Plant Archives Vol. 19 No. 2, 2019 pp. 2301-2314 **e-ISSN:2581-6063 (online), ISSN:0972-5210**

RESPONSE OF SOME WHEAT CULTIVARS TO FOLIAR APPLICATION OF SOME NUTRIENT COMPOUNDS UNDER SANDY SOIL CONDITIONS IN WADI EL-NATRON

Hanaa F.Y. Mohamed[1], H.M. Abdel-Lattif[2] and R.M. Abd El-Salam[2]

[1]Plant Physiology Section, Dept. of Agricultural Botany, Fac. of Agric. Cairo Univ., Egypt
[2]Agronomy Department, Faculty of Agriculture, Cairo University, Giza, Egypt.

Abstract

To minimize the adverse effect of salinity and improve of productivity and chemical constituents of wheat grown in sandy soil by using foliar applications two field experiments were laid out in the Desert Experimental Station, Faculty of Agriculture, Cairo University in Wadi El-Natroon, El-Beheira Governorate, Egypt during 2015/2016 and 2016/2017 seasons to study the response of three wheat cultivars (Gemmiza12, Sakha93 and Misr2) to foliar application with humic acid, Power Mix, zinc sulphate and putrescine compared with a control treatment on some growth parameters, yield and its components as well as chemical composition content compared with untreated wheat plants. A split-plot design in a randomized complete block arrangement was used with three replications. The main plots were allotted to the seven levels of foliar application and three Egyptian commercial varieties of wheat were devoted to sub-plot. The results indicated significant varietal differences response to the above mentioned treatments in most of traits under study. Misr2 was superior in plant height, fresh and dry weights, root length, No. of spikes/plant, spike weight/plant, straw and grain yields/plant, grain yield/fed, total grain sugar and total free amino acids (FAA) contents. The use of putrescine gave the best results in most of growth traits under study. Particularly plant height, and plant fresh and dry weights. Use of power mix recorded the best results regarding (straw weight/ plant, grain weight/spike and spike weight/plant. Sakha93 gave the highest average of grain N, K and shoot N, P and K. The application of 200 ppm putrescine recorded the same results while Misr2 gave the highest reading in shoot N and P. Finally Sakha93 was superior in phenol, total FAA in shoot and grains in phenol content while Misr2 recorded the highest total sugar and total FAA in grain contents.

Key words : Wheat, salinity, humic acid, Power Mix, zinc sulphate and putrescine.

Introduction

Wheat as cereal crop consider the second most important crop that contributes significantly to the global food and food security (Kumar *et al.,* 2013). Through the last 20 years, the global wheat acreage varied between 207 and 227 million hectares with a production and productivity around 728.28 million tons (Ljubicic, *et al.,* 2014).

In Egypt wheat (*Triticum aestivum*) is the most important cereal crop. The total wheat production sedum covers 40-50% of consumption. A number of high yielding wheat cultivars have been released during the last three decades of these cultivars Gemmiza12, Sakha93 and Misr2, proved their high yielding potentially (Omar *et al.,* 2014).

Moreover the extension of wheat cultivated area in sandy soils needs the search for different modified agronomic practices in order to overcome the poor soil fertility level in these soils. The foliar application of nutrient solutions has been proved as successful as it helps in avoiding the low uptake of plant nutrients. Furthermore a number of nutrient compounds have been reported to increase wheat productivity.

Salinity is one of the primary limiting factors in crop production. It causes water deficit, ion toxicity, and nutrient deficiency, leading to growth and yield reduction, and even to plant death (Li *et al.*, 2013). Under arid and semi- arid conditions, the negative effects of salinity are increased due to practices such as fertilization and irrigation with saline ground water (Villa- Astoria *et al.,* 2003).

Zinc is an essential micronutrient for all organisms and serves as cofactor for more than 300 enzymes (Xu *et al.,* 2010, Chen *et al.,* 2011 and L. H. Xu, *et al.,* 2014). Zn is closely involved in a wide range of cellular processes such as free radical defence, electron transport protein and auxin biosynthesis, cell proliferation and production. Zinc deficiency is one of the most widespread limiting factors in crop production especially in saline soil. Dangyum *et al.,* (2017) found foliar application of Zn increased grain yield of wheat.

Zn plays a role in alleviating wheat plant drought stress by Zn-mediated increase in photosynthesis pigment and active oxygen scavenging substances and reduction in lipid peroxidation. Zinc plays a great role in carbonic anhydrase (CA) activity and hence photosynthesis particularly in C_3 plants which wheat belongs as it helps to decrease photorespiration Seemann, *et al.,* (1985). Zinc sulphate increased the Leaf Area Index, the total number of productive tillers m^{-2}, number of spikelets/ spike, spike length and grain weight, thousand grain weight, grain yield, straw yield and biological yield but decreased harvest index (Khan *et al.,* 2008).

Concerning the humic acid, Sebastiano *et al.,* (2005) reported that, humic acid had limited promoting effects on plant growth, grain yield, quality and photosynthetic metabolism of durum wheat crop. Howevere, Bezuglova *et al.,* (2017) refered that, humic substance (H.S) had a positive effect on the high crop yielding formation, based on high availability of mobile forms of phosphorus on the variants treated with humic substances. This is due to the active control mechanism through root exudates and an increase in the humic substances during the vegetation.

Moreover, amino acid is commonly applied to several crops due to their activation role in the physiological and metabolic processes. Abdel-Mawgoud *et al.,*(2011) and Zewail (2014) reported that, spraying plants with amino acids improved growth parameters, harvest index and biochemical constituents of N, P, K, Mg, Ca, Fe, Zn total carbohydrate and crude protein in leaves. Also Halpern *et al., (*2015) mentioned that, this practice has direct effects on plants including modulation of N uptake and assimilation by the regulation of enzymes involved in N assimilation and of their structural genes and by acting on the signalling pathway of N acquisition in roots. Also, by regulating the enzymes of TCA cycle, they also contribute to the cross bridge between C and N metabolisms.

Concerning the putrescine, Prakash and Prathapasenan (1988) found that, foliar application of Putrescine ($10M^{-3}$) significantly increased the growth and yield under salt stress. Galston and Kaur-Sawhney (1990) reported that, polyamines are present in a variety of plant growth and development processes, including cells division, vascular differentiation, root initiation, shoot formation, flower initiation and development, fruit ripening and senescence. Thus, the aim of this study was to evaluate the response of three wheat cultivars to foliar application of different nutrient compounds under sandy soil condition in Wadi El Natroon.

Materials and Methods

Two field experiments were conducted in the Desert Experimental Station, Fac. of Agric., Cairo Univ. in Wadi El-Natroon, El-Beheira Governorate, Egypt (located between 30°32'30'' and 30° 33'0'' N and between 29° 57'15'' and 29°58'15'' E with an altitude of 45 meters) during the two successive seasons of 2015/2016 and 2016/2017 to evaluate growth, yield and its components as well as chemical analysis of three wheat cultivars (Gemmiza12, Sakha93 and Misr2) grown in sandy soil under drip irrigation. The experimental soil physiochemical analysis was conducted according to Jackson (1973). Soil and irrigation water properties are presented in Tables 1, soil of the experimental site was sandy loam, saline and poor in nutrients. Little variances were found in the soil and irrigated water properties between the two seasons of the experiment.

