J.Agric.&Env.Sci.Alex.Univ.,Egypt Vol.6 (2)2007

EFFECTS OF SWEET CORN CULTIVARS AND NPK FERTILIZERS APPLICATIONS ON THEIR GROWTH, YIELD,QUALITY AND CHEMICAL COMPOSITION IN NEWLY RECLAIMED SOILS

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ABSTRACT

The aim of this investigation was to study the effect of different sweet corn cultivars (Basin ,Challenger and Shimmer) ,different rates of the mineral NPK fertilizers (0-0-0 ,60-30-30 , 90-45-60 and 120-60-90 Kg N-P_2O_5-K_2O fad.$^{-1}$) and their interactions on the vegetative growth , yield and its components ,kernels quality and chemical composition of leaves characteristics of the studied cultivars. To achieve this aim , two field experiments, in a newly reclaimed calcareous soils , at the Experimental Farm (at El-Noubaria),Horticultural Research Station of the Ministry of Agriculture and Land Reclamation ,during the two summer seasons of 2004 and 2005, were conducted .The results showed ,generally, that the differences among the mean performances values of the used sweet corn cultivars for the vegetative growth , yield , and its components characters, appeared to be significant ; but, with different magnitudes ,in the two seasons .Cultivar Challenger gave the highest significant values for most of vegetative growth characters ; whereas, cultivar Shimmer was the best that reflected the highest significant values for the most studied yield and its component characters, during the two seasons .The increments of application mineral NPK fertilizers were, significantly ,associated with corresponding increases in all vegetative growth ,yield and its component characters, in both seasons. The highest values for the vegetative growth ,yield and its components were given by the application of the NPK fertilizers at the rate of 120–90–60 Kg N–P_2O_5–

K_2O fad.$^{-1}$. The results showed, generally, that the effects of the interactions between the cultivars and the mineral NPK fertilizers rates on the studied parameters were found significant in most cases ,during both summer seasons .The treatment combination between the cultivar Shimmer and the highest levels of NPK fertilizers gave the most favorable effects for vegetative growth characters, in both years ;and for yield and its components characters ,during the first season .Meanwhile ,the interaction between the cultivar Challenger and the highest level of NPK fertilizers gave the best treatment combination for the yield and its components ,in the second season .The evaluated cultivars varied, significantly, in their performances for the most kernels quality characters ,in both seasons. The two cultivars Shimmer and Challenger were the best for kernels quality characters . Application of NPK fertilizers in successive amounts up to120-60-90Kg N–P_2O_5–K_2O fad.$^{-1}$resulted in steady corresponding increments in dry weight of kernels ,T.S.S. ,reducing sugars , sucrose ,and total sugars constituents of the grains. The interaction effects between each cultivars and the irrespective amounts of NPK fertilizers applied levels gave increasing values of the most biochemical constituents ,in both seasons. The results showed that the best cultivar that reflected the significant highest values of N and K%, in the first season ; and N% and P% in the second season was found to be the cultivar "Challenger" .The highest significant value of P% , in the first season ;and K%, in the second season ,was given by the cultivars Shimmer and Basin, respectively .The obtained results reflected ,generally, that N and K contents in sweet corn leaves were, significantly, affected with different magnitudes, by increasing NPK fertilizer applications ,in both years.Generally , the results indicated that the differences among the values of all treatments combinations for the chemical compositions ;i.e., N, Pand K% ,of sweet corn leaves were high enough to be significant in most cases ;but, with different magnitudes ,in the two seasons.

J.Agric.&Env.Sci.Alex.Univ.,Egypt Vol.6 (2)2007

INTRODUCTION

Sweet corn (*Zea mays var . rugosa*, L.;know earlier as *Zea mays var . saccharata* ,Sturt.) belongs to the family Poaceae .It is annual , herbaceous ,and one of warm season vegetable crops .It is a variety of maize ,but with a high sugar content , since ,the grains of sweet corn accumulate two to three times more sugars in the endosperm than the normal starchy maize (Doehlert *et al* . ,1993). In addition ;sucrose ,which gives sweetness to grain ,is the dominant sugar and considered the responsible factor for quality of sweet corn (Nonnecke ,1989 ; Pajic *et al* ,1994) .Therefore ,sweet corn is the result of a maturely occurring recessive mutation in the genes which control conversion of sugar to starch inside the endosperm of the corn kernel .So ,sweet corn grown for edible immature kernels (at milky stage) to be used in many food dishes , cooking ingredient in salads and soups because of its unique taste and high nutritional values as well as livestock feed and as row material in industry .Therefore, sweet corn is a popular vegetable , occupying position in many countries of the world , especially , north and west Europe , United States of America as well as Asia ; whereas ,in Egypt ,the production of sweet corn (as untraditional vegetable crop) is still very limited ,mainly due to lack of the information concerning cultivation practices such as fertilization under the prevailing conditions , suitable cultivars , poor market practices and limited awareness on its use.

It is well known that good cultivars are essential for the production of a satisfactory crop of vegetables for both growers and consumers .Also, fertilizer application is one of the principle factors that materially set up the maize yield and quality of vegetable crops .Plants take up large amounts of the three primary nutrients ;nitrogen ,phosphorus and potassium ;since , they are essential nutrients for plant growth and yield (Marschner , 1997) .Therefore ,it is of great importance to improve the production and quality by modifying the cultural practices such as using a balanced NPK fertilizers and good cultivars of sweet corn .In addition, the total economic returns from fertilization programs for production of crops should be evaluated by the responses of the crops to the fertilizers applied directly for a crop.

Gromove *et al*(1994) reported that the efficiency of utilization of nutrients from fertilizers applied to soils depends on weather conditions, biological characteristics of the crops and fertilizer rates .Since, improved cultural practices ;such as fertilization ,higher yielding cultivars and higher plant populations have led to increased sweet corn production (Patel *et al* , 1988) .

