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Chemical Properties and Juice Quality of Three Sugarcane Varieties as Affected by Gypsum, Filter Mud Cake and Inorganic Fertilization

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Abstract

A field experiment was conducted at Mallawi Agriculture Research Station Farm – El-Minia Governorate, Egypt in two successive seasons of 2012/2013 and 2013/2014 (plant crops) to find out the influence of gypsum, filter mud cake with inorganic fertilization on chemical composition and juice quality of three sugarcane varieties. The obtained results could be summarized as follow:

Gypsum rates had insignificant effect on leaves consists of P and K and significantly on the percentages of N, S and Ca of sugarcane leaves in the both seasons. Each increment in gypsum rate was associated with a significant increase in juice quality (brix% and sucrose%) in the two seasons. Juice purity% and reducing sugars% significantly affected by gypsum rates only in the first season, but the same traits showed insignificant response to gypsum rates in the second growing season.

As for, filter mud cake with inorganic fertilization, the data cleared that fertilization had a significant effects on the traits of N, P, K, S and Ca leaves consist, juice quality traits (brix, sucrose and reducing sugars percentages) in the first and the second growing seasons. Juice purity percentage significantly affected only in the 1st season.

Also, varieties differed significantly in respect to the traits of N, P and K leaves consists and brix% in the first and the second growing seasons, but had insignificant effect in respect of S and Ca leaves concentrations, purity% and reducing sugars% not only in the first season but also in the second one as well as it had significant effect on sucrose% in the second growing season.

The second order interaction showed insignificant effects on N, P, S and Ca leaf concentrations, significant effect on brix and sucrose percentages in the first and the second growing seasons, while it showed significant effect in K concentration in the second season only, however it had a significant effect on purity and reducing sugars percentages only in the first growing season.

Keywords: *Sugarcane-Fertilization-Gypsum-Inorganic –Varieties.*

Introduction

Sugarcane is a C4 plant that is able to maintain higher rates of photosynthesis compared to C3 plants, so in sugarcane plants, depending on the availability of water and nutrients, the rate of photosynthesis will vary according with light intensity. Under conditions of good supply of nutrients, sugarcane plants can express the best genetic characteristics and produce the highest quality of cane and sugar which is the main goal of sugarcane cultivation. Under the continuous increase the fertilizers prizes the present work try to look for dif-

ferent source of fertilization such as filter mud cake and improving soil properties through gypsum component to make the plant ready to grow in a good soil condition.

Gypsum which is a naturally occurring mineral that is made up of calcium sulfate and water ($CaSO_4$+$2H_2O$) that is sometimes called hydrous calcium sulfate. The effect of gypsum on soil occurs because of the dissociation of dihydrate calcium sulfate ($CaSO_4.2H_2O$). The leaching of Ca^{+2} and SO_4^{-2} result in the ionic exchange of toxic aluminum on the surface with Ca^{+2} and formation of the $AlSO_4^+$ ionic pair, which is not toxic to plants. Saroha and Singh (1979) studied the relationship between sulphur content of leaves and juice characteristics showed that every 1% increase in sulphur content of leaves increased sugar content in cane juice by 0.038%, recovery of sugar by 0.038% and purity of juice by 0.033%.

Depletion of available nutrients and organic matter due to continuous cane cropping with inorganic fertilizers as found by Kumar and Verma (2002) and Sarwar *et al.* (2010) necessitates the integrated use of organic and mineral fertilizer resources. Press mud can serve as a good source of organic manure as said by Bokhtiar *et al.* (2002). The usefulness of filter mud cake as a valuable organic manure has been reported by several workers Nehra and Hooda (2002) and Jamil *et al.* (2008).

Venkatakrishnan and Ravichandran (2007) stated that the integrated use of mineral fertilizers together with organic manures/ industrial agricultural wastes in suitable combination complementing each other to optimize input use and maximize production and sustain the same without impairing to crop quality of soil fertility. Shankaraiah and Murthy (2005) found that the highest values of soil available NPK were observed with EPMC (Enriched Press Mud Cake) at 15 ton/ha. at recommended fertilization.

It is well known that all commercial sugar cane varieties are interspecific hybrids and consequently differ in their performance due to the great variation in their gene make up. Nowadays the sugar crop institute is advertising the success of the promising varieties like G. 99-103 and G. 99-160 sugar cane varieties, so that these cultivars could partially replace the commercial G.T. 54-9 sugar cane cultivar, which represent about 99.79% (308.070 thousand fed.) of the planted sugar cane area in Egypt MALR's Sugar Crops Council (2017). Muhammad *et al.* (2002) stated that sugarcane genotypes; SPSG-26 and Co-1148 differed significantly in sucrose content. Azzazy *et al.* (2005) found that cane varieties G.T.54-9, Phil.8013, G.95-21, G.99-165, G.98-28 and G.95-19 differed significantly in their sucrose % and sugar recovery % as well as cane and sugar yields.

The objective of this study is to determine the best coefficients of mineral and organic fertilization which achieves the highest yields of cane and sugar of the three studied varieties, maintain soil fertility, which is heavily depleted by recurrent sugarcane cultivation and reducing pollution and costs resulting from unhelpful use of mineral fertilization.

Materials and Methods

A field experiment was conducted at the Agricultural Experiment Farm of Mallawi Agriculture Research Station – El-Minia Governorate, Egypt during 2012/2013 and 2013/2014 seasons (plant crops) to study the influence of gypsum, filter mud cake with inorganic fertilization (mineral fertilization) on chemical composition and juice quality of three sugarcane varieties at plant crop. Mechanical and chemical properties of the experimental soil are shown in Table (1). The study included 45 treatments which were the combination of three factors of the different levels. The experiment was conducted in Randomized Complete Block Design (RCBD) with four replications using split plots arrangement. Plot area of each sub included five ridges, seven meters in length and one meter in width, thus plot area was 35 m^2 (1/120 fed.).

The different treatments were:

Main plots: Gypsum (G), Sub plots: Filter mud cake with inorganic fertilization (F.M.C + I.F), Sub-sub plots: varieties (V).

Table 1. Physical and chemical properties of the experimental soil at Mallawi Agriculture Research Station (2012/13 and 2013/2014).

Seasons	2012/2013	2013/2014
Physical analysis		
Coarse sand %	3.00	3.00
Fine sand %	14.00	14.50
Silt %	43.00	40.60
Clay %	40.00	41.90
Soil texture	Silty clay	Silty clay
Chemical analysis:		
Available nitrogen ppm	76.85	75.45
Available phosphorus ppm	5.20	5.30
Av. K^+ meq/100 g soil	0.57	0.56
So_4 mg/g	0.54	0.58
$CaCO_3$ %	2.11	1.94
E.C. (1:5 extract) mm hos/cm	1.61	1.71
pH (1:2.5 extract)	7.84	7.91
Organic matter%	1.19	1.16

1- **Gypsum levels:** Zero, 1ton and 2ton gypsum per feddan.

2- **Filter mud cake with inorganic fertilization levels (per feddan):**

1]Zero filter mud cake + 100% NPK (220, 60 and 48 kg/feddan recommended dose).

2]1ton filter mud cake + 100% NPK. (220, 60 and 48 kg/feddan recommended dose).

3]2ton filter mud cake + 100% NPK (220, 60 and 48 kg/feddan recommended dose).

4]1ton filter mud cake + 196.9 kg N + 35 kg P + 44.9 K (kg/fed.) (based on average contents of one ton of filter mud cake).

5]2ton filter mud cake + 173.8 kg N + 10 kg P + 41.8 K (kg/fed.) (based on average contents of 2tons of filter mud cake).

3- Varieties: Three sugar cane varieties were (G.T. 54-9, G. 99-103 and G. 99-160).

