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Impact of Nitrogen Fertilization Levels on Morphophysiological Characters and Yield Quality of Some Maize Hybrids (*Zea mays* L.)

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A FIELD experiment was conducted in two successive seasons 2012 and 2013 at the experimental farm, faculty of agriculture, Kafrelsheikh University, Egypt, to investigate the effect of different nitrogen levels on growth, yield and quality of grains and forage of some maize hybrids (*Zea mays* L.). A split plot design with four replicates was used. Main plots consisted of four nitrogen levels (60, 90, 120 and 150 kg urea/fed) and subplots, including three hybrids of maize (S.C.10, S.C.122 and S.C.124). Results indicated that the effect of nitrogen fertilizer and hybrids effects on chlorophyll a and b, leaf area, the number of grains per ear, number of grains per row, 100 grain weight of maize, grain yield were significant. The S.C.10 was significantly higher than other hybrids in all traits under study except shelling percentage and crude fiber %, which could increase palatability and digestibility of the hybrid. There was no significant difference occur among hybrids in crude fat in both seasons. N management by the application of 150 kg N/fed produced significantly more leaf area, number of grains row^{-1}, number of grains ear^{-1},100-grain weight (g), grain yield (ard /fed), crude fat (%), fresh forage yield (ton/fed, protein (%) in forage yield and grain protein (%) however it had the lowest crude fiber %. Furthermore, there was not find significant difference among N fertilizer levels on oil (%) and moisture (%), however, application of 120 kg N/fed. produced significantly more shelling (%) and fresh forage yield (ton/fed). Thus, it concluded that applying 150 kg N/fed for S.C.10. could be used successfully for improving production of maize grain and forage yield as well as quality traits.

Keywords: *Zea mays* L.**,** N fertilizer, Physiological characters, Grain yield, Quality.

Maize (*Zea mays* L.**)** an important cereal crop of the world, ranked 1*st* in seed yield production (Stephen *et al*., 2006). Maize is one of the important cereal crops in the world's agricultural economy both as food for men and feed for animals (Chandrasekaran *et al*., 2010). In Egypt it is the third most important staple food crop both in terms of area and production after wheat and rice. Total area under cultivation of maize in Egypt is 888329 hectares which is about 25.17 % of the total cultivated agricultural land while average yield is 7.80 ton ha^{-1}.

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It is about 21.90 % of the total cereals production (FAO, 2011). Nitrogen is vital for most plant metabolic activities and plays an important role in tillering, stalk elongation and photosynthesis (Koochekzadeh *et al*., 2009). Its deficiency results in leaf area reduction which causes decreased photosynthesis which in turn leads to suppression of yields and crop quality (Sreewarome *et al*., 2007). The crop has a wider range of uses. These include the following: human food, industrial processed food production of starch and used as forage to feed animals.

Nitrogen fertilization is known to affect the grain production and N concentration of maize (*Zea mays* L.). Increasing N fertilization applications resulted in higher grain N concentrations (Abou El-Hassan *et al*., 2014). Maize plant as a whole is an important forage for many dairy and beef animals. The crop is palatable, quick growing with a high dry matter production and relatively high nutritive value. Dry matter yield of maize is a function of numerous interacting environmental and genetic factors. Temperature and available soil water are major environmental factors, with subsequent influence on leaf area development and subsequent dry matter yield (Dwyer & Stewart, 1986). Maize is commonly fed to livestock as fodder forage or silage (Christopher *et al*., 1966). The feeding of corn fodder is popular in the semi-arid as well as in areas where corn often fails to reach the stage of mature grain. The stalks of the crop at this stage are more palatable and higher in protein than other stages (John &Warren, 1967).

Nitrogen fertilization increased dry matter production, chlorophyll content and leaf area. The increase in leaf to stem ratio with nitrogen application is probably due to the increase in number of leaves and leaf area, producing more and heavy leaves (Gasim, 2001). John & Warren (1967) and Muhammad *et al*. (2012) noted that the addition of nitrogen increased number of grains per row and ear. Koul (1997) recorded that nitrogen application resulted in greater values of grain yield and fresh forage yield were also increased due to addition of nitrogen. Significant differences among maize genotypes in yield and its components were frequently detected by many investigators (Zeynali *et al*., 2005; Zandi, 2012 and Hejazi & Soleymani, 2014). N application at 80 kg N ha^{-1} and 500 kg ha^{-1} rates of lime significantly increased the crop productivity compared to those sown at other N and lime rates (Effa *et al*., 2012).