Positive responses of either sweet corn or maize to the mineral fertilizers ;nitrogen, phosphorus and potassium individually or in combinations with either one or more of each were reported by several researchers such as Yodpetch and Bautista (1984) for ear yield ; Peck and MacDonald (1989) for fresh weight of ear ;Salardini *et al.* (1992) for weight and number of cobs and shoot dry weight ;Wong *et al* (1995) for ear weight and kernels yield; Hemphill *et al* (1996) for ear weight , ear length ,dry weight , leaf N content and yield; Michalojc *et al* (1996-a) and Nihayati and Damhury (1996) for yield ; New York Vegetable and Cultural Practices (1999) for unhusked and husked ear weight , ear diameter and length , Miftahulla *et al* (2002) for plant height and grain yield and Amin (2006) for plant growth and grain yield. They illustrated generally that increasing in the used mineral fertilizers in their studies characters resulted in increasing effects on all the previously mentioned characters of either sweet corn or maize plants .Also,similar findings were obtained by several investigators such as; Metwally *et al* (1988) using N P on dry weight , grain ear^{-1}, number of ear plant^{-1}and grain yield fad.$^{-1}$;Koteva (1995) using NPK on K and starch contents ;Koteva and Mikhov (1995) using NPK on dry matter; Tosheva(1995) using NPK on yield ; Bizik (1997) using NPK on grain yield and plant height.

Concerning the chemical compositions of leaves and some components of sweet corn kernels, Michalojc *et al* (1996-b) found that leaf N content increased, significantly, with increasing NK rates ; but , leaf K content decreased . Peck and MacDonald (1989) stated that P fertilizer rates decreased K in the leaves of sweet corn ; whereas , increasing rates of K fertilizer increased K concentration in the leaves .Michalojc *et al* (1996-a) found that N fertilizer rates reflected little effects on dry matter ,sucrose ,N,P and K contents in sweet corn .Generally ,in most of the previously mentioned studies ,the responses of the cultivars to the mineral fertilizers varied from one to another according to the fertilizers rates and sources.

J.Agric.&Env.Sci.Alex.Univ.,Egypt Vol.6 (2)2007

The objective of this study was to provide the sweet corn growers under similar prevailing conditions and with information concerning suitable cultivar (s) and NPK fertilization rates to maximize the benefits of their commercial production . Accordingly , the effects of different cultivars and different rates of the mineral NPK fertilizers were used to investigate their main effects and their interactions on vegetative growth, yield and its components , kernels quality and chemical composition of leaves of sweet corn in the newly reclaimed area at EL-Noubaria region . .

MATERIALS AND METHODS

Tow field experiments were carried out, during the summer seasons of 2004 and 2005 at the Experimental Farm (El- Noubaria) ,Horticultural Research Station , Ministry of Agriculture and Land Reclamation,A .R . E .

The experimental site belongs to the newly reclaimed calcareous soils irrigated by the surface irrigation system . Preceding the initiation of the investigation , in each season , soil samples from the upper layer of the experimental sites to 20 and 20–40 cm depthes were collected and analyzed for some chemical and physical properties according to the published procedures (Page *et al*,1982, Klute,1986) , and the results of analyses are shown in Table 1 .It was a deep sandy clay loam, has a medium permeability and well drained .

Table 1.Some chemical and physical properties of the experimental sites in the two growing seasons of 2004 and 2005.

Seasons	**2004**		**2005**	
Characteristics	0 – 20 cm	20 – 40 cm	0 – 20 cm	20 – 40 cm
Ec;dsm^{-1}	1.52	1.85	1.75	2.05
PH(1:2.5soil:water)	8.25	8.19	8.15	8.10
OM ; %	0.55	0.39	0.45	0.35
$CaCO_3$; %	26.50	28.05	28.20	29.35
NO_3+ NH_4;mg kg^{-1}	39.80	48.50	30.28	33.51
$NaHCO_3$-p;mg kg $^{-1}$	13.30	10.65	12.12	11.52
Exch-K;mg kg $^{-1}$	385.50	320.50	325.50	298.50
Sand; %	85.50	84.30	83.50	85.30
Soil texture class	SCL	SCL	SCL	SCL

SCL = Sandy Clay Loam

J.Agric.&Env.Sci.Alex.Univ.,Egypt Vol.6 (2)2007

Each experiment contained twelve treatments ,which represented the combinations among three cultivars of sweet corn (Basin, Challenger and Shimmer) and four levels of the compound mineral NPK fertilizer at the rates of 60–30–30 ; 40–45-60 ;120–60–90 kg $N–P_2O_5–K_2O$ fad.$^{-1}$ as well as the control ,0–0–0, (without application).The forms of the three types of mineral fertilizers ,NPK ,were used as follows ; ammonium nitrate (33.5% N) , calcium super phosphate (15.5 % P_2O_5) and potassium sulphate (48 % K_2O) .

The experiments were conducted using a split –plot system in a randomized complete blocks design (RCBD) with three replications .The used cultivars occupied the main plots ; whereas , the mineral NPK fertilizer levels were, randomly, assigned in the sub-plots .The sub-plot area was 9.6 m^2, including four rows each of 4 m long and 60cm width , with a plant spacing of 30cm .Border rows were established between sub-plots to minimize the fertilizer carryover between treatments.

Seeds of the three cultivars of sweet corn were sown on one side of the row at 30 cm a part on May 15 and 18 in 2004 and 2005 , respectively .With respect to the rates of the used mineral fertilizers required amount of nitrogen and potassium were applied at three equal quantities through the growing stages .The first addition was after three weeks from planting ; the second portion was after five weeks from sowing ; whereas , the last one was performed during the ears formation stage (after seven weeks from planting time). Phosphorus fertilizer rates were completely added, during soil preparation Throughout the growing seasons ,the other common recommended agricultural practices for the commercial production of sweet corn were carried out .

Data Recorded

During the growing seasons, the following data were recorded as follows:

Vegetative growth characters

Ten plants from the central two rows in each experimental unit , at the taseling and silking stages (after 35–40 days from sowing date) ,were randomly collected to measure the following vegetative growth characters: plant height (cm) ,number of leaves plant^{-1},stem diameter(cm) and leaves dry matter content (%). .

