), sucrose (%), and sugar yield (t/fed) as compared with the other levels in both seasons, while the lowest level (50 kg potassium sulphate/fed) gave the lowest ones during the two seasons. The differences among levels of K-fertilizer under the study could be due to the role of K in plants and soil. These results are in the same line of those results observed by Feltrin *et al*. (2010), Singh *et al*., (2010), Kumar (2012) and Pancelli *et al*. (2015).

Results in the same Table cleared that all the first order interaction between studied factors organic manure, P- levels and K- levels were significant in both seasons. While, the second order interaction were not significant in both seasons, this showed that organic manure, phosphorus and potassium fertilizer act independently on cane weight, total cane yield, TSS %, sucrose %, and sugar yield (t/fed) as shown in Table (4).

Table (4). The ratoon yield sugarcane attributes as affected by organic manure, phosphorus and potassium fertilizers in both seasons

Treatments	Cane weight (kg)		Total cane yield (t/fed)		Total soluble solid (TSS)		Sucrose %		Commercial cane sugar (t/fed)	
	2017/2018	2018/2019	2017/2018	2018/2019	2017/2018	2018/2019	2017/2018	2018/2019	2017/2018	2018/2019
A) Organic manure (FYM) (m^3/fed)										
10	1.2	1.1	49.2	50.9	20.3	18.8	14.1	13.3	4.2	4.2
20	1.2	1.1	52.4	55.9	21.2	19.5	15.0	14.2	4.9	5.0
30	1.3	1.2	55.1	59.3	22.0	20.3	16.3	15.5	5.7	6.0
LSD at 0.05	0.1	0.04	1.6	1.5	0.5	0.5	0.9	0.8	0.4	0.5
B) P- fertilizer levels (kg of mono super calcium phosphate/fed)										
100	1.1	1.1	50.7	53.3	20.5	18.9	14.2	13.4	4.4	4.5
200	1.2	1.1	52.7	56.2	21.5	19.9	15.5	14.7	5.2	5.3
300	1.2	1.2	53.3	56.6	21.5	19.8	15.7	14.9	5.2	5.4
LSD at 0.05	0.1	0.03	1.6	1.9	0.4	0.5	0.5	0.4	0.3	0.3
C) K- fertilizer levels (kg potassium sulphate/fed)										
50	1.1	1.0	48.9	51.0	19.7	18.2	14.2	13.4	4.4	4.4
100	1.2	1.1	52.5	55.9	21.5	19.7	15.1	14.3	4.9	5.1
150	1.2	1.2	55.2	59.2	22.3	20.6	16.0	15.3	5.5	5.8
LSD at 0.05	0.03	0.04	1.1	1.3	0.7	0.7	0.5	0.5	0.2	0.3
Interaction:										
A x B	*	*	*	*	*	*	*	*	*	*
A x C	*	*	*	*	*	*	*	*	*	*
B x C	*	*	*	*	*	*	*	*	*	*
A x B x C	ns	ns	*	*	ns	ns	ns	ns	*	*

* and ns: significant and not significant difference, respectively.

Results in Table (5) revealed the effect of the first order interaction between organic manure X P- fertilizer, organic manure X K- fertilizer and P- fertilizer X K- fertilizer on total cane yield and commercial cane sugar of the ratoon sugarcane in both seasons. Where, the highest mean value of total cane yield and commercial cane sugar obtained by using 30 m^3/fed organic manure + 300 kg/fed P- fertilizer which had no significant with 20 m^3/fed organic manure + 300 kg/fed P- fertilizer in both seasons. On the other hand, soil application of 30 m^3/fed organic manure + 150 kg/fed K- fertilizer which had no significant difference with 20 m^3/fed organic manure + 150 kg/fed K- fertilizer in both seasons. However, interact between P- fertilizer level (200 kg/fed) + K- fertilizer (150 kg/fed) in both seasons.