Plant materials and experimental design

Three wheat cultivars (Gemmiza12, Sakha93 and Misr2) were planted via seven foliar applications. A split-plot design in a randomized complete block arrangement was used with three replications. The main plots were allotted to the seven levels of foliar application [Control (untreated, sprayed with tap water at the same time of foliar application of the other six treatments), Humic acid (85 %) commercial product supplied by biotech for Bio-acids fertilizer Company, Egypt.), Power Mix (consists of amino acids (21 %), potassium citrate (4.5 %), microelements (3.5 %), riboflavin (3%), cytokinin (0.3 %), gibberllic acid (0.001 %), inert ingredients (67.69%) added at 50ml/100 litre, Zinc sulphate100 ppm)$ZnSO_4$(, Zinc sulphate 200 ppm, Putrescine 100 ppm) $C_4H_{12}N_2$(and Putrescine 200 ppm] and varieties were devoted to sub-plot. Each sub-plot consists of 3 ridges of 0.80 m in width and 4.0 m in length, *i.e.* the experimental plot area was 9.6 m^2. Each main plot was surrounded with a wide ridge (1.6 m) to avoid interference of the seven foliar applications.

Cultural practices

The preceding crop was peanut (*Arachis hypogaea*

Table 1: Soil and irrigation water properties at the experimental site in 2015/16 and 2016/17 seasons.

Soil analysis	2016	2017
Physical properties		
Sand (%)	94.15	92.27
Silt (%)	4.35	5.20
Clay (%)	1.50	2.53
Texture class	Sandy loam	Sandy loam
Chemical properties		
$pH_{(1:1)}$	7.43	7.29
$EC_{(1:1)}$ ($dS\ m^{-1}$)	5.54	5.22
Organic matter (%)	0.51	0.62
Total $CaCO_3$ (%)	3.74	5.91
Available N ($mg\ kg^{-1}$)	6.4	8.9
Available P ($mg\ kg^{-1}$)	1.65	2.04
Available K ($mg\ kg^{-1}$)	168	187
Irrigation system	Drip irrigation	Drip irrigation

Chemical properties of irrigation water										
EC						Ions concentration meq L^{-1}				
Season	pH	ds m^{-1}	ppm	HCO_3^-	CL^-	SO_4^-	Ca^{++}	Mg^{++}	Na^+	K^+
2016	7.7	4.1	2624	2.8	30.5	9.0	3.9	4.3	33.3	0.64
2017	7.5	4.2	2688	3.2	29.1	7.9	5.3	4.6	32.5	0.55

L.) in both seasons. Seeds of all wheat varieties were obtained from Wheat Research Department, Field Crops Research Institute, Agricultural Research Centre, Egypt. The seeds were sowing on the last week of October in both seasons. Seeds were sown in drilling by hand on both sides of the ridges, calcium super phosphate fertilizer (15.5% P_2O_5) at the rate of 45 kg P_2O_5 fed^{-1} was applied during seedbed preparation. Nitrogen was added at rate of 90 kg N fed^{-1} in the form of ammonium nitrate (33.5% N). Potassium sulphate (48% K_2O) was applied at the rate of 48 kg K_2O fed^{-1}. Application of both of N and K fertilizers was started at 20 days from planting through 12 equal doses at 7-day intervals. At 30 and 45 day after sowing the foliar application solution was sprayed by a hand sprayer at 10.00 -12.00 am. The weed management was carried out during the growing season by hoeing twice times. The other cultural practices were applied as recommended by the Agricultural Research Center (ARC), Giza, Egypt.

Recorded data

A- Growth traits: The following data were recorded at 75 days from sowing where random sample of ten plants were taken to measure the following characters:

Plant height (cm), root length (cm), shoot and root fresh and dry weight (g).

B- Yield and yield attributes: at harvest, ten guarded plants were taken at random to determine the following traits:-

No of spikes/ plant, weight of Spike / plant (g), no. of grains/plant, grain index (g), grain yield / plant (g), straw yield /plant (g). Grain yield in kg was weighed from the one square meter of each experimental unit (sub-plot) and then adjusted into ton/fed.

C- Chemical traits: Shoot, root and grains were chemically analysed to determine their chemical content. N, P, K and Na were carried out on the dry material where samples were digested as recommend by Piper (1947).

Nitrogen was determined by using micro Kjeldahel method as described by Jones *et al.,* (1991).

Phosphorus was determined spectro photometerally by using stannous chloride method according to (A.O.A.C 1980).

Potassium and sodium were determined by flame photometer (BWBI).

Chlorophyll a, b, and carotenoids: Fresh leaves were extracted with dimethyl formamide and calculated according to (Nornai, 1982).

Proline concentration was determined as follow according to Bates *et al.,* (1973).

Ethanol extract was used for determination of total sugar by phosphomolibdic acid method according (A.O.A.C., 1975).

Total free amino acids (FAA) content was determined by using ninhydrin reagent (Moore and Stein, 1954).

Total soluble phenols were estimated using the folinciocalteou colorimetric method according to (Swain and Hillis, 1959).

Statistical analysis

Test of normality distribution was carried out according to Shapiro and Wilk, method (1965), by using SPSS v. 17.0 (2008) software package. Also, data were tested for violation of assumptions underlying the combined analysis of variance by separately analyzing of each season and then combined analysis across the two seasons was performed if homogeneity (Bartlet test) was insignificant. Estimates of LSD were calculated to test the significance of differences among means according to Snedecor and Cochran (1994) by using MSTAT-C software package.

Results and Discussion

Analysis of variance

The combined analysis of variance of studied varieties and for all characters under seven foliar treatments across seasons is presented in Tables 2, 3 and 4. Mean squares due to seasons were significant at ($P \leq 0.05$ or $P \leq 0.01$) for all studied traits, except No. of spikes/p, grain yield/ feddan, of P & Na in shoots, N & Na in roots and all studied traits of photosynthetic pigments, proline in leaves and total soluble phenols, total sugars and total free amino acids in shoots and grains, that indicating the effect of climatic conditions on most studied traits. However, mean squares due to cultivars were significant at ($P \leq 0.05$ or $P \leq 0.01$) for all traits, except K in shoots, N in roots and total sugars in grain that indicating the effect of genetic background among cultivars on most studied traits. Also, mean squares due to foliar treatments were significant at ($P \leq 0.05$ or $P \leq 0.01$) for all traits, except phenol in shoots that suggesting that the foliar treatments had a significant effect on most studied traits. The mean squares due to interaction between cultivars and foliar treatments were significant at ($P \leq 0.05$ or $P \leq 0.01$) for all studied traits, except P & K in shoots, K in roots and phenol in shoots.

A- Growth traits

Data in table 5 cleared that, there were significant

Table 2: Combined analysis of split plot design for three cultivars evaluated under seven treatments across 2015/16 and 2016/17 seasons.

S. O. V	df	No. of Spikes/p	Spike weight/p	No. of grains /p	Grain index	Grain yield/p	Straw weight/p	Grain yield /fed
Seasons	1	0.07	198.2**	2460**	26.94	149.1**	240**	0.68
R(S)	4	0.64	0.8	197.0	19.03	1.67	3.56	0.11
Cultivars C	2	10.05**	43.4**	3979**	129**	21.18**	37**	1.36**
SC	2	4.59**	12.3**	1180.2	9.94	6.68*	1.41	0.01
Error	8	0.19	1.3	841.3	8.20	1.30	1.15	0.13
Treatments T	6	0.74*	31.7**	7199**	57**	20.60**	24**	0.65**
ST	6	0.41	4.3*	1224*	13.55	3.48**	5.89	0.10
CT	12	1.43**	20.6**	3377**	33**	12.10**	15**	0.37**
SCT	12	0.29	6.3**	849.7	22.16	3.02**	5.12	0.09
Error	72	0.27	1.5	524.7	9.24	0.85	1.37	0.05

S. O. V	df	Dry weight		Fresh weight		Root length	Plant height
		Root	Shoot	Root	shoot		
Seasons	1	0.82*	46.06**	8.42**	644.6**	0.79	644.6**
R(S)	4	0.04	1.04	0.37	19.3	0.44	19.3
Cultivars C	2	1.84**	89.23**	6.59**	323.1**	116.1**	323.1**
SC	2	0.15	3.50	0.15	305.3**	9.91*	305.3**
Error	8	0.10	0.88	0.44	6.2	1.71	6.2
Treatments T	6	0.65**	16.03**	1.09**	333.2**	24.3**	333.2**
ST	6	0.25	0.66	0.17	46.1**	3.89	46.1**
CT	12	0.40*	5.17**	0.92**	58.5**	10.1**	58.5**
SCT	12	0.17	1.75	0.26	31.4**	2.78	31.4**
Error	72	0.17	1.00	0.35	11.3	2.33	11.3

*and** indicate significant and highly significant at 0.05 and 0.01 levels of probability respectively.

