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Response of sugar cane variety (phil. 8013) to fertilizers application

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Abstract:

To fulfill the objectives of this study a field experiment was conducted. The experiment was conducted using (phil.8013) cane variety and lasted for two growth seasons(2005/2006)and (2006/2007) under Aswan Governorate condition. Twenty four treatments were evaluated. Two levels of filter mud cake (0 and 4 t/fed.), three levels of phosphorus fertilizer (0, 30 and 60 kg P_2O_5/fed.) and four methods of phosphorus applications and interactions were studied. Methods of P placement included incorporation of P with the soil before planting, surface banding application at one side of the furrow, placement in trench at both sides of the furrow and placement below the cane cutting in the furrow at planting. The study aimed to evaluate the direct effect of these treatments on the plant cane (phil.8013) during the growth season of 2005/2006. However, the residual effect of the aforementioned treatments on the first ratoon cane (2006/2007). The results obtained could be summarized as follows: Adding 4 tons/fed. dry filter mud resulted in a significant increase in stalklength, stalk diameter, millable

cane yield t/fed, sugar yield t/fed. While, the quality traits such as brix %, sucrose %, purity %, sugar recovery % were not affected significantly. Phosphorus fertilization levels up to 60 kg P_2O_5/fed exhibited significant effect for all the studied traits except Brix, sucrose and sugar recovery percentage of juice in plant cane. Incorporating P with the soil before planting was best the method for applying P with reference number of millable cane /m^2, stalk length, stalk diameter, millable cane yield t/fed and sugar yield t/fed. this is a summary for the effect of the investigated treatments on plant cane or the 1st ratoon.

Key words: Sugarcane, filter mud cake, phosphorus fertilizer, phosphorus placement, sugar yield, millable cane, Phil. 8013

Introduction:

Sugar consumption in Egypt reached approximately 2.8 million tons per year. Fifty percent of this quantity is produced from sugar cane while nearly 25 % is coming from sugar beet factories. The 25% gab between consumption and production is

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imported yearly from outside the country. Decreasing this gab is possible through the expansion of cultivating sugar crops on new areas or through increasing the crop productivity by unit area. In Egypt, cane sugar industry depends on the commercial sugarcane cultivar G.T.54-9 which occupied 96% from the cultivated area. This cultivar is classified as a medium maturity cultivar (El-Taib *et al*., 2005).

Press mud is an organic waste of sugar mills and a rich source of organic carbon (35–37 %) and contains 1.0 –1.5 % N, 1.09-1.53% P and 0.25- 0.66% K. (Kale 1981).

Phosphorus has long been recognized as an important element in plant nutrition and considerable research has been directed towards defining the chemistry of phosphate in soil system. The generally small quantities of available P in soils and its tendency to react with soil components to form relatively insoluble compounds, many of which have only limited availability to plants, make it a topic of major importance in soil fertility management. The major factors influencing the selection of the rate and placement of fertilizer are the crop, soil characteristics; climate, especially moisture supply; yield goal; and the cost of the fertilizer in relation to the sale price of the crop. Thus, increasing the efficiency of P fertilizers is important when the economical and environmental impacts are considered.

Bokhtiar, *et al*., (2001) noticed that, application of press mud alone increased cane yield by 20-30% compared to plots receiving no press mud. Nagaraju, *et al*. (2000) noticed that, the integrated use of press mud cake at 4 t ha-1 resulted in increasing cane and sugar yields up to 11 and 9.85%, respectively. Tiwari and Nema (1999) noticed that application of press mud at 6 t ha–1 increased cane and sugar yield. Similar results were obtained by Durai, (1997). Sharma, *et al*. (2009) noticed that application of 10 tones/acre PMC (press mud cake) with 80 kg P were not affecting the juice quality and increased the leaf P and K. Muhammad, *et al*. (2010) found that, application of press mud into the soil had increased the sugar yield and cane juice quality. Bokhtiar and Sakurai (2005) found that, Brix of sugar cane did not significantly affected by the application of press mud.

Ismail *et al*. (2000) studied the effect of six levels of Phosphorus (0, 15, 30, 45, 60 and 75 kg P_2O_5/ fed.) on sugar cane. They obtained a significant influence due to application on juice quality and sugar yield up to 60 kg P_2O_5/fed. El-Soghier (2003) and El-Sayed *et al*. (2005) showed that increasing phosphorus fertilizer up to 90 kg P_2O_5/fed. increased juice quality, cane yield, sugar yield tons/fed. Korndorfer, *et al*. (1998) found that the cane yield of the plant crop was increased with increasing P rate, while that of the ratoon crop was the highest with 120 kg P.

El-Tilib *et al.* (2004) studied the effect of three levels of phosphorus fertilizer (0, 29 and 58 kg P/ha) on sugar cane, applied in bands in the furrow at the time of planting. Bokhtiar, *et al.* (2002) noticed that, nutrient uptake was also increased with increasing P rates. Hilton and Nomura (1984) determined that 45% of P placed under the sugarcane seed piece was taken up, whereas 10-15% of P applied through drip tubing between rows was absorbed. While, (Fox 1986) found that with an adequate fertilization rate, the best results are usually obtained by incorporating P in the entire soil volume. Significant residual effects due to broadcast P treatments in the plant crop were apparent compared with that of in the first ratoon crops. Dardak, *et, al. (*1990) noticed that, the incorporation of phosphate in the subsoil under the row using sub soil increased cane yield.

Materials and Methods

To fulfill the objectives of this study a field experiment was conducted using (phil.8013) cane variety and lasted for two growth seasons (2005/2006 and 2006/2007). Twenty four treatments were evaluated. Two levels of filter mud cake (0 and 4 t/fed.), three levels of phosphorus fertilizer 0, 30 and 60 kg P_2O_5/fed. and four methods of phosphorus applications and interactions were studied. The methods of application were incorporated with the soil before planting, surface banding application at one side of furrow, placement in trench at both sides of the furrow and placement below the cane cutting in the furrow at planting.

The first ratoon did not receive any new treatments but it concentrated on studying the residual effect of the previous treatments which was started in the first spring plant cane 2005/2006 on growth, yield and quality of the first ratoon crop of Phil.8013 variety.

Each replicate included five rows one meter wide and seven meters long.Calcium superphosphate 15.5% P_2O_5 was the source of P. The filter mud was taken from the industrial dump of Kom Ombo Sugar mill and dried before use. Chemical analysis of filter mud cake is shown in table (2).Planting date of the experiment was the third week of March 2005. Twenty eight 3-buded pieces of cane cuttings were planted in each furrow. All plots received basal dressing of Nitrogen fertilization 210 kg N /fed. as ammonium nitrate 33.5% N and 72 kg K_2O /fed. as potassium sulphate 48% K_2O. Nitrogen and Potassium fertilization rates were divided into two equal parts in both plant cane and ratoon. In plant crops, the first dose was applied after 60 days from planting and the second dose was applied 30 days later. In the first ratoon, the first nitrogen and potassium doses were added 30 days after previous crop harvest, while the second dose was added 30 days after the first one.

Both fertilizers were broadcasted on soil surface. Irrigation of plant and first ratoon crops and the other cultural practices procedures such as hand hoeing and borer control were practiced when necessary. Harvesting of plant crop was took place after 12 months of planting date, while the first ratoon harvesting was took place after 11.5 months of harvesting the plant cane. At harvest, plants of the three guarded rows were harvested, cleaned, topped to determined millable stalk yield and top (ton/fed.). 10 stalks were chosen at random and the following growth criteria were recorded. Growth criteria: Stalk length (cm), Stalk diameter (cm). Yield and yield components: Number of stalks/m^2, Millable cane yield (ton/fed.). Sugar yield (ton/fed.): were estimated according to the following equation as described by Herbert *et al.*(1973).Sugar yield (ton/fed.) = Millable cane yield (t/fed.) x Sugar recovery %.

Juice quality:

A sample of 25 stalks from each treatment was randomly chosen at harvest. Sample of the juice was taken and the following data were recorded: Juice purity percentage was calculated according to the following equation: Purity % = Sucrose % / TSS % x 100. Reducing sugar percentage was determined according to chemical control in Egyptian production factories (Anonymous 1981). Sugar recovery % = [S - 0.4 (B – S)] 0.73. Where, S = sucrose %; B = Brix %

Soil analysis

The following analyses of soil samples were carried out: Soil texture: mechanical analysis of soil samples was carried out using the pipette method (Piper, 1950). Soil pH was measured in 1:2.5 (soil: water) suspension using a glass electrode. Total calcium carbonate was determined using the Calcimeter method. Organic matter content was determined by cromic acid method according to Walkley and Black (Jackson, 1973). Total soluble salts were determined in 1:5 (soil: water) extract by measuring electrical conductivity (Jackson, 1973). Soluble cations; calcium and magnesium were determined by versenate method, while sodium and potassium were measured by flame photometry (Jackson, 1973). Available phosphorus was extracted according to Olsen methods and measured colorimetrically by the chlorostannous phosphomolypdic method Olsen *et al*. (1954). Eexchangeable potassium was extracted by ammonium acetate method and measured by Flame Photometry (Jackson, 1973). The soluble anions; carbonate and bicarbonate were determined by titration with sulphuric acid solution. The chloride was determined by titration with silver nitrate solution. The sulphate was determined by the turbidity method using barium chloride (Jackson, 1973). The total nitrogen in soil was determined using the macro Kjeldahl method (Black *et. al* 1982).The physical and chemical characteristics of the soil are shown in Table (1)

Plant analysis

The full expanded Top Visible Dewlap (TVD) leaf blade is the plant tissue often used for sugarcane foliar analysis. Plant materials were dried, ground and wet digested, using the sulphuric acid and hydrogen peroxide method (Parkinson and Allen,1975).Total nitrogen in plant was determined using the micro Kjeldahl method (Black, *et. al* 1982).

