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EFFECT OF MACRO AND MICRO-NUTRIENTS INTERACTED WITH PLANTING METHODS ON MAIZE GROWN UNDER SINAI CONDITIONS

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ABSTRACT

Two field experiments were carried out in Wady-El Areish North Sinai Governorate during the two growing seasons of 1998 and 1999. Soil texture was sandy, moderate in salinity and poor in organic matter and nutrition of elements. This work aimed to study response of maize S.C 10 to two planting methods; ridges and rows and 7 times of foliar application with micro- and macro-elements. Strip design in split plot with 4 replicates was used in this investigation, main plots (horizontal) were devoted to planting methods and sub-plots (vertical) were occupied by foliar application times. The main results obtained from this study could be summarized as follows:

- Ridges method surpassed rows method, stimulate the vegetative growth and most of traits under study and increased grain yield with average 21.62 % than rows method.
- Spraying time at 30, 45 and 60 days from planting with foliar application (Nervatin-Vit) formula (10% N, 8% P_2O_5, 7% K_2O, 0.6 % Mg, 1.1% Fe, 0.5% Mn, 0.5 % Zn, 0.05% B, 0.02% Mo, 0.02 %Cu) with rate of 1.8 liter /fed was significantly increased no. of days to 50% tesseling, no. of days to 50% silking, plant height, stem diameter, leaf area/plant, ear position, ear length and diameter, no. of kernels, kernels weight /ear, shilling percentage, 100-kernel weight and grain yield ardab /fed than the others application times (control, spraying at 30, 45, 60, (30, 45) and (45, 60) days from planting with dose of 0.0, 0.6, 0.6, 0.6, 1.2 and 1.2 L /fed, respectively from mentioned formula.
- The contents of N, P and K (4.2, 0.5, 3.0 % dry weight, respectively in ear leaf at one week after silking) and Fe, Mn, Zn and B (220, 110, 75 and 15 mg/kg dry weight of ear leaf at one week after silking, respectively) gave the maximum grain yield of maize which resulted from spraying at 30, 45 and 60 days from planting.

In general, the results of this study recommended that planting maize S.C 10 with ridge methods and foliar application with rate of 1.8 L/fed / season from this foliar nutrient divided on 3 intervals times at 30, 45 and 60 days from planting gave the higher grain yield under the condition of this experiment.

INTRODUCTION

Maize yield can be maximized by adopting suitable cultural practices especially when high yielding cultivars are utilized.

Maize grain yield is the resultant of many factors, among them the mineral fertilization in general and micro elements application in particular. Under unfavourable soil conditions, using macro and micro-nutrients through foliar spraying is particularly preferable to avoid nutrients fixation and leaching during irrigation systems. Foliar application for most crops becomes a common in the Egypt fertilizer policy especially for micronutrients.

Time of spraying is very important factor for increasing grain yield on both of quality and quantity. Ibrahim (1989) studied the combined effect of K fertilizer and foliar application with commercial compounds of micro -elements (Irral) on corn plants. He found that the compound gave the highest grain yield and its components comparing with the other compounds and control.

Sunwanarit and Sestapukdee (1991) found that spraying maize with K solution on the 3rd day after 50% tesseling was most effective than application at 7 days after 50% tasselling. Some micro-nutrients i.e. Zn, Mn and Fe is not sufficient in most Egyptian soils and its application to plants resulted in better growth and more grain yield, 1000-grain weight and protein contents of maize (Abo-Soliman *et al*., 1992).

Dawood *et al*. (1992) mentioned that maize grain yield was increased with foliar application of the trace element solution of fetrilon combi sahary which contain on (50, 34 and 17 ppm of Zn, Mn and Fe, respectively).

