

RESPONSE OF SOME MAIZE HYBRIDS TO DIFFERENT NITROGEN FERTILIZATION LEVELS AND FILTER MUD CAKE FOR SUGAR PRODUCTION.

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ABSTRACT

Two field experiments were conducted at Bardies, Sohag Governorate, Egypt, during the summer seasons of 2011 and 2012. The objective of this investigation aimed to study the response of some maize hybrids to different nitrogen fertilization levels and filter mud cake. A split-split plot design with three replications was used. Two Maize Hybrids (H₁- Single cross Watania-4 and H₂- Three way cross-310) were allocated in the main plots. Nitrogen fertilization levels (N₁- 80, N₂- 100 and N₃ 120 kg N/fed) were distributed in the sub plots. While, organic fertilizer (filter mud cake B₁- Control (without addition, B₂- one ton/fed, B₃- 1.5 ton/fed and B₄- 2 ton/fed) were randomly distributed in the sub-sub plots.

The results indicated that single cross Watania-4 surpassed significantly three way cross 310 in ear length cm, ear diameter cm, number of rows/ear, number of kernel/ear, ear weight gm, grains weight/ear gm, 100-grain weight gm and grain yield (ardab/feddan). There were gradual and significant increases in ear length cm, ear diameter cm, number of rows/ear, number of kernel/ear, ear weight gm, grains weight/ear gm, 100-grain weight gm and grain yield (ardab/feddan) resulted from raising mineral N-level from 80 to 100 and 120 kg N/fed.

There were significant differences in the studied traits as affected by the organic fertilizer (filter mud cake) in both seasons. Under Sohag Governorate conditions of the present work, growing single cross Watania-4 fertilized with 120 N/fed and applied 2.0 ton filter mud cake that were recommended to get the maximum grain yield (ardab/feddan).

Key words: Maize hybrids, ear length, ear diameter, number of rows/ear, ear weight, number of kernel/ear, 100-grain yield and grain yield ardab/fed.

INTRODUCTION

Maize (*Zea mays* L.) is one of the most important cereal crops grown principally during the summer season in Egypt. Nitrogen is very important nutrient element in maize production than other field crops, Shafshak *et al.* (1994) pointed that the increase in mineral N levels from zero to 45, 90 and 135 kg/fed significantly increased ear height, number of ears/plant, ear length, ear diameter, ear weight, 100-grain weight and grain yield/fed. Gouda and El-Banna (1995) stated that number of ears/plant, ear length, 100-grain weight and grain yield/fed were significantly increased by increasing nitrogen fertilizer levels from 60 to 120 kg N/fed. Salem (2000) revealed that applying 120 kg N/fed gave the highest ear length, ear diameter, number of rows/ear, number of kernels/row, ears weight, grain weight/ear, grain yield per feddan. Abd El-Aty (2007) stated that increasing nitrogen fertilizer levels from 60 to 120 kg N/fed significantly increased height, ear length, ear diameter, number of rows/ear, number of kernels/row and grain yield/fed., Attia *et al.* (2008)

stated that application nitrogen fertilization at the level of 125 kg N/fed significantly increased plant and ear height, ear length and diameter, number of ears/plant, number of rows/ear, number of grains/row, ear weight, ear grains weight, 100 grain weight and grain yield yield/fed. compared with other levels (75 and 100 kg N/fed) in both seasons. Ahmed, Manar (2009) declared that ear length was increased with increasing N levels from 40 to 80 and 120 kg N/fed whereas, number of rows/ear, number of grains/row, 100-grain weight, grain shelling percentage, grain yield/plant and grain yield/fed were significantly increased by adding 80 kg N/fed. Similar conclusions were reported by Bamuaafa (2012). Maryam Jasemi *et al.* (2013) reported that nitrogen application significantly affected all studied traits expect number of kernels/ row. Application of 150 kg/ha produced grain yield of 11768 kg/ha while non using nitrogen fertilizer produced of 6547 kg/ha. On the other hand, with increasing nitrogen fertilizer from 150 N kg/ha to 200 N kg/ha decreased grain yield.

Maize hybrids differed in its productivity as well as its response to nitrogen fertilization. Ahmed and Mekki (2005) confirmed that maize S.C. Bashair-13 surpassed T.W.C.-310 in ear length, 100-grain weight and grain yield/feddan. Ibrahim and Hala, Kandil (2007) study aimed to evaluate the yield characters of maize plant CV. single cross-10 (S. C.10) as well as the grain chemical constituents. The highest values of plant height, ear characters (length, diameter and weight) as well as ears and grains yield of corn plants per feddan. Mansour and Abd El Maksoud (2009) pointed out that T.W.C. 310 maize hybrid was superior in each of number of rows/ear, number of grains/row, number of grains/ear. 100-grain weight compared with S.C.-122. Ahmed, Howida (2011) demonstrated that maize hybrids S.C. Watania-4 significantly surpassed T.W.C.-310 for ear height, ear diameter, number of rows/ear, number of grains/row, 200-grain weight, grain yield/fed. Moharram, Zainab (2011) found that four hybrids of maize namely white single cross S.C. Watania, yellow single cross Shams, white three Way Cross-310 and yellow three Way Cross-351 possessed a marked differences in growth characters, yield components and grains quality. Single cross hybrids were superior in ear height, ear diameter, number of rows/ear, number of grains/row, 100-grain weight, grain yield/fed as compared with three-way cross hybrids. Bamuaafa (2012) found that single cross hybrid Watania-4 was superior in plant height, ear height, ear leaf area, ear length, ear diameter, number of rows/ear, number of grains/row, ear weight, grain weight/ear, 100-grain weight and grain yield /fed as compared with three-way cross hybrid in the two growing seasons. Kandil (2013) found that hybrid S.C.-10 gave the maximum 1000-kernel weight with 357 kg N/ha, while the minimum weight of 1000-kernel was obtained by S.C.-129 with nitrogen level 214 kg/ha.