Table 3: Combined analysis of variance of split plot design for three cultivars evaluated under seven treatments across 2015/16 and 2016/17 seasons.

S. O. V	df	Grains			Shoots		
		N	P	K	N	P	K
Seasons	1	29.92**	1.43**	5.66*	57.75**	2.20	31.6*
R(S)	4	3.28**	0.21*	16.42**	1.03	1.01	8.44
Cultivars C	2	10.28**	1.93**	3.13*	6.42**	6.33**	15.67
SC	2	0.49	0.16	0.45	5.91*	0.52	18.69
Error	8	0.22	0.05	0.57	0.74	0.59	4.31
Treatments T	6	293.92**	3.18**	8.07**	361.38**	14.05**	84.46**
ST	6	0.21	0.12	0.07	0.04	0.27	0.31
CT	12	6.81**	0.48**	1.61**	8.09**	0.80	6.85
SCT	12	0.09	0.09	0.03	0.17	0.21	0.21
Error	72	2.44	0.07	0.61	2.73	0.71	8.07

S. O. V	df	Shoots		Roots		
		Na	N	P	K	Na
Seasons	1	4.02	6.97	1.20**	16.53**	4.02
R(S)	4	9.90**	1.76	0.27*	10.22**	11.51*
Cultivars C	2	10.90**	2.21	4.99**	2.97**	39.89**
SC	2	11.32**	5.60	0.04	1.81**	2.60
Error	8	1.12	1.54	0.06	0.15	2.04
Treatments T	6	7.32**	19.30**	0.76**	7.52**	6.64**
ST	6	0.40	0.16	0.01	0.07	0.03
CT	12	5.38**	1.60**	0.77**	2.06	12.97*
SCT	12	0.31	0.07	0.00	0.07	0.01
Error	72	0.97	0.48	0.06	1.51	0.45

*and** indicate significant and highly significant at 0.05 and 0.01 levels of probability respectively.

differences among the studied cultivars in plant height, root length,shoot and root fresh and dry weight where Misr2 pronounced its superiority in all growth characters under study followed by sakha93 cultivars,

Misr2 recorded the highest averages of root and shoot fresh and dry weights, root length and plant height.

These varietal differences could be attributed on the genetics factors and their responses to the environmental conditions. Concerning foliar application all treatments had a significant effect on all growth characters. Increasing putrescine level from 100 ppm to 200 ppm enhanced significantly plant height, root length, root, and shoot fresh and dry weight.

The interaction (cultivars × treatment) had substantially effects on fresh and dry weights, root length and plant height where the application of putrescine at level of 200 ppm to Masr2 surpassed the other treatment in the other two studied cultivars, root and shoot dry weight, root and shoot fresh weight. Spray with 200 ppm putrescine give the same result and did not differ significantly with using 100 ppm from zinc sulphate in root length and plant height, and 200 ppm putrescine compared to the untreated control treatment. Slocum *et al.,* (1984) reported that the exact function of (spermidine, spermine and their precursor putrescine) were important in physiological and developmental events in plants including cell division, DNA and protein synthesis and protection against different kinds of stress. It also participates in regulation of organogenesis and embryogenesis and in some light- induced growth responses. Galston and Kaur-Sawhney (1990) added that, putrescine (put) involved in a variety of plant growth and developmental processes including cell division, vascular differentiation, root initiation and shoot formation, Hanafy Ahmed *et al.*, (2002) mentioned that, using low level of putrescine (0.10 ppm) resulted in a highly pronounced increment in shoot height, root length, fresh and dry weight of shoots and roots of plants.

Moreover, the lowest concentration of humic acid led to the highest shoot dry weight. From previous trials, it was found that spraying plants of common bean with humic acid scored the highest vegetative growth characters (plant height, number of leaves and branches as well as fresh and dry weight). Hanafy Ahmed *et al.,* (2010) and EL-Bassiony *et al.,* (2010) on snap bean), as

Table 4: Combined analysis of variance of split plot design for three cultivars evaluated under seven treatments across 2015/16 and 2016/17 seasons.

S. O. V	df	Shoots				
		ch a	Chb	carot	Proline	Phenols
Seasons	1	0.27	0.20*	0.14	2.11*	0.00
R(S)	4	0.06	0.01	0.01	1.73*	4.11
Cultivars C	2	1.70**	1.69**	1.03**	3.57**	14.41*
SC	2	0.02	0.15*	0.06	0.42	7.81
Error	8	0.10	0.03	0.03	0.27	2.13
Treatments T	6	0.04**	0.02**	0.01*	4.91**	6.26
ST	6	0.02	0.01	0.00	0.07	1.51
CT	12	0.03**	0.04**	0.06**	1.20**	4.14
SCT	12	0.02	0.02**	0.02**	0.27	0.82
Error	72	0.01	0.01	0.01	0.20	3.52
S. O. V	**df**	**Shoots**			**Grains**	
		Total sugars	**Total FAA**	**Phenol**	**Total sugars**	**Total FAA**
Seasons	1	10.26	0.71	0.001	54.34*	0.003
R(S)	4	3.95	2.18*	0.003	4.69	0.462
Cultivars C	2	70.10**	5.14**	0.13**	13.23	2.3**
SC	2	27.14*	1.99*	0.15**	30.51	0.8
Error	8	5.09	0.43	0.005	8.62	0.244
Treatments T	6	445.5**	10.02*	1.59**	323.0**	1.91**
ST	6	4.29	0.05	0.07**	7.30**	0.043
CT	12	63.78**	0.43	0.54**	19.09**	0.24**
SCT	12	1.99	0.18	0.15**	12.74**	0.056
Error	72	5.27	0.46	0.007	2.35	0.095

*and** indicate significant and highly significant at 0.05 and 0.01 levels of probability respectively.

well as Aydin *et al.,* (2012) on bean (*Phaseolus vulgaris* L.).

However, Sayed (2011) mentioned that Zinc is playing principal metabolically role in plants. This micronutrient have an important role on most enzymes structure such as: dehydrogenises, aldolase and isomerase. Also zinc is effective in energy production and Krebs cycle.

The results in table 1 regarding the soil fertility of the experimentalist indicate that its, relatively, high content from HCO_3 which is known to render Zn unavailable to crop plants. Therefore, foliar application of zinc was effective to minimize this effect.

B- Yield Characters

Data in Tables (6) cleared that, the differences among the three studied cultivars for grain index, grain yield/ plant, No of grains /plant, spike weight/ plant, No of spike/ plant and grain yield/fed were significant in both seasons. Misr2 variety pronounced superiority for grain yield/plant, No of grains/plant, spike weight/plant and grain yield / fed as experiencing with other tested cultivars whereas Gemmiza12 ranked first and recorded the highest average for grain index. Misr2, Sakha93 and Gemmiza12 did not differ significantly in straw yield /plant. All the previous studied yield characters were significantly affected by treatment under study compared with untreated treatment.