Sugarcane seed were propagated by cutting contains three buds and placed into trenches directly and irrigated just after planting. Sugar cane varieties were planted during the 2nd week of March in the two growing

seasons and harvested after twelve months age in both seasons. Also supplementary irrigation was done as recommended. Nitrogen fertilizer levels were added as Urea (46.5% N) two equal doses, the 1st application was applied after two months from planting and the second one was added one month later, phosphorus fertilizer was added as calcium super phosphate (15% P_2O_5) once at planting whereas, potassium fertilizer was applied once as potassium sulfate (48% K_2O) with the 2nd addition of N fertilizer. Full dose of filter mud cake and gypsum were applied in trenches and mixed with soil prior to planting of seed as basal. The other agricultural practices were carried out as recommended.

Table 2. Chemical composition of filter mud cake as described by Ferweez *et al.* (2011).

pH	6.22
EC	6.51
Organic matter	65.81
Total N%	2.31
Total P%	2.50
Total K%	0.31

Collected data:

Chemical analysis of leaves and juice quality:

1. Leaves consists of N, P, K, S and Ca (%): were measured at the 4th leaf blade after finishing of all fertilization treatments, analyzed by Atomic absorption spectrophotometry which based on the principle that free atoms of an element can absorb the characteristic radiation, known as resonance radiation, of that specific element. The amount of light absorbed by the atoms of the element is proportional to the number of atoms through which the light beam is assed, and therefore proportional to the concentration of the element in the sample, provided that the sample is atomized at a constant rate as said by (Preez 1966).

2. Juice quality traits. A sample of 25 stalks from each sub sub plot was randomly taken at harvest. One liter of the extracted juice was taken and the following data were recorded:

a. Brix reading (T.S.S %): was determined by using (Brix hydrometer) standardized at 20°C. according to A.O.A.C. (1995).

b. Sucrose percentage: was determined using Saccharometer according to A.O.A.C. (1995).

c. Juice purity percentage: was calculated by using the following formula:

Purity%= (Sucrose% ÷ T.S.S%) x 100 according to A.O.A.C. (1995).

d. Reducing sugars percentage: was determined according to A.O.A.C. (1995)

Statistical analysis:

The collected data were subjected to proper statistical analysis of Randomized Complete Block Design (RCBD), Split plots arrangement according to procedure outlined by Sendecor and Cochran (1981). L.S.D. at 5% level of probability was used for comparison between means.

Results and Discussion

1- Leaves consist of N, P, K, S and Ca (%):

The presented data in Tables 3-7 revealed that gypsum rates insignificantly effected on the percentages of P and K and significantly on the percentages of N, S and Ca of sugar cane leaf in the both seasons. The highest mean leaves values of N (2.833 and

2.465), S (0.567 and 0.661) and Ca (0.574 and 0.627) were attained by 2ton gypsum/fed. in the 1st and the 2nd seasons, respectively.

These findings are in line with that obtained by Viator *et al.* (2002) who found that gypsum increased Ca and S leaf concentrations, but had not significant effect on P, K concentrations in sugarcane plant. These results may be due to that the gypsum Ca So_4. 2 H_2O contain Calcium and Sulphur elements and can provide the soil by theses elements when using as an amendment and also addition of gypsum to soils resulted in only small changes to soil pH these adjustment could be played an essential role in availability of the elements, gypsum could be able to decreasing loss of nitrogen fertilization to the atmosphere, Improves uptake of fertilizers on many soils and other amendments and Promotes uptake of nutrients by plants (N, P, K, Ca, S, Cu, and Mn) as found at (GYPSUM ($CaSO_4$) www.natureswayresources.com).

Treatments of filter mud cake with inorganic fertilization had significant effects on the percentages of N, P, K, S and Ca of sugar cane leaves in the two growing seasons. The highest values for N concentration (2.834 and 2.606), P concentration (0.757 and 0.720), K concentration (1.687 and 2.003), S concentrations (0.591 and 0.685) and Ca concentration (0.592 and 0.642) achieved by using 2ton filter mud cake with 173.8 N + 10 P + 41.8 K (kg/fed.), whereas the lowest values of N (2.810 and 2.231), P (0.710 and 0.665), K (1.576 and 1.641), S (0.501 and 0. 584) and Ca (0.495 and 0.572) achieved by using the recommended doses of NPK without adding filter mud cake in the both growing seasons, respectively.

Press mud improved the soil conditions by increasing the amount of organic C, total N, and available P as well as in some cases available S in the soils as said by Islam *et al.* (1998).

Table 3. Effect of gypsum, filter mud cake with inorganic fertilization on leaves nitrogen concentration (%) of three sugarcane varieties at plant crop season 2012/2013 and 2013/2014.

Gypsum (ton/fed.) (A)	Filter Mud Cake (ton/fed.) + Inorganic Fertilization (kg/fed.) (B)	2012/2013				2013/2014			
		Varieties (C)				Varieties (C)			
		G.T 54-9	G 99-103	G 99-160	Mean	G.T 54-9	G. 99-103	G. 99-160	Mean
Zero	0.00+100%NPK	2.807	2.803	2.797	2.803	2.087	2.293	2.250	2.210
	1ton+100%NPK	2.798	2.799	2.867	2.821	2.229	2.477	2.277	2.327
	2ton+100%NPK	2.827	2.817	2.813	2.819	2.442	2.444	2.590	2.492
	1ton+196.9N+35.0P+44.9K	2.816	2.830	2.820	2.822	2.443	2.533	2.584	2.520
	2ton+173.8N+10.0P+41.8K	2.830	2.825	2.814	2.823	2.515	2.656	2.643	2.605
	Mean	2.816	2.815	2.822	2.818	2.343	2.480	2.469	2.431
1ton	0.00+100%NPK	2.819	2.816	2.811	2.816	2.130	2.234	2.283	2.216
	1ton+100%NPK	2.813	2.813	2.864	2.830	2.146	2.526	2.456	2.376
	2ton+100%NPK	2.833	2.826	2.823	2.827	2.484	2.495	2.631	2.537
	1ton+196.9N+35.0P+44.9K	2.825	2.836	2.829	2.830	2.481	2.563	2.629	2.558
	2ton+173.8N+10.0P+41.8K	2.836	2.832	2.824	2.831	2.536	2.632	2.683	2.617
	Mean	2.825	2.825	2.830	2.827	2.355	2.490	2.536	2.461
2ton	0.00+100%NPK	2.817	2.813	2.807	2.813	2.124	2.321	2.356	2.267
	1ton+100%NPK	2.804	2.805	2.887	2.832	2.362	2.516	2.354	2.411
	2ton+100%NPK	2.840	2.829	2.823	2.831	2.518	2.438	2.610	2.522
	1ton+196.9N+35.0P+44.9K	2.830	2.848	2.845	2.841	2.483	2.534	2.568	2.528
	2ton+173.8N+10.0P+41.8K	2.852	2.842	2.850	2.848	2.499	2.646	2.645	2.597
	Mean	2.829	2.827	2.843	2.833	2.397	2.491	2.506	2.465
(F.M.C + I.F) X Varieties		2.815	2.811	2.805	2.810	2.114	2.283	2.296	2.231
		2.805	2.805	2.873	2.828	2.246	2.506	2.362	2.371
		2.834	2.824	2.820	2.826	2.481	2.459	2.610	2.517
		2.823	2.838	2.831	2.831	2.469	2.543	2.594	2.535
		2.839	2.833	2.829	2.834	2.517	2.645	2.657	2.606
Varieties mean		2.823	2.822	2.832	2.826	2.365	2.487	2.504	2.452

Treatments	2012/2013		2013/2014	
	F test	L.S.D at 5%	F test	L.S.D at 5%
A	**	0.004	**	0.014
B	**	0.005	**	0.021
A x B	NS	---	**	0.037
C	*	0.011	**	0.025
A x C	NS	---	NS	---
B x C	**	0.025	**	0.057
A x B x C	NS	---	NS	---

Note: The symbols: (*) = Significant, (**) = High significant and (N.S) = Not significant

The three examined varieties differed significantly in respect to N, P and K and insignificantly differed in respect to S and Ca of sugar cane leaves in the two growing seasons. G. 99-160 sugarcane variety marked the highest percentages of N (2.832 and 2.504), P (0.752 and 0.715) and K (1.667 and 1.874) in the 1st and the 2nd growing seasons, respectively followed by G. 99-103 sugarcane variety, only in N concentration in the first season recorded the lowest value (2.822%) whereas, the G.T 54-9 commercial sugarcane variety recorded the lowest concentration of N (2.365%) in the second season, P (0.722 and 0.680) and K (1.609 and 1.827) in the 1st and the 2nd growing seasons, respectively.