Phosphorus in plant was measured colorimetrically in the wet extract using the chlorostannous phosphomolypdic method (Jackson, 1973).Potassium in plant was determined in the wet extract using Flame Photometry (Jackson, 1973).

Statistical analysis:

The experiment was designed as a factorial experiment in a complete randomized block design. Each treatment was replicated three times, replicated area was 1/120 fed. All data obtained from this study were statistically analiezed through analysis of variance(ANOVA) and least significant difference (LSD) at 0.05 probability level was applied to make comparisons among treatment means according to Snedecor and Cochran (1980).

Table (1) The physical and chemical characteristics of soil samples.

Property	Value
Sand (%)	60.24
Silt (%)	16.12
Clay (%)	23.64
Texture	Sandy clay loam
Organic matter	0.84
Calcium carbonate (%)	2.48
pH(1:2.5 suspension)	7.62
EC (dS/m) (1:5 extract)	0.30
Soluble ions meq l^{-1}	
Calsium	0.74
Magnesium	0.31
Sodium	0.33
Potassium	0.07
Bicarbonate	0.84
Chloride	0.31
Sulphate	0.3
Total N (%)	0.020
$NaHCO_3$ -extractable P (ppm)	5.34
NH_4OAC - extractable K (meq/100gm soil)	0.77

Each value represent the mean of two determinations

Table (2) Some chemical properties of the filter mud cake.

Characteristics	pH (1:2.5)	EC dSm^{-1} (1:5)	O.C. %	C/N ratio	Total nutrients %		
					N	P	K
Filter mud cake	6.4	2.64	46.10	20.95	2.2	2.0	0.61

RESULTS AND DISUSSIONS

I-Growth traits Stalklength(cm)

Stalk length (cm) of plant cane, variety phil.8013 responded to the investigated treatments as presented in table 3. Adding 4 tons/fed. dry filter mud resulted in a significant increase in the stalk length of cane compared with the control treatment (0 tons/fed.). The higher length of stalk was resulted from the application of 60 kg/fed. P_2O_5. Methods by which phosphatic fertilizers were applied had also a significant effect on stalk length of cane. The best methods for applying P were with incorporating P with the soil before planting or the addition below the cane cutting in the furrow at planting.

Table (3): Direct and residual effects of filter mud cake, rates of phosphorus fertilizer and methods of phosphorus placement and their interactions on the stalk length of sugar cane variety (Phil.8013) at harvest of plant crop and first ratoon.

P rates		Plant cane 2005/2006					First ratoon 2006/2007				
		P placement methods					P placement methods				
		M1	M2	M3	M4	Mean	M1	M2	M3	M4	Mean
		Without filter mud cake					Without filter mud cake				
P0		249.3	249.3	249.3	249.3	**249.3**	240.3	240.3	240.3	240.3	**240.3**
P1		261.6	256.6	254.6	261.3	**258.5**	260.0	258.3	259.0	255.6	**258.2**
P2		271.3	264.0	264.0	270.0	**267.3**	265.3	261.0	261.3	263.3	**262.7**
Mean		**260.7**	**256.6**	**256.0**	**260.2**	**258.4**	**255.2**	**253.2**	**253.5**	**253.1**	**253.7**
		Adding 4 tons/fed. dry filter mud cake					Adding 4 tons/fed. dry filter mud cake				
P0		263.0	263.0	263.0	263.0	**263.0**	246.6	246.6	246.6	246.6	**246.6**
P1		286.0	277.0	280.0	286.0	**282.2**	265.6	264.3	265.3	265.0	**265.0**
P2		287.6	282.6	284.6	286.6	**285.4**	269.0	268.3	268.6	269.6	**268.9**
Mean		**278.8**	**274.2**	**275.8**	**278.5**	**276.8**	**260.4**	**259.7**	**260.2**	**260.4**	**260.2**
Mean		**269.8**	**265.4**	**265.9**	**269.3**		**257.8**	**256.5**	**256.8**	**256.7**	
Mean	**P0**	**256.1**	**256.1**	**256.1**	**256.1**	**256.1**	**243.0**	**243.0**	**243.0**	**243.0**	**243.0**
	P1	**273.8**	**266.8**	**267.3**	**273.3**	**270.4**	**260.3**	**258.8**	**259.6**	**257.8**	**261.6**
	P2	**279.5**	**273.3**	**274.3**	**278.3**	**276.3**	**267.1**	**264.6**	**265.0**	**266.5**	**265.8**
F test F		**					**				
L.S.D. at 5%		**P=4.80**			**M=2.83**		**P=3.45**			**M= N. S**	
		F P= 6.78			**F M=N.S**		**F P= N. S**			**F M=N.S**	
		P M= 4.90			**F P M= N.S**		**P M= N. S**			**F P M= N.S**	

The data in table (3) clearly indicate that the best stalk length response was obtained from the interaction between adding four tons/fed. dry filter mud cake and 60 kg P_2O_5/fed. While, interaction between adding dry filter mud cake and incorporating of P with the soil before planting recorded the highest value (278.8 cm). The interaction between rates of P and different placement methods significantly affected stalk length. The highest values was found under the high rate of P fertilizer incorporated with the soil before planting. The interaction between adding dry filter mud cake, P rates and different placement methods was not significantly affecting the stalk length of cane. Significant was residual effects due to filter mud cake and rate of P application on the stalk length of cane was recorded, while, no significant residual effect was obtained due to methods of applying phosphorus.These results are in agreement with those of El-Sogheir *et al*. (2003), El-Sayed *et al*. (2005), Dardak, *et*, *al*. *(*1990) and Fox (1986)

Stalk diameter (cm)

Diameter of cane stalk was increased due to the addition of filter mud cake to the soil and due to increasing the rate of applied phosphorus (table 4).However the role of methods of applying P was better when the fertilizer was either incorporated with the soil before planting or placed below the cutting at planting time.

Table (4): Direct and residual effects of filter mud cake, rates of phosphorus fertilizer and methods of phosphorus placement and their interactions on the stalk diameter (cm) of sugar cane variety (Phil.8013) at harvest of plant crop and first ratoon.

P rates		Plant cane 2005/2006					First ratoon 2006/2007				
		P placement methods					P placement methods				
		M1	M2	M3	M4	Mean	M1	M2	M3	M4	Mean
		Without filter mud cake					Without filter mud cake				
P0		2.38	2.38	2.38	2.38	**2.38**	2.40	2.40	2.40	2.40	**2.40**
P1		2.57	2.55	2.55	2.57	**2.56**	2.56	2.57	2.59	2.59	**2.58**
P2		2.66	2.62	2.63	2.63	**2.63**	2.57	2.54	2.55	2.58	**2.56**
Mean		**2.54**	**2.51**	**2.52**	**2.53**	2.52	**2.51**	**2.50**	**2.51**	**2.52**	**2.51**
		Adding 4 tons/fed. dry filter mud cake					Adding 4 tons/fed. dry filter mud cake				
P0		2.50	2.50	2.50	2.50	**2.50**	2.47	2.47	2.47	2.47	**2.47**
P1		2.71	2.64	2.63	2.71	**2.67**	2.59	2.58	2.59	2.60	**2.59**
P2		2.76	2.68	2.68	2.74	**2.71**	2.62	2.60	2.62	2.62	**2.61**
Mean		**2.66**	**2.60**	**2.60**	**2.65**	**2.63**	**2.56**	**2.55**	**2.56**	**2.56**	**2.56**
Mean		**2.60**	**2.56**	**2.56**	**2.59**		**2.53**	**2.53**	**2.54**	**2.54**	
Mean	**P0**	**2.44**	**2.44**	**2.44**	**2.44**	**2.44**	**2.44**	**2.44**	**2.44**	**2.44**	**2.44**
	P1	**2.64**	**2.59**	**2.59**	**2.64**	**2.62**	**2.58**	**2.57**	**2.59**	**2.59**	**2.58**
	P2	**2.71**	**2.65**	**2.65**	**2.68**	**2.67**	**2.59**	**2.57**	**2.59**	**2.60**	**2.59**
F test F		**					**				
L.S.D. at 5%		**P=0.05**			**M=0.02**		**P=0.03**			**M= N.S**	
		F P= N. S			**F M=0.03**		**F P= 0.04**			**F M=N.S**	
		P M= 0.03			**F P M= N.S**		**P M= N.S**			**F P M= N.S**	