J.Agric.&Env.Sci.Alex.Univ.,Egypt Vol.6 (2)2007

Yield and yield components characters

At maturity stage ; in the milky stage, when the kernel moisture content was 75-80 % (Evensen and Boyer,1986) ; husked ears of the plants in the middle two rows of each sub-plot were harvested (after 70 days from planting time) to determine the yield and its components .All harvested husked ears were allocated to determine total ear yield fad.$^{-1}$and number of ears plant^{-1}; since, the total ear yield fad.$^{-1}$was estimated by weighing all harvested husked ears in each experimental unit and then converted into tons fad.$^{-1}$; and total number of harvested ears from each sub-plot was divided by number of the harvested plants to estimate the average number of ears plant^{-1}.Ten harvested ears from each sub-plot were randomly selected to determine averages of husked ear weight (g),ear length (cm) and ear diameter (cm) Sub samples of five husked ears , were also collected randomly to estimate the average of unhusked ear weight (net weight of ear) after removing the husks and shanks .

The kernels were separated by cutting from the cobs of the five selected ears and weighed. Then ,the weight of the kernels were divided by the five ears to estimate the kernels weight ear^{-1}(g), which were used to estimate the kernels weight plant^{-1}, then converted into tons fad^{-1} to calculate kernels yield fad.$^{-1}$ (tons).

Kernels quality :

The kernels quality were expressed by the grains constituents of dry matter ,reducing sugars,total sugars,sucrose ,starch,carbohydrate ;(expressed as mg.g^{-1}d.w.) and total soluble solids T.S.S (%) .Directly after harvest , samples of ears kernels were randomly bulked, as previously described from each experimental unit to determine such compositions in grains. Total soluble solids percentages readings were taken on the samples of immature kernels, collected at harvest from each sub-plot ,as previously mentioned ,after extracting kernels juice ,and identified by hand digital Refractometer .Thirty grams samples of kernels were oven dried at 70^{0}C for 48 hours to constant weight, and then samples were reweighed to estimate the percentage of grains dry matter .Sub samples, of dried kernels were then taken , ground into fine powder with a coffee grinder for subsequent sucrose, reducing sugars, total sugars, starch and carbohydrates analyses.Determination of sucrose and reducing sugars concentrations (mg.g^{-1}dry weight of grain) was conducted as outlined by Cornin and

Smith (1979).Total sugars contents were obtained by the summation of the reducing sugars and sucrose. Phenol sulphoric acid method proposed by Malik and Singh (1980) was to determine the starch content in grains .Total carbohydrates content were obtained by summation of the total sugars and starch contents .

Chemical compositions of leaves

A random sample of leaves of sweet corn plants from each sub-plot were collected, washed with distilled water, oven dried at 70^0C to a constant weight, then ground in order to measure the chemical N, P and K compositions .The concentrations of N, P and K contents in sweet corn plants leaves were determined on the basis of dry weight ,as illustrated by Evenhuis and Dewaard (1980) .

Statistical analysis

All obtained data were, statistically, analyzed using CoStat Software (2004), and the Duncan's multiple range test was used to compare the differences among treatments' means as illustrated by Steel and Torrie (1984).

RESULTS AND DISCUSSIONS

The results concerning main effects of cultivars ,mineral NPK and their interactions on the characters of vegetative growth, yield and its components, kernels quality and chemical compositions of leaves for sweet corn plants are shown in the Tables from 2 to 5 .

Vegetative Growth Characters

The results of the main effects of cultivars and levels of the mineral NPK fertilizers ,and their interactions on vegetative growth characters of sweet corn plants ,in the two growing seasons ,are presented in Table 2. The results of the comparisons among the performances of the used three cultivars regarding the vegetative growth characters ;i.e., plant height ,number of leaves plant^{-1},stem diameter and leaves dry matter content, illustrated, generally, that differences among the means of these characters appeared to be significant ; but, with different magnitudes , in the two summer seasons .In the first season ,the results reflected that the cultivar Shimmer gave the highest significant mean values for the characters plant height and stem diameter. Meanwhile ,the cultivar Challenger gave the highest significant mean value for the number of leaves

J.Agric.&Env.Sci.Alex.Univ.,Egypt Vol.6 (2)2007

J.Agric.&Env.Sci.Alex.Univ.,Egypt Vol.6 (2)2007

J.Agric.&Env.Sci.Alex.Univ.,Egypt Vol.6 (2)2007

J.Agric.&Env.Sci.Alex.Univ.,Egypt Vol.6 (2)2007

plant^{-1}character.Such results meant, generally, that the evaluated cultivars varied in their general performances with respect to these characters. The obtained results concerning plant height and stem diameter characters seemed to cope with the findings of Akman (1998) for plant height and Mullins (2000) for plant height and plant stem diameter , who reported that cultivars sweet corn reflected significant differences for these characters.Concerning the percentages dry matter content of leaves , the results revealed that the differences among the mean values of the three cultivars appeared to be insignificant . In the second season ,the differences among the mean values of the four vegetative growth characters were not significant ,with an exception ;stem diameter character; since, the two cultivars Challenger and Shimmer gave the highest significant means ,compared to the cultivar Basin that reflected the lowest mean value .Such results indicated, generally ,that the evaluated cultivars tended to rank differently when grown at different years.

With respect to the main effect of mineral NPK fertilization levels on the vegetative growth characters ,Table 2 showed generally that the application of the mineral NPK fertilizer levels to the grown sweet corn plants ,irrespective of the used amount significantly gave longer plants ,thicker stems ,more number of leaves plant^{-1},and attained heaver dry matter percentages ,compared with those of the control (without NPK application), in both growing seasons. Generally , the previous mentioned results could be explained on the basis of the availability of the nutritive elements of the mineral NPK fertilizers in the soil .The proportional enhancement of plant height ,stem diameter ,number of leaves plant^{-1} and dry weight of leaves to the levels of compound mineral fertilizing emphasized the ability of sweet corn plants to meet its demand from the nutritive elements. Similar findings were obtained by Ping–Wu *et al* (1991) ,who found that fertilizing sweet corn plants with high levels of NPK significantly increased plant height , number of leaves plant $^{-1}$and stem diameter. .In addition Abdel–Razik and Ghoneim (1999) found that NK fertilizers caused generally some increments on the percentage of leaves dry weight of sweet corn .In a study made by El–Noemani *et al* (1990),it was found that increasing N applied rate up to 120kg N fad^{-1} was accompanied with significant increases in the growth parameters of maize .On the contrary, Abdel–Razik and