In Egypt, a tremendous mass of filter mud is annually produced as a by-product obtained from the clarification of cane juice in the sugar industries Arafat *et al.* (1992) tried to examine the effect of filter mud cake on soil characteristics cultivated with maize. Data revealed that the application of filter mud cake at rates of 2 and 4% induced significant increase of dry matter yield. Also, it has been observed that filter mud cake raised the

concentrations of NPK as well as the uptake by maize plants. Tejada and Gonzalez, (2004) and Marwa (2007) found that the organic matter in soil play an important role through building up soil aggregates and enhancing proper soil physical and chemical properties. The application of organic matter to examined sand soil improved its physical as well as chemical and fertility properties, characteristic the positive effect of compost application. Azam Shah *et al.* (2010) revealed that integrated application of organic N sources (farmyard manure, poultry manure and filter cake) and mineral N source (urea) resulted an upward trend in the yield of maize crop. Maximum biomass, (9554 kg/ha) and stover yield (8136 kg/ha) of maize were obtained from those treatments where 100% (FYM) was used. Maximum grain yield (1838 kg/ha) was recorded from treatment where 25% farmyard manure (FYM) and 75% mineral nitrogen source (urea) were used.

MATERIALS AND METHODS

Two field experiments were conducted at Sohag Governorate, Egypt, during the summer of 2011 and 2012 seasons. The aim of this research was to study the response of some maize hybrids to different nitrogen fertilization levels and filter mud cake. A split-split plot design with three replications were used. Two Maize Hybrids (H₁- Single cross Watania-4 and H₂- Three way cross-310) were allocated in the main plots. Nitrogen fertilization levels (N₁- 80, N₂- 100 and N₃- 120 kg N/fed) were distributed in the sub plots. While, organic fertilizer (filter mud cake B₁- Control without addition, B₂- one ton/fed, B₃- 1.5 ton/fed and B₄- 2 ton/fed) were randomly distributed in the sub-sub plots. The experimental unit area was 10.5 m² (1/400 feddan). Nitrogen fertilizer was applied on tow doses. The 1st dose of nitrogen fertilization was added before the first irrigation, the 2nd dose of nitrogen fertilization was added before the second irrigation in the form of Urea (46.5% N) [CO (NH₂)₂]. Filter mud cake contents, total N (2.05%), total P (1.49%) and total K (0.95%) and Macro elements (mg/kg) i.e., Fe, 7540, Mn 281, Zn 102 and Cu173, organic mater 31.60%, organic C% 18.33, PH (1:5) Susp 7.61 EC (dsm-1) (1:5) 1.050 C/N Ratio 9:1. Chemical and physical properties of the experimental soil are presented in Table (1).

At harvest time on the first week of October of two seasons, the inner tow rows of each plot were harvested and the ears were collected, counted and weighted, a sample of 5 ears from each plot was taken at random and the following data were recorded: 1- Ear length (cm). 2- Ear diameter (cm). 3- Number of rows/ear. 4- Number of kernel/ear. 5- Ear weight (gm). 6- Grains weight/ear (gm). 7- 100 - grain weight (gm), adjusted to 15.5% moisture. 8- Grain yield (ardab/feddan). It was determined by the weight of grains per kilograms adjusted to 15.5% moisture content of each plot, then converted to ardab/feddan (one ardab = 140 kg) The data were statistically analyzed according to Gomez and Gomez (1984), using the computer "MSTAT-C" statistically analysis package by Freed *et al.* (1989). The least significant differences (LSD) treatment at probability level at 0.05 was manually calculated to compare the differences among means

Table 1: Physical and chemical properties of the upper 40 cm of the experimental soil sites

Season		2011	2012
Physical analysis	Sand %	43.60	42.00
	Silt %	27.20	24.71
	Clay %	29.20	33.29
Soil texture		Clay Loam	Clay Loam
Chemical analysis	N Available (ppm)	0.22	0.20
	Total - P (%)	0.04	0.05
	Total - K (%)	0.09	0.07
	CaCo3 %	0.85	1.38 %
	Co3 Meq / 100g	Absent	Absent
	HCo3 Meq / 100g	0.57	0.22
	Cl - Meq / 100g	0.77	0.24
	So4= Meq / 100g	0.60	0.60
	Ca++ Meq / 100g	0.87	0.50
	Mg ++ Meq / 100g	0.45	0.30
	Na+ Meq / 100g	0.25	0.16
	K+ Meq / 100g	0.27	0.1 0
	EC (ds/m) (1:5)	1.021	1.010
	PH	7.85	7.25
Organic mater		1.09	0.87 %

Table 2: Chemical composition of filter mud cake used in the experiments.