These results may be due to the differences among the examined varieties in their gene structure.

Regarding to the interaction between gypsum and filter mud cake with inorganic fertilization, the collected data in the same Tables cleared that all of the combination between the two factors had not a significant effect on the percentages of P, S and Ca of sugar cane leaves in the 1st and the 2nd growing seasons, as for N and K percent the interaction between the same factors had significant effect only in the second growing season. The highest values of N (2.617) and K (2.017) were attained by using 1ton gypsum and 2ton filter mud cake with 173.8 N + 10.0 P + 41.8 K (kg/fed.) in the second growing season.

Table 4. Effect of gypsum, filter mud cake with inorganic fertilization on leaves phosphorus concentration (%) of three sugarcane varieties at plant crop season 2012/2013 and 2013/2014

Gypsum (ton/fed.) (A)	Filter Mud Cake (ton/fed.) + Inorganic Fertilization (kg/fed.) (B)	2012/2013 Varieties (C)				2013/2014 Varieties (C)			
		G.T 54-9	G 99-103	G 99-160	Mean	G.T 54-9	G. 99-103	G. 99-160	Mean
Zero	0.00+100%NPK	0.675	0.712	0.717	0.702	0.625	0.669	0.674	0.656
	1ton+100%NPK	0.711	0.730	0.718	0.720	0.667	0.689	0.675	0.677
	2ton+100%NPK	0.724	0.735	0.746	0.735	0.681	0.695	0.707	0.694
	1ton+196.9N+35.0P+44.9K	0.733	0.737	0.745	0.738	0.692	0.697	0.706	0.698
	2ton+173.8N+10.0P+41.8K	0.743	0.756	0.754	0.751	0.705	0.719	0.717	0.713
	Mean	0.717	0.734	0.736	0.729	0.674	0.694	0.696	0.688
1ton	0.00+100%NPK	0.679	0.712	0.700	0.697	0.629	0.668	0.655	0.651
	1ton+100%NPK	0.703	0.784	0.725	0.737	0.658	0.751	0.684	0.697
	2ton+100%NPK	0.730	0.731	0.756	0.739	0.689	0.690	0.719	0.700
	1ton+196.9N+35.0P+44.9K	0.729	0.742	0.815	0.762	0.688	0.702	0.788	0.726
	2ton+173.8N+10.0P+41.8K	0.738	0.752	0.827	0.772	0.697	0.715	0.801	0.738
	Mean	0.716	0.744	0.765	0.742	0.672	0.705	0.729	0.702
2ton	0.00+100%NPK	0.678	0.706	0.807	0.730	0.629	0.661	0.779	0.689
	1ton+100%NPK	0.712	0.734	0.725	0.724	0.668	0.694	0.683	0.682
	2ton+100%NPK	0.746	0.755	0.749	0.750	0.707	0.718	0.711	0.712
	1ton+196.9N+35.0P+44.9K	0.803	0.737	0.743	0.761	0.773	0.697	0.704	0.724
	2ton+173.8N+10.0P+41.8K	0.734	0.754	0.755	0.748	0.693	0.717	0.717	0.709
	Mean	0.734	0.737	0.756	0.742	0.694	0.697	0.719	0.703
(F.M.C + I.F) X Varieties		0.677	0.710	0.742	0.710	0.628	0.666	0.702	0.665
		0.709	0.750	0.723	0.727	0.664	0.711	0.681	0.685
		0.733	0.741	0.750	0.741	0.693	0.701	0.712	0.702
		0.755	0.739	0.767	0.754	0.718	0.699	0.732	0.716
		0.738	0.754	0.778	0.757	0.698	0.717	0.745	0.720
Varieties mean		0.722	0.739	0.752	0.738	0.680	0.699	0.715	0.698

Treatments	F test	L.S.D at 5%	F test	L.S.D at 5%
A	NS	---	NS	---
B	**	0.021	**	0.026
A x B	NS	---	NS	---
C	**	0.016	**	0.019
A x C	NS	---	NS	---
B x C	NS	---	NS	---
A x B x C	NS	---	NS	---

Note: The symbols: (*) = Significant, (**) = High significant and (N.S) = Not significant

As for the interaction between the gypsum rates and the studied varieties, the results in the same Tables showed that a significant effect in K and Ca leaves concentrations only in the second growing season.

The interaction between filter mud cake with inorganic fertilization and the studied varieties showed a significant effect on N leaves concentration in the two growing seasons, significant effects on K and Ca only in the second season and insignificant effects on P and S leaves concentrations either in the first or the second growing seasons. For N leaves concentration, the sugarcane variety G. 99-160 superior the other studied varieties when received 1ton filter mud cake + 100% NPK and 2ton FMC with 173.8 N + 10.0 P + 41.8 K (kg/fed.), in the first and the second growing seasons, respectively and gave the highest N leaves concentration 2.873 and 2.657 in the 1st and the 2nd seasons, respectively. The lowest N leaves concentration 2.805 and 2.114 were attained from planting the G.T 54-9 sugarcane variety and treated the soil by 1ton filter mud cake + 100% NPK and 100% NPK without adding filter mud cake (the control) in the first and the second growing seasons, respectively.

Table 5. Effect of gypsum, filter mud cake with inorganic fertilization on leaves potassium concentration (%) of three sugarcane varieties at plant crop season 2012/2013 and 2013/2014

Gypsum (ton/fed.) (A)	Filter Mud Cake (ton/fed.) + Inorganic Fertilization (kg/fed.) (B)	2012/2013				2013/2014			
		Varieties (C)				Varieties (C)			
		G.T 54-9	G 99-103	G 99-160	Mean	G.T 54-9	G. 99-103	G. 99-160	Mean
Zero	0.00+100%NPK	1.531	1.598	1.617	1.582	1.570	1.726	1.727	1.674
	1ton+100%NPK	1.608	1.640	1.601	1.616	1.790	1.842	1.722	1.785
	2ton+100%NPK	1.629	1.630	1.671	1.643	1.887	1.779	1.931	1.866
	1ton+196.9N+35.0P+44.9K	1.629	1.655	1.669	1.651	1.951	1.909	1.944	1.935
	2ton+173.8N+10.0P+41.8K	1.650	1.689	1.685	1.675	1.975	2.038	1.994	2.003
	Mean	1.609	1.642	1.648	1.633	1.835	1.859	1.864	1.852
1ton	0.00+100%NPK	1.541	1.570	1.585	1.565	1.596	1.559	1.623	1.593
	1ton+100%NPK	1.546	1.655	1.632	1.611	1.585	1.895	1.789	1.756
	2ton+100%NPK	1.618	1.644	1.682	1.648	1.935	1.873	1.969	1.926
	1ton+196.9N+35.0P+44.9K	1.643	1.663	1.681	1.662	1.987	1.959	1.996	1.981
	2ton+173.8N+10.0P+41.8K	1.655	1.682	1.689	1.675	1.991	2.014	2.047	2.017
	Mean	1.601	1.643	1.654	1.632	1.819	1.860	1.885	1.855
2ton	0.00+100%NPK	1.539	1.595	1.606	1.580	1.572	1.678	1.717	1.656
	1ton+100%NPK	1.606	1.650	1.604	1.620	1.787	1.892	1.720	1.800
	2ton+100%NPK	1.650	1.628	1.676	1.651	1.885	1.862	1.962	1.903
	1ton+196.9N+35.0P+44.9K	1.640	1.741	1.798	1.727	1.947	1.913	1.970	1.943
	2ton+173.8N+10.0P+41.8K	1.645	1.686	1.803	1.711	1.945	2.029	1.997	1.990
	Mean	1.616	1.660	1.697	1.658	1.827	1.875	1.873	1.858
(F.M.C + I.F) X Varieties		1.537	1.588	1.602	1.576	1.579	1.654	1.689	1.641
		1.587	1.648	1.612	1.616	1.721	1.877	1.744	1.780
		1.633	1.634	1.676	1.648	1.902	1.838	1.954	1.898
		1.637	1.686	1.716	1.680	1.962	1.927	1.970	1.953
		1.650	1.686	1.725	1.687	1.970	2.027	2.013	2.003
Varieties mean		1.609	1.648	1.667	1.641	1.827	1.865	1.874	1.855