Ghoneim (1999) found that the effect of the interaction between N and K fertilizer levels was insignificant for the plant height and number of leaves plant^{-1}of sweet corn .Also ,in the same line ,depressing effect of NK fertilizer on the percentage of leaves dry weight of maize was indicated by Madhavi *et al* (1995) .The application of 120-60-90Kg N-P_2O_5–K_2O fad.$^{-1}$gave significantly the highest mean values for the four studied vegetative growth characters than the control (without addition),during both seasons of 2004 and 2005. Such results reflected such coping with those obtained by Metwally *et al*(1988), using NP fertilizers,on dry weight plant^{-1}of corn plants ,Samad (1992) ,and Mascagni and Boquet (1996), using NPK fertilizers on corn plants for plant height character ;Amin *et al*(2006) ,using NP fertilizers, on sweet corn plants for vegetative growth characters ; since they found that application of mineral fertilizers with high levels to the plants significantly increased the previously mentioned characters .On the contrary ,such results disagreed with the findings of Eltelib *et al* (2006) ,who found that number of leaves plant^{-1}, plant height and stem diameter characters were not significantly affected by using N and P fertilizers .Similarly ,Michalojc *et al* (1996-a) found that N fertilizer levels had a little effect on dry mater content of sweet corn .

Results in Table 2 illustrated the effect of the first- order interaction between the three cultivars and mineral NPK fertilizers rates on all studied vegetative growth characters, in the two experimental seasons of 2004 and 2005 .The results showed, generally, that the effects of interactions between the cultivars and the different levels of mineral NPK fertilizers on plant height ,stem diameter ,number of leaves plant^{-1} and leaves dry weight percentages were found to be significant in most cases ,in both seasons. Such results seemed generally to indicate, that the used three cultivars of sweet corn reacted well ,in the newly reclaimed area at El–Noubaria region .Also ,the cultivars responded well to fertilization by mineral NPK fertilizers and gave the most favourable performances for all studied vegetative growth characters of sweet corn .The combination between the cultivar Shimmer and the application of mineral NPK fertilizers at the rate of 120–60-90Kg N–P_2O_5–K_2O fad.$^{-1}$resulted in ,significantly ,the highest mean values of plant height, stem diameter and leaves dry weight percentages ,in the two growing seasons .The obtained result of dry

matter content seemed to mach with the finding of Kamprath *et al*(1982) who found that the improved populations of sweet corn produced more total dry matter at different N fertilization .Samad (1992) found that the cultivars of maize differed in their responses to NPK fertilizers rates for this character .Concerning the number of leaves plant^{-1}character, in the first season, the results reflected that the interaction between the cultivar Challenger and the application of mineral NPK at the rates of either 90-45-60 Kg N–P_2O_5–K_2O fad.$^{-1}$or of 120-60–90kg N-P_2O_5-K_2O fad.$^{-1}$gave the significant highest mean value .In the second season ,the interaction between each of the three cultivars and the highest level of the mineral NPK fertilizers at the rate of 120-60-90Kg N-P_2O_5-K_2O fad.$^{-1}$gave the highest significant mean values .The favourable effect of NPK on number of leaves plant^{-1}of sweet corn plants could be explained on the basis of the fact that these elements played major roles on plant life and stimulated the meristemic activity ,which in turn , resulted in more new tissues and organs (Novoa and Loomis ,1981; Marschner ,1986) .In addition ,the ability of the used hybrids of sweet corn to produce more number of leaves plant^{-1} as affected by applied NPK fertilizers might be related to the genetic potential of these hybrids.

Yield and its components

The results of the main effects of the sweet corn cultivars and mineral NPK fertilization levels on the yield and its components are presented in Table(3) .The results of the comparisons among the mean values of the studied characters of sweet corn cultivars illustrated generally that there were significant differences among the values of all the studied parameters ; but , with different magnitudes, during both growing seasons .Regarding the number of ears plant^{-1}and ears yield characters , the results illustrated, in general, that the used cultivars reflected different mean values of these two characters .The best cultivar that showed the highest mean values for these two characters was found to be Challenger, in both seasons. However ,the results illustrated, generally, that the differences in the values of the two characters ,.i.e. number of ear plant^{-1} and ears weight perhaps refer to different cultivars of sweet corn ,which used in this study .In addition, the used cultivars may be reacts well in the newly reclaimed area at El–Noubaria region ;since ,they reflected good performances for these two characters .On the other hand ,the result concerning the

number of ears plant^{-1} disagreed with that finding of Mullins (2000) ,who found that yield as expressed as number of ears was not different due to cultivars used of sweet corn .Among the three sweet corn cultivars ,the highest significant mean values were found to be that of the cultivar Shimmer for the characters husked ear weight, unhusked ear weight and kernels weight ear^{-1},in the two growing seasons .The obtained results seemed to cope with the findings of Wong *et al* (1994) for ear weight ;Wong *et al* (1995) for kernels weight ;New York Vegetable and Cultural Practices (1999) for husked and unhusked ear weight ; and Mullins (2000) for ear weight ;since ,they reported significant differences among their used genetic populations of sweet corn.

The results presented in Table 3 , demonstrated that cultivar Shimmer ,in the first season ,gave the highest significant mean values for the characters kernel yield fad.$^{-1}$,ear diameter and ear length ,followed by cultivars Challenger and Basin, respectively. In the second season , cultivar Challenger gave the highest significant mean value for kernels yield fad.$^{-1}$and ear diameter characters ;whereas , the cultivar Basin gave the longer ears than the other two cultivars ; but, with insignificant differences. These results were generally in accordance with those reported by Rogers and Lomman (1988) for yield of cobs ; Wong *et al* (1995) for kernels yield and ear length ; New York Vegetable and Cultural Practices (1999 and 2000) for ear length and diameter ; and Mullins (2000) for ear length and kernels yield , who showed that these characters differed significantly among the used cultivars or hybrids of sweet corn. Similar findings were also in line with those obtained by Dawood *et al* (1992) and Oikeh *et al* (1997), who stated that their used cultivars of maize differed in their performances for grain yield character .