Power mix treatment was more significantly effective than the other foliar treatments in some yield characters where; reflected its superiority in grain index, grain weight/ spike and straw yield/plant. Use of 100ppm zinc sulphate recorded the highest averages of No of grains /plant and spike weight/plant whereas. Use of 100ppm putrescine produced the highest No of spike/plant only.

The interaction between cultivars and nutrient compounds had a significant effect on all yield characters where, Misr2 responded to power mix which had a pronounced superiority for grain yield /plant, spike weight/ plant, No of grains/plant and straw yield/plant while use of 100ppm putrscine gave the highest average in No of spikes/plant.

Salwa and Osama (2014) recorded that, application of natural biostimulant improved the productivity and grain quality of wheat plant. Also Yunsheng *et al.,* (2015) recommended that, spraying bean plant with Asparagine

Table 5: Mean performance of growth traits for cultivars, treatments and cultivars × treatments interaction combined over 2015/16 and 2016/17 seasons.

Cultivars	Treatments	Dry weight (g)		Fresh weight(g)		Root length (cm)	Plant height (cm)
		Root	Shoot	Root	Shoot		
Gemmiza12		0.92	4.41	1.33	8.79	10.43	88.52
Sakha93		1.01	4.32	1.53	11.28	9.64	86.41
Misr2		1.32	6.89	2.10	21.81	12.83	91.91
$LSD_{0.05}$		0.16	0.47	0.34	1.24	0.66	1.25
	Control	0.89	4.21	1.46	10.20	10.22	84.06
	Humic acid	0.96	4.93	1.46	12.04	11.33	84.33
	Power mix	0.89	4.31	1.50	11.05	9.78	85.56
	Zn- 200ppm	1.08	4.72	1.62	13.23	9.39	89.67
	Zn- 100ppm	1.21	5.58	1.85	15.83	11.89	93.61
	Putrescine 200ppm	1.42	6.86	2.12	19.68	11.78	94.11
	Putrescine 100ppm	1.11	5.82	1.56	15.68	12.39	91.28
$LSD_{0.05}$		0.27	0.66	0.39	1.53	1.01	2.23
Gemmiza12	Control	0.92	3.39	1.65	7.03	9.00	83.67
	Humic acid	0.74	3.86	1.04	7.33	10.83	85.00
	Power mix	0.92	4.58	1.36	8.15	10.83	84.83
	Zn- 200ppm	0.81	3.62	1.06	7.66	9.17	90.17
	Zn- 100ppm	1.00	5.34	1.41	10.78	12.00	93.33
	Putrescine 200ppm	1.40	6.18	1.99	13.56	10.50	92.50
	Putrescine 100ppm	0.66	3.86	0.81	7.05	10.67	90.17
Sakha93	Control	0.82	4.09	1.23	9.58	8.17	83.83
	Humic acid	0.95	4.29	1.43	11.44	9.00	85.67
	Power mix	0.76	3.49	1.41	9.22	8.17	85.33
	Zn- 200ppm	0.96	3.94	1.46	10.53	9.00	86.33
	Zn- 100ppm	1.31	4.72	1.82	12.27	9.50	87.50
	Putrescine 200ppm	0.86	4.59	1.37	12.43	10.67	90.17
	Putrescine 100ppm	1.37	5.12	2.01	13.46	13.00	86.00
Misr2	Control	0.94	5.15	1.51	13.99	13.50	84.67
	Humic acid	1.20	6.64	1.91	17.34	14.17	82.33
	Power mix	1.00	4.87	1.73	15.79	10.33	86.50
	Zn- 200ppm	1.48	6.59	2.34	21.50	10.00	92.50
	Zn- 100ppm	1.31	6.66	2.32	24.46	14.17	100.0
	Putrescine 200ppm	2.00	9.80	3.01	33.07	14.17	99.67
	Putrescine 100ppm	1.29	8.48	1.86	26.52	13.50	97.67
$LSD_{0.05}$		0.47	1.15	0.68	2.65	1.75	3.87

increased vegetative growth (fresh and dry weight), total yield and quality.

Gharib and Hanafy (2005) showed that, foliar spraying of putrescine significantly increased plant yield compared to the untreated (control) plants Bibi and Oasterhuis (2007) revealed that, Exogenous application of putrescine in flowers and this was associated with increased seed set. Therefore the possibility exists of ameliorating high temperature stream in plant through exogenous application of putrescine. Dangyun *et al.,* (2017) also in this provides evidence for the use of Zn application in arid and semiarid environments to increase grain yield and Zn concentration. Bhattacharjee and Singh, (2008) and Omar *et al.,* (2014) indicated that increasing nitrogen fertilizer rates significant increase in plant height (cm), number of grain/spike, number of spikes, 1000 grain weight, grain yield, straw yield, and harvest index.

Table 6: Mean performance of yield components for cultivars, treatments and cultivars × treatments interaction combined over 2015/16 and 2016/17 seasons.

Cultivars	Treatments	No. of spikes/p	Spike weight/p	No. of grains /p	Grain index(g)	Grain yield/p	Straw weight/p (g)	Grain yield/ fedton
Gemmiza 12		3.19	8.13	118.5	42.44	6.19	8.21	1.79
sakha93		2.76	8.79	133.7	42.02	6.92	9.39	1.88
Misr2		3.74	10.13	154.8	39.21	7.62	10.07	2.19
$LSD_{0.05}$		0.22	0.57	14.59	1.44	0.57	0.54	0.18
	Control	3.28	6.26	95.4	41.06	4.68	6.74	1.61
	Humic acid	3.33	9.59	139.6	42.00	7.34	9.01	2.09
	Power mix	3.06	9.78	142.2	43.75	7.81	10.14	2.02
	Zn- 200ppm	3.17	9.69	150.6	39.01	7.08	9.55	2.10
	Zn- 100ppm	3.17	10.19	153.2	40.14	7.81	10.16	2.19
	Putrescine 200ppm	3.00	8.53	124.7	43.06	6.67	9.29	1.90
	Putrescine 100ppm	3.61	9.07	144.1	39.54	6.98	9.66	1.98
$LSD_{0.05}$		0.33	0.81	15.21	2.02	0.61	0.78	0.15
Gemmiza12	Control	3.83	6.76	100.5	43.03	5.20	7.36	1.71
	Humic acid	3.00	10.17	120.5	45.25	7.17	8.04	2.01
	Power mix	3.33	5.76	77.3	46.30	4.31	6.01	1.46
	Zn- 200ppm	3.67	9.44	155.3	36.63	6.45	8.27	2.01
	Zn- 100ppm	3.00	9.49	139.2	39.49	7.65	9.66	2.21
	Putrescine 200ppm	2.17	6.03	98.0	43.56	5.20	8.21	1.71
	Putrescine 100ppm	3.33	9.27	138.5	42.79	7.39	9.90	2.05
Sakha93	Control	2.67	4.97	74.3	41.01	3.79	5.67	1.21
	Humic acid	3.00	8.86	136.0	41.73	7.11	8.91	2.15
	Power mix	2.67	9.14	143.2	44.56	7.86	10.27	2.02
	Zn- 200ppm	2.50	10.18	146.5	42.97	7.67	10.50	2.05
	Zn- 100ppm	2.83	9.98	159.2	40.96	7.79	10.61	1.95
	Putrescine 200ppm	2.83	8.79	133.7	41.68	6.83	9.51	1.77
	Putrescine 100ppm	2.83	9.60	143.3	41.20	7.37	10.27	2.00
Misr2	Control	3.33	7.05	111.3	39.12	5.06	7.20	1.89
	Humic acid	4.00	9.74	162.3	39.00	7.73	10.10	2.10
	Power mix	3.17	14.45	206.0	40.39	7.00	14.15	2.59
	Zn- 200ppm	3.33	9.44	150.0	37.43	7.11	9.89	2.25
	Zn- 100ppm	3.67	11.09	161.2	39.96	7.99	10.20	2.41
	Putrescine 200ppm	4.00	10.78	142.5	43.93	7.99	10.16	2.22
	Putrescine 100ppm	4.67	8.33	150.3	34.64	6.17	8.79	1.88
$LSD_{0.05}$		0.59	1.41	26.35	3.50	1.06	1.35	0.26