Maize grain yield per unit area involves multiplying the number of rows per ear, number of kernels per row and grain yield is affected by genotype and environment modified and may reduce or increase. Nitrogen availability affects plant growth and may cause changes in yield components. Increase the rate of accumulation of dry weight of aerial plant population and grain yield per unit area increases, because the increase in leaf area increase the growth rate of the product (Hejazi & Soleymani, 2014). Hence, to improve yield and quality of maize fodder, it is indispensable to decide its nitrogen requirement as the application of nitrogen not only affects the forage yield of maize but also improve its quality especially its protein contents (Khandakar & Islam, 1988). Although the present varieties/hybrids of maize have good yield potential but still yield per feddan is much less to tackle the food security threat.

So, this is the need of time to develop an N management strategy using the available high yielding varieties. So, our study was planned to evaluate the effect of N applications on the yield, forage yield, yield components, and quality attributes of maize hybrids.

Materials and Methods

Plant materials

Three maize hybrids, *i.e.* hybrid single cross (S.C.) 10, 122 and 124 (Table 1) , all of which are widely cultivated in Egypt and four N fertilization levels, *i.e.* 60, 90, 120, 150 kg N/fed were used to study the effect of nitrogen fertilizer levels in two successive seasons 2012 and 2013 on some morphophysiological characters, yield and its components, quality characters and forage yield for three single crosses of maize. The grains were sown on 10 June in 2012 and 14 June in 2013 at the experimental farm, faculty of agriculture, Kafrelsheikh University. A split-plot design with four replications conducted in both seasons, main plots were assigned to nitrogen fertilization levels, while, maize hybrids were randomly distributed in the sub-plots. The size of the sub-plot was 25.2 m^2 (6 rows each row 6 m long and 70 cm rows spacing). Grains were planted in hills spaced 25 cm apart within the row. Maize plants were later thinned to one plant per hill. The first irrigation was applied after 21 days from sowing, while the following irrigations were applied at two or three weeks intervals. Handing hoeings were done before the first and second irrigations and pesticides were sprayed as necessary. Nitrogen fertilizer, according to the treatment, was applied in the form of urea (46.5% N) in two equal doses before the first and second irrigation. Other cultural practices for growing maize were conducted as recommended.

TABLE 1. The pedigree of maize hybrids.

Hybrids	Pedigree
SC10	Sids-7 x Sd-63
SC122	Giza-628 x Gz-603
SC124	Giza-629 x Gz-603

Soil samples were taken for conducting some mechanical and chemical analyses according to A.O. A.C. (2005) and all the data were shown in Tables 2 and 3.

TABLE 2. Mechanical properties of soil used in growing seasons 2012 and 2013.

Year	Clay (%)	Silt (%)	Sand (%)	Textural class
2012	46.0	36.9	17.1	clay
2013	49.0	35.2	15.1	clay

TABLE 3. Chemical properties of soil used in growing seasons 2012 and 2013.

Year	N (ppm)	P (ppm)	K (ppm)	Organic matter (%)	PH	EC (dsm^{-1})
2012	33.5	12.70	291.55	1.5	8.2	0.335
2013	26.3	11.45	292.32	1.6	8.1	0.337

Sakha meteorological station data, during 2012 and 2013 seasons, were recorded. Meteorological data having air temperature, relative humidity (%), and pan evaporation from class A pan are presented in Tables 4 and 5.

TABLE 4. Soil moisture constants for the experimental site.

Soil depth (cm)	Field capacity (%)	Wilting point (%)	Bulk density (g/cm^3)	Available soil water	
				%	mm/ day
0-15	44.12	27.31	1.34	21.51	33.13
15-30	42.23	25.30	1.56	17.03	29.76
30-45	38.42	21.56	1.65	15.28	26.59
45-60	35.36	20.29	1.72	14.37	23.32

TABLE 5. Monthly accumulative pan evaporation (A.P.E), air temperature ^{o}C and relative humidity (%) during 2012 and 2013 seasons.