Interactions between rates of P application and methods by which P was applied were significant and gave the best results at the rate of 60 kg P_2O_5/fed. incorporated with the soil before planting (table 4). These results generally indicated that sugar cane variety Phil. 8013 can use the dose of applied P more efficiently when added with four tons/fed. dry filter mud cake as reflected in increasing stalk diameter. Application of 60 kg P_2O_5/fed.gave the best result in stalk diameter when added with four tons/fed. dry filter mud cake. However, interaction between adding filter mud cake and method of applying P gave the higher stalk diameter (2.66 cm) due to addition of four tons/fed. dry filter mud cake and incorporating P with the soil before planting. In the same time, the interaction between rates of phosphorus and method of applying P was significantly affected stalk diameter. The highest values were found due to the high rate of P fertilizer and incorporated with the soil before planting method (2.71 cm). Adding four tons/fed. dry filter mud cake, application of 60 kg P2O5/fed. incorporated with the soil before planting gave the best value on stalk diameter (2.76 cm). Significant residual effects was obtained due to filter mud cake and rates of P application on the stalk diameter of cane. While, no significant residual effects due to methods of applying phosphorus (Ismail, *et al.* 2000. Dardak, *et*, *al*. 1990. Fox, (1986).

II- Cane yield and yield contributing traits

Number of stalks/m^2

The results obtained in table 5 indicated that the number of millible cane per m^2 was increased significantly due to increasing the rates of P application and not significantly as a result of adding filter mud cake. The best method for applying phosphorus was the incorporation of P with the soil before planting followed by placement P below the cane cutting at planting. In the presence of filter mud, increasing the rates of P gave better results in increasing the number of millible cane per m^2, while, the interaction between filter mud and methods of P application on the number of millible cane per m^2 was not significant. Interaction between filter mud, rates of P fertilizer and methods of P application on the number of millible cane per m^2 was not significant.

Decomposition of filter mud in the soil might have a direct effect in enhancing the availability of the applied phosphorus in the soil which might activate the tillering of plant cane. No significant residual effect due to filter mud cake and methods of applying phosphorus on the number of stalks/m^2. While, a significantly residual effects due to rates of P application the third phosphorus levels (60 kg P_2O_5/fed.) on the number of millible cane m^2 (9.68 m^2) in first ratoon. These results are in agreement with those of

El-Sogheir *et al*. (2003), El-Sayed *et al*. (2005), Dardak, *et, al. (*1990) and Fox, (1986).

Table (5): Direct and residual effects of filter mud cake, rates of phosphorus fertilizer and methods of phosphorus placement and their interactions on the number of millable cane / m^2 of sugar cane variety (Phil.8013) at harvest of plant crop and first ratoon.

P rates		Plant cane 2005/2006					First ratoon 2006/2007				
		P placement methods					P placement methods				
		M1	M2	M3	M4	Mean	M1	M2	M3	M4	Mean
		Without filter mud cake					Without filter mud cake				
P0		9.56	9.56	9.56	9.56	**9.56**	9.61	9.61	9.61	9.61	**9.61**
P1		10.04	9.85	9.90	9.95	**9.94**	9.66	9.66	9.61	9.61	**9.64**
P2		10.14	9.95	9.95	10.09	**10.03**	9.71	9.71	9.66	9.71	**9.69**
Mean		**9.91**	**9.79**	**9.80**	**9.87**	**9.84**	**9.66**	**9.66**	**9.63**	**9.64**	**9.65**
		Adding 4 tons/fed. dry filter mud cake					Adding 4 tons/fed. dry filter mud cake				
P0		9.66	9.66	9.66	9.66	**9.66**	9.61	9.61	9.61	9.61	**9.61**
P1		10.09	9.95	9.95	10.04	**10.01**	9.66	9.66	9.66	9.76	**9.68**
P2		10.19	10.00	9.95	10.14	**10.07**	9.66	9.66	9.61	9.71	**9.66**
Mean		**9.98**	**9.87**	**9.85**	**9.95**	**9.91**	**9.64**	**9.64**	**9.63**	**9.69**	**9.65**
Mean		**9.95**	**9.83**	**9.83**	**9.91**		**9.65**	**9.65**	**9.63**	**9.67**	
Mean	**P0**	**9.61**	**9.61**	**9.61**	**9.61**	**9.61**	**9.61**	**9.61**	**9.61**	**9.61**	**9.61**
	P1	**10.07**	**9.90**	**9.93**	**10.00**	**9.97**	**9.66**	**9.66**	**9.64**	**9.68**	**9.66**
	P2	**10.16**	**9.97**	**9.95**	**10.11**	**10.05**	**9.68**	**9.68**	**9.64**	**9.71**	**9.68**
F test F		**N. S**					**N. S**				
L.S.D. at 5%		**P=0.19 F P= N. S P M= 0.07**			**M=0.04 F M=N.S F P M= N.S**		**P=0.06 F P= 0.08 P M= N. S**			**M= N. S F M=N.S F P M= N.S**	

Millable cane yield (t./fed)

The separate and combing effect of filter mud, rates of applied phosphorus and methods of P application on the yield of millable cane is presented in table 6 and figs (1,2,3). Adding 4 tons/fed. filter mud increased the yield of millable cane from 49 to 53 tons/fed. Cane yield responded positively to the rates of applied phosphorus. Adding the highest rate of P (60 kg P_2O_5/fed.) resulted in an increase of more than 11 tons millable cane/fed. compared to the control (zero kg P_2O_5/fed.).

Methods of applying P were the least effective factor on cane yield with the best yield when P was incorporated with the soil followed by placement P below cane cutting at planting. Interactions between the experimental treatments on cane yield were significant except that interaction between filter mud and methods of P application (table 6).

Data presented in table (6) summarized the interaction between filter mud cake, phosphorus rates and method of applying P. Maximum cane yield (59.3 ton/fed) was obtained due to the addition of 4 tons filter mud and 60 kg P_2O_5/fed. incorporated with the soil. The second maximum yield (58.1 tons/fed) was resulted from applying 60 kg

P_2O_5/fed. incorporated with the soil. The interaction between the addition of filter mud and the method by which P was applied had no significant effect on the millable cane yield (table 5).

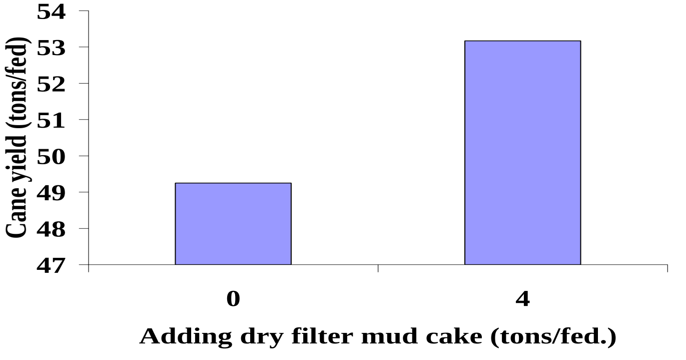

Fig.1. Effect of filter mud cake on cane yield (tons/fed.) of plant cane variety (Phil.8013)

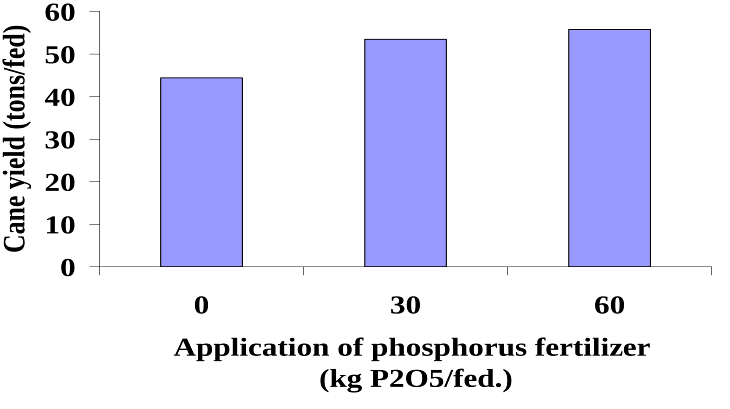

Fig.2. Effect of application of phosphorus fertilizer on cane yield (tons/fed.) of plant cane variety (Phil.8013)