Dornescu *et al*. (1992) reported that the effect of simple and complex foliar fertilizer including Zn on maize increased grain yield by 14 - 25%. Abo-El-Salam *et al*. (1994) found that foliar application with mixture of 400 ppm Mn, 300 ppm Zn and 200 ppm Cu on maize cv Giza 2 increase grain yield. Also, Mohamed (1998) found that foliar application of urea + Mn +Zn solution increased grain yield of maize. Spraying maize cv. S.C. 10 with Nervatein-Vit formation (micro-macro-nutrients) caused to increased in yield with 24.6% (El-Hawary, 1999). Mosalem (1999), reported that foliar spraying with micro-nutrients (Zn, Fe and Mn) individually or in mixture increased significantly both of maize yield and most its components compared with untreated plants.

Planting methods and ridges must be study in new reclaimed soil especially ridges, rows and slot sowing methods. Sowing in ridges increased grain yields slightly compared with sowing in flat beds (Jadhav *et al*., 1993). While Bhagwandin and Bhatia (1994) found that maize grain and stover yields were higher in the ridge and furrow system than in flat beds. Also, Princppi *et al* (1994), mentioned that the highest grain values were obtained with the conventional tillage and sowing system on ridges followed by integral min tillage.

This work aimed to study the effect of macro and macro-elements as a foliar application at different times on yield of corn under sandy soil conditions and in the same time comparing between two planting methods as ridges and rows planting.

MATERIALS AND METHODS

The present investigation was performanced at Wadi –El-Areish North Sinai Governorate during 1998 and 1999 growing seasons to investigate the effect of foliar application of nutrient elements at different times on growth and yield of maize plants. Foliar spraying treatments was applied with Nervatin-Vit (10.0% N, 8.0% P_2O_5, 7.0% K_2O, 0.6% Mg, 1.1% Fe, 0.5% Mn, 0.5% Zn, 0.05% B, 0.02% Mo, 0.02% Cu. The comparing between two planting methods i.e. ridges and rows planting under sandy soil conditions with drip irrigation system were done also. A combined experiment in strip plot

design with 4 replicates was used in this investigation. Each replicate was divided horizontally to two strips as main plots which devoted to planting methods, 6 ridges were done in distance of 70 cm with tractor in separate strip, and 6 rows were marked manually in other strip with the same distance, vertically each strip was divided to 7 division 5.0 m long which devoted to macro and micro-elements spraying time. The treatments of spraying time were as follows:

Foliar application frequency	No. of spraying	Total volume of water (L/fed / season)*	Total Nervatine (L/fed /season)**
1-Free foliar application (control)	---	300	Water only
2- At 30 days after sowing	1	300	0.6
3- At 45 days after sowing	1	300	0.6
4- At 60 days after sowing	1	300	0.6
5- At 30 and 45 days after sowing	2	600	1.2
6- At 30, 45 and 60 days after sowing	3	900	1.8
7- At 45 and 60 days after sowing	2	600	1.2

*** Each spraying with 300 L/fed.**

**** Dose 2 ml Nervatin per litter water of spraying.**

Grains of maize (S.C 10) were sown on 26th and 28th of May in the first and second seasons, respectively, in hills 25 cm, apart. Maize plants were thinned to one plant /hill after three weeks from planting.

Nitrogen fertilization at the rate of 130 kg N/fed was added, 20 % of this amount equal to 26 kg N/fed was added in form of ammonium sulphate (20.6% N) during soil preparing and the rest amount of nitrogen (104 kg N) was applied every week directly after thinning was done in 6 doses through the drip irrigation system in form of ammonium nitrate (33.5% N).