The results concerning the effects of mineral NPK fertilization treatments on yield and its components of sweet corn plants are presented in Table 3 .The results showed generally that the increments of the NPK fertilization levels were significantly associated with corresponding increases in all studied yield and its components ;i.e ,number of ears plant^{-1} , husked ear weight, unhusked ear weight , ear diameter , ear length , kernels weight ear^{-1},kernels yield fad^{-1},and ears yield fad.$^{-1}$,compared with those of the control , in both summer seasons .The obtained results appeared to be in general agreement with

the findings of several investigators , who studied the effects of one or more of the mineral N,P and K fertilizers on yield and its component characters of sweet corn and maize such as Kamprath *et.al*.(1982) for number of ears and yield ;Yodpetch and Bautista (1984) ,Navarro *et al* (1985)and Malzer and Randall (1986) for yield; Peck and MacDonald (1989) and Wong *et al* (1995) for ear weight; Samad (1992) and Toshave (1995) for grain yield ;Wong *et al* (1995) for ear weight ,ear length and kernels yield; Nihayati and Damhury (1996) ;Hemphill (1996) for ear weight and ear length; Hemphill (1996) and Miftahullah *et al* (2002) for yield ;Oikeh *et al* (1997) and New York Vegetable and Cultural Practices (1999 and 2000) for husked and unhusked ear weight ,ear diameter and length for grain yield and kernel weight .All previously mentioned researchers reported that increasing the mineral fertilizers levels reflected significant increases on yield and its components .On the contrary ,Wong *et al* (1995) for ear length ; Michalojc *et al*(1996), for ear diameter, reported that N application treatments did not significantly affect these characters of sweet corn .Similarly , Peck and MacDonald (1973) found that increasing rates of K fertilizer led to small increase on yield of sweet corn. Application of mineral NPK fertilizer at the highest rate of 120-60-90 Kg N- P_2O_5-K_2O fad.$^{-1}$ gave higher mean values of sweet corn yield and its components , compared with the rates of 90-45-60 or 60-30-30 N-P_2O_5-k_2O fad.$^{-1}$,in the two growing seasons. Significant linear effects of K on sweet corn and maize yield were indicted by Chu *et al* (1989), EL-Fouly *et al* (1991) ;Heckman and Kamprath (1992), who reported that application of N and K fertilizers to sweet corn plants significantly increased ears and kernels yield .The obtained results were also in accordance with the findings of Abdel-Razik and Ghoneim (1999), who found that increasing the amounts of applied N with K rates were associated with increments on kernels yield, ear length and ear weight of sweet corn .

Concerning, the results of the interaction effects between the cultivars and mineral NPK fertilization on yield and its components are presented in Table (3) .The comparisons among the mean values of the different combinations of the cultivars with mineral NPK fertilizers rates for each studied parameter of yield and yield components were found to be significant in most cases ;but ,with different magnitudes ,in the two seasons of 2004 and 2005 .The results reflected that , in the first

season ,the optimum interactive treatment combination for the number of ears plant^{-1}character was between the cultivar Challenger and the highest level of NPK fertilization at the rate of 120-60-90 Kg N-P_2O_5-K_2O fad.$^{-1}$. As for the characters husked ear weight , unhusked ear weight ,ear diameter ,ear length, kernels weight ear^{-1}, kernels yield fad.$^{-1}$. and ears yield fad^{-1}, the results in Table 3 illustrated that the best interaction effect for increasing these parameters , in the first season , was given by the combined treatment of cultivar Shimmer and the mineral NPK fertilizer at the rate of 120-60-90 Kg N-P_2O_5-K_2O fad.$^{-1}$, which produced the highest mean values for yield and its components Kamprath *et al*(1982) showed that hybrid populations of sweet corn. varied in their responsiveness to environments , because N supply is an important factor of the environment which affect yield .Maize cultivars differed in their responses to N fertilization for grains yield (Kling *et al* ,1997 ;Oikeh *et al* ,1997). In the second season , the presented data in Table 3 illustrated that using the cultivar Challenger with the application of mineral NPK fertilizer at the rate of 120-60-90 Kg N-P_2O_5-k_2O fad.$^{-1}$,was the best combination treatment for all the studied yield and its components parameters ,with only one exception ,followed by the combination between cultivar Shimmer and the application of NPK fertilization at the rate of 120-60-90 Kg N-P_2O_5-K_2O fad.$^{-1}$. The only exception was noticed for the ear length character ;since, using of the cultivar Basin with the application of the mineral NPK at the highest rate increased this parameter .Such results generally indicated that the studied cultivars reflected high responses to the mineral NPK fertilizers under the environmental conditions of the newly reclaimed area at El- Noubaria region .Also ,the evaluated cultivars of sweet corn reflected significant differences in their responses of yield and its component characters. These results seemed to agree with the findings of Dawood *et al* (1992) for grain yield of maize ; Samad (1992) for grain yield of maize; Novero *et al* (1992) for yield of maize ;Wong *et al* (1995) for ear weight ,kernels yield , ear length of sweet corn ;Oikeh *et al* (1997) for grain yield and kernels weight of maize ;New York Vegetable and Culture Practices (1999) for unhusked ear weight , husked ear weight , ear diameter and ear length of sweet corn. They concluded that the used cultivars differed in their general performances for these characters to response to mineral fertilizers rates.

J.Agric.&Env.Sci.Alex.Univ.,Egypt Vol.6 (2)2007

Kernels Quality

The results concerning the effects of cultivars, NPK fertilization and their interactions on kernels quality characteristics ; i.e. kernels dry weight, T.S.S. , sucrose , reducing sugars ,total sugars ,starch and carbohydrates contents; are presented in Table 4 . The comparisons among the mean values of the three cultivars showed insignificant effects on kernels dry weight , during both seasons .In the same line , a study made by Mullins (2000) illustrated that the moisture content of sweet corn grains did not significantly differ among the used cultivars .On the contrary ,Doehlert *et al* (1993) found that lines of sugary genotypes of sweet corn differed in their kernels dry contents , and explained this result on the basis that sugary kernel is attributed to a decrease in starch and phytoglycogen in the endosperm .