Macro elements (%)	Total -N (%)	2.05
	Total - P (%)	1.49
	Total - K (%)	0.95
Macro elements (mg/kg)	Fe	7540
	Mn	281
	Zn	102
	Cu	173
	Organic matter %	31.60
	Organic - C %	18.33
	PH (1:5) Susp	7.61
	EC (dsm-1) (1:5)	1.050
	C/N Ratio	9:1

RESULTS AND DISCUSSION

1. Ear length, ear diameter and number of rows/ear:

The results in Tables 3 and 4 clearly showed that maize hybrids were significant differences in ear length, ear diameter and number of rows/ear in both seasons. Single cross Watania-4 hybrid produced the highest ear length, ear diameter and number of rows/ear which were 23.24, 4.04 and 12.96 cm in 2011 and 21.84, 4.12 and 12.84 in 2012 seasons, respectively. These results could be attributed to the genetic differences among the two studied hybrids. Similar results were obtained by Ahmed, Manar (2009).

The results in Tables 3 and 4 showed that ear length, ear diameter and number of rows/ear were affected by application of nitrogen fertilizer levels, the highest values (23.34, 4.24 and 13.30 in 2011 season and 21.95, 4.27 and 13.28 rows/ear) being at 120 kg N/fed in 2012 seasons, respectively, where the lowest value of (21.24, 3.50 and 11.80 in 2011 season and 20.15, 3.61 and 11.76 rows/ear in 2012 season, respectively, were recorded at level 80 kg N/fed in the two seasons. This is to be expected since nitrogen fertilizer may activate vegetative growth and consequently increased plant and ear height. Therefore, the amount of metabolites may be increased in such case which contributed to a large extent in increasing yield components of corn. These results are in harmony with those reported by Attia *et al.* (2008), Ahmed, Manar (2009), Mansour and Abd El Maksoud (2009) and Maryam, Jasemi *et al.* (2013).

Results given in Tables 3 and 4 clearly showed that ear length, ear diameter and number of rows/ear were statistically affected by filter mud cake applications. These effects were true in the 1st and 2nd seasons. Regardless the significant effect, the available results revealed that the most effective dose of filter mud cake on ear length, ear diameter and number of rows/ear were between control or 1.0 and 2 ton/fed. The positive effect of filter mud cake on number of rows/ear is mainly due to important role of filter mud cake as the most important element in building up plant organs.

The effect of the maize hybrids x nitrogen fertilizer levels interaction on ear length was insignificantly in both seasons, while, ear diameter was affected in the second season only. Moreover, number of rows/ear were significantly affected in both seasons.

The effect of the maize hybrids x filter mud cake interaction on ear diameter/cm was significantly in both seasons, while, ear length affected in the second season and number of rows/ear affected in the first season only. The highest ear diameter/cm was 4.57 and 4.63 cm which recorded by H₁ and 2.0 ton/fed. filter mud cake in the 1st season and 2nd seasons, respectively.

The effect of nitrogen fertilizer levels x filter mud cake on ear diameter was significantly in both seasons. Ear length was affected in the second season only. Number of rows/ear was significantly affected in the interaction among nitrogen fertilizer levels x filter mud cake in both seasons. The highest number of rows/ear were 14.37 and 14.43 which recorded by 120 kg N/fed and 2.0 ton/fed filter mud cake in the 1st and 2nd seasons, respectively.

Ear diameter was significantly affected by the interactions among the three studied factors in both seasons, while, ear length and number of rows/ear significantly affected only in the first season. Planting H₁ and fertilizing with 120 kg N/fed and 2.0 ton filter mud cake gave the highest ear length, ear diameter and number of rows/ear.

2. Ear weight (gm), number of kernel/ear and grains weight/ear (gm):

The results in Tables 5 and 6 showed that maize hybrids were significant differences in ear weight gm in both seasons, while, number of kernel/ear and grains weight/ear gm were significant in the first season only. Single cross Watania-4 hybrid produced the highest ear weight/gm, number

of kernel/ear and grains weight/ear gm (213.21 gm, 577.59 and 169.20 gm in 1st season and 259.34 gm, 565.22 and 196.61 gm) in the 2nd season, respectively. These results could be attributed to the genetic differences among two hybrids studied. Similar results were obtained by Ahmed, Manar (2009). The results in Tables 5 and 6 showed that ear weight/gm, number of kernel/ear and grains weight/ear gm were affected by nitrogen fertilizer levels in both seasons, the highest values 215.97 gm, 616.28 and 172.94 gm in 1st season and 256.99 gm, 606.71 and 197.88 gm being at 120 kg N/fed in the 2nd season, respectively. Where, the lowest values which were 201.56 gm, 520.84 and 155.81 gm in the 1st season and 247.51 gm, 513.50 and 197.88 gm in the 2nd season, respectively were recorded at nitrogen fertilizer level of 80 kg N/fed. in the tow seasons. This is to be expected since nitrogen fertilizer may activate vegetative growth. Therefore the amount of metabolites may be increased in such case which contributed to a large extent in increasing yield components of corn. These results are in harmony with those reported by Attia *et al.* (2008), Ahmed, Manar (2009), Mansour and Abd El Maksoud (2009) and Maryam, Jasemi *et al.* (2013).