Treatments	F test	L.S.D at 5%	F test	L.S.D at 5%
A	NS	---	NS	---
B	**	0.016	**	0.003
A x B	NS	---	**	0.008
C	**	0.023	**	0.004
A x C	NS	---	**	0.006
B x C	NS	---	**	0.008
A x B x C	NS	---	**	0.014

Note: The symbols: (*) = Significant, (**) = High significant and (N.S) = Not significant

As for K concentration the sugarcane variety G. 99-103 marked the highest values 2.027 when received 2ton filter mud cake with 173.8 N + 10.0 P + 41.8 K, the commercial sugarcane variety G.T 54-9 recorded the lowest values in K concentration 1.579 by using the control one (100% NPK without adding filter mud cake).

The G. 99-160 sugarcane variety superior the other studied varieties when received 2ton filter mud cake with 173.8 N + 10.0 P + 41.8 K (kg/fed.) inorganic fertilization and marked the highest values in the Ca concentration (0.683) in the 2nd growing season. The commercial sugarcane variety G.T 54-9 when received the control level (100% NPK without adding filter mud cake) recorded the lowest values in the Ca concentration 0.561 in the 2nd growing season.

Table 6. Effect of gypsum, filter mud cake with inorganic fertilization on leaves sulphur concentration (%) of three sugarcane varieties at plant crop season 2012/2013 and 2013/2014

Gypsum (ton/fed.) (A)	Filter Mud Cake (ton/fed.) + Inorganic Fertilization (kg/fed.) (B)	2012/2013 Varieties (C)				2013/2014 Varieties (C)			
		G.T 54-9	G 99-103	G 99-160	Mean	G.T 54-9	G. 99-103	G. 99-160	Mean
Zero	0.00+100%NPK	0.494	0.446	0.417	0.452	0.556	0.599	0.584	0.580
	1ton+100%NPK	0.467	0.483	0.472	0.474	0.593	0.589	0.573	0.585
	2ton+100%NPK	0.517	0.463	0.494	0.491	0.618	0.599	0.615	0.611
	1ton+196.9N+35.0P+44.9K	0.516	0.489	0.517	0.508	0.621	0.610	0.620	0.617
	2ton+173.8N+10.0P+41.8K	0.554	0.548	0.519	0.540	0.624	0.676	0.619	0.640
	Mean	0.510	0.486	0.484	0.493	0.602	0.615	0.602	0.606
1ton	0.00+100%NPK	0.454	0.606	0.565	0.542	0.576	0.574	0.575	0.575
	1ton+100%NPK	0.567	0.541	0.544	0.551	0.591	0.605	0.574	0.590
	2ton+100%NPK	0.576	0.511	0.593	0.560	0.633	0.589	0.626	0.616
	1ton+196.9N+35.0P+44.9K	0.591	0.577	0.528	0.566	0.660	0.623	0.631	0.638
	2ton+173.8N+10.0P+41.8K	0.531	0.612	0.558	0.567	0.718	0.661	0.631	0.670
	Mean	0.544	0.569	0.558	0.557	0.636	0.610	0.607	0.618
2ton	0.00+100%NPK	0.470	0.576	0.480	0.508	0.599	0.597	0.597	0.598
	1ton+100%NPK	0.496	0.553	0.554	0.534	0.610	0.625	0.596	0.610
	2ton+100%NPK	0.540	0.572	0.536	0.549	0.643	0.773	0.707	0.708
	1ton+196.9N+35.0P+44.9K	0.538	0.618	0.572	0.576	0.648	0.641	0.648	0.646
	2ton+173.8N+10.0P+41.8K	0.518	0.726	0.755	0.666	0.714	0.720	0.798	0.744
	Mean	0.512	0.609	0.579	0.567	0.643	0.671	0.669	0.661
(F.M.C + I.F) X Varieties		0.472	0.542	0.487	0.501	0.577	0.590	0.585	0.584
		0.510	0.526	0.523	0.520	0.598	0.606	0.581	0.595
		0.544	0.515	0.541	0.534	0.631	0.654	0.649	0.645
		0.549	0.561	0.539	0.550	0.643	0.625	0.633	0.634
		0.535	0.628	0.611	0.591	0.685	0.686	0.683	0.685
Varieties mean		0.522	0.555	0.540	0.539	0.627	0.632	0.626	0.628

Treatments	2012/2013 F test	2012/2013 L.S.D at 5%	2013/2014 F test	2013/2014 L.S.D at 5%
A	*	0.061	**	0.024
B	**	0.039	**	0.026
A x B	NS	---	NS	---
C	NS	---	NS	---
A x C	NS	---	NS	---
B x C	NS	---	NS	---
A x B x C	NS	---	NS	---

Note: The symbols: (*) = Significant, (**) = High significant and (N.S) = Not significant

Table 7. Effect of gypsum, filter mud cake with inorganic fertilization on leaves calcium concentration (%) of three sugarcane varieties at plant crop season 2012/2013 and 2013/2014

Gypsum (ton/fed.) (A)	Filter Mud Cake (ton/fed.) + Inorganic Fertilization (kg/fed.) (B)	2012/2013 Varieties (C)				2013/2014 Varieties (C)			
		G.T 54-9	G 99-103	G 99-160	Mean	G.T 54-9	G. 99-103	G. 99-160	Mean
Zero	0.00+100%NPK	0.463	0.460	0.479	0.467	0.579	0.538	0.552	0.556
	1ton+100%NPK	0.469	0.507	0.470	0.482	0.547	0.589	0.548	0.561
	2ton+100%NPK	0.509	0.484	0.513	0.502	0.595	0.556	0.580	0.577
	1ton+196.9N+35.0P+44.9K	0.549	0.524	0.513	0.529	0.605	0.585	0.581	0.591
	2ton+173.8N+10.0P+41.8K	0.539	0.549	0.573	0.554	0.603	0.609	0.622	0.611
	Mean	0.506	0.505	0.510	0.507	0.586	0.575	0.576	0.579
1ton	0.00+100%NPK	0.474	0.529	0.475	0.492	0.548	0.603	0.562	0.571
	1ton+100%NPK	0.487	0.571	0.475	0.511	0.571	0.623	0.560	0.584
	2ton+100%NPK	0.521	0.507	0.509	0.512	0.593	0.577	0.588	0.586
	1ton+196.9N+35.0P+44.9K	0.524	0.555	0.538	0.539	0.598	0.616	0.599	0.604
	2ton+173.8N+10.0P+41.8K	0.535	0.548	0.573	0.552	0.597	0.615	0.626	0.613
	Mean	0.508	0.542	0.514	0.521	0.581	0.607	0.587	0.592
2ton	0.00+100%NPK	0.484	0.487	0.605	0.526	0.557	0.572	0.637	0.589
	1ton+100%NPK	0.565	0.524	0.496	0.528	0.613	0.593	0.575	0.594
	2ton+100%NPK	0.535	0.571	0.540	0.549	0.599	0.626	0.602	0.609
	1ton+196.9N+35.0P+44.9K	0.535	0.653	0.599	0.596	0.599	0.685	0.644	0.643
	2ton+173.8N+10.0P+41.8K	0.568	0.638	0.808	0.671	0.618	0.688	0.803	0.703
	Mean	0.538	0.575	0.610	0.574	0.597	0.633	0.652	0.627
(F.M.C + I.F) X Varieties		0.474	0.492	0.520	0.495	0.561	0.571	0.584	0.572
		0.507	0.534	0.480	0.507	0.577	0.602	0.561	0.580
		0.521	0.521	0.521	0.521	0.595	0.586	0.590	0.590
		0.536	0.577	0.550	0.554	0.601	0.629	0.608	0.613
		0.547	0.578	0.651	0.592	0.606	0.637	0.683	0.642
Varieties mean		0.517	0.540	0.544	0.534	0.588	0.605	0.605	0.599