Table (5). Interaction effect between organic manure X P- fertilizer, organic manure X K- fertilizer and P- fertilizer X K- fertilizer on total cane yield and commercial cane sugar of the ratoon sugarcane in both seasons

Treatments		Total cane yield (t/fed)		Commercial cane sugar (t/fed)	
Organic manure (FYM) (m^3/fed)	P- fertilizer levels (kg/fed)	2017/2018	2018/2019	2017/2018	2018/2019
	100	47.2	47.5	4.2	4.1
10	200	49.6	52.1	4.4	4.5
	300	50.8	53.0	4.1	4.1
	100	51.1	54.7	4.0	4.1
20	200	53.2	56.7	5.2	5.4
	300	53.0	56.5	5.3	5.5
	100	53.7	57.7	5.0	5.2
30	200	55.4	59.9	6.1	6.4
	300	56.2	60.3	6.1	6.4
LSD at 0.05		3.5	4.2	0.5	0.5
Organic manure (FYM) (m^3/fed)	K- fertilizer levels (kg/fed)				
	50	44.0	44.7	3.3	3.2
10	100	50.7	51.9	4.5	4.5
	150	52.9	55.9	4.9	5.1
	50	50.1	52.4	4.6	4.6
20	100	52.0	56.0	4.6	4.8
	150	55.2	59.4	5.4	5.6
	50	52.9	56.0	5.2	5.4
30	100	54.8	59.8	5.6	5.9
	150	57.5	62.2	6.3	6.6
LSD at 0.05		2.0	2.2	0.4	0.5
P- fertilizer levels (kg/fed)	K- fertilizer levels (kg/fed)				
	50	45.8	47.7	3.6	3.6
100	100	51.2	53.5	4.2	4.3
	150	55.0	58.7	5.4	5.5
	50	50.2	51.8	4.8	4.8
200	100	52.6	56.9	5.2	5.4
	150	55.4	60.0	5.7	6.1
	50	50.9	53.6	4.7	4.8
300	100	53.8	57.4	5.3	5.5
	150	55.2	58.8	5.5	5.7
LSD at 0.05		2.0	2.2	0.4	0.5

CONCLUSION

The results from this study revealed that sugarcane ratoon should be fertilized by organic manure (FYM) at the rate of 20 $m^{3/}$fed with 200 kg super calcium phosphate and 150 kg from potassium sulphate/fed under Aswan region for getting the highest yield, yield components and quality of sugar cane crop.

REFERNCES

Abdul Ghaffar, E., N. Akbar, S. H. Khan, K. Jabran, R. Q. Hashmi, A. Iqbal and M. A. Ali (2012). Effect of trench spacing and micronutrients on growth and yield of sugarcane (*Saccharum officinarum* L.). Austr. J. Crop Sci., 6(1):1-9.

Albuquerque, A.W., L. de A. Sá1, W. A. R. Rodrigues, A. B. Moura and M. S. O. Filho (2016). Growth and yield of sugarcane as a function of phosphorus doses and forms of application. R. Bras. Eng. Agríc. Ambiental, 20 (1):29-35.

Bokhtiar, S. M., G. C. Paul, and K. M. Alam (2008). Effects of organic and inorganic fertilizer on growth, yield, and juice quality and residual effects on ratoon crops of sugarcane. J. Pl. Nut., 31: 1832–1843.

Caione, G., M. T. R. Teixeira, A. Lange, A. F. Silva and F. M. Fernandes (2011). Modos de aplicação e doses de fósforo em cana-de-açúcar forrageira cultivada em Latossolo Vermelho-Amarelo. Revista de Ciências Agro-Ambientais, (9):1- 11.

CoStat, Ver. 6.4 (2005). Cohort software798 light house Ave. PMB320, Monterey, CA93940, and USA. email: info@cohort.com and Website: http://www.cohort.com/DownloadCoStatPart2.html

FAO (2018). Food and Agriculture Organization Statistics, FAOSTAT. *http://www.fao.org/faostat*

Feltrin, M.S., M.G.D.P Lavanholi., H.S. Silva and R.M. Prado (2010). Adubação potássica na produtividade da soqueira de canade-açúcar colhida sem queima. Nucleus. 7(1): 307-314.

Gareau, S.E. (2004). Analysis of Plant Nutrient Management Strategies: Conventional and Alternative Approaches, Agriculture and Human Values, 21: 347-353.

Gomez, K. A. and A. A. Gomez (1984). Statistical Procedure for Agricultural Research, (2 eds.), Wiley, New York, USA. pp. 680.