Seasons	2012						Pan evaporation (mm/day)	2013						Pan evaporation (mm/day)
	Air temperature ^{o}C			Relative humidity (%)				Air temperature ^{o}C			Relative humidity (%)			
Months	Max.	Min.	Mean	Max.	Min.	Mean		Max.	Min.	Mean	Max.	Min.	Mean	
June	30.8	16.2	23.8	80.1	45.0	62.6	7.24	33.2	16.5	24.9	69.0	46.0	57.5	8.40
July	32.0	18.0	25.0	80.4	43.0	61.7	8.13	29.5	15.9	22.7	79.0	46.0	62.5	8.08
August	31.7	18.4	25.1	86.0	53.0	69.5	8.00	32.7	19.1	25.9	86.3	50.0	68.2	8.41
September	34.0	20.0	27.0	92.3	52.1	72.2	7.10	34.3	19.8	27.1	96.0	62.0	79.0	6.86

Sampling and measurements

In 2012 and 2013, five guarded plants from each sub-plot were randomly taken from the second inner ridge at 60 days after sowing (DAS) to measure dry matter production, Chl a, Chl b and leaf area. To measure dry weight of leaves and stems, samples were oven-dried at 70°C until a constant weight. Each part of the plant sample was ground into powder for the determination of total nitrogen content by the Kjeldahl method. The leaf chlorophyll content was determined in representative samples, which was taken from ear-leaf by spectrocolorimeter, using N, N-Dimethyl formamide, according to Moran & Porath (1982). Chlorophyll contents were calculated according to the following formula:

$Chl.a = 12.64\ A_{664} – 2.99\ A_{647}$.

$Chl.b = -5.6\ A_{664} + 23.26\ A_{647}$.

Leaf area/plant in dm^2 measured according to Alessi & Power (1975) using the following formula: Leaf area (LA) = leaf length x maximum leaf width x 0.75. Leaf area in dm^2 of three plants were summed and the leaf area/plant was calculated.

At harvest the following characters were recorded from the inner ridges in each sub-plot: number of grains row^{-1}, number of grains ear^{-1}, 100-kernel weight, shelling % = (weight of grains of five ears/ weight of five ears) and the ears of two inner ridges were harvested in each sub-plot and shelled, and the grains were weighted and adjusted to 15.5% moisture and then transformed to ard/fed . Also to determine grain quality random sample of 200 grams of grains taken of ten ears, randomly. These grains were ground for characters as follows: Grain protein (%) of grains was estimated by the modified Kjeldahl method (A.O.A.C, 1964). Oil % of grains was estimated by Sockselt method (A.O.C.S, 1980) and grain moisture % was estimated using Moisture Tester Model 400M (Dole). Also was determined fiber quality as follows: The protein (%) of forage yield, the crude leaf fiber %, crude fat % and fresh forage yield (ton fed^{-1}).

Statistical analysis

All data were statistically analyzed according to procedures outlines by Gomez & Gomez (1984). The mean values of studied factors were compared at 0.01 and 0.05 level of significance by the Duncan's multiple range test (Duncan, 1955).

Results and discussions

Effect of maize hybrids and N fertilizer levels (kg N/fed)

Results in Table 6 showed that N fertilizer levels significantly influenced dry matter production, Chl a and Chl b at anthesis date on maize hybrids in both successive seasons under study. Dry matter production, Chl a , Chl b and leaf area at anthesis date were the highest at S.C.10 as compared to S.C.122 and S.C.124 the difference in chlorophyll content among hybrids are mainly attributed to the difference in genetical factors. These results supported those obtained by Bahr *et al*. (2006), Szulc *et al*. (2008) and Hafez *et al*. (2014). Regarding the effect of nitrogen levels on dry matter production, Chl a , Chl b and leaf area, there were significantly increased with increasing nitrogen levels up to 150 kg N/fed at anthesis date in both successive seasons. This may be due to the role of nitrogen in increasing leaf area and chlorophyll content of leaves. This in turn caused an increase in photosynthetic nitrogen levels. Similar results were obtained by Bahr *et al*. (2006) and Hafez *et al*. (2014). The increase in leaf area could possibly be ascribed to the fact that nitrogen increases plant growth and plant height and this resulted in more nodes and internodes and subsequently more production of le12345aves (Amin, 2011). In this respect, Jhones *et al*. (1995) found that nitrogen fertilization, significantly increased the number of leaves and they suggested that the increasing in number of leaves may be as a result of increasing number of nodes.