Results given in Tables 5 and 6 clearly showed that was statistically affected by filter mud cake applications. These effects were true in the 1st and 2nd seasons. Regardless the significant effect, the available results revealed that the most effective dose of filter mud cake on ear weight/gm, number of kernel/ear and grains weight/ear gm were between control or 1.0 and 2 ton/fed. The positive effect of filter mud cake ear weight gm, number of kernel/ear and grains weight/ear gm is mainly due to important role of filter mud cake as the most important element in building up plant organs.

The effect of the maize hybrids x nitrogen fertilizer levels interaction on ear weight gm and number of kernel/ear were significantly in both seasons.

The effect of the maize hybrids x filter mud cake interaction on ear weight/gm, number of kernel/ear and grains weight/ear were significantly in both seasons. The effect of nitrogen fertilizer levels x filter mud cake interaction on number of kernel/ear was affected in both seasons, while, ear weight/gm and grains weight gm significantly affected in the 1st season only.

Ear weight/gm was significantly affected by the interactions among the three studied factors in the first season only, while, number of kernel/ear and grains weight/ear gm significantly affected in the second season only. Planting H₁ and fertilized with 120 kg N/fed and application of 2.0 ton filter made cake gave the highest ear weight/gm.

3- 100-grain weight (gm) and grain yield ardab/feddan.

Results in Tables 7 and 8 clearly showed that the two maize hybrids differed significantly for 100- grain weight/gm and grain yield ardab/fed in both seasons. Single cross Watania-4 H₁ surpassed three ways cross-310 H₂ in 100- grain weight/gm by 2.31 and 2.02 gm and grain yield by 2.39 and 2.49 ardab/fed in 2011 and 2012 seasons, respectively. These results could be attributed to the genetic differences among two studied hybrids. Similar results were obtained by Abd El-Aty (2007), Ahmed, Manar (2009), Ahmed, Howida (2011), Moharam, Zainab (2011) and Kandil (2013).

Results presented in Tables 7 and 8 revealed that increasing nitrogen fertilizer rates significantly increased 100-grain weight (gm) and grain yield ardab/fed in both seasons. Highest 100-grain weight/gm (36.06 and 41.70 gm) and highest grain yield (24.25 and 27.74 ardab/fed) were obtained at 120 kg N/fed in both seasons, respectively. Whereas the lowest one (32.71 and 38.29 gm and 21.34 and 24.24 ardab/fed) were recorded when applied 80 kg N/fed in the two season, respectively. These results may be due to the increase of photosynthetic surface, which in turn resulted in an increase in metabolic processes and building more grain yield. Furthermore, the effect of nitrogen in increasing the vegetative growth and its components consequently increased the 100- grain weight and grain yield. These results are confirmed by those reported by Attia *et al.* (2008), Ahmed, Manar (2009), Mansour and Abd El Maksoud (2009), Maryam Jasemi *et al.* (2013).

Results in Tables 7 and 8 clearly indicated that application of filter mud cake (FMC) as organic fertilizer has a significant influence on 100-grain weight/gm and grain yield (ardab/feddan) in both seasons. In general, 100-grain weight/gm and grain yield ardab/feddan gradually increased by increasing FMC rate. The increase of yield supplied with 1.0, 1.5 and 2.0 ton FMC/fed over the control were 2.54, 4.37 and 6.15 gm and 2.19, 3.53 and 5.09 ardab/fed, respectively, in the first season, while in the second season these values were 2.54, 4.18 and 5.66 gm and 2.01, 3.42 and 4.79 ardab/fed, respectively. The increase in 100-grain weight/gm and grain yield (ardab/feddan) as result of FMC application may be due to the increase of dry matter yield. Also, it has been observed that filter mud cake raised the concentrations of NPK as well as the uptake by maize plants (Arafat *et al.* 1992). This is due to stimulation effect on plant growth of treated plants and increases the ability of such plant to form more metabolites required for building more plant organs. These results are in line with those obtained by Azam Shah *et al.* (2010) and Ossom and Dlamini (2012).

The effect of the maize hybrids x nitrogen fertilizer levels interaction on 100-grain weight/gm and grain yield ardab/fed were significantly in both seasons. Highest weight of 100-grain and grain yield ardab/fed were 37.49 and 42.67 gm and 25.09 and 28.77 ardab/fed which recorded by H₁ with using 120 kg N/fed. in the 1st and 2nd seasons, respectively. The effect of the maize hybrids x filter mud cake interaction on 100-grain weight/gm was significantly in both seasons, while, grain yield affected in the first season only. The highest 100-grain weight/gm was 38.64 gm and 43.48 gm which recorded by H₁ which fertilized with 2.0 ton/fed. filter mud cake in the 1st and 2nd seasons, respectively.

