Response of Some Maize Hybrids to Foliar Spray of Seaweed and Biofertilization

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ABSTRACT: Two filed experiments were carried out at the Farm of Faculty of Agriculture (Saba Basha), Alexandria University, at Abees region Alexandria, Egypt during 2016 and 2017 seasons to study the response of some maize hybrids to foliar spray of seaweed and biofertilization on yield and its components and chemical composition. The applied experimental design was split- split plots with three replicates. The main plot was allocated for the three maize hybrids. Seaweed spray (water, 350 and 700 mg/L SWE) were applied in sub plot, and three biofertilization (control, Microbein and Phosphorein) were distributed in sub-sub plot. The main results could be summarized as follows; i. The maize hybrid 310 gave the highest mean values of all studied characters, ii. Spraying foliar seaweed at 700 mg/L recorded the increased yield and its components and chemical composition over the control treatment, iii. The biofetilizer (Phosphorein) inoculation was the best treatment to obtain the highest mean values of ear length, number of rows/ear, number of grains/ear, 100- grain weight, grain yield (ton/ha) and biological yield (ton/ha), protein content, N, P and K (%). However, the traits under this study increased significantly with inoculation treatment over uninoculation. The investigation suggests more studies concerning the effect of biofetilizer and their interaction, as well as foliar spraying of seaweed extracts for maize plants under different environments using different types of soil to reach the optimum combination to achieve the highest maize yield and quality.
Keywords: maize, seaweed, biofertiliztion, yield, chemical composition.

INTRODUCTION

Maize (*Zea mays* L.) is one of the three most important cereal crops in Egypt and the world. Maize is high yielding, easy to pocess, readily digested and cheaper than other crops. Every part of the maize plant has economic value which the grain, leaves, stalk, tassel and cob can all be used to produce a large variety of food and non-food products. The cultivated area in Egypt occupied about 1.58 million feddan (one feddan=4200 m^2) producing up to 5.85 million tons of grains (FAO, 2014) with an average yield of 24.02 ardab/feddan (ardab = 140 kg grains).

Seaweed extracts are natural source of organic liquid fertilizer capable of supplying macro and micro nutrients directly to the plant, as well as, seaweed manure is also a better option than conventional organic manure (farmyard manure) due to its easy decomposability of carbonaceous matter and presence of micro-nutrients (Dhargalkar and Pereia, 2005). Kaliperumal (2000) also reported that the conjunction of seaweed manure with inorganic fertilizer has been found to be better than the other organic input for growth and development of the plants. Seaweed liquid fertilizer is a blend of both plant growth regulators and organic nutrient input is ecofriendly promoting sustainable productivity and maintaining soil heath (Mohanty *et al.,* 2013 and Singh *et al.,* 2015). Furthermore, biofertilization is one of the most important factors used to produce products free from mineral fertilizer that cause environmental pollution problems and high rates of it lead to decrease in the potential activity of micro-flora and the mobility of organic matters. Hence, the

attention has been focused on the researches of bio-fertilizers to safe alternative for the chemical fertilizers. Bio-fertilizers play vital role in increasing the number of microorganisms and accelerate certain microbe processes in the rhizosphere of inoculated soil plants which can change the available forms of nutrients into plant (Zayed, 2003, El-Rewainy and Galal 2004, Kandil, 2004, AbdAlla, 2005, Abdel-Maksoud and Sarhan, 2008 and El-Basuony *et al.,* 2009).

Therefore, this study aimed to increase maize production, and discusses the agronomic aspects of adding seaweed extract levels and biofetilizers application to soil on maize hybrids production.

MATERIALS AND METHODS

Two field experiments were conducted at the Experimental Farm of Faculty of Agriculture (Saba Basha), Alexandria University, Egypt, during the summer seasons of 2016 and 2017 to study the response of some maize hybrids to foliar spray of seaweed and bio-fertilization on the growth, yield and quality of maize hybrids. A split- split plot design with three replicates was used. The three maize hybrids (T.W.C. 310, Single Cross 2031 and Single Cross 1100) were randomly distributed in the main plots. The sub-plots were assigned to three seaweed extract (SWE) i.e. (control, 350 and 700 mg/L SWE). The bio-fertilization used in both seasons of was uninoculation, microbein and phosphorein which allocated to sub- sub plot. Calcium superphosphate (15.5 % P_2O_5) at level of 200 kg/fed. and 50 kg K2O/fed in form of potassium sulphate (48 % K_2O), nitrogen fertilization at level of 120 kg N/fed. in the form of urea (46.5 N%) were used. The white hybrids were obtained from Ministry of Agriculture (TWC310) and Hytech company (S.C.2031 and S.C.1100). Each sub plot consisted of 6 ridges 3.50 m in length and 70 cm in the width and plot area was 14.7 m^2. The sowing date was 15th of May in both seasons. Seaweed extracts treatments (control, 350 and 700 mg/L) were applied as foliar spray at three times (20 days after sowing, after 15 from the first and after 15 days from the second). The product analysis is presented in Table (1).