Calcium superphosphate (15.5% P_2O_5) at the rate of 200 kg /fed was added during land preparation. Potassium sulphate (48 % K_2O) at the rate of 50 kg /fed, half the amount was added with superphosphate at preparation of the soil and the rest half amount was added at 60 days from planting. The other usual agricultural practices of maize were done as the recommendation of Agric. Res. Center. No. of days to 50% tesseling and silking was recorded. At 88 days from sowing (4 weeks after the last spraying with macro and micro -elements), ten plants from each sup-plot were chosen for determinate growth characters; i.e. plant height, stem diameter, ear position and leaf area/plant (cm^2). Also, plant samples from ear leaf at one week after silking were collected to chemical analysis for macro and micro elements. Directly before harvesting 10 plants or 10 ears randomly were taken from each sub plot to determine, ear length, ear diameter, number of kernels/row, kernels weight/ear, 100-kernel weight and shilling %. Harvesting was carried out on 28th and 29th of September in the first and second seasons, respectively. Final grain yield in ardab measured as bulk yield of the whole plot transformed into yield per feddan adjusted to 15% moisture .

Before conduct the experiment, soil sample were taken from different place representative Wadi-El-Arish area, North Sinai Governorate for analysis. Average of mechanical and chemical analysis of soil of two growing seasons were presented in Table (1).

Fe, Mn, Zn and B in soils were determined using the Unicom 90 series atomic absorption spectrophotometer. Available Fe, Mn and Zn of soil were extracted using DTPA solution as described by Hassanein *et al.* (1980).

Table (1): Averages of mechanical and chemical soil characteristics of experimental site during the two seasons

Characters	Mechanical analysis	
	First season	**Second season**
Clay	2.43 %	3.7 %
Silt	5.29 %	6.4 %
Fine sand	62.21 %	60.4 %
Coarse sand	24.63 %	24.2 %
O.M	0.7 %	0.8 %
Ca carbonate	3.8 %	4.4 %
Texture	Sandy	Sandy
Chemical analysis		
Aval. N ppm	32.0	30.2
Aval. P ppm	8.3	9.5
Aval. K ppm	136	128
pH*	8.9	8.8
E.C. ds/m	4.7	4.9
Fe ppm	1.03	1.07
Mn ppm	0.80	0.72
Zn ppm	0.07	0.06
B ppm	0.004	0.007

*** 1 : 2.5 soil-water suspension.**
- N according to Jackson (1967).
- P according to Olsen *et al.* (1954).
- K according to Jackson (1967).

Obtained data were subjected to the statistical analysis as the usual technique of analysis of variance (ANOVA) of the combined analysis for the strip plot design as mentioned by Gomez and Gomez (1984). Whereas, macro and micro-nutrients data for method of sowing which gave higher grain yield (ridge) were exposed only to the proper statistical analysis of variance (RCBD) according to Snedocor and Cochran (1967). The treatment means were compared using the Newly Least Significant Differences (N-LSD) as the procedures outlined by Waller and Duncan (1969).

RESULTS AND DISCUSSION

Data of Table (1) illustrated the mechanical and chemical of soil of the two seasons. As seen from Table (1), soil was moderate in salinity and alkalinity of both seasons. Soil had low available contents of N, P, K and organic matter content in both seasons. The texture of soil was sandy. Also, the soil had low content of micro-nutrients i.e. Fe, Mn and Zn. According to Hamissa *et al*. (1993) they mentioned that the critical limits of macro and micro-nutrients in soils were low for N, P and K if were < 40, <10- 15 and < 200 ppm, respectively. While micro-nutrients Fe, Mn, Zn and B were low if their limits < 2, < 1.8, < 1.0 ppm and < 0.01, respectively.

A- Effect of planting methods:

Data in Tables 2, 3 and 4 showed the effect of planting methods on growth, yield and yield components of maize during the two growing seasons. Results revealed that most of estimated characters were significantly affected by the two methods of planting, except plant height, ear diameter, 100-kernel weight and shelling percentage in both seasons. Whereas, stem diameter and ear position were significantly affected in the second seasons. The data showed that ridges method surpassed the rows method of grain yield and most of its components. This may be attributed to the formulation of ridge increased the aeration around the roots, promote the roots to grow fastly and helps to fixing the plants will with the soil, this meaning less lodging of the plants. The increasing percentage of grain yield from row to ridge methods were 12.28 % and 12.0 % in first and second seasons, respectively this represent 2.87 and 2.52 ardab/fed, respectively. These results are in good agreement with those obtained by Bhagwandin and Bhatia (1990) and Jadhav *et al*. (1993), they mentioned that maize grain and stover yields were higher in the ridge and furrow system than in flat beds, while, Kohler *et al*. (1999), reported that both of sowing methods, till or slot did not significantly affected grain yield.