C- Chemical traits

1- Minerals in grains, shoots and roots

Data in (Tables 7, 8) showed that cultivars, treatments and their interaction had a significant effect in concentration of N, P, K and Na in shoots, roots and grains of wheat. Sakha93 had the highest in N and K in content grains and shoots and K only roots. Misr2 gave the highest average of P in grains, N, P and Na in roots as well as the highest Na content in shoots. Use of 200ppm Putrescine showed superiority in N and K in grains, N, P in shoots and K, Na in roots. Humic acid was superior in K in grains, shoots and Na in roots. Power mix gave the highest average of P in roots. Misr2 cultivar with 200 ppm putrescine or 100 ppm Zn gave the highest average as P in grains, N in shoots and Na in roots while Sakha93 with 100ppm Zn or 200 ppm Putrescine superior in N and K grains, N, P in shoots. Gemmiza12 with 200 ppm putrescin or 100ppm Zn superior in K and P in grains, N, P in shoots and K in roots.

Table 7: Mean performance of chemical traits for cultivars, treatments and cultivars × treatments interaction combined over 2015/16 and 2016/17 seasons.

Cultivars	Treatments	Grains			Shoots	
		N	P	K	N	P
Gemmiza12		19.99	2.46	4.79	23.85	4.32
sakha93		20.05	2.62	5.17	24.01	4.15
Misr2		19.17	2.88	4.64	23.26	3.58
$LSD_{0.05}$		0.24	0.11	0.38	0.43	0.39
	Control	15.19	2.11	4.07	19.23	2.30
	Humic acid	18.27	2.85	5.51	23.99	4.28
	Power mix	17.44	2.28	4.58	19.99	3.95
	Zn- 200ppm	16.50	2.49	4.35	21.72	3.78
	Zn- 100ppm	24.94	3.26	5.52	28.81	4.85
	Putrescine 200ppm	25.38	3.07	5.66	30.84	4.97
	Putrescine 100ppm	20.43	2.51	4.37	21.34	3.99
$LSD_{0.05}$		1.04	0.17	0.52	1.09	0.56
Gemmiza12	Control	15.17	2.08	4.16	19.37	2.88
	Humic acid	20.22	2.37	4.57	23.83	4.86
	Power mix	17.00	2.24	4.33	19.76	4.30
	Zn- 200ppm	18.04	2.29	4.57	22.77	4.31
	Zn- 100ppm	24.00	3.07	5.25	29.21	4.83
	Putrescine 200ppm	24.68	2.88	6.21	31.57	5.33
	Putrescine 100ppm	20.84	2.26	4.46	20.41	3.73
Sakha93	Control	15.12	2.30	4.22	19.40	2.29
	Humic acid	18.23	3.15	6.33	26.45	4.18
	Power mix	18.31	2.38	4.51	20.53	3.81
	Zn- 200ppm	16.13	2.46	4.39	21.17	4.06
	Zn- 100ppm	26.06	3.11	6.22	29.02	5.33
	Putrescine 200ppm	26.53	2.72	6.11	30.67	5.29
	Putrescine 100ppm	19.98	2.21	4.40	20.79	4.08
Misr2	Control	15.29	1.94	3.82	18.93	1.72
	Humic acid	16.36	3.02	5.64	21.70	3.80
	Power mix	17.02	2.20	4.91	19.68	3.75
	Zn- 200ppm	15.33	2.73	4.11	21.23	2.97
	Zn- 100ppm	24.75	3.61	5.08	28.21	4.39
	Putrescine 200ppm	24.95	3.60	4.64	30.29	4.28
	Putrescine 100ppm	20.48	3.06	4.24	22.81	4.15
$LSD_{0.05}$		1.79	0.30	0.89	1.90	0.98

Putrescine, humic acid and power mix as well as zinc sulphate play important role in plant. The effects of humic acid refer to its role the in stimulation of plasma membrane H+-ATP ases, which convert the free energy released by ATP hydrolysis into a transmembrane electrochemical potential used for the import of nitrate and other nutrients (Jardin 2015). Besides nutrients uptake, proton pumping by plasma membrane ATPase also contributes to cell wall loosening, cell enlargement and organ growth. Also Fernandez-Escobar *et al.,* (1996) reported that, foliar application of leonardite extracts (humic substances extracted) stimulated shoot growth and promoted the accumulation of K, B, Mg, Ca and Fe in leaves of wheat under field condition. In this regard, Aydin *et al.,* (2012) and Gad El-Hak *et al.,* (2013) reported that, spraying snap bean plants and pea which grown under salt stress conditions with humic acid increase the concentration of nitrogen, potassium and calcium in leaves. The beneficial effects of Humic acid on macronutrients concentrations could be referred to its

Table 8: Mean performance of chemical traits for cultivars, treatments and cultivars × treatments interaction combined over 2015/16 and 2016/17 seasons.

Cultivars	Treatments	Shoots			Roots		
		K	Na	N	P	K	Na
Gemmiza 12		30.34	7.76	15.66	0.87	14.63	10.75
sakha93		30.70	8.48	15.94	1.30	14.80	10.07
Misr2		29.51	8.75	16.12	1.55	14.28	11.99
$LSD_{0.05}$		1.04	0.53	0.12	0.10	0.19	0.72
	Control	27.89	9.50	13.86	1.26	14.40	11.48
	Humic acid	34.31	8.14	16.53	1.03	14.65	11.75
	Power mix	29.08	8.20	15.52	1.60	14.05	10.39
	Zn- 200ppm	28.39	7.43	15.79	1.21	13.59	10.74
	Zn- 100ppm	30.70	8.10	16.86	1.08	15.08	10.65
	Putrescine 200ppm	31.17	8.23	16.79	1.09	15.56	11.40
	Putrescine 100ppm	29.76	8.71	16.00	1.41	14.67	10.15
$LSD_{0.05}$		1.89	0.65	0.46	0.16	0.81	0.45
Gemmiza12	Control	28.60	9.94	13.76	0.98	14.01	11.69
	Humic acid	35.93	8.46	16.22	1.00	14.52	10.81
	Power mix	28.74	8.03	15.41	1.33	14.07	10.93
	Zn- 200ppm	28.08	5.02	15.37	0.81	14.03	11.13
	Zn- 100ppm	30.46	7.71	16.86	0.65	15.13	10.25
	Putrescine 200ppm	31.27	7.36	16.64	0.67	16.14	10.48
	Putrescine 100ppm	29.33	7.83	15.38	0.66	14.50	9.95
Sakha93	Control	27.44	8.62	13.88	1.72	14.18	12.41
	Humic acid	34.21	7.55	16.38	0.71	15.55	11.33
	Power mix	28.89	7.73	16.04	1.88	14.00	7.97
	Zn- 200ppm	30.72	9.16	15.14	1.09	13.19	10.98
	Zn- 100ppm	31.57	8.62	16.81	0.72	15.73	8.51
	Putrescine 200ppm	32.05	8.58	17.39	1.28	16.05	9.53
	Putrescine 100ppm	30.05	9.13	15.95	1.70	14.93	9.78
Misr2	Control	27.62	9.95	13.95	1.10	15.02	10.34
	Humic acid	32.80	8.42	16.98	1.38	13.87	13.12
	Power mix	29.62	8.84	15.10	1.59	14.07	12.26
	Zn- 200ppm	26.38	8.11	16.85	1.73	13.56	10.12
	Zn- 100ppm	30.08	7.97	16.91	1.87	14.39	13.21
	Putrescine 200ppm	30.19	8.77	16.35	1.33	14.48	14.18
	Putrescine 100ppm	29.91	9.17	16.68	1.87	14.57	10.72
$LSD_{0.05}$		3.28	1.13	0.7 9	0.27	1.41	0.77

acting as a good manure state causing more availability for the nutrients in the soil.