Respecting the influence of NPK fertilization levels on kernels dry weight , the results of the two seasons , presented in Table 4,revealed that application of NPK in successive amounts up to120-60-90 Kg N-P_2O_5-K_2O fad.$^{-1}$ resulted in steady corresponding increments on this character . The highest significant value of kernel dry weight percentage was given by applying NPK fertilizer at the highest rate of N-P_2O_5-K_2O fad.$^{-1}$. Koteva and Mikhov (1995) found that increasing the rates of NPK fertilizers resulted in increasing dry matter content of maize grains .Similarly, Hemphill (1996) showed that N fertilizer rates increased significantly dry weight content of sweet corn grains .On the other hand , Michalojc *et al* (1996-b) found that N fertilizer application had a little effect on dry matter content of sweet corn .

With respect to the interaction effects between cultivars and NPK fertilization levels on kernels dry weight percentage, the results reflected that the comparisons among the mean values of this character appeared to be significant ; but , with different magnitudes , in the two growing seasons . Such a result seemed to indicate that the used cultivars of sweet corn reflected high responses to mineral NPK fertilizers and reacted well under the environmental conditions of the reclaimed area at El-Noubaria region for this character .The highest value of kernels dry weight was obtained when the cultivar Shimmer was supplied with 120-60-90 Kg N-P_2O_5-K_2O fad.$^{-1}$,in the first season. However, in the second season , using cultivar Challenger

with the application of NPK at the rate of120-60-90 Kg N-P_2O_5-K_2O fad.$^{-1}$ resulted in the highest mean value of the studied character .

The results in Table 4, concerning T.S.S. and sucrose contents , illustrated that cultivar Challenger was the best genotype that reflected the highest values of these two characters. However, the differences among the cultivars appeared to be insignificant in the case of sucrose content, and significant in the case of T.S.S. parameter, in the first season .The result concerning T.S.S. content seemed to agree with the finding of Kleinhez (2003) , who found that soluble solids percentages varied significantly by the different cultivars of sweet corn . Zhu *et al* (1992) reported that there was a negative relationship between soluble solids and total sugars of sweet corn .The results concerning reducing sugars , total sugars , starch and carbohydrates reflected generally that the evaluated cultivars varied significantly in their performances for these characters , with only one exception ,in the first season .Similar findings were obtained by Evensen and Boyer (1986) ,who reported that sugar , reducing sugars and total sugars contents differed significantly among the used cultivars of sweet corn . Cultivar Shimmer gave the highest values for reducing sugars ,total sugars and carbohydrates contents, with significant differences; and starch content, without significant differences; among the three cultivars .In the second season ,the results reflected generally that the comparisons among the cultivars for the parameters sucrose ,reducing sugars ,total sugars , starch and carbohydrates contents were significant, with different magnitudes ; but ,the T.S.S. content did not reflect any significant differences .Abdel-Razik and Ghoneim (1999) found that the effects of N and K levels on sucrose, reducing sugars as well as total sugars appeared to be significant . Cultivar Challenger gave the highest significant values for sucrose ,total sugars ,starch and carbohydrates ,and cultivar Basin was the best for reducing sugars content .Such results seemed to agree with those reported by Evensen and Boyer (1986) ,who found that starch concentration in grains of sweet corn varied with different cultivars .Wong *et al* (1994) illustrated that sucrose and total sugars concentrations in Sh_2 hybrids of sweet corn varied from one to another. Since , the variability among Sh_2 hybrids refer to genotypic differences .They suggested also that variability among the Sh_2 hybrids suggests that allelic variation at other loci is profoundly

influencing sucrose and total sugars level in freshly harvested sweet corn .Similarly , Pardee (1963) attributed the increased sweetness in sweet corn to a single inheritance gene called *shrunken(Sh_2.)*

As for the effects of the different levels of NPK fertilizer on the T.S.S., sucrose ,reducing sugars ,total sugars ,starch and carbohydrates contents ,the results in Table 4 revealed generally that application of NPK fertilization in successive amounts up to 120-60-90Kg N-P_2O_5-K_2O fad.$^{-1}$resulted in steady corresponding increments in T.S.S.,sucrose ,reducing sugars and total sugar constituents of grains, in the two experimental seasons , with only the exception that was found in the case of sucrose content, in the first season .These results seemed to agree with the finding of Abdel-Razik and Ghoneim (1999) ,who found that the effects of N and K fertilizers levels on sucrose ,reducing sugars as well as total sugars appeared to be significant. Such results can be explain on the basis that sucrose ,which gives sweetness to grains ,is the dominant sugar and can be considered the responsible factor for quality of sweet corn (Boyer and Shannon ,1983 ;Nonnecke,1989 ;Pajic *et al* ,1994) . In the same line , Mansour and Raab (1996) stated that the kernels quality ;as expressed as kernels texture ,shape and flavor , are governed by starch and sugar contents.On the other side , the results in Table 4 illustrated that the contents of starch and carbohydrates were increased by applying the NPK fertilizer at the rate of 60-30–30 Kg N-P_2O_5-K_2O fad.$^{-1}$;but, decreased as a result of applying the other two rates of NPK fertilizers ,in the first season .Nevertheless , in the second season , the results revealed that application of NPK fertilizer in successive amounts up to 90-45-60 Kg N-P_2O_5-K_2O fad.$^{-1}$,resulted in corresponding increments on the starch and carbohydrates contents. The result concerning starch content in kernels of sweet corn , in this study, seemed to agree with that obtained by Koteva (1995) ,who found that starch of maize decreased by increasing NPK fertilizer rates ; Whereas , the result respecting carbohydrates content did not agree with that reported by Palani and Shanthi (1994) ,who indicted that carbohydrates concentration was higher than control in plants given a high N rate .Similarly, Abdel- Razik and Ghoneim (1999) reported that the effects of N and K levels on carbohydrate and starch constituents appeared to be insignificant . These results could be explained on the basis that , in potassium deficient plants ,some gross changes occur ,including an

accumulation of soluble carbohydrates , a decrease in levels of starch , and an accumulation of soluble components (Lauchli and Pfluger,1978) .It is possible, also,due to the fact that potassium activates the enzymes involved in sugar biosynthesis and helps in translocation of sugars (Evans and Sorger ,1966 ;Archer ,1985).