B- Effect of macro and micro-nutrients and spraying times:

Time and frequency of macro and micro-nutrients spraying had marked effect on all estimated traits in both seasons (Tables 2, 3 and 4): The highest grain yield (ardab/fad) and the highest values for all the yield components i.e. no. of days to 50% tesseling and silking, plant height, stem diameter, ear leaf area, ear position, ear length, ear diameter, no. of kernels/row, kernels weight/ear, 100-kernel weight and shelling percentage were observed when the spraying macro and micro-elements at 30, 45 and 60 days from planting, with total amount of 1.8 L Nervatin/fed/season.

Data from Tables 2, 3 and 4 revealed that the highest grain yield was obtained from spraying at 30, 45 and 60 days from sowing with 16.77 and 16.37 ardab/fed with economically increased of 5.29 and 4.94 ardab/fed with increasing percentage of 31.54 % and 30.18 % in the first and second seasons, respectively compared to the untreated treatment (control). The results obtained were in agreement with that obtained by Ibrahim (1989), Dawood *et al*. (1992) Dornescu (1992), El-Hawary (1999) and Mosalem (1999). The highest values may be attributed to foliar frequency at 30, 45 and 60 days after sowing caused availability of macro and micro-nutrients during tesseling and silking stage, with suitable rate of macro and micro-nutrients (2 ml /liter of water) and good amount of spraying water, while if the frequency was done one or two times may be the rate concentration of microelements not enough to meet requirements of plant growth.

Table 4: Averages shelling percentage, 100-kernel weight and grain yield of maize plants as affected by planting methods and macro and micro-elements during 1998 and 1999 seasons.

Characters / Treatments	Shelling %		100-kernel weight (g)		Grain yield (ardab/fed)	
	1998	1999	1998	1999	1998	1999
A: Planting methods:						
Ridge	77.0	78.2	39.3	39.5	15.39	14.91
Row	77.5	78.4	38.8	38.7	12.52	12.39
F-test	NS	NS	NS	NS	**	*
B: Time of macro and micro-elements application:						
1-Free foliar application (control)	75.5	78.0	32.6	32.9	11.48	11.43
2- At 30 days after sowing	77.5	76.9	36.6	37.2	12.93	12.08
3- At 45 days after sowing	77.3	77.2	39.4	38.8	13.08	12.72
4- At 60 days after sowing	76.8	78.6	40.6	40.2	14.25	14.10
5- At 30 and 45 days after sowing	77.3	78.6	41.1	40.4	15.18	14.73
6- At 30, 45 and 60 days after sowing	78.8	79.5	42.9	43.5	16.77	16.37
7- At 45 and 60 days after sowing	77.6	78.9	40.3	40.7	14.00	14.13
F-test	*	*	**	**	**	**
N-LSD at 5%	1.8	2.0	0.9	1.1	0.5	0.61
N-LSD at 1%	---	---	1.2	1.5	0.7	0.81
C: Interaction:						
A x B	*	NS	NS	**	**	**

C- Interaction effect:

The interaction between nutrition elements and planting methods had significant effects on ear leaf area, kernels weight /ear and grain yield /fed in both seasons, while no. of days to 50 % tessiling, no. of kernels /row, 100-kernel weight and shelling % in one season only. The highest values of ear leaf area, no. of days to 50% tessiling, no. of kernel/ row, kernel weight /ear, 100-kernel weight and grain yield were obtained from treatment of spraying of macro and micro-nutrients at 30, 45 and 60 days after planting maize and sowing plants in ridges (Tables 5, 6, 7, 8 and 9).