The effect of nitrogen fertilizer levels x filter mud cake interaction on 100-grain weight/gm was significantly in both seasons, while, grain yield ardab/fed affected in the second season only. Highest weight of 100-grain were 39.33 and 43.81 which recorded by fertilizing with 120 kg N/fed and a rate of 2.0 ton/fed, while, the highest grain yield ardab/fed. were 29.88 ardab/fed which recorded by application of 120 kg N/fed and FMC at a rate of 2.0 ton/fed in the second season only. Grain yield ardab/fed was significantly affected by the interactions among the three studied factors in the second season only, planting H₁ and application of 120 kg N/fed and FMC at a rate of 2.0 ton filter made cake gave the highest grain yield ardab/fed which were 30.95 ardab/fed in the second season.

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استجابة بعض هجن الذرة الشامية لمستويات مختلفة من التسميد النيتروجيني وطينة المرشحات لاستخلاص السكر

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أجريت تجربتان حقليتان بمحافظة سوهاج مصر العليا خلال موسمي صيفيين ٢٠١١ و ٢٠١٢ بهدف دراسة استجابة بعض هجن الذرة الشامية لمستويات مختلفة من التسميد النيتروجيني واستخدام طينة المرشحات كسماد عضوي. استخدم تصميم القطع المنشقة مرتين في ثلاث مكررات حيث وضعت هجن الذرة الشامية (هجين فردي وطنيه-٤ ، والهجين الثلاثي-٣١٠) في القطع الرئيسية ووضعت مستويات التسميد النيتروجيني (٨٠ ، ١٠٠ ، ١٢٠ كجم نيتروجين للفدان) في القطع الشقيه الاولى بينما وضع التسميد بطينة المرشحات الناتجة من مصانع السكر (بدون ، ١ طن ، طن ونصف ، اثنين طن للفدان) في القطع الشقيه الثانيه وتم الحصول على النتائج التاليه

أوضحت النتائج تفوق معنوي للهجين فردي وطنيه-٤ على الهجين الثلاثي-٣١٠ في طول وقطر الكوز وعدد الصفوف للكوز وعدد حبوب الكوز ووزن الكوز ووزن حبوب الكوز ووزن ١٠٠ حبه بالجرام وكذ محصول الحبوب بالاردب للفدان.

أوضحت النتائج زيادة في طول وقطر الكوز وعدد الصفوف للكوز وعدد حبوب الكوز ووزن الكوز ووزن حبوب الكوز ووزن ١٠٠ حبه بالجرام وكذ محصول الحبوب بالاردب للفدان تدريجيا ومعنويا بزيادة مستوى السماد النيتروجيني المعدني من ٨٠ الى ١٠٠ وحتى ١٢٠ كجم/ن/فدان.

أوضحت النتائج ان هناك فروق معنويه في جميع الصفات المدروسه نتيجة استخدام التسميد بطينة المرشحات من مصانع السكر في كلا الموسمين

يمكن التوصية بزراعة الهجين فردي وطنيه-٤ واطافة ١٢٠ كجم نيتروجين للفدان مع استخدام ٢ طن من طينة المرشحات الناتجة من مصانع السكر للحصول على أعلى محصول من الحبوب بالاردب للفدان للذرة الشامية تحت ظروف محافظة سوهاج.

Table 3: Means of Ear length, ear diameter (cm) and number of rows/ear of maize hybrids as affected by nitrogen fertilizer levels and filter mud cake and their interactions in 2011 season

Maize hybrids (A)	N-levels kg N/fed (B)	2011														
		Ear length (cm)					Ear diameter (cm)					Number of rows/ear				
		Flitter mud cake FMC (C)				Average	Flitter mud cake FMC (C)				Average	Flitter mud cake FMC (C)				Average
		Control	1.0 ton	1.5 ton	2.0 ton		Control	1.0 ton	1.5 ton	2.0 ton		Control	1.0 ton	1.5 ton	2.0 ton	
H ₁	80 kg	19.43	21.90	22.73	24.37	22.11	3.20	3.50	3.87	4.20	3.69	11.20	12.00	12.60	13.27	12.27
	100 kg	20.50	23.47	24.43	22.50	23.48	3.47	3.90	4.13	4.53	4.01	11.67	12.53	13.33	14.00	12.88
	120 kg	21.60	23.77	25.23	25.90	24.13	3.80	4.27	4.67	4.97	4.43	12.47	13.47	14.20	14.73	13.72
Average		20.51	23.04	24.13	25.26	23.24	3.49	3.89	4.22	4.57	4.04	11.78	12.67	13.38	14.00	12.96
H ₂	80 kg	17.17	20.33	21.37	22.60	20.37	2.97	3.13	3.40	3.70	3.30	10.27	11.33	11.53	12.20	11.33
	100 kg	18.50	21.53	22.37	23.37	21.44	3.30	3.60	3.83	4.03	3.69	10.80	11.33	12.20	13.13	11.87
	120 kg	19.83	22.60	23.50	24.30	22.56	3.57	3.90	4.20	4.53	4.09	11.60	12.53	13.40	14.00	12.88
Average		18.50	21.49	22.41	23.42	21.46	3.28	3.54	3.81	4.05	3.68	10.89	11.73	12.38	13.11	12.03
N levels kg N/fed	80 kg	18.30	21.12	22.05	23.48	21.24	3.08	3.32	3.63	3.95	3.50	10.73	11.67	12.07	12.73	11.80
	100 kg	19.50	22.50	23.40	24.43	22.46	3.38	3.75	3.98	4.28	3.85	11.23	11.93	12.77	13.57	12.38
	120 kg	20.72	23.18	24.37	25.10	23.34	3.68	4.08	4.43	4.75	4.24	12.03	13.00	13.80	14.37	13.30
Average FMC		19.51	22.27	23.27	24.34		3.38	3.72	4.02	4.33		11.33	12.20	12.88	13.56	