Halpern *et al., (*2015) mentioned that, polyamines has direct effects on plants included modulation of N uptake and assimilation by the regulation of enzymes involved in N assimilation and of their structural genes and by acting on the signalling pathway of N acquisition in roots. Also, by regulating the enzymes of TCA cycle, they also contribute to the cross talk between C and N metabolisms

Dongyum *et al.,* (2017) reported that, Zn application could alleviate the oxidative stress of wheat through transcriptional regulation of multiple defence pathways, such as antioxidant enzymes, the ASC–GSH cycle, and flavonoid secondary metabolism. Zn application may improve the effects caused by drought stress through enhancing reactive species biosynthesis.

2- Photosynthetic pigments, Proline in leaves and total soluble phenols, total sugars and total free amino acids in shoots and grains

Table 9: Mean performance of chemical traits for cultivars, treatments and cultivars × treatments interaction combined over 2015/16 and 2016/17 seasons.

Genotypes	Treatments	Shoots			
		ch a	chb	carot	Proline
Gemmiza12		1.11	0.84	0.85	5.48
sakha93		0.81	0.57	0.56	5.47
Misr2		1.19	0.96	0.61	4.97
$LSD_{0.05}$		0.15	0.07	0.08	0.26
	Control	1.06	0.75	0.63	4.65
	Humic acid	1.09	0.84	0.72	5.22
	Power mix	0.98	0.84	0.70	4.65
	Zn- 200ppm	0.99	0.80	0.64	5.55
	Zn- 100ppm	0.99	0.81	0.67	5.68
	Putrescine 200ppm	1.07	0.76	0.69	6.06
	Putrescine 100ppm	1.06	0.76	0.67	5.34
$LSD_{0.05}$		0.06	0.05	0.05	0.29
Gemmiza12	Control	1.06	0.61	0.59	5.04
	Humic acid	1.17	0.86	0.94	4.98
	Power mix	1.01	0.88	0.85	5.14
	Zn- 200ppm	1.06	0.94	0.82	5.84
	Zn- 100ppm	1.15	0.94	0.87	5.68
	Putrescine 200ppm	1.15	0.83	0.97	6.25
	Putrescine 100ppm	1.16	0.85	0.91	5.46
Sakha93	Control	0.83	0.64	0.59	4.38
	Humic acid	0.78	0.56	0.52	5.28
	Power mix	0.82	0.60	0.58	5.14
	Zn- 200ppm	0.83	0.59	0.54	6.06
	Zn- 100ppm	0.80	0.56	0.57	6.31
	Putrescine 200ppm	0.81	0.54	0.57	5.91
	Putrescine 100ppm	0.77	0.51	0.56	5.22
Misr2	Control	1.30	1.00	0.71	4.55
	Humic acid	1.33	1.09	0.70	5.40
	Power mix	1.09	1.03	0.66	3.67
	Zn- 200ppm	1.08	0.87	0.57	4.75
	Zn- 100ppm	1.02	0.92	0.56	5.07
	Putrescine 200ppm	1.24	0.92	0.53	6.03
	Putrescine 100ppm	1.26	0.92	0.54	5.34
$LSD_{0.05}$		0.11	0.10	0.09	0.51

Data in (Tables 9, 10) showed that all treatments and the interaction with wheat cultivars under study had significant effects on chemicals traits. Gemmiza12 gave the highest average of carotenoids and prolin content. While Sakha93 was superior in phenols, Total sugar, total FAA in shoots and phenols only in grains. Misr2 recorded the highest content in total sugars and total FAA in grains and chlorophyll a and b in shoots. Use of 200ppm putrescine recorded the highest averages inmost traits under study as well as chlorophyll a, proline and total FAA in shoots.

Spraying plant with humic acid gave the highest averages of chlorophyll a, b, carotenoids in shoots, phenol and total FAA in grains. This result agreement with that obtained by El-Ghamry *et al*., (2009) who found that, faba bean plants sprayed with humicacid increased chlorophyll a, b and carotenoids in green leaves, Hanafy Ahmed *et al*., (2010) obtained the same result on snap bean. Alloway, (2008) found that zinc exerts a great influence on basic plant life processes, *i.e.* (nitrogen metabolism, uptake of nitrogen, protein quality, photosynthesis, chlorophyllsynthesis and carbon anhydrase activity). Also resistance to abiotic and biotic stresses and protection against oxidativedamage. Ali *et al., (*2008) reported that Zinc is essential element for required in carbonic enzyme which present in all photosynthetic tissues, and required for Chlorophyll biosynthesis.

The interaction between cultivars and nutrient compounds

Use of putrescine at level of 200 ppm recorded highest averages in total FAA in shoots and grains.

Use of 100 or 200ppm putrescine with Misr2 showed superiority in chlorophyll a, proline in shoots. Misr2 with 100ppm recorded the highest result in total sugars in shoots and grains compared with other treatments Spray Sakha93 with 100 or 200ppm Zn achieved best data for proline total sugar and FAA in shoots.

Regarding Gemmiza12 use 200 ppm putrescine give the highest averages proline and total FAA in shoots while spraying with 100 ppm Zn recorded high content in phenols and total sugar in grains. Hussein *et al.,* (2006) and El-Quesni *et al.,* (2007) showed that putrescine concentration increased proline content, chlorophyll a, b and carotenoids. Ahmed, Hebatallah (2008) reported that spraying putrescine counteracted the depressive effect of salinity on chlorophylla,b and carotenoids concentration.

Lee *et al.,* (1997) added that application of putrescine

Table 10: Mean performance of chemical traits for cultivars, treatments and cultivars × treatments interaction combined over 2015/16 and 2016/17 seasons.

Cultivars	Treatments	Shoots			Grains		
		Phenols	Total sugars	Total FAA	Phenol	Total sugars	Total FAA
Gemmiza12		7.86	46.61	5.72	1.79	32.66	2.00
sakha93		8.78	48.69	6.24	1.89	32.36	1.93
Misr2		7.68	46.31	5.58	1.89	33.44	2.37
$LSD_{0.05}$		0.73	1.13	0.33	0.04	1.48	0.25
	Control	7.86	38.92	4.84	1.71	25.70	2.52
	Humic acid	7.55	49.29	6.10	2.10	34.69	2.53
	Power mix	8.45	48.78	5.36	1.37	35.61	2.03
	Zn- 200ppm	9.24	45.46	5.21	1.61	30.52	1.75
	Zn- 100ppm	7.80	53.82	6.54	2.10	36.97	1.93
	Putrescine 200ppm	7.65	50.70	6.90	2.15	36.51	2.16
	Putrescine 100ppm	8.18	43.45	6.00	1.97	29.73	1.77
$LSD_{0.05}$		1.24	1.53	0.45	0.06	1.02	0.33
Gemmiza12	Control	7.39	34.80	4.70	1.18	21.77	1.98
	Humic acid	7.71	50.57	5.60	2.02	34.26	2.40
	Power mix	8.38	49.24	5.58	1.11	37.38	2.10
	Zn- 200ppm	7.76	49.05	4.78	1.57	30.47	1.76
	Zn- 100ppm	8.02	51.64	6.41	2.41	37.54	1.92
	Putrescine 200ppm	7.65	48.67	6.99	2.19	37.43	2.18
	Putrescine 100ppm	8.12	42.33	5.97	2.08	29.77	1.64
Sakha93	Control	9.24	47.02	5.27	2.29	28.07	2.54
	Humic acid	9.21	48.74	6.61	2.15	35.02	2.33
	Power mix	8.97	51.14	5.72	1.23	33.05	1.75
	Zn- 200ppm	10.24	44.16	5.89	1.54	29.90	1.38
	Zn- 100ppm	7.86	54.25	6.82	1.84	35.63	1.85
	Putrescine 200ppm	7.71	51.96	6.94	2.21	34.76	2.00
	Putrescine 100ppm	8.19	43.53	6.46	1.98	30.08	1.66
Misr2	Control	6.97	34.96	4.55	1.66	27.25	3.05
	Humic acid	5.73	48.55	6.08	2.15	34.81	2.85
	Power mix	8.01	45.95	4.77	1.79	36.40	2.23
	Zn- 200ppm	9.73	43.18	4.96	1.73	31.20	2.11
	Zn- 100ppm	7.51	55.58	6.38	2.05	37.74	2.02
	Putrescine 200ppm	7.59	51.48	6.77	2.05	37.36	2.30
	Putrescine 100ppm	8.25	44.49	5.56	1.84	29.36	2.00
$LSD_{0.05}$		2.15	2.64	0.78	0.10	1.76	0.58