Treatments	F test	L.S.D at 5%	F test	L.S.D at 5%
A	**	0.024	**	0.019
B	**	0.037	**	0.026
A x B	NS	---	NS	---
C	NS	---	NS	---
A x C	NS	---	*	0.028
B x C	NS	---	*	0.036
A x B x C	NS	---	NS	---

Note: The symbols: (*) = Significant, (**) = High significant and (N.S) = Not significant

The second order interaction among all studied factors showed insignificant effects on N, P, S and Ca leaf concentrations in the first and the second growing seasons, while showed significant effect in K concentration only in the second season.

2. Juice quality traits:

a. Brix reading (T.S.S %):

Data in Table 8 indicated that brix% significantly affected by gypsum rates, in the two seasons. The highest values of brix percentage (22.17 and 22.25%) were recorded with application of 2ton gypsum/fed in the first and the second seasons. The lowest values of brix % (19.73 and 20.46%) were produced under control treatment (zero gypsum). This result is in agreement with Izhar *et al.* (2007) who reported that the brix reading significantly affected by gypsum rates.

Brix % was significantly affected by filter mud cake application with mineral fertilization; these re-

sults were true in the 1st and the 2nd growing seasons. The highest values of brix % (21.26%) were attained by using 2ton filter mud cake with 100% NPK doses in the first growing season, however the highest values (21.71) in the 2nd growing season were recorded by using 1ton filter mud cake with 196.9 N + 35.0 P + 44.9 K (kg/fed.). These results as found by Bokhtiar *et al.* (2002) who reported that using 12.5 ton/hectare press mud/cow dung gave the highest value in respect to brix% (20.58%) than the other treatments in the experiment. Mahar *et al.* (2008) reported that NPK at rate of 225-112-168 kg/ha prove to be more effective to produce significantly greater and better brix%.

Table 8. Effect of gypsum, filter mud cake with inorganic fertilization on Brix reading (T.S.S %) of three sugarcane varieties at plant crop season 2012/2013 and 2013/2014

Gypsum (ton/fed.) (A)	Filter Mud Cake (ton/fed.) + Inorganic Fertilization (kg/fed.) (B)	2012/2013				2013/2014			
		Varieties (C)				Varieties (C)			
		G.T 54-9	G 99-103	G 99-160	Mean	G.T 54-9	G. 99-103	G. 99-160	Mean
Zero	0.00+100%NPK	19.32	19.30	19.63	19.41	19.35	19.76	20.19	19.77
	1ton+100%NPK	19.67	19.60	19.93	19.74	20.16	20.01	20.84	20.34
	2ton+100%NPK	19.85	19.69	20.33	19.96	20.74	20.42	21.76	20.97
	1ton+196.9N+35.0P+44.9K	20.32	19.35	19.71	19.79	21.69	19.59	20.56	20.61
	2ton+173.8N+10.0P+41.8K	19.70	19.87	19.72	19.76	20.31	20.89	20.61	20.60
	Mean	19.77	19.56	19.86	19.73	20.45	20.13	20.79	20.46
1ton	0.00+100%NPK	21.26	21.25	21.33	21.28	20.17	19.58	20.23	19.99
	1ton+100%NPK	21.34	21.33	21.41	21.36	20.36	20.28	21.01	20.55
	2ton+100%NPK	21.39	21.35	21.51	21.42	20.49	19.99	21.96	20.81
	1ton+196.9N+35.0P+44.9K	21.51	21.26	21.35	21.38	21.65	22.61	21.35	21.87
	2ton+173.8N+10.0P+41.8K	21.35	21.40	21.36	21.37	20.89	20.85	20.86	20.87
	Mean	21.37	21.32	21.39	21.36	20.71	20.66	21.08	20.82
2ton	0.00+100%NPK	22.02	22.01	22.09	22.04	19.92	20.78	20.89	20.53
	1ton+100%NPK	22.11	22.09	22.17	22.13	22.72	23.52	22.90	23.05
	2ton+100%NPK	21.91	23.08	22.27	22.42	21.73	22.08	22.77	22.19
	1ton+196.9N+35.0P+44.9K	22.27	22.03	22.12	22.14	23.00	22.77	22.19	22.66
	2ton+173.8N+10.0P+41.8K	20.91	23.13	22.35	22.13	23.52	22.49	22.45	22.82
	Mean	21.85	22.47	22.20	22.17	22.18	22.33	22.24	22.25
(F.M.C + I.F) X Varieties		20.87	20.85	21.02	20.91	19.81	20.04	20.44	20.10
		21.04	21.01	21.17	21.07	21.08	21.27	21.58	21.31
		21.05	21.37	21.37	21.26	20.99	20.83	22.16	21.33
		21.37	20.88	21.06	21.10	22.11	21.66	21.36	21.71
		20.66	21.47	21.14	21.09	21.57	21.41	21.31	21.43
Varieties mean		21.00	21.12	21.15	21.09	21.11	21.04	21.37	21.17

Treatments	F test	L.S.D at 5%	F test	L.S.D at 5%
A	**	0.17	**	0.30
B	**	0.11	**	0.49
A x B	NS	---	**	0.41
C	**	0.11	**	0.16
A x C	**	0.18	**	0.27
B x C	**	0.24	**	0.35
A x B x C	**	0.41	**	0.61

Note: The symbols: (*) = Significant, (**) = High significant and (N.S) = Not significant

Concerning the influence of the studied sugarcane varieties, the obtained results in Table 8 pointed out that brix percentage was significantly affected by the studied sugarcane varieties in the first and the second growing seasons. G. 99-160 Sugarcane variety recorded the highest val-

ues of brix% (21.15 and 21.37%) in the two seasons, whereas the lowest value of brix% (21.00) was recorded with the G.T 54-9 commercial sugarcane variety in the 1st season. On the contrary El-Labbody *et al.* (2011) found that the commercial sugarcane variety G.T. 54-9 surpassed G.98-28 and G.99-160 varieties in brix% in the plant cane and 1st ratoon crops.

The interaction between gypsum rates and filter mud cake with mineral fertilization had a significant effect on brix% only in the second growing season. The highest values of brix% in the second season (23.05%) attained by application of 2ton gypsum and 1ton filter mud cake with 100% doses of NPK (recommended levels).

The interaction between gypsum and the three studied varieties had significant influence on the trait of brix% in the both seasons. The sugarcane variety G. 99-103 recorded the highest values of brix% (22.47 and 22.33%) with 2ton gypsum/fed in the two seasons followed by sugar cane variety G. 99-160 (22.20 and 22.24%) with the same rate of gypsum.

Regarding the interaction between the filter mud cake with inorganic fertilization and the studied varieties, sugarcane variety G. 99-103 recorded the highest value of brix% (21.47%) when fertilized by 2ton FMC with inorganic fertilization at rates of 173.8 N+ 10.0 P + 41.8 K in the first growing season, while the sugarcane variety G. 99-160 recorded the first level by 22.16% in the second growing season when the plots which planted by it received 2ton filter mud cake + 100% NPK.