Table (1). Structure of Acadiano- extract Alage*

Content	Percentage %
Oligo karidz	3.00
Algenic acid	5.00
Zinein	0.003
Mentol	0.001
K_2O	1.20
Zinc	0.30
Iron	0.20
Manganese	0.10
Natural growth hormones	
Cytokinin	0.001
IAA (Indole Acetic Acid)	0.003
Bena fine	0.020

*Analyzed by Alga chem Sri (Genova) company, Italy.

Soil Physical and chemical analysis of experimental site of the two seasons are given in Table (2).

Table (2). Some Physical and chemical properties of the experimental soil in 2016 and 2017 seasons

Soil properties		
	Season	
	2016	2017
A) Mechanical analysis:		
Clay %	38	37
Sand %	32	33
Silt %	30	30
Soil texture	**Clay loam soil**	
B) Chemical properties		
pH (1 : 1)	8.30	8.20
EC (dS/m)	3.70	3.80
1) Soluble cations (1:2) (cmol/kg soil)		
K^+	1.53	1.54
Ca^{++}	9.30	9.10
Mg^{++}	18.30	18.50
Na^{++}	13.50	13.80
2) Soluble anions (1 : 2) (cmol/kg soil)		
$CO_3^{--} + HCO_3^-$	2.80	2.70
Cl^-	20.40	19.90
SO_4^{--}	12.60	12.80
Calcium carbonate (%)	31.60	31.57
Total nitrogen %	1.00	0.92
Available phosphate (mg/kg)	3.80	3.90
Organic matter (%)	1.42	1.41

The preceding crop was Egyptian clover (berseem) in the first season and barley (*Hordeum vulgare* L.) in the second season, respectively. At harvest the three inner rows were used for grain yield estimation. The following data were recorded:

1. Yield and its components: ear length (cm), number of rows/ear, number of grains/ear, 100-grain weight, grain yield and biological yield (ton/ha).
2. Chemical characters:

a) Grain protein content calculated as total nitrogen in the grains and multiplied by 6.25 to obtain seeds protein percentage according to AOAC (1990).

b) Phosphorus was determined by the Vanadomolybdate yellow method as given by Jackson (1973) and the intensity of colour developed was read in spectrophotometer at 405nm. All collected data were subjected to analysis of variance according to Gomez and Gomez (1984). All statistical analysis was performed using analysis of variance technique using CoStat computer software package (CoStat, Ver. 6.311., 2005). The least significant difference (LSD at 0.05) was used to compare the treatment means.

RESULTS AND DISCUSSIONS

Yield and its components

The recorded results in Tables (3 and 4) showed that yield and its components in both seasons were significantly affected by maize hybrids. Maize hybrids 310 gave the highest ear length, number of rows/ear, number of

grains/ear, 100-grain weight, grain yield and biological yield (ton/ha). The three maize hybrids which play an important role for up make of the available nutrients and photosynthesis process, this led to differences in dry matter production and potentially yield for these hybrid under study. Maize 310 cultivar was superior one in yield and its components in both seasons. The previous results agree more or less with the finding of Amin *et al.* (2003) and Atia and Abdel Azeem (2005).The yield and its components significantly increased by adding seaweed extract (SWE) levels over the control treatments in both seasons. Spraying foliar at 700 mg/L (SWE) gave the highest mean values of yield and its components. Similar results were obtained by Kozlouiski and Swedrznk (2001) and Strik *et al.* (2004). Biofertilization inoculation with Phosphorein increased the production of maize. However, this could be attributed to more adsorption of nutrients, amino acids, cytokinins, gebberelins and sugars that come from adding Phosphorein which reflect more growth activity of phosphorus and nitrogenous compounds assimilation, forming more growth substances, more cell division and elongation in meristematic zones and the direct or indirect role of fertilization treatments on metabolism and photosynthesis processes of the plants. Similar finding was reported by Mohamed and Gebraiel (2001), El-Rowainy and Galal (2004) and Rizk *et al.* (2006).The interaction between maize hybrids and seaweed extracts was significant for yield and its components (Tables 3 and 4).

Table (3). Ear length (cm), number of row/ear, and number of grains/ear as affected by maize hybrids, seaweed extracts (SWE), biofertilization and their interaction during 2016 and 2017 seasons.