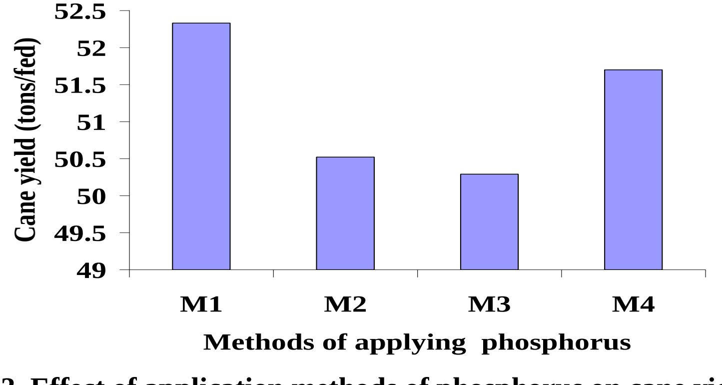

Fig.3. Effect of application methods of phosphorus on cane yield (tons/fed.) of plant cane variety (Phil.8013)

Significant residual effect was obtained due to filter mud cake, rate of P application and methods of applying phosphorus on cane yields. Residual effects due to the placement of P below the cane cutting in the furrow at planting was significant. Simlar results were obtained by Nagaraju, *et al.* (2000), Tiwari and Nema (1999), El-Soghier (2003), El-Sayed *et al.* (2005), Muhammad, *et al.* (2010), Fox (1986) and Dardak, *et, al. (*1990)

Table (6): Direct and residual effects of filter mud cake, rates of phosphorus fertilizer and methods of phosphorus placement and their interactions on the cane yield (tons/fed) sugar cane variety (PhilL.8013) at harvest of plant crop and first ratoon.

P rates	Plant cane 2005/2006					First ratoon 2006/2007				
	P placement methods					P placement methods				
	M1	M2	M3	M4	Mean	M1	M2	M3	M4	Mean
	Without filter mud cake					Without filter mud cake				
P0	41.94	41.94	41.94	41.94	**41.94**	38.15	38.15	38.15	38.15	**38.15**
P1	52.68	51.21	50.40	52.17	**51.61**	43.61	43.52	44.00	44.18	**43.83**
P2	56.88	52.37	52.25	55.32	**54.20**	46.34	45.33	45.21	45.91	**45.69**
Mean	**50.50**	**48.50**	**48.19**	**49.81**	**49.25**	**42.70**	**42.33**	**42.45**	**42.75**	**42.56**
	Adding 4 tons/fed. dry filter mud cake					Adding 4 tons/fed. dry filter mud cake				
P0	46.85	46.85	46.85	46.85	**46.85**	39.84	39.84	39.84	39.84	**39.84**
P1	56.27	54.57	54.36	55.98	**55.29**	46.55	46.24	46.29	46.75	**46.46**
P2	59.34	56.20	55.95	57.93	**57.35**	47.88	46.98	46.92	47.93	**47.43**
Mean	**54.15**	**52.54**	**52.38**	**53.58**	**53.17**	**44.76**	**44.35**	**44.35**	**44.84**	**44.58**
Mean	**52.33**	**50.52**	**50.29**	**51.70**		**43.73**	**43.34**	**43.40**	**43.79**	
Mean P0	**44.39**	**44.39**	**44.39**	**44.39**	**44.39**	**39.00**	**39.00**	**39.00**	**39.00**	**39.00**
Mean P1	**54.47**	**52.89**	**52.38**	**54.07**	**53.45**	**45.08**	**44.88**	**45.15**	**45.46**	**45.15**
Mean P2	**58.11**	**54.29**	**54.10**	**56.62**	**55.78**	**47.11**	**46.15**	**46.07**	**46.92**	**46.56**
F test F	**					**				
L.S.D. at 5%	P=0.88 F P= 1.24 P M= 0.63			M=0.36 F M=N.S F P M= 0.89		P=0.41 F P= 0.57 P M= 0.32			M=0.19 F M=N.S F P M= N.S	

III. Juice quality traits and sugar yield/fed.

Brix percentage

Brix is the percentage of total soluble solids in cane juice. The separate effect of adding 4 tons/fed. filter mud cake had no significant effect on the values of brix in juice. Similar results were obtained from all interactions between the investigated treatments. However, the addition of 30 or 60 kg P_2O_5/fed. affected the Brix values of juice significant (table 7). Methods of applying P had a significant effect of Brix values where adding P below cane setts gave the least significant effect on cane Birx compared with all methods of P application. No significant residual effects due to filter mud cake and methods of applying phosphorus were found. While, a significant residual effects due to filter mud cake and methods of applying phosphorus were found. While, a significant residual effect due to rates of P application was resulted the third phosphorus level (60 kg P_2O_5/fed.) had the highest effect on Birx percentage of cane juice of the first ratoon. Sharma, *et al*. (2009), Bokhtiar and Sakurai (2005), Ismail *et al*. (2000) El-Soghier (2003) and El-Sayed *et al*. (2005) found similar results.

Table (7): Direct and residual effects of filter mud cake, rates of phosphorus fertilizer and methods of phosphorus placement and their interactions on the Birx percentage of sugar cane variety (Phil.8013) at harvest of plant crop and first ratoon.

P rates	Plant cane 2005/2006					First ratoon 2006/2007				
	P placement methods					P placement methods				
	M1	M2	M3	M4	Mean	M1	M2	M3	M4	Mean
	Without filter mud cake					Without filter mud cake				
P0	21.94	21.94	21.94	21.94	**21.94**	22.01	22.01	22.01	22.01	**22.01**
P1	23.18	22.99	23.28	22.73	**23.04**	22.15	22.70	22.33	22.31	**22.37**
P2	23.31	23.05	22.83	22.62	**22.95**	22.88	22.43	23.00	23.18	**22.87**
Mean	**22.81**	**22.66**	**22.68**	**22.43**	22.64	**22.35**	**22.38**	**22.44**	**22.50**	22.42
	Adding 4 tons/fed. dry filter mud cake					Adding 4 tons/fed. dry filter mud cake				
P0	22.24	22.24	22.24	22.24	**22.24**	22.39	22.39	22.39	22.39	**22.39**
P1	22.86	23.13	23.24	23.05	**23.07**	23.50	23.00	22.12	22.80	**22.86**
P2	22.66	22.91	23.51	22.35	**22.86**	22.93	23.20	23.07	23.16	**23.09**
Mean	**22.59**	**22.76**	**23.00**	**22.55**	22.72	**22.94**	**22.86**	**22.53**	**22.78**	22.78
Mean	**22.70**	**22.71**	**22.84**	**22.49**		**22.64**	**22.62**	**22.49**	**22.64**	
Mean P0	**22.09**	**22.09**	**22.09**	**22.09**	22.09	**22.20**	**22.20**	**22.20**	**22.20**	22.20
Mean P1	**23.02**	**23.06**	**23.26**	**22.89**	23.06	**22.83**	**22.85**	**22.23**	**22.56**	22.61
Mean P2	**22.98**	**22.98**	**23.17**	**22.49**	22.90	**22.90**	**22.81**	**23.03**	**23.17**	22.98
F test F	**N. S**					**N. S**				
L.S.D. at 5%	**P=0.52**			**M=0.34**		**P=0.53**			**M= N. S**	
	F P= N. S			**F M=N.S**		**F P= N. S**			**F M=0.25**	
	P M= N. S			**F P M= N.S**		**P M= 0.31**			**F P M= 0.44**	

Reducing sugar %

Reducing sugar percentage is very important triat for sugar industry. It is well known that each molecule of the reducing sugar prevents the crystallization of sucrose molecule during sugar extraction processes from sugar cane syrup.

Percentage of reducing sugar in cane juice was significantly affected by the separate effect of rates of P and methods of its application. Meanwhile this triat was not affected by filter mud application as well as by all interactions between treatments as illustrated in table 8. The highest values of reducing sugar % in cane juice was obtained when the crop was not fertilized by phosphorus as the values of this triat was nearly 3times its values in the P fertilized cane. This indicates the role of P application on the quality and productivity of sugar yield from cane plants.

The results obtained in table (8) indicate that, application of filter mud cake had no significant effect on the reducing sugar percentage of cane juice. However, the reducing sugar percentage of cane juice was significantly affected by rates and methods of applying P. The best phosphorus rates to obtain the lowest value of reducing sugar % was obtained with the adding of 30 kg P_2O_5/fed. (0.18%). The methods of applying phosphorus had significant effect on the reducing sugar percentage of cane juice. In general the methods of applying phosphorus by placement in trench at both sides of the furrow attained the lowest value of reducing sugar % (0.31%). Adding four tons/fed. dry filter mud cake and placement of P in trench at both sides of the furrow gave lowest value of thus triat (0.31%).The lowest value of reducing sugar percentage of cane juice was obtained by the application of 30 kg P2O5/fed. placement in trench at both sides of the furrow. The results showed that, the lowest value of reducing sugar percentage of cane juice was obtained by plants without filter mud cake, receiving 30 kg P_2O_5/fed. and placement in trench at both sides of the furrow. Similar results were obtained by adding four tons/fed. dry filter mud cake, applying of 30 kg P_2O_5/fed. and surface banding of P application at one side of furrow. Significant residual effects were obtained due to rates of P application and methods of applying phosphorus on reducing sugar percentage of cane juice. While, no significant residual effect was obtained on reducing sugar % due to filter mud cake. The methods of applying phosphorus by placement as a surface banding application at one side of furrow attained the lowest value of reducing sugar in the juice**.** Sharma, *et al*. (2009), Bokhtiar and Sakurai (2005), El-Soghier (2003) and El-Sayed *et al*. (2005) found similar results.