Table 5: Averages ear leaf area of maize plants as affected by the interaction between planting methods and macro and micro–elements during 1998 and 1999 seasons.

Seasons / Planting methods	1998		1999	
	Ridge	Row	Ridge	Row
Time of macro and micro -elements application:				
1-Free foliar application (control)	749.4	679.8	749.6	688.3
2- At 30 days after sowing	758.6	700.5	753.5	740.2
3- At 45 days after sowing	765.8	722.4	764.3	747.0
4- At 60 days after sowing	768.4	739.9	768.2	751.3
5- At 30 and 45 days after sowing	747.0	756.4	746.9	748.8
6- At 30, 45 and 60 days after sowing	769.4	767.9	782.3	761.6
7- At 45 and 60 days after sowing	762.2	699.3	760.8	697.5
F-test	**		*	
N-LSD at 5%	20.7		38.6	
N-LSD at 1%	28.0		---	

Table 6: Averages no. of days to 50% tesseling and no. of kernels /row of maize plants as affected by the interaction between planting methods and macro and micro –elements in 1999 season.

Characters / Planting methods	No. of days to 50% tesseling		No. of kernels /row	
	Ridge	Row	Ridge	Row
Time of macro and micro-elements application:				
1-Free foliar application (control)	60.1	60.0	40.6	37.7
2- At 30 days after sowing	62.9	61.4	41.7	40.8
3- At 45 days after sowing	62.7	62.3	42.1	41.7
4- At 60 days after sowing	63.1	61.6	45.0	42.6
5- At 30 and 45 days after sowing	62.4	61.7	46.4	42.5
6- At 30, 45 and 60 days after sowing	66.4	63.9	48.5	47.1
7- At 45 and 60 days after sowing	61.5	60.7	43.5	40.6
F-test	*		**	
N-LSD at 5%	0.9		1.2	
N-LSD at 1%	---		1.5	

Table 7: Averages kernels weight /ear of maize plants as affected by the interaction between planting methods and macro and micro – elements during 1998 and 1999 seasons.

Seasons / Planting methods	1998		1999	
	Ridge	Row	Ridge	Row
Time of macro and micro-elements application:				
1-Free foliar application (control)	248.2	210.7	243.3	207.3
2- At 30 days after sowing	257.1	240.9	257.3	239.0
3- At 45 days after sowing	277.3	257.5	264.6	258.8
4- At 60 days after sowing	288.2	287.4	283.4	282.7
5- At 30 and 45 days after sowing	301.2	290.8	297.5	285.6
6- At 30, 45 and 60 days after sowing	312.5	301.5	313.0	301.0
7- At 45 and 60 days after sowing	262.1	254.1	261.9	256.9
F-test	*		**	
N-LSD at 5%	22.0		6.8	
N-LSD at 1%	---		9.0	

Table 8: Averages 100-kernel weight and shelling percentage of maize plants as affected by the interaction between planting methods and macro and micro elements in 1998 season.

Characters / Planting methods	Shelling %		100-kernel weight (g)	
	Ridge	Row	Ridge	Row
Time of macro and micro -elements application:				
1-Free foliar application (control)	75.8	75.1	35.0	30.9
2- At 30 days after sowing	75.7	79.2	37.7	36.7
3- At 45 days after sowing	76.5	78.2	39.1	38.4
4- At 60 days after sowing	75.8	77.7	40.1	40.3
5- At 30 and 45 days after sowing	78.3	76.4	40.3	40.2
6- At 30, 45 and 60 days after sowing	79.2	78.5	42.5	44.5
7- At 45 and 60 days after sowing	77.9	77.2	41.2	40.2
F-test	*		**	
N-LSD at 5%	3.1		1.6	
N-LSD at 1%	---		2.3	

Table 9: Averages grain yield of maize plants as affected by the interaction between planting methods and macro and micro - elements during 1998 and 1999 seasons.