Treatments	Ear length (cm)		Number of row/ear		Number of grains/ear	
	2016	2017	2016	2017	2016	2017
A) Maize hybrids						
TWC. 310	18.14	20.28	12.50	13.70	541.00	596.79
SC.1100	16.58	18.75	12.25	13.46	508.51	559.67
SC. 2031	14.90	16.41	11.73	12.88	485.71	534.02
L.S.D. at 0.05	1.50	1.40	0.20	0.22	10.00	11.20
B) Seaweed extract concertation (mg/L)						
water	14.76	16.24	11.05	12.88	462.35	508.61
350	16.50	18.18	12.03	13.18	540.08	566.21
700	18.66	20.52	13.40	14.76	527.48	615.65
L.S.D. at 0.05	1.40	1.30	0.16	0.19	8.70	10.52
C) Bio-fertilization						
Uninoculation	15.49	16.97	11.75	12.89	484.35	532.69
Microbein	16.59	18.21	12.15	13.32	511.85	584.82
Phosphorein	17.90	19.69	12.55	18.84	538.90	591.89
L.S.D. at 0.05	1.10	1.00	0.11	0.14	8.50	6.40
Interactions						
Ax B	*	*	ns	ns	*	*
AxC	*	*	ns	ns	*	*
BxC	*	*	ns	ns	*	*
AxBx C	*	*	ns	ns	*	*

ns: Not Significant, and *: Significant at 0.05 level of probability.

Table (4). 100-grain weight, grain yield and biological yield (ton/ha) as affected by maize hybrids, seaweed extracts (SWE), biofertilization and their interaction during 2016 and 2017 seasons

Treatments	100-grain weight (g)		Grain yield (ton/ha)		Biological yield (ton/ha)	
	2016	2017	2016	2017	2016	2017
(A) Maize hybrids						
TWC. 310	33.57	37.85	7.17	7.89	16.21	17.84
SC.1100	30.09	33.28	6.69	7.36	14.63	16.09
SC. 2031	27.22	30.09	6.03	6.60	13.18	14.84
L.S.D. at 0.05	1.60	1.80	0.40	0.60	1.10	1.30
(B) Seaweed extract concentration (mg/L)						
Water	27.25	29.99	5.81	6.39	13.13	14.44
350	30.11	32.94	6.65	7.31	14.58	16.04
700	33.53	37.05	7.44	7.71	16.30	17.99
L.S.D. at 0.05	1.50	1.60	0.30	0.40	0.80	1.00
(C) Bio-fertilization						
Uninoculation	25.53	28.11	6.10	6.78	13.99	15.39
Microbein	30.40	32.92	6.81	7.35	14.93	16.42
Phosphorein	34.49	38.81	7.81	7.66	15.09	16.60
L.S.D. at 0.05	1.40	1.50	0.40	0.40	0.50	0.60
Interactions						
Ax B	*	*	*	*	*	*
AxC	*	*	*	*	ns	ns
BxC	ns	ns	ns	ns	*	*
AxBx C	ns	ns	ns	ns	ns	ns

ns: Not Significant, and *: Significant at 0.05 level of probability.

A) Chemical composition

Results in Table (5) reveal a significant effect from maize hybrids on the studied characters for protein content, P and K (%) in both seasons. Maize 310 cultivar gave the highest mean values of protein, P and K percentages, while, the lowest one was recorded with maize hybrid S.C.2031 in both seasons. Protein in maize grains resulted from other parts of maize plant especially leaves and translocation to the grains filling period (Abdel-Ghany *et al.,* 2005). The results are in harmony with those obtained by Amin *et al.* (2003), Ashmowy (2003), Atia and Abdel Azeem (2005), Abdel-Ghany *et al.* (2005) and Mekki and Ahmed (2005).

Presented results in Table (5) indicate that seaweed extract (SWE) levels significantly affected protein, P and K percentages. Generally, increasing seaweed extracts (SWE) led to positive increase in both seasons. Spraying foliar (SWE) at 700 mg/L gave the maximum protein, P and K percentages, while, the lowest chemical composition was recorded by control treatment in both seasons. Seaweed extracts can increase nutrient availability in the soil better absorption of the chelated compound at leaf have recently. These results are in harmony with those obtained by Gathiattia *et al.* (2007), Khan (2009), Subromanlyn *et al.* (2012) and Ashraf and Harris (2013).