Table (8): Direct and residual effects of filter mud cake, rates of phosphorus fertilizer and methods of phosphorus placement and their interactions on the reducing sugars percentage of sugar cane variety (Phil.8013) at harvest of plant crop and first ratoon.

P rates	Plant cane 2005/2006					First ratoon 2006/2007				
	P placement methods					P placement methods				
	M1	M2	M3	M4	Mean	M1	M2	M3	M4	Mean
	Without filter mud cake					Without filter mud cake				
P0	0.64	0.64	0.64	0.64	**0.64**	0.84	0.84	0.84	0.84	**0.84**
P1	0.22	0.20	0.15	0.16	**0.18**	0.43	0.37	0.43	0.43	**0.41**
P2	0.19	0.17	0.19	0.16	**0.17**	0.39	0.44	0.44	0.44	**0.43**
Mean	**0.35**	**0.33**	**0.32**	**0.32**	**0.33**	**0.55**	**0.55**	**0.57**	**0.57**	**0.56**
	Adding 4 tons/fed. dry filter mud cake					Adding 4 tons/fed. dry filter mud cake				
P0	0.59	0.59	0.59	0.59	**0.59**	0.67	0.67	0.67	0.67	**0.67**
P1	0.20	0.15	0.16	0.22	**0.18**	0.49	0.43	0.47	0.38	**0.44**
P2	0.25	0.24	0.17	0.39	**0.26**	0.61	0.56	0.57	0.61	**0.59**
Mean	**0.35**	**0.32**	**0.31**	**0.40**	**0.34**	**0.59**	**0.55**	**0.57**	**0.55**	**0.57**
Mean	**0.35**	**0.33**	**0.31**	**0.36**		**0.57**	**0.55**	**0.57**	**0.56**	
Mean P0	**0.61**	**0.61**	**0.61**	**0.61**	**0.61**	**0.75**	**0.75**	**0.75**	**0.75**	**0.75**
Mean P1	**0.21**	**0.17**	**0.15**	**0.19**	**0.18**	**0.46**	**0.40**	**0.45**	**0.41**	**0.43**
Mean P2	**0.22**	**0.20**	**0.18**	**0.28**	**0.22**	**0.50**	**0.50**	**0.51**	**0.52**	**0.51**
	F= N. S					F= N. S				
L.S.D. at 5%	P=0.03 F P= 0.04 P M= 0.03			M=0.02 F M=0.03 F P M= 0.05		P=0.03 F P= 0.04 P M= 0.03			M=0.02 F M=0.03 F P M= 0.05	

Sucrose percentage

Data presented in table (9) illustrate the data of sucrose percentage accumulated in stalk cane. Adding filter mud cake did not affect the percentage of sucrose in cane plant. However, the sucrose percentage of cane juice was significantly affected by application different rates of phosphorus in cane juice . Applying 30 kg P_2O_5/fed. significantly increased the sucrose percentage. In the same time application of phosphorus in trench at both sides of the furrow gave the best values of sucrose percentage (19.66%) compared with all other methods of application. The interactions between treatments had no significant effect on sucrose percentage of cane juice. No significant residual effect due to filter mud cake and methods of applying phosphorus on sucrose percentage of cane juice. But significant residual effect was obtained due to rates of P application. The third phosphorus levels (60 kg P_2O_5/fed.) was pronounced on sucrose percentage of cane juice Sharma, *et al*. (2009), El-Soghier (2003) and El-Sayed *et al*. (2005) obtained similar results.

Table (9): Direct and residual effects of filter mud cake, rates of phosphorus fertilizer and methods of phosphorus placement and their interactions on the sucrose percentage of sugar cane variety (Phil.8013) at harvest of plant crop and first ratoon.

P rates	Plant cane 2005/2006					First ratoon 2006/2007				
	P placement methods					P placement methods				
	M1	M2	M3	M4	Mean	M1	M2	M3	M4	Mean
	Without filter mud cake					Without filter mud cake				
P0	18.10	18.10	18.10	18.10	**18.10**	18.62	18.62	18.62	18.62	**18.62**
P1	20.21	20.18	20.41	19.72	**20.13**	18.91	19.51	19.27	19.04	**19.18**
P2	20.44	20.28	20.20	19.84	**20.19**	19.47	19.12	19.48	19.70	**19.44**
Mean	**19.58**	**19.52**	**19.57**	**19.22**	19.47	**19.00**	**19.08**	**19.12**	**19.12**	**19.08**
	Adding 4 tons/fed. dry filter mud cake					Adding 4 tons/fed. dry filter mud cake				
P0	18.40	18.40	18.40	18.40	**18.40**	19.06	19.06	19.06	19.06	**19.06**
P1	20.10	20.33	20.07	19.91	**20.10**	19.91	19.57	19.07	19.43	**19.49**
P2	19.64	19.79	20.79	19.34	**19.89**	19.41	19.88	19.78	19.88	**19.69**
Mean	**19.38**	**19.50**	**19.75**	**19.21**	19.46	**19.46**	**19.50**	**19.30**	**19.46**	**19.43**
Mean	**19.48**	**19.51**	**19.66**	**19.21**		**19.23**	**19.29**	**19.21**	**19.29**	
Mean P0	**18.25**	**18.25**	**18.25**	**18.25**	**18.25**	**18.84**	**18.84**	**18.84**	**18.84**	**18.84**
Mean P1	**20.16**	**20.25**	**20.24**	**19.81**	**20.11**	**19.41**	**19.54**	**19.17**	**19.24**	**19.34**
Mean P2	**20.04**	**20.20**	**20.36**	**19.59**	**20.04**	**19.44**	**19.50**	**19.63**	**19.79**	**19.57**
F test F	**N. S**					**N. S**				
L.S.D. at 5%	**P=0.50**			**M=0.42**		**P=0.72**			**M= N. S**	
	F P= N. S			**F M=N.S**		**F P= N. S**			**F M=N.S**	
	P M= N. S			**F P M= N.S**		**P M= 0.31**			**F P M= 0.45**	

Juice purity percentage (%)

Results obtained in table (10) indicate that, application of filter mud cake was not significantly affecting the juice purity percentage. However, rates of applied P had a significant effect on the juice purity. Applying 30 and 60 kg P_2O_5/fed. resulted in increasing juice purity % of 87.35 and 87.31%, respectively compared to the control (82.62%). Methods of applying phosphorus was significantly affecting the juice purity. Applying phosphorus in trench at both sides of the furrow gave the best values of purity percentage (85.99 %) compared with all other methods of P application. The data in table (10) showed that, application of 60 kg P2O5/fed. placed in trench at both sides of the furrow gave the best result of purity 87.85 %. However, the highest value of purity 88.42% was found with the from of adding four tons/fed. dry filter mud cake, applied together with 60 kg P_2O_5/fed. placed in trench at both sides of the furrow. Significant residual effects was obtained due to rates of P application and methods of applying phosphorus on the juice purity percentage. While, no significant residual effect was found due to filter mud cake. The methods of applying phosphorus by placement in trench at both sides of the furrow attained the highest value of the juice purity percentage similar results were obtained by Sharma, *et al*. (2009), Bokhtiar and Sakurai (2005), El-sayed *et al.* (2005).

Table (10): Direct and residual effects of filter mud cake, rates of phosphorus fertilizer and methods of phosphorus placement and their interactions on the purity percentage of sugar cane variety (Phil.8013) at harvest of plant crop and first ratoon.