As for the second order interaction there was a significant effect on the trait of brix% in the two growing seasons. The available data in Table (8) showed that the highest brix% (23.13 %) in the 1st season recorded with sugarcane variety G. 99-103 and sugar cane variety G.T 54-9 (23.52%) in the 2nd season when fertilized by 2ton gypsum and 2ton filter mud cake with inorganic fertilization at rate of 173.8, 10.0 and 41.8 NPK (kg/fed.).

b. Sucrose percentage (%):

The obtained data in Table 9 revealed that sucrose percentage was significantly influenced by the gypsum application in the two growing seasons. The highest values of sucrose% (18.14 and 18.69 %) recorded with adding 2 ton gypsum/fed. corresponding the lowest sucrose% (16.76 and 17.00) recorded with control in the 1st and the 2nd growing seasons, respectively. This finding is in agreement with that obtained by Izhar *et al.* (2007) who stated that sucrose percentage showed significant improvement due to gypsum application. These results may be due to the results of adding gypsum which had better influence on soil quality parameters, along with 50% Gypsum requirement significantly reduced the soil pH under poor quality irrigation water and also registered low EC (exchangeable cations) as said by Udayasoorian *et al.* (2009).

Results in Table 9 showed significant difference in sucrose% due to application of filter mud cake with inorganic fertilization in the both growing seasons. The highest sucrose% (17.65 and 18.13 %) was gained plants treated by 1ton filter mud cake and 196.9 N + 35.0 P + 44.9 K (kg/fed.), however, control treatment of filter mud cake with inorganic fertilization produced the lowest values of sucrose% (16.99 and 16.92%) in the first and the second

growing seasons, respectively. Sarwar *et al.* (2010) found that using of 7.3 Mg/ha i.e. 100 % N_2 through PM (168-98.5-54.74 NPK kg/ha) + 0-13.5-57.25 NPK kg/ha. gave the maximum sucrose (18.81%).

Data given in the Table (9) pointed out that there were insignificant differences in sucrose percentage among the studied varieties in the first growing season, while its effect was significantly in the second growing seasons. The highest sucrose% (17.76%) was obtained from the commercial sugarcane variety G.T 54-9. Moreover, the lowest sucrose% (17.32 and 17.47%) were found with G. 99-103 sugar cane variety in the 1st and the 2nd growing seasons, respectively. Osman *et al.* (2010) reported that varieties, i.e. G.T.54-9, Phil.8013 and G.98-28 and G.84-47 of sugarcane, had significant effect on sucrose% in the plant cane and 1st ratoon crops.

El-Labbody *et al.* (2011) cleared that sugarcane varieties differed significantly, where G.98-28 variety recorded the highest sucrose.

Table 9. Effect of gypsum, filter mud cake with inorganic fertilization on sucrose (%) of three sugarcane varieties at plant crop season 2012/2013 & 2013/2014

Gypsum (ton/fed.) (A)	Filter Mud Cake (ton/fed.) + Inorganic Fertilization (kg/fed.) (B)	2012/2013 Varieties (C)				2013/2014 Varieties (C)			
		G.T 54-9	G 99-103	G 99-160	Mean	G.T 54-9	G. 99-103	G. 99-160	Mean
Zero	0.00+100%NPK	16.26	16.36	16.53	16.39	16.19	16.42	16.59	16.40
	1ton+100%NPK	16.52	16.61	16.98	16.70	16.55	16.76	17.35	16.89
	2ton+100%NPK	16.55	16.68	17.33	16.85	16.52	16.86	17.87	17.08
	1ton+196.9N+35.0P+44.9K	17.30	16.58	17.26	17.05	17.79	16.82	18.02	17.54
	2ton+173.8N+10.0P+41.8K	16.61	16.83	16.95	16.80	16.72	17.09	17.39	17.07
	Mean	16.65	16.61	17.01	16.76	16.76	16.79	17.45	17.00
1ton	0.00+100%NPK	17.25	16.69	17.11	17.02	17.28	16.16	16.96	16.80
	1ton+100%NPK	17.17	17.10	17.13	17.13	17.06	16.93	16.96	16.98
	2ton+100%NPK	17.36	17.14	17.93	17.48	17.44	17.00	18.50	17.65
	1ton+196.9N+35.0P+44.9K	17.82	17.75	16.83	17.47	18.30	18.26	16.38	17.65
	2ton+173.8N+10.0P+41.8K	17.30	17.34	17.22	17.28	17.33	17.38	17.16	17.29
	Mean	17.38	17.20	17.24	17.28	17.48	17.15	17.19	17.27
2ton	0.00+100%NPK	17.52	17.54	17.67	17.58	17.46	17.49	17.71	17.55
	1ton+100%NPK	18.40	18.21	18.23	18.28	19.17	18.80	18.80	18.92
	2ton+100%NPK	18.45	18.67	18.06	18.39	18.89	19.26	18.42	18.86
	1ton+196.9N+35.0P+44.9K	18.81	18.18	18.27	18.42	19.92	18.77	18.91	19.20
	2ton+173.8N+10.0P+41.8K	17.60	18.06	18.35	18.00	19.80	18.00	18.95	18.92
	Mean	18.16	18.13	18.12	18.14	19.05	18.47	18.56	18.69
(F.M.C + I.F) X Varieties		17.01	16.87	17.10	16.99	16.98	16.69	17.09	16.92
		17.36	17.31	17.45	17.37	17.60	17.50	17.70	17.60
		17.45	17.50	17.77	17.57	17.62	17.71	18.26	17.86
		17.98	17.50	17.46	17.65	18.67	17.95	17.77	18.13
		17.17	17.41	17.50	17.36	17.95	17.49	17.83	17.76
Varieties mean		17.40	17.32	17.46	17.39	17.76	17.47	17.73	17.65

Treatments	F test	L.S.D at 5%	F test	L.S.D at 5%
A	**	0.25	**	0.53
B	**	0.17	**	0.24
A x B	NS	---	*	0.42
C	NS	---	**	0.20
A x C	**	0.21	**	0.34
B x C	**	0.28	**	0.44
A x B x C	**	0.48	**	0.76

Note: The symbols: (*) = Significant, (**) = High significant and (N.S) = Not significant

Sucrose percentage affected significantly by the interaction of gypsum x filter mud cake with inorganic fertilization in the second growing season. The highest values of sucrose% (18.42 and 19.20 %) were obtained by adding 2ton gypsum and 1ton filter mud cake with mineral fer-

tilization at rates of 196.9 N + 35.0 P + 44.9 K in the first and the second growing seasons, respectively.

Once more, the interaction between gypsum rates and varieties had significant effect on sucrose percentage in the two growing seasons. The highest level of gypsum (2ton/fed.) with the commercial sugarcane variety G.T 54-9 recorded the highest values of sucrose% (18.16 and 19.05%) in the first and the second growing seasons respectively.

Concerning the influence of the interaction between Filter mud cake with inorganic fertilization and the studied varieties on sucrose%, the obtained results cleared that there was a significant response on sucrose percentage in the two growing seasons. The highest values of sucrose% (17.98 and 18.67 %) were obtained from the commercial sugarcane variety G.T 54-9 when received 1ton FMC with 196.9 N + 35.0 P + 44.9 K (kg/fed.) in the first and the second growing season, respectively followed by G. 99-160 which marked the highest sucrose percentage (17.77 and 18.26%) when fertilized by 2ton filter mud cake with 100 % doses of NPK in the first and the second growing season, respectively.