Hawkesford, M., W. Horst, T. Kichey, H. Lambers, J. Schjoerring, I.S. Müller and P. White (2012). Functions of macronutrients: Potassium. In: Marschner P. (ed) Mineral Nutrition of Higher Plants, Elsevier, Adelaide

Jadoon, M. A., A. U. Bhatti, F. Khan and Q. A. Sahibzada (2003). Effect of farm yard manure in combination with NPK on the yield of maize and soil physical properties. Pakistan Journal of Soil Science 22: 47–55.

Korndörfer, G.H. and L. A. Oliveira (2005). Opotássio na cultura da cana-de-açúcar. In: Yamada T, Roberts TL (eds) Potássio na agricultura brasileira. Esalq/USP, Piracicaba.

Korndörfer, G.H., A.C.Ribeiro and L.A.B. Andrade (1999). Cana-deaçúcar. In: Ribeiro AC, Guimarães PTG, Alvarez VH (eds) Recomendações para o uso de corretivos e fertilizantes em Minas Gerais: 5th aproximação. CFSEMG, Viçosa

Kumar, N. (2012). Productivity, quality and nutrient balance in spring sugarcane (Saccharum spp. hybrid complex) under organic and inorganic nutrition. Ind. J. Agronomy 57 (1): 68-73.

Kumar, S., N.S. Rana, R. Chandra and K. Sandeep (2007). Effect of phosphorus and potassium doses and their application schedule on yield, juice quality and nutrient use efficiency of sugarcane ratoon crop sequence. J Indian Soc Soil Sci., 55(4): 122-142.

Meyer, J. H. and R.A. Wood (2001). The effects of soil fertility and nutrition on sugarcane quality: A review. South African Sugar Technologists Association,75:242-245.

Otto, R., G.C. Vitti and P.H.C. Luz (2010). Potassium fertilizer management for sugarcane. Rev Bras Ci Solo., 34(4):1137- 1145.

Page, A. I., R. H. Miller and D. R. Keeney (1982). Methods of soil analysis. Part 2. Chemical and Microbiological properties. Amer. Sci. Agron. Madison. Wisconsin.

Pancelli, M. A., R.M. Prado, R. A. Flores, H. J. Almeida, L. R. Moda and J.P. S. Junior (2015). Growth, yield and nutrition of sugarcane ratoon as affected by potassium in a mechanized harvesting system. Aust. J. Crop Sic., 9(10):915-924.

Santos, H. Q., D. M. Fonseca, R.B. Cantarutti, V. V. H. Alvarez and D. N. Júnior (2002).Níveis críticos de fósforo no solo e na planta para gramíneas forrageiras tropicais em diferentes idades. Revista Brasileira de Ciência do Solo, 26:173-182.

Santos, V. R., G. M. Filho, A. W. Albuquerque, J. P. V. Costa, C. G. Santos and A. C. I. Santos (2009). Crescimento e produtividade agrícola de cana-de-açúcar em diferentes fontes de fósforo. Revista Brasileira de Engenharia Agrícola e Ambiental, v.13, p.389-396, 2009.

Shukla, S.K., R.L.Yadav, P.N. Singh, and I. Singh (2009). Potassium nutrition for improving stubble bud sprouting, dry matter partitioning, nutrient uptake and winter initiated sugarcane (*Saccharum* spp. hybrid complex) ratoon yield. Eur. J. Agron., 30(1):27-33.

Silva, F.C., T. Muraoka, P.R.C.Castro, S. Tavares, P.C.O. Trivelin, M.J.L. Brossi, J.V.D. Packer and M.B. Santos (2007). Avaliacão da adubação com nitrogênio e potássio em soqueiras de canade-açúcar sem queima. Embrapa, Campinas. 32 p.

Singh, G.B. and A. Swarup (2000). Lessons From Long Term Fertility Experiments, Fertilizer News, 45(2):21-24.

Singh, G.K., R.L. Yadav and S.K. Shukla (2010). Effect of planting geometry, nitrogen and potassium application on yield and quality of ratoon sugarcane in sub-tropical climatic conditions. Indian J. Agric. Sci., 80(12):1038-1042.