LSD at 0.5 level for:

Maize hybrids (A)	0.43	0.07	0.13
Nitrogen (B)	0.21	0.06	0.16
Flitter mud cake (C)	0.23	0.08	0.15
A x B	NS	NS	0.22
A x C	NS	0.11	0.22
B x C	NS	NS	0.26
A x B x C	0.57	0.19	0.37

Table 4: Means of Ear length, ear diameter (cm) and number of rows/ear of maize hybrids as affected by nitrogen fertilizer levels and filter mud cake and their interactions in 2012 season

Maize hybrids (A)	N-levels kg N/fed (B)	2012														
		Ear length (cm)					Ear diameter (cm)					Number of rows/ear				
		Flitter mud cake FMC (C)					Flitter mud cake FMC (C)					Flitter mud cake FMC (C)				
		Control	1.0 ton	1.5 ton	2.0 ton	Average	Control	1.0 ton	1.5 ton	2.0 ton	Average	Control	1.0 ton	1.5 ton	2.0 ton	Average
H ₁	80 kg	18.83	20.57	21.63	22.37	20.85	3.27	3.70	3.90	4.30	3.79	11.40	11.87	12.40	13.00	12.17
	100 kg	19.33	21.53	22.67	23.53	21.77	3.57	4.00	4.30	4.73	4.15	11.93	12.47	13.07	13.73	12.80
	120 kg	20.57	22.48	23.50	24.67	22.80	3.90	4.30	4.63	4.87	4.43	12.60	13.20	13.73	14.67	13.55
Average		19.58	21.52	22.60	23.52	21.84	3.58	4.00	4.28	4.63	4.12	11.98	12.51	13.07	13.80	12.84
H ₂	80 kg	16.60	19.17	20.53	21.53	19.46	3.03	3.30	3.57	3.80	3.43	10.73	11.07	11.40	12.20	11.35
	100 kg	17.60	19.53	21.40	22.63	20.29	3.30	3.63	3.97	4.27	3.79	11.20	11.67	12.27	13.13	12.07
	120 kg	18.63	20.67	22.00	23.13	21.11	3.70	3.97	4.20	4.57	4.21	11.80	12.53	13.47	14.20	13.00
Average		17.61	19.79	21.31	22.43	20.29	3.34	3.63	3.91	4.11	3.77	11.24	11.76	12.38	13.18	12.14
N levels kg N/fed	80 kg	17.72	19.87	21.08	21.95	20.15	3.15	3.50	3.73	4.05	3.61	11.07	11.47	11.90	12.60	11.76
	100 kg	18.47	20.53	22.03	23.08	21.03	3.43	3.82	4.13	4.50	3.97	11.57	12.07	12.67	13.43	12.43
	120 kg	19.60	21.57	22.75	23.90	21.95	3.80	4.13	4.42	4.72	4.27	12.20	12.87	13.60	14.43	13.28
Average FMC		18.59	20.66	21.96	22.98		3.46	3.82	4.09	4.42		11.61	12.13	12.72	13.49	

LSD at 0.5 level for:

Maize hybrids (A)	0.21	0.06	0.18
Nitrogen (B)	0.13	0.07	0.16
Flitter mud cake (C)	0.24	0.06	0.13
A x B	NS	0.09	NS
A x C	0.34	0.09	NS
B x C	0.41	NS	0.22
A x B x C	NS	0.15	NS

Table 5: Means of Ear weight (gm), number of kernel/ear and grains weight/ear (gm) of maize hybrids as affected by nitrogen fertilizer levels and filter mud cake and their interactions in 2011 season