was shown to retard chlorophyll loss and senescence and protect plants against environmental stress. Also El-Tohamy *et al.,* (2008) mentioned that, treated plants with foliar application with putrescine had significantly higher total chlorophyll content compared with the control plant. Moreover, Hanafy *et al.,* (2002) added that spraying plants with putrescine resulted in an increase of proline, total soluble phenol and total free amino acids concentration in shoots and roots of plants grown in non-salinized and salinized soil. Abd-Elsamad *et al.,* (2010) indicated that the exogenous amino acid treatment may reduce the negative effect of salinity and increased accumulation of saccharides, nitrogen metabolism and mineral, which promote plant growth.

Conclusion

The present study aimed at sustaining yield potentiality of three wheat cultivars in a sandy soil through the foliar application of three nutrient compounds two of them were used at two levels (100 and 200 ppm) and tried twice (one month and 15 days later from sowing). Significant varietal of treated could be detected in wheat growth and yield attributes as well as in shoot and grains contents from N, P and K. The content of chlorophyll a, b and carotenoids varied also among cultivars and the foliar application of the different nutrient component. Results clearly indicated significant varietal differences responses to studied foliar application treatments. A harmony could be noticed between the response of growth attributes plant contents and yield indicating their validity in predicting yield.

References

A.O.A.C. (1975). Official Methods of Analysis. Association of Official Analytical Chemists Washington D. C. 12thed

A.O.A.C. (1980). Official Methods of Analysis. Association of Official Analytical Chemists Washington D. C.13thed

Abdel-Mawgoud, A.M.R., A.M. El- Bassiouny, A. Ghoname and S.D. Abou-Hussein (2011). Foliar application of Amino acids and Micronutrients enhance performance of green Bean crop under Newly reclaimed land conditions. *Australian J. of Basic Applied Sciences*, **5(16):** 51-55

Abdel-Mawgoud, A.M.R., A.MEl-Bassiouny, A. Ghoname and S.D. Abou- Hussein (2011). Foliar application of Amino acids and Micronutrients enhance performance of green Bean crop under Newly reclaimed land conditions. *Australian J. of Basic Applied Sciences*, **5(16):** 51-55.

Abd-ElSamad, H.M., M.A.K. Shaddad and N. Barakat (2010). The role of amino acids in improvement in salt tolerance of crop plants. *Journal of Stress Physiology & Biochemistry*, **6(3):** 25-37.

Ahmed, H.A.H. (2008). Amelioration of salinity effect in Fenugreek plant by polyamines. Fac. of Sci., Azhar Univ., Cairo (Girls Branch) Egypt.

Ali, S., K.A. Riaz, G. Mairaj, M. Arif, M. Fida and S. Bibi (2008). Assessment of different cropnutrient management practices for yield improvement. *Australian Journal of Crop Science*, **2(3):**150-157.

Alloway, B.J. (2008). Zinc in soils and crop nutrition. Second edition, published by IZA and IFA, Brussels, Belgium and Paris, France.

Arnon, D.I. (1949). Copper enzymes in isolated chloroplasts polyphenol oxidase in beta vulgaris plant physiology, **24:**1-10.

Aydin, A., C. Kant and M. Turan (2012). Humic acid application alleviate salinity stress of bean (*Phaseolus vulgaris* L.) Palnts decreasing membrane leakage. *Afi. J. Agric. Res*., **7(7):** 1073-1086.

Bates, L.S., R.P. Waldern and I.D. Teare (1973). Rapid determination of freeproline for water stress studies. *Plant soil*, **39:** 205-207.

Bezuglova, O.S., E. A. Polienko, P.D. Gorovtsov, V.A. Yhman and P.D. Parlov (2017). The effect of humic substances on winter wheat fertility of cher no zen. *Annals of Agrarian Science,* **15:** 239-242.

Bibi, A.C. and D.M. Oosterhuis (2007). Effect of the plant growth regulator BM86 on polyamines and seed set efficiency of cotton during reproduction stage. *Summaries of Arkansas cotton Research*, **552:** 45-48.

Chen, Y., Q. Guo, L. Liu and Z. Zhu (2011). Influence of fertilization and drought stress on the growth and production of secondary metabolites in Prunella vulgaris *L. J. Med. Plants. Res*., **5:** 1794-1755.

Chen, L.N., H.X. Yin, J. XU and X.J. Liu (2011). Enhance dantioxidative response of a salt – resistant wheat cultivar facilitate its, adaptation to salt stress. *Afr. J. Biotechnol*., **10:** 16887-16896.

DongyumMa, D. Sun, C. Wang, H. Ding, H. Qin, J. Hou, X. Huang, Y. Xie, and T. Guo (2017). Physiological Responses and yield of wheat plant in zinc. *Mediated Alleviation of drought stress frontiers in plant science*, **8:** 860:1-12.

El– Quesni, F.E.M. and M.H. Mahgoub (2007). Some studies on the effect of putrescine and paclobutrazol on the growth and chemical composition of *Bougainvillea glabra* L. at nubaria. *American-Eurasian J. Agric. and Environ. Sci.*, **2(5):** 552-558.

El-Bassiony, A.M., Z.F. Fawzy, M.M.H. Abd El-Baky and A.R. Mahmoud (2010). Response of snap bean plants to mineral fertilizers and humic acid application. *Res.J. Agric. Biol. Sci.*, **6(2):** 169-175.

El-Ghamry, A.M., K.M. Abd El-Hai and K.M. Ghoneem (2009). Amino and humic acids promote growth, yield and disease resistance of faba bean cultivated in clayey soil. *Austr. J. of Basic and Appl. Sci*., **3(2):** 731-739.

El-Tohamy, W.A., H.M. El-Abagy and N.H.M. El-Greadly (2008). Studies on the effect of putrescine, Yeast and Vitamin C on growth, yield and physiological responses ofeggplant (*Solanummelongena* L.) under sandy soil conditions. *Australin Journal of Basic and Applied Sciences*, **2(2):** 296-300.

Fernandez -Escober, R., D. BenllochBarranco, A. Dueñas and J.A. Gutérrezgañán (1996). Response of olive trees to foliar application of humic substances extracted from leonardite. *Scientific Horticulture*, **66:** 191-200.

Freed, R.S.P., S.G. Einensmith, D. Reicosky, V.W. Smail and P. Wolberg (1989). User's Guide to MSTAT-C Analysis of agronomic research experiments. Michigan State University, East Lansing, USA.