Soumare, M. F., M. G. Tack, and M. G. Verloo (2003). Effects of municipal solid waste compost and mineral fertilization on plant growth in two tropical agricultural soils of Mali. Bioresource Tech. 86: 15–20.

Thakur, D.S. and K.D. Sharma (2005). Organic farming for sustainable agriculture and meeting the challenges of food security in 21st century: An Economic Analysis, Indian J. Agric. Econ., 60(2):205-219.

Weber, H., E. Daros, J.L.C. Zambon, O.T. Ido and J.D. Barela (2002). Ratoon sugarcane productivity recovering with NPK fertilization. Scientia Agraria., 2(1):73-77.

الملخص العربي

التسميد العضوي والفوسفاتي والبوتاسي وعلاقته بنمو وإنتاجية وجودة قصب السكر

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أجريت تجربتان حقليتان في المزرعة البحثية بكلية الزراعة جامعة أسوان – مصر، خلال موسمي ٢٠١٧/٢٠١٨ ، ٢٠١٨/٢٠١٩ لدراسة استجابة محصول قصب السكر للتسميد العضوي والفوسفاتي والبوتاسي واثرها علي إنتاجية وجودة محصول الخلفة الأولى من القصب (صنف التجاري جيزة تايوان – س ٩) ، صممت التجربة باستخدام القطع المنشقة مرتين في ثلاث مكررات حيث كانت المعاملات موزعة توزيعاً عشوائياً كما يلي:

– القطع الرئيسية: معدلات السماد العضوي (سماد الماشية) بمعدلات (١٠ ، ٢٠ ، ٣٠ م^{٣}/فدان).

– القطع الشقية الأولى: معدلات السماد الفوسفاتي (١٠٠ ، ٢٠٠ ، ٣٠٠ كجم سوبر فوسفات الكالسيوم/فدان ١٥.٥% فو$_{٢}$أ$_{٥}$).

– القطع الشقية الثانية: معدلات السماد البوتاسي (٥٠ ، ١٠٠ ، ١٥٠ كجم سلفات بوتاسيوم/فدان ٤٨% بو$_{٢}$ أ).

المعاملات الزراعية والمعدلات السمادية الأخرى تمت كتوصيات وزارة الزراعة لمحصول قصب السكر تحت ظروف منطقة أسوان. ولخصت النتائج فيما يلى:

- أثرت عوامل الدراسة الثلاثة تأثير معنوي على نمو وإنتاجية وجودة محصول قصب السكر خلال موسمي الدراسة.
- أوضحت النتائج ان زيادة معدل التسميد العضوي من ١٠ الى ٣٠ طن/فدان أدت لزيادة معنوية لجميع صفات والنمو ومحصول القصب وجودته مع ملاحظة أنه لا يوجد فرق معنوي عند استخدام ٢٠ طن/فدان من السماد العضوي مع معدل ٣٠ طن/فدان خلال الموسمين.
- كما أن زيادة معدل السماد الفوسفاتي من ١٠٠ الى ٣٠٠ كجم سوبر فوسفات الكالسيوم الأحادي حققت أعلى قيم لمحصول وجودة محصول القصب حيث وجد أنه لا يوجد فرق معنوي عند استخدام ٢٠٠ كجم سوبر فوسفات و٣٠٠ كجم سوبر في صفات المحصول خلال موسمي الزراعة.
- كما أن زيادة معدل السماد البوتاسي من ٥٠ الى ١٥٠ كجم سلفات البوتاسيوم سجلت أعلى قيم لمحصول وجودة محصول القصب.
- وأظهرت النتائج أن هناك تأثير معنوي للتداخل من النوع الأول خلال موسمي الزراعة.

التوصية

من خلال نتائج هذه الدراسة التي تمت تحت ظروف أسوان في الوجه القبلي من جمهورية مصر العربية يمكن أن نوصي باستخدام سماد الماشية كإضافة أرضية خلال عملية الخدمة الأولية عند بداية نمو محصول قصب السكر بمعدل ٢٠ م٣/فدان مع ٣٠٠ كجم من سماد سوبر فوسفات الكالسيوم/فدان و ١٥٠ كجم من سلفات البوتاسيوم/فدان حيث أن هذه المعدلات أعطت أعلى محصول وجودة لقصب السكر.