Seasons / Planting methods	1998		1999	
	Ridge	Row	Ridge	Row
Time of macro and micro -elements application:				
1-Free foliar application (control)	12.53	10.43	12.57	10.30
2- At 30 days after sowing	14.53	11.33	13.10	11.07
3- At 45 days after sowing	14.43	11.73	13.83	11.60
4- At 60 days after sowing	15.83	12.67	15.40	12.80
5- At 30 and 45 days after sowing	17.30	13.07	16.60	12.87
6- At 30, 45 and 60 days after sowing	18.33	15.20	17.83	14.90
7- At 45 and 60 days after sowing	14.77	13.23	15.07	13.20
F-test	**		*	
N-LSD at 5%	0.76		0.81	
N-LSD at 1%	1.02		---	

Macro and micro-nutrients content and uptake:

Data presented in Table (10) show the effect of spraying times with foliar of macro and micro-nutrients on the contents of ear leaf at one week after silk stage. It can be seen from the Table that, the N, P, K, Fe, Mn, Zn and B content of ear leaf at one week after silk was increased with increasing spraying frequency. Raising the frequency of spraying from control to treatment with 3 times increases the nitrogen content in plant sample. Phosphorus content increased 16.7% in plant sample, while potassium content gave 39.4 % increase in plant sample. From the results obtained it can be concluded that the spraying with Nervatein-Vit increased N, P and K content in ear leaf. Maximum contents as percentage obtained with 3 spraying times (30, 45 and 60 days after planting). It means that, the optimum time of N, P and K to obtained maximum grain yield were gave at spraying Nervatein-vit compound at 15, 45 and 60 days after planting.

Table (10): Effect of spraying frequency of macro and micro-nutrients on the content ear leaf at one week after silk (average of the two seasons) of corn plant of ridges method.

Spraying frequency	Macro-elements (%)			Micro-elements (mg/1000 gm)			
	N	P	K	Fe	Mn	Zn	B
1-Free foliar application (control)	2.0	0.10	1.3	30	15	15	4
2- At 30 days after sowing	2.2	0.30	2.2	100	80	40	6
3- At 45 days after sowing	2.6	0.30	2.3	180	85	60	10
4- At 60 days after sowing	2.8	0.40	2.6	185	95	60	11
5- At 30 and 45 days after sowing	2.9	0.40	2.6	200	90	70	12
6- At 30, 45 and 60 days after sowing	3.2	0.60	3.3	235	120	80	17
7- At 45 and 60 days after sowing	3.0	0.50	3.0	220	110	75	15
F-test							
N-LSD at 5%	0.2	0.04	0.2	12	5.3	7.6	1.3

No doubt that, the nutrition of plants by foliar application is not only an addition channel of nutrients but also a mean of regulating root absorption by

such plants. The micro-nutrients contents of ear leaf at one week after silk were represented in Table (10). From that Table, it can be seen that all micro-nutrients increased by increasing the frequency of spraying. Maximum increases showed with the treatment of spraying at 30, 45 and 60 days after planting. The increasing in elements contents were amounted to 7.33, 7.33, 5.00 and 3.75 % for Fe, Mn, Zn and B, respectively (Comparing between treatment with 3 spraying times and control). Also, the maximum contents of all micro-nutrients under the study showed with the same treatment which gaves maximum grain yield of maize. From results obtained , it could be concluded that the contents of N, P and K (4.2, 0.5, 3.0 % dry weight, respectively in ear leaf at one week after silk) and Fe, Mn, Zn and B (220, 110, 75 and 15 mg /kg dry weight of ear leaf at one week after silk, respectively) were considered sufficient concentrations to obtain maximum grain yield of maize.