Results of Table 4 illustrated the effects of the interaction between the evaluated cultivars and mineral NPK fertilizers on the biochemical constituents of grains ;i.e. , T.S.S.. ,sucrose , reducing sugars , total sugars , starch and carbohydrates , in the two summer seasons of 2004 and 2005 .The results showed that the effects of the two studied main factors ; on the biochemical constituents ;were found to be significant in most cases , in both seasons .The results reflected that the cultivars varied in their responses to the different NPK fertilizers levels for the studied biochemical constituents ,in both seasons .Concerning the effects of the interaction between the two studied factors on the sucrose and reducing sugars contents , the results illustrated generally that the three cultivars of sweet corn responded differently to be increments of NPK fertilizer rates in most cases , in the two growing seasons .

Results of Table 4 demonstrated generally that the interaction effects between cultivars and NPK fertilization levels on starch and carbohydrates contents were significant ;but, with different magnitudes , in both years .The results illustrated, also, that the interactions between each cultivar and application of NPK fertilizers in successive amounts up to 90-45-60 Kg N-P_2O_5-K_2O fad.$^{-1}$resulted in corresponding increments in the two constituents of grains ;i.e.,starch and carbohydrates ,in the two seasons ,in most combinations .However, the cultivars did not responded to increase of the application of NPK fertilizer rats over 90–45–60 kg N-P_2O_5-K_2O fad.$^{-1}$; since ,the interaction between each of the three cultivars and application of the NPK fertilizer at the rate of 120–60–90 Kg N-P_2O_5-K_2O fad.$^{-1}$ reduced , significantly ,the values of these two constituents ,in both years .These results seemed to agree with the findings of Koteva (1995) using NPK fertilizers ;who found that increasing the used fertilizer levels resulted in decreasing in starch .On the contrary ,Palani and Shanthi (1994) reported that carbohydrates contents increased with increasing N fertilizer .

J.Agric.&Env.Sci.Alex.Univ.,Egypt Vol.6 (2)2007

Chemical compositions of leaves

Results presented in Table 5 reflected the main effects of cultivars and rates of NPK fertilizers , and their interactions on the leaves chemical compositions ; i.e. , N , P and K percentages ; in both seasons. The results indicated that the cultivars varied significantly in their contents of N , P an K percentages , in the two growing seasons . The best cultivar that showed the significant highest values of N% and K% , in the first season , and N% and P% in the second season , was found to be Challenger. The data demonstrated also that the highest significant value of P% , in the first season ,and K% , in the second season, was given by cultivars Shimmer and Basin ,respectively.

The comparisons among the values of the nutrient contents of sweet corn leaves ,as influenced by the different levels of NPK fertilizers are presented in Table 5 .The results showed that N concentration of sweet corn leaves was significantly affected by increasing NPK fertilizer applications. The highest percentage of this content was noticed in plants received 120–60-90 Kg N-P_2O_5-K_2O fad.$^{-1}$,in both seasons. This result a greed with Malzer and Randall (1986) ; Kostandi (1991) ; and Hemphill (1996) who found that increasing N fertilizer rates resulted in increasing N concentration of corn leaves .Similarly , Michalojc *et al* (1996-b) illustrated that leaf N content of sweet corn increased with increasing NK fertilizer rates .On the other side, application of the different levels of NPK fertilizers did not reflect any significant effect on the P concentration of sweet corn leaves , in both years .Nevertheless , the increased percentages of K content in leaves were found significant ;but ,with different magnitudes, in both seasons .The highest percentage of K content was reported for the highest level of NPK fertilizer at the rate of 120-60-90 Kg N-P_2O_5-K_2O fad.$^{-1}$,in the first season ; but , in the second season , the significant highest value of K content was given by the NPK fertilizer at the rate of 60–30-30 Kg N-P_2O_5- K_2O .In the same line , Classen and Wilcox (1974) found that K composition of corn leaves was increased by increasing K rates . On the other hand , Michalojc *et al* (1996-a) found that leaf K content was decreased with increasing NK fertilizer rates. Kostandi (1991) indicated that increasing N application to sweet corn plants decreased K content .Classen and Wilcox (1974) found that K fertilizer rates did not affect on either N or P percentages in tissues of corn.

Table 5 showed the effects of interaction between the tested cultivars and the different levels of NPK fertilizers on N, P and K percentages of leaves ,in the two growing seasons. Generally , the results illustrated that the differences among the values of all treatments combinations for the chemical compositions of sweet corn leaves were high enough to be significant in most cases ;but ,with different magnitudes ,in the two seasons . In the first season ,the interaction between cultivar Challenger and the highest level of NPK fertilizer at the rate of 120 –60-90 Kg N-P_2O_5-K_2O fad.$^{-1}$ gave the highest significant values of N and K percentages .In the second season , the highest significant value of N content was given by the interaction between the cultivar Challenger and the highest level of NPK fertilizer. Meanwhile. the optimum interactive treatments for the P and K contents were achieved by the combination between the cultivar Challenger with each of the first and the second levels of NPK fertilizers , respectively .