TABLE 6. Dry matter production, Chl a, Chl b and leaf area at anthesis date as affected by some maize hybrids and different nitrogen levels (kg N/fed) during 2012 and 2013 seasons.

Treatments	DMP (g/plant)		Chl.a (mg dm^{-2})		Chl.b (mg dm^{-2})		Leaf area (dm^2/plant)	
	2012	2013	2012	2013	2012	2013	2012	2013
Maize hybrids (H)								
S.C.10	174.87 a	148.54a	7.56 a	6.78 a	2.67 a	1.92 a	77.99a	81.25a
S.C.122	151.12b	122.44b	7.24 b	5.52 b	2.45 b	1.63 b	74.75b	76.45b
S.C.124	138.55c	113.98c	7.24 b	5.72 b	2.29 c	1.65 b	72.85c	72.42c
F-Test	*	*	**	*	**	*	*	*
N-fertilization level (kg N/fed)								
60	154.87c	112.78c	6.05 d	4.75 d	2.37 d	1.45 c	71.55d	74.89d
90	163.23b	128.65b	6.53 c	5.06 c	2.67 c	1.65 b	76.25c	78.25c
120	178.55a	134.69a	6.96 b	5.29 b	2.80 b	1.82 a	79.35b	81.67b
150	181.68 a	139.54a	7.45 a	5.48 a	2.96 a	1.85 a	83.12a	85.25a
F-Test	*	*	**	*	*	*	*	*
H×N interaction	ns	ns	ns	ns	ns	ns	ns	ns

**: highly significant at the 1% level of probability . Means within the same column of each factor followed by a common latter is not significantly different at 5% level, by DMRT.

Data in Table 7 showed that S.C.10 surpassed significantly than S.C.122 and S.C.124 in number of grains row^{-1}, number of grains ear^{-1},100-grain weight (g) and grain yield (ard/fed) during the two successive seasons. The differences in hybrids may be due to the differences in their genetic make up to stress condition and environmental factors affecting developmental processes and ability to thrive and benefit after the available nutrients. Similar results were obtained by Bahr *et al*. (2006) and Hejazi & Soleymani (2014). In addition to high efficiency of that hybrid in photosynthesis process which led to an increase in dry matter production this is in harmony with that obtained by Bahr *et al*. (2006). The data in Table 2 indicated that increasing nitrogen level up to 150 kg N/fed led to significant increasing in number of grains row^{-1}, number of grains ear^{-1},100-grain weight (g) and grain yield (ard/fed) in both successive seasons. The positive increase in yield components demonstrates that N increased assimilates supply for component development and yield set (Akmal *et al*., 2010). These results might be attributed to the effect of nitrogen on the vigor vegetative growth and accumulation of photosynthesis assimilates which produce high number of grains/row and grains/ear and meristematic activity of maize plant and increasing yield attributes as final grain yield. These results are in accordance with Bahr *et al*. (2006) and Shapiro & Wortmann (2006).

From Table 8, it could be noticed that shelling % had a significant effect for S.C.124 in both seasons than S.C.10 and S.C.122. Similar results were reported by El-Moursy & Badwai (1998) and no significant difference among hybrids on crude fat % in both seasons. Both of fresh forage yield and protein % in forage had a high significant difference among hybrids whereas S.C.10 and S.C.122 showed the highest values than S.C.124 in both seasons. These single crosses could be useful for utilization in silage production and animals feeding. Similar results were reported by Radwan *et al*. (2001).

TABLE 7. No. of grains row^{-1}, number of grains ear^{-1},100-grain weight (g) and grain yield (ard /fed) as affected by some maize hybrids and different nitrogen levels (kg N/fed) during 2012 and 2013 seasons.