P rates		Plant cane 2005/2006					First ratoon 2006/2007				
		P placement methods					P placement methods				
		M1	**M2**	**M3**	**M4**	**Mean**	**M1**	**M2**	**M3**	**M4**	**Mean**
		Without filter mud cake					**Without filter mud cake**				
P0		82.48	82.48	82.48	82.48	**82.48**	85.33	85.33	85.33	85.33	**85.33**
P1		87.20	87.77	87.68	86.73	**87.34**	85.37	85.94	86.36	85.34	**85.75**
P2		87.70	88.00	87.28	87.67	**87.66**	85.08	85.22	84.71	84.99	**85.00**
Mean		**85.79**	**86.08**	**85.81**	**85.62**	**85.83**	**85.26**	**85.50**	**85.47**	**85.22**	**85.36**
		Adding 4 tons/fed. dry filter mud cake					**Adding 4 tons/fed. dry filter mud cake**				
P0		82.76	82.76	82.76	82.76	**82.76**	85.00	85.00	85.00	85.00	**85.00**
P1		87.92	87.86	87.35	86.35	**87.37**	84.71	85.10	86.18	85.23	**85.30**
P2		86.66	86.34	88.42	86.46	**86.97**	84.67	85.70	85.74	85.86	**85.49**
Mean		**85.78**	**85.65**	**85.84**	**85.19**	**85.70**	**84.79**	**85.27**	**85.64**	**85.36**	**85.26**
Mean		**85.78**	**85.87**	**85.99**	**85.41**		**85.03**	**85.38**	**85.55**	**85.29**	
Mean	**P0**	**82.62**	**82.62**	**82.62**	**82.62**	**82.62**	**85.16**	**85.16**	**85.16**	**85.16**	**85.16**
	P1	**87.56**	**87.81**	**87.51**	**86.54**	**87.35**	**85.04**	**85.52**	**86.27**	**85.28**	**85.53**
	P2	**87.18**	**87.17**	**87.85**	**87.06**	**87.31**	**84.88**	**85.46**	**85.23**	**85.42**	**85.25**
F test F		**N. S**					**N. S**				
L.S.D. at 5%		**P=0.98**			**M=0.44**		**P=0.19**			**M=0.35**	
		F P= N. S			**F M=0.62**		**F P= 0.50**			**F M=0.43**	
		P M= 0.76			**F P M= 1.08**		**P M= 0.52**			**F P M= N.S**	

sugar recovery percentage of millable cane

Results obtained in table (11) indicate that, adding filter mud cake had no significant effect on sugar recovery percentage of plant cane. However, the application rate of phosphorus was significantly affected the sugar recovery percentage of plant cane. Applying of 30 kg P_2O_5/fed. gave the highest value on sugar recovery percentage (13.83%) compared to the control (12.20%).

Table (11): Direct and residual effects of filter mud cake, rates of phosphorus fertilizer and methods of phosphorus placement and their interactions on the sugar recovery percentage of sugar cane variety (Phil.8013) at harvest of plant crop and first ratoon.

P rates	Plant cane 2005/2006					First ratoon 2006/2007				
	P placement methods					P placement methods				
	M1	M2	M3	M4	Mean	M1	M2	M3	M4	Mean
	Without filter mud cake					Without filter mud cake				
P0	12.09	12.09	12.09	12.09	**12.09**	12.65	12.65	12.65	12.65	**12.65**
P1	13.89	13.91	14.07	13.52	**13.84**	12.86	13.31	13.17	12.94	**13.07**
P2	14.08	14.00	13.86	13.67	**13.90**	13.22	12.99	13.19	13.36	**13.19**
Mean	**13.35**	**13.33**	**13.34**	**13.09**	13.28	**12.91**	**12.98**	**13.00**	**12.98**	12.97
	Adding 4 tons/fed. dry filter mud cake					Adding 4 tons/fed. dry filter mud cake				
P0	12.31	12.31	12.31	12.31	**12.31**	12.83	12.83	12.83	12.83	**12.83**
P1	13.87	14.02	13.72	13.62	**13.81**	13.49	13.28	13.03	13.20	**13.25**
P2	13.45	13.54	14.38	13.23	**13.65**	13.15	13.54	13.48	13.55	**13.43**
Mean	**13.21**	**13.29**	**13.47**	**13.05**	13.25	**13.15**	**13.22**	**13.11**	13.2	13.17
Mean	**13.28**	**13.31**	**13.40**	**13.07**		**13.03**	**13.10**	**13.06**	**13.09**	
Mean P0	**12.20**	**12.20**	**12.20**	**12.20**	12.20	**12.74**	**12.74**	**12.74**	**12.74**	12.74
Mean P1	**13.88**	**13.96**	**13.89**	**13.57**	13.83	**13.17**	**13.30**	**13.10**	**13.07**	13.16
Mean P2	**13.77**	**13.77**	**14.12**	**13.45**	13.76	**13.18**	**13.26**	**13.34**	**13.46**	13.31
F test F	**N. S**					**N. S**				
L.S.D. at 5%	**P=0.39**			**M=0.31**		**P=0.43**			**M= N. S**	
	F P= N. S			**F M=N.S**		**F P= N. S**			**F M=N.S**	
	P M= N. S			**F P M= N.S**		**P M= 0.22**			**F P M= 0.31**	

Method of applying P was significantly affecting sugar recovery percentage of plant cane. Application of phosphorus in trench at both sides of the furrow gave the best value of sugar recovery percentage (13.40 %) compared with all other methods of P application. Results in Table (11) show that the highest values of sugar recovery were found due to the interaction between the addition of four tons/fed. dry filter mud cake, the high rate of P fertilizer and the placement of P in trench at both sides of the furrow. No significant residual effect was found due to filter mud cake and methods of applying phosphorus on sugar recovery percentage. But significant residual effect was found due to the highest rate of P application (60 kg P_2O_5/fed.) on sugar recovery percentage of cane juice**.** Sharma, *et al*. (2009), Bokhtiar and Sakurai (2005), El-Soghier (2003) and El-Sayed *et al*. (2005) and Fox, (1986), obtained similar results.

Sugar yield (t/fed)

The data obtained for sugar yield are recorded in Table (12) and figs (4,5,6). Sugar yield (tons/fed.) was significantly increased due to the addition of

four tons/fed. filter mud cake the increase was 0.5 ton sugar/fed. over the control.

Sugar yield (tons/fed.) significantly responded and increased due to the higher rates of applied phosphorus. Phosphorus application at the rates of 30 and 60 kg P_2O_5/fed. produced an increase of 36.37 and 41.53 % in the sugar yield over the control respectively. Incorporating phosphorus with the soil before planting gave the best value of sugar yield (6.99 tons/fed.) compared to the surface banding application at one side of furrow, placement in trench at both sides of the furrow or placement of P below the cane cutting in the furrow at planting (6.76, 6.78 and 6.79 tons/fed.) (Table 12) This increase might be due to the role of P in sucrose formation

Table (12): Direct and residual effects of filter mud cake, rates of phosphorus fertilizer and methods of phosphorus placement and their interactions on the sugar yield (tons/fed.) of sugar cane variety (Phil.8013) at harvest of plant crop and first ratoon.

P rates		Plant cane 2005/2006					First ratoon 2006/2007				
		P placement methods					P placement methods				
		M1	M2	M3	M4	Mean	M1	M2	M3	M4	Mean
		Without filter mud cake					Without filter mud cake				
P0		5.07	5.07	5.07	5.07	**5.07**	4.83	4.83	4.83	4.83	**4.83**
P1		7.31	7.12	7.09	7.05	**7.14**	5.61	5.79	5.79	5.72	**5.73**
P2		8.01	7.33	7.15	7.56	**7.51**	6.12	5.88	5.96	6.13	**6.02**
Mean		**6.79**	**6.51**	**6.44**	**6.56**	**6.57**	**5.52**	**5.50**	**5.53**	**5.56**	**5.52**
		Adding 4 tons/fed. dry filter mud cake					Adding 4 tons/fed. dry filter mud cake				
P0		5.77	5.77	5.77	5.77	**5.77**	5.15	5.15	5.15	5.15	**5.15**
P1		7.80	7.65	7.59	7.62	**7.66**	6.28	6.14	6.03	6.17	**6.15**
P2		7.98	7.60	8.05	7.66	**7.82**	6.29	6.36	6.33	6.49	**6.37**
Mean		**7.18**	**7.01**	**7.13**	**7.02**	**7.08**	**5.90**	**5.88**	**5.83**	**5.94**	**5.89**
Mean		**6.99**	**6.76**	**6.78**	**6.79**		**5.71**	**5.69**	**5.68**	**5.75**	
Mean	**P0**	**5.42**	**5.42**	**5.42**	**5.42**	**5.42**	**4.99**	**4.99**	**4.99**	**4.99**	**4.99**
	P1	**7.55**	**7.39**	**7.34**	**7.33**	**7.40**	**5.94**	**5.97**	**5.91**	**5.94**	**5.94**
	P2	**7.99**	**7.47**	**7.60**	**7.61**	**7.67**	**6.21**	**6.12**	**6.14**	**6.31**	**6.20**
F test F		**					**				
L.S.D. at 5%		**P=0.20**			**M=0.15**		**P=0.12**			**M= 0.06**	
		F P= 0.28			**F M=0.21**		**F P= N. S**			**F M=N.S**	
		P M= 0.26			**F P M= 0.37**		**P M= N. S**			**F P M= 0.16**	

Data presented in table (12) show that the combined effect of filter mud cake and rates of phosphorus application had a significant effect on sugar yield (tons/fed.). The best value for