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تأثير العناصر الغذائية الكبرى والصغرى وطرق الزراعة المختلفة على محصول الذرة الشامية المنزرع تحت ظروف سيناء

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أقيمت تجربتان حقليتان فى وادى العريش ـ محافظة شمال سيناء حيث التربة رملية ـ متوسطة فى نسبة الأملاح الكلية ومنخفضة فى المادة العضوية والعناصر الغذائية الكبرى والصغرى وذلك فى موسمى النمو ١٩٩٨ و ١٩٩٩ بهدف دراسة استجابة الذرة الشامية صنف هجين فردى ١٠ لكل من طريقتى الزراعة على خطوط وطريقة الزراعة فى سطور على سطح التربة مع دراسة أثر ٧ مواعيد للرش الورقى (عناصر كبرى وصغرى) حيث استخدم تصميم الشرائح المتعامدة فى ٤ مكررات خصصت القطع الرئيسية وهى الشرائح الأفقية لطرق الزراعة والرأسية لمواعيد الرش.

ـ وقد تبين من النتائج أن الزراعة على خطوط شجعت معظم صفات النمو وأدى ذلك إلى زيادة محصول الحبوب عن الزراعة فى سطور بمتوسط ٢١,٦٢%.

ـ أدى الرش كل ٣٠ ، ٤٥ ، ٦٠ يوم من الزراعة بمركب النرفاتين بتركيبة (١٠% ن ، ٨% فو٢أ٥ ، ٧% بو٢أ، ٠,٦% مغ، ١,١% ح، ٠,٥% من، ٠,٥% ز، ٠,٠٥% ب، ٠,٠٢% مو، ٠,٠٢% نح) بمعدل ١,٨ لتر للفدان إلى زيادة معنوية فى كل من (عدد الأيام إلى ٥٠% خروج النورة المذكرة و ٥٠% خروج النورة المؤنثة وارتفاع النبات وقطر الساق ومساحة أوراق النبات وارتفاع الكوز وطول الكوز وقطر الكوز ووزن حبوب الكوز ونسبة التصافى ووزن المائة حبة ومحصول الفدان من الحبوب) عن باقى مواعيد الرش الأخرى وهى ٣٠ ، ٤٥ ، ٦٠ ، (٣٠،٤٥) ، (٤٥،٦٠) يوم من الزراعة بمعدل (صفر ، ٠,٦ ، ٠,٦ ، ٠,٦ ، ١,٢ ، ١,٢ لتر للفدان) على التوالى من التركيبة السابقة.

ـ أثبتت الدراسة أن محتوى ورقة الكوز من النتروجين ، الفوسفور والبوتاسيوم هى ٤,٢، ٥,٠ ، ٣,٠% على التوالى والحديد والمنجنيز والزنك والبورون بتركيز ٢٢٠، ١١٠، ٧٥، ١٥ مليجرام / كيلو جرام وزن جاف من ورقة العلم يعتبر كافيا للحصول على محصول جيد من الذرة الشامية تحت الدراسة.

من النتائج السابقة يمكن التوصية بزراعة الذرة الشامية صنف هجين فردى ١٠ على خطوط والرش الورقى من مركب النرفاتين بالتركيبه المذكوره بمعدل ١,٨ لتر للفدان قسمت على ٣ فترات عند ٣٠ و ٤٥ و ٦٠ يوم من الزراعة مع اتباع باقى التوصيات الفنية للذرة وذلك تحت ظروف المنطقة التى تمت بها الدراسة.

Table 2: Averages number of days to 50% tesseling and silking, plant height, stem diameter and ear leaf area of maize plants as affected by planting methods and macro and micro-elements during 1998 and 1999 seasons.