Maize hybrids (A)	N-levels kg N/fed (B)	2011														
		Ear weight (gm)					Number of kernel/ear					Grains weight/ear (gm)				
		Flitter mud cake FMC (C)					Flitter mud cake FMC (C)					Flitter mud cake FMC (C)				
		Control	1.0 ton	1.5 ton	2.0 ton	Average	Control	1.0 ton	1.5 ton	2.0 ton	Average	Control	1.0 ton	1.5 ton	2.0 ton	Average
H ₁	80 kg	196.05	203.50	209.15	214.69	205.85	464.60	529.20	550.07	572.40	529.07	149.25	155.44	162.62	169.11	159.10
	100 kg	202.96	210.18	217.24	223.13	213.38	491.00	579.93	612.13	632.47	578.88	157.90	175.75	173.00	178.91	171.39
	120 kg	209.24	216.13	224.44	231.80	220.40	513.27	642.73	662.00	681.27	624.82	164.45	172.38	181.00	190.53	177.09
Average		202.75	209.93	216.95	223.21	213.21	489.62	583.96	608.07	628.71	577.59	157.20	167.86	172.21	179.52	169.20
H ₂	80 kg	190.64	195.40	199.12	203.95	197.28	447.60	504.93	536.67	561.27	512.62	142.55	149.95	155.98	161.52	152.51
	100 kg	197.64	202.65	208.08	213.14	205.38	471.60	568.60	597.27	613.93	562.85	150.92	157.15	164.43	168.73	160.31
	120 kg	202.65	207.54	213.84	222.08	211.53	500.73	621.53	640.20	668.53	607.75	157.98	165.01	171.81	180.35	168.79
Average		196.98	201.87	207.01	213.06	204.73	473.11	565.02	591.38	614.58	561.07	150.48	157.38	164.07	170.20	160.54
N levels kg N/fed	80 kg	193.35	199.45	204.14	209.32	201.56	456.10	517.07	543.37	566.83	520.84	145.90	152.71	159.30	165.32	155.81
	100 kg	200.30	206.42	212.66	218.13	209.38	481.30	574.27	604.70	623.20	570.87	154.41	166.45	168.71	173.82	165.85
	120 kg	205.95	211.83	219.14	226.94	215.97	507.00	632.13	651.10	674.90	616.28	161.21	168.69	176.41	185.44	172.94
Average FMC		199.86	205.90	211.98	218.13		481.47	574.49	599.72	621.64		153.84	162.62	168.14	174.86	

LSD at 0.5 level for:

Maize hybrids (A)	0.72	9.80	4.91
Nitrogen (B)	0.77	3.67	2.69
Flitter mud cake (C)	0.77	3.37	2.54
A x B	0.77	5.19	NS
A x C	1.09	4.76	1.03
B x C	1.34	5.84	1.26
A x B x C	1.90	NS	NS

Table 6: Means of Ear weight (gm), number of kernel/ear and grains weight/ear (gm) of maize hybrids as affected by nitrogen fertilizer levels and filter mud cake and their interactions in 2012 season

Maize hybrids (A)	N-levels kg N/fed (B)	2012														
		Ear weight (gm)					Number of kernel/ear					Grains weight/ear (gm)				
		Flitter mud cake FMC (C)				Average	Flitter mud cake FMC (C)				Average	Flitter mud cake FMC (C)				Average
Control	1.0 ton	1.5 ton	2.0 ton	Control	1.0 ton		1.5 ton	2.0 ton	Control	1.0 ton		1.5 ton	2.0 ton			
H ₁	80 kg	245.61	251.16	256.04	260.55	253.34	454.67	517.00	540.07	557.40	517.28	182.16	187.90	192.55	195.33	189.48
	100 kg	251.75	257.18	263.40	267.54	259.97	479.00	567.00	607.13	624.13	569.32	188.95	193.37	199.33	203.20	196.21
	120 kg	254.02	263.11	268.28	273.48	264.73	504.60	635.40	621.67	674.53	609.05	197.38	201.41	206.09	211.56	204.11
Average		250.46	257.15	262.57	267.19	259.34	479.42	573.13	589.62	618.69	565.22	189.50	194.23	199.33	203.36	196.61
H ₂	80 kg	233.95	239.24	244.85	248.70	241.69	448.20	506.40	534.20	550.07	509.72	169.85	208.45	182.48	188.63	187.35
	100 kg	237.54	241.16	247.78	251.10	244.40	468.27	570.60	593.93	610.60	560.85	176.86	183.63	190.27	196.10	186.72
	120 kg	242.90	246.65	250.36	257.08	249.25	496.73	618.20	637.40	665.13	608.60	184.51	189.77	194.21	198.07	191.64
Average		238.13	242.35	247.66	252.30	245.11	471.07	565.07	588.51	604.37	558.31	177.07	193.95	188.99	194.26	188.57
N levels kg N/fed	80 kg	239.78	245.20	250.44	254.62	247.51	451.43	511.70	537.13	553.73	513.50	176.00	198.18	187.52	191.98	188.42
	100 kg	244.65	249.17	255.59	259.32	252.18	473.63	568.80	600.53	617.37	565.08	182.91	188.50	194.80	199.65	191.46
	120 kg	248.46	254.88	259.32	265.28	256.99	500.67	626.80	629.53	669.83	606.71	190.95	195.59	200.15	204.82	197.88
Average FMC		244.30	249.75	255.12	259.74		475.60	569.10	589.07	613.64		183.28	194.09	194.16	198.82	