Gad El-Hak,S.H., A.M. Ahmed and Y.M.M. Moustafa (2013). Effect of foliar application with two antioxidants and humic acid on growth, yield and yield components of peas (*Pisumsativum* L.). *J. Hort. Sci. & Ornamen. Plants*, **4(3):** 318-328.

Galston, A.W. and R. Kaur-Sawhney (1990). Polyamines in plant physiology. *Plant physiol.*, **94:** 406-410.

Gharib, A.A. and A.H. Hanafy Ahmed (2005). Response of pea (*Pisum sativum* L.) to foliar application of putrescine, glucose, foliafeed D and silicon. *J. Agric. Sci. Mansoura Univ.*, **30(12):** 7563-7579.

Halpern, M., A. Bar-Tal, M. Ofek, D. Minz, T. Muller and U. Yermiyahu (2015). The use of biostimulants for enhancing nutrient uptake. In: Sparks, D.L. (Ed.), *Advances in Agronomy*, **129:** 141-174.

Hanafy Ahmed, A.H., M.R. Nessiem, A.M. Hewedy and El-S.H. Sallam (2010). Effect of some simulative compounds on growth, yield and chemical composistion of snap bean plants grown under calcareous soil condition. *Journal of American Science*, **6(10):** 552-569.

Hanafy Ahmed, A., M.M.A., Gad, H.M. Hassan and M.A. Amin (2002). Improving growth and chemical composition of *Myrtuscommunis* grown under soil salinity condition by bolyamines foliar application. In Minia 1st conf. for Agric. & Environ. Sci. Mini.

Hay, R.K.M. and A.J. Walker (1989). An introduction to the physiology of crop yield, pp. 31-86. New York: Longman Scientific & Technical.

Hussein, M.M., N. H. M. El-Gereadly and M. El-Desuki (2006). Role of putresceine in resistance to salinity of pea plants (*Pisum sativum* L.). *J. of Appl. Sci. Research*, **2(9):** 598-604.

Jackson, M.L. (1973). Soil Chemistry Analysis. Prentice, Hall of India Private Ltd. New Delhi, 125-179.

Jardin, du P., (2015). Plant biostimulants: Definition, concept, main categories and regulation. *Scientia Horticulturae*, **196:** 3-14.

Jones, J.R., J. Benton, B. Wolf and H.A. Mills (1991). Plant Analysis hand Book. Methods of plant analysis and interpretation Micro- Macro publishind Inc., U.S.A., 30-34.

Khan, M.A M.P. Fuller and F.S. Baluch (2008). Effect of Soil Applied Zinc Sulphate on Wheat (*Triticum aestivum* L.) Grown on a Calcareous Soil in Pakistan. *Cereal Research Communications,* **36(4):** 571-582.

Khan, R.U., M.Z. Khan, A. Khan, S. Saba, F. Hussain and I.U. Jan (2018). Effect of humic acid on growth and crop nutrient status of wheat on two different soil. *Journal of plant Nutrition*, **41(4):** 453-460.

Kumar, A., V.K. Mishra, R.P. Vyas and V. Singh (2013). Heterosis and combining ability analysis in bread wheat. *Journal of Plant Breeding and Crop Science*, **10:** 209-217

Lee, M., S. Lee and K. Park (1997). Effect of spermine on ethylene biosynthesis in cut carnation (*Dianthus caryophyllus* L.) Flowers during senescence. *J. Plant Physiol*., **151:** 68-73.

Li, G., X. Peng, L. Wei and G. Kang (2013). Salicylic acid increases the contents of glutathione and ascorbate and temporally regulates the related gene expression in salt-stressed wheat seedlings. *Gene.*, **529:** 321-325.

Ljubicic, N., S. Petrovic, M. Dimitrijevic, N. Hristov, M. Vukosavljev and Z. Sreckov (2014). Diallel analysis for spike length in winter wheat. *Turkish Journal of Agricultural and Natural Sciences*, **2:** 1455-1459.

Moore, S. and M.N. Stein (1954). A modified ninhydrin reagent for the photometric determination of amino and related compounds. *J. Biol.Chem*., **211:** 907-913.

Nornai, R. (1982). Formula for determination of chlorophellous pigments extracted with N.N dim ethyl formamide. *Plant Physiol*., **69:** 1371-1381.

Omar, M.I., B.B. Ahmed, T.T. Alice and F.E. Mohamed (2014). Influence of nitrogen fertilizer and foliar application of salicylic acid on wheat. *Agricultural sciences*, **5:** 1316-1321.

Piper, C.S., (1947). Soil and Plant Analysis.1st Ed. Interscience Publishers, N.Y,.P: 48.

Prakash, L. and G. Prathapasenan (1988). Effect of NaCl salinity and Putrescine on shoot growth, tissue ion concentration and yield of rice (*Oryza sativa* L. var. GR3). *J. of Agron. And Crop Sci.*, **165(5):** 325-334.

Salwa, A.R. Hammad; Osama and A.M. Ali (2014). Physiological and biochemical studies on drought tolerance of wheat plant by application of amino acids and yeast extract. *Annals of Agri., Sci.*, **59(1):** 133-145

Sayed Roholla Mousavi (2011). Zinc in Crop Production and Interaction with Phosphorus. *Australian Journal of Basic and Applied Sciences*, **5(9):** 1503-1509.

Sebastiano, D., R. Tognetti, E. Desiderio and A. Lvinoa (2005). Effect of foliar application of N and humic acid on growth and yield of durum wheat. *Agron., Sustain. Dev*., **25:** 183-191, INRA, EDP Science.

Seemann, J.R. and C. Critchley (1985). Effects of salt stress on the growth, ion content, stomatal behaviour and photosynthetic capacity of a salt-sensitive species, *Phaseolus vulgaris* L. *Planta*, **164:** 151-162.

Shapiro, S.S. and M.B. Wilk (1965). Analysis of variance test for normality (complete samples), Biometrika, **52(3/4):** 591-611.

Slocum, R.D., R. Kaur-Sawhney and A.W. Galston (1984). The physiological biochemistry of poly a mines in plants. *Arch. Biochem. Biophys*., **235:** 283-303.

Snedecor, G.W. and W.G. Cochran (1994). Statistical Methods. 9th Ed., Iowa State Univ. Press, Ames, Iowa, USA.

SPSS Statistics 17.0. (2008). SPSS for Windows. SPSS Inc. 2008.

Swain, T. and W.F. Hillis (1959). The quantitative analysis of phenolic constituent. *J. Sci., Food Agric*., **10:** 63-69.

Villa-Astoria, M., A.P. Ellery, E.A. Catalan-Valencia and M.D. Ramming (2003). Salinity and nitrogen rate effects on the growth and yield of Chile pepper plant. *Soil Sci. Soc. Am. J.*, **67:** 1781-9.

Xu, J., H.X. Yin, Y.L. Li and X.J. Liu (2010). Nitric Oxide is associated with long –Term Zinc tolerance in solanumnigrum. *Plant physiol*., **154:** 1319-1334.

Xu, L.H., W.Y. Wang, J.J. Guo, J. QIN, D.Q. SHI, Y.L.I and J. Xu (2014). Zinc improves salt tolerance by increasing reactive oxygen species scavenging and reducing Na accumulation in wheat seedlings. *Biologia. Plantarum*, **58(4):**751-757.

Yunsheng, Li, A.M. El-Bassiony, M.E. El-Awadi and Z.F. Fawzy (2015). Effect of foliar spraying of Asparagine on growth, yield and quality of two snap bean varieties. *J. of Agri., and Biological Sci.*, **1(3):** 88-94.

Zewail, R.M.Y. (2014). Effect of see weed extract and Amino acids on growth and productivity and some Biocostituents of common bean plant. *J. plant production, Mansoura Univ.*, **(8):** 1441- 1453.