Characters / Treatments	No. of days to 50% tesseling		No. of days to 50% silking		Plant height (cm)		Stem diameter (cm)		Leaf area/ plant (cm^2)	
	1998	1999	1998	1999	1998	1999	1998	1999	1998	1999
A: Planting methods:										
Ridge	62.7	62.9	66.3	66.0	266.1	266.3	2.92	2.91	760.1	760.8
Row	61.6	61.9	65.1	64.9	266.9	266.9	2.69	2.60	723.7	733.5
F-test	**	*	*	**	NS	NS	*	NS	*	*
B: Time of macro and micro-elements application:										
1-Free foliar application (control)	60.1	60.8	63.3	62.7	258.6	255.5	2.23	2.20	714.6	718.9
2- At 30 days after sowing	62.1	62.1	65.1	64.8	262.7	262.4	2.57	2.43	729.5	746.8
3- At 45 days after sowing	62.5	62.4	66.5	66.6	264.9	264.2	2.72	2.73	744.1	755.6
4- At 60 days after sowing	62.3	62.8	65.7	65.6	270.1	271.1	2.93	2.98	754.2	759.7
5- At 30 and 45 days after sowing	62.1	62.3	66.5	65.9	270.4	271.1	3.00	3.08	762.9	747.8
6- At 30, 45 and 60 days after sowing	65.1	65.6	69.0	68.7	275.1	276.5	3.48	3.32	757.5	771.9
7- At 45 and 60 days after sowing	61.1	60.7	64.1	64.1	263.8	265.3	2.70	2.52	730.8	729.1
F-test	**	**	**	**	**	**	**	**	**	**
N-LSD at 5%	0.6	1.0	1.1	1.0	1.7	2.0	0.13	0.16	14.0	23.4
N-LSD at 1%	0.9	1.3	1.4	1.2	2.3	2.6	0.17	0.21	18.7	29.7
C: Interaction:										
A x B	*	NS	NS	NS	NS	NS	NS	NS	**	*

Table 3: Averages of ear position, ear length, ear diameter, no. of kernels /row and kernels weight /ear of maize plants as affected by planting methods and macro and micro-elements during 1998 and 1999 seasons.

Characters / Treatments	Ear position (cm)		Ear length (cm)		Ear diameter (cm)		No. of kernels /row		kernels weight /ear	
	1998	1999	1998	1999	1998	1999	1998	1999	1998	1999
A: Planting methods:										
Ridge	131.9	133.2	21.4	21.3	3.89	3.89	44.3	44.0	278.1	274.4
Row	135.9	137.1	19.7	19.8	3.87	3.89	42.0	41.9	263.3	261.6
F-test	*	NS	**	**	NS	NS	*	**	*	**
B: Time of macro and micro-elements application:										
1-Free foliar application (control)	122.9	124.4	18.5	18.5	3.68	3.63	39.9	39.2	229.4	225.3
2- At 30 days after sowing	125.9	127.9	19.1	19.5	3.67	3.72	41.6	41.3	248.9	248.2
3- At 45 days after sowing	132.4	135.5	20.4	21.0	3.83	3.83	42.3	41.9	267.4	261.7
4- At 60 days after sowing	138.1	138.2	20.9	21.2	3.88	3.93	43.9	43.8	287.8	283.1
5- At 30 and 45 days after sowing	140.6	140.8	21.1	20.6	4.08	3.98	44.3	44.4	296.0	291.6
6- At 30, 45 and 60 days after sowing	145.4	146.0	23.8	23.3	4.15	4.28	47.6	47.8	307.0	307.0
7- At 45 and 60 days after sowing	131.9	133.2	19.9	20.0	3.85	3.85	42.5	42.1	258.1	259.4
F-test	**	**	**	**	**	**	**	**	**	**
N-LSD at 5%	3.6	1.6	0.6	0.8	0.24	0.17	1.0	0.7	9.0	4.6
N-LSD at 1%	4.8	2.2	0.9	1.0	0.33	0.23	1.4	1.0	12.0	6.1
C: Interaction:										
A x B	NS	NS	NS	NS	NS	NS	NS	**	*	**