Treatments	No. of grains row^{-1}		No.of grains ear^{-1}		100-grain weight (g)		Grain yield (ard/fed)	
	2012	2013	2012	2013	2012	2013	2012	2013
Cultivars(V)								
S.C.10	46.3a	47.8a	378.5a	387.4a	47.66a	43.56a	29.25a	26.45a
S.C.122	44.5b	45.5b	360.3b	374.2b	42.45b	35.54b	24.55c	19.67c
S.C.124	43.4b	44.3b	355.4b	359.8c	43.78b	36.43b	27.45b	22.58b
F-Test	**	**	**	**	**	**	**	**
N-fertilization level (kg N/fed)								
60	42.5d	43.3d	285.9d	291.5d	43.22c	39.65c	23.85d	20.40d
90	45.8c	46.3c	312.5c	322.4c	44.38b	39.55c	25.55c	22.25c
120	46.5b	46.9b	345.8b	353.4b	44.88b	40.55b	27.78b	25.85b
150	47.7a	48.1a	408.3a	422.3a	45.75a	41.25a	28.38a	26.32a
F-Test	**	**	**	**	**	**	**	**
V×N interaction	ns	ns	ns	ns	ns	ns	**	**

**: highly significant at the 1% level of probability . Means within the same column of each factor followed by a common latter is not significantly different at 5% level, by DMRT .

TABLE 8. Shelling (%), crude fat (%), fresh forage yield (ton/fed) and protein (%) in forage yield as affected by some Maize hybrids and different nitrogen levels (kg N/fed) during 2012 and 2013 seasons.

Treatments	Shelling (%)		Crude fat (%)		Fresh forage yield (ton/fed)		Protein (%) in forage	
	2012	2013	2012	2013	2012	2013	2012	2013
Cultivars(V)								
S.C.10	80.32c	78.43c	3.01	3.34	15.34a	14.56a	2.75a	2.85a
S.C.122	82.28b	81.88b	2.88	3.25	15.11a	13.98a	2.64a	2.76a
S.C.124	84.47a	83.12a	2.75	3.12	12.24b	11.55b	2.38b	2.48b
F-Test	**	**	ns	ns	**	**	**	**
N-fertilization level (kg N/fed)								
60	80.56d	82.55d	2.35d	2.55d	10.92d	11.65c	2.05d	2.25d
90	82.78b	82.89b	2.85c	3.12c	12.54c	13.75b	2.38c	2.45c
120	83.54a	83.22a	3.15b	3.29b	14.67b	14.45a	2.62b	2.75b
150	81.98c	82.25c	3.55a	3.72a	16.25a	15.78a	2.88a	3.15a
F-Test	**	**	**	**	**	**	**	**
V×N interaction	ns	ns	ns	ns	**	**	ns	ns

**: highly significant at the 1% level of probability . Means within the same column of each factor followed by a common latter is not significantly different at 5% level, by DMRT .

From the same table, it could be noticed that increasing nitrogen fertilizer level up to 150 kg N /fed led to significantly increase in crude fat %, fresh forage yield and protein % in forage in both seasons. However increasing nitrogen fertilizer level up to 120 kg N /fed led to significantly increase than 150 kg N/fed in shelling % in both seasons. Similar results were reported by El-Moursy & Badwi (1998). The increase in fresh yield of forage under nitrogen application can be attributed to the positive effect of nitrogen on all the investigated growth parameters in this study.

Data presented in Table 9 indicated that the variations between single crosses were highly significant for both of oil %, crude fiber % and moisture % in both successive seasons, as well as protein% in the first season only. The highest values were obtained from S.C.10 in both seasons and the lowest for crude fiber % which could increase palatability and digestibility of the hybrid. These results are mainly due to differences in the genetic make up of the evaluated hybrids and this in agreement with those reported by Almodares *et al*. (2009). Concerning the effect of nitrogen fertilizer levels, data in Table 4 revealed that nitrogen fertilizer levels significantly affected protein % and crude fiber % . Protein % gradually increased by increasing N level from 60 up to150 kg N/fed in both seasons. However, increasing nitrogen fertilizer led to significantly decreasing in crude fiber % in both seasons. Similar results were reported by Khan (2008), Almodares *et al*. (2009) and Iqbal *et al*. (2010). Regarding to oil % and moisture %, the results indicated that increasing of nitrogen fertilizer levels up to 150 kg N/fed did not show any significant increase in both seasons, this confirmed with Khan (2008) and Iqbal *et al*. (2010). Increasing grain protein content of maize may be due to an increase in available N-around root zone, which increase nitrogen supply to plant under high fertilization level of nitrogen, whereas, nitrogen plays an important role in the synthesis of protein. Similar results were obtained by Koul (1997) and Almodares *et al*. (2009).