The 2nd order interaction appeared a significant influence on the values of sucrose% in the two growing seasons. The highest values of sucrose percentage (18.81 and 19.92%) were recorded with the combination between the commercial sugarcane variety G.T 54-9 treated by 2ton gypsum and 1ton filter mud cake with 196.9 N + 35.0 P + 44.9 K (kg/fed.) in the 1st and the 2nd growing seasons, respectively. As for the other studied varieties G. 99-103 marked the second place on the sucrose percentage (18.67 and 19.26%) when received 2ton gypsum and 2ton FMC + 100% NPK followed by the sugarcane variety G. 99-160 which gave the highest values of sucrose% (18.35 and 18.95%) by using 2ton gypsum and 2ton FMC with 173.8 + 10.0 + 41.8 NPK (kg/fed.) in the first and the second growing seasons, respectively. This finding may be reflected the different response of varieties to the different treatment according their gene make up.

c. Juice Purity percentage(%):

Data in Table 10 revealed that despite of the significant effect of gypsum rates on purity% in the 1st growing season, it could be noted that gypsum rates did not attained a positive effect on the purity percentage. The highest purity percentage (84.91%) in the first season resulted from the control treatment (zero gypsum). These results may be due to that gypsum increases the salt (E.C.) of the soil which also increases aggregate stability and water flow. Lingle and Wiegand (1997) reported that each dS/m increase in EC decreased apparent purity (Pol as a percentage of brix) by 1.3%, increased juice conductivity by 0.8 dS/m and increased cane residue (fiber) by 0.5%. It is noted that there were no significant differences between adding 1 or 2ton gypsum/fed. in respect to purity percentage. However, Saroha and Singh (1979) found that every 1% increase in sulphur of leaves as a result of adding gypsum increased purity of juice by 0.033%.

Also, the available data revealed that the differences among filter mud cake with inorganic fertilization rates in their effect on purity percentage were significant only in the first growing season. The highest juice pu-

rity percentage (83.68%) resulted from the application of 1ton filter mud cake with 196.9 N + 35.0 P + 44.9 K (kg/fed.), while the lowest values 81.37% attained from plants treated by 100% recommended doses of NPK without adding filter mud cake. Sarwar *et al.* (2010) found that significant and maximum purity percentage (86.68 %) was obtained in T3 (7.3 Mg/ha i.e. 100 % N_2 through PM (168-98.5-54.74 NPK kg/ha).

Differences among varieties in respect to juice purity percentage were as small as to reach the level of significance in both growing season. However, the commercial sugarcane variety G.T 54-9 surpassed the other varieties in purity percentage (82.90 and 84.13%) in the 1st and the 2nd growing seasons, respectively. These results in agreement with Ismail *et al.* (2008) who found that the tested sugarcane varieties significantly differed in all the studied traits except purity%, they added that the commercial sugarcane variety G.T 54-9 showed superiority in purity percentage.

As for, the interaction between gypsum and filter mud cake with mineral fertilization was significant in the second growing season with respect to purity percentage. The highest purity percentage 85.58% resulted from using 2ton gypsum and 100% NPK doses without adding filter mud cake.

Table 10. Effect of gypsum, filter mud cake with inorganic fertilization on juice purity (%) of three sugarcane varieties at plant crop season 2012/2013 and 2013/2014

Gypsum (ton/fed.) (A)	Filter Mud Cake (ton/fed.) + Inorganic Fertilization (kg/fed.) (B)	2012/2013 Varieties (C)				2013/2014 Varieties (C)			
		G.T 54-9	G 99-103	G 99-160	Mean	G.T 54-9	G. 99-103	G. 99-160	Mean
Zero	0.00+100%NPK	84.15	84.82	84.22	84.40	83.72	83.06	82.13	82.97
	1ton+100%NPK	83.98	84.75	85.18	84.63	82.13	83.81	83.16	83.03
	2ton+100%NPK	83.34	84.68	85.28	84.43	79.59	82.55	82.17	81.44
	1ton+196.9N+35.0P+44.9K	85.09	85.67	87.59	86.11	82.06	85.83	87.66	85.18
	2ton+173.8N+10.0P+41.8K	84.31	84.73	85.96	85.00	82.35	81.86	84.36	82.86
	Mean	84.17	84.93	85.64	84.91	81.97	83.42	83.90	83.10
1ton	0.00+100%NPK	81.17	78.55	80.21	79.98	85.69	82.54	83.81	84.01
	1ton+100%NPK	80.42	80.17	80.01	80.20	83.84	83.58	80.78	82.73
	2ton+100%NPK	81.18	80.27	83.34	81.60	85.16	85.15	84.31	84.87
	1ton+196.9N+35.0P+44.9K	82.86	83.45	78.81	81.71	84.55	80.94	77.06	80.85
	2ton+173.8N+10.0P+41.8K	81.01	81.03	80.61	80.89	83.00	83.50	82.25	82.92
	Mean	81.33	80.69	80.60	80.87	84.45	83.14	81.64	83.08
2ton	0.00+100%NPK	79.57	79.67	79.95	79.73	87.64	84.26	84.83	85.58
	1ton+100%NPK	83.24	82.43	82.22	82.63	84.44	79.92	82.16	82.17
	2ton+100%NPK	84.33	80.93	81.09	82.11	86.97	87.26	80.87	85.04
	1ton+196.9N+35.0P+44.9K	84.46	82.54	82.61	83.21	86.62	82.45	85.30	84.79
	2ton+173.8N+10.0P+41.8K	84.35	78.06	82.10	81.50	84.20	80.06	84.44	82.90
	Mean	83.19	80.72	81.60	81.84	85.98	82.79	83.52	84.10
(F.M.C + I.F) X Varieties		81.63	81.01	81.46	81.37	85.69	83.28	83.59	84.19
		82.54	82.45	82.47	82.49	83.47	82.44	82.03	82.65
		82.95	81.96	83.23	82.71	83.91	84.99	82.45	83.78
		84.14	83.89	83.00	83.68	84.41	83.07	83.34	83.61
		83.22	81.27	82.89	82.46	83.18	81.81	83.68	82.89
Varieties mean		82.90	82.12	82.61	82.54	84.13	83.12	83.02	83.42

Treatments	F test	L.S.D at 5%	F test	L.S.D at 5%
A	**	1.10	Ns	---
B	**	1.35	Ns	---
A x B	Ns	---	*	2.78
C	Ns	---	Ns	---
A x C	**	1.12	**	1.05
B x C	Ns	---	Ns	---
A x B x C	**	2.51	Ns	---

Note: The symbols: (*) = Significant, (**) = High significant and (N.S) = Not significant

Moreover, juice purity percentage differed significantly as a result of the interaction between gypsum rates and the three studied varieties in the two growing seasons. The highest values of Juice purity percentage (85.64%) recorded with G. 99-160 sugarcane variety when using the control treatment of gypsum (zero gypsum) in the first season, however the G.T 54-9 commercial sugarcane variety recorded the highest purity percentage (85.98%) as a result of adding 2ton gypsum/fed. in the second growing season.

The interaction between the rates of filter mud cake with inorganic fertilization and the three studied varieties were not significant either in the first and the second growing seasons with respect to juice purity percentage.

The second order interaction was significant with respect to purity% in the first growing season. The highest values of purity percentage (87.59%) produced from the combination between G. 99-160 sugarcane variety treated by the control of gypsum treatment (zero gypsum) and 1ton filter mud cake with inorganic fertilization at rates of 196.9 N + 35.0 P + 44.9 K (kg/fed.).

d.Reducing sugars percentage (%):

Reducing sugars percentage is very important for sugar industry. It is well known that each molecule of the reducing sugar prevents two molecule of sucrose to be crystallized.

Results in Table 11 revealed that gypsum rates exhibited significant effect on reducing sugars percentage only in the first growing season. An increase in reducing sugars% was recorded as gypsum rates increased from zero up to 2 ton gypsum/fed. It is worth mentioning that the lowest mean values of reducing sugars (0.323 %) obtained with adding 1ton gypsum/fed.

Filter mud cake with inorganic fertilization levels had a significant effect on reducing sugars percentage in the both growing seasons. It could be noted that the lowest values of reducing sugars% (0.316% and 0.288%) attained from using 1ton+ 196.9 N + 35.0 P + 44.9 K (kg/fed.) in the first season and using 1ton filter mud cake with 100% NPK in the second one, respectively. Sarwar *et al.* (2010) found that the highest values in respect of reducing sugars 0.630% attained from the control treatment (0 Press mud + 0 inorganic fertilization).