Data in Table (5) indicate that biofertilization treatments significantly affected protein, N percentage in both seasons and P % in the first season only. Microbein gave the highest P and K%. Hence, it could be the concluded has taken place due to that the active role of N_2- fixing and phosphate dissolving and increasing the endogenous phytohormones e.g. IAA, CAs and CKs which play important roles information big active root system and hence increasing the nutrients uptake, photosynthesis rate and translocation, as well as, accumulation the assimilate within different plant organs. These results are matching with those obtained by Zayed (2003), El-Rewainy and Galal (2004), Kandil (2004), Abdel- Allah (2005), Abdel-Maksoud and Sarhan (2008) and El-Basuony *et al.* (2009).

Table (5). Protein (%), phosphorus (P %) and potassium (K %) in grain as affected by maize hybrids, seaweed extracts (SWE), biofertilization and their interaction during 2016 and 2017 seasons

Treatments	Protein (%)		P (%)		K (%)	
	2016	2017	2016	2017	2016	2017
(A) Maize hybrids						
TWC. 310	8.13	9.16	0.622	0.710	1.75	1.92
SC.1100	7.34	8.06	0.577	0.673	1.57	1.73
SC. 2031	6.60	7.26	0.555	0.553	1.40	1.55
L.S.D. at 0.05	0.90	0.60	0.012	0.040	ns	0.10
(B) Seaweed extract concentration (mg/L)						
Water	7.00	7.52	0.497	0.545	1.44	1.58
350	7.45	8.18	0.615	0.640	1.58	1.73
700	7.78	8.38	0.641	0.770	1.71	1.89
L.S.D. at 0.05	0.22	0.23	0.110	0.060	0.21	ns
(C) Bio-fertilization						
Uninoculation	6.80	7.72	0.576	0.603	1.46	1.49
Microbein	7.88	8.50	0.669	0.643	1.57	1.79
Phosphorein	7.33	8.11	0.569	0.677	1.69	1.86
L.S.D. at 0.05	0.33	0.40	0.40	ns	0.09	0.06
Interactions						
Ax B	ns	ns	ns	ns	ns	ns
AxC	ns	ns	ns	ns	ns	ns
BxC	ns	ns	ns	ns	ns	ns
AxBx C	ns	ns	ns	ns	ns	ns

ns: Not Significant, and *: Significant at 0.05 level of probability.

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الملخص العربي

إستجابة بعض هجن الذرة الشامية للرش الورقي بالأعشاب البحرية والتسميد الحيوي

فتحي إبراهيم رضوان ، محمود عبد العزيز جمعة ، عصام اسماعيل اسماعيل قنديل ، فؤاد غيث فرج منصور

قسم الإنتاج البناتي – كلية الزراعة (سابا باشا) – جامعة الأسكندرية – مصر

أجريت تجربتان حقليتان في مزرعة كلية الزراعة (سابا باشا) جامعة الأسكندرية خلال موسمي الزراعة ٢٠١٦، ٢٠١٧ لدراسة تأثير إستجابة هجن الذرة الشامية للرش بالأعشاب البحرية والتسميد الحيوي وقد أستخدم في هذه التجربة تصميم القطع المنشقة مرتين ووزعت الأصناف داخل القطع الريئسية (هجين ثلاثي ٣١٠، هجين فردي ١١٠٠، هجين فردي ٢٠٣١)، القطع الشقية الأولي ثلاث معاملات رش بمستخلص الطحالب البحرية (ماء ، ٣٥٠ ، ٧٠٠ مجم/لتر)، وزعت معاملات التسميد الحيوي (بدون تلقيح – ميكروبين– فوسفورين) داخل القطعة الشقية الثانية.

ويمكن تلخيص أهم النتائج:

١. تفوق هجين الذرة الشامية ٣١٠ على باقي الهجن تحت الدراسة حيث أعطي أعلي متوسط قيم لجميع صفات المحصول ومكوناته.

٢. سجل الرش بمستخلص الطحالب البحرية عند ٧٠٠ مجم/لتر زيادة في المحصول ومكوناته والمحتوي الكيماوي مقارنة بالكنترول.

٣. أدي التلقيح بالفوسفورين الى الحصول على أعلي متوسطات قيم لصفات المحصول ومكوناته (طول الكوز– عدد الصفوف/كوز– عدد الحبوب/كوز–وزن ١٠٠ حبة– محصول الحبوب (طن/هكتار)– المحصول البيولوجي (طن/هكتار)– النسبة المئوية لكل من البروتين والفوسفور والبوتاسيوم) مقارنة بمعاملة الكنترول.

٤. يوصي البحث بزراعة هجين ثلاثي من الذرة الشامية ٣١٠ وتسميده بالسماد الحيوي مع الرش بمستخلصات الطحالب البحرية بمعدل ٧٠٠ مجم/لتر حيث حققت هذه المعاملات زيادة في محصول الحبوب والجودة.