TABLE 9. Grain protein (%), grain oil (%), leaf crude fiber (%) and grain moisture (%) as affected by some maize hybrids and different nitrogen levels (kg N/fed) during 2012 and 2013 seasons.

Treatments	Protein (%)		Oil (%)		Crude fiber (%)		Moisture (%)	
	2012	2013	2012	2013	2012	2013	2012	2013
Cultivars(V)								
S.C.10	10.95a	8.75	5.45a	4.88a	25.45c	27.02c	30.34a	27.56a
S.C.122	10.07b	8.38	4.85b	4.25b	28.87b	29.23b	27.55b	24.43b
S.C.124	10.15b	8.44	4.88b	4.28b	29.43a	31.67a	27.75b	23.78b
F-Test	**	ns	**	**	**	**	**	**
N-fertilization level (kg N/fed)								
60	9.04c	8.55d	4.35	4.54	32.45a	33.78a	28.56	26.14
90	9.38b	8.75c	4.46	4.66	29.56b	29.77b	28.85	26.35
120	10.12ab	9.12b	4.59	4.75	26.78c	27.96c	29.15	26.65
150	10.33a	9.59a	4.58	4.72	24.68d	25.88d	29.32	26.95
F-Test	**	**	ns	ns	**	**	ns	ns
V×N interaction	ns	ns	ns	ns	ns	ns	ns	ns

**: highly significant at the 1% level of probability . Means within the same column of each factor followed by a common latter is not significantly different at 5% level, by DMRT.

Effect of the interaction

The interaction between maize hybrids and nitrogen fertilizer levels had only significant effect on fresh forage yield (ton/fed) and grain yield (ard/fed) in the two growing seasons as shown in Tables 6 and 7 and graphically illustrated in Fig. 1 and 2. The significant highest values of these characters resulted from S.C.10 with application of 150 kg N/fed. Similar results have been reported by Oscar & Tollenaar (2006) who found that the highest fresh forage yield were obtained by increasing both of leaf area and dry matter production, this may due to apply high N fertilizer level on the rate of growth of meristemic cells and the appearance and development of leaves (Ahmad *et al*., 1993). These results are in agreement with those reported by Bahr *et al*. (2006) and Hejazi & Soleymani (2014), and were similar, more or less, with those obtained by Onasanya *et al.* (2009), Khaliq *et al*. (2009), Sharifi & Taghizadeh (2009), Akmal *et al.* (2010), Hammad *et al.* (2011), Dawadi & Sah (2012), Khan *et al*. (2012), Sharifai *et al*. (2012), Moraditochaee *et al*. (2012) and Kandil (2013).

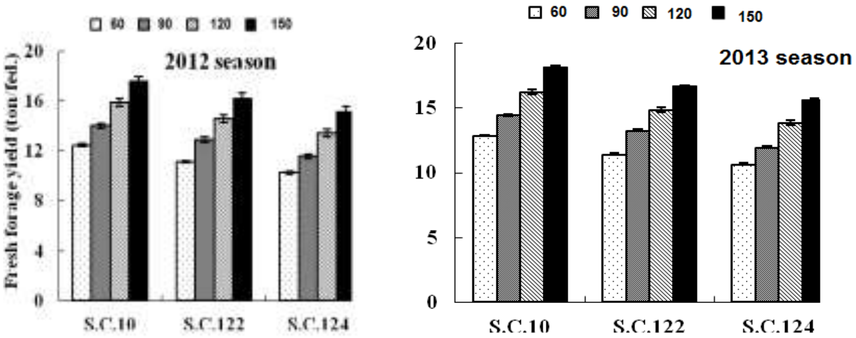

Fig. 1. Fresh forage yield (ton/fed) of maize as affected by the interaction between maize hybrids and nitrogen fertilizer levels (kg N/fed) during 2012 and 2013 seasons. The data are the mean ± standard error of four replicates.