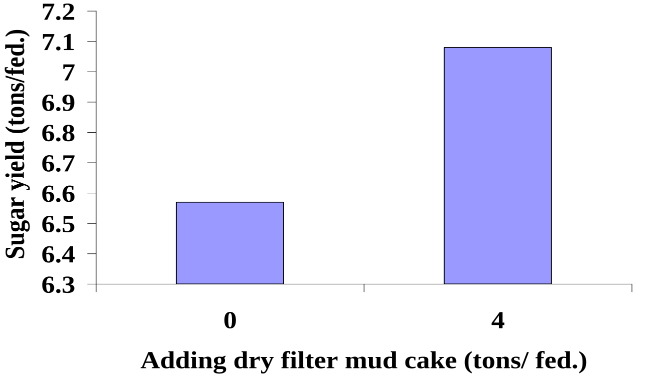

Fig. 4. Effect of filter mud cake on the sugar yield (tons/fed.) of plant cane variety (Phil.8013)

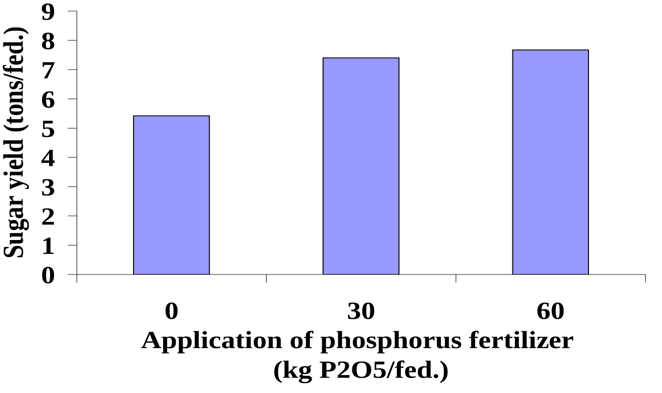

Fig. 5. Effect of application phosphorus fertilizer on sugar yield (tons/fed.) of plant cane variety (Phil.8013)

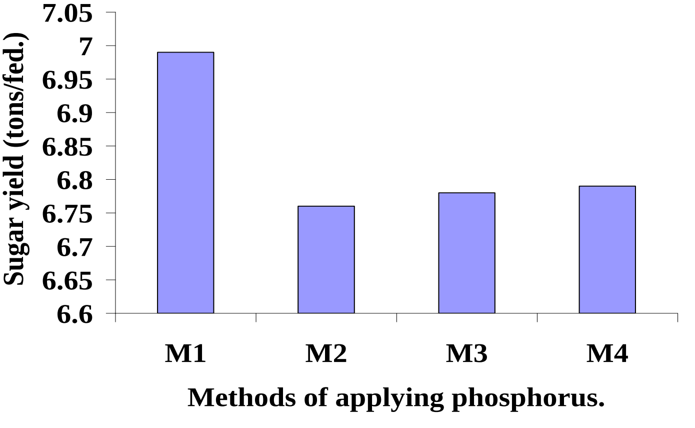

Fig. 6. Effect of methods of phosphorus application on sugar yield (tons/fed.) of plant cane variety (Phil.8013)

sugar yield (7.82 tons/fed.) was obtained due to the addition of four tons/fed. dry filter mud cake and 60 kg P2O5/fed.

Methods of applying P with or without filter mud cake had also a significant effect on sugar yield (tons/fed.). Adding four tons/fed. dry filter mud cake and incorporating P with the soil before planting had a significant effect on sugar yield (7.18 tons/fed.). However, applying 60 kg P2O5/fed. incorporated with the soil before planting gave the best effect on sugar yield (7.99 tons/fed.). The third order interaction between adding filter mud cake, phosphorus application and method of applying P had a significant effect on sugar yield (tons/fed.). The highest value on sugar yield (8.05 tons/fed.) was obtained due to adding four tons/fed. dry filter mud cake, applying 60 kg P2O5/fed. and of placement P in trench at both sides of the furrow. Significant residual effects was resulted due to filter mud cake, rate of P application and methods of applying phosphorus on sugar yields. Placement of P below the cane cutting in the furrow at planting time gave the best value of sugar yield. Nagaraju, *et al.* (2000), Tiwari and Nema (1999), Muhammad, *et al*. (2010), Ismail *et al*. (2000), El-Soghier (2003), El-Sayed *et al*. (2005), Fox (1986), Dardak, *et, al*. (1990) and Korndorfer, *et al.* (1998) found similar results.

<u>Nitrogen contents of sugar cane leaves</u>

Nitrogen contents of cane leaves were not significantly affected by adding filter mud cake as presented in table (13). However, nitrogen content was significantly affected by P rates. Applying 30 kg P2O5/fed. increased nitrogen contents by 6.81 % over the control. The method of phosphorus application had a significant effect on nitrogen contents of cane leaves. The highest value was obtained when P was incorporated with the soil before planting or placed below the cane cutting in the furrow at planting.

Results in table (13) show that the third order interactions between all treatments were significantly affecting the nitrogen contents of cane leaves. The interactions between filter mud cake and P placement methods did not significantly affect the nitrogen contents of leaves. The highest value of N content was obtained due to the addition of four tons/fed. dry filter mud cake together with the application of 30 Kg P2O5/fed. In the same time the highest values of N % in leaves were found when P was applied at 30 Kg P2O5/fed. placed below the cane cutting in the furrow at planting. Whoever, high value of N % was obtained due to the third order interaction which include without filter mud cake, with the application 30 Kg P_2O_5/fed. placed below the cane cutting in the furrow at planting time. Significant residual effects were resulted due to rates of P application and methods of applying phosphorus on the nitrogen contents in leaves. No significant residual effects due to filter mud cake on N %. Incorporating P with the soil before planting and placement of P below the cane cuttings in the furrow at planting gave the highest value of nitrogen concentration in leaves. Similar results were reported by Sharma, *et al*. (2009)

Table (13): Direct and residual effects of filter mud cake, rates of phosphorus fertilizer and methods of phosphorus placement and their interactions on the nitrogen contents (%) of cane leaves for variety (Phil.8013) at tiller completion stage of plant crop and first ratoon.

P rates		Plant cane 2005/2006					First ratoon 2006/2007				
		P placement methods					P placement methods				
		M1	M2	M3	M4	Mean	M1	M2	M3	M4	Mean
		Without filter mud cake					Without filter mud cake				
P0		1.25	1.25	1.25	1.25	**1.25**	1.31	1.31	1.31	1.31	**1.31**
P1		1.46	1.31	1.31	1.53	**1.40**	1.36	1.26	1.23	1.47	**1.33**
P2		1.43	1.43	1.31	1.25	**1.35**	1.34	1.32	1.27	1.22	**1.29**
Mean		**1.38**	**1.33**	**1.29**	**1.34**	**1.34**	**1.33**	**1.30**	**1.27**	**1.33**	**1.31**
		Adding 4 tons/fed. dry filter mud cake					Adding 4 tons/fed. dry filter mud cake				
P0		1.38	1.38	1.38	1.38	**1.38**	1.45	1.45	1.45	1.45	**1.45**
P1		1.48	1.42	1.30	1.50	**1.42**	1.44	1.34	1.23	1.45	**1.37**
P2		1.35	1.26	1.40	1.33	**1.33**	1.31	1.26	1.31	1.36	**1.31**
Mean		**1.40**	**1.35**	**1.36**	**1.40**	**1.38**	**1.40**	**1.35**	**1.33**	**1.42**	**1.37**
Mean		**1.39**	**1.34**	**1.32**	**1.37**		**1.37**	**1.32**	**1.30**	**1.37**	
Mean	**P0**	**1.32**	**1.32**	**1.32**	**1.32**	**1.32**	**1.38**	**1.38**	**1.38**	**1.38**	**1.38**
	P1	**1.47**	**1.36**	**1.30**	**1.51**	**1.41**	**1.40**	**1.30**	**1.23**	**1.46**	**1.35**
	P2	**1.39**	**1.35**	**1.35**	**1.29**	**1.34**	**1.33**	**1.29**	**1.29**	**1.29**	**1.30**
F test F		**N. S**					**N. S**				
L.S.D. at 5%		**P=0.09**			**M=0.06**		**P=0.08**			**M= N. S**	
		F P= 0.13			**F M=N.S**		**F P= 0.11**			**F M=N.S**	
		P M= 0.10			**F P M= 0.14**		**P M= 0.09**			**F P M= 0.12**	

<u>Phosphorus contents of sugar cane leaves</u>

Data presented in table (14) indicated that the addition of filter mud cake was significantly affecting the phosphorus contents on cane leaves. Also, rates of applied P significantly increased the phosphorus contents of cane leaves. It was observed that P contents of leaves were gradually increased as P rates were increased. Methods by which phosphate fertilizers were applied had also a significant effect of P contents of leaves where the best method for applying P was obtained with the incorporation of P with the soil before planting The least response was observed when phosphate was applied in trench at both sides of the furrow or added below the cane cutting in the furrow at planting time.

Data in the same table include also the effect of interaction between treatments on P % of cane leaves. Phosphorus content of leaves was significantly affected by all other interaction including the third order interaction between filter mud cake, rates of P and methods of P application.