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J.Agric.&Env.Sci.Alex.Univ.,Egypt Vol.6 (2)2007

الملخص العربى

تأثيرات اصناف الذرة السكرية وإضافة الأسمدة المعدنية على نموها الخضرى وإنتاجها وجودتها والتركيب الكيماوى تحت ظروف الأراضى المستصلحة حديثاً

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يهدف هذا البحث إلى دراسة تأثير ثلاثة أصناف من الذرة السكرية كمحصول خضر غير تقليدى فى مصر و هم (باسين – شالنجر – شيمر) وثلاثة مستويات من التسميد المعدنى المركب (نيتروجين ، فوسفور ، بوتاسيوم) بمعدلات 60-30-30 ، 90-45-60 ، 120-60-90 كجم ن – فو$_2$أ$_5$ – بو$_2$ أ للفدان . بالأضافة الى الكنترول (غير مضاف) كذلك جميع التداخلات الممكنة بينهم على صفات النمو الخضرى (إرتفاع النبات – قطر الساق – عدد الأوراق للنبات – النسبة المئوية للمادة الجافة للأوراق) وصفات المحصول ومكوناته (عدد الكيزان / نبات ، وزن الكوز بالغلاف ، وزن الكوز بدون غلاف ، قطر الكوز – طول الكوز – وزن الحبوب / كوز- المحصول الكلى للكيزان / فدان ، المحصول الكلى للحبوب / فدان) ، وكذلك صفات الجودة للحبوب (النسبة المئوية للمادة الجافة للحبوب ، محتوى الحبوب من كل من السكروز ، السكريات الكلية ، السكريات المختزلة ، المواد الصلبة الذائبة الكلية ،النشا ، الكربوهيدرات) بالأضافة إلى محتوى أوراق الذرة السكرية من عناصر النيتروجين والفسفور والبوتاسيوم . حيث اجريت هذه الدراسة بمزرعة بحوث البساتين (بالنوبارية) والتابعة لوزارة الزراعة وأستصلاح الأراضى تحت ظروف الأراضى المستصلحة حديثاً .استخدم تصميم القطاعات العشوائية الكاملة بنظام القطع المنشقة لمرة واحدة وذلك فى ثلاث مكررات ،حيث وزعت المعاملات الخاصة بالأصناف فى القطع الرئيسية والمعاملات الخاصة بالتسميد المعدنى المركب على القطع تحت الرئيسية . ولقد أوضحت الدراسة النتائج التالية : -

- عكس السلوك العام لأصناف الذرة السكرية المستخدمة وجود أختلافات معنوية بدرجات مختلفة على صفات النمو الخضرى وكذلك المحصول ومكوناتة خلال الموسمين الصيفيين لعامى 2004 ، 2005 وعكس الصنف " شالنجر " اعلى القيم لمعظم صفات النمو الخضرى بينما تميز الصنف " شيمر " بأنه أفضل الأصناف حيث أعطى اعلى القيم لمعظم صفات المحصول ومكوناته فى الموسمين .
- ادى أضافة السماد المعدنى المركب ن – فو$_2$ أ$_5$ – بو$_2$ أ بكميات متذايدة على التوالى إلى زيادة مستمرة فى كل صفات النمو الخضرى والمحصول ومكوناته . كما تبين أن استخدام التسميد المعدنى المركب بمعدل 120-60-90 كجم ن – فو$_2$ أ$_5$ – بو$_2$ أ/ فدان اعطى اعلى القيم لهذة الصفات ، وذلك فى الموسمين الصيفيين .
- اظهرت النتائج بصفة عامة وجود تأثيرات معنوية للتداخل (المستوى الأول) بين الأصناف ومعدلات التسميد المعدنى على معظم صفات النمو الخضرى والمحصول ومكوناته ، كما تبين أن أفضل معاملة للتداخل بين الصنف " شيمر " واستخدام السماد المعدنى المركب بمعدل 120-90-60 كجم ن – فو$_2$ أ$_5$ – بو$_2$ أ/ فدان والتى اعطت اعلى القيم لصفات النمو الخضرى

J.Agric.&Env.Sci.Alex.Univ.,Egypt Vol.6 (2)2007

فى الموسمين ، بينما عكست أعلى القيم لصفات المحصول ومكوناته فى الموسم الأول فقط ، وتميزت معاملة التداخل بين الصنف" شالينجر" وأعلى مستوى للتسميد المعدنى 120-60-90 كجم ن – فو$_2$ أ$_5$ – بو$_2$ أ/ فدان لصفات المحصول ومكوناته فى الموسم الثانى .

- اوضحت النتائج وجود اختلافات معنوية فى السلوك العام للأصناف على معظم صفات الجودة لحبوب الذرة السكرية ، كما تميز الصنفين" شيمر" " وشالنجر" فى هذة الصفات .

- أدت الأضافة المتزايدة لمعدلات التسميد المعدنى المركب حتى معدل120-90-60 كجم ن – فو$_2$ أ$_5$ – بو$_2$ أ/ فدان الى زيادة مستمرة فى قيم كل من المادة الجافة للحبوب ، المواد الذائبة الكلية ، السكريات المختزلة والكلية وكذلك السكروز فى حبوب الذرة السكرية لكلا الموسمين.

- تبين من النتائج أن معظم صفات الجودة لحبوب الذرة السكرية قد تأثرت نتيجة للتداخل بين الأصناف المختلفة والكميات المتذايدة من التسميد المعدنى المركب ن – فو$_2$ أ$_5$ – بو$_2$ أ ، حيث عكست أعلى القيم خلال الموسمين الصيفيين لعامى 2004 و 2005 .

- أوضحت النتائج أن محتوى أوراق الذرة السكرية من عناصر النيتروجين والبوتاسيوم قد تأثر إيجابياً بأختلاف الأصناف المستخدمة ، وكذلك بزيادة معدلات التسميد المعدنى المركب خلال الموسمين ، كما تبين أن الصنف " شالنجر " هو أفضل الأصناف فى محتوى أوراقه من النيتروجين والبوتاسيوم فى الموسم الأول وكذلك محتواها من النيتروجين والفسفور فى العام الثانى .

- أوضحت نتائج التداخل بين الأصناف والمعدلات المختلفة من التسميد المعدنى المركب وجود أختلافات معنوية للقيم الخاصة بمحتوى الأوراق من عناصر النيتروجين والفسفور والبوتاسيوم خلال الموسيمين .

- وبصفة عامة أظهرت النتائج لهذة الدراسة وجود درجات متباينة من التأثيرات المختلفة المستخدمة سواء كانت لأصناف الذرة السكرية أو استجابتها للتسميد المعدنى المركب أو التداخل بينهما على كل من صفات النمو الخضرى والمحصول ومكوناتة ، جودة الحبوب ومحتوى الأوراق من عناصر النيتروجين والفسفور والبوتاسيوم تحت ظروف الأراضى المستصلحة حديثاً.