LSD at 0.5 level for:

Maize hybrids (A)	1.16	NS	NS
Nitrogen (B)	0.96	8.38	NS
Flitter mud cake (C)	0.95	9.40	7.96
A x B	1.36	11.84	NS
A x C	1.34	13.29	11.26
B x C	NS	16.28	NS
A x B x C	NS	23.02	16.65

Table 7: Means of 100-grain weight (g) and grain yield ardab/fed of maize hybrids as affected by nitrogen fertilizer levels and organic fertilizer using filter mud cake and their interactions in 2011 season

Seasons		2011										
Maize hybrids (A)	N-levels kg N/fed (B)	100-grain weight (g)					Average	Grain yield ardab/fed				
		Flitter mud cake (C)						Flitter mud cake (C)				
		Control	1.0 ton	1.5 ton	2.0 ton		Control	1.0 ton	1.5 ton	2.0 ton	Average	
H ₁	80 kg	29.65	33.01	35.13	36.82	33.65	19.83	22.87	23.87	24.82	22.82	
	100 kg	32.31	33.90	35.87	38.21	35.07	20.95	23.71	24.64	26.04	23.83	
	120 kg	34.10	36.18	38.81	40.87	37.49	22.94	24.55	25.78	27.11	25.09	
Average		32.02	34.36	36.60	38.64	35.41	21.24	23.71	24.73	25.99	23.92	
H ₂	80 kg	28.10	31.75	33.00	34.24	31.77	17.00	18.90	20.84	22.67	19.85	
	100 kg	30.19	32.66	33.83	34.93	32.90	18.67	20.48	22.01	24.14	21.33	
	120 kg	31.60	33.66	35.5	37.79	34.64	20.73	22.73	24.27	25.85	23.40	
Average		29.97	32.69	34.11	35.65	33.10	18.80	20.70	22.37	24.22	21.53	
N levels kg N/fed	80 kg	28.88	32.38	34.07	35.53	32.71	18.42	20.88	22.31	23.74	21.34	
	100 kg	31.25	33.28	34.85	36.57	33.99	19.81	22.09	23.33	25.09	23.51	
	120 kg	32.85	34.92	37.15	39.33	36.06	21.84	23.64	25.02	26.48	24.25	
Flitter mud cake		30.99	33.53	35.36	37.14		20.02	22.21	23.55	25.11		

LSD at 0.5 level for:

Varieties (A)	1.05	0.17
Nitrogen (B)	0.36	0.35
Flitter mud cake (C)	0.33	0.23
A x B	0.51	0.49
A x C	0.47	0.33
B x C	0.57	NS
A x B x C	NS	NS

Table 8: Means of 100-grain weight (g) and grain yield ardab/fed of maize hybrids as affected by nitrogen fertilizer levels and organic fertilizer using filter mud cake and their interactions in 2012 season

Seasons		2012										
Maize hybrids (A)	N-levels kg N/fed (B)	100-grain weight (g)					Average	Grain yield ardab/fed				
		Flitter mud cake (C)						Flitter mud cake (C)				
		Control	1.0 ton	1.5 ton	2.0 ton		Control	1.0 ton	1.5 ton	2.0 ton	Average	
H ₁	80 kg	35.55	38.92	40.98	43.44	39.72	23.00	25.19	26.58	28.15	25.73	
	100 kg	37.70	39.39	40.65	42.31	40.01	24.39	26.36	27.64	28.92	26.83	
	120 kg	40.11	42.18	43.72	44.69	42.67	25.92	28.64	29.75	30.95	28.77	
Average		37.79	40.16	41.78	43.48	40.80	24.44	26.67	27.99	29.34	27.11	
H ₂	80 kg	33.22	36.60	38.14	39.50	36.75	20.17	22.23	23.51	25.11	22.76	
	100 kg	36.09	38.06	39.59	41.25	38.75	21.98	23.88	25.04	26.65	24.39	
	120 kg	37.51	40.27	42.18	42.94	40.73	24.40	25.77	27.87	28.82	26.71	
Average		35.61	38.31	39.97	41.23	38.78	22.18	23.96	25.47	26.86	24.62	
N levels kg N/fed	80 kg	34.39	37.76	39.56	41.47	38.29	21.58	23.71	25.04	26.63	24.24	
	100 kg	36.89	38.72	40.12	41.78	39.38	23.18	25.12	26.34	27.78	25.61	
	120 kg	38.81	41.22	42.95	43.81	41.70	25.16	27.12	27.78	29.88	27.74	
Flitter mud cake		36.70	39.24	40.88	42.36		23.31	25.32	25.61	28.10		

LSD at 0.5 level for:

Varieties (A)	0.21	0.37
Nitrogen (B)	0.27	0.28
Flitter mud cake (C)	0.40	0.27
A x B	0.39	0.40
A x C	0.06	NS
B x C	0.69	0.46
A x B x C	NS	0.65