Table (14) indicated that the data of the interaction between filter mud cake and methods of P placement had significantly affected phosphorus contents. Positive response was found under the addition of filter mud cake together with the incorporation of P in the soil before planting (0.219 %). The interaction between P rates and P placement methods significantly affected the phosphorus contents of cane leaves. The highest values were found under the P applied at 60 Kg P2O5/fed. and by using surface banding application at one side of furrow (0.220 %). While, the interaction between filter mud cake, P rates and P placement methods did not significantly affect the phosphorus contents of cane leaves. Significant residual effects were obtained due to filter mud cake, rate of P application and methods of applying phosphorus on phosphorus concentration in cane leaves. Incorporating P with the soil before planting gave the highest value of P content in leaves. Similar results were obtained by Sharma, *et al*. (2009)

Table (14): Direct and residual effects of filter mud cake, rates of phosphorus fertilizer and methods of phosphorus placement and their interactions on the phosphorus contents of cane leaves for variety (Phil.8013) at tiller completion stage of plant crop and first ratoon.

P rates		Plant cane 2005/2006					First ratoon 2006/2007				
		P placement methods					P placement methods				
		M1	M2	M3	M4	Mean	M1	M2	M3	M4	Mean
		Without filter mud cake					Without filter mud cake				
P0		0.175	0.175	0.175	0.175	**0.175**	0.165	0.165	0.165	0.165	**0.165**
P1		0.210	0.204	0.203	0.206	**0.206**	0.195	0.195	0.190	0.198	**0.195**
P2		0.208	0.211	0.210	0.212	**0.210**	0.195	0.205	0.202	0.207	**0.203**
Mean		**0.198**	**0.197**	**0.196**	**0.197**	**0.197**	**0.185**	**0.189**	**0.186**	**0.19**	**0.187**
		Adding 4 tons/fed. dry filter mud cake					Adding 4 tons/fed. dry filter mud cake				
P0		0.193	0.193	0.193	0.193	**0.193**	0.183	0.183	0.183	0.183	**0.183**
P1		0.230	0.216	0.205	0.209	**0.215**	0.225	0.204	0.186	0.203	**0.204**
P2		0.232	0.230	0.220	0.213	**0.224**	0.220	0224	0.205	0.216	**0.216**
Mean		**0.219**	**0.213**	**0.206**	**0.205**	**0.211**	**0.209**	**0.204**	**0.191**	**0.201**	**0.201**
Mean		**0.208**	**0.205**	**0.201**	**0.201**		**0.197**	**0.196**	**0.189**	**0.195**	
Mean	P0	**0.184**	**0.184**	**0.184**	**0.184**	**0.184**	**0.174**	**0.174**	**0.174**	**0.174**	**0.174**
	P1	**0.220**	**0.210**	**0.204**	**0.208**	**0.211**	**0.210**	**0.200**	**0.188**	**0.200**	**0.199**
	P2	**0.220**	**0.220**	**0.215**	**0.213**	**0.217**	**0.208**	**0.215**	**0.204**	**0.212**	**0.209**
F test F		* *					* *				
L.S.D. at 5%		P=0.014			M=0.006		P=0.006			M= 0.004	
		F P= 0.009			F M=0.006		F P= N. S			F M=0.006	
		P M= 0.004			F P M= N.S		P M= 0.31			F P M= N. S	

Potassium contents of sugar cane leaves

Data presented in table (15) indicated that the addition of filter mud cake significantly affected the potassium contents of cane leaves. Adding four tons/fed. dry filter mud cake increased potassium contents of cane leaves by (17.33 %) compared to the control. However, increasing the level of applied phosphorus also increased the potassium contents of cane leaves. Raising the P rate from 0 to 30 kg and 60 Kg P2O5 /fed. increased the potassium content of leaves by 11.68 and 5.19 % over the control. The method of applying phosphorus did not significantly affect the potassium content of cane leaves.

Data in the same table indicated that the interactions between all treatments were significantly affected the potassium contents of cane leaves. Potassium % was increased due to the addition of filter mud cake and the application of 60 Kg P2O5/fed. Similar increase in K% in leaves was also attained due to the addition of filter mud cake and placement of P in trench at both sides of the furrow (0.91 %) compared to the control.

Application of 30 Kg P2O5/fed. incorporated with the soil before planting increased K %by (0.0.89 %) over the control. While, the highest values were found due to the addition of filter mud cake, 30 Kg P2O5/fed. placed of P in trench at both sides of the furrow (1.04 %). Significant residual effects was obtained due to filter mud cake on potassium content of cane leaves. Significantly residual effect was found due to the rate of P application and methods of applying phosphorus on potassium content of cane leaves. Similar results were obtained by Sharma, *et al*. (2009)

Table (15): Direct and residual effects of filter mud cake, rates of phosphorus fertilizer and methods of phosphorus placement and their interactions on the potassium contents of cane leaves for variety (Phil.8013) at tiller completion stage of plant crop and first ratoon.

P rates		Plant cane 2005/2006					First ratoon 2006/2007				
		P placement methods					P placement methods				
		M1	M2	M3	M4	Mean	M1	M2	M3	M4	Mean
		Without filter mud cake					Without filter mud cake				
P0		0.73	0.73	0.73	0.73	**0.73**	0.77	0.77	0.77	0.77	**0.77**
P1		0.84	0.88	0.70	0.73	**0.79**	0.77	0.84	0.66	0.70	**0.74**
P2		0.68	0.79	0.70	0.80	**0.74**	0.64	0.74	0.67	0.78	**0.71**
Mean		**0.75**	**0.80**	**0.71**	**0.75**	**0.75**	**0.73**	**0.78**	**0.70**	**0.75**	**0.74**
		Adding 4 tons/fed. dry filter mud cake					Adding 4 tons/fed. dry filter mud cake				
P0		0.81	0.81	0.81	0.81	**0.81**	0.86	0.86	0.86	0.86	**0.86**
P1		0.94	0.87	1.04	0.89	**0.93**	0.91	0.83	0.99	0.86	**0.89**
P2		0.88	0.89	0.89	0.90	**0.89**	0.85	0.89	0.83	0.92	**0.87**
Mean		**0.87**	**0.86**	**0.91**	**0.87**	**0.88**	**0.87**	**0.86**	**0.89**	**0.88**	**0.87**
Mean		**0.81**	**0.83**	**0.81**	**0.81**		**0.80**	**0.82**	**0.79**	**0.81**	
Mean	P0	**0.77**	**0.77**	**0.77**	**0.77**	**0.77**	**0.81**	**0.81**	**0.81**	**0.81**	**0.81**
	P1	**0.89**	**0.88**	**0.87**	**0.81**	**0.86**	**0.84**	**0.83**	**0.82**	**0.78**	**0.82**
	P2	**0.78**	**0.84**	**0.79**	**0.85**	**0.81**	**0.74**	**0.81**	**0.75**	**0.85**	**0.79**
F test F		* *					* *				
L.S.D. at 5%		P=0.04			M= N.S		P=0. N.S			M= N. S	
		F P= 0.06			F M=0.04		F P= 0.08			F M=0.06	
		P M= 0.05			F P M= 0.07		P M= 0.07			F P M= 0.10	

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استجابة صنف قصب السكر فلبيني ٨٠١٣ لطرق التسميد المختلفة

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أقيم هذا البحث بمحطة البحوث الزراعية بكوم امبو محافظةِ أسوان خلال موسمي الزراعة (٢٠٠٦/٢٠٠٥ و٢٠٠٧/٢٠٠٦) بغرض دراسة استجابة صنف قصب السكر فلبيني ٨٠١٣ لطرق التسميد المختلفة. اشتملت المعاملات على مستويين من طينة المرشحات الجافة صفر و ٤ طن للفدان وثلاثة مستويات من التسميد الفوسفاتي صفر و٣٠ و ٦٠ كجم فو٢ أ٥ /فدان. وأربعة مِنْ طرقِ لإضافة الفسفورِ مخلوط بالتربةِ أثناء التجهيزِ قبل الزِراعَة و سرسبة على جانب واحد من الخط و في خندق على جانبي الخط وأسفل العقلة.
وفيما يلي أهم النتائج المتحصل عليها:
أدت إضافة طينة المرشحات الجافة بمعدل ٤ طن للفدان إلى زيادة ارتفاع وسمك العيدان ومحصول القصب والسكر ومحتوي الأوراق من الفوسفور والبوتاسيوم.
لم تؤثر إضافة طينة المرشحات الجافة بمعدل ٤ طن للفدان معنويا على جودة العصير.
أدى زيادة التسميد الفوسفاتي إلى زيادة كل الصفات المدروسة عدا السكريات الكلية الذائبة و نسبة استخلاص السكر.
وكانت طريقة إضافة الفوسفورِ مخلوط بالتربة إثناء التجهيزِ قبل الزِراعَة أفضل طرق إضافة الفوسفور.