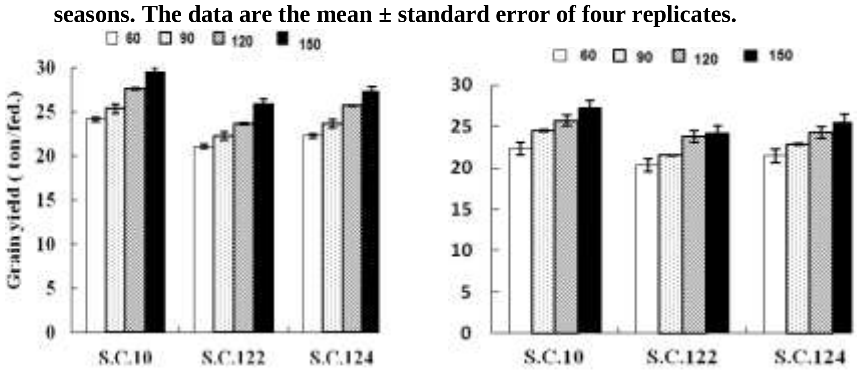

Fig. 2. Grain yield (ard/fed) of maize as affected by the interaction between maize hybrids and nitrogen fertilizer levels (kg N/fed) during 2012 and 2013 seasons. The data are the mean ± standard error of four replicates.

Conclusion

From the above results and discussion, protein and fiber content could be suitable parameters for determining forage quality. In contrary, fiber content has a negative effect on forage quality. Application of nitrogen fertilizer increased the amount of grain and forage protein content and decreased the fiber content in maize hybrids. Therefore, it seems that application of nitrogen fertilizer could increase palatability and digestibility of maize hybrids. Thus, based on above mentioned, it is suggested to apply 150 kg N/fed among the nitrogen treatments and S.C.10 hybrid among the hybrids under the study, both of them together gave the highest values for all traits in this study.

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تأثير معدلات التسميد النيتروجينى على الصفات المورفولوجية والفسيولوجية وجودة المحصول فى بعض الهجن الفردية لنبات الذرة الشامية

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أجريت تجربتان حقليتان بالمزرعة البحثية لكلية الزراعة جامعة كفرالشيخ – مصر خلال موسمى ٢٠١٢ و ٢٠١٣م لدراسة تأثير مستويات السماد النتروجينى على النمو والمحصول وجودة محصول الحبوب ومحصول العلف لبعض هجن الذرة الشامية. التصميم المستخدم كان قطع منشقة مرة واحدة لأربع مكررات حيث وزعت مستويات سماد اليوريا النتروجينى ٤٦,٥ % (٦٠ ، ٩٠ ، ١٢٠ و ١٥٠ كجم نيتروجين/ فدان) على الشرائح الأفقية بينما وزعت هجن الذرة الشامية (هجين الفردى ١٠ ، ١٢٢ و ١٢٤) على الشرائح الرأسية. وقد أوضحت النتائج المتحصل عليها أن تأثير السماد النتروجينى وتأثيرات هجن الذرة الشامية الفردية على المساحة الورقية، عدد الحبوب/الصف، عدد الحبوب/الكوز، وزن الـ ١٠٠ حبة ومحصول الحبوب كان معنوياً، وأن الهجين فردى ١٠ كان الأعلى معنوية من الهجن الأخرى تحت الدراسة فى كل الصفات المدروسة عدا نسبة التصافى، ومن ناحية أخرى لم يكن هناك اختلافاً معنوياً بين الهجن الفردية فى نسبة الدهن الخام فى كلا الموسمين، وعند زيادة معدل السماد النتروجينى إلى ١٥٠ كجم/فدان أدى إلى زيادة معنوية فى كل الصفات المدروسة عدا نسبة الزيت ونسبة الرطوبة. وقد أدى استخدام النيتروجين بمعدل ١٢٠ كجم/فدان إلى زيادة معنوية فى نسبة التصافى ومحصول العلف الأخضر ولم يكن هناك اختلافاً معنوياً بين المستويين ١٢٠ كجم و١٥٠ كجم نتروجين/فدان فى إنتاج المادة الجافة عند التزهير وأيضاً محتوى الكلوروفيل أ و ب وكذلك محتوى العلف الطازج. وبناءاً على النتائج نوصى باستخدام السماد النيتروجينى بمعدل ١٥٠ كجم نيتروجين/فدان للهجين فردى ١٠ من الذرة الشامية للحصول على أفضل محصول من الحبوب والعلف الطازج وكذلك أفضل جودة.