The trait of reducing sugars% insignificantly affected by the examined sugar cane varieties in the first and the second growing seasons. On contrary Mohamed *et al.* (2012) found that sugarcane cvs. G.T.54-9, G.84-47 and G.2001-79 differed significantly in their reducing sugars.

The interaction between gypsum and filter mud cake with mineral fertilization showed a significant effect in the values of reducing sugars% in the two seasons. The combination between 2ton gypsum/fed. and 1ton filter mud cake with inorganic fertilization at rates of 100% NPK (recommended) recorded the lowest mean values of reducing sugars percentage (0.263 and 0.271%) in the 1st and the 2nd growing seasons, respectively.

The interaction between gypsum and studied varieties showed insig-

nificant effect in respect of reducing sugars percentage in the first and the second growing seasons.

The interaction between filter mud cake with inorganic fertilization and the studied sugar cane varieties significantly affected on reducing sugars percentage only in the first growing season. The lowest reducing sugars percentage (0.295%) marked by the G.99-103 sugar cane variety with 1ton FMC with 100% NPK.

Once more reducing sugars percentage significantly affected by the second order interaction among the three studied factors in the first growing season. The highest values in the trait of reducing sugars percentage 0.586% resulted from applying of 2ton gypsum, 2ton filter mud cake with inorganic fertilization at rates of 173.8 N + 10.0 P + 41.8 K and the G. 99-160 sugarcane variety in the first seasons.

Table 11. Effect of gypsum, filter mud cake with inorganic fertilization on reducing sugars (%) of three sugarcane varieties at plant crop season 2012/2013 and 2013/2014

Gypsum (ton/fed.) (A)	Filter Mud Cake (ton/fed.)+ Inorganic Fertilization (kg/fed.) (B)	2012/2013				2013/2014			
		Varieties (C)				Varieties (C)			
		G.T 54-9	G 99-103	G 99-160	Mean	G.T 54-9	G. 99-103	G. 99-160	Mean
Zero	0.00+100%NPK	0.313	0.305	0.282	0.300	0.292	0.285	0.306	0.294
	1ton+100%NPK	0.301	0.303	0.458	0.354	0.235	0.238	0.366	0.280
	2ton+100%NPK	0.362	0.334	0.327	0.341	0.311	0.312	0.294	0.305
	1ton+196.9N+35.0P+44.9K	0.326	0.355	0.363	0.348	0.305	0.332	0.339	0.325
	2ton+173.8N+10.0P+41.8K	0.375	0.357	0.343	0.359	0.350	0.333	0.320	0.335
	Mean	0.336	0.331	0.355	0.340	0.299	0.300	0.325	0.308
1ton	0.00+100%NPK	0.331	0.336	0.355	0.341	0.309	0.313	0.332	0.318
	1ton+100%NPK	0.341	0.326	0.344	0.337	0.318	0.305	0.320	0.315
	2ton+100%NPK	0.361	0.345	0.332	0.346	0.337	0.322	0.310	0.323
	1ton+196.9N+35.0P+44.9K	0.308	0.277	0.251	0.279	0.287	0.258	0.235	0.260
	2ton+173.8N+10.0P+41.8K	0.255	0.369	0.315	0.313	0.238	0.345	0.294	0.292
	Mean	0.319	0.331	0.319	0.323	0.298	0.308	0.298	0.302
2ton	0.00+100%NPK	0.329	0.312	0.295	0.312	0.308	0.291	0.275	0.291
	1ton+100%NPK	0.279	0.255	0.255	0.263	0.337	0.238	0.238	0.271
	2ton+100%NPK	0.337	0.376	0.333	0.349	0.315	0.292	0.310	0.306
	1ton+196.9N+35.0P+44.9K	0.324	0.312	0.323	0.320	0.306	0.291	0.298	0.298
	2ton+173.8N+10.0P+41.8K	0.549	0.574	0.586	0.570	0.396	0.352	0.333	0.361
	Mean	0.364	0.366	0.358	0.363	0.332	0.293	0.291	0.305
(F.M.C + I.F) X Varieties		0.324	0.318	0.311	0.318	0.303	0.296	0.304	0.301
		0.307	0.295	0.352	0.318	0.297	0.260	0.308	0.288
		0.354	0.352	0.331	0.345	0.321	0.308	0.305	0.311
		0.320	0.315	0.313	0.316	0.299	0.294	0.291	0.294
		0.393	0.433	0.415	0.414	0.328	0.344	0.316	0.329
Varieties mean		0.340	0.342	0.344	0.342	0.310	0.300	0.305	0.305

Treatments	F test	L.S.D at 5%	F test	L.S.D at 5%
A	**	0.014	NS	---
B	**	0.022	**	0.032
A x B	**	0.026	**	0.037
C	NS	---	NS	---
A x C	NS	---	NS	---
B x C	*	0.036	NS	---
A x B x C	**	0.062	NS	---

Note: The symbols: (*) = Significant, (**) = High significant and (NS) = Not significant

While the lowest values of reducing sugars% (0.251%) attained when planting the same sugarcane variety with 1ton gypsum and 1ton filter mud cake with 196.9, 35.0 and 44.9 kg/fed. of N, P and K, respectively.

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تأثير الجبس وطينة المرشحات والتسميد الغير العضوى على الخصائص الكيميائية وجودة العصير لثلاثة أصناف من قصب السكر

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الملخص

أقيمت تجربة حقلية فى مزرعة محطة بحوث ملوى الزراعية بمحافظة المنيا، مصر خلال موسمي ٢٠١٢/٢٠١٣ و ٢٠١٣/٢٠١٤ (قصب غرس) لمعرفة تأثير الجبس وطينة المرشحات مع التسميد الغير عضوى على التركيب الكيميائي وجودة العصير لثلاثة أصناف من قصب السكر. ويمكن تلخيص النتائج التي تم الحصول عليها على النحو التالي:

أظهرت معدلات الجبس تأثيراً معنوياً على نسب النيتروجين والكبريت والكالسيوم فى أوراق قصب السكر في كلا الموسمين ولكن لم تظهر تأثيرمعنوى على محتوى الأوراق من الفوسفور والبوتاسيوم فى كلا الموسميين كما ارتبطت كل زيادة في معدلات الجبس مع زيادة معنوية في جودة العصير (بركس و السكروز) في الموسمين. بالنسبة للنقاوة والسكريات المختزلة تأثرت معنوياً بمعدلات الجبس فقط في موسم النمو الأول ولكن نفس الصفات لم تظهر أستجابة معنوية فى موسم النمو الثانى.

بالنسبة لطينة المرشحات مع التسميد غير العضوي فقد أوضحت البيانات أن لها تأثير معنوي على محتوى الأوراق من النيتروجين والفوسفور والبوتاسيوم والكبريت والكالسيوم وكذلك صفات جودة عصير (البركس والسكروز ونسبة السكريات المختزلة%) في موسمي النمو. النسبة المئوية لنقاوة العصير تأثرت معنوياً فقط فى موسم النمو الأول.

أختلفت الأصناف اختلافاً معنوياً فيما يتعلق بتركيز الأوراق من النيتروجين والفوسفور والبوتاسيوم في موسميين النمو. ولكن لم يكن لها تأثير معنوى فيما يتعلق بتركيزات الأوراق من الكبريت والكالسيوم والنقاوة٪ والسكريات المختزلة٪ في موسمي النمو. وأظهرت تأثيراً معنوياً فى النسبة المئوية للسكروز فقط فى موسم النمو الثانى.

أظهر تفاعل الدرجة الثانية تأثيرات غير معنوية على تركيزات الأوراق من النيتروجين والفوسفور والكبريت والكالسيوم وتأثير معنوى على البركس و السكروز في الموسمين الاول والثاني، بينما أظهرالتفاعل تأثير معنوي على تركيز البوتاسيوم فى الأوراق فقط في الموسم الثاني وأظهر التفاعل تأثير معنوى على نسبة النقاوة والسكريات المختزلة في موسم